ECOSYSTEM SERVICES-LIVELIHOOD LINKAGES OF BHITARKANIKA MANGROVES, ODISHA

AN ASSESSMENT FOR INTEGRATED MANAGEMENT

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IKI INTERNATIONAL CLIMATE INITIATIVE

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of:

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

the Federal Republic of Germany

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn

Address
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Indo-German Biodiversity Programme (IGBP),
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Programme/project description
Wetlands Management for Biodiversity and Climate Protection
Indo-German Biodiversity Programme

Implementing Partners
Ministry of Environment, Forest and Climate Change
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Wetlands International South Asia, New Delhi

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Prepared by
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Suggested Citation
Taru leading Edge, Pvt. Ltd. (2023). Ecosystem Services-Livelihood Linkages of Bhitarkanika Mangroves, Odisha - An Assessment for Integrated Management. Prepared for GIZ.

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Photo credits/sources
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This project is part of the International Climate Initiative (IKI).

On behalf of
German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV).

New Delhi, 2023

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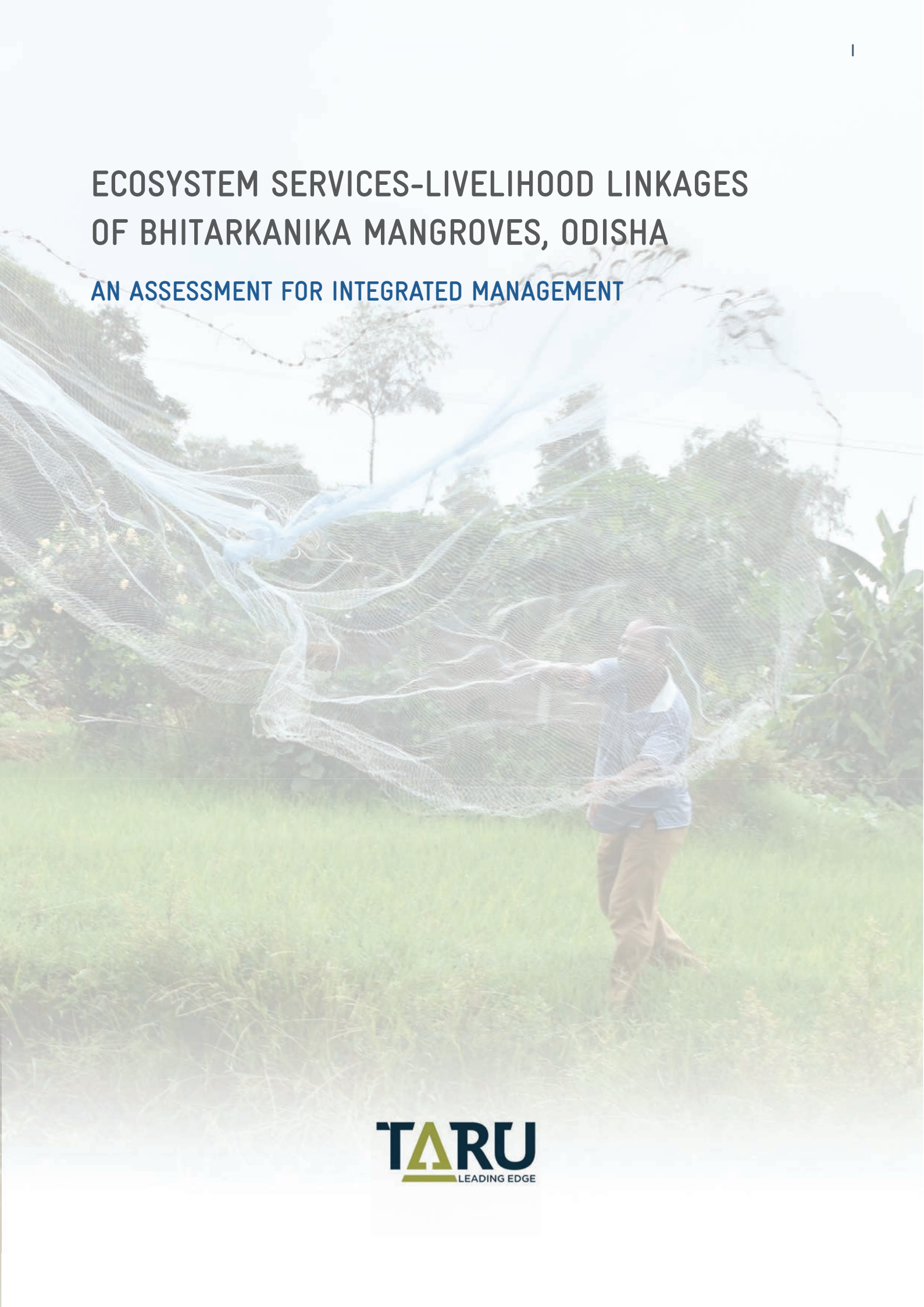

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Abbreviations

BMU	GERMAN FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY
BPL	BELOW POVERTY LINE
CAA	COASTAL AQUATIC AUTHORITY
CCA	COMMUNITY CONSERVED AREA
CRZ	COASTAL REGULATORY ZONE
CSOs	CIVIL SOCIETY ORGANIZATIONS
DAP	DIAMMONIUM PHOSPHATE
DFO	DISTRICT FOREST OFFICER
DWC	DISTRICT WETLAND COMMITTEE
EbA	ECOSYSTEM-BASED ADAPTATION
EDC	ECODEVELOPMENT COMMITTEE
ESZ	ECOSENSITIVE ZONE
FGD	FOCUS GROUP DISCUSSION
GAP	GOOD AGRICULTURAL PRACTICES
GIS	GEOGRAPHIC INFORMATION SYSTEM
GoO	GOVERNMENT OF ODISHA
GP	GRAM PANCHAYAT
HH	HOUSEHOLDS
ICZMP	INTEGRATED COASTAL ZONE MANAGEMENT PROJECT
IKI	INTERNATIONAL CLIMATE INITIATIVE
KIIS	KEY INFORMANT INTERVIEWS
LAMPS	LOCAL AREA MULTI-PURPOSE COOPERATIVE SOCIETIES
LPG	LIQUEFIED PETROLEUM GAS
MGNREGA	MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE ACT
MoEF&CC	MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
MPY	MATSHYA POKHARI YOJANA
NbS	NATURE-BASED SOLUTIONS
NDVI	NORMALISED DIFFERENCE VEGETATION INDEX
NGOs	NON-GOVERNMENTAL ORGANIZATIONS
NPCA	NATIONAL PLAN FOR CONSERVATION OF AQUATIC ECOSYSTEMS
OLM	ODISHA LIVELIHOOD MISSION
PDS	PUBLIC DISTRIBUTION SYSTEM
PHC	PRIMARY HEALTHCARE CENTRE
PMMPY	PRADHAN MANTRI MATSHYA POKHARI YOJANA
PRI	PANCHAYATI RAJ INSTITUTIONS
RAWES	RAPID WETLAND ASSESSMENT APPROACH
RWSS	RURAL WATER SUPPLY AND SANITATION
SC	SCHEDULE CASTE
SRI	SYSTEM OF RICE INTENSIFICATION
ST	SCHEDULE TRIBE
ToR	TERMS OF REFERENCE
WIAMS	WETLANDS INVENTORY, ASSESSMENT AND MONITORING FRAMEWORK

EXECUTIVE SUMMARY

Bhitarkanika Ramsar site is located in the northeastern region of Kendrapara District of Odisha, between longitudes 86° 45′ and 87° 03′ East and latitudes 20° 30′ and 20° 48′ North (RIS 2002). Known for its rich biodiversity, this Ramsar site comprises a national park and wildlife sanctuary. The sanctuary is majorly spread across Rajnagar and Rajkanika blocks of Kendrapara District. Its extent is 672 sq. km, having 27 forest blocks. The national park has an extent of 145 sq. km spread across Rajnagar Block. Gahirmatha Marine Sanctuary is located on the northeastern border of the sanctuary between longitudes 80° 77′ and 87° 05′ East and latitudes 20° 52′ and 20° 72′ North (Shunmugaraj 2001). The area extends along nearly 35–40 km of the coastline, from the Maipura river mouth in the north to the Hansua river mouth in the south. This region is famous for mass nesting of Olive Ridley Turtles. Further, this region has the highest density of Saltwater Crocodiles in India and hosts a large number of resident and migratory water birds that breed in the winter. bBhitarkanika is a wetland of international importance and attracts a large number of birds, particularly during winter. It was declared a Ramsar site on 19 August 2002 owing to its majestic mangrove forests (RIS 2021). Recently, there has been a change in the boundary of the wildlife sanctuary, but the Ramsar site boundaries remain unchanged.

The site is situated in the deltaic region of the Brahmani and Baitarani rivers. The Bay of Bengal demarcates the eastern and southern boundaries of the Bhitarkanika landscape, and along the northern and western boundaries are the villages of adjoining district. There are more than 300 plant species in Bhitarkanika, including mangroves species (Wildlife Conservation 2007-08). The area is ecologically sensitive; mangroves being critical species that require a regular flow of fresh water and the influence of tidal water from the sea. The region has rivers, creeks and streams, which makes it ecologically significant, and the changing landforms have resulted in the formation of micro-habitats, such as islands, sand bars and mud flats. These provide critical habitats for coastal biodiversity and support key ecosystem services.

This study looked into following key assessment areas to support the preparation of an integrated management plan for Bhitarkanika:

- Assessment of the wetland services provided by the Bhitarkanika Ramsar site using the Rapid Assessment of Wetland Ecosystem Services (RAWES) framework
- Carrying out a baseline assessment of the socio-economic conditions
- Assessment of ecosystem–livelihood interlinkages
- Assessment of institutional arrangements

Methodology

The RAWES approach and the Wetlands Inventory, Assessment and Monitoring (WIAMS) framework were used to conduct the assignment, with inputs being provided by GIZ. In the RAWES approach, the scale of benefit presents a diagnosis of the ecosystem services provided and of the impact of these services on the wetland and the communities therein. Qualitative methods, including Focus group discussion (FGDs), IDIs and expert observations, were used to collect information and analyse the findings. A mixed-method approach using the Household (HH) survey tool and FGD was used to collect baseline demographic information on ecosystem services–livelihood linkages in the WIAMS framework for inventory and assessment. A survey was conducted in which 920 HHs in 46 villages and 15 gram panchayats in Bhitarkanika were covered. The project area was divided into four broad categories: three inside the Ramsar site and one outside the Ramsar site (Group D). Details of the functional indicators of the categorization and the coverage of samples are provided in Chapter 1 (Section 1.5.1).

Findings

Assessment of the wetland services provided by the Bhitarkanika Ramsar site using the RAWES framework

Wetlands are significant natural areas. They perform many valuable functions and provide services to the environment and society. An assessment of the wetland ecosystem services rendered by the Bhitarkanika Mangroves, including provisioning, regulating, cultural and supporting services, is presented in Table 1 in accordance with the RAWES framework.

The agricultural ecosystem of Bhitarkanika provides the community residing in the wetland with food. About 43% of the households are reportedly associated with farming. Farmlands are taken on lease for rice cultivation. The rice produced in the area is sold in the local market. A decade back, green gram was cultivated after the paddy harvest. However, an increased salinity of the tidal river during summers, among other factors, has led to a decline in the production and made fallow lands of rice fields. Overall, the dependency on agriculture has reduced due to the soil salinity increase, salt -water ingress, increased exposure to floods and cyclones, and change in rainfall patterns.

Traditionally, the local community has enjoyed a close relationship with the mangroves and has been dependent on its resources for various personal needs. With the declaration of the national park and the introduction of regulations by the forest department, which is focused on the preservation and conservation of these resources, there has been a drastic reduction in the interaction between the forest and the local people. The study revealed 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 (findings from FGD). Gradual changes due to social and economic development have forced forest-dependent households to search for alternative options.

The estuarine ecosystem comprises interlinked networks of river channels, bayous, tidal creeks, wetlands and sand/gravel bars, which continuously evolve through the collective action of the flow of the river, waves, tides, sediment deposition and construction of infrastructure by humans. The salt marsh wetlands and associated coastal waters are highly productive. They support the fisheries of the area. Their biodiversity is rich, and they provide a range of valuable ecosystem services. Fishing is carried on using traditional means as well as using trawlers in the deep sea. Commonly found species include the 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. Over the years, fish species such as the Khasuli, Manohari, Vatei, Kantia and Balia have become rare in the area due to overfishing (including illegal fishing and using certain techniques to attract fish) and the release of polluted water from agricultural fields and shrimp farms into the creeks and rivers.

Overall, the ecosystem services have been classified into four broad categories, namely provisioning services, regulating services, cultural services and supporting services, as defined by the Millennium Ecosystem Assessment. In accordance with the RAWES framework, an assessment of the wetland ecosystem services provided by the Bhitarkanika Ramsar site is presented in Table 6 of the main report. The table provides details of each of the provisioning, regulating, cultural and supporting services provided by the wetland, the extent of the services and an expert analysis of these. The scale of benefit of each service is provided according to the baseline scaling of the RAWES framework. A summary of the findings is presented in this executive summary.

Table 1 *Details of services provided by wetland ecosystems*

Ecosystem Services	Details	Benefit	Scale of Benefit		
			Local	Regional	Global
Global	Food	++		✓	
	Fresh water – drinking	++	✓		
	Fresh water – irrigation	++		✓	
	Fibre and fuel	+	✓		
	Medicines and pharmaceuticals	+	✓		
	Ornamental resources	0			
	Harvesting clay, minerals, aggregates	+	✓		
	Harvesting energy from natural air and water flows	0		✓	
	Ecotourism	++		✓	
Regulatory	Air quality regulation	+		✓	
	Local climate regulation	++		✓	
	Global climate regulation	++			✓
	Water regulation (hydrological flows)	++		✓	
	Flood hazard	++		✓	
	Tropical cyclone/storm hazard	++		✓	
	Coastal erosion	++	✓		
	Pest regulation	-	✓		
	Pollination	+		✓	
	Noise and visual buffering	+		✓	
Cultural	Cultural heritage	+	✓		
	Recreation and tourism	+		✓	
	Aesthetic value	+	✓		
	Spiritual and religious values	+	✓		
	Inspirational value	+	✓		
	Social relations	++		✓	
	Educational and research	+			✓
Supporting	Soil formation	++		✓	
	Primary production	++		✓	
	Nutrient cycling	++		✓	
	Water recycling	++		✓	
	Provision of habitats	++			✓

Legend :

++ Significant Positive Benefit: The service contributes highly to the sustenance of organisms.

+ Positive Benefit: The service has positive impacts, and there is some degree of reliance on it.

0 Negligible Benefit: There is little reliance on the wetland service, and no direct or indirect benefits are received.

-- Significant Negative Benefit: Wetland service that does not have positive supporting characteristics.

- Negative Benefit: Wetland service that does not have positive supporting characteristics to a higher degree.

? Gaps in Evidence: No concrete data/perception accounts were available for the contributions of the wetland service, either positive or negative, to the sustenance of organisms.

Table 2 *Major livelihood activities and their dependence on ecosystem services*

Ecosystem or Activity	Livelihood	Dependence of Population	
Agriculture	Agriculture is the mainstay of rural India, including Odisha. However, the household income dependence on agriculture has been declining over the years. (The paradox of Bhitarkanika is that even though there is a decline in the percentage of HHs dependent on agriculture for income, this change has contributed towards degradation of the ecosystem). This is reflected in the increasing salinity of the tidal river in the region, which has been the source of irrigation. 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. Rice is the staple diet. The population primarily engages in paddy cultivation for supporting its HH needs. Almost one in two families in Bhitarkanika is involved in rice cultivation (own or leased farmland). Till the late 1990s, multiple cropping was practiced, i.e., paddy cultivation followed by green gram and vegetable cultivation. The increased salinity of the soil and the decline in irrigation have resulted in single-season cultivation and an increase in the extent of the land that is fallow. The hybrid crop varieties that are preferred now have led to increased use of chemical-based fertilizers and pesticides as well as an increase in the input cost. These chemicals pollute the water, soil and biota, affecting the health of humans and the ecosystem.	43%	
Estuarine Fishing	Fisheries are the next predominant occupation. They provide employment to 11% of the HHs in Bhitarkanika (as well as form 20% of secondary income source). Brahmani and Baitarani are the two main rivers of the area. Due to diversity of ecosystems, inland, estuarine and marine fisheries are practiced here. Traditionally, the benefit is received by the HHs in the proximity of the resource. The ecosystem has predominantly supported traditional fishing practice using fibre boats. Over the years, trawler-based fishing mechanisms have been adopted. 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 agricultural and shrimp-farming fields and the use of chemicals to increase fish catch also have a detrimental effect. Only around 4-5 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 community found the government-provided one-time assistance of INR 7500 during the ban period to be low to meet household expenses.	11%	

Ecosystem or Activity	Livelihood	Dependence of Population	
Shrimp Cultivation	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 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. This unregulated conversion has led to environmental issues. Shrimp farming is propelled at the expense of the fragile wetland environment and results in biological degradation. The increase in shrimp cultivation in the wetland has triggered both short- and long-term environmental contamination and biological imbalance. Effluents from shrimp ponds (rich in suspended solids and having high biochemical oxygen demand (BOD)) are discharged through creeks and tidal channels, destroying the aquatic life. Fishers link their low-quantity fish catches to effluent contamination. The shrimp farms not only affect the marine life but also degrade the soil and water quality of cultivated paddy fields. The release of saline water from shrimp ponds increases the salinity further in neighbouring paddy farms. Taking cognizance of 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 within the CRZ (about creeks, rivers, and backwaters). MoEF&CC has declared 192 villages around Bhitarkanika National Park as Ecosensitive Zones (ESZs). The ESZ guidelines prohibit any shrimp farming.		
Mangroves	Historically, the population has used various plant species in the area for survival. With the declaration of the site as a national park, the dependence of the communities on these resources has reduced. According to the community members from nearby villages, there have been major changes, including gradual decrease, in forest dependency since the regulations were initiated in 1970s. The inhabitants were knowledgeable about forest resources and their use, but seldom they could use these resources in their daily lives, as a result of which there was a decline in knowledge transfers to the next generation. Gradual changes in social and economic development forced forest-dependent households to search for other options. Three fourths of the working population in ‘Group A’ villages born after the regulations were put in place, have migrated out of the state. The availability of modern medicines has also reduced the dependence on medicinal plants.		

Institutional Arrangements

Site-based management planning has been recognized as one of the elements of a multi-scalar approach to wise use, planning and management of wetlands. The management plan aims to provide a framework for interlinking the ecosystem components of the wetland with the communities, including broad-scale landscape and ecosystem planning at the integrated river basin and coastal zone scales.

Currently, the discretion of each department is limited to its administrative boundaries. But in Bhitarkanika Mangroves, the confluence of ecosystems extends beyond the physical boundaries. The physical, biophysical and anthropogenic features co-exist and are in interaction with each other. Thus there is a requirement for an institution that works closely with various departments as a coordinated unit for the development and maintenance of such sites. The objective is to form a joint unit that is concerned with the complete 'site' as an area of influence, for the 'wise use' of the wetland and the well-being of the human population in the area. It is recommended that a District Wetland Committee (DWC), constituted by representatives from various government agencies, knowledge partners and civil society personnel will work towards achieving the objectives of integrated management in compliance to Wetland (Conservation and Management) Rules 2017. The proposed institutional setup of DWC comprises a Board of Members, an Executive Committee, knowledge partner and data-monitoring agencies. The roles, responsibilities and functional schema of all is detailed in Chapter 4.

Recommendations

Recommendations are being proposed for wise use and management of the wetlands and balancing human–ecosystem interactions. Due to the inherent time lags due to sectoral challenges, requirements of funds/skilled manpower, and desirable changes in policy/governance mechanisms, the suggested recommendations are classifieds into short-term (> 2 years), medium-term (2–5 years), and long–term (>5 years) time scales (Chapter 6). A summary of the recommendations follows:

- A farm demonstration of replacing inorganic agrochemicals with bio-fertilizers and pesticides can be initiated in selected farm plots as a first step. Formation of farm field schools (FFS) for experimental learning will help scaling up. In the short term this will help reduce farm input costs
- Sustainable rice intensification (SRI) can to be practiced through SHGs on locally available organic inputs using traditional, salt-/pest-tolerant high-yielding varieties. SRI has been proven to be sustainable and to have the potential to increase yields 20-50%, reduce seed requirements up to 90% and effect water savings up to 50%. The possibility of practicing integrated rice fish culture (IFRC) to optimize the yield/unit area and to diversify the products and spread the risks can be explored.
- Low-cost, affordable practices to reduce soil salinity need to be documented. Application of rice straw and green manuring are some of the measures that are locally adopted by farmers to treat saline soils. In Tamil Nadu, application of organic matter and gypsum are found to be beneficial.
- Forming market linkages of organic produce is key to sustain organic farming. Organic produce from Bhitarkanika has to be promoted under a single brand to build market linkages with various commodities/fisheries products from Bhitarkanika. The precursor to brand building is the formation of farmer producer cooperatives (FPOs) which need to accelerate Odisha Livelihoods Mission programmes, On-farm demonstrations. Farmschools can help setup the producers group with common areas of interest. Community-based certification for organic farming is to be developed, through which organic produce market linkages could be firmed up with domestic retailers. Organic produce from Bhitarkanika can potentially be exported.

- Apiculture (bee farming), which had limited success in the past, has to be re-considered with improved practices and market linkages. There could be potential for high-quality honey collected from the mangroves. Promotion of the honey could be channeled through SHGs or FPOs. The bee-keepers can earn additional incomes if the infrastructure and markets are created for bee pollen, bee venom and royal jelly, and the bee-keepers are trained to extract them. All three have medicinal value and command very high prices in the international market.
- Protection of key fishing habitats and the genetic diversity of small indigenous fishes (SIFs) by formulating local nutritional fish feeds, practicing backyard fish farming and forming SHGs collectives can be effectively used as change agents in the community. The inland fisheries have been promoting fish rearing ponds. Augmenting the existing schemes with the preparation of fish feed and establishing market linkages beyond districts boundaries/states will enhance the incomes of fishing-dependent households.
- Ranching of fish seed in rivers, strengthening the forward–backward linkages in the sustainable supply chain, creating cooperatives/SHGs, and expanding the market potential of fishing outside the district boundaries is recommended.
- The development of fingerling rearing ponds (earthen) through SHGs will help enhance incomes and fill the demand-supply gap. Tie-ups with OLM/ICAR for fingerling rearing, with an emphasis on diversification of species, will facilitate the scaling up of fish rearing.
- Farmers engaging in Participating farmers can be rewarded with payments for ecosystem services (PES) for production of healthy, nutritious food, pollination and biogeochemical cycling. Meritorious girl students and scholarship holders from fisher folk communities can be trained as part-time animators to foster community-based conservation of biodiversity (both domesticated and wild) and cultural heritage. This effort can be linked to community-based ecotourism for alternative livelihoods through the Department of Women and Child Development, Government of Odisha.
- Community conserved areas (CCAs) in estuarine/marine ecosystems can be expanded so as to incentivize the local communities for their conservation efforts. This will protect biodiversity, sustain livelihoods and make the local communities resilient.

Photo credit: GIZ_APOWA

1. PROJECT DESCRIPTION

Image *Fishing in Bhitarkanika © TARU Leading Edge 2021*

Note: The photographs, tables and graphics added in the report were shot and designed by the Taru Leading Edge team in 2021.

1.1 Assignment Details

The Ministry of Environment, Forest and Climate Change (MoEF&CC), in partnership with Deutsche Gesellschaft für Technische Zusammenarbeit (GIZ) GmbH, is implementing a technical cooperation project 'Wetlands Management for Biodiversity and Climate Protection' with funding support from the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) under the International Climate Initiative (IKI). The goal of the project is to strengthen the institutional framework and capacities for ecosystem-based integrated management of wetlands of international importance (Ramsar Sites) in India. The project is being implemented in close co-ordination with the centrally sponsored scheme 'National Plan for Conservation of Aquatic ecosystems (NPCA)' of MoEF&CC.

Bhitarkanika Mangroves was identified in this project for a pilot study of an ecosystem-based integrated management approach for 'strengthening the institutional framework and capacities for an ecosystem-based integrated management of wetlands of international importance (Ramsar Sites) in India.' Taru Leading Edge Pvt. Ltd. was awarded a contract, through a tendering process, by GIZ, to conduct an assessment of the ecosystem services–livelihood linkage for integrated management of the Bhitarkanika Ramsar site, Odisha, India.

1.2 Site Description

Bhitarkanika Mangroves is located in the northeastern region of Kendrapara District of Odisha, between longitudes 86° 45′ and 87° 03′ East and latitudes 20° 30′ and 20° 48′ North (RIS 2002). Known for its rich biodiversity, this Ramsar site comprises a national park and wildlife sanctuary. The sanctuary is majorly spread across Rajnagar and Rajkanika blocks of Kendrapara District. Its extent is 672 km2, having 27 forest blocks. The national park has an extent of 145 sq. km spread across Rajnagar Block.

Gahirmatha Marine Wildlife Sanctuary is located on the northeastern border of the sanctuary between longitudes 80° 77′ and 87° 05′ East and latitudes 20° 52′ and 20° 72′ North (Shunmugaraj 2001). The area extends along nearly 35–40 km of the coastline, from the Maipura river mouth in the north to the Hansua river mouth in the south. This region is famous for mass nesting of Olive Ridley Sea turtles. Further, this region has the highest density of Saltwater Crocodiles in India and hosts a large number of resident and migratory water birds that breed in the winter.

Bhitarkanika Mangrove is a wetland of international importance and attracts a large number of birds, particularly during winter. It was declared a Ramsar Site on 19 August 2002 owing to its majestic mangrove forests (RIS 2021). Recently, there has been a change in the boundary of the wildlife sanctuary, but the Ramsar site boundaries remain unchanged.

Administratively, Rajnagar Block is the dominant unit of the Ramsar site. It is surrounded by the Rajkanika, Aali and Pattamundai blocks. In total, there are around 410 villages inside the sanctuary limits, which have been revised recently to include eight forest blocks. Fifty-two villages have been excluded as per GIZ Odisha Field Report March 2020. Besides having abundant and diverse plants and animals, the site is endowed with plenty of minerals. The local communities derive key ecosystem goods such as food, fish, medicines, tannins, fuel wood, construction materials and honey from this region.

The ecosystem of Bhitarkanika Mangrove is situated in the deltaic region of the Brahmani and Baitarani rivers. The Bay of Bengal demarcates the eastern and southern boundaries of the Bhitarkanika Mangrove landscape. Villages of the adjoining district form the northern and western boundaries. Bhitarkanika Mangrove has more than 300 plant species, both mangroves and non-mangrove species (Wildlife Conservation 2007-08). The area is ecologically sensitive as mangroves are a critical species. They require a regular flow of fresh water and the influence of tidal water from the sea. The region has rivers, creeks and streams, which makes it ecologically significant. The changing landforms have micro-habitats, such as islands, sand bars and mud flats, that provide critical habitats for the coastal biodiversity and support key ecosystem services.

Bhitarkanika is one of the major mangrove areas in India, next only to the Sundarbans, in West Bengal, with the richest biodiversity. Of the 72 mangrove and associated species found across the globe, Bhitarkanika Mangrove has 62 (Das and Chhaterjee 2015). Therefore, the floral diversity of Bhitarkanika Mangroves is to be maintained on a long-term basis.

In keeping with the floral diversity, the faunal diversity of Bhitarkanika Mangroves is also very significant. Within the protected areas there are different micro-habitats, depending on the salinity, distance from the sea and the extent of the freshwater flow. Each type of habitat has its own representative fauna. The faunal diversity in Bhitarkanika Mangroves includes 42 species of reptiles, 5 species of amphibians, 280 species of birds and 28 species of mammals (Das & Chhaterjee 2015).

