Wetlands for Resilience (W4R) Initiative India Inception Report

Wetlands for Resilience in Mahanadi Delta:

Thriving Sustainable Wetlands, Resilient Communities and Economies

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Wetlands for Resilience in Mahanadi Delta:

Thriving Sustainable Wetlands, Resilient Communities and Economies

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Aerial photograph of Chilika near Ramalenka in Odisha. (© Wetlands International South Asia)

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INDEX

1 INTRODUCTION

1.1 Background

Wetlands are amongst the most biologically diverse ecosystems on Earth. They sequester vast amounts of carbon, are home to 40% of our planet's biodiversity and help save billions in property damages due to disaster risks every year. Wetland ecosystems are massive carbon stores, especially peatlands and coastal wetlands like mangroves and sea grass beds. However, when these ecosystems are drained or degraded, they release greenhouse gases (GHG) into the atmosphere. Intact wetlands also play vital roles in protecting humans and wildlife from the impacts of extreme weather events caused by climate change.

Wetlands enhance societal resilience by reducing disaster risks and enabling adaptation to changing environmental conditions. They are a vital part of resilient landscapes and sustainable economies, but they are degrading and disappearing at an alarming rate. The global conversion and degradation of wetlands has been devastating – with an estimated 35% loss in the past 50 years alone and 70% lost since the 1900s, nearly half of which has been freshwater. The impacts of wetland loss and deterioration on human well-being, combined with climate change, are severe in all regions and are felt disproportionately by the poor and vulnerable, increasingly leading to human insecurity and social conflict. Ongoing conversion, drainage and disturbance of wetlands contribute significantly to greenhouse gas emissions and undermine adaptation potential.

The urgency to reverse the fate of wetlands to tackle the joint biodiversity and climate crises has yet to receive a proportional response. Attention is increasing on wetlands partly because rising water risks limit development and are a primary consequence of climate change impacts through changes in the water cycle. It is increasingly acknowledged that wetlands need better conditions to meet the linked biodiversity, climate, development goals, and economic development. The global outlooks indicate that a plan for sustainable food production supported by healthy wetlands and wise use is needed instead of continued agricultural expansion driving wetland loss.

The W4R (Wetlands for Resilience) initiative addresses wetlands' continuing loss and degradation and responds to the recent understanding that humanity urgently needs wetlands to be safeguarded and restored at scale to achieve climate, biodiversity and sustainable development goals. The initiative aims to achieve global influence of countries, institutions and sectors, resulting in shifts in approach, policies and investments towards the regeneration of wetland landscapes. This responds to and helps to mobilise and bring substance to the existing global agendas set by Conventions and the SDGs. The initiative is designed to extract learning and experience from wetland landscape programmes implied in the Mahanadi Delta as an accelerator for wetland recovery and resilience building.

W4R Objectives

1. To bring together and share globally the learning and methodologies for holistic, ecosystem-led resilience building from our global wetland landscape portfolio and partner programmes;
2. To design and apply a Wetlands 4 Resilience model approach, toolkit and guidance to accelerate upscaling in our major wetland landscape regeneration programmes;
3. To catalyse wetland landscape regeneration by others through the uptake and implementation of the W4R model approach across different sectors globally.

1.2 Scope of the report

The report aims to assess the roles and functions of wetlands as a resource to support sustainable development and resilience in the Mahanadi Delta, a lighthouse (learning) landscape [1]within the W4R initiative. Almost 12 % of the area in the Mahanadi Delta is covered by wetlands. These areas provide various crucial ecosystem functions and serve as forage and breeding habitats for sensitive wildlife, especially migratory birds and numerous fish species. They play a vital role in supporting the livelihoods and

Figure 1: Fishing boats at Kalupadaghat, Chilika

[1] Wetlands International through the W4R initiative will engage with existing Landscape Partnerships across our portfolio of landscape programmes which are in different stages along the pathway to landscape resiliency, from start-up situations to ones where there is already global recognition of our work as a lighthouse example.

traditional lifestyles of indigenous people. They serve as a baseline for future policy measures.

Effective management of Mahanadi wetlands, including restoration and conservation, holds enormous potential to contribute significantly to climate adaptation and mitigation and protect biodiversity.

As part of W4R's inception stage, regulatory efforts and management approaches were examined through case studies and the indigenous knowledge of wetlands in the Mahanadi Delta. The insights gained through these case studies deliver insights and actionable recommendations for enhanced management and upscaling tangible actions in the further phases of the initiative.

2 THE MAHANADI DELTA

2.1 Ecology

The Mahanadi Delta, situated on the east coast of Odisha, India, is a dynamic composite delta formed by three major rivers: the Mahanadi River and its distributaries (Devi, Daya, Bhargavi, Kushbhandra, and Parchi), along with the Brahmani and Baitarini Rivers. Originating in the Chhattisgarh region, the Mahanadi River meanders through the delta, depositing sediments and creating a complex system of channels. The delta's geography is shaped by the interplay of riverine and tidal forces, forming islands, sandbars, and wetlands. With the Mahanadi River spanning 851 km, it holds one of the largest drainage basins on the east coast. The delta's coastline stretches approximately 200 km, from the Chilika in the south to the Dhamara River in the north. Encompassing five coastal districts—Puri, Khordha, Jagatsinghpur, Kendrapara, and Bhadrak—these regions, constituting 83% of the delta, are particularly susceptible to cyclone-induced floods and rising sea levels. The constant interaction between freshwater from the river and saltwater from the Bay of Bengal shapes the dynamic landscape of the delta. The delta is a biodiversity hotspot, supporting a wide array of flora and fauna. Coastal wetlands are dominant features, providing critical habitats for various species.

The delta's fertile soils and varied habitats support a diverse plant and animal life range. Mangrove ecosystems, in particular, play a crucial role in stabilising the shoreline, preventing erosion, and providing breeding grounds for various marine species. Avicennia marina and Rhizophora mucronata Mangrove species thrive in brackish waters, offering breeding grounds for numerous fish and crustaceans. The fertile soils of the delta sustain vibrant agriculture, predominantly marked by rice paddies. The rich flora, featuring jackfruit and mango trees, fosters diverse fauna, ranging from tigers and elephants to fishing cats. Aquatic plants like Azolla pinnata and *Nymphea nouchali* thrive in the delta's aquatic ecosystem. One prominent feature is the presence of sea grass along Nalaban Island in Chilika, contributing significantly to biodiversity. This area, particularly Nalaban Island, serves as a habitat for prawn fish and supports numerous bird species, making it a hotspot for dolphin sightings, with approximately 150-160 dolphins primarily around Satpada.

Figure 2: The Irrawaddy Dolphin is one of the flagship species inhabiting the Chilika

