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COMPARATIVE FINANCIAL EVALUATION OF HOMESTEAD AGROFORESTRY, CROPLAND AGROFORESTRY AND ANNUAL CROPPING AT RAJSHAHI, BANGLADESH

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Abstract: Agroforestry plays a vital role in rural socio-economic development. Since the main beneficiaries are individual farmers, the study examines the financial benefits to the individual farmers of the three different cropping systems i.e., homestead agroforestry (HAF), cropland agroforestry (CAF) and annual cropping (AC) in the four upazillas (Bagha, Charghat, Puthia and Tanore) of Rajshahi district of Bangladesh. The results indicate that, agroforestry practices are financially profitable and viable. A small number of farmers practice the CAF system in the area. Overall results reveal that, the Benefit-Cost Ratio (BCR), net benefit, Net Present Value (NPV) and Internal Rate of Return (IRR) of CAF in the study area are 6.73; Tk. 312018; Tk. 415918 and 15.67% respectively. The result of HAF reveals that the BCR, net benefit, NPV and IRR are 12.90; Tk. 783468; Tk. 880305 and 36.09% respectively. The BCR, NPV and IRR of AC are 2.30; Tk. 206662 and 8.59% respectively. These results of profitability criteria indicate clearly that HAF system is the best and financially most profitable system in the study area.

Key words: Cropland agroforestry, Homestead agroforestry, Annual cropping, Financial evaluation.

Introduction

Homestead agroforestry (HAF) and annual cropping (AC) are very much familiar and popular to the people of Bangladesh. On the other hand, cropland agroforestry (CAF) is not so much popular. Traditionally people follow these three practices from the ancient period of time. But the farmers are not aware about the actual financial and economical benefits of these practices. Our land and other resources are very limited. Therefore, every practice particularly the land based practices should be well justified from the economic as well as ecological point of view. If introduction of tree species in the cropland and homestead areas would be economically profitable and act as benevolent to the farmers, then it (agroforestry) should be practiced for the betterment of the people to uplift their socio-economic condition.

Within the forestry profession economics generally seeks the answer to the "why" of a problem rather than the "how". Much of what a forester learns is how to grow trees under different environmental conditions or how to tell which species will grow better in a given place. Economics, on the other hand is usually concerned with such questions as to why should trees be grown in a certain environment instead of undertaking some other activity (Nautial, 1988).

Growing of tree species in crop fields was found to be extremely location specific. Species that are planted in crop fields are determined by land and soil type, family needs, market demand and tradition. Trees per farm are higher in case of large farmers (Abedin and Quddus, 1991). Bangladesh has 8.6 million ha of cultivated land within which about 29% is situated above normal flood level (FAO, 1991). This 29% (2.49 million ha) of the cultivated land is potential for cropland agroforestry (BBS, 1999).

Mixed cropping of annual and perennial crops in homestead area is often defined as homestead agroforestry (MacDicken, 1990). Homestead is the easiest niche for planting trees as it is the place where farmers usually grow a wide variety of trees. It has been reported that, the estimated 30,400 ha of homesteads of Bangladesh provide 85% of all wood consumed including 90% of all fuelwood and 90% of bamboo (Douglas, 1982). Homestead contributed about 10% of the total income of the farmers. The ratio of income from homestead did not vary significantly due to the farm size or homestead size (Miah *et al*,. 1990). The data from HAF practicing households in Bangladesh reveal that these farms have earned substantial income and production gains. The women of the households gained in terms of higher social status (Rahman, 1995). Total homestead area of Bangladesh is 1.32 million acres and average area per holding is 0.07 acre (BBS, 1999). This per holding homestead area has great potential to plant more trees in their farmland.

The objectives of the study are to find out and compare the financial values of homestead agroforestry, cropland agroforestry and annual cropping systems.

