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Research Paper

Livelihood, conflict and tourism: An assessment of livelihood impact in Sundarbans, West Bengal

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ABSTRACT

Sundarbans delta is renowned as the largest mangrove forest reserve in the world with distinct species of wild flora and fauna. It acts as a source of livelihood for several communities residing in the vicinity. The indigenous plants, extraction of honey and catching fish from rivers, lakes and rivulets have good economic value in surroundings markets. The local community were highly attached to their land, air, water, animals and plants of the area which have simultaneously became part of their culture and tradition over the years. The aim of the study is to identify and analyse the community's perception about Sundarbans and impacts on their livelihood along with the threat faced by Sundarbans. The study is based on primary survey following secondary data for data collection while descriptive and ethnographic methods were used to get the desired outcome. Post discussion, it was concluded that apart from human and animal conflict, the community is also facing livelihood conflict as the shift has registered over the years. The water level has continued to rise and submerge much of the areas of Sundarbans. Tourism is highly appreciated, but unregulated and irresponsible tourists are the major concern for wild floral and faunal species in Sundarbans ecosystem. The people living there don't have capacity to do other work except cultivation and fishing. The area specific approach and regional plan for the region is the need of hour as the region is suffering from multiple problems threat to tiger conservation, increased salinity of the water and erosion of embankment.

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1. Introduction

Sundarbans is a UNESCO (United Nations Educational, Scientific and Cultural Organisation) World Heritage Site and abode of the highest number of Royal Bengal tigers (Banerjee, 2014). Ganga and Brahmaputra are two giant rivers of India, meet in Sundarbans and eventually disappear in the Bay of Bengal (Jalais, 2007). Ganges renowned as the most sacred river of Hindus, travelled >2000 km to reach Gangasagar (Chakrabarti, 2009). It has been a holy pilgrimage for millions of Hindus across the country for centuries (Siddiqi, 1995). The ecologically contiguous region between India and Bangladesh separate Sundarbans delta with a territorial boundary. (Chatterjee, 1990). In India, the delta is divided in mixed category with protected ecological habitat and human habitation around it (Mitra, Gangopadhyay, Dube, Schmidt, & Banerjee, 2009). It's the very lifeline for thousands of

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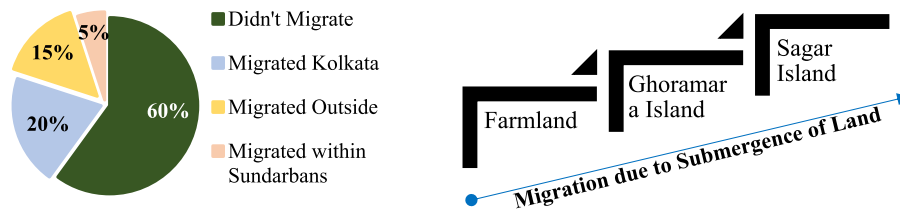


Fig. 1. Migration pattern in Sundarbans. Adopted from World Bank (2018) and prepared by authors in 2022.

households who are living there in a harmony with nature for generations (Uddin, 2019). The massive mangrove swamps and hundreds of low-lying islands are now disappearing at a very rapid pace never before in human history (Bandyopadhyay, 2000). It is home to millions of impoverished masses who are struggling for their survival (Kumar, Kaur, Chandrasekar, & Bandyopadhyay, 2020). They face day to day contest with natural and anthropogenic disasters to earn their livelihood (Sarker, Reeve, Paul, & Matthiopoulos, 2019). In the late 1970s, water of Sundarbans started submerging farmland of the surroundings causing threat to survival of the people (Das Gupta & Shaw, 2015). Thereby, several people abandoned their homeland and migrated to safer islands like Ghoramara Island in due course (Fig. 1) (Rahaman et al., 2015). Ghoramara Island started sinking as the water level was rising around the Island in 2015 (Nasrin, Mahmood, Siddique, & Masudur, 2020). When Ganges engulfed Ghoramara Island, people have finally shifted to Sagar Island because they are left with no safer place to reside (Saha & Goswami, 2020). This is catastrophic for the marginal and poor farmers living in the South Twenty-Four Pargana district of West Bengal, India (Mukherjee, Chaudhuri, Kundu, Mitra, & Homechaudhuri, 2013). The entire villages with market, farms, homes, roads, mosques and temples have vanished under cyclones and floodings (Koli, 2013).

The surface temperature of seawater has increased which reveals the adverse impact of climate change in Sundarbans (Iftekhar, 2008). Almost 4 months of massive rainfall that starts in June and ends in September become a common phenomenon in the region (Mukhopadhyay, 2011). The acidic rain penetrates deep into the farmlands which not only destroy standing crops and mangroves, but also ruin soil fertility for future farming in the region (Iftekhar & Islam, 2004a, 2004b). Rice and Indigo are the main crops grown in the delta and their productivity have declined over the past few years due to decrease in soil fertility and increase in farmland salinity (Banerjee, Gatti, & Mitra, 2017). Analysis of past cyclones reveal that there is an increase in the number of high and very high-intensity cyclones in region (Dutta, Das, Paul, Sharma, & Dadhwal, 2015). One of the deadliest cyclones code name *Aila* occurred in May 2009 that resulted in massive loss of life and property (Mukhopadhyay, 2011). The failure of sustainable livelihood is making life more miserable over time (Abdullah, Katharina Zander, Myers, Stacey, & Garnett, 2016). Locals have shifted to the restricted forest areas to feed their family members where, wild animals often attack on them (Inskip et al., 2013). It is a myth that all animals are human eaters and blamed for future threats in the dense forest (Giri et al., 2014). All animals are not human eaters, they are like any human being, trying to protect their family and keep their home safe from any harm or danger (Ghimire & Vikas, 2019). The need and purpose of the study is to address anthropogenic and environmental challenges including rural livelihood, tourism and conflict with wild animals in Sundarbans. The immediate issues for the comprehensive management and sustainable development of the region is to adopt people centric approach.

1.1. Contextual framework

The indigenous people of Sundarbans devote the utmost respect and compassion to the forests since the immemorial time (Dubey, Trivedi, Chand, Mandal, & Rout, 2017). They worship Gods and Goddesses of the Sundarbans delta and serve their core purpose of preserving and protecting the entire ecosystem (Saha, 2017). The region is naturally accessible as locally built boats are the only means for traveling and navigating the delta, from one part of the region to another (Ghai, 2019). It looks like a heaven during dawn and become very attractive moment for tourists, especially during winters (UNESCO, 2020). Locals depend on tourism and rich resources of the delta as forests are more than just a source of livelihood for them in Sundarbans (Abdullah, 2014). The thick mangroves belt is renowned as the greatest protector of the region due to its location in the cyclone developing areas of Bay of Bengal (Singh, Bhattacharya, Vyas, & Roy, 2010). The rising water develops several deadly turbulences including frequent cyclones causing torrential rainfall in Sundarbans (Fig. 2; Inskip et al., 2013). The frequency and severity of

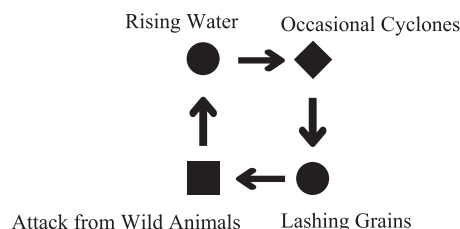


Fig. 2. Domino effect of uncertainties. Adopted from Inskip et al. (2013 and 2018), and prepared by authors in 2022.