The Saltwater Crocodile *(Crocodylus porosus)* is the flagship species of Bhitarkanika Mangroves. As per the 2020 census, there are a total of 1757 crocodiles in Bhitarkanika Mangroves (Senapati 2020).

The avian diversity of Bhitarkanika Mangroves is unique. As many as 280 species have been reported from the sanctuary. Both resident and migratory birds use this mangrove wetland in some part of the year or other. Bagagahan, the heronry, is amongst the largest in Asia. About 30,000 resident water birds nest in a compact area of 4 ha. The park attracts about 1,00,000 migratory birds in winter. More than eight species of kingfisher and five species of woodpecker are found in Bhitarkanika Mangroves, which highlights the biodiversity of the area (Das & Chhaterjee 2015). The site management should therefore protect and restore the habitats of these species so that they continue to be found here.

The mangrove habitat of Bhitarkanika is very dynamic. Landforms, rivers and creeks are continuously changing. Existing landforms, with their forests, are eroded. New islands appear from time to time. The floral and faunal diversity is also affected by these changes. Therefore, the management objective should be adaptive to these phenomena and directed towards the maintenance of such dynamism in the coastal biogeography of the area.

Bhitarkanika, with its natural bounty, is already one of the major tourist destinations on the east coast in Odisha. It has been attracting ecotourists for quite some time. In recent years, the inflow of tourists to the park increased till 2019. In 2020, there was a decline due to Covid-19. According to the DFO, on an average about 60,000 to 75,000 tourists visit the park annually.

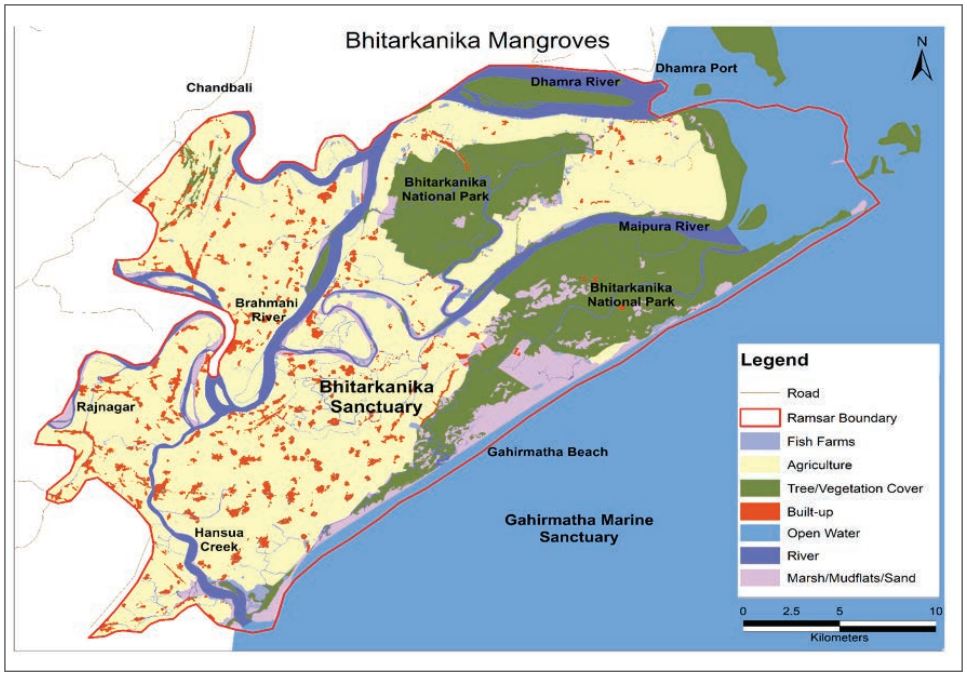

Figure 1 *Bhitarkanika Mangroves (Source: GIZ}*

1.3 Sope of work

The objective of this assignment is to conduct an assessment of the inter-linkages between the livelihoods of the local communities and the ecosystem services provided by the wetland and to recommend appropriate measures to sustaining the ecosystem services and improve the livelihoods.
The following tasks are specified in the terms of reference (ToR).

Socio-economic profile of the Bhitarkanika Mangroves

- Document and analyse trends of population, decadal population growth, age–sex structure, workforce characteristics, occupation (seasonality), migration (with focus on COVID-19) and income profile.
- Identify and document the status of physical infrastructure within the Ramsar site, including the water supply system, drainage and sewerage system, solid waste management system and transportation system.
- List the ecosystem services (provisioning, regulating, supporting and cultural services).

Dependence on the wetland

- List all the livelihood and economic activities within the Ramsar Site.
- Document the number of people involved in the wetland-based livelihood activities, considering the seasonality. This should include, in addition to the major activities such as agriculture and fishing, other wetland-dependent activities such as extraction of fuel wood, honey, medicines, tannins and raw materials for rope and basket making.
- Document the status of tourism in Bhitarkanika Mangroves, focusing on tourism-dependent livelihoods.
- Identify markets for wetland resources, considering seasonality.
- Document cultural practices of the communities dependent on the wetland.
- Identify sources of water and fuel for domestic purposes.

Assessment of Institutional Arrangement

- Review the existing policies, plans and programmes, at the national, state and district levels, related to the wetland, including the ESZ.
- Document the existing legal and regulatory setup governing the activities within the Ramsar Site.
- Document local institutional arrangements impacting livelihoods/wetland resource use.
- Identify community-level organizations, NGOs, local institutions and resource persons for stakeholder engagement.
- Perform a stakeholder analysis – assessment of interests, power and influence of state-, district- and community-level institutions.
- Identify existing conflicts within different stakeholders.
- Assess the status of human–wildlife conflict – most impacted livelihoods, major species involved in the conflict, drivers of conflict.

Assessment of Inter-linkages between Livelihoods and Ecosystem Services

- Trends in livelihood activities, including changes in cropping and fishing patterns, trends in livestock numbers and grazing area, aquaculture practices, tourism, etc.
- Changes in livelihood practices due to impact of Covid-19 and lockdown, focusing on changes in dependence of people on natural resources.
- Prioritization of ecosystem services on the basis of existing livelihoods, economic activities and protection from natural hazards.
- Assess impact of current livelihoods/economic practices on the key wetland features (water quality, soil, mangroves, wildlife).

- Assess the effects of changes in the ecological characteristics of the wetland on livelihood activities.
- Identification of synergies and conflicts between various livelihoods/economic activities.

Recommendations

- Suggest measures to manage livelihoods/economic activities that have existing and potential detrimental impacts on the wetland ecology, focusing on agriculture and aquaculture.
- Suggest measures for livelihood improvement through sustainable use of wetland resources, focusing on agriculture, aquaculture and tourism.
- Suggest green recovery measures for livelihoods impacted by Covid-19.
- Suggest strategies to strengthen synergies and minimize conflicts between different livelihood activities.
- Suggest measures to minimize human–wildlife conflict.
- Suggest an institutional arrangement for integrated management of the wetland.
- Recommend a strategy for multi-stakeholder engagement for integrated management. This should be done by initiating an early engagement with all the stakeholders at the community level, local NGOs and other site-level institutions, line departments, institutions at the state level and any other institution working within the Ramsar site.
- Also, recommend strategies to minimize conflicts between different stakeholders. The engagement strategy should be developed considering its long-term effect beyond the time period of the project.

1.4 Methodology

1.4.1 Regional Profiling

Regional profiling involves collection of information related to the demographic profile, geographical details, site-specific characteristics and the socio-economic details of the Ramsar Site from secondary sources. This provides a comprehensive profile of the region. The task includes searching for and collating data from various government sources (national and regional levels) and published documents. Descriptive and statistical social and economic information were referred to for developing a comprehensive understanding of the region.

The sources of information included the Census of India, 2011; District Statistical Handbooks; Management Plan of Bhitarkanika National Park and Wildlife Sanctuary, 2008–09 to 2017–18, Mangrove Forest Division (Wildlife), Kendrapara, Rajnagar, Odisha; ICZMP Report prepared by IPE Global Pvt. Ltd.; and Atlas of Mangrove Wetlands of India, 2004. Other relevant project reports and research studies were also referred to.

1.4.2 Literature Review

A detailed review of the previous wetland assessment reports and research studies conducted on ecosystem–livelihood interlinkages at the Bhitarkanika Mangroves was carried out. Reports of similar studies conducted at the national and global levels were also critically reviewed. Research reports pertaining to the ecosystem of the Ramsar site (including the mangrove, coastal, agricultural and riverine parts), status reports, annual reports, and studies of the regional biodiversity/ecosystem services, conservation efforts, carbon sequestration, etc. were reviewed.

1.4.3 Spatial Imagery and GIS System

GIS systems and tools were utilized to understand the land use pattern and the geographical spread of the Bhitarkanika Mangroves. These helped classified the ecosystems of the Ramsar Site and helped identify the ecosystem distribution. The GIS tools, a rapid site visit and a deliberation with the GIZ team showed that there were primarily four ecosystems at the Ramsar site: forest, riverine, marine and agricultural ecosystems.

1.4.4 Stakeholder Consultation

Key informant interviews (KIIs) were conducted with the department functionaries, extension officers at the block and district levels and the panchayat and ward members. The stakeholder consultations were conducted between 14 February and 10 March 2021. A mapping of the departments and the functionaries closely associated with regulating and provisioning services at the wetland site was carried out. On the basis of the RAWES approach and the WIAMS framework, certain key areas were identified for the discussions and the interviews. The Forest, Agriculture and Inland and Marine Fisheries departments, OLM and RWSS were among the departments consulted. Additionally, KIIs were conducted with the representatives of the local NGOs and CSOs. The details of these consultations are provided in Annexure 1.

1.4.5 Site Visit

The Taru team conducted visits to the Bhitarkanika Mangroves along with the experts, field managers and enumerators. The preliminary visit, to understand the site and its complexities, was conducted between 4 and 12 January 2021. The second visit, to facilitate stakeholder consultations and collect data, was conducted between 14 February and 10 March 2021.

1.4.6 Primary Data Collection

Quantitative Survey

A Household (HH) survey was conducted to collect quantitative data covering the following thematic areas:

- Socio-economic profile of the Bhitarkanika Mangroves
- Ecosystem–wetland interlinkages
- Institutional arrangements
- Wetland dependence

A quantitative tool was prepared for the HH survey. The survey was based on purposive sampling. The details are mentioned in a section ahead.

Qualitative Survey

Focus Group Discussions (FGDs) were conducted to further the understanding of interlinkages between the community and the ecosystems and of wetland dependence. These were to substantiate the analysis of the quantitative findings and bring enriching insights to the wetland assessment. The FGDs enlist the direct and indirect nature of the dependences, the scales of benefit and the community's willingness to be involved in wetland protection and conservation.

Case Studies

Case studies have been identified and documented on the thematic areas and special features of the ecosystems of the Ramsar Site. These provide a holistic understanding over a time of the ecosystem–livelihood linkages, the conflicts and the current status of engagement.

1.5 Sampling

The Ramsar Site is a dynamic mosaic of forest areas (mangroves), a marine ecosystem, a riverine system and agricultural habitats/ecosystems. The Ramsar Site was divided into four sub-categories to gain a holistic understanding of the dependence on the wetland and the ecosystem–livelihood linkages. The area inside the Ramsar Site was divided into Group A, Group B and Group C, and the area outside the Ramsar Site was considered as Group D for the purpose of the study. The sub-categorization into three units inside the Ramsar Site was to engage with the

national park, the wildlife sanctuary and the borders of the Ramsar site. The sampling included the area outside the Bhitarkanika Ramsar boundary. This was done in an attempt to establish a distinction between the lives and livelihoods of the people dependent on the wetland services and the population outside the wetland.

Further, the villages were identified on the basis of their proximity to the ecosystem and interactions with the ecosystem services.

The total number of samples (HH survey) was calculated using the following scientific formula:

$$N = \frac{\{Z^2\ (1-p)p*D\}}{NonResponse*E^2}$$

where

N = sample size,

Z= confidence interval, 1.96

p = proportion of key characteristics, 2.0

D = design effect, 1.5

E = standard error, 0.05

Non-response = 0.85

The total number of households from which data were to be collected was 900.

1.5.1 Gram Panchayat and Village Identification

A consultative and collaborative approach was adopted with the concerned stakeholders to finalize the villages. The categories were created to determine the scale of dependency of communities on the ecosystem services offered by the wetland and the conflicts. The functional indicators of the four categories and the coverage are detailed here:

Group A – The Ramsar site has a notified national park, and some panchayats and villages are located along its boundary, outside the park. These villages were earmarked as Group A to generate a comparative understanding of the ecosystem–livelihood linkages of the communities residing along the boundary of the protected area.

Group B – This region is the area inside the wildlife sanctuary but outside the boundary of the national park. Supported by the geospatial distribution and the land use characteristics, the region is occupied by agriculture- and riverine ecosystem-dependent communities.

Group C – These are villages within the wildlife sanctuary boundary but are located at the farthest distance from the forest and riverine ecosystems of Bhitarkanika.

Group D (outside Ramsar site) – The panchayats outside the boundary of the Bhitarkanika Mangroves were identified as falling in this group. This area was included as a part of the quantitative assessment to capture relationships between the natural ecosystem and the communities in the absence of direct benefits.

Table 3 provides details of the number of panchayats, villages and HHs covered across these categories. A complete list with the names of the selected panchayats and villages is included in Annexure 2.

Table 3 *Sample distribution of study area*

Particulars	Inside the Ramsar Site			Outside the Ramsar Site
	Group A	Group B	Group C	Group D
Number of GPs	5	5	5	3
Number of Villages per GP	3	3	2	2
Number of HHs per village	20	20	20	20
Total (HHs)	300	300	200	120
Grand Total				**920**

As a part of the qualitative data collection, FGDs, case studies and KIIs were conducted by the Taru team. The FGDs were conducted to understand the nuances of the relationships between the ecosystem services and the human population. Five FGDs each were conducted in each of the four groups. Case studies highlighting the interlinkages between livelihoods and ecosystem services were documented. The KIIs were conducted with the representatives of the department functionaries at the sub-divisional, block and district levels.

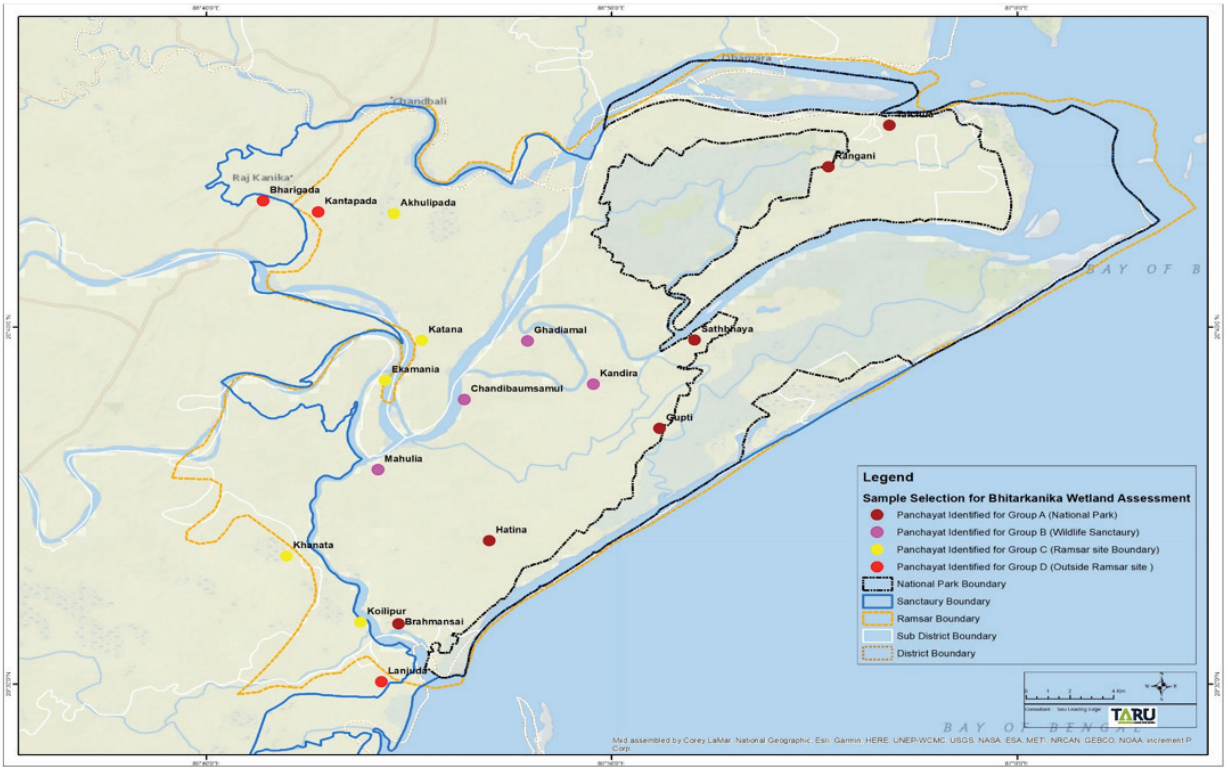

Figure 2 *Representative sample coverage across the Bhitarkanika Mangroves in the assignment (Source: Taru Leading Edge, 2021)*

1.6 Limitations of the Study

Bhitarkanika wetland assessment was conducted using the Rapid Wetland Assessment Approach (RAWES framework) using simple and efficient workable models of data collection and record-keeping. The site is a mosaic of interactions of various ecosystems and organisms and thus one may be at the risk of not recognizing some aspects. The study was conducted during the pandemic period and thereby was exposed to its challenges. In addition, the sample selection was carefully implemented to be representative of the elements found in the Bhitarkanika region, but due to operational reasons there may have been lapses. Further, as observed, there was limited knowledge and exposure of the community towards the resources and benefits provided by the wetland, due to which the perception of the community of the wetland's services lacked clarity.

2. WETLAND ASSESSMENT

Image *A village scene near the Ramsar Site*

2.1 Bhitarkanika Ecosystem

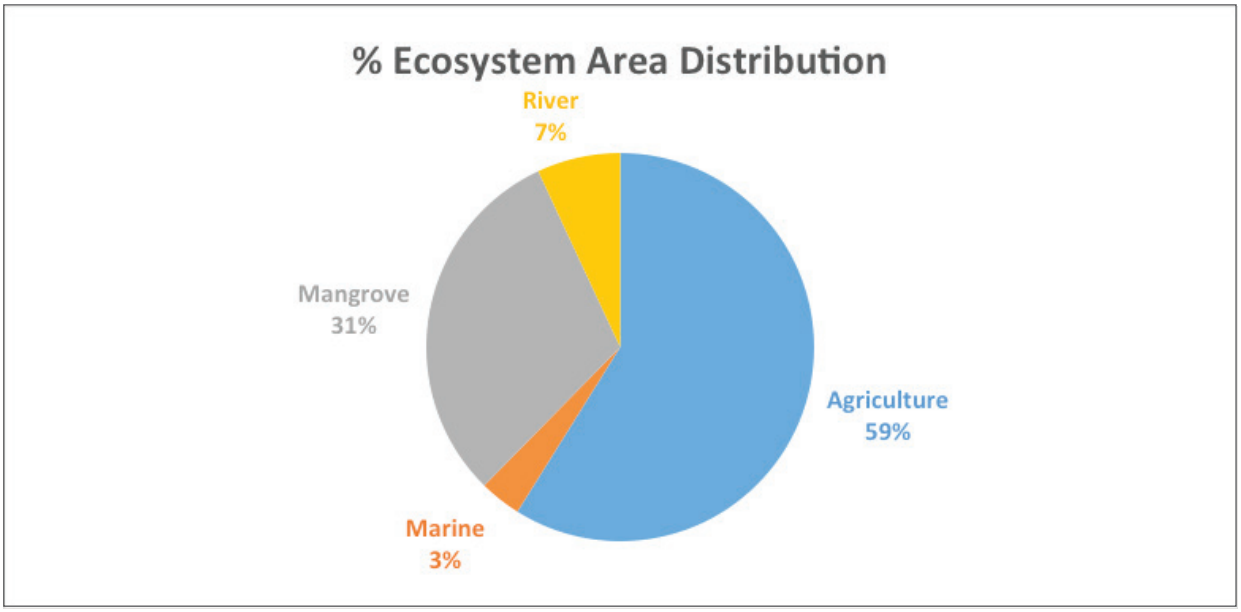

Figure 3 *Area-wise distribution of Bhitarkanika ecosystem*
(Source: Taru Leading Edge, 2021)

The ecosystem in the region is a mosaic of many sub-ecosystems. It comprises mangrove, river, marine and agricultural ecosystems. Each of these provides services at the micro-level separately as well as together at the macro-level and maintains the balance of the larger wetland as a whole (Banerjee & Pasha 2017). The diverse habitats in Bhitarkanika Mangroves include agricultural fields, rivers, freshwater ponds, mangroves, tidal rivers, creeks, creek lets, estuaries, mud flats, freshwater and brackish water wetlands, riverine islands, offshore islands and muddy and sandy coasts (Biswas 2012). The accompanying graph indicates the land distribution percentage of the ecosystem (tentative) of the Ramsar site.

According to the study "Population Status of Mangrove Species in Estuarine Regions of Odisha Coast, India", the total area of Bhitarkanika Wildlife Sanctuary is 672 km^2. The extent of the national park is 145 km^2. There are mangrove forests, water bodies, villages, uninhabited private lands and other revenue lands at the site. The area is located in the combined delta of the rivers Mahanadi, Brahmani and Baitarani. The distributaries of the Mahanadi and Brahmani join together near the coast and have a common estuarine region. Similarly the Baitarani, at its lower reaches, drains into the river Brahmani, and these two rivers have a common mouth near Dhamra (Sinha, 1999). Bhitarkanika is located in the estuarine environment created by the Brahmani and Baitarani. (Mishra, 2008)

The Ramsar site at Bhitarkanika is situated in Rajnagar and Rajkanika blocks and lies adjacent to Chandbali Block, of Bhadrak District. The entire area can be classified as four ecosystems:

- Mangrove ecosystem
- Riverine ecosystem
- Marine ecosystem
- Agricultural ecosystem

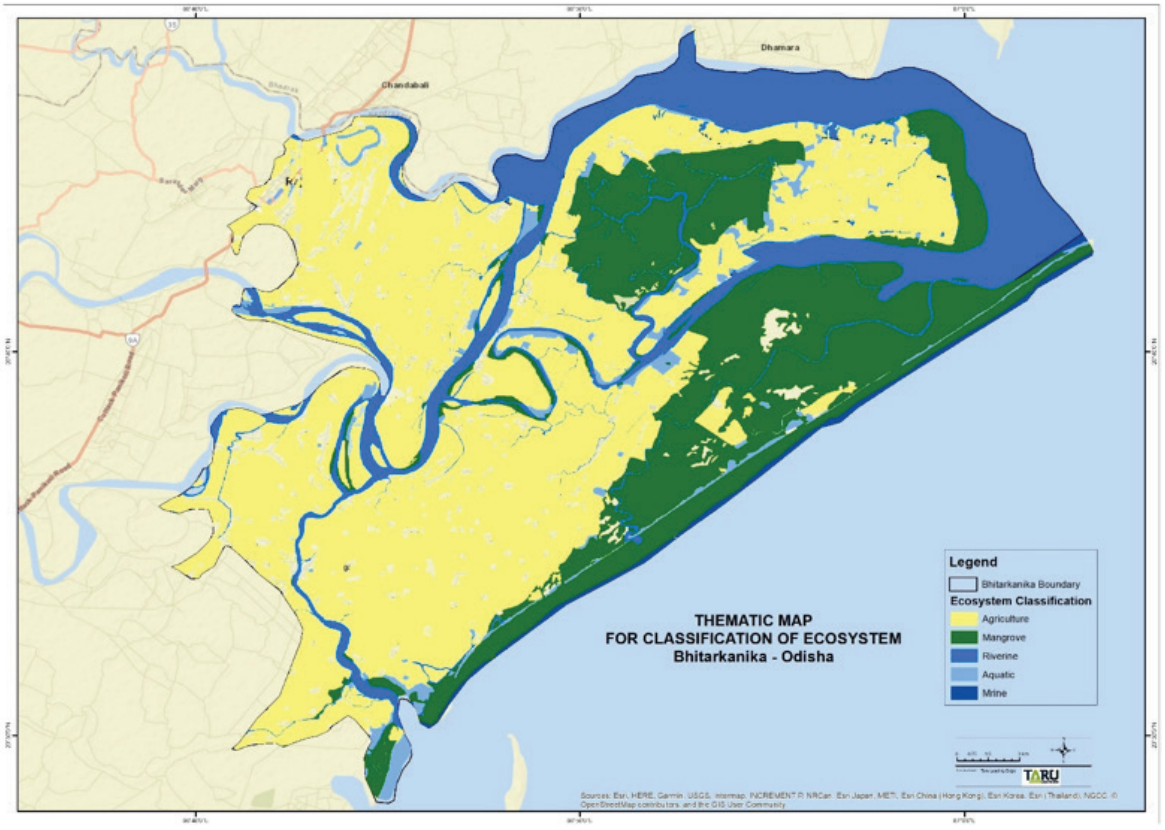

Figure 4 *Thematic map for classification of different ecosystemsMangrove Ecosystem*

The ecosystem in the national park is mostly the mangrove ecosystem. There are about 62 species of mangrove, and associated species are also found here (Das & Chhaterjee, 2015), the most common ones being the Bani (Avic*ennia officinalis),* Guan *(Excoecaria agallocha),* Sundari *(Heritiera fomes),* Kerua *(Sonneratia apetela)* and Pitamari *(Xylocarpus moluccensis).* The forest is dense and is home to many animals and birds, including endangered species. There are human settlements on the periphery of the national park. The estuarine wetlands of the Odisha coast are characterized by mangroves, tidal marshes and saline grass.

Table 4 *Administrative and operational distribution of forests under Rajnagar Forest Division*

S.No.	Name of Range	Name of Section
1	Kujanga	Kujanga
		Hawakhana
		Nuagan
		Bandara
2	Mahakalpada	Jamboo
		Batighara
		Jagarijora
3	Rajnagar	Rajnagar
		Gupti
		Satabhaya

S .No.	Name of Range	Name of Section
4	Kujanga	Kanika
		Talchua
		Khola
5	Gahirmatha	Barunei
		Ekakula

There are five ranges under Rajnagar Division, but administratively, Bhitarkanika has three forest ranges, viz., Rajnagar, Rajkanika and Mahakalpada, within Kendrapara and Bhadrak districts, of Odisha. The Bhitarkanika mangroves differ substantially from those of other patches in India because of the dominance of *Sonneratia apetala, Heritiera fomes, H. littoralis* and several *Avicennia* species (Kadaverugu, et al. 2021). According to the 2011 census, there are 310 villages adjoining the national park, which have a population of 145,301 people who are directly or indirectly dependent on the mangroves for their subsistence. This makes Bhitarkanika Mangroves one of the most complex socio-ecological systems. Traditionally, the local community has enjoyed a close relationship with the forest and has been dependent on its resources for various personal needs. Over the decades, with the declaration of the national park and the introduction of regulations by the forest department that focus on the preservation and conservation of these resources, there has been a drastic reduction in the interaction between the forest and the locals. The present study revealed that the inhabitants were informed about forest resources and their uses but due to a decline in continued resource access and utilization there has been a decline in knowledge transfer to the next generation (findings from FGD). Gradual social and economic development forced forest-dependent households to go in search of alternative options. Three-fourths of the working population in Group A villages born after the 1970 Act have migrated out of the state for their income (in accordance with the primary findings). The availability of modern medicine has reduced the dependence on medicinal plants.

