A STUDY ON ECONOMICS OF NATURAL RUBBER IN KHOWAI DISTRICT OF TRIPURA

A thesis
submitted to the Uttar Banga Krishi Viswavidyalaya
in partial fulfillment of the requirements for the degree

of

Master of Science (Agriculture)

in

AGRICULTURAL ECONOMICS

by

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A-2020-002-M

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2022

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Certificate I

This is to certify that the work recorded on the thesis entitled ***"A Study on Economics of Natural Rubber in Khowai District of Tripura"*** submitted by **Miss Mousumi Debnath (Reg. No. A-2020-002-M)** in partial fulfillment of the requirements for the degree of **Master of Science (Agriculture) in Agricultural Economics** to be conferred by **Uttar Banga Krishi Viswavidyalaya**, has been checked against plagiarism through URKUND software on 27.09.2022 and that the similarity index has been achieved as **0** % (zero percent) which is in accepted range as per stipulation of this Viswavidyalaya. The thesis of Miss. Mousumi Debnath may be accepted for the award of the degree of Master of Science (Agriculture) in Agricultural Economics.

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Certificate II

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27.09.2022

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APPROVAL OF EXAMINERS FOR THE AWARD OF THE DEGREE MASTER OF SCIENCE (AGRICULTURE) IN AGRICULTURAL ECONOMICS

We, the undersigned, having been satisfied with the performance of Miss Mousumi Debnath (Registration number A-2020-002-M), in the Viva-Voce examination on final evaluation of thesis, conducted today, the 10th November 2022, recommended that the thesis be accepted for the award of the degree Master of Science (Agriculture) in Agricultural Economics.

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Acknowledgement

First and foremost, I want to express my gratitude to "Almighty God," who has always showered his favour on me, helping me to complete my course successfully.

I would like to express my sincere gratitude and unbounded respect to my honourable chairman Professor Ashutosh Sarkar, Department of Agricultural Economics, Faculty of Agriculture, Uttar Banga Krishi Viswavidyalaya, for his invaluable guidance, constant encouragement throughout the course of the investigation, unfailing and amiable behavior, sustained interest, kind to co-operation, and painstaking assistance during the preparation of this manuscript.

I am happy to recognise the gratitude I owe to Professor Kalyan Kanti Das, Head of the Department of Agricultural Economics, Faculty of Agriculture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, for his never-ending encouragement for task completion.

I'm very appreciative of Dr. Gobinda Mula, a member of the advisory committee for the department of agricultural economics, Dr. Partha Sarathi Medda, a member of the advisory committee for the department of horticulture, and Mr. Litan Das, a member of the advisory committee for the department of agricultural extension, for their insightful advice, kindness, and blessings bestowed upon me. These things gave me hope and zeal and inspired me to continue the work.

I feel exhilarated by expressing my profound gratitude to professor Tuhin Narayan Roy Department of Agricultural Economics, Faculty of Agriculture, U.B.K.V, for putting their helpful commands during pre submission thesis seminar and also like to thanks to Dr. Gunja Kumari Assist. Professor Deptt. of Agril. Economics, Faculty of Agriculture, U.B.K.V.

On a different note, a lot of people contributed to my education, and I'd like to thank everyone who helped me in any way as I finished my studies.

Most importantly, I dearth the time to adequately thank my parents and other family members for their tireless efforts to raise me to this level of education, as well as for their unfailing encouragement, moral support, and warm affection. I will always be grateful to them and will pray for their well-being.

Special thanks for the person who are playing major roles for collection of data for completion of my thesis, they are Mr. Haripada Debnath , Mr. Nipendra Poul , Mr. Chandan Nath Sharma , Mr. Subodh Chandra Debnath and Mr. Amrit Kumar Sen.

Dated 27 /09/2022

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Abstract

With a basic research question on economic performance of Natural Rubber (*Hevea brasilliensis*) farming the present study has been designed upon three objectives on production system, cost and return analysis and identification of major constraints. The study was under taken for the period of February 2021 to January 2022 in three rubber producing Blocks of Khowai district of Tripura. It comprises of 52 respondents with total 234 family members of which 113 are participating in any kind of earning activity and 96.46 per cent of earning members are associated with rubber of which 39.82 per cent are exclusive to rubber only. Farmers possess 168.44 acre of total land of which 87.39 per cent goes under high land. Average holding size come to 3.24 acre per farmer of which 2.73 acre goes for rubber plantation. Overall tapping days are 68.12 in Summer and 99.30 in Winter season. The average yield of latex per acre comes at 1011.83 litre in Summer and 2149.31 litre in Winter. Farmer has to incur Rs. 43283.65 annually for running activities for one acre of rubber plantation of which Rs. 25488.79 is paid out. The net return obtained over paid out cost comes at Rs. 105088.20 with a return cost ratio 6.10: 1.The net return over total cost comes at Rs.69513.05 with a return cost ratio 3.57: 1. The government should take third party role for negotiation with industry for ensuring selling price of latex and sheet in favour of farmer

Key words: Economic performance, natural rubber, return cost ratio, tapping day, latex, dry rubber sheet.

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Introduction

The natural rubber is an environmentally beneficial industrial raw resource, in contrast to the creation of synthetic rubber that uses petroleum feedstock in energy-intensive manufacturing plants (**Thorpe 1996)**. India is one of the leading consumers of natural rubber in the world with a supply support from her domestic production. The traditional region of natural rubber production is southern part of the country comprises with states like Kerala and Karnataka. But over a period of last ten years from 2011-12 to 2020-21 the import share of domestic consumption has increased from 18.64 per cent to 39.54 per cent (**Rubber Board, GOI**). Thus there emerges an urgent search for exploring new areas for natural rubber plantation apart from traditional zone which became saturated both on area and yield. As a part of this venture and with active persuasion from Rubber Board the cultivation of natural rubber has got its new abode at north eastern part of India as a non- traditional zone. Over a period of five years from 2015-16 to 2019-20 the said non- traditional zone has got a boost and increased her national share of area under natural rubber from 18.48 per cent to 30.36 per cent when during the same period the share of traditional zone reduced from 81.52 per cent to 69.54 per cent. According to a prediction made on 2011, due to climatic warming productivity of natural rubber in Kerala would decrease by 4–7 per cent while the same would increase by as much as 11 per cent in North East India during the following ten years (**Satheesh 2011**). By giving the said prediction a reality now Tripura, a member of north eastern India became the second largest producer of natural rubber in the country with a national share 10.39 per cent.

The rubber plant (*Hevea brasiliensis*) was first brought to Tripura by the Forest Department in 1963 for conservation of soil moisture. But the species has shown excellent performance in hill terrace traditionally used by Jhumia in shifting cultivation. The said success on adoptability of natural rubber in Tripura soil opened up an option for alternative utilization of hill terrace. The tribal farmers were advised to give up Jhum cultivation and go for natural rubber with government subsidy. The momentum achieved a reality over time and natural rubber gradually became an alternative livelihood of tribal farmers in the state.

It is to mention that 59.52 per cent of geographical territory of Tripura comprises of high land. The said land is locally termed as tila land and usually unfit for growing field crops. In most of the cases the private owners of such land would keep them uncultured. The forest department of the state of Tripura has started to grow rubber plants on such tila

land to recover crown density of denuded forest which may be considered as a show case example of rubber tree on such land. On the other hand the government of Tripura decided to introduce the rubber plantation as a tool for policy intervention for marginalized people of the state (Debbarma, 2019). Thus establishment of rubber plantation in tila land by private owner got state patronage at its initial phase. Finally the area expansion of said plantation achieved due momentum and farming of natural rubber has emerged as a potential livelihood option before the farming community of the state.

The production system of rubber tree has a long value chain. It generates multiple types of specified activities on regular basis. The final output of rubber farm (latex and dry sheet) is sold as raw material for rubber industry who takes major role in deciding the price. Hence once established, farmers have little option to discontinue the plantation because of its long gestation period. On the other hand, if found remunerative farmer may optimum the rubber farming because of its regularity of income and employment.

Under the given perspective the present study was taken for understanding the natural rubber framing in Khowai district of Tripura from economic rationales.

Research question of the study:

What is the economic performance of Natural Rubber (*Hevea brasiliensis*) farming in Khowai district of Tripura at farm level?

Objectives of the study:

1. To study the production system of natural rubber at farm level.
2. To study the cost and return analysis of natural rubber production at farm level.
3. To identify the major constraints faced by natural rubber grower in study area.

Table 1.1: Export, Import, Production and Consumption of natural rubber in India over time (thousand MT)

Year	Production	Exports	% share of export to production	Imports	Consumption
2011 – 2012	861.95	29.85	**3.46**	190.69	947.71
2012 – 2013	903.700020	27.14	3.00	214.43	964.41
2013 – 2014	913.70	30.59	3.35	262.75	972.70
2014 – 2015	774	5.39	0.70	360.26	981.52
2015 – 2016	645	1.00	0.16	442.13	1020.91
2016 – 2017	562	0.86	0.15	458.37	994.41
2017 – 2018	691	20.92	3.03	426.19	1044.07
2018 – 2019	694	5.07	0.73	469.76	1112.21
2019 – 2020	651	4.55	0.70	582.35	1211.94
2020 – 2021	712	12.87	**1.81**	457.22	1134.12

Source : Rubber Board, GOI

Table 1.2 Inter regional Comparison of Area coverage by Natural Rubber (in % to national total)

Region/State	2015-16	2016-17	2017-18	2018-19	2019-20
By production Region					
Traditional Region	81.52	81.26	80.96	79.01	69.54
Non-Traditional Region	18.48	18.74	19.04	20.99	30.36
By leading States					
Kerala	78.05	78.21	77.92	75.69	66.95
Tripura	7.87	7.38	7.28	8.19	10.39
Karnataka	5.23	5.62	5.52	5.90	6.25
Assam	2.59	2.89	3.36	3.75	7.02

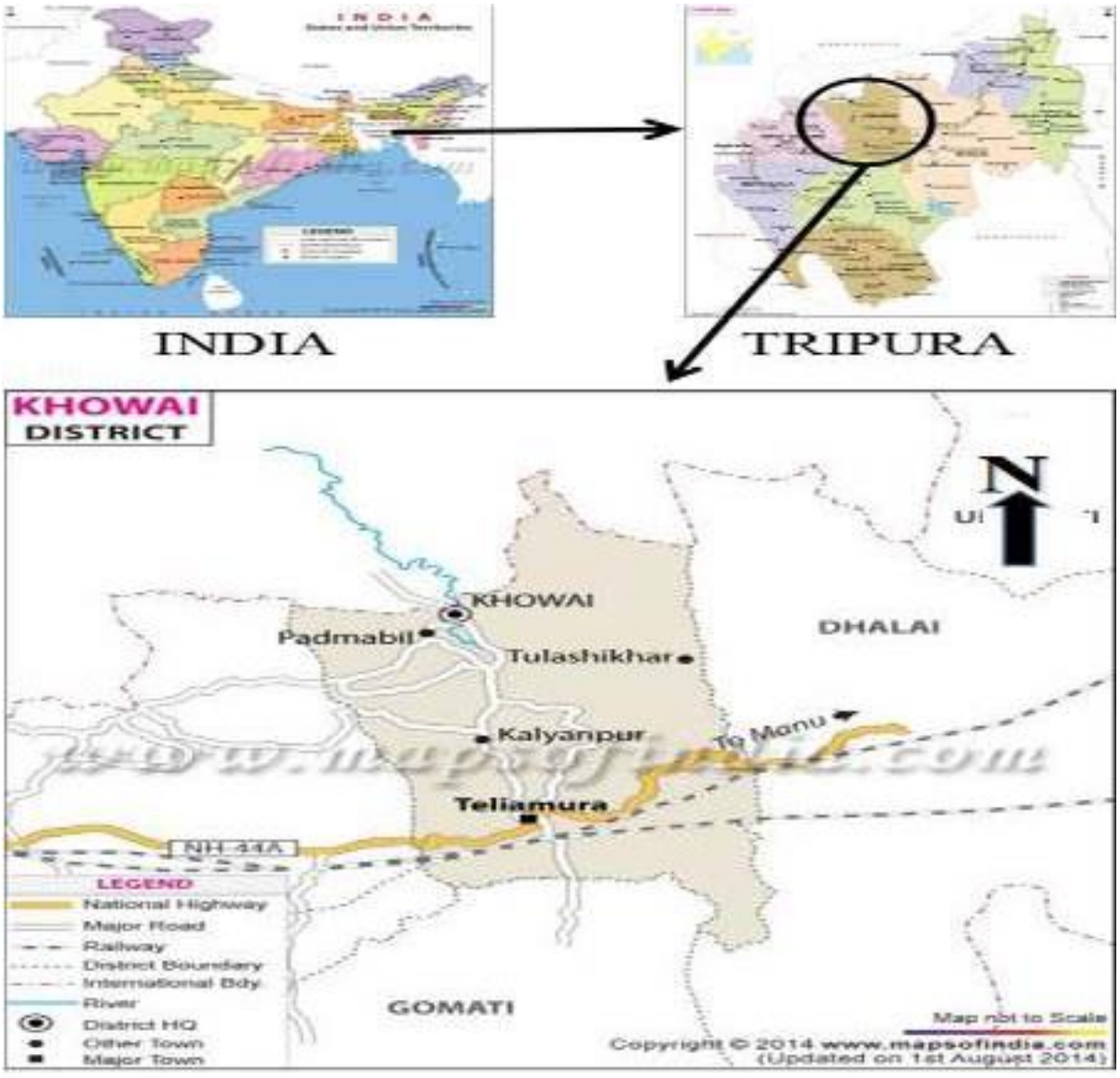
Table 1.3: Sources of supply for consumption of natural rubber in India

Year	% share from Import source	% share from Production source	Consumption
2011 – 2012	18.64	81.36	100.00
2012 – 2013	19.65	80.35	100.00
2013 – 2014	22.93	77.07	100.00
2014 – 2015	31.91	68.09	100.00
2015 – 2016	40.71	59.29	100.00
2016 – 2017	44.96	55.04	100.00
2017 – 2018	38.88	61.12	100.00
2018 – 2019	40.54	59.46	100.00
2019 – 2020	47.39	52.61	100.00
2020 – 2021	39.54	60.46	100.00

Source : Rubber Board, GOI

Table 1.4 : Land Classification in Tripura by Type of Topography

Land	Area in sq.km	percentage
Tila land / high land	6256.52	**59.52 %**
Medium land	2181.26	**20.36 %**
Low land	1999.84	**19.54 %**
Water logged land	54.07	**0.58 %**
Total Geographical area	**10491.69**	**100 %**



KHOWAI DISTRICT

Map of Khowai District

Review of Literature

The review of literature for this present study has been restricted only with those works directly associated with production of natural rubber. The collected information are being presented through time line from 1984.

Job and Mukundan (1984) examined the economics of small-scale rubber farming in Kerala's Kottayam area. For 1980–81 pricing, the cost of cultivation during the seventh year of the tapping stage was calculated at Rs. 11,054 per hectare. Payback Period, Benefit Cost Ratio, Internal Rate of Returns, and Net Present Value for the Enterprise for the District were the project evaluation indicators, and they were 9.51 years, 2.04, 24.20 percent, and Rs. 25,957 per hectare, respectively

Babu (1989) studied on initial investment and maintenance costs in the rubber plantation in the Dakshina Kannada area of Karnataka. According to the per hectare of rubber plantation required Rs. 29,510.04 and Rs. 27,174.71 for establishment and Rs. 8,022.17 and Rs. 7,709.30 for maintenance for small and large plantations respectively. Tapping and collection contributed 32.48 and 30.91 percent of the maintenance costs. In relation to the financial viability , the PBP for small farmers was approximately 9 years and 8 months, whereas it was 9 years 9 months and 3 days for large farmers. They calculated on NPV for small farmers was Rs. 19,961.82 per hectare and for large farmers it was Rs. 18,846.70 per hectare. Small farmers (1.45) had a slightly higher B-C ratio than large farmers (1.40). For small and large farmers, the IRR was 25.83 and 24.69%, respectively

Kuriakose *et al* (1995) studied on the marketing channels of natural rubber with special reference to co-operative marketing in Kerala. In Kerala, natural rubber plays a significant part in supplying rural labourers with work. According to the study an estimated 2 lakh families depend on the production of rubber for their livelihood. An additional one lakh people are also actively employed in processing, shipping, marketing, and related activities. During 1994–1995, the Rubber Board, which has its main office in Kottayam, collected Rs. 26.1 crores in rubber cess.

Thorpe *et al* (1996) examined the environmental effects for the production ofnatural rubber from *Hevea brasiliensis*, a crop that is economically significant for millions of small growers in tropical nations. The study concluded that natural rubber is an

environmentally beneficial industrial raw resource, in contrast to the creation of synthetic rubber, which uses petroleum feedstock in vast, energy-intensive manufacturing plants.

. **Lekshmi*et.al* (2003)** studied on Expansion of Natural Rubber Cultivation in Kerala. It is found that expansion of area under NR had been primarily determined by the relative profitability ensured under a comprehensive institutional support mechanism, of which protected price policy had been the critical component.

Goswami and Challa (2007) studied on the economic evaluation of small-scale rubber plantations in Meghalaya's West Garo Hills district. The study's showed that the installation cost per acre was Rs. 22,548.00 and the maintenance cost was Rs. 19,935.38. The researcher claimed that the discounted net cash flow method was extremely suitable for investments of the depreciating kind The study revealed that the plantation's NPV, B:C ratio, IRR, and Pay Back Period were, respectively, Rs. 55,014.11, 2.14, 14.40 percent, and 9.14 years.

Satheesh *et al* (2011) studied on the long-term changes in climate of the main natural rubber (NR) growing tracts in India using multiple linear regression models and their effects on NR productivity. According to their analysis it is found that current warming trend could decrease by 4–7% productivity of NR in Kerala while increasing by as much as 11% in North East India during the following ten years.

Much *et al* (2011) studied on applied a partial adjustment and adaptive expectation mechanism to examine how the supply of natural rubber in Cambodia has changed. Their supply response was determined by the planted area and average output. They demonstrated that rubber farmers modify their production strategy more frequently over the long term than over the short term

Sethuraj *et al* (2012) examined in the focus areas for upcoming research on the traditional and non-traditional growing locations for natural rubber. It is reported that *Hevea brasiliensis* had undergone significant genetic improvement as a result of conventional breeding and selection during the past 100 years

Anuja *et al* (2012) studied on the role of producers cooperative in input delivery, processing and marketing of natural rubber in Kerala. Their study evaluated the contribution of RPSs (Rubber Producer Societies)to input delivery services. According to the report, RPS

members could reduce manufacturing costs and greater price realization for their products than non-members. The production of high-quality rubber sheets is assisted by group processing and a local smoke house facilities. The key services offered by RPSs like marketing, financial, infrastructural, and social were identified using the factor analysis technique.

Siju *et al* (2012) studied on contract farming of pineapple as an intercrop in the early stages of NR in central Kerala was became more and more common. Their analysis showed that thewidening gap between recommended and implemented agro-management methods in pineapple intercropping under contract farming, may be a threats for the long-term agronomic viability of NR agriculture.

Varghese (2012) studied on Challenges and Opportunities of Cooperative Marketing with respect to Small Rubber Growers in Kerala. Small-scale rubber farming is one of the most prevalent and underprivileged industries in the nation. The study pointed that lack of knowledge and training to understand market trade movements, and lack of resources and post-harvest logistics to boost value-adding activities are major issues behind the non-improvement of economic well-being.

Hameedu (2014) studied on role of Rubber producers societies (RPS) in Kerala, one of the biggest producers and users of natural rubber is India. Small-scale farmers make up the majority of the agricultural sector in Kerala. Despite the fact that RPS has its own drawbacks, its establishment has benefited the welfare of small rubber growers. The study revealed that due to the lack of organization among tiny rubber farmers and the lack of scientific processing, the product's quality was quite poor and Small rubber growers lacked organization and unscientific rubber processing . RPS has helped to increase small rubber's quality of life.

Melba *et al* (2016), studied on price formation and supply response of natural rubber. Natural rubber is a significant economic plant in the plantation industry since it gave growers They concluded that pricing played a substantial role in explaining output increase. Their investigation proved that lagged price had a favourable impact on the natural rubber market

Raju (2016) studied on instability of the prices of natural rubber in India. Prices for natural rubber had fluctuated significantly over the past 20 years. The study revealed that the volatility and unpredictability of natural rubber prices causes due to the fall in oil prices accompanied by declined in the pricing of synthetic rubber. The price volatility on the global market had a substantial impact on domestic market prices also.

Khin *et al* (2017) studied on supply and demand of natural rubber. They explained two goals: to know the exchanged rate volatility affects the prices of SMR20 and RSS4 in Malaysian natural rubber (NR) and to forecast a short-term exchange rate (ERP) for Malaysian Ringgit (RM per USD) and NR prices that are prominent in the Malaysian NR market. According to their study the NR supply-demand balance to stabilized, the government and dealers had to alter their behaviour by raised domestic consumption.

