Financial Analysis of Agroforestry Trial at Ichamati, Chittagong

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Abstract

Agroforestry is not a new concept in Bangladesh. This concept has been practising in this country for a long time. A case study of financial analysis on agroforestry research conducted at Ichamati Research Centre under Chittagong district was done. The financial analysis of both the tree crops and agricultural crops has been done separately and combinedly. The trees were considered as fuelwood with six years rotation. In both the cases, the result is found to be negative. The present worth of benefit is Tk. 12,610 (US$1 = Tk. 40/-) and the present worth of cost is Tk. 44,947. The net present worth is Tk. 32,337 with a benefit-cost ratio of 0.28. The agroforestry trial would, however, be profitable if 18 years rotation of the trees with ploe values and other intangible benefit are considered.

সারসংক্ষেপ

বাংলাদেশ কৃষি-বন পদ্ধতির ধারণা নতুন নয়। এ প্রযুক্তি এদেশে দীর্ঘকাল যাবত ব্যবহৃত হয়ে আসছে। চট্রগ্রাম জেলার ইছামতি গবেষণা কেন্দ্রে কৃষি-বন গবেষণা পদ্ধতির আর্থিক বিশ্লেষণের উপর এক অনুশীলন করা হয়। বাগানের রোপণকৃত গাছ ও কৃষি পণ্যের পৃথক এবং যৌথভাবে আর্থিক বিশ্লেষন করা হয়েছে। বাগানের গাছগুলো জ্বালানি কাঠ হিসাবে ছয় বছর আবর্তনকাল ধরা হয়েছে। উভয় ক্ষেত্রে ঋণাত্মক ফল পাওয়া গিয়েছে। প্রেজেন্ট বেনিফিট ও খরচের পরিমাণ যথাক্রমে ১২,৬১০/- টাকা ও ৪৪,৯৪৭/- টাকা। প্রেজেন্ট বেনিফিট-কষ্ট-এর অনুপাত ০.২৮ সহ নেট বেনিফিটের পরিমাণ -৩২,৩৩৭/- টাকা। খুঁটির ব্যবহারে ও মূল্যে গাছের ১৮ বছর আবর্তনকাল ধরলে এবং অন্যান্য পরোক্ষ বেনিফিট বিবেচনা করলে আলোচ্য কৃষি-বন পদ্ধতি পরীক্ষা লাভজনক হবে।

Key words: Agroforestry, benefit-cost ratio, intercrop, present worth, rotation planned

Introduction

The forest resources of Bangladesh are very limited. These resources should be increased and utilized properly to strengthen forestry sector development. Bangladesh Forest Research Institute (BFRI) undertakes various research projects for the purpose of solving various problems relating to forestry and forest based agriculture. But little attention has so far been given for economic analyses of all these projects. It is, therefore, reasonable to analyse the projects from economic view point before starting large scale programme. Decision to develop and adopt new technologies is ultimately based on economic consideration.

Agroforestry is considered as one of the strategies for augmenting tree production for a country like Bangladesh where there is little scope of developing pure forest due to obvious priority for

food crop production (Abedin *et al.* 1990). The agroforestry project not only helps to increase food and fodder but also protects the existing forest where unemployed and poor people rush to earn their livelihood Agroforestry technique is a land management technique that implies the combination of forest trees with crops (Bude Waki 1977). Agroforestry has now earned a distinct identity as an approach to land use (Lundgren and Raintree 1983, Nair 1989).

Agroforestry was started is Burma in 1962 and came to India, first in Bengal, for raising sal *(Shorea robusta)* in conjunction with agriculture crops in 1911. It was also mentioned that in the Andaman and Nicobar Islands, agroforestry (Taungya) system has been found successful (Agarwala 1985). In Assam, sal has been successfully raised along with paddy, and this has even reduced the Jhuming resulting in mutual advantage to forestry and agriculture. In Sri Lanka, the rationale for the practice is that other crops can profitably be grown between coconut trees during different growth stages of the plants and trees. Thus overall productivity of the land under this long duration crops can be substantially increased (Liyanage *et al.* 1984).

