

ANALYSIS OF TRADITIONAL FISHING IN THE BHITARKANIKA

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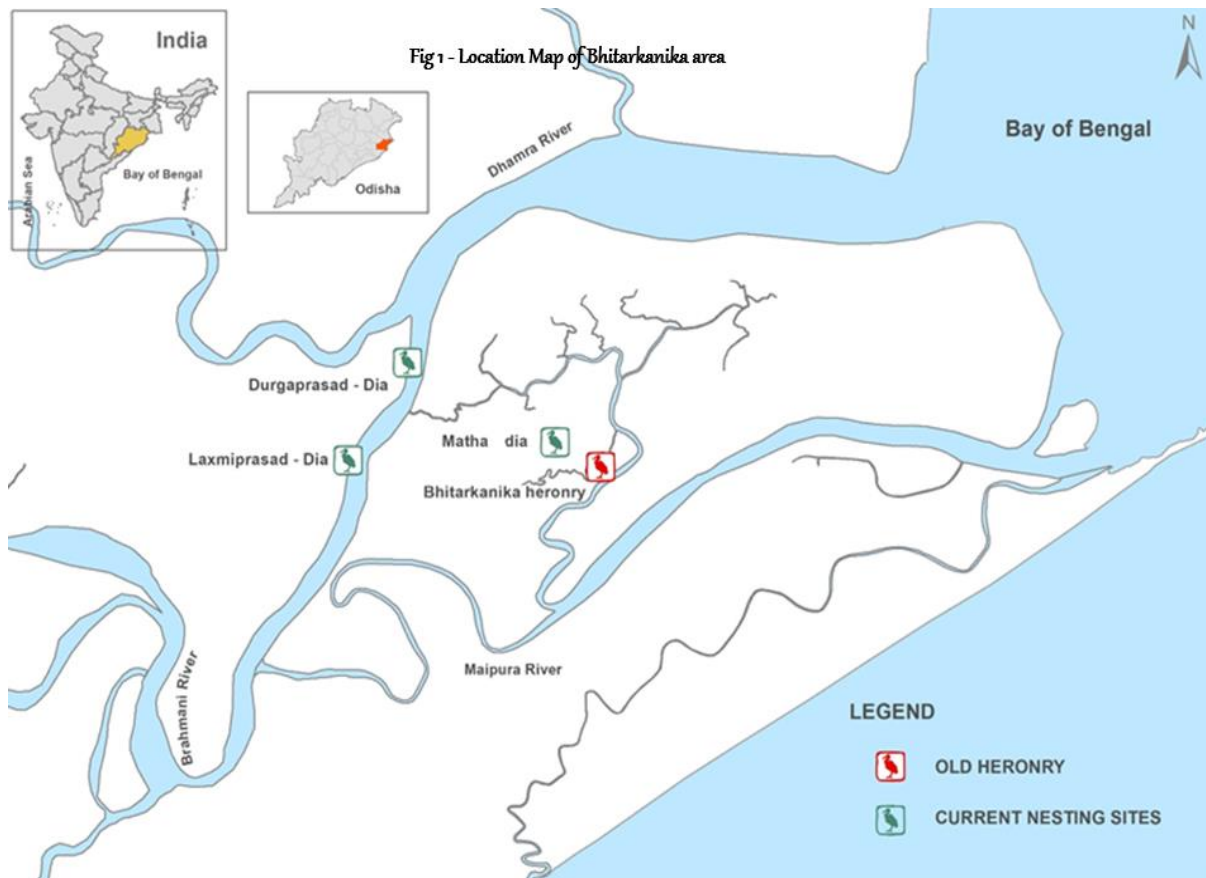
ABSTRACT