Karan (2017) studied on volatility in price of rubber crop in Kerala. It is found that the prices were so low that rubber growers were unable to meet workers' wages. Due to this , unprecedented price volatility and declining of rubber yield standard of living of Kerala's rubber farmers got worsen., the state government of Kerala developed a program that ensures a minimum price of Rs. 150 per kg for natural rubber sheets produced by the farmer.

Arunwarakorn *et al* (2017) observed that the imbalance between supply and demand lowers the price of natural rubber on the global market. The said analysis became useful to the governments of the major producers of natural rubber in the world. The study emphasized on strategies to lower production costs and stabilize the price of natural rubber in future. It is suggested for establishing suitable areas for global natural rubber plantations in each nation and defining suitable and sustainable alternative crop areas in each nation.

Raju Debbarma and Dr. S. Purkayastha (2019) studied on expansion of area under Rubber plantation and its distribution in Tripura. The study made an effort to evaluate the state's use of rubber plantations as a tool for policy intervention for Tripura's marginalized people. The researcher used secondary data and analyzed a concentration index. The study also identified variables responsible for NR expansion.

Liu ruijin (2019) examined in the relationships between natural rubber production and price in order to gauge how much production will change in response to price changes and how the local market will respond to production shocks from the major producing nations. The findings of the study indicated that monthly pricing and productions at various regions followed similar trends.

Ashok (2020) studied on assessment of financial value of investments in rubber plantations though Capital budgeting methods. It investigated the cost of production and returns on investment in rubber plantations in Kerala's Pathanamthitta district. The study concluded that Rubber is a perennial commodity that requires significant cultivation and maintenance costs.

Pandey *et al* (2020) study was conducted to evaluate the production and trading status of natural rubber in the Jhapa area in 2019. The researchers used descriptive and inferential statistics to derive conclusions. The study explained economics of production and marketing of natural rubber and estimated discounted cost benefit ratio and NPV of natural rubber.

Roselyn *et al* studied on the price and marketing trends for natural rubber in the Kanyakumari region. The study was conducted by multistage sampling procedure, and 120 respondents were chosen at random. The growth rate, seasonal price index, price spread, and Garrett's ranking technique were used to analyze the collected data. The study concluded that despite a reduction in price, price has a positive growth rate and rubber prices fluctuated seasonally.

METHODOLOGY

3.1 Period of the study:

The study was under taken for the period of February 2021 to January 2022 of whichApril to January belongs to latex producing tapping time of Natural Rubber plantation.

3.2 Collection of data:

The collection of primary data was carried on during January to April 2022. The primary data was collected through personal interview method from latex producing farmer with the help of structured questionnaire. The primary survey was limited at farm level only where the raw output is Latex and finished output is sundried sheet of natural rubber processed from latex at farm level.

3.3 Sampling frame:

The sampling frame may be considered as the Rubber growing farmers of Khowai district of Tripura.

3.4 Selection of District:

The study has been conducted at Khowai district of Tripura. The selection of the district was purposive due to covid-19 movement restriction. It is to note that the said district is one of the early adopters of rubber cultivation in Tripura due to prevalence of Jhum cultivation in tila land.

3.5 Selection of Block:

There are six administrative blocks in Khowai district of Tripura. Out of that practice of rubber cultivation is observed at three blocks namely, Khowai, Padmabil and Tulasikhar. All the three blocks has been considered for the study.

3.6 Number of respondents for selected Block:

Due to non-availability of actual area under rubber from official source, area under tilla land suitable for cultivation of rubber has been considered for apportioning the number of respondents among blocks. The said apportioning has been decided by probability proportional to total tila land in respective block. Accordingly fourteen respondents were

selected from Khowai block, sixteen respondents from Padmabil block and twenty two respondents were selected from Tulasikhar block.

3.7 Selection of ultimate respondents from the selected Block:

A single block consists of homogeneous production practice by rubber growers. Again, the producer farmers remain in forms of cluster of contiguous villages. One of such cluster has been selected randomly from each block. After selection of cluster an exhaustive list of farmers under that cluster was made and the targeted number of sample respondent of respective block was randomly selected from that list. The village clusters of Khowai, Padmabil and Tulasikhar block refers to Tablabari cluster area, Dhalabil cluster area and Asharambari cluster area respectively.

3.8: Plantation of natural rubber:

3.8.1 : Establishment of plantation:

` The respondent farmers developed rubber plantation in their private tila land only. The said category of land is usually in distance from residential house and fell uncultivated for long time. As covered by bushy shrubs in terracing slopes the land needs intensive cleaning before going for plantation. After cleaning of land saplings are transplanted during early monsoon days maintaining due horticultural practice. The plant needs six years gestation period for the attainment of taping vigour usually 18 inches of breast height girth and 14 feet bole height at the beginning of seventh year. In some trees the maturity may be delayed up to 10^{th} year of age. During this period every year two times cleaning one in month of March and another in month of October and one time manuring in the month of May are done as an intercultural operation. No farmer of study area reported any inter cropping within rubber plantation.

3.8.2 : Annual maintenance of plantation:

The plantation needs two times cleaning and one time manuring in a year. These activities are taken as a regular part of annual maintenance cost.

Operation during establishment phase	
Cleaning	March
Pit making	1.5 ft X 1.5 ft X 1.5 ft
Manure in pit	Cow dung (5 – 6 kg / pit)
Sapling	100/ 90/ 80 per 0.4 acre
Fertilizer	NPK (100 gm / plant)

3.9: Activities from tapping to sheet making:

3.9.1 : Actual hour of operation:

Name of operation	Summer	Winter
Tapping of latex	Time	Time
Channel making	4 – 7 am	5 – 8 am
Latex collection	7 – 9 am	8 – 10 am
Bringing latex	9.30 am	10.30 am
Dough setting	9.30 – 11 am	10.30 am – 12 pm
Dough to sheet making	3 – 3.30 pm	2.30 – 3 pm
Sheet making	3.30 – 5 pm	3 – 5 pm

3.9.2 : Tapping of rubber plants:

Tapping of rubber tree is a skillful operation which needs to be completed at early morning hours only in cool temperature. Incision to bark with sharp knife followed by instant collection of oozing latex in small bowl and finally accumulation of total collection in drum are steps of this taping activity. The tapping activity is continued for a period of ten months in a year. The production of latex starts at the month of April and prolongs up to the month of January. The total production period may be categorized into two phases, one the summer phase for the months of April to August and another is winter phase for the months of September to January. There are differences of working hour and volume of yield of latex per tree between these two phases.

3.9.3 : Tapping days in a season:

Farmer usually follows alternative day for tapping. In some good healthy trees the number of tapping day may increase.

$$\text{Tapping tree day in a season} = \frac{\text{Aggregate tapping tree days for the season}}{\text{number of trees tapped}}$$

3.9.4 : Use of Latex:

Once collected the farmer has two options before. In first option the farmer can dispose the latex to the latex purchasing processor (at garden itself) or to latex purchasing Cenex industry. The latex is sold in litre unit only. In second option the farmer can go for processing of own latex into sheet. In this case the collected latex needs to be carried upto house of farmer and subsequently arranged for dough making as a pre-step of sheet making.

In case of contract labour (System 3) the dough setting activity is done in house of labour only.

3.9.5 : Making of Sheet from latex at farm level:

3.9.5.1 : Dough setting:

For making of sheet from latex the first step is dough setting. The garden fresh liquid latex is poured into square trays mixed with little amount of acid for coagulation. The said water is made with 100: 1 ratio between water: liquid formic acid .The process takes 24 hours to attain at a semi solid dough form at the end. In case of Tulasikhar1 litre latex is mixed with 2 litre acid water while in Khowai 1 litre latex is mixed with 2 litre acid water. In both cases the mixture is poured into $17^{//} \times 12^{//} \times 3.5^{//}$ tray.

3.9.5.2 : Raw Sheet from dough:

In second step, the said latex dough needs to be put in pressing roller that will give soft rectangular sheet. The size of sheet is $27^{//}$ - $26^{//} \times 12^{//}$. The thickness of sheet is $0.5^{//}$ at Khowai and $0.25^{//}$ at Tulasikhar area.

Use of roller for making sheet: The sheet roller is used in different practice.

Practice 1: The own sheet roller is used for processing of own latex or purchased latex first. In addition the roller can be rented out for use by other. The rate is @ Rs. 2.50/sheet at Khowai and @ Rs.2.00/ sheet at Tulashikhar.

Practice 2: The owner will provide full service of making sheet. The charge is @ Rs. 4.00 per sheet

3.9.6 : Drying of sheet:

The soft sheet thus achieved then exposed to sun drying in hanger. Farmers use horizontal hanging bar made of bamboo or rope for this drying. The drying time varies season to season depending on availability of sun shine. Usually it takes 2 to 4 days for complete drying. The dried sheet is sold to the industry in Kg unit only.

3.10: Engagement of human labour:

One of the basic aims of this study is to identify the generation of employment in rubber cultivation in various forms. The identified activities are, cleaning of land either at beginning or in intercultural management, digging of soil cum transplanting of sapling and application of fertilizer, taping of trees cum collection of latex, setting of dough for sheet,

making of sheet and finally drying of sheet. Participation of male labour is observed in all the activities either from family source or from hired source. Participation of female labour has been recorded in processing of sheet only, they do actively participate in dough setting, sheet making and drying of sheet. In present study no female labour has been hired. In case of male hired labour the hiring was made in two forms, either in daily wage basis or in piece contract basis.

3.11: Classification of business groups into System:

The researcher could identify 6 performing sub-system groups as follows:

System 1: The whole manual activities from taping to sheet making are performed by family labour only. In extreme case occasional help for tapping and collection of latex is done by wage labour. The sheet is processed in own roller.

System 2: The whole manual activities from taping to sheet making are performed by family labour only. In extreme case occasional help for tapping and collection of latex is done by wage labour. The sheet is processed in rented roller.

System 3: The whole manual activities from taping to sheet making are performed by the contract labour. The sheet is processed in rented roller. The processed sheets are handed to farmer before drying. The contract is monthly basis.

System 4 : The manual activities from tapping to dough making are performed by family labour. The sheet is processed in service roller by paying charge.

System 5: The manual activities taping and latex collection are done by family labour. Collected latex is sold at field level to sheet processor.

System 6: The manual activities from tapping to bringing latex to home and putting the same in cenex collection drum are performed by family labour or wage labour. The latex is sold to cenex industry.

3.12: Collection of scrap:

Residual part of latex remains in bowl gets dried and hard in next morning. Such coagulated lumps are known as scrap latex and needs to be removed before setting of bowl for fresh collection for the day. The said scrap is also considered as a form of output by the farmer.

3.13: Hiring charge of human labour:

The hiring charge has been calculated on prevailing labour wage rate for the financial year 2021-22. The working hour of labour varies on activity to activity. In case of works with establishment or intercultural activity with plantation the labour will work in day shift for 8 hours. But in other cases like taping of tree and collection of latex such working hour will start from early morning and cover 5 hours in morning shift only. In sheet making also working time is different. There also exists contract based work. In case of sheet making the labour payment may be accounted on the basis of number of sheet produced. Hence to eliminate technical complexity in most cases wage of labour has been calculated per man hour basis.

3.14.1 : Use of implements:

The farmer has to use a set of implants for working with rubber activities. Tamplet is used for to mark the tapping zone on tree burk, Knief is for incision of tree burk , Nali is for draining out of latex in desired pathway, Cup is for collection of oozing latex from tree burk, Bucket is for storing of latex from cup, Drum is for final aggregation of latex Tray is for setting of dough, Hanger for binding cup with tree, Bamboo is for making structure for drying sheet and Rope is used for drying of sheet. The coagulation of latex is done by adding acid water.

3.14.2 : Cost for of implements:

The cost for implements has been made by depreciation method (straight line). The unit of time has been considered in terms of production season only i.e one such implements can be used for how many production season.

3.15 : Valuation of standing plantation of latex producing rubber trees:

It is observed that the plantation requires establishment cost at 1^{st} year and then from 2^{nd} year to 6^{th} year (total five years) expenditure to be made for inter cultural operations like cleaning, manuring, replacement of damaged tree etc. Hence an aggregated total cost up to sixth year has been taken as capital value of plantation. It is reported by the farmer that the said amount can be recovered by selling out wood of rubber trees at the end of productive life. An amount of 5 per cent on this capital value of plantation has been taken as annual rental value of mother plantation during her latex producing period of life.

3.16 : Paid out cost:

The conclusion of this study has been made on the basis of net return over paid out cost and total cost . The paid out cost covers those which are incurred only through out of hand cash by the farmer. It is observed that farmers usually emphasize on reducing paid out cost to maximize return of family labour.

The cost related with all payments to hired male labour (no female labour was found), annual depreciation cost for implements, cost paid for rolling of sheet from rented roller or service roller and purchased inputs like manure, fertilizer, acid etc have been coveredunder this group.

3.17 : Total cost:

Imputed value of family labour (both male and female), imputed value of own sheet rolling charge, annual rental value of own plantation has been added with paid out cost to get total cost.

3.18 : Gross return:

Gross return in this study accounts with the output components like latex in liquid form, latex in scrap form and dried natural rubber sheet form . Net return obtained from of own roller over renting out receipt has also been accounted under gross return for respective section of farmer.

3.19 : Net return:

Net return has been calculated on the basis of paid out cost and total cost. Net return over paid out cost implies the apparent benefit obtained by farmer with maximum possible participation of family labour in the production process. The net return over total cost will represent by adding paid out cost and imputed values of labour, machine and annual rental value

3.20 : Study on sheet processing:

A separate study has been presented to show a comparison between two groups of sheet maker, one producing sheet from own source of latex and other who produce sheet from purchased source of latex. For this, the second group of respondents has been selected from same study area. Here also the conclusion has been made on the basis of net return over paid out cost and total cost to identify the relative employability of family labour.

3.21 : Net return of own sheet making roller:

A group of farmer belongs to system 1 are having their own investment in roller. The roller is primarily used for making sheet from own latex. But the said roller is also rented out to other farmers those who have no roller. The annual depreciation cost and maintenance cost of roller unit (roller and working shade) has been added to arrive at total annual cost for roller. The said annual cost is deducted from the total receipt obtained from renting out of roller to get net return of roller.

3.22 : Price of latex, sheet, scrap and sheet making charge:

	Latex in garden	Latex to Senex industry	Scrap latex	Dry sheet	Sheet making charge rented roller	Sheet making charge service roller
Unit	Rs/ litre	Rs/litre	Rs/ Kg	Rs/ Kg	Rs/Sheet	Rs/ sheet
Khowai	30-35	-	90-110	150-155	2.5	-
Padmabil	30-35	50	90-110	150-155	-	-
Tulasikhar	30-35	-	90-110	150-155	2	4

3.23 : The imputed value of own roller for System 1 farmer:

It is to mention that this group of farmer can fully recover their roller cost from renting out charges and even get positive net return out of that rented charge. Hence they enjoy opportunity of using own roller for own sheet making absolutely free of charge. The amount of this free charge has been shown as imputed value of own roller.

3.24 : Method of Garrette ranking

The constraints faced by farmers were enlisted by focused group discussion with the farming community of the study area. Then each respondent were asked to rank all the eleven constraints according to his independent rating. The constraints were the ranked by using the Garrett's Ranking Technique. The percent position of each rank is converted into scores by referring tables given by Garrett and Woodworth (1969). Then for each factor the scores of individual respondents are added together and divided by the number of respondents for whom scores are added. The mean scores for all the factors are ranked by arranging in descending order.

$$\text{Per cent Position} = \frac{100(Rij-0.5)}{Nij}$$

Where,

R_{ij} is the rank given by the i^{th} item by j^{th} individual.

N_{ij} is the number of items ranked by the j^{th} individual.

Results and Discussion

The present study comprises of three administrative Blocks of Khowai district of Tripura state. There are 52 respondents of which 14 has been taken from Khowai, 16 from Padmabil and rest 22 has been taken from Tulasikhar Block. The demographic details of responding farm families have been delineated in Table 4.1.1 to Table 4.1.4. The main target of said tables is to understand the strength and types of association of family members in rubber farming activities. Along with money return rubber farming can also provide opportunity of self- employment to farmer. The information has been given both for male and female members separately so as to get a clear assessment of participation of female members in rubber activity.

Table 4.1.1 shows the classification of family members according to age group .The members have been sub classed into three age groups, below 20 years, as a representative of non- earner minor, between 20 to 60 years, covering all probable active earners and above 60 years as optional earners in good physique. It is observed that there are 234 members altogether of which male: female ratio is 51.71: 48.29. The result is similar across the Blocks. It to note that 31.62 percent population is below 20 years of age and 17.75 percent are over 60 years. It reveals that 50.43 percent of total population may be considered as potential job seeker.

Table 4.1.2 revealed that out of total potential and optional job seeker how many of family members actually participates in earning activities. Here again the population has been subdivided into three age groups , 20-40 years , the enthusiastic youths, 40-60 years , the compulsive adults and above 60 years , the optional olds. The analysis reveals that out of 160 members of given age groups 113 are participating in any kind of earning activity of which 23.01 percent goes to 20-40 age group, 59.29 percent to 40-60 age group and 17.70 per cent to old age group. The said ratio differs in Padmabil block where percentage share of middle age group is a bit lower. It is also to note that participation of male member is more than female in earning activity.

The degree of attachment of earning family member in rubber activity has been explored in Table 4.1.3. The earning member has been grouped in to three categories, exclusively associated with only rubber farming, partially associated with rubber farming and no association with rubber farming. It is observed that 96.46 percent earning members are

Table no 4.1.1: Classification of family members according to age groups (years)

Block	Total family	Category	Male member				Female member				Total member			
			Below 20	20-60	Above 60	Total	Below 20	20-60	Above 60	Total	Below 20	20-60	Above 60	Total
Kh	14	Block total	**8**	**17**	**7**	**32**	**7**	**17**	**6**	**30**	**15**	**34**	**13**	**62**
		% of intra block	12.90	27.42	11.29	51.61	11.29	27.42	9.68	48.39	24.19	54.84	20.97	100.00
		% of inter block	18.60	31.48	29.17	26.45	22.58	26.56	33.33	26.55	20.27	28.81	30.95	26.50
		Average per family	0.57	1.21	0.50	2.28	0.50	1.21	0.43	2.14	1.07	2.43	0.93	4.43
Pb	16	Block total	**13**	**14**	**7**	**34**	**9**	**18**	**3**	**30**	**22**	**32**	**10**	**64**
		% of intra block	20.31	21.88	10.94	53.13	14.06	28.13	4.69	46.88	34.38	50.00	15.63	100.00
		% of inter block	30.23	25.93	29.17	28.10	29.03	28.13	16.67	26.55	29.73	27.12	23.81	27.35
		Average per family	0.81	0.87	0.43	2.12	0.56	1.12	0.18	1.87	1.37	2.00	0.62	4.00
Ts	22	Block total	**22**	**23**	**10**	**55**	**15**	**29**	**9**	**53**	**37**	**52**	**19**	**108**
		% of intra block	20.37	21.30	9.26	50.93	13.89	26.85	8.33	49.07	34.26	48.15	17.59	100.00
		% of inter block	51.16	42.59	41.67	45.45	48.39	45.31	50.00	46.90	50.00	44.07	45.24	46.15
		Average per family	1.00	1.04	0.45	2.50	0.68	1.31	0.41	2.41	1.68	2.36	0.86	4.91
Total	52	Sample total	**43**	**54**	**24**	**121**	**31**	**64**	**18**	**113**	**74**	**118**	**42**	**234**
		% of intra goup	18.38	23.08	10.26	51.71	13.25	27.35	7.69	48.29	31.62	50.43	17.95	100.00
		% of inter block total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Average per family	0.82	1.03	0.46	2.32	0.59	1.23	0.34	2.173	1.423	2.27	0.82	4.50

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.1.2: Number of family members participated in earning activity (according to age group)

Block	No of family	Category	Male member				Female member				Total member			
			20-40	40-60	>60	Total	20-40	40-60	>60	Total	20-40	40-60	>60	Total
Kh	**14**	**Working member**	**5**	**13**	**5**	**23**	**5**	**9**	**0**	**14**	10	22	5	37
		Actual member	**5**	**12**	**7**	**24**	**6**	**11**	**6**	**23**	**11**	**23**	**13**	47
		% of work participation	**13.51**	**35.14**	**13.51**	**62.16**	**13.51**	**24.32**	**0.00**	**37.84**	**27.03**	**59.46**	**13.51**	**100.00**
		Average per family	0.36	0.93	0.36	1.64	0.36	0.64	0.00	1.00	0.71	1.57	0.36	2.64
Pb	**16**	**Working member**	**4**	**9**	**6**	**19**	**3**	**5**	**1**	**9**	7	14	7	28
		Actual member	**6**	**8**	**7**	**21**	**4**	**14**	**3**	**21**	**10**	**22**	**10**	42
		% of work participation	**14.29**	**32.14**	**21.43**	**67.86**	**10.71**	**17.86**	**3.57**	**32.14**	**25.00**	**50.00**	**25.00**	**100.00**
		Average per family	0.25	0.56	0.38	1.19	0.19	0.31	0.06	0.56	0.44	0.88	0.44	1.75
Ts	**22**	**Working member**	**6**	**17**	**8**	**31**	**3**	**14**	**0**	**17**	9	31	8	48
		Actual member	**6**	**17**	**10**	**33**	**8**	**21**	**9**	**38**	**14**	**38**	**19**	71
		% of work participation	**12.50**	**35.42**	**16.67**	**64.58**	**6.25**	**29.17**	**0.00**	**35.42**	**18.75**	**64.58**	**16.67**	**100.00**
		Average per family	0.27	0.77	0.36	1.41	0.14	0.64	0.00	0.77	0.41	1.41	0.36	2.18
Total	**52**	**Working member**	**15**	**39**	**19**	**73**	**11**	**28**	**1**	**40**	26	67	20	113
		Actual member	**17**	**37**	**24**	**78**	**18**	**46**	**18**	**82**	**35**	**83**	**42**	160
		% of work participation	**13.27**	**34.51**	**16.81**	**64.60**	**9.73**	**24.78**	**0.88**	**35.40**	**23.01**	**59.29**	**17.70**	**100.00**
		Average per family	0.29	0.75	0.37	1.40	0.21	0.54	0.02	0.77	0.50	1.29	0.38	2.17

