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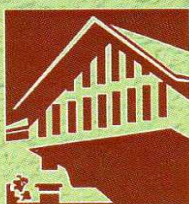
Discussion Paper No.55



COST AND RETURNS OF NATURAL RUBBER PRODUCTION IN KERALA

(Preliminary draft for discussion in Rubber Board)

K J Joseph
C E Ajith Kumar



CENTRE FOR DEVELOPMENT STUDIES, THIRUVANANTHAPURAM

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ABSTRACT

Given the ongoing crisis in India's natural rubber sector, which is known for its remarkable performance in the past, there has been demand for state intervention from natural rubber growers. Any policy intervention however calls for the reliable data on cost and returns of natural rubber production, which is presently not available. The present study is an attempt at estimating the cost and returns of NR production. The study begins by highlighting some of the important dimensions of the ongoing crisis- unprecedented decline in the price, productivity and production. While the sector has been faced with heightened import competition, the state support for the sector appears to be on the declining trend. Drawing from the primary data collected from districts-Kottayam and Thiruvananthapuram, the study comes with different estimates of costs like operating cost, total cost, and total economic cost per acre and per Kg of rubber produced. The operational cost per acre of rubber is found to be Rs 37936 in Kottayam and Rs 48816 in Thiruvananthapuram and per Kg of rubber it is Rs 91 in Rs 87 in Kottayam and Thiruvananthapuram respectively. The total cost per acre is estimated at Rs 48424 in Kottayam and Rs 64155 in Thiruvananthapuram. With this total cost per acre, cost per Kg of rubber produced turns out to be Rs 117 in Kottayam and Rs 118 in Thiruvananthapuram. The above estimate may involve an underestimation of about 20-25 percent when compared with the cost involved as per the practices recommended by the Rubber Board and that we observed in case of about 11% of the growers who did not compromise on various operations in the plantations. The underestimation could be attributed to the generally observed behavior of the growers to cut down various cultural operations during crisis on account of reduced cash flow. We have also generated different economic cost scenarios by taking into account, returns from inter crop, subsidy received, potential income from the sale of rubber wood and finally the interest on the value of land used for cultivation. The estimated ratio of returns to cost is found to be greater than one in both the districts. Yet, it is important to note that the estimated net operating income per acre is only Rs 16732 and Rs 19681 respectively in Kottayam and Thiruvananthapuram. The net total income from an acre is estimated to be much lower at Rs 5685 and Rs 4343 respectively in Kottayam and Thiruvananthapuram. At the going market price, the recorded net operating income and net total income for those with holding size below two hectares and depending entirely on rubber cultivation for their livelihood is likely to be below the poverty line. In the current context, the need to ensure remunerative prices along with measures that contribute to cost minimization, higher yield and improving output quality by revamping the R&D, extension, training and developmental activities of the Rubber Board with a new orientation cannot be over emphasized.

Key words: cost of cultivation; Natural rubber; rubber plantation crisis; Kerala

1. Introduction

India's rubber plantation sector is currently undergoing an unprecedented crisis. It is said to have had most adverse impact on over a million small holders cultivating rubber and nearly half a million workers engaged in NR production. There have been demands from various quarters, for the state intervention to bail out the growers from the crisis¹. Attributing the crisis to increased imports and crashing prices, the often-made demands, inter alia, included imposing anti dumping duty, invoking the WTO clause on substantial injury and restricting import through non-tariff measures. However, any informed policy intervention by the state at this juncture has to be on the basis of a proper understanding on costs and returns involved in the NR production. Unfortunately, our understanding on these two crucial policy variables at best remains rudimentary because of the absence of any authentic study on the issue involved. The present study is an attempt at filling this gap in our understanding on the issue.

This paper is divided into three sections. Second section sets the context for estimating the cost and returns of NR cultivation by highlighting the different dimensions of the ongoing crisis. Natural Rubber, apart from being a perennial crop, has certain unique characteristics, which make the estimation of cost a difficult task. Section three highlights these issues and discusses how the present study has addressed them. The procedure used in the primary data collection is also discussed here. Section 4 presents the empirical results of the study especially the cost of production during the entire life span of the crop for different size holdings in two rubber-growing areas in Kerala followed by the last section wherein the concluding observations are presented.

2. The Context

Among the different plantation crops in India, the performance of Natural Rubber (NR hereafter) has been remarkable. This is true regardless of the indicators that one may choose. The production of NR in 1970 was only 0.92 lakh MT from a tapped area of 1.41 lakhs ha. Accordingly the production per hectare (yield) was 653Kgs. By 2011-12 total production touched 9.04 lakh MT (almost an increase of 10 fold!) recording an annual compound growth rate of 5.75 per cent. Since the recorded annual compound growth in tapped area was only about

¹For details, refer to the report "Crisis in plantation sector: In search of long term strategies" which was prepared by NRPPD on 6th February, 2016, in consultation with stakeholders involved in crops such as tea, coffee and spices along with natural rubber.

3 per cent, much of the increase in production could be attributed to the growth in yield which experienced almost three fold increase during this period. By 2011-12, with a yield of 1841kg/ha India emerged as the country with highest productivity among the NR producing countries – a rare achievement in Indian agriculture². The estimates by the Rubber Board shows that at 2010-12 prices, the net additional income per annum on account of the higher yield of the new clone developed by RR11 amounts to Rs 2856 crores. What is more, it is with suboptimal agro-climatic conditions in India that such an achievement has been made. An equatorial climate is best suited for the faster growth of natural rubber. Hence, in the South-East Asian countries the immaturity period is only 5-6 years as compared to over 7 years in India.

The performance record of NR becomes all the more striking, as it has been associated with major changes in the holding structure (George et.al 1988). Traditionally, cultivation of natural rubber has been mainly by the large estates. In 1955-56, for example, about 80 per cent of the total area under natural rubber was held by holdings above two hectares. While the average holding size was 3.08 ha in 1950 it steadily declined to 0.54 ha in 2011-12. By 2013, nearly 1.17 million holdings are under the two hectares category and they account for 98% of the total number of rubber holdings, and 86% of the total area. The point to be noted is that it is with the active involvement of over a million smallholdings that the natural rubber sector recorded its remarkable performance. It is also to be noted that a large proportion of the state's expenditure for this sector is recouped by way of cess from the growers. During the 11th plan period out of the total expenditure (plan and non-plan) of Rs 822 crores nearly 62% was recovered by way of cess collected from NR .

Though there has been considerable regional diversification in the cultivation of NR in the recent past into nontraditional areas including the North eastern states like Tripura, Assam and Meghalaya and other states like Karnataka, Andhra Pradesh, Goa and others, NR still holds much importance in the regional economy of Kerala(George and Joseph 1992; Indian Rubber Statistics 2012). Even today, Kerala accounts for nearly 89 percent of the total production, though its share in area over time declined to 75 percent. Thus viewed, Kerala has been the major beneficiary of the observed growth performance of NR. Within Kerala's agricultural

²Eleventh Five Year Plan document (2007-12), Rubber Board of India

sector, natural rubber accounts for about 26 per cent of the net sown area and about 46 per cent of the agricultural GDP in 2010-11 and act as a main source of livelihood for about over million small holders and nearly 4 lakh labourers engaged in NR.

The observed remarkable performance, needless to say, has been an outcome of the R&D, extension, training and development activities undertaken at the instance of the Rubber Board (Kannan and Pushpangadan, 1999; Lekshmi and George, 2003; Joseph and George, 2010; Sethuraj and Jacob 2012) within the protected environment wherein the domestic prices remained about 20 to 25% higher than the international prices. Apart from the technological innovations, there were also organisational and institutional innovations oriented towards evolving a vibrant NR sector while protecting the concerns of labourers (NRPPD 2013).

But today, the NR sector is in crisis often attributed to the decline in prices (see Table 1). On a decadal basis, price of NR has been recording a positive growth since 1981. Recorded growth in the price has been 4.5% per annum during 1980s, 5.9% during 1990s and about 15.9 per cent during 2000-09. However, there has been a downward trend during the last four to five years. With a recorded growth of -9.5% in the price of natural rubber during 2010-11 to 2014-15 the price prevailed in February 2016 was around Rs 92/kg which was not even 50 per cent of what prevailed a few years ago and was at the level that prevailed a decade ago. Though there has been an upward trend thereafter for short while, the price in September has been only about Rs 120 per Kg. Fig. 1 presents trends in the price of NR along with other plantation crops. It is evident that the recent price decline is not confined to NR alone. In case of other crops like coffee, cardamom and to a lesser extent in tea as well, there has been a declining trend. Thus viewed, the price induced crisis is not confined to NR alone. But in this study we shall focus on rubber where in the observed decline in price is perhaps most drastic.

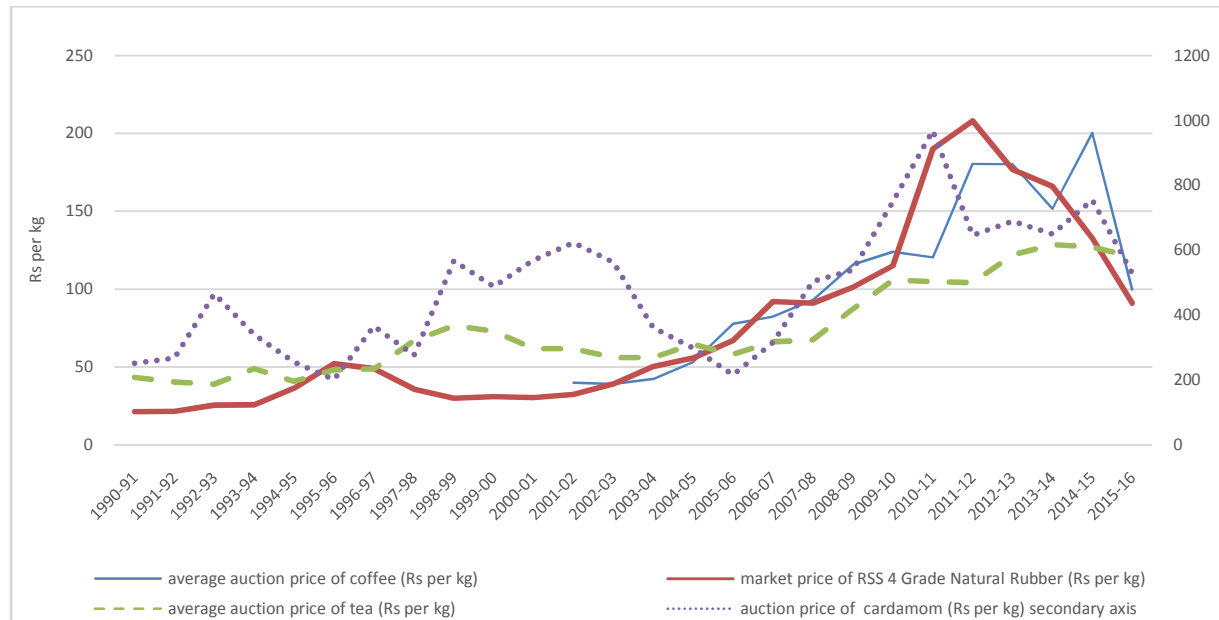
Table 1: Growth Rate in the price of plantation crops (%)

Year	Natural Rubber
1980-81 to 1989-90	4.46
1990-91 to 1999-00	5.89
2000-01 to 2009-10	15.86
2010-11 to 2014-15	-9.46

Source: Computed from respective commodity board's data

Note: '*' for coffee, growth rate is for the year 2001-02 to 2009-10. Coffee price is calculated as the average of auction prices (Bangalore) for four major grades of coffee.