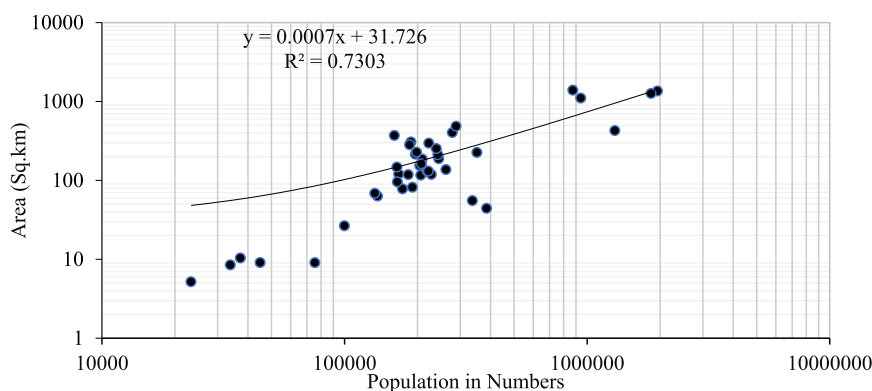


Fig. 3. Linear relationship between population and area in South 24 Parganas. Adopted from District Statistical Handbook (Bureau of Applied Economics and Statistics, Department of Statistics and Programme Implementation, Government of West Bengal, 2010; 2011), and prepared by authors in 2022.

cyclones & storms has increased leading to rise in sea level temperature over the past few years (The Tribune, 2021). The employment opportunities are quite limited in Sundarbans, which has forced the inhabitants to risk their life in procuring economic resources from the dense forests (WWF, 2021). The native communities are unable to showcase their locally prepared products such as dried fish and honey to outside world due to partial isolation from the mainstream, mainland and markets (Singh, 2020). It is quite challenging to take step in the land, which is covered with dense roots and swamps (Sanyal & Routray, 2016). The number of inhabitants in South 24 Parganas has increased, but resource base remained constant leading to constant conflict between people and wildlife in the forest (Bureau of Applied Economics and Statistics, Department of Statistics and Programme Implementation, Government of West Bengal, 2010; 2011). The maximum population are spread across an area of 100–1000 sq. km, which is a potential threat for wildlife as many of prey and herbivores food are found in the forests (Fig. 3). Keeping in view, the government of India with the West Bengal government, came out with several projects for the safe passage of wildlife, including Project Tiger, 1973 and Project Crocodile, 1975 (The Wild Life (Protection) Act, 1972). All these projects are providing the highest level of protection to the concerned species from any threat and poaching (Datta, Chattopadhyay, & Deb, 2011). Though, local dwellers are allowed to collect forest resources like honey, fish, shrubs, timber, mahua, bamboo and other resources from the designated areas under Forest Rights Act, 2006 (Ministry of Tribal Affairs, 2021; Schwartzstein, 2019). Forest officials many times deny the locals their right to collect forest resources, which results negative impacts on their livelihood (Rajagopal, 2019). Thereby, the lives of the locals are often exposed to corruption, mismanagement and over-exploitation despite several efforts from walks of stakeholders in Sundarbans (Nath, 2020).

1.2. Literature review

World Wide Fund for Nature (WWF) (WWF, 2021) has kept Indian Sundarbans in its priority domain since 1973 due to ecological fragility and biodiversity richness. The region is highly fragile to global warming and climate change wherein indigenous communities and wildlife are facing several challenges. It includes submergence of low-lying areas and coastal islands are highly susceptible to frequent floodings. Sundarbans has one of the maximum numbers of human animal conflict rates world over. The future of Sundarbans will be largely influenced on how well it is resilient to integrate conservation strategies and negative impacts of climate. The main focus of WWF is to prepare communities and build ecosystem resilient to climate change. Human-animal conflict is one of the main challenges for the continuous survival of several species in different areas of Sundarbans. Long-term strategies including access to clean energy, sustainable livelihood and concrete human-animal conflict management are the vital focused area (WWF, 2021).

The Sundarbans forests are home to one of the largest mangrove forests across the world and declared as the World Heritage Site in 1987. It is the only mangrove forest abode to *Panthera tigris* species in the world. It lies on delta of two lifelines of India such as Ganga and Brahmaputra rivers on Bay of Bengal. The area is renowned for wide variety of flora and fauna like hundred species of birds, the royal Bengal tigers, endangered species of Indian pythons, Irrawaddy dolphins and crocodiles. Natural calamities like cyclones are always cause of concern and posed threat to life and property together with intrusion of saline water and problem of siltation. Over exploitation of forest resources, poaching, illegal trapping of endangered animals and agricultural encroachment are disturbing the forest ecosystem (UNESCO, 2020).

Based on Saha (2017), the Sundarbans has a prominent place in historical and mythological events in tangible and intangible heritage of West Bengal. It includes honey collection, fishing, traditional handicraft preparation, religious festivals, ancient myths, traditional dance and music. The interaction of nature with wildlife and human beings has paved the way for creation of new dimensions of social and cultural landscape in the region. Sundarbans being managed over hundred years based on recommendations of the local communities. The forest department under the Ministry of Environment Forest and Climate Change (MoEFCC) being managed Sundarbans. The sectoral management measures are adopted that includes fisheries management, forest management and wildlife management. The Sundarbans is classified into two division such as east and west wherein Divisional Forest

Officers (DFO) are responsible for the resource management. DFO are in charge of wildlife conservation activities under the provisions of International Union for Conservation of Nature Saha (2017).

Aquaculture generates livelihood opportunities due to reliable source of income to communities residing in Sundarbans. Fisheries are integral component of employment in Sundarbans and important drivers of determining local economy. Earthen embankment surrounding the islands keep brackish water far away from the islands and maintain freshwater feasible within the islands. Climate change is a potential threat for freshwater aquaculture. Frequent cyclones are one of the most important phenomena that cumulatively affecting aquaculture due to sea level rise, frequent coastal flooding and salinity intrusion. Saline water encroachment due to breakdown of earthen embankment and rapid erosion with extreme weather phenomena affect biodiversity of the delta. The pre-monsoon days of rainfall showed an increasing pattern while post-monsoon days of rainfall showed a decreasing pattern (Dubey et al., 2017).

The communities residing in Sundarbans have a feeling that the lowest priority is assigned to solving their grievances. There is hardly any institution dealing with timely response and rescue to disaster management in the region. The easily avoidable cyclones are becoming dangerous for dwellers because most of them lost their settlements in cyclones and become homeless. People's essential needs are kept secondary since it is designated as a World Heritage Site. Indigenous knowledge, social capital, experiences and skills being passed from one community to another and from one generation to another. The bonding among members generates a high level of faith which was experienced when some member of the community faces any problem, then they together firmly solve it. The response of local administration was very poor like swift response to evacuation process at the stuck of cyclone Aila in 2009 (Sanyal & Routray, 2016).

