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# The Impact of Policy and Institutional Environment on Costs and Benefits of Sustainable Agricultural Land Uses: The Case of the Chittagong Hill Tracts, Bangladesh

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**Abstract** As in other mountain regions of Asia, agricultural lands in the Chittagong Hill Tracts (CHT) of Bangladesh are undergoing degradation due primarily to environmentally incompatible land-use systems such as shifting cultivation (*jhum*) and annual cash crops. The suitable land-use systems such as agroforestry and timber tree plantation provide benefit to the society at large, but they might not provide attractive economic benefits to farmers, eventually constraining a wide-scale adoption of such land-use systems. Therefore, it is essential to evaluate agricultural land-use systems from both societal and private perspectives in the pursuit of promoting particularly environmentally sustainable systems. This article evaluated five major land-use systems being practiced in CHT, namely *jhum*, annual cash crops, horticulture, agroforestry, and timber plantation. The results of the financial analysis revealed the annual cash crops as the most attractive land use and *jhum* as the least attractive of the five land-use systems considered under the study. Horticulture, timber plantation, and agroforestry, considered to be suitable land-use systems particularly for mountainous areas, held the middle ground between these two systems. Annual cash crops provided the highest financial return at the cost of a very high rate of soil erosion. When the societal cost of soil erosion is considered, annual cash crops appear to be the most costly land-use system, followed by *jhum* and horticulture. Although financially less attractive compared to annual cash crops and horticulture, agroforestry and timber plantation are the socially most beneficial land-use systems. Findings of the alternative policy analyses indicate that there is a good prospect for making environmentally sustainable land-use systems, such as agroforestry and timber plantation, attractive for the farmers by eliminating existing legal and institutional barriers, combined with the provision of necessary support services and facilities.

**Keywords** Agricultural land use · Policy and institutional environment · Market failure · Cost · benefit analysis · Chittagong Hill Tracts · Bangladesh

## Introduction

Agricultural land degradation caused by soil erosion has been a serious environmental and economic problem in developing countries of Asia (Napier 1991; Rambo 1997; Scherr and Yadav 2001). About 20% of the agricultural land in Asia has been degraded over the years (WRI 1993 in Rambo 1997). Although several biophysical and geomorphological factors are responsible for soil erosion, inappropriate land-use practices have accelerated its pace, thereby threatening the sustainability of agriculture and jeopardizing the livelihoods of millions of poor people (Rambo 1997). This problem is more acute in mountain areas primarily because of steep slopes and high vulnerabilities (Jodha 2005).

Shifting cultivation, known as *jhum* in Bangladesh, is being still practiced in several mountain regions of Asia, including the Chittagong Hill Tracts (CHT) of Bangladesh. This was an environmentally compatible land use when the farmers could keep the land fallow for a long period (15–20 years), under the situations of low population pressure and

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free access to forests. It has become both an environmentally and economically incompatible land use with shortening of the fallow period caused by the government control over forests, legal restrictions on keeping land fallow for a long period, steadily increasing population pressure, and commercialization of agriculture (Brady 1996; Rasul and Thapa 2003). Shortening of the fallow period deters regeneration of secondary forest, and accelerates soil erosion and water pollution (Alegre and Cassel 1996; Borggaard and others 2003; Gafur 2001; Holscher and others 1997; Juo and Manu 1996).

In view of its adverse environmental and economic impacts, efforts have been made to control shifting cultivation and promote sedentary agricultural systems in CHT ever since 1860. Still, shifting cultivation remains as the dominant type of land use in the region. Environmentally suitable land uses, such as agroforestry and plantation, are being practiced at a very limited scale in some areas (ADB 2001; DANIDA 2000; Rasul and others 2004).

The question arises as to why the farmers are practicing shifting cultivation, which causes land degradation but provides them little benefit. Any land-use decisions that smallholders, such as shifting cultivators, make are guided by multiple objectives (Brady 1996; Vosti and Witcover 1996) under the influence of several biophysical, socioeconomic, cultural, and political factors (Rasul and others 2004; Hosier 1989; Sharawi 2006). National policies and institutional arrangements under which the farmers operate also play equally significant roles in land-use decisions by creating constraints and opportunities for adoption of sustainable land-use practices and by governing the structure of the market and other institutions (Lele and Stone 1989; Ehui and others 1994; Cairns 2002; Rasul and Thapa 2003). Some scholars (e.g., Ehui and others 1994; ESR/USDA 2002; Lutz and others 1994; Pagiola 2001; Veeman and Politylo 2003) argued that farmers are compelled to practice unsustainable land use when the market and policies fail in providing them incentives for sustainable land use. Particularly due to the market failure, the land users neither receive some of the external benefits accruing to the society through their environmentally compatible land-use practices nor do they consider the external costs through their environmentally incompatible land-use practices (Richards 1994; Veeman and Politylo 2003). Instead of designing policies and institutions to address the problem of market failure, many developing countries have resorted to pursue polices and enforce rules and regulations that increase the transaction cost, distort market prices, and create disincentives for environmentally sustainable land use (North 1995; Pagiola 2001; Rasul 2003; Richards 1994).