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.1.3: Number of family members engaged in rubber activities

Block	No of family	Attributes	Male member				Female member				Total member			
			Only rubber	Rubber and other	Only other	Total	Only rubber	Rubber and other	Only other	Total	Only rubber	Rubber and other	Only other	Total
Kh	**14**	Number of participants	**0**	**21**	**2**	**23**	**6**	**7**	**1**	**14**	**6**	**28**	**3**	**37**
		% of intra block participation	0	56.76	5.41	62.16	16.22	18.92	2.70	37.84	16.22	75.68	8.11	100
		% of inter block participation	0	39.62	100.00	31.51	22.22	63.64	50.00	35.00	13.33	43.75	75.00	32.74
		Average per family	0	1.5	0.14	1.64	0.43	0.50	0.07	1.00	0.43	2.00	0.21	2.64
Pb	**16**	Number of participants	**9**	**10**	**0**	**19**	**5**	**3**	**1**	**9**	**14**	**13**	**1**	**28**
		% of intra block participation	32.14	35.71	0.00	67.86	17.86	10.71	3.57	32.14	50.00	46.43	3.57	100
		% of inter block participation	50	18.87	0.00	26.03	18.52	27.27	50.00	22.50	31.11	20.31	25.00	24.78
		Average per family	0.56	0.63	0.00	1.19	0.31	0.19	0.06	0.56	0.88	0.81	0.06	1.75
Ts	**22**	Number of participants	**9**	**22**	**0**	**31**	**16**	**1**	**0**	**17**	**25**	**23**	**0**	**48**
		% of intra block participation	18.75	45.83	0.00	64.58	33.33	2.08	0.00	35.42	52.08	47.92	0	100
		% of inter block participation	50	41.51	0.00	42.47	59.26	9.09	0.00	42.50	55.56	35.94	0.00	42.48
		Average per family	0.41	1.00	0.00	1.41	0.73	0.05	0.00	0.77	1.14	1.05	0.00	2.18
Total	**52**	Number of participants	**18**	**53**	**2**	**73**	**27**	**11**	**2**	**40**	**45**	**64**	**4**	**113**
		% of intra block participation	15.93	46.90	1.77	64.60	23.89	9.73	1.77	35.40	39.82	56.64	3.54	100
		% of inter block participation	100	100	100	100	100	100	100	100	100	100	100	100
		Average per family	0.35	1.02	0.04	1.40	0.52	0.21	0.04	0.77	0.87	1.23	0.08	2.17

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

associated with rubber of which 39.82 per cent earning members are exclusively working with rubber only. The observation is enthusiastic from employability point of view. There remains inter Block variation in this respect. In Tulasikhar Block 55.56 per cent earning members are exclusively associated with rubber when the percentage is only 13.33 for the Khowai Block.

The analysis done in Table 4.1.3 has been repeated Table 4.1.4 but in different perspective. As discussed in methodology (3.11) the farmers are categorized into six system groups according to their difference in participation in rubber farming. It is to note that System 1 to System 4 farmers work up to dry Sheet making while System 5 and System 6 farmers are Latex sellers. The table shows that 100 percent of earning members of System 1 and System 2 are associated with rubber farming of which 50 percent are exclusive to rubber. In case of System 3, 92.11 percent earning members are associated with rubber of which 28.95 percent are exclusive. In case of System 4, all the earning members are engaged partially with rubber along with their other job attachment. In case of latex selling System 5 and System 6, the participation to exclusive rubber is 26.67 percent and 54.55 percent respectively. The participation of female members in rubber activity is ensured in all cases.

Category wise possession of land by responding farmer has been delineated in Table 4.2.1 and Table 4.2.2. The target of this analysis is to understand where the farmers are cultivating rubber plantation, how far the rubber plantation competing with other land use option, remaining of land for future expansion of rubber area etc. According to farmer rubber is grown in terracing highland (locally known as tilla land) kept fallow from years back. Table 4.2.1 reveals that the study farmers possess 168.44 acre of land of which 95.73 percent is under use. The pattern is similar for all Blocks. Out of this 95.73percent, percentage share of high, medium, low and home stead land are 87.39, 2.11, 5.49 and 4.70 respectively. The area under pond is insignificant. It is also to note that Rubber alone occupies 84.18 percent of land of responding farmer. Only 3.21 percent of land under tilla category still remains vacant for future expansion of rubber in need. In case of inter Block comparison Tulashikhar block has highest percentage (39.92) of rubber growing land or high land due to her more share in sapling. The analysis further asserts that Rubber has come to Tripura farmer as a potential option to operate tilla land otherwise kept uncultured.

Table 4.2.2 reveals the holding size of farmer under different Blocks. Average holding size come to 3.24 acre per farmer of which 2.73 acre goes for rubber plantation. Due to possession of very small area under medium and low category practice of crop cultivation

Table no 4.1.4: Participation of working members in different system of production

System	No of family		Male member				Female member				Total member			
			Only rubber	Rubber and other	Only other	Total	Only rubber	Rubber and other	Only other	Total	Only rubber	Rubber and other	Only other	Total
1	9	Number of participants	4	7	0	3	5	2	0	2	9	9	0	18
		% of intra system participation	22.22	38.89	0.00	16.67	27.78	11.11	0.00	11.11	50.00	50.00	0.00	100.00
		% of inter system participation	22.22	13.21	0.00	13.04	18.52	18.18	0.00	14.29	20.00	14.06	0.00	15.93
		Average per family	0.44	0.78	0.00	0.33	0.56	0.22	0.00	0.22	1.00	1.00	0.00	2.00
2	6	Number of participants	2	9	0	2	7	0	0	2	9	9	0	18
		% of intra system participation	11.11	50.00	0.00	11.11	38.89	0.00	0.00	11.11	50.00	50.00	0.00	100.00
		% of inter system participation	11.11	16.98	0.00	8.70	25.93	0.00	0.00	14.29	20.00	14.06	0.00	15.93
		Average per family	0.33	1.50	0.00	0.33	1.17	0.00	0.00	0.33	1.50	1.50	0.00	3.00
3	14	Number of participants	2	19	2	16	9	5	1	10	11	24	3	38
		% of intra system participation	5.26	50.00	5.26	42.11	23.68	13.16	2.63	26.32	28.95	63.16	7.89	100.00
		% of inter system participation	11.11	35.85	100.00	69.57	33.33	45.45	50.00	71.43	24.44	37.50	75.00	33.63
		Average per family	0.14	1.36	0.14	1.14	0.64	0.36	0.07	0.71	0.79	1.71	0.21	2.71
4	1	Number of participants	0	1	0	0	0	1	0	0	0	2	0	2
		% of intra system participation	0.00	50.00	0.00	0.00	0.00	50.00	0.00	0.00	0.00	100.00	0.00	100.00
		% of inter system participation	0.00	1.89	0.00	0.00	0.00	9.09	0.00	0.00	0.00	3.13	0.00	1.77
		Average per family	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	2.00	0.00	2.00

Contd ...

Table no 4.1.4: Participation of working (contd...)

System	No of family		Male member				Female member				Total member			
			Only rubber	Rubber and other	Only other	Total	Only rubber	Rubber and other	Only other	Total	Only rubber	Rubber and other	Only other	Total
5	11	Number of participants	3	10	0	2	1	1	0	0	4	11	0	15
		% of intra system participation	20.00	66.67	0.00	13.33	6.67	6.67	0.00	0.00	26.67	73.33	0.00	100.00
		% of inter system participation	16.67	18.87	0.00	8.70	3.70	9.09	0.00	0.00	8.89	17.19	0.00	13.27
		Average per family	0.27	0.91	0.00	0.18	0.09	0.09	0.00	0.00	0.36	1.00	0.00	1.36
6	11	Number of participants	7	7	0	0	5	2	1	0	12	9	1	22
		% of intra system participation	31.82	31.82	0.00	0.00	22.73	9.09	4.55	0.00	54.55	40.91	4.55	100.00
		% of inter system participation	38.89	13.21	0.00	0.00	18.52	18.18	50.00	0.00	26.67	14.06	25.00	19.47
		Average per family	0.64	0.64	0.00	0.00	0.45	0.18	0.09	0.00	1.09	0.82	0.09	2.00
Total	52	Number of participants	18	53	2	23	27	11	2	14	45	64	4	113
		% of intra system participation	15.93	46.90	1.77	20.35	23.89	9.73	1.77	12.39	39.82	56.64	3.54	100.00
		% of inter system participation	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
		Average per family	0.35	1.02	0.04	0.44	0.52	0.21	0.04	0.27	0.87	1.23	0.08	2.17

Table no 4.2.1: Category wise possession of total land by the whole responding rubber farming community study area (in acre)

Block	High/tila land			Medium land			Low land			Pond area	Home stead area	Total land		
	Rubber	Fallow	Total	Crop	Fallow	Total	Crop	Fallow	Total			Use	No use	Total
Khowai	37.6	1.8	39.4	0.8	0.2	1	3.6	0.44	4.04	0.08	2.12	44.12	2.52	46.64
	80.62	3.86	84.48	1.72	0.43	2.14	7.72	0.94	8.66	0.17	4.55	94.60	5.40	100.00
	26.52	33.33	26.77	27.40	31.25	28.09	41.86	68.75	43.72	15.38	26.77	27.36	35.00	27.69
Padmabil	47.6	1.6	49.2	1.6		1.6	2	0.2	2.2	0.14	2.34	53.54	1.94	55.48
	85.80	2.88	88.68	2.88	0	2.88	3.60	0.36	3.97	0.25	4.22	96.50	3.50	100
	33.57	29.63	33.42	54.79	0.00	44.94	23.26	31.25	23.81	26.92	29.55	33.21	26.94	32.94
Tulasikhar	56.6	2	58.6	0.52	0.44	0.96	3		3	0.3	3.46	63.58	2.74	66.32
	85.34	3.02	88.36	0.78	0.66	1.45	4.52	0.00	4.52	0.45	5.22	95.87	4.13	100.00
	39.92	1.41	41.33	0.37	0.31	0.68	2.12	0.00	2.12	0.21	2.44	44.84	1.93	46.77
Total	141.8	5.4	147.2	2.92	0.64	3.56	8.6	0.64	9.24	0.52	7.92	161.24	7.2	168.44
	84.18	3.21	87.39	1.73	0.38	2.11	5.11	0.38	5.49	0.31	4.70	95.73	4.27	100
	100	100	100	100	100	100	100	100	100	100	100	100	100	100

*Figure in left orientation indicates intra block and in right orientation indicates inter block percentage comparison

Table no 4.2.2: Category wise average quantity of land possession by a single responding rubber farmer in study area (in acre)

Block	High/ tila land			Medium land			Low land			Pond	Home stead	Total land		
	Rubber	Fallow	Total	Crop	Fallow	Total	Crop	Fallow	Total			Use	No use	Total
Khowai	**2.69**	**0.13**	**2.81**	**0.06**	**0.01**	**0.07**	**0.26**	**0.03**	**0.29**	**0.01**	**0.15**	**3.15**	**0.18**	**3.33**
Padmabil	**2.98**	**0.10**	**3.08**	**0.10**	**0.00**	**0.10**	**0.13**	**0.01**	**0.14**	**0.01**	**0.15**	**3.35**	**0.12**	**3.47**
Tulasikhar	**2.57**	**0.09**	**2.66**	**0.02**	**0.02**	**0.04**	**0.14**	**0.00**	**0.14**	**0.01**	**0.16**	**2.89**	**0.12**	**3.01**
Total	**2.73**	**0.10**	**2.83**	**0.06**	**0.01**	**0.07**	**0.17**	**0.01**	**0.18**	**0.01**	**0.15**	**3.10**	**0.14**	**3.24**

remains insignificant in study area. The holding size of Padmabil is more than other two Blocks. It may be concluded that the selected respondents may be accepted as typical rubber farmer for which the study has been under taken.

Table 4.3 shows the distance from rubber plantation to the farmer's house. Out of the total 52 respondents 17 respondents has less than 1 km, 16 grower has 1 to 3 km, 14 farmers has 3 to6 km and 2 are 6 to 10 km and rest 3 are more than 10 km distance from the rubber plantation to their house. The said mention is required to understand the distance to be covered every day for carrying latex up to house of the farmer. This also has influence on farmers' decision for going with contract labor under System 3.

It is observed that at the time planting farmers have followed three types of spacing model for optimization plant density per unit of land. In case of high density planting the spacing is 12 feet by 12 feet, in case of medium density planting the spacing is 15 feet by 12 feet and in case of low density planting the spacing is 15 feet by 15 feet. The details about number of participating farmer, their land and total number of sapling planted have been explained in Table 4.4.1 and Table 4.4.2. The aim of this analysis is to know the technical details about rubber tree stock practiced by the farmer.

Table 4.4.1 revealed that according to the different spacing model out of the total area 69.68 percent follow low density spacing and 25.24 percent follow in medium density spacing model and rest 5.08 percent following high density spacing model. In terms of number of farmer 32 farmers are following low density, 13 are following medium density and 7 farmers are following high density model.

Average number of sapling planted per acre of land and possession of sapling per farmer has been explained in Table 4.4.2. It is observed that average number of sapling planted per acre is 208 which varies as 249.42, 222.91 and 200.5 respectively for high, medium and low density planting model. It is noted that in totality average number of sapling planted by each respondent is 568.88 which again varies between Blocks.

Details about survivalist of planted sapling under different spacing have been explained in Table 4.5.1 to Table 4.5.3. The aim of this discussion is to know the ultimate standing stock that actually gives latex after a long gestation. The damage of sapling during establishment phase and their replacement by the farmer has also been explained duly.

Table 4.5.1 shows that in high density spacing model out of total 1798 sapling planted 573 plants (31.87 per cent) was damaged and finally 1301 plants survived (72.36 per cent)

Table no 4.3: Distance of rubber plantation from residential house of farmer

Block	Total farmer	< 1 km	1 – 3 km	3 – 6 km	6 – 10 km	>10 km
Khowai	14	9	3	2	0	0
Padmabil	16	2	6	5	1	2
Tulasikhar	22	6	7	7	1	1
Total	52	17	16	14	2	3

- The said distance is travelled by farmer for making of channel and collection of latex.
- At the onward journey movement is free,
- But on backward journey the sheet making farmer and cenex choosing farmer will carry the collected latex.
- The travelling is usually made by two wheeler

Table no 4.4.1: Distribution of farmer according to their degree of participation, area under rubber and sapling planted in different spacing model.

- High density model : 12 feet X 12 feet,
- Medium density model: 15 feet X 12 feet,
- Low density model : 15 feet X 15 feet

Block	High density spacing 12x12			Medium density spacing 15x12			Low density spacing 15x15			Total		
	No of farmer	Area	Sapling planted	No of farmer	Area	Sapling planted	No of farmer	Area	Sapling planted	No of farmer	Area	Sapling planted
Khowai	4	6	1500	3	10.8	2432	7	20.8	4176	14	37.6	8108
	28.57	16	18.5	21.42	28.72	29.99	50	55.319	51.6	100	100	100
	57.14	83.33	83.43	23.08	30.17	30.48	21.88	21.05	21.09	27	26.5	27.4
Padmabil	1	0.6	148	3	7.8	1728	12	39.2	7876	16	47.6	9752
	6.25	1.3	1.5	18.75	16.385	17.7	75	82.35	80.8	100	100	100
	14.29	8.33	8.23	23.08	21.79	21.65	37.50	39.68	39.77	30.7	33.5	33.0
Tulasikhar	2	0.6	150	7	17.2	3820	13	38.8	7752	22	56.6	11722
	9.1	1	1.27	31.8	30.38	32.6	59.1	68.55	66.1	100	100	100
	28.57	8.33	8.34	53.85	48.04	47.87	40.63	39.27	39.14	42.3	40	39.6
Total Dist	7	7.2	1798	13	35.8	7980	32	98.8	19804	52	141.8	29582
	13.46	5.08	6.1	25.00	25.24	30.0	61.54	69.68	66.9	100	100	100
	100	100	100	100	100	100	100	100	100	100	100	100

*Figure in left orientation indicates intra block and in right orientation indicates inter block percentage comparison.

Table no 4.4.2: Average number of sapling planted in different spacing model

Block	High density spacing 12x12		Medium density spacing 15x12		Low density spacing 15x15		Total	
	Sapling/farmer	Sapling/acre	Sapling/farmer	Sapling/acre	Sapling/farmer	Sapling/acre	Sapling/farmer	Sapling/acre
Khowai	375.00	250.00	810.67	225.19	596.57	200.77	579.14	215.64
Padmabil	148.00	246.67	576.00	221.54	656.33	200.92	609.50	204.87
Tulasikhar	75.00	250.00	545.71	222.09	596.31	199.79	532.82	207.10
Total	256.86	249.72	613.85	222.91	618.88	200.45	568.88	208.62

Table no 4.5.1: Details about total stock of rubber trees planted by the sample farmers in High density model

Block	Sapling planted	Damaged and replaced						Total standing tree	Distribution of standing tree	
		Initial phase		Breaking stage		Total				
		Damaged	Replaced	Damaged	Replaced	Damaged	Replaced		Immature	Latex producing
Khowai	1500	60	30	426	30	486	60	1074	60	1014
	100	**4**	**2**	**28.4**	**2**	**32.4**	**4**	**71.6**	(5.59)	(94.41)
Padmabil	148	0	0	30	0	30	0	118	0	118
	100	**0**	**0**	**20.27**	**0**	**20.27**	**0**	**79.73**	0	(100)
Tulasikhar	150	48	10	9	6	57	16	109	16	93
	100	**32**	**6.67**	**6**	**4**	**38**	**10.67**	**72.67**	(14.68)	(85.32)
Total	1798	108	40	465	36	573	76	1301	76	1225
	100	**6.01**	**2.22**	**25.86**	**2.00**	**31.87**	**4.23**	**72.36**	(5.84)	(94.16)

- Figure in bold indicates percentage of sapling planted
- Figure in parenthesis indicates percentage share between immature and latex producing standing trees.

after replacement of 76 trees (4.23 percent) . The damage is caused due to high wind. Out of trees survived, 94.16 percent produces latex. Survivality is more in Padmabil in comparison to other.

Table 4.5.2 is showing the medium density spacing model. Out of the total standing trees 97.09 percent are latex producing and rest 2.91percentage are immature trees. Out of the total sapling planted 4.54 percent damaged in initial phase due to wilting and 11.29 percentage damaged by breaking due to high wind. Percentages of total replaced are 2.01 (1.13 in initial phase and 0.88 in breaking stage). Depending on sapling planted, the percentage of total standing trees are 86.23 percent. Table 4.5.3 is showing the low density spacing model. Out of the total standing trees 95.15 percentages are latex producing and rest 4.85 percentage are immature trees. Out of the total sapling planted 2.21 percent damage in initial phase due to wilting and 16.05 percentage damaged by breaking due to Strom or high wind. Percentage of total replaced is2.39 (0.59 in initial phase and 1.80 in breaking stage). Depending on sapling planted, the percentage of total standing trees are 84.06 percent.

For understanding the change of density of plants per acre over initial planting to ultimate survival has been delineated in Table 4.4.6 and Table 4.4.7. The perspective of Table 4.6 is to judge from agronomic point of view and for Table 4.7 it is from economic point of view.

Table 4.6 revealed that in high density spacing model the total proposed density was 249.72 per acre and effective density of standing both mature and immature total trees is 180.7 and thus the survival percentage is 72.36. An agronomist may be concerned about the result. In medium density spacing model the total proposed density was 222.9 per acre and effective density is 192.2 and the survival percentage is 86.23. In low density spacing model the total proposed density was 200.45 and effective density is 168.5 and the survival percentage is 84.06. The survivality percentage is better in medium density planting and it is lowest for high density model. Hence in case of new plantation farmers are avoiding high density spacing.