2.1.1 Riverine Ecosystem

The rivers Brahmani and Baitarani are the two main rivers of the Bhitarkanika Mangroves. The ecosystem comprises interlinked networks of river channels, bayous, tidal creeks, wetlands and sand/gravel bars that continuously evolve through the collective action of the flow in the river, waves, tides, sediment deposition and construction of infrastructure. The saltmarsh wetlands and associated coastal waters are highly productive, supporting fisheries and a rich biodiversity, along with a range of valuable ecosystem services. The dependent population engages in fishing using traditional means, and at the same time there is deep sea fishing by trawlers. Commonly found species include the 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. Over the years, fish species such as the Khasuli, Manohari, Vatei, Kantia and Balia have become rare in the area due to practices such as overfishing, illegal fishing, unsustainable fishing techniques, and releasing polluted water from agricultural fields and shrimp farms into the creeks and rivers.

2.1.2 Agricultural Ecosystem

The major landuse in the site is agriculture. In the early 1970s, the inhabitants of nearby villages/areas crossed the Brahmani river and reclaimed the forest land on the banks for paddy cultivation. Further, migrant people from

Bangladesh reclaimed marshy land from the Bay of Bengal for cultivation. A rice-based rain-fed cropping system is practiced in the region. Traditional organic rice varieties have been replaced by hybrid varieties that need large inputs of chemicals and fertilizers. The primary survey in the study area shows that about 43% of the households are associated with farming. The rice produce is sold in the local market. Also, farmlands are taken on lease by cultivators near the Group A areas for rice cultivation. A decade back, green gram was cultivated after the paddy harvest. However, due to the increased salinity of the tidal river in summer, there was a decline in the produce, as a result of which the rice fields were left fallow. In addition, the practice of shrimp aquaculture farming along with rice paddy cultivation has impacted the farmlands near the creek and tidal rivers. According to the research paper titled "Influence of Brackish Water Aquaculture on Soil Salinization", there has been a 94-fold increase in aqua farming since 1989, most of it within the agricultural fields.

2.2 Ecosystem Services

The natural environment is capable of providing a range of services that are fundamental for the well-being, physical and emotional health, livelihoods and survival of the community. Ecosystem services are the natural capital provided by nature and formed by the interaction of human capital (people), social capital (communities) and built capital (built environment).

Ecosystems and their services determine human health and well-being as they provide (safe) water, nutrition (through fish, agriculture, etc.), fibre, fuel, fodder, shelter and medicinal products. A livelihood system can be conceived as based on a set of five broad categories of asset: natural, human, social, financial and physical (DFID 2001). While ecosystem services of wetlands can be considered to form part of the natural capital, through transforming structures and processes, ecosystem services can contribute to all other forms of capital (Kumar, et al., 2011).

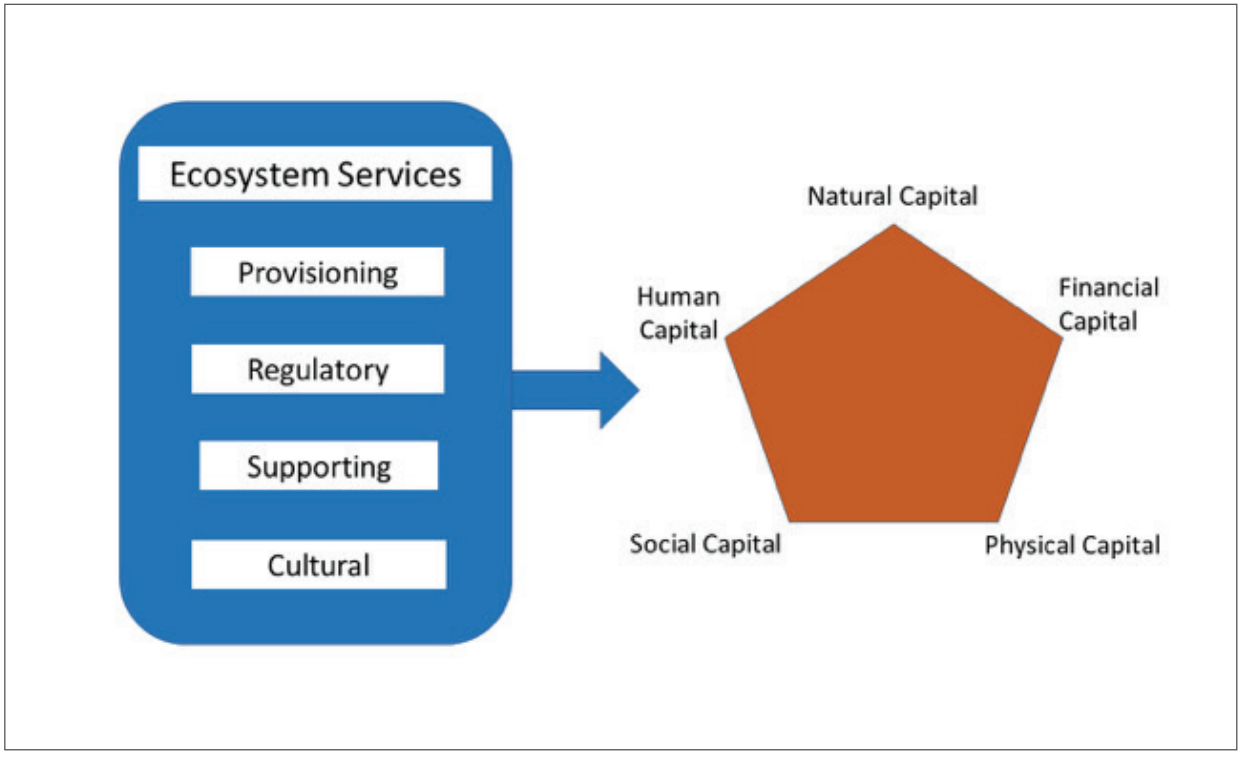

Figure 5 *Linkages between ecosystem services and livelihood assets*
(Source: Taru Leading Edge, 2021)

The benefits that ecosystem services provide to society are assessed by looking at the social demand of a service and the valuation of the service by different groups of people. When comparing the demand and supply, we can gauge whether there is a balance or whether an excess demand or any other form of impact has led to degradation. A framework for understanding the main links between ecosystems, ecosystem services and human well-being is presented in Figure 5 (Renner, Emerton & Kosmus, 2018)

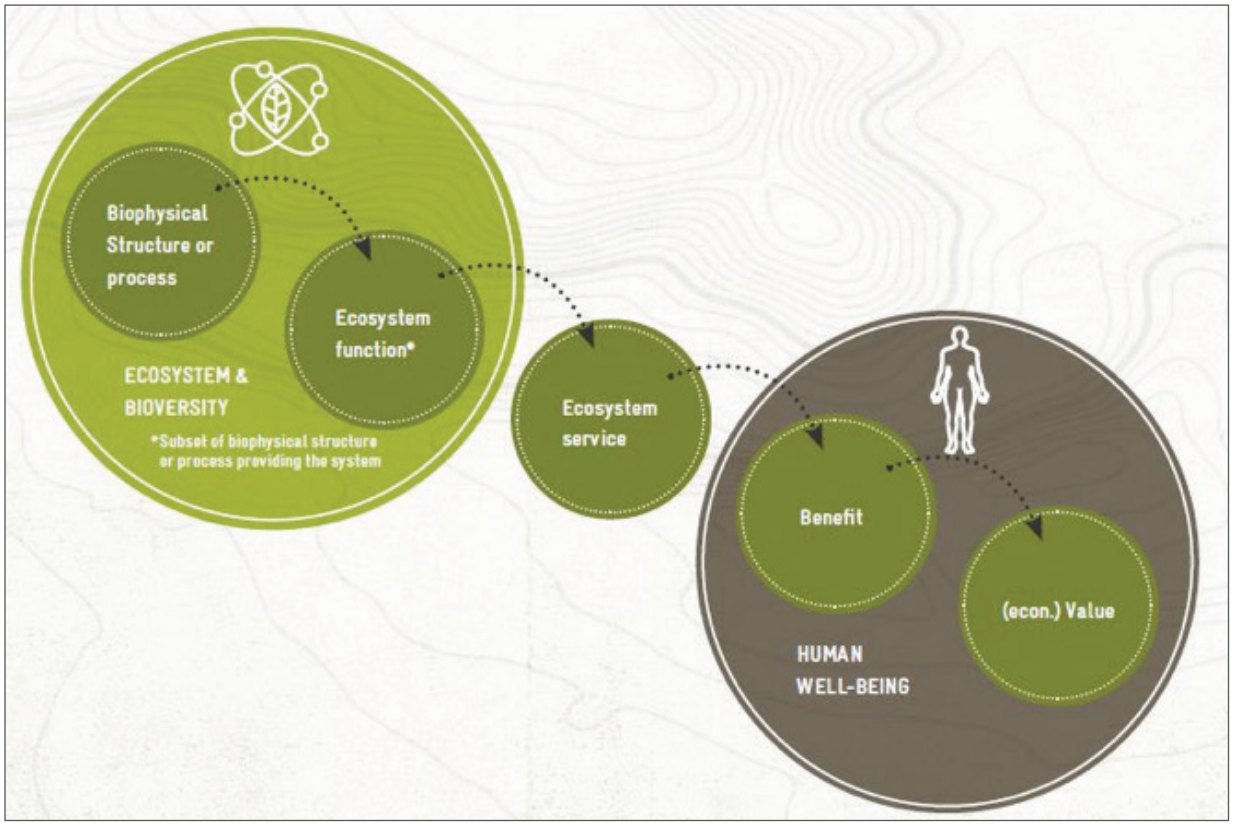

Figure 6 *Linkages between ecosystems, ecosystems services and human well-being (Source: Integrating Ecosystem Services into Development Planning, GIZ, 2018)*

The ecosystem services have broadly been classified by the Millennium Ecosystem Assessment into four broad categories, namely, provisioning services, regulating services, cultural services and supporting services.

An assessment of the wetland ecosystem services (in accordance with the RAWES framework) provided by the Bhitarkanika Mangroves is presented in Table 6. The table provides details of each of the services provided by the wetland, the quantum of the services and an expert analysis of the health of the wetland. The scale of benefit of each service (reference scale indicated in Table 5) is indicated as per the baseline scaling introduced in the RAWES framework.

Table 5 *Scale of benefit reference and description*

Relative 5-point scale for assessment of ecosystem score (adapted from Defra, 2007)		Linking services to beneficiaries at different scales
++	Potential significant positive contribution	• Local benefits: Those experienced by individuals, households or communities living and working in the immediate vicinity of the wetland. • Regional benefits: Those delivered to individuals, households or communities living and working in the wider catchment of the wetland. • Global benefits: Those that extend beyond national boundaries.
+	Potential positive contribution	
NB	Negligible contribution	
-	Potential negative contribution	
--	Potential significant negative contribution	
?	Gaps in evidence	

(Source - Rapid Assessment of Wetland Ecosystem Services (RAWES) Training Material, 2019)

Photo credit: JoblessStudios.GIZ

Table 6 *Scale of benefit of ecosystem services in Bhitarkanika*

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
Provisioning	Food (Agriculture)	The resource is of importance in supporting the nutritional needs of the community residing in the wetland (Group A) as well as the community of Group B. About 49% of the HHs (i.e., half the HHs in the Bhitarkanika region) are currently dependent on agriculture. As per the discussions with the community, this dependence level has reduced over the years. With an increase in water ingress and soil salinity, increased exposure to floods and cyclones and changes in rainfall patterns, the dependence on agriculture has reduced. Rice is a major crop that is produced in the region. Green gram and vegetables are also produced in some areas, but the yields of these crops have reduced due to the various factors mentioned. Livestocks are commonly maintained in the HHs for self-consumption.	++	Regional	Due to the increased dependence of the population on resources and increasing pressure to maximize the yield, the population in the region is utilizing excessive fertilizers and synthetic chemicals, causing nitrates and pesticides to leach into the surface water and groundwater in the wetland. This happens through rainfall, soil infiltration and surface runoff from agricultural lands. The wetlands retain/accumulate the chemicals, garbage and other pollutants, resulting in the degradation/ pollution of the ecosystem.	Due to the impacts from coastal inundation, seawater intrusion, storm surges and flooding, there have been shifts in agricultural practices. Mono-cropping has become more common in the region compared with the multi-cropping patterns practiced previously. Further, the varieties of paddy grown have also become fewer. A shift in land use pattern is emerging due to the increasing extent of fallow lands.
	Food (fishing)	Fishing is an important livelihood sustenance activity of the population of Bhitarkanika. Close to one fifth of the fishing villages are present in the Ramsar site region. Fishing is carried out using traditional boats and motorized boats as well as trawlers. The primary survey conducted for the study showed that boats used for fishing	++	Regional	The large population and its over-dependence on the resource has caused depletion of the rich diversity of fishes in the region. Further, the respondents said that the	Over the years, there has been a reduction in the fish catch as well as the variety of species present, along with a gradual reduction in the average body size of the fish caught, due to practices such

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
		are owned by 35% of the HHs and that 23% of them rent boats for fishing. Also, members from 41% of the HHs work on trawler boats. The survey showed that fishing is the primary occupation of 11% of the HHs and the secondary occupation of 20%. Among the fishing communities at least one family member was engaged in daily labor on trawlers in 41% of the HHs. Additionally, an increasing proportion of HHs engages in aquaculture because of the high returns and the government support. land of an extent of almost 47 ha has been converted to aquaculture farms.			loss of critical spawning and nursery grounds due to the practice of aquaculture is affecting local fisheries, resulting in reduced local fishers' yields. The practice of catching post-larva shrimps results in losses of other species as bycatch, which affects the local aquatic biodiversity.	as overfishing, illegal fishing, the use of certain techniques to catch fish and the release of polluted water from agricultural fields and shrimp farms into the creeks and rivers
	Fresh water (drinking)	The population is highly dependent on the resources for drinking water and water for other domestic purposes. 97% of the population within the Ramsar site depends on tube wells for water, and 0.65% depends on the piped water supply. On an average, four tube wells have been provided in each village. Traditionally, wells were the source of water, but over the years, due to an increase in salinity, they were replaced by tube wells. The aspirations of the population and the ease of access to water lead to a demand for piped water. Additionally, the quality of the available water has changed	++	Local	The population is heavily dependent on the groundwater. This has caused excessive extraction, exerting a high pressure on the aquifer. Additionally, seawater intrusion is the consequence of over-exploitation of the coastal freshwater aquifers. Considering the two phenomena, i.e., increasing saline intrusion and the heavy exploitation of the aquifer may lead to drastic consequences such as aquifer overdraft and even subsidence or sinking of the land in the long run (KRISHNA 2009).	An increase in the salinity of the freshwater resources alters the biodiversity composition of the ecosystem (Herbert, et al., 2015)..

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
	Fresh water (irrigation)	Primarily, rain-fed farming is practiced at the Ramsar Site. Thirteen gram panchayats along the shore do not have irrigation infrastructure, and deep tube wells are rare in paddy farms. Villages in the Group C area and along the Ramsar Site, such as Ekmania, Khanata and Kantapada, have a lift irrigation programme. Lift irrigation has had limited success due to a lack of clarity regarding the water distribution from one end to the other. Also, the water supply is disrupted by the erratic electricity supply. Coastal villages close to the creek and coastal channels were dependent on the tidal river for irrigation of winter crops previously. The increased salinity of the surface water and groundwater has forced them to keep the cultivable land fallow after harvesting paddy. Introduction of aquaculture farms within the sanctuary area requires saline waterto be transported to the aquaculture ponds through feed channels. These, in turn, are the carriers of irrigation water for the agricultural fields of the area, and this may have a bearing on the increase in soil salinity in the region. Aquaculture practices promote salinization of agricultural soil, mostly by means of salt leaching. Salt encrustation may result at times.	++	Regional	Same as previous.	Same as previous.
	Fibre and fuel	Since the declaration of the national park and the imposition of subsequent regulations in the region, the dependence of the community on the forest resources has reduced. Traditionally, families greatly relied on firewood for cooking purposes. A shift emerged with the strict	+	Local	Historically, the heavy dependence of the communities on the forest ecosystem has led to systematic reduction of species such as	Historic dependence on firewood has resulted in a reduction of the populations of such plant species.while this dependecen is now reduced, rejuvenation of lost species if

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
		protocols and penalties imposed by the forest department for conservation of plants. Cow dung and crop residues were used in larger amounts, and the use of firewood was reduced. Additionally, with the implementation of the Pradhan Mantri Ujjwala Yojana and the distribution of LPG cylinders, there has been a greater trend of reliance on non-forest resources. There still is some reliance on forest resources in times of crisis.			Hental *(Phoenix paludosa)* and Bani *(Avicennia officinalis)* in the region.	pertinent for preservation of biodiversity, rejuvenation of the lost species is pertinent.
	Medicines and pharmaceuticals	The discussion with the community shows that there is no direct dependence. Traditionally, certain plants of medicinal value were utilized, but at present the practice is not prevalent.	+	Local	Historically, the heavy dependence of the communities on the forest ecosystem has led to a systematic reduction of species that are in demand in the region.	Historic dependence on firewood has resulted in a reduction of the populations of such plant species.while this dependecen is now reduced, rejuvenation of lost species if
	Ornamental resources	No such activity is reported.	?		NA	NA
	Harvesting of clay, minerals and aggregates	Although no direct evidence of such incidences were found, it was reported that sand, clay and gravel were extracted from the wetland to help repair and maintain *kutcha* houses.	+	Local	Overextraction of clay and sand may lead to a reduction in water-holding capacity and loss of important minerals.	Reduction in soil quality may lead to an increase in the extent of fallow land, loose soil and ingress of water.
	Energy from natural air and water flows	No such activity is carried out at the Bhitarkanika Ramsar Site.	NB	Regional	NA	NA

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
Regulatory	Air quality regulation	As there is no heavy industry producing air-borne pollutants in the region, and the state of the wetland does not make it a source of air pollutants, no empirical evidence of such a provision was available. Dhamra is the nearest port, and Paradip is the nearest industrial area (around 20 km' air distance) that might be a major cause of air pollution.	+	Regional	NA	NA
	Local climate regulation	The ecosystem supports the regulation of temperature in the region. The heavy forest cover and the presence of water bodies reduce the temperature.	++	Regional	Regulation helps maintain favourable temperatures in the wetland and supports the human population and the rich flora and fauna.	NA
	Global climate	Bhitarkanika has the largest mangrove forest cover in India after the Sundarbans. The vast forest cover supports temperature regulation in the area and climate regulation on a larger scale.	++	Regional	The large wetland ecosystem supports climatic regulations at a larger scale as well	NA
	Water regulation (hydrological flows)	The rivers Brahmani and Baitarani have extremely variable trace element concentrations. The high elemental concentration, especially in Brahamani, is also related to the presence of highly industrial areas. The effluents (from NALCO, FCI and TTPS) combine with the runoff from the agricultural fields and pollute the water Water from a stream channel or surface runoff spreads out and flows through the dense mangrove vegetation. The velocity of the flow is reduced, allowing suspended material to settle down.	++	Regional	The health of the wetland is regulated by the mangroves through water regulation and filtration of the heavy metals	The mangrove cover and density are reduced. There is also a reduction in the biodiversity over the years.

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
		The roots of the plants can then bind with the accumulated sediments. (Chauhan and Ramanathan 2008). The srudy noted highlighted the fact that the mangrove acts as a filter of the ecosystem because the water received by the coastal region from the mangroves is devoid of heavy metals.				
	Flood hazard	Located in a low-lying area, the wetland receives surface runoff water during intense rainfall. Water gets collected in the area, contributing to stream flow and ground water recharge. Wetlands act as holding areas for large quantities of surface water that can be released slowly.	++	Regional	Mangroves absorb surges in riverine water and reduce the initial impact, reducing the flood levels. Various scientific studies suggest that they help maintain the pH balance. Hence, this leads to protection of the biodiversity from damage as well as protection of lives and the property of the community.	As a consequence of increased sedimentation and a reduced mangrove cover, the flood hazard has increased over the years.
	Tropical cyclone/ storm hazard	Human settlements closer to the mangrove belts of the region experience less material loss compared with those in areas with degraded or no mangrove patches. Reportedly, the forest cover has significantly reduced the mortality of the population in the region; the highest losses were in the villages that were sheltered not by mangroves but by embankments, and the lowest per capita damage was recorded in the villages with mangrove barriers. The impact of storm surges on lives and property are highly pronounced in coastal areas where natural mangrove patches have been cleared or are in a degraded state (Needham et al. 2015).	++	Regional	Mangroves help protect the flora and fauna and reduce the loss of lives and property of the people.	According to earlier studies and the FGDS with the local community, the mangroves have played a critical role in protecting the region from the recurrent cyclones experienced in Bhitarkanika. Due to the increasing frequency of the cyclones in the region, the rejuvenation of the mangroves takes more time.

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
	Coastal erosion	Bhitarkanika National Park is located between Dhamara port, in the north, and Paradip port, 40 km towards the south. Construction of coastal structures (sea walls, breakwaters, jetties, etc.) has resulted in modification of the shoreline and geomorphology at Dhamara and Maipura. Bhitarkanika wetland shoreline erosion was reported by (Murali, et al. 2015) Community group express the soil erosion in recent time.	++	Local	According to the local communities, people have been displaced due to coastal erosion. The village of Satabhaya was relocated entirely to Bagpatia. Further, this led to a loss of fertile agricultural land and residential areas.	The phenomenon has resulted in a loss of mangrove cover as well as increased saline intrusion in the region. Further, the loss of farmlands and people's HHs can be ascribed to the decline in mangrove cover. Thus, targeted rejuvenation of such species will be beneficial in restoring the balance.
	Pest regulation	No information was available.	NB	Local	-	-
	Pollination	The wetland has large populations of pollinating agents such as butterflies, wasps, and bees.	+	Regional	Pollination plays a key role in regulating ecosystem services that support food production, habitats and natural resources.	Both, agriculture and the mangrove ecosystem are reliant on the pollinating agents for their subsistence
	Noise and visual Buffering	Areas with thick vegetation benefit from a buffering of noise and protection from sunlight. They are also aesthetically beautiful, attracting more tourists.	+	Regional	The vegetation helps maintain optimal temperatures in the wetland.	NA.
Cultural	Cultural heritage	The communities have deep connections with the water bodies as well as the forest. Many local functions, activities, songs, folklore and interactions are closely associated with the water bodies and forests.	+	Local	NA	NA.
	Recreation and tourism	Ecotourism has been promoted in the area by the state government. Local, national and international tourists are attracted by the beauty of the ecosystem and the experience it offers.	+	Regional	Currently, the administration is following a sincere and conscious approach to	NA.

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
					promote ecotourism with minimal harm to the ecosystem. With expansion of the scope of the tourism, one may have to evaluate its impact on the mangroves. The optimal water and carbon footprints of the tourists, the GHG emissions and the resultant impacts on the wetland needs to be evaluated.	
	Aesthetic value	The ecosystem adds tremendously to the aesthetic value of the region.	+	Local	NA	NA
	Inspirational value	The help of the goddess of the sea and rivers, locally known as Ganga Devi, is sought in navigating at sea, in increasing the fish catch and in obtaining protection against bad weather.	+	Local	-	-
	Spiritual and religious values	The ecosystem holds high religious value for the community. The forest has an ancient temple as well. During the occasion of Sankaranti puja , some locals, along with the priest, make offerings to the deity. Also, an annual mela is organized in which there are participants from Bankuala, Nua Sahi and Dangamal (Dangamal Panchayat). This happens during the month of Chaitra (Odia calendar), i.e., during March–April.Further, some local ceremonies and pujas are carried	+	Regional	During the festivities, the local people make certain offerings that may pollute the wetland.	NA

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
		out along the river banks in the wetland. An informal fishermen's collective is named after the deity, i.e., Ganga Mata Traditional Fishermen's Association.				
	Social relations	The wetland and the ecosystem services provided have been pivotal in attracting and supporting the communities. Activities such as fishing, grazing and cultivation of crops have developed within and around the wetland.	+	Global	Research studies help evaluate the health of the ecosystem continuously and strengthening our understanding of the biodiversity and preservation of the same.	NA.
Supporting	Soil formation	The wetland ecosystem helps soil formation via the accretion processes (both sedimentation of mineral material and building up of organic material).	++	Local	As indicated above.	As indicated above.
	Primary production	The nutritional needs of the community residing in the wetland as well as in the Group B zone are met by the agriculture and fishing practiced in the wetland. About 49% of the HHs (i.e., half the HHs in the Bhitarkanika region) are currently dependent on agriculture, and 11% depend on fishing.	++	Local	As indicated above.	As indicated above.
	Nutrient cycling	Wetlands contribute towards nutrient cycling through inputs and outputs from agricultural land, internal cycling of plant material, floodwaters, presence of fauna and more	++	Local	As indicated above.	As indicated above.
	Water cycling	The health of the wetland is regulated by the mangroves through water regulation and filtration of the heavy metal in the water.	++	Local		

Ecosystem Services	Service	Details	Benefit	Scale of Benefit	Impact on Wetland	Resultant Impact on ecosystem
	Provision of habitats	The wetland is home to as many as 280 species of bird. Both resident and migratory birds use this mangrove wetland during some part of the year or other. Bagagahan, the heronry, is amongst the largest in Asia. About 30,000 resident water birds nest in a compact area of 4 ha. The park attracts about 1,00,000 migratory birds in winter. More than eight species of kingfisher and five species of woodpecker are found in Bhitarkanika, highlighting the biodiversity of the area (Das & Chhaterjee 2015).	++	Global	As indicated previously	As indicated previously

Photo credit: TARU

Finding new homes: The crucial case of Satavaya

Satabhaya is a remote village in the Bhitarkanika Mangroves, in Rajnagar Tehsil, Kendrapara District. The current population of the village is around 4000, with 571 households. The village is a part of the Satabhaya Gram Panchayat, in which the villages of Kanhupur, Gahirmatha and Gobindpur fall. The sarapanch, Ms. Rasmita Sahani, says that in 1971 Gobindpur was badly affected by a cyclone and that there were more than 700 deaths. The submergence of the land in the sea resulted in the relocation of the population to Okilapa, 12 km inland. The relocation of the people was facilitated by Bhudaan Andolan (Land Gift Movement).

"That was the first time as I can recall, that we suffered so much. Everything was destroyed, our homes, fields, livestock and all our belongings. We were still optimistic that the water will recede and eventually, we will live on the little space that is left of our land. But nature had other plans," said Sunakar Behera, 73, a resident of the former Gobindpur village and current Okilapala village.

A similar series of events happened because of the 1999 super cyclone, and people had to relocate from Kanhupur village to Magarkanda and Rabindrapalli villages from Satabhaya. ***"These were the two sudden events which required us to find another place to live. But in Satabhaya, the story was slightly different",*** Banchhanidhi Patra, aged 75, mentions. He then continues to say, ***"The sea was at a distance of almost 5 km when they were young but over time it came as close as 50 m".*** The community believes that the 1999 cyclone was the trigger event for this change. As indicated, after the event, there was regular water ingress in homes and agricultural fields in Satavaya, resulting in an incremental dislocation process.

Agriculture has been the primary occupation in the area. An increase in water salinity and expansion of creeks contributed to the difficulties of crop production. The sarpanch, Rasmita Sahani, explains: ***"There was around 800 ha of agriculture land in the village which began reducing. There was more water in the fields than was required by the rice to grow and was highly saline. Our yield declined, and the sea water and the sand almost reached our homes during the rainy season."*** The increasing salinity of the water in the wells made it difficult for the people to have access to safe drinking water. From around 2012–13 onwards, people began to move inwards from Satabhaya.

Majority of the community from Satavaya had to restart their lives in Bagpatia, which is almost 10 km from their previous village. Here, the relocated households were allocated 0.040 ha (10 decimal land area) each for construction of their houses, but no land was allocated to help continue with their means of livelihood, i.e., agriculture. ***"We lost our only means of livelihood, our fields,"*** says Trilochan Sethy, aged about 68, from Bagapatia.

