

Integrating Climate Change Adaptation and Disaster Resilience: Issues for Sundarbans

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Abstract

Climate change has been one of the major threats in the recent decades. It is a significant and lasting change in the statistical distribution of weather pattern over long periods of time and one of the greatest environmental, social and economic threats. According to the IPCC, Sundarbans, a dynamic delta is mostly affected and is vulnerable to climate change and natural disasters. Sundarbans delta is the largest single block of tidal mangrove forest in the world and UNESCO world heritage site covering two third parts in Bangladesh and one third part in India. This paper discusses the climate change adaptation with disaster resilience issues in the Sundarbans (India). The coastal communities of

Sundarbans are adapting to different issues such as sea level rise, cyclone, storm surges, coastal erosion, salt water intrusion etc. These extreme events are the great challenges to people living on this delta. In the Sundarbans delta, the above challenges have affected the physical, human, financial, social and natural capital. Not only these but also agriculture, fishing, forestry, tourism, infrastructure, trading and health are under risk of insecurities due to climate change and natural disaster. The present paper examines the critical issues and challenges of Sundarban's environment and its communities with respect to impact of climate change and disasters in view of disaster resilience and climate change adaptation.

Keywords: Sundarbans, climate change, disaster resilience, adaptation.

Introduction

Climate change has been a global problem in the last few decades and it is an issue integrally linked to the achievement of sustainable development, involving a much broader set of conceptual and institutional linkages, domestically and internationally

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in the late 1980s and early 1990s (Depledge & Yamin, 2009). At the heart of the existing climate change regime is a divide between developed and developing countries (Ghosh and Woods, 2009). Climate, the totality of weather conditions over a given area, is variable. Although it is not as fickle as weather, it fluctuates globally as well as locally in irregular pulsations (Landsberg, 1997). It is caused by the different factors that including oceanic processes, variations in solar radiation received by Earth, plate tectonics, volcanic eruptions and human-induced alterations. Scientists are working actively to point out the past and future climate by using observations and theoretical models.

Climate change as a global challenge has evolved through a series of stages in the last few decades which are divided into different eras which are characterised by the scientific evidence, public perceptions, responses and engagement of different groups to address the problem (Huq and Toulmin, 2006). There are different impacts of climate change in different places in the world such as North America, South America, Europe, Africa and Asia. Not only there in the continents but also thousands of islands which are low-lying have problems which are very specific to them, and the problems of climate change are the most severe for the low-lying islands, but for those that are volcanic have unique challenges in terms of transportation, and in terms of access (Chand, 2011). In India, since the industrial revolution, climate change has started endangering biodiversity, human health and food and fresh water supplies, coastal and low lying system, impacting people due to low adaptive capacities. The Sunderbans is a world heritage site and becoming increasingly vulnerable to climate change and disasters in the world (IPCC, 2007). Each island has its uniqueness and that uniqueness needs to be nurtured and strengthened through sustainable policies and will examine the specific issues and problems that islands face in sustainable tourism development (Sheldon, 2005). Deltas, which occupy less than 2 percent of the world's coastline, vary in shape and size in relation to the quantity and type of sediment supplied by rivers and the ability of oceanic processes to rework and redistribute them (Coleman and Wright, 1971).

Disasters generally have a negative impact on the environment. In a direct way, it can physically damage the environment in proportion to its intensity. In an indirect way, it might put additional anthropogenic pressure on the natural resources caused by the loss of usual livelihood of the affected people. However in the case of Sunderbans, the impact of the disaster was not so much on the environment but much more on the livelihood of the people, and especially the poor (Ghosh, 2010). Adaptation measures embedded within climate change policies could, by design, try to reduce vulnerabilities and risks by enhancing the adaptive capacity of communities and