It is essential particularly for the policy-makers to become aware of the true costs and benefits of alternative land-use options and to understand how the policies and institutional arrangements influence farmers' economic interest while designing strategies for promoting environmentally sustainable land use. Despite the increasing concern about economic and environmental impacts of land-use practices, little effort has been made to understand how the government policies and institutional arrangements indirectly influence farmers' land-use decisions through their direct impact on economic returns from specific land uses (Franzel and Scherr 2002). Most past studies were based either on the ex-ante or model-based data (Swinkels and Scherr 1991). Findings of the ex-ante models or the data available from experimental research stations do not reflect farmers' actual situation. Therefore, they are not useful for the formulation of policies conducive to promote sustainable land-use systems.

Some recent studies (e.g., Rasul and others 2004; Tomich and others 2001; Vosti and others 2001) have attempted to explore the factors determining land-use practices based on farm household data. These studies, however, did not evaluate the suitability of different types of land use based on the analyses of private and societal costs and benefits under variable policy and institutional arrangements. A particular type of land use might be highly beneficial from the financial or private perspective. However, it might impinge severely upon the local environment, thereby undermining the sustainability of that particular land use (Barbier 1998; Pimentel and others 1995). In view of the need for the promotion of environmentally and economically sustainable land uses in CHT, this study makes an attempt to analyze the private and social profitability[1] of the five major land-use systems being practiced there. In this regard, the possible effects of some policy and institutional changes on different types of land use have also been examined.

## Research Methods

### Data Collection Methods

This study is based on both primary and secondary data. Primary data were collected through a household survey, focus group discussions, key informant interviews, and case studies. Information was collected at two stages from two representative subdistricts, namely Bandarban Sadar

[1] Private profitability is measured based on prices faced by individual farmers (e.g., price of seeds, fertilizers, rice, or wheat) at which goods and services are actually being exchanged. These are also called market or financial prices. Social profitability, on the other hand, is measured on the basis of undistorted prices, which would prevail in the absence of any policy distortions and market imperfections. These are sometimes called shadow prices, efficiency prices, or opportunity costs (Monke and Pearson 1989).

and Alikadam in Bandarban district of CHT from January to July 2002. Initially, information on farmers' socioeconomic condition, land use, land management and farming systems, employment, income, and personal experience in different types of land use was collected from 304 randomly sampled farm households using a standard questionnaire. The household survey facilitated the collection of detailed information on specific land-use practices, such as area under cultivation, amount of inputs used, price of inputs, output produced, price of outputs, and management practices adopted and time spent on each management activity, through detailed interviews with randomly sampled farm households. The validity of information provided by individual farmers was verified with key informants, agriculture extension and forestry officials, local 3 non-governmental organization (NGO) officials, and different land-use groups of farmers.

## Land Use Systems Under the Study

Several types of land use are being practiced in the study area. *Jhum* (shifting cultivation), characterized by cultivation of upland rice and other mixed crops, is the dominant type of land use in the majority of villages. Annual cash crops, such as turmeric and ginger, horticulture, agroforestry, and timber plantation are the other major land uses, all of which are gradually gaining prominence in some villages. Therefore, these five major land-use systems were considered for the study.

Of the five land-use systems, *jhum* and agroforestry are characterized by a blend of trees and several field crops. Therefore, costs and benefits of all major crops and tree species under each of these land-use systems were taken into account for the analysis. Although *jhum* is the dominant land use, its importance to household economy varies largely. Whereas some households entirely depend on this, others depend very little. In order to enhance the reliability of the result of the analysis, households with 50% of the cropland being used for *jhum* and that had practiced such land use continuously for last 12 years were considered for the survey. Out of the total 304 sample farmers, 127 met these criteria. One-third of them were randomly selected for the interview. Regarding the agroforestry, farmers who had planted trees deliberately in association with field crops and earned some income from them during January–December 2001 were considered for the interview. Out of the total 103 farmers who had planted some trees, 27 met these criteria. One-third of them were randomly interviewed.

Regarding the three other types of land use, the most dominant crop or tree species under each type of land use was selected as representative of a specific type of land use. Thus, ginger was selected from among the annual cash crops, pineapple from the horticulture system, and *gamar* (*Gmelina arborea Roxb.*) from timber plantation. The methods followed for determining representative crops or tree species and households to be surveyed from each land-use system is described next.

Ginger, aroid, and turmeric are the major annual cash crops grown in the study area. Of these, ginger is the most important both in terms of its contribution to the household income and the proportion of land under cultivation. Farmers cultivating ginger for the last 12 years and earning at least 10% of their household income from annual cash crops were considered for the study. Of the 86 farm households cultivating annual cash crops, 32 met these criteria. One-third of them were selected randomly for detailed information collection.

Pineapple, banana, and papaya are the main crops farmed under the horticulture system. Of these, pineapple was selected for the study, as it occupied the major proportion of the land under horticulture as well as made a substantial contribution to the household economy. Following this, the farmers whose income from horticulture accounted for at least one-fourth of the total household income and who were cultivating pineapple for at least the past 12 years were considered for the interview. Of the 112 farmers practicing horticulture, 52 met these criteria. One-third of them were randomly interviewed.