The availability of effective number of latex giving mature trees directly related to production has been mentioned in Table 4.7. It revealed that in high density spacing model the total proposed density was 249.72 plants per acre but effective density of latex giving trees per acre is 170.15 and the survival percentage is 68.13. In medium density spacing model the total proposed density was 222.9 and effective density is 186.62 and the survival

Table no 4.5.2: Details about total stock of rubber trees planted by the sample farmers in Medium density model

Block	Sapling planted	Damaged and replaced						Total standing tree	Distribution of standing tree	
		Initial phase		Breaking stage		Total				
		Damaged	Replaced	Damaged	Replaced	Damaged	Replaced		Immature	Latex producing
Khowai	2432	10	10	87	0	97	10	2349	30	2319
		0.41	**0.41**	**3.58**	**0**	**3.99**	**0.41**	**96.59**	(1.28)	(98.72)
Padmabil	1728	50	0	347	0	397	0	1333	20	1313
		2.89	**0**	**20.08**	**0**	**22.97**	**0**	**77.14**	(1.5)	(98.5)
Tulasikhar	3820	302	80	467	70	769	150	3199	150	3049
		7.91	**2.09**	**12.23**	**1.83**	**20.13**	**3.93**	**83.74**	(4.69)	(95.31)
Total	7980	362	90	901	70	1263	160	6881	200	6681
		4.54	**1.13**	**11.29**	**0.88**	**15.83**	**2.01**	**86.23**	(2.91)	(97.09)

- Figure in bold indicates percentage of sapling planted
- Figure in parenthesis indicates percentage share between immature and latex producing standing trees.

Table no 4.5.3: Details about total stock of rubber trees planted by the sample farmers in Low density model

Block	Sapling planted	Damaged and replaced						Total standing tree	Distribution of standing tree	
		Initial phase		Breaking stage		Total				
		Damaged	Replaced	Damaged	Replaced	Damaged	Replaced		Immature	Latex producing
Khowai	4176	44	0	635	165	679	165	3662	225	3437
	100	**1.05**	**0**	**15.21**	**3.95**	**16.26**	**3.95**	**87.69**	(6.14)	(93.86)
Padmabil	7876	138	80	1305	95	1443	175	6633	323	6310
	100	**1.75**	**1.02**	**16.57**	**1.21**	**18.32**	**2.22**	**84.22**	(4.87)	(95.13)
Tulasikhar	7752	255	36	1239	97	1494	133	6353	259	6094
	100	**3.29**	**0.46**	**15.98**	**1.25**	**19.27**	**1.72**	**81.95**	(4.08)	(95.92)
Total	19804	437	116	3179	357	3616	473	16648	807	15841
	100	**2.21**	**0.59**	**16.05**	**1.80**	**18.26**	**2.39**	**84.06**	(4.85)	(95.15)

- Figure in bold indicates percentage of sapling planted
- Figure in parenthesis indicates percentage share between immature and latex producing standing trees

Table no 4.6: Total number of standing trees per acre in comparison with initial proposed density under different planting model

Block	High density model			Medium density model			Low density model			Total		
	Proposed density	Effective density	% of survival	Proposed density	Effective density	% of survival	Proposed density	Effective density	% of survival	Proposed density	Effective density	% of survival
Khowai	250.00	179	71.60	225.17	217.5	96.59	200.77	176.05	87.69	215.65	188.42	87.38
Padmabil	246.67	196.67	79.73	221.55	170.9	77.14	200.92	169.2	84.22	204.87	169.82	82.90
Tulasikhar	250.00	181.67	72.67	222.1	186	83.74	199.8	163.72	81.95	207.1	170.7	82.42
Total	249.72	180.7	72.36	222.9	192.2	86.23	200.45	168.5	84.06	208.62	175.1	83.94

Table no 4.7: Effective number of latex giving trees per acre in comparison with initial proposed density under different planting model

Block	High density model			Medium density model			Low density model			Total		
	Proposed density	Effective density	% of survival	Proposed density	Effective density	% of survival	Proposed density	Effective density	% of survival	Proposed density	Effective density	% of survival
Khowai	250.00	169	67.60	225.17	214.72	85.88	200.77	165.25	82.30	215.65	180.05	83.50
Padmabil	246.67	196.67	79.73	221.55	168.32	75.98	200.92	160.97	80.12	204.87	162.62	79.38
Tulasikhar	250.00	155.00	62.00	222.1	177.27	79.82	199.8	157.05	78.61	207.1	163.17	78.79
Total	249.72	170.15	68.13	222.9	186.62	83.72	200.45	160.32	79.99	208.62	167.47	80.28

percentage is 83.72. In low density spacing model the total proposed density was 200.45 and effective density is 160.32 and the survival percentage is 79.99. It is once again established that from economic point of view medium density spacing is the best.

Table 4.8 revealed that according to the different spacing model attainment of latex giving age of trees. The objective of this table is to judge the length of gestation period. In case of high density plantation 94.20 percent trees are giving latex at 7^{th} year age. In medium density spacing model 92.38 percent trees are giving latex in 7^{th} year of age and in low density plantation model 98.04 percent given latex at 7^{th} year. So out of the total plantation 96.25 percent are giving latex at 7^{th} year age , 1.91 percent are giving latex at 8^{th} year age, 1.15 percent are giving latex at 9^{th} year age and 0.69 percentage giving latex at 10^{th} or more than 10^{th} year of the age . Hence it can be concluded that the rubber tree has gestation period up to 6^{th} year of age.

Block wise distribution of number of farmers in different System category (as explained in Methodology 3.11) has been shown in Table 4.9. The said table will guide the total analysis hence forth. Out of the 52 respondents 57.70 percent selling out put in sheet form (System 1 to System 4) and 42.30 percent selling out put in latex form (System 5 and System 6). In Khowai block 92.86 percent farmers are selling out put in sheet form and rest 7.14 percent farmers are selling the output in latex form. In Padmabil Block 100 percent farmers are selling out put in latex form. In Tulashikhar block 22.73 percent farmers are selling the output in latex form and rest 77.27 percent farmers are selling the output in sheet form.

System wise inventory possession of land area and number of tapping trees belongs to respondent farmers has been explained in Table 4.10.1 to Table 4.10.3. The aim is to understand the size of inventory and basis of unit selection for further analysis of the study. Table 4.10.1 reveals that the study is encompassed with 23747 latex giving rubber trees of which 15230 trees (64.13 per cent) are belongs to Sheet making farmers and 8517 trees (35.87 per cent) are belongs to Latex selling farmers. The individual percentage share of Systems are 21.36 ,9.75,32.40 and , 0.62 respectively for Sheet making System 1,System 2, System 3 and System 4 farmers. For latex selling System 5 and System 6 farmers the said percentage share are 8.74 and 27.13 respectively.

Table no 4.8: Details about attainment of latex giving girth size of existing standing mature trees in different model group.

Block	High density model					Medium density model					Low density model					Total				
	7^{th}yr	8^{th}yr	9^{th}yr	10^{th} and more	Total	7^{th}yr	8^{th}yr	9^{th}yr	10^{th} and more	Total	7^{th}yr	8^{th}yr	9^{th}yr	10^{th} and more	Total	7^{th}yr	8^{th}yr	9^{th}yr	10^{th} and more	Total
Khowai	961	53	0	0	1014	2011	100	108	100	2319	3362	22	53	0	3437	6334	175	161	100	6770
	94.77	**5.23**	**0**	**0**	**100**	**86.72**	**4.31**	**4.66**	**4.31**	**100**	**97.82**	**0.64**	**1.54**	**0**	**100**	**93.56**	**2.58**	**2.38**	**1.48**	**100**
Padmabil	100	0	18	0	118	1299	14	0	0	1313	6169	39	52	50	6310	7568	53	70	50	7741
	84.75		**15.25**		**100**	**98.93**	**1.07**			**100**	**97.77**	**0.62**	**0.82**	**0.79**	**100**	**97.77**	**0.68**	**0.90**	**0.65**	**100**
Tulasikhar	93	0	0	0	93	2862	175	12	0	3049	5999	50	31	14	6094	8954	225	43	14	9236
	100	**0**	**0**	**0**	**100**	**93.87**	**5.74**	**0.39**	**0**	**100**	**98.44**	**0.82**	**0.51**	**0.23**	**100**	**96.95**	**2.44**	**0.47**	**0.15**	**100**
Total	1154	53	18	0	1225	6172	289	120	100	6681	15530	111	136	64	15841	22856	453	274	164	23747
	94.20	**4.33**	**1.47**		**100**	**92.38**	**4.33**	**1.80**	**1.50**	**100**	**98.04**	**0.70**	**0.86**	**0.40**	**100**	**96.25**	**1.91**	**1.15**	**0.69**	**100**

- Figure in bold indicates intra age percentage distribution within the respective model.

Table no 4.9: Distribution of responding farmer on the basis of making output in different forms and ways

Block	Selling output in latex form			Selling output in sheet form					Total respondent
	To sheet maker	To Cenex industry	Sub total	Own labour own roller	Own labour rented roller	Contract labour rented roller	Service labour service roller	Sub total	
Khowai	1		1	3	1	9		13	14
	(7.14)		(7.14)	21.43	7.14	64.29		92.86	(100)
	(9.09)	0.00	(4.55)	33.33	16.67	64.29	0.00	43.33	26.92
Padmabil	5	11	16						16
	(31.25)	(68.75)	(100)						(100)
	(45.45)	(100.00)	(72.73)	0.00	0.00	0.00	0.00	0.00	30.77
Tulasikhar	5		5	6	5	5	1	17	22
	(22.73)		(22.73)	27.26	22.73	22.73	4.55	77.27	(100)
	(45.45)	0.00	(22.73)	66.67	83.33	35.71	100.00	56.67	42.31
Total	11	11	22	9	6	14	1	30	52
	(21.15)	(21.15)	(42.30)	(17.3)	(11.54)	(26.94)	(1.92)	(57.70)	(100)
	100	100	100	100	100	100	100	100	100

- *Figure in left orientation indicates intra block and in right orientation indicates inter block percentage comparison
- In case of sheet maker the latex is sold at plantation site. The sheet maker collects latex from plantation, brings it to own house, makes dough and finally makes sheet in own roller. The total work is done by family members only.
- In case of Cenex, the latex is collected by the farmer either by family member or by wage labourer and bring it to own house. Store it in200 litre container (latex will not coagulate even upto 8 months). After that bring the container to buyer industry at a distance of 40 km with own transportation cost.

Table no 4.10.1: Number of total tapping trees belongs to respondent category of farmer.

Block	Selling output in latex form			Selling output in sheet form					Total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Sub total	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller (S3)	Service labour service roller(S4)	Sub total	
Khowai	52		52	1307	188	5223		6718	6770
	0.77		**0.77**	**19.31**	**2.78**	**77.15**		**99.23**	**100**
									(28.51)
Padmabil	1299	6442	7741						7741
	16.78	**83.22**	**100.00**						**100**
									(32.6)
Tulasikhar	724		724	3765	2128	2471	148	8512	9236
	7.84		**7.84**	**40.76**	**23.04**	**26.75**	**1.6**	**92.16**	**100**
									(38.89)
Total	2075	6442	8517	5072	2316	7694	148	15230	23747
	8.74	**27.13**	**35.87**	**21.36**	**9.75**	**32.40**	**0.62**	**64.13**	**100.00**
									(100)

- Figure in bold indicates intra block percentage comparison between various system in respective group of farmer
- Figure in parenthesis indicates inter block percentage comparison in respect to total tree.

Table 4.10.2 shows plantation area of farmer in acre. Out of the total 141.8 acre 53.4 acre (37.66 per cent) are devoted to latex selling group and rest 88.4 acre (62.34 percent) area used by sheet selling group.

Table 4.10.3 reveals System wise average number of latex giving trees per acre and per farmer. Out of the total Blocks, average number of trees per acre is 167.5 and average number of trees per farmer is 456.67. Number of trees per acre for Blocks like Khowai, Padmabil and Tulashikhar are 180.1, 162.6 and 163.2 respectively. For individual Blocks tree per farmer are 483.57, 483.81 and 419.82 respectively. It is noted that Block Khowai has highest number of trees per acre but Block Tulasikhar has highest number of trees per farmer.

The yield of latex from natural rubber tree is directly associated with number of tapping days. The information in regard to total number of tapping days in summer (April to August) and winter seasons (September to January) has been delineated in Table 4.11.1 and Table 4.11.2 respectively. Table 4.11.1 shows that the average number of tapping days in summer season. Including all the selling output Systems, overall tapping days in summer season are 68.12 days out of total 150 days. Block wise count of tapping days for Khowai, Padmabil and Tulashikhar are71.59, 66.85, 66.64 days in summer season. Table 4.11.2 shows the average number of tapping days in winter season. Including all the selling output Systems, overall tapping days in winter season are 99.30 days out of 150 days .Block wise count of tapping days for Khowai , Padmabil and Tulashikhar are 99.99, 100.29, 99.97 days in winter season. The tapping days are less in summer season because of rain during April to July and also for variation in temperature.

The total yield obtained in the form of latex from standing trees is the first step output of this study. Details about the said yield have been presented through Table 4.12.1 and Table 4.12.2 for the seasons of summer and winter separately. It may be noted that winter yield is more than summer yield both for increased number of tapping days and yield per day per plant.

According to Table 4.12.1 it is found that average quantity of latex collected during summer months from one acre of plantation are 880.75 liter, 953.59 litre,1176.17 liter, 572.86 liter, 836.1 liter and 1038.22 liter respectively for System 1 , System2,System3, System 4, System 5 and System 6. The average yield of latex per acre considering all system together comes at 1011.83 liter. Although the quantity of latex is low in summer but dry matter content is high during this time.

Table no 4.10.2: Plantation area belongs to different category of respondent farmer (in acre)

Block	Selling output in latex form			Selling output in sheet form					Total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Sub total	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller (S3)	Service labour service roller(S4)	Sub total	
Khowai	0.4		0.4	7.6	0.80	28.8		37.2	37.6
	1.06	**0.00**	**1.06**	**20.21**	**2.13**	**76.60**	**0.00**	**98.94**	**100.00**
									(26.52)
Padmabil	8.8	38.8	47.6						47.6
	18.49	**81.51**	**100.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**100.00**
									(33.57)
Tulasikhar	5.4		5.4	22.8	13.4	13.6	1.4	51.2	56.6
	9.54	**0.00**	**9.54**	**40.28**	**23.67**	**24.03**	**2.47**	**90.46**	**100.00**
									(39.92)
Total	14.6	38.8	53.4	30.4	14.2	42.4	1.4	88.4	141.8
	10.30	**27.36**	**37.66**	**21.44**	**10.01**	**29.90**	**0.99**	**62.34**	**100.00**
									(100.00)

- Figure in bold indicates intra block percentage comparison between various system in respective group of farmer.
- Figure in parenthesis indicates inter block percentage comparison in respect to total area.

Table no 4.10.3: Average number of latex giving trees per acre and per farmer basis across the system and blocks

Block	Selling output in latex form				Selling output in sheet form								Total respondent	
	To sheet maker (S5)		To Cenex maker(S6)		Own labour own roller (S1)		Own labour rented roller(S2)		Contract labour rented roller (S3)		Service labour service roller(S4)			
	Tree/acre	Tree/farmer	Tree/acre	Tree/farmer	Tree/acre	Tree/farmer	Tree/acre	Tree/farmer	Tree/acre	Tree/farmer	Tree/acre	Tree/farmer	Tree/acre	Tree/farmer
Khowai	130	52			171.97	436	235	188	181.4	580.3			180.1	483.57
Padmabil	148	260	166.03	586									162.6	483.81
Tulasikhar	134	145			165.13	628	158.8	426	181.7	494.2	105.7	148	163.2	419.82
Total	142	189	166.03	586	166.84	564	163.1	386	181.5	549.6	105.7	148	167.5	456.67

Table no 4.11.1: Category wise average number of taping days in a season during summer season

Block	Selling output in latex form		Selling output in sheet form				Overall total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller(S3)	Service labour service roller (S4)	
Khowai	64	65.83	63.55	68.00	73.81		71.59
Padmabil	71.88	65.83					66.85
Tulasikhar	63.34	65.83	61.36	75.52	68.96	51.00	66.64
Total	68.70	65.83	61.92	74.91	72.25	51.00	68.12

Table no 4.11.2: Category wise average number of taping days in a season during winter season

Block	Selling output in latex form		Selling output in sheet form				Overall total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller(S3)	Servicelabour service roller (S4)	
Khowai			94.00	101.00	101.42		99.99
Padmabil	97.05	100.95					100.29
Tulasikhar	95.24		98.06	99.19	97.58	98.00	97.97
Total	96.56	100.95	97.01	99.33	100.19	98.00	99.30

Table no 4.12.1: Category wise total quantity of latex collected from one acre of plantation area during summer season

Block	Selling output in latex form		Selling output in sheet form				Total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller(S3)	Servicelabour service roller (S4)	
Khowai	555		680.26	975	1071.74		985.05
Padmabil	906.48	1038.22					1013.87
Tulasikhar	742.22		947.59	952.31	1397.35	572.86	1027.92
Total	836.1	1038.22	880.75	953.59	1176.17	572.86	1011.83

Table no 4.12.2: Category wise total quantity of latex collected from one acre of plantation area during winter season

Block	Selling output in latex form		Selling output in sheet form				Total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller(S3)	Service labour service roller (S4)	
Khowai	1710		1472.63	2217.50	2358.47		2169.52
Padmabil	1881.19	2317.37					2236.73
Tulasikhar	1622.54		1990.30	1725.35	2732.35	1650.00	2062.37
Total	1780.83	2317.37	1860.88	1753.07	2478.40	1650.00	2149.31

Table 4.12.2 explains the collection of latex from one acre of plantation during winter season. The study found that respective yield of latex per acre comes at 1860.88 liter for System 1, 1753.07 liter for System 2,2478. 40 liter for System 3, get 1650 liter for System 4,1780.83 liter for System 5 and 2317.37 liter for System 6. The overall average collection is 2149.31 liter per acre.

The second step of this production system is making of sheet from collected latex. As four types of farmers like System 1 to system 4 are selling their output in Sheet form hence a separate study has been made over Sheet item only. Table 4.13.1 and Table 4.13.2 are being explained for this purpose.

Table 4.13.1.explains the production of number and kg of sheet made from collected latex at Khowai and Padmabil Block per acre during summer season. Average of total sheet from all system together come at 770.49 in number and 329.05 Kg in weight. For Khowai it is 489.57 in number and 304.33 in weight and for Tulashikhar it is 957.10 in number and 345.48 in kg in weight. No sheet is made in Padmabil block because they sell the output in latex form. There remains inter system and inter block difference. The average yield is 309.62 kg for System 1, 343.20 Kg for System 2, 387.51 Kg for System 3 and 200.50 Kg for System 4. The said variation signifies performance efficiency of famers of different systems.

Table 4.13.2.explains production sheet in number and Kg at Khowai and Padmabil Block per acre during winter season. Khowai Block produces 1075.66 number of sheet which is 554.73 kg in weight. Tulashikhar Block produces 1907.56 number of sheet which is 592.29 kg in weight. The total no of sheet produced in winter season from one acre of plantation is 1575.51 which is 577.30 Kg in weight. The average yield are 569.86 kg for System 1, 542.55 Kg for System 2, 675.96 Kg for System 3 and 495.00 Kg for System 4. The difference in yield once again establishes the performance variation.

The value return obtained by the farmer by selling out of output either in Latex form or in Sheet form has been explained in Table 4.14.1 and Table 4.14.2 respectively for Summer and winter season. The said tables have quantity reference with Table 4.12 (for System 5 and System 6 latex selling farmers) and Table 4.13 (System 1 to system 4 for Sheet selling farmer).