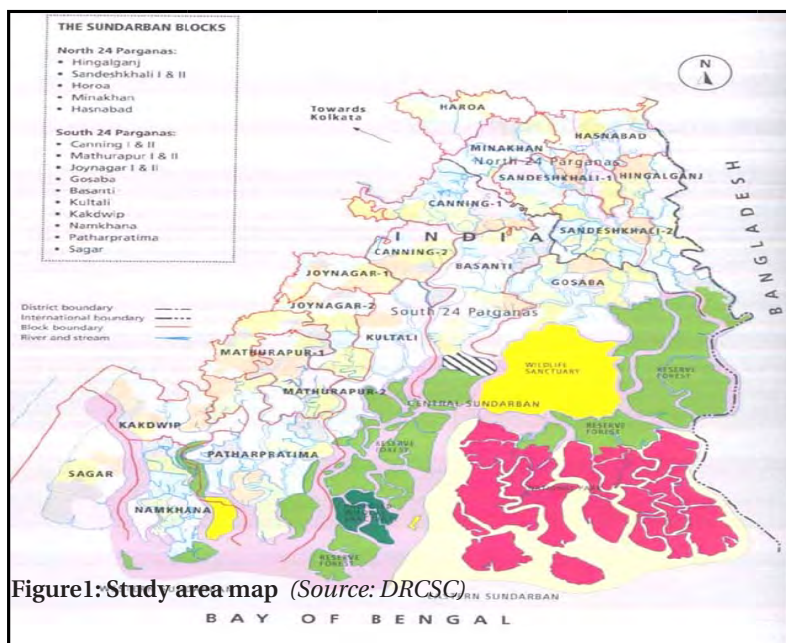
economies. This would be consistent with sustainability goals. Researchers and practitioners should not equate vulnerability to poverty, though, and they should not consider adaptation and adaptive capacity in isolation. Brooks et al. (2005) conclude that efforts to promote adaptive capacity should incorporate aspects of education, health and governance and thereby extend the context beyond a particular stress (such as climate change) to include factors that are critical in a broader development context. Many people have worked on Sundarbans Delta from different angles such as some of the people has shown how the climate change has affected the perspective view on climate change livelihood of the people. Some of the people has described about the disaster resilience. But this is different from other studies because this is an Integrating study where we highlighted the key issues and challenges of Sundarbans Delta. The study aimed at understanding the impacts of climate change on the Sundarbans environment for suggesting an integrated strategy for Climatic resilience and Disaster Risk Reduction. The key objectives of the study are-

- To identify and analyse the impacts of Climate change on livelihood and disaster impacts in the Sundarbans delta.
- To identify the issues and challenges with the current situation of Sundarbans Delta.
- To strategise to protect the ecosystems/natural resource base from the impacts of climate change and natural disasters while providing for human needs.

Study Area

Sundarbans is the largest delta in the world formed at the Ganges-Brahmaputra river system. The Indian Sundarbans is situated in between latitude 21° 32'-22° 40'N and longitude 88° 22'- 89°0'E in the north east coast of India occupy 9630 square kilometer and surrounded by Raimangal river in the East, Hooghly river in the West, Dampier Hodges line in the North and Bay of Bengal in the South. There are 56 islands of various sizes in Sundarbans and these are separated from each other by a network of tidal channels and creeks, some of which act as pathways for both freshwater discharge from upland and to and fro movement of flood and ebb. The world's largest Heritage Site awarded by UNESCO in 1997, the Sundarbans is an archipelago of several hundred islands, spread across 9,630 sq km in India and 16,370 sq km in Bangladesh. On the Indian side, it extends over two districts: 13 blocks in South 24 Parganas and six in North 24 Parganas. The Sundarbans delta has taken its current shape over the past 300 years. The islands are low, marshy, alluvial plains that are still in the process of being formed through siltation and powerful tidal currents,

a continuous process of erosion and accretion. As new land is added to the existing mass, some parts are eroded away as part of a natural cycle.



The Sundarbans delta is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests, and presents an excellent example of ongoing ecological processes. Not only is the Sunderban ecosystem of enormous value to mankind, millions of people are generating their livelihood from the resources of the region. Some of the activities include agriculture, fishing, woodcutting, honey-collection etc. However, the Sundarban, its flora, fauna, and the people who depend upon it are in danger. The area covered by the mangrove forests has halved in the last two decades. Many of the species of flora and fauna are endangered. The Sundarbans has been celebrated in numerous Bengali language and Indian English novels, songs, and film. The Bengali folk epic *Manasamangal* mentions Netidhopani and has some passages set in the Sundarbans during the heroine Behula's quest to bring her husband Lakhindar back to life. Sundarbans being a part of West Bengal, the people follow Bengali culture; since it is a total forest area tribal lifestyle is followed. The state is well-known for its superb arts and crafts made of silk, ivory, shola, conchshell, dhokra and beautiful clay models. Also worth-mentioning are Baluchari saris and the famous woollen carpets, blankets as well as knitted garments. The average maximum and minimum temperature is 34°C and 20°C respectively. Rainfall is heavy

with humidity as high as 80% as it is close to the Bay of Bengal. The monsoon lasts from mid-June to mid-September. Prevailing wind is from the north and north-east from October to mid-March and south-west westerlies prevail from mid-March to September. Storms which sometimes develop into cyclones are common during the months of May and October. Sundarbans where a highly vulnerable system would be a system that is very sensitive to modest changes in climate, where the sensitivity includes the potential for substantial harmful effects, and for which the ability to adapt is severely constrained.

