



Livelihood Status Of Local Residents And Threats Of Climate Change In Surrounding Sundarbans Mangrove Ecosystem, West Bengal, India.

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Abstract:

The Sundarbans, the world's biggest contiguous mangrove forest, is one of the world's most diverse and distinctive ecosystems. 4.5 million of India's poorest and most vulnerable citizens reside in the Sundarbans. The region's per capita income is around 50 cents per day, or half of the threshold for extreme poverty as defined by the international community. The only sources of income available to the residents of the Sundarbans are land and resource-based enterprises, as they are not allowed to pursue industrial growth. In the Indian Sundarbans, agriculture and fishing are the two main sources of income, while animal husbandry also plays a significant role in this area. In addition to paddy and various vegetables, the Indian Sundarbans' inhabitants benefit economically greatly from the growth of betel vine. Approximately eighty percent of the households engage in aquaculture, fishing, and agriculture using inefficient techniques of production. Because the mangroves produce fish, honey, fish oil, fire wood, fish, and medicines, the local people is strongly dependent on them. Marginal farmers and fishermen make up the majority of these populations; they are totally reliant on the local natural resources, particularly mangroves. Extreme weather events and their frequency and intensity present a risk to climate change. Sea level rise, contaminated salt water, increased storms and flooding, and draughts are a few possible ones. The purpose of this article is to assess local residents' existing and alternative livelihood prospects, as well as the hazards of climate change to their livelihoods in the surrounding Sundarbans.

Key word: Mangrove Forest, Ecosystems, livelihood, agriculture, climate change.

I. Introduction

The Sundarbans region covers 25,500 square kilometres on the Bay of Bengal coast, at the mouths of the Ganges and Brahmaputra rivers. After the country was divided, the Indian Sundarbans covered 9630 square kilometres and stretched from Ichhamati-Kalindi-Raimangal in the east to the Hooghly River in the west, and from the Dampier-Hodges line in the north to the Bay of Bengal in the south.

The Sundarbans, which span Bangladesh and India, are home to the world's biggest mangrove forest, an ecological hotspot, and a UNESCO World Heritage Site because of its importance to biodiversity. The area is a tidal delta, and its islands have not reached their full potential. Of the 102 islands on the Indian side, 48 are part of the Sundarban Reserve Forest (SRF), which is the habitat of the renowned Royal Bengal Tiger.

Mangroves cover around 75% of the tropical coastlines on Earth and are among the physiologically most prolific ecosystems on the planet. Mangroves serve as nursery environments for fish and crustaceans of commercial significance in addition to supporting around 80 species of flora and 1300 species of fauna. Furthermore, mangrove swamps are useful for retaining sediment, recycling nutrients, preventing coastline erosion, and producing a wide range of items that are necessary for society's daily needs, including food, fuel wood, lumber, honey, wax, and tannin. Unfortunately, the mangrove area worldwide has decreased by 35% over the past 20 years and continues to do so at a rate of around 2.1% year. The FAO (2005) reported that there has been a noticeable reduction in the global mangrove coastlines from 198000 km in 1980 to 146530 km in 2000. The production of fuel and lumber from logging and shrimp aquaculture causes the decline to occur more quickly in emerging nations. Over the course of two decades, mangrove production and growing stock have decreased by 25% and 51%, respectively.

A densely populated region, while other times it gave way to the vagaries of nature and became a deep, forested marsh that was inhospitable due to numerous rivers and creeks. Additionally, the local population moved and established towns in safer areas. Currently, the majority of the more than a million residents of the Sunderbans are marginal farmers and fishermen. This area still retains a significant amount of mangrove cover in spite of its high population. This is primarily because, on the one hand, the Forest Protection Committees (FPCs), acting as community initiatives under the Joint Forest Management (JFM) program, are protected and monitored by the FD as part of the Biosphere Reserve.

The enormous human population of the Sundarbans faces a new set of difficulties as a result of climate change. According to studies, variations in river discharge, tides, temperature, precipitation, and evaporation would impact wetland nutrient variations, which will impact the physiological and ecological processes of the Sundarban mangroves and, ultimately, their productivity and biodiversity. Wetland habitats will see hydrological changes due to cyclones and increasing salinity, which will reduce food security and make people more susceptible to waterborne illnesses. Nearby communities' livelihoods that depend on the natural world would suffer from a variety of negative effects as a result of these changes. It will be harder for the local communities to escape poverty, according to studies, because of higher health hazards, decreased productivity of land and labor, and increased exposure to extreme weather events like storms, floods, and droughts. A thorough understanding of the state of these mangrove-dominated ecosystems and their patterns of use is required in order to establish sustainable productivity of natural resources through appropriate management regimes. The purpose of this article was to find out the current pattern of livelihood. And to find out the issue of climate change and the threat to local livelihoods in the Sundarbans and any prospective alternate livelihood options that may exist in the future.