1.3. Research objective

The objective of this paper is to identify and analyse community perception about Sundarbans and the livelihood challenges faced by them in the current scenario.

2. Materials and methods

2.1. Study area

Sundarbans is situated in the midst of two countries such as India and Bangladesh (Bagchi, 2017). It spreads over an area of 10,000 sq. km of which 62% lies in Bangladesh and the remaining 38% in India (Ghosh, Schmidt, Fickert, & Nüsse, 2015). It covers an area of 6017 sq. km forest in Khulna region of Bangladesh and over 4267 sq. km forest in North 24 Pargana districts of West Bengal, India (District Statistical Handbook, 2010 and 2011). It lies between 21°30' N to 21°30' N latitudes and 89°00' E to 89°55' E longitudes (Iftakhar and Islam, 2004) (Fig. 4) This UNESCO site is located on the delta of three rivers namely Ganga, Brahmaputra and Meghna on the Bay of Bengal (District Census Handbook, 2011/2011). It includes three wildlife sanctuaries including Sajnekhali Wildlife Sanctuary, Haliday Wildlife Sanctuary and Lothian Wildlife Sanctuary (District Statistical Handbook, South 24 parganas, 2010 and 2011). The topography of the region is highly diverse due to presence of more than hundreds of islands (Bureau of Applied Economics and Statistics, Department of Statistics and Programme Implementation Government of West Bengal, 2015). The water level increases, then around 30% of the area is completely inundated at an interval of every six hours (District Human Development Report, 2010). Tropical weather condition with a good amount of rainfall is prevalent which is further supported with 90% relative humidity (O'Malley, 1914). Sweating is very common, but environment is free from any kind of mosquito and leaches (De, 1968). Saltwater has surrounded Sundarbans from all sides, thereby mangroves are very common (Development and Planning Department, Government of West Bengal, 2010).

2.2. Database and research methodology

The research paper is based on the secondary research on studies conducted worldwide. The primary survey was conducted to achieve in-depth understanding of Sundarbans' community, their livelihood and understand local's perception about the human and animal conflict. A household survey was conducted after 10 years of cyclone Aila at Bali village and Satjelia village in South 24 Parganas district of West Bengal, India in 2019 (Fig. 5). The survey conducted was divided into two parts, first household survey number of households once engaged in primitive source of livelihood and now have migrated to tourism or involved in both (Fig. 6). These households were directly or indirectly connected with tourism sector. The second part exclusively focused on tourists' survey including both national and foreign tourists. Bali and Satjelia villages were chosen for the study as the first approach towards sustainable tourism was implemented at Bali in 2001 by employing local inhabitants while Satjelia was later considered for it. In total, 80 respondents were selected using purposive random sampling whereas 40 respondents were selected from each village for the interview (Figs. 7 and 8). The sample size consists of 30 local inhabitants, 5 Indian tourists and 5 foreign tourists in each village. The respondents were between the age-group from 18 to 80 years including 4 women in each village. The key informants include bee keepers, boatmen, fisherman, farmers, shopkeepers and construction workers because they had good knowledge and experience of the past incidents. Informed consent was obtained from survey participants.

The tourists survey includes their understanding about the islands, level of satisfaction and discomfort at different scales varying from very low to very high were observed through questionnaire. The study was based on particular section of people, whose livelihood was completely dependent on forest resources and tourism activities. The two selected villages are quite significant as

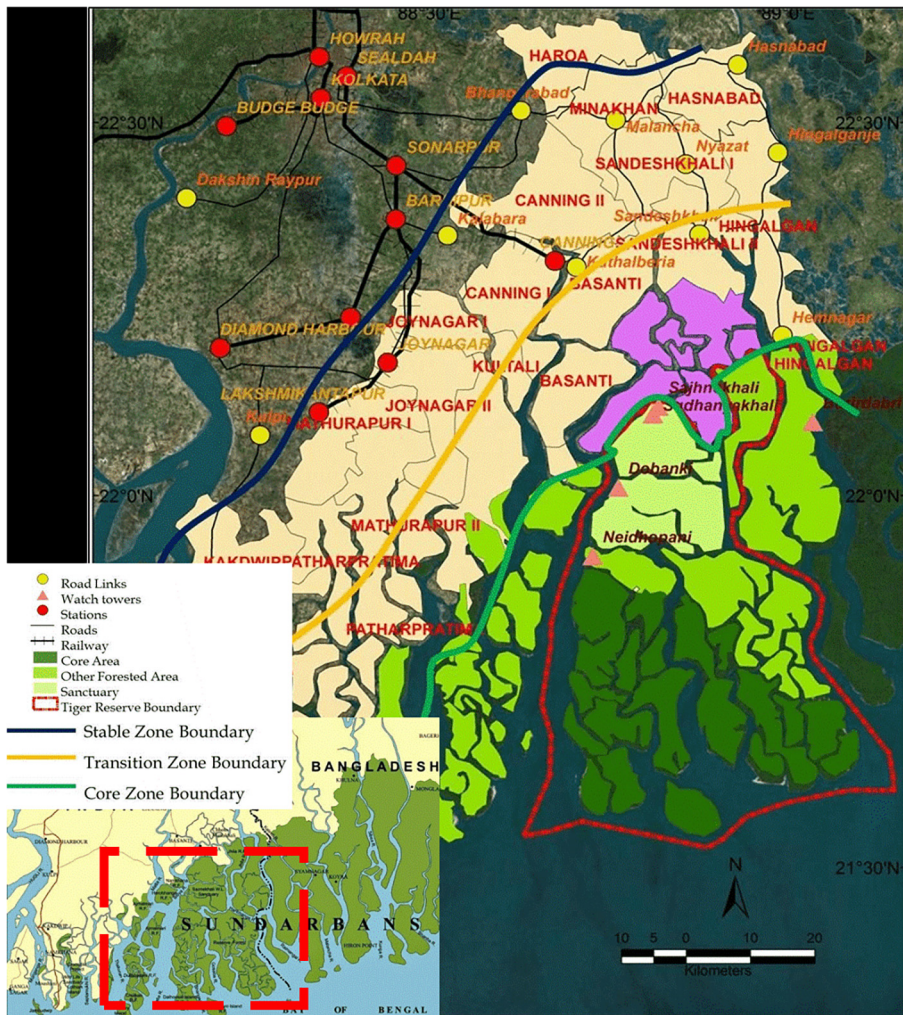


Fig. 4. Geographical map of Indian sundarbans.
Source: ArcMap 10.1 and prepared by authors in 2022.

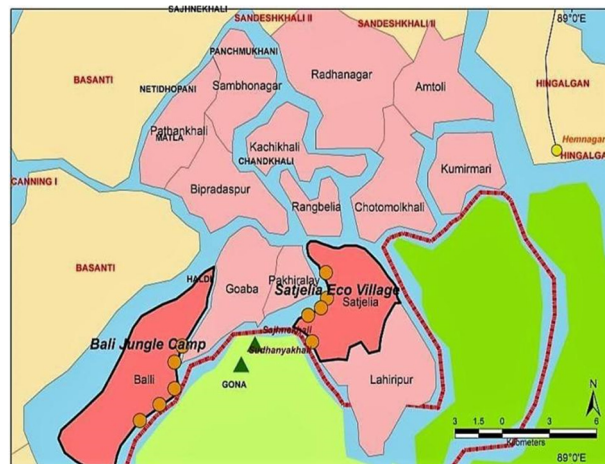


Fig. 5. Geographical map of Satjelia and Bali Village.
Source: ArcMap 10.1 and prepared by authors in 2022.

