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Carbon Forestry: Scope and Benefit in Bangladesh

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Abstract

The aim of the study was to reveal the scope and benefits derives from establishing carbon forests in a country like Bangladesh. Carbon forestry is the modernized forestry practice that evolves no cutting of trees or vegetation rather conserves them in the wood. Trees might be the source of carbon sink at large scale by establishing carbon forests. To find out how and in what extent forests of Bangladesh could contribute to global emission reduction, tree species of economic importance were taken into account about their carbon sequestration potential. Data source was a secondary one. Bangladesh has subtropical evergreen and deciduous forest tree species. Here trees can sequester almost 45-55 percent organic carbon in their biomass. On an average, trees in different types of stands can sequester 150-300 tC/ha. Carbon value of these forests might be 7,500-15,000 USD per hactre (assuming 50 USD per equivalent tCO_2). Thus, accounting tree carbon credits of total forested lands of Bangladesh, there might be a lump sum value of 1.89×10^{10}-3.79×10^{10} USD. If soil carbon is added, this amount would jump. Alternatively, there are two times higher spaces as marginal lands than this for starting carbon forestry. However, carbon forestry concept is still a theoretical conception unless otherwise their challenges are addressed and solved. Despite of this, forests of Bangladesh might be the key showcase for conserving biodiversity in association with carbon capture. Protected areas in Bangladesh are of government wealth, however, degraded and denuded waste and marginal lands might be the best fit for establishing carbon forests.

Key Words: Bangladesh, carbon sequestration, carbon forest, scope and benefit

Introduction

Deforestation worldwide contributes 18% of all CO_2 emissions (Stern 2006). However, terrestrial biosphere is the one that has the ability to ameliorate greenhouse gas (GHG) emissions (Ardö and Olsson 2004). Carbon forestry practices might be used to reduce these atmospheric greenhouse gases globally (Polglase et al. 2011). Carbon credits could be gained from reforestation and afforestation activities in developing countries (FAO 2001). An atmospheric concentration of carbon dioxide is kept in harmony by forests (Rotter and Danish 2002). And forests have the potential to be managed to reduce atmospheric concentrations of carbon and thus mitigate climate change (Houghton et al. 1992; Brown et al. 1996; Williams 2002; Matthews et al. 2000). Active absorption of CO_2 from the atmosphere through photosynthesis, and its subsequent storage in the biomass of growing trees or plants is known as carbon storage (Matthews et al. 2000; Baes et al. 1977; Heath and Smith 2004).

Effective forest management is one of the way that can contribute towards emissions reductions and to carbon se-

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questration (Sohel et al. 2009). In that context, carbon forestry is the right way to achieve green economy in Bangladesh involving local community. It is the authentic method to restore organic carbon in biomass from the atmosphere. This involves afforestation and reforestation practices with no cutting of trees where primary objective is to store atmospheric CO_2 (Rahman 2012). Not only this, in an existing forest special practices like silvicultural treatments, protecting secondary forests and other degraded forests might be useful in increasing carbon stock of the stand (Brown 1997). Specific forestlands can be turned into carbon forestry. These land use will be considered as conservation sites. No cutting of the trees before physical death, i.e. physical rotation of the forest. Here high potential carbon sequestering plants will be planted. This forest will sequester carbon, store it and act as a carbon sink. Other biological processes will be constant. The carbon credits those are sequestered will be traded with developed industrialized countries that emit CO_2 largely (Rahman 2012). It was reported that a hectare of actively growing forest can sequesters 2-5 tonne of carbon per year (Brown 1996). Potential scope of establishing carbon forestry in Bangladesh is immense large (Rahman 2012). Bangladesh may think of trading forest biomass organic carbon with developed industrialized countries following rules and procedures of the Kyoto Protocol (Sohel et al. 2009). The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol have introduced a mechanism named CDM (Clean Development Mechanism) allowing for the development of carbon forestry activities in the developing world as means to mitigate climate change and promote sustainable development (UNFCCC 2002).