II. Objective Of the Study:

The objectives are

- i) To Analyze livelihood opportunities in the Sundarbans area.
- ii) To review and evaluate the existing livelihood and alternative livelihood opportunities of local communities.
- iii) to find out the issue of climate change and the threat to local livelihoods in the Sundarbans.
- iv) To understand the comprehensive knowledge about Sundarbans Mangrove ecosystem and its uses to the daily life of local peoples.

III. Methodology:

The secondary sources used for this article include government publications, newspapers, periodicals, journals, and online portals, among others. Additionally, a local perspective on the Sundarbans community, their way of life, and the dangers they face was established.

IV. Sundarbans Livelihood Opportunities:

The Sunderbans inhabitants have long relied on the mangrove ecosystems for their daily needs. Understanding the current livelihood activities and the corresponding changes in the landscape or land use is crucial in order to suggest coordinated livelihood possibilities that take into account the ecology and society of the Sunderbans. Millions of people depend on the Sundarbans for a sustainable way of life. Young people from the village go to the forest to work in jobs like fish farming and wood chopping. These young people occasionally inadvertently approach the reserve forest; as a result, tigers frequently attack them, killing numerous of them. The various forms of livelihood that can be seen in the Sunderbans include these.

A. Livelihood associated with agriculture: The Sundarbans' rural population depends only on agriculture for their subsistence, but the salinity of the soil makes it difficult for them to grow high-yield crops, which puts them in a difficult financial situation. Complex, varied, and risky agricultural practices are used in the Sunderbans. The entire landscape is dominated by agricultural systems of paddy, interspersed with minor areas of oilseeds and seasonal vegetables like watermelon. In most places, growing salt-tolerant rice cultivars is the only remaining alternative. The low success rate of HYV paddy, low lying salted lands, and lack of micro-irrigation infrastructure all contribute to the steadily declining rate of agricultural returns. Salt accumulated on the top soil due to the extensive destruction of embankments during Aila and the resulting entry of saline water into the agricultural fields, making the lands even less productive. Thus, alternative farming systems must be implemented in compliance with the necessary environmental criteria as traditional agriculture is not viable in this area. Two thirds of the land is used for agriculture, and the remaining one third is used for aquaculture or water storage. The Sundarban Development Board (SDB), which is part of the West Bengal government, developed the paddy cum fish culture with rainwater harvesting capabilities. Likewise, prioritizing rice cultivars and plants that can withstand salt should be the focus in the aftermath of the Aila. Native Dhani grass (*Portersia coarcatata tatecoa*), which has persisted as permanent wastelands since Aila, can be cultivated as fodder on the fallow lands in the most severely salinity-affected areas of Satjalia island, Basanti, and Hingalganj. The fact that many inland water basins have recently been transformed into brick fields is just adding to the problems. In the Indian Sundarbans, the area under cultivation decreased from 2149 sq km to 1691 sq km between 2001 and 2008. Estimates indicate that more than 2,000 hectares of the approximately 70,000 hectares for fish cultivation—mostly in the Indian districts of Minakha, Haroa, Sandeshkhali, and Hingalganj—have been turned into brick fields.



Fig 1: Land prepared by local peoples for Agriculture in Sundarban.

B. Livelihood associated with Fishing: In the Sundarbans, fishing is a major industry, and fishermen have historically taken in fish. A diverse range of fishing and aquaculture industries, including shrimp farming, brackish water aquaculture, estuary and riverine fisheries, and many freshwater aquaculture variations, characterize the entire Sunderbans region. In October, they fish in a different way than they do the other months of the year. These men cruise the Sundarbans rivers in groups of three to five, leaving their dwellings for about twenty days a month to go fishing and crab fishing. The forest fishermen pray to Bonbibi, the Mother of the Forest, believing she is watching over them when they fish in the forest. They also steadfastly uphold the idea that they should only take what they absolutely need from the forest in order to avoid depleting its resources or upsetting its residents and their way of life. The forest fishermen view Bonbibi as a motherly figure who provides for all the creatures that inhabit the forest; in particular, they view the Royal Bengal Tigers as their "brothers." It is considered to be very harmful to the relationship between humans and the forest to injure or upset their brothers. Forest fishermen believe that those who "do the forest" undermine the forest's tranquility and drain its resources for their own benefit. This is the height of avarice and conceit, in their opinion.

