

Financial Variability of Shifting Cultivation Versus Agroforestry Project: A Case Study in Chittagong Hill Tracts

M.A. HOSSAIN¹, M.A. ALAM, M.M. RAHMAN, M.A. RAHAMAN[†] AND M.N. NOBI[‡]

Institute of Forestry and Environmental Sciences, and [‡]Department of Economics, University of Chittagong, Bangladesh

[†]Sylhet Forest Division, Sylhet, Bangladesh

¹Corresponding author's e-mail: aktar_forestry@hotmail.com

ABSTRACT

The present study compares the financial variability of shifting cultivation and agroforestry system practised in the Chittagong Hill Tracts (CHT) of Bangladesh. The study was conducted in Thanchi upazilla of Bandarban Hill District over a period of six months from January to June of 2003. A multi stage simple random sampling technique was adopted. Twenty farmers, each having at least five acres (1acre = 0.40468 ha) of cultivated land, were selected from each of the farming systems. The component compositions and the present return from the systems were explored through input-output analysis. Finally the financial variability of the farming systems was determined by comparing the Present Net Worth (PNW) calculated at 10% rate of discount with a project duration of 15 years. The PNW so calculated were Tk. 39,147 and Tk. 1, 16, 653, respectively in shifting cultivation and agroforestry project. The PNW of the agroforestry project was much higher than that of shifting cultivation. This will help in making decision for future investment in the farming sector in the region.

Key Words: Agroforestry; Component composition; Fallow period; Shifting cultivation; Present net worth

INTRODUCTION

Agriculture and forestry are interrelated landuse system in Bangladesh particularly in the southern hilly region of the country. The southern hilly part of Bangladesh popularly known as Chittagong Hill Tracts (CHT) administratively comprises three districts namely Ragamati, Bandarban and Khagrachari having a present population of 1.1 million (Khisa, 1998a); the historical development has marked it as a unique place (Ahmed, 2002). About twelve tribal communities inhabit in this region who earn their livelihood through shifting cultivation with some variations from place to place (Karim, 1994; BBS, 1997). The tribal communities of this region for centuries have been living on slash-and-burn agriculture (shifting cultivation or popularly known as jhum cultivation), fishing, hunting and harvesting of forest products (Millat-e-Mustafa *et al.*, 2002). Shifting cultivation is the indigenous technological knowledge of forest husbandry practised by the ethnic communities of the hills / mountains of humid tropics (Ramkrishnan, 1984). It is a distinct type of agricultural practice generally practised in the hill slopes after sacrificing the natural forest cover standing on it (Thakur, 1997). Shifting cultivators usually grow mixed crops in their land. The selection of crop pattern depends on their requirements as well as tradition (Hutchinson, 1906; Tewari, 1991). The shifting cultivation is practised in a particular plot and continued only for one or two years. The land is left fallow before being cleared for cultivation again. The fallow period is reported to be reduced to 5 years from 10-15 years, which their ancestors followed earlier. Again, Khisa (1998a) reported that the

length of fallow period has been reduced to 3-5 years.

This process of cultivation is bringing about massive deforestation and soil erosion. Khisa (1998b) opined that removal of vegetation on steep slope in conjunction with intense rainfall is triggering massive erosion and landslide resulting in impoverishing of soil and deteriorating of biophysical environment. Although dependable statistics is lacking, it is estimated that 2, 63, 342.76 ha (4.3% of CHT area) is cleared every year for shifting cultivation (Ishaq, 1971). Khisa and Farid (1996) studied that, land degradation along with the lack of appropriate farming technology, weak community organization, inadequate credit facilities and extension service, natural calamities, small land holdings and land tenure insecurity are leading to a sharp decline in the productivity of up-lands in the CHT and ultimately the farming system is becoming fragile. Several scientists have reported the harmful effects due to cutting and burning in shifting cultivation in the hilly areas of Bangladesh. Hossain *et al.* (1985) reported about soil erosion at the rate of 162 tone/ha/yr at Reinkhong Forest Reserves due to such activities. The effects of cutting and burning the vegetations in Bandarban are causing degradation of soil (Hassan & Mazumder, 1995), and soil erosion at the rate of 41.5 tone/ha/yr (Uddin *et al.*, 1997).

