



CLIMATE CHANGE AND THE VULNERABILITY OF THE SUNDARBANS

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Abstract: Importance of the *Sundarbans* in the economy and environment of Bangladesh has been high lighted in this paper. The impact of climate change on the *Sundarbans* has been analyzed and some recommendations are made for the sustainable management of the mangrove forest of Bangladesh.

Key words: Climate change, sea level rise, IPCC, the *Sundarbans*

Introduction

The *Sundarbans*, in the south- west part of Bangladesh (Fig.1) is a, complex and dynamic ecosystem in delicate balance with soil, water and other components of environment. The forest is important for its floristic economic uses and wild life. It is important in the culture and heritage of Bangladesh. The total area of this mangrove forest is 6,017 sq km of which 68.85% (4,143 sq km) is land and 31.15% (1,874 sq km) is in water bodies. The *Sundarbans* is located in the south of the districts of Khulna, Bagerhat and Satkhira along the coast of the Bay of Bengal. It occupies the area between 21°39' to 22°30'15" North latitudes to 89°12'54" to 89°29'04" East longitudes. The *Hariabhanga*, *Raymongal* and *Kalindi* rivers in the west, the *Baleswar* river in the east, the Bay of Bengal in the south and small rivers, canals and settlements in the North make the border of the forest. It constitutes about 44% of the forest area in the country.

The *Sundarbans* is playing a vital role in maintaining the coastal environment and ecological balance of the region and also protecting the agricultural land and settlement from cyclones and tidal surges. Besides, this forest is contributing about 50% of the revenue earned by the forestry sector. A wide range of forest products, such as timber, fuel wood, pulp wood, etc. are obtained from this forest. The mangrove resource e.g. forest, water and fish play a vital role in the local and national economy. The *Sundarbans* provides a livelihood to about 500,000 people working as wood cutter, fishermen, honey collector, golpatta leaves thatching grass and other non timber forest produce collectors.

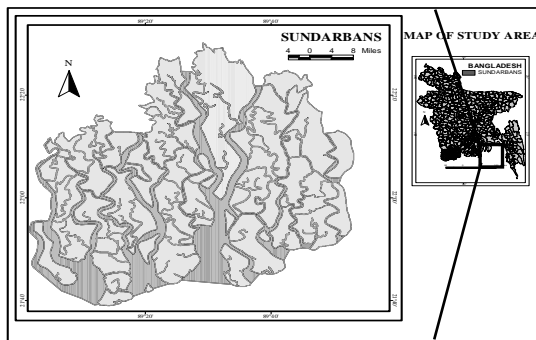


Fig. 1. Location of the *Sundarbans*

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The *Sundarbans* forest with its rich flora and fauna are the natural gift to the country and maintaining the ecosystem with direct and indirect effects. The *Sundarbans* mangrove forest has a large number of non-forest products which is of great economic importance. These include fish, shrimp, crab, squid, honey, bee-wax, turtle, crocodile etc. It is important that a mangrove forest is managed at a level where all the above mentioned resources can be explored on a sustainable basis.

Although mangrove ecosystems have tremendous value for associated ecosystems and coastal communities, they are being destroyed at alarming rates. Over the last 50 years about one-third of the world's mangrove forests have been lost. The *Sundarbans* region of Bangladesh and India has changed substantially. It is today only one half of the size it was 150 years ago. Another half has been cleared for agriculture and other uses. Human threats to mangroves include the overexploitation of forest resources by local communities, conversion into large scale development such as agriculture, salt production, urban development and infrastructure, and diversion of freshwater for irrigation.

Mangroves are often viewed as wastelands, many developing countries are replacing these forests with agricultural land and/or shrimp aquaculture production. Shrimp aquaculture accounts for the loss of 20 to 50 percent of mangroves worldwide. In Bangladesh this coastal ecosystem is also under threat of physical disaster due to unscientific and excessive human interference. In the 1990s, the 'Shrimp Culture project' in the south-eastern part of Bangladesh resulted complete destruction of *Chokoria Sundarbans* the second largest mangrove patch in Bangladesh (21020.45 ha). In addition to these anthropogenic threats, mangroves are also threatened by the impact of global climate change. Global climate change and concomitant effects such as, changes in temperature and CO₂ concentration, altered precipitation pattern, storminess, and sea-level rise as observed over recent decades, are due primarily to anthropogenic activities.

Projected of sea level rise in Bangladesh will be 14cm in 2030, 32 cm in 2050 and 88 cm in 2100. IPCC (2007) forecasted that a mere 1 meter rise in sea level will inundate 20% of its landmass. Bangladesh will lose about 8% of its rice and 32% wheat production by the year 2050 (IPCC, 2007).

Rising sea level threatens to inundate low-lying areas and offshore islands in the country's coastal belt and destroy ecosystems such as mangroves and wetlands that protect the coast against storms and tidal surges. Sea level rose between 10.16 and 20.32 cm in the past 100 years while, according to the scientists, it can rise between 10.16 cm and 91.44 cm over the next 100 years. The *Sundarbans* has faced with the threat of drowning because of global warming. Kausher *et al.* (1993) have shown in their research that the different magnitude of sea level rise will have different levels of impact on *Sundarbans*. They have shown that sea level rise by 10 cm will flood 15%, 25 cm will flood to 40%, 45 cm will flood 75%, 60 cm will flood the entire *Sundarbans* and a rise of 100 cm will destroy the whole ecosystem.