The major timber species grown in the study area are gamar (*Gmelina arborea Roxb.*), teak (*Tectona grandis*), akashmoni (*Acacia auriculiformis*), mangium (*Acacia mangium*), koroi (*Albizia sp.*), kanak (*Schima wallichii*), goda (*Vitex sp.*), chapalish (*Artocarpus chama*), mahogany (*Swietenia macrophylla*), and simul (*Bombax ceiba*). The most important of these are gamar and teak. Gamar is a fast-growing tree species. Normally it matures after 10–12 years and the wood is used mainly as construction material. Teak is a hard-wood tree, which matures in 30–40 years and is used mainly for furniture-making and construction work. Most small farmers grow *gamar* because it matures in a relatively short period and is well adapted to local conditions. Therefore, we considered this tree species to represent the timber plantation. The farmers who had planted at least 200 *gamar* trees and harvested timber during January–December 2001 were considered for the interview. Of the 74 farmers growing trees for commercial purpose, 25 met the set criteria. One-third of them were randomly interviewed.

## Estimation of Financial Costs and Benefits

Different land-use systems have different production cycles. For *jhum* and annual crops, the production cycle is 1 year; for horticulture, it is 5–6 years; and in timber plantation, it is 12 years. In order to compare the costs and benefits of different land-use systems, a 12-year time horizon was considered. The costs and benefits of each land-use system were analyzed based on inputs used, outputs, and farm-gate prices of products sold. The opportunity cost of labor in the study area varies by gender and season. Following the prevailing wage labor rates, Tk. 90 and Tk. 60 were considered to be the daily per capita opportunity costs of adult male and female workers, respectively. The national interest rate for agricultural credit is 11% and farmers incur an additional cost of about 1% while getting credit. Therefore, a discount rate of 12% was considered as the cost of the capital.[2] The same discount rate was considered to reflect the cost of capital in some forestry projects of the neighboring country India (Kumar 2002, p. 771).

## Evaluation Criteria

Returns to land and labor were used as criteria to evaluate the land-use systems under the scope of the study. Given the scarcity of land, both private and social objectives are to maximize returns per unit of land. Return to land is expressed by net present value (NPV), which determines the present value of net benefits by discounting the streams of benefits and costs back to the base year. The NPV of each land-use system was calculated using the standard method available in any economics textbook.

Smallholder households seek to maximize return to household labor, as it is their main asset. Therefore, return to labor was calculated by subtracting the material costs from the gross benefit and dividing the proceeds by the total person-days, following Fagerstroem and others (2001).

## Considerations for Economic Evaluation

The rate of soil erosion varies from one type of land use to another in CHT (Table 1). Therefore, it is necessary to examine the cost of soil erosion while evaluating the competitive land-use systems. Soil erosion has both on-site and off-site effects. On-site effects are soil nutrient depletion and deterioration of physical and biological structures of soil (Alfsen and Franco 1996; Attaviroj 1990). Due to a lack of data required for analyses of all sorts of on-site and off-site effects of soil erosion, we considered only the cost of nutrient depletion to assess the value of soil erosion. As others (e.g., Barbier 1998; Borggaard and others 2003; ESR/USDA 2002), we are of the opinion that, although partial, such an analysis provides a better idea about the environmental costs and benefits of alternative land uses than a simple subjective assessment. This eventually enables the policy-makers to promote land uses that are environmentally and economically sustainable.

## Valuation of the Cost of Soil Erosion

The most significant on-site effect of soil erosion is the loss of soil fertility (Alfsen and Franco 1996; Attaviroj 1990; Barbier 1998). This results from the depletion of organic matter and decreased availability of phosphorus, nitrogen, potassium, and other trace elements. Farid and Hossain (1988), based on data collected from 215 sample sites in CHT, found considerably less (25–40%) availability of organic carbon, nitrogen, phosphorus, and potassium in eroded soil than in noneroded soil. Similarly, Gafur (2001) and Borggaard and others (2003) reported nutrient loss due to soil erosion in the Bandarban district of CHT.

Different innovative approaches have evolved to estimate the value of nonmarket goods and services (Macmillan and others 2002; Pagiola 2002). To estimate the cost of soil erosion, in particular, hedonic pricing or property valuation, change in productivity, and replacement cost are commonly used (Enters 1998; Magrath and Arnes 1989). Following several other studies (e.g., Salzer 1993; Samarakoon and Abeygunawardena 1995), we adopted the replacement cost method for valuation of the cost of soil erosion.[3] Any reliable valuation of soil loss entails deduction of the natural rate of soil formation from the rate of erosion. Although an estimation of soil formation in CHT is not available, Hamer (1982) cited in Salzer 1993, p. 98) has estimated the natural rate of soil formation in temperate climates to be about 10 tons/ha/year. However, in tropical climates as in Thailand (Salzer 1993), the rate of

[2] Private and social discount rates can vary and the social discount rate can be much lower than the private, as the time preference is relatively higher for an individual than a society. Because of that, the discount rate for economic analysis should be lower than the rate of financial analysis. Although a high discount rate might reduce the profitability of certain land uses, for which the gestation period is relatively large such as timber plantation and agroforestry, we used the same discount rate (12%) for both financial and economic analyses following the advice of renowned economist Samuelson (1976), who suggested taking a high discount rate for forestry projects because of high risks and uncertainties.