Table 4.14.1.showsgross value return obtained by selling of output per acre in summer season. The average total price received from different systems is Rs 50662 per acre. The respective values are Rs 47371.12 for System 1, Rs 52514.23 for System 2, Rs 59289.15

Table no 4.13.1: Production of sheet under various categories of farmer during summer season from one acre plantation

Block	Own labour own roller (S1)		Own labour rented roller(S2)		Contract labour rented roller (S3)		Service labour service roller (S4)		Total respondent	
	Number of sheet	Kg of sheet	Number of sheet	Kg of sheet	Number of sheet	Kg of sheet	Number of sheet	Kg of sheet	.	Kg of sheet
Khowai	340.13	212.23	487.50	294.64	535.87	333.13			489.57	304.33
Tulasikhar	947.59	342.08	952.31	346.10	1397.35	502.68	572.86	200.50	957.10	345.48
Total	795.72	309.62	926.13	343.20	812.19	387.51	572.86	200.50	770.49	329.05

Table no 4.13.2: Production of sheet under various categories of farmer during winter season from one acre plantation

Block	Own labour own roller (S1)		Own labour rented roller(S2)		Contract labour rented roller (S3)		Service labour service roller (S4)		Total respondent	
	Number of sheet	Kg of sheet	Number of sheet	Kg of sheet	Number of sheet	Kg of sheet	Number of sheet	Kg of sheet	Number of sheet	Kg of sheet
Khowai	736.32	421.67	1108.75	597.51	1179.24	596.36			1075.66	554.73
Tulasikhar	1990.26	619.26	1725.30	539.26	2732.35	844.50	1650.00	495.00	1907.56	592.29
Total	1676.78	569.86	1690.56	542.55	1677.41	675.96	1650.00	495.00	1575.51	577.30

Table no 4.14.1: Gross return (in Rs) obtained by selling of output per acre in Summer season on 2021-22 price

Block	Selling output in latex form		Selling output in sheet form				Total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller(S3)	Servicelabour service roller (S4)	
Khowai	19425		32471.11	45078.75	50968.4		46768.60
Padmabil	31726.71	51911.08					48179.52
Tulasikhar	25977.78		52337.81	52958.14	76909.56	30676.5	55338.13
Total	29263.36	51911.08	47371.12	52514.23	59289.15	30676.5	50662.81

Table no 4. 14.2: Gross return (in Rs) obtained by selling of output per acre in Winter season on 2021-22 price

Block	Selling output in latex form		Selling output in sheet form				Total respondent
	To sheet maker (S5)	To Cenex maker(S6)	Own labour own roller (S1)	Own labour rented roller(S2)	Contract labour rented roller(S3)	Servicelabour service roller (S4)	
Khowai	51300		64447.51	91293.3	98390.76		90877.91
Padmabil	56435.62	115868.51					104880.91
Tulasikhar	48676.11		94550.04	82385	128973.53	75596.57	95095.87
Total	53424.96	115868.51	87024.41	82886.87	108200.33	75596.57	97262.11

for System 3, Rs 30676.5 for System 4, Rs 29263.36 for system 5 and Rs 51911.08 for system 6. Inter system differences of gross output indicates that there remains differences of efficiency of utilization of resource by the farmers. It is expected that latex selling farmer will earn less than Sheet selling farmer which is established from poor performance of System 5 farmer. On the other hand Good performance of System 6 farmers is due to higher price of latex given by cenex industry.

The gross value return obtained during winter season has been explained in Table 4.14.2. The average total price received from different systems is Rs 97262.10 per acre. The respective values are Rs 87024.41 for System 1, Rs 82886.87 for System 2, Rs 108200.33 for System 3, Rs 75596.57 for System 4, Rs 53424.96 for System 5 and Rs 115868.51 for System 6 including all three block during winter season. The best performance of System 6 is once again established.

It is to mention that farmers perform tapping in early morning and collects latex within one hour of tapping. After collection of latex the oozing continues in small drops. Such types of latex coagulates and gets hardened within the bowl The said dried latex is called scrap and is collected in next morning only. Such scraps are sold by the farmer in low price. Table 4.15 explains details about quantity and value of the collected scrap across the seasons. Average quantity of collected scrap during summer is 29.67 kg per acre having value of Rs. 2967.11. During winter they said figures are 54.87 kg and Rs 4938.24 respectively. During summer between the Systems the quantity ranges from 17.97 kg (System 4) to 42.84 kg (System 1) and value ranges from Rs. 1797.14 to Rs. 4284.47 respectively. During winter between the Systems the quantity ranges from 34.89 kg (System 4) to 70.45 (System 1) and value ranges from Rs. 3139.71 to Rs. 4956.17 respectively. The average annual return from scrap considering all the Systems comes at Rs 7905.35 per acre.

Details about establishment cost for rubber plantation has been explained in Table 4.16.1 and Table 4.16.2. The former table is meant for indicating quantity aspect of cost items while later table is meant for showing value of respective quantity. It is to mention that as the plantations are old the farmer has given quantity figure from their memory. The price of respective item has been used from contemporary market by the researcher. Hence the valuation may be considered at current price i.e. 2021-22 financial years.

The basic cost structure of establishment of rubber plantation comprises of human labour, manure, fertilizer and sapling. The human labour is again subdivided into family and

Table no 4.15: Production of Scrap latex by the farmer though out the season Production in Kg, value in Rs.

System	Block	Summer season		Winter season		Total season value
		Per Acre		Per Acre		Per Acre
		Quantity	Value	Quantity	Value	Value
1	Kh	29.26	2925.79	56.79	5111.53	8037.32
	Ts	47.38	2807.24	75.01	4904.41	7711.65
	Total	42.84	4284.47	70.45	4956.17	9240.64
2	Kh	35.28	3527.50	68.48	6162.75	9690.25
	Ts	27.00	2699.70	52.41	4716.54	7416.24
	Total	27.46	2746.34	53.31	4445.90	7192.24
3	Kh	21.58	3082.43	41.89	5385.19	8467.62
	Ts	30.88	3087.50	59.93	5394.04	8481.54
	Total	24.56	2456.18	47.68	4291.09	6747.27
4	Ts	17.97	1797.14	34.89	3139.71	4936.85
	Total	17.97	1797.14	34.89	3139.71	4936.85
5	Kh	22.10	2210.00	42.90	3861.00	6071
	Pb	25.09	2509.43	48.71	4384.13	6893.56
	Ts	22.79	2279.26	44.24	3982.00	6261.26
	Total	24.16	2416.10	46.90	4221.06	6637.16
6	Pb	28.23	2823.40	54.81	4932.65	7756.05
	Total	28.23	2823.40	54.81	4932.65	7756.05
	Total kh	23.43	3050.96	45.48	4093.23	7144.19
	Total pb	27.65	2765.36	53.68	4831.24	7596.6
	Total ts	35.51	3551.43	62.11	5589.57	9141
	G .total	29.67	2967.11	54.87	4938.24	7905.35

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.16.1: Details about quantity of establishment labour and other material inputs incurred for Rubber plantation per acre

Units: Labour in man days, manure in bucket, fertiliser in Kg, sapling in number (Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar)

System	Block	Labour used									Material used			
		Cleaning		Pit making		Transplanting		Total		Total labour	Manure		Fertiliser	Sapling
		Family	Wage	Family	Wage	Family	Wage	Family	Wage		Own	Purchased	kg	No.
1	Kh	4.21	81.05	0	82.53	0	33.01	4.21	196.59	200.8	0	103.16	82.53	206.32
	Ts	2.81	69.12	0	83.37	0	33.35	2.81	185.84	188.65	0	104.21	83.37	208.42
	Total	3.16	72.11	0	83.16	0	33.26	3.16	188.53	191.68	0	103.95	83.16	207.89
2	Kh	20	80	0	100	0	40	20	220	240	0	125	100	250
	Ts	5.37	68.06	0	79.76	0	31.9	5.37	179.73	185.1	0	99.7	79.76	199.4
	Total	6.2	68.73	0	80.9	0	32.36	6.2	181.99	188.19	0	101.13	80.9	202.25
3	Kh	3.89	77.22	0	86.67	0	34.67	3.89	198.56	202.44	0	108.85	86.67	216.67
	Ts	4.12	70	0	83.76	0	33.51	4.12	187.27	191.39	0	104.71	83.76	209.41
	Total	3.96	74.91	0	85.74	0	34.29	3.96	194.94	198.9	0	107.52	85.74	214.34
4	Ts	5.71	57.14	0	85.71	0	34.29	5.71	177.14	182.86	0	107.14	85.71	214.29
	Total	5.71	57.14	0	85.71	0	34.29	5.71	177.14	182.86	0	107.14	85.71	214.29
5	Kh	40	100	0	100	0	40	40	240	280	0	125	100	250
	Pb	4.55	76.36	0	81.64	0	32.65	4.55	190.65	195.2	0	102.05	81.64	204.09
	Ts	8.89	81.48	0	85.33	0	34.13	8.89	200.95	209.84	0	106.67	85.33	213.33
	Total	7.12	78.9	0	83.51	0	33.4	7.12	195.81	202.94	0	104.38	83.51	208.77
6	Pb	2.89	72.78	0	78.72	0	32.81	2.89	184.31	187.2	0	102.53	82.02	205.05
	Total	2.89	72.78	0	78.72	0	32.81	2.89	184.31	187.2	0	102.53	82.02	205.05
Grand Total		4.06	73.34	0.00	82.55	0.00	33.38	4.06	189.27	193.34	0.00	104.42	83.45	208.63

Table no 4.16.2: Details about value of establishment labour and other material inputs incurred for Rubber plantation per acre (in Rs) 2.21-22 price (Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar)

System	Block	Labour used									Material used					Total cost
		Cleaning		Pit making		Transplanting		Total		Total labour	Manure		Fertiliser	Sapling	Total material	
		Family	Wage	Family	Wage	Family	Wage	Family	Wage		Own	Purchased				
1	Kh	157.89	3039.47	0	4126.32	0	1650.53	157.89	8816.32	8974.21	0	4332.63	2063.16	22694.74	29090.53	38064.74
	Ts	87.72	2160.09	0	4168.42	0	1667.37	87.72	7995.88	8083.6	0	4376.84	2084.21	22926.32	29387.37	37470.97
	Total	105.26	2379.93	0	4157.89	0	1663.16	105.26	8200.98	8306.24	0	4365.79	2078.95	22868.42	29313.16	37619.4
2	Kh	750	3000	0	5000	0	2000	750	10000	10750	0	5250	2500	27500	35250	46000
	Ts	167.91	2126.87	0	3988.06	0	1595.22	167.91	7710.15	7878.06	0	4187.46	1994.03	21934.33	28115.82	35993.88
	Total	200.7	2176.06	0	4045.07	0	1618.03	200.7	7839.16	8039.86	0	4247.32	2022.54	22247.89	28517.75	36557.61
3	Kh	145.83	2895.83	0	4333.33	0	1733.33	145.83	8962.49	9108.32	0	4571.88	2166.67	23833.33	30571.88	39680.2
	Ts	128.68	2187.5	0	4188.24	0	1675.29	128.68	8051.03	8179.71	0	4397.65	2094.12	23035.29	29527.06	37706.77
	Total	140.33	2668.63	0	4286.79	0	1714.72	140.33	8670.14	8810.47	0	4515.99	2143.4	23577.36	30236.75	39047.22
4	Ts	178.57	1785.71	0	4285.71	0	1714.29	178.57	7785.71	7964.28	0	4500	2142.86	23571.43	30214.29	38178.57
	Total	178.57	1785.71	0	4285.71	0	1714.29	178.57	7785.71	7964.28	0	6000	2142.86	31428.57	39571.43	47535.71
5	Kh	1500	3750	0	5000	0	2000	1500	10750	12250	0	0	2500	0	2500	14750
	Pb	147.73	2481.82	0	4081.82	0	1632.73	147.73	8196.37	8344.1	0	4285.91	2040.91	22450	28776.82	37120.92
	Ts	277.78	2546.3	0	4266.67	0	1706.67	277.78	8519.64	8797.42	0	4480	2133.33	23466.67	30080	38877.42
	Total	232.88	2540.41	0	4175.34	0	1670.14	232.88	8385.89	8618.77	0	4240.27	2087.67	22210.96	28538.9	37157.67
6	Pb	93.81	2365.46	0	3936.08	0	1640.41	93.81	7941.95	8035.76	0	4306.08	2050.52	22555.67	28912.27	36948.03
	Total	93.81	2365.46	0	3936.08	0	1640.41	93.81	7941.95	8035.76	0	4306.08	2050.52	22555.67	28912.27	36948.03
Grand	Total	136.04	2452.54	0.00	4127.50	0.00	1669.06	0.00	0.00	0.00	0.00	4385.71	2086.32	22949.51	29421.54	136.04

hired group to understand degree of work sharing between these two groups. The labour component has again been segregated according to activities like cleaning of old bushes, pit making in hard soil and transplanting of sapling.

Table 4.16.1 explains quantity of inputs used for establishment of per acre plantation. Total human labour used per acre comes at 191.68 man days for System 1, 188.19 man days for System 2, 198.9 man days for System 3, 182.86 man days for System 4, 202.94 man days for System 5 and 187.2 man days for System 6. The variation of man days between systems to system may have effect of site. In all most all the cases the labour was hired. This is because of hard work for reclaiming long uncultured Tilla land first time. No female labour is associated with this job.

In context to previous quantity of expenditure, Table 4.16.2 shows that the value of respective items. The total expenditure both for labour and material cost has been presented in the table. The per acre expenditure for establishment of rubber plantation comes as Rs.37619.4 for System 1, Rs..36557.61 for system 2, total cost, farmer need to pay Rs 39047.22 for System 3, Rs.47535.71 for System 4, need Rs. 37157.67 for System 5 and Rs.36948.03 for System 6 farmer. There are remains variations of cost from System to System and Block to Block.

After initial establishment the rubber plantation needs to be maintained for six years so as to attain her latex producing age at seventh year. During this period continuous intercultural operation is practiced though out the year. At this phase two times cleaning and one time fertilizer application is done. The components of cost structure are human labour, fertilizer and sapling. Again human labour has been divided into family and hired source. For application of fertilizer no extra labour is required.

Table 4.17.1 reveals the quantity aspect of said expenditure. It is observed that total engagement of human labour including family labour and hired labour together comes at labour 88.42 man days for System 1, 130.7 man days for System 2, 99.63 man days for System 3, 91.43 man days for System 4, 162.19 man days for System 5 and 67.63 man days for System 6. The wide differences of labour quantity among the systems represent the relative attention of farmer to the plantation. The said difference may be reduced by increasing of sample size also. Mere minimization of labour cost may not be taken as input use efficiency criteria. In case fertilizer application like difference is also observed. Farmers

Table no 4.17.1: Details about quantity of labour and other material inputs incurred for Rubber plantation during establishment phase per acre (Unit: Labour in mandays, Fertilizer in kg, Sapling in number)

System	Block	Material used								
		Cleaning 1		Cleaning 2		Total		Total labour	Fertiliser	Sapling replaced
		Family	Wage	Family	Wage	Family	Wage			
1	Kh	33.68	16.84	33.68	16.84	67.37	33.68	101.05	275.16	7.89
	Ts	22.46	19.65	0	0	44.91	39.3	84.21	248.16	5.83
	Total	25.26	18.95	8.42	4.21	50.53	37.89	88.42	254.9	6.35
2	Kh	160	80	160	80	320	160	480	400	12.5
	Ts	42.99	11.94	0	0	85.97	23.88	109.85	238.81	4.25
	Total	49.58	15.77	9.01	4.51	99.15	31.55	130.7	247.88	4.72
3	Kh	31.11	15.56	31.11	15.56	62.22	31.11	93.33	291.11	5.73
	Ts	32.94	23.53	0	0	65.88	47.06	112.94	273.53	4.41
	Total	31.7	18.11	21.13	10.57	63.4	36.23	99.63	285.47	5.31
4	Ts	45.71	0	0	0	91.43	0	91.43	158.57	6.43
	Total	45.71	0	0	0	91.43	0	91.43	158.57	6.43
5	Kh	320	160	320	160	640	320	960	208	0
	Pb	36.36	18.18	36.36	18.18	72.73	36.36	109.09	148.64	5.68
	Ts	71.11	23.7	0	0	142.22	47.41	189.63	201.11	7.41
	Total	56.99	24.11	30.68	15.34	113.97	48.22	162.19	95.28	6.16
6	Pb	23.09	10.72	23.09	10.72	46.19	21.44	67.63	166.49	3.22
	Total	23.09	10.72	23.09	10.72	46.19	21.44	67.63	166.49	3.22
	Total kh	37.45	18.72	37.45	18.72	74.89	37.45	112.34	289.32	6.25
	Total pb	25.55	12.1	25.55	12.1	51.09	24.2	75.29	163.19	3.68
	Total ts	35.05	18.66	0	0	70.11	37.31	107.42	245.34	5.28
	grandTotal	32.5	16.47	18.5	9.03	64.99	32.95	97.94	229.42	5.00

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.17.2: Details about value of labour and other material inputs incurred for Rubber plantation during establishment phase per acre (Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar) [unit in Rs.]

System	Block	Labour used									Material used					Total Cost
		Cleaning 1		Cleaning 2		Transplanting		Total		Total labour	Manure		Fertiliser	Sapling	Total material	
		Family	Wage	Family	Wage	Family	Wage	Family	Wage		Own	Purchased				
1	Kh	421.05	473.68	421.05	473.68	0	0	842.11	947.37	3578.95	0	0	6878.95	868.42	7747.37	11326.32
	Ts	736.84	614.04	736.84	614.04	0	0	1473.68	1228.07	5403.51	0	0	7444.74	641.67	8086.4	13489.91
	Total	657.89	578.95	657.89	578.95	0	0	1315.79	1157.89	4947.37	0	0	7303.29	698.36	8001.64	12949.01
2	Kh	3000	1500	3000	1500	0	0	6000	3000	18000	0	0	10000	1375	11375	29375
	Ts	1194.03	417.91	1194.03	417.91	0	0	2388.06	835.82	6447.76	0	0	7164.18	467.91	7632.09	14079.85
	Total	1295.77	478.87	1295.77	478.87	0	0	2591.55	957.75	7098.59	0	0	7323.94	519.01	7842.96	14941.55
3	Kh	902.78	458.33	902.78	458.33	0	0	1805.56	916.67	5444.44	0	0	7277.78	630.21	7907.99	13352.43
	Ts	941.18	647.06	941.18	647.06	0	0	1882.35	1294.12	6352.94	0	0	8205.88	485.29	8691.18	15044.12
	Total	915.09	518.87	915.09	518.87	0	0	1830.19	1037.74	5735.85	0	0	7575.47	583.73	8159.2	13895.05
4	Ts	1142.86	0	1142.86	0	0	0	2285.71	0	4571.43	0	0	4757.14	707.14	5464.29	10035.72
	Total	1142.86	0	1142.86	0	0	0	2285.71	0	4571.43	0	0	4757.14	707.14	5464.29	10035.72
5	Kh	8000	4000	8000	4000	0	0	16000	8000	48000	0	0	5200	0	5200	53200
	Pb	1090.91	500	1090.91	500	0	0	2181.82	1000	6363.64	0	0	3715.91	625	4340.91	10704.55
	Ts	1777.78	592.59	1777.78	592.59	0	0	3555.56	1185.19	9481.48	0	0	6033.33	814.81	6848.15	16329.63
	Total	1534.25	630.14	1534.25	630.14	0	0	3068.49	1260.27	8657.53	0	0	4613.7	678.08	5291.78	13949.31
6	Pb	556.7	329.9	556.7	329.9	0	0	1113.4	659.79	3546.39	0	0	4162.37	354.38	4516.75	8063.14
	Total	556.7	329.9	556.7	329.9	0	0	1113.4	659.79	3546.39	0	0	4162.37	354.38	4516.75	8063.14
Grand	Total	1017.09	422.78	1017.09	422.78	0	0	2034.18	845.57	5759.52	0	0	5955.98	590.11	6546.10	12305.63

are using 229.42 kg of fertilizer per acre regarding annual maintenance. Average 5 numbers of saplings also replaced annually during establishment phase.

Table 4.17.2 explains the annual maintenance expenditure during 2 – 6 year of gestation phase in value term. The value of total cost for labour and material come at Rs. 12949.01 for System 1 farmer, Rs. 14941.55 for System 2 farmer, Rs. 13895.05 for System 3farmer, Rs.10035.72 for System 4 farmer, Rs.13949.31 for System 5 farmer and Rs. 8063.14 for System 6 farmer. It noted that more number of family labour is engaged irrespective of Systems for maintenance work in plantation and the same has reduced paid out cost.

The capitalized value of standing rubber plantation at the end of sixth year has been calculated by adding 1st year establishment cost with five times of annual maintenance cost incurred by farmer. Here imputed value of family labour has been assumed paid out. Now five percent of this capitalized value has been considered as rental value of own rubber plantation for a year. It is assumed that the plantation will appreciate wood value during her life time and the said capitalized value will be accordingly recovered when the plantation will be felled. The details of such capitalized value of plantation and respective annual rental value of plantation has been explained in Table 4.18. It is observed that capitalized value of one acre rubber plantation comes at Rs. 98650.47 at the end of sixth year. Hence rental value of said plantation comes at Rs.4932.52. The said two figure varies farmer to farmer as per their own investment pattern. In present case the annual rental value varies from Rs. 3863.19 (System 6) to Rs.5563.27 (System 2).

As the tapping process starts, the farmer need to maintain the rubber plantation annually as a part of annual cost related to production. Details about annual maintenance cost of standing rubber plantation from the age of seventh year have been delineated in Table 4.19. It is observed that 14.89 man hour is required for annual maintenance of one acre plantation of which 8.12 goes to male family labour an amount of Rs. 1968.51 is incurred for total cost of which Rs. 216.50 is unpaid. The value of total maintenance cost varies from System to System as per information obtained from the farmer. However the share of family labour is low except a case of Khowai Block in System 5.

Engagement of human labour in man days for tapping of trees, collection of latex and making of sheet has been delineated in Table 4.20.1 and Table 4.20.2 for the season summer and winter. The aim of this table is to understand the potentiality of rubber farming in generations of employment. All types of labour has been accommodated for getting a clear

Table no 4.18: Details about valuation of own plantation per acre (unit in Rs.)