The Kyoto Protocol recognizes forestry activities as a sink for atmospheric carbon (IPCC 2000). A number of carbon sequestration and carbon conservation initiatives have already been developed, including CDM (Miah et al. 2011), REDD+ (MoEF 2012) etc. The implication of the legal frameworks of the Clean Development Mechanism (CDM) on the Kyoto Protocol is important for creating CDM forests in Bangladesh and to achieve the 'Certified Emission Reduction' (CER) as a non annex 1 country (Miah et al. 2011). Moreover, the UNFCCC mechanism for Reducing Emissions from Deforestation and Degradation in developing countries (REDD+) represents an unprecedented opportunity for the conservation of forest biodiversity and carbon credits (Gardner et al. 2011).

In Bangladesh several forest tree species can sequester almost fifty percent carbon of their biomass (Akter 2011). Thus, credit of this sequestered carbon within trees in the carbon forest could be traded with developed countries (Rahman 2012).

With a huge pool of existing plantations and natural forests in Bangladesh, it can be assumed that Bangladesh is playing a major role in mitigating global warming. To realize the potential of the forestry sector in Bangladesh for full-scale emission mitigation, understanding carbon sequestration potential of different species in different types of plantations are important (Miah et al. 2011). Thus, the concept of carbon sequestration is required to understand sink and storages by forest trees (Bass et al. 2000).

The potential organic carbon in forest stands is almost 92 tC/ha especially in the natural hill forest of Bangladesh (Miah et al. 2011) where Akter et al. (2013) found this to be 150-300 tC/ha in managed plantation forest. Brown et al. (1993) found this to be 255 tC/ha in potential biomass, 144 tC/ha in actual biomass and 148 tC/ha in soils within Asia. However, there is ample potential of the forests of Bangladesh to convert them as carbon forest without hampering natural conditions either.

Prospect of Carbon Forestry in Bangladesh

Total forestlands are about 2.53 million ha in Bangladesh (Mukul et al. 2008). If managed properly, the whole forested lands might be used under carbon forestry protocol. Following (Table 1) is a gross estimate of the prospect of carbon forestlands in the country.

Specific Scope

Besides forested areas, non-forested areas might be used as plantation sites. There are twenty-eight districts those have no government forest (BBS 1999). These areas would be used as carbon forest playground. Moreover, there are 0.70 million ha Unclassed State Forest (USF) areas in three hill tract districts viz. Rangamati, Bandarban,

Table 1. Prospect of carbon forestry in Bangladesh (FRA 2010)

Forest type	Location/district	Area (ha)
Hill Forest	Kassalong	88,589
	Rankhiang	43,870
	Sitapahar	5,440
	Sangu Matamuhuri	74,500
	Chittagong	73,789
	Cox's bazaar	49,838
	Sylhet	41,566
	Jhum plantation	15,360
Plain Sal Forest	Dhaka	11,920
	Tangail	15,380
	Mymensing	7,456
	Dinajpur	3,328
	Rangpur	632
	Rajshahi	328
Mangrove Forest	Sundarbans	399,000
	Coastal afforestation	76,000
Rubber Plantation	Chittagong, CHTs, Sylhet	35,000
Unclassed State Forest	Khagrachari	1,410
	Bandarban Pulp Wood	8,720
	Bandarban	9,360
	Kaptai Pulp Wood	18,170
Strip Plantation	Mazor Highways throughout the country	72,498
Village Homestead	Whole Bangladesh	270,000

