

CLIMATE CHANGE AND BIODIVERSITY & FORESTS IN BANGLADESH

INFORMATION BRIEF



Photo: IUCN / Abdul Quayyum

KEY POINTS

- The impact of climate change on the biodiversity and forests of Bangladesh is complex. With direct impacts consisting of subtle changes in ecosystems through changes in salinities and the attrition of habitats.
- Indirect impacts to both of these sectors will occur as a result of changes in other factors. The diminishment of cultivatable land due to the projected increase in flooding will could result in deforestation to clear room for agriculture. Similarly destruction to infrastructures and homes may induce migration which may result in increased deforestation.
- Bangladesh's forest ecosystems, as carbon dioxide sinks, are forefront when considering mitigation mechanisms. The Sundarbans are a natural barrier to tropical storms and as such conservation of these coastal ecosystems are important when considering adaption mechanisms.
- A review of existing policy is done that takes adaption and mitigation into account and key gaps are found.

INTRODUCTION

The impacts of climate change, such as increased air and ocean temperatures, and increased frequency of extreme climatic events will directly and indirectly affect biodiversity. The responsiveness of species to recent and past climate change raises the possibility that anthropogenic climate change could act as a major cause of extinctions in the near future. Climate change may render a quarter of land animals and plants extinct, according to a major study published in the journal *Nature*, unless greenhouse gas emissions are drastically reduced. Climate change over the past 30 years has produced numerous shifts in the distribution and abundance of species worldwide. It can affect the distributional area of each species independently and has already produced shifts in the distribution of some species, such as amphibians, grasses, migratory birds and butterflies.

While over-exploitation, deforestation, habitat change to agriculture, pollution, and invasive species are being considered the most important current drivers of biodiversity loss in Bangladesh, climate change is expected to become increasingly important. A wide range of mammals, birds, amphibians, reptiles, crustaceans, and above all the Royal Bengal Tiger will face extinction in Bangladesh due to climate change. For some species there will no longer be anywhere with a suitable climate to survive; in other cases they may be unable to reach distant regions where the climate is suitable. Other species may survive elsewhere only to face new threats, notably if the new area is covered by crops or urban sprawl. However, an essential first step in developing climate change response activities is to identify the specific threats to a species or ecosystem.

A list of questions concerning biodiversity, forest and climate change should produce a greater synergy between policy, practice and research, and could inform researchers and research fund managers as to where their efforts might best be focused.

- Which species are likely to be the best indicators of the effects of climate change?
- Which habitats and species might we lose completely because of climate change?
- What will be the ecological impacts of

changing management pattern in response to climate change?

- What is the likely relationship between the extent of climate change and the pattern of species extinction?
- How does climate change interact with other ecological pressures like invasive species and habitat fragmentation to create synergistic effects?
- How can we increase the resilience of habitats and species to cope with climate change?
- How well suited is the protected area system for conserving biodiversity in the face of climate change and how can it be enhanced in light of this?
- How will changes to oceanographic conditions as a result of climate change affect marine ecosystems?
- What actions are required to recreate the full range of coastal landscapes, habitats and species distributions to compensate for their loss, for example as a result of sea-level rise?

Forest Processes

Forests provide water, timber and pulp for residential and industrial use, and are an important sink of atmospheric carbon dioxide (CO₂). Long-term impacts of changes in air temperature, precipitation, atmospheric CO₂, and ozone (O₃) and their variation could significantly impact these forest processes during the next century. Examination of national and regional scale forest process models, combined with two transient and five static climate change scenarios, suggested that forests will experience slight to moderate (5 to 30%) increases in forest productivity.

Although most of the climate scenarios suggest a generally more productive environment, certain regions may experience significant reductions (>20%) in forest productivity, especially if other stresses such as ozone impacts are included in the analysis. Carbon accumulation may increase or decrease, depending on the extent of and severity of fire and climate change model predictions of precipitation change. Forest water may increase, resulting in decreased water flow from forests.

Biodiversity Change

Climate and land use are the two major factors controlling biological diversity. Species richness generally increases with increasing air temperature and precipitation. As climate changes during the next century, biological diversity will also change. Under all of the climate scenarios, many of the forest types adapted to monsoon temperatures will migrate northward, while isolated communities of other species may become extinct within their current region.