Data Sources and Methodology

The present study was conducted based on primary and secondary data sources. The household survey was based on semi-structured questionnaire that encompassed a large set of queries on households' experience with climate shocks in general and cyclone Aila in particular, impact on household economic conditions, adopted coping mechanisms, health and morbidity status, treatment seeking behaviour, health expenditure and health shocks, migration history of the de-facto household members and detailed information on presently out-migrated members. Village level information was collected using an in-depth interview guidelines. This encompasses probe on the impact of Aila on village infrastructure such as transportation and communication facilities, civic amenities, productivity of lands, breach of embankment & repair etc. These issues of livelihood and migration of villagers, overall health status of population as an aftermath of Aila, utilization of services for health and nutrition, understanding of environmental vulnerability at the community level and strategies undertaken by the community for mitigation and adaptation against future climate shocks. Villages were taken to elicit their perception about the human-animal conflicts and different aspects of the problem and its probable solution.

The Sundarbans delta is increasingly becoming vulnerable to climate change. It is high time the government policies are formulated giving much needed emphasis to the menace," said Chandra Bhushan, deputy director, Centre for Science and Environment (CSE). An increase in the salinity of land and its erosion has drastically lowered agriculture productivity of the area. Fishing, which is an important occupation here, has also been hit with the fish migrating to cooler waters, said Aditya Ghosh of CSE, elaborating on the ill effects of climate change. "Our disaster management is reactive. We wait for disasters to hit and then we go for rescue and rehabilitation. But the need is for a proactive system which can give sufficient prior information about a disaster so that we can prepare ourselves," Ghosh said. Increased risk of high tidal inundation, salinity, cyclonic storm / tidal surges for the livelihoods of the local people, land infrastructure etc. lead to direct loss of agricultural land, pond and other community assets and human settlement. Disasters in Sundarbans have already

aggravated by climate change, importantly through increased salinity and extreme weather events like tropical cyclones.

Results and Discussion

Climate change issues for Sunderbans

Most of the islands in the Sunderbans are low lying, even the mainland does not have any sharp elevation near the seafront. This means the rise in sea level has a direct impact on the people living there. Two type of impact are there: firstly land is lost to the sea which decreases landholdings and puts more pressure on agriculture. Secondly, the land lost to the sea is difficult to reclaim for agriculture in the near future, since salinity destroys the productivity of the soil. The loss of land due to the rise of the sea level is but one factor in the decreasing size of the Sunderbans landmass. The other is the constant erosion of embankments built to stop the seas from invading islands. This is again a recurrent theme throughout the islands of the Sunderbans where there is a constant battle between man and sea to stop large chunks of land being dragged away, and islands, once capable of supporting hundreds of people, now lie uninhabited. Although land erosion affects everyone in the Sunderbans, the table below depicts the land loss in the 10 most vulnerable Islands in the last decade, where Jambudwip is the most vulnerable island with approximately 20.19% land loss.

Table 1: Land Loss in 10 most vulnerable Island in eight years of the last decade

S. No.	Islands	2001 (In sq km)	2009 (In sq km)	Loss (In sq km)	% Loss
1	Dakshin Surrender-nagar	44.336	42.015	2.324	5.23
2	Sagar	244.434	239.091	5.343	2.18
3	Namkhana	150.155	145.488	4.667	3.1
4	Moushuni	28.283	28.283	0.64	2.28
5	Ghoramara	5.339	4.564	0.774	14.52
6	Dalhousie	36.084	34.28	1.904	5.26
7	Dhanchi	67.101	62.201	4.9	7.3
8	Bulchery	26.915	23.287	3.628	13.45
9	Bhangaduani	31.316	26.159	5.157	16.44
10	Jambudwip	6.242	4.979	1.263	20.19
Cumulative Land loss for ten Islands				30.6	

Source: Hazra, et. al. 2010

Cyclone Aila of 2009 was the most dramatic of the climatic disasters to have recently

hit the Indian Sundarbans. Residents say that the storm incidences are on the rise over the years, both in frequency and in intensity. Although the months of July to October were always the season for storms, the storms now come more often, and do much more damage than before. The people of the Sundarbans feel much more vulnerable, and they have little to protect them when these storms strike.