Figure1: Trend in the price of plantation crops (Rs per kg)



Source: Computed from respective commodity board’s data.

Note: Coffee prices was available from 2001-02 onwards, hence it has been reported as such.

For the year 2015-16, price of tea was calculated from the month wise auction price data from Tea Board of India while for the other three crops, it corresponds to the average daily price reported by the respective commodity boards.

Other Dimensions of Crisis

Decline in yield

After recording a sustained increase in productivity for more than four decades, there has been a declining trend especially during the last 7-8 years. From Table 2 it is evident that along with negligible growth in area under cultivation the period since 2011 witnessed sharp a decline (-15.7%) in production and still sharper decline in yield (-16.9%). Apparently, as the sector has been exposed to more competition, there has not been any marked increase in productivity (see Figure 2).

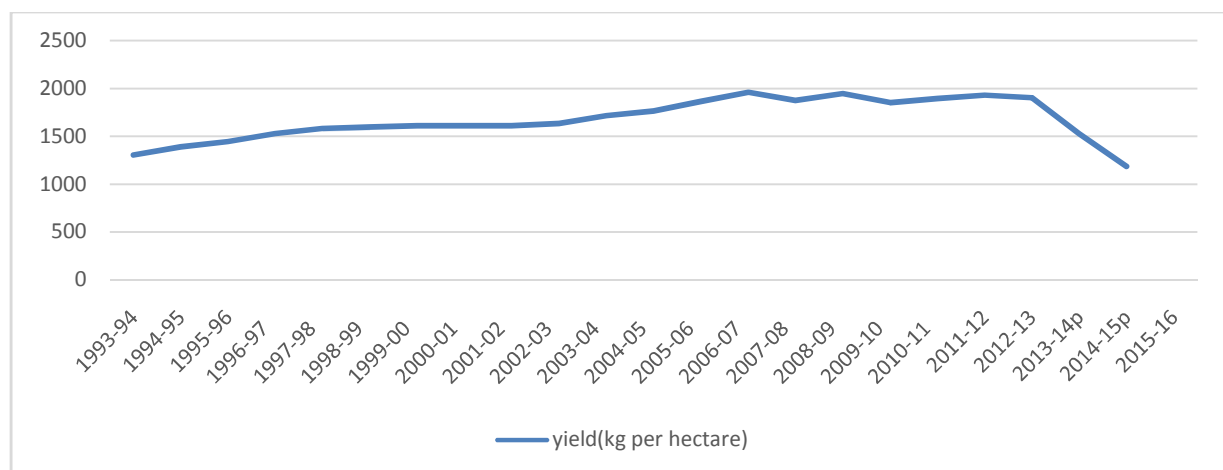
Table 2: Growth rates in Tapped Area, Production and Productivity of Natural Rubber in Kerala

Year	Growth rate in tapped area	Growth rate in production	Growth rate in yield
1953-77	5.13	9.68	4.56
1978-93	4.40	8.03	3.64
1994-10	1.55	3.52	1.97
2011-14	1.19	-15.71	-16.90

Source: Indian Rubber Statistics, Rubber Board of India and Economic Review, Government of Kerala.

During the period of price fall, though farmers had area with trees of tapping age, they did not tap them since the prevailing prices were not able to cover their cost of production. Such behavior has been by earlier studies as well (Mohanakumar and Chandy 2005; Chandy, George and Raj 2010). Cost of employing labour in the plantations increased due to scarcity of skilled labour (tappers) (Viswanathan, George and Joseph 2003). With respect to labour shortage in natural rubber, Viswanathan (2013) has shown 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.

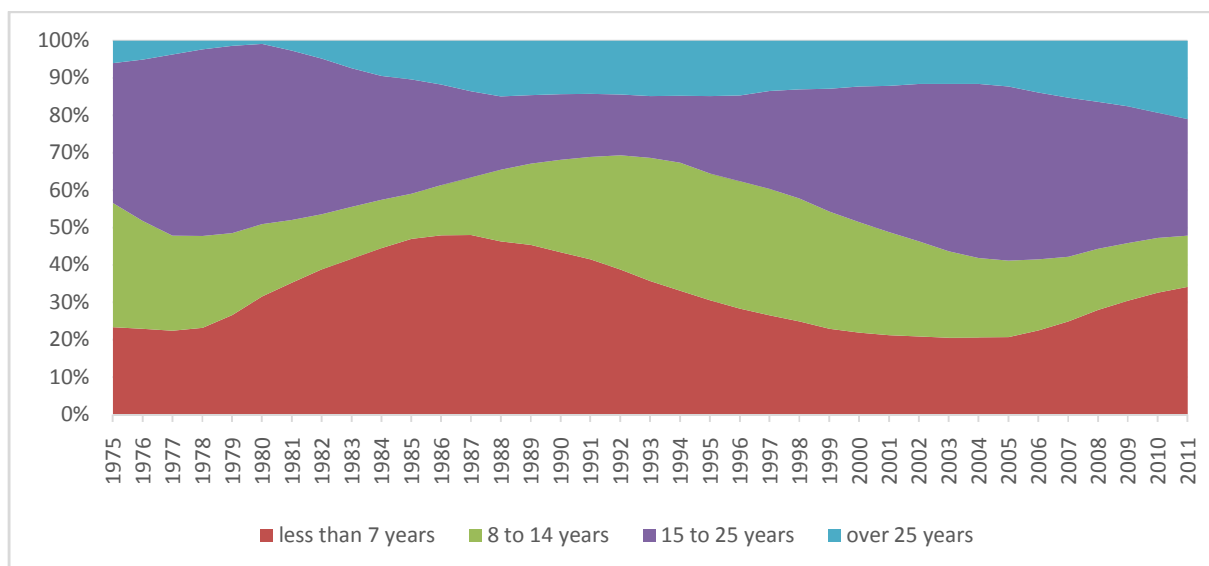
Figure 2: Trend in yield of natural rubber in Kerala (1993-2015)



When we are discussing about yield, it needs to be noted that in case of perennial crops such as rubber, the age profile of existing stock of trees affects yield per hectare and thus total output in any given period (Bateman, 1962). The yield cycle of rubber involves broadly four phases. There

is an initial pre-bearing phase of about seven years, followed by an early harvesting phase of about one to three years wherein yield is positive and increasing with high variability. Then comes the third phase, which can be termed as peak bearing phase and it lasts for about four to 13 years wherein the yield reaches the highest level. In the last phase, there is a decline in yield. Since the age of the plant, *interalia*, has a crucial bearing on the yield, timely replanting of the plants is required. Keeping this in mind, replanting scheme has been undertaken by the board and the basic objective of this scheme is to induce the growers to undertake timely replanting such that the shares of old age plants are reduced to minimum level (George et al., 1988). However, a preliminary enquiry of the age distribution of NR by suggests that there has not been any marked decline in the share of old aged plants; instead their share has increased significantly over time (Figure 3). In 2011, the share of plants over 25 years of age in total planted area was 21 per cent. This questions the effectiveness of the subsidized replanting scheme in influencing the decision of the farmers to go for replanting.

Figure 3: Distribution of Area under NR according to age structure



Source: Calculated from various issues of Indian Rubber Statistics, Rubber Board of India.

Increasing import intensity

Given the heavy dependence on imported natural rubber on account of the growing demand from the growing automotive and other rubber based industries, increasing domestic availability

through domestic production has been the prime agenda of the Rubber Board since its inception (Joseph and George 2016). Towards this end, supply enhancing measures³ was initiated by the Rubber Board to increase the production and productivity of NR. It is important to note that these supply enhancing measures by the Rubber Board was initiated in a period wherein NR had protection from import competition that ensured remunerative prices to the growers. The domestic price used to be about 20-25 per cent above the international price. However, along with vigorous supply-enhancing measures commensurate attempts towards demand expansion and, more specifically, to ensure remunerative prices have been missing (Harilal and Joseph, 1998). To make matters worse, the period of protection, over time, has given way to open competition with the removal of tariff and non-tariff barriers in the event of WTO and Free Trade Agreements with Sri Lanka and ASEAN.

The mis-match between interventions at the supply and demand along with exposure to open competition has had its adverse effect on natural rubber. During the pre WTO period, natural rubber had an import duty of about 85 per cent. But under WTO natural rubber has been treated as an industrial raw material with a bound tariff of only 25%. This has led to a situation of double standard wherein natural rubber is treated as an industrial raw material when it comes to trade without receiving any consideration of an industrial product when it comes to its production. What is more, the growers had to compete with their counterparts from other countries like Thailand who receive much higher level of production subsidy⁴ (Viswanathan 2008).

As the sector got exposed to open competition without adequate measures to enable them to withstand international competition, import intensity (import as a proportion of production) of natural rubber crossed all the limits during the recent years to reach nearly 70 percent at present (See Table 3). It is also important to note that nearly 60% of the NR imports consists of block rubber and its price about Rs 50 lower than that of rubber sheets (Joby and George 2016). The

³ Supply enhancing measures was included in Rubber plantation development scheme which was grouped under three major components namely, plantation development, productivity enhancement; and farmer group formation and empowerment. Under the productivity enhancement component, the various schemes undertaken are related to distribution of rubber plantation inputs (such as HYV plants) offering price concessions. The other is related to the setting up of rubber agro-management units which would promote the adoption of four vital cultural practices such as manuring, plant protection, rain-guarding and scientific tapping.

⁴ While the planting grants in Thailand was around US\$722 per ha, in the traditional areas of India, the subsidy at the current exchange rate is US\$ 378.78 per ha.

preference of the manufacturers for block rubber also needs to be viewed in the context of perennial complaint by the manufacturers about the lack of uniformity in the quality of sheets rubber produced by millions of NR rubber growers (Parliamentary standing committee report 2015).

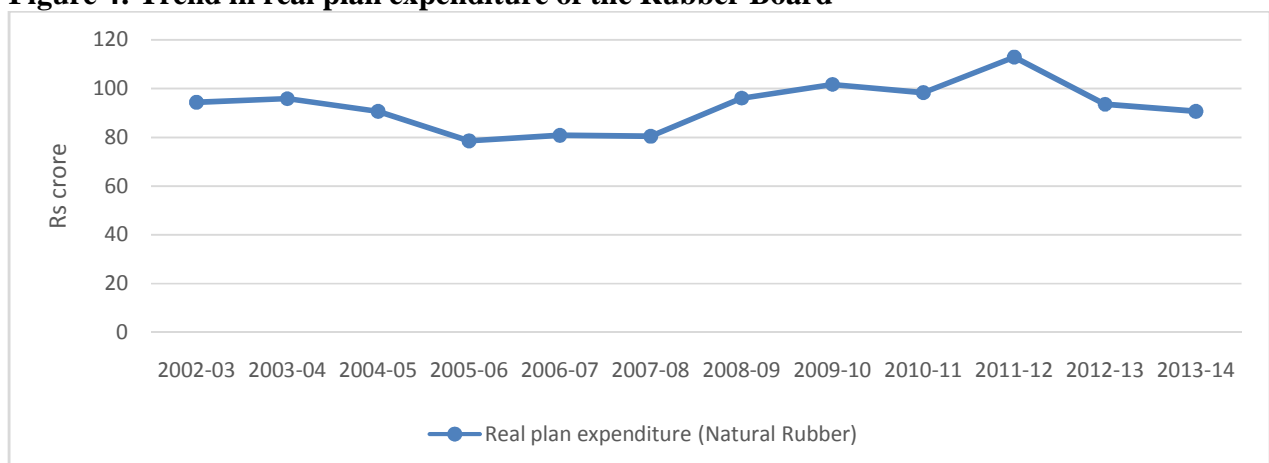
Table 3: Import intensity of natural rubber

Year	Import intensity (Natural Rubber)
1990-91	14.87
2000-01	1.42
2009-10	21.31
2010-11	22.12
2011-12	23.73
2012-13	28.76
2013-14	46.55
2014-15	68.55

Source: Calculated from respective commodity board's data.