System	Block	Total establishment cost	Total Cost Annual	Aggregate cost	Total Value	Annual Rental Value
1	Khowai	38064.74	11326.32	56631.6	94696.34	4734.82
	Tulasikhar	37470.97	13489.91	67449.55	104920.5	5246.03
	Total	37619.4	12949.01	64745.05	102364.5	5118.22
2	Khowai	46000	29375	146875	192875	9643.75
	Tulasikhar	35993.88	14079.85	70399.25	106393.1	5319.66
	Total	36557.61	14941.55	74707.75	111265.4	5563.27
3	Khowai	39680.2	13352.43	66762.15	106442.4	5322.12
	Tulasikhar	37706.77	15044.12	75220.6	112927.4	5646.37
	Total	39047.22	13895.05	69475.25	108522.5	5426.12
4	Tulasikhar	38178.57	10035.72	50178.6	88357.17	4417.86
	Total	47535.71	10035.72	50178.6	97714.31	4885.71
5	Khowai	14750	53200	266000	280750	14037.5
	Padmabil	37120.92	10704.55	53522.75	90643.67	4532.18
	Tulasikhar	38877.42	16329.63	81648.15	120525.6	6026.28
	Total	37157.67	13949.31	69746.55	106904.2	5345.21
6	Padmabil	36948.03	8063.14	40315.7	77263.73	3863.19
	Total	36948.03	8063.14	40315.7	77263.73	3863.19
Grand total		37806.67	12168.76	60843.79	98650.47	4932.523

Table no 4.19: Annual Maintenance cost born by the farmer for rubber plantation per acre (unit in Rs.)

System	Block	Labour component								Material component		Total	Unpaid	Paid
		Family male		Wage male		Contract male		Total labour						
		Man hour	Value	Man hour	Value	Man hour	Value	Man hour	Value	Qty	Value	Value	Value	Value
1	Kh	8.42	105.26	4.21	118.42	4.21	118.42	16.84	342.11	68.79	1719.74	2061.84	105.26	1956.58
	Ts	5.61	184.21	4.91	153.51	1.05	35.09	11.58	372.81	62.04	1861.18	2233.99	184.21	2049.78
	Total	6.32	164.47	4.74	144.74	1.84	55.92	12.89	365.13	28.95	855.26	1220.39	164.47	1055.92
2	Kh	40.00	750.00	20.00	375.00	0.00	0.00	60.00	1125.00	100.00	2500.00	3625.00	750.00	2875.00
	Ts	10.75	298.51	2.99	104.48	4.18	100.75	17.91	503.73	59.70	1791.04	2294.78	298.51	1996.27
	Total	12.39	323.94	3.94	119.72	3.94	95.07	20.28	538.73	213.10	5654.93	6193.66	323.94	5869.72
3	Kh	7.78	225.69	3.89	114.58	0.00	0.00	11.67	340.28	72.78	1819.44	2159.72	225.69	1934.03
	Ts	8.24	235.29	5.88	161.76	0.59	11.03	14.71	408.09	68.38	2051.47	2459.56	235.29	2224.26
	Total	7.92	228.77	4.53	129.72	0.19	3.54	12.64	362.03	1.31	39.27	401.30	228.77	172.52
4	Ts	11.43	285.71	0.00	0.00	17.14	392.86	28.57	678.57	39.64	1189.29	1867.86	285.71	1582.14
	Total	11.43	285.71	0.00	0.00	17.14	392.86	28.57	678.57	442.36	12028.57	12707.14	285.71	12421.43
5	Kh	80.00	2000.00	40.00	1000.00	0.00	0.00	120.00	3000.00	52.00	1300.00	4300.00	2000.00	2300.00
	Pb	9.09	272.73	4.55	125.00	5.45	119.32	19.09	517.05	37.16	928.98	1446.02	272.73	1173.30
	Ts	17.78	444.44	5.93	148.15	13.33	259.26	37.04	851.85	50.28	1508.33	2360.19	444.44	1915.74
	Total	14.25	383.56	6.03	157.53	8.22	167.81	28.49	708.90	110.62	2765.41	3474.32	383.56	3090.75
6	Pb	5.77	139.18	2.68	82.47	2.89	114.69	11.34	336.34	41.62	1040.59	1376.93	139.18	1237.76
	Total	5.77	139.18	2.68	82.47	2.89	114.69	11.34	336.34	49.93	1430.54	1766.88	139.18	1627.71
Grand	Total	8.12	216.50	4.12	120.59	2.65	75.11	14.89	412.20	57.36	1556.31	1968.51	216.50	1752.01

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.20.1: Engagement of human labour per acre in different activity during summer season in man days

System	Block	Family male	Family female	Family total	Casual wage male	Contract wage male	Service male	Total hired male	Total labour
	Kh	29.44	17.56	47	9.57	0	0	9.57	56.58
	TS	23.65	9.76	33.4	7.45	0	0	7.45	40.85
	Sub Total	25.07	11.66	36.73	7.97	0	0	7.97	44.7
System1	%	56.09	26.09	82.17	17.83	0.00	0.00	17.83	100.00
	Kh	63.75	10.63	74.38	10.63	0	0	10.63	85
	TS	19.37	8.45	27.83	21.84	0	0	21.84	49.67
	Sub Total	22.09	8.57	30.66	21.1	0	0	21.1	51.76
System 2	%	42.68	16.56	59.23	40.77	0.00	0.00	40.77	100.00
	Kh	2.24	2.88	5.13	0	43.25	0	43.25	48.37
	TS	4.44	5.7	10.14	0	41.2	0	41.2	51.34
	Sub Total	2.98	3.83	6.82	0	42.6	0	42.6	49.42
System 3	%	6.03	7.75	13.80	0.00	86.20	0.00	86.20	100.00
	TS	18.21	4.55	22.77	0	0	4.55	4.55	27.32
	Sub Total	18.21	4.55	22.77	0	0	4.55	4.55	27.32
System4	%	66.65	16.65	83.35	0.00	0.00	16.65	16.65	100.00
	Kh	30	0	30	20	0	0	20	50
	Pb	14.73	0	14.73	7.36	0	0	7.36	22.09
	TS	6.23	0	6.23	12.48	0	0	12.48	18.71
	Sub Total	11.87	0	11.87	9.83	0	0	9.83	21.7
System 5	%	54.70	0.00	54.70	45.30	0.00	0.00	45.30	100.00
	Pb	7.59	0	7.59	15.18	0	0	15.18	22.77
	Sub Total	7.59	0	7.59	15.18	0	0	15.18	22.77
System 6	%	33.33	0.00	33.33	66.67	0.00	0.00	66.67	100.00
Grand total		11.96	4.55	16.51	8.99	12.74	0.04	21.77	38.28

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.20.2: Engagement of human labour per acre in different activity during winter season in man days

System	Block	Family male	Family female	Family total	Casual wage male	Contract wage male	Service male	Total hired male	Total labour
	Kh	53.14	30.92	84.06	14.16	0	0	14.16	98.22
	TS	41.01	18.28	59.29	11.9	0	0	11.9	71.2
	Sub Total	44.14	21.54	65.68	12.49	0	0	12.49	78.17
System1	%	56.47	27.56	84.02	15.98	0.00	0.00	15.98	100.00
	Kh	118.36	15.78	134.14	23.67	0	0	23.67	157.81
	TS	31.92	12.95	44.88	32.38	0	0	32.38	77.26
	Sub Total	36.72	13.12	49.84	31.92	0	0	31.92	81.75
System 2	%	44.92	16.05	60.97	39.05	0.00	0.00	39.05	100.00
	Kh	3.52	4.4	7.92	0	70.43	0	70.43	78.35
	TS	4.48	5.38	9.87	0	107.63	0	107.63	117.49
	Sub Total	3.84	4.73	8.57	0	82.7	0	82.7	91.27
System 3	%	4.21	5.18	9.39	0.00	90.61	0.00	90.61	100.00
	TS	35	17.5	52.5	0	0	13.13	13.13	65.63
	Sub Total	35	17.5	52.5	0	0	13.13	13.13	65.63
System4	%	53.33	26.66	79.99	0.00	0.00	20.01	20.01	100.00
	Kh	48.28	0	48.28	32.19	0	0	32.19	80.47
	Pb	19.89	0	19.89	9.94	0	0	9.94	29.83
	TS	9.37	0	9.37	18.76	0	0	18.76	28.13
	Sub Total	16.68	0	16.68	13.82	0	0	13.82	30.51
System 5	%	54.67	0.00	54.67	45.30	0.00	0.00	45.30	100.00
	Pb	11.64	0	11.64	23.28	0	0	23.28	34.91
	Sub Total	11.64	0	11.64	23.28	0	0	23.28	34.91
System 6	%	33.34	0.00	33.34	66.69	0.00	0.00	66.69	100.00
Grand total		19.54	7.52	27.05	13.66	24.73	0.13	38.52	65.58

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

picture of absorption. Table 4.20.1.showsthe human labour engaged during Summer season. The table shows that per acre plantation can engage required for system 1 to system 6 was 44.7 man days in System 1, 51.76 man days in System 2, 49.42 man days in System 3 , 27.32 man days in System 4, 21.7 man days in System 5 and 22.77 man days in System 6 . It is to note that in System 1, 82.17 percent labour is engaged from family and the figure are 59.23 per cent for system 2, 13.80 per cent in system 3, 83.35 percent in system 4, 54.70 percent in system 5 and 33.33 percent for system 6. Average number of man days generated during summer considering all the system comes at 38.28. In case of System 1 participation of female member is high in comparison to other system. But in case of system 3 the total hired labour percentage is high because in this system minimum work is done by family members, only contract hired laborer doing all the activities.

Table 4.20.2.shows that the engagement of human labour for different activities in one acre of plantation during winter season. Engagement of total man day from System 1 to System 6 comes at 78.17, 81.75, 91.27, 65.63, 30.51, and 34.91 respectively. In case of system 1 has engagement of family labour percentage are higher (84.02 per cent) compare to other System and in this system engagement of total hired labour is also less (15.98 percent) compared to other system. But in case of System 3 the total hired labour percentage is high (90.61 per cent) because this system is fully based on contract hired labour. Considering all the Systems togather 65.58 number of man days can be generated for one acre of rubber plantation during winter season of which 38.52 is hired.

Table 4.21.1.shows the value of human labour per acre in different activities during summer season as mentioned in Table 4.20.1. It is observed that average toal cost of human labour comprising all the Systems comes to the tune of Rs. 11370.63 per acre of which Rs. 6804.70 goes to hired labour category. The figure is Rs.11436.3, Rs.13750.21, Rs.16239, Rs.7285.71, Rs. 6515.02 and Rs.7102.51 respectively for System 1 to System 6. There exists variation between Blocks even in same group of farmers. The analysis reveals that there is a difference of efficiency towards engagement of labours in various activities.

Table 4.21 shows the value of human labour engaged during winter season. It is observed that average cost of total labour comes at Rs. 19308.87 during winter. The said figure varies from Rs. 9157.06 (System 4) to Rs. 29593.86 (System 2). The imputed value of family labour comes at Rs. 6990.90 of which Rs. 1767.52 goes in favor of female. In case of System 1 the family labour can maximize their value return to the tune of rs.16809.47 of which female labour can get share Rs. 5533.40. Labour engagement of Sheet making farmers

Table no 4.21.1: Value of human labour per acre in activities of tapping, latex collection and sheet making during summer season Rs in 2021 – 2022 price

System	Block	Family male	Family female	Family total	Casual wage male	Contract wage male	Service male	Total hired male	Total labour
	Kh	8008.81	4776.28	12785.09	2604.21	0	0	2604.21	15389.3
	TS	5891.1	2419.41	8310.51	1846.99	0	0	1846.99	10157.5
	Sub Total	6409.49	2994.57	9404.06	2032.24	0	0	2032.24	11436.3
System 1	%	56.05	26.18	82.23	17.77	0.00	0.00	17.77	100.00
	Kh	17850	2975	20825	2975	0	0	2975	23800
	TS	5114.51	2231.79	7346.29	5765.44	0	0	5765.44	13111.74
	Sub Total	5895.21	2273.68	8168.88	5581.32	0	0	5581.32	13750.21
System 2	%	42.87	16.54	59.41	40.59	0.00	0.00	40.59	100.00
	Kh	681.72	876.49	1558.21	0	13147.41	0	13147.41	14705.62
	TS	1490.75	1916.68	3407.44	0	15820.24	0	15820.24	19227.67
	Sub Total	954.25	1226.89	2181.13	0	14058.08	0	14058.08	16239.21
System 3	%	5.88	7.56	13.43	0.00	86.57	0.00	86.57	100.00
	TS	5828.57	1457.14	7285.71	0	0	0	0	7285.71
	Sub Total	5828.57	1457.14	7285.71	0	0	0	0	7285.71
System 4	%	80.00	20.00	100.00	0.00	0.00	0.00	0.00	100.00
	Kh	7920	0	7920	5280	0	0	5280	13200
	Pb	4242.55	0	4242.55	2119.64	0	0	2119.64	6362.2
	TS	2043.89	0	2043.89	4092.59	0	0	4092.59	6136.47
	Sub Total	3496.88	0	3496.88	3018.14	0	0	3018.14	6515.02
System 5	%	53.67	0.00	53.67	46.33	0.00	0.00	46.33	100.00
	Pb	2366.83	0	2366.83	4735.69	0	0	4735.69	7102.51
	Sub Total	2366.83	0	2366.83	4735.69	0	0	4735.69	7102.51
System 6	%	33.32	0.00	33.32	66.68	0.00	0.00	66.68	100.00
Gtand total		3315.01	1250.92	4565.93	2601.16	4203.54	0.00	6804.70	11370.63

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.21.2: Value of human labour per acre in activities of tapping, latex collection and sheet making during winter season Rs in 2021 – 2022 price

System	Block	Family male	Family female	Family total	Casual wage male	Contract wage male	Service male	Total hired male	Total labour
	Kh	14453.49	8410.53	22864.02	3852.02	0	0	3852.02	26716.04
	TS	10171.57	4533.12	14704.7	2951.69	0	0	2951.69	17656.39
	Sub Total	11276.07	5533.4	16809.47	3183.91	0	0	3183.91	19993.38
System 1	%	56.40	27.68	84.08	15.92	0.00	0.00	15.92	100.00
	Kh	33140.63	4418.75	37559.38	6628.13	0	0	6628.13	44187.5
	TS	8427.45	2753.63	11181.08	8549.59	0	0	8549.59	19730.67
	Sub Total	9800.09	2846.99	12647.09	8446.55	0	0	8446.55	21093.63
System 2	%	46.46	13.50	59.96	40.04	0.00	0.00	40.04	100.00
	Kh	1070.54	1338.18	2408.73	0	21410.89	0	21410.89	23819.61
	TS	0	0	0	0	41328	0	41328	41328
	Sub Total	718.34	897.93	1616.27	0	27977.58	0	27977.58	29593.86
System 3	%	2.43	3.03	5.46	0.00	94.54	0.00	94.54	100.00
	TS	11200	2800	14000	0	0	0	0	14000
	Sub Total	11200	2800	14000	0	0	0	0	14000
System 4	%	80.00	20.00	100.00	0.00	0.00	0.00	0.00	100.00
	Kh	12746.25	0	12746.25	8497.5	0	0	8497.5	21243.75
	Pb	5728.16	0	5728.16	2861.87	0	0	2861.87	8590.03
	TS	3073.25	0	3073.25	6153.74	0	0	6153.74	9226.99
	Sub Total	4914.97	0	4914.97	4242.09	0	0	4242.09	9157.06
System 5	%	53.67	0.00	53.67	46.33	0.00	0.00	46.33	100.00
	Pb	3629.52	0	3629.52	7262.16	0	0	7262.16	10891.67
	Sub Total	3629.52	0	3629.52	7262.16	0	0	7262.16	10891.67
System 6	%	33.32	0.00	33.32	66.68	0.00	0.00	66.68	100.00
Grand total		5223.38	1767.52	6990.90	3952.31	8365.66	0.00	12317.97	19308.87

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.22: Total use value of implements and ingredients used by the farmer summer and winter seasons per acre (Rs)

System	Block	Tamplet	Knief	Nali	Cup	Bucket	Drum	Tray	Acid	Hanger	Bambo	Rope	Total
1	Kh	2.76	93.75	99.38	126.40	42.29	30.74	381.91	302.63	168.59	15.79	7.89	1272.13
	ts	1.58	100.00	93.75	121.37	35.07	35.62	444.08	426.97	161.82	22.37	14.91	1457.54
	sub total	1.88	98.44	95.16	122.63	36.88	34.40	428.54	395.89	163.52	20.72	13.16	1411.22
2	Kh	8.75	356.25	142.50	172.73	125.50	98.00	632.81	718.75	231.56	50.00	25.00	2561.85
	ts	2.24	106.34	98.90	116.72	47.98	41.42	409.70	418.66	150.92	27.43	18.28	1438.59
	sub total	2.61	120.42	101.36	119.88	52.35	44.61	422.27	435.56	155.46	28.70	18.66	1501.87
3	Kh	2.19	98.96	103.41	133.30	49.27	46.93	413.28	405.30	175.28	21.88	10.94	1460.72
	ts	3.97	115.26	108.97	133.54	56.84	48.77	800.74	509.56	177.08	31.99	21.32	2008.03
	sub total	2.76	104.19	105.19	133.38	51.70	47.52	537.56	438.74	175.86	25.12	14.27	1636.27
4	ts	4.29	101.79	61.07	77.70	57.14	58.24	723.21	275.00	154.38	21.43	14.29	1548.54
	sub total	4.29	101.79	61.07	77.70	57.14	58.24	723.21	275.00	154.38	21.43	14.29	1548.54
5	Kh	17.50	356.25	71.25	95.55	125.50	98.00			154.38			918.43
	pb	4.55	97.16	89.06	108.50	49.89	42.23			145.60			536.98
	ts	5.56	131.94	79.17	98.54	58.37	42.69			137.22			553.49
	sub total	5.27	117.12	84.91	104.46	55.10	43.93			142.74			553.54
6	pb	2.27	95.49	96.22	122.03	40.94	40.61			161.14			558.71
	sub total	2.27	95.49	96.22	122.03	40.94	40.61			161.14			558.71
Grand	Total	2.69	103.51	97.68	123.09	46.05	42.26	302.04	262.39	163.52	15.04	9.10	1167.37

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

(system 1 to system 4) are apparently double than latex selling farmers (system 5 and system 6).

Rubber farmer has to undertake a series of activities like tapping of tree, collection of latex, making of dough, making of raw sheet and finally drying of sheet . For doing the said activities good number of small implements and utensils like Tamplet, Knief, Nali, Cup, Bucket, Drum, Tray, Hanger, Bamboo and Rope are required. The life such implement and utensils are seasonal. Use value of such items has been calculated through straight line depreciation method and explained in Table 4.22. It is to mention that farmer has use acid for coagulating the latex , hence the cost of acid has also been accommodated in said table although it is exhaustive. The analysis reveals that the aggregate use value of these implements for a working season come at Rs. 1411.22 , Rs.1501.87, Rs.1636.27, Rs.1548.54, Rs. 553.54 and Rs.558.71 for System 1, System 2, System 3, System 4, System 5 and System 6 farmers respectively. It is to note that the cost incurred by Sheet selling farmer becomes three times more than cost made by latex selling farmer. There remains inter group variation that may be taken as optional on part of farmer.

Sheet making is practiced on in two Blocks in study are namely Khowai and Tulasikhar. A separate analysis of cost has been made to better understand the making of raw sheet from dough. Hence only the Sheet making farmers of System 1, System 2, System 3 and System 4 has been taken in account. Table 4.23.1 and Table 4.23.2 explain the results for summer and winter seasons. Raw rubber sheet is made from latex dough by pressing the later in hand operated roller. Hence farmer has to incur two types of cost namely cost for manual labour and rent for using roller. In case of System 1 farmer makes sheet in own roller and thus he need not pay the roller rent. In System 2 and System 3 farmer has to bear rent for roller but the manual labour is born by farmer and contract labour respectively. In case of System 4 farmer has to pay roller charge along with charge for manual labour provided by service roller. According to Table 4.23.1 average number of sheet produced to the tune of 795.72, 926.13, 812.19, 572.86 and 821.04 respectively by System 1, System 2, System 3 and System 4 farmers during summer season. On an average, farmers produced 821.04 number of sheet from one acre of land which costs Rs. 1764.34 only. There is variation of cost among the Systems as the number of Sheet varies.

The result of Sheet making activity has been explained in Table 4.23.2 for the season winter. It is observed that farmer produces 1678.88 number of rubber sheet on an average from one acre of plantation during winter season with a costing Rs. 3638.78. In case of

Table no 4.23.1: Cost incurred for pressing of sheet in summer per acre (Unit: Sheet in number, Value in Rs.)

Block	Own labour own roller (S1)		Own labour rented roller (S2)		Contract labour rented roller (S3)		Service labour service roller (S4)		Total respondent	
	Total sheet	Imputed value of sheet	Total sheet	Value of Sheet	Total sheet	Value of sheet	Total sheet	Value of sheet	Total sheet	Value of Sheet
Khowai	340.13	850.33	487.50	1218.75	535.87	1339.67			494.84	1237.10
Tulasikhar	947.59	2.00	952.31	2.00	1397.35	2794.71	572.86	2291.43	1058.05	2147.42
Total	795.72	2.05	926.13	2.01	812.19	1806.38	572.86	2291.43	821.04	1764.34

Table no 4.23.2: Cost incurred for pressing of sheet in winter per acre (Unit: Sheet in number, Value in Rs.)