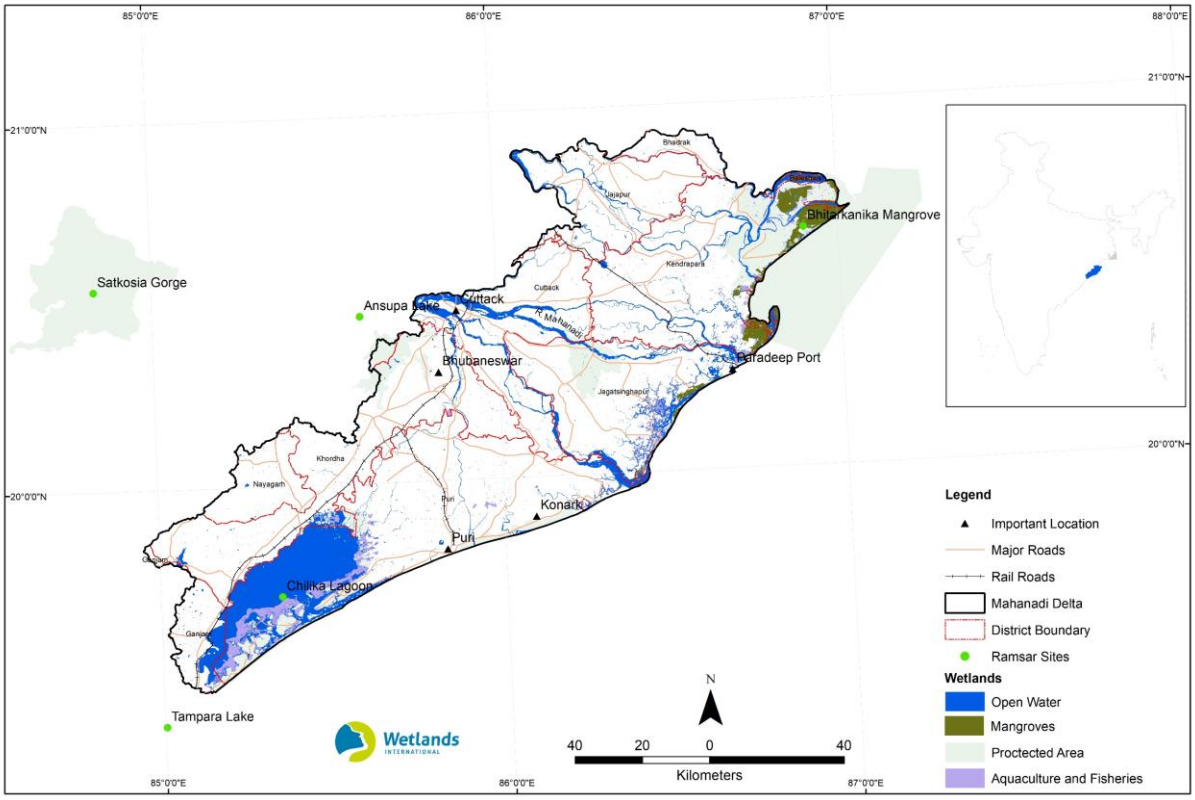


Figure 3: Location and extent of Mahanadi Delta

The wetlands within the delta are a vibrant ecosystem adorned with diverse vegetation, including Oryza rufipogon grasses, Eleocharis dulcis sedges, and Typha angustifolia emergent plants. The interplay of these elements creates a dynamic environment crucial for the delta's ecological balance. Salinity, a defining factor, shapes the delta's vegetation, with low salinity areas hosting Potamogenon sp. and Najas sp., and high salinity areas featuring Ruppia sp. and Halophila sp. This nuanced relationship between salinity and flora highlights the adaptability of the delta's plant life.

The delta also houses mammals, including otters, civets, and leopards, unintentionally safeguarded by the Crocodile Conservation Programme. Snakes like the King Cobra and Banded Krait share their habitat with other reptiles like the Water Monitor and Chameleon.

The delta is also home to Horseshoe Crabs, crucial for medical research. Protected fish species, like Hilsa and Mullet, contribute to the economic and ecological balance of the region. The fisheries industry, integral to the delta's economy, encompasses marine capture and aquaculture. The delta is a haven for avian biodiversity, attracting numerous migratory birds. Bird species such as ducks, cranes, flamingos, herons, egrets, and kingfishers thrive in the delta's wetlands. Additionally, the wetlands support a variety of fish species, contributing to the livelihoods of local communities engaged in fishing activities. Critical areas within the delta, such as Bhitarkanika National Park & Chillika, stand out as biodiversity hotspots.

Bhitarkanika National Park, located in Odisha, India, is a testament to biodiversity and ecological richness. This unique park, spread across the delta of rivers Brahmani, Baitarani, and Dhamra, is renowned for its vast mangrove forests, making it one of the largest mangrove ecosystems in India. Home to diverse flora and fauna, including around 55 species of mangroves

and salt-tolerant trees, the park provides a sanctuary for numerous species. Notable inhabitants include saltwater crocodiles, Indian pythons, various species of kingfishers, and migratory birds. Bhitarkanika is also crucial for conserving the endangered Olive Ridley turtles, serving as one of the largest nesting sites. The delta is a refuge for diverse mammalian species, including otters, civets, and leopards. The heronry, locally known as Baga gahana, witnesses groups of herons and other birds, emphasising the delta's significance in avian conservation. Notable avian residents include the White-bellied sea eagle and the Brahminy Kite. Snakes like the King Cobra and Banded Krait share their habitat with other reptiles like the Water Monitor and Chameleon. The delta is also home to Horseshoe Crabs, crucial for medical research. Protected fish species, like Hilsa and Mullet, contribute to the economic and ecological balance of the region despite these ecological marvels. In 2002, Bhitarkanika was designated as a Ramsar Wetland under the Ramsar site. Numerous factors are putting Bhitarkanika under a growing threat, such as the conversion of land for inland aquaculture, the discharge of waste from aquaculture farms and the surrounding area, intensive agriculture, pollution from the nearby Dhamra port and fishing trawlers, coastal erosion, and the community's reliance on the area's natural resources. While the protection and conservation efforts now in place for Bhitarkanika are sufficient, an all-encompassing ecosystem-based strategy is required to keep an eye on this delicate habitat.

Figure 4: One of Asia's largest multispecies heronry is present in Bhitarkanika National Park

Figure 5: Bhitarkanika has one of the largest populations of endangered saltwater crocodiles in India

Chilika, a shallow lagoon nestled along the eastern coast of India, stands as a testament to the delicate balance between natural ecosystems and human livelihoods. With an average depth of 1.5 meters, this expansive water body is intricately connected to the Bay of Bengal through a 32-km-long, 1.5-km-wide outer channel. Dotted with numerous islands like Mahisa, Berhampura, and Nalabana, Chilika serves as a thriving habitat for diverse marine life. This legal designation marked a crucial event in the area’s conservation efforts. Its rich fishing grounds sustain the livelihoods of over 200,000 fisherfolk in the surrounding areas. The biodiversity of Chilika boasts an impressive array of around 729 plant species, 314 fish species, and 224 bird species, contributing to a delicate balance of life. Chilika is a striking feature, with rare species like the limbless skink (Barkudia Insularis) found exclusively in this region. The presence of the Irrawaddy dolphin (Orcaella Brevirostris) is another highlight, and the opening of the sea mouth has led to the expansion of their distribution within Chilika. The 2021 avian census reported an astounding estimate of 1.21 million birds in the lagoon, showcasing its significance as a crucial stopover point for migratory birds. census data reveals a positive trend in the population of dolphins. In 2021, about 166 Irrawaddy Dolphins and around 22 Indo-Pacific Bottlenose Dolphins were sighted, indicating a growth compared to previous years.

The Mahanadi Delta, historically resilient to floods and droughts, underwent significant changes due to 19th-century water regulation projects. Hydraulic structures, including the Naraj Spur and Hirakud Dam, aimed at water control for irrigation and flood prevention, led to hydrological fragmentation. Subsequent embankments and canal systems worsened issues, causing waterlogging and a 32% decline in wetland area from 1975 to 2010. Mangrove conversion along the coastline and nutrient pollution in wetlands added ecological challenges. Unplanned development transformed the once flood-dependent landscape into a flood-vulnerable one, underscoring the need for sustainable delta management.

Chilika confronts significant threats. Elevated silt loads, driven by land use changes and floodplain fragmentation, impact water quality and ecosystem health. Altered lagoon-sea connectivity, influenced by littoral drift and tidal forces, disrupts stability and essential ecosystem services. Climate change shifts precipitation patterns, affecting freshwater flow and crucial salinity levels for wetland biota. The expansion of Phragmites karka increases siltation, jeopardising fish breeding grounds and posing health hazards. Unmanaged tourism strains the wetland, stressing biota, especially species like Irrawaddy Dolphins. Rising demands for upstream water use and increased fishing pose risks to fishery resources and community livelihoods. Destructive fishing practices, from shrimp aquaculture to cast net operations, harm biodiversity and disrupt migration. The prevailing fish marketing system results in higher returns for intermediaries, leaving fishers with insufficient livelihood returns. Addressing these threats is imperative for preserving Chilika's unique ecosystem.

Figure 6: Proliferation of phragmites karka in Chilika impedes traditional fishing routes

2.2 Demography

The Mahanadi Delta, situated on the eastern coast of India, is a geographical marvel and a region deeply intertwined with intricate social structures, where gender dynamics play a significant role in shaping daily life. Understanding the complexities of gender relations in the Mahanadi Delta requires a comprehensive exploration of historical, cultural, economic, and educational factors contributing to the multifaceted landscape of gender roles in this region. The Mahanadi Delta region, characterized by its diverse demographic profile, encompasses a mix of urban and rural populations. The delta region spans multiple districts in Odisha and is marked by a dynamic population engaged in various economic activities. The people in this region primarily depend on agriculture, fisheries, and allied sectors for their livelihoods. The delta's demographic landscape reflects a blend of traditional and modern lifestyles, with communities coexisting amidst the Mahanadi Delta's rich ecological and cultural tapestry.