While the sector has been reeling under crisis, there are evidences of withdrawal of the State. This is manifested in terms of the decline in the expenditure of the Rubber Board which is entrusted with the overall development of the crop. The Rubber Board has experienced a sharp fall in its real plan expenditure particularly from 2011-12 onwards (Figure 4). With a decline in plan expenditure, the activities having long-term implications like R&D, extension and production promotion could have been adversely affected.

Figure 4: Trend in real plan expenditure of the Rubber Board



Source: Computed from Rubber board's data and RBI data.

The above discussion tends to highlight the different dimensions of crisis in NR sector, which was once known for its remarkable performance. It appears that the strategies and policies found

effective during the earlier regime of protection remain unchanged while they turned out to be not appropriate in enabling the sector to thrive in the new context characterized by heightened competition under globalization.

3. The approach and method

As already indicated the NR sector is going through a period of crisis that calls for policy interventions. There are demands from different quarters that *inter alia* include imposing anti dumping duty on NR, invoking substantial injury clause under WTO and others. A pre requisite for any informed policy intervention is an understanding on the cost involved in its production and the returns accrued therein. In the absence of any published estimates on cost and returns of rubber cultivation this study is an attempt at making estimates on these two important policy variables.

Cost of Cultivation Surveys in India – Objectives and Approaches

In India, Farm Management Surveys are the mechanisms for data generation on cost of cultivation of crops and returns derived from them. These estimates are based on intensive ‘inquiry-based surveys’ on use of inputs and on outputs harvested by farmers whom the investigators visit repeatedly at various stages of growth of the crop(s). Cost of production studies are undertaken with a view to get information for a class of cultivators belonging to a particular region or an area. By analyzing the information on costs and returns of different crops in different crop-complex conditions and agro-climatic regions, very useful inputs for policy could be gathered relating to labour absorption in agriculture, wage structure and quality of living of labourers etc. The production function analysis on the time-series and spatial data could assess the technical, allocative and economic efficiency of farmers across time, space and categories. But the most important use of this data by the planners is for evolving policy related to price, i.e., for fixing the benchmark ‘Minimum Support Prices’ (MSP).

In India, Farm Management Studies have a long history. Immediately after Independence, a scheme entitled “Studies in the Economics of Farm Management in India” was started by the Directorate of Economics and Statistics, Ministry of Agriculture in six regions of the country i.e. Bombay (Maharashtra), Madras, Punjab, Uttar Pradesh and West Bengal in 1954-55. Madhya Pradesh was subsequently included in 1955-56. The crops covered included all the crops coming

under the MSP regime. The data generated through these surveys had some inherent weaknesses especially in comparing across different regions and time. However, with the experiences gained in planning and organization of the scheme on Farm Management Studies a new scheme called “Comprehensive scheme for cost of cultivation of principal crops” was launched in 1970-71 on the recommendations of the Standing Technical Committee chaired by Ashok Mitra. A uniform set of schedules was devised for the collection of data so that the data belonging to different regions could be compared. The scheme is being implemented by the Department of Economics and Statistics with the help of SAUs/ colleges. The working of the scheme had been thoroughly reviewed first in 1980-81 by SR Sen Committee and then in 1990 by CH Hanumantha Rao Committee. The Alagh Committee and the Inter-Ministerial Committee also made their reviews of the scheme. Over the years the number of crops covered increased from just two (wheat and bajra) in the beginning to 29 at present, and 19 major states are covered. However, natural rubber is, as yet, not included in the list of crops in any region of the country.

CoC survey in Kerala: Comprehensive Scheme (CS)

Unlike other states in India, the CS in Kerala is implemented through the Department of Economics, University of Kerala. The CS covered for the period 2002-05, the following crops, paddy, tapioca, coconut, areca nut and black pepper. However, CS now covers only Paddy and Coconut regularly. The two crops namely areca nut and pepper are later done away with by the agency, since Spices Board is the agency to conduct studies on these crops. The sample size they adopt is 200

DES, Kerala

The Cost of Cultivation Wing of the Department Economics and Statistics, Government of Kerala, has been conducting field study on Cost of Cultivation of important crops of Kerala since 1980-81. The crops being studied are Paddy (all 3 seasons), coconut, arecanut, tapioca, banana, pepper, ginger and turmeric. Some crops like ginger and turmeric were only recently added. The survey covered 61 taluks covering all the districts of Kerala, selected through circular systematic sampling method.

The Cost Concepts adopted by CS

The items of costs included under each group are given below:

Paid-out Costs

- i. Hired labour (human, animal and machinery).
- ii. Maintenance expenses on owned animals and machinery.
- iii. Expenses on material inputs such as seed (home grown and purchased), fertilizer, manure (owned and purchased), pesticides and irrigation.
- iv. Depreciation on implements and farm buildings (such as cattle sheds, machine sheds, storage sheds).
- v. Land revenue.
- vi. Rent paid for leased- in land.

Imputed Costs

- i. Value of family labour,
- ii. Managerial input of family,
- iii. Rent of owned land ; and
- iv. Interest on owned fixed capital.

The following standard cost notations are used :

Cost A1: All actual expenses in cash and kind incurred in production by owner operator

Cost A2: Cost A1+ rent paid for leased-in-land

Cost B1: Cost A1 + interest on value of owned capital assets (excluding land),

Cost B2: Cost B1 + rental value of owned land (net of land revenue) and rent paid for leased-in-land

Cost C1: Cost B1+ imputed value of family labour

Cost C2: Cost B2 +imputed value of family labour

13. It may be noted that costs progressively escalate in an alphabetical order, that is to say that $C_i > B_i > A_i$, where $i = 1$ or 2 . Further, costs with suffix 1 (A1, B1 and C1) exclude components of land rent/rental value while costs with suffix 2 (A2, B2 and C2) include them and therefore,

$A_2 > A_1$, $B_2 > B_1$ and $C_2 > C_1$.

Cost Concept adopted by DES, Kerala

Cost A

- i. Hired human labour
- ii. Animal labour
- iii. Machine labour
- iv. Seed/ seedlings
- v. Farm Yard Manure and Chemical fertilizers
- vi. Plant Protection
- vii. Land tax and Irrigation cess
- viii. Repair and Maintenance charges of implements, machinery and buildings
- ix. Interest on working capital
- x. Other expense

Cost B1: Cost A + Interest on fixed assets (excluding land)

Cost B: Cost B1 + interest on land value

Cost C: Cost B + Imputed value of family labour

Except for the case of paddy, a plot of size not less than 10 cents is made eligible for consideration for the survey. For paddy, the plot size not smaller than 25 cents of area. For perennial crops, the selection criterion is, at least 25 trees/ plants, of which a minimum of 50% should be bearing.

Cost of Cultivation Survey of Rubber in India

The Tariff Board conducted a study on the cost of production of NR as early in 1951. Subsequently, the Tariff Commission studied the cost of cultivation of NR and recommended prices to the Union Government for declaration of notified minimum and maximum prices of rubber. In late 1990s, the Costs Accounts Branch of the MoF, GoI again conducted such a study, based on the report of which the government revised the notified the indicative price of Rs.34.05 per kg of RSS4 grade rubber. The Cost Accounts branch of the MoF had many times in the past undertaken studies on cost of cultivation of rubber. Though the small growers do not keep proper accounts of costs and products, this branch conducted such surveys on small growers, but for unknown reasons the information collected was not published. As no accounting guidelines have been formulated till then, the ICWAI have undertaken, in 1998-99, a project to formulate the farm accounting guidelines and a format for ascertaining cost of production of NR by following

the standard accounting principles of financial accounting (ICWAI, 1999 *Formulation of Farm Accounting – Guidelines on Rubber Plantation Industry*). This apart, none of the cost accounting agencies – either the DES of either the GoI or the State Government – is known to have included rubber as a crop among the list of crops that are being surveyed by them for estimating the cost and returns of cultivation.

The method suggested by ICWAI (1999 p 75-77), could not be adopted by the present study for the following reasons.

1) The study used financial accounting principles, which treated each individual plantation as an accounting unit, and aggregation across samples was not attempted. The statement of costs and returns is prepared and presented individually for all the 150 units.

2) It appears from the tables presented in the appendix that the costs covered all the trees belonging to the farmer (across different holdings), because no separate cost is given for “immaturity” plants and others. Age-wise accounting was not either done or the sample design did not accommodate such segregation.

3) The standard cost concepts as developed and adopted in the CSS and DES surveys were neither consulted, nor used. The cost elements are discretely classified as “Maintenance and upkeep”, “Tapping and collection”, “Processing the packing”, “Transportation cost” and “Indirect expenses” which included land rent, amortization of development cost, interest on loan, interest on working capital at 12%, adjustment of loss on a scrap (only 20% less than that of sheet), b) grade difference, and managerial expense at 10%.

Conceptual/methodological issues in estimating of cost of production of NR

There are a number issues of that arise while estimating the cost of production of a perennial crop. In addition to such issues NR has certain specific issues of its own

1. NR being a perennial crop cost and returns are spread over a long time. Hence arises the issue of discounting the cost incurred and returns accrued.

To get over this issue we have selected the sample of farmers is such a way that all the age group is represented and the data on cost and returns for the year 2014-15 for all the age group is collected

2. Being a perennial crop there is a gestation period of 7-8 years followed by 15-30 years of yielding phase (varies with the type of cultivars, level of crop management and type and skill of tapping). However, for adopting a uniform accounting procedure the ANRPC (Association of Natural Rubber Producing Countries) have recommended a productive life of 22 years (as quoted in ICWAI 1999, p 19). Since the cultivation of NR involves a pre-bearing period of seven years wherein the growers incur cost of establishment and maintenance without any income, there is the issue of accounting the cost incurred during the pre-bearing period.

In the present study we have amortized the establishment cost (cost incurred during the pre-bearing period) spread it over the yielding phase.

3. As part of the promotional schemes, the Rubber Board provides subsidy to the growers to compensate, at least partly, for the cost incurred during the pre-bearing period. This has to be accounted for while estimating the cost during the pre-bearing period.

In the present study a cost scenario has been created after adjusting the amortization cost for the subsidy received. It may be noted that only 13.5% of the sample growers reported to have received subsidy.

