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**More details/abstract:** This paper is conceived at a time when new paradigms are sought for the development of a framework to deal with the problem of forest resources degradation. Deforestation in Bangladesh, has reached an alarming rate in recent years. The forest coverage of Bangladesh is one of the lowest and the deforestation rate is the highest of any country in the world. Coupled with the process of deforestation, flawed afforestation programmes have seriously exposed Bangladesh to environmental vulnerability. Considering this situation various strategies should be taken at different levels. The main objective of this paper is to suggest the possible steps that Bangladesh could halt and reverse the trend of deforestation. An extensive literature review and structured interviews of key informants have been used to collect relevant information to understand the reasons and consequences of forest degradation in the country. Based on the information gathered, this paper suggests some positive steps where the Government could be the main mitigating actor by implementing integrated programmes, which will also ensure mass awareness and wider impact.

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# Extent and Consequences of Tropical Forest Degradation: Successive Policy Options for Bangladesh

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**Abstract:** This paper is conceived at a time when new paradigms are sought for the development of a framework to deal with the problem of forest resources degradation. Deforestation in Bangladesh, has reached an alarming rate in recent years. The forest coverage of Bangladesh is one of the lowest and the deforestation rate is the highest of any country in the world. Coupled with the process of deforestation, flawed afforestation programmes have seriously exposed Bangladesh to environmental vulnerability. Considering this situation various strategies should be taken at different levels. The main objective of this paper is to suggest the possible steps that Bangladesh could halt and reverse the trend of deforestation. An extensive literature review and structured interviews of key informants have been used to collect relevant information to understand the reasons and consequences of forest degradation in the country. Based on the information gathered, this paper suggests some positive steps where the Government could be the main mitigating actor by implementing integrated programmes, which will also ensure mass awareness and wider impact.

**Key words:** Deforestation, environmental degradation, policy options.

## 1. Introduction

According to the National Forest and Tree Resources Assessment of Bangladesh, approximately 10% of the surface area of the country is under forest [1]. But data suggests that 90% of Bangladesh's forestry are lost or degraded due to the various pressures of a growing population, development interventions, gaps in policy and legislation, and conflicting institutional mandates [2-4]. The protected area consists 1.4% of the surface area, which is one of the smallest in the world. Even though the current

deforestation rate is low (less than 1 percent), Bangladesh is at a major risk of losing its forest resources and biodiversity unless the trend is reversed [5].

Deforestation due to land clearances for agriculture, principally through shifting cultivation in the hill forests, already affected one eighth of the country's land area. [3]. Other causes of forest loss include forest land encroachments, grazing, fire, uncontrolled commercial and subsistence logging, and fuel wood collection [6]. While existing forest cover is lost on a large scale, there are very small gains by afforestation of denuded areas and newly accreted land. Local wood supply cannot keep up with the demand for raw materials resulting in shortages and increased use of imports. Biomass fuels are predominantly used in household cooking. Outdated inefficient technology is evident in forest resource harvesting and manufacturing, resulting in unnecessary wastage.

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In this context, forest should have special attention for the government, and the people should be more concerned. Each and every country requires one fourth of her surface area under forest, which is congenial to ecological balance. But Bangladesh is far beyond this equation. To arrest or at least to minimize the processes and drivers of deforestation, mass awareness should be taken into serious consideration. The multifaceted importance of forest in the lives of the country's inhabitants and the danger of deforestation should be well publicized and to build up awareness, different strategies should be taken seriously by the government, NGOs and other social organizations.

## **2. Material and Method**

Structured interviews and content analysis have been used for this study. For content analysis, different types of government and nongovernment literature were used to obtain relevant information related to deforestation. Structure interviews with government officials, forestry professionals and NGO workers have been used to understand their experience and vision about the main reasons for forest depletion in Bangladesh as well as prospective management prospects.

## **3. Results and Discussion**

### *3.1 Trend and Extent of Deforestation*

Bangladesh is facing a serious problem of degradation of natural resources particularly land and forest. For example the entire area of Chittagong Hill Tracts (CHT) was covered with dense forest in the early 19th century, now most of the area has been denuded and covered with obnoxious weeds with some scattered trees and shrub [1].

