Income augmentation in small farm agriculture from adoption of rubber production : a study in northeast India

Income Augmentation in Small Farm Agriculture from Adoption of Rubber Production: A Study in Northeast India

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Abstract

Rising demand for rubber in general, steep rise in the price of synthetic rubber and reduced supply from some traditional big producers contributed to sharp rise in the price of natural rubber in the last decade. This opened up an opportunity for countries like India to increase their rubber acreage. With the scope for area expansion in traditional locations becoming limited, India ventured into extension of rubber plantation to non-traditional areas such as the northeastern part of the country. For farmers in this region, who typically possess small land-holdings, this initiative has come as an opportunity to enhance and diversify their livelihood. Though adoption of rubber by farmers in the region has been impressive, concerns about longer term viability of rubber in such non-traditional areas often arise. Based primarily on a sample survey of rubber growers in Goalpara in northeast India, the present work attempts to address such concerns.

Key words: Natural Rubber, Cost, Rate of Return, Sustainability

JEL Classification: Q 12

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1. Introduction

After fluctuating around a fixed level for about a decade and half, price of natural rubber registered a sharp rising trend since 2001. Rising demand for rubber in general, steep rise in the price of synthetic rubber and reduced supply from some traditional big producers like Malaysia are some of the factors that contributed to this upswing in the price. The favorable market condition has come as an incentive to rubber producing nations to step up production. In India, with scope of acreage expansion in the traditional rubber belt becoming increasingly limited (Krishnakumar and Meenattoor 2000), emphasis has been on extending rubber plantation to non-traditional areas such as the northeast region of the country. Within that region, rubber production had already got established as a significant economic activity in the State of Tripura. But in more recent times, it has been gaining grounds in the Garo hills in the State of Meghalaya and in Cachar, Karbi Anlong and Goalpara districts in the State of Assam.

The northeast region of India, comprised of the seven States of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura, accounts for roughly about 8% of area, 4% of population and 2% of Gross Domestic Product of the country. Yet the region occupies a place of special significance to the country for both strategic and economic reasons[1]. Geographically the region is a mixture of hills and plains. The Eastern Himalayan range, forming its northern part, extends southward from its east side into the Barail range, a branch of which extends westward through the middle of the region. Lying between these hill-ranges are the Brahmaputra, the Barak and the Imphal valleys, named after the respective rivers flowing down the plains. While the plains comprise about 30% of the area of the region, they together hold about 70% of the population. Hills comprising the remaining 70% thus

[1] Linked to the rest of the country only by a narrow corridor, the region is virtually surrounded on all sides by foreign countries. The region has more than 2000 kilometres of India's international border, which it shares with Bhutan, China, Myanmar and Bangladesh. Geographically, as well as, ethno-culturally the region forms a transition zone between South Asia and Southeast Asia. In view of India's „look east' policy the region has the potential to turn into India's gateway to the east.

are home to about 30% of the region's population. The population in the hills is predominantly from the aboriginal tribes, who traditionally depended on shifting cultivation for subsistence livelihood. But with growing population and reduced availability of land for shifting, the cycles of rotation has been shrinking over the years endangering economic and environmental sustainability of such practice. Meanwhile, as a result of improvement in connectivity, development of infrastructure, spread of education and penetration of market forces, there has been significant diversification of livelihood of the tribal populations. It is interesting to note that the promotion of plantation and horticultural crops as an alternative to shifting cultivation did not meet with much success till the 1970s (Borah 1993). But with changes in the circumstances and alterations in the promotional packages, the same activities have gained greater acceptance among farmers in more recent times (Bezbaruah 2007).

Though growth in area and production of rubber in the region exemplifies successful diversification and commercialization of an agriculture predominated by small farmers, several questions regarding longer term viability and economic sustainability of rubber production in such non-traditional areas warrant attention. What is the extent of generation of total factor income from rubber production? How much is the profit accruing to the producer? What is the rate of return from the investment in rubber production? Will rubber production remain viable in these new areas as the promotional support from the government will have run its course? Are the economics strong enough to sustain the activity through the cycles of rise and fall of price, which a commercial agro-based activity like rubber production is typically subjected to? Answers to such questions cannot be extracted from analysis of secondary data which are generally available in aggregated form. Micro-level field investigation with a rubber grower as the unit of observation is required to gather the necessary inputs for the probe. The present study of rubber production in Goalpara is induced by this necessity.

The paper has been organized in eight sections. Section two states the specific objectives of the study along with the prime research question underlying the whole exercise. Section three outlines the data source and the analytical tools. Section four presents the attainments of rubber producers in the study area in the context of world natural rubber production situation. The fifth section portrays the institutional set up in which rubber production in the study area is situated and presents the profile of the sample growers. The economics of rubber production

extracted from the data on operations of sample growers has been analyzed in details in section six. Section seven is an attempt to trace the environmental consequences of rubber plantation in the study area. Besides summarizing the broad inferences emanating from the study, policy implications have been drawn in the concluding section.