Rasul (2001) forwarded that, shifting cultivation is now in dwindling condition because of deteriorating soil quality and declining yield. However, SRDI (1986) showed that one third of the CHT covering an area of 27,000 ha is still with the potential of growing horticultural crops including other commercial cash crops like rubber, tea, coffee etc. Another study shows that, about 6% of the total

land of CHT is suitable for intensive cultivation and this constitutes a vital source for food production having scopes for significant increase in production (Khisra & Farid, 1996). Gain (1998) opined that shifting cultivation should surely be restricted and be replaced by a permanent mode of cultivation. But too hurried pushing of shifting cultivation will injure the tribal community system. The agricultural reform should be formed 'within'. The research in agronomy and sociology must go in hand incorporation with silviculture technology best suited to the microclimate of different hill slope. This type of cultivation should be acceptable socially, economically and environmentally (Borang, 1996).

According to Jha (1979), technology should be similar to traditional practice with low input and production cost. The agricultural system should be sustainable and be able to protect the land from degradation. Schlippe (1956) suggested to advocate finding improvement without doing violence to the limiting framework of tradition and environment. Due to these opinions, based on the deteriorating characteristics of shifting cultivation, many suggested to go for a sustainable and environment friendly cultivation system—agroforestry farming system. Forestall Forestry and Engineering Limited Survey (1966) suggested that most of the CHT land could be profitably used only for forestry or horticulture or a combination thereof.

The hill people are even not aware of the destructive impacts of shifting cultivation on their environment and economic life. These people are required to be motivated to adopt agroforestry farming system in place of shifting cultivation. In this field there is ample scope of study to explore more information for viable hill cultivation system. The field level research works on agroforestry farming system regarding this poor part of Bangladesh are very scarce. The vision of the present study is to highlight the economic viability and sustainability of agroforestry farming system and hence to get hill people self motivated for large scale adoption to practise this system leaving the traditional shifting cultivation.

METHODOLOGY

The study was conducted from January to June 2003. A multi stage simple random sampling technique was employed to collect necessary information. Bandarban district was selected as primary sampling unit while the secondary unit was Thanchi upazilla of the district. Balipara and Kamalongpara of Thanchi upazilla were selected as the ultimate sampling units. These two sites were selected since shifting cultivation is still prevalent in Balipara while CARITAS, Bangladesh (a local NGO) is implementing an agroforestry project in Kamalongpara. The key informants were selected with the active help of the project manager of KARITAS and the Headmen of the tribal villages.

A preliminary socio-economic survey was conducted in the areas to develop a list of the farmers involved in

shifting cultivations and in agroforestry projects. A detailed socio-economic survey was then conducted over the respondents to ascertain their age, educational status, land holdings, annual income etc. Information regarding the crop component composition, arrangement, interaction and functions of different components of the selected plots along with crop management and marketing system were finally sought out through a semi-structured interview schedule which was confirmed later on with the help of the available literature. The information was collected through personal contact with the farmers, physical visit to their field and group discussions focussing mainly on their land use pattern, crop component composition and livelihood. In both the cases such farmers were selected who manage at least an operative land of 5 acres (1 acre = 0.40468 ha).

A semi-structured questionnaire was used to collect field level information regarding the cultivation systems under consideration. Information was mainly from primary sources viz shifting cultivators and agroforestry project farmers. Group discussions were conducted with both male and female cultivators. The secondary information concerning background of traditional cultivation, meteorological and socio-demographic data of the communities were collected from published sources of Chittagong Hill Tracts Development Board, Bangladesh.

The average cost of production and yield obtained from shifting cultivation were compared with those of agroforestry project. The market value of timber was assessed from an intensive interview of the farmers and timber merchants of the local markets. For both shifting cultivation and agroforestry project the Present Net Worth (PNW) were compounded for a project duration of 15 years at a discount rate of 10%. The PNW was calculated with the following formula popularly known as Faustman's soil expectation value formula.

$$PNW = \frac{\sum_{t=0}^T B_t}{(1+i)^t} - \frac{\sum_{t=0}^T C_t}{(1+i)^t}$$

Where, B_t = Cash received at the end of t years

C_t = Investment at the end of t years

T = Number of years

i = Discount rate = required rate of return = interest rate

RESULTS AND DISCUSSION

Component composition. In the study area, 27 species were reported in shifting cultivation (Table I). Species in shifting cultivation were all agricultural crops including food grains, vegetables and cash crops. No perennial fruit, horticultural or timber species were reported in the shifting cultivation area (Fig. 1). In shifting cultivation the common species were *Oryza sativa*, *Sesamum indicum*, *Capricum frutescens*, *Gossypium herbaceum*, *Abelmoscus esculantus*,