Impact on mangrove bio-diversity

The rise in sea level and availability of less fresh water particularly during winter low rainfall will cause inland intrusion of saline water. As a result, many mangrove species, intolerant of increased salinity, may be disappeared. In addition, the highly dense human settlements just outside the mangrove area will restrict the migration of the mangrove areas to less saline areas. The shrinking of the mangrove areas will have effect on the country's economy. Many industries which depend on raw materials from the *Sundarbans* will be closed and create large scale unemployment.

Climate change is real a threat to ecosystem. The *Sundarbans* may be completely inundated by a 1m rise in sea level. The area may shrink and many flora and fauna may face extinction. A wide range of mammals, birds, amphibians, reptiles, crustaceans, and above all the Royal Bengal Tiger will face extinction. The coastal length covered by mangrove forest will be exposed to cyclones and storm surges.

Increased salt water intrusion is considered as one of the causes of top dying of Sundri trees (*Heritiera fomes*). The salt water intrusion will also affect the ability of the ecosystem to adapt. These are causing the negative effects in the ecosystem of the *Sundarbans* (Shams, 2008). Due to a combination of high evapo-transpiration and low fresh water flow in winter, the salinity of the soil would increase. As a result the growth of plants would be severely affected. Eventually the species offering canopy cover would be replaced by shrubs and bushes, while the overall forest productivity would decline significantly. The degradation of forest quality might cause a gradual depletion of rich diversity of the forest flora and fauna of the *Sundarbans* ecosystem (Ahmad *et al.*, 1999).

Impact on Mangrove Ecosystem

In recognition of the forest's significance in biodiversity wealth, UNESCO has declared three wildlife sanctuaries in the southern part of the forest as World Heritage Sites in 1997. As a consequence of salinity penetration in the *Sundarbans*, majority of the mesohaline areas will be transformed into polyhaline areas, while oligohaline areas would be reduced to only a small pocket along the lower-Baleswar river in the eastern part of the forest. Therefore, a different environmental condition might be expected in the winter months with lesser freshwater supply in the rivers facilitating greater saline ingress into the *Sundarbans*. If the saline water moves further inland, Sundri could be threatened. The existing oligohaline zone might even be completely transformed into mesohaline zone. Species in the two other ecological zones (mesohaline and polyhaline) would also suffer over time, as salinity increases. In other words commercially more valuable *sundari* could be replaced by *gewa* (now dominant in oligohaline area), and *gewa* by less valuable *goran* (now dominant in mesohaline area). In addition, more than half a million people, dependent on forest products in the *Sundarbans*, would also be exposed to economic uncertainties. Preliminary estimates suggested that, disappearance of oligohaline area combined with decreasing mesohaline area would result into over 50% loss of merchantable wood from the *Sundarbans*. Increase in salinity in the Indian side of the forest would have compounding effect to the existing poor productivity of the forest.

Degradation of the Sundarbans Forest

The causes of degradation of the *Sundarbans* are the following:

Over Population: Bangladesh is a small country with a huge population. In November 2009, the total population was 162.2 million (UNFPA, 2009). The density of population is the highest in the world. Man land ratio is very small. Due to the scarcity of land and resources people have move towards even disaster prone areas of the coast. This people are also exploiting the available resources of the *Sundarbans* for their livelihood.

Poverty: The people living around the *Sundarbans* are very poor, illiterate and deprived of any basic needs from the government of the country. They are cutting the forest for fulfilling the present needs without thinking about their next generations.

Unemployment: About 500,000 people depend on forest directly or indirectly for their livelihood. The poor people living around the *Sundarbans* are mainly engaged in harvesting wood, fish, honey, *golpata* etc. They do not have any other alternative livelihoods excepting the exploitation of resources from the *Sundarbans*.

Increase of demand of fuel wood and wood: With the increase of population the demands of the fuel woods for cooking and burning the bricks as well as for furniture wood has been increasing at an alarming rate. To satisfy the demands of fuel wood and wood the people are attracted to cut wood indiscriminately without taking any consideration for the future generation.

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Forest policies: The current forest policy enacted in 1994 represents an initial move in the right direction. It has incorporated some of the issues which are considered vital for a people-oriented forest policy, such as sustainable development, poverty alleviation, people's participation in forest protection. The implementation of the present forest policy will definitely accelerate the development of the forest resources of the country.

Conclusion and recommendations

The *Sundarbans* is a gift of nature. It provides us many resources and safe-guard us from disasters. In spite of its importance, this natural mangrove forest is highly vulnerable due to climate change. The following are few recommendations for sustainable management of the *Sundarbans*.

- Choosing 'soft' environmental reconstruction solutions that work with existing natural environmental features, such as creating mangrove buffer zones, or re-vegetating river banks with grass
- International efforts to protect this World Heritage, particularly against top dying of *Sundri*
- Periodic mapping of the *Sundarbans* mangrove forests has to be carried out using the Remote Sensing and GIS technology to monitor the changes in the ecosystem.
- Balanced age classes should be achieved through management practices.
- The conservation and management planning of the coastal areas should be based on proper understanding, analysis and assessment of the various complex geomorphologic, fluvial, oceanic and climatic characteristics of the whole area along with the influence of human interventions
- Action has to be taken for the restoration of the mangroves.
- Promotion of integrated management systems between mangroves and aquaculture
- The forest department to be strengthened by employing efficient, honest and sincere staffs. Administrative corruptions should be stopped immediately.
- Public education campaign is to be conducted to make local communities, the tourism industry and other sectors aware of the importance of mangroves.

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