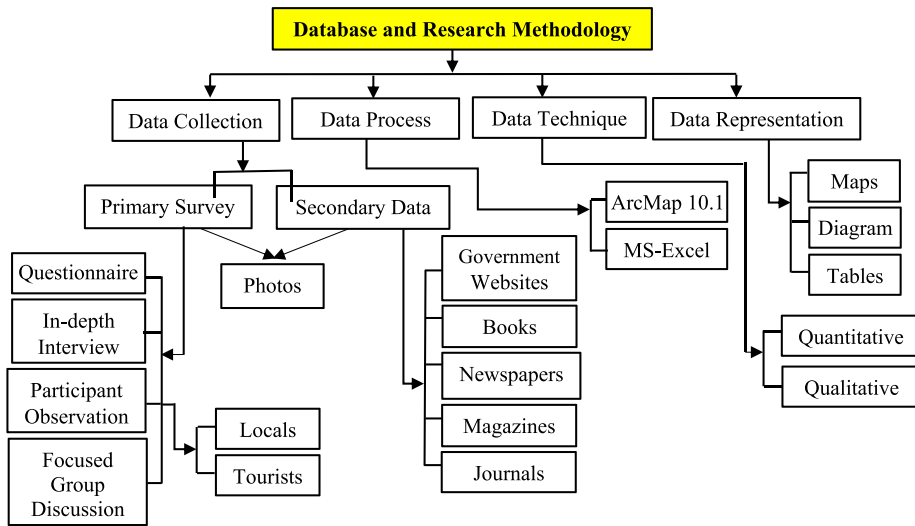


Fig. 6. Diagrammatic representation of database and research methodology. Source: Prepared by authors in 2022.



Fig. 7. Satjelia Village.



Fig. 8. Bali Village. Source: Primary survey conducted by authors in 2019.

because tourism have a good source of livelihood. Tourism is boom both in account of number of annual visitors and for that there was increased demand for local tourists guide in the vialges. The villages are located in the surroundings of Gosaba block which was very close to Sundarbans tiger reserve. The qualitative and quantitative techniques were used for the analysis including focused group discussion, in-depth interview, questionnaire and participatory observation. In focused group discussions (FDGs), it was cleared that low intensity disasters like damage of embankments and sea storms causing frequent floodings resulting washout of people's settlements dwelling in low-lying areas. In another FDGs, there is no clarity regarding the patrolling of forest officials as many times unknown people in name of forest officials extort their forest products in the name of illegal practice. Such practice of forest officials are creating a sense of avenge against them which neither good for them and nor for their family in long-term because these forest officials' duty keeps on changing from one island to another. In the in-dept interview, respondents discussed that community bonding and trust had helped a lot in facing any disaster like Aila. They frequently visit block development officer's office to collect their pending relief that the government announced for them. In another in-depth interview, they elaborated several wild animal attacks on them and many times either they lost their life or animal. The questionnaire includes workers profile such as personal and professional, previous and current standard of living, work and problems that they are facing over the past few decades. It was apparently observed that their present condition is not as good as government and other official reports projects. Tourism had become mere source of livelihood and regarding that their viewpoint, and suitable suggestions were taken into accounts.

ArcMap 10.1 versions were used to prepare maps while bar, table, pie and figure were drawn for data representation. Descriptive and ethnographic methods were used to get the desired outcome. For secondary data, Census of India, District Census Handbook, State Statistical Handbook, District Statistical Handbook, United Nations Development Programme and West Bengal Library Network were used for further analysis. Magazines such as National Geographic, Down to Earth and websites such as WWF and UNESCO for the same purpose. Apart from these resources, multiple literary works like newspapers, journals, research papers, books, dissertation and thesis were accessed for analysis. Important information from government and NGOs websites were incorporated for critical analysis.

$$I^s = \frac{I - \min(I)}{\max(I) - \min(I)}$$

- I^s : standardized value of I and satisfy $0 < I^s \leq 1$.
- I: indicator of unit.
- $\max(I)$: maximum value of I.
- $\min(I)$: minimum value of I.

3. Results

Sundarbans is a vast and endangered ecosystem where natural characteristics are under severe threat of extinction. The human population are on the brink with over millions of people becoming landless in the region. They were solely dependent on agriculture and allied activities. It is bizarre to observe that human beings have discovered fire for their own safety, but its wrongful use will be disastrous for the whole civilization. It depicts the two faces of same coin with pros and cons.

3.1. Inundation of settlements

Sundarbans is renowned as an iconic landscape where freshwater meets seawater and rhythmic phenomenon of tides shifting governs the landscape. Mangroves holds this ever-changing region together despite of multiple constrains. The locals have to be daring enough to withstand a delicate terrain and poor-quality dwelling infrastructure, otherwise it is impossible to survive. Sundarbans is a home for over 5 million people which is an ecologically fragile and climatically vulnerable region. People don't have many alternate ways to survive in the region. Housing issues trouble women member of the family because they mostly spend a large period of the year alone, without any male member in the household. After cyclones, many houses get washed away. However, receiving government's compensation for the mishap is not an easy task. Government helps including few kilograms of rice, sugar is insufficient to start a life from scratch. Questions such as how will their family survive with such a meagre resource and how will they feed their children's empty stomach remain unanswered? A few numbers of families have received compensation and many have to pay bribe to get it on time. Monthly food allowances are not enough and they have to borrow from others to feed their family. Water ascends to all the houses built up to 3–4 ft across Sundarbans at least twice in a month. It was noted that the houses remain submerged up to 3 h before receding. Water level reaches to their highest level around 9 pm in the evening. The terrified and helpless residents can only hope the night passes by and the water recedes knowing well. They have lost everything in the flood and leaving them truly destitute. Their households are mostly made of mud, bricks and thatch, which cannot stand against the disastrous flow of water.

3.2. Frequent disasters

Sundarbans shields the city of Kolkata (the heart of West Bengal) from several cyclonic turbulences otherwise, the alternate scenario could be unimaginable. Cyclones are frequently formed in the Bay of Bengal and cause phenomenal destruction across

Table 1
Frequency of cyclones in Sundarbans.