However, ecosystems are complex communities and current models only associate biodiversity with existing environmental conditions. If climate change occurs faster than functioning ecosystems can be developed, then the historic relationships between plants, animal and climatic conditions may not be re-established and biological diversity will be reduced.

IMPACTS OF CLIMATE CHANGE ON BIODIVERSITY AND FORESTS

Climate is an important determinant of the geographical distribution, species composition and productivity of forests and changes in the climatic regimes can modify the pattern and productivity irreversibly, affecting anthropogenic livelihoods, forest based industries, soil and water resources. Impact of climate change on biodiversity and forest will be very complex. It is already established that forest production is increasing due to higher concentration of CO₂ and temperature. According to the IPCC, at least one third of the forests will be adversely affected by climate change, reducing carbon sinks, soil fertility and precipitation and conversely increasing the incidence of pests, forest fires and natural disasters.

The Intergovernmental Panel on Climate Change (IPCC)¹ projected that the state of tropical forest ecosystems is likely to be worsen from climate change. Bangladesh being in the tropical region, different physical effects of climate change including increased temperature and precipitation, increased salinity and extreme weather events such as floods, cyclones and droughts will have profound negative impacts on its forests.

Because of the increased rainfall in monsoon, water

runoff rate on the forest floor has increased from the previous one. As a result, rapid soil erosion causes nutrient leaching and destroys micro organism and reduces overall site quality for better forest growth in the previously dense hill forests of Chittagong, Chittagong Hill Tracts (CHT), Sylhet, and Cox's Bazar. Most of the forests are also likely to be affected from the absence of ecological memory that is the network of species for interaction between each other and environment, and building the capacity for reorganization within or outside the forest patch after different perturbations.

Sundarbans

A modest projected sea level rise during this century is expected to be 90 to 880 mm (IPCC). Thus by 2050 the sea level at Sundarbans may rise by over 15.5 cm. Sea level rise may cause permanent inundation to about 115 1h of the Sundarbans by 2050.

- All the terrestrial fauna in these areas are very likely to move initially towards the North. But they will disappear ultimately.
- The composition of aquatic fauna is also likely to change.
- The permanently inundated vegetation will gradually die.
- During the process more detritus will be released from the rotting vegetation and that in turn will temporarily boost up the aquatic population, especially the fish.

Higher Inundation

One of the resultant affects of sea level rise is likely to be higher levels of inundations. Such situations will definitely change the species composition.

- The species that do not thrive under higher inundation will die off from the areas that start receiving higher inundations.
- The fauna will be affected by loss of habitat and elimination of many of water holes that are supplying drinking water to the wildlife at present.

¹ IPCC. (2001). *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

- The tiger population in turn is very likely to decline and seriously suffer from short of prey possibly turning to humans as prey.

Higher Tide Current

During higher inundation situation, higher volumes of water will flow during the given time period (fixed by lunar timings). Thus the tide current will be more than what it is at present. Such situation will adversely affect the softer vegetations, especially the creepers, which in turn may ultimately decline.

Besides these, movement of soft clayey particles is likely to increase. The water turbidity may increase. Such situation will change the soil texture at some locations, which in turn will affect the species composition at those specific sites as well. More over the enhanced water turbidity will adversely affect the aquatic population and its composition.

Higher Salinity

Salinity is a very important factor for mangrove ecosystems. With the impact of climate change, the whole of Sundarbans is very likely to experience higher salinity. Salinity is a very important factor for the mangroves, in determining the species. The existing fresh water zone (technically low salinity zone of Northern parts of Sundarbans) is likely to get obliterated.

Biodiversity

Human induced land use, land use change, and forestry (LULUCF) activities worldwide currently account for 20 - 25% of annual global GHG emissions, or roughly 1 - 1.5 billion tons of carbon.² This encompasses influencing flows within the carbon cycle from activities such as forest removal, hydroelectric damming, road expansion, urban sprawl, and soil degradation and losses from agriculture, ranching, and logging. It also includes the annual destruction of an estimated 6 - 10 million ha of tropical rain forest, harbouring some of the planet's most biologically diverse and abundant flora and fauna.