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Materials and Methods

The study was carried out in Rajshahi district of Bangladesh in 2001 at eight villages under four upazillas namely, Atghori and Chatari villages under Bagha upazilla; Baladiar and Charghat villages under Charghat upazilla; Dhokrakol and Nokulbaria villages under Puthia upazilla; Hatisail and Dhantere villages under Tanore upazilla of Rajshahi district. Rajshahi district is located between $24^0 07'$ and $24^0 43'$N latitude and between $88^0 17'$ and $88^0 58'$E longitudes (Bangladesh Population Census, 1991). It covers Tropical monsoon climate like other parts of Bangladesh. It rains about 90% of the total rainfall in the rainy season. The mean max. temperature and mean min. temperature is 35.3^0 C (in April) and 11.2^0 C (in January) respectively. The annual rainfall in winter, pre-rainy and rainy season is 46 mm, 232 mm and 1,276 mm respectively (Rajshahi Weather center, 1996). Topography of the four upazillas is more or less plain in nature and included in Ganga river floodplain area. The field survey was conducted at the more or less same type of site factors for cropland agroforestry, homestead agroforestry and annual cropping practices to compare among their different aspects.

The agroforestry program of the region is not old but in young stage. The pre-mature and matured agroforest were surveyed. In the field survey, the sampling units were selected at different stages because of the uneven and discrete distribution of agroforestry land in the region. A total of 192 samples were selected comprising 64 samples from each cropping systems. At first four upazillas of Rajshahi district were selected purposively depending on the availability of agroforestry type of lands. Then two unions from each upazilla were selected randomly. After that eight villages, one from each union, were selected randomly. Finally eight samples from each cropping system (CAF, HAF, AC) were selected from each village. Two sets of diagnostic semi-structured questionnaire were surveyed for conducting the survey. One is for cropland agroforestry or pure agricultural crops on agricultural land. The second one was for homestead agroforestry survey. Three traditional methods of profitability measurement have been used. These are Net Present Value or Present Net Worth (NPV or PNW); Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR).

Labor cost has been divided into market price cost and opportunity cost which includes establishment (such as field preparation, fencing, etc.), maintenance (weeding, irrigation, fertilizer and pesticides) and harvesting cost. Capital includes seeds, equipments or tools, ploughing, fertilizer (organic and inorganic), pesticides, irrigation, fodder, stacking, marketing and other cost. After getting the total costs, it is then compounded at 6% interest rate by using the compounding formula. For benefits, items such as food, fuel, fodder, timber and pole or post have been considered. Then calculating the total benefits, it is compounded at 6% rate of interest. Finally, the BCR is calculated by dividing the compounded benefits by compounded costs. The NPV and IRR have also been calculated following the profitability methods that indicate mainly the financial profitability of the three systems in the area. The calculation has been done on per acre per year basis.

Results and Discussions

Annual cropping system is the most traditional method in the study area. The main annual crops in the area are: different types of paddy, wheat and sugarcane. It is the most common cropping system in the area.

The Benefit Cost Ratio (BCR) of annual cropping system from overall financial analysis is found to be 2.30 that means if one farmer invest Tk. 1.0 then the farmer returns Tk. 2.30 per year per acre of land. In other word, one can get output (benefit) 2.30 times of the present value of the input (investment) per year per acre. It measures the amount of benefits, expressed in present value terms. The compounded cost is Tk. 149377 and compounded benefit is Tk. 356038.

The Net Present Value (NPV) of annual cropping is found to be Tk. 206662, which means a farmer returns a net surplus of Tk. 206662 of consumption benefits in present value terms taking into account the rate of interest of 6%. Any business or activities for which the estimated NPV is positive, is economically acceptable (FAO, 1979). Here the NPV is a higher value for one year per acre of land which indicate the acceptability of annual cropping system for the people of the area.

As a general rule, any Internal Rate of Return (IRR) over 8% may be considered satisfactory and anything over 12% highly satisfactory when assessing projects at the national economic level (Filius, 1982). The IRR of annual cropping is found to be 8.59%, which means Tk. 8.59 can be received back per year for each Tk. 1.0 invested during the years in which the investment is left in annual cropping system.