Bangladesh's natural forests are controlled by the government Forest Department and fall broadly under three main classes: inland deciduous Sal forests, Sundarbans mangrove forests and hill forests. Inventories show an overall depletion in forest stocks in all the major forests [1]. However, the net deforestation rate is more severe than the official statistics.

FAO supported inventory of Chittagong forest with FMP indicates that closed forest have decreased from 30,003 in 1985 to 22,223 ha in 1996 and the total volume has gone down from 2.27 million m<sup>3</sup> in 1985 to 0.648 million m<sup>3</sup> in 1996 [7].

The Sal forests belongs under the tropical moist deciduous forest class (greater Dhaka, Mymensingh, Tangail, Rangpur and Dinajapur region) which constitutes of about 2.3% of the total forest [1]. Considerable forest destruction occurred during the liberation war of Bangladesh in 1970 in the country as a whole and particularly in the Sal forests. The natural Sal forests were previously managed by clear felling for timber followed by coppice regeneration. The Government banned the felling realizing the fact that the forest had degraded due to excessive felling and coppicing. But the law was unable to protect this natural deciduous forest. This central and northern part of the country is the most densely populated and the main cause of the depletion of this forest was due to land clearance for agriculture and forest land encroachment. More than half of the total Sal forest has been already depleted. The remaining patches are in poor condition, degraded and in the process of being lost. Some measures by the government and also non-governmental organizations were taken to involve farmers in forestry, i.e., agroforestry and community woodlot plantations. However, this was ineffective in halting the deforestation process and encroachment. Arguably due to the negligence and corruption of the government forest department staff and the extended support of the local political leaders to those responsible for encroachment. Recently, another problem has been found that the farmers who participated in the community forestry programs are not getting their share from the harvesting of the timber crop. Initially all shareholders agreed to the program that the profits will be distributed to them according to an agreed predetermined ratio. However, due to lack of proper management and prompt response from the government FD when the plantations have reached to

the harvesting age for the first rotation, the farmers stopped looking after the plantations. Mature trees are now being felled and taken away by the illicit loggers taking this opportunity of inactivity of farmers. Once the trust of the farmers is lost, then it will be very difficult to regain for government FD and to implement this type of participatory approach of forestry practice in future.

Encroachment and illicit removal of timber and firewood from the forests are the major forest conservation problems in the area. The Sal forests are under constant human pressure from all sides as there were no boundaries of the forest. The forests are in patches, intermingled with private agricultural lands and habitation encircling that small blocks of forest. The areas under encroachments estimated about 0.036 million ha and the number of encroachers are about 100,000. The chief reasons of encroachments are: legal lacunae due to past tenorial history of the lands, and intricate nature of the boundary of the forest land and cultivable lands, and failure to complete the forest settlement operations initiated in the 1950's. The main reasons of illicit removal of timber are: wide gap between the demand and supply of wood and its consequent high prices (illicit removal of even a head-load of firewood turns out to be more lucrative than a day's wage of rural labourer, removal of timber and poles is even more lucrative); limited year round employment in rural areas resulting in compelling dependence on the collection of wood from the forests for subsistence; existence of organized groups who professionally indulge in illicit cutting and removal of valuable trees of the forests [1].

Most of the Sal forests are now severely degraded and poorly stocked. Some three decades ago, more than 60 percent of these forests were fairly densely wooded. But today, the forest has been reduced both in extent and tree density as well as stand quality. These are, in fact, the worst hit of all the forests in the country. FAO estimated that about 36 percent of the forest cover existed in 1985; more recent estimates suggest that

only about 6.7 percent of the forest cover remains [5]. Despite a moratorium imposed in 1972 on extraction of wood from Sal forests, illicit felling has continued unabated.