Traditional fishing communities' livelihoods solely depend on the freshwater, estuary, brackish water, creeks and coastal areas abutting the Bhitarkanika National Park, Orissa India. Bhitarkanika Mangrove ecosystems serve as vital nursery grounds for the economically important nearshore fish and shellfish species. The freshwater rivers, channels, creeks, salt marsh wetlands, and associated coastal waters are highly productive. The fishing community have been pressurised by the forest department to implement restrictions in the National Park Area to protect the sea turtles, crocodiles and other endangered wild animals. In addition to the restrictions of the Forest Department, immigrated fishermen who are using advanced instruments, crafts and gears in capture fisheries reduce the fish stock distribution and diversity. The climate change impacts also influence the fish stock population, distribution, diversity and recruitment reducing the catch per effort of the traditional fishermen. In this research paper, traditional fishermen of the Bhitarkanika National Park Area fishing population, fishery, fishing culture, livelihoods, various issues, and recommendations to find alternative employment opportunities to reduce fishing pressure in the Bhitarkanika National Park have been discussed.

Keywords: Bhitarkanika, Fishery, Livelihoods, Climate Change

1.0 INTRODUCTION

Traditional fishing communities' livelihoods solely depend on the freshwater, estuary, brackish water, creeks and coastal areas abutting the Bhitarkanika National Park, Orissa India (Fig-1). A traditional Fishing Community is a defined group of people who share identity and attachment toward one another and interact on an ongoing basis to perform activities along the fisheries value chain based on experiential knowledge accumulated over time and passed along generations (Berkes., 2001). 'Traditional' in Indian law refers to those 'who have been living in these areas for at least 2–3 generations, or 25 years', based on the Forest Rights Act 2006 to identify indigenous forest dwellers. Traditional fishing is any kind of small-scale, commercial, or subsistence fishing practice using traditional techniques such as rod and tackle, arrows, harpoons, handpicking, throw nets drag nets, etc. Traditional fishermen typically rely on small boats and hand-held nets, lines, or traps to catch fish. These methods are less damaging to the marine environment and can help preserve fish stocks for future generations. In general, fishing activities may affect water bird distribution, abundance, and diversity, however, traditional fishing supports nature conservation, local social maintenance, human relationship enhancement, and local landscape formation which have been enhancing ecosystem health and management (Aarif et al., 2017).



The Bhitarkanika National Park, in the Kendrapara district of Odisha is the second largest mangrove forest, after the Sundarbans, covering 672 km² and is well-known for its biodiversity richness and fish breeding habitats. Bhitarkanika Mangrove ecosystems serve as vital nursery grounds for the economically important nearshore fish and shellfish species. The Freshwater rivers, channels, creeks, salt marsh wetlands, and associated coastal waters are highly productive. Traditionally, the local community has enjoyed a close relationship with the mangroves and has been dependent on its resources for various personal needs. The freshwater rivers, channels, creeks, salt marsh wetlands, and associated coastal waters are highly productive. They provide a wide range of valuable ecosystem services including fisheries. Traditional fishermen of the Bhitarkanika area depend on freshwater, brackish water marine fishing, and prawn aquaculture for their livelihoods. The rich biodiversity and ecology have been saved by traditional fishing methods. In this paper, traditional fishing practices, issues, and management options in Bhitarkanika National Park area have been discussed in this chapter.

2.0 DEMOGRAPHY AND INFRASTRUCTURE FACILITIES FOR TRADITIONAL FISHING

According to the 2011 census, there were 310 villages with 145,301 people living inside the park out of which 123 villages are fishing villages. The population density in the district is 216 persons per km². The literacy rate of the district is 85.15% including 91.45% males and 78.96% females. The total fisherfolk population in the villages is 72,478 which is 14% of the

total fisherfolk population of Odisha State. Active fishermen in the Kendrapara fishing villages are 19,632. The average family size is 5 in the fishing villages. Among the six coastal districts, the largest proportion of fishermen families below the poverty line (52.6%) is found in Kendrapara where the Bhitarkanika mangroves have been distributed. Among the fisherfolk, 2,791 persons have been engaged in the marketing of fish. About 805 fishermen families have been engaged in aquaculture activities. Out of the total families, 15,693 are following Hinduism, and 478 are following Islam. About 12,622 families have mobile phone connections. In total 1027 inboard motorized and 90 non-motorized fishing crafts have been used for fishing in the fishing villages. Four boat jetties, 30 boat yards, 31 cyclone shelters, 14 post offices, 3 hospitals and 16 bus stops are present in the fishing villages (CMFRI Census., 2016).