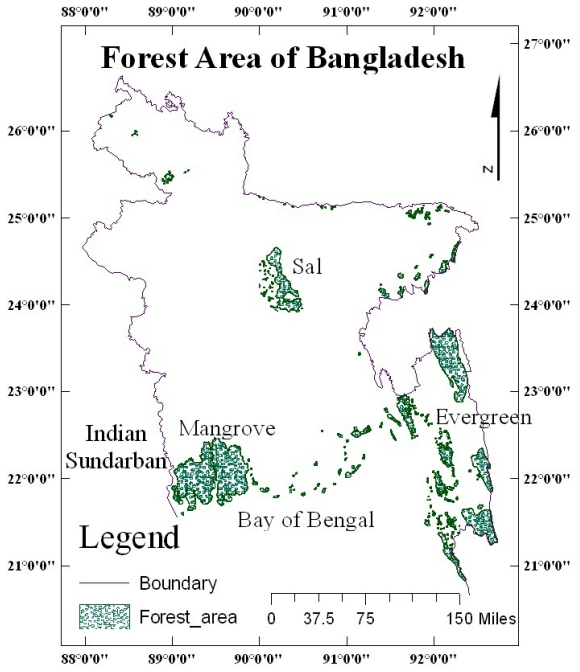

Fig. 1. Forestlands in Bangladesh (Adopted from Bangladesh Forest Department in FAO 2007).

Khagrachari (Banglapedia 2006). The hills are almost nude or depleting at high speed. These areas would be of great scope.

According to Forest Department there is 0.27 M ha village forest areas in Bangladesh (BFD 2011). These areas could be used as carbon forest plots. Marginal lands like pastures, waste lands etc. could be used as carbon forest plots. Wetlands in northeastern part of the country can be of great opportunity to establish carbon forestry. Total forested area of the country is shown in Fig. 1.

Choice of Species

Those forest species that sequester more carbon during its lifetime are the promising one. Several researchers found that indigenous forest species could sequester more carbon as CO_2 during their lifetime. Studies depict that indigenous tree species like *Dipterocarpus turbinatus, Anisoptera scaphula, Hopea odorata, Lagerstoemia speciosa, Shorea robusta, Terminalia belerica, Gmelina arborea, Chickrassia tabularis* all sequester higher carbon content (45-55 percent organic carbon) in their biomass (Akter et al. 2013). These species might be planted in carbon forests. However, Fig. 2 depicts that exotic species like *Casuarina, Eucalyptus, Pinus* etc. sequester less carbon in their biomass. Fig. 2 shows the organic carbon percentage in wood content of different tree species in Bangladesh.

Carbon Forestry Projects

Various afforestation and reforestation projects might be used for carbon forestry purposes. Such projects might be of large, medium or small. In a country like Bangladesh, small projects are very much suitable and effective. Small-scale afforestation or reforestation projects were defined by Decision 19 of the COP9 as those that are expected to result in net anthropogenic greenhouse gas removals by sinks of less than 8 kilotonnes of CO_2 per year. Nevertheless, these projects have to be developed by low-income communities or individuals as defined by the

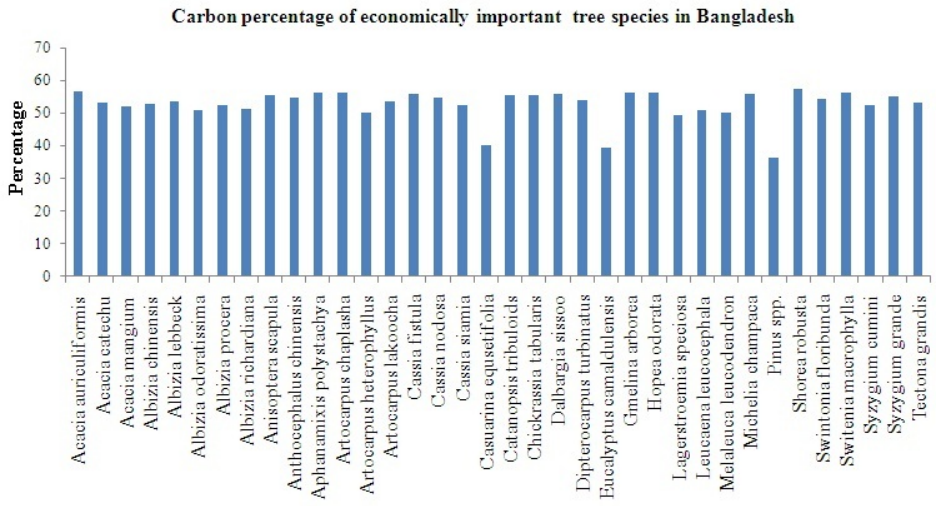

Fig. 2. Carbon percentage (%) of different tree species in Bangladesh (Hossain 2004; Roshid 2005; Hossain 2007; Ahmed 2007; Khandaker 2008; Ullah 2008; Akter 2009; Bhuiyan 2009).

host Party (Forner 2005). Selective cutting schemes, lengthened rotations, reduced-impact logging, and species choice may achieve a higher average level of sequestered carbon in those carbon sink projects (Rosenbaum et al. 2004). In establishing small scale projects three strategies may be kept in mind as suggested by FAO (2001). The first is to increase the amount or rate of carbon accumulation by creating or enhancing carbon sinks (carbon sequestration). The second is to prevent or reduce the rate of release of carbon already fixed in existing carbon sinks (carbon conservation). The third strategy is to reduce the demand for fossil fuels by increasing the use of wood, either for durable wood products (i.e., substitution of energy-intensive materials such as steel and concrete) or for biofuel (carbon substitution).

Benefit of Carbon Forestry

Carbon forestry has immense good to natural resources, economy and development of the country. Being a member of the LDCs (Least Developed Countries) (UNCTAD 2005) Bangladesh has plentiful opportunities for gaining carbon budget from developed countries for her forest sinks.

Carbon credits

Credit of sequestered carbon within trees in the carbon forest could be traded with developed countries. As developed countries emit enormous CO_2 they need to reduce those according to Kyoto protocol (1997) (EPRI 1998). One way to reduce this is buying the carbon credits from developing countries that have much forest plantations or reserves. Thus if the country can increase forest growing stock, REDD/ REDD+ projects may be undertaken at appropriate places.

For the developing countries concept of carbon trading is a great opportunity. In the Kyoto protocol a strategy was developed by which the developed country will sponsor for the establishment of a new forest to the developing countries. The Clean Development Mechanism (CDM) was established on the basis of this concept, which will supervise the projects of the establishment of new forest. According to this the project implementers will receive the forest credits (Schoene 2002).

The concept of carbon trading is becoming more popular throughout the world. Bangladesh has an immense opportunity to become profitable by adopting the carbon-trading concept. It is estimated that more than 500 species of higher plants appear in Bangladesh. Thick foliage density and their diversity have made this country one of the richest flora region in the world (Anonymous 1998). Homestead flora of Bangladesh provides about 70% of all timber and timber and 90% of all fuel wood and bamboo consumed incorporating 149 village tree species (Khan and Alam 1996). In Bangladesh several forest tree species can sequester almost fifty percent carbon of theirs biomass. Reports found

that a healthy forest can sequester almost 150 to 300 tonne carbon per hactre area. Where, plantation in Chittagong University campus can store 107.48 tonneC/ha (Akter et al. 2013). If one tonne carbon dioxide equivalent price is 50 USD in near future then the carbon value of a living forest is about 7,500-15,000 USD per hactre area. This income is huge and exclusive of the trees timber value. Thus, conserving the forest trees in carbon forest it may earn up to million credits per hactre area.

Climate change mitigation

To reduce greenhouse gas (GHGs) emissions Carbon forestry is the best fit way (Polglase et al. 2011). It could act as mitigating the GHGs and thus take part in global climate change consequences. Forest trees are considered as storehouse of organic carbon in their biomass (Brown 1997). Thus if forests store atmospheric carbon, they would surely mitigate global warming (Rahman 2012).

Trees uptake CO_2 from the atmosphere through photosynthesis and store them in their biomass. The carbon is stored in the foliage, stems, root systems and the woody tissue in the main stems of trees (Ciesla 1998). Forest can sequester and store more carbon than any other terrestrial ecosystem (Matthews et al. 2000) and this amount has been estimated to be 10-20% of the world's fossil fuel emissions by 2050 (McCarthy 2001).

Vine et al. (1999) describe two main ways that forests play a role: (1) by preserving existing forests, thereby avoiding emissions due to deforestation; (2) by increasing the amount of carbon uptake (sequestration) from the atmosphere by afforestation, reforestation or implementation of additional forest management activities (IEA Bioenergy 2001).