Cropland agroforestry is a new concept of cropping system in the area. Now people are growing trees in their cropland to get some extra benefits from the same piece of land. A small number of farmers practice the cropland agroforestry system in the area. But now a days, the number of cropland agroforestry farmers is

increasing. Mango (*Mangifera indica*), sissoo (*Dalbergia sissoo*), mahagony (*Swietenia macrophylla*), date palm (*Phoenix sylvestris*) and eucalyptus (*Eucalyptus species*) are the main tree species in CAF.

Table 1. Overall average financial analysis of cropland agroforestry (CAF) system (in Tk.).

Type of System	Cost (a)	Compounded Cost (b)	Benefits (c)	Compounded Benefit (d)	Net Benefits (c-a)	BCR (d/b)	NPV (d-b)	IRR (%)
Annual Crops (AC)	235951	265114	436825	490817	200875	1.85	225703	6.32
Tree Crops (TC)	11014	14806	122157	205021	111142	11.61	190215	37.57
AC+TC	246964	279920	558982	695837	312018	6.73	415918	15.67

Source: Field survey, 2001.

Overall average result reveals that the BCR of annual crop in cropland is 1.85 (Table 1). Net benefit is Tk. 200875 and the NPV is Tk. 225703 and IRR is 6.32%. The BCR of tree crops in cropland is 11.61; net benefit is Tk. 111142 and the NPV is Tk. 190215 and IRR is 37.57%. The BCR of combination of annual crop and tree crop i.e., cropland agroforestry (CAF) is 6.73. Net benefit is Tk. 312018, NPV is Tk. 415918 and IRR is 15.67%. Similar picture have been found by Shaikh (1995). People are now motivated towards CAF system as it is a new profitable cropping system for them.

Homestead agroforestry is also a traditional landuse system in the area. Now, some improved technologies are applied in the system to increase the profitability.

Table 2. Overall average financial analysis of Homestead agroforestry system (in Tk.).

Type of System	Cost (a)	Compounded Cost (b)	Benefits (c)	Compounded Benefit (d)	Net Benefits (c-a)	BCR (d/b)	NPV (d-b)	IRR (%)
Annual Crops (AC)	64972	73003	284065	319176	219093	4.35	246173	15.71
Tree Crops (TC)	27942	31395	592317	665527	564375	21.44	634132	45.34
AC+TC	92914	104398	876382	984703	783468	12.90	880305	36.09

Source: Field survey, 2001.

Overall average result reveals that the BCR of annual crop system in HAF is 4.35 (Table 2). Net benefit is Tk. 219093; the NPV is Tk. 246173 and the IRR is 15.71%. The BCR of tree crops in HAF is 21.44. Net benefit is Tk. 564375; the NPV is Tk. 634132 and IRR is 45.34%. The BCR of combination of annual crop and tree crop in HAF is 12.90; net benefit is Tk. 783468; the NPV is Tk. 880305 and the IRR is 36.09%.

Table 3. Comparison of profitability criteria among the three systems (AC, CAF & HAF).

Profitability Criteria	Annual Cropping	Cropland Agroforestry	Homestead Agroforestry
NPV (Tk.)	206662	415918	880305
BCR	2.30	6.73	12.90
IRR (%)	8.59	15.67	36.09

Source: Field survey, 2001.

From the above Table 3, it reveals that the profitability criterion of homestead agroforestry is the highest among the three systems (AC, CAF & HAF). The similar status of profitability criteria is seen in the Fig. –1. The overall average NPV of HAF is Tk. 880305 while for AC and CAF it is only Tk. 206662 and Tk. 415918 respectively i.e., HAF is 77% and 53% greater than AC and CAF respectively. The overall average BCR of HAF is 12.90 while for AC and CAF it is 2.30 and 6.73 respectively i.e., HAF is 82% and 48% greater than AC and CAF respectively. The overall average IRR of HAF is 36.09% while for AC and CAF it is 8.59% and 15.67% respectively i.e., HAF is 76% and 57% greater than AC and CAF respectively in the overall study area. These profitability criteria clearly indicate that homestead agroforestry system is the best and financially most profitable system in the study area. This is probably due to higher density of trees in HAF than that of CAF.