2. Objectives and Research Question

The specific objectives of the study have been the following.

a) To examine the growth trends in area, production and yield of rubber in Goalpara and assess the yield achievement by growers in the district in the Indian and the international perspective;

b) To find out the organizational set up and other institutional conditions in which the rubber growers of Goalpara are operating;

c) To examine the economic viability of rubber production in Goalpara in terms of current profitability and long term rate of return on investment; and

d) To trace the environmental consequences and food security implications of rubber plantation in the area.

The principal research question underlying the exercise has been whether rubber production is an economically viable activity in the present set up and also economically sustainable in the longer run.

3. Materials and Methods

Secondary data on area, production and yield of rubber, land holding and ownership pattern of planters and the price trends have been collected/compiled from the regional and field offices of the Rubber Board[2] and the Board's monthly journal Indian Rubber Statistics. The secondary data have been useful for estimating growth trends in area, produc-

[2] The Rubber Board is a statutory body constituted by the Government of India, under the Rubber Act 1947, for the overall development of the rubber industry in the country.

tion and yield of rubber in Goalpara. The growth rates have been estimated by fitting the following semi log trend equation.

$$\log Y_t = a + bt$$

Where t = time

Y_t = value of the relevant variable at time "t"

b = the exponential growth rate.

The annual compounded growth rate „r' has been estimated from the estimate of "b" by using the conversion formula $r = e^b - 1$. Yield achievement has been assessed by comparing the yield achieved in Goalpara with the corresponding all-India and international yield levels.

Rest of the study is based on primary data collected through a sample survey of 78 randomly selected rubber producers of the district. The survey was conducted in the autumn of 2008.

Profitability from rubber production has been computed by estimating the economic cost incurred and the returns appropriated. To examine the economic viability and sustainability of rubber production, a number of indicators of return on investment such as the Pay Back Period (PBP), the Net Present Value (NPV), the Benefit-Cost Ratio (BCR) and the Internal Rate of Return (IRR) have been calculated.

(a) *Payback Period:* The payback period is the length of time from the time of plantation until the net value of the incremental production stream reaches the total amount of capital investment. Thus the PBP gives a rough estimate of time by which the amount invested can be expected to be recovered. Though PBP is usually treated as a crude indicator, in the present context it assumes significance. For, the first concern for a small farmer investing in rubber plantation may well be recovering the invested sum rather than the longer term rate of return.

(b) *Net Present Value (NPV): T*he net present value of an investment is calculated from the series of future payments and accruals associated with it by using a discount rate. If n is the number of cash flows resulting from the investment, the formula for NPV is:

$$NPV = \sum_{i=1}^{n} \frac{(R_i - C_i)}{(1+r)^i}$$

where,

R_i = the series of accruals,

C_i = the series of future payments,

r = the rate of discount, and

$i = 1, 2, 3.....n$. (In the present context n=32, which is the normal economic life of a rubber tree.)

An investment project is considered to be economically viable if its NPV exceeds the capital invested in it.

(c) Benefit-Cost Ratio (BCR): BCR is the ratio of discounted stream of benefits to the discounted series of costs over the life of an investment project. It is estimated by using the following formula.

$$BCR = \frac{\sum_{i=1}^{n} \frac{B_i}{(1+r)^i}}{\sum_{i=1}^{n} \frac{C_i}{(1+r)^i}}$$

where,

B_i = benefit received from rubber plantations in period i (for the present purpose, B_i has been equated to R_i),

C_i = cost on the plantation incurred in period i.

For a project to generate overall net positive benefit, the BCR has to be in access of one.

(d) Internal Rate of Return (IRR): The internal rate of return for a series of cash flows is the rate of discount that would reduce its discounted present value to zero. Thus, derivation of the IRR is equivalent to solving the equation of NPV for „r' after setting the NPV at 0, i.e., the IRR is equal to the solution value of „r' in the following equation.