[3] Some argue that replacement cost might overstate the cost of soil erosion, as much of the soil eroded from one field is merely transported to another field rather than into streams. Others (Stocking 1987; Lal 1995), however, considered that replacement costs cannot take into account all of the effects of soil erosion, such as damages of soil physical structure and diminishes the resilience of the soil. In fact, it is impossible to value the actual cost of all environmental implications of soil erosion, and none of the nonmarket valuation techniques is a perfect substitute for the real market value. However, the valuation of nutrients lost provides some basis for quantification of the environmental cost incurred through soil erosion. Alhough not perfect, such assessment is far better than the subjective assessment of the nutrients value and very helpful for policy-making. Because of this, the replacement cost approach has been widely used by environmental and natural resource economists, in particular, and policy-makers to assess the environmental cost of human-induced activities.

**Table 1** Soil erosion in CHT under different agricultural land-use systems

| Land use | | Soil loss (tons/ha/year) | Average soil loss (tons/ha/year) |
|---|---|---|---|
| *Jhum* (shifting cultivation) | | 39.00[a] | 41.23 |
| | | 39.70[b] | |
| | | 45.00[c] | |
| Pineapple | | 18.05[d] | 18.05 |
| Root[e] crops | Conventional tillage: hoeing without mulch | 88. 85[f] | 99.15 |
| | | 109.45[g] | |
| | Conventional tillage: hoeing with mulch | 35.43[d] | 35.16 |
| | | 34.89[g] | |
| | Mixed plantation/fallow *jhum* (5-year rotation) | 10.00[a] | 10.00 |
| | Agroforestry, tree plantation | | |

[a] Data from Gafur (2001)

[b] Data from Shoaib (2000)

[c] Data from SRDI (1998)

[d] Data from Chowdhury (2001)

[e] Ginger, *mukhi kachu (Colocasia esculanta),* turmeric

[f] Data from Quader and others (1991) and Shoaib and others (1998)

[g] Data from Uddin and others (1992)

soil formation was estimated to be 15 tons/ha/year. Because Salzer's study area is similar to CHT in terms of climatic condition and topography, we assumed that the soil formation rate of 15 tons/ha/year is applicable to our study area as well.

## Financial Performance of Land-Use Systems

The financial analysis shows the highest gross benefit from the annual cash crops, followed by timber plantation and horticulture. The *jhum* system provides the lowest gross benefit—about one-fourth of annual cash crops and one-third of timber plantation (Table 2). Although the gross benefit reflects the relative size of benefit, it does not indicate the financial performance of land-use systems because the cost component is not considered. The NPV is the common indicator of financial performance, as it takes into account both the cost and income components of land-use systems.

Annual cash crops appear to be the best performer from the NPV perspective, followed by horticulture, timber plantation, and agroforestry. The NPV of *jhum* is negative, indicating that this is the least financially attractive type of land use (Table 2). Consistent with this finding, the return to labor is highest from annual cash crops, followed by timber plantation, horticulture, and agroforestry. The return from *jhum* is lowest—less than the opportunity cost of labor.

The question arises as to why farmers are practicing *jhum* when the net benefit from this is negative; the return to labor is even less than its opportunity cost. Results of the analysis without the opportunity cost of labor, which shows a positive rate of return to labor, provide the answer to this question (Table 2). As in other subsistence economies, nonfarm employment opportunities are scarce in the study area. Farmers therefore have no choice but to work on their farms and be satisfied with whatever income they get, even if it is less than the value of their labor input. If they decide to abandon the *jhum* because of the very low return from this, they will have to face a severe food shortage during the greater part of the year. Despite not being financially beneficial, *jhum* contributes to meeting the demand for subsistence requirements. Shortage of capital required for land development and for procurement of necessary implements and inputs is another important factor compelling farmers to continue practicing *jhum* (Rasul 2003).

In view of the above-mentioned situation in the study area, the financial analysis was carried out assuming the opportunity cost of household labor to be zero. The result of the analysis corroborates our above explanation, as the NPV of *jhum* is changed to positive and becomes comparable with the NPV of agroforestry (Table 2). Still, the annual cash crops appeared to be the best, followed by horticulture, timber plantation. and agroforestry.

## Economic Performance of Land-Use Systems

Findings of the scientific studies conducted in the study area show the soil loss rates exceeding the formation rates under annual cash crops and *jhum*. To the contrary, the

**Table 2** Financial performances of five land-use systems

| | | *Jhum* | Cashcrops | Horti-culture | Agroforestry | Timber plantation |
|---|---|---|---|---|---|---|
| Gross benefits (Tk.[a]/ha) | | 80,806[b] | 277,430 | 132,911 | 100,783[c] | 131,947[d] |
| Total costs (Tk./ha) | | 98,279 | 223,708 | 98,348 | 78,647 | 102,125 |
| Labor costs (Tk./ha)[e] | | 85,363 (87) | 124,043 (55) | 60,270 (61) | 56,593 (72) | 54,886 (51) |
| Nonlabor costs (Tk./ha)[f] | | 12,916 (13) | 99,665 (45) | 38,078 (39) | 22,052 (28) | 49,709 (49) |
| Financial performance | | | | | | |
| Net financial benefits (NPV) (Tk./ha) | With opportunity cost of HH[g] labor | –17,473 | 53,723 | 34,563 | 22,139 | 29,823 |
| | Without opportunity cost of HH labor | 67,890 | 195,550 | 94,833 | 78,731 | 82,239 |
| Initial establishment costs (Tk./ha) | | 0 | 0 | 17,759 | 13,390 | 31,863 |
| Return to labor (Tk./person-day) | | 72 | 129 | 102 | 91 | 108 |