3.0 COMMON FISHES AND TRADITIONAL FISHERY

The fishermen community can broadly be classified into three groups traditional fishermen, mechanized gill-netters, and mechanised trawlers. Traditional country fishermen have been fishing for centuries along the Orissa coast with the help of rowing and sailing boats and do not pose much danger to turtles. Traditionally, the fishery benefit has been received by the HHs living in the proximity of the resource of Bhitarkanika mangroves. Fishing is practised by 11% of the HHs as a primary occupation and by 20% as a secondary occupation, with 41% of the people working on trawlers as wage labourers (Taru Leading Edge., 2023).

Traditional fishermen's catches have been marketed to a maintain flow of cash and also for personal consumption. Mostly, groups of two or three people go fishing on country boats. The fish catch is sold to middlemen regularly, and there is an average earning of Rs. 800-900 per week. The people who go fishing in trawler boats usually earn Rs. 10,000-12,000 in 26 days, i.e., almost a month. Fishing is carried on using traditional means as well as using trawlers in the deep sea.

Sixty-three species have been identified in the freshwater and brackish water area of Kendrapara district. Out of the 63 species, some species namely *Cirrhinus reba*, *P. sarana*, *Tor tor*, *Notopterus notopterus*, *Catla catla*, *Cirrhinus mrigala* *Chitala chitala*, *Cirrhinus reba*, *Labeo bata*, *Labeo calbasu*, *Labeo dero*, *Labeo rohita*, *Sperata aor*, *Sperata seenghala*, *Wallago attu*, *Clarias batrachus*, *Heteropneustes fossilis*, *Anabas testudineus*, *Channa striata*, and *Liza tade*, are identified as commercially important food fishes in the river. The following species such as *Apolocheilus panchax*, *Danio rerio*, *p. ticto*, *p. sophore*, *Acanthocobitis botia*, *Lepidosephalus guntia*, *R. daniconius*, *Chaca chaca*, *Terapon jarbua*, *Badis badis*, *Scatophagus argus*, *Chanda nama*, *Nandus nandus*, are *Trichogaster fasciata* are identified as export value as ornamental fishes. The fish fauna includes 49 least concern, 7 not assessed, 5 near threatened, and 2 data deficient (IUCN, 2018; Baliarsingh et al., 2020). In the coastal areas, the following fish species have been commonly captured; *Hilsa*, *Lotia*, *Pomfret*, *Borei Kantia*, *Maala*, *Koni Pateli*, *Manohari*, *Bhuasa Prawn Khasuli*, *Tuali*, *Kantia*, *Vekti*, *Khanga Khasuli*, *Vatei*, *Tiger Prawn*, *Bhodei Prawn*, *Patpatia*, *Cheruan* and *Chitua Crab* (Taru leading Edge, Pvt. Ltd., 2023).

The annual marine fish catch has increased by 96%, from 4797.64 MT in 2009 – 2010 to 9399.38 MT in 2019 – 2020, in eight fish landing centres all around the sanctuary (Barunei,

Gopalpur, Talachua, Tantiapal, Kandarapatia, Jamboo, Kharanashi and Kajalapatia). It has been reported that the average fish landing in the Kansabansa Jetty is 356MT, Kajalapatia 857MT, Kharanasi 2214MT, Jamboo 1838MT, Kendrapatia 732MT, Tantiapal 797MT, Talachua 1803MT, Gopalpur 1662MT, Barunei meagre quantity of fish landed (Directorate of Fisheries., 2021).