Historically, the Mahanadi Delta has been marked by traditional norms that dictate distinct roles for men and women within the societal framework. These roles are often deeply rooted in cultural practices and have persisted through generations. Traditionally assigned

responsibilities related to household chores and caregiving, women find their roles extending into preserving cultural traditions and familial customs. Conversely, men are usually the primary breadwinners, engaged in occupations such as agriculture and fishing, which are central to the delta's economy. The Mahanadi Delta's predominantly agrarian and fishing-based economy has traditionally favoured men. Women in these sectors often face challenges accessing resources, credit, and markets. Economic disparities contribute to their vulnerability, as financial dependence on male family members can limit their agency and autonomy.

Figure 7: Fishing is one of the significant mainstays in Mahanadi Delta

Of about 1.7 million formally employed, 92% are men, and 8% are women. The primary sector is the most significant formal employment sector, including cultivators, agricultural labourers, and other primary activities (livestock, hunting, fishing, etc.) Women have a lower share of participation in all the sectors. Only in the primary and some minor sectors (mining and quarrying and hospitality) is women's employment rate higher than 25%. Women's participation in paid work is notably low. Women do not engage in any paid activity except for very few women employed in the public sector as teachers, school cooks, or village health workers (Accredited Social Health Activists, ASHA). Rigid social norms of masculinity and patriarchy play a significant role in determining the gender division of labour and constraining women's mobility.

Figure 8: Mushroom cultivation by women SHGs as alternative livelihood in Kendrapada District

Furthermore, the average proportion of women-headed households over the five delta districts is 12.5 %. Still, Kendrapara district has a high percentage age of women-headed families (15.3 %), of whom 46.4 % are currently married. While the district of Puri has a high %age (64 %) of widow-headed households, the four other delta districts have a lower percentage age (55 % on average). The status of women in the delta districts presents a complex picture with high literacy rates and low work participation of women, accompanied by the presence of a significant proportion of widows and married women heads in some districts. This scenario merits a nuanced understanding not only of the gender dynamics but also of the heterogeneity of the women, specifically the women's heads of households.

Cultural practices are crucial in shaping gender dynamics in the Mahanadi Delta. Festivals, rituals, and ceremonies often reinforce traditional gender norms, reinforcing specific expectations for men and women. These cultural practices can act as preservers and challengers of gender roles, depending on how they are interpreted and embraced within the community.

Economic factors also contribute significantly to gender dynamics in the Mahanadi Delta. The delta's economy relies heavily on agriculture and fisheries, where men have historically dominated. However, changing economic landscapes have led to a shift in traditional

gender roles. With increased urbanisation and diversification of the economy, women are now entering non-traditional sectors, contributing to a redefinition of gender dynamics. The expansion of educational opportunities and awareness about gender equality have also played a role in challenging stereotypical gender roles. Agriculture is shifting from an income-generating to a self-consumption activity. Youth are losing interest in agriculture, preferring to migrate to earn what the elders describe as 'fast cash'.

Education, or the lack thereof, plays a pivotal role in shaping gender dynamics in the Mahanadi Delta. Historically, educational opportunities for girls have been limited, reinforcing traditional gender norms. However, concerted efforts to improve access to education have resulted in a gradual transformation. As more girls receive education, there is a growing awareness of gender equality and the dismantling of stereotypes. Education empowers women to challenge traditional roles, providing them with the skills and knowledge to pursue diverse careers and contribute to community decision-making.

Emigration from the Mahanadi Delta is primarily male. About 30% of migrants are females and 70% are males. For rural migration, the shares are 14% and 86%, respectively, while for urban migration, they are approximately 48% and 52%. Higher percentages of female migration in metropolitan areas can be explained by family-linked migration, as women join their in-law households after marriage.

Despite these changes, challenges persist. Deeply ingrained patriarchal norms can resist change, and pockets of society may be slow to embrace evolving gender roles. Traditional power structures, both within families and communities, often favour men, making it challenging for women to break free from entrenched gender norms. Additionally, economic disparities persist, and women may face hurdles in accessing resources, credit, and markets compared to their male counterparts. Government and non-governmental initiatives

Figure 9: Women employed for deweeding in Nalaban, Chilika

are crucial in addressing gender dynamics in the Mahanadi Delta. Programs focused on women's empowerment, education, and skill development aim to create a more inclusive and equitable society. Advocacy for legal reforms and policies that promote gender equality also contributes to changing the landscape.

The gender dynamics in the Mahanadi Delta are shaped by a complex interplay of historical, cultural, economic, and educational factors.

While traditional gender roles have deep roots, the region is undergoing transformative changes driven by economic shifts, increased education, and concerted efforts toward women's empowerment. The journey towards gender equality in the Mahanadi Delta is a dynamic process that requires ongoing collaboration between communities, policymakers, and various stakeholders to create a more inclusive and equitable society.

Figure 10: Local fisher drying anchovies for pickling

2.3 Culture

The culture of Odisha is a tapestry woven with vibrant threads of history, traditions, art, and spirituality. Rooted deeply in antiquity, Odisha's cultural richness is evident in its diverse facets. The architectural brilliance of Odisha is exemplified by its ancient temples, some of which date back to the 6th century. The Konark Sun Temple, a UNESCO World Heritage Site, is a masterpiece of Kalinga architecture and is a testament to the state's artistic prowess. The Jagannath Temple in Puri is another iconic pilgrimage site known for its Rath Yatra, a grand chariot festival. The intricate silver filigree work, appliqué art, and Pattachitra paintings showcase the skill and creativity of the state's artisans. These crafts often depict scenes from mythology, folklore, and daily life, preserving and promoting the cultural narrative. Spirituality is pivotal in Odisha's culture, with numerous ancient temples and sacred sites dotting the landscape. The Jagannath temple, centred around Lord Jagannath, is a significant religious tradition that attracts pilgrims from across the country. Cultural practices, such as serving food on plantain leaves, echo a close connection with nature. Integrating such traditions into conservation efforts, like using plantain leaves sustainably, promotes awareness and eco-friendly practices. Wetlands inspire art and traditional dishes like Pakhala, connecting lifestyle with these natural ecosystems. Linking traditional methods with wetland conservation creates a symbiotic relationship, sustaining cultural traditions and local livelihoods. Handicrafts depicting natural landscapes bridge cultural preservation and economic opportunities. Supporting traditional crafts indirectly invests in wetland conservation by valuing artisanal skills. For Odisha's fishermen, wetlands are more than a resource; they're sacred. Kartik Purnima holds particular importance in Odisha, where the celebration revolves around wetlands, notably Chilika . Devotees observe rituals near the lake, and the festival coincides with the congregation of migratory birds, adding a unique ecological dimension. The Boita Bandana ceremony, symbolising ancient trade, underscores water bodies' cultural and environmental significance in the region's history. With wetlands at its centre, the festival beautifully merges spirituality, cultural traditions, and environmental awareness in a concise celebration. Generations have worshipped these ecosystems, recognising their dependence for livelihood. This cultural heritage underscores the holistic interplay between Odisha's rich traditions and the wetlands, fostering a balanced approach to conservation, livelihood sustainability, and spiritual connection to the natural world. Dhela Fishing, Bamboo stake traps, Beach Seine fishing, and Crabbing with Bamboo Traps are some traditional fishing methods that sustain the livelihoods of coastal communities and reflect a deep understanding of the local marine ecosystem.

Figure 11: Ram Mandir in Bhubaneshwar

Local communities in Bhitarkanika utilise mangrove species like Rhizophora and Avicennia for traditional medicine, extracting medicinal properties from their leaves and bark. Additionally, these mangroves play a pivotal role in sustaining the local economy through

activities such as honey collection and woodcraft. Climate change has made agriculture and fishery unprofitable in Odisha's Mahanadi delta, prompting large-scale labour migration. Dominated by males (15-40 years) and females (26-40 years), these migrants are mostly below the poverty line, with low literacy and limited skills. Supercyclones in 1999 and 2013 intensified this trend. Effective interventions are crucial to addressing these communities' economic challenges and vulnerabilities. Natural disasters and climate change can threaten cultural sites and practices integral to Odisha's identity.

