

Environmental sustainability for better livelihood and Ecology in Sundarban: West Bengal

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Abstract— Sundarban is world famous for its mangrove vegetation and is approximately of 10,000 sq km in area in the northern Bay of Bengal, which is also designated as world heritage site by UNESCO in the year 1987. It is the home of several animals and plant species, specially the mangrove trees (Sundari) and Royal Bengal tiger of this forest is world famous. Mangroves functions as a buffer against frequently occurring cyclones and helps to protect South Bengal specially Kolkata and southern part of Bangladesh. But now a day due to the climate change and repetitive cyclone occurring every year, Sundarban faces lots of challenges, with rising sea level- island are disappearing, salinity of water increasing day by day in addition of that there have been a major disturbances to hydrological parameters, changing fishing patterns are resulting disastrous consequences for the fisher man. Frequent cyclones and erratic monsoon damaging ecology, humidity, livelihood as well as ecotourism. The objective of this research is to focus the area of Sundarban and its potentials, challenges and probable solution to overcome the situation as well as the impact of mangrove degradation on local people and tourism. Here we use some data and statistics to understand the situation better. In this process researcher collected data from 130 respondents in the study area and further analysis has been taken through percentage method, statistical tools like t test with the help of software like SPSS, MS excel etc to conclude. Study findings suggest that significance difference exists on profile base of residents due to environmental degradation and minimize the negative impacts on same could bring a prosperous livelihood for residents.

Keywords— Ecology, Environmental Degradation, Sustainability, Mangrove.

I. INTRODUCTION

Mangrove forests are among the world's most productive ecosystem. The Sundarban mangrove forests covering about 9630sqkm area in the delta of the rivers Ganga, Brahmaputra and Meghna. Around 60% of the total area lies in Bangladesh and 40% in West Bengal. Sundarban has extremely rich bio diversity of aquatic and terrestrial flora and fauna. This area is also consider as home of many endangered animals like Javan rhinoceros (*Rhinoceros sondaicus*), wild buffalo (*Bubalusarnee*), Swamp deer (*Rucervusduvaucelii*), Barking deer (*Muntiacusmuntjak*) etc but the most famous animal of this forest is Royal Bengal Tiger (*Pantheratigristigris*). The entire area is conglomeration of river, channels, 2creeks, and island which total about 100 in number of these 52 islands are inhabited while the remaining 48 island are forested. It is believed that the name of Sundarban is derived from Sundari tree (*Heritierafomes*).

The local population relies heavily on the mangrove as it provides fodder, fuel, wood, fish, honey, and medicines. Sundarban also provide several environmental services such as nutritional inputs of costal water. Generation of nutrients

by mangrove root and biomass deposition etc. but now a day's Sundarban delta faces massive threat due to the global warming and climate change. As per the 2011 census data conducted by the government of India. There are approximately 4.37 million people living around the Sundarban delta. Due to the natural causes this region is unsuitable for industry hence the people of this locality heavily dependent on agriculture and tourism activity for their earning. Although the irrigation facilities and basic infrastructure are not that up to the mark, people heavily dependent on seasonal rainfall. Maximum people supplement their income by exploiting mangrove forest, catching fish, crabs and honey collection from deep forest, wood cutting, illegal honey collection, unscientific fishing and also some time indulge themselves on illegal wildlife trade. Every year thousands of tourist comes visit Sundarban as no of attraction is there for example Sundarban mangrove forest, Sundarban national park, Royal Bengal tiger etc. Although agriculture is the main sources of livelihood of the people but mono cropping nature of agriculture practice at a large scale. People live here in below poverty level and on the other hand the treasure of mangrove ecosystem along with is unique biodiversity is facing several threat. The

strategic position of Sundarban has helped her to house maximum number Tigers in the country in a natural way but it is still from continual threat due to poaching, illegal trade with tiger parts as also predominant pirate activities which need to address involving the stakeholder through their capacity building.

II. PROBLEM STATEMENT

Mangroves are salt-tolerant forest ecosystem of tropical and sub tropical intertidal regions. Owing to their high detritus content and rich biodiversity the mangroves can be highly productive land that can be used for various purposes like fishing, navigation, research work, recreation and also for tourism purpose. But in recent time due to the environmental changes the entire eco-system of this area getting affected and it's creates direct impact on people's livelihood. Some prominent problem researchers found in that area are-increasing temperature of water at the rate of 0.060C per decade, change in agricultural pattern due to number of reasons, increasing salinity of sea water which directly impact on local agriculture, deforestation, spread of diseases specially infectious and skin diseases due to lack of awareness, education, and poor sanitary condition of the locality, and finally various illegal activity by the offender occurring now a days in the forest.