In Bangladesh, agroforestry has been non-officially practising in different areas for a long time. In this country it was officially initiated in 1977-78 (Alim 1980). It was reported that agriculture crops grown with normally planted tree species were found successful at Cox's Bazar, Chittagong and Chittagong Hill Tracts.

It is, therefore obvious that agroforestry has been found successful in various countries. Considering these, Bangladesh Forest Research Institute undertook an agroforestry project as a tool for financial analysis. The agroforestry project was a contract research project started at four research centres of Seed Orchard Division of this Institute. Forest Economics Division of this Institute took up only Ichamati Research Centre for financial analysis. This analysis is expected to help in selecting the agroforestry projects in the field in future.

The Ichamati Research Centre is a hilly area in government khas land in Chittagong. Before introducing agroforestry, this forest land was barren and used as a grazing area for cattle. So, it may be considered economically unproductive. There are villages surrounding the area. The villagers tend their cattle in this barren area. Seed Orchard Division considers this barren forest land suitable for introducing agroforestry research. This will also help motivate people for introducing agroforestry on their own land. *Eucalyptus camaldulensis and Acacia mangium* were planted as forest tree species intercropped with differernt agriculture crops such as the lady's finger *(Hibiscus esculentus)* barbati *(Vigna sinensis)*, bean *(Dolichos lablab)*, ginger *(Zingiber officinale)* turmeric *(Curcuma longa)* and arum *(Colocasia esculenta)*. These crops give production in summer and winter.

Data on cost and return were collected from the project records. In order to calculate volume, 20% of the existing tree species were selected randomly. The area was divided into sites-top and bottom. Data on height and diameter at breast height were recorded, and the volume was calculated using the following equation :

a) $\ln(V_{ob}) = -9.352 + 1.8055 \ln(D) + 0.859 \ln(H)$ for *Eucalyptus camaldulensis*

b) $\ln(V_{ob}) = -9.1426 + 1.7612 \ln(D) + 0.83335 \ln(H)$ for *Acacia mangium*

where, V_{ob} = Volume over bark
   D = Diameter at breast height
   H = Total height

The financial analysis was carried out using the following methods :

1. a) Agricultural crops :
   Cost = Nursery + site preparation and cultivation + management and establishment
   Benefit = Value of agriculture crops

   b) Tree crops :
   Cost = Nursery + site preparation and cultivation + subsequent operation + management and establishment.

Benefit = Value of tree crops as firewood at the rotation age of six years.

2.   Profit analysis :

The following economic criteria were used for calculating the profit analysis :

a) Present Net Worth (PNW) = $\sum\limits_{t=1}^{n} \dfrac{B_t - C_t}{(1+i)^t}$

b) Benefit-Cost Ratio (B/C) = $\dfrac{\sum\limits_{t=1}^{n} \dfrac{B_t}{(1+i)^t}}{\sum\limits_{t=1}^{n} \dfrac{C_t}{(1+i)^t}}$

Where,

B_t = Benefit in each year
C_t = Cost in each year
t   = (1, 2, ...n)
n   = Number of years
i   = Discount rates

Results and discussion

The total plantation area under the trees and the agriculture crops was 2.024 hectare. The agriculture crops were planted between lines of tree crops in pits or in lines. There were 40 plots under 10 blocks. The plot size was 27.43 m x 16.5 m and the spacing of forest tree species was 2.27 m x 2.75 m. The total trees initially planted in the area were 1200 for *Eucalyptus camaldulensis* and 1200 for *Acacia mangium*. The existing tree species was found to be 1,445 which is 60% of the total number of planted tree species. The rest 40% were found dead or missing. Among the existing trees, 737 were *Eucalyptus camaldulensis* and 708 were *Acacia mangium* both on the top and at the bottom areas. Out of the total number of existing trees, there were 928 trees on the top and 517 trees at the bottom areas. The height of these dominant trees varied from 9.5 m to 14.5 m.