There are some other benefits derived from carbon forestry like biodiversity conservation, amelioration of microclimate, soil amelioration, community development, ecotourism etc.

Conservation of biodiversity

Conservation strategy of a carbon forest might be a model for conserving biodiversity worldwide. Reports found that carbon forest can restore landscapes (Polglase et al. 2011). Trees remain without any commercial cut or harvest, only salvage and sanitation cutting or partial thinning could act as a great tool for biodiversity conservation.

Amelioration of micro and macroclimate

If trees are not cut spontaneously, on spot micro and macroclimate will be ameliorated. This might happen when a carbon forest is grown enough that means about 5-7 years old.

Soil conservation

Soil will be conserved in hill forests of Bangladesh where soil erosion, landslide are very much severe. In Unclassed State Forest of the hill districts where soil erosion is very common there this practice can change the situation.

Benefit to community

Because of benefit sharing between carbon forestry management committee and local community, the whole economy will be enhanced.

Carbon sequestration projects through land use, land-use change and forestry (LULUCF) activities could demonstrate a win-win situation from the point of view of climate change and sustainable development. In many parts of the developing world carbon sequestration projects have been implemented in association with community development. To some extent the projects are in line with the dual objectives of the Kyoto Protocol's Clean Development Mechanism (CDM). It is generally demonstrated that local participation is very strong in all of the carbon sequestration projects run in countries like Mexico, Colombia, Costa Rica, Philippines, Indonesia, and Timor-Leste. However, large-scale plantation projects offer few benefits for the community, whereas small-scale projects that allow the community to participate offer the possibility to earn carbon credits as well as socio-economic and cultural benefits (Murdiyarso 2005).

Ecotourism

Ecotourism is one of the ways to provide green services rather than production and consumption system. Carbon forestry concept is very much relevant to support eco-tourism as it allows conservation for long time.

Co-management

The Integrated Protected Area Co-management (IPAC)

project in Bangladesh is a successful story of co-management strategies that trades carbon credits with developed countries (USAID 2008).

Challenges to Achieve Carbon Forestry in Bangladesh

Bangladesh is the most densely populated country in the world (Streatfield and Karar 2008) having 155 million people in the year 2006 with 1,198 persons per square kilometer land (FAO 2009). Because of the high demand of forest products like wood, fuel, fodder (Choudhury and Hossain 2011), government owned forests are depleting rapidly (FRA 2010). Moreover, forestry sector contributes very less to the national GDP, about 1.84% of the country's GDP and 10.2 % of the agriculture income in 2003/ 2004 (GOB 2004). For such cases carbon forestry projects (CFPs) might be adopted to accelerate GDP growth with this sector. But the country lacks appropriate policies and research on different forestry options (Miah et al. 2011). Bangladesh can effectively participate in carbon trading. However, it is necessary to develop national policies in mitigating global warming to bring about large-scale changes in land-use and forestry practices and to address some of the technical and policy issues that have proven to be particularly problematic from carbon accounting and project-level perspectives (Kennett 2002). Encroachment is another problem in forest land-use of Bangladesh. Ali (2002) reported about 62,000 ha of national forest land has been encroached till December 1980. Besides this, in the hilly areas of Bangladesh, shifting cultivation is an age-old practice which cause massive forest destruction practiced by the ethnic community (Ali 2002). Thus, these challenges might hamper carbon forestry projects in future in Bangladesh. To run a practical framework effective enough to sustain carbon forestry projects, forest department and other non government organizations together with local community have to establish a 'national carbon forestry commission' that will work for the community interest, national interest and overall for the GDP development.

Conclusion

Management of carbon forests might be the useful future forest management scheme in Bangladesh if properly monitored. Forests of Bangladesh have many drawbacks. However, they can sequester fair amount of organic carbon in their tree biomass. Potential carbon sequestration by forests in the country may lead to the establishment of carbon forestry. This will lead the country toward a strong negotiation that Bangladesh has the scope, potential and beneficial opportunity to establish carbon forestry projects to offset green house gases efficiently.

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