The Sundarbans is the largest single tract mangrove formation in the world. The main species is Sundri (*Heritiera* spp.) and other associated mangroves mainly species belongs to Rhizophoraceae family (*Sonneratia* spp., *Excoecaria* spp., *Xylocarpus* spp., *Ceriops* spp. etc.). The forest is fully controlled and managed by the Government Forest Department. The area is legally declared as a Reserve Forest so there are no human habitation and locality inside the forest except some people inhabiting the periphery. The Sundarbans constitute about 30.2 percent of the natural productive forests of the country [1] and provide livelihood for at least 0.5 million people mainly wood cutters, fisherman, honey collectors and *Nypa* palm leaf (fronds) locally known as Golpata collectors, *Phoenix paludosa* (hental) collectors, shell collectors and fishermen [1]. Beside forest resources, the Sundarbans forest is extremely important for fish production, wildlife conservation, recreation and serves as a protective barrier against coastal erosion, cyclones, storms and tidal surges. The mangrove forests and mudflats of the Sundarbans provide the vital breeding and nursery grounds for a large proportion of the fin fish, crustaceans and mollusks harvested. The significant depletion of the growing stock, notably of *Heritiera* (Sundri) and *Excoecaria* (Gewa) which appears to have been reduced by 40% and 45% respectively between 1959 and 1983. The incidence of crown death of *Heritiera* spp. seems to be increasing with rapid ecological changes rendering the site unsuitable for the species. The lack of experienced and trained staff, inadequate data base and accessibility are also the main problems to manage the forest properly [8].

The main reasons of the depletion of this forest are due to improper and poor management, over exploitation and, to some extent, ecological reasons.

For example, the construction of the Farraka barrage over the upstream of the Ganges by India in West Bengal, reduced the water flow significantly during the dry season which increased the salt intrusion from the sea and disturbed/changed/altereD/modified the ecosystem. The causes of the 40% top-dying of the main species Sundri (*Heretiera* spp) is still partially known [8, 9]. The depletion of this mangrove forest should be stopped immediately due to its ecological significance. Recently, the Sundarbans mangrove forest (an important habitat for the Bengal Tiger) has been declared as a world heritage site by the UNESCO. This should encourage the Government of Bangladesh to take necessary steps to protect and reserve this unique dynamic but fragile and complex ecosystem.

The tropical moist evergreen and semi-evergreen hill forest occurs in the greater Chittagong, CHT and Sylhet region and comprises roughly 38.2% of the country's total forest [1]. The main species represented are in the family Dipterocarpaceae and its associates including also a portion of plantation species. The main causes of depletion of hill forest are to shifting cultivation and sustained over-exploitation. A system of clear felling followed by artificial regeneration has been practiced in the hill forest for long period and these areas were not replanted with adequate management and silvicultural practices in place. The establishment of plantations is problematic in the clear felled areas due to encroachment of the land for agricultural conversion, particularly swidden agriculture by minority and other ethnic groups, human habitation and livestock grazing [4, 7]. The international boundary between Bangladesh and Myanmar is in this hill forest area and the Rohingya refugees of up to 1 million were forced to take shelter in the hill forests area in the early 1990's due to military oppression in that part of Myanmar adjacent to Bangladesh. The United Nations High Commission for Refugees is working to repatriate them to Myanmar and an estimated quarter of them have already returned. In the meantime, a result of the slow negotiation

process is the scale of destruction of a large part of the forest for shifting cultivation and timber extraction has taken place. This has put oil in the fire of destruction which was undertaken previously by local illegal timber traders.

### 3.2 Consequences of Forest Degradation

Forest degradation and deforestation bring about the local extirpation of forest products. Some forest products such as litsea bark (*Litsea glutinosa*), forest ginger (*Zingiber spp.*) and alpinia (*Alpinia galangal*) can be found just at more than 10 km from the villages. Rattan is almost no longer collected due to its scarcity. Therefore, harvesters have to spend more time and labor to collect once common forest products such as bamboo shoots or fuelwood. As a result, the life of the villagers has been directly impoverished and their living standard has been lowered.

The major consequence of deforestation is seriously affecting the economy of the country. The effects of uncontrolled logging are most destructive in the hilly areas [7].