Livelihood Challenges in Sundarbans

Sundarbans population lives within the mainland and their livelihood pattern are similar to the rest of the rural population in both the districts of North and South 24 Parganas. It is the island villagers whose way of living and entitlements are considerably different from that of their mainland counterparts. The livelihood options in these remote islands are indeed very limited till date. Typically in the delta region rain-fed, single-crop agriculture and fishing are the two main sources of livelihood. For the blocks bordering the reserve forest, during agricultural lean season, substantial part of the population depends on forest and river resources. Traditional methods of cultivation have been put at risk, and today the farmer in the Sundarbans does not know what to grow when. The most puzzling part of the rainfall changes cited by the people indicates that most of the rains do not come in the monsoons. Rainfall has shifted to the post-monsoon period. There is widespread agreement that rainfall patterns are changing over the Sundarbans. Almost all of those interviewed agreed that rainfall has decreased during a certain phase of the season, and the pattern of rainfall has changed, making conventional cultivation of crops difficult for farmers. Climate change-induced salinity intrusion is likely to affect the productivity of the Sundarbans. A significant decrease in regeneration and growth is noticed with an increase in salinity (Siddique et. al., 2001). The germination of seedlings and metabolic activities are dependent on salinity. Salinity reduces the productivity growth of the mangrove timbers (Siddique et. al., 2001; McLeod & Salm, 2006). Salinity intrusion causes change in fish composition and shifting of fishing zone. These changes in productivity ultimately affect other livelihood capitals.

After agriculture, fishing is the most common means of livelihood in the Sundarbans. In the interviews conducted, most fishermen complained of lower volumes of fish caught. Although the reasons attributed to this are many, including the entry of deep sea trawlers which sometimes violate territorial waters, there is a feeling among the fishermen in the Sundarbans that the quality of water has also changed. Not only that but also the forest cover area also changing day by day, according to the 1990 to 2000 study. Until 1770, the total area of the Sundarbans in India and Bangladesh combined was 36,000 sq km. In 2000, it was 25,000 sq km. The Indian part consisted of 9,630 sq km out of which 4,264 sq km constituted reserve forests. This was made up of 2,168 sq km of mangrove forest and 2,096 sq km of tidal river.

This means that an area of around 5,366 sq km has been cleared of forest and used for human settlements since 1770.

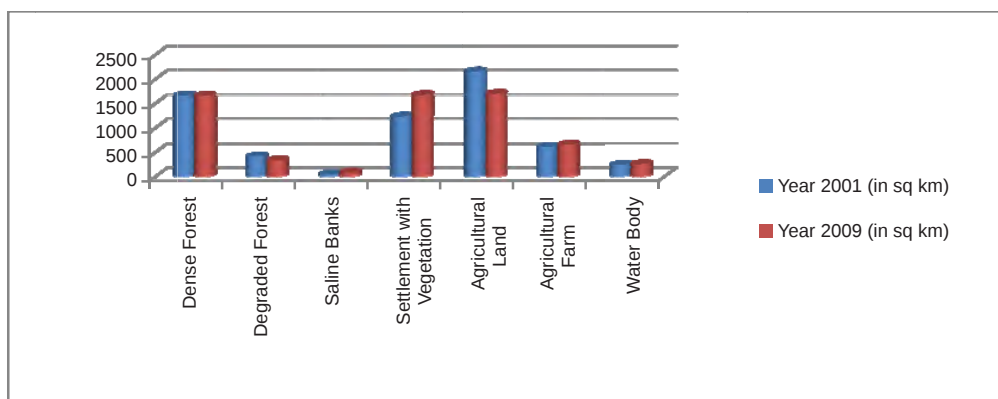


Figure 2: Landuse patterns and landcover changes in Sunderbans between 2001 and 2009
Source: (Hazra, et. al. 2010).