$$0 = \sum_{i=1}^{n} \frac{(R_i - C_i)}{(1+r)^i}$$

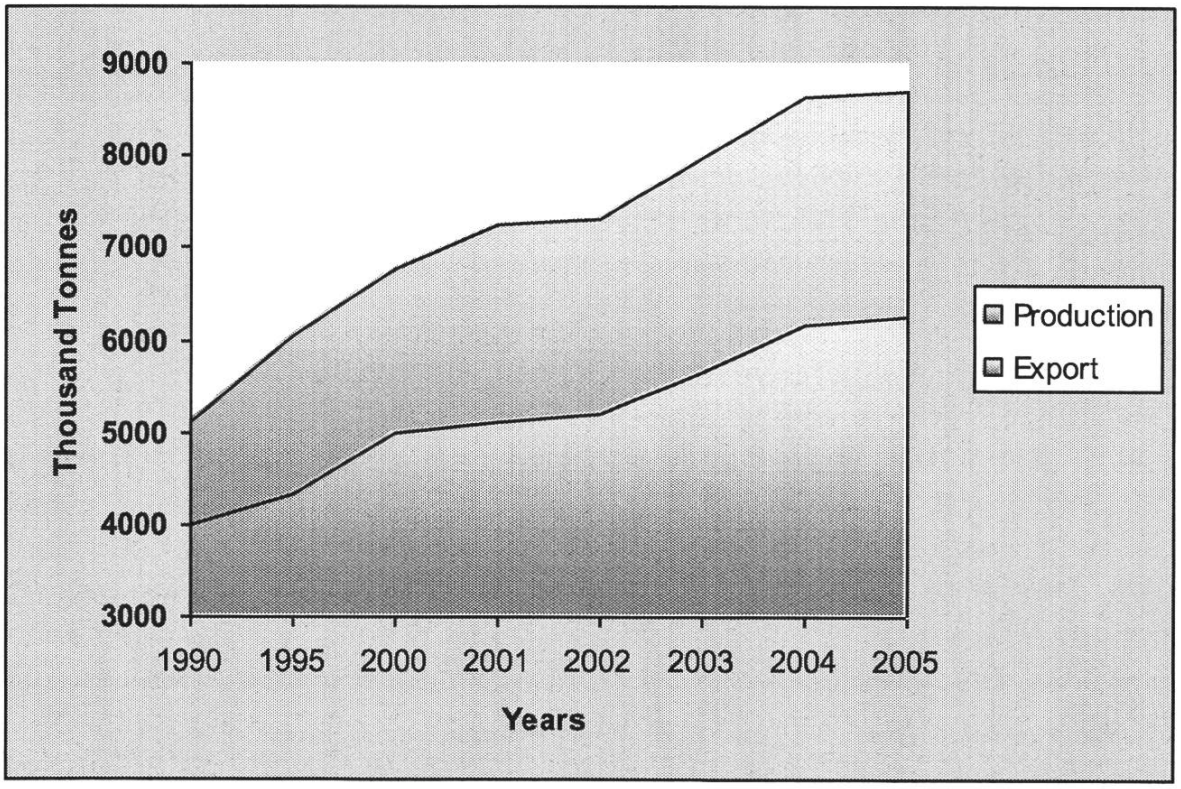
For a project to be considered as viable, its IRR must be greater than actual rate of discount of the investor.

The above-outlined methodology for assessing the prospect of investment in rubber in the study area falls in the cost-benefit analysis approach. The approach suffers from some limitations, especially when it is applied for appraisal of publicly funded projects, usually for provision of some public goods (Oka 2003). Capturing and quantifying all the social costs and benefits of such projects is often difficult. Choice of an appropriate social rate of discount is also usually a matter of debate. Moreover, IRR and NPV criteria may sometime give conflicting results while trying to choose between alternative projects competing for investment funds.

In the present context however, most of the controversies and complications surrounding a social cost benefit exercise are obviated, as the tools of IRR or NPV have been used here only for the limited purpose of checking whether an average sample farmer setting up a rubber plantation can expect to reap a reasonable rate of return from his/her investment. Of course, even in a private cost benefit analysis as the present one, a serious problem may remain as the results will be conditional upon the assumptions about the future prices. To guard against this problem, the investment appraisal exercise has been iterated for a number of alternative price scenarios. Use of multiple criteria such as the NPV, the BCR and the IRR has been made for corroboration of our conclusion from the alternative ways of drawing them.

4. Rubber Production in Goalpara in the Global Natural Rubber Outlook

Figure 1 shows that both world production and world export of natural rubber have been growing steadily since 1990. However, exports have grown at a slower annual compound rate of 3.01% than production which has grown at the rate of 3.50%. This is mainly due to increase in domestic demand and consumption in some of the main rubber producing countries. Thailand, Malaysia and Indonesia, the top three producers of natural rubber, have emerged during these years as the newly industrialized countries. Concomitantly, demand for industrial raw materials including natural rubber must have increased in these countries.

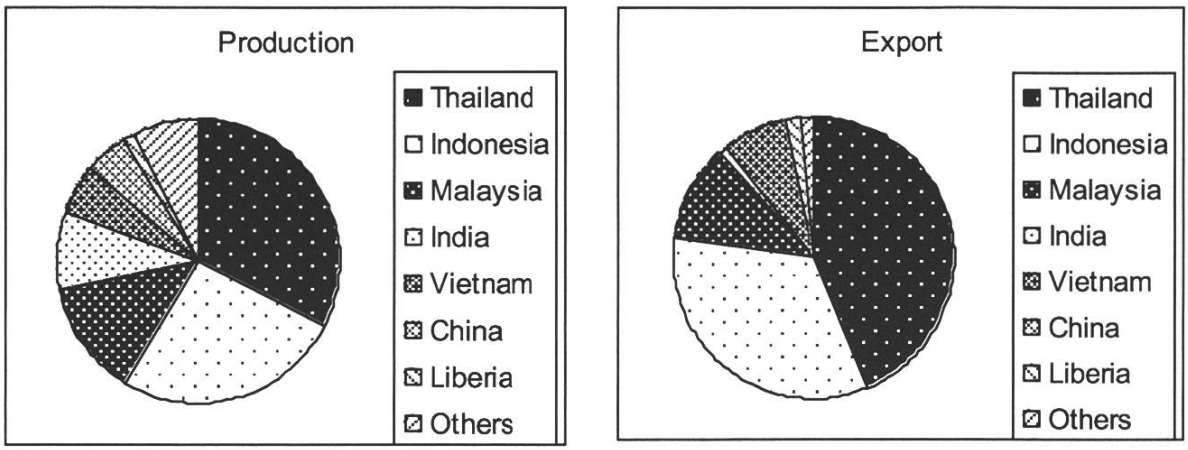


Source: Rubber Board (2006)