Fig. 1. Crop compositions of shifting cultivation (L) and Agroforestry project (R)


Colcasia esculanta, *Cucurbita pepo*, *Zea mays*, *Lablab purpureus*, *Ipomoea batatas*, *Trichosanthes anguina*, *Abrus precatorius*, *Luffa acutangula*, *Momordica charantea*, *Trichosanthes diocia*, *Basella alba*, *Pithecellobium dulce*, *Carica papaya*, *Cucurbita maxima*, *Benincasa hispida*, *Solanum tuberosum*, *Saccarum officinarum*, *Manihot esculenta*, *Solanum melongena*, *Curcuma longa*, *Zingiber*

officinale, *Lageneria siceraria* etc. The crops in shifting cultivation were more diversified compared to that in agroforestry project.

In agroforestry project, 24 species were reported (Table I). One of the major components of agroforestry project was timber species, which was totally missing from shifting cultivation. The diversity of other components was more or less similar to that in shifting cultivation. Here timber species from medium to long rotation like *Tectona Grandis*, *Gmelina arborea*, *Albizia procera*, *Artocarpus heterophyllus*, *Michelia champaca* etc. were found in association with other horticultural and agricultural crops in the agroforestry project (Fig. 1). The prevalent species in the agroforestry project of the study area were *Musa paradisiacal*, *Musa sepientum*, *Annus comosus*, *Citrus reticulata*, *Psidium guajava*, *Carica papaya*, *Citrus aurantifolia*, *Curcuma longa*, *Colcasia esculanta*, *Abelmoscus esculantus*, *Luffa acutangula*, *Momordica charantea*, *Trichosanthes diocia*, *Basella alba*, *Solanum melongena*, *Cucurbita maxima*, *Lageneria vulgaris*, *Citrus paradisi*, *Capricum frutescens* etc. In agroforestry project, un-like shifting cultivation, vegetables of both summer and winter are grown.

Cost-benefit analysis of shifting cultivation. In shifting cultivation, the farmers incur the production capital from their own sources in most of the cases. Sometimes labourers were found to be exchanged among the farmers as the

Table I. Component composition of shifting cultivation and Agroforestry project (with project duration of 15 years)

Shifting cultivation				Agroforestry project			
Local name	Name of the species Scientific name	Harvestable time (year)	No. of productive years (shifts)	Local name	Name of the species Scientific name	Harvestable time (year)	No. of productive year
Dhan	<i>Oryza sativa</i>	1	4	Teak	<i>Tectona grandis</i>	15	1
Til	<i>Sesamum indicum</i>	1	4	Gamar	<i>Gmelina arborea</i>	15	1
Marich	<i>Capricum frutescens</i>	1	4	Sil Koroi	<i>Albezia procera</i>	15	1
Tula	<i>Gossypium harbaceum</i>	1	4	Champa	<i>Michelia champaca</i>	15	1
Bhendi	<i>Abelmoscus esculantus</i>	1	4	Kola	<i>Musa paradisiaca</i>	1	14
Kachu	<i>Colcasia esculanta</i>	1	4	Aittakola	<i>Musa sepientum</i>	1	14
Sada Kadu	<i>Cucurbita pepo</i>	1	4	Anarosh	<i>Annus comosus</i>	3	12
Bhutta	<i>Zea mays</i>	1	4	Komla Lebu	<i>Citrus reticulata</i>	8	7
Shim	<i>Lablab purpureus</i>	1	4	Peyara	<i>Psidium guajava</i>	6	9
Misti Alu	<i>Ipomoea batatas</i>	1	4	-	-	-	-
Chichinga	<i>Trichosanthes anguina</i>	1	4	Lebu	<i>Citrus aurantifolia</i>	4	
Gungchi	<i>Abrus precatorius</i>	1	4	Halud	<i>Curcuma longa</i>	1yr	14
Jhinga	<i>Luffa acutangula</i>	1	4	Kachu	<i>Colcasia esculanta</i>	1	14
Karulla	<i>Momordica charantea</i>	1	4	Bhendi	<i>Abelmoscus esculantus</i>		
Patol	<i>Trichosanthes diocia</i>	1	4	Jhinga	<i>Luffa acutangula</i>		
Puishak	<i>Basella alba</i>	1	4	Karulla	<i>Momordica charantea</i>		
Khoi	<i>Pithecellobium dulce</i>	1	4	Patol	<i>Trichosanthes diocia</i>		
Pepe	<i>Carica papaya</i>	1	4	Puishak	<i>Basella alba</i>		
Misti kumra	<i>Cucurbita maxima</i>	1	4	Begun	<i>Solanum melongena</i>		
Chal kumra	<i>Benincasa hispida</i>	1	4	Misti kumra	<i>Cucurbita maxima</i>		
Gol Alu	<i>Solanum tuberosum</i>	1	4	Pepe	<i>Carica papaya</i>		
Akh	<i>Saccarum officinarum</i>	1	4	Lau	<i>Lageneria vulgaris</i>		
Shimul Alu	<i>Manihot esculenta</i>	1	4	Shaddock	<i>Citrus paradisi</i>		
Begun	<i>Solanum melongena</i>	1	4	Marich	<i>Capricum frutescens</i>		
Halud	<i>Curcuma longa</i>	1	4				
Ada	<i>Zingiber officinale</i>	1	4				
Lau	<i>Lageneria siceraria</i>	1	4				

Table II. Schedule of cost for 5 acres of lands in shifting cultivation: (Value in Tk.*)

Items		Year											
		1	2	3	4	5	6	7	8	9	10-12	13	14 - 15
Labour	Felling, cutting and burning of stumps etc.	180	F	90	F	90	F	90	F	90	F	90	F
(Man days)	Creation of fire line	30	F	12	F	12	F	12	F	12	F	12	F
	Shack construction	4	F	4	F	4	F	4	F	4	F	4	F
Labour	Seed sowing	90	F	80	F	80	F	80	F	80	F	80	F
(Man days)	Vegetable sowing	12	F	12	F	12	F	12	F	12	F	12	F
	Weeding-1	12	F	12	F	12	F	12	F	12	F	12	F
	Weeding-2	12	F	12	F	12	F	12	F	12	F	12	F
	Harvesting	180	F	180	F	180	F	180	F	180	F	180	F
	Total man days	520	F	402	F	402	F	402	F	402	F	402	F
	Total labor cost @Tk. 50	26000	F	20100	F	20100	F	20100	F	20100	F	20100	F
Materials	Paddy seed	900	F	900	F	900	F	900	F	900	F	900	F
and	Vegetables	2073	F	2073	F	2073	F	2073	F	2073	F	2073	F
Equipment	Agricultural equipment	400	F	400	F	400	F	400	F	400	F	400	F
	Material (Shack construction)	500	F	500	F	500	F	500	F	500	F	500	F
	Cash crop	1013	F	1013	F	1013	F	1013	F	1013	F	1013	F
	Total cost Tk.	4886	F	4886	F	4886	F	4886	F	4886	F	4886	F
Grand Total Tk.		30886	F	24986	F	24986	F	24986	F	24986	F	24986	F

* Tk. 60 = 1 US Dollar F = Fallow period

Table III. Schedule of cost for 5 acres of lands in Agroforestry model (Value in Tk.*)

Item		Year														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Labour	Felling, cutting and burning of stumps etc.	100	4	4	4	4	4	4	4	4	4	4	4	4	4	4
site	Pit digging															
preparation	Timber	18														
(Man days)	Fruit	15														
	Vegetables	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Labour	Seed sowing and planting	30		5												
planting and	Weeding	10	8	8	8											
management	Fertilizer and insecticide application	5	5	5	5											
(Man days)	Protection	20	15	15	4	4	4	4	4	4	4	4	4	4	4	4
	Harvesting	30	30	42	45	45	47	47	52	52	50	50	50	50	50	300
	Total man days	248	82	99	91	73	75	75	80	80	78	78	78	78	78	328
	Total labour cost @ Tk. 50	12400	4100	4950	4550	3650	3750	3750	4000	4000	3900	3900	3900	3900	3900	16400
Materials and	Seeds	1065	1065	1065	1065	1065	1065	1065	1065	1065	1065	1065	1065	1065	1065	1065
Equipments	Suckers	3107	945	945	945	945	945	945	945	945	945	945	945	945	945	945
	Seedlings	3035		500												
	Fertilizer	1910	1000	1000	1000											
	Insecticides	100	100	100	100											
	Total cost (Tk.)	9217	3110	3610	3110	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
Grand total (Tk.)		21617	7210	8560	7660	5660	5760	5760	6010	6010	5910	5910	5910	5910	5910	18410

* Tk. 60 = 1 US Dollar

shifting cultivation activities are within a certain time limit. Both male and female counterparts of a cultivator's family were equally engaged in the production system. Sometimes labourers were hired and Tk. 60 and Tk. 40 were usually paid for female and male labourers, respectively on daily basis. The family labourers, in the study, were calculated at the same rate and were considered paid. Other costs such as exchanged labourers, purchasing of seeds and other agricultural implements were carefully included to sum up the total production cost of shifting cultivation. Since the land under shifting cultivation was left fallow for three years, there were only four productive years in 15-year project duration. The first shift required higher cost compared to sub-subsequent shifts. The cost in the first shift was Tk. 30,886 for 5 acres of land and each of the sub-subsequent shifts required Tk. 24,986 (Table II).

The production in the shifting cultivation was found to

decline in the subsequent shifts. The production was the highest in the first shift and it worth Tk. 48,695 (Table IV). The 2nd, 3rd and 4th shifts brought to the farmers Tk. 43,200, Tk. 41500 and Tk. 41100, respectively. The highest benefits derived from paddy, vegetables, cash crops, and firewood (obtained in the first shift) were found to be Tk. 7,500, Tk. 26,195, Tk. 10,000 and 5,000, respectively while the lowest (obtained in the last shift) were Tk. 7100, Tk. 25000, Tk. 9000, from paddy, vegetables, cash crops, respectively and no return from firewood. Comparing the total input and output from the shifting cultivation, it is found that the farmers were getting almost the same production equal to their input cost. Farmers were providing their own family labour to balance the cost.

Cost-Benefit analysis of agroforestry project. The daily payment for each labourer was taken to be Tk. 50 as per the rate fixed by CARITAS, a local NGO implementing an

Table IV. Inflow of revenues from 5 acres of land in shifting cultivation (Value in Tk.*)

Sources and income	Year							
	1	2 - 4	5	6 - 8	9	10-12	13	14-15
1. Paddy	7500	F	7200	F	7000	F	7100	F
2. Vegetable	26195	F	26500	F	25500	F	25000	F
3. Cash crop	10000	F	9500	F	9000	F	9000	F
4. Firewood collection	5000	F		F		F		F
Total (Tk.)	48695	F	43200	F	41500	F	41100	F

* Tk. 60 = 1 US Dollar F = Fallow period

Table V. Inflow of revenues from 5 acres of land in Agroforestry models (Value in Tk.*)

Sources of income	Year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Vegetables	3947	3947	3947	3947	3947	3947	3947	3947	3947	3947	3947	3947	3947	3947	3947
2. Fruits	3731	3731	17467	14673	14673	14673	14673	29154	29154	28000	26915	24950	22540	22050	19800
3. Cash crop	1772	1772	1772	1772	1772	1772	1772	1772	1772	1772	1772	1772	1772	1772	1772
4. Firewood	3000														
5. Timber															4440237
Total	12450	9450	23186	20392	20392	20392	20392	34873	34873	33719	32634	30669	28259	27769	4465756

* Tk. 60 = 1 US Dollar

Table VI. PNW for 5 acres of lands in shifting cultivation and agroforestry project (Value in Tk.*)

Land use pattern	Year															TNPV
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Shifting Cultivation	Revenue	48695	F	F	F	43200	F	F	F	41500	F	F	F	41100	F	F
	Cost	30886	F	F	F	24986	F	F	F	24986	F	F	F	24986	F	F
	Net Revenue	17809	F	F	F	18214	F	F	F	16514	F	F	F	16114	F	F
	DF	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319	0.29	0.263	0.239
	PNW	16188	F	F	F	11311	F	F	F	7002	F	F	F	4674	F	F
Agroforestry	Revenue	12450	9450	23186	20392	20392	20392	20392	34873	34873	33719	32634	30669	28259	27769	4465756
	Cost	21617	7210	8560	7660	5660	5760	5760	6010	6010	5910	5910	5910	5910	5910	18410
	Net Revenue	-9167	2240	14626	12732	14732	14632	14632	28863	28863	27809	26724	24759	22349	21859	4447346
	DF	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319	0.29	0.263	0.239
	PNW	-8333	1850	10984	8696	9149	8252	7506	13479	12238	10734	9353	7898	6481	5749	1062916

* Tk. 60 = 1 US Dollar F = Fallow period DF = Discounting Factor

agroforestry project. The cost involvement for agroforestry project had a wide variation in different years within the 15-year project duration. The highest annual cost was Tk. 21617 incurred in the first year of the project followed by the amount Tk. 18410 incurred in the concluding year of the project (Table III). In the year of the project establishment, the farmers had to bear the total input cost (fixed cost and variable cost) and in the final year they had to harvest about 2000 trees along with other agroforestry crops, which increased the cost in these years. The cost from 2nd to the 14th year was mainly related to the production of annual vegetables and cash crop. This is because the annual cost incurred in these years was low. A noticeable character in the annual cost from the 2nd year to the 9th year was that, it showed a diminishing sequence with a slight irregularity. But from the 10th through the 14th year it remained static. The underlying reason of this static condition is that the project has reached its optimum level of production. The project may be considered economically viable for crop production until it shows a further diminishing nature.

The cash inflow in the agroforestry project started from the 1st year of its establishment with an amount of Tk 12450 and it showed an increasing trend up to the final year with an exception in the 2nd year (Table V). The lowest amount of return of Tk. 9450 was obtained in the 2nd year,

as there had been no firewood collection in that year and not all other agroforestry components were in production other than vegetables, cash crops and some fruits. Annual vegetables and cash crops were the source of the starting revenues. A sustainable state of revenue collection is a prominent feature of agroforestry project. In every year the farmers got considerable revenue. However, a slight fluctuation was observed in the rate of production due to the termination after the 3rd year of some species like banana. The more aged the project became, the more number of components entered into production system. In the final year, except for some annuals like papaya or banana, almost all the components were found to add to farmers' economic return. Among the agroforestry components, timber contributed the highest portion of income. The highest return was Tk. 4465756 obtained from the 15th year's production (Table V). This amount is too high compared to other years. The reason behind this is the harvesting of about 2000 timber species from the project farm. Except for lemon and pineapple, most of the fruit crops were in production from the 8th year to the end of the project duration.

Comparative Analysis. For shifting cultivation the revenue came only in four shifts leaving the farm 11 years in total out of 15 years as fallow land. The total PNW in the 1st, 2nd, 3rd

and 4th shifts were Tk.16, 188, Tk.11, 310, Tk.7001 and Tk.4673, respectively (Table VI). The cash inflow was not continuous in this farming system. But in agroforestry the scene is different with continuous inflow of income. PNW of shifting cultivation was always positive. But in agroforestry project, both net revenue and PNW in the first year of production were negative due to the higher initial investment. There after, the PNW in the agroforestry went on increasing. At the end of the project, the total PNW became Tk. 39,174 in shifting cultivation and Tk. 11, 66, 953 in agroforestry project (Table VI). The comparative study between shifting cultivation and agroforestry project showed that agroforestry technology was economically more viable compared to shifting cultivation.

CONCLUSION

Agroforestry project in the study area accounted for food, immediate and long term return with an involvement of little external input may be an attractive alternative of shifting cultivation practice since the PNW of agroforestry project was much higher than that in shifting cultivation. It can be remarked that agroforestry project was more profitable as well as sustainable practice for hilly people from the financial point of view. Moreover, agroforestry farming system is environmentally sound and not a causing agent of soil erosion and landslide. It is also not associated to deforestation as in the case of shifting cultivation. Hence, agroforestry could be the best alternative to shifting cultivation at the moment.

REFERENCES

- Ahmed, F.A., 2002. An Ehtnographic perspective on the CHTs: the people and the resources. *In: Farming practices and sustainable development in Chittagong Hill Tracts* (N.A. Khan *et al.* eds.), pp. 11–34. CHTDB, Government of Bangladesh and VFFP-IC Swiss Agency for Development and Co-operation
- Bangladesh Bureau of Statistics (BBS), 1997. *Statistical Year Book of Bangladesh*, Ministry of Planning, the People Republic of Bangladesh, Dhaka, Bangladesh
- Borang, A., 1996. Jhum Fallow and its rehabilitation strategy for Arunachal Province. *In: S.P. Shukla and N. Sharma* (eds.) *Sustainable Development Strategy (Indian Context)*, p. 379. Mittali Publication, Delhi
- Forestal, 1964. *Reconnaissance soil and land use survey: Chittagong Hill tracts*, Forestry and Engineering Int. Ltd. Vancouver, Canada
- Gain, P., 1998. *Forest and Environment: Facing the 21st Century*, pp. 93. Society for Environment and Human Development, Dhaka
- Hassan, M.M. and A.H. Mazumder, 1995. *Land Management for sustainable productivity in Chittagong Hill Tracts based on Geographical Characteristics*, Paper No. 7. Paper prepared for presentation at the National workshop on Development experiences and projects in Chittagong Hill Tracts organized jointly by ICIMOD/Special Affair Division/ CHTDB/BIDS, held at Rangamati from 23–25 January 1995
- Hossain, M. and B.K. Jahangir, M.A.U. Sarker, F.I. Choudhury and M.S. Rahman, 1985. *Country report of slash and burn forestry communities in Bangladesh*, Dhaka
- Hutchison, R.H.S., 1906. *An account of Chittagong Hill Tracts.*, p. 202. The Bengal Secretariat Book Depot, Calcutta
- Ishaque, M., 1971. *Bangladesh Districts Gazetteers-Chittagong Hill Districts*, p. 319. Ministry of Cabinet Affairs, Government of the People Republic of Bangladesh, Dhaka
- Jha, L.K., 1979. *Shifting Cultivation*, p. 194. APH publication, New Delhi
- Karim, A.H.M.J., 1994. *Parbatya Chattagramer Upajatyoder Bhashagoto Boishadrishtya; Proborton O Songmisron* (in Bengali). *Shomaj Nirikkhon* 51: 63–75
- Khisa, S.K., 1998 b. Farming system approach to land husbandry and watershed management in the culture of ethnic communities of Chittagong Hill Tracts. *In: M.O. Gani, S.K. Bose and L.R. Khan* (eds.) *Application of indigenous knowledge in watershed management in Bangladesh*, pp. 46–53. Proceeding of the National Workshop held at Bangladesh Forest Academy, Chittagong from 30 November to 03 December 1997
- Khisa, S.K., 1998a. *Ethno botanical and cultural background of the ethnic communities in forest resource management in Chittagong Hill Tracts*, p. 17. Paper presented at the Ethno botanical seminars, held at BFRI, Chittagong From 17th December to 22nd December, 1997
- Khisa, S.M. and A.T.M. Farid, 1996. Promoting a farming system approach to soil conservation in Chittagong Hill Tracts, Bangladesh. *In: S. Sombatpanit, M.A. Zobisch and M.G. Cook* (eds.) *Soil Conservation Extension: From concept to application*, pp. 316–24. Soil and Conservation Society of Thailand
- Millat-e-Mustafa, M., M.A. Siddiqi, N.A. Khan and M.S. Newaz, 2002. An empirical study on the *Jhum* farming system in the CHTs. *In: Farming Practices and Sustainable Development in Chittagong Hill Tracts* (N.A. Khan *et al.* eds.), pp. 65–79. CHTDB, Government of Bangladesh and VFFP-IC Swiss Agency for Development and Co-operation
- Ramkrishnan, P.S., 1984. The Science Behind Rotational Bush Fallow Agriculture System (*Jhum*) Proceedings of the Indian Academy Science. *Pl. Sci.*, 93: 397–400
- Rasul, G., 2001. *Evaluation and Changes in shifting cultivation in south and south East Asia: process and detriments*, A special study submitted to Asian Institute of Technology, Thailand, in July 2001
- Schlippe, D.E., 1956. *Shifting Cultivation in Africa*. Routledge and Paul, London
- SRDI (Soil Research and Development Institute), 1986. *Reconnaissance soil and land use survey: Chittagong Hill Tracts*, p. 206. Soil Resources Development Institute, Dhaka
- Tewari, D.N., 1991. Shifting cultivation in India. *Indian Forester*, 117: 91–10
- Thakur, B.N., 1997. Impact of shifting cultivation on forest ecosystem. *In: Mohapatra, P.M. and P.C. Mohapatro* (eds.), *Forest Management in Tibet Areas*, Dehradun. pp. 99–104
- Uddin, S.J. and S. Hossain, L. Rahman and S. Rahman, 1997. *Annual Report: 1996-97*. Soil Conservation and Watershed Management Center. SRDI, Bandarban, Bangladesh

(Received 20 June 2005; Accepted 08 October 2005)