The loss of vegetation cover increases the incidence of soil erosion because the soil is frequently affected by rain drops. The soils of hilly area are the most susceptible to water erosion in which sheet, rill and gully erosion occurs [10, 11, 12]. About 75% of the hilly areas have very high susceptibility to erosion, 20% have high susceptibility and 5% have moderate susceptibility to erosion [13]. Shifting cultivation in hilly area causes gully erosion and losses in topsoil ranges from 10 to 120 t/ha/yr. [14]. In the past, the thick forests surrounding shifting cultivation fields helped to control the erosion. Nowadays, with the decrease in forest cover, soil erosion has become increasingly problematic. Hence, soil erosion becomes one of the causes of low productivity in agricultural production.

The average organic matter content of top soils (high land and medium high land situation) has reduced from about 2% to 1% over the last 20 years due to intensive

cultivation which means and decline by 20-46% [15]. Each year, the eroded soil from all the *jhum* fields in CHT carries out about 4309 tons of nitrogen along with other nutrients [16]. About 14,071 tons of commercial fertilizers would be required to replace nutrients in eroded soil that would cost approximately US\$1.8 million annually [16].

Soil degradation in the plain lands due to nutrient deficiency is also common. Previous natural nutrient cycling from the forest to the plain arable lands has been destroyed by clearing the forest and afterwards using large quantities of chemical fertilizers and uncontrolled use of the hazardous toxic pesticides [4]. The dose of the chemical fertilizer application is increasing every year and results in infertile, barren soil. Land degradation is accelerated by this process. Also the devastation after the cyclones and storms in exposed areas to the bay near the coastal lines is now more severe than the past. The situation is becoming worse as the time passes.

The reduction in availability of forest products due to forest loss and degradation, lowers the productivity of agricultural land by a decrease in soil fertility due to soil erosion and shorten fallow periods. There is a cycle of poverty being caused by shorter cropping cycles and soil impoverishment leading to more poverty.

The soil erosion and hydrological regime disruption in the upper watershed result in a range of downstream effects for its lowland and coastal region. More frequent and more serious flooding, more rapid siltation of irrigation channels and deposits of gravel (as well as silt) in delta areas have the effects on agricultural productivity and outputs of the lowland farmers, and thus on their standard of living as well.

### 3.3 Possible Pathway

Bangladesh evolved through a long process of political and administrative change over several centuries. As part of greater India, Bangladesh was colonized by Britain from 1760 until 1947. Following independence from colonial rule, Bangladesh became a

part of Pakistan and remained so until its emergence as an independent nation in 1971. Forest policies during these different politico-administrative periods have had a direct bearing on land use in this country.

Comprehensive planning is required to utilize the Unclassed State Forest (USF) land (which is virtually barren and unproductive), marginal and waste land, homesteads, roadside lands and railway side, embankments, pond banks, canal and river banks, institutional premises etc. These lands can be planted with multipurpose tree species, which may provide significant alternative sources of forest produce and timber and can help to reduce the pressure on the remaining natural forests. Despite the shortages of skilled forestry personnel, the Green-Belt project by the FD to restore the coastal lands is a promising approach. Forestry graduates from universities of the country can be appointed to implement this type of program effectively.

The major causes are more or less the similar for the depletion of all the forest types. In some cases, all these causes are affecting and operating simultaneously making the situation worse. Without the firm commitment of the government to stop the forest depletion, probably little or no change will occur. In general, motivation, awareness creation among the general public, updating and enforcement of laws, employing trained, honest and efficient manpower equipped with forestry knowledge may be some much-needed remedial measures.

Developing awareness regarding deforestation and forestation programme is not systematic and well co-ordinated. Without the inter-ministerial effort and co-ordinated programme rate of deforestation cannot be checked. However, the government is not particularly concerned about the long-term impacts of deforestation. It is noteworthy that the Bangladesh Bureau of Statistics, under the Ministry of Planning, in its Statistical Pocket Book of Bangladesh, 2008 has furnished considerable statistical information, but there is almost no information regarding forest loss.

Environmentalists and organisations or people working in this field try to make the government more concerned about the menace of the deforestation and as well as the development of reserve forests and in addition to that develop the awareness of agroforestry. To make the progress a success government's positive and potential participation is essential, but unfortunately it is negligible.