The Brahmani and Baitarani are the two main rivers flowing into the Bhitarkanika Mangroves National Park. As these rivers flow through the National Park, only regulated fishing has been permitted in the area. The forest department closely monitors the fishing. The Government of Odisha has imposed an annual ban on fishing in the region between November and May. The fishing ban ceased fishing in a 20 km radius from the coast for a period of seven months (November 1–May 31) coinciding with the breeding period of the Olive Ridley turtles, which the forest department enforces to protect these endangered turtles, under the Orissa Marine Fishing Regulation Act, 1982 and Orissa Marine Fishing Rules, 1983 (Banerjee 2017). To compensate for the loss of their income, the state government has decided to extend one-time livelihood assistance of Rs 15,500 to each of the affected fishermen's families, under the Livelihood Support to Marine Fishermen scheme. In addition, the Department of Fisheries provides support to farmers to dig ponds to culture suitable species.

The Government of Odisha introduced the Odisha Fisheries Policy, 2015 (vide Gazette notification No. 1282, Dt. 2nd September 2015). The policy was intended to be a pioneer in aquaculture development and fisheries extension for ensuring food security, livelihoods, the welfare of fishers, and employment generation which support the traditional fishing community of Bhitarkanika. The policy aims to address sustainable utilisation, protection/promotion of nutritional security, livelihood security of the fishing community, gaps in the legal and regulatory framework and their enforcement, gaps in the administrative structure and processes, financing mechanisms including subsidies, technology, and extension support as well as social and environmental implications will support sustainable livelihoods of the fishing community.

The Department of Fisheries, Government of Odisha, highlights the following objectives, among others: generating employment and higher income in the fisheries sector, improving the socio-economic conditions of traditional fisher folk and fish farmers, doubling the income of fishers, acquiring self-sufficiency in the inland sector and conserving aquatic resources and generic diversity. This will increase the life and livelihoods of traditional fishing communities.

4.0 ALTERNATIVE LIVELIHOODS OF TRADITIONAL FISHING COMMUNITY

Traditional fishermen's livelihoods are complex, dynamic, and adaptive in the Bhitarkanika area, unlike the fishermen in other parts who engage in fishing full-time and all year round the fishermen in Bhitarkanika are fishing only for five months. For their livelihood, they engaged in other activities to earn income. The other livelihood activities include agriculture, betel leaf farming, aquaculture, cattle farming, wage laborers, handicraft making, shop keeping, apiculture, employment in Government Schemes and NGOs, migrating to other cities, States, and countries for earning, etc.

Paddy is the prime production and consumable of the area and is considered an indicator of the regional economy. The rice produced in the area is sold in the local market. A decade back,

green gram was cultivated after the paddy harvest. However, salinity ingress reduced the farming areas of the traditional fishing community. Dependency of 92.78% of the population on agriculture either solely or in combination with marine or estuarine capture fisheries. Since the area under the coastal zone agricultural land has transformed to aquaculture the livelihood is in danger (Rajarshi Mitra and Sugata Hazra., 2005).

Shrimp farming is a very profitable business compared to agriculture and animal husbandry (Kumar, 1997). The mangrove ecosystem is suitable for brackish water shrimp culture a large number of aquaculture ponds have been developed in the Bhitarkanika area (Thatoi and Rath, 2006). Out of the total area of Bhitarkanika 0.4% (0.2 Km²) in 1990 has increased to 2.9% in 2020 (19 km²), which increases the livelihoods of the local fishermen as owners or employed for wages in aquaculture (Behera et al., 2021). Regarding unscrupulous, non-regulated shrimp farming, the Supreme Court constituted the Coastal Aquaculture Authority (CAA) in 2005. It mandated the Aquaculture Authority to provide directives for shrimp aquaculture in the coastal zone. Aquaculture farms were to obtain licenses. No permission was granted for aquaculture farming proposed within 200 m of the high tide line or the CRZ (about creeks, rivers, and backwaters). MoEF&CC has declared 192 villages around Bhitarkanika National Park as Eco-sensitive Zones (ESZs). The ESZ guidelines prohibit any shrimp farming. District Administration and Forest Department have demolished large tracts of illegal prawn farms in villages near Bhitarkanika during the past 10 years. However, the prawn mafia repaired and were back in business within two months of the demolition drive. Continuous monitoring and regular patrolling in the Bhitarkanika area and the surrounding area to stop unapproved shrimp farms and reduce the saltwater intrusion of the fishing villages.