Figure 12: Miniature boita (boats) used for Boita Bandana on Kartika Purnima

2.4 Economics

The Mahanadi Delta of Odisha's economy is intricately tied to various sectors. Agriculture and allied activities are pivotal, contributing nearly 22.5% to the Gross State Value Added (GSVA) and employing over 40% of the workforce. The state has seen notable growth in the industry sector, averaging 7% before the COVID-19 era, with a projected growth of 6.1% in 2022-23. The mining sector, contributing over 10% to GSVA, has ripple effects on manufacturing and other sectors due to backward and forward linkages. The services sector, diverse and encompassing trade, transport, education, health, financial services, and more is expected to grow 8.8% in 2022-23, constituting nearly 36% of GSVA. Ports, such as Paradip, play a crucial role in facilitating trade and commerce, contributing to economic development in the delta region. Infrastructure development and disaster risk reduction are pivotal for sustained economic growth. Freshwater aquaculture has grown consistently at 9% CAGR, reaching 4.73 lakh MT in 2019-20. The sector's productivity in culture tanks doubled from 1.85 MT/Ha to 3.94 MT/Ha. Brackish water aquaculture expanded 15 times, producing 90,000 MT in 2019-20, with shrimp productivity increasing nearly sixfold to 5.85 MT/Ha. Marine fish production slightly increased from 1.21 lakh MT to 1.57 lakh MT. Seafood exports surged tenfold, reaching Rs. 3,243 Crores in 2019-20, contributing 6.81% to the state's export revenue. The state's focus on these aspects, along with advancements in fishery and aquaculture, tourism, and trade and commerce, reflects a comprehensive approach to economic development. The rise in fish production, diverse agricultural outputs, and increased marine exports underscore the state's resilience and potential for economic progress.

Figure 13: Brackish water shrimp export is one of the major economies in Mahanadi Delta

Odisha has over 1.5 million fishers, with a significant fish-consuming population of 94.5%. Per-capita fish consumption rose from 7.71 kg in

2000-01 to 16.24 kg in 2019-20. Odisha's Forest, Environment, and Climate Change Department spearheads ecotourism development. In 2021-22, 47 ecotourism destinations were established across 18 districts, accommodating 769 eco-tourists, generating INR 55.7 million in revenue. Eco-tourism serves as an alternate livelihood for over 600 forest-dependent community members. The manufacturing sector is the largest in the industry, with a growth rate of 7.7% from 2001-02 to 2022-23. Odisha's Industrial Development Plan envisions the growth of agriculture, chemicals, textiles, and electronics. Micro, Small, and Medium Enterprises (MSMEs) contribute significantly to Odisha's economy, with about 40% of exports and 45% of manufacturing output. The state ranks high in the Logistic Ease Across Different States (LEADS) Index 2022. The services sector expanded by 8.8% in 2022-23, with key sub-sectors like "Trade, Repair, Hotel & Restaurants" and "Transport, Communication" showing buoyant growth. Tourism, a vital sector, has exponential potential. Initiatives like e-VISAs, infrastructure development, safety measures, and marketing have increased tourist arrivals. The Hotel and restaurants sector contributed 0.6% to GSVA in 2021-22, showing a growth of 62.7%. In summary, Odisha's strategic focus on ecotourism, sustainable practices, climate change initiatives, industrial growth, MSME development, and tourism holds promise for the state's economic vibrancy and community well-being. Natural hazards like cyclones and floods pose significant risks to agricultural and infrastructural stability, impacting the economy. Apart from losses to life and property, natural disasters also lead to crop failure, decline in surface and groundwater levels, increasing unemployment and under-employment, migration and indebtedness. Overreliance on sectors like agriculture and mining makes the economy vulnerable to market fluctuations. Infrastructure Gaps: Inadequate Roads, railways and telecommunications infrastructure hinder economic growth and discourage potential investors. High levels of unemployment can strain the economy and lead to social issues. The lack of a skilled workforce hampers the state's ability to attract diverse industries and investments.

2.5 Evolution of the Mahanadi Delta

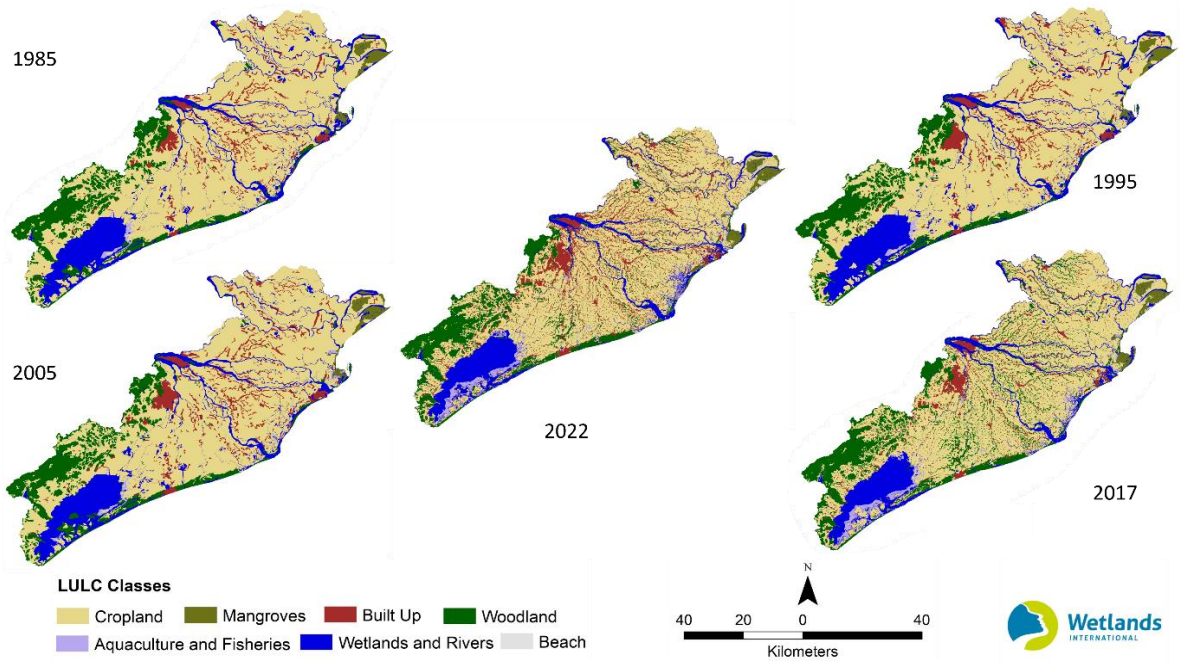
In recent decades, the Mahanadi Delta has experienced significant changes in its land use and land cover (LULC). All the LULC changes were detected using moderate-resolution satellite images (Landsat and Sentinel). LULC maps for 1985, 1995, 2005, 2017 and 2022 indicate the changes in 7 prominent LULC classes. Over the past four decades, substantial infrastructural development has been observed, namely rural to urban expansion, development of ports for trade, linear infrastructures like roads and highways and commercial industries. The built-up land has increased multi-folds, from 5.74% in 1985 to 11.72% in 2022, representing a net increase of 822.2 km^2.

This LULC influences biotic diversity through habitat fragmentation and biodiversity loss, having an essential and extensive effect on the climate by altering the distribution of ecosystems. The changes observed in the LULC are shown in *Figures* 14 and 15.

The cropland, wetlands and rivers categories have a decline in their area, whereas the built-up land and aquaculture and fisheries categories exhibit a substantial increase in their area. The decrease in cropland from 65% in 1985 to 58% in 2022 is mainly attributed to agriculturalists shifting from farming to aquaculture, crab culture and fishery. Aquaculture and fisheries farms have significantly increased, covering 57.07 km^2 in 1985 and 332.36 km^2 in 2022, growing almost six times in 4 decades.

The vegetation covers mainly woody areas and mangroves show a decline in area from 1715.03 km^2 in 1985 to 1647.94 km^2 in 2005 and 222.80

km^2 in 1985 to 197.58 km^2 in 2005, respectively. In contrast, significant plantation efforts have led to a considerable increase of 0.32% in mangrove cover and 1.65% in woodland area in the last two decades. The increased development infrastructure at the cost of woodlands and mangroves posed significant ecological damage from 1985 to 2010. However, since 2010, there have been a large number of



interventions focusing on mangrove restoration, and it is reported that mangrove restoration was successful, and the mangrove area improved from 1.42% in 2005 to 1.74% in 2022 of the total area of Mahanadi Delta.

Figure 14: The land-use land-cover maps of Mahanai delta (1985-2022)

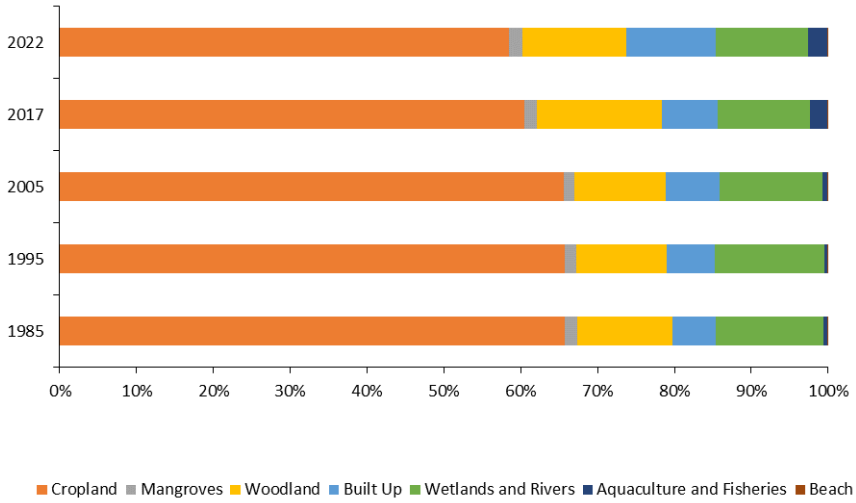


Figure 15: The land-use land-cover maps of Mahanai Delta

3 STAKEHOLDERS POWER ANALYSIS AND POLICY INFLUENCING STRATEGY

3.1 Stakeholder Assessment

As a complex and dynamic ecosystem, the Mahanadi Delta attracts diverse stakeholders, each contributing to its multifaceted tapestry. A stakeholder analysis of the delta reveals a myriad of actors operating at the central, state, and district levels, emphasising the intricate interplay of interests in this vital area.

Some of the key stakeholders in the Mahanadi Delta landscape are described below:

1. MoEFCC- The Ministry of Environment, Forest and Climate Change (MoEFCC) in India is dedicated to the sustainable development and conservation of the country's natural resources.
2. Ministry of Ports, Shipping and Waterways - The Ministry of Ports, Shipping, and Waterways plays a crucial role in the development of maritime infrastructure and waterborne transport in India, including the state of Odisha, to boost economic growth and connectivity along the coastal regions.
3. Ministry of Commerce & Industry - The Ministry of Commerce and Industry actively promotes trade and economic development while addressing conservation measures for the state's vital wetlands to ensure sustainable growth and environmental protection.
4. OSWA - Odisha State Wetlands Authority is dedicated to the sustainable management of all wetlands of Orissa.
5. OSDMA - The Odisha State Disaster Management Authority (OSDMA) plays a pivotal role in disaster preparedness, response, and recovery, ensuring a resilient and proactive approach to mitigate the impact of natural disasters in Odisha, India.
6. SPCB- The Odisha State Pollution Control Board (SPCB) oversees environmental regulations, monitors pollution levels, and promotes sustainable practices to safeguard the environment and public health in Odisha, India.
7. CDA- The Chilika Development Authority (CDA) in Odisha is dedicated to the conservation and sustainable management of the Chilika, the largest brackish water lagoon in Asia, ensuring

ecological balance and promoting the well-being of local communities.

8. CZRA- The Coastal Zone Regulation Authority oversees and regulates development activities along coastal areas to ensure sustainable coastal management and environmental protection.
9. Odisha Forest Department - The Odisha Forest Department is dedicated to biodiversity conservation, sustainable forest management, and wildlife protection in Odisha, India. Divisional Forest Officers (DFOs) are responsible for managing the protected areas under their divisional jurisdiction.
10. District Disaster Management Authority - The DDMA serves as the district planning, coordinating, and implementing body for Disaster Management, adhering to the National Authority's and State Authority's guidelines while focusing on all measures to ensure adequate regional disaster management.
11. The District Agricultural Department is committed to overseeing comprehensive agricultural research and education, encompassing horticulture, natural resources management, agricultural engineering, extension services, animal science, economic statistics, marketing, and fisheries. This involves facilitating coordination between central and state agencies to ensure holistic development in the sector.
12. PWD - PWD stands for Public Works Department, an Indian government agency entrusted with constructing and maintaining essential public services, including government buildings, highways, bridges, public transportation, and drinking water sources.
13. District Biodiversity Management Committee- According to the Biological Diversity Act of 2002, Biodiversity Management Committees (BMCs) are established by local bodies nationwide to " promote conservation, sustainable use, and documentation of biological diversity".
14. Irrigation Department - The Irrigation Department of Odisha is responsible for planning, implementing, and managing irrigation projects to enhance water resources for the state's agricultural development and rural prosperity.
15. Eco-Tourism Management Committee- The Eco-Tourism Management Committee promotes sustainable tourism practices and conservation efforts to preserve natural ecosystems and biodiversity in the designated areas.
16. SHGs - Self-Help Groups in Odisha empower local communities by fostering financial independence, skill development, and social cohesion for sustainable rural development.
17. Schools, Colleges & Universities - Schools and colleges in Odisha act as stakeholders for wetlands by playing a crucial role in environmental education, awareness, and conservation initiatives, fostering a sense of responsibility and stewardship among students to sustain wetland ecosystems.
18. Aquaculture farmers and fishermen in Odisha serve as stakeholders, contributing to the sustainable management and conservation of these ecosystems through responsible practices, biodiversity preservation, and community engagement.
19. Donors- Donors such as the World Bank and UNDP, etc., play a vital role as stakeholders by providing financial support, expertise, and resources to various projects, contributing to sustainable development, poverty alleviation, and social welfare globally
20. NGOs, CSOs and CBOs like WISA, APOWA, NetCoast, etc., serve as stakeholders by actively engaging in diverse projects, contributing grassroots efforts, and promoting community welfare through their expertise, resources, and advocacy initiatives.

Different structures have been constituted in line with the existing regulatory framework, each with specific roles and responsibilities. These include regulating and implementing authorities at national, state, district, and site level, as shown in *Figure 16*.

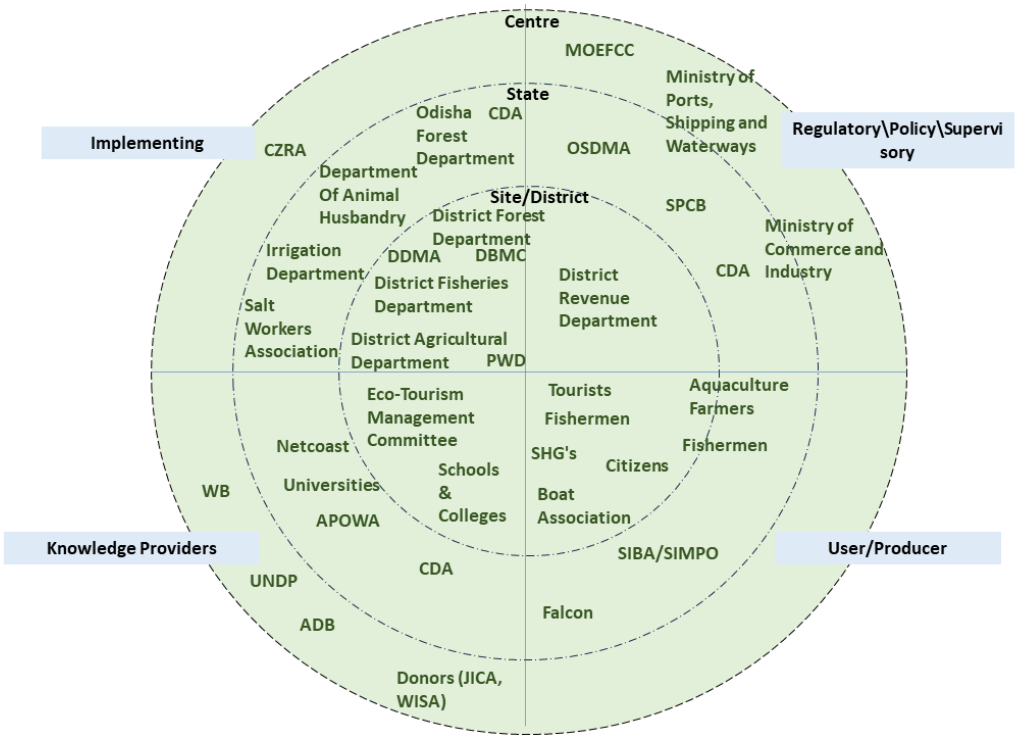


Figure 16: Institutions in the Mahanadi Delta landscape

3.2 Power and Interest Analysis

The management of the Mahanadi Delta involves multiple actors and stakeholders. Several stakeholders were identified during the workshop on "A shared understanding of W4R-4R framework on Mahanadi Delta" that have an interest in and/or impact on the landscape of the Mahanadi Delta. These stakeholders' actions can positively or negatively impact the conservation and management of the Mahanadi Delta. After identifying and listing the stakeholders, the groups were asked to place them on the Power/Influence versus Interest/Impact grid, as shown in *Figure* 16.

The results of the group work and discussions highlighted the following points:

- There are multiple actors and stakeholders that have high interest/impact and high influence/power (e.g., MoEFCC, CDA, District Fisheries Department, DDMA, among others), or low interest/impact but high influence/power (e.g., Aquaculture farmers, Irrigation Department and PWD), or high Interest/impact but low influence/power (e.g., NGOs, Universities and Boat Associations) in management of the Mahanadi Delta.
- Active engagement with the key stakeholders that have either high interest/impact or influence/power in the process of integrated management planning, implementation and monitoring is necessary for the conservation of the landscape.

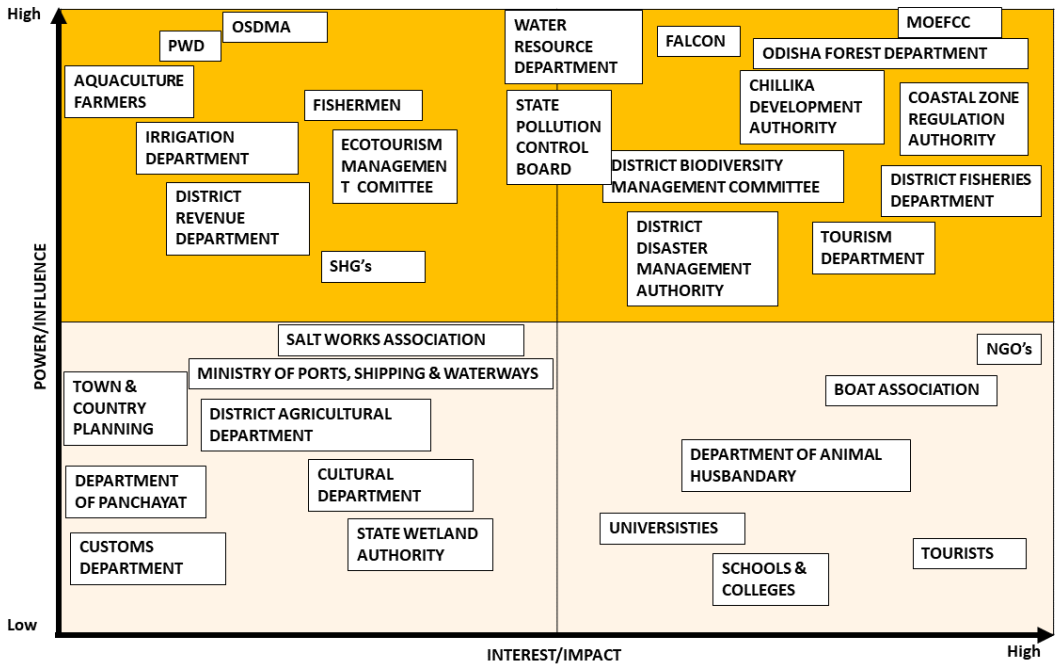


Figure 17: Stakeholder power and interest mapping for Mahanadi Delta (Proceedings of Workshop on a shared understanding of W4R-4R framework for Mahanadi Delta)

3.3 Policy Influencing Strategy

The successful experience in restoring Chilika by opening the artificial mouth in the year 2000 and the desiltation of the lead channel, not only rejuvenated the ecosystem of the lagoon but also immensely benefited the community. With this experience in mind Wetlands International South Asia and Chilika Development Authority prepared Chilika's Integrated Management Plan that ensured further interventions and sustainability strategies with different stakeholders in the Chilika's catchment.

Moreover, Wetlands International South Asia will use the Mahanadi Delta as the lighthouse (learning) landscape for upscaling the learnings from the projects such as PfR, Watershed, Eco-DRR, 4R and Integrated management planning projects for Ramsar sites such as Chilika and Bhitarkanika for policy influencing and engagement strategies. At the Mahanadi Delta landscape level, Wetlands International South Asia, along with landscape partners, envisages the following strategy for policy influencing:

- Ensure catchment conservation through the protected area plans (Integrated Management Plans of Chilika and Bhitarkanika) by multistakeholder

dialogues with representation of local and indigenous communities.

- Use information derived from monitoring various sites to assess effectiveness and modify management to make it adaptive.
- Compliance with all existent regulations is ensured by strict implementation of Acts, Rules and Policies through regular stakeholder meetings and community awareness programs.
- Integrating gender mainstreaming as a part of inclusive planning, programme development and implementation activities for landscape development.
- Generate mechanisms to address emergent knowledge and capacity needs by developing communication products catering to various stakeholders (such as Nature-based Solutions for Reducing Disaster Risks: A Guidebook for District Disaster Management Planning, Building with Nature Solutions, Chilika Health Card, etc.)
- Build on the achievements of Eco-DRR to upscale the development of disaster resilience infrastructure in the landscape by incorporating wetlands as a Nature-Based Solution.
- Promoting equity by enhancing inclusivity, economic equality, participation, and capacity building; in particular, the resilience interventions implemented to result in significant education, health, safety and financial improvements for women.
- Leverage the partnerships established in the landscape to mobilise financing for landscape management.

4 LANDSCAPE RESTORATION PROCESS

The landscape restoration process in the Mahanadi Delta has been a part of several interventions carried out through projects, programmes, and activities for measures like Ecological restoration, building effective landscape partnerships, building resilience, empowering communities, conservation and management planning, knowledge development and capacity building. This section highlights Wetlands Landscape Restoration for resilience in Mahanadi Delta over several years of engagement by Wetlands International South Asia.

4.1 Ecological Restoration of Chilika

Chilika is a unique assemblage of marine, brackish, and freshwater ecosystems with estuarine characteristics and a biodiversity hotspot. It is an avian grandeur and the wintering ground for more than one million migratory birds. The highly productive ecosystem of the lagoon, with its rich fishery resources, sustains the livelihood of more than 0.15 million fisher folk who live in and around the lagoon.

The Ramsar Bureau placed the lagoon in the Montreux record in 1993 due to a change in its ecological characteristics. Being concerned with the degradation of the lagoon ecosystem, the Chilika Development Authority (CDA) was created in 1992 for the restoration and overall development of the lagoon.

Chilika ecosystem has been encountering several problems and threats like – siltation, shrinkage of water spread area, choking of the inlet channel as well as shifting of the mouth connecting to the sea, decrease in salinity and fishery resources, the proliferation of freshwater invasive species, and an overall loss of biodiversity more so the decline in the productivity adversely affecting the livelihood of the community who depend on it.

CDA, along with Wetlands International South Asia and other stakeholders, achieved an engineering marvel by opening an artificial mouth on 23rd September 2000, which reduced the length of the outflow channel by 18 km. This is considered historic in the restoration ecology. Monitoring results indicated that there is a marked improvement in the lagoon ecosystem.

- The other components of the restoration program were community-based treatment of the catchment on a micro watershed basis, restoration of Nalabana Bird Sanctuary and improvement of bird habitats with the active participation of the community.
- The opening of the artificial mouth and the desiltation of the lead channel not only rejuvenated the lagoon ecosystem but also immensely benefited the fisher folk.

- The salinity regime of the lagoon improved and marked improvement in the fishery resources of the lagoon as the gradual reduction in the salinity provided the desirable sense of direction for the euryhaline forms to enter into the lagoon from the sea. This facilitates the auto-recruitment of the fish, prawn, and crab juveniles into the lagoon, resulting in remarkable improvement of the fishery resources.
- The improvement of the tidal flux has resulted in better flushing of the sediment to the sea through the outlet channel.
- There is a significant improvement in the water level variation during the tidal cycle, which has turned the lagoon into pulsing mode, thus making it more productive by nourishing it with additional nutrients and flushing out the residue and waste products efficiently.
- Due to the improvement of the salinity gradient, there is a phenomenal decrease of the freshwater invasive species by 172 km^2 and an improvement of the seagrass bed.
- The hydrological interventions taken to restore the lagoon have resulted in considerable improvement of its fishery resources and water quality, a positive impact on the biodiversity, and an overall improvement of the lagoon's ecosystem.
- Substantially contributed towards the community's per capita income who depend on the lagoon for their livelihood.
- Community participation, linkage with the various national and international institutions, and intensive monitoring and assessment systems are some of the unique management practices adopted by CDA to restore this unique wetland.
- The restoration approach of CDA with a substantial contribution from WISA is considered the most appropriate and unique in the history of restoration ecology.
- Ramsar Advisory Mission, based on their assessment of the management interventions, have recommended the removal of the Chilika lagoon from the Montreux record. Chilika Development Authority was also conferred the prestigious Ramsar Wetland Award-2002, given its outstanding achievements in restoration and wise use of the wetlands.

Figure 18: Chilika artificial mouth opening by engineers

4.2 Building effective landscape partnership from resilience

The Partners for Resilience programme, led by WISA, has strengthened community resilience in the Mahanadi landscape for the people whose lives have been impacted by the project. Wetlands International South Asia has achieved this through a combination of improving the management of natural capital, diversifying livelihood options, and increasing disaster preparedness, as well as the tireless efforts of local communities. The Wetlands International South Asia insighted the crucial role of wetlands in building resilience in the Mahanadi Delta. Emphasizing their ecological significance, the WISA approach highlighted wetlands as natural

buffers against climate challenges and vital habitats for diverse species.

WISA and the NGO partners, including the Foundation for Ecological Security (FES), actively fostered a collaborative approach to balance preserving the Mahanadi Delta's unique ecosystems and uplifting dependent communities. The focus extended beyond ecological sustainability to social justice, acknowledging the necessity for harmonious coexistence between nature and society.

The effectiveness of the community-managed risk reduction promoted by Partners for Resilience became clear during Cyclone Hud Hud in 2014. WISA, along with PfR partners, in collaboration with district authorities in Ganjim and Puri, supported disaster response committees in disseminating early warning messages, stockpiling food, protecting important belongings and ensuring timely evacuation. The measures paid off; few casualties were reported. Communities whose crops were affected by the cyclone received assistance from agricultural centres.

Under the programme, Partners for Resilience (PfR) led by Wetlands International South Asia, a case study on sustainable community-based disaster risk management – *Responding to emergencies, A PfR perspective* – was selected as one of the best practices in Asia by the Asian Disaster Preparedness Centre (ADPC).

4.3 Empowering communities for integrating wetland management

The Watershed project provided support to build capacities (of landscape partners, local institutions and CSOs) to execute the advocacy and influencing efforts for sustainable WASH services, water security planning, and budget tracking, with updated information and evidence-based engagement in villages of Ganjam in the state of Odisha.

Wetlands International South Asia (WISA) was the lead partner in the Watershed India project, along with consortium partners like IRC and Akvo. It was responsible for implementation, providing scientific and technical support for the use and conservation of wetlands. WISA coordinated project implementation in the consortium, including direct liaison with partners and content support on water security elements. The project's landscape partner, Gram Uthhan, a non-profit organisation, worked with underprivileged groups on issues such as sustainable livelihood development, promotion of microenterprises, financial inclusion, WASH, etc. In the Watershed project, Gram Uthan was the field implementation partner in Odisha.

Centre for Budgetary Governance and Accountability (CBGA), an independent non-profit organisation that worked on enhancing transparency and accountability in governance through rigorous analysis of policies and budgets. Arid Communities and Technologies (ACT) is a non-profit organisation that aims to strengthen the livelihoods of communities by resolving ecological constraints. through access to technological and institutional solutions.

The Watershed India project provided an ideal ground to demonstrate how 'evidence-based advocacy' could result in improved recognition of the importance of interfacing water security planning with WASH planning and programming. The project invested in building the capacities of communities and the local CSOs to advocate for better service delivery and ensure water security in their landscapes within the context of the stated political will of the government policies and programmes.

However, the key challenges were primarily. around effective execution of these initiatives. The Watershed programme in India seeks to

address some of these challenges and capacitate rural communities to benefit from the favourable environment. Some of the obstacles were weak delivery systems, inadequate human resources for execution, no designated budgets, for major (and minor) maintenance, water quality issues not recognised or addressed and low ownership & participation of community

The opportunities included good political will, resources allocated for WASH, defined institutional structures & arrangements, information about progress in the public domain, and local institutions playing a more prominent role in implementation.

4.4 Upscaling Community Resilience through Ecosystem-based Disaster Risk Reduction

The Ecosystem-based Disaster Risk Reduction (Eco-DRR) project in India undertaken by Wetland International and the Indian Red Cross upscaled community resilience through Eco-DRR activities in the areas of Mahanadi Landscape experiencing frequent floods, drought, and storm surge aimed to enhanced resilience of 12,000 households to water-induced disaster risks.

The knowledge implemented through WISA's approach achieved

- Participative Eco-DRR interventions implemented within two pilot lake basins and one dryland area
- Key ministries acknowledge wetland restoration as an Eco-DRR approach for reducing water-induced risks in urban landscapes
- Selected national institutes adopt curriculum on Eco-DRR to support policy and practice mainstreaming, and modules are integrated into training calendars
- Demonstrated the effectiveness of Eco-DRR to civil society stakeholders and governments at local, national, regional, and global levels in a resource package that consolidates good practices and facilitates the replication and scaling up of the Eco-DRR approach.

A few of the challenges faced were:

- Community members are highly dependent on wetlands for livelihood activities in Odisha.
- A full range of wetland ecosystem services and biodiversity values, such as Gram Panchayat Development Plans, are not integrated into developmental planning. The ecosystem services of wetlands, as manifested through their role in groundwater recharge, reducing flooding risk, and providing water and food security, have not been considered while developing and implementing these plans.
- Cross-sectoral arrangements for implementation or upscaling of Eco-DRR are absent.
- Resources for wetlands management are highly dependent on central government funding, and the level of mainstreaming within local development programmes is low.
- Requires intensive advocacy and capacity building to promote ownership of local government institutions in owning wetlands management for reducing water-mediated risks and integrating Eco-DRR measures into local/Gram Panchayat Development Plans (GPDPs).
- Increasing conflicts between farmers and fishermen over Kanwar wetland complex resource use. There is presently no institutional mechanism at the local level to resolve these concerns with due consideration of the needs of wetland management.

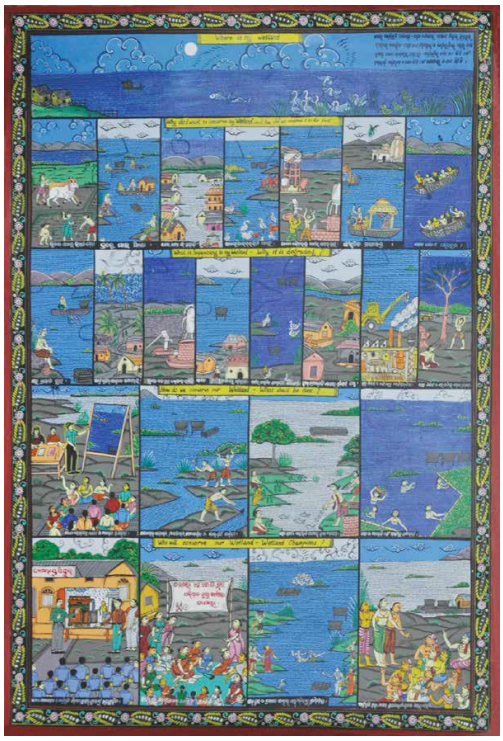


Figure 19: Integrated management planning in the form of Pattachitra, a traditional cloth-based scroll painting based in Odisha

Gender mainstreaming has been a vital component of Eco-DRR implementation in India, considering the gender nuances in India, which is very diverse from area to area. Engagement with male and female community members in planning and implementing Eco-DRR measures has been strategic and progressive. The project engaged with women as community members, female members of Panchayat Raj Institution/Local Self-Government, female school students, and various women-centric Community-based Organisations such as Self-Help Groups. This ensures their opinions, views, and suggestions are reflected in baseline surveys, training, and the implementation of Eco-DRR actions. Women are growing to be interested in participating in the decision-making process of local development plans (ward and Panchayat levels). It is necessary to engage with a local CSO partner on gender mainstreaming efforts at an early stage.

4.5 Building with Nature

Water-mediated disasters (floods, droughts and storm surge) constitute a significant proportion of disaster events in India, claiming an exorbitant proportion of human lives lost and economic damage, besides causing immense setbacks to financial gains and social progress. The extremities of the Indian monsoon result in frequent floods and droughts. The Indian coast is routinely battered by landfalls of cyclonic storms forming over the North Indian Ocean. With intensifying climate change, water-mediated risks are projected to increase. The response to water-mediated risks has mostly been structural, in the form of the construction of embankments, dams, and barrages following the colonial legacy of attempts to harness water for economic gains. The efficacy of structural solutions has been intensely debated, and repeated calls have been made to consider nature-based solutions, primarily wetlands, within the suite of response options.

The adoption of Building with Nature (BwN) as a socially and environmentally inclusive engineering approach transforms the engineering sector and accelerates climate change adaptation across Asia was initiated in the Mahanadi Delta. During the Building with Nature project in India, a policy review and a landscape proposition were prepared with local and National stakeholders.

One of the entry points included integrating BwN within the existing policies, schemes, and programs for mainstreaming. This will also enable more accessible finance by utilising the existing budget components. Also, it will allow easier approvals, better engagement, and acceptance from the stakeholders.

Challenges included:

- Lack of collaboration and coordination among different stakeholders, including the absence of engagement with and participation of local communities, will

impede the implementation of sustainable BwN interventions and converging funds for implementation.
- Owing to a lack of understanding of the functions of natural systems as effective buffers against the perils of climate change, many policies fall short of including them within the recommended measures. This leads to ambiguity on the relevance of BwN solutions within the ambit of these policies and programs.
- The concept is still in nascent stages within the country, with very few examples of best practices available as reference. This acts as a barrier and discourages more extensive adoption.

4.6 Integrated Management Planning of Ramsar Sites

Wetlands International South Asia has been integral in providing technical assistance for developing Integrated Management Plans for Ramsar sites across India.

Wetlands International–South Asia (WISA) and CDA formulated a proposal for integrated management planning for Chilika for financial support under the Small Grants Fund (SGF) for Wetland Conservation and Wise Use of the Ramsar Convention. The management planning framework was developed with Ramsar SGF support from 2012 to 2017. Expert review and analysis of ecological character status and trends were carried out under the International Development Research Center (IDRC) and also supported the climate vulnerability assessment project being implemented by WISA and CDA. The integrated management framework represented the commitment of CDA, the Government of Odisha, the Government of India, WISA, and the Ramsar Convention on Wetlands to support the conservation and wise use of Chilika.

The framework intended to:

- outline a management strategy to identify the objectives of the site management;
- describe the management actions required to achieve the objectives;
- determine the factors that affect, or may affect the various site features, including functions;
- define monitoring requirements for detecting changes in ecological character;
- support obtaining resources for implementation;
- enable communication within and between sites, organisations and stakeholders; and
- ensure compliance with local, national and international policies.

A critical part of the process was extensive stakeholder consultations at various stages of project implementation. Chilika NGO Forum organised consultations in 42 villages in and around Chilika and representing diverse stakeholder groups. Further, a consultation workshop was also held in 2009, wherein the summary framework was presented as a discussion paper. Several component-specific assessments coordinated by CDA have also enriched the process. Notable amongst these is the Fisheries Resource Management Plan (FRMP) supported by the Japan International Cooperation Agency (JICA) during 2006-2009, a response strategy for the invasion of *Phragmites karka*.

The development of the Wetland Research and Training Centre (WRTC) at Chilika in 2002 provided a platform to research several landscape features to create a strong baseline for landscape planning and programming.
In 2019, WISA was envisaged to provide

technical and knowledge support for ecosystem-based integrated management of Ramsar sites in India under the BMUV-IKI-funded “Wetlands Management for Biodiversity and Climate” project. The project included Bhitarkanika as one of the pilot areas wherein the objectives were to “establish knowledge systems to enable wetland managers the Ramsar sites to integrate biodiversity, ecosystem service values and climate risks in wetland management planning, enhance capacities of wetland managers and stakeholders and management plans enables the use of climate vulnerability assessments. This was achieved by partnering with local NGOs like APOWA to mobilise communities in the landscape and CDA for carrying out field assessments. The Integrated Management Plan provided a platform for wetland managers and stakeholders to cooperate and participate in identifying opportunities for intersectoral coordination.

4.7 4-Returns Framework for Landscape Assessment

The 4Returns (4R) restoration programme in 2022-2023 within the Chilika Catchment looked into four different returns, i.e. natural, social, financial, and inspirational, that society derives from the landscape. Diagnosing these returns provided an overview of the landscape's complex socio-ecological and economic processes. It helped in understanding the focus areas where interventions are being prioritised.

Wetlands International South Asia and Wetlands International Global Office and critical stakeholders like Chilika Development Authority and Pallishree, a grassroots organization from the landscape, provided technical support wherever required. The overall insight from the programme is to integrate the 4R approach into Chilika’s current management framework to simplify and work on critical areas of intervention.

For upscaling, we have developed a shared understanding with the Chilika Development Authority to integrate the 4R framework in their management plans. For finances, we are looking into different convergence schemes and funding from global partners like the Commonland Foundation. We are reaching out to the market players and have already agreed with private players (like crab culture farmers) to work on sustainable business development in the landscape.

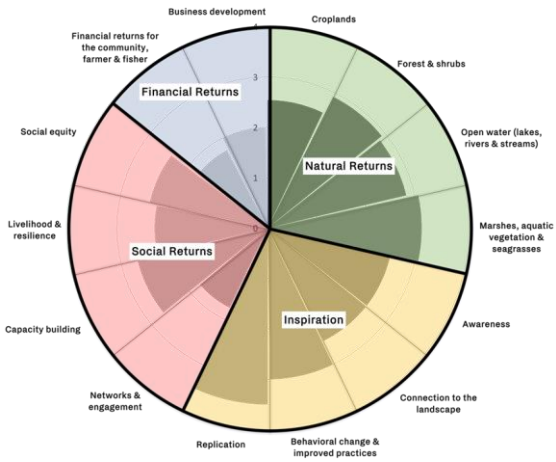


Figure 20: 4R scenario in Chilika Catchment

The wheel diagram provides a snapshot of the Chilika catchment landscape's current state concerning the 4 Returns: inspiration, social, financial, and natural returns. The natural returns component is customised to reflect the main biomes in the landscape. The wheel illustrates the landscape's condition based on stakeholder assessments, with each return comprising specific attributes scored on a scale of 1 (Poor) to 4 (Excellent), indicating the state relative to the landscape’s full potential.

4.8 Community of Practice

Here tools and approaches are presented that can support practitioners and decision-makers to safeguard wetlands to advance resilience. These tools and approaches will feature in the W4R model approach. Learning on them will be shared and deepened through communities of practice.

Some of the tools and methodologies are supplemented with a review of existing policies and perspectives to develop responses best suited to a region/community. Due to the magnitude of the challenges, action requires proper coordination. WI will play a vital role in fostering concerted local efforts by rallying action from various stakeholders. This report has identified twelve tools or methods (table below) from which the best fit could lead us to drive W4R upscaling and help ensure a favourable outcome.

Table 1: Community of practice for resilience building in Mahanadi Delta

S No.	Title	Short description/remarks	Project
1	Including Ecosystem-based DRR approaches within the district	This document guides how district planning can be embellished and made forward-looking by integrating ecosystem-based disaster risk reduction (Eco-DRR) approaches.	Eco-DRR
2	MANUAL OF TOOLS: PARