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Full Length Research Paper

An overview on shifting cultivation with reference to Bangladesh

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Shifting cultivation is a form of land use among resource poor communities with a rotation of cultivation and fallow in the same unit of land. Millions of indigenous people are dependent on shifting cultivation practice, with majority households for subsistence living. This practice is in transition these days with rising population of shifting cultivators and demand for more food. Bangladesh like other neighboring countries has hills which are subjected to degradation due to deforestation enhanced by shifting cultivation. There has been a continuous debate on shifting cultivation. Soil erosion is in large extent in Chittagong Hill Tracts (CHT) due to faulty cultivation in hill slopes, shifting cultivation, change in land use and reduction of land cover. This paper provides a review on shifting cultivation practice in the world with reference to Bangladesh, with an insight on emerging land use transition, its impacts and future priorities.

Key words: Shifting cultivation, biodiversity, fallow, climate change, Bangladesh.

INTRODUCTION

Shifting cultivation is a form of land use among resource poor communities with a rotation of cultivation and fallow in the same unit of land. It involves the clearing of certain patches of forests by slashing and/or burning (in many cases), followed by short span of crop cultivation and long span of fallow period. It involves the cyclical shifting of cultivation sites.

Kerkhoff and Sharma (2006) referred to shifting cultivation as an adaptive forest management practice predicated on sound scientific principles that productively uses hill and mountain lands, conserves forest, soil, and water resources, and is ecologically preferable to alternative agricultural and forestry activities. Shifting cultivation in Bangladesh (locally known as Jhum), is the land use practice in which indigenous communities clear and cultivate secondary forests in plots of different sizes, leave these plots to regenerate naturally through fallows of medium to long duration. Hills constitute about 12% of total area of Bangladesh having alternating beds of little-consolidated sands and shale providing a basis for the formation of complex mixtures of deep and shallow soils. Hills are located in the south and southeastern parts of the country, and are often located on tracts susceptible to erosion and difficult to irrigate.

Mostly, human induced land degradation in the form of water erosion is severe in the hills. About 2.5 million tons of soil is transported from hills to the foot hills (piedmont), drainage channels and ultimately to floodplains and sea (Shoaib et al., 1998). Jhum is the major agricultural practice in hilly areas occupying about 32000 ha/yr and average soil loss from Jhum is 40-45 t/ha/yr, the highest being observed in steep (33-42%) slopes and the lowest in gentle slopes (15%) (Shoaib et al., 1998). The economic implication of land degradation is enormous. An assessment has been made in terms of crop production loss and additional agricultural inputs needed to maintain soil nutrient levels. It was estimated that total economic cost of land degradation (inclusive of hills) in Bangladesh exceeded an amount of 2000 million US$ per year (GOB-BCSA-SACEPNORAD-UNEP, 2001).

This review paper focuses on the productivity and land degradation due to shifting cultivation in Chittagong Hill Tracts (CHT) and possible interventions to check the degradation processes.

Table 1. Distribution of high and low hills in Bangladesh.

Greater District	High hills (hectares)		Low hills (hectares)	
	Tipam-Surma formation		Dupitila formation	
Chittagong Hill Tracts	650,887	86.0	279,461	48.7*
Chttagong	100,516	13.3	134,700	23.5
Noakhali	-	-	1,226	0.2
Comilla	-	-	3,120	0.5
Sylhet	5284	0.7	147,638	25.7
Jamalpur	-	-	6,136	1.1
Mymensingh	-	-	1,431	0.3
Total	756,687	100	573,892	100

Source: Land Resources Appraisal of Bangladesh, FAO (1999). * Percentage of total hill area.

Hills of Bangladesh

Hills of Bangladesh could be broadly classified in two classes depending on the formation- Tipam-Surma (57%) and Dupitila (43%) distributed in different districts (Table 1). Major areas covered by hills occur in CHT (Rangamati, Bandarban and Khagrachhari hill districts) which is about 70%. Chittagong and Sylhet hills occupy about 18 and 11%, respectively. Reserve forests are mostly concentrated in CHT but also there are some reserve forests in other districts. Other than CHT, hills are used for growing many commercial and high value crops like tea in Sylhet and Chittagong, rubber, pineapples and other fruits (guava, *Psidium* sp.; lemon, *Citrus limon;* kul, *Ziziphus ziziphus*; mango, *Mangifera indica*; orange, *Citrus sinensis* etc) in addition to forest species. In reality, degradation of land and productivity decline in hills are mainly focused in CHT and other areas skip attention of planners, policy makers and environmentalists.

Shifting cultivation and land degradation

Shifting cultivation by ethnic minorities is accounted for major deforestation and subsequent land degradation in the hills though it is their only farming activity. There has been a noticeable deforestation in CHT. The Reinkhyong, Kassalong, Sangu and Matamuhuri reserve forests have been worst affected due to settlement of plain land people in hills, encroachments by displaced jhumias and also because of illegal logging during 1979-1984. Several research works were conducted with shifting cultivation in different parts of the world and in Bangladesh. Many scientists have reported that shifting cultivation causes land degradation by encouraging erosion of fertile topsoil with ultimate exposure of rocks (Kleinman et al., 1995). A considerable amount of nutrients is also washed away from the upper 10 cm soil with run off sediments as an outcome of shifting cultivation (Gafur, 2001; Gafur et al., 2003). Weil (1982) has found a significant reduction in the organic matter content and the total nitrogen of the soil due to erosion in the Upper Mahaweli catchments in Sri Lanka.

The rate of soil erosion varies with the elevation of the land and type of crop that is grown. In Bangladesh, there is an evidence that the use of contour hedgerows on steep slopes (40-50%) can reduce erosion by 55-80% and run off by 30-70% compared to shifting cultivation (Khisa, 2001). Several agro-forestry production techniques, designed with locally adapted trees and crops for different slopes are found to optimize the production of agro-forestry crops and minimize environmental degradation in the hills of Bangladesh (Paul and Hossain, 2001).

On the contrary, a number of scientists are of the opinion that shifting cultivation is not as alarming as often posed. It was good for the time when it emerged as the population was low. The merits of this system are: it causes least disturbance to soil, build up natural fertility through remains of mixed cropping (rice, maize, sesame, cotton, beans, cucumber, chilies, yam, ginger, banana, etc.) on moderate to steep slopes with minimum tillage under rainfed condition depending on local resources (Sharma, 1976). The economics and efficiency of shifting agriculture has been studied in Meghalaya and other states of north east India by a team of scientists led by P.S. Ramakrishnan. These studies showed that, far from being primitive and inefficient, jhum is an ingenious system of organic multiple cropping well suited to the heavy rainfall areas of the hill tracts. The economic and energetic efficiency of jhum is higher than alternative forms of agriculture such as terrace and valley cultivation (Ramakrishnan, 1992).

Soil nutrient build up was observed to be highly influenced by the topographical condition of slopes and on vegetative cover (Luna-Orea et al., 1996). Slopes under bamboo and trees with undergrowth like *Mikana rodata*, *Eupatorium odoratum* shrubs and creepers showed good accumulation and retention of nutrients. Rill formation was observed on 3% slopping land of 43 m length (Truman et al., 2002). On an average soil organic carbon (SOC) was found highest (3%) under forest cover

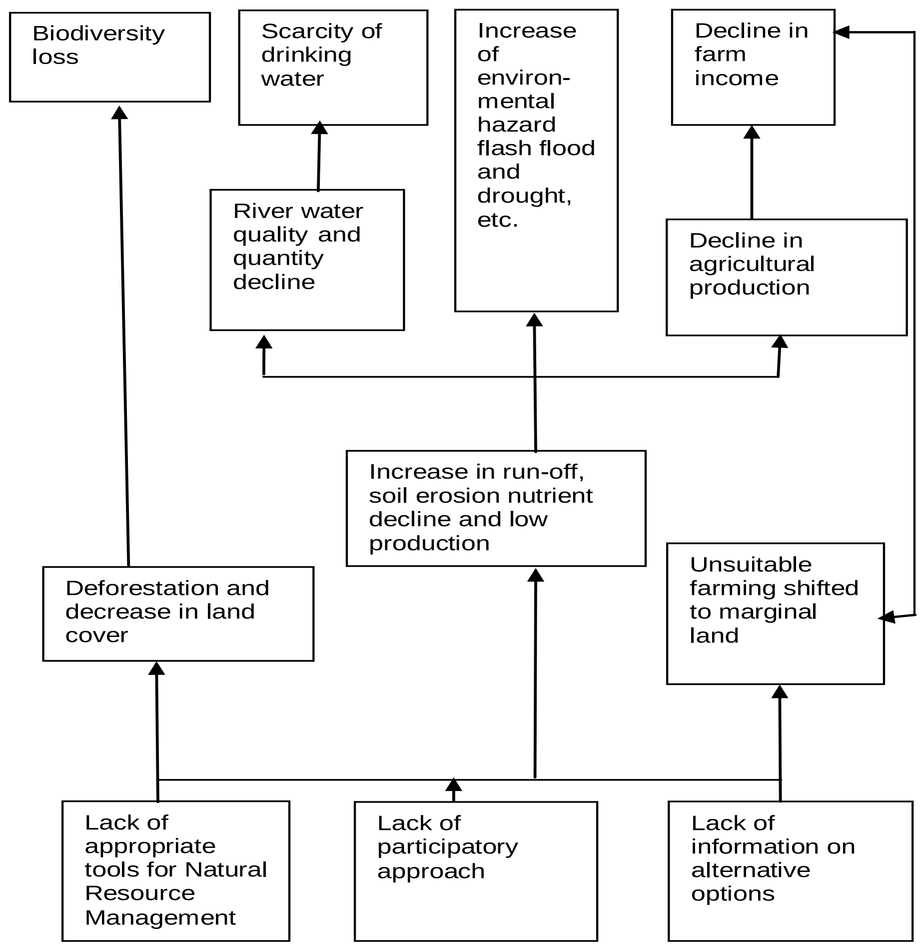

Figure 1. Schematic diagram showing interrelated factors causing declining productivity and land degradation in Chittagong Hill Tracts (after Shoaib, 2007).

and lowest (1.6%) in soils used for tuber crops. On the other hand, decreasing trend in SOC, N and P, slight increase in K was observed in soils under Unclassed State Forest between 1992 and 2001 (Shoaib, 2007). Productivity and land degradation in CHT may be explained by the following flow chart (Figure 1).

In traditional shifting cultivation, land is denuded and exposed to degradation forces like water erosion, land slide, etc. On the contrary, modern planting approach keeps the land covered and obstructs speedy run off and thereby restricts water erosion and landslide. The difference between traditional shifting cultivation and modern planting approach can easily be noticed from Figures 2(a) and (b).

Shifting cultivation and biodiversity

Both the cropping phase and the forest-fallowing phase host a rich biodiversity, including crop diversity (Liang et al., 2009). However, shifting cultivation and other utilitarian activities are widely believed to be incompatible with conservation of biological diversity (Terborgh, 1999). The effect of shifting cultivation on biological diversity depends on specific attributes of the disturbances created and the niche, dietary, habitat, and other requirements of individual species. More specifically, the type, size, intensity, duration, frequency, and return interval of shifting cultivation affects and in turn are affected by flora and fauna (Wangchuk, 2005; Kerkhoff and Sharma, 2006).

Relationships between biological diversity and historical anthropogenic disturbances, particularly shifting cultivation, collection of forest products, and extensive livestock grazing, warrant empirical investigation and that one should not simply assume a negative relationship a priority (Namgyel et al., 2008). Whether shifting cultivation is beneficial or not, congenial to conservation depends on the specific conservation objective (Kerkhoff and Erni, 2005).

No systematic study has been done in Bangladesh to find out the relationship between shifting cultivation

Figure 2(a). Traditional shifting cultivation.

Figure 2(b). Contour planting.

and bio-diversity.

Changing shifting cultivation scenario over time

Lands available for shifting cultivation are shrinking (Rasmussen and Jensen, 1999). A natural process of agricultural intensification under population pressure with increased frequency of land use has been described by many other authors as the process of shifting cultivation breaking down or becoming unsustainable (Gilruth et al., 1995; Juo and Manu, 1996; Szott et al., 1999). Traditional shifting cultivation in the tropics integrates a relatively short cropping phase and a relatively long forest-fallowing phase as a rotational system in space and time (Yin, 2001; Kerkhoff and Sharma, 2006). Traditional shifting cultivation in long fallow shifting cultivation is generally higher; however, the short fallow periods have limited such capacity (AIPP/IWGIA/IKAP, 2009).

In Bangladesh, with increase in population, practicing shifting cultivation in these areas, reduced the cycle of slash and burn agriculture, from 15-25 years in 1960's to 2-4 years in 1990's promoting land degradation. Shifting cultivation practice in Nepal in many cases is characterized by 2-4 years of cultivation and 4-9 years of fallow. There is severe lack of information on the effect of varying fallow period on the carbon stock throughout the soil profile.

Importance of fallowing in shifting cultivation

Weed suppression and build up of ecosystem fertility are the two major reasons for fallowing. The fallowing phase is essential to help restore soil fertility lost during the preceding cropping phase (Liang et al., 2009). Many studies have demonstrated that weeds become more problematic when the fallow is short (de Rouw, 1995; Dingkuhn et al., 1999). When the fallow period goes below 3-4 years, soil fertility is not renewed, and erosion and weed competition increase dramatically (Van Keer, 2003). Yield levels in shifting cultivation are influenced by a wide range of biophysical, socioeconomic, and cultural factors and it is difficult to isolate fallow length as a single determining factor.

Shifting cultivation and climate change

Shifting cultivation is widely believed as a practice promoting deforestation and carbon emission. Cumulative losses from shifting cultivation in the tropics can affect the local to regional to global balance of carbon and nutrient cycles. Eaton and Lawrence (2009) found that the repeated shifting cultivation further depressed carbon stocks in live above-ground biomass and coarse woody debris and carbon fluxes in litter. Additional cycles of shifting cultivation may limit future recovery of ecosystem carbon through a decrease in organic matter inputs to the soil. Above-ground carbon stock in long fallow shifting cultivation with cycles of 8 years and more was found to be between 74 and 80 t/ha. When shifting cultivators are forced to shorten their cycle to 4 years fallow, the carbon stock is reduced to 8-9 t/ha. Under continuous annual cropping, the carbon stock is only 1-4 t/ha. When comparing with industrial tree plantations such as oil palm monocultures, the carbon sequestration capacity of agro-forestry systems, including traditional long fallow shifting cultivation is generally higher, however, the short fallow periods have limited such capacity (AIPP/IWGIA/IKAP, 2009).

Approach towards sustainable land management

Efforts were also observed to upscale the livelihood and sustainability of sloping land by incorporating local knowledge with resource based technologies and approaches. Among them, agro-forestry, watershed based production unit, multilayered home garden, contour planting, papaya/flower in jhum, community forest management, seepage water harvesting, etc are the potential technologies adopted by the hill dwellers for sustainable livelihood (Shoaib, 2007). More documentation of local knowledge based technologies, refinement and dissemination will empower the hill dwellers in managing their lands.

CONCLUSION

Shifting cultivation is in transition across the world. The characteristics of the shifting cultivation are changing over time. Reducing fallow period, or in some cases with no fallow, and changing vegetation management practices are major alterations in shifting cultivation.

Altering crop and fallow management practices are widely perceived and practiced to improve the traditional shifting cultivation practices. The available studies on shifting cultivation in Bangladesh are inadequate in concluding status, distribution, management practices and practical implications in relation to this practice. There is an urgent need of systematic studies on shifting cultivation in Bangladesh, and based on this, result based recommendations will be provided to the government for its mainstreaming in national plans, policies and priorities.

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