Cattle have been reared in the households of Bhitarkanika for milk, and agriculture support. In addition, piggery is also supporting the livelihood of the fishing community.

Migration to other states for work has acquired serious proportions in the Kendrapara district due to extreme climatic conditions hampering agriculture and a lack of livelihood opportunities. Moreover, with income from agriculture dipping due to climate change, and lack of irrigation facilities, people are increasingly resorting to migration to earn a livelihood. Over 57,000 graduates and technically qualified youths have registered their names in the district employment office and waiting to get any jobs (<https://www.orissapost.com/poor-livelihood-scope-spurs-migration-in-kendrapara/>). Since the area is industry-free, without any mines or industries to support the livelihoods of the coastal communities including the fishers industry sector could not provide alternative employment to the traditional fishing community.

The rise in the price of paan has brought hopes of good returns for betel vine farmers of the coastal district of Kendrapara. Around 5000 seaside villages of Kedrapara are involved in betel leave farming (<https://www.newindianexpress.com/states/odisha/2017/Jan/02/betel-leaf-growers-in-the-red-1555254.html>) is a livelihood opportunity of the traditional fishing community.

5.0 PROBLEMS FACED BY THE TRADITIONAL FISHING COMMUNITY

Only around 5 months a year are available for fishing because of the fishing ban imposed during the nesting of Olive Ridley sea turtles at Gahirmatha. The ban period is a concern for fisher folk. The fishing ban coincides with the breeding period of the Olive Ridley turtles, which the

forest department enforces to protect these endangered turtles, under the Orissa Marine Fishing Regulation Act, 1982, and Orissa Marine Fishing Rules, 1983 hence the traditional fishing community shall adopt suitable alternative livelihoods in the period. The government shall initiate new schemes to support income generation activities for alternative employment for traditional fishermen shall be very useful for income and reduce migration.

The Wildlife Protection Act, 1972 has been applied to protect the saltwater crocodile habitats. The inlets are the ideal habitat for saltwater crocodiles and other aquatic animals. Hence, any fishing activity in the habitation corridors of crocodiles is a punishable offence under the Wildlife Protection Act. The accused have been produced to court under different sections of the Wildlife Protection Act, 1972 whether traditional or mechanised fishermen. The Department of Forest has intensified its vigil on trespassing into prohibited territories to ensure the safety of the flora, fauna, and the fragile eco-system of Bhitarkanika. Given the above, the traditional fishing community living in the periphery of the park shall be sensitised and recommended to practice to limit the dependence on forest and adjacent water bodies. Traditional fishermen shall be supported with income-generation activities in other rural employment sectors of the district.

Traditional fishermen have the view that the fishing ban for 7 months is not necessary at Gahirmatha as the turtles nest between January and March, and there is no need to keep fishers out in November and December, which are the key months for Hilsa fishing. Over the years, species such as prawns, Khasuli, Manohari, Vatei, Kantia and Balia have become rare due to overfishing (Taru leading Edge, Pvt. Ltd., 2023).

The technological advancement over the years in the fishery sector promotes trawler-based fishing mechanisms. Although the people at the site are engaged in wage labour on trawlers, the vessels are owned by corporates. Deep-sea fishing by trawlers has an impact on the coastal fisheries and habitats. Overfishing and the use of finer nets by trawlers have resulted in reduced catch diversity. Juvenile fish are caught, which further reduces the yield. Chemicals released from agriculture, aquaculture and chemicals used to increase fish catch also have a detrimental effect on the water environment.

At present, a fisherman's card has been provided to 1500 fishermen by the Inland Fisheries Department in Rajnagar Block. Only holders of the cards are legally allowed to engage in fishing activities. The discussion with the stakeholders showed that there is technically no upper limit for issuing licenses, and the community is required to obtain annual approval for Rs. 150/-.