Government may take different strategies to make the people understand the importance of afforestation and the menace of deforestation. It is easier for the government to use its different machineries more widely and effectively. The Government can use the remits of the Ministry of Agriculture, Ministry of Forest, Ministry of Education, and Ministry of Information for wider publicity in favour of deforestation. Inter-ministerial integrated programme should be taken to develop the knowledge and awareness of the people regarding deforestation. To protect and develop the country's forest resource integrated inter-ministerial programme is an urgent need.

Ministry of Agriculture and Ministry of Forests: To check the deforestation programme and to make it a success, these two ministries should work together in an integrated way. If the government desires, the Ministries of Agriculture and Forestry can prepare co-ordinated programmes for afforestation and to cease deforestation of the country the following programmes may be conducted:

In rainy season both the ministry should try to supply saplings, manure, booklets and other materials to the villagers and interested persons at absolutely minimum price. The ministry should campaign that at least five saplings of the same species should be planted prior to cutting a tree for economic reasons. To make the campaign viable, along with the materials of forestation they will also supply booklets, posters, hand bills, leaf-lets, free of charge to promote awareness among the people regarding the multifarious environmental risks of deforestation.

The Ministry of Forest can arrange training programmes for different types of agro-forestry. Those who have no extra land he can grow homestead forest or cropland agro-forestry. Bangladesh has long heritage of homestead tree cultivation with species such as mango, lychee, guava, blackberry, coconut etc. these trees give lucrative fruits and after a long duration these are disposed of as timber for furniture and other house building works. In addition to these there are some special trees such as mahogany, *Dalbergia sisso*, the sal tree (*Vatica robusta*), teak, and silk cotton tree etc which are sold as timber at a high price. It strengthens the family economy and country as well. But early deforestation has ruined both environment and economy. In this regard data may be furnished which is discouraging for the interest of the country. Table 1 shows a hopeless scenario of our forest products. The production of timber and fire wood in 2005-2006 has been declining in comparison to 2004-2005.

Ministry of Education: The Ministry of Education can also play a vital role to make the people understand the importance of forestry which is a dominant factor in the social, economic and environmental upliftment of the country. The Ministry of Education could include matters related to forestation and deforestation in the curriculum of schools and colleges.

At primary level, the importance of trees may be included in the syllabus such as: trees give us oxygen, it gives us shade, gives us fruits, gives wood for different household purposes. At junior level, how trees are planted and nursed and how it creates environmental balance. Practical and demonstration classes may be arranged regarding plantation and nursing of plants. Finally at the high school level, the advantages of forestation and the demerits of deforestation may be taught. At higher level forestry as a subject may be included in the syllabus. Moreover, the Ministry of Education should be seriously concerned about the menace of deforestation. Education Ministry can arrange training programme for the agricultural labour

regarding afforestation, and how that could be expedited. In addition to that ministry may arrange constant campaign against wide spread deforestation as well.

The Ministry of Education may also arrange training programmes for the teachers to develop knowledge and awareness regarding danger of deforestation and benefit of forestation. Later on teachers may extend their knowledge to their students. In the rural areas school and college teachers can help develop mass awareness as they are very much respected in the wider society.

The Ministry of Information may play an important role in propagating the divesting effects of deforestation and the need of forestation in the economy and environmental balance of the country. This publicity may be undertaken by collecting data and information from the field level. Without accurate data policy makers cannot take the potential decisions to address the problem. Country should know the progress of forestation and the rate of deforestation accurately. In this regard, the Ministry of Information may play a key role as media facility is available to them. The ministry may take a consolidated propaganda programme regarding the matter.

The Department of Film and Publication may also play essential role to develop the mass awareness regarding the danger of wide scale deforestation in Bangladesh which may affect economy as a whole and environmental balance in the long run. This can be propagated in the following ways:

- By distributing leaflets;
- Printing and displaying posters;
- Preparing and showing documentaries especially in the rural areas;
- Publishing and distributing free of cost booklets;
- Arranging funds for distributing seed and seedlings at a cheap rate; also hand bills free of cost

building awareness against deforestation.