III. OBJECTIVES

Sundarban is a tourist's paradise. Every year thousands of tourists come to visit mangrove forest and specially the Royal Bengal Tiger. In this study we will focus on

- To study the ecology and resource potential for sustainable growth.
- To examine the impact of mangrove degradation on ecology and local people.
- To suggest strategic intervention on environmental sustainability for better livelihood.

IV. HYPOTHESIS

1. There is a noticeable impact of environment and ecology on residents.
2. Significant difference exists on residents profile base due to environmental degradation.

V. STUDY AREA

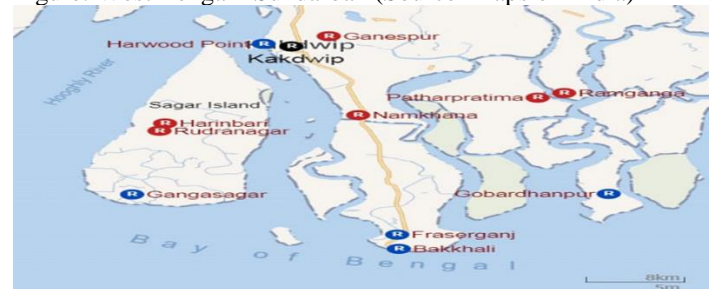
The Indian Sundarban consists of 13 blocks in the South 24 Parganas and 6 blocks in the North 24 Parganas. The South 24 Parganas consists of Sagar, Namkhana, Kakdwip, Patharpratima, Mathurapur I & II, Jaynagar I & II, Canning I & II, Basanti, Gosaba and Kultali. While 6 blocks of the North 24 Parganas are Haroa, Hasnabad, Minakahn, Sandeshkali I & II and Hingalganj. The total area of Indian Sundarban is about 9360 sq km. comprising of 102 Islands. Out of these 52 have human settlements. Latitude: 21.94970N to 89.18330E

The entire area is connected with road and railway transport system. Ferry service is also available here as number of river and small canals present here.

The population of that area is very poor economically and also contains a significant no of Tribal population.



Figure: West Bengal –Sundarban (Source- maps of India)



Study area (Source- maps of India)

VI. REVIEW OF LITERATURE

Mangroves forests are intertidal forested wetlands confined to tropical and sub tropical regions (Tomlinson, 1986). The global area of mangrove is estimated at only 18 million ha (Spalding et al. 1997), against over 570 million ha of fresh water wetlands including peat lands globally but excluding paddy fields; (Spicrs, 1999). Although mangroves have been exploited for many centuries, our scientific understanding of this wetland forested remained poor until 1970s (Lugo and snedaker, 1974; Blasco, 1975; Chapman, 1976).

In their article 'Community based mangrove management: A review on status and sustainability, Dutta D, Chattopadhyay R.N and Guha.P (2012) have marked higher

number of community based mangrove management initiatives in south Asia and compared to lesser form south America and Africa. Identification of causes of degradation at a site and use specific zonal re plantation, with respect to species associations are identified by them as major criteria of ecological sustainability.

Regarding economic sustainability, transformation of potential use of mangrove known by local communities into actual ones has been found to be necessary. Proper disbursement of accrued benefits among community members irrespective of their socio-cultural status is also a major concern. Restructuring of Community based mangrove management institutions by ensuring participation of subsistence based users in decision-making and resource sharing have been identified as a prime determinant of institutional sustainability.

Sustainability cannot be defined in the same way that physical scientists might define the standard meter. Indeed, discussion and debate about the concepts of sustainability and sustainable development provide a focus for contact between contending positions (Myerson & Rydin, 1996) and so become essential parts of the practical process of working towards sustainability. Sustainability and sustainable futures are treated here as the goals or endpoints of a process called 'sustainable development'.

A sustainable society is considered to be a society that has reached sustainability through this process. So, it remains to define 'sustainable development'. The well-known broad definition in the Brundtland Report (WCED, 1987) is: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

The biodiversity of mangroves has also been of increasingly greater interest, firstly because of the convention of biological diversity, secondly because of mangrove ecosystem are among the most threatened by the global climate change, particularly the sea level rise (Macintosh and Ashton, 2002, 2004). Mangroves are relatively well known for their floral diversity which is comprised of only 65-69 species of vascular plant which have several specific adaptation to the dynamic coastal environment (Kathireson and Bingham 2001) fisheries resources are better understood. In their article, Resident's awareness towards sustainable tourism for ecotourism destination in Sundarban forest, Bangladesh, Sarkar S and Hubin X. (2018) have suggested how nature oriented tourism destination Sundarban can achieve sustainability through public awareness well planned sustainable tourism and residence awareness could provide economic and long term benefits to local communities and local economics.

Exploration of the Sundarban mangrove's dates back to the 16th century (Rollet, 1981). A large bulk published literature exists on the Sundarban of both India (Naskr and Guha, Bakshi; 1987; Choudhury, 1994; Guha Bakshi et al., 1991; Hussain and Acharya, 1994, IUCN –BD 2002, Iseam and Wahab, 2005) covering many aspects of their habitat characteristics, flora, fauna, utilization and management.