Fig 1: Trend in world production and export of natural rubber

As can be seen from figure 2, India occupies the 4th position in the list of countries producing natural rubber. However production in India is

insufficient to meet even the domestic demand. Hence India's share in world export is negligible and in most of the time India is a net importer of rubber.



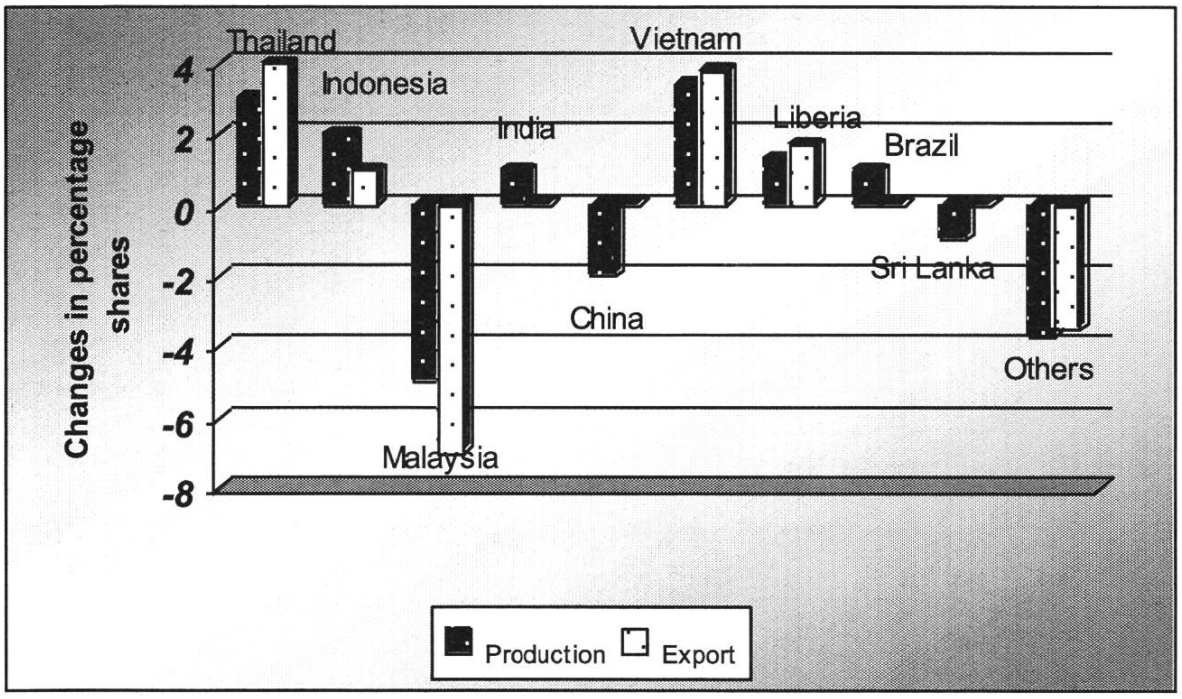
Source: Rubber Board (2006)

Fig 2: Shares of different countries in world production and export in 2005

Figure 3 shows some ups and downs in the shares of countries in world production and export of natural rubber over the period from 1995 to 2005. While shares of Thailand and Indonesia, the top two producers, further increased both in world production and export, the share of Malaysia, the other major producer, declined sharply in both production and export. India and Vietnam recorded increase in shares in production, but in contrast to India, Vietnam emerged as a significant contributor to export also. Shares of China and Sri Lanka in production declined. Liberia and Brazil emerged as visible contributors to world production.

Extension of rubber plantation to non-traditional areas like the northeast region has contributed in no small measure in India securing a larger share in world production of natural rubber. As for our study area of Goalpara, acreage under rubber grew at a high annual compound rate of 17.5% during 1986-87 - 2006-07. Total area under rubber in the district at the end of 2006-07 was 3550 hectares, which constituted 6% of the rubber acreage of northeast India. Of the total rubber plantation of the district, 36% had attained maturity in which tapping of latex was done. The total production of rubber in the district in the year 2006-07 was 1814MT. The annual compound growth rates of production and

yield in the district were 19% and 2.9% respectively over the period 1986-87 - 2006-07.



Source: Rubber Board (2006)

Fig 3: Changes in percentage shares of countries in world production and export over 1995 - 2005

In the year 2004, India's average yield of natural rubber was 1,705 kg per hectare, which was the highest in the world. Thailand came second with 1,418 kg a hectare, while Vietnam followed with 1,412 kg (Nair 2005). The yield attainment of 1500 kg per hectare in Goalpara in the same year compares favorably with the average yield levels in India and other important rubber producing countries. Indeed, the average yield of the sample growers in the reference year of the survey was substantially higher (1869 kg per hectare),

5. The General Background of Rubber Producers in the District

5.1 Organizational set up and institutional background of rubber production

The pattern of holdings under rubber plantation in the district is shown in table 1. As many as 92% of the holdings are of less than one hectare and these holdings account for nearly 81% of total rubber plantation in the district. The average size of holding in the district works out to be 0.68 hectare. It is amply clear that rubber plantation in the district is predominantly a small farmers' activity.

Tab 1: Pattern of Holdings under Rubber in Goalpara (2006-07)

Size class (in hectare)	No. of holdings	%. of total holdings	Area (in hectare)	%. of total area
Less than 0.5	3327	64.00	1624.22	45.75
0.5-1.0	1446	27.81	1236.17	34.82
1.0-2.0	368	7.07	531.36	14.97
Above 2.0	58	1.12	158.63	4.46
Total	5199	100	3550.38	100

Source: Field Office of Rubber Board at Agia, Goalpara

As for organization of production of rubber in the district, about 80% of the rubber holdings are under individual ownership and the rest 20% are owned by groups. In terms of area, individual holders account for about 65% and groups own the remaining 35% of the acreage under rubber in the district.

5.2 A brief profile of the sample growers

Before taking up analysis of cost, profitability and economic sustainability of rubber production in Goalpara, it may be useful to note a few socio-

economic characteristics of the sample rubber growers. These features are summarised in the form of table 2. It can be seen from the table that an overwhelming majority of the growers hail from historically disadvantaged population groups; a vast majority of the growers have not had any tertiary level education and on the average they own a modest size of land, which is the prime asset of people in rural India.

Another feature of the growers is that none of them is exclusively dependent on rubber production for their livelihood. Rubber growing has resulted in diversification and enhancement of their livelihood from their respective pre-existing occupations. Indeed it has transpired in the field investigation that having a side occupation has helped the growers in coping with the risk associated with a commercial activity like rubber production.

Tab 2: Some Socio-economic Parameters of the Sample Rubber Growers

Sl. No.	Parameter	Value
1	Percentage of growers belonging to Scheduled Tribe/Caste communities#	85
2	Percentage of growers who did not complete high school education	75
3	Average size of homestead land owned (in hectares)	0.53
4	Average size of crop land¥ owned (in hectares)	1.11
5	Average size of rubber plantation* (in hectares)	1.53

Scheduled Tribe and Scheduled Caste groups are formally acknowledged as socio-economically disadvantaged by the Indian Constitution.

¥ Land area used for cultivation of rice and other field crops

*Rubber plantation is set up by growers on parts of their homestead land and/or on acquired degraded forest areas formally owned by the state.

6. The Economics of Rubber Production in Goalpara as Reflected in Operations of Sample Growers

6.1 Cost and profitability of rubber production

The cost of production activity in a rubber plantation consists of two parts - establishment cost and maintenance cost. The establishment cost of a rubber plantation is spread over the first six years. As soon as tapping of latex begins, the maintenance costs are required. While calculating these costs, it needs to be borne in mind that the paid out costs do not reveal the true economic cost of production since a large portion of both material and labour inputs are contributed by the growers themselves. The imputed value of this unpaid component of the cost of production comprising contributions of own land, labour and materials used by the growers have been estimated at the ruling prices of these resources in the local markets.

6.1.1 Estimation of the establishment cost

A typical grower cannot be expected to recall in details all the costs incurred during the entire establishment period of six years. Therefore, only the information on the current year expenditure under different heads was gathered from the growers. To estimate the establishment cost, the last year's cost under different heads of sample growers in 2^{nd}, 3^{rd}, 4^{th}, 5^{th}, 6^{th} and 7^{th} year of starting plantation have been recorded. For instance, if a grower has two holdings of (suppose) 2 and 4 years old, then the grower's last year's expenditure on different heads in the two holdings were collected separately. Collected information has then been clubbed into six groups on the basis of the age of holdings. Costs per hectare of these six groups have been taken as the estimated costs per hectare in the first six years of planting. Using these estimates, establishment cost per hectare of rubber plantation has been calculated.

Table 3 shows the operation-wise and year-wise establishment cost of one hectare rubber plantation by an individual grower. Nearly 40% of the total establishment cost occurs in the first year itself. In the subsequent years, the cost shares hover between 10 to 13%. This shows the

high capital requirement during the first year of plantation. Operation-wise, cultural operation is the most important function in the establishment of a rubber plantation. Of the total establishment cost, 25.6% is incurred for cultural operation; 22.6% on establishment and maintenance of boundary, drainage and footpath; 14.7% on fertilizer and manure; and 11.5% on filling and planting. Though the overall establishment cost per hectare does not differ much across individual and group growers, there are variances in the year-wise and operation-wise compositions of the cost. In case of groups, the expenditure in the first year is 61.53% of the total which is much higher compared to the individual growers. This is because most of the group plantations are established in the degraded forests which require higher initial expenditure under almost all heads to make the ground fit for plantation. Moreover, unlike the individuals, the groups mostly buy the planting materials from the market instead of rearing the same by themselves. Again, as the group plantations are larger and usually away from dwelling areas of group members, expenditure on watch and ward is also higher compared to individual growers whose plantations are much smaller and nearer home.