The rapid loss of forests is not only contributing to the build up of atmospheric carbon dioxide (CO₂), but is also directly undermining the world's biological resources, ultimately precipitating species extinctions

and biodiversity loss. This, in turn, jeopardizes the climate adaptation services which many complex ecosystems deliver, further exacerbating the potential impacts of climate change.

Maintaining high biodiversity has been linked to ecosystem resilience in the face of common climate change related impacts such as storms, floods, fires, and droughts. Ecosystems that have more diversity in terms of species, structure, and function provide more alternatives for transferring energy and nutrients, and have a greater capacity for resisting and reacting resiliently to such shocks compared to systems with low biodiversity, which are more likely to decline or even collapse and not recover.

The actual effects of climate change on biodiversity can be summarized as follows:

- Inability of many species to cope and adapt to change;
- Major loss of biodiversity through changes in the community;
- Migration and extinction of certain species;
- Boom in the population of alien invasive species; and
- Reduced supply of biodiversity resources and extremely negative impacts on human lives and livelihoods.

MANAGING CLIMATIC HAZARDS

Mitigation

According to the IPCC, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks in the long term, while producing an annual sustained yield of timber, fibre, or energy from the forest, will generate the largest sustained mitigation benefit. In its Fourth Assessment Report, the IPCC considers four groups of activities as available options to reduce emissions by sources and to increase removals by sinks in the forest sector:

² Watson, R.T., Noble, I.R., Bolin, B. (eds.). 2000. *Intergovernmental Panel on Climate Change (IPCC) special report on land use, land use change and forestry*. Cambridge, UK: Cambridge University Press.

Afforestation and Reforestation

The role of forests in carbon sequestration from photosynthesis is well known. Because trees have a much longer lifespan than agricultural crops, they act as long term reservoirs, which lock up the carbon for decades, even centuries, in the form of cellulose and lignin. Therefore, enhancing carbon sinks and reducing GHG emissions from forests can contribute substantially to mitigating climate change and its effects on ecological and social systems. Afforestation and reforestation are the direct human induced conversion of no forested land to forested land through planting, seeding, human induced promotion of seed sources, and/or natural seed sources. The two terms are distinguished by how long the no forest condition has prevailed. Afforestation and reforestation activities lead to increases in the carbon pools. These two activities are currently the only forest management practices that contribute to the mitigation of climate change for which developing countries can be rewarded. That reward is possible through the CDIVI.

Bio Fuel Plantations and Substitution Through Wood Products

Substitution of products with high upstream emissions by products with lower upstream emissions is an interesting possibility for mitigating climate change. In the forest sector, it includes mainly three options:

- Substituting wood for high energy consuming materials in the building industry Using wood for heating;
- Promoting forest based bio fuels (for example through the planting of *Jatropha curcas*, *Pongamia pinnata*, *Croton megalocarpus*, and other species);
- Those activities have a positive carbon balance when (a) wood is produced sustainably (that is, carbon stocks are renewed in the forest) and when (b) emissions from producing wood materials or bio fuels are equal to or less than the products they substitute.

Reduction of Emissions from Deforestation and Forest Degradation

Deforestation and forest degradation are the main emission sources in many developing countries and are responsible for up to 20 - 25 percent of the total global anthropogenic emissions. In some circumstances, deforestation and forest degradation can be delayed or reduced through strict protection of forests, through sustainable forest management practices, and through forest uses not involving tree removal, such as tourism and harvesting of non-timber forest products. Protecting forest from all harvests typically results in maintained or increased forest carbon stocks, but it also reduces the wood and land supply needed to meet other societal needs.

Improvement of Forest Management

Forest management activities include silvicultural interventions that promote a greater proportion of the desired species, tree population, and size structure, which, in terms of timber, means promoting the maximum volume of usable growing stock and, therefore, of carbon that may not be released to the atmosphere. Such activities also include harvest systems that maintain partial forest cover, minimize losses of dead organic matter or soil carbon by reducing soil erosion, and avoid slash burning and other high emission activities.

Forest Restoration

What is missing in the currently discussed approaches of forests in climate mitigation is the entire field of restoration, which is probably the most promising option in forestry for restoring carbon stocks. Restoration is a combination of the planting of trees and human induced natural regeneration within a degraded forest area that has lost most of its carbon stock.