[a] I US $ = Taka 57

[b] In a typical *jhum*, several crops, such as rice, cotton, sesame, chili, different types of vegetable, and banana, and root crops, such as ginger, turmeric, yam, and cassava, are grown together. Gross benefit was calculated based on average yield of each crop multiplying the average farm-gate price

[c] In a typical agroforestry farm, there are annual crops and tree crops. In tree crops, there are both fruit trees and timber trees. Average production of each crop and corresponding farm-gate prices were considered for calculating gross benefits

[d] The average production was 2100 cubic feet of timber over 12 years. Average farm-gate price was Tk. 90/cubic foot. At 7 or 8 years, farmers make major thinning, and thinning materials are sold as fuel wood to a brick field and tobacco processor. Average return from thinning was Tk. 30,000

[e] Labor costs include for site selection, slashing, burning, cleaning, land preparation, planting, weeding, fertilization, harvesting, and carrying

[f] Nonlabor costs include seeds, seedlings, fertilizers, pesticides, and interest on capital

[h] HH = household

rates of soil formation under agroforestry and timber plantation are higher than the rate of loss (Table 3), indicating the superiority of these land-use systems from an environmental perspective. Without replenishment, the steady removal of soil nutrients through erosion would severely undermine the productive capacity of land, thereby undermining sustenance of farmers' livelihoods.[4] Replenishment of the eroded nutrients incurs substantial economic cost. We therefore carried out an economic analysis to examine the environmental suitability of different types of land use by converting the eroded soil nutrients into a monetary value.

The results of the analyses show that the economic value of soil nutrient depletion ranges from Tk. 900/ha/year under horticulture to Tk. 25,000/ha/year under annual cash crops (Tables 3 and 4). Replenishing the lost soil fertility would incur a substantial increment in farmers' production costs. The cost of fertility replenishment under annual cash crops accounts for about 11% of the total production cost; under *jhum*, it is about 8%. However, under agroforestry and timber plantation, farmers have savings of about Tk. 1502/ha/year because the soil formation rates under these land-use systems exceed the erosion rates. As a result, the profitability of land-use systems is changed substantially (Tables 2 and 3). Horticulture appears to be the most profitable land use, followed by timber plantation. To the contrary, the profitability of annual cash crops and *jhum* is reduced considerably due to their high rate of nutrient depletion through soil erosion. The actual cost of nutrient loss would, however, be higher than the estimated cost, as the price that farmers are paying for inorganic fertilizers is normally higher than the border price used in the analysis.

## Impacts of Policy and Institutional Environment on Profitability of Land-Use Systems

As in most developing countries, the free operation of agricultural markets in CHT has been constrained by formal as well as informal rules and regulations and government policies, thereby adversely affecting the price of farm products. The effect is worse on tree, agroforestry, and horticultural products. Timber plantation is an environmentally suitable land use in CHT, and there is a rapidly increasing demand for timber in the market. However, the

[4] A question of whether the cost of on-site soil erosion is a private or social cost might be raised. In CHT of Bangladesh, most land is owned by the state and the land users avoid the cost of nutrient replacement by shifting plots. Although individual land users avoid this cost by moving from one plot to another, the society as a whole has to bear the cost of soil erosion, which degrades the stock of natural capital of a nation.

**Table 3** Economic valuation of soil loss by land-use system

| | | *Jhum* | Annual cash crops | Horticulture | Agroforestry | Timber plantation |
|---|---|---|---|---|---|---|
| Soil loss rate (tons/ha/year)[a] | | 41.23 | 99.15 | 18.05 | 10 | 10 |
| Natural rate of soil formation (tons/ha/year) | | 15 | 15 | 15 | 15 | 15 |
| Net soil loss (tons/ha/year) | | (–26.23) | (–84.15) | (–3.05) | (+5.00) | (+5.00) |
| Loss equivalent to inorganic fertilizers (kg/ton/eroded material)[b] | N (total)-Urea | 235.64 | 755.98 | 27.40 | 44.91 | 44.91 |
| | P (available)-TSP | 11.89 | 38.47 | 1.39 | 2.29 | 2.29 |
| | K (exchangeable)-MP | 15.74 | 58.90 | 2.14 | 3.5 | 3.5 |
| | Ca-lime | 103.61 | 332.39 | 12.05 | 19.75 | 19.75 |
| | OM (kg) | 1,674.00 | 5,370.45 | 194.65 | 319.10 | 319.10 |
| Economic loss/gain (Tk./ha)[c] | N (total) | 2,262 | 7,257 | 263 | 431 | 431 |
| | P (available) | 137 | 439 | 16 | 26 | 26 |
| | K (exchangeable) | 151 | 486 | 18 | 29 | 29 |
| | Lime | 311 | 997 | 36 | 59 | 59 |
| | OM | 5,022 | 16,110 | 584 | 957 | 957 |
| | Total | (–7,883) | (–25,289) | (–917) | 1,502 | 1,502 |

[a] For source of average soil loss rate under different land use systems, see last column of Table 1

[b] Loss equivalent to inorganic fertilizers = the net soil loss rate × nutrient lost per ton eroded soil × nutrient: fertilizer conversion factor. According to Gafur (2001), nutrient loss (kg/ton of eroded soil) is as follows: N (total) = 4.14; P (available) = 0.09; K (exchangeable) = 0.35; Ca = 1.58, and OM = 63.82. Nutrient: fertilizer conversion factors are adopted from Bangladesh Agricultural Research Council (1997), which are as follows: N-urea. 2.17; P (available)-TSP, 5.08; K (exchangeable)-MP, 2.00; Ca-lime, 2.50