Cyclones Time Period		
(1). Aila, 2009	(2). Bulbul, 2019	(3). Amphan, 2020
<ul style="list-style-type: none"> • Loss ₹150 crore • Households damaged 3,25,000 • >2.3 million directly affected 	<ul style="list-style-type: none"> • Loss ₹23,811 crore • Households damaged 517,535 • >3.5 million directly affected 	<ul style="list-style-type: none"> • Loss ₹1,02 lakh crore • Households damaged 28.6 lakh • >2 million directly affected

Source: Mukhopadhyay (2011), Das (2019) and Mitra, Dutta, Mitra, and Thakur (2020). Prepared by authors in 2021.

the deltaic area. The freshwater gets contaminated by saline water during the arrival of cyclones. Locals are dependent on the transported water from outside to meet their daily water needs in such a scenario. In some cases, officials carry drinking water in their boats for the local people. Cyclone Sidr which hit coastal areas in 2007 caused around 40% damage to the ecologically sensitive area. Later, cyclone Aila was struck in 2009, during which >300 hundred people were killed and around millions were displaced. Afterwards, cyclone Bulbul hit this deltaic region in 2019, causing damage to life and property. Super cyclone Amphan, wind speed of >150 km/h hit Sundarbans resulting in massive casualties in recent past (Table 1). The cyclone's damage was high on wild flora and fauna. Making timely relief operations during flash floods are impossible as it is very sudden with almost no time for rescue operations. South 24 Pargana is India's one of the poorest districts and such disasters have shattered the lives of people residing there (Fig. 9). The rising water submerged their lands every year. Afterwards, they have to construct a new house for their survival. The floodings due to cyclones, storms and continuous rise in sea level have resulted in a high level of salination in the delta, making it completely infertile for farming.

3.3. Standard of living

The standard of living in Sundarbans was very low as most of inhabitants belong to Below Poverty Line (BPL) (Fig. 10). The region is under the grip of acute poverty, unemployment, hunger, illiteracy, poor health and well-being (Table 2). Rain seems to accompany the region throughout the year. Rainfall is common for around 5 to 6 months, which makes it quite difficult for students to attain regular and quality education in the delta. Most of the time, schools are closed as it is difficult for the students to attend their classes during the monsoons. They continue to work on very low wages because they were left with no alternatives. Most of the area was inundated during the monsoon thereby, infrastructures like essentials streets, roads and bridges break connections with each other. However, most villages of Sundarbans have primary schools and number of students is quite high. It lacks opportunity for professional education and work due to absence of any higher education institutions and factory respectively.

3.4. Basic instinct and conflict

Sundarban is famed as an abode of the world's ferocious Royal Bengal tiger besides wild boar, common otter, spotted deer, fishing cats, porcupine and poisonous snake (Fig. 11). Saltwater crocodiles are very often spotted as well. Humans have encroached animal's living ground across Sundarbans (Fig. 12). Animals are unable to sense and differentiate between poachers and local people. That's why whosoever obstruct their path they simply attack and kill them in self-defence. All tigers are not man-eaters, although some of them are. According to villagers, they mostly attack on human beings in their self-defence as

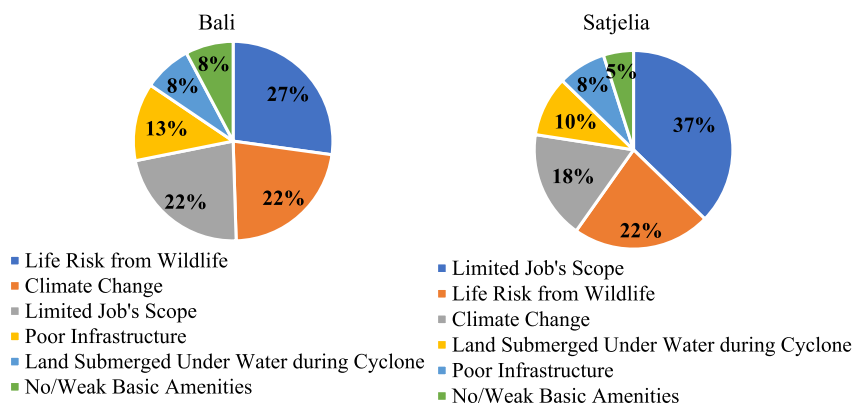


Fig. 9. Difficulties faced by residents in sundarbans.

Source: Primary survey conducted by authors in 2019 and prepared by authors in 2022.

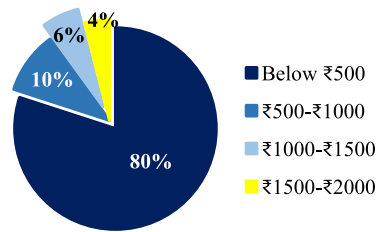


Fig. 10. Monthly income of household.

Source: Primary survey conducted by authors in 2019 and prepared by authors in 2022.

Table 2

Occupational profile of household.

Occupational Profile	Respondents (%)	Standardization
Fishermen	45	1
Honey collector	6	0.1086
Agriculture labourer	5	0.0869
Woodcutter	6	0.1086
Tourism activities	10	0.1956
Shopkeeper	7	0.1304
Crab collector	8	0.1521
Boatmen	6	0.1086
Construction worker	1	0
Others	6	0.1086
Total	100	1.9994

Source: Primary survey conducted by authors in 2019.

food available to them were decreasing due to increased tourism and illegal forest activities. There were several incidences where human beings with intention of saving the trapped tigers have become their food. When the tiger is freed from the trap, it often attacks and kills that person (Fig. 13). After tiger, salt water crocodiles are the next threat to humans in the region. Despite such constant threat to life, the communities are living in the dense forested region for generations. Humanity doesn't teach us to take lives but, it teaches us to value and save lives. Mahatma Gandhi has truly said that an eye for an eye will definitely make the whole world blind.

3.5. Animals turned man eaters

During the survey, one of the villagers explained that human corpses are one of the main reasons why the tigers have turned into man-eaters. When human corpses flow into the Ganges, after loss of lives during cyclones and floods. These corpses



Fig. 11. Royal Bengal Tiger.

Source: Primary survey conducted by authors in 2019.



Fig. 12. Saltwater crocodile.

Source: Primary survey conducted by authors in 2019.

eventually reaches to mud bank and deltaic region of Sundarbans where tigers feed on them owing to lack of food. Villagers further stated that after cyclone, excessive salt water penetrates into creeks, causing tigers to drink salted water. Salt water contributes to turning them into human eaters. When water level rises in their territory, scarcity of prey is common. In search of feed, they entered into the villages and attack humans and cattle. Fear is the only thing that completely consumes the forest. Here, fathers become tiger's food, when they enter the forest to collect resources to feed their children and family. Mothers go to the river bank to fetch water and sometimes never return is the agony of the World Heritage Site.

3.6. Loophole in the system

The forest management policy didn't recognise the locals, thereby they are unable to contribute in the discussions of Sundarbans forest management policy. When the inhabitants return to their home with honey, fish, herbs, forest palm and woods then, it is the riskiest leg of their entire trip. They can't reach to their locality without support of the Forest Department Staffs and have to pay ₹5000 to them. One of the respondents replied that they could earn quite well through selling of the resources if there were no bribes to pay to anyone. The community have to pay around ₹3000 to ₹5000 to obtain a forest permit which is illegal and against the law of the land. In the process, they need to borrow from someone and as a result, they're often trapped in the vicious cycle of debt and poverty. Many a time, they lose their happy and dignified life and carry the burden of debt and live off the sales of the honey. Nypa leaves are highly multipurpose in nature as it is used in construction works to build wall, roofs and in shops. The community themselves built their house with Nypa leaves and live under its shade. One of the Nypa leaves collectors explained that the Forest Officers are their biggest headache and problem because they need to obtain their permits from them only. When these officers inspect their tracts, then demand bribe from them to issue and renew their permits. If they are refused bribe, no new permits are issued.