In the cost items of agroforestry research, expenditure for salary and allowances, office supplies, travel and daily allowances, furniture, construction of temporary shed, etc. is included in the management and establishment. But this cost has not been included due to the fact that this type of cost is not normally counted at farmers' level. When the technology will be applied practically, the farmers would provide their own labour and hired labour. Hence, the cost of management and establishment is not applicable. The cost items for agriculture crops included raising of nursery, site preparation and cultivation. The nursery and site preparation included the buying of polybag, cowdung, bamboos, seeds, soil collection, land preparation and cultivation, etc. As regard to benefits of the agriculture crops, value at market price (different prices for different crops) was included. For forest crop the price of fuelwood was taken as Tk. 50/- (US$1=Tk.40/-) per 37.33 kg. The cost items of the tree crops were nursery, site preparation, planting and subsequent operations. The operational costs of tree crops relating to nursery, site preparation and planting were the same as those of agriculture crops. The rotation age for tree species was considered at 18 years, but for this analysis, the rotation age was taken at six years. The tree species at six years rotation age generally become fuelwood. So, the fuelwood value of the species was taken into consideration.

The production cost of the agriculture crops and the benefits for the year 1990-91 has not been considered, because the same not available at that time. Further, the additional weeding expenditure for the standing tree crops was not necessary due to the production of agriculture crops under the trees. If the agriculture crops were not produced, this weeding expenditure would have been necessary and as such it enters into benefit side which was not shown in the analysis. Moreover, the indirect benefits such as soil erosion, environmental improvement, etc. were not taken into consideration. The basic information of the experimental plots is shown in Table 1.

The gross benefit and cost of agriculture and forest crops for the period from 1986-87 to 1990-91 has been shown in Table 2. It is seen that in the year 1986-87, the cost of agriculture crops was Tk. 3,160.00, but the benefit of the same was nil. The

cost of forest species was Tk. 7575.00, but the benefit was also nil. In the year 1990-91, the costs of both the agricultural and forest crops were nil, but the benefit against forest crops ·was Tk. 13,695.00.

The cost-benefit analysis of the forest crops and agro-crops are is shown in Table 3a and 3b. In these Tables, at 10% discount rate the present worth of benefit was Tk. 9,354.00 and the present worth of cost Tk. 17,474.00. The benefit-cost ratio is 0.54 which means that the benefit of forest crops was less than the cost incurred during the period. In the cost-benefit analysis of the agriculture crops, it appears that at the 10% discount rate the present worth of benefit was Tk. 3,256.00 and the present worth of cost was Tk. 27,534.00. The net present worth is negative. The benefit-cost ratio was 0.12. This also indicates that the costs incurred during the period was more than the benefits.

In Table 4, the cost-benefit analysis of both agricultural and forest crops has been combinedly shown. At 10% discount rate at six years rotation age, the present worth of benefit was found to be Tk. 12,610.00 and the present worth of cost

Tk.44,947.00. The net present worth appeared to be Tk.-32337.00 and the benefit-cost ratio was 0.28. So, it is clear that the result was found to be negative.

In this connection, present worth of revenue and expenditure of agroforestry crops for the years from 1986-87 to 1990-91 is shown in Fig.1. It reflects the actual position of the agroforestry crops in relation to cost, benefit and loss.
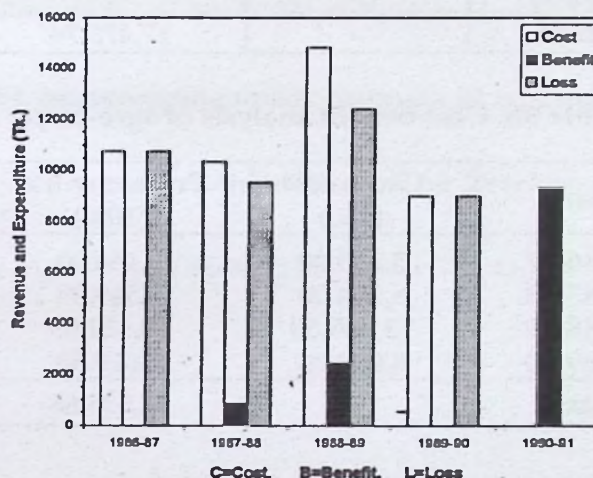

Figure 1. Present worth of revenue and expenditure of agro-forestry crops for 1986-91.