[c] Economic loss was calculated based on the border price of inorganic fertilizers. Border prices were determined by taking average of coast insurance and freight prices. The prices used were as follows: urea = 9.6 Tk./kg, P = 11.4 Tk./kg, K = 8.25 TK/kg, lime = 3.0 Tk./kg, and OM = 3.0 Tk./kg

TSP = triple super phosphate; MP = muriate of potash; OM = organic matter

farmers who have grown timber trees on their farms are receiving only a small fraction of the market price of timber primarily because of detrimental rules and regulations. As in the case of Nepal (Thapa and Weber 1993), the regulations in CHT [such as the Chittagong Hill Tracts Forest Transit Rules (1973)] require farmers to get written permission from the forest department officials for cutting farm-trees and for transportation of timber to the market centers. Because of the bureaucratic meandering and bribe-seeking attitude of officials, getting a permission is very difficult, particularly for small farmers (Adnan 2004; Roy 2002; Uttam 2000). Therefore, the farmers are compelled to sell timber in the black market at a very low price. Timber traders who obtain transit permits by bribing government officials are the ones who make a high profit margin by purchasing timber at a low price and selling it at a high price in the regional city of Chittagong.

Likewise, farmers are receiving a very low price for horticultural crops, because of the government policy of allowing local organizations such as the Hill District Council, municipalities, and union councils to collect taxes from farm products. Farmers have to pay taxes to the local authorities, and the traders have to pay levies to both the Hill District Council and municipalities when taking the purchased products to the market centers. Moreover, the traders have to bribe officials when transporting products from one place to another. These practices have not only depressed the price of farm products but also constrained farmers' direct participation and investment in trade. As a result, all agricultural marketing channels and transportation are controlled by a few traders based outside the region (Chakma 1975 in Khisa 1996), resulting in the formation of a buyers' syndicate and monopsony. Particularly, the marketing of fruits in the entire CHT is controlled by a small number of Bengali traders (ADB 2001). These constraints combined with the high transportation cost stemming from a lack of all-weather roads compel farmers to sell their farm products at low prices. The problem is further aggravated due to the fluctuation of the market price arising primarily from a lack of storage facilities, especially for horticultural crops. Seasonal variation in the prices of horticultural crops such as pineapple and banana ranges from twofold to three fold (ADB 2001).

It would be sensible to know as to how the land-use systems will perform financially if the above detrimental policies are reformed to eliminate the existing price distortion, which is expected to increase farmers' income. Accordingly, the following four alternative scenarios are examined:

A. Removal of the permit system for selling farm-timber
B. Elimination of double levies and illegal payments

**Table 4** Economic performance of land-use systems

| | *Jhum* | Annual cash crop | Horticulture | Agroforestry | Timber plantation |
|---|---|---|---|---|---|
| Gross benefits (Tk./ha)[a] | 80,806 | 277,430 | 132,911 | 100,783 | 131,947 |
| Net financial benefits (NPV) (Tk./ha) | –17,473 | 53,723 | 34,563 | 22,139 | 29,823 |
| Net soil loss/gain (tons/ha) | –26.23 | –84.15 | –3.05 | 5 | 5 |
| Economic loss/gain due to soil loss (Tk./ha) | –7883 | –25,289 | –917 | 1,502 | 1,502 |
| Net economic benefits (NPV) (Tk/ha) | –25,356 | 28,434 | 33,646 | 23,641 | 31,325 |
| Return to labor (Tk./person-day) | 63 | 111 | 101 | 118 | 110 |

[a] I US $ = Taka 57

**Table 5** Profitability of land use systems under different policy and institutional environments

| Land use | Base case[a] | | Scenario A[b] | | Scenario B[c] | | Scenario C [d] | | Scenario D[e] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Net benefit Tk./ha) | Return to labor (Tk./ person-day) | Net benefit (Tk./ha) | Return to labor (Tk./ person-day) | Net benefit (Tk./ha) | Return to labor (Tk./ person-day) | Net benefit (Tk./ha) | Return to labor Tk./ person-day) | Net benefit (Tk./ha) | Return to labor |
| *Jhum* | –17,473 | 72 | –17,473 | 72 | –15,166 | 74 | –15,166 | 69 | –10,480 | 79 |
| Annual cash crops | 53,723 | 129 | 53,723 | 129 | 86,535 | 153 | 58,793 | 125 | 106,869 | 173 |
| Horticulture | 34,563 | 102 | 34,563 | 102 | 60,300 | 130 | 67,246 | 96 | 93,828 | 166 |
| Agroforestry | 22,139 | 91 | 53,345 | 152 | 50,031 | 150 | 29,292 | 104 | 87,623 | 191 |
| Timber plantation | 29,823 | 108 | 147,106 | 264 | 132,194 | 245 | 41,234 | 109 | 264,905 | 418 |

[a] Profitability at the current market price

[b] Profitability after removal of the permit system for selling farm timber

[c] Profitability after elimination of double levies and illegal payments

[d] Profitability after making provision of improved marketing and storage facilities

[e] Profitability when all the three options are adopted

C. Provision of improved marketing and storage facilities
D. Adoption of options A–C

The simulated benefits are compared with the actual benefits derived by farmers, which are considered ''private benefits,'' following Monke and Pearson (1989) and Pagiola (2001) (see Table 3). Benefits, based on the assumption of the removal of detrimental policies and other mechanisms, reflect the benefits gained in an undistorted market situation. Following Monke and Pearson (1989) and Pagiola (2001), this benefit is labeled ''social benefit,'' which ensures the efficient use of resources and provides benefits to the society as a whole.