4. Rubber crop hardly hosts another crop(s) under its canopy, once it attained the age of four. But during the initial three years of its gestation period of 6-7 years, it is possible to cultivate other crops that can tolerate a fair amount of shade, and that have shallow root zone. Therefore the farmers have the option of intercropping as a strategy to recover, at least partly, the cost incurred during the pre-bearing period. Banana, plantain, ginger and pineapple are the most prevalent crops that found favor with the farmers. Hence it is important to account for the income earned from intercrops while estimating the cost incurred during the pre-bearing period

In the present study returns income from intercrop is taken care of by considering the practice of leasing out the land planted with rubber for the cultivation of crops like pineapple and banana during the first three years. The commonly observed practice is one wherein the land is leased out for intercrop in return for meeting all the expenses associated with growing rubber during the first three years. Hence one plausible way to take into account the intercrop income is by way of considering the establishment cost only from the fourth year while estimating the amortized cost.

A cost scenario has been generated after adjusting the intercrop income with the amortization cost .

Having said this it needs to be noted that intercrop option is found prevalent only among growers with holding size above one hectare. Perhaps such service providers need certain scale to engage in such activities. The hesitation of growers with less than one Ha to engage themselves in intercropping may be seen in the context of high labour intensity in cultivation such crops and alternative income sources available to the growers.

It may be noted that only too few growers raise inter crops on their own. Hence the net income from intercrop is potential than real.

5. Unlike in many other costs NR involves primary processing at the farm gate level - processing the latex into rubber sheets. This calls for investment in capital goods like rubber rollers, sheds and smoke houses

In the present study, to get over the procedural issues related to cost of rubber roller and the construction of related facilities along with the depreciation associated with it, we have taken one day's yield per year as the cost of sheet making

(From the field survey we understand that many farmers have avoided substantial investment on sheet roller by paying, in return, one day's yield from the plantation for the service provider. But the service provider fixes the day of such recovery. The farmers are of the opinion that they have to dispense with about 20 to 25 percent extra of the average daily latex yield of the plantation, as the service provider chooses the highest yielding day as the yield-recovery day)

6. Good quality smoked-ribbed-sheets fetch higher prices. There remained the practice of smoking the sheet by hanging them inside the kitchen chimney. This has been almost dispensed with by a majority of farmers including the small holders on account of using LPG for cooking instead of firewood. Smoking the sheet at the right temperature and for right duration requires exclusive smoking shed and fuel for smoking. Many farmers, who still do not own such systems for smoking, but who sell the farm produce after processing the latex into sheets, have reported that they managed the processing by paying Rs 5/- per kg of sheets to the nearby smoke house owner.

7. While rubber sheet/scrap is the major source of income for the growers, after maturity, farmers get a lump-sum income from the sale of rubber trees. This lumpsum income also needs to be accounted along with the regular income earned the growers from latex/rubber sheets.

The present study considers income from the sale of rubber wood as a potential saving which will accrue only at the end of the life span of the crop. Hence it cannot be accounted in the current return. Nonetheless this potential income does influence the farmers' decision to continue with crop rather than shifting to other crops in response to prices and other factors. We have created a scenario of Annualized Potential Savings (APS) spread over the entire life span.

8) Finally there is the issue of accounting for the price of land used for cultivation. This issue arises especially because NR is considered as an industrial raw material. Given the high land price in Kerala, no crop could be economical if we consider the entire value of land. In the present study we have estimated what proportion of the land value could be accounted for by the estimated APS.

Sample selection method

Population:

Inclusion criterion : Rubber farmer with holding size of not less than 20 cents (about 0.1 ha) and not more than two hectares who is willing to respond to the field investigator freely as many times as the investigator wants in Kerala

Location: For the present, the survey area is restricted only to Kerala

Period for the Re-call method: 12 months ending the month of the survey (April 2015). The survey was conducted from May-July 2015.

The Sampling Method:

Method: Stratified Three-stage random sampling method.

Two districts in from Kerala - Kottaym and Thiruvananthapuram - were purposively selected. Two regional offices of Rubber Board were randomly selected from these districts. The selected regions from Thiruvananthapuram zone are Nedumangad and Amboori and those from Kottayam are Kanjirappally and Palai. The sample size was 300 per district.

The sample of 300 was stratified on the basis of age and holding size.

Stage 1:

Table 4 Distribution of Rubber area according holding size (Year 2012)

Holding size	% of Area	% of N
< 2 ha	77.8	80%
2 - 20 ha	12.2	10%
> 20 ha	10	10%

Source: Compiled from Indian Rubber Statistics 2012

It is seen that the small holdings (of less than 2 ha) hugely dominate the holdings distribution, and therefore, the present study was limited to holdings less than 2 Hectares. However, it is to be ascertained whether the rubber cultivation enjoys the benefit of economy of scale, and therefore the samples were so chosen that the holdings of size less than 1 ha and larger holdings (1-2 ha) are sufficiently represented in the sample.

Stage 2:

A look at the distribution of plantations based on the age composition, as that is derived from the data on area under re-planted and new-plantations, suggests that the sampling size could be distributed as indicated in table 5.

Table 5: Distribution (%) of rubber trees according age

Age (years)	Kerala ^{\$}	Kottayam [#]	Thiruvananthapuram
1	4.29	3.64	4.65
2 & 3	9.43	9.28	10.12
4 - 7	16.34	16.58	24.92
8 - 12	9.50	16.09	16.08
13 - 30	49.46	53.85	41.70
31 - 35	10.98	0.56	2.53

Source: \$ Compiled from data on New-planted area for the period from 1977-78 to 2011-12, from Indian Rubber Statistics, various issues

: Field survey 2015

The method adopted for the present survey warranted the representation of plantations of all ages up to 8 years to estimate the year-wise establishment cost of plantation, from which the annual amortization value could be arrived at. Therefore, care was taken while choosing the individual holdings that each age-group is sufficiently represented in the sample. It may be seen that the field survey when finally done, the distribution of the holdings of the survey tally, by and large, the pattern already reported in Kerala (IRS 2012).

Final sample size: $N = 600$.

No of samples from Kottayam: 300 (150 from each regions)

No of samples from Thiruvananthapuram: 300 (150 from each regions)

Limitations of the study

We shall conclude this section by highlighting some of the limitations of the present study

(a) This study is confined to only two rubber growing districts in the state of Kerala -Kottayam and Thiruvananthapuram. Hence, inference about other rubber regions may be taken with due reservation

(b) The present study is based on a relatively small sample of only 600 growers. Given the small sample size the result may be considered as indicative.

(c) The study is based on the data collected from holdings with less than two hectares. Though this size category constitutes, 86% of the total area and 98% of the total number of holdings in 2011, it provides only a partial picture. Since the larger holdings have to incur additional costs while they also may have economies of scale, a separate enquiry for the larger holdings is called for

(d) The survey was conducted in a period wherein the industry was in crisis inter alia on account of reduction in prices – we mean not a normal period. In case of plantation crops, as indicated by earlier studies, on account of the reduced cash flow resulting from lower prices, the growers generally have a tendency to cut down many of the cultural operations, maintenance activities and even tapping. Hence, the possibility of an extent of underestimation in cost cannot be ruled out. The extent of underestimation in the present study based on the reported cost that we have

arrived at from the mean values is about 20-25 percent when compared to the cost involved as per the package of practices recommended by the rubber board. In our sample about 11 % of the farmers belonged to this category. Table A8 indicates the cost difference between two types of growers. The details of underestimation is evident from their yield level however is not found to be significantly different presumably because in case of perennial crops reduction in current expenditure will be reflected only in the future yield. They are found to be having at the same time, given the crisis condition there is also the likelihood of over reporting of expenses.

4. Cost of production and income

As already indicated, the central concern of the present study is to arrive at cost incurred and income accrued by the NR growers. In case of agricultural crops the cost and returns are governed to some extent by the characteristics of the farm and the characteristics of the farmer who undertakes farming. To the extent that this holds good with respect to NR production as well we shall begin with a brief discussion on these two aspects without any claim of being exhaustive.

Household characteristics of the growers

It is observed that the household size for the rubber growers in Kottayam (4.3) and Thiruvananthapuram (3.8), which is lower than what was reported at the state level (5) as per 2011 census (see Table 6). It appears that the average age of the grower is found to be 54.5 years in Kottayam and 54 years in Thiruvananthapuram. Only growers with less than 30 years of age are found to be only 3 in Thiruvananthapuram and 1 in Kottayam. Further, as expected, being in a highly literate state, the growers are better educated with over 90% of them in Kottayam and 80% in Thiruvananthapuram having more than 10 years education. More importantly about 20% of the growers are having education at the level of degree or above. The higher educational level appears to have enabled them to diversify their income sources and that only 20% of the growers in Kottayam and 51% of them in Thiruvananthapuram reported agriculture as their prime occupation.

Table 6: Household characteristics of the growers in the study areas

Characteristics	Kottayam	Thiruvananthapuram
Average household size (number)	4.3	3.8
Average age of the grower (years)	54.5	53.0
Sex ratio - family members	1080	1136
Members with age < 15 (%)	41.5	42.5
Growers completed 10 years of schooling (%)	90.5	80
Growers with a degree and above	21	19
Woman growers (%)	6.5	24
Primary occupation- Grower - Agriculture %	20.5	51.5
Experience in rubber cultivation (years)	44	13

Source: CDS-NRPPD Survey, 2015

As is evident from Table 7 the growers' income from non-agricultural sources is about Rs 10000 per month in Kottayam and Rs 9000 per month in Thiruvananthapuram. The family income from sources other than rubber is found to be Rs 20000 and Rs 15000 respectively in Kottayam and Thiruvananthapuram. No wonder, unlike in other crops wherein the price crash like the one being reported in NR induced farmers to commit suicide, hardly any such episodes have been reported in case of rubber. The implications of the access to non-agricultural income on the response of NR growers to price crash and their decisions regarding their involvement with rubber cultivation deserve further reflection. Having alternate income sources, with an unremunerative price many of the growers could afford not to tap their rubber trees that, in turn, have led to the drastic reduction in the production of NR in the recent past. Further, with alternate income sources, a sustained decline in prices could induce the NR growers to shift to other crops. The plausible supply shock on account of such responses from the growers on NR consuming industries needs to be a point of concern for the policy makers.

Table 7: Average monthly income from sources other than rubber (Rupees)

	Kottayam	Thiruvananthapuram
Farmer	9780.3	8885.9
Other members	25419	15872
All members	20114	15273

Source: CDS - NRPPD Survey, 2015

Table 8 provides some idea about the borrowing behaviour and outstanding debt by the rubber growers. The outstanding debt in Kottayam (Rs 3.86 lakhs) is found to be significantly higher than that of in Thiruvananthapuram (Rs 2.29 lakhs). Out of the total outstanding debt almost 79 percent has been for agricultural purposes in Kottayam and that of in Thiruvananthapuram was as high as 94 percent. Table 8 also indicates that over 95 percent of the borrowing has been from the institutional sources and the negligible incidence of borrowing from the non-institutional sources like money-lenders. This in turn has led to borrowing at a relatively low rate of interest which in turn also could be a factor that explains why hardly any rubber farmers committed suicides despite sharp fall in prices.