Fewer than 15% of the households from Satabhaya have managed to retain their agricultural land in the village. The majority are dependent on shared agriculture practices for income generation in villages close to Bagpatia. The household income has declined over the years, and migration for better sustenance opportunities has increased.

3. ECOSYSTEM SERVICES– LIVELIHOOD LINKAGES

Photo credit: TARU

Image *community members from around the wetland*

3.1 Background

This report provides details of two core aspects required to arrive at an integrated management plan for the Ramsar site as per the WIAMS framework. This includes making an inventory and conducting an assessment of the ecosystem services, livelihoods, institutions and governance.

Figure 7 *Components of integrated wetland management planning covered in this study (Source: An Inventory, Assessment and Monitoring Framework for Indian Wetlands, 2020.)*

Table 7 *Indicators of ecosystem services and livelihoods*

INVENTORY		ASSESS	
• Identify benefits and beneficiaries • Map services, interactions and trade-offs • Understand spatio-temporal availability of services • Determine livelihood dependence on wetlands		• Understand the trends in ecosystem service values • What are the trade-offs? • Determine the impact of wetland degradation on livelihoods • Determine the impact of livelihoods on the eological character of wetlands	
Parameter	**Indicator**	**Parameter**	**Indicator**
Listing of ecosystem services	Provisioning, regulatory, cultural, supporting	Trends in ES provision in relation with underpinning wetland features	Yearly trends in ES derived from the wetland components, processes
Identification of nursery sites		ES services trade - offs	Reported resource use conflicts if any
Ecosystem service beneficiaries	List of stakeholders dependent on wetland services	Changes in wetland use and priorities	Cultural practices, change in extraction practices

Seasonal variation in ecosystem services	Ecosystem services distribution throughout the year	Trends in livelihood diversity and impacts on wetland features	
Demography around the wetland	Population, occupation profile, seasonality, migration, income profile	Threats to existing livelihoods from changes in wetland features and competing livelihoods	
Dependence on wetlands	Type (livelihood, culture and identity), extent, seasonality	Vulnerability assessment - direct and indirect drivers of change in wetland ecology impacting livelihoods	Frequency and intensity of flooding, storm surges, drought, spread of invasive species, use of pesticides and fertilizers, fragmentation land use change
Resource use systems (valuation)	Capture fisheries, culture fisheries, vegetation-based enterprise, ornamental fisheries, wetland agriculture, salt production, food and medicinal products, tourism (quantity, quality, income generated techniques and equipment)		

(Source: An Inventory, Assessment and Monitoring Framework for Indian Wetlands, 2020)

In accordance with the framework presented, this section details the demographic profile of the Bhitarkanika Mangroves, the population characteristics, the ecosystem services, the dependence of the population and the livelihood trends. The development of the site management plan should be conducive to all the present stakeholders in the region. Specifically, the composition of the community, details of the multiple groups and the socio-economic characteristics help identify the level of vulnerability exhibited and thereby convey the dependence on the ecosystem services. Further, this provides information about the bargaining capacity of the local people and the resource allocation mechanisms that are effective for sustainable management of the region.

This section, thus, focuses on development of a socio-economic baseline of the region and assessment of interlinkages between livelihoods and ecosystem services. Further, an outline is provided of the socio-economic conditions of the representative population in Bhitarkanika, the extent of its dependence on the wetland resources, its income and livelihoods and plausible means of arriving at a management framework that supports ecological conservation and preservation and provides sustenance for the community. As indicated in the methodology section, for the purpose of the assignment, the site has been categorized into four regions to analyse the inter-dependence levels.

3.2 Demographic Details of the Bhitarkanika Ramsar Site

Population characteristics provide essential details for site management and development. Underlining the critical areas of caste and gender, disaggregated data present an opportunity to locate these in the socio-economic fabric of coastal India and consider the welfare mechanisms required for better subsistence support for these vulnerable groups when developing an integrated management plan for Ramsar Sites.

The Bhitarkanika Mangroves has been at a confluence of community and nature. With the declaration of the region as a wildlife sanctuary and national park, a need for maintaining a balancing act between the two forces has received priority. The population in the region has increased four-fold between 1951 and 2011, with heavy migration from Bangladesh between 1961 and 1971 (S. Banerjee, 2016). According to the 2011 census accounts the total population is 2,29,826 and there are 47,816 households in the Ramsar site.

The rising trend of the population is presented in Figure 7. It indicates a population increase of more than three times of what it was in 1951 in the region, at which time there were 38,148 people in 183 villages (census data). According to the 1991 census, there were 309 villages, with a population of 1,18,939 people, and in 2011, there were 401 census villages (list of villages in Annexure 2), with a total population of 229,826 in Bhitarkanika (including the additional villages and excluding 52 villages as per census 2011).

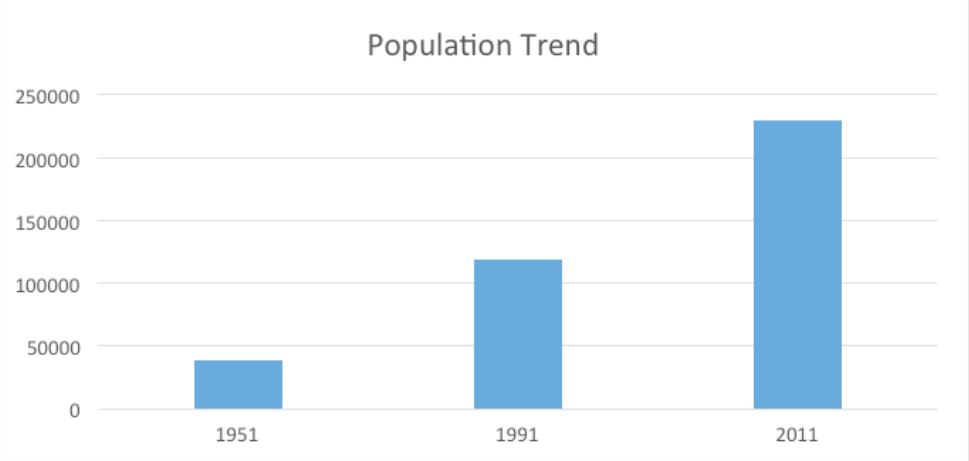

Figure 8 *Population trend*

The rising population resulted in an increasing reliance on the wetland services. Subsequently, over the decades, there has been a greater burden on the limited wetland resources, resulting in a greater need for preservation and management of the ecosystem diversity.

Image *Fisher folk near the wetland*

3.2.1 Demographic Details

The Ramsar site is home to various communities. The OBC population is the majority (46%), followed by the General (33%), SC (18%) and ST (3%) groups. Historically, the region has been home to a large number of populations that have migrated from the neighbouring state of Bengal. Thus, unlike the rest of the state, Bhitarkanika has a large number of Bengali linguistic communities in the coastal areas. The Odiya-speaking groups reside inland. The region is populated with OBC sub-castes rather than ST groups, which traditionally reside near forest areas.

The family size was found during the survey to be 4.63, slightly larger than the average family size in Odisha, as per the NFHS (4.5). Further, a larger percentage of families was found to be nuclear (86%) than joint (14%). The total female population in the sample covered is 47.6%, and the male population is 52.3%. Hinduism is practiced by most of the population (97%), followed by Islam (3%) (Figure 8).

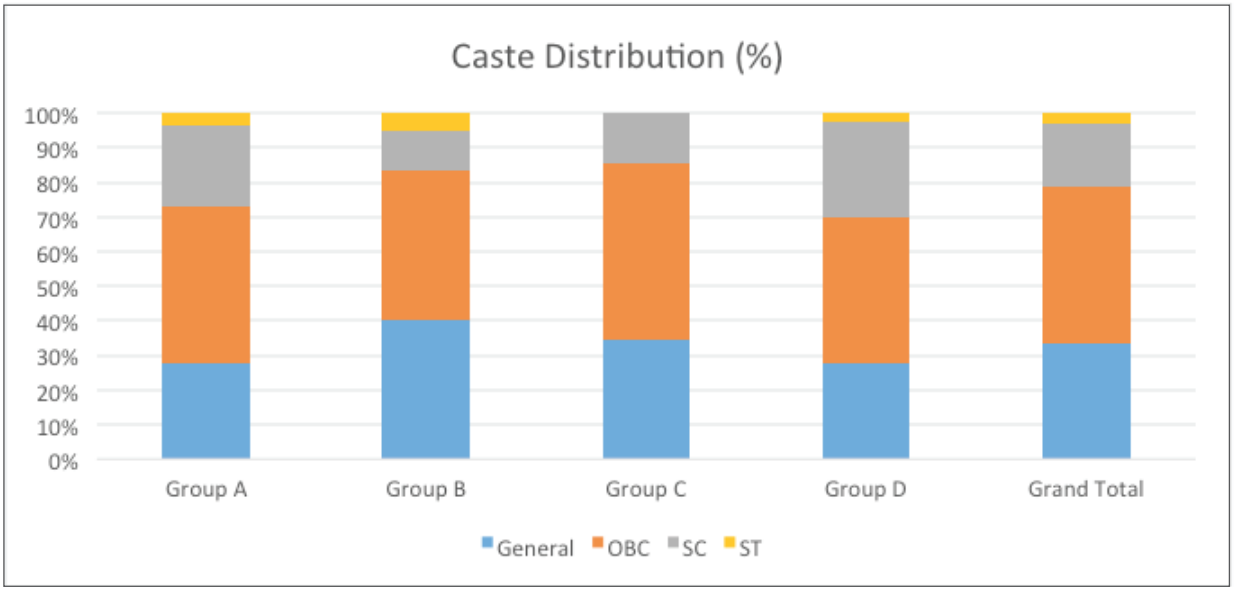

Figure 9 *Caste Distribution in Bhitarkanika Mangroves*
(Source: Taru Leading Edge, 2021)

The female members account for 47.6% of the population among the surveyed HHs. The traditional division of roles between women and men is fairly dominant as in other parts of India. The female members are responsible for the maintenance of the house, childcare, supporting livelihood activities (such as field preparation, crop sowing, and cleaning, separation and drying of the fish catch), care of the livestock and suchlike. The female members are not paid for the services offered in supporting the family income. Further, only 2% HHs have registered assets in the name of female family members. It was found that although there are bank accounts in the names of female family members, their male counterparts maintain the accounts and manage the finances.

3.2.2 Education Status

The literacy levels were found to be very low, with only half the population having completed formal school education up till standard 8. Only 28% of the surveyed population had completed formal school education till class 12 (28%). The literacy rate in Bhitarkanika (85.15%) is marginally lower than that of Kendrapara District. The literacy rate of Odisha is 72.87% as per the 2011 census, and the national literacy rate is 74.04% (Directorate of Census Operations 2011).

This indicates disproportional access to education opportunities in the region. Higher education is accessible to only 1.5% of the total surveyed population and post-graduation to 0.5%. 0.3% of the male members of the population and 0.2% of the female members are post-graduates. Technical courses offering degrees are accessible to 0.6% of the population (0.28% males and 0.26% females).

These data reflect the limited opportunities for higher education in the region. The communities are pushed towards greater dependence on the available natural resources for their sources of livelihood. There is an urgent need to support the local population with skill-building and better opportunities that will facilitate effective ecosystem management in the region. Access to education is a limiting factor due to infrastructure constraints. The numbers of high schools and colleges in Bhitarkanika are small; primary and middle school facilities are more accessible. There are only 15 government high schools and two degree-colleges in Rajnagar Block.

Because of the limited access to affordable education, there are few opportunities for employment and for building knowledge about ecological preservation. The population, particularly the children can be sensitized to adopt eco-friendly practices and contribute towards the conservation of the region by strengthening the educational institutions and literacy.

Image *Firewood collection*

3.2.3 Housing and Other Amenities

Traditionally, the population in the area has lived in kutcha and semi-kutcha houses, built from locally available resources. The people have been dependent on the forest resources for building their houses. The locally available Hantal has been widely used for roofs, but over the decades, the community's dependence on the available forest resources has reduced, largely because of the regulations relating to access to forest resources. Crop residues were predominantly used for preparing the roofs, and they were tied using ropes. After the 1999 cyclone, concerted efforts were made to provide housing to people with pucca roofs. Efficient and affordable housing initiatives that are sensitive to the geography of the area and innovative architectural designs that help minimize the impact of extreme events would be a step forward in supporting the communities in the region under schemes such as Biju Pucca Ghar Yojana and Pradhan Mantri Grameen Awas Yojana.

94% of the HHs have access to electricity, but toilet coverage has been achieved in only 53% of the HHs. The percentage of HHs with electric connections in Group A is 89.3%, and 97% of the HHs in the Group C area and in Group D have electricity. The survey indicates that the toilet coverage is poor everywhere in the Bhitarkanika Ramsar Site. This indicates a need for institutionalization of robust and safe waste management systems at the site.

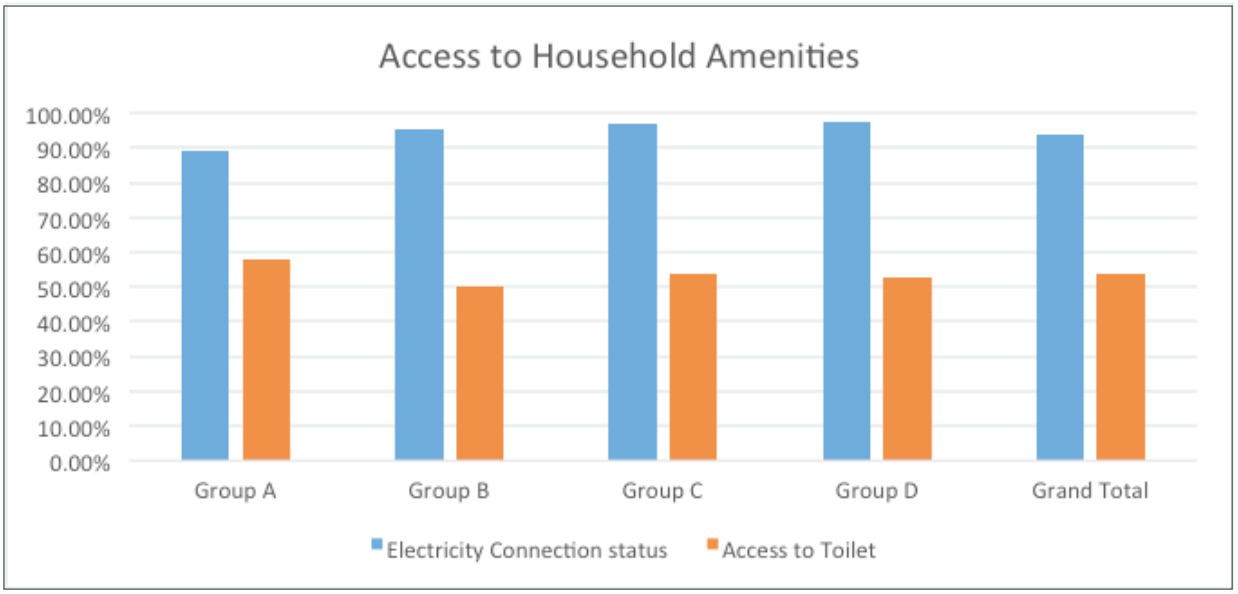

Figure 10 *Access to household amenities at Bhitarkanika Mangroves*

Communication devices are occupying greater roles in the lives of people, providing a plethora of services including real time communication, spreading awareness and supporting disaster response channels and entertainment. There is a growing reliance on mobile phones as sources of information, tools of financial management and tools for emergency communication services. In a place like Bhitarkanika, higher mobile phone penetration has the potential to facilitate state-led governance and site management.

96% of the HHs surveyed own at least one mobile phone, with 56% having feature phones and 40% having smartphones. Larger percentages of houses in the Group C and Group D areas have smartphones, i.e., 48% and 53%, respectively, whereas only 33% of the HHs in the Group A area have smartphones.

90% of the community of the Ramsar Site own the houses they are living in. Livestock (cow/buffalo) maintenance is higher among the HHs of Group A (34.09%) and Group B (33.58%) compared with Group C (18.8%) and outside

Bhitarkanika (13.53%). Whereas, even lesser number of HHs practice goatery in the Group C and outside Bhitarkanika area (12.5%).The people own cycles and two-wheelers. In the Group A area, a higher percentage of HHs own cycles (34.19%) compared with other areas, but the ownership of two-wheelers is much less (21.82%). In Group B, Group C and Group D, the pattern is reversed, with larger percentages of HHs having access to two-wheelers compared with bicycles.

Table 8 *Details of asset ownership at the Bhitarkanika Ramsar site*

Particulars	House Ownership (%)	Livestock Ownership (%)		Vehicle Ownership (%)		TV/Radio Ownership (%)	Total
		Cow/Buffalo	Goat	Cycle	Two-Wheeler		
Group A	87.72	34.09	38.64	34.19	21.82	25.06	300
Group B	93.06	33.58	36.36	27.57	30.00	30.83	300
Group C	94.71	18.80	12.50	22.79	27.27	28.07	200
Group D	86.49	13.53	12.50	15.44	20.91	16.04	120

(Source: Taru Leading Edge, 2021)

3.3 Access to and Status of Provisioning Services

3.3.1 Drinking Water

The 2018–19 groundwater year book published by the Central Ground Water Board reports that the maximum fall in water level in the districts of Odisha was recorded at Kendrapara (94%). Another report, published by Climate Research and Services, India Meteorological Department (IMD), Ministry of Earth Sciences, documents the rainfall variability and changes over Odisha in 2020. There is a significant increase in the number of dry days in all the districts of Odisha. The number of dry days is greatest in some parts of Kendrapara, Jajpur, Cuttack, Khurda, Jagatsingpur, Puri, Ganjapm, Bargarh, Bolangir, Nawapara, Koraput and Malkangiri districts (66-70 dry days out of 122 days during the monsoon). These studies substantiate the fast decline in groundwater in these districts.

Tube wells are the main source of drinking water for the HHs. On an average, a village has access to four sources. In summer, i.e., between March and June, there are fewer sources because of the high iron and saline content in the water. The average depth of the tube wells in the region is 200-250 m (approx. 700-800 ft.) During summer, the village population is dependent on one or two sources that are even deeper, up to 300 m (approx. 1000 ft.) According to the community, there is iron content in the water at all times and has to be removed using traditional filtration techniques such as tying a cloth around the mouth of the source.

Historically, the population was dependent on open wells. Saline intrusion, an increase in the levels of other impurities and and an aspirational shift caused a move towards tube wells. Over the last decade, there has been a demand for piped water among the population.

Water drawn from the ground is provided from overhead tanks (OHTs) through pipes in a few villages in the region, including Rangani, Talchua, Gupti and Bagapatia. Groundwater is being extracted further to meet the increasing demand in the region. Tube wells are dug to depths of 800-1000 ft. and lifted to OHTs for distribution. The Rural Water

Supply and Sanitation Department, GoO is the authority that maintains the water supply, in coordination with the Department of Panchayati Raj and Drinking Water. The Junior Engineer, Rural Water Supply and Sanitation Department, Rajnagar Block, says that the piped water supply is to be provided across the site to every HH by 2024. Under the current design, the overhead tanks are fitted with four-phase 10 HP water pumps, and the electric bills are paid by the gram panchayat from untied fund allocation. All major sahis (hamlets) are provided with a piped water supply from within 2-3 revenue villages. The department provides water delivery points (taps) for every 5–10 HHs. Water is supplied twice a day. The drinking water supply network in Rajnagar Block includes 16 overhead tanks and 1800 tube wells, covering approximately 4800 households and a population between 2.7 lakhs and 3.2 lakhs.

Image *Handpump at a nearby village*

The heavy dependence of the population on groundwater has led to excessive extraction, which is a contributor to the high pressure on the aquifer. Seawater intrusion is a consequence of overexploiting coastal freshwater aquifers. These may lead to drastic consequences such as aquifer overdraft and even subsidence or sinking of the land in the long run (KRISHNA 2009).

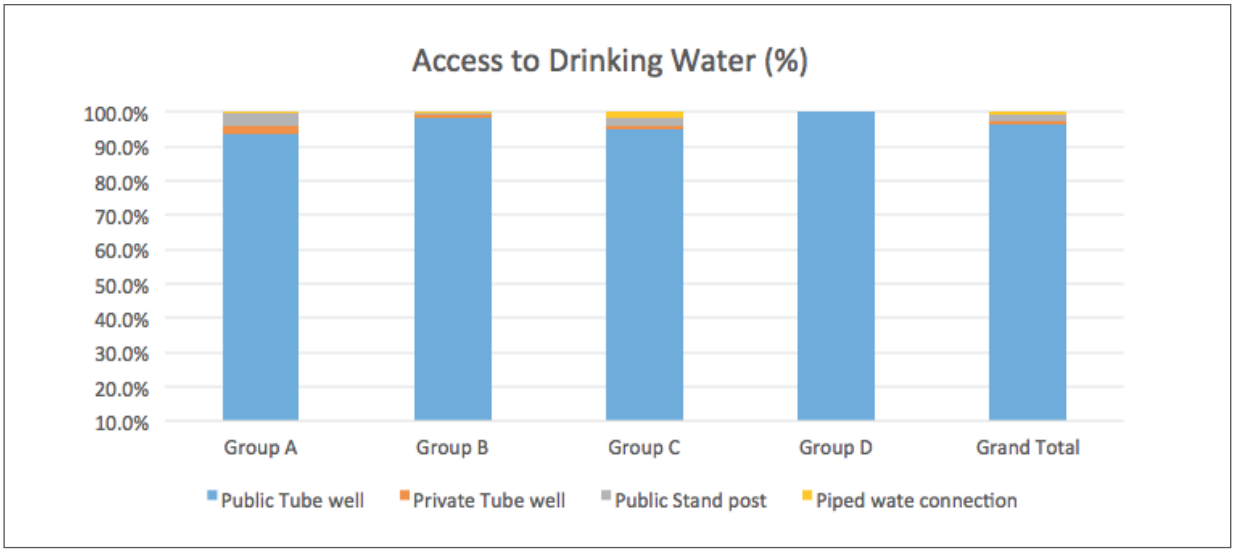

Figure 11 *Access to drinking water at the Bhitarkanika Mangroves*
(Source: Taru Leading Edge, 2021)

The quality of the available water was assessed by asking the community about its salinity. As indicated in figure 11, according to the HHs surveyed in the Group A area there was a high level (66%) of saline ingress in the water sources, 38% in Group B and 34% (lowest) in Group C.

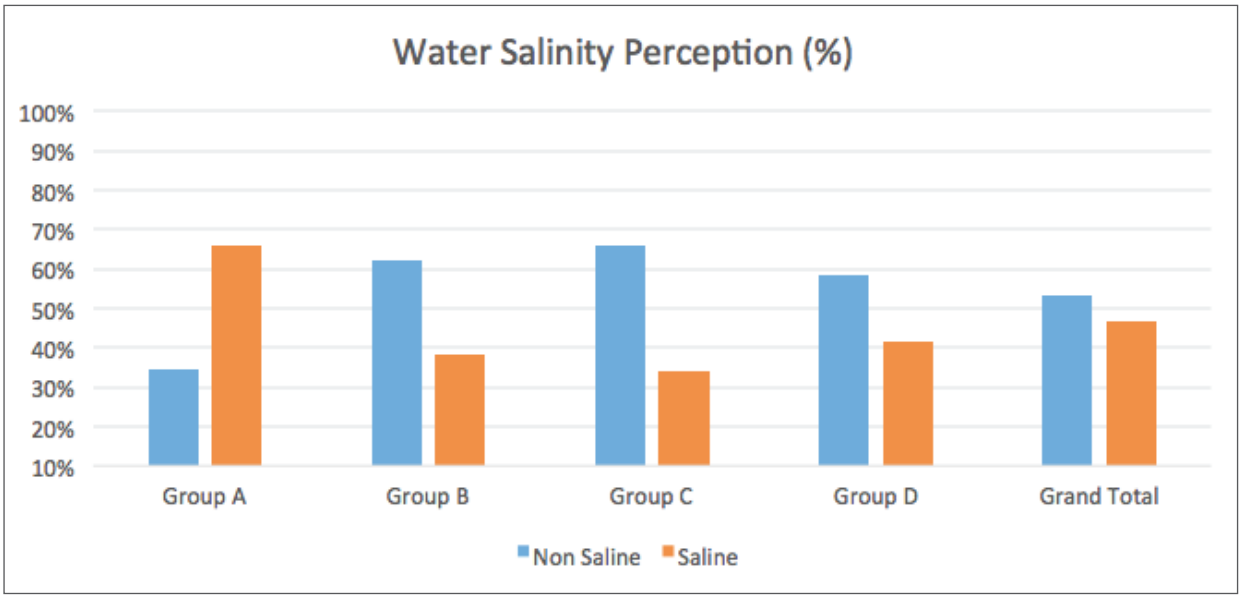

Figure 12 *Water salinity perception at the Bhitarkanika Mangroves*
(Source: Taru Leading Edge, 2021)

The population needs water for personal needs and household chores in addition to drinking. There is considerable dependence of the HHs on ponds/tanks for water for these in the Group A area (48.3%). The dependence is greater in the Group B (66.7%) and Group C (79%) areas (figure 12).

The groundwater information booklet of Kendrapara District suggests that the entire district suffers from a salinity problem and that it is essential to precisely identify the freshwater aquifers through borehole logging to avoid failure of tube wells in the saline hazard tract. However, in the saltwater-intruded areas, which constitute more than 60% of the district, suitable rainwater harvesting is necessary.

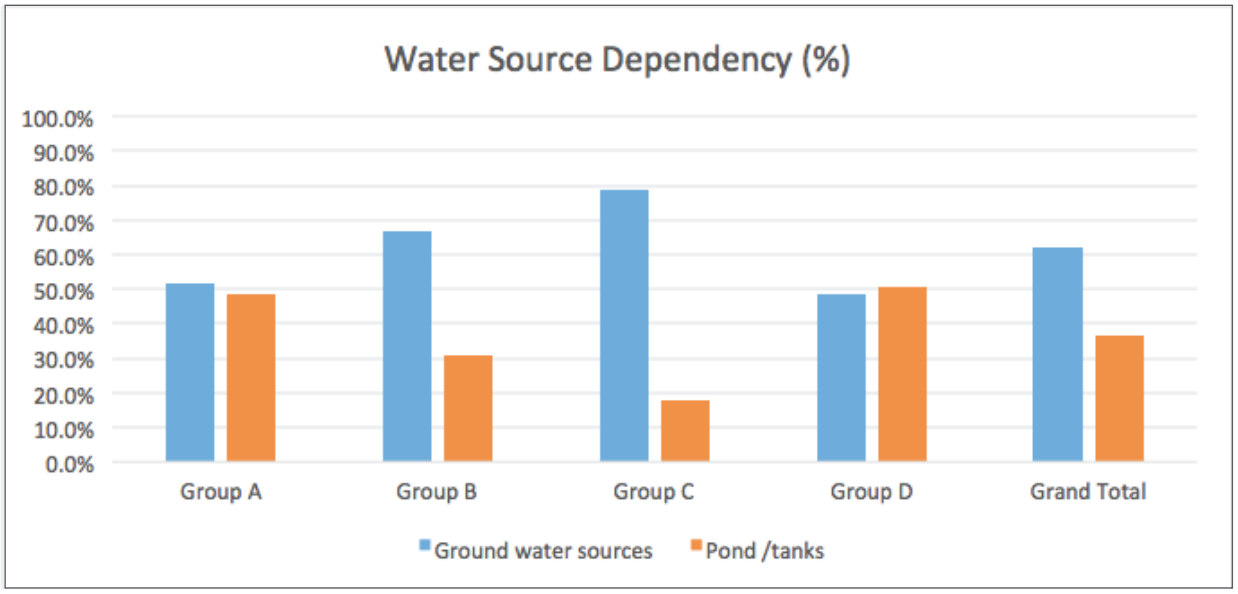

Figure 13 *Water dependence at the Bhitarkanika Mangroves*
(Source: Taru Leading Edge, 2021)

3.3.2 Fuel

The local people use LPG, crop residues, cow dung, dry coconut leaves, etc. as cooking fuel. LPG and crop residue are the fuels used most, followed by cow dung and dry coconut leaves. Recently, Pradhan Mantri Ujjwala Yojana has made LPG accessible to the HHs. However, the dependence on LPG for cooking is still limited (26%) according to the surveyed HHs. Cow dung is kept in reserve. Crop residues are also a popular fuel (28%).