The Land Equivalent Ratio (LER) of the three cropping systems have also been compared (Table 4) and LER is determined by dividing returns of one landuse by another. It may symbolize LER=Returns from one landuse system/returns from another landuse system of same area. From the above Table 4, the uppermost LER is 4.26 between homestead agroforestry and annual cropping system. This designates that HAF landsue system is 4.26 times profitable than annual cropping landuse system. This LER has been calculated by suing Net Present Value (NPV) of the respective landuse systems. LER between CAF and AC is 2.01 reveals that

CAF is more than two times profitable than AC system. HAF is 2.12 times profitable than CAF system in the study area. So, from LER point of view, HAF is the most profitable system and Annual Cropping is the least.

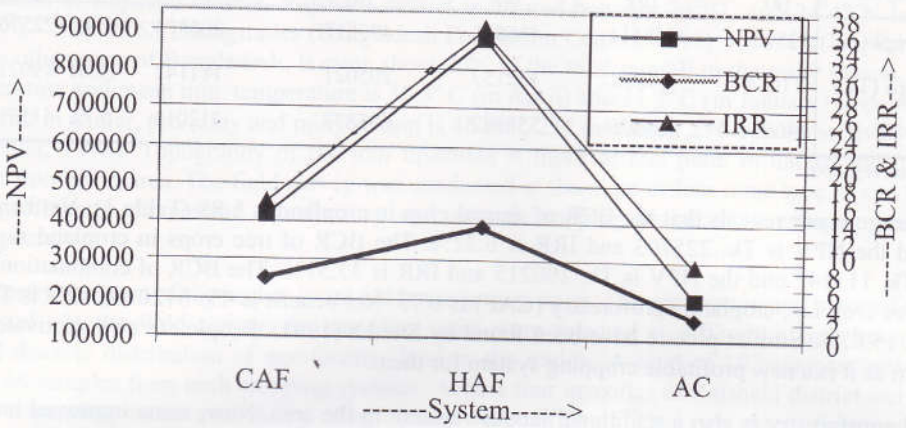

Fig. –1. Relationship among NPV, BCR and IRR of CAF, HAF and AC System I in the study area.

Table 4. Land Equivalent Ratio (LER) among the three systems in the area.

	Annual cropping	Cropland agroforestry	Homestead agroforestry
NPV (Tk.)	206662	415918	880305
LER Relation	CAF VS AC	HAF VS CAF	HAF VS AC
LER Result	2.01	2.12	4.26

Source: Field survey, 2001.

Conclusion

The potential and importance of trees as savings and security for many of the rural poor has been overlooked and neglected by outsider professionals. The outcomes and findings of this study obviously lead the people to take decision about agroforestry particularly in their cropland. Selection of suitable and appropriate tree species can make these systems technically and financially very attractive which would create interest about agroforestry. In this aspect, agroforestry field demonstration should be well organized and easy to know-how for the rural people. Out of the three types of cropping systems homestead agroforestry found to be more economically profitable and socially acceptable. There may have a government policy to afforest agricultural land to improve land productivity or to produce forestry benefit. If training for the local people by agroforestry professionals can be arranged fruitfully, then the people will be judicious for agroforestry and develop their living standards as well as can ameliorate the ecological imbalance. Some kind of incentive program (credit or land revenue exemption) is suggested to encourage cropland and homestead agroforestry. Appropriate silvicultural practice (mainly thinning and pruning) should be developed and followed. The practice of silviculture will not only secure intermediate income for especially the poor people but also improve the timber and non-timber product's quality. Future research agendas should entail a judicious blending of science and technology.

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