Table 8: Borrowing and loan outstanding of the sample growers

	Kottayam			Thiruvananthapuram		
	N	Mean	CV%	N	Mean	CV%
Total outstanding debt Rs 000	168	385.9	117.3	134	228.7	91.9
Out of which:						
% for Agriculture	46	78.6	40.5	50	94.3	21.1
From institutional sources (%)	130	94.5	102	80	85.5	91.2
Highest interest rate:						
Agriculture		7.2	57.5		7.1	52.5
Institutional		11.7	29.6		9.4	39

Source: CDS - NRPPD Survey, 2015

Holding/farm characteristics

The average rubber holding size of the sample growers in Kottayam is found to be 219 cents and 101 cents in Thiruvananthapuram (Table 9). This suggests that the holding size in Kottayam is about 40% higher than that of state average of 134 cents (0.54 ha) and that of in Thiruvananthapuram is only 75% of the state average. However, NR is the most important crop for the farmers because in both districts over 82 percent of the total land owned by the growers is cultivated with rubber. We also observe similarity in both districts with respect to the average age of trees, which is 14.5 years in Kottayam and 12.4 years in Thiruvananthapuram. RRI 105 is found to be having very high rate of diffusion among the growers with 89 percent of the farmers using it in Thiruvananthapuram and 80 percent in Kottayam.

At the same time, there are notable differences regarding the holding characteristics between the two areas. The grower families in Kottayam are found to be significantly more experienced in growing rubber (43.8 years) as compared to their counterparts in Thiruvananthapuram (13 years).

The planting density in Kottayam (376) is found to be only 73% of that in Thiruvananthapuram. The growers also vary in terms of the tapping practice. While the most popular tapping practice is S2d2 (“half-spiral, alternate daily”) in Kottayam where as that of in Thiruvananthapuram is S2d1 (half-spiral daily). This has had its effect on total number of tapping days. Days tapped in Kottayam (77) are found to be only 68% of what was reported in Thiruvananthapuram. Yet another difference is in term of the holdings in tapping age, which is higher in Kottayam indicating more new plantations in Thiruvananthapuram. Finally, the table indicates that the reported mean value of land value is Rs50.01 lakh per acre in Kottayam and Rs46.32 lakh per acre in Thiruvananthapuram.

Table 9: Rubber holding characteristics in the study area

Characteristics	Kottayam	Thiruvananthapuram
Average land holding size (cents)	265.1	124.2
Purchased by current owner (cents)	125.0	81.0
Area under rubber (cents)	219.2	101.5
Area under rubber (%)	83.4	82.0
Years since rubber cultivation began	43.8	13.0
Planting density (trees/hectare)	376	512
Holdings under tapping age (%)	73.5	62.5
No of days tapped in the year	77	114
Mean age of trees (years)	14.5	12.4
Land value per acre (Rs Lakhs)	50.01	46.32
Most popular tapping system	S2d2	S2d1
Plantations adopting most popular tapping system (%)	70.9	77.6
Growers who planted cultivar RRI 105 (%)	80	89

Source: CDS - NRPPD Survey, 2015

Table 10 shows the distribution of tapping days in the study area according to the age distribution of trees. The number of tapping days increases with age and more importantly the number of tapping days with holdings having more than 20 years of age is almost double that of the age group with less than 8 years. Perhaps, the higher number of tapping days for the age group more than 25 years could be attributed to the slaughter tapping that takes place during the period. Here again one could observe some difference in the tapping behaviour of holdings with

less than one hectare and more than one hectare. In Kottayam, the tapping days for those below one hectare is found to be 78.6 whereas for their counterparts in Thiruvananthapuram the observed number of tapping days is 113.

Table 10: Number of tapped days in the year

Age-group	Kottayam		
	Below 1 ha	Larger	All size
< 8 years	20.00	60.00	40.00
8 - 9	59.29	65.00	60.56
10 - 17	73.72	83.00	74.97
18 - 25	84.17	71.67	82.34
> 25 years	78.64	87.00	80.19
All ages	76.32	78.35	76.64
Thiruvananthapuram			
< 8 years	56.67		56.67
8 - 9	112.50	122.00	113.23
10 - 17	108.15	160.00	109.26
18 - 25	117.33	128.33	118.02
> 25 years	139.38	116.67	133.18
All ages	113.07	127.13	113.99

Source: CDS - NRPPD Survey, 2015

Labour involvement:

Table 11 presents the labor use per acre in the study area for tapping and activities other than tapping. Following observations emerges from the table. The labor use, for both tapping and other activities, is found to be higher in Thiruvananthapuram as compared to Kottayam. Labour use for activities other than tapping in Kottayam is found to be only 60 percent of that of Thiruvananthapuram and the tapping labor is 91.2% of Thiruvananthapuram. In case of labor employed for all activities, the total labor days used per annum in Kottayam (41.7) are only 83 percent of that of reported in Thiruvananthapuram (50.4). Secondly, the use of family labor is found to be higher in Kottayam both for tapping and other activities. To be more specific, in Kottayam 37 percent of the tapping work and 38 percent of other work are undertaken by using family labour. But in Thiruvananthapuram the respective share family for tapping and other work is 25.7 per cent and 23.9 per cent. As expected the incidence of family labor declines in larger holdings and it is true of both the districts. The higher incidence of family labor along with higher experience in Kottayam is likely to have its impact in terms of improved efficiency in production and minimizing cost as compared to rubber growers in Thiruvananthapuram.

Table 11: Use of family labor and hired labor per acre (Number)

Labor Category	Non-tapping			Tapping		
	Below 1 ha	Larger	All size	Below 1 ha	1 - 2 ha	All size
Kottayam						
Family labour	5.32	4.73	5.22	21.76	7.94	19.59
Hired labour Male	2.75	2.83	2.76	12.25	21.24	13.66
Hired labour female	0.55	0.26	0.51	0	0	0
Total Hired	8.62	7.81	8.49	34.01	29.18	33.25
Total labour	13.94	12.54	13.71	55.77	37.12	52.84
Share of Family Labor (%)	38.2	37.7	38.1	39.0	21.4	37.1
Share of Hired Labor (%)	61.8	62.3	61.9	61.0	78.6	62.9
Share of females in Hired Labor (%)	6.4	3.3	6.0	0.0	0.0	0.0
Share of Hired Female labor in total (%)	3.9	2.1	3.7	0.0	0.0	0.0
Thiruvananthapuram						
Family labor	4.72	0	4.42	13.43	0	12.57
Hired labor male	8.92	5.31	8.69	22.09	39.88	23.23
Hired labor female	0.77	3.41	0.94	0.57	0	0.53
Total hired labor	14.42	8.73	14.06	36.09	39.88	36.33
Total labour	19.1	8.7	18.5	49.5	39.9	48.9
Share of family labor (%)	24.7	0.0	23.9	27.1	0.0	25.7
Share of females in Hired Labor (%)	5.3	39.1	6.7	1.6	0.0	1.5
Share of Hired Female labor (%)	4.0	39.1	5.1	1.2	0.0	1.1

Source: CDS - NRPPD Survey 2015

Price obtained by the growers

We have obtained data on prices received, as it is a crucial variable influencing the income received by the growers. Table 12 shows the price received by the growers during 2013-14 and 2014-15 for their output Price of all three outputs - rubber sheet, scrap and latex are reported. Most of the output is in the form of sheets and scrap and the sale in the form latex found is to be of very minimal prevalence. The following observations could be made from the table. First in sync with the general decline in the price of rubber the growers in the study area also received lower price in 2014 as compared to 2013. Secondly, the average price that the growers received in Kottayam is found to be higher than that of in Thiruvananthapuram. This is true of both rubber sheet and scrap. To illustrate in 2014 the price that growers in Thiruvananthapuram received for

the rubber sheets is found to be only 83.7 percent of what was received by the growers in Kottayam. Thirdly, there is significant variation in the price of rubber sheets received by the rubber growers. The observed price variation across growers is higher in Thiruvananthapuram as compared to Kottayam. Higher price realization along with lower price variation for rubber sheets in Kottayam could be attributed to the better quality of the output resulting from the longer experience of the rubber growers in Kottayam as compared to their counterparts in Thiruvananthapuram. At the same time, it needs to be noted that price variation is also governed by the time of sale by the growers. Nonetheless the considerable variation that prevails in Kottayam and Thiruvananthapuram should be a point of concern.

Table 12: Price per Kg of output received by the farmers (Rs)

	Year	Mean	CV%	Annual growth % - Price received
		Kottayam		
Sheet	2014	123.01	19.82	-26.39
Sheet	2013	167.12	21.64	
Scrap	2014	68.00	13.10	-40.35
Scrap	2013	114.00	11.10	
Latex	2014	71.07	33.28	
		Thiruvananthapuram		
Sheet	2014	103.05	26.04	-31.54
Sheet	2013	150.52	24.16	
Scrap	2014	63.17	15.65	-28.13
Scrap	2013	87.89	18.20	
Latex	2014	68.75	47.00	-30.08
Latex	2013	98.33	13.13	

Source: CDS - NRPPD Survey 2015

Yield Performance

Yet another factor, apart from price, that governs the return from cultivation is the output per the unit of land cultivated (yield). Table 13 provides the yield performance of sample households in the study area. Yield has been estimated in terms of sheet produced per acre as well as sheet equivalent of all the output. Following observations could be made from the table: Recorded production per acre in Kottayam is found to be only 450 Kgs as compared to 645Kgs in

Thiruvananthapuram. Thus, the yield in Kottayam is only about 69% of that reported in Thiruvananthapuram. Further, it is evident that the reported yield in both the districts is lower than what is recorded a few years ago at the national level (1841 Kgs/Ha). There is also some evidence to suggest that while the holdings with less than one hectare are found to be more productive in Kottayam, holdings with the size between one and two hectares are more productive in Thiruvananthapuram. The observed difference in yield could be attributed to the number of days for which the plantations had been tapped. The farmers in Kottayam, having access to other sources of income, have reduced the number of tapping days possibly to tackle the situation of rising tapping costs in the context of price crash. Reduction in tapped days in the Kottayam district, which is the most NR-productive region in the country, affected the yield quite drastically.

Table 13: Annual yield of sheet and sheet-equivalent (kg/acre)

Age-group	Sheet kg/acre			Sheet equivalent kg/acre		
	Below 1 ha	Larger	All size	Below 1 ha	Larger	All size
Kottayam						
8 - 9	242.02	240.00	241.44	270.39	259.60	267.31
10 - 17	377.77	312.12	369.39	459.18	388.28	450.13
18 - 25	492.75	337.60	465.37	556.49	402.66	529.34
> 25 years	324.01	354.65	329.84	371.72	425.43	381.95
All ages	392.00	312.99	378.47	458.09	376.40	449.96
Thiruvananthapuram						
8 - 9	526.02	800.00	548.85	568.14	860.00	590.59
10 - 17	573.28	1000.00	582.56	630.04	1100.00	640.03
18 - 25	659.36	1030.00	684.07	698.26	1062.00	721.48
> 25 years	496.38	410.42	472.93	558.46	456.67	530.70
All ages	585.30	765.16	597.60	634.02	814.50	645.95

Source: CDS - NRPPD Survey 2015

Cost of production

Following the methodology described in the previous section, we have estimated the cost of cultivation of NR in the study area. Item-wise cost incurred by the farmers on different operations involved as well as materials used during the entire life span of the crop has been estimated and presented in appendix tables. These tables also include imputed value of family

labour, managerial cost, depreciation allowance as well as amortization of cost incurred during the pre-bearing period.