The primary data collected through the HH survey, FGDs and KIIs indicate that there is a decline in the use of firewood for HH fuel needs. LPG gas connections have taken precedence due to the provisions under the Pradhan Mantri Ujjwala Yojana scheme. According to the FGDs, the government is facilitating continued usage of LPG as the primary fuel source. LPG connections and refilling have reached the remotest location, but there is a demand-and-supply gap.

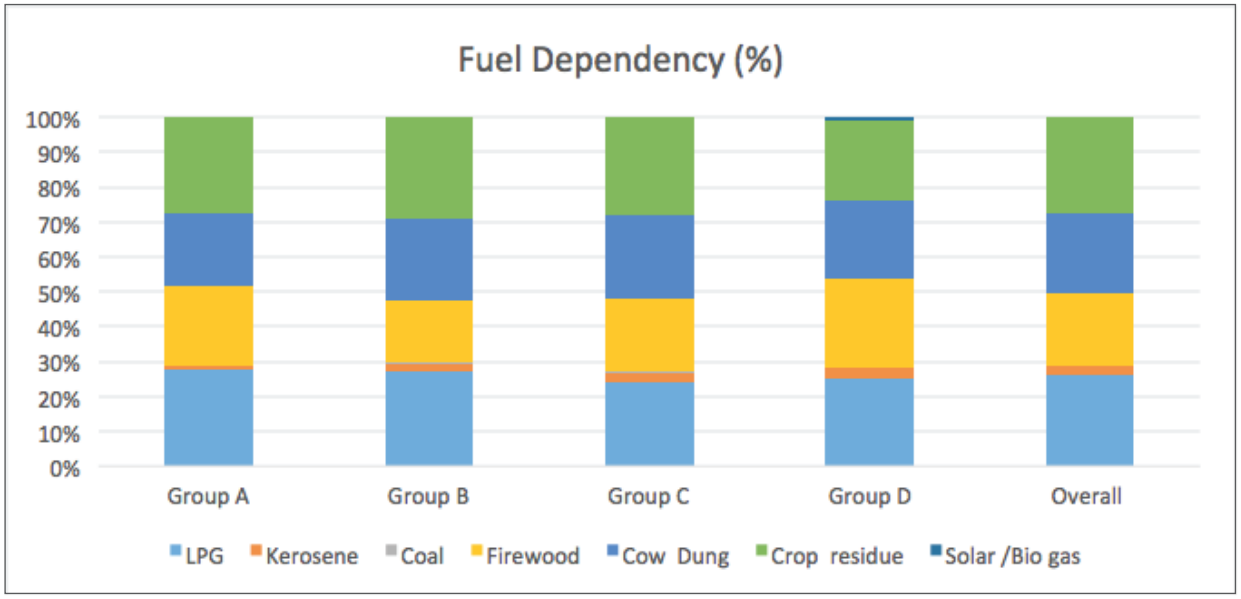

Figure 14 *Fuel dependence at the Bhitarkanika Mangroves*
(Source: Taru Leading Edge, 2021)

3.4 Access to Services

3.4.1 Connectivity

The Bhitarkanika Mangroves is accessible via road, rail and air. Bhubaneshwar airport is located around 172 km from the site via the Cuttack–Chandabali Road. Via NH 16, the distance is 190.5 km. The nearest railway stations are Paradip (54.63 km) and Bhadrak (55.37 km). All-weather motorable roads connect the villages. The community has access to a bus service that connects all the nearby towns. Thus even remote villages on the borders of the national park, such as Talchua, enjoy connectivity. The only exception is the village of Pattaparia, in Rangani Panchayat, where road construction is pending and only a kutcha road is present. This becomes highly inconvenient during the monsoon, during which season the path is flooded. Some areas within the Ramsar site are accessible by boat. Group A areas such as Talchua and Dangamal Panchayat are connected to Chandbali and Dhamra port. Two boats are used by the people of these regions to commute.

3.4.2 Health Services

There is a health infrastructure in some parts of the wetland. There are PHCs in a few panchayats such as Talchua. Rajnagar Block has medical facilities, but the population can access specialized services only in Cuttack and Bhubaneshwar.

3.4.3 Income and Livelihood

The population in Bhitarkanika Mangroves has mainly been dependent on the land and water resources for its livelihood. The primary income generation activities are agriculture or fishing, according the topographical setting of the HHs. Interestingly, the dependence on one occupation, i.e., the primary occupation, for income is not ideal in Bhitarkanika. It was observed that the HHs engage in multiple activities during different times of the year to meet different family needs. To elaborate, agriculture is practiced by 43% of the surveyed HHs. People cultivate their own farms or practice sharecropping or farm leasing. They also work as daily labourers. Fishing is practiced 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.

Public works development under MGNREGA is another source of income for the households. During the Covid pandemic, MGNREGA has been an important support of family incomes. Cattle rearing is limited to household dairy consumption, with the exception of villages such as Ekmania (Ekmania Panchayat, Group C), where cattle rearing is one of the main sources of livelihood. The village has around 2500 buffaloes, and milk is sold locally and in the adjoining villages. Goat rearing and poultry also support household incomes in villages such as Kurunti and in Bramhansai Panchayat. In Kurunti, goat rearing is encouraged under the Odisha Livelihoods Mission. Furthermore, greater numbers of HHs are taking up shrimp cultivation.

Shrimp cultivation has been taken up as an income-generation activity over the last decade. High-risk, high-return shrimp cultivation is supported by a strong input supply chain, credit and buy-back of produce by seafood export firms and their market agents. The shrimp ponds are dispersed among paddy fields in estuarine areas and along the dilute estuarine water zone of Talchua, Rangani, Keruanpal, Bramhansai and Hatina. 30% of the paddy cultivators along the creek and tidal river have converted paddy fields to shrimp farms, and the area under shrimp cultivation is increasing. Migration for better job opportunities is common in Bhitarkanika. About 35% of the surveyed HHs mentioned that at least one member in each HH has a job outside Bhitarkanika. The younger people in the region are moving towards greener pastures. They are moving for better incomes to states such as Kerala, Tamil Nadu, Gujarat and Delhi, where they take up jobs such as plumbing, carpentry and civil works. The survey shows that the migration trend is more prevalent amongst families dependent on only agriculture as their income source. These families are mainly in panchayats such as Bramhansai, Hathina and Kurunti (amongst the surveyed panchayats).

In addition, ecotourism is presenting opportunities for income generation: investing/participating in commercial activities such as running homestays, running food stalls and boating. However, tourism is a seasonal activity at this Ramsar Site. The season is from October to February.

As can be inferred from the foregoing, Bhitarkanika Mangroves is still in a labyrinthine concept of development, with agriculture as the major livelihood support activity. Although, it is close to Paradip and Dhamra port, there have been concerted efforts to retain the ecosystem of the Ramsar Site. Avenues such as shrimp cultivation and trawler-based fishing are still fairly new. The commercial units involved in these activities have little impact on the incomes of the local population. Migration in search of better job opportunities to different states of India as well as outside the country is becoming popular. Thus, one may conclude that family incomes in Bhitarkanika Mangroves are sustained by multiple sources, with agriculture contributing a seasonal income and nutrition. Fishing helps provide a regular cash flow. Fish is also a part of the staple diet. This observation indicates that the sources of income may not be looked at as mutually exclusive but mutually complementary.

Table 9 presents a snapshot of the major livelihood activities and their dependence on the ecosystem services. It also highlights the trajectory of shifts in livelihoods by presenting a historical perspective and linking it with the phenomena observed in the region during the study. Further, the issues identified pertaining to the ecosystem–livelihood interlinkages have been listed.

Table 9 *Snapshot of major livelihood activities and their interdependence on the ecosystem services*

Ecosystem/Activity	Livelihood	Population Dependence		Historical Practice	Current Situation	Interlinkages/Income Generation	Impact	Issues
Agriculture	Rice forms the staple diet. The population primarily engages in paddy cultivation for supporting its HH needs. Almost one in two families in Bhitarkanika is involved in rice cultivation through its own or leased farmland. After retaining the paddy required for household consumption, the surplus is sold in local markets. In some areas, away from the national park boundary, green gram is cultivated after the paddy harvest. As only a few HHs engage in this two-crop agriculture, details are not available. Further, vegetables are grown by some HHs along the water bodies (irregular activity).	43%		Till the late 1990s, multiple cropping was practiced, i.e., paddy cultivation followed by green gram and vegetable cultivation. The rice cropping system involves indigenous varieties such as Sathia, Belandi, Rajamaali, Sola, Moti and Hira Kalama. Green gram was cultivated in upland paddy fields in winter. In the mid- and low-lying areas, vegetables such as green chili, lady's fingers, brinjal, bitter gourd, pumpkin, cauliflower, cabbage and tomato were grown as winter crops. The cropping system met the household's requirements, and the marketable surplus was sold locally.	High-yielding varieties have replaced traditional paddy varieties. The high-yield potential often outweighs the high input costs of the seed, fertilizers and chemical insecticides. Close to 95% of the paddy cultivation-practicing farmers grow improved paddy varieties. A few cultivators (less than 5 %) in low-lying areas practice traditional means of paddy cultivation. Agricultural practices are mostly dependent on rains. Cultivation practices depend on markets for seed, chemicals and fertilizers.	The population in Bhitarkanika has adopted traditional farming practices to support its subsistence needs. Thus, there is a high dependence of the population on the ecosystem as it provides soil, a conducive environment, water for irrigation, fodder and pollination services. As estimated 1000–1200 kg of rice is produced in 0.40 ha of land. The ownership of cultivable land varies from 0.68 ha to 0.38 ha. A typical cultivator reportedly earns a revenue of INR15,000–18,000 (INR9600–11500 constant price) from 0.4 ha. Sharecropping is a common practice.	Because of the increase in salinity, the groundwater and tidal rivers are no longer conducive for gram cultivation. This has led to an increase in the extent of fallow cultivable land at the Ramsar site. Conversion of paddy fields to shrimp farms has further impacted the rice cultivation where the land is located along creeks/tidal rivers and tributaries	Increased soil salinity has led to mono-cropping. The hybrid varieties of the crops preferred now have led to increased use of chemical-based fertilizers and pesticides as well as an increase in the input cost. This pollutes the water, soil and biota, affecting the human and ecosystem health.

Ecosystem/Activity	Livelihood	Population Dependence	Historical Practice	Current Situation	Interlinkages/Income Generation	Impact	Issues
Estuarine Fishing	Fishing is the second predominant occupation. It provides employment to 11% of the HHs in Bhitarkanika (it also forms 20% of the secondary income source). Brahmani and Baitarani are the two main rivers of the Ramsar site. Thanks to the diversity of ecosystems, inland, estuarine and marine fishing are practiced here. The benefits are enjoyed by the HHs located in the proximity of the resource, traditionally. The ecosystem resource has predominantly supported traditional fishing practices and fibre boats. Over the years, trawler-based fishing has also been taken up. However, people mostly work as wage labourers in trawlers, while the ownership rests with corporates. Trawlers were introduced in Odisha in 1960.	11% 	Fishing has been a dominant subsistence activity in this region. Interestingly, over the years, the Bengali speaking linguistic community has settled near the water bodies and has engaged in fishing, unlike the Odiya-speaking group, which has had limited exposure to fishing activities due to the location.	Still, the majority of the population that practices fishing engages in traditional fishing practices, with a few people owning country craft, such as “dongas”, while others own motorized fibre boats (9–20 hp engines), such as “bhut-bhutis” and gill netters. Primary reports suggest that 11% of the HHs depend on fishing primarily for their income. For almost 20% of the HHs, fishing is a secondary source of income. Fishing boats are owned by 35% of the HHs, while 23% of the HHs rent boats. Also, members from 41% of the HHs work on trawler boats.	Fishing is practiced by the HHs for personal consumption as well as for maintaining a cash flow. Mostly, they go fishing on country boats as group of two or three people. The fish catch is sold to the middlemen on a regular basis, and the average earning per week is INR800–900 (INR500–570, constant price). The people who go fishing in trawler boats usually earn INR10,000 –12,000 (INR6400–7700 at constant price) in 26 days, i.e., almost a month’s time. The fishes that are commonly caught include the Hilsa, Lotia, Pomfret, Borei Kantia, Maala, Koni Pateli, Manohari, Bhuasa Prawn Khasuli, Tuali, Kantia, Vekti, Khanga Khasuli, Vatei, Tiger Prawn, Bhodei Prawn, Manohari, Patpatia, Cheruan and Chitua Crab.	Fishes and other small aquatic animals are part of the larger food chain. Deep -sea fishing by trawlers has an impact on the coastal fisheries and coastal habitats. Overfishing and the use of finer nets by trawlers have resulted in a reduced catch diversity. Juvenile fish are caught, which has further reduced the fish yield. Over the years, fish species such as prawns, Khasuli, Manohari, Vatei, Kantia and Balia have become rare due to overfishing and continued catching of fish during the government-mand ated ban, i.e., the ban under which trawlers must operate beyond the 20 km boundary. To reach this region, the trawlers pass	Fishing can be carried on during 4 or 5 months. The fishing ban imposed during the nesting of Olive Ridley Turtles at Gahirmatha has raised concerns among fishermen In the area. The government provides one-time assistance of INR7500 to fishermen’s HHs during the ban. This welfare scheme assistance is too low to meet household expenses with for 6 months. Further, all fishermen are not covered under the scheme.

Ecosystem/Activity	Livelihood	Population Dependence		Historical Practice	Current Situation	Interlinkages/Income Generation	Impact	Issues
							through the banned areas. Further, the chemicals used in agriculture and shrimp farming and to increase the fish catch have had a detrimental effect.	
Shrimp Cultivation	The area under shrimp aquaculture increased six-fold in the last decades. Increasingly, the HHs are taking up shrimp farming to increase their incomes.			Shrimp cultivation has been adopted as an income-generation activity over the last decade. Because of the market linkages and government policy to promote shrimp export, export houses have been attracted to this trade.	It was found that shrimp ponds are interspersed among paddy fields in estuarine areas and along the dilute estuarine water zone of Talchua, Rangani, Keruanpal, Bramhansai and Hatina. 30% of the paddy cultivators along the creeks and tidal river have converted paddy fields to shrimp farms, and the area under shrimp cultivation is increasing. High risk and high return shrimp cultivation is supported by strong input supply chain, credit and buy-back of produce by seafood export firms and their market agents.	The annual yield of a semi-intensive shrimp farms is about 2200 kg per 0.40 ha, with an average of two or three harvests in a year. Intensive farming with aerated ponds and a central drainage system to remove sludge can enhance the productivity to 3000–3500 kg per 0.40 ha. Licenses for shrimp farming were issued to 155 beneficiaries and 42 ha of land in 2020. In practice, shrimp gherries outnumber the designated areas and licenced beneficiaries. Enforcement becomes difficult as local livelihoods are involved. A favourable environment, improved inputs and organized market forces have led to a proliferation of shrimp farms in the region.	Loss of critical spawning and nursery grounds affects local fisheries, resulting in reduced yields of local fishers. Many rare species spend a portion of their life cycle in mangrove forests. The practice of catching post-larva shrimps causes losses of other species (as bycatch) and affects the local aquatic biodiversity.	Land is converted to shrimp farms. The increase in shrimp cultivation has an effect on the health of the ecosystem. Overextraction of fresh water from aquifers for shrimp cultivation and drinking has worsened the salinity ingress in recent decades.

Ecosystem/Activity	Livelihood	Population Dependence	Historical Practice	Current Situation	Interlinkages/Income Generation	Impact	Issues
Mangroves	Historically, various plant species in the area have supported the population in various ways. With the declaration of the site as a national park, the dependence of the communities on this resource has reduced.	11% 	Many species of mangrove were used as natural medicines to treat diseases. However, the traditional knowledge of biodiversity and natural medicine has declined as the local communities' dependence has come down with access to allopathic medicines.	The inhabitants were knowledgeable about forest resources and their use, but they could seldom use their knowledge in their daily lives, as a result of which there is a decline in knowledge transfers to the next generation. Gradual changes in social and economic development have forced forest-dependents households in search of other options. Three fourths of the working population in Group A villages born after the 1970 act have migrated out of the state for their living. The availability of modern medicine has reduced the dependence on medicinal plants.	Villages close to the national park have witnessed a great change in the five decades since the forest ban was initiated in the 1970s. The dependence on the forest has gradually decreased. Earlier, fuel, honey and fibre were collected from the forest. Plant parts of medicinal value were gathered from forests. A particular type of grass is grown in the wetland in Bhitarkanika. It is locally known as Bedhuan. It is grown on the banks of the tidal river and is used for making mats and other decorative items. Another species of grass known as Nalia Grass, botanically called Myriostachia wightiana, is abundant along the banks and mud flats. These grasses crowd the core area of the national park. They are used for making baskets, toys, mattresses and ropes. The grasses provide employment to hundreds of local people. There has been a ban on grass collection since 1988, when Bhitarkanika became a national park. The increased use of chemical fertilizers and increase in salinity have impacted the growth of such species of grass.		

3.5 Agricultural Ecosystem

Agriculture is the mainstay of rural India, and this is true for Odisha. However, the dependence of households agriculture for income has been declining over the years. Rajnagar Block is not an exception to this trend. The paradox of Bhitarkanika is that even though there is a decline in the percentage of HHs dependent on agriculture for their income, the trend has contributed to degradation of the ecosystem. This is reflected in the increasing salinity of the tidal river (the source of irrigation) during the monsoon in the region. Further, the conversion of agricultural lands to shrimp farms has worsened the deterioration of the health of the soil of fields close to the creeks and tidal channels. According to the primary data, in the early 1970s the inhabitants of nearby villages/areas crossed the Brahmani river and reclaimed the forest land on the river banks for paddy cultivation. Further, a large number of migrants from Bangladesh settled on marshy lands along the Bay of Bengal and reclaimed the land for cultivation. Traditionally, a rice-based cropping system involving indigenous varieties such as Sathia, Belandi, Rajamaali, Sola, Moti and Hira Kalama was common in the Bhitarkanika Ramsar site. After harvesting of paddy, green gram was cultivated in upland paddy field during winter. In the mid- and low-lying areas, vegetables such as such as green chili, lady's fingers, brinjal, bitter gourd, pumpkin, cauliflower, cabbage and tomato were grown as the winter crops. The rice-based multi-cropping system provided for the household's consumption around the year, and he marketable surplus was sold locally. The traditional rice varieties reportedly had a unique adaptive capacity. The terminal part of the rice plant bent upward when it touched the ground during a flood. This capacity, combined with the elongated stem and leaves, made the plants tolerant of floods.

Photo credit: GIZ_APOWA

Amongst the surveyed HHs, 43% were dependent on agriculture as the primary source of livelihood. This percentage varies among the four regions. One in two households (49%) was reportedly involved in agriculture outside the Ramsar site, while a marginally smaller percentage of HHs (40%) in Group A and Group B was engaged in agriculture. Farmers near the creek and tidal rivers grow paddy during summer, while the fields remain fallow during winter. Because of increased salinity, the groundwater and tidal rivers are no longer conducive for pulse cultivation. As a result, the extent of fallow cultivable land in the Ramsar site has risen. Conversion of paddy fields to shrimp farms has further impacted the rice cultivation in the area.

The extent of cultivable land owned varies from 0.68 ha to 0.38 ha. The land ownership in Group A and Group B areas is smaller compared with Group C. Shared cropping (leased/rented farmlands) is commonly practice in the region. Under the arrangement, 50% of the produce is given as rent to the landowners. Shared croppers bear the input cost and risks associated in the farming. The shared cropping arrangement is widely practiced in the Bengali-speaking villages close to the national park area. There are mangroves and creeks, and the land holdings are too small (average leased land in Group A is 1.11 ha; in Group D it is 0.50 ha) to produce a surplus of marketable rice.

Rain-fed farming is practiced primarily at Bhitarkanika Mangroves. 13 gram panchayats located near the shoreline do not have irrigation infrastructure, and deep tube wells are rare in paddy farms. Villages in the Group C area and bordering Ramsar GPs such as Ekmania, Khanata and Kantapada have lift irrigation programmes. These programmes have had limited success because there is a lack of clarity regarding distribution of water from farmers at the head end to the tail end. The water supply is also disrupted because of the erratic electricity supply.

About 1000–1200 kg of paddy is harvested from 0.40 ha (or an acre) of land in Group A areas. The yield is marginally higher in farms located in Group C areas. The daily wages for work in paddy fields typically vary from INR 400 to INR 450. Paddy residues such as straw are used as fodder and for making thatched roofs and mats. Largely, manual labor is deployed for the work in fields, but there is a gradual increase in the use of mechanized harvesters in the Ramsar Site area.

Generally, paddy is sold to the market agents at rates 15-20% lower than the market price. Farmer prefer to sell through agents at such discounted prices as the cost of transportation and logistics management and the waiting time at the APMC market are reduced. A typical cultivator reportedly earns an income of INR 15,000-18,000 (INR 9600 -11,500 at constant price) from 0.40 ha of land.

Over the years, high-yielding varieties have replaced the traditional paddy varieties. The high-yield potential of the new varieties often outweighs the high input costs of seed, fertilizers and chemical insecticides. Close to 95% of the farmers grow improved paddy varieties. A few cultivators (less than 5%) in low-lying areas practice traditional means of paddy cultivation. Farmers maintain that they could recover losses from recurring flooding partially by growing traditional varieties rather than hybrid varieties. Paddy from traditional varieties is kept for self-consumption.

In Bhitarkanika, the paddy seeds are procured from a government organization each cropping season by the cultivators. Suvarna Masuri, Hazar Attrah and Kanak+ are popular hybrid varieties. Intensive inorganic chemical input farming using fertilizers and pesticides to obtain the maximum yield has become a common practice. A dosage of 50kg di-ammonium phosphate (DAP), 25 kg potash and 25 kg urea per 0.40 ha is used. Kanan, Zilo, Catch, Lethal Super, Saheb, and Provision Plus are commonly used pesticides. These pesticides mainly contain Chlorpyriphos 50% and Cypermethrin 50%. The mixture of these two pesticides treats the external pests of the paddy crop as well as the internal viral and fungal infestations. Fertilizers and pesticides are purchased on partial credit from the pesticide dealers. Interestingly, licences for selling pesticides are not issued in the Bhitarkanika sanctuary area. Pesticides are procured by the farmers from the stores in adjacent Pattamundi Block. The community members were found to be unaware of any extant regulations on use of pesticides and fertilisers in the farm fields.

The farmers in the region were aware (as seen from the FGDs) of the means by which pesticide application reduces the population of natural pest predators such as frogs, spiders, flies, beetles and wasps and beneficial biota such as earthworms and honeybees. Farmers reported that pesticides could contaminate surface water, form residues during the rainy season, seep into creeks and ponds and affect the aquatic biota. Still, these pesticides are preferred as traditional varieties of paddy produce low yields compared with hybrid varieties and thus yield low incomes.

Additionally, there is no incentive provided to the farmers for taking up organic farming techniques. While farmers recognize the environmental impacts on the local biodiversity and livelihoods, the management of the ecosystem has to be addressed by all the stakeholders.

The heavy textured soils, with high water-holding capacity, are suitable for growing rice in summer. Coastal villages were dependent on the tidal river for the irrigation of the winter crop earlier. The increased salinity of the surface water and groundwater has forced the villagers to keep the cultivable land fallow after the paddy harvest. Several studies have also confirmed that salinization and subsequent acidification of agricultural soil reduces the rice yield significantly. As rice is the only cash crop of the study area, the enhanced salinity of the soil is expected to have adverse effects on the local economy (Hazra n.d.). The ecosystem also facilitates the provision of the required nutrients and ambient environment to support this livelihood activity. But over the years, unregulated and excessive use of chemicals to boost the yield can harm the health of the ecosystem.

3.6 Estuarine Ecosystem

Fishing is the second dominant occupation. It provides employment to the people of Bhitarkanika. Due to the diversity of ecosystems, inland, estuarine and marine fishing are practiced here. The benefit is received by the HHs located close to the resource, traditionally. The trawler-based fishing mechanism represents a shift from the traditional fishing practices. Odisha has been at the centre of fish production and consumption, with 6.83 lakh ha of freshwater resources, 4.18 lakh ha of brackish water resources and 480 km of coastline. ‘Odisha Fisheries Policy, 2015’ is an ambitious visionary document aiming to foster production in the sector. 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.

The Brahmani and Baitarani are the two main rivers of the Bhitarkanika Mangroves. As these rivers flow through the national park, only regulated fishing is permitted in the area. The fishing is closely monitored by the forest department. Fishing is practiced by 11% of the 920 HHs surveyed. Talchua and Dangamal panchayats are important fishing areas. In these panchayats too, HHs engage in multiple livelihood activities as sustenance based on only one activity is difficult. Here, people mainly engage in traditional fishing practices, with a few owning country craft such as “dongas”, while others own fibre boats (“bhut-bhutis” and gill netters) with motorized engines (9–20 hp). 35% of these HHs own the boats, while 23% rent boats for fishing. Also, members from 41% of these HHs work on trawler boats.

Members of the HHs fish for personal consumption as well as to a maintain flow of cash. Mostly, groups of two or three people go fishing on country boats. The fish catch is sold to middlemen on a regular basis, and there is an average earning of (a) INR 800-900 per week (INR 500-575 constant price). The people who go fishing in trawler boats usually earn (b) INR 10,000-12,000 (INR 6400-7700 at constant price) in 26 days, i.e., almost a month’s time. The fish commonly caught include the 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. Over the years, species such as prawns, Khasuli, Manohari, Vatei, Kantia and Balia have become rare due to overfishing. Fishing continues during the government-mandated ban, chemicals are released from agricultural fields and shrimp farms, and prohibited chemicals are used to increase fish catches.

Image *Fishing boat in Bhitarkanika*

Regulations

The Government of Odisha has imposed an annual ban on fishing in the region between November and May. During this period, the people are not to indulge in any fishing activity. Also, a remuneration of INR 7500 (INR 4800 at constant price) is provided annually to fishing HHs to help them sustain their families under the Livelihood Support to Marine Fishermen scheme. The Department of Fisheries provides support to farmers to dig ponds and for fodder and medicines as well as maintenance.

Currently, 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 at a cost of INR 150.

Issues

The reduction in fish catch availability is a major issue for the community, for sustenance as well as income. This is due to several factors; one of the more visible factors is the use of nets with smaller mesh sizes (< 35 mm) by the community. The nets catch juveniles, which is a concern for the health of the ecosystem. The catching of juveniles creates a pressure on the natural fish stocks. In the past, trawlers used to discard fishes that were considered "trash" and juvenile or non-edible fishes. But an escalating demand for fish that are not fully grown among shrimp and poultry seed factories has triggered the exploitation of these fishes. Consequently, there have been steady declines in the production of several economically important species such as the Hilsa.

Against this backdrop, the Odisha fisheries policy for 2015 was released, with the following key components:

- Restriction of the number of vessels, number of days or hours at sea, engine power, size of the fishing gear and mesh size.