3.7. Hardships of tribal women

Numerous tributaries, creeks and dense network of tidal waterways are prime characteristics of Sundarbans. Water is everywhere, but is unfit for human consumption which is causing the availability of potable water a great concern in the area.

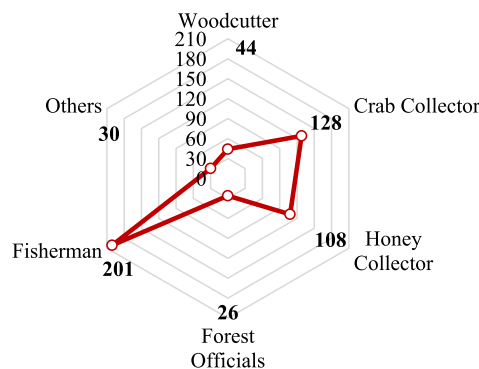


Fig. 13. Victims of tiger attack.

Source: Primary survey conducted by authors in 2019 and prepared by authors in 2022.

Employment is not the only thing that troubles tribal women in Sundarbans such as fetching water is a challenging task that every woman performs. The quality of water that they collect from ponds is not satisfactory, that's why they boil it and use alum for purification to make it drinkable. They wake up around 4 am in the morning to fetch water in groups of 4–5 and return back around 10 am. They have very limited time to sleep and eat. Around 2010, post-Aila, water pipelines were laid down to connect and supply drinking water in all villages, but rarely implemented widely. Officials inspected and understood problem of water crisis and addressed the same in quite an effective manner. Water purification machines and other supported equipment have been installed in few localities too. Even today, the inhabitants are struggling for drinking water, however less compared to before Aila. They now travel to their village chowk to fetch water as these machines are installed there. The Government may be allocated resources, but its benefits are yet to reach them.

3.8. Implications of COVID-19

The thick mangrove forests are everything to the locals and they wouldn't survive without it as it is the means for their sustenance. All types of movements and tourism activities were stopped during the COVID-19 pandemic in Sundarbans. Coronavirus was causing conservation disaster which might potentially lead to irreversible impact on Sundarbans' biodiversity. Surveillance in the forests was reduced and poaching increased relentlessly. Authorities were facing crisis of fund, resulting into inability to buy new surveillance and maintenance of existing equipment. Repairing of infrastructure and setting up new infrastructure was a challenging task. The lockdown created a hindrance to access the benefits of several schemes being funded through Non-Government Organisations (NGOs). The wildlife habitat was ravaged during the lockdown and there were several evidences that proved deforestation has increased in several part of Sundarbans. It is the perfect example of negative repercussion of an exploitative relationship with nature. The nationwide lockdown has negatively impacted the livelihood in the delta like never before. Coronavirus has put a brake on tourism as a result hotels, restaurants and resorts were empty because people were prohibited to gather in crowded places. During lockdown everyone was focusing on basic needs while excursion in Sundarban falls under the extravagant needs. The income of locals has declined exponentially and since most of them were dependent on tourism and forest resources for their survival. They were looking for alternative way of living in the crisis and adopting survival strategies to subsist the new normal. The pandemic is an alarm for the entire human civilization that if human beings mess around with nature, then they are bound to face such deadly consequences in the near future as well.

4. Discussions

The main motive behind the consumption of natural resources was these are a good source of revenue for the local economy (Chaudhuri, 1976). It involves healthy and bright participation of local for its comprehensive development. The profits and benefits gained from the exploitation of forest and natural resources must be shared with actual forest dwellers (Mitra et al., 2009). The discussion with the community revealed their dwindling source of livelihoods, miserable living health conditions and they are not liable for it indeed.

4.1. Uniqueness of sundarbans

Sundarban is renowned as nature's wall of defence and falls under the category of exceptional level of biodiversity (Chakrabarti, 2009). It is well known for its wide range of fauna including numerous birds, Royal Bengal tiger and many threatened species like salt water crocodile and Indian python (Siddiqi, 1995). It is the abode of several species such as Sundarbans' salt water crocodile is one of the largest crocodiles in the world and are renowned as estuarine crocodile (Iftekhar, 2008). It was observed that villagers never go alone or enter remote areas in Sundarbans. The Moali and Neekarand woodcutter carryout their traditional practices such as honouring Bono Bibi who is worshipped as forest goddess before beginning of journal in the forest. The life of fishermen, woodcutters and honey hunters is always under threat, the moment they enter into the forest (Banerjee et al., 2017). When the water level rises, boating is the only means to navigate within the Sundarbans, as infrastructures like bridge or road are difficult to build. The pugmark of tigers is different from each other like the fingers of human beings. Tigers are excellent swimmers and have 10 times more efficient smelling capacity than any human being.

4.2. Source of livelihood

Sundarban provides sustainable livelihood to millions of people (Jalais (2007)). Village youngsters go to the forest for their livelihoods like cutting of woods and fish catching (Table 3). These youngsters sometimes enter into the reserve forest unintentionally, thereby tigers often attacked on them, many of them lost their lives. Post this event, the entire family of deceased person is forced to live in extreme conditions because in most cases these youngsters are the sole bread earner of their family. Fishing is allowed in the periphery of the forest only and it is completely illegal inside the reserve forest. However, the quality of fish catch available in the periphery has deteriorated. Thus, for every single meal of the day, the locals have to break the law and illegally enter the dense core forested area, putting their life in jeopardy. Selling that fish is illegal, but most villagers sell those fishes through the middleman that has worsened the vicious cycle of poverty (Azad, Pitol, & Rakkibu, 2021). The entire agriculture activities in the region are solely dependent on rainfall due to absence of irrigation facilities (Fig. 14). The intrusion of seawater has compelled people to grow dry climate crop (Nasrin et al., 2020). Building embankment to protect the crops from encroaching

Table 3
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: Primary survey conducted by authors in 2019.

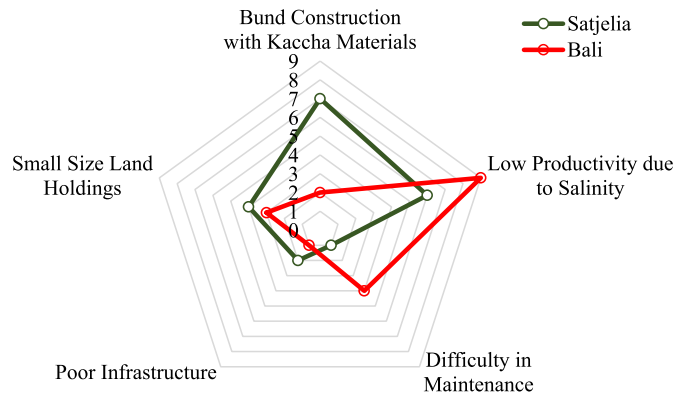


Fig. 14. Difficulties associated with agriculture.