Drawing from the appendix tables, we have estimated the operational cost (defined as all paid out costs and family labour) per acre of rubber during the tapping phase and presented in table 14. It presents cost per acre across different age groups in the tapping age. It is evident that cost per acre is higher in Thiruvananthapuram as compared to Kottayam regardless of the size class. The cost per acre in Kottayam for the below one hectare category is only 65 percent and 55 percent in case of 1-2 hectare category. When it comes to all size class the operational cost in Kottayam is found to be 78 percent of that in Thiruvananthapuram. The observed cost difference could be attributed to the larger number of trees per hectare, higher incidence of hired labour in Thiruvananthapuram as compared to Kottayam. In addition, it could also be inferred that more experienced NR growers in Kottayam are able to optimize cost of production as compared to their counter parts in Thiruvananthapuram.

Table 14: Operational cost per acre of rubber (Rs)

Age-group	Operational Cost (All paid-out costs and family labour value)					
	Below 1 ha	1-2 ha	All size	Below 1 ha	1-2 ha	All size
	Kottayam			Thiruvananthapuram		
8 - 9	30467.16	31577.60	30713.92	49291.15	66671.91	50628.14
10 - 17	39584.37	31062.47	38439.64	49285.44	48245.20	49263.31
18 - 25	42478.46	28199.83	40388.90	49841.26	59702.96	50457.62
> 25 years	34839.17	38149.76	35452.24	44069.22	40535.86	43105.58
All ages	31743.54	28840.70	37936.81	48596.31	51954.20	48816.50

Source: CDS - NRPPD Survey 2015

Making use of the data on yield per acre and operational cost per acre, presented already, we have worked out operational cost per Kg of rubber produced (see table 15). The operational cost per Kg of rubber produced across different age group category helps us to make some inference regarding the bearing of age profile on cost per Kg of rubber produced. The table suggests that the cost per Kg of rubber produced is the lowest for the age group 18 to 25. The overall operational cost per kg of rubber is found to be Rs 91.5 in Kottayam and Rs 87.7 in Thiruvananthapuram. It is to be noted that while there has been significant difference between

the two regions in terms of operational cost per acre, the difference in terms of operational cost per Kg of rubber produced not substantial (only Rs 3.7 per Kg)

Table 15: Operational cost per Kg of sheet-equivalent (Rs)

	Operational cost (Paid-out cost & household labour value)		
Age-group	Below 1 ha	Larger	All size
Kottayam			
8 - 9	168.62	126.61	156.62
10 - 17	88.11	86.35	87.88
18 - 25	81.78	76.91	80.92
> 25 years	97.72	83.23	94.96
All ages	96.54	94.52	91.49
Thiruvananthapuram			
8 - 9	108.63	77.53	106.04
10 - 17	88.48	43.86	87.51
18 - 25	81.66	58.73	80.13
> 25 years	87.45	88.99	87.87
All ages	88.99	70.57	87.73

Source: CDS - NRPPD Survey 2015

For a perennial crop like NR operational cost provides only a partial picture of the cost incurred. Hence, he have estimated the total cost per acre of rubber by incorporating the amortization cost that takes into account of the cost incurred during pre-bearing period, along with other imputed cost like depreciation, interest on fixed capital and management cost. The total cost per acre of NR cultivation is presented in Table 16. The total cost per acre, needless to say presents broadly the same pattern as that of operational cost. In Kottayam, total cost per acre is found to be about 21 percent higher than operational cost and in Thiruvananthapuram it was higher by 24 percent.

Table 16: Total cost per acre of rubber

Age-group	Below 1 ha	Larger	All size	Below 1 ha	Larger	All size
Kottayam			Thiruvananthapuram			
8 - 9	39823.29	43135.20	40237.28	65635.35	84860.21	67114.19
10 - 17	49961.12	40253.62	48657.12	65112.37	61845.18	65042.86
18 - 25	53611.52	37674.32	51279.25	65253.09	76377.24	65948.35
> 25 years	45467.43	48218.88	45996.56	58936.81	55183.96	57913.30
All ages	40050.65	36355.53	48424.71	63908.30	67673.62	64155.21

Source: CDS - NRPPD Survey 2015

Following the procedure described above we have estimated total cost per Kg of rubber in the study area (see Table 17). For the all size category the estimated cost per Kg is found to be Rs.117 in Kottayam and Rs 118.4 in Thiruvananthapuram. It is interesting to note that the more experienced NR growers in Kottayam who adopted a strategy of lower tree density along with low frequency tapping have been able to optimize the cost per Kg of rubber produced as compared to their counterparts in Thiruvananthapuram who adopted higher tree density and high frequency tapping.

Table 17: Total costs per Kg of sheet produced

Age-group	Below 1 ha	Larger	All size
Kottayam			
8 - 9	231.55	67.40	184.65
10 - 17	114.99	113.40	114.78
18 - 25	104.34	102.47	104.01
> 25 years	123.64	106.79	120.43
All ages	125.11	112.70	117.00
Thiruvananthapuram			
8 - 9	147.23	98.67	143.18
10 - 17	120.90	56.22	119.49
18 - 25	111.26	75.28	108.86
> 25 years	117.70	121.12	118.63
All ages	120.27	93.01	118.41

Source: CDS - NRPPD Survey 2015

Total Economic Cost

Now to arrive at the total economic cost we need to take into account the following issues. a) Subsidy received by the growers, b) income from intercrop c) both subsidy and intercrop d) interest on land value and finally e) income from the sale of rubber wood after maturity which we have already articulated as potential savings which may not be considered in the current cost and returns.

Tables 18 incorporates the effect of only subsidy, only intercrop and both on the cost per acre of rubber cultivated. We have accounted for the subsidy from Rubber Board - Rs.7959 per acre spread over 6 years. The effect of inter-crop is accounted for as per the discussion in the methodology section. These items essentially get reflected in the amortization cost. The table

tends to suggest that with inter crop the total economic cost per acre of rubber cultivated could be lower by 8.5 percent for the pooled sample. By availing subsidy, total economic cost of cultivation per acre could be lower by 0.6 percent. Finally, in case of those holdings that availed subsidy and engaged in intercrop the total economic cost per acre could be lower by 9.1 percent.

Table 18: Effect of Subsidy and Inter-crop on total cost (Rs per acre)

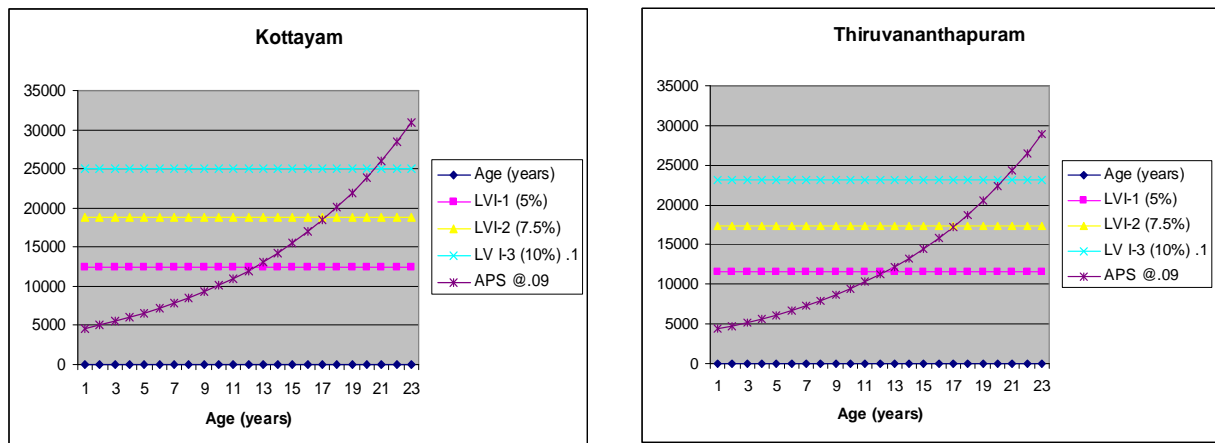
Year	Subsidy (RPDS 11 th FYP)	Accrued liability at the end of the year			
		No assistance	Intercrop	Subsidy	Intercrop & Subsidy
1	2040.82	67492.55	0	65451.73	-2040.82
2	1428.57	20431.56	0	19002.99	-1428.57
3	1020.41	21027.88	0	20007.47	-1020.41
4	1020.41	19195.78	19195.78	18175.37	18175.37
5	1020.41	16976.17	16976.17	15955.76	15955.76
6	1428.57	15677.91	15677.91	14249.34	14249.34
7	0	12505.34	12505.34	12505.34	12505.34
Establishment cost	7959.18	173307.2	64355.21	165348	56396.02
Amortized cost during 8- 30 years Rs		7535.1	2798.052	7189.044	2452.001
Total cost per acre per year Rs		55639.44	50902.39	55293.38	50556.34
% decline in total cost per kg		0	8.51	0.62	9.14

Land price and potential income from the sale of rubber wood

Let us now take the issue of land value. As already noted, natural rubber is considered as an industrial raw material under WTO negotiations. Hence, being an industrial raw material its cost of production has to take into account fixed cost incurred by the growers. Here the main fixed cost relates the value of land used for cultivating NR. An issue with limited consensus is how to account for the value of land? It is well known that unlike in other states the value of land in Kerala is very high. The average price of land per acre in Kottayam is reported as Rs 5001212 in Kottayam and Rs 4632615 in Thiruvananthapuram. It is a matter of common knowledge that none of the crops produced in Kerala will be viable if one accounts for 100 percent of the land value. At the same, ignoring the land value in cost estimation could not be justified since it is treated as industrial product and it doesn't receive the tariff protection that other agricultural commodities receive.

If we consider land price, we cannot ignore the issue of potential income that the grower would receive after the maturity of the crop by the sale of rubber trees. We have estimated the Annualized Potential Saving (APS) based on the data collected from the field on number of trees in holdings with more than 30 years of age and the reported average price per tree. Drawing from the reported land price by the respondents, we have also estimated the interest on the value of the land used for cultivation. Given the high land price in the state, no crop could be viable if we consider 100 percent of the land value. We have considered three scenarios a) considering 10 percent of the land value b) accounting for 7.5 percent of the land value and finally c) 5 percent of the land value. It appears that with 5 percent of the land value, the APS from rubber wood almost compensates for the interest on land value.

Figure 5: Interest on Land Value vs APS: Different Scenarios



Income from rubber cultivation

Making use of the data on yield and price, we have estimated the gross income. We also estimated the net operating income by subtracting operating cost from gross income (Table 19). It is evident that the recorded gross income is substantially higher in Thiruvananthapuram as compared to Kottayam. However, on account of the cost minimizing strategies of growers in Kottayam the difference in net operating income is much lower. To be more specific for all size classes the gross income in Kottayam is only 79 percent of that in Thiruvananthapuram. But when it comes to the net income, in Kottayam it is as high as 85 percent of that of Thiruvananthapuram. It is also important to note that the net operating income per acre of rubber is only Rs.16732.15 in Kottayam as compared to Rs.19681 per in Thiruvananthapuram.