Forest restoration aims to enhance and accelerate natural processes of forest regeneration, including carbon stocks, to regain the desired species composition and growing capacity of the forest ecosystem. In terms of mitigating climate change, forest

restoration becomes complementary to reducing emissions from reducing forest degradation. In those areas where a strategy of reduction of emissions from degradation is not completely successful or where degradation has already occurred, one would need to restore the forest.

Adaptation

According to Huq (2002)³ the following adaptation measures should be undertaken:

Table: Adaptation Measures

Adaptation measures	Effectiveness /feasibility	Current state of implementation & /or requirements for improvement	Priority for future incremental action
Integrated ecosystem planning and management	High/Medium	Not yet practiced. Proposed Coastal Zone Development Program could be a vehicle for this	High
Management of mangrove ecosystems in the Sundarbans	High/Low	Proposed Ganges barrage would be very costly. Need to look for an appropriate option.	High
Management of protected areas and 14 ecologically critical areas	High/Medium	Improved understanding in needed	High
Reduction of habitat fragmentation and promotion of establishment of migration corridors and buffer zones	Low/Low	Trans-boundary co-operation needed	Low
Coastal greenbelt	High/High	Recently started. Promising results	High
Introduction of alien species or genetically modified organisms	Low/Low	More research needed	Low
Agro-forestry development	High/High	Ongoing programs such as FRMP/Coastal greenbelt need further pansion/improvement	High
Studies on, e.g., Risks to endemic species and ecosystems	Medium/Medium	Improvement understanding is required, e.g., biodiversity action plan to be prepared and implemented	Medium

³ Huq, S. (2002). Lessons learned from: Adaptation to climate change in Bangladesh. *Climate change discussion paper*. Environment Department. The World Bank.

POLICY IMPLICATIONS

Previous findings depict that huge populations are displaced environmentally from major natural occurrences. It is expected that the frequency and the severity of these occurrences will only increase due to the effects of climate change. However, as coastal populations consist of 28% of its total population (Ahmad, 2005), if the sea level rises by about 88 cm, approximately 43 million people from coastal area might be dislocated in the future. This huge population displacement will pile on extra pressure on the remainder of the land. Disasters also make people poorer, therefore raising the national poverty level. This rising population displacement, poverty and population growth will create immense pressures on the government's development programs. To address susceptibility of such environmentally displaced people to drastic environments, an adequate development guideline is a pressing demand on decision makers.

National Environment Policy (1992), the coastal zone policy (2005), and the NAPA (2009), Bangladesh climate change strategy and action plan (2009) talk about this phenomenon, but there is no clear indication about the problems of population displacement. For instance, it is written in coastal zone policy, 2005 that susceptibilities of coastal communities will be addressed as these people are very dependent on natural resources for their livelihood. However, how will their sufferings be addressed? There is no action plan with a timeframe in the national policy to address the problem.

As some of the policies are very old with respect to the changing environment, public debates in this regard continue to draw the attention of decision makers. In this case, there is still contradiction that increasing the frequency and intensity of natural calamities is due to the effect of climate change, which induces the population displacement in search of a secure life.



Photo: IUCN / Abdul Quayyum

CONCLUSION AND RECOMENDATIONS

- Bangladesh is disaster prone country. Environmental disaster like tropical cyclones, storm surges, floods, tornadoes and droughts ravage the country almost every year. Due to climate change frequency and intensity of natural disasters have increased.
- Bangladesh is a low land country. Two-thirds of the country is less than 5 meters above sea level. Sea level rise (SLR) and saline water intrusion due to climate change will adversely affect the low land coastal areas.
- About 50 percent of Bangladesh's Forest is in the coastal areas (Sundarbans natural mangrove forest and mangrove plantation). The mangrove forests are mitigating the adverse effects of lives and properties.
- Measures should be taken for conservation and development of mangrove forest.
- For employment generation, creation of renewable resources and carbon storage, emphasis should be given on the expansion of social forestry activities throughout the country.
- To observe the impacts of climate change on ecosystems and biodiversity a long term research and monitoring is necessary.
- For biodiversity conservation, enforcement of laws, and bringing more areas under afforestation, capacity building and institutional strengthening of the Forest Department is necessary.



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