## Option A: Removal of the Permit System for Selling Farm-Timber

The discussions held with farmers and timber traders revealed that they have to bribe officials at an average rate of Tk. 80 per cubic foot of timber to obtain a permit for selling farm-timber. According to them, it is virtually impossible to get a permit without bribing the officials. Provided the permit system is abolished, the farm-gate price of timber would increase by Tk. 80 per cubic foot,[5] leading to a substantial increment in profitability of, in particular, timber plantation and agroforestry (Table 5). The profitability of timber plantation, in particular, would increase by about five times (from Tk 29,823/ha to Tk. 147,106/ha) and the profitability of agroforestry would increase by more than two times (from Tk. 22,139/ha to Tk. 53,343/ha). As a result, the financial attractiveness of annual cash crops is reduced substantially compared to timber plantation and horticulture. Consistent with this, the return to per unit of land and labor from timber plantation

[5] As one of the anonymous reviewers pointed out, the farm-gate price of timber might not increase proportionately because of price elasticity of supply; the higher price will lead to higher timber production and result in a lower price in the long run. Yes, it is correct in a state of constant demand. However, the case of Bangladesh is different. In view of the steadily growing demand for timber in Bangladesh arising from the growing urbanization, industrialization, and fast population growth and constantly shrinking area for tree plantation, we assumed that the price effect of supply would be offset by the increasing demand for timber.

and agroforestry would be considerably higher than from *jhum* and annual cash crops (Table 5).

### Option B: Elimination of Double Levies and Illegal Payments

The requirement of paying levies to several local government authorities imposes additional cost on the marketing of agricultural products, accounting for about 10% of the price of products (Rasul 2003). additionally, the traders have to make illegal payments to officials at all check-posts established to control illegal timber trade. According to the traders, such payments account for about 10% of the market price of the products. Particularly for timber, such cost is extremely high. Despite possession of the transit permits obtained by bribing officials, traders have to pay an additional Tk. 70–75 per cubic foot to get the timber through all check-posts. All of these costs are ultimately passed on to the farmers, thereby reducing the amount of their income. The elimination of double levies and illegal payments would help to increase the farm-gate price of all cash crops by 20% and timber by Tk. 70 per cubic foot. This would eventually encourage farmers to expand the areas under timber plantation and agroforestry.

When the levies and illegal payments are removed, the profitability of land-use systems changes significantly (Table 5). Timber plantation would again become financially most attractive, as it would provide more than one and half times the profit of annual cash crops. The profitability of horticulture and agroforestry would also increase considerably and become on par with annual cash crops. However, *jhum* would still have a negative return, as the elimination of levies and illegal payments will have no effect on this, because farmers have very little for sale under such a system. Likewise, the return to labor would increase in all land-use systems, with timber plantation standing out as the most remunerable. In all land-use systems, except *jhum*, social benefits would exceed the private benefits.

### Option C: Provision of Improved Marketing and Storage Facilities

Any kind of difficulty in transportation and lack of storage facilities tend to increase transaction costs and seasonal price fluctuation of agricultural commodities (Ellis 1992). The experience from elsewhere suggests that improvements in agricultural infrastructure contribute to enhance the prices of agricultural commodities (Amadi 1988; Scherr 1995). Consistent with this, it is assumed that the problems of transportation and storage of farm products are addressed in CHT. As a result, the farm-gate prices of all cash crops would increase by 10%, and the price of fresh fruits and vegetables would increase by 20%. When this happens, horticulture would become the most profitable land use (Tk 67,246/ha), followed by annual cash crops (Tk. 58,793/ha), timber plantation (Tk. 41,234/ha), and agroforestry (Tk. 29,292/ha). However, the profitability of *jhum* would still remain negative. The return to labor would increase under all land-use systems; however, the rate of increment would be relatively higher under horticulture, agroforestry, and timber plantation (Table 5).

### Option D: Adoption of Options A–C

When policy options A–C are adopted at the same time, the profitability of all land-use systems except *jhum* would increase considerably (Table 5). *Jhum* would still be characterized by a negative benefit. This implies that any subsistence-oriented land-use systems cannot take advantage of the proposed policy and institutional reforms. The extent of profitability would vary considerably from one type of land-use system to another. Remarkably, from the point of view of net social benefit and return to labor, environmentally sustainable land-use systems such as timber plantation, agroforestry, and horticulture are considerably more attractive than *jhum* and annual cash crops (Table 5).