- prolonged seasonal closure to allow recovery of overfished species, preventing fishing of juveniles and spawners during breeding/ spawning season.

The population depends greatly on this sector for a livelihood and a nutrition source. Due to the increasing burden imposed by the trawlers and other forms of fishing, there is a larger need for the preservation and practice of responsible fishing activities. Fisheries reforms are to focus on a more democratic and participatory management system based on a community-based co-management approach that will ensure the recovery, sustainability and resilience of the sector.

3.7 Shrimp Cultivation

Shrimp aquaculture is considered the economic engine of the state of Odisha because of its financial benefits and the scale of its contributions to employment generation and food production. Farmed shrimps contribute nearly 90% of the value of the seafood exported from the state. There has been an incredible annual growth (CAGR) in exports of 42%. The shrimp produce increased from 12,610 Mt in 2013 to 71,615 MT in 2019. The area under shrimp farms increased by 27%, from 8990 ha (2015) to 14,600 ha (2018). Odisha has set itself an ambitious seafood export earnings target of INR 20,000 crores, up from INR 3000 crores in 2019. To complement the vision, the state has identified 32,587 ha of land suitable for brackish water farming, out of the total 4.08 lac ha brackish water area in the state. The government leases out land to farmers, SHGs, cooperative societies and private companies.

However, such a rapid development of the shrimp sector required the conversion of flat coastal lands to shrimp ponds. Unregulated conversion of low-lying lands to shrimp ponds led to environmental and social problems, including water pollution, salinization of drinking-water sources and paddy fields and destruction of fingerlings of wild fish. Against the backdrop of growing exports and a state-backed policy, habitat/ecosystem degradation, environmental pollution and social conflicts are increasing. Hence, conservation of coastal wetlands and sustainable shrimp farming in Bhitarkanika Sanctuary are to be viewed in this context.

Traditional and semi-intensive (controlled water exchange) shrimp farming became popular from the mid-1990s. The Bhitarkanika Sanctuary area witnessed a rapid surge in shrimp aquaculture. The extent of the shrimp farms has increased 92 times since 1989 (Mitra & Santra, 2011). Shrimp ponds are interspersed among paddy fields in estuarine areas and in the dilute estuarine water zone of Talchua, Rangani, Keruanpal, Bramhansai and Hatina. The average annual yield of semi-intensive farms in India is about 2200 kg per hectare, and there are two harvests in a year on average.

The quick returns of highly capital-intensive shrimp farms lured traditional paddy cultivators. They converted paddy fields to shrimp ponds *(gherries).* The enabling market functions on credit inputs (from private finances), the readily available input supply chain, technical support, and buy-back options offered by export firms, which catalysed shrimp farming in the Bhitarkanika region. High-intensity aquaculture developed through improvements in operations and the desire to maximize profits. Farms with aerated ponds, deep tube wells (to extract fresh water to maintain the pH of the water), a central drainage system to remove sludge, etc. have improved productivities of 3000-35,000 kg per hectare. An estimated gross return is INR 7.5 lakhs (INR 4.8 lakhs constant price) in 110-120 days.

The high return on investment lured non-fishing communities, small businesses and organized industries to Bhitarkanika Sanctuary. *Gherries* of inhabitants were leased out for five years because the owners could not afford the high input costs (INR 2.5 lakhs to INR 3 lakhs (INR 1.6-1.92 lakhs constant price) for 0.40 ha). The leased-out farm pond functions with various sets of arrangements. Labour is available at the local level, while the management, operational maintenance and risks (failure of farming due to viral diseases or other reasons) and profits associated with the business are borne by the lease holder.

Image *An aquaculture poind in the area*

Other arrangement include a revenue sharing model and sub-contracting by the lease holder to a third party. New farm ponds are in great demand compared with re-use ponds due to the potential high yield. This demand has led to the emergence of new farm ponds inland, away from tidal rivers and creeks. The water requirements of shrimp ponds located away from tidal creeks are met by saline and fresh water drawn from surface water and groundwater.

Though shrimp farming has brought wealth and economic well-being to the primary producers and associated value chain agents, including shrimp farmers, they have faced devastating losses due to outbreaks of diseases. On an average, at least one outbreak leading to one crop failure is reported per five or six harvest cycles. Physicochemical factors such as pH, temperature and dissolved oxygen change every now and then. Shrimps are vulnerable to stress, and so there are diseases such as red colour, soft shell, tail rot and black gill, which lower the value of the yield. Unstable markets, with highly volatile prices, have also been affecting the industry as a whole.

Issues

Shrimp farming is propelled at the expense of the fragile wetland environment by biological degradation. The increase in shrimp cultivation in the wetland has triggered both short- and long-term environmental contamination and biological imbalances. Effluents from shrimp ponds enriched with suspended solids and having high biochemical oxygen demand (BOD) values are discharged through creeks and tidal channels. This destroys the aquatic life. Fishers link low fish catches to affluent contamination and degraded livelihoods. Shrimp farms not only affect the marine life but also degrade the soil and water quality of cultivated paddy fields. The release of saline water from shrimp ponds additionally increases the salinity in neighbouring paddy farms. Prolonged inundation inhibits the fixation of free nitrogen and halts mineralization, thereby reducing the soil fertility. Paddy cultivators from neighbouring ponds are left with no option but lease out adjacent areas to shrimp farms and thus create a vicious negative feedback loop.

A significant correlation has been found between aquaculture farming and high soil salinity in Bhitarkanika. The impact is predominant within a distance of 500 m of an aquaculture pond. Villages having higher aquaculture densities are also reported to have a tendency of high soil salinity. This is unsuitable especially for production of paddy, the only crop of the region. Considering other environmental conditions, the findings strongly suggest that aquaculture farms play predominant roles in soil salinization (Mitra & Santra, 2011).

The fishing community highlighted the loss of critical spawning and nursery grounds, which affects local fisheries and results in reduced yields. Many rare species spend a portion of their life cycle in mangrove forests. The practice of catching post-larva shrimps results in losses of other species (as bycatch), which affects the local aquatic biodiversity. In the Bhitarkanika Sanctuary area, the CAA issued 155 licenses for 47 ha of land. The difference between the actual extent under shrimp aquaculture and the CAA-approved area indicates that the larger shrimp farms operate without approvals. While laws have been passed to regulate shrimp farms/farming, the authorities are often hesitant to enforce regulations due to the the dependence of the local population on aquaculture for their income. The lack of enforcement may continue to remain a challenge. Better pathways centered around conservation, livelihoods and sustainability need to be identified within the constraints and reality on the ground. Shrimp farming needs to be prohibited in line with court orders with strict enforcement and regular monitoring.

3.8 Migration

The population of Bhitarkanika Mangroves is highly dependent on agriculture and fishing for their income and livelihoods. Over the decades, a decline in the revenue and income from these activities and increasing difficulties in the operations have pushed people to better options. Further, there are limited opportunities for industrial and infrastructural development in the region owing to its sensitive ecosystem. Migration is an emerging trend that is visible in the region. The migration ranges from interstate to intrastate migration as well as migration outside India.

Around 35% of the surveyed HHs have at least one person in the family working as a wage labourer outside Bhitarkanika. Amongst these people, 70% have moved to other states for jobs, while 30% have moved to nearby cities or areas. Intermittent migration is practiced by members of 30% of the HHs, whereas about 7% engage in seasonal migration. States such as Kerala, Gujarat and Delhi, and adjoining states such as West Bengal and Andhra Pradesh, are popular destinations for finding better job opportunities. But for shorter time periods, the workforce moves to nearby cities such as Bhubaneshwar, Cuttack, Visakhapatnam and Kolkata. Employment is mostly found in sectors such as construction, plumbing, carpentry and road work.

The increase in migration has resulted in a decrease in the dependence on the ecosystems around the Bhitarkanika area. There are limited work opportunities for the villagers as the sanctuary area cannot create employment for all. The able workforce has better opportunities for work with a regular flow of income in other cities. The economic stability has helped people develop their assets (housing, bikes, etc.) and sustain themselves in difficult times. The migration has shifted the direct dependence on primary sources of income, i.e., agriculture and fishing. A large number of people in villages, particularly members of low-income groups, were dependent on wetland resources to sustain their livelihoods, but as the able manpower has moved out of the villages, there has been a resultant shift away from the dependence on natural resources (income generation, fishing, hunting, poaching, etc.).
At the other end of the social framework, migration has caused the able workforce to move outside the villages. Tasks earlier assigned to male members for agriculture and fishing are taken up by women members of the family or are performed by agricultural labourers. The older members engage in cleaning, storage of paddy, segregating and drying fishes, etc.

Migration is emerging as a credible source of income generation and is contributing to the financial needs of households. Multiple income sources help maintain the cash flow of a household, support social well-being and improve lifestyles.

3.9 Ecotourism

Bhitarkanika is a major tourist attraction for the local people as well as for people from all over India. It even draws international guests, especially environmental enthusiasts. The site is connected to the nearest airport, railway station and state and national highways with all-weather motorable roads. Inter-site connectivity is facilitated by the road network and boats. The site offers activities such as wildlife spotting, bird watching and exploration of the varied fauna and flora, which include the Saltwater Crocodile, Spotted Deer, Wild Boar, Wild Hen and Red Crab. Thousands of water birds flock to the heronry during the monsoon.

Ecotourism is being promoted by the Department of Forests and Environment and Department of Culture and Tourism. They are providing accommodation and transportation facilities. Dangmal, Gupti, Ekakula and Kalibhanjadia are some locations with accommodation.

The tourist season is during winter, i.e., from November to February. Routes have been identified for tourists to experience the diversity of the region. The mangrove belt is accessible via Khola, Gupti and Chandbali. Government-managed boats (eight) and privately managed boats (40) take tourists through this area. Each boat is operated by at least two persons. The average income of these operators is INR 200-300 per day. As a result of the increase in the footfall at Bhitarkanika during the tourist season, small business such as food stalls, shops and homestays have been established at Danagamal, Gupti, Khola and Chandbali panchayats.

Although there is considerable potential for ecotourism to expand and to provide alternative incomes for the local community members through small businesses, daily wage employment and government jobs, the impacts of such tourism on the wetland biodiversity and ecosystem services need to be analysed carefully.

4. INSTITUTIONAL ARRANGEMENTS

4.1 Integrated Management Planning: Purpose and Objectives

The wise use of the Bhitarkanika wetland ecosystem is to be ensured by the Government of India and Government of Odisha because it is a Ramsar site. The Ramsar Convention defines wise use as “the maintenance of the ecological character, achieved through implementation of ecosystem approaches, within the context of sustainable development”. Maintenance of the ecological character provides the basis for management planning and management actions. Ecological character is further defined as “the combination of ecosystem components, processes and benefits/services that characterize the wetland at any given point of time”.

Wise use is the longest established example amongst intergovernmental processes. The implementation of wise use has become known as ecosystem approaches to conservation and sustainable development of natural resources, including wetlands. The wise use approach identifies the critical linkages that exist between people and sustainable development of wetlands. It encourages community engagement and transparency in negotiating trade-offs and determining equitable outcomes for conservation (Finlayson, et al. 2011).

4.2 Need for District Wetland Committee

In the current situation, the discretion of each department is limited to its administrative boundaries. But in the Bhitarkanika wetland, the confluence of ecosystems extends beyond the physical boundaries. The physical, biophysical and anthropogenic features co-exist and interaction with each other. Thus, there is a requirement for an

institution that works closely with various departments in a coordinated manner for the development and maintenance of such sites. The objective is to form a joint unit that is concerned with the complete 'site' as an area of influence, for the 'wise use' of the wetland and well-being of the human population of the area. The DWC, constituted by representatives from various government agencies, knowledge partners and civil society personnel via integrated management, will work towards achieving the objectives of the Wetland Rules 2017.

The committee is to function as a nodal authority for all wetland-specific authorities within the district and delineated Ramsar site and coordinate the implementation of integrated management plans in coordination with the State Wetland Committee while continuing to provide support for traditional uses of wetlands that are harmonized with their ecological character. The committee will develop a comprehensive list of activities to be regulated, permitted and prohibited within the notified area of the wetlands and their zone of influence. In addition, the committee will identify the mechanisms for convergence of implementation of the management plan with the existing state development plans and programmes.

4.3 Stakeholder Mapping

This section provides details of the existing key departments in the Bhitarkanika area, their overall roles and responsibilities and their importance as well as contributions towards constituting the DWC and supporting IMP implementation. Currently, various department functionaries fulfil their responsibilities as per the mandates of the state departments. Each has roles, responsibilities and functions. Key departments and agencies have been mapped in accordance with the Wetland Rules and the envisaged role of the IMP. Along with their current roles, the probable contribution to implementation of the IMP has been described. Their participation and regular engagement will be priorities for coordinated site management. In the context of Bhitarkanika, the departments identified are the following.

4.3.1 Forest Department

The Forest & Environment Department is the key institution responsible for the overall management, conservation and protection of the sanctuary. It plays a central role in wetland conservation. It has been functional in the region for decades. It holds a rich repository of information about the forest region. It also has an advantage of having constituted a well-established team with frontline staff members for continuous engagement as well as information dissemination at the ground level. The department plays a key role in navigating between the protection and conservation of the natural forest cover and the human interactions and negotiating conflict management and fostering coexistence. Due to its nature of engagement in Bhitarkanika, it is envisaged that the department will play a key role in implementing the IMP and will be at the focus of all activities. It will support the planning and implementation of conservation measures and site maintenance.

4.3.2 Fisheries and Animal Resources Development Department

The fisheries are a major source of livelihoods and nutrition in Bhitarkanika. The region is conducive to the practice of both inland and marine fisheries. Officials from both the Fisheries and Animal Resources departments are housed at Rajnagar Block to attain the objectives of fisheries production and sustainable development. The department is the nodal agency for facilitating infrastructure, market linkages, maintenance of fisheries stocks and ensuring cautious use of the resources by the communities. It also promotes safe fishing practices and sustains the livelihoods of the dependent population by facilitating loans, technical studies, surveys, assistance, advice and vocational training for fishermen under various schemes to improve the productivity of the fishery sector. Due to the department's role as a key agency in negotiating between the use of the natural resource and its maintenance and development, i.e., wetland conservation and livelihood sustenance, its role in the execution and advancement of the IMP will be pivotal.

4.3.3 Agriculture and Farmers' Empowerment Department

Agriculture is the primary occupation for the population in Bhitarkanika. This department plays a critical role in ensuring that sustainable agriculture practices and adaptive farming techniques are practiced to cope with climate change and enhance productivity. The department focuses on the well-being of farmers, with the overall aim of ensuring climate-resilient, sustainable, stable and scalable yields (by encouraging efficient and ecologically sensitive use of inputs).

While the promotion of sustainable agricultural practices is the key objective, the department is to engage with the base in the context of the geographical settings, changing land use pattern, increasing salinity and changes in temperature and seasonal variations. Participation of this department in the Integrated Management Planning (IMP) process would enhance these considerations on one hand while also establishing interlinkages with other key departments to exchange knowledge an understanding of the region to promote sustainable agriculture as well as wetland conservation techniques and practices. Therefore, the participation of this department in the IMP will recognize the interdependences between agriculture and healthy wetlands and the potential for mutually beneficial outcomes.

4.3.4 Department of Women and Child Development

A large percentage of the population in Bhitarkanika is made up of socially vulnerable groups. Empowerment of women and integration of women into the economic, political and social spheres are important. The Women and Child Development Department and Mission Shakti are working for the overall development of children and women through a host of specially designed schemes and programmes. The focus of activities continues to be on the empowerment and entitlements of children, women and adolescent girls. So, the department has a high level of engagement with the local communities and is concerned with the formation of self-sufficient community institutions in the form of SHGs to help with the economic and social empowerment of the population. The nature of the institutions formed under the department will be crucial in implementing the objectives of the IMP. This is because of the facilitation of interactions with the community, ensuring higher community participation in planning and the implementation of the IMP and thereby lending a community-centric approach to effective engagement with the IMP and enhancing its envisaged outcomes. The Livelihoods Mission programme is focused on nurturing the livelihood opportunities in the region. These initiatives, when planned in tandem with the conservation and wise use of the wetland, will be able to contribute to better site management and sustainable development of the region. Further, women's participation in decision-making and protection of their local resources will be ensured.

4.3.5 Panchayati Raj and Drinking Water Department

This department functions as a nodal agency for carrying out multiple tasks for promoting the overall development of the region. It is responsible for implementing various state and central government welfare schemes. The supply of safe drinking water also falls within its ambit. The Bhitarkanika region relies mainly on groundwater. Treatment of the extracted water and maintenance of the supply network are critical areas of engagement of the department. The District Panchayat Officer (DRDA) and Assistant Engineer Rural Water Supply and Sanitation (RWSS) are responsible for the conduct of its activities. In this context, it is important for this department to participate in the implementation of the IMP of the Ramsar site to maintain the aquifer and meet the demands of the population. The demand for water has a significant impact on the ecosystem. Providing water is the primary provisional service of the ecosystem. Therefore, careful management of the water resources and supplying water to support the local population while maintaining the health of the ecosystem requires concerted planning and inter-departmental coordination.

4.3.6 Department of Water Resource

The Water Resources Department is one of the major departments, and it is the nodal agency for the development of groundwater resources, establishment of utilizable resources and formulation of policies for overseeing and supporting state-level activities in groundwater development. Integrated water management is one of the vital tasks of environmental sustenance and sustainable economic development.

The mangrove ecosystem is one of the most dynamic ecosystems. It depends upon a regular inflow of fresh water from the rivers and the tidal influence of the sea. Though Bhitarkanika is a wetland surrounded by water bodies, fresh water is a limiting factor in this protected area. Wild animals find it difficult to meet their drinking water requirements. The problem is aggravated during summer. Digging of freshwater ponds and renovation of existing ponds is necessary to augment the availability of fresh water. In mangrove areas, the earth is washed away by rainwater, and the ponds are silted up very quickly. Therefore, careful management of the surface freshwater resources and maintaining them for environmental sustenance and sustainable economic development requires concerted planning and inter-departmental coordination.

4.3.7 District Disaster Management Authority

The District Disaster Management Authority (DDMA) is responsible for planning, coordinating and implementing disaster management (DM) activities at the district level and taking measures for DM in accordance with the guidelines laid down by the NDMA and SDMA. It has a mandate to setup, maintain, review and upgrade the mechanism for early warnings and dissemination of proper information to public, prepare, review and update district level response plan and guidelines. Due to the department's role as a key agency in management of disasters and in being prepared for disasters and responding to them, its role in the execution and advancement of the IMP will be pivotal in terms of wetland conservation and livelihood sustenance. A detailed 5-year District Disaster Management Plan has been developed and is being rolled out in Kendrapara District. Building the capacity of the local people to be prepared for disasters helps vulnerable communities in coastal villages greatly.

Multi-Purpose Cyclone Centres have been built for the people affected in Rajnagar, Rajkanika and Mahakalpada Blocks. The Red Cross has built 10 Multi-Purpose Cyclone Centres in Rajnagar and nine in Mahakalpada Block. These centres are functional. It is reported that vulnerable communities along the coastline have been provided with training to be prepared for disasters and for disaster mitigation. Preparedness training has been imparted in 27 GPs of Rajnagar and Mahakalpada. Frontline workers such as Accredited Social Health Activist (ASHA) workers and community resource persons from OLM and AWWs of all coastal blocks have been trained to operate during emergencies.

4.3.8 Odisha Coastal Zone Management Authority

The Odisha Coastal Zone Management Authority has the power to take measures to protect and improve the quality of the coastal environment and to prevent and control environmental pollution in Odisha. The Authority will help identify ecologically sensitive areas in the Coastal Regulation Zone and formulate area-specific management plans for such areas. The Authority will also identify coastal areas that are highly vulnerable to erosion or degradation and formulate area-specific management plans for such identified areas and arrange funding for implementing the plans. The key role of the authority is to provide guidance in IMP preparation and monitoring ICZMP implementation in tandem with the IMP.

4.3.9 Tourism Department

This department aims to promote/coordinate sustainable tourism/ecotourism/eco-retreats with necessary linkages and synergies in the policies and programmes of all the departments/agencies involved. The objective is to create employment opportunities so that the community enjoys socio-economic benefits. The department is concerned with protection/conservation and revival of Odisha's unique bio-cultural heritage, natural resources and environment to achieve sustainable development. The department also addresses the regulatory and tourism promotion/ development functions in PPP mode at all levels. The department will align the tourism development plans with wetland management plans.

4.3.10 Formal Community Institutions

Local Area Multi-purpose Cooperative Societies (LAMPS): Farmers are primary members of LAMPS. LAMPS facilitates farmers' loans and market linkages, and thus its representation in the IMP will be important for taking into account the challenges of the farmers in the region and for pushing forward practices that promote wetland conservation.

4.3.11 Informal Institutions

Ganga Mata Paramparik Matsyajibi Sangathan (GMPMS): This is an association of the traditional fishermen in the Group B area of the Talchua fishing jetty. The organization is responsible for the resolution and management of general conflicts between the fisher folk. It also monitors the trawlers and the fishing boats that ply from Talchua and Pravatai. As the association is composed of members from community who engage in fishing, it will be important to have its representation in the IMP so that efficient fishing practices are fostered, complete fishing bans are imposed and community concerns are voiced.

Ecodevelopment Committees: Local communities are made members of EDCs. However, these EDCs have been observed to be dormant. EDC can be useful links with communities. They can serve to build capacities and train groups. They can support the management of the protected area through community participation in education and skill development and in infrastructure development and awareness campaigns.

4.4 Gaps

As mentioned in the foregoing, multiple departments at the district and block levels are responsible for implementing various governance initiatives. The concern arises about the nature of the inter-departmental interactions at the Bhitarkanika Mangroves, a special setting. Bhitarkanika is at the confluence of interacting natural resources and human settlements. The administration of this dynamic setup cannot function in isolation. There are always areas of conflicts that this region will face; there are also hidden opportunities for cooperation. Hence, inter-department coordination is essential for achieving the sustainable development goals in the region. Clear lines of coordination and establishment of a regular monitoring and reporting framework and technical knowledge support systems are required for the overall development of the site. A dedicated long-term knowledge partner, data collection and monitoring agency are required to engage regularly at the site.

4.5 Proposed Institutional Arrangement

A well-defined and workable institutional setup is crucial for successful management of the wetland and its catchment area. The existing administrative structure and sectoral arrangements at the state, district and site levels may be

improved and facilitated through appropriate coordinating mechanisms. The State Wetland Authorities as well as District Wetland (Management) Committees can be pioneers in facilitating inter-sectoral arrangement and convergence. In line with Wetland Rules 2017 and the example of Tamil Nadu, the proposed DWC may be constituted as an 11-member committee, with member representation from line departments, local NGOs, fisheries cooperatives and eminent citizens. There may be revisions in the number of members as well as the departmental representation. Further, the DWC is to be supported ably by knowledge partners, data providers and local stakeholders.

The DWC is to comprise a Board of Members, an Executive Committee, a knowledge partner and a data monitoring agency. Details of the functionaries who are to constitute the DWC are provided in figure 15.

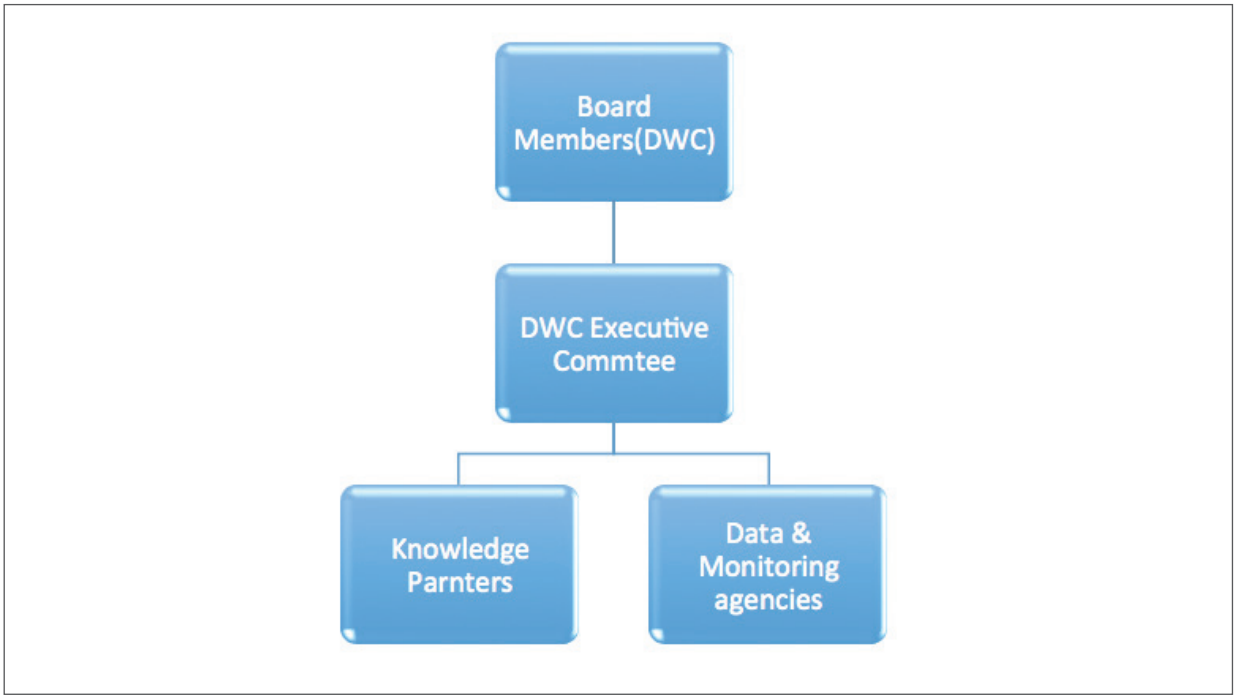

Figure 15 *Composition of District Wetland Committee*
(Source: Taru Leading Edge, 2021)

The DWC will be the consenting authority for all the activities and welfare progammes being carried out in the wetland according to the proposed IMP. Further, approvals will be obtained from the DWC for all projects related to development and any other activities at the Bhitarkanika Ramsar site. Other specialized agencies will play an advisory role.

The DWC will be placed within the lead department for wetland management in the state, e.g. the Forest Department. It will monitor the wetland regularly, its consent will be sought for any development programmes to be implemented in the region, and it will prepare an annual integrated management plan and monitor the execution of the plan. It will maintain quarterly reports on the activities of each department as per the proposed IMP, maintain a repository of all the data sets and the MIS system associated with the wetland, provide advice for holistic wetland development and wise use and perform any other functions as directed by the State Wetland Authority.

4.5.1 Composition of the Board

As the committee is to be formed at the district level, the District Collector may be recognized as the Chairperson of the committee. Key departmental functionaries may be recognized as members. The board members will include the

District Forest Officer, as the Member Secretary, the District Revenue Officer, the Chief Wildlife Warden, Odisha, the Chief Executive, Chilika Development Authority and any other nominee member from state- or central-level technical institutions (Table 10).

Table 10 *Potential Board Members of the DWC*

District Wetland Committee – Board Members		
S.No.	**Name of the Post**	**Designation in the Committee**
1.	District Collector	Chairman
2.	District Forest Officer	Member Secretary
3.	District Revenue Officer	Secretary
4.	Chief Wildlife Warden	Member
5.	Chief Executive, Chilika Development Authority	Member
6.	Project Director, Coastal Zone Management Authority, Odisha	Member
7.	Assistant Director, Coastal Aquaculture Authority	Member

(Source: Taru Leading Edge, 2021)

4.5.2 Composition of the Executive Committee

The Executive Committee will be formed with members representing the key departments. These members will include district-/block-level officials from the Fisheries Department (Inland & Marine Fisheries), Agriculture Department, Coastal Aquaculture Authority, Panchayati Raj & Drinking Water Department, Women and Child Development Department, Coastal Zone Regulation Authority and Tourism Department. The committee will also have representatives of local NGOs, representatives of community institutions and eminent citizens (Table 11).

