ECONOMIC POTENTIALS OF RUBBER (*Hevea brasiliensis*) MONOCULTURE AND RUBBER-AGROFORESTRY SYSTEM: A CASE STUDY OF NORTHERN BANGLADESH

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Abstract: A financial analysis of rubber (*Hevea brasiliensis*) plantation was made in February 2003 to determine economic profitability of rubber monoculture and rubber-agroforestry system in a rubber plantation of Sherpur district of Bangladesh. Rubber was intercropped with ginger (*Zingiber officinale*), turmeric (*Curcuma longa*), paddy (*Oryza sativa*), eggplant (*Solanum melongena*), different types of vegetables and fruits. Output was calculated on the basis of present market price. Financial indicators used were Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit-Cost Ratio (BCR). Level of profit was determined at the 15th year of the economic life of the plantings while average profit was increasing. Using 6% nominal interest rate NPV was found to be Taka 57751 for rubber-agroforestry and Taka 78043 (negative) for monoculture of rubber, IRR was 9% for rubber-agroforestry and -12% (negative) for monoculture and BCR was 1.43 for rubber-agroforestry and 0.22 for monoculture. Higher profit in rubber plantation can be achieved by practicing agroforestry. Agroforestry practice in rubber gardens has great potential in terms of profitability and enhanced environmental amelioration.

Keywords: Rubber-Agroforestry; Rubber-Monoculture; Financial Analysis.

Introduction

Rubber (*Hevea brasiliensis*) is an economic tree species widely planted all over the world as well in Bangladesh (southeastern, northeastern and central region). Establishment and management of rubber plantation need large investment and there is no return for eight to ten years. In order to make full use of the land, a large scale intercropping practice in rubber is indispensable. The rubber-agroforestry system is the most widespread complex agroforestry system combining production and environmental benefits (decrease runoff and soil erosion; increase soil moisture, soil organic matter and the number of beneficial soil microorganisms), as well as certain biodiversity conservation (Young, 1997).

The rubber-agroforestry system involves practice of agricultural crops under bands of rubber trees in spatial arrangement. Further, the rubber-agroforestry provides income for the farmers from the intercrops even if any damage transpired to the rubber trees. Numerous other benefits increase to the farmers and the natural environment by practicing the rubber-agroforestry. The income per unit area of the rubber agroforestry system is significantly higher than that of rubber monoculture (Juriprik, 1996).

In Bangladesh, with the increase in population the land became the scarcest resource. So we should make optimum use of that resource. And from this outlook rubber-agroforestry has great potential. Approximately 22,672 ha of land area are covered with rubber plantation in Bangladesh of which 12,146 ha under Bangladesh Forest Industries Development Corporation (BFIDC), 3,239 ha under Chittagong Development Board and 7,287 ha under private enterprise (Sattar, 1995). The introduction of agricultural crops or fruit trees along with the rubber plantation would be economically a profitable practice in all the rubber gardens, which will ultimately preach benefits to the people by uplifting the socioeconomic condition of the country. Considering these points in view, the study was conducted to compare the economic potentials between rubber-monoculture and rubber-agroforestry practices.

Research Methods

Most of the rubber gardens in Bangladesh are managed for monoculture rubber plantation. Only a few of them are practicing intercropping (rubber-agroforestry) of which the present garden is the pioneer and attained a considerable stage, which creates a scope to assess the profitability of rubber-agroforestry, thus it was selected purposively. Input and output data was collected in February 2003 from the records of the garden.

The analysis was made based on the yield data and operation cost upto 15th year (1987-2002) from establishment. Labor cost includes establishment (such as site preparation, field planting etc), intercultural operations (weeding, irrigation, application of fertilizer and pesticides) and harvesting (collection of latex and intercrops). Capital includes seeds, seedlings, equipments or tools, fertilizer, pesticides, tapping materials and other cost. The cost of land was not taken into account because only monetary cost were considered, where land has its shadow price that reflects opportunity cost (opportunity cost is not considered in case of financial analysis and in this study economic potentials have been determined based on financial analysis) (Anon,
1991). After getting the total cost it was compounded at nominal interest rate 6%, because with a high discount rate, a greater relative value is placed on the earlier years of a system, this can bias the design toward this earlier period can cause the design to be suboptimal in the latter years (Wojtkowski, 1998). For benefits, item such as rubber shits, intercrops include zinger, turmeric, paddy, vegetables etc have been considered. After calculating the total benefits, it was then compounded at the same rate. Finally, the Benefit-Cost Ratio (BCR) was calculated by dividing the compounded benefit by compounded cost. The Net Present Value (NPV) and Internal Rate of Return (IRR) have also been calculated following the technique that includes mainly the financial profitability of the two systems in the area. The calculation has been made on the basis of per hectare per annum and the amount in Taka.

There are three techniques of appraisal traditionally used to measure economic Cost-Benefit are (Gittinger, 1974):
- Net Present Value (NPV)
- Benefit-Cost Ratio (BCR)
- Internal Rate of Return (IRR)

**Results and Discussion**

Costs and benefits of rubber monoculture and rubber-agroforestry have been presented in Table 1 and Table 2 respectively. Labor and capital cost of monoculture and rubber-agroforestry are shown separately and in combination also. Labor cost of 1st year for monoculture and rubber-agroforestry was Taka 7896 and Taka 10528 respectively. For the other years labor cost ranging from Taka 1147 to Taka 4310 for monoculture and Taka 2232 to Taka 5264 for rubber-agroforestry. Capital cost of 1st year for monoculture and rubber-agroforestry was Taka 16000 and Taka 16110 respectively and for the other years Taka 135 to Taka 515 for monoculture and Taka 271 to Taka 812 for rubber-agroforestry. There was no return from latex upto 11th year in monoculture and it gets started from the 12th year. On the other hand benefit from intercrops were coming from the very beginning.

![Table 1: Results of monoculture of rubber](image)

**Table 1:** Results of monoculture of rubber

| Costs (Tk/ha)       | Year       | Total |
|---------------------|------------|-------|
| Labor               |            |       |
| Capital             |            |       |
| Total               |            |       |
| Compounded cost     |            |       |
| Latex               |            |       |
| Compounded benefit  |            |       |
| BCR                 |            |       |
| Average BCR         | 0.22       |       |

(Source: Field study, 2003)

The BCR of the 12th, 13th, 14th and 15th years of rubber-agroforestry system, when the collection of latex was started, were much higher (1.84, 2.36, 2.58 and 3.92) than the BCR of those similar years in the monoculture (0.57, 0.87, 1.11 and 1.66) respectively. However the other years (1st to 11th) when the latex collection was not yet started a considerable worth of BCR were obtained in the rubber-agroforestry system, which were by no means possible in the monocropping.

The BCR for rubber-agroforestry was 1.43, which can be considered very satisfactory while for monoculture it was only 0.22. The BCR of monoculture was much less than the former one, because the analysis was executed at the half-life of the rotation. If the study could be conducted at the end of the rotation the BCR of monoculture might be found more than that of present time. Sutardi (1976) found BCR of 0.54 for monoculture of rubber from an economic analysis of rubber estates of Indonesia, which was made, at the end of the economic life (29 years) of the plantings when average profit was maximum. It reveals that the BCR (0.22) of monoculture for the present study is reasonable.

From the Table 3 it is clear that the profitability criterions of rubber-agroforestry are much higher between the two systems. The NPV was Taka 57751 for rubber-agroforestry and Taka –78043 (negative) for
monoculture of rubber in the study area. The IRR of rubber-agroforestry was 9% where as at the same time it was found to be negative for monoculture of rubber (-12%).

Table 2: Results of rubber-agroforestry

| Costs (Tk/ha)          | 1st  | 2nd  | 3rd  | 4th  | 5th  | 6th  | 7th  | 8th  | 9th  | 10th | 11th | 12th | 13th | 14th | 15th | Total |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Labor (rubber + intercrops) | 10528| 2232| 2265| 2350| 2410| 2490| 2554| 2561| 2557| 2628| 2642| 5048| 5097| 5154| 5264| 55780|
| Capital (rubber)       | 16000| 135| 152| 163| 118| 210| 165| 153| 185| 196| 189| 485| 450| 496| 515| 19612|
| Capital (intercrops)   | 110| 136| 189| 151| 208| 208| 192| 269| 336| 178| 210| 271| 280| 316| 240| 3294|
| Total                  | 26638| 2503| 2606| 2664| 2736| 2908| 2911| 2983| 3078| 3002| 3041| 5804| 5827| 5966| 6019| 78686|
| Compounded Cost        | 60541| 5326| 5212| 5026| 4886| 4929| 4621| 4452| 4397| 4003| 3849| 6910| 6547| 6347| 6019| 130365|

| Benefits (Tk/ha)       | 1st  | 2nd  | 3rd  | 4th  | 5th  | 6th  | 7th  | 8th  | 9th  | 10th | 11th | 12th | 13th | 14th | 15th | Total |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Latex                  | -    | -    | -    | -    | -    | -    | -    | -    | -    | 2638| 4161| 5321| 8000| 20120|
| Intercrops             | 2150| 3929| 6530| 7628| 7820| 8908| 5665| 7326| 9188| 7335| 8048| 8021| 9617| 10101| 15461| 115577|
| Total                  | 2150| 3929| 6530| 7628| 7820| 8908| 5665| 7326| 9188| 7335| 8048| 8021| 9617| 10101| 15461| 135697|
| Compounded Benefit     | 4886| 8360| 13060| 14392| 13964| 15098| 8992| 7628| 7628| 5665| 5665| 5665| 5665| 5665| 5665| 190816|
| BCR                    | 0.08| 1.57| 2.51| 2.86| 2.86| 3.06| 1.95| 2.46| 2.99| 2.44| 2.65| 1.84| 2.36| 2.58| 3.92| 1.43 |

Average BCR = 1.43
(Source: Field study, 2003)

Table 3. Comparison of financial attribute between rubber-agroforestry and rubber monoculture

| System                   | Compounded Costs (Tk) | Compounded Benefits (Tk) | BCR  | NPV (Tk) | IRR (%) |
|--------------------------|-----------------------|--------------------------|------|----------|---------|
| Monoculture of Rubber    | 100519                | 22476                    | 0.22 | -78043   | -12     |
| Rubber-Agroforestry      | 133065                | 190816                   | 1.43 | 57751    | 9       |

Conclusion

The study shows the comparative profitability of the two mentioned systems where rubber-agroforestry shows its great economic potentiality over monoculture of rubber. In this study the costs and benefits of fifteen years were taken into account after establishment of rubber plantation. It was found that collection of latex was started from 12th year of plantation while production is mounting every year. The production of latex would be higher than that of these days toward its rotation age. In this condition the BCR of rubber-agroforestry is 1.43, which is very satisfactory. So it is recommended that rubber intercropping (agroforestry) should be practiced in all the rubber gardens in Bangladesh that could lead to increased income and optimum use of scarce land resources.

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