C. Livelihood associated with Prawn Seed Collection: The number of people collecting prawn seeds in the Sundarbans was not always high. See "Blue Revolution: The Prawn Business" under "Regional" for a detailed account of how the prawn industry got its start and flourished in the Sundarbans. It will be discussed here how the forest and prawn seed collectors interact. For the collectors and dealers of prawn seeds, spirituality is less essential to their daily routines than it is for the forest workers who pray to Bonbibi for protection, as prawn seed gathering is more "businesslike" than forest work and they must deal with a volatile market and constantly shifting prices. Because their work does not fall under Kali's purview, they do not offer prayers to Kali like those who "do the forest." While women who pull prawn seed nets along riverbanks run a significant risk of being attacked by sharks, crocodiles, and even tigers, this does not negate the necessity for protection for them. Granted, prawn seed collecting is totally dictated by the times of the daily tides, but this does not imply that they have no interaction at all with the natural environment. To make sure they are there during the busiest time for collecting, prawn seed gatherers use these periods as a sort of work schedule. Prawn seed collectors are seen poorly by forest workers due to the business-like character of their occupation.

Forest workers perceive prawn seed collectors as individuals seeking quick money and transforming the Sundarbans' culture altogether, just like they perceive landlords as avaricious and uninterested in the region. Forest workers accuse prawn seed collectors of "defiling the forest [and] disturbing the tigers" due to their "get rich quick" mentality.



Fig 2: Prawn Seed Collection in Sundarban.

D. Wood gathering, and others livelihood: Wood gathering is still a very uncommon activity for the residents of the Sunderbans. In the Sunderbans' rural civilization, which is dominated by immigrants, these people primarily belong to the few indigenous demographic groups that still exist. Wood harvesting has less of a focus on harvesting timber and more on gathering fuel wood. The possibility for the average person to earn a direct living from lawful timber harvesting is nearly nonexistent since large-scale logging is actually directly supervised by the state forest department. Although they are not good for the mangrove ecosystem, plantations grown under social forestry do have the ability to collect timber from *Eucalyptus* (*Eucalyptus grandis*) and *Akashmani* (*Accacia auriculiformis*) trees.

E. Livelihood associated with Tourism: The Sundarbans are a popular tourist destination because of its rugged terrain, largest mangrove forests, population of Royal Bengal tigers, and other exotic species. Indigenous people have some employment opportunities thanks to tourism. Tourists are drawn to the Sundarbans by a variety of beautiful features, including wildlife—especially the royal Bengal tiger—dense mangrove vegetation, bird watching, and village life. The local population has several job options thanks to ecotourism. These people have more and different chances to make a living during the tourist season. The river is revered by the people who live in the Sundarbans as a life preserver and protector. Young people in the surrounding Sundarbans were involved in a variety of livelihood status (Table-1).

Table 1: The Sundarbans Peoples' major source of livelihood.

Source	Respondents (%)	Standardization
Agriculture	51	1
Fishing	13	0.1739
Honey	7	0.0434
Crab	5	0
Shop	8	0.0652
Tourism	6	0.0217
Boating	10	0.1086
Total	100	1.4128

Source: <https://www.sciencedirect.com/science/article/pii/S2577444122000442>

F. Livelihood associated with Honey and wax collection: Many residents in the Sunderbans' forest-fringe areas make a living by selling honey and wax, as well as collecting others non-timber forest products (NTFPs). Honey is considered a nutrient-dense food and is in high demand on the market. It is harvested from both manmade confined boxes and wild (*Apis indica*). Wax is a valued commodity in a similar manner. Each year, the Sunderbans yield an average of 2000 quintals of honey—both from wild sources and bee hives—and 1000 kg of wax. The usual places to obtain honey are forbidden wilderness regions. The current situation is difficult

for honey collectors because illegal tree cutting disturbs and harms bee hives. Since the blooms are essential to the sweetness of honey, flowering branches are illegally removed. Because of animal attacks, forest officials advise against villages searching deep within the forest for honey. They take a danger when they enter protected zones. It negatively affects that specific livelihood. Therefore, a large number of the forest-dependent people had either moved to harvesting prawn seeds or started working in agriculture.