Disaster risks – hazards and vulnerability in Sunderbans context

Climate change-related hazards have a catastrophic impact in the coastal area which is subjected to intensive human use. These areas are highly vulnerable to both natural and man-made hazards and disasters like coastal flooding, cyclones, storm surges, erosion, salinity, arsenic contamination, pollution, etc. Disasters related to climatologically disturbance impact natural and human system, either directly or in synergy with other determinants, and alter the productivity, diversity and functions of many ecosystems and livelihoods (Hossain, 2009). Vulnerability is the inability to resist a hazard or to respond when a disaster has occurred. For instance, people who live in plains are more vulnerable to floods than people who live higher up. In actual fact, vulnerability depends on several factors, such as people's age and state of health, local environmental and sanitary conditions, as well as on the quality and state of local buildings and their location with respect to any hazards. Vulnerability is an essential part of hazards and risk research and refers to the susceptibility of people, communities or regions to natural or technological hazards (Kumpulainen, 2006). There are three dimensions of vulnerability: economic, social and ecological (ESPON Hazards project 2004, Schmidt-Thomé, 2005).

Vulnerability is defined as the extent to which a natural or social system is susceptible to sustaining damage from climate change; it is also a function of the sensitivity of a system to changes in climate (the degree to which a system will respond to a given

change in climate, including beneficial and harmful effects), adaptive capacity (the degree to which adjustments in practices, processes, or structures can moderate or off set the potential for damage or take advantage of opportunities created by a given change in climate), and the degree of exposure of the system to climatic hazards. Under this framework, a highly vulnerable system would be one that is very sensitive to modest changes in climate, where the sensitivity includes the potential for substantial harmful effects, and for which the ability to adapt is severely constrained. Resilience is the flip side of vulnerability—a resilient system or population is not sensitive to climate variability and change and has the capacity to adapt (Schneider, et. al. 2000).

Conclusion and Recommendations

From the above analysis it is clear that intensity of both damage and frequency of climate change disasters is increasing over the time with enhanced vulnerability of communities though they are undertaking some coping strategies. It is important to incorporate information on climate change and its impacts of long-term predictions and local knowledge about trends and changes experienced by the communities, NGOs and Government. Government departments and NGOs can enable the community to take part in disaster risk reduction. Government efforts during emergency condition are valuable as they provide accommodation and relief facilities (Sarker and Hossain, 2012). Impact of climate change on Sundarbans mangrove is already being felt and the Sundarbans ecosystem is changing. Change in Sundarbans mangrove system and poverty are making the livelihood tough since dependence on Sundarbans is becoming highly vulnerable. Bangladesh Government has banned felling down of living tree and limited the harvesting season in response to changing state of Sundarbans. Sea level rise and associated salinity intrusion will further hamper the productivity of Sundarbans. That will reduce the resilience of the livelihoods dependent on Sundarbans. The adaptation and capacity building strategy has basically three types aspects: to develop a better understanding of current and future climate challenges, to develop and implement pilot adaptation strategies at selected sites, to regenerate mangrove patches, construction of a disaster relief shelter, and installation of early warning system and establishment of effective disaster-response mechanism and e-introduction of salt-tolerant paddy and pisciculture.

Following are the lists of activities are recommended to reduce climate vulnerability and build resilience of the vulnerable communities in the Indian Sundarbans such as the Climate Adaptation Centre (MCAC) should work actively and introduction of salt tolerant paddy and fish varieties re-introduced. Early warning system and disaster response teams need to work more actively and warning should reach to inside of the rural area. Environmental management is crucial for island sustainability, given the

challenges to the island's ecosystems. Environmental management includes recovery from natural disasters to which islands are so vulnerable (Meheux and Parker, 2004). Funds for conservation and disaster management are needed and can be gained through taxation, visitor fees or other mechanisms (Shah, 2002). Long term planning, developed with comprehensive community inputs is becoming an important foundation for tourism on islands. A study of tourism in the Canary Islands showed that when these two growth patterns were out of balance the industry is not healthy (Gil, 2003). Through all our activities we are trying to convey the message of great climate risk to the Sunderbans eco-region and its inhabitants. Often, we are asked about climate adaptation strategies for the Sunderbans in light of predicted future changes. In trying to answer such a question we are increasingly realising that what we are currently doing is essentially "buying time" for the people of the Sunderbans. Climate adaptation for a place like the Sunderbans beset with development challenges emanating from inadequate infrastructure, lack of period-appropriate education, health, and modern energy services needs not only a robust methodology for vulnerability assessment but also a future looking basket of options for the people in the Sunderbans delta.

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