Table 19: Net operating income per acre

Age-group	Gross income - All			Net operating income		
	Below 1 ha	1-2 ha	All size	Below 1 ha	1-2 ha	All size
Kottayam						
8 – 9	29593.12	31000	29944.84	-874.04	-577.6	-769.08
10 - 17	52041.31	41166.8	50512.08	12456.94	10104.33	13608.77
18 - 25	67004.02	50243.67	64489.97	24525.56	22043.83	23543.74
> 25 years	57173.72	57234.2	57184.92	22334.55	19084.44	21732.67
All ages	55793.55	45473.23	54110.09	24050.01	13071.48	16732.15
Thiruvananthapuram						
8 - 9	60140.21	86000	62129.43	10849.06	19328.09	11501.29
10 - 17	67922.06	82500	68583.29	18636.62	34254.8	19319.98
18 - 25	73843.75	97493.36	76845.18	24002.49	37790.4	26387.56
> 25 years	55755.99	45666.67	53004.36	11686.77	5130.81	9898.78
All ages	67273.81	85950	68498.48	18677.5	33995.8	19681.98

Table 20 presents net total income after deducting total cost from gross income. The net total income for all the classes is found to be only Rs 5685 per acre in Kottayam and Rs 4343 for Thiruvananthapuram.

Table 20: Net total income per acre

Age-group	Annual Income - All			Net income		
	Below 1 ha	1-2 ha	All size	Below 1 ha	1-2 ha	All size
Kottayam						
8 – 9	29593.12	31000	29944.84	-10230.17	-12135.2	-10292.44
10 - 17	52041.31	41166.8	50512.08	2080.19	913.18	1854.96
18 - 25	67004.02	50243.67	64489.97	13392.5	12569.35	13210.72
> 25 years	57173.72	57234.2	57184.92	11706.29	9015.32	11188.36
All ages	55793.55	45473.23	54110.09	15742.9	9117.7	5685.38
Thiruvananthapuram						
8 - 9	60140.21	86000	62129.43	-5495.14	1139.79	-4984.76
10 - 17	67922.06	82500	68583.29	2809.69	20654.82	3540.43
18 - 25	73843.75	97493.36	76845.18	8590.66	21116.12	10896.83
> 25 years	55755.99	45666.67	53004.36	-3180.82	-9517.29	-4908.94
All ages	67273.81	85950	68498.48	3365.51	18276.38	4343.27

Table 21 provides the estimated ratio of total income to operating cost, which turns out to be greater than one regardless of the age, and size categories except for the 8-9-age

Table 21: Income ratio to both Operating cost and total cost

Age-group	Income to Operating cost Ratio			Income to total Cost Ratio		
	Below 1 ha	1-2 ha	All size	Below 1 ha	1-2 ha	All size
Kottayam						
8 - 9	1.0	1.0	1.0	0.7	0.7	0.7
10 - 17	1.3	1.3	1.3	1.0	1.0	1.0
18 - 25	1.6	1.8	1.6	1.2	1.3	1.3
> 25 years	1.6	1.5	1.6	1.3	1.2	1.2
All ages	1.8	1.6	1.4	1.4	1.3	1.1
Thiruvanthapuram						
8 - 9	1.2	1.3	1.2	0.9	1.0	0.9
10 - 17	1.4	1.7	1.4	1.0	1.3	1.1
18 - 25	1.5	1.6	1.5	1.1	1.3	1.2
> 25 years	1.3	1.1	1.2	0.9	0.8	0.9
All ages	1.4	1.7	1.4	1.1	1.3	1.1

Source: CDS - NRPPD Survey 2015

category in Kottayam. This might be taken as an indication of the economic viability of the rubber cultivation. At the same time, the policy makers cannot afford to ignore the important fact that the net operating income from an acre of rubber cultivated is only Rs.16732 in Kottayam and Rs.19681 in Thiruvananthapuram, which is not adequate to induce the rubber growers to continue with rubber cultivation. It is evident that at the going market price, the recorded net income of those with holding size below 2 ha and depending only on rubber cultivation for their livelihood will be below the poverty line. Fortunately, a large proportion of the rubber growers appear to be having access to other sources of income. In such a context, for inducing rubber growers to continue with rubber cultivation, there is the need to ensure remunerative price along with measures that contribute to higher yield and better quality output.

5 Concluding observations

India's NR sector, which is known for its remarkable performance in the past, is undergoing an unprecedented crisis conditions with its associated adverse impact on millions of small holders and workers engaged therein. The demands for state intervention to ameliorate the crisis, have been more than ever before. Informed policy intervention by the state at this juncture, however, has to be based on a proper understanding of the ground level realities. Perhaps the most

important input needed for policy making at this juncture, among others, is the reliable data on cost and returns of NR production. In the absence of any authentic study on cost and returns of NR production, a prerequisite for any effective policy intervention, the present study makes an attempt to fill this gap in our understanding. In estimating the cost and returns, all attempts have been made to take care of a number of conceptual and methodological issues in the estimation of cost of production of perennial crops in general and those specific to natural rubber in particular.

The study begins by highlighting some of the important different dimensions of the ongoing crisis. It is observed that a drastic decline in the price of NR also coincided with an unprecedented rate of decline in the growth of productivity and production. While the decline in prices has been associated with heightened import competition, as manifested in increased import intensity, there are also evidences to suggest that the state support for the sector has been on a declining trend. Therefore, the observed trend in the area under over aged trees coupled with declining productivity cannot be delinked from reduced state support for this sector.

The study comes with different estimates of costs like operating cost, total cost, and total economic cost. We have estimated operational cost (all paid out cost and cost of family labor) per acre of rubber cultivated along with per kilo of rubber produced. The operational cost per acre of rubber is found to be Rs 37936 in Kottayam and Rs 48816 in Thiruvananthapuram. After taking yield into account operational cost per Kg of rubber is Rs 91 in Kottayam and Rs 87 in Thiruvananthapuram. When it comes to total cost, which takes into account cost incurred during the pre-bearing period, and select imputed costs (depreciation, management cost, and interest on fixed capital) the cost per acre is estimated at Rs 48424 in Kottayam and Rs 64155 in Thiruvananthapuram. With this total cost per acre, cost per kg of rubber produced turns out to be Rs 117 in Kottayam and Rs 118 in Thiruvananthapuram. These estimates may involve an underestimation of about 20-25 percent when compared with the cost involved as per the practices recommended by the Rubber Board and that we observed in case of about 11% of the growers who did not compromise on various operations in the plantations. The underestimation could be attributed to the generally observed behavior of the growers to cut down various cultural operations during crisis on account of reduced cash flow. We have also generated different economic cost scenarios by taking into account, returns from inter crop, subsidy

received, potential income from the sale of rubber wood and finally the interest on the value of land used for cultivation.

The estimated ratio of returns to cost is found to be greater than one in both the districts. Yet, it is important to note that the estimated net operating income per acre is only Rs 16732 and Rs 19681 respectively in Kottayam and Thiruvananthapuram. The net total income from an acre is estimated to be much lower at Rs 5685 and Rs 4343 respectively in Kottayam and Thiruvananthapuram. Thus viewed, at the going market price, the recorded net operating income and net total income per acre for those with holding size below two hectares and depending entirely on rubber cultivation for their livelihood is likely to be below the poverty line. The industry still survives plausibly because of the access to other sources of income for a large number of growers. This, however, could turn out to be a potential threat to the rubber sector as a whole. Having alternative income sources, unremunerative prices induce the farmers not to tap their trees which explain the drastic reduction in the production of NR observed in the recent past. The plausible supply shock resulting from such response from NR growers on rubber consuming industries needs to be a point of concern for the policy makers. In the current context, the need to ensure remunerative prices along with measures that contribute to higher yield and better quality output by revamping the R&D, extension and developmental activities of the Rubber Board with a new orientation cannot be over emphasized.

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K J Joseph is the coordinator of NRPPD at CDS

C E Ajith Kumar, formerly with Kerala Agricultural University is now associated with NRPPD

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Appendix Table A1 : Year-wise, item-wise expense for establishing one acre of rubber – Kottayam 2014-15

Age-code	1 ^a	2	3	4	5	6	7
Cost Item							
1. Hired human labour	13327.28	1950	2545	2791.68	3353	3796.67	2001.37
2. Machine labour	4667						
3. Seed/seedling	9454	932					
4. Farmyard manure & Bio-fertilisers	3400	3500	7368	7784	7943	5000	3600
5. Chemical fertilisers	1018	2033	1800	1856	1500	1856	1714
6. Plant protection- Bio controls & chemicals	260	300	750	291	1470	458	160
7. Land tax	226.6	226.6	226.6	226.6	226.6	226.6	226.6
8. Repair and maintenance charges ^c	1200		700	1450	1150	1217	750
9. Interest on working capital	869	282	308	331	361	262	232
10. Transport + incidental	1750	300	220	250	193	170	429
11. Imputed value of household labour	10705	1575	2347	3409	2233	3225	771
12. Interest on fixed capital	306	729	435	163	1082	121	1435
13. Depreciation Rs	371	882	535	190	917	161	1055
14. Management cost ^b	3137	775	943	910	1042	885	540
Operational costs (Items 1 to 11)	32592	8257	9899	9587	10928	9214	5914
Total cost (Items 1 to 14)	37164.4	16019.1	10922.6	10132.3	13705.11	9525.2	8903.1

Note: The total given may not tally with the total with the sum of the averages given, as the number of responses from which the average computed may vary.

^a: Hired labour in the first year refers mainly to labour for land preparation and improvement

^b: Management cost is taken as 10% of operational cost

^c: Repair and maintenance charges included the charges by way of interest paid or received.

^d: Incidental expenses cover all items costs not covered in the list of items 1 to 14.

Appendix Table A2 : Year-wise, item-wise expense for establishing one acre of rubber – Thiruvananthapuram in 2014-15

Age-code	1 ^b	2	3	4	5	6	7
Cost Item							
1. Hired human labour	10182	6100	12966	11499	9910	13094	8370
2. Machine labour	32040						20000
3. Seed/seedling	16032	628					
4. Farmyard manure & Bio-fertilisers	8262	7200	7912	8178	5307	5735	16767
5. Chemical fertilisers	2760	5850	7924	3987	5061	7980	3273
6. Plant protection-Bio controls & chemicals	500	500	5000	750	3331	1062	444
7. Land tax	226.6	226.6	226.6	226.6	226.6	226.6	226.6
8. Repair and maintenance charges ^c				1667	2857		
9. Interest on working capital ^d	1800	358	519	768	650	842	878
10. Transport+ incidental	937	467	952	1038	996	1686	479
11. Imputed value of household labor	7208	3400	1714	3000	6820	2167	2000
12. Interest on fixed capital	1524	42	63	673	33	17	
13. Depreciaton Rs	1033	73	145	723	73	46	
14. Management cost	4738	1070	1992	1864	1830	2079	2198
Operational cost (Items 1 to 11)	49804.2	11337.6	21327.3	20183	19755.3	23040	23172.8
Total cost (Items 1 to 14)	54880.9	12432.6	23346.8	2383.1	1591.2	25122.1	25370.4

Note: The total given may not tally with the total with the sum of the averages given, as the number of responses from which the average computed may vary.

^a: Hired labour in the first year refers mainly to labour for land preparation and improvement

^b: Management cost is taken as 10% of operational cost

^c: Repair and maintenance charges included the charges by way of interest paid or received.

^d: Incidental expenses cover all items costs not covered in the list of items 1 to 14.