Tab 3: Year-wise and Operation-wise Break up of Cost of Establishment of a Hectare of Rubber Plantations for Individual Growers (in Rs.[3])

	Operations	Year of Planting						Total	% of Co-lumn Total
		1st	2nd	3rd	4th	5th	6th		
1	Preparatory Operation	3674						3674	5.6
2	Lining & Pitting	2355						2355	3.6
3	Cost of Planting Materials	2884						2884	4.4
4	Filling & Planting	7534						7534	11.5
5	Fertilizer & Manure	1350	1340	1889	683	1640	2759	9661	14.7
6	Cultural Operation	292	2264	2264	4259	4163	3542	16784	25.6
7	Plant Protection	37	266	336	586	547	462	2234	3.4
8	Current Crop Estab-lishment	1388	333	100	193			2014	3.1
9	Boundary, Drainage & Footpath	5924	3470	1536	1140	1367	1422	14859	22.6
10	Watch, Ward & Miscellaneous	759	475	621	444	795	527	3621	5.5
Total		26197	8148	6746	7305	8512	8712	65620	100
% of Row Total		39.9	12.4	10.3	11.1	13.0	13.3	100	

6.1.2 Maintenance cost

Maintenance costs are those costs which the growers have to incur during the tapping period of a plantation. Table 4 show the maintenance cost of one hectare rubber plantation of an average individual grower. Out of the total maintenance cost, more than 80% is labour cost and the rest is for materials. Operation-wise, tapping is the single largest item of

[3] Rs. stands for the Indian currency (INR). The exchange rate as on March 10, 2010 was US$ 1 = Rs 45.47. The Purchasing Power Parity (PPP) conversion factor given by the World Bank being 0.21, the internationally comparable conversion rate works out to be PPP$ 1=Rs.9.55 on the same date.

expenditure with more than 65% of the total expenditure being spent on it. Tapping and processing are specialized task requiring skilled labour. Fertilizer, manure and its application and plant protection are other minor heads of expenditure during tapping period of a plantation.

Tab 4: Maintenance Cost Structure of a Hectare of Rubber Plantation for Individual Grower (in Rs)

Sl. No.	Item	Labour cost	Material cost	Total	% of Column Total
1	Fertilizer, Manure and Application	276	1976	2252	5.9
2	Cultural Operation	1261		1261	3.3
3	Plant Protection	1310	835	2145	5.6
4	Tapping	24968	331	25299	66.3
5	Processing and Marketing	2933	3294	6227	16.3
6	Miscellaneous	641	326	967	2.6
Total		31389	6762	38151	100
%of Row Total		82.28	17.72	100	

6.1.3 Profitability of rubber production

While attempting to assess profitability of rubber production, it is worth noting that total cost of production of rubber will have a few more components over and above the cost involved in the plantation. Apart from the annual share of the establishment cost, the fixed cost will include rental value of land, depreciation of fixed capital assets, payment of land revenue and interest on fixed capital. Similarly, the variable cost also will include interest on working capital along with other heads of expenditure on maintenance cost. The rental value of land has been calculated as per the existing rental rate of land in the villages. Fixed capital involved in a rubber producing unit mostly consists of a rubber sheet roller machine, a processing house and one smoke house. Following Goswami and Challa (2007), depreciation of these fixed capital assets has been taken to be ten percent. As the economic life of rubber plantations is about 32 years, the total establishment cost has been divided by 32 to find out its annual share. Interest on fixed and working capital has been

taken to be 9%, which is the cost of capital for an average grower calculated as the weighted average of the opportunity cost of own fund[4] and cost of borrowed fund.

Tab 5: Cost Involved in and Profit Accrual from Rubber Production per Hectare of Plantation of Individual Growers (in Rs)

Sl. No	Items / components	Amount (Rs)	% of Total Cost
A	**Fixed Cost per Hectare**		
	a) Rental value of land	5250.00	10.04
	b) Interest on fixed capital	885.60	1.69
	c) Depreciation on fixed assets	2500.00	4.78
	d) Annual share of establishment cost	2050.63	3.92
	e) Land revenue	39.38	0.08
	f) Sub total	**10689.63**	**20.45**
B	**Variable Cost per Hectare**		
	a) Fertilizer, manure & application	2252.00	4.31
	b) Cultural operation	1261.00	2.41
	c) Plant Protection	2145.00	4.10
	d) Tapping charges	25299.00	48.40
	e) Processing & Marketing	6227.00	11.91
	f) Miscellaneous	967.00	1.85
	g) Interest on working capital	3433.59	6.57
	h) Sub total	**41584.59**	**79.55**
C	**Total Cost per Hectare {A(f)+B(h)}**	**52274.22**	**100.00**
D	**Value of Output per Hectare**	**161272.10**	
E	**Profit per Hectare**	**108997.88**	

[4] Existing interest rate on long term deposit offered by nationalized banks has been taken as the opportunity cost of own fund invested in rubber production.