Fig 3: Honey and Bee-wax collection in Sundarban

V. Livelihood and potential Sustainable resources:

In light of the current situation, where the majority of livelihood practices are proving to be detrimental to the mangrove ecosystem, a well-structured inventory for potential sustainable resources and related livelihood opportunities can significantly benefit the Sunderbans' populace as well as the environment. Therefore, a thorough analysis of a few of these potential resources was provided in the section that follows, drawing from input from participants in participatory assessments, forest guards, beat officers, and mangrove experts.

The chemical and leather industries both make extensive use of tannins as a non-timber forest products. Tannin is also used by Sunderbans fisherman in their nets and other equipment. Local fishermen still use natural tannins derived from mangroves for their purposes, even though artificial tannin is increasingly used in industrial sectors due to its easy availability and ready-to-use form.

The Sunderbans' reclaimed regions saw a population expansion during the course of the last century as a result of migrants from south-west Bengal and Bangladesh. It led to the marginalization and segregation of the native inhabitants. In addition to being separated, the traditional knowledge of the mangrove resources' medicinal and other qualities began to fade and disappear. As a result of the immigrants' continued lack of knowledge about the full range of applications for mangroves, these forests are viewed as simply trees with no practical use. Yet, both local experts and researchers from across the globe have noted that mangroves do have significant therapeutic qualities. A preliminary list has been produced to illustrate some of the fundamental therapeutic properties of particular mangrove plants (Table 2).

Table 2: Selected mangrove plants and their medicinal qualities:

Name of the plant	Common medicinal uses
<i>Tamarix diocia</i>	Tonic, skin disease
<i>Tamarix gallica</i>	Astringent in dysentery
<i>Thespia lampus</i>	Fruits for syphilis
<i>Derris indica</i>	Seed powder in bronchitis
<i>Cerriops tagal</i>	Root as substitute of quinine
<i>Acanthus ilicifolius</i>	Asthma, snake bite
<i>Rhizophora apiculata</i>	Root for blood pressure
<i>Casuarina equisetifolia</i>	Bark in diarrhea
<i>Derris trifoliata</i>	Antispasmodic and stimulant

Source: <https://scialert.net/fulltext/?doi=rjes.2011.536.543>

Mangrove plants are an inexpensive supply of gums and resins for the coastal fishing villages in India that live close to the mangroves. Few fishermen have been observed utilizing plant extracts instead of manufactured gums in their fishing and boating equipment in the Sunderbans. It has been reported that two mangrove plants, Dhundhul (*Xylocarpus granatum*) and Kala Bien (*Avicennia marina*), can be used to extract the sap that forms gum. These can also be considered as possible suppliers of sap and bark for the production of resin. Therefore, if appropriate manufacturing chains are built, well-maintained mangrove plantings can be a satisfactory supply for environmentally benign gums and resins.

The mangrove ecosystem is regarded as one of the most abundant sources of edible goods among all the major forest ecosystems, encompassing both floral and faunal origins. *Avicennia marina*, *Pluchea indica*, *Bruguiera gymnorrhiza*, *Avicennia officinalis*, *Oncosperma tigillaria*, and *Sonneratia apetala* are among the many marginal families of mangrove-fringe villages around the world that commonly use their tender leaves, buds, and fleshy fruits as vegetables in their daily diets, aside from honey. Additionally, just ten to fifteen years ago, fruits from Hental, Golpata, and Sundari (*Heritiera fomes*) were sold in the Sunderbans' local marketplaces.

In the past, the leaves of Golpata (*Nypa fruticans*) and Hental (*Phoenix paludosa*) were commonly used in the Sunderbans to thatch hut roofs, make ropes, and create handicrafts. These plants, together with the Dhani grass variety that grows along riversides and embankments, and the Hogla (*Typha elephantina*) plant that grows farther inland, have a remarkable potential to support small-scale handicraft, straw, rope, and mat-making industries in rural areas, provided that the right technological and marketing interventions are implemented. By establishing thriving mangrove belts surrounding the islands, this can help to conserve the ecosystem while also improving livelihoods.

VI. Alternative non-traditional livelihood:

Alternative livelihoods such as seaweed culture, oyster culture, Monosex tilapia culture, mangrove related species cultivation, and salt-tolerant rice have been addressed with the respondents, and an assessment has been conducted to determine the process's effectiveness. It has been noted that, in this mangrove-dominated deltaic complex, a deeper comprehension of the ecological situation combined with the creation of awareness may strengthen the idea of an alternative livelihood with institutional backing.