Source: Primary survey conducted by authors in 2019 and prepared by authors in 2022.

brackish water is a pre-requisite in this ecosystem, which hardly works against adverse climatic conditions (Abdullah et al., 2016). Hence, agricultural productivity in the region is declining. Fragmentation of the land holdings among cultivators is another reason for declining agriculture yield (Fig. 15). Both agriculture and fishing are good livelihood option where productivity is very low. Many of the villagers are increasingly scramble to earn their livelihood through their traditional and the oldest livelihood called honey collection (Fig. 16). Honey is sacred to them and they believe a drop of honey is more potent than a drop of blood. Honey collection is usually done in prohibited forest areas. In the present scenario, honey collectors face hardship as illegal felling of trees, disrupts and damages the bee hives. Flowering branches are cleared out illegally and since the flowers play a pivotal role in making honey sweet, it has negative consequences on that particular livelihood (Koli, 2013). Forest officials discourage villagers from going deep inside the forest for honey due to attack of wild animals. They enter inside protected areas at their own risk. Hence, in occurrence of any mishap, forest official are not held accountable and they refuse to provide any kind of compensation.

4.3. Tourism

The rough terrain, the largest mangrove forests, Royal Bengal tiger population and other exotic animals are key attractive points for tourists in Sundarbans (Uddin, 2019). The scenic beauty of the deltaic region is one of its kind (Rahaman et al.,

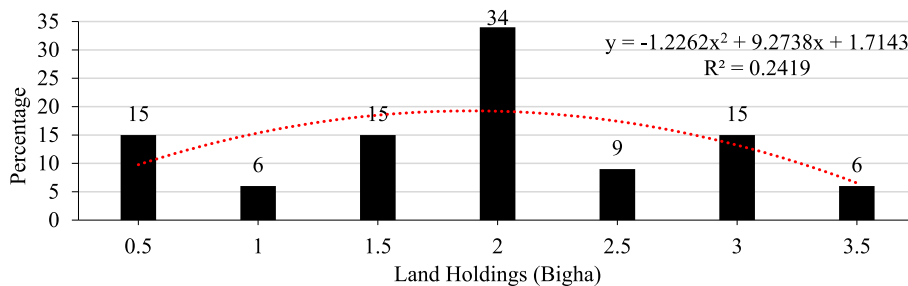


Fig. 15. Distribution of land holdings among cultivators.

Source: Primary survey conducted by authors in 2019 and prepared by authors in 2022.

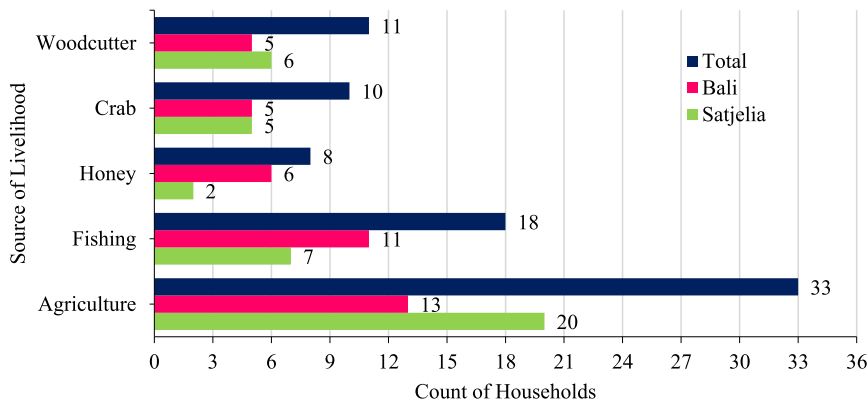


Fig. 16. Count of households associated with traditional livelihood in their lifetime.
 Source: Primary survey conducted by authos in 2019 and prepared by authors in 2022.

2015). Thousands of tourists across the world visit Sundarbans every year to experience its scenic beauty (Fig. 17). Tourism brings some scope of employment to indigenous people as there is a wide scarcity of employment opportunities, especially for the female in the region. Different aspects of the scenic beauty attract tourists to Sundarbans such as bird watching, dense mangrove vegetation, wildlife, particularly the royal Bengal tiger and village life (Table 4). Eco-tourism provides multiple opportunities for work to the local people (Das & Bandyopadhyay, 2013). During the tourist season, these people get additional and alternative opportunities to earn their livelihood. The residents of Sundarbans treat the river as their protector and preserver of life (Kumar et al., 2020). Women are mostly jobless because there is no work for them except engaging in cultural activities. The surge in tourism has provided tribal women, at least some jobs with an opportunity to earn their livelihood on the islands. They entertain tourists with folk songs and dance (Fig. 18). Performing folk song and dance is neither adequate nor glamorous to earn sufficient income. It was observed during the survey that there was mass exodus of people from forest area wherein women were highly affected throughout the years. Although, job card of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) was available, but women were not allowed get the job. Adivasis were completely deprived of all the government schemes, benefits and supports due to loopholes in the system. Some of them are getting the benefit of direct cash transfer and for that they pay a certain portion of their income either panchayats or local leaders. They get their stipend, which is only 1/10th of the money credited to their accounts.

4.4. Mangroves protection

Sundarbans has been named after large mangrove trees name *Sundari*. The aquatic web hosts a wide diversity of uniquely adapted life from the bottom to the top of the food chain. Mangroves acts as a shock absorber as it protects coast against violent winds and fierce waves. Sundarbans delta has the largest remaining area of mangroves in the world (Giri et al., 2014). It functions as a protective barrier for its inhabitants from storms, cyclones, intrusion and sea water seepage. Mangroves always helped to reduce the intensity of cyclones hitting the coastal infrastructures in the area (Iftekhar & Islam, 2004a, 2004b). It has complex roots that trap and bind together the soil and resist any kind of erosion. It is asserted as one of the Earth's greatest wildernesses, giant and living wall of defence that cradle the entire civilisation beyond it. Recovering land and developing climate resilient coastlines are the main challenges (Mukherjee et al., 2013). In the vulnerable part of the world, these extraordinary forested areas are one of the vital protections against nature's extreme events. The most recent cyclone, Amphan, has ravaged the mangrove forest of

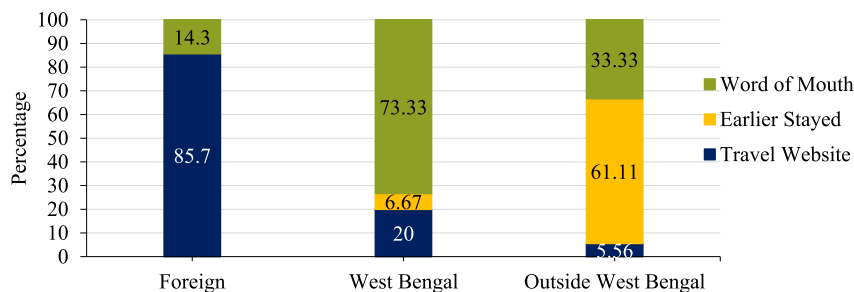


Fig. 17. Tourist visit pattern, knowledge about accommodation.
 Source: Primary survey conducted by authos in 2019.

Table 4
Tourists attraction in Sundarbans.