A case study from east cost of India (Badola R, Shivani Barthwal S and Hussain. S.A, 2012) have revealed that local communities in the area have positive attitudes towards conservation and that their demographic and socio economic conditions influenced people's attitudes. Despite human wild life conflict the attitude of local community are not always negative. They found that the peoples are ready to adopt alternative resources if access to forest resource were curtailed.

Authors also examine threats, (Romanacha, S.S, De Angelisb, D.L, Koch, H.L, et .al, 2018) examine threats to the persistence of mangroves, consequences, and potential solutions for effective conservation. Moreno & Becken (2009) said that coastal tourism is vulnerable to climate change impacts. Studies have demonstrated that beach tourism demand is expected to change in response to climate change in coastal environments.

VII. METHODOLOGY

Research Design:

The study was conducted in the villages of Sundarban- West Bengal. The villages were Fraserganj, Bakkhali, Namkhana, Patharprotima and Sagar. All these villages are under Kakdwip subdivision and under the district of South 24 Parganas. This research was conducted in two parts. In the first part, total 150 respondents were finalized for this study (5 villages and 30 from each village), after removing research error total 130 sample/ respondents were finalized and data collected through structured questionnaire. In the second part again interviewed some residents to know the actual status of environment, ecology in the area and impacts of the same in their livelihood.

VIII. ANALYSIS

The below table represents the demographic profile of the 5 villages.

| <u>Description</u> | <u>No of Respondents</u> | | <u>Percentage (%)</u> |
|-----------------------|--------------------------|----|-----------------------|
| Age | Below 40 yr | 50 | 38.4 |
| | Above 40 yr | 80 | 61.5 |
| Marital Status | Married | 90 | 69.2 |
| | Unmarried | 40 | 30.7 |
| Gender | Male | 82 | 63 |
| | Female | 48 | 36 |
| Occupation | Farmer | 55 | 42.3 |
| | Non Farmer | 75 | 57.6 |
| | Above 5000 | 72 | 55 |

| | | | |
|--|----------------|----|------|
| Family Income | Below 5000 | 58 | 44.6 |
| Education | Metric & above | 47 | 36 |
| | under metric | 83 | 63 |
| Dependent on ENV for livelihood | Direct | 86 | 66 |
| | Indirect | 44 | 33 |

A profile of respondent rural residents is depicted in table 1. N=130

Of the total 130, around 61% of people were above the age group of 40 yr and 38% of people were below the age group of 40 yr. As maximum people were above 40 the marital status of the respondents automatically high, representing 69% married people and 37% unmarried. During study 82 male participated but due to some conservative approach not much more no of women participate, still who all were present that was about 36% of total respondents. At the time of study it was observed that being a rural community maximum people of those areas were either farmer or doing something else other than farm work. Like some were associated with handicraft, specially the tribal population. Researchers also noticed that some people work outside this area i.e. in urban area or some time in big cities as a daily wage earner. As per the study 57.6% people represent non farmer group while 42.3% people associated with agricultural activity. Around 61% people said their income per month is above Rs5000/-. Especially those people who work outside, their income is above Rs 5000. Education level in this area is very low, it was found that only 36% People among the respondents completed their secondary level and went for more studies.

Respondents were asked question on impact on environment and ecology in their livelihood (same was rated in 5 point liker scale) where 1-Strongly Disagree, 2-Disagree, 3- Undecided, 4- Agree, 5- Strongly Agree. And over all mean value noticed 4.17, proved the first hypothesis.

Table II: Significantly different scores of Overall

Attitude on the bases of profile of residents

| Description | | N | Me an | SD | t | P Value |
|-----------------------|--------------|----|-------|------|-------|---------|
| Marital Status | Married | 90 | 4.21 | 0.93 | 2.36* | 0.02 |
| | Unmarried | 40 | 3.94 | 0.90 | | |
| Gender | Male | 82 | 4.17 | 0.93 | 1.85 | 0.1 |
| | Female | 48 | 3.97 | 0.91 | | |
| Qualific ation | Under Matric | 83 | 4.30 | 0.84 | | 0.01 |

| | | | | | | |
|--|----------------|----|------|------|----------|------|
| | Matric & above | 47 | 4.02 | 0.96 | -2.56** | |
| Dependent on ENV for livelihood | Direct | 86 | 4.33 | 1.01 | -2.78*** | 0.00 |
| | Indirect | 44 | 3.87 | 0.84 | | |

* - $p \leq 0.05$, ** - $p \leq 0.01$ *** - $p \leq 0.001$

The demographics for which overall attitude for tourism impacts was found positive are married (4.21), non-matric (4.30), direct ENV involvement (4.33) in comparison to unmarried(3.94), matric (4.02), indirect ENV involvement (3.87) with the t value for all significant at 0.01 & 0.001, i.e. $p \leq 0.01$ and $p \leq 0.001$. In terms of the gender as demography related with tourism impact, mean value of male residents (4.17) is higher than, female residents (3.97) with $t = 1.85$. From the above table it was clearly understood that demographics for which overall attitude for environmental and ecological impacts was found positive t value reaches to significant level in most of the cases which proves the second hypothesis- "Significant difference exists on residents profile base due to environmental degradation".