Appendix Table A3: Cost of Cultivation of rubber plantation per acre of rubber, by age-group in - Kottayam

Age	Early (8,9)	10-17	18-25	> 25	Tapped	All
1. Hired human labour-tapping	16838.92	27288.69	26612.50	24934.80	25648.30	25648.30
2. Hired human labour-others	3144.97	2604.21	3124.37	3171.94	2921.24	3350.41
3. Machine labour			5466.70		5466.70	5066.70
4. Seed/seedling						10386.33
5. Farmyard manure & Bio-fertilisers	3675.34	6287.24	4654.25	4173.49	5254.81	5537.79
6. Chemical fertilisers	1491.18	1888.39	1818.50	1521.59	1768.68	1733.77
7. Plant protection-Bio controls & Bourdeaux mixture	3275	2852.4	2064.62	4772.03	5049.79	4784.28
8. Land tax and irrigation cess	226.6	226.6	226.6	226.6	226.6	226.6
9. Repair and maint charge of implements	533.33	1610.42	1194.41	1797.06	1411.89	1433.37
10. Interest on working capital	626.77	678.77	601.25	742.34	667.74	587.13
11. Transport + incidental	91.74	5685.9	173.98	477.24	5549.97	5510.8
12. Latex processing expense Rs	1582.47	2238.68	3170.91	2163.26	2449.87	2449.87
13. Imputed value of household labor	19780.50	21655.81	29271.71	25047.36	24215.09	20597.50
14. Imputed value of HH tapping labour	26272.88	24042.48	29413.15	23321.99	25587.72	25587.72
15. Interest on fixed capital	757.10	1007.40	1857.79	2063.52	1419.31	1220.25
16. Depreciation Rs	702.97	900.52	1506.28	1665.82	1195.40	1044.44
17. Amortization cost	5861.00	5861.00	5861.00	5861.00	5861.00	5861.00
18. Management cost	2878.49	3541.35	3695.35	3267.39	3492.08	2873.23
Operational cost (Items 1 to 14)	30714	38440	40389	35452	37937	31289
Total costs	40237	48657	51279	45997	48425	39482

Note: The total given may not tally with the total with the sum of the averages given, as the number of responses from which the average computed may vary.

^a: Hired labour in the first year refers mainly to labour for land preparation and improvement

^b: Management cost is taken as 10% of operational cost

^c: Repair and maintenance charges included the charges by way of interest paid or received.

^d: Incidental expenses cover all items costs not covered in the list of items 1 to 14.

Appendix Table A4: Cost of Cultivation of rubber plantation per acre of rubber, by age-group in - Thiruvananthapuram

Age	Early (8,9)	10-17	18-25	> 25	Tapped	All
1. Hired human labour-tapping	35626.51	31494.29	28703.45	30237.9	30125.11	30125.11
2. Hired human labour-others	7476.45	7167.22	7638.31	3430.06	7026.35	8376.9
3. Machine labour		11638.89			11638.89	28610.18
4. Seed/seedling						16660.31
5. Farmyard manure & Bio-fertilisers	5546.45	7354.17	8356.51	1500	7344.49	7712.89
6. Chemical fertilisers	4888.12	5006.36	5056.36	3136.46	4815.16	5082.21
7. Plant protection-Bio controls & Bourdeaux mixture	731.22	2714.48	1639.05	750	1776.77	2392.6
8. Land tax and irrigation cess	226.6	226.6	226.6	226.6	226.6	226.6
9. Repair and maint charge of implements	4914.49	5830.42	6205.72	1627.69	4941.62	4790.53
10. Interest on working capital	1334.63	1323.93	1384.37	1024.41	1309.3	1113.09
11. Transport + incidental	424.49	637.94	1139.52	313.41	759.95	869.05
12. Latex processing expense Rs	796.6	1124.81	1159.91	608.3	1034.88	1034.88
13. Imputed value of household labor	19691.25	21776.52	26912.31	36361.35	24550.12	21260.57
15. Interest on fixed capital	1704.72	1241.5	809.34	713.09	1046.54	943.31
16. Depreciation Rs	1787.79	1264.11	878.83	626.99	1086.76	977.7
17. Amortization cost	9955.3	9955.3	9955.3	9955.3	9955.3	9955.3
18. Management cost	4826.03	4601.51	4726.09	4139.34	4587.3	3692.31
Operational cost (Items 1 to 13)	50628	49263	50458	43106	48817	39367
Total cost (Items 1 to 18)	67114	65043	65948	57913	26267	49971

Note: The total given may not tally with the total with the sum of the averages given, as the number of responses from which the average computed may vary.

^a: Hired labour in the first year refers mainly to labour for land preparation and improvement

^b: Management cost is taken as 10% of operational cost

^c: Repair and maintenance charges included the charges by way of interest paid or received.

^d: Incidental expenses cover all items costs not covered in the list of items 1 to 14.

Appendix table A5: Chart 1: List of cost items used in the study and their description

Code of Cost Class	Item	Description	Reference
a1	Hired labour - tapping	No. of trees x No of days tapped x Tapping wage for man/ woman (as the case be)	
a2	Hired labour - Others	These include two categories of labour - Hard labour like clearing & terracing, Constructing boundary walls, Felling trees etc.; and Light labour like Filling & Planting, Pruning, Weeding, Manuring, Irrigation, Spraying, Shading, Cover crop, Marking for tapping, Fixing crup, Rain guarding, Stimulant application, and Intercrop operations	
a3	Machine labour	Rent & other charges paid for works done by machines and earth movers. The operations of Clearing & Terracing, Felling trees, Weeding etc. are now a days being done by earth movers.	
a4	Seedling	Actual expense incurred by farmer on this account during the current year that survey done	
a5	FYM & Bio-fertiliser	Actual expense incurred by farmer on this account during the current year that survey done	
a6	Chemical fertiliser	Actual expense incurred by farmer on this account during the current year that survey done	
a7	Plant protection agents like Bio-control agents and Bourdeaux mixture	Actual expense incurred by farmer on this account during the current year that survey done	
a8	Chemical insecticides	Actual expense incurred by farmer on this account during the current year that survey done	
a9	Land tax	Rs. 226.6 per acre for all plantations (as reported by investigators)	
a10	Repair & Maintenance	Actual expense incurred by farmer on this account during the current year that survey done	
a11	Net rent paid to machinery/ implements	Actual expense incurred by farmer on this account during the current year that survey done	
a12	Interest on working capital	Interest at the rate of 1/3rd of agricultural loan interest, if availed loan, or 4% for the total paid out cost excluding land tax, if otherwise. This definition varies slightly with that of NIC 2008 in that this includes the value of inventories (materials) held/ used and the cash in hand to be spent for charges for labour	NIC-2008 definition suitably modified
a13	Transport cost and other expenses	related to cultivation/ harvesting of rubber	
a14	Intercrop expenses	All expenses related to raising of intercrops in the rubber plantation	
a15	Latex processing expense	Actual expense incurred by farmer for coagulation during the current year that survey done	

A	All Paid-out costs	sum a1+a2+ ... + a15	
Code of Cost Class	Item	Description	Reference
c1	Imputed value of household labour	No of labour days expended by family members for the cultivation operation in rubber plantation multiplied by market wage for Man for light agricultural labour	
B	All Operational costs	A + c1	
b1	Interest on fixed capital (b1)	Interest (fixed @ 9% pa) on Fixed Capital; ie., the depreciated value of fixed assets owned by the plantation as on the day of survey	NIC-2008 definition
c2	Depreciation charged on assets owned	The rate is given in chart 2	
c3	Management charge	10% of sum: a1, a2, a3, a4, a5, a6, a7, a8, a10, a11,c1	
C	All Economic costs	B + b1 + c2 + c3	
b2	Interest on land value	Interest @ 10% for total value of the extent of rubber plantation (Value in Rs per cent x No of cents)	
cost C1	All costs	C + b2	

Appendix table A6: Rate of depreciation applied

Item No (in schedule)	Item Description	No of years of economic utility	Rate (%) of depreciation
24.1	Storage shed	30	5
24.2	Smoke house	20	5
24.3	Weighing balance	15	15
24.6	Sprayer (Small)	12	15
24.7	Weed cutter	12	15
24.8	Jeep/ other farm vehicle	15	13.91
24.9	Big Container (Can/ barrel)	15	15
24.1	Container (Bucket)	15	15
24.11	Latex Dish	20	10
24.12	Agri Implements (Hand)	20	25
24.13	Cup, hanger set	3	15
24.14	Tapping knife	10	10
24.15	Seive	5	20
24.16	Light (Head)	3	15
24.17	Others		10

Appendix Table A7 : List of items that the farmer receives from the plantation

Returns:		
r1	Rubber-latex income Rs	Income (Rs) accrued by way of selling latex during the current year
r2	Rubber-sheet income Rs	Income (Rs) accrued by way of selling rubber sheet during the current year
r3	Rubber-scrap income	Income (Rs) accrued by way of selling scrap rubber during the current year
r4	Rubber-other yield (firewood etc) income	Income (Rs) accrued by way of selling the rubber wood collected from the plantation during the current year, and this does not include the timber value of rubber wood after slaughter
r5	Intercrop-income Rs	Income (Rs) accrued by way of selling the intercrop produces, if any available in the plantation, during the current year
Returns	All income Rs	Sum: r1, r2, r3, r4

Table A5: Extent of difference in the reported cost for different items for the pooled sample

Cost Item	Low (Below Mean- SD)	High (Below Mean- SD)	Ratio
Plot size cents	144.86	146.13	1.01
Age (yrs)	15.00	18.32	1.22
Per acre trees	143.65	150.73	1.05
Tapped days	53.93	75.24	1.40
Hired human labour-tapping	16713.73	24114.02	1.44
Hired human labour-others	2851.42	3107.4	1.09
Farmyard manure & Bio-fertilisers	3674.66	4673.52	1.27
Chemical fertilisers	1286.11	1707.49	1.33
Plant protection-Bio controls & Bordeaux mixture	1759.85	2728.90	1.55
Chemical insect/pesticides		2608.70	
Interest on working capital	381.72	599.09	1.57
Transport (crop purposes)	109.06	457.02	4.19
Interest on fixed capital	969.63	1687.21	1.74
Imputed value of household labour	11676.92	23930.50	2.05
Imputed value of HH tapping labour alone	11610.17	25112.43	2.16
Depreciation Rs	857.69	1376.82	1.61
Management cost	1917.12	3369.48	1.76
Operational cost	20508.55	37298.85	1.82
Total cost	28155.27	47884.58	1.70

About National Research Programme on Plantation Development (NRPPD)

This research programme, established with the support of the Ministry of Commerce and Industry, Government of India, envisages to help transforming the plantation sector in India to be internationally competitive and sustainable – economically, environmentally and socially - by;

Undertaking Policy oriented Research – on all aspects of plantation economy at the regional, national and international levels

Promoting Policy advocacy – at the regional national and international level - to influence particularly the National and State level policies

Facilitating Networking – of all relevant stakeholders and

Help Capacity building - of all concerned at the regional and national levels.

The programme works under the overall guidance of a Steering Committee, chaired by the Chairman, CDS. The Steering Committee comprises of the Chairpersons of Coffee Board, Rubber Board, Tea Board, Spices Board, Joint Secretary/Director in Charge of Plantations in MoC, Director CDS and an expert on plantation sector. Chair Professor of the Programme is the Convenor. A Research Advisory Committee chaired by the Director CDS has been set up to provide guidance to the research being undertaken by the programme.

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CENTRE FOR DEVELOPMENT STUDIES

Prasanth Nagar, Ulloor, Thiruvananthapuram - 695 011
Ph : 0471-2774200, 2448881, 2448412, Fax : 0471-2447137
Website : www.cds.edu