Prime factors for visit	Foreigners	West Bengal	Outside West Bengal
Bird watching	Red	Green	Blue
Mangroves	Blue	Blue	Red
Enjoy remote place	Blue	Red	Blue
Wildlife	Green	Blue	Red
Royal Bengal Tiger	Green	Red	Blue
Village culture	Green	Green	Green
Boat ride	Green	Blue	Red

Note: Red-most preferred; blue-moderately preferred and green-least preferred.

Source: Primary survey conducted by authors in 2019.

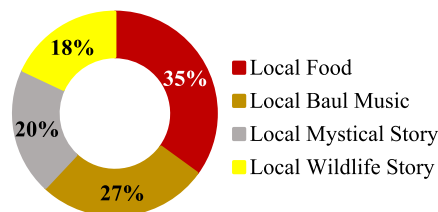


Fig. 18. Satisfaction in terms of indigenous culture.
Source: Primary survey conducted by authors in 2019.

Sundarbans and destroyed several thousand kilometres of forest and wrecked several local villages (Mukhopadhyay, 2011). It is an awful reminder of why we must stand together to safeguard the fragile mangroves which safeguard our coasts.

If this vast stretch of mangroves doesn't exist, then cyclones would reach Kolkata and ruin it. This protective citadel can't be taken for granted. More than half of the mangroves covers in Sundarbans were lost in the past 200 years (Saha, 2017). These mangroves were cleared for human settlements and agricultural activities due to population pressure. Leaving deforested areas exposed to the vicious consequences of nature would lead to the emergence of another threat. The sea level is rising faster than ever before due to the global warming and rising water carries more salinity. It is essential to maintain the delicate balance of saltwater and freshwater for the health of Sundarbans. Mangrove's species which can't bear extreme saline water and eventually perish in time to come. Mangrove's health is degrading which definitely affect its resilient and recovery potential against climate change consequences. The intensity and frequency of extreme weather events will increase in the future (Das Gupta & Shaw, 2015). Hence, it is very important to conserve the mangroves at any cost. Otherwise, it will ruin the last resort of tigers and lead to its extinction, cause millions of its residents to go homeless and leave Kolkata defenceless. Not all is lost yet, only if we together rigorously protect and take a stand to preserve the mangroves.

4.5. Fishing

Fishing is one of the vital professions in Sundarbans and fisherman traditionally catches fish (Mukherjee et al., 2013). They practice fishing differently in October than the rest months of the year (Mahmood et al., 2021). They don't catch fish from the river directly during October, but they setup their nets strategically. Afterwards, fishermen enter inside the delta with their

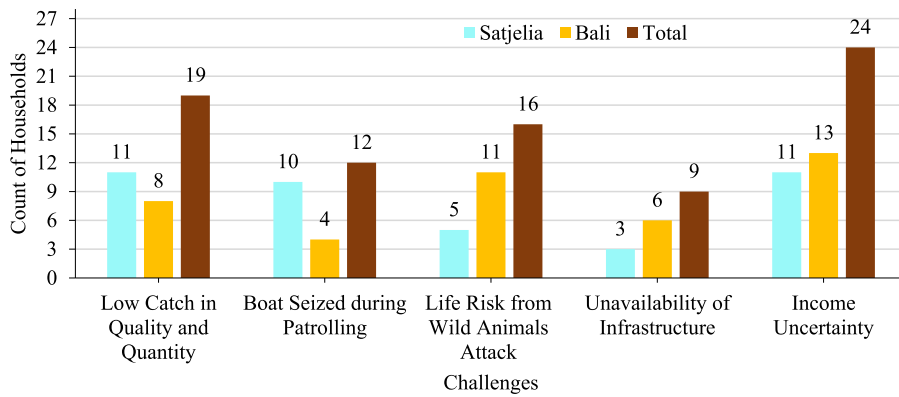


Fig. 19. Challenges in fish and crab collection.

Source: Primary survey conducted by authos in 2019 and prepared by authors in 2022.

food, water, other essential particulars and stay there for 8 to 10 days (Fig. 19). First, they select their fishing area, then construct a temporary base camp for their dwelling, locally renowned as Tong (Singh et al., 2010). The base camp is mainly made up of bamboo and thatch, which takes around 2 to 3 days to prepare it. After the camp preparation, they tie their fishing net with bamboo in a tricky manner. Fisherman folk stays awake, get down from the camp or tong and stand up in their boat from where the end portion of the net starts. They pass their time through cooking and gossiping after setting up their nets and fishing trap. After a few days, they pick up their nets and catch fish. They throw caught fish at the underneath of boat where fishes are alive as it contains little amount of water. Alive fish is needed to get a sufficient market price. After the fish catch, some of them set off to the fish buyer who is locally called *Paiker*. The rest of them are busy in preparing fish for breakfast to the rest of members in the fishing group or family. They not only catch fish to sell but also for their consumption as it fulfils their body essential nutritional requirements.

5. Suggestions and recommendations

The idea of conservation, sustainability and their yield in the preservation of traditional forests are an integral part of natural ecosystem. The set of laws to govern the forest resources should be drafted in a manner that follows bottom-up approach instead of top-down approach. Locals must be trained through capacity building programs to boost eco-friendly tourism activities in Sundarbans. Government officials at the top of the policy-maker should keep local's grievances in their mind, whenever they are framing any policy for them like construction of safe passage in wildlife dominated areas to avoid wildlife-human conflict. The foundation of forest laws in Sundarbans states that multiple natural resources are found in abundance and these resources should be utilized sustainably. Those who are not abiding forest laws shouldn't be allowed in any case into the forest premises. Only local dwellers should be permitted to cut down the needed trees because these are their vital source of livelihood since the ages. Any developmental plan should be participatory in nature from all walks of lives including roof builders, harvesters and Nypa palm collectors, honey collectors, lime makers, snail gatherers and many others. The wisdom and traditional knowledge of indigenous people and local community should be respected, promoted, and responsibly disseminated as these are playing crucial role in promoting tourism in Sundarbans. If the Government cares to stop dacoity and corruption should follow the aforesaid suggestions and recommendations.

6. Conclusion

Sundarbans is blessed with limitless potential, besides abode of several species of amphibians, reptiles, mammals, vegetation and trees. The Royal Bengal tigers renowned as swamp tigers are found in no other mangrove forest on the earth except Sundarbans. The region is under pressure and facing a lot of extreme weather events with increased intensity over the last few years. The protection of these wild animals lies in the hands of the present generation so that the entire world can acknowledge the beauty of such rare species of wild flora and fauna. However, mismanagement, over-exploitation and corruption have threatened the forest and the communities dwelling there. Killing and exploitation of any of the species are wrong and illegal whether it may be for the cure of any kind of a deadly disease or any other purpose. Human being tends to provoke everything and their consequences will be faced by the entire community. The development work in the region must ensure equity, feasibility, accessibility, accountability and affordability for people from all walks of life. The management of Sundarbans resources to be sustainable to support livelihood that includes means of living and making them resilient to any natural hazards. There is need for more secure ecosystem to preserve and protect all the stakeholder residing in the region. We should do our work keeping in mind resilient, synergy and sustainability of the nature and they will do their own work.

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Declaration of Competing Interest

There is no potential conflict of interest in the research paper.

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