Table 11 *Potential executive members of the DWC*

District Wetland Committee – Executive Members		
S.No.	**Name of the Post**	**Designation in the Committee**
1.	District Forest Officer (DFO Mangrove Forests Division (WL) Rajnagar)	Member Secretary
2.	District Revenue Officer	Member
3.	Fisheries and Animal Resources Development Department	Member
4.	Agriculture and Farmers' Empowerment Department	Member
5.	Panchayati Raj & Drinking Water Department	Member
6.	Rural Water Supply and Sanitation Department	Member
7.	Department of Women and Child Development	Member
8.	Odisha State Livelihoods Mission	Member
9.	Bhitarkanika Ecotourism & Ecodevelopment Society (BEES)	Member

(Source: Taru Leading Edge, 2021)

It is suggested that the board convene a general body meeting every six months and review reports submitted under the IMP.

4.5.3 Knowledge Management Partner

Knowledge management agencies will be appointed by the Chairman of the DWC. The agencies will take part in the Executive Committee meeting. The knowledge partners will be responsible for reviewing documents and management plans related to the wetlands. They will provide expert advice and review and provide updates of technical and scientific projects in the area. They will conducting research and scientific analysis in the wetland area periodically.

Institutions such as the NCSCM could be approached for informed insights and for conducting scientific studies for promoting sustainable livelihoods, conservation practices, scientific research and knowledge management. The agencies will provide support in systematic identification, analysis, planning and implementation of the IMP (Table 12).

Table 12 *Potential knowledge management partners of the DWC*

S.No.	Organization
1.	National Centre for Sustainable Coastal Management (NCSCM)
2.	World Wildlife Fund for Nature (WWF)
3.	College of Forestry (Odisha University of Agriculture and Technology)
4.	Regional Plant Resource Centre, Bhubaneshwar
5.	Odisha State Wetland Authority (OSWA)
6.	Chilika Development Authority (CDA)
7.	Disaster Management Authority

(Source: Taru Leading Edge, 2021)

4.5.4 Data Monitoring Agencies

Data monitoring agencies will be appointed by the Chairman of the DWC. The agencies will be a part of the Executive Committee. The data monitoring agencies such as the Odisha Pollution Control Board and Central Water Commission will support the DWC. The agencies will provide data for safety reviews of the water salinity, water ingress temperature variability, ground water level, groundwater depletion, etc. The data may be provided on a monthly basis for monitoring (Table 13). Regular monitoring of the water salinity, water ingress temperature variability, etc. may also be conducted and progress reports submitted to the DWC.

Table 13 *Potential data monitoring agencies of the DWC*

District Wetland Committee - Potential Data Monitoring Agencies		
S.No.	**Name of the Post**	**Designation in the Committee**
1.	Chilika Development Authority	Member
2.	Pollution Control Board	Member
3.	Central Water Commission	Member

(Source: Taru Leading Edge, 2021)

4.6 Functions of the District-Level Wetland Management Committee

- The District-Level Wetland Management Committee shall be responsible for the management and conservation of wetlands in the District and will be accountable to the Odisha State Wetland Authority.
- It may recommend any activity related to development and management of any wetlands to the Odisha State Wetland Authority for approval.
- It may co-opt experts and specialists in technical and scientific fields to undertake studies and work as may be required from time to time.
- The District-Level Wetland Management Committee shall be responsible for the preparation of a brief document on prioritized wetlands as well as for delineating the zone of influence.
- The Management Committee shall formulate a District Wetland Inventory Team to collect data and to delineate the boundaries and zones of influence of enlisted wetlands to enable field validation. The team will carry out an assessment based on the scientific sampling and data derived from stakeholder consultations and from indigenous traditional knowledge. After a detailed assessment to ensure standardization, the team will prepare the brief report on prioritized wetlands.
- The District-Level Wetland Management Committee will be entrusted with the responsibility of managing a district-level database.
- The District-Level Wetland Management Committee will also oversee and monitor the water sources of the district, ecosystem services, factors adversely affecting the wetlands, wetland management needs, etc.
- The committee will enforce the Wetland (Conservation and Management) Rules, 2017 in the district.
- The committee will interact with the line departments, viz., the Revenue, Forest, Agricultural Engineering, and Public Works departments, the Water Supply and Drainage Board and local bodies.
- The District-Level Committee will function as an advisory body for the smooth functioning of the State Wetland Authority.
- The committee will implement schemes allocated by the Government of Odisha and State Wetland Authority from time to time.

The DWC will promote inter-department coordination and monitoring of departmental functions by organizing monthly update meetings and quarterly review meetings and by annual reporting. The conduct of activities by each department under the IMP will be approved and updates provided to the DWC via monthly meetings. For instance, beneficiary selection and issue of permits for fishing by the Fisheries Department will be communicated to the DWC. Allocation of fishing routes and use of fishing equipment, etc. will also be finalized in consultation with the DWC. The DWC will constitute authorities for land allocation, safe water usage and disposal and marketing for shrimp cultivation. Further, the DWC will be the absolute decision-making authority for allocating funds under various schemes. Continuous implementation and monitoring of the IMP will be the DWC's prerogative.

4.7 Stakeholder Engagement

The District Wetland Executive Committee should be constituted within 3 months of its appointment by the Chairman of the committee. The first meeting should be organized within a month of the constitution of the committee. The agenda for the first meeting should be to address the broad agenda of the authority and the roles, responsibilities and functions with regard to the design and implementation of the IMP. The board members should convene every 6 months for monitoring the overall wetland conservation and to evaluate the effectiveness and monitoring of the IMP (Table 14). A detailed description of the roles, responsibilities and reporting mechanisms of various departments is provided in Table 15. A detailed description of the roles, responsibilities and timeliens of various knowledge management partners is provided in Table 16.

Table 14 *Roles and responsibilities of board members of the DWC*

S.No.	Role in Committee	Responsibilities in Committee	Meeting Schedule
1.	Board Members	• Overall management or supervision of committee • Biannually meetings • Approval of quarterly reporting • Approval of programmes, reports, knowledge works and targeted work	Biannual reporting
2.	Executive Committee	• Supervision and commission of targeted works/programmes/ development plans for effective site management • Review monthly update reports from all departments on the management objectives and status	Monthly reporting
3.	Knowledge Partners	• Support in systematic identification, analysis, planning and implementation of programmes and targeted works • Conducting research and scientific analysis	Quarterly reporting
4.	Data Monitoring Agency	• Providing and analysing data on various factors such as water salinity and water ingress temperature variability	Monthly reporting

(Source: Taru Leading Edge, 2021)

Table 15 *Roles and responsibilities of Executive Committee members of the DWC*

S.No.	Name of the Post	Designation	Roles and Responsibilities	Review Meeting
1.	**District Forest Officer (DFO Mangrove Forests Division (WL) Rajnagar)**	Member Secretary	• Convening monthly meetings of DWC and assessing wetland conservation measures • Monitoring the overall conservation measures and guiding the DWC on overall wetland conservation • Providing progress reports on conservation measures, forest cover and species	• Quarterly reporting • Annual reporting

S.No.	Name of the Post	Designation	Roles and Responsibilities	Review Meeting
2.	**District Revenue Officer**	Member	• Land use planning, updating site boundaries, providing track record of land use monitoring and changes • Conducting one-time survey of conversion of agriculture lands to shrimp ponds and reporting on status of defunct shrimp ponds and land reclamation	• Quarterly reporting • Annual reporting
3.	**Fisheries and Animal Resources Development Department**	Extension Officer, Inland Fisheries	• Reporting on the status and promotion of rearing of freshwater fish • Producing progress report on beneficiary identification and implementing various government welfare schemes • Maintenance of records of HHs dependent on fisheries	• Quarterly meeting
		Extension Officer, Marine Fisheries	• Reporting on promotion of sustainable fishing practices and monitoring of fishing activities	• Quarterly meeting
4.	**Agriculture and Farmers' Empowerment Department**	Assistant Agriculture Officer, Rajnagar Block	• Reviewing progress on conservation area measures and monitoring of agricultural practices • Monitoring usage of fertilizers and pesticides • Promotion of sustainable and climate-adaptive agricultural practices, i.e., organic varieties of produce • Recording increase in organic farming in wetland areas • Establishing market linkages to promote organic farming in wetlands	• Quarterly meeting
5.	**Panchayati Raj & Drinking Water Department**	Block Development Officer	• Monitoring supply of safe drinking water • Monitoring groundwater level	• Quarterly meeting • Quarterly reporting • Annual reporting

S.No.	Name of the Post	Designation	Roles and Responsibilities	Review Meeting
			• Identifying areas with depleting groundwater • Maintaining records of groundwater usage • Conservation measures related to rainwater	
6.	**Department of Water Supply**	Chief Engineer	• Monitoring and maintaining surface water resources	• Quarterly meeting • Quarterly reporting • Annual reporting
7.	**Rural Water Supply and Sanitation Department**	Executive Engineer	• Providing access and ensuring usage • Identifying alternate technologies to single-/twin-pit toilets in areas with high groundwater levels • Planning for safe faecal disposal management	• Quarterly meeting • Quarterly reporting • Annual reporting
8.	**Department of Women and Child Development**	District Social Welfare Officer, Kendrapara	• Review progress on awareness programmes and alternative livelihood support programs	• Quarterly reporting • Annual reporting
	Odisha State Livelihoods Mission	SHGs, VOs	• Community ownership and conscious use of ecosystem resources • Generation of awareness generation about wetland preservation and conservation • Community-led wetland management	• Quarterly reporting • Annual reporting
10.	**Bhitarkanika Ecotourism & Ecodevelopment Society (BEES)**		• Sustainable ecotourism activities • Regulation of tourism infrastructure development and safe waste disposal	• Quarterly meeting
11.	**Coastal Aquaculture Authority**	Assistant Director	• Monitoring shrimp cultivation • Community-driven planning for effluent disposal	• Quarterly reporting • Annual reporting
12.	**Coastal Zone Management Authority**	Project Director, Integrated Coastal Zone Management Project	• Guidance in preparation of IMPs • Monitoring implementation of ICZMP in tandem with the IMP	• Quarterly reporting • Annual reporting

(Source: Taru Leading Edge, 2021)

Table 16 *Roles and responsibilities of knowledge management partners of the DWC*

District-Level Wetland Management Committee – Knowledge Management Partners				
S.No.	**Name of the Institute**	**Designation**	**Roles and Responsibilities**	**Timeline**
1.	**National Centre for Sustainable Coastal Management (NCSCM)**	Scientist	• Providing expert advice and reviewing and providing updates about programmes • Conducting research and scientific analyses • Providing expertise in technical and scientific fields to undertake studies	• Quarterly meeting
2.	**World Wildlife Fund for Nature (WWF)**	State Programme Manager		
3.	**College of Forestry (Odisha University of Agriculture and Technology)**	Dean		
4.	**Regional Plant Resource Centre, Bhubaneshwar**	Research and Development - Senior Scientist		
5.	**Chilika Development Authority (CDA)**	Chief Executive Officer	• Providing knowledge (research and training) • Preparation and submission of reports • Reviewing water salinity, water ingress temperature variability, usage of IoT sensors and data analysis	• Monthly meeting • Quarterly Reporting • Annual Reporting
6.	**Disaster Management Authority**	Consultant	• Reviewing and updating infrastructure regularly • Updating the community regularly regarding emergency responses and preparedness	• Quarterly meeting
Formal Community Institution				
7.	**Local Area Multi-purpose Cooperative Societies (LAMPS)**	Community group	• Facilitating access to government schemes • Organizing meetings regularly to promote sustainable farming practices • Exploring marketing opportunities	• Quarterly meeting

District-Level Wetland Management Committee – Knowledge Management Partners				
S.No.	**Name of the Institute**	**Designation**	**Roles and Responsibilities**	**Timeline**
Informal Community Institution				
8.	**Ganga Mata Paramparik Matsyajibi Sangathan (GMPMS)**	Community group	• Promotion of sustainable fishing practices • Monitoring of fishing • Developing market linkages	• Quarterly meeting
NGO				
9.	**APOWA (Action for Protection of Wild Animals)**	NGO	• Organizing meetings regularly to promote sustainable conservation practices	• Quarterly meeting

(Source: Taru Leading Edge, 2021)

With the aim of implementing the proposed institutional arrangement, an action plan is proposed in the following table (Table 17) along with a timeline so as to give the initiative institutional backing.

Table 17 *Proposed Action Plan*

Ecosystem	Proposed Action Points for Wise Use	Intervention Areas	Implementation Period	Conduct of Activity	Agencies Responsible
Bhitarkanika Wetland	• Delineation of site boundary	Ramsar site	3 months	To be revised once every 5 years	Forest Department and Revenue Department
	• Identification of "most vulnerable" areas in the site on the basis of the following variables: Critical habitats Decreasing mangrove cover High level of water ingress Soil erosion	Ramsar site	3 months	To be revised once every 3 years	Forest Department with support from knowledge partner agencies
	• Constitution of District Wetland Committee and Preparation of Integrated Management Plan	Ramsar site	3 months	Annual and quarterly meetings	
Mangroves	• Valuation of ecosystem services	Ramsar site	3 months	To be conducted once every 5 years	Forest Department

Ecosystem	Proposed Action Points for Wise Use	Intervention Areas	Implementation Period	Conduct of Activity	Agencies Responsible
Mangroves	• Building community engagement	Ramsar site	Immediate	To be conducted annually	Forest Department and Panchayati Raj Department
	• Community-led plantation drives	Villages in Group B area of national park	3 months	To be conducted quarterly	Forest Department and Panchayati Raj Department
	• Knowledge dissemination to communities in need of forest preservation	Villages in Group B area of national park	3 months	To be conducted biannually	Forest Department and Panchayati Raj Department
Agriculture	• Identification of areas undergoing loss of agricultural land due to various problems – soil erosion, siltation, water ingress	Ramsar site	Immediate	To be conducted once every 3 years	Agriculture Department, Revenue Department and Forest Department
	• Promotion of organic farming practices • Introduction of seed varieties that are suited to the climatic conditions • Exploring options to produce other crops	Ramsar site	6 months	Annual review and update	Agriculture Department
	• Introduction of practices for improving yield • Introduction of improved saline-resistant rice varieties • Organizing field trials • Exploring opportunities for seed production	Ramsar site	6 months	Annual review and update	Agriculture Department
	• Revival of multi-cropping system, specifically pulses • Improving local varieties that are suited to low-lying areas	Ramsar site	6 months	Annual review and update	Agriculture Department

Ecosystem	Proposed Action Points for Wise Use	Intervention Areas	Implementation Period	Conduct of Activity	Agencies Responsible
Agriculture	• Development of Market linkages and production of vegetables as per local market needs	Ramsar site	6 months	Annual review and update	Agriculture Department
	• Establishment of custom hiring centres for enabling accessibility of agricultural equipment (through FPO or SHGs)	Ramsar site	6 months	Annual review and update	Agriculture Department
	• Introduction of solar-powered pumps to facilitate canal-based irrigation in areas with electricity problems	Ramsar site	1 year	Review and updating to be conducted once every 5 years	Panchayati Raj Department
	• Introduction of integrated pest management practices and only ecosystem-friendly pesticides and fertilizers • Regulated provision of pesticides and fertilizers via department-managed stores	Ramsar site	1 year	Review and updating to be conducted once every 5 years	Agriculture Department
	• Monitoring salinity of water	Ramsar site	Immediate	Review and updating to be conducted annually	Agriculture Department and Rural Water Supply Department
	• Forming village-level committees for the following: monitoring agricultural practices adopted dissemination of information on sustainable practices record maintenance, provision of feedback to department authorities regarding grievances of communities in relation to maintaining soil fertility through nutrient loading and controlling soil processes so that agriculture is viable developing knowledge about the soil fertility, drainage and hydrology of the areas cultivated	Ramsar site	6 months		Agriculture Department and Panchayati Raj Department

Ecosystem	Proposed Action Points for Wise Use	Intervention Areas	Implementation Period	Conduct of Activity	Agencies Responsible
Agriculture	• Monitoring the health of the soil	Ramsar site	Immediate	Soil health report cards to be prepared annually	Agriculture Department
Riverine & Marine	• Demarcation of areas for for traditional fishermen and trawlers	Ramsar site	Immediate	To be updated once every 2 years	Riverine Fisheries Department, Marine Fisheries Department and Forest Department
	• Reducing the practice of catching juvenile fish by sensitizing the community	Ramsar site	Immediate	To be reviewed annually	Riverine Fisheries Department and Marine Fisheries Department
	• Distribution of common resources efficiently to the fishing population	Ramsar site	Immediate	To be reviewed annually	Riverine Fisheries Department and Marine Fisheries Department
	• Introduction of sustainable and cutting-edge fishing gear and equipment	Ramsar site	6 months	To be reviewed annually	Riverine Fisheries Department and Marine Fisheries Department
	• Exploring the introduction of fishing practices such as trapping and rear-cultivation in estuaries	Ramsar site	6 months	To be reviewed annually	Riverine Fisheries Department and Marine Fisheries Department
	• Introduction of shrimp spawn-rearing options under a PPP model with community groups as partners	Ramsar site	1 year	To be reviewed annually	Riverine Fisheries Department and Coastal Aquaculture Authority

Ecosystem	Proposed Action Points for Wise Use	Intervention Areas	Implementation Period	Conduct of Activity	Agencies Responsible
Riverine & Marine	• Introduction of technology to help process fish catches, for example, using solar powered fish drying machines	Ramsar site	6 months	To be reviewed annually	Riverine Fisheries Department
	• Mainstreaming financial cover for fishermen by strengthening insurance provisions	Ramsar site	1 year	To be reviewed annually	Riverine Fisheries Department and Marine Fisheries Department
	• Revision of the quantum of financial relief provided during the ban period, introduction of alternative models such as disbursement	Ramsar site	1 year	To be reviewed once every 5 years	Riverine Fisheries Department and Marine Fisheries Department
	• Regulating areas of trawler fishing	Along the coastline	Immediate	Annually	Marine Fisheries Department
	• Introduction of SOPs for trawler fishing in accordance with sustainable ecosystem management • Making SOPs mandatory for trawler permits • Giving fishing permits on the basis of compliance reports	Along the coastline	6 months	To be monitored and revised annually	Marine Fisheries Department
	• Imparting training to traditional fishermen in sustainable fishing practices and building their capacity • Creating awareness regarding insurance provisions for boats, etc.	Villages in Group B area of national park	3 months	Annually	Riverine Fisheries Department
	• Conducting awareness campaigns on fishing during the breeding season	Ramsar site	Immediate	Twice every year	Riverine Fisheries Department
	• Revival of fisher cooperatives and linking with better marketing and credit facilities • Community led fishing monitoring committees- reporting at panchayat	Villages in Group B area of national park	6 months	Annually	Riverine Fisheries Department

Ecosystem	Proposed Action Points for Wise Use	Intervention Areas	Implementation Period	Conduct of Activity	Agencies Responsible
Livelihood Enhancement	• Conducting feasibility studies to explore areas of intervention	Ramsar site	3 months	To be conducted every 3 years	Odisha Livelihoods Mission and Panchayati Raj Department
	• Promotion of livelihood activities that constitute ecosystem-based adaptation	Ramsar site	6 months	To be conducted every 3 years	Odisha Livelihoods Mission, Panchayati Raj Department and Forest Department
	• Conducting supply chain studies and market assessment studies	Ramsar site	6 months	To be conducted every 3 years	Odisha Livelihoods Mission and Panchayati Raj Department

5. RECOMMENDATIONS

Recommendations

This report presents a socio-economic profile of the Bhitarkanika Ramsar site and an assessment of the ecosystem-livelihood linkages. Recommendations are being proposed that are aimed at wise use of the wetland and to manage the human–ecosystem interactions. Due to the inherent time lags arising from sectoral challenges, requirements for funds/skilled manpower and desirable changes in policy/governance mechanisms, the suggested recommendations are classified into short-term (> 2 years), medium-term (2–5 years) and long-term (>5 years) time scales.

Concerted efforts need to be made to promote alternative livelihood opportunities in the region. Bhitarkanika traditionally has been dependent on agriculture and fishing. With changed availability of resources, changed accessibility and land use changes, a shift from traditional agriculture to chemical-intensive farming practices is clearly evident. The detrimental impacts on the ago-ecology are evident. A decline in the farm income has a direct impact on the household income. Replacing inorganic agro-chemicals with bio-fertilizers and pesticides, and relying on traditional crop/livestock, we can conserve/regenerate agro-biodiversity as well as wild biodiversity, along with the associated ecosystem services.

Table 18 *Recommendations for wetland management and human–ecosystem interactions*

Topic	Timeframe	Recommendation	Institutional Arrangements
Agro-biodiversity	Short term	A farm demonstration of replacing inorganic agrochemicals with bio-fertilizers and pesticides can be initiated in selected farm plots as a first step. Formation of farm field schools (FFS) for experimental learning will help scaling up. In the short term this will help reduce farm input costs.	NGOs, Krishi Vigyan Kendra (KVK), Department of Agriculture, National Rice Research Institute (NRRI)
		Sustainable rice intensification (SRI) can to be practiced through SHGs on locally available organic inputs using traditional, salt-/pest-tolerant high-yielding varieties. SRI has been proven to be sustainable and to have the potential to increase yields 20–50%, reduce seed requirements up to 90% and effect water savings up to 50%. The possibility of practicing integrated rice fish culture (IFRC) to optimize the yield/unit area and to diversify the products and spread the risks can be explored.	Department of Women and Child Development, GoO; implementation partner agency; SRI; IFRC (to be involved in training and demonstrations to farmers)
		Paddy varieties tolerant to salinity that are recommended by National Rice Research Institute (NRRI), Cuttack for coastal Odisha are to be promoted during farm trial demonstrations. Further, cultivation of other crops promoted by NRRI for residual moisture cropping in the coastal areas of Odisha can be explored.	KVK and implementation partner with support from NRRI, Cuttack

Topic	Timeframe	Recommendation	Institutional Arrangements
Agro-biodiversity	Short term	Affordable practices to reduce soil salinity need to be documented further. It has been found that application of rice straw and green manuring are two of the measures that farmers adopt locally to treat saline soils. In Tamil Nadu, application of organic matter and gypsum is found to be beneficial.	NGOs or implementation partners are to document the traditional methods of reducing soil salinity
		Before utilizing tidal river water for irrigation on a large scale, the quality of the water must be investigated in different seasons and tidal periods. This is especially so in coastal areas because there are larger tidal ranges in these areas.	Water quality to be monitored at different seasons by water resource or environment monitoring agencies.
		Excess rainwater must be stored at all feasible sites and probable places using water harvesting structures such as nala bunds and check dams. Ponds and tanks must be created in regions with hard rocks. Networks of streams in which there are flows during periods of heavy rainfall and that remain almost dry during the non-monsoon period must be identified. Constructing reservoirs on these streams is essential for utilizing surface flows that otherwise go waste.	Department of Water Resources and Agriculture Department, in close coordination with farmers and implementation partners
	Medium term	Marketing linkages for organic produce are the key to sustaining organic farming in the area. Organic produce from Bhitarkanika has to be promoted under a single brand to build market linkages. Farmer Producer Cooperatives (FPOs) are the precursors to brand building. FPOs needs to accelerate to OLM programmers, On-farm demonstrations, Farm school would help to set the producers group with common areas of interest.	Odisha Livelihoods Mission - Department of Mission Shakti, Government of Odisha, with active support from the fiesheries and SHGs promoted by the Department of Women and Child Development
		FPOs can bargain collectively when they aggregate into a unit and follow uniform agriculture practices. and leverages their combine strength on supply chain of produce. FPO Training and managements their linkages to credit institutions, hand holding support by local NGOs/KVK	
		Community-based certification is to be developed for the organic farming. The market linkages for the organic produce could be firmed up with domestic retailers and potential exporters.	

Topic	Timeframe	Recommendation	Institutional Arrangements
Agro-biodiversity	Long term	Provision of shelter belts along embankments will prevent drifting of saline sands inland, thereby protecting the land from salinity. Dykes/embankments have to be provided with one-way sluice gates so that the ingress of sea water into the land is prevented during high tides and water is drained to the sea during low tides.	Forest Department, Department of Water Resources
		Appropriate grey and green coastal infrastructure is to be planned to mitigate coastal erosion.	Foresry Community
		The participating farmers can be additionally rewarded with Payments for Ecosystem Services (PES) for food production, pollination and biogeochemical cycling. Meritorious girl students from fisher folk who hold scholarships can be trained as part-time animators to foster community based-conservation of biodiversity (both domesticated and wild) and cultural heritage. The scheme can be linked to the initiative of community-based ecotourism for alternative livelihoods of the Department of Women and Child Development, Odisha.	Forest Department for effort on carbon sync.
Coastal Forest Ecosystems (including Mangroves)	Short term	Community-based protection, regeneration, mangrove replanting/gap filling is recommended. Apiculure (bee farming), which had limited success in the past, has to be re-considered with improved practices and market linkages. High-quality honey collected from the mangroves have good market potential. These inkages can be channelized through SHGs or FPOs	Odisha Livelihood Mission, with active support from the Forest Department. Implementation through SHGs and FPOs
	Medium/long term	Bee-keepers could earn additional incomes if the infrastructure and market are created for bee pollen, bee venom and royal jelly. The bee-keepers also need to be trained to extract these items. All three have medicinal value and command very high prices in the international market.	State Rural Livelihood to explore the potential for value addition
Inland Ecosystems	Short term	Key fishing habitats and the generic diversity of small indigenous fishes (SIFs) can be protected by formulating local nutritional fish feeds and developing the practice of backyard	Department of Inland Fisheries. Implementation through

Topic	Timeframe	Recommendation	Institutional Arrangements
Inland Ecosystems		fish farming. SHGs can be effectively used as change agents in the community. The Inland Fisheries Department has been promoting fish-rearing ponds. Augmenting the existing schemes with preparation of fish feed and establishing market linkages beyond district/state boundaries will enhance the incomes of fishing-dependent households. The government could explore the feasibility of mechanical drying of fishes for clusters of fishermen. The use of mechanical dryers driven by solar or electric power could be explored to provide a continuous supply of dry fish at all seasons.	community organizations, fishermen's groups and SHGs.
	Medium term	Ranching of fish seed in rivers, strengthening the forward–backward linkages in the sustainable supply chain, creating cooperatives/SHGs and expanding the market potential of fish beyond district boundaries can be considered. Construction of fingerling rearing ponds (earthen) by SHGs will help enhance incomes and fill potential demand–supply gaps. Tie-ups with OLM/ICAR for fingerling rearing (with an emphasis on diversification of species) will facilitate scaling up of fish rearing.	Implementing partners (NGOs) are to impart training. ICAR, as the knowledge partner for fingerling rearing
	Long term	Better human resources and infrastructure are to be developed, fish seed is to be ranched in rivers. Fish hatcheries are to be built in the district.	Fisheries Department
Marine/Estuarine Ecosystem	Short term	Community-based protection and restoration of fishing/breeding/nursery habitats, monitoring fishing regulations, planning community-based co-management of marine fisheries. The court's directive on prohibition of shrimp farming in the area is to be enforced.	Awareness to Communities by NGOs Strict enforcement by Department of Forest to prohibit shrimp farming in the sanctuary
	Medium term	Community-based co-management of marine fisheries must be implemented and artificial reefs placed in the sea. Sea ranching, focusing on the integration of fisheries conservation /revival with sustainable and diversified livelihoods, can lead to certified sustainable seafood operation and revenue	The Department of Marine Fishing and OLM are to develop a plan. Community groups

Topic	Timeframe	Recommendation	Institutional Arrangements
Marine/Estuarine Ecosystem		generation. Production of processed seafoods such as pickles and tinned fish for domestic markets could be explored.	
	Long term	Community conserved areas (CCAs) in estuarine/marine ecosystems can be expanded so as to incentivize the local communities for their conservation efforts. This will protect biodiversity, sustain livelihoods and make the local communities resilient.	MoEF&CC can prepare the road map. The state department can then adapt the plan according to local context.