Good numbers of non-government organisations (NGO) are working in different fields, to develop the country. NGOs are working in the field of education, micro credit, water supply, sanitation, healthcare, forestry, etc.. There are also some NGOs working in afforestation programmes. The government may patronise the NGOs to include mass awareness programmes regarding deforestation throughout the country.

In private level there are many villagers interested in agroforestry. Now many people are doing cropland agroforestry by their own initiative as they have realized its benefits. There is a growing evidence of planting trees with crops, because commercial thinking has been developed among the village people. They need only some government and NGO support and co-operation, because initial investment is required for agroforestry cultivation and many poor farmers do not have money to invest.

Public and private plantation programmes should be undertaken in the barren hilly areas and clear felled areas immediately. The most successful story of FD may be demonstrated like the Betagi Community Forestry model farm as in the hill forest areas of Chittagong. Landless labourers, farmers, encroachers, illicit loggers were selected and given about 2 hectares of land to each on a leasehold basis. They were given also the loan initially for raising the tree plantations. Periodic repayments of the loan were ensured. The incomes of the farmer had increased from US\$70 to US\$1,600 per year after seven years of the practice, which has been shown in several studies [17]. In similar fashion, the hill forest may be recovered again by selecting the individuals based on some well accepted criteria (i.e., poverty, gender, regular loan

**Table 1 Output of some selected forest products (Reserve forest).**

Items	Unit	2002-03	2003-04	2004-05	2005-06
Timber	'000' cft.	2669.97	3606.32	5216.04	3324.37
Firewood	'000' cft.	6958.56	4645.75	6638.89	3117.15
Bamboos	'000' nos	57604.32	15741.58	57051.73	68280.98

Source: Ref. [1].



repayment etc.). Segments of the poor, destitute women, landless labourers, small co-operatives, medium entrepreneurs may be the target client groups.

Emphasis should also be given to translating policies into action. There are many good policies in Bangladesh but they are not being implemented. For example, the Private Forest Ordinance developed during the 1950s made provision for financial support for smallholder tree growers, but this has not yet been translated into action. Likewise, the Land Commission established in 2001 to address land issues is not yet functioning. In order to remove the gaps between policies and practice provision should be made for participatory monitoring and evaluation of the policies, along with room for necessary adjustments. Without such policies, there may be a tendency to switch from one degrading system to another, such as from shifting cultivation to root crops on hill slopes and to mining of resources, eventually leading to a spiral of degradation and poverty.

#### **4. Conclusion**

Human wellbeing and forest cover should be examined as joint problems because of mutual causal links [18]. Poverty is seen as a cause of forest loss and forest loss contributes to maintain or even increase poverty [19]. Forest is particularly important in the context of present environmental degradation and ecological purposes of Bangladesh. Developing mass awareness regarding afforestation is the crucial need of the present time. Attempts should be taken to check wide scale deforestation of Bangladesh to save the economy of the country and maintain ecological balance. Along with forestation campaign large scale plantation should also be focused. This mammoth task cannot be done without the governments' active participation and inspiration. Inter ministerial efforts and co-ordinated programme can bring positive results against large scale deforestation, and ensure wide scale forestation in the country. Along with the government efforts NGOs could be included to bring fruitful results.

Conservation could be the potential alternative measure to conserve Sal forest. Enforcement of the laws, forestry extension in the adjacent localities, motivation and campaign can stop further depletion of the forest. For the mangrove forests specific policy is required by the government. Enough control of the Forest Department over the Sundarbans is still strong. This may be used for its proper management and conservation. Immediate steps should be taken to stop the over-exploitation of resources before complete deterioration of the administrative control of Forest Department over the Sundarbans.

Finally, sustainable land use and management require the participation of the people who directly depend on those resources. However, since the British colonial period local people have been kept outside the policy and decision-making process. At present local people have little involvement in policy formulation and decision-making and their needs and views are rarely considered. Drawing on the experience of other countries, policymakers should develop appropriate mechanisms to involve local people in planning and decision-making about the use and management of land and forest resources. Traditional institutions, which have close relationships with local people, should be involved in managing resources and government agencies should work together with those institutions. Moreover, the policy formulation process should be made participatory.

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