Often fishermen have been taken into custody by the Bhitarkanika National Park authorities in Odisha for illegal fishing activity in the core area of the Park, posing a danger to estuarine crocodiles and aquatic species. The Park authorities in Kendrapara district also seize crafts and gears to restrict the movements of fishing crafts. Occasionally, when a turtle gets caught in one of their nets, it can escape if the fisherman frees it. But the turtles only have a chance if the net is small in length (up to 100-200 meters) and not like the large mechanized gill-netters whose nets may stretch up to 2-3 km. In addition, the dominance of outside fishermen over the native fishermen in Bhitarkanika area creates distress. Traditional fishermen apprise that all the fisheries violations have been accomplished by the outside fishermen of Orissa. The

interests of these traditional fishermen very often clash with the powerful people who operate mechanised trawlers and gill-netters also creating conflicts among the fishing and local communities.

Increasing salinity of the tidal river during summers, among other factors, has led to a decline in the production and increase of fallow lands of rice fields of the fishing villagers of Bhitarkanika. Overall, the livelihood dependency on agriculture has reduced due to the soil salinity increase, salt-water ingress, increased exposure to floods and cyclones, and changes in rainfall patterns in the fishing villages. Further, the conversion of agricultural land to shrimp farms has also contributed to the deterioration of the health of the soil of fields close to the creeks and tidal channels.

The area under shrimp aquaculture has increased six-fold in recent decades. The high-risk, high-return shrimp cultivation is supported by a strong input supply chain, credit, and buy-back of the produce by seafood export firms, which has led to the conversion of cultivable land to shrimp ponds. The rapid development of the shrimp industry has resulted in the conversion of flat coastal lands to shrimp ponds. Farmers blame the mushrooming of illegal shrimp farms and their effluent for destroying their fertile agricultural lands. The villagers protested for the construction of a river embankment that would prevent the salt water from the creeks to agriculture fields. The Forest Department was not in favour of the embankment since the flow of water would be disturbed. Most of them have grievances against the government for not granting them their rights and providing better amenities (Subhashree Banerjee 2017).

Frequent cyclones and floods in the Bhitarkanika area are ravaging trees, mostly casuarina, palm, coconut, and other trees of the households. The traditional fishermen believed that the inhabitants were knowledgeable about the forest resources and their uses but that due to a decline in continued resource access and utilization, there has been a decline in knowledge transfer to the next generation. Gradual changes due to social and economic development have forced forest-dependent households to search for alternative options (Taru leading Edge, Pvt. Ltd., 2023).

6.0 IMPACT OF CLIMATE CHANGE ON FISHERIES

Fisheries are affected by climate change in many ways: marine aquatic ecosystems are being affected by rising ocean temperatures, ocean acidification, and ocean deoxygenation, while changes in water temperature, water flow, and fish habitat loss are impacting freshwater ecosystems. The annual marine fish catch has increased by 96%, from 4797.64 MT in 2009 – 2010 to 9399.38 MT in 2019 – 2020, in eight fish landing centres all around the sanctuary (Barunei, Gopalpur, Talachua, Tantiapal, Kandarapatia, Jamboo, Kharanashi and Kajalapatia). A decade ago, fishermen used to catch fish within 5 km of the Brahmani and Baitarani estuaries, but now they have to travel 50 to 150 km to have a good catch. The increase in salinity, pollution, and overfishing, have reduced catches (Telia and Chandi) and some species have locally extinct. Fishermen used to catch Hilsa with an average weight of 2 – 3 kg. During the past decade, the size of Hilsa has reduced to 250 – 500 g. Telia of weighing 20 kg were available during winters earlier. Now due to the reduced duration of the season, these fish are less available. 15 years ago, fishermen used to catch white Chandi fish in tons, but now in one catch, they are netting about 10 – 20 kg. Earlier the size of Chandi fish was 1000 – 1200 g,

which was fetching Rs. 4000 per kg. Now the size of the fish has been reduced to 500 – 700 g, which is selling for Rs.1200 per kg. Fish species such as Hunda, Kantia, Adikantia, Telia, Tudi, Dhuma, Hilsa and Sankucha have almost vanished from the catches. The species mix and size of fish populations in the Ramsar site are likely affected most by the availability of freshwater from catchment run-off and rainfall, the overall salinity in the creeks and mudflats, and the increased temperature (ICEM., 2023). Important climate change impacts on fisheries are given below;