The western Indian Sundarbans, with its nearly semi-urbanized fish landing sites and harbors, tourism establishments, and pilgrimage centers, are represented in **Table 3** by the findings of the respondent analysis. Due to shrimp farms, which are one of the main sources of income in this area, the mangroves in this sector have mostly been destroyed.

Table 3: Mangrove based alternative livelihoods with scaling in western Indian Sundarbans.

Alternative livelihood category	Forester (Respondent Type 1)		
	ALR	% of Vote	ALS1
Pisciculture with mangrove floral based feed	7	24.4	170.8
Seaweed culture	3	10	30
Food products development from mangrove associates	3	6.1	18.3
Oyster culture	3	22.6	67.8
Mangrove fruit based food products	6	12.5	75
<i>Salicornia</i> and <i>Suaeda</i> cultivation	2	8.1	16.2
Monosex tilapia culture	4	11.8	47.2
Salt tolerant rice cultivation	1	04.5	4.5
Alternative livelihood category	Researcher (Respondent Type 2)		
	ALR	% of Vote	ALS2
Pisciculture with mangrove floral based feed	7	27.9	195.3
Seaweed culture	3	8	24
Food products development from mangrove associates	5	13.7	68.5
Oyster culture	5	5	25
Mangrove fruit based food products	6	20.6	123.6
<i>Salicornia</i> and <i>Suaeda</i> cultivation	2	4.9	9.8
Monosex tilapia culture	5	16.5	82.5
Salt tolerant rice cultivation	1	03.4	3.4
Alternative livelihood category	Fisherman (Respondent Type 3)		
	ALR	% of Vote	ALS3
Pisciculture with mangrove floral based feed	7	27.2	190.4
Seaweed culture	4	10.2	40.8

Food products development from mangrove associates	4	15	60
Oyster culture	7	2.3	16.1
Mangrove fruit based food products	6	19.8	118.8
<i>Salicornia</i> and <i>Suaeda</i> cultivation	2	4.3	8.6
Monosex tilapia culture	5	19	95
Salt tolerant rice cultivation	1	2.2	2.2
Alternative livelihood category	Agriculturist (Respondent Type 4)		
	ALR -1	% of Vote	ALS4
Pisciculture with mangrove floral based feed	7	19.7	137.9
Seaweed culture	4	11	44
Food products development from mangrove associates	7	7.3	51.1
Oyster culture	5	16.3	81.5
Mangrove fruit based food products	5	18.1	90.5
<i>Salicornia</i> and <i>Suaeda</i> cultivation	2	9	18
Monosex tilapia culture	4	14.1	56.4
Salt tolerant rice cultivation	1	4.5	4.5
Alternative livelihood category	Local inhabitant (Respondent Type 5)		
	ALR	% of Vote	ALS5
Pisciculture with mangrove floral based feed	7	22.4	156.8
Seaweed culture	3	11.1	33.3
Food products development from mangrove associates	4	11.7	46.8
Oyster culture	5	16	80
Mangrove fruit based food products	6	19	114
<i>Salicornia</i> and <i>Suaeda</i> cultivation	2	9.9	19.8
Monosex tilapia culture	7	7.4	51.8

Salt tolerant rice cultivation	1	2.5	2.5
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[https://www.biolscigroup.us/articles/AMS-3-](https://www.biolscigroup.us/articles/AMS-3-115.php#:~:text=The%20alternative%20livelihoods%20like%20oyster,the%20success%20of%20the%20process.)

[115.php#:~:text=The%20alternative%20livelihoods%20like%20oyster,the%20success%20of%20the%20process.](https://www.biolscigroup.us/articles/AMS-3-115.php#:~:text=The%20alternative%20livelihoods%20like%20oyster,the%20success%20of%20the%20process.)

Table 3 shows that there is a significant preference for livelihoods related to pisciculture among the stakeholders in the western Indian Sundarbans. The stakeholders showed the least interest in seaweed and oyster cultivation. This could be because of the Sundarbans in western India's proximity to the port and industrial complex at Haldia. Aside from businesses and tourism establishments, the western sector's population is primarily employed in agriculture and fish landing-related activities; as a result, they have limited interest in non-traditional alternative livelihoods. Employment opportunities are provided at various levels by the chain of factories and industries, fish landing sites (like Kakdwip, Namkhana, etc.), tourism establishments (like Bakkhali, Sagar Island, etc.), brick kilns (like Kakdwip), and pilgrims (like Kapil Muni Ashram at Sagar South). The study demonstrated the viability of alternative lifestyles such as seaweed farming, oyster farming, pisciculture using mangrove flowers as feed, and the production of food products from mangrove partners.