## Conclusion and Policy Implications

*Jhum* was the only agricultural system in the CHT of Bangladesh until a few decades ago. With the changing socioeconomic situation, national policies, and physical infrastructure development, several other types of land use, including annual cash crops, horticulture, agroforestry, and timber plantation, have evolved over the years. Still, *jhum* is the dominant type of land use. Amid growing concern about the promotion of sustainable land-use systems in land- degradation-prone mountainous areas like CHT, findings of our study revealed that all of the above-mentioned land uses were better than *jhum* from both financial and economic perspectives. Because of the high rate of soil erosion and considerably low return compared to other land uses, *jhum* appeared to be the least attractive land use. Annual cash crops provides the highest financial return. However, it is at the cost of very high rate of soil erosion, as reflected in the highest economic or social cost. Therefore, when land uses are evaluated based on social cost, horticulture, agroforestry, and timber plantation appear to be more attractive than *jhum* and annual cash crops primarily because of the relatively lower nutrients loss through soil erosion under these land-use systems. However, it should be noted that the actual cost of soil erosion would be considerably more than what is reflected in this study, as the removal of soil from a plot of land causes several environmental problems (Stocking 1987). If the costs of all environmental problems associated with soil erosion are taken into account, horticulture, agroforestry, and timber plantation would appear far more beneficial than our economic analysis revealed.

Because the soil erosion under forestry, agroforestry, and horticulture is considerably lower than under annual crops, these are considered to be the most suitable land-use systems for mountainous regions like CHT. In view of their environmental benefits, forestry, pasture, and horticulture have been highly subsidized in the mountains of developed countries such as Austria (Hovorka 2001) and Switzerland (second author's communication with Swiss farmers at a village in the Interlaken region in October 2004; see Flury and others 2005).

Contrary to policies promoting environmentally sustainable land uses in developed countries, the policies adopted in Bangladesh, such as requirements of permission for selling timber available from trees grown on farm and payment of levies, have discouraged farmers from a wide-scale adoption of agroforestry and plantation in CHT. In addition to reducing farm-gate prices, these policies have also been instrumental in promoting corruption on the part of forestry and local government officials, thereby further cutting farmers' profit margin. The barrier created by these policies has been reinforced by difficult access to market centers and the lack of an efficient marketing system including storage facilities. The analysis with ''undistorted price'' indicates that the removal of the existing permit system and levies would help to increase farmers' income from horticulture, agroforestry, and timber plantation substantially, eventually making them more attractive than *jhum* and annual cash crops. Indigenous communities would be able to take full advantage of such policy reforms only when they are provided with necessary support for marketing and transportation of their farm products. In this regard, attention should be paid to the promotion of a group marketing system and provision of storage facilities to enhance the bargaining power of local people and weaken the monopoly of a few middle-men and traders.

The government would lose some revenue, particularly from the abolition of the levy system, which is justified in view of the environmental benefits that the whole society would gain through the expansion of areas under agroforestry and plantation. As found elsewhere (Thapa and Weber 1993), the forestry officials in CHT have implemented a permit system in order to control illegal logging in national forests under the guise of timber harvested from private farmlands. It has not helped much to control illegal logging due to rampant corruption on the part of forest officials (Roy 2002; Uttam 2000). There is the risk of accelerated logging if the permit system is not replaced with a simple but effective alternative regulatory system. In this regard, the certification of timber harvested from private lands by community-based organizations, such as community forest user and farmer groups, would serve the purpose.

As argued by one of the reviewers of this article, the above-proposed institutional reforms might not necessarily provide additional benefit to the farmers for two reasons. First, the elimination of the levy, in particular, might open an opportunity for everyone to grow more trees, eventually increasing the supply and lowering the price of timber. Second, the benefits of ther removal of a levy and corruption might actually go to the timber traders who have dominated timber marketing. Whether or how much the farmers would benefit depends on other institutional arrangements made. The suggested removal of the levy system, in particular, is for only sloping areas, which account for a very small proportion of the total land area. Therefore, the removal of the levy would not have any negative effect on the market price of timber. Rather, the market price is likely to go up because of a rapidly increasing demand for timber with the growing urbanization of the country.

However, as stated earlier, there is a real risk of farmers not reaping the benefits of the proposed reforms if a few traders continued to dominate the marketing of timber. Cognizant of such a possibility, it would be appropriate to promote the marketing of timber through a farmers' group, which would strengthen farmers' bargaining power when negotiating the price of timber. However, an effective implementation of these policies would require the provision of reliable information collection and dissemination on a routine basis, in which the farmers' groups can play a very important role. Farmers who are well informed about the market prices of their products are less likely to be cheated by the traders, whether it be at the farm-gates or in the market centers (Pokhrel 2005).

The above-suggested policy measures would pave the way for a wide-scale adoption of environmentally sustainable land-use systems only when the farmers have secured rights to their landholdings. In CHT, the majority of farmers neither have ownership nor usufruct rights to their farmlands (Rasul 2003). Therefore, they cannot be expected to use their land for forestry or other plantation agriculture, which requires a substantial initial investment and provides returns only after several years. The evidence from CHT and elsewhere suggests that farmers are encouraged to adopt such land uses when they have a secure land use or ownership rights (Rasul and others 2004; Suryanata 1994; Suyanto and others 2001). Therefore, as we have suggested elsewhere (Rasul and others 2004), the government should immediately adopt a policy of granting secure land rights to the farmers in CHT and make efforts to resolve the land disputes as soon as possible. In this regard, the Land Commission, which was established in 2001 to address this particular issue, should be activated immediately to undertake the entrusted task effectively.

Given the complexity of the task, it will take time for granting land-ownership certificates to the concerned farmers. The government, however, should immediately adopt a policy of granting inheritable usufruct rights to the land being cultivated by them.

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