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ANNEXURES

Image *View of Bhitarkanika Mangroves*

Annexure 1 : List for Consultation and Discussion

S. No.	Department	Name	Designation	Date
1.	Department of Forest & Environment	Bikash Ranjan Dash	Divisional Forest Officer, Rajnagar Division	06-01-2021
2.	Department of Women and Child Development	Rashmi Ranjan Das	Block Programme Manager, Odisha Livelihood Mission	19-02-2021
3.	Department of Fisheries	Bikash Kumar Nayak	Block Fisheries Extension Officer	19-02-2021
4.	Department of Marine Fishing	Chandrasekhar Behera	In-Charge/Marine Fishing Officer	19-02-2021
5.	Department of Fisheries	Mamata Mohapatra	District Fisheries Officer (Fresh Water)	22-02-2021
6.	Rural Water Supply and Sanitation Department	Asit Kumar Sundarray	Junior Engineer	25-02-2021
7.	Department of Agriculture and Farmer Welfare	Lipsa Priyadarsini	Block Agriculture Officer	06-03-2021

S. No.	Department	Name	Designation	Date
8.	Department of Forest & Environment	Dhaneshwar Ratha	Ranger, Rajnagar Forest Range	15-02-2021
9.	Department of Forest & Environment	Niranjan	Forest Guard	15-02-2021
10.	Dangamal Gram Panchayat	Ramesh Chandra Behera	Sarpanch	06-01-2021
11.	Talchua Gram Panchayat	Kalu Babu	Sarpanch	16-02-2021
12.	Rangini Gram Panchayat	Subodh Jala	Sarpanch	16-02-2021
13.	Keruapal Gram Panchayat	Sukhdev Pradhan	Sarpanch	17-02-2021
14.	APOWA (Action for Protection of Wild Animals)	Bijiya Kumar Kabi	Director, APOWA	07-01-2021

Annexure 2 : List of FGD Villages

S. No.	Location	Panchayat	Village	Date
1.	Group A	Talchua	Rajendranagar	18-02-2021
2.		Rangani	Pattaparia	18-02-2021
3.		Bramhansai	Prahrajpur	20-02-2021
4.			Sundaripal	20-02-2021
5.		Satabhaya Colony	Bagpatia	21-02-2021
6.		Kurunti	Kurunti	05-03-2021
7.	Group B	Mahulia	Rajgarh	22-02-2021
8.			Baghataila	02-03-2021
9.		Chandibansumal	Dakhinaveda	22-02-2021
10.		Kandira	Chakamanpur	02-03-2021
11.		Ghadiamal	Junagadi	08-03-2021
12.	Group C	Koilipur	Badakota	04-03-2021
13.		Ekmania	Ekmania	03-03-2021
14.		Khanata	Sankhapur	08-03-2021
15.	Group D	Suniti	Tantiapal	04-03-2021
16.		Lanjuda	Bhopal	04-03-2021

Annexure 3 : List of Sample Panchayats and Villages

Inside the Ramsar Site						Outside the Ramsar Site	
Group A		Group B		Group CA		Group D	
Panchayat	Village	Panchayat	Village	Panchayat	Village	Panchayat	Village
Talchua	Tikayat Nagar	Mahulia	Rajgarh	Koilipur	Kankadia	Suniti	Jagarijora
	Rajendranagar		Baghataila		Badakota		Tantiapal
	Rajpatna		Jhatpara	Ekamania	Ekamania	Lanjuda	Bhopala
Rangani	Pattaparia	Chandibaumsamul	Dakhinaheda		Nalaphi		Ratapanga
	Vekta		Jaduchandrapur	Khanata	Sankhapur	Kantapada	Gobindpur
	Charakola		Lokanathaprasad		Balijhari		Kotasahi
Brahmansai	Prahrajpur	Kandira	Chakamanpur	Akhulipada	Bartani		
	Sundaripal		Padmanavpur		Nahulia		
	Govardhanpur		Badapal	Katana	Garadapur		
Hatina	Pentha	Ghadiamal	Ghadiamal		Katanabania		
	Prasannapur		Junagadi				
	Hatina		Panchupali				
Sathbhaya Colony	Bagpatiya	Iswarpur	Madhupur				
Gupti	Rajrajeshwarpur		Balabharadaprasad				
	Devendranarayanpur		Rabaneswar				

Annexure 4 : Details of Villages in the Ramsar Site

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Bhadrak	Chandabali	1	Kaudiapal	395425	216	143	704	353	351
		2	Dakshinadhamara	395574	117	265	1268	673	595
Kendrapara	Rajkanika	3	Gualigan	395615	191	202	850	408	442
		4	Bangarakuan	395616	238	212	895	451	444
		5	Deuli	395617	76	135	683	310	373
		6	Baradia	395618	42	104	396	187	209
		7	Sikudi	395619	88	90	500	237	263
		8	Kuhudi	395620	41	44	213	100	113
		9	Baghuasuni	395621	22	33	148	80	68
		10	Baranga	395622	170	89	445	214	231
		11	Burudia	395623	48	90	358	176	182
		12	Taras	395624	141	287	1369	653	716
		13	Sialia	395625	81	52	274	128	146
		14	Badagara	395665	90	131	658	324	334
		15	Gangadharpur	395666	74	56	276	128	148
		16	Cherantapada	395667	59	399	1692	775	917
		17	Kalikapur	395668	75	175	850	409	441
		18	Porala	395669	58	98	413	206	207

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajkanika	19	Pimpudi	395670	73	102	458	219	239
		20	Akhulipada	395671	98	91	400	197	203
		21	Hariharpursasan	395672	78	64	306	150	156
		22	Malisahada	395673	91	251	1211	579	632
		23	Kalisipada	395674	57	44	279	142	137
		24	Pandiapali	395675	29	52	246	123	123
		25	Bartani	395676	221	257	1201	539	662
		26	Madhupara	395677	43	129	627	326	301
		27	Mantapara	395678	282	69	295	148	147
		28	Taneipada	395679	160	170	754	362	392
		29	Upulei	395680	106	111	441	211	230
		30	Upulei-Dia	395681	95	0	0	0	0
		31	Iswarpur	395682	83	109	570	272	298
		32	Anantapur	395683	93	139	585	285	300
		33	Endulapur	395684	95	131	627	307	320
		34	Bajarpur	395685	217	256	1289	639	650
		35	Nuagan	395686	114	0	0	0	0
		36	Asoka-Dia	395688	40	0	0	0	0
		37	Balabhadraprasad-Dia	395689	104	0	0	0	0

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajkanika	38	Kusunpur	395690	140	85	468	235	233
		39	Jayanagar	395691	315	237	1152	597	555
		40	Raulia	395692	119	140	758	387	371
		41	Badapanka	395693	128	62	296	143	153
		42	Kantapada	395694	20	23	95	41	54
		43	Sisua	395695	211	194	934	480	454
		44	Joral	395696	125	107	500	254	246
		45	Chalunia	395697	72	78	376	175	201
		46	Nahulia	395698	93	141	622	317	305
		47	Nandimahara	395699	49	103	573	287	286
		48	Giria	395700	87	226	826	395	431
		49	Kothasahi	395701	134	347	1446	706	740
		50	Dalikaenda	395717	292	426	1736	808	928
		51	Gobanga	395719	124	106	537	283	254
		52	Siko	395720	190	454	2219	1105	1114
		53	Koranda	395721	121	179	965	499	466
		54	Badaraja	395722	110	71	381	195	186
		55	Ayatan	395723	119	223	1014	478	536
		56	Rautabartani	395724	120	149	823	414	409

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajkanika	57	Meghapur	395725	181	135	577	294	283
		58	Tentulikoli	395726	264	261	1330	673	657
		59	Kantipokhari	395727	116	74	378	206	172
		60	Sangrampur	395728	100	89	539	264	275
		61	Trailokyapur	395729	102	60	312	155	157
		62	Kujipur	395730	166	119	571	293	278
		63	Tarapada	395731	256	365	1724	868	856
		64	Khunta	395732	111	199	918	438	480
		65	Jaganathprasad-Dia	395733	93	0	0	0	0
		66	Subhadraprasad-Dia	395734	66	0	0	0	0
		67	Gobindakana	395735	49	61	283	138	145
		68	Koilipur	395736	123	116	576	293	283
		69	Gharabhanjakola	395737	99	132	666	343	323
		70	Ghusuria	395738	136	71	353	184	169
		71	Charipokharia	395739	89	74	438	217	221
		72	Gajarajpur	395740	55	181	703	347	356
		73	Khulari	395741	113	100	458	232	226
		74	Biswanathpur	395742	105	62	329	161	168
		75	Khandeita	395743	131	98	507	254	253

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajkanika	76	Mahadeiadia	395744	80	179	778	391	387
		77	Nuadia	395745	58	0	0	0	0
		78	Gangadharprasaddia	395746	165	143	815	410	405
		79	Pandurkoli	395747	103	110	542	266	276
		80	Singidi	395748	113	111	576	291	285
		81	Garadapur	395749	121	133	637	311	326
		82	Madarangapata	395750	113	183	874	434	440
		83	Bandhamala	395751	147	124	551	276	275
		84	Katanabania	395752	56	222	885	430	455
		85	Bajapur	395753	80	139	534	254	280
		86	Daenigiri	395754	85	192	774	385	389
		87	Jhadamala	395755	161	110	539	254	285
		88	Dhamara	395756	46	68	339	174	165
		89	Biradia	395757	80	125	503	266	237
		90	Patarapur	395758	429	244	1125	547	578
		91	Jayakunda	395759	707	155	746	361	385
	Rajnagar	92	Nalitapatia	395760	215	152	716	327	389
		93	Khamarsahi	395761	173	198	923	451	472
		94	Saradaprasad	395762	71	16	85	43	42

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	95	Badhadia	395763	84	239	1145	579	566
		96	Kamalpur	395764	54	11	63	31	32
		97	Trilochanpur	395765	125	69	347	180	167
		98	Dangamal	395766	195	339	1502	706	796
		99	Pinchapatia	395767	96	47	227	115	112
		100	Subarnpur	395768	125	96	463	240	223
		101	Baghua	395769	155	138	854	461	393
		102	Krishnanagar	395770	142	183	973	486	487
		103	Kanak Nagar	395771	124	120	627	324	303
		104	SailendraNagar	395772	154	117	638	343	295
		105	RajeswariNagar	395773	125	89	419	211	208
		106	RajendraNagar	395774	191	233	1094	565	529
		107	Tikayat Nagar	395775	251	210	1064	534	530
		108	Birabhanjapur	395776	86	106	568	310	258
		109	Jyoti Prasad	395777	74	80	413	207	206
		110	Bhanja Prasad	395778	53	48	276	141	135
		111	Rajpatana	395779	36	75	444	222	222
		112	Suravi	395780	63	0	0	0	0
		113	Sailendra Sarai	395781	80	174	915	472	443

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	114	Ananta Keshari	395782	103	100	463	240	223
		115	Khas Munda	395783	169	166	894	463	431
		116	Udyan	395784	141	135	737	387	350
		117	Dalei Sahi	395785	146	103	527	274	253
		118	Keruapal	395786	70	214	1026	538	488
		119	Giria Pahi	395787	138	140	753	388	365
		120	Radhamalipur	395788	127	116	628	329	299
		121	Baghamari	395789	154	190	1037	539	498
		122	Amarabati	395790	137	123	775	394	381
		123	Garta	395791	85	177	938	493	445
		124	Chanra Kolha	395792	175	194	1037	523	514
		125	Sourendrapur	395793	154	107	526	255	271
		126	Sikar Pahi	395794	181	135	670	358	312
		127	Harina Pokhari	395795	110	86	400	204	196
		128	Narayanpur	395796	66	45	211	111	100
		129	Rangani	395797	164	164	824	409	415
		130	Vekta	395798	99	295	1427	726	701
		131	Bankual	395799	56	51	234	103	131
		132	Ragada Patia	395800	107	74	377	194	183

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	133	Durga Prasad	395801	11	8	45	24	21
		134	Rajendra Narayanpur	395802	24	9	48	26	22
		135	Govindpur	395803	64	29	138	72	66
		136	Paramanandpur	395804	132	42	229	120	109
		137	Rajendra Narayanpur	395805	204	84	497	235	262
		138	Bhitarkanika	395806	185	0	0	0	0
		139	Pata Paria	395807	109	316	1710	886	824
		140	Gopaljew Patana	395808	78	80	351	179	172
		141	opaljew Patna J Block	395809	78	0	0	0	0
		142	Sailendranarayanpur	395811	175	115	613	318	295
		143	Righa Garh	395812	49	247	1239	611	628
		144	Iswarpur	395813	284	192	885	449	436
		145	Dighi	395814	102	337	1349	687	662
		146	Madhupur	395815	128	165	753	391	362
		147	Padmanavpur	395816	79	80	324	165	159
		148	Panchu Palli	395817	66	259	1087	534	553
		149	Sila Pokhari	395818	64	48	237	115	122
		150	Nuakhunta	395819	65	54	249	123	126
		151	Pitanda	395820	107	5	23	12	11

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	152	Sana Gokhani	395821	109	13	69	36	33
		153	Rajbijaya Nagar	395822	123	65	420	222	198
		154	Balabhadrapur	395823	215	155	882	439	443
		155	Ajagar Patia	395824	232	101	492	243	249
		156	Balunga Patia	395825	74	12	40	19	21
		157	Gumura	395826	96	23	147	78	69
		158	Bagapatia(Uttar)	395827	162	19	85	45	40
		159	Kaduanasi	395828	86	0	0	0	0
		160	Habelichintamanipur	395829	31	0	0	0	0
		161	Sanagahiramatha	395830	51	0	0	0	0
		162	Badagahiramatha	395831	40	0	0	0	0
		163	Baunsagarh	395832	182	0	0	0	0
		164	Magarkanda	395833	269	205	1047	553	494
		165	Bagapatia	395834	531	195	861	409	452
		166	Purusottampur	395835	102	39	173	96	77
		167	Junus Nagar	395836	255	160	756	396	360
		168	Adabhutia	395837	108	0	0	0	0
		169	Gupti	395838	184	233	1254	629	625
		170	Sribantapur	395839	91	8	42	21	21

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	171	Arjunpur	395840	123	0	0	0	0
		172	Chakamanpur	395841	224	33	183	81	102
		173	Dibakarpur	395842	691	11	53	29	24
		174	Nuagan	395843	66	76	355	170	185
		175	Ghadiamal	395844	202	391	1693	821	872
		176	Balarampur	395845	365	130	608	282	326
		177	Daruora	395846	106	251	1093	498	595
		178	Ramchandrapur	395847	111	0	0	0	0
		179	Hansina Dia	395848	9	1	5	4	1
		180	Gothakolha	395849	63	19	66	38	28
		181	Loknathprasad	395850	96	52	221	122	99
		182	Bedhuakolha	395851	53	0	0	0	0
		183	Dholamara	395852	137	208	912	467	445
		184	Kusunpur	395853	49	82	365	188	177
		185	Khuntakana	395854	36	5	20	11	9
		186	Hansua	395855	61	180	778	396	382
		187	Hansina	395856	73	78	309	150	159
		188	Jaganathpur	395857	164	113	509	259	250
		189	Nethuria	395858	42	62	257	137	120

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	190	Baruna	395859	41	78	334	172	162
		191	Kandira	395860	79	201	756	401	355
		192	Amanapari	395861	30	16	67	34	33
		193	Madhupur	395862	51	67	294	152	142
		194	Nuagan (Baragan)	395863	52	175	707	378	329
		195	Baunsakani	395864	78	96	428	221	207
		196	Handiagarh	395865	204	6	25	9	16
		197	Balarampur	395866	87	182	819	417	402
		198	Nalajodi	395867	69	64	287	141	146
		199	Padmanavpur	395868	128	73	347	176	171
		200	Badapal	395869	218	53	209	115	94
		201	Bimisnagar	395870	97	16	55	30	25
		202	Sankarnathpeta	395871	57	2	11	7	4
		203	Singadapal	395872	166	62	277	151	126
		204	Rajrajeswaripur	395873	125	149	701	351	350
		205	Banabiharipur	395874	226	165	926	450	476
		206	Debendranarayanpur	395875	171	464	2368	1168	1200
		207	Sadanandapur	395876	20	0	0	0	0
		208	Tentuliakolha	395877	110	0	0	0	0

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	209	Govindapur	395878	166	0	0	0	0
		210	Mohanpur	395879	84	0	0	0	0
		211	Paramanandapur	395880	28	0	0	0	0
		212	Sahebnagar	395881	27	0	0	0	0
		213	Krishnapriyapur	395882	75	138	564	300	264
		214	Baliora	395883	66	0	0	0	0
		215	Narangarh	395884	40	42	154	77	77
		216	Gopalpur	395885	50	106	449	215	234
		217	Hariharpur	395886	29	64	306	149	157
		218	Bektakolha	395887	110	39	156	80	76
		219	Kendukolha	395888	60	0	0	0	0
		220	Gadadharpur	395890	87	9	51	22	29
		221	Ambaora	395891	86	3	18	10	8
		222	Silapokhari	395892	157	153	726	376	350
		223	Charipokharia	395893	117	202	1034	505	529
		224	Badhinakolha	395894	67	34	164	86	78
		225	Brahmanikholha	395895	60	97	439	226	213
		226	Bishnupara	395896	40	57	307	138	169
		227	Laxminarayanpur	395897	122	174	973	483	490

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	228	Bahargarh	395898	114	139	694	330	364
		229	Bhitargarh	395899	173	313	1341	679	662
		230	Chandibaunsamula	395900	101	283	1412	722	690
		231	Bhadia	395901	43	71	334	181	153
		232	Chardia	395902	92	110	660	329	331
		233	Jaduchandrapur	395903	84	212	956	442	514
		234	Jharkata	395904	57	38	169	86	83
		235	Nuagaon (Satagan)	395905	52	0	0	0	0
		236	Gopinathpur	395906	14	0	0	0	0
		237	Dakhinaveda	395907	79	79	477	246	231
		238	Jharpada	395908	75	69	320	163	157
		239	Mangalpur	395909	42	0	0	0	0
		240	Padini	395911	85	81	325	153	172
		241	Balisahipatna	395912	78	335	1784	909	875
		242	Pancheswar	395913	62	0	0	0	0
		243	Keradagarh	395914	247	605	3371	1711	1660
		244	Chandanpur	395915	91	214	1091	572	519
		245	Rajpur	395916	472	476	2593	1292	1301
		246	Balabhadraprasad	395917	40	114	576	262	314

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	247	Madhupur	395918	75	174	894	424	470
		248	Manikhandi	395919	41	14	58	25	33
		249	Baradia	395920	100	86	493	252	241
		250	Sanolara	395921	105	71	310	159	151
		251	Jaganathpursasan	395922	66	96	393	196	197
		252	Bhagabanpur	395923	115	188	843	430	413
		253	Balikana	395924	258	347	1604	784	820
		254	Belpal	395925	213	781	3635	1870	1765
		255	Bandhapatana	395927	88	235	1047	538	509
		256	Ostia	395928	110	279	1325	682	643
		257	Nagada	395929	125	395	1848	910	938
		258	Tangataila	395932	63	86	564	289	275
		259	Santhapada	395933	142	269	1281	644	637
		260	Govindpur	395934	151	430	1748	927	821
		261	Bandhapara	395938	75	187	692	295	397
		262	Madhyapara	395939	128	303	1230	582	648
		263	Khandeipara	395940	104	166	731	383	348
		264	Kusailo	395941	127	147	802	427	375
		265	Badolara	395942	106	134	624	326	298

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	266	Bhatapara	395943	114	152	667	322	345
		267	Nurugan	395944	146	227	1565	801	764
		268	Kiajori	395945	79	49	336	176	160
		269	Baragudidanda	395946	268	27	153	73	80
		270	Dhandia	395947	202	199	805	362	443
		271	Rajagarh	395948	198	339	1508	773	735
		272	Maliabuda	395949	125	74	379	194	185
		273	Kani	395950	165	188	933	472	461
		274	Benudharpur	395951	49	14	54	27	27
		275	Baghataila	395952	72	249	1101	512	589
		276	Mahulia	395953	147	207	1009	501	508
		277	Hatiagadi	395954	80	114	605	271	334
		278	Khamarsahi	395955	52	79	351	170	181
		279	Manapara	395956	109	233	972	485	487
		280	Pokharia	395957	115	148	696	338	358
		281	Jhinkiria	395958	93	78	359	180	179
		282	Guhalkani	395959	57	91	431	223	208
		283	Pachimaveda	395960	38	130	700	340	360
		284	Nathapur	395961	79	111	514	262	252

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	285	Nodhabasanta	395962	92	139	619	278	341
		286	Paripangara	395963	129	112	539	234	305
		287	Chandrasekhar	395964	68	115	535	269	266
		288	Maliparida	395965	68	11	48	22	26
		289	Ogalasendha	395966	44	0	0	0	0
		290	Bhatasahi	395967	92	0	0	0	0
		291	Sendhakani	395968	157	8	36	15	21
		292	Nuapokhari	395969	48	0	0	0	0
		293	Junapangara	395970	55	101	462	224	238
		294	Gokhani	395971	84	244	1217	626	591
		295	Badhi	395972	60	87	465	237	228
		296	Kathapangara	395973	120	113	500	266	234
		297	Dhobeigarh	395974	64	79	375	199	176
		298	Laxmiprasad	395975	31	57	247	122	125
		299	Nachhipara	395976	69	122	687	330	357
		300	Kanafulia	395977	50	74	326	164	162
		301	Kanakapur	395978	71	29	114	56	58
		302	Kathuaganda	395979	60	61	251	121	130
		303	Nuagan	395980	74	167	840	428	412

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	304	Khandiora	395981	32	0	0	0	0
		305	Chinchiri	395982	121	67	306	158	148
		306	Gahmasikhar	395983	61	55	289	134	155
		307	Kaitha	395984	195	196	971	499	472
		308	Badkuji	395985	49	0	0	0	0
		309	Endulapur	395986	103	226	1059	524	535
		310	Dera	395987	75	159	880	437	443
		311	Hatina	395988	222	312	1732	886	846
		312	Mugakani	395989	42	86	406	228	178
		313	Kurunti	395990	329	318	1693	853	840
		314	Dhagua	395991	71	24	128	64	64
		315	Tiara	395992	39	61	351	174	177
		316	Baghua	395993	104	60	365	173	192
		317	Kanhua	395994	56	114	622	310	312
		318	Mahinsasur	395995	329	342	1674	894	780
		319	Guludia	395996	142	220	1068	546	522
		320	Tarapada	395997	113	128	583	296	287
		321	Rajnagar	395998	278	1063	4701	2364	2337
		322	Sanora	395999	48	65	288	146	142

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	323	Sanabadagopalpur	396000	108	194	1100	551	549
		324	Garjanpur	396001	141	201	906	438	468
		325	Jagannathapur	396002	98	136	583	262	321
		326	Tamulia	396003	45	0	0	0	0
		327	Dhaneswarpur	396004	87	91	451	232	219
		328	Badkota	396005	123	104	457	241	216
		329	Arakhadiha	396006	44	0	0	0	0
		330	Mangarajpur	396007	156	136	700	361	339
		331	Sukdevpur	396008	14	0	0	0	0
		332	Balarampur	396009	204	232	1323	679	644
		333	Chakradharpur	396010	147	208	964	478	486
		334	Lunia	396011	39	21	95	45	50
		335	Kandhamara	396012	89	187	863	438	425
		336	Prasanpur	396013	84	115	468	257	211
		337	Chittakolha	396014	86	0	0	0	0
		338	Sankuji	396015	59	0	0	0	0
		339	Baghadia	396016	38	0	0	0	0
		340	Teisimouza	396017	61	0	0	0	0
		341	Jaudia	396018	70	0	0	0	0

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	342	Junapanga	396019	55	0	0	0	0
		343	Bikeikani	396020	12	0	0	0	0
		344	Penth	396021	192	103	402	203	199
		345	Brahmansahi	396022	234	405	1767	922	845
		346	Badanaukana	396023	104	192	1084	564	520
		347	Jayapur	396024	169	88	446	220	226
		348	Gobardhanpur	396025	173	269	1420	735	685
		349	Kshirkot	396026	81	0	0	0	0
		350	Tetelenga	396027	138	153	684	360	324
		351	Kankdia	396028	96	203	993	509	484
		352	Bilakalupara	396029	50	62	331	149	182
		353	Gankalu Para	396030	92	29	187	90	97
		354	Isani Palla	396032	55	73	341	169	172
		355	Badmaricha Palli	396035	161	115	473	236	237
		356	Barunipalla	396036	71	52	265	121	144
		357	Basantpur	396037	103	118	597	314	283
		358	Inkiria	396038	56	48	248	114	134
		359	Barhapur	396039	115	231	1020	506	514
		360	Taradeipur	396040	70	4	19	13	6

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Rajnagar	361	Duttapur	396041	63	14	70	36	34
		362	Koilipur	396042	76	49	238	129	109
		363	Praharajpur	396043	153	176	952	493	459
		364	Bindhanaukana	396044	56	102	470	247	223
		365	Akarapara	396045	86	0	0	0	0
		366	Kadalichua	396046	82	0	0	0	0
		367	Velsari	396047	124	0	0	0	0
		368	Harishpur	396048	97	0	0	0	0
		369	Karanjia	396049	110	0	0	0	0
		370	Kanhupur	396050	119	0	0	0	0
		371	Bandhapur	396051	105	17	122	65	57
		372	Talapatta	396052	36	0	0	0	0
		373	Gohipur	396053	127	0	0	0	0
		374	Padmanavpatna	396054	192	27	134	72	62
		375	Tantiapal	396055	67	155	740	359	381
		376	Talchua	396062	85	161	843	445	398
	Mahakalpada	377	Ahirajpur	396063	105	131	663	343	320
		378	Pravati	396064	86	111	630	317	313
		379	Sir Rajendrapur	396065	70	112	674	346	328

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Mahakalpada	380	Manjula Palli	396066	91	136	727	379	348
		381	Banipal	396067	178	141	800	428	372
		382	Barahipur	396068	97	98	502	259	243
		383	Satavaya	396069	299	255	1169	616	553
		384	Rabindrapalli	396070	206	32	152	70	82
		385	Dantiapada	396071	274	0	0	0	0
		386	Kanhupur	396072	116	40	195	103	92
		387	Sundripal	396073	90	64	305	166	139
		388	Joginatha	396074	55	0	0	0	0
		389	Barunei	396075	60	0	0	0	0
		390	Kharakhara	396105	79	48	301	161	140
		391	Sahupada	396189	254	224	1080	540	540
	Aali	392	Chaudamania	396205	116	0	0	0	0
		393	Nalapahi	396206	74	200	912	445	467
		394	Ekmania	396207	344	289	1174	552	622
		395	Madanpur	396288	169	336	1657	811	846
	Pattamundai	396	Bali Jhari	396291	86	60	305	152	153
		397	Garjang	397001	69	0	0	0	0
		398	Sasana	397007	225	85	394	208	186

District	District	Sl. No.	Village	Location Code	Total Area (ha)	No. of Households	Population	Male Members	Female Members
Kendrapara	Pattamundai	399	Chakulidiha	397009	86	0	0	0	0
		400	Baro	397010	95	0	0	0	0
		401	Mundatala Sahara kani	397013	162	34	144	76	68
			Total		**46,534**	**47,816**	**2,29,826**	**1,15,226**	**1,14,600**

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