1. Changes to the mangrove ecosystem and its productivity: Climate change and sea-level rise result in serious negative impacts on the mangrove ecosystems, with loss and degradation of mangrove cover and density. The critical role of the Ramsar site as a nursery ground for fish and shellfish will be reduced, resulting in decreased productivity of the mangrove ecosystems with falling fish catches. Climate change will tend to compound the effects of illegal and overfishing within the Ramsar site.
2. Changes to fish populations and species diversity: The species mix and size of fish populations in the Ramsar site are likely to be affected most by the availability of freshwater from catchment run-off and rainfall, the overall salinity in the creeks and mudflats, and the increased temperature. The projected increase in salinity will favour more marine species, with the fresh- and brackish water species tending to be displaced. The increased water temperatures in creeks and estuarine areas will tend to favour those fish species that are less sensitive to higher temperatures and lower dissolved oxygen levels.
3. Water quality changes: The likely increasing salinity and temperature of the waters will further decrease the water quality and aggravate existing stresses on fish caused by water pollution caused by sources in the catchment. Water quality stresses may lead to lower juvenile fish survival, lower fishery productivity, and in extreme cases to adult fish kills.
4. Damage and loss of fishing opportunities: In addition to the lowered fish productivity and fish catches resulting from climate change, the impacts of cyclones and storm surges on fishing livelihoods will be expressed through loss of fishing days and damage to boats and fishing gear.

7.0 ANALYSIS AND RECOMMENDATION

SWOT analysis of traditional fishing of Bhitarkanika National Park has been used to assess internal and external factors, as well as current and future potential, strengths and weaknesses of traditional fishing.

Fig. – 2 SWOT analysis

S STRENGTHS		W WEAKNESSES	
1	Fisheries is the second predominant livelihood	1	Increased exposure to floods and cyclones
2	Regulated fishing closely monitored by the forest department	2	Soil salinity rise and salt-water ingression
3	Non-fishing communities access and use beach in multiple ways for leisure, salt farming, agriculture, cattle grazing or undertaking commercial activities	3	Drop in agricultural production and fallowing of rice fields
4	Increase in annual marine fish catch	4	Water quality changes
5	Presence of valuable ecosystems like mangroves, salt marshes and wetlands	5	Increased stress on fishes, lowering fish production
6	Odisha Fisheries Policy, 2015	6	Changes in rainfall patterns
O OPPORTUNITIES		T THREATS	
1	Regulation of shrimp culture	1	Overfishing and the use of finer nets by trawlers
2	Negotiating additional releases of water from upstream reservoirs	2	Chemicals released from agricultural and shrimp-farming fields
3	Collaborating with the Odisha State Pollution Control Board	3	Unregulated conversion of agricultural lands for shrimp farming
4	Create awareness to avoid encroachments	4	Climate change and sea-level rise resulting in loss and degradation of mangrove cover and density
5	Encouraging freshwater aquaculture and fish farming	5	Changes in fish populations and species diversity
6	Regenerate the mangrove habitat	6	Impacts of cyclones and storm surge on fishing livelihoods

Based on the SWOT analysis, the importance of alternative livelihoods of the traditional fishing community to reduce the fishing pressure is significantly important in the present situation. Hence, the coastal community of Bhitarkanika shall enhance agriculture activity to increase productivity by planned irrigation, controlling surplus water, improving drainage, crop selection based on salt tolerance, and leaching to manage soil salinity. Bhitarkanika farmers can plant more densely in the agriculture farms to increase productivity. Interplant (growing different crops) in the farm area at the same time also increases the income. Rice can be grown under these adverse conditions of unstable water levels and highly saline locations. There is a great scope of crop diversification of mono-crop rice, based on soil salinity and water availability. Selection of saline-tolerant seeds for the Bhitarkanika soil which often faces seawater intrusion, flood and cyclones. Integrated farming systems combining crop production with sericulture, apiculture, dairy, poultry, duckery, aquaculture, agroforestry, etc have a scope to increase the income of the Bhitarkanika coastal community. Among the above income generation activities rice-fish culture has given very good income to the coastal communities.