Profit has been estimated as the surplus of value of output over total cost of production. Value of output per hectare has been calculated by multiplying the average yield with the average price received by the growers. Results of these calculations have been summarized in table 5. As the table shows, variable costs comprise almost four fifths of the total cost and the fixed costs form only just one fifth of the same. Tapping charges with 48.4% of the total cost, is the largest component of the cost. Processing and marketing and rental value of land are the other two major annual cost components. Annual profit per hectare, has been found to be Rs.108,998.

One important divergence of cost structure for an average group grower from an individual grower is that the cost of land is understated in case of the former. Group plantations are mostly established on degraded government forest lands which are acquired at a nominal cost. Thus for group growers, the private rate of return tends to exceed the true economic and social rate of return from rubber production.

6.2 Economic feasibility of rubber production

To study the economic feasibility of rubber production, the net returns over the entire of economic life of a rubber plantation of one hectare has been first calculated. In doing so, the cost and yield pattern in the life cycle of the plantations have been taken into account. The life cycle indicates an appreciation phase of both cost and yield and then stabilization and decline. The costs and returns have been calculated based on the actual cost incurred by the growers and the mean price received by them during the year preceding the survey.

Based on the cost and return estimations, PBP, NPV, BCR and IRR for a hectare of rubber plantation have been estimated. The discount rate for NPV and BCR has been taken to be 9% which was the cost of capital for an average grower calculated as the weighted average of the opportunity cost of own fund and cost of borrowed fund.

For individual growers, pay back period has been found to be 7.11 years, the net present value of one hectare plantation to be Rs.582,019, benefit cost ratio to be 2.49 and the internal rate of return 35.4%. Fairly short PBP and high NPV, BCR and IRR suggest sound economic prospect of rubber in the study area at the existing cost and price structure. For group plantations, PBP has been found to be 7.27 years. NPV and

BCR estimates have come out to be Rs.480,474 and 2.27 respectively. The IRR for group plantations has been found to be 30.6%. Lower NPV and IRR for groups than for the individual holdings can be attributed to higher capital investment per hectare required by the groups during initial period of plantation for factors mentioned in section 6.1.1.

These findings broadly corroborate with those of Goswami and Challa (2007) who found PBP, BCR and IRR to be 9.14 years, 2.41 and 14.4% respectively for smallholder rubber plantations in the State of Meghalaya bordering Goalpara; and Maibangsa and Subramanian (2000) who estimated PBP, BCR and IRR for small scale rubber plantations in Assam as 10.58 years, 1.71 and 17.58% respectively.

6.3 Economic sustainability of rubber production

The above mentioned rates of return from rubber plantations of sample growers appear to be exceptionally high. This is due to the high price of rubber prevailing during the reference period of the field survey. Since rubber price is subject to fluctuations, it is not realistic to assume that such favorable price conditions will persist for long. To verify whether rubber plantation in Goalpara will remain economically sustainable, the rates of return have been recalculated for less favorable price scenarios. First, the returns have been recalculated for the lowest price of the last completed cycle of rubber price. Expectedly, PBP increases and NPV, BCR and IRR decline under the new price assumption. But, their values still remain sufficiently robust. To find out the worst price scenario that will keep rubber plantation economically viable, an exercise was done to find out the price which will set the IRR at 10%. This price turned out to be Rs 36/kg. Since in recent history price of natural rubber has not fallen to such a low level, it seems safe to conclude that rubber production is economically sustainable in Goalpara.

Tab 6: Returns on Investment on Rubber Production in Goalpara under Alternative Price Scenarios

Sl. No.	Price Scenario	Indicators			
		PBP in years	NPV in Rs/hectare	BCR	IRR in %
1	At Prevailing Price during Survey Period (Rs.86/kg)	7.11	582019	2.49	35.4
2	At Price at the Bottom of the Last Completed Cycle (Rs.78/kg)	7.29	488029	2.25	33
3	At the Price which will Reduce IRR to 10% (Rs 36/kg)	13.87	14577	1.04	10

7. Environmental and Food Security Implications of Rubber Plantation in the Study Area

Environmental consequences of rubber plantation can be mixed in nature. As for the beneficial effects, Jacob (2000) points out "The rubber tree is a renewable, sustainable, non-polluting and environment-friendly source of elastomer in sharp contrast to synthetic rubber manufactured from petroleum bases.....The nutrient use efficiency of rubber plantation is far superior to field crops like wheat and rice. Such field crops also require larger amounts of water and other inputs such as insecticides and pesticides." Goldthrope and Tan (1996) also reiterate "A mature rubber plantation is a dynamic and self-sustaining ecosystem and a renewable source of rubber with minimum external agronomic inputs." Apart from its soil and water conserving attributes, rubber plantation provides green cover (Wan and Jones 1996) and contributes to carbon sequestration process leading to reduction of green house gasses in the atmosphere. In the longer run, at the end of its economic life, the rubber three adds to supply of wood. On the down side, a rubber plantation can lead to reduced bio-diversity in the area not only through homogenization of plant species but also by not hosting bird and animal lives, as rubber is not a fruit bearing tree. However, according to Sethuraj and Jacob (1997) "Rubber plantations ... could maintain a fair degree of biodiversity, if properly managed."