Table 1. Basic information of agroforestry.

Species	Area (ha)	Block (nos.)	Plots (nos.)			Existing trees (nos.)		
			Top	Bottom	Total	Top	Bottom	Total
E. camaldulensis	1.012	5	12	8	20	390	347	737
A. mangium	1.012	5	17	3	20	538	170	708
Total	2.024	10	29	11	40	928	517	1,445

Table 2. Cost and revenue of agriculture and forest crops.

Year	Costs (Tk.)		Revenue (Tk.)	
	Agricultural crops	Forest crops	Agricultural crops	Forest crops
1986-87	3,160.00	7,575.00	-	-
1987-88	8,304.33	3,085.00	904.49	-
1988-89	13,085.00	4,875.00	2,943.10	-
1989-90	8,000.00	4,000.00	-	-
1990-91	-	-	-	13,694.80

Table 3a. Cost-benefit analysis of forestry crops at six years' rotation age.

Year	Gross cost (Tk.)	Present worth (10%)	Gross revenue (Tk.)	Present worth (10%)	Cash flow (Tk.)
1986-87	7,575.00	7,575.00	-	-	-7,575.00
1987-88	3,085.00	2,864.55	-	-	-2,864.55
1988-89	4,875.00	4,028.93	-	-	-4,028.93
1989-90	4,000.00	3,005.26	-	-	-3,005.26
1990-91	-	-	13,694.80	9,353.73	+9,353.73
Total	-	17,473.74	-	9,353.73	-8,120.01

Table 3b. Cost-benefit analysis of agro-crops.

Year	Gross cost (Tk.)	Present worth (10%)	Gross revenue (Tk.)	Present worth (10%)	Cash flow (Tk.)
1986-87	3,160.00	3,160.00	-	-	-3,160.00
1987-88	8,304.00	7,549.09	906.49	824.08	-6,725.01
1988-89	13,085.00	10,814.05	2,943.10	2,432.31	-8,381.74
1989-90	8,000.00	6,010.52	-	-	-6,010.52
Total	-	27,533.66	-	3,256.39	-24,277.27

Table 4. Cost-benefit analysis of agroforestry crops.

Year	Gross cost (Tk.)	Present worth (10%)	Gross revenue (Tk.)	Present worth (10%)	Cash flow (Tk.)
1986-87	10,735.00	10,735.00	-	-	-10,735.00
1987-88	11,389.00	10,353.64	906.49	824.06	-9,529.56
1988-89	17,960.00	14,842.98	2,943.10	2,432.31	-12,410.67
1989-90	12,000.00	9,015.78	-	-	-9,015.78
1990-91	-	-	13,694.80	9,353.73	+9,353.73
Total	-	44,947.40	-	12,610.10	32,337.28

Conclusion

In the light of the above discussion and financial analysis, the introduction of both forest and agricultural crops during the period was not found profitable. The expenditure incurred for the forest and agricultural crops appeared to be more than the benefit. The result was, therefore, found negative. The financial analysis of both the crops was done separately and also combinedly, but in both the cases the result was found negative. That is at six year rotation, considering trees as fuelwood, the agroforestry trial is not profitable. It will be profitable when 18 year rotation of the trees with pole values is considered. Moreover, intangible benefits like reduction of soil erosion, popularization of agroforestry plantation and environmental improvement, etc. are obvious due to agroforestry approach. If these intangible benefits could be included in this study the benefit-cost ratio might be higher.

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