In the second part in this research, researchers used interview method (Direct interview) and also compilation of some data that are available from various government and official platforms. For research purposes three questions for them was prepared i.e.

1. What all are the problems they faced due to ecological degradation?
2. What all are the steps have taken to save the environment by them and government and NGO's?
3. What all are the illegal activities they found in their area or locality?

On first question what all are the problem they faced due to ecological degradation, maximum people said their main concern is about lose of embankment because at the time of natural calamities the embankment are largely effected and the salt water directly enter into the cultivable land and damage it properly. According to them every year at least one or two major cyclone comes like very recent example Amphan cyclone, it damaged the agricultural field at a huge area and they are still suffering due to this situation. So the overall concept is that, the main impact due to climate change that Sundarban faced is flood, repetitive cyclone, Sea level and coastline erosion. It has been found that relative mean sea level in a Sagar Island (in Sundarban) and adjacent areas the Bay of Bengal is raising at the rate of 12mm per year. At the time of study few women of that area raised the issue of human wild life conflict. According to them due to the massive loss of mangrove forest, over the last few year tiger attack increased. According to the official data between 1985 and 2008, 789 persons were attacked by tigers, out of which 666 succumbed to their injuries, and a total of 279 incidents of tiger-straying cases occurred in the

fringe villages. This level of conflict leads to antagonism towards wildlife conservation initiatives.

In the second question about the steps taken for conservation of mangrove, here about 70 people said they participate in tree plantation program from their end but apart from this not much special initiatives found from their side. Although 30 people said some awareness camp is conducted by the local authority and NGO.

In the third question was about the illegal activities, 70% people of respondents were jointly agreed about some illegal activities that occur frequently in the biosphere reserve and the surrounding area. The main thing they pointed out is the cutting of mangrove trees and also some valuable trees which's economic value is very high in the open market. During researchers study it was found that the peoples of this area involved regular collection of dry wood from the forest as fuel for their time of cooking. But when researches asked them about the illegal hunting of the animal, they didn't say much. According to the official data it is found the criminal activity in the Sundarban region increasing rapidly day by day. According to the government data around 3000 suspect are currently involved with criminal activities in the mangrove forest exploiting valuable forest resources and poaching the wildlife. Suspected criminals frequently enter the forest illegally and log Sundari trees, hunt tigers and deer through trapping and firing, and catch fish from its rivers and canals using pesticide. Even they set fire to the forest to make it clean so that they can catch fish during monsoon

IX. CONCLUSION

Mangroves are very rich and highly productive ecological communities. This natural wonder is under serious threat due to global warming and illegal practice by human being. Promoting eco tourism is an innovative new plan that can drastically increase chances of forest survival. Along with that it is very important to understand the real potency of that area and accordingly it is needed to take action so that the people of that concern area leave their livelihood much better so that need not to depend entirely on the forest product. There should be proper education, proper agriculture facility, well maintain health care system, drinking water facility etc. If the governments of both the country join hand to ensure that entire thing then the situation of the people of that area will be better and they will not indulge with any illegal activity. Not only that it is also important to take the advice of environmental scientist so that Sundarban maintain her rich bio-diversity and all the flora and fauna of that area remain balanced. Although measures have taken in Sundarban to address the crucial issues of mangrove degradation, more needs to be done. The Forest (Conservation) Act, amended by the Government of India in 1988, addresses the depleting mangrove forests of India. The Government has set up a National Mangrove Committee with state level steering committees to plan and implement research and development programs for the rehabilitation and conservation of mangroves. It is

recommended that by the private public partnership, encouraging eco-tourism, creating alternative source of livelihood, more tree plantation program it is possible to present a healthy environment for human being and the world life. It is also important to ensure proper security of Sundarban bio sphere reserve, because now a days it is noticed that day by day the illegal activity increase throughout the area, According to the data available from the forest department of India in 2016 there was around 4838 cases against 25000 people filed for allegedly committing crimes in the forest. Tiger conservation also another aspect that needs to give focused although according to the latest census data 2019-20 the number of tiger in West Bengal Sundarban has increase by 8 tiger over the last year and now there was 96 Royal Bengal Tiger. Finally I would say it is very much possible to save the mangrove and to make a better life for the people of that entire area if peoples, governments, and non government participation and collaboration go hand in hand

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