In the study area, the beneficial impacts of rubber plantation are likely to be more pronounced as plantations have come up primarily on degraded forests and barren land. The data in table 7 show that 87% of individual rubber holdings and 94% of group holdings have been set up on degraded forest or barren land. By the end of 2006-07, about 3160 hectares of barren land and degraded forest area were converted to rubber plantations. This is an addition of more than 30 square kilometers (1.64% of the total geographical area) of green cover in the district. This has definitely led to enhanced carbon sequestration and release of more oxygen into the atmosphere. Again, establishment of the plantations on hill slopes and barren lands must have led to greater soil and water conservation too. In the longer run, rubber plantation will also become a source of timber in the district.

Tab 7: Land Use Pattern in Planted Areas before Rubber Plantation

Sl. No	Land use prior to rubber plantation	% of area under individual holdings	% of area under group holdings
1	Barren	33.0	7.48
2	Degraded forest	53.7	86.13
3	Others	13.3	6.39
4	Total	100	100

While the overall environmental impact of rubber plantation in Goalpara appears to be in the positive direction, quantification of the various local and global environmental benefits and assessment of biodiversity related implication of the plantation will require a separate multi-disciplinary investigation.

Adoption of a commercial crop like rubber by farmers often raises a concern about its possible adverse impact on food security. Substitution of food crops by lucrative looking commercial crops may lead to reduced supply and access to food at the levels of the farm household, the locality and even the nation. However, such a concern is unwarranted in case of rubber plantation in Goalpara as the plantations have been set up on lands other than those used for cultivation of food crops. Moreover, as mentioned in Section 5.2 above, rubber production has been taken up by farm households as a new economic activity in addition to their pre-existing farming and non-farm occupations. Thus rubber plantation has

helped farm families to utilize labour and land at their disposal in a fuller way, which in turn should have contributed to enhancement of their income. Many small operators are actually net buyers of food, and the enhanced income from plantation should have improved their access to food and hence strengthened their food security.

8. Conclusion

The robust growth trends in area and production of rubber in Goalpara implies that rubber production has steadily emerged as an important economic activity in the district. The yield attainment by farmers in the district is impressive by national and international comparison. A large majority of the growers being from the socio-economically disadvantaged sections of the population, this new activity has served the cause of economic empowerment at the grassroots.

The rate of returns from rubber production has been found to be quite high as per the cost-price structure prevailing at the time of the study. This is partly due to the high price of rubber at that time. However, our calculations show that rubber production in Goalpara remains economically viable and sustainable at a price as low as Rs. 36 per kg, a level to which rubber price has not plummeted to since November 2002.

Environmental implications of rubber plantation are by and large favorable. The beneficial effects are like to be more pronounced in our study area as plantations have come up mostly on degraded forests and barren land. Food production in the district is unlikely to be affected as rubber has not eaten into the acreage under food crops. Indeed, income gain from rubber production is likely to improve access to food.

However, a few areas of concern about rubber production in Goalpara have also come to notice in course of our investigation during the present study. Suitable policy interventions are needed to address these concerns.

a) One such area of concern is the ambiguity about the ownership of the land on which a substantial part of the group plantations have come up. It may be recalled that groups own about 35% of acreage under rubber in the district. As per government records most of the areas under group plantation are state owned forest land. The planters hold these lands without possessing title to them. This adds

an extra element of risk to investment in plantation on such land. A lenient approach in this regard on the part of the government may however encourage encroachment of other government and forest land. The issue can get trickier if not addressed in time. One solution could be outright transfer of the land to the planters – a process already initiated in case of waste land. A more practical solution could be offering the land on long term lease to the planters. This way, the government will be able to earn revenue, the ambiguity of land ownership will get removed and the cost of land will also get internalized.

b) Institutional credit is found to be almost non-existent in rubber plantation sector of Goalpara district. As rubber plantation requires large capital in the first year of plantation itself, the growers might have faced lot of hardship in generating their own capital. Thus, it is an utmost necessity for financial institutions such as banks and micro finance institutions (MFIs) to come forward to offer credit to the rubber growers. Greater availability of finance will induce others in the district to take up rubber productions who have so far not being able to do so due to inability to self-finance the activity.

c) As of now, there is no systematic procedure of grading the rubber produced in Goalpara. Traders usually grade all the rubber produced in the district as RSS-5, which fetches the lowest price. To serve better interest of the producers, it is necessary to establish the procedure for objective grading of rubber sheets.

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