Block	Own labour own roller (S1)		Own labour rented roller(S2)		Contract labour rented roller (S3)		Service labour service roller (S4)		Total respondent	
	Total sheet	Imputed Value of sheet	Total sheet	Value of sheet	Total sheet	Value of sheet	Total sheet	Value of sheet	Total sheet	Value of Sheet
Khowai	736.32	1840.79			1179.24	2948.09			1087.23	2718.08
Tulasikhar	1990.26	3980.53	1725.30	3450.60	2732.35	5464.71	1650	6600	2108.75	4307.73
Total	1676.78	3445.59	1690.56	3412.36	1677.41	3755.31	1650	6600	1678.88	3638.78

Table no 4.24: Total Annual cost for all activities per acre (Rs)

System	Block	Tapping and sheet making imputed family labour cost	Tapping and sheet making hired labour cost	Plantation maintenance family labour cost	Plantation maintenance hired labour and input cost	Annual depreciation cost for implement and acid cost	Cost of pressing sheet		Annual rental value	Total Paid out cost	Total cost
							Unpaid	Paid			
System 1	Kh	35649.11	6456.23	105.26	1956.58	2544.27	2691.12		4734.82	10957.08	54137.39
	TS	23015.21	4798.68	184.21	2049.78	2915.11	5875.70		5246.03	9763.57	44084.72
	Sub Total	26213.53	5216.14	164.47	1055.92	2822.40	5079.56		5118.22	9094.46	45670.24
System 2	Kh	58384.38	9603.13	750.00	2875.00	5123.70		3990.63	9643.75	21592.45	90370.58
	TS	18527.37	14315.04	298.51	1996.27	2877.18		5355.22	5319.66	24543.71	48689.25
	Sub Total	20815.96	14027.87	323.94	5869.72	3003.75		5278.35	5563.27	28179.68	54882.86
System 3	Kh	3966.94	34558.30	225.69	1934.03	2921.45		4287.76	5322.12	43701.53	53216.29
	TS	3407.44	57148.24	235.29	2224.26	4016.06		8259.41	5646.37	71647.97	80937.11
	Sub Total	3797.41	42035.68	228.77	172.52	3272.55		5561.69	5426.12	51042.43	60494.73
System 4	TS	21285.71	0.00	285.71	1582.14	3097.07		8891.43	4417.86	13570.64	39559.93
	Sub Total	21285.71	0.00	285.71	12421.43	3097.07		8891.43	4885.71	24409.93	50867.07
System 5	Kh	20666.25	13777.50	2000.00	2300.00	1836.85			14037.5	17914.35	54618.1
	Pb	9970.71	4981.52	272.73	1173.30	1073.97			4532.18	7228.78	22004.4
	TS	5117.14	10246.32	444.44	1915.74	1106.98			6026.28	13269.04	24856.91
	Sub Total	8411.85	7260.23	383.56	3090.75	1107.08			5345.21	11458.06	25598.68
System 6	Pb	5996.35	11997.84	139.18	1237.76	1117.41			3863.19	14353.01	24351.72
	Sub Total	5996.35	11997.84	139.18	1627.71	1117.41			3863.19	14742.96	24741.67
Grand total		11556.83	19122.67	216.50	1752.01	2334.73	3368.36	4932.52	11556.83	25488.79	43283.65

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

individual System the number comes at 1676.78, 1690.56, 1677.41, and 1650 and the sheet making charge comes at Rs 3445.59, Rs. 3412.36, Rs.3755.31 and Rs. 6600 for System 1 to System 4 farmers respectively. The doubling charge for System 6 farmer is due to use of service roller where farmer need not give his own manual labour for making Sheet.

To understand the nature of all different types of cost in a common frame an attempt has been made to accommodate all associated costs made by different system category of farmers. Out of the given set segregation has also made to find paid out cost and total cost. The result has been explained in Table 4.24. The subjective classification of costs has been made on Imputed value of family labour in tapping to sheet processing, actual value of hired labour for tapping to sheet processing, imputed value of family labour in maintenance of plantation, actual value of hired labour in maintenance of plantation along with input cost, annual depreciation cost for own implements and utensils, cost of pressing sheet and rental value of own standing plantation. The given cost items are then grouped into paid out costs to understand return of family investment separately. It is observed that on an average farmer has to incur Rs. 43283.65 annually for running activities in one acre of rubber plantation of which Rs. 25488.79 is paid out. Farmers usually consider this paid out cost as his notional expenditure. The paid out cost varies from Rs.9094.46 (System 1 farmer) to Rs. 54882.82 (System 2 farmer) according to degree of involvement of family members in rubber farming. The difference between total costs to paid out cost is minimum for System 3 farmer because the total tapping to sheet making activity is done by contract labour. The positive side of this aspect is apart from family involvement rubber farming is potentially creating employment to farming society with due consistency when crop farming is indecisively uncertain.

The category wise gross return obtained by farmer has been explained in Table 4.25. There are four sources of return like selling of scrap latex, selling of rubber sheet, selling of liquid latex and net return over rent out receipt from own roller. The System 1 can enjoy all forms except selling of liquid latex. System 2, System3 and System 4 farmers can enjoy scrap and sheet selling and while System 5 and System 6 farmer can enjoy scrap and latex selling only. Under the given perspective gross return obtained by System 1 farmers comes at Rs. 145924.40 from all possible sources. The figures are Rs. 142593.3 for System 2 farmer, Rs 214364.6 for System 3 farmer, Rs.111210.00 for System 4 farmer, Rs. 89325.49 for System 5 farmer and Rs. 175535.70 for System 6 farmer. The reason behind best performance by System 3 farmer may be due to over exploitation of standing trees by contract laborer.

Table no 4.25: Annual Gross return obtained from different types of output per acre (Rs)

System	Block	Gross Return from latex and sheet			Net return obtained from roller	Total Gross Return obtained per acre
		Scrap form	Sheet form	Latex form		
1	Kh	8037.32	96918.62		658.32	105614.30
	Ts	7711.65	146887.90		2831.51	157431.10
	Total	9240.64	134395.50		2288.22	145924.40
2	Kh	9690.25	136372.10			146062.40
	Ts	7416.24	135343.10			142759.30
	Total	7192.24	135401.10			142593.30
3	Kh	8467.62	149359.20			157826.80
	Ts	8481.54	205883.10			214364.60
	Total	6747.27	167489.50			174236.80
4	Ts	4936.85	106273.10			111210.00
	Total	4936.85	106273.10			111210.00
5	Kh	6071.00		70725.00		76796.00
	Pb	6893.56		88162.34		95055.90
	Ts	6261.26		74653.89		80915.15
	Total	6637.16		82688.33		89325.49
6	Pb	7756.05		167779.60		175535.70
	Total	7756.05		167779.60		175535.70
Grand	Total	147924.90	4767.56	2805.62	490.56	155988.70

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

Table no 4.26: Annual net return obtained by farmer from all activities per acre (Rs)

System	Block	Gross Return	Paid out cost	Total cost	Net return over paid out cost	Net return over total cost	Return – paid out cost ratio	Return - total cost ratio
1	Kh	105614.30	10957.08	54137.39	94657.22	51476.91	9.64	1.95
	Ts	157431.10	9763.57	44084.72	147667.50	113346.40	16.12	3.57
	Total	145924.40	9094.46	45670.24	136829.90	100254.20	16.05	3.20
2	Kh	146062.40	21592.45	90370.58	124470.00	55691.82	6.76	1.62
	Ts	142759.30	24543.71	48689.25	118215.60	94070.05	5.82	2.93
	Total	142593.30	28179.68	54882.86	114413.60	87710.44	5.06	2.60
3	Kh	157826.80	43701.53	53216.29	114125.30	104610.50	3.61	2.97
	Ts	214364.60	71647.97	80937.11	142716.60	133427.50	2.99	2.65
	Total	174236.80	51042.43	60494.73	123194.40	113742.10	3.41	2.88
4	Ts	111210.00	13570.64	39559.93	97639.36	71650.07	8.19	2.81
	Total	111210.00	24409.93	50867.07	86800.07	60342.93	4.56	2.19
5	Kh	76796.00	17914.35	54618.10	58881.65	22177.90	4.29	1.41
	Pb	95055.90	7228.78	22004.40	87827.12	73051.50	13.15	4.32
	Ts	80915.15	13269.04	24856.91	67646.11	56058.24	6.10	3.26
	Total	89325.49	11458.06	25598.68	77867.43	63726.81	7.80	3.49
	Pb	175535.70	14353.01	24351.72	161182.70	151184.00	12.23	7.21
6	Total	175535.70	14742.96	24741.67	160792.70	150794.00	11.91	7.09
Grand	Total	155988.70	50900.55	86475.65	105088.20	69513.05	6.10	3.57

Kh: Khowai, Pb: Padmabil, Ts: Tulashikhar

The outcome of this study has been summarized in Table 4.26. The table examines annual net return obtained by farmer over their paid out cost and total cost along with return cost ration in respective system category. It is observed that from rubber farming on one acre of land the respondent farmers could earn Rs. 155988.70 as a gross return over the year. The farmer has to incur Rs. 86475.65 as total cost of which Rs. 50900.55 is paid out. Thus farmer could save Rs. 35575.10 by utilizing family labour. The later may also be recognized as imputed earning of family labour from rubber activity. The net return over total cost comes at Rs.69513.05 with a return cost ratio 3.57: 1. This implies that rubber farming is a profitable enterprise in comparison to other land use activity. In present case it seems golden opportunity before the farmer to utilize their tilla land remained uncultured for a long period of time. The net return obtained over paid out cost comes at Rs. 105088.20 with a return cost ratio 6.10: 1. The result is overwhelming to marginal and small farmer who could get this opportunity. In case of System 1 farmer said ratio is 16.05:1. The study asserts that expansion of rubber plantation in Tripura will increase in future.

A separate study has been conducted to understand the performance of rubber sheet making roller which acts as the basic support for sheet making. System 1 farmers have their own roller to make sheet but the other three types of sheet producing farmers have to depend on rented roller. On the other hand there are some members who produce rubber sheet from purchased latex. Both of this two types of roller owner use the roller for producing own sheet from own latex or purchased latex and besides that they rent out the roller to other farmers who has no roller. In this way possession of own roller is also become a business pursuit. To know the economics behind this roller use, the study has been extended to another 4 respondents who are making sheet from purchased latex but in own roller. Hence the present analysis is under taken with 13 number of respondents of whom 9 are using latex from own plantation (actually System 1 farmers of main study) and 4 others who are using latex from purchased source.

The study of use of roller has been presented through Table 4.27.1 to Table 4.27.3. The employment and income generated by installation of own processing unit during summer season has been explained in Table 4.27.1. The data has been presented in the form of average value of per processing unit. It is observed that a processing unit could process 6874.62 numbers of sheets for the whole season of which 4018.46 numbers is her own. Rest 2856.15 numbers of sheets has been processed by other farmer giving the rental charge to owner. On an average 1.46 number of male and 1.08 number of female family members are

Table no 4.27.1: Cost for installation and maintenance of own processing unit per processor (Annual) (Unit in Rs)

Block	Category	Number	Cost for roller				Cost for housing shade				Total annual cost
			Installation value	Annual depreciation	Annual maintenance	Annual cost	New value	Annual depreciation	Annual maintenance	Annual cost	
Khowai	Own latex	3	56100.00	5049.00	1000.00	6049.00	42366.67	2012.42	500.00	2512.42	8561.42
	Purchased latex	1	52000.00	4680.00	1000.00	5680.00	35400.00	1681.50	500.00	2181.50	7861.50
	Total	4	55075.00	4956.75	1000.00	5956.75	40625.00	1929.69	500.00	2429.69	8386.44
Tulasikhar	Own latex	6	63700.00	5733.00	1000.00	6733.00	46166.67	2192.92	500.00	2692.92	9425.92
	Purchased latex	3	62333.33	5610.00	1000.00	6610.00	40000.00	1900.00	500.00	2400.00	9010.00
	Total	9	63244.44	5692.00	1000.00	6692.00	44111.11	2095.28	500.00	2595.30	9287.28
Total	Own latex	9	61166.67	5505.00	1000.00	6505.00	44900.00	2132.75	500.00	2632.75	9137.72
Total	Purchased latex	4	59750.00	5377.50	1000.00	6377.50	38850.00	1845.37	500.00	2345.37	8722.87
Grand	Total	13	60730.77	5465.77	1000.00	6465.77	43038.46	2044.33	500.00	2544.33	9010.10

Table no 4.27.2.1: Employment and income generated by installation of own processing unit per processor (Summer season)

Block	Category	Number of respondent	Volume of business done			Person involved		Rent for roller			Imputed value of family labour for own sheet	Gross return received	
			Own sheet	Rented sheet	Total sheet	Male	Female	Own sheet	Rented sheet	Total sheet		Actual	Nominal
Khowai	Own latex	3	861.67	1651.67	2513.33	1.33	1.00	2154.17	4129.17	6283.33	1723.34	4129.17	8006.67
	Purchased latex	1	4410.00	1680.00	6090.00	2.00	1.00	11025.00	4200.00	15225.00	8820.00	4200.00	24045.00
	Total	4	1748.75	1658.75	3407.50	1.50	1.00	4371.88	4146.88	8518.75	3497.50	4146.88	12016.25
Tulasikhar	Own latex	6	3600.83	3572.50	7173.33	1.33	1.00	7201.67	7145.00	14346.67	7201.66	7145.00	21548.33
	Purchased latex	3	7880.00	3020.00	0	1.67	1.33	15760.00	6040.00	21800.00	15760.00	6040.00	37560.00
	Total	9	5027.22	3388.33	8415.56	1.44	1.11	10054.44	6776.67	16831.11	10054.44	6776.67	26885.55
Total	Own latex	9	2687.78	2936.67	5624.44	1.33	1.00	2687.78	6139.72	8827.50	5375.56	6139.72	14203.06
	Purchased latex	4	7012.50	2685.00	9697.50	1.75	1.25	8115.00	5580.00	13695.00	14025.00	5580.00	27720.00
	Total	13	4018.46	2856.15	6874.62	1.46	1.08	4357.69	5967.50	10325.19	8036.92	5967.50	18362.11

Table no 4.27.2.2: Employment and income generated by installation of own processing unit per processor (Winter season)

Block	Category	Number of respondent	Volume of business done			Person involved		Rent for roller			Imputed value of family labour for own sheet	Gross return received	
			Own sheet	Rented sheet	Total sheet	Male	Female	Own sheet	Rented sheet	Total sheet		Actual	Nominal
Khowai	Own latex	3	1865.33	2440	4305.33	1.33	1	4663.33	6100	10763.33	3730.66	6100	14493.99
	Purchased latex	1	7140	3150	10290	2	1	17850	7875	25725	14280	7875	40005
	Total	4	3184	2617.5	5801.5	1.5	1	7960	6543.75	14503.75	6368	6543.75	20871.75
Tulasikhar	Own latex	6	45378	6520.33	14083.33	1.33	1	15126	13040.67	28166.67	90756	13040.67	118922.7
	Purchased latex	3	42630	5530	19740	1.67	1.33	28420	11060	39480	85260	11060	124740
	Total	9	9778.67	6190.22	15968.89	1.44	1.11	19557.33	12380.44	31937.78	19557.34	12380.44	51495.12
Total	Own latex	9	5663.78	5160.22	10824	1.33	1	5663.78	10727.11	16390.89	11327.56	10727.11	27718.45
	Purchased latex	4	12442.5	4935	17377.5	1.75	1.25	12442.5	10263.75	22706.25	24885	10263.75	47591.25
	Total	13	7749.54	5090.92	12840.46	1.46	1.08	7749.54	10584.54	18334.08	15499.08	10584.54	33833.16

Unit: Sheet in number, Value in Rs.

Table no 4.27.3: Income generated by installation of own processing unit per processor (Annual) (Unit in Rs)

Block	Category	Number of respondent	Gross return received						Annual cost	Annual net income	
			Summer season		Winter season		Annual total				
			Actual	Nominal	Actual	Nominal	Actual	Nominal		Actual	Nominal
Khowai	Own latex	3	4129.17	8006.67	6100.00	14493.99	10229.17	22500.66	8561.42	1667.75	13939.24
	Purchased latex	1	4200.00	24045.00	7875.00	40005.00	12075.00	64050.00	7861.50	4213.50	56188.50
	Total	4	4146.88	12016.25	6543.75	20871.75	10690.63	32888.00	8386.44	2304.19	24501.56
Tulasikhar	Own latex	6	7145.00	21548.33	13040.67	118922.70	20185.67	140471.03	9425.92	10759.75	131045.11
	Purchased latex	3	6040.00	37560.00	11060.00	124740.00	17100.00	162300.00	9010.00	8090.00	153290.00
	Total	9	6776.67	26885.55	12380.44	51495.12	19157.11	78380.67	9287.28	9869.83	69093.39
Total	Own latex	9	6139.72	14203.06	10727.11	27718.45	16866.83	41921.51	9137.72	7729.11	32783.79
	Purchased latex	4	5580.00	27720.00	10263.75	47591.25	15843.75	75311.25	8722.88	7120.88	66588.38
	Total	13	5967.50	18362.11	10584.54	33833.16	16552.04	52195.27	9010.10	7541.94	43185.17

Unit: Sheet in number, Value in Rs.

associated with processing of own sheet for which they earned Rs. 8036.92 as imputed value of their work. The cash receipt from rental charge comes at Rs. 5967.50. However considering all forms of return i.e. imputed rental value of own sheet processing, imputed value of family labour and cash receipt from rented sheet the nominal gross return comes at Rs. 18362.11 for the season.

The same analysis has been made for winter season in Table 4.27.2. Here the processing unit has processed 12840.46 number of sheets of which 7749.54 was for own purpose. The processing unit could earn Rs. 10584.54 from renting out of own roller against a gross nominal gain of Rs. 33833.16 by imputing own family gain.

The net return received by the processing unit combining summer and winter together has been depicted in Table 4.27.3. The annual cost of processing unit has been worked out by taking into consideration of annual depreciation cost of roller and processing shade along with annual maintenance cost borne by the farmer. It is observed that average annual cost of unit comes to Rs. 9010.10 against cash earning of Rs. 16552 from rental charge. Hence the unit can easily manage their cost of depreciation and maintenance from earning from rent only. Thus the unit can enjoy actual net return Rs. 7541.94 from rent only. If the imputed value of own activities be considered the unit can earn nominal net return Rs. 43185.17 as a rational gain.

The constraints faced by rubber farmer have been delineated in Table 4.28.1 to Table 4.28.4. Eleven number of constrain issues have been identified at the time of pilot survey by the researcher. Accordingly each responding farmer was requested to rank the given constraints by his own experience. The ranking obtained from farmer has been analysis through Garrett ranking procedure. It is found that breaking of trees due to high wind comes as a topmost constraint by all farmers. The response may be justified from the observation made in Table 4.7 where survival percentage of effective number of latex giving trees comes down to 80.28 percent only. Farmer could not replace the broken trees which have been shown in Table 4.5.1 to Table 4.5.3. Non availability of institutional loan comes as second constraint at Block level but that goes in third ranking at district level. In case of district level increase of wage rate of hired labour has come as second rank which again goes in third rank in Block level. Price latex and sheet comes as fourth important constraint issue commonly at District and Block level. Low price of latex and sheet and high price of sapling have also been mentioned by farmers in their core group of constraints.