VII. Climate Change and threats to Local Livelihood:

The possibility of modifying the climate, as well as the regularity and intensity of extreme weather events, present risks. These could include rising sea levels, draughts, storms, flooding, and pollution of salt water. The temperature of the waters of the Sundarbans has been found to have risen at an accelerated rate of 0.50°C per decade between 1980 and 2007, in contrast to the 0.060°C per decade reported global sea surface temperature change. Aquatic life is severely impacted by this sea temperature rise that is happening so quickly. Because the Sundarbans region is an estuary delta, this alteration has a significant influence there. It also has a negative impact on the mangrove ecosystem's health.

The Sundarbans' sea level is constantly fluctuating. The cause of this is immersion in deeper water. Once more, the availability of sediment is being impacted by sea level rise, which directly hinders the development of new groves. According to studies, there may have been a decline in runoff in the eastern Sundarbans rivers during the past 20 years, which has led to an increase in salinity and concentrations of marine sulfate. Additionally, the main cause of the sea level rise is ongoing immersion in deeper water, which has an impact on plants since they are narrower, shorter, and have fewer branches and leaves. Decreases in photosynthetic rates are another cause of this. A reduction in freshwater runoff has impacted the growth of mangroves. In addition, problems with water stagnation—which can occur long beyond monsoon seasons—and the high salinity of the soils brought on by high tides, cyclones, and storm surges are all having an impact on agriculture. There may also be a threat to human health and life. In addition, there has been a 50% loss in dense forest area and a 19.3% decrease in mangrove forest area. As a result, the way of life for those living in the Sundarbans has altered.

Super-Cyclones and cyclones are a common occurrence on India's eastern coast. Between 1951 and 2010, there has been a noted increase in the strength of cyclonic storms that hit the Sundarbans. Compared to its equivalents on the mainland, its impact on agriculture and life in the Sundarbans delta region is not quite the same.

This article's interest in the region grew as climate change predictions designated this big coastal population, especially those living in the western half of the Sundarban, as one of the world's most vulnerable groups. While this region's long-term vulnerability stems from soil salinization and area loss due to sea-level rise, the more immediate consequence is an increase in cyclonic storm frequency in the Bay of Bengal.

A study using data on tropical cyclone frequency along the eastern coast of India from 1891 to 2013 showed that there is a pattern of heightened cyclogenesis during the months of May, October, November, and December (Mishra, 2014). An further recent study examined cyclonic storm trajectories in the Bay of Bengal between 1877 and 2016 using a georeferenced panel database. The study discovered that, when taking into

account the history of cyclone landfall over the whole coastlines of Bangladesh, the Indian states of Odisha and West Bengal, and the state of Bangladesh, the median location of cyclones has moved eastward over time, with the highest-impact zones currently located in northern Odisha and the Sundarban region of West Bengal. Salinization of the soil and water will also have an impact on the number and geographic distribution of mangroves in the Sundarbans, according to studies. These alterations are probably going to have an impact on people's chances of making a living from forests. Because the highest-value timber species are being lost as a result of salinity-induced mangrove migration, the value of timber stocks is predicted to be strongly regressed. Furthermore, the increased potential for honey production is probably going to lead to more human-wildlife confrontations in the area.

VIII. Conclusion:

The indigenous community's resilience to natural calamities has increased as a result of livelihood diversification. Modern agriculture and fishing techniques include composite farming, superior species of inland fish, and salinity-resistant paddy varieties. Because they now have more possibilities for a living, the local population has moved less during the dry season. Regarding the legal implementation of technological interference in natural From the preceding discussions, it is clear that little has been done up to this point to develop sustainable livelihoods for the villages living on the edge of the forest, despite the fact that the Sunderbans mangroves are rich in natural resources. In turn, effective resource management that is both commercially viable and environmentally sustainable depends on the proper investigation of NTFP-based rural enterprise generating prospects in the Sunderbans. Climate change has a serious impact on the people living in the Sunderbans. These could include a rise in sea level, contaminated salt water, an increase in storms and flooding, draughts, etc. As the climate changes, they attempt to obtain employment in new ways.

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