The Odisha livestock policy (Government of Orissa 2002) identified livestock as a poverty reduction instrument – more than 80% of rural households own livestock, and this generates up to 30% of their income. Although crop production is the principal activity, livestock is an important source of secondary income for many small-scale and marginal farmers in Odisha who may own only a few animals. Livestock products such as milk, meat and eggs also provide important macronutrients (proteins and fats) and micronutrients (vitamins and minerals) to farm households (Bahta et al., 2022). Cattle and buffalo density is highest in the coastal plain zone – more than double the density of hill areas and inland plain areas (Bahta et al., 2022). Bhitarkanika coastal community shall increase the cattle population density for food requirements like milk and another for labour purposes like ploughing, irrigation, manure etc. An increase of livestock density in the home backyards such as goats, buffalo, cows, etc., will provide additional income to the coastal communities of Bhitarkanika. The main approaches to further developing the livestock sector include facilitating greater private sector involvement in rural areas. Agencies involved in the marketing of livestock inputs and products (including integrators) could be encouraged to invest in the animal healthcare sector (Bahta et al., 2022). Modern practices in cattle rearing with the support of the veterinary department of the areas shall increase the income and healthy and sustainable management of livestock.

Frequent droughts, floods and water shortages often prevent the cultivation of more than one crop per year, driving farmers and landless labourers to migrate to neighbouring states for work. The rising inequality across regions gave rise to new migration corridors and “the human flow became a flood” (Amrita Sharma et al., 2014). Data also reveals that remittances received by migrant households are low, with total household incomes lower than non-migrant households. Most of them face a debt burden and have no savings. Even though women in these households spend most of their time on agriculture, most consider it their secondary activity. NSS data shows that the dependence on domestic remittances has risen most strikingly in Odisha since the 1990s (Amrita Sharma., 2014). Small land holdings make agriculture a subsistence enterprise just enough to feed the household. Women-headed households have the lowest incomes and low productivity because of a lack of knowledge and skills for farm management, limited access to technologies and training opportunities, lack of access to ‘women-friendly’ machinery and equipment and access to institutional credit, and lack of information to make production and marketing decisions. A comprehensive policy and programmes focused on women in migrant farming households would be very helpful in providing a level playing field for these women and increasing their incomes and empowerment (Ranjitha Puskur., 2024).

Temperature affects fish distribution and migration; the combined effects of changes in distribution, abundance and physiology may reduce the body size of marine fishes, particularly in the tropics and intermediate latitudes (Cheung et al., 2013). Coastal systems are susceptible to three key drivers related to climate change: sea level, ocean temperature and ocean acidity. While the impacts of sea level changes can be revealed only through long-term data analysis and modelling, short-term changes in the distribution and abundance of species in the coastal water can be easily quantified by precise scientific investigations. The major adaptive strategies evolved around providing awareness to the coastal population, and training on alternate livelihoods to negate the risks and ill effects of climate change (Biju Kumar., 2017).

Reducing illegal fishing in the park area requires the implementation of the new Control and Surveillance Center (CCV), equipped with advanced satellite platforms and a state-of-the-art radar system. Reduction in illegal fishing will be achieved by the participation of fishermen in rules regulations and monitoring programmes. In addition to the participation of the fishermen population, collaboration among the NGOs especially conservation organisations to demonstrate the importance of protected areas and research and monitoring shall reduce the illegal fishing in the protected areas.

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