Table no. 4.28.1: Ranking of constraints given by rubber farmer of Khowai Block

Garrett score of constraints

Sl. no.	Constraints	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7	Rank 8	Rank9	Rank10	Rank 11	Total score	Final rank
1	Breaking of trees	656	142	256	0	0	0	0	0	0	0	0	1054	1
2	Labour wage increase day by day	82	213	256	295	0	0	45	0	0	0	0	891	3
3	High rate of sapling	0	213	0	118	108	200	90	40	0	0	0	769	5
4	No loan from government side	328	284	128	59	54	100	0	0	0	0	0	953	2
5	Quality of sapling is not good	0	0	0	118	0	0	225	120	140	0	0	603	8
6	Prices of different inputs are increased	0	0	64	118	486	100	0	0	0	0	0	768	6
7	Latex/ sheet prices not increased	82	142	192	59	108	200	45	0	0	0	0	828	4
8	No financial help from govt. During losses	0	0	0	59	0	100	180	160	105	0	0	604	7
9	Non availability of electricity	0	0	0	0	0	0	0	0	35	140	136	311	11
10	Collection problem due to high rain	0	0	0	0	0	0	45	240	210	28	0	523	9
11	Collection problem due to darkness in winter season	0	0	0	0	0	0	0	0	0	224	102	326	10

Table no. 4.28.2: Ranking of constraints given by rubber farmer of Padmabil Block

Garrett score of constraints

Sl. no.	Constraints	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7	Rank 8	Rank9	Rank10	Rank 11	Total score	Final rank
1	Breaking of trees	820	213	192	0	0	0	0	0	0	0	0	1225	1
2	Labour wage increase day by day	246	497	384	0	0	0	0	0	0	0	0	1127	2
3	High rate of sapling	0	0	0	59	162	400	180	0	0	0	0	801	5
4	No loan from government side	246	355	448	59	0	0	0	0	0	0	0	1108	3
5	Quality of sapling is not good	0	0	0	59	216	0	225	160	70	0	0	730	8
6	Prices of different inputs are increased	0	0	0	59	54	300	135	160	35	0	0	743	6
7	Latex/ sheet prices not increased	0	0	0	354	378	50	45	40	0	0	0	867	4
8	No financial help from govt. During losses	0	0	0	0	54	0	135	200	245	0	0	634	9
9	Non availability of electricity	0	0	0	0	0	0	0	40	140	168	85	433	10
10	Collection problem due to high rain	0	71	0	354	108	50	0	0	35	84	34	736	7
11	Collection problem due to darkness in winter season	0	0	0	0	0	0	0	0	0	196	153	349	11

Table no. 4.28.3: Ranking of constraints given by rubber farmer of Tulasikhar Block

Garrett score of constraints

Sl. no.	Constraints	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7	Rank 8	Rank9	Rank10	Rank 11	Total score	Final rank
1	Breaking of trees	1066	213	320	59	0	0	0	0	0	0	0	1658	1
2	Labour wage increase day by day	246	710	448	59	0	50	0	0	0	0	0	1513	3
3	High rate of sapling	0	71	192	236	324	250	45	0	70	0	0	1188	4
4	No loan from government side	410	426	384	295	0	0	0	0	0	0	0	1515	2
5	Quality of sapling is not good	0	0	0	59	378	300	180	40	70	28	0	1055	6
6	Prices of different inputs are increased	0	0	0	0	216	400	270	120	35	0	0	1041	7
7	Latex/ sheet prices not increased	0	0	0	413	270	50	225	160	0	0	0	1118	5
8	No financial help from govt. During losses	0	0	0	0	108	100	135	360	140	28	17	888	9
9	Non availability of electricity	0	0	0	0	0	0	0	120	210	112	153	595	10
10	Collection problem due to high rain	82	142	64	177	0	0	0	80	245	84	51	925	8
11	Collection problem due to darkness in winter season	0	0	0	0	0	0	0	0	0	364	153	517	11

Table no. 4.28.4: Ranking of constraints given by total rubber farmer

Garrett score of constraints:

Sl. no.	Constraints	Rank1	Rank2	Rank3	Rank4	Rank5	Rank6	Rank7	Rank 8	Rank9	Rank10	Rank 11	Total score	Final rank
1	Breaking of trees	2542	568	768	59	0	0	0	0	0	0	0	3937	1
2	Labour wage increase day by day	574	1420	1088	354	0	50	45	0	0	0	0	3531	3
3	High rate of sapling	0	284	192	413	594	850	315	40	70	0	0	2758	5
4	No loan from government side	984	1065	960	413	54	100	0	0	0	0	0	3576	2
5	Quality of sapling is not good	0	0	0	236	594	300	630	320	280	28	0	2388	7
6	Prices of different inputs are increased	0	0	64	177	756	800	405	280	70	0	0	2552	6
7	Latex/ sheet prices not increased	82	142	192	826	756	300	315	200	0	0	0	2813	4
8	No financial help from govt. During losses	0	0	0	59	162	200	450	720	490	28	17	2126	9
9	Non availability of electricity	0	0	0	0	0	0	0	160	385	420	374	1339	10
10	Collection problem due to high rain	82	213	64	531	108	50	45	320	490	196	85	2184	8
11	Collection problem due to darkness in winter season	0	0	0	0	0	0	0	0	0	784	408	1192	11

Summary and Conclusion

The study was under taken for the period of February 2021 to January 2022 .Total 52 farmers were selected from three rubber producing Blocks of Khowai district of Tripura. It deals with a research question on economic performance of Natural Rubber (*Hevea brasiliensis*) with three basic objectives on production system, cost and return analysis and identification constraints at farm level.

The rubber plant (*Hevea brasiliensis*) was first brought to Tripura by the Forest Department in 1963 for conservation of soil moisture. The tribal farmers were advised to give up Jhum cultivation and go for natural rubber with government subsidy. Thus establishmentof rubber plantation in tila land by private owner got state patronage at its initial phase andthe farming of natural rubber has emerged as a potential livelihood option before the farmers of Tripura.

The production system of rubber tree has a long value chain. It generates multiple types of specified activities on regular basis and farmers are opting rubber farming because of its regularity of income and employment.

Rubber plants needs six years of establishment phase to start tapping from the age of seventh year. The tree gets 18 inch breast height girth and 14 feet bole height at this stage. Harvesting continues for ten months in a year in two seasons , Summer and Winter. The latex is collected by tapping of trees during early morning hours. Some farmers prefer sell the out put in latex form. Others go for farm level processing of dry rubber sheet.

The researcher could identify six Systems of functional participation groups of farmer that makes variation in engagement of family labour, paid out cost and selling form of output etc. The economic analysis has been focused on these System groups.

Calculation of rental value of latex giving standing rubber tree may be taken as a unique method for this study. It is assumed that the rubber plantation will gain a capitalised value at the end of sixth year of establishment. The said capital value will be recovered at the end of tree life by selling of wood.

The study comprises of three administrative Blocks of Khowai district of Tripura state. There are 52 respondents of which 14 has been taken from Khowai, 16 from Padmabil and rest 22 has been taken from Tulasikhar Block. Out of total 234 family members male: female ratio is 51.71: 48.29. In age distribution 31.62 percent population is below 20 years of

age and 17.75 percent are over 60 years. It reveals that 50.43 percent of total population may be considered as potential job seeker.

Out of 160 members in 20-60 years age group, 113 are participating in any kind of earning activity and 96.46 percent of earning members are associated with rubber of which 39.82 per cent earning members are exclusive to rubber only.

Farmers are categorized into six system groups according to their difference in participation in rubber farming. It is to note that System 1 to System 4 farmers work up to dry Sheet making while System 5 and System 6 farmers are Latex sellers.

Farmers possess 168.44 acre of total land of which 95.73 percent is under use. Out of this share of high, medium, low and home stead land are 87.39, 2.11, 5.49 and 4.70 per cent respectively. Only 3.21 percent of land under tila category still remains vacant for future expansion of rubber in need.

Average holding size come to 3.24 acre per farmer of which 2.73 acre goes for rubber plantation.

For planting farmers have followed three types of spacing model, high density 12 feet by 12 feet, medium density 15 feet by 12 feet low density 15 feet by 15 feet. Average number of sapling planted per acre is 208 which varies as 249.42, 222.91 and 200.5 respectively for high, medium and low density planting model.

. The availability of effective number of latex giving mature trees directly related to production. In high density spacing model the proposed density was 249.72 plants per acre but effective density of latex giving trees per acre is 170.15 and the survival percentage is 68.13. In medium density spacing model the proposed density was 222.9 and effective density is
186.62 and the survival percentage is 83.72. In low density spacing model the total proposed density was 200.45 and effective density is 160.32 and the survival percentage is 79.99.

In this study total rubber plantation has been practiced on 141.8 acre of which 53.4 acre (37.66 per cent) is devoted to latex selling group and rest 88.4 acre (62.34 percent) area used by sheet selling group.

Overall tapping days are 68.12 days in Summer 99.30 daysin Winter season. The average yield of latex per acre considering all system together comes at 1011.83 litre in Summer and 2149.31 litre in Winter.

Average of total sheet from all system together come at 770.49 in number and 329.05 Kg in weight per acre during Summer and1075.66 in number and 554.73 kg in weight in winter. The value return of said sheet comes at Rs 50662 in Summer and Rs97262.10 in Winter.

Average quantity of collected scrap during Summer is 29.67 kg per acre having value of Rs. 2967.11. During winter they said figures are 54.87 kg and Rs 4938.24 respectively.

The capitalized value of standing rubber plantation at the end of sixth year comes at Rs. 98650.47. Hence rental value of said plantation comes at Rs.4932.52.

On an average farmer has to incur Rs. 43283.65 annually for running activities in one acre of rubber plantation of which Rs. 25488.79 is paid out.

From rubber farming on one acre of land the respondent farmers could earn Rs. 155988.70 as a gross return over the year. The farmer has to incur Rs. 86475.65 as total cost of which Rs. 50900.55 is paid out. Thus farmer could save Rs. 35575.10 by utilizing family labour. The net return over total cost comes at Rs. 69513.05 with a return cost ratio 3.57: 1. This implies that rubber farming is a profitable enterprise in comparison to other land use activity.. The net return obtained over paid out cost comes at Rs. 105088.20 with a return cost ratio 6.10: 1. The result is overwhelming to marginal and small farmer who could get this opportunity. In case of System 1 farmer said ratio is 16.05:1.

The average annual cost of a sheet processing unit comes to Rs. 9010.10 against cash earning of Rs. 16552 from rental charge. If the imputed value of own activities be considered the unit can earn nominal net return Rs. 43185.17 per year as a rational gain.

Eleven number of constraints issues have been identified at the time of pilot survey by the researcher. It is found that breaking of trees due to high wind comes as a top most constraint by all farmers. Non availability of institutional loan comes as second constraint.

Conclusion

The study asserts that there will be expansion of rubber plantation in Tripura in future. Farmers are getting sustainable income and employment out of this enterprise.

In present case it seems golden opportunity before the farmer to utilize their tila land remained uncultured for a long period of time.

However the government should take third party role for negotiation with industry for ensuring selling price of latex and sheet in favour of farmer.

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Scrap rubber

Dough setting

Sheet rubber

Latex rubber

ANNEXURE I

A study on Economics of Natural Rubber in Tripura
Department of agricultural Economics, UBKV, West Bengal

Name of the respondent:

Address: **Phone no.:**

.1.About the Respondent

Name of Respondent	Age	Qualification	Training experience	Expertise skill	Primary occupation			Auxiliary occupation		
					Name	Daily Working hour	Earning	Name	Daily Working	Earning

2. About the Family: Member wise information

Sl. no	Name of the member (Only first name)	Age	Gender (M/F)	Qualification	Whether Earner (Y/N)	Information on his/her primary assignment			How does he/she use lean hours of the day?
						Name of activity	Actual Engagement hour in a day (am/pm)	Wage earn (daily/monthly)	

3. About the involvement of family members (including respondent) in different livelihood activities (including Rubber):

Sl. no	Name of Enterprise/Activity	Activity season	Whether using own farm Resource? (Yes/no)	Details about family members engaged in said lively hood activity				Annual gross investment	Annual gross return
				Full time participation		Part timet participation			
				Number	Activity days in year	Number	Activity days in year		

4. Details about possession of land by the household

Total area	High land (Tila)			Medium land			Low land			Water logged land		
	Plot no	area	Use	Plot no	area	Use	Plot no	area	Use	Plot no	area	Use

5. Details about leasing of land

A) About leased in land

Plot no	Type of land	Area under the plot	Crop grown	Period for leasing	Terms of contract

B) About leased out land

Plot no	Type of land	Area under the plot	Crop grown	Period for leasing	Terms of contract

6. Details about land area under Rubber plantation

Plot code	Year of plantation	Type of land	Use of land before rubber (crop sequence)	Alternative crop could be (crop sequence)	Reasons behind adoption to rubber?	Source of motivation and guidance

7. Planting morphometry of Rubber

7.1 Establishment period

Plot code	Year and month of plantation	Area	Number of sapling	Source of sapling	Spacing		Mortality with year	Whether inter cropped?	Remark about quality of sapling, spacing and inter cropping and mortality
					Plant X Plant	Row X Row			

7.2 Current status of standing plantation (Mature and Immature) on April 2022

Plot code	Immatured			Matured			
	No of tree	Av. Bole height (ft)	Av Girth size at BH (inch)	No of trees	Av. Bole height (ft)	Av Girth size at BH (inch)	No of trees in tapping

8. Details about possession of Fixed Asset required for Rubber crop

Sl.no	Name	Purchase price	Purpose of use	Useable life	Junk value if any

9. Cost of cultivation of Rubber plants (memory based actual data)

A) Cost for Establishment period (before tapping)

A.1 Labour component

Plot code	Age of plantation (in year)	Name of operation	For Main/ Inter crop/ both	Family labour in number		Hired labour									
						Casual daily wage basis								Contract basis	
						Male			Female			Total			
				Male	Female	Number	Rate	value	Number	Rate	Value	Number	Value	Estimated Man days	Value

A.2 Material component:

Plot code	Age of plantation	For Main/ Inter crop/both	Name of operation	Season of operation	Material Used			
					Name	Source	Quantity	value

B) Cost for Maintenance and harvesting (during tapping)

B.1 Labour component

Plot code	Age of plantation (in year)	For Main/ Inter crop/ both	Operation	Family labour in number		Hired labour									
						Casual daily wage basis								Contract basis	
						Male			Female			Total		Estimated Man days	Value
				Male	Female	Number	Rate	value	Number	Rate	Value	Number	Value		

B.2 Material component:

Plot code	Age of plantation	For Main/ Inter crop/both	Name of operation	Season of operation/Period of harvesting	Material Used			
					Name	Source	Quantity	value

10. Return from inter crop

Plot code	Age of plantation	Name of inter crop	Total yield obtained	Utilisation of yield		Value obtained from selling	Remark if any
				Quantity consumed	Quantity sold		

11. Return from Rubber plants:

Plot code	Age of tree	Age in tapping year	Tapping gap practice	Total number of tapping days	Total latex obtained	
					Quality grade	Quantity

12. In situ processing of latex:

Quantity of latex	Grade	Cost of Material input			Cost of labour input				Output obtained		
		Name	Quantity	Value	Source	Gender	Number	Value	Name	Quantity	Value

13 Drying of sheet

Month of working	No of raw sheet	Area used for drying	Number of shake	Number of hanging bar in a stake	Accomodation capacity of a bar	Time required for drying	Dry weight	Labour cost involved					
								Family		*Hired*			
								Male	Female	Male		Female	
								no	no	no	rate	no	Rate

ANNEXURE II

A Study on Economics of Natural Rubber in Tripura
(A research study for PG dissertation)
Department of Agricultural Economics
Uttar Banga Krishi Viswavidyalaya, West Bengal

Questionnaire for processor of Natural Rubber: Latex to Sheet

1. **Name of the respondent :**
2. **Address (with phone number)**
3. **Type of practice : i) Latex producing farmer having own sheet processing unit ii) Sheet supplier (depend on purchased latex) having processing unit i) sole sheet processing unit work as service provider**
4. **Other personal details about the respondent**:

Age	Qualification	Training experience	Expertise skill	Primary occupation			Auxiliary occupation			Association with Latex processing unit	
				Name	Daily Working hour	Earning	Name	Daily Working	Earning	As a worker	As a owner

5. **Cost of Establishments:**

Items	Cost of making/ purchase	Economic life	Cost of annual maintenance	Working capacity (size)	Junk value	Source of funding	Interest paid (loan)

6. Performance of Processing Activity carried for last one year:(2021-22)

Month of working	Quantity processed	Latex grade	Source of latex supply own/purchased/ for service	Daily working hour (am/pm)	Working days in month	Cost involved									Output received		
						Labour cost						Material cost					
						Family		Hired									
						Male	Female	Male		Female					No of raw sheet	Expected Dry weight	Charge/price received
						no	no	No	rate	No	rate	Item	Quantity	Rate			

7. Drying of sheet

Month of working	No of raw sheet	Area used for drying	Number of shake	Number of hanging bar in a stake	Accomodation capacity of a bar	Time required for drying	Dry weight	Labour cost involved					
								Family		*Hired*			
								Male	Female	Male		Female	
								no	no	no	rate	no	rate

8. Source of external finance (for processing unit) :

Purpose of loan	Lending agency	Amount	Period	Interest %	Amount repaid	Remark

9. Purchase of latex and sell of sheet:

Month	Purchase of latex					Selling of dry sheet				
	Quantity	Grade	Rate	From whom	Payment Cash/ credit	Quantity	Grade	Rate	From whom	Payment Cash/ credit

10. Please specify the reasons behind the adoption of rubber enterprise by you.

11. Will you expand the business in future? Specify your answer with reason.

12. In your opinion if rubber plantation of Tripura increases then who will be benefited and how 9 under present structure)?

13. Do you think that expansion of area under rubber may hamper food production of the state?

14. Do you think that expansion of area under rubber mono crop will be a threat for general agricultural diversity of the state?

15. Do you think that farmers share in rubber return is low in comparison to share obtained by industry?

16. Do you think that Rubber production may reduce future unemployment of Tripura?

17. What type of favour do you expect from govt. in relation with your association with rubber?

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Document Information

Analyzed document	mousumi debnath.pdf (D144927075)
Submitted	9/27/2022 11:30:00 AM
Submitted by	DEEPA ROY
Submitter email	roydeepa87@gmail.com
Similarity	0%
Analysis address	roydeepa87.ubkv@analysis.urkund.com

Sources included in the report

Entire Document

1 Introduction The natural rubber is an environmentally beneficial industrial raw resource, in contrast to the creation of synthetic rubber thatuses petroleum feedstock in energy-intensive manufacturing plants (Thorpe 1996). India is one of the leading consumers of natural rubber in the world with a supply support from her domestic production. The traditional region of natural rubber production is southern part of the country comprises with states like Kerala and Karnataka. But over a period of last ten years from 2011-12 to 2020-21 the import share of domestic consumption has increased from 18.64 per cent to 39.54 per cent (Rubber Board, GOI). Thus there emerges an urgent search for exploring new areas for natural rubber plantation apart from traditional zone which became saturated both on area and yield. As a part of this venture and with active persuasion from Rubber Board the cultivation of natural rubber has got its new abode at north eastern part of India as a non- traditional zone. Over a period of five years from 2015-16 to 2019-20 the said non- traditional zone has got a boost and increased her national share of area under natural rubber from 18.48 per cent to 30.36 per cent when during the same period the share of traditional zone reduced from 81.52 per cent to 69.54 per cent. According to a prediction made on 2011, due to climatic warming productivity of natural rubber in Kerala would decrease by 4–7 per cent while the same would increase by as much as 11 per cent in North East India during the following ten years (Satheesh 2011). By giving the said prediction a reality now Tripura, a member of north eastern India became the second largest producer of natural rubber in the country with a national share 10.39 per cent. The rubber plant (Hevea brasiliensis) was first brought to Tripura by the Forest Department in 1963 for conservation of soil moisture. But the species has shown excellent performance in hill terrace traditionally used by Jhumia in shifting cultivation. The said success on adoptability of natural rubber in Tripura soil opened up an option for alternative utilisation of hill terrace. The tribal farmers were advised to give up Jhume cultivation and go for natural rubber with government subsidy. The momentum achieved a reality over time and natural rubber gradually became an alternative livelihood of tribal farmers in the state. It is to mention that 59.52 per cent of geographical territory of Tripura comprises of high land. The said land is locally termed as tila land and usually unfit for growing field crops. In most of the cases the private owners of such land would keep them uncultured. The forest department of the state of Tripura has started to grow rubber plants on such tila

27.09.2022

Mousumi Debnath

79 Average of total sheet from all system together come at 770.49 in number and 329.05 Kg in weight per acre during Summerand1075.66 in number and 554.73 kg in weight in winter. The value return of said sheet comes at Rs 50662 in Summer and Rs97262.10 in Winter. Average quantity of collected scrap during Summer is 29.67 kg per acre having value of Rs. 2967.11. Duringwinter theysaid figures are 54.87 kg and Rs 4938.24 respectively. The capitalized value of standing rubber plantation at the end of sixth year comes at Rs. 98650.47. Hence rental value of said plantation comes at Rs.4932.52. On an average farmer has to incur Rs. 43283.65 annually for running activities in one acre of rubber plantation of which Rs. 25488.79 is paid out. From rubber farming on one acre of land the respondent farmers could earn Rs. 155988.70 as a gross return over the year. The farmer has to incur Rs. 86475.65 as total cost of which Rs. 50900.55 is paid out. Thus farmer could save Rs. 35575.10 by utilizing family labour. The net return over total cost comes at Rs.69513.05 with a return cost ratio 3.57: 1. This implies that rubber farming is a profitable enterprise incomparison to other land use activity.. The net return obtained over paid out cost comes at Rs. 105088.20 with a return cost ratio 6.10: 1. The result is overwhelming to marginal and small farmer who could get this opportunity. In case of System 1 farmer said ratio is 16.05:1. The average annual cost of a sheet processing unit comes to Rs. 9010.10 against cash earning of Rs. 16552 from rental charge. If the imputed value of own activities be considered the unit can earn nominal net return Rs. 43185.17 per year as a rational gain. Eleven number of constrain issues have been identified at the time of pilot survey by the researcher. It is found that breaking of trees due to high wind comes as a topmost constraint by all farmers. Non availability of institutional loan comes as second constraint. Conclusion The study asserts that there will be expansion of rubber plantation in Tripura in future. Farmers are getting sustainable income and employmentout of this enterprise. In present case it seems golden opportunity before the farmer to utilize their tila land remained uncultured for a long period of time. However the government should take third party role for negotiation with industry for ensuring selling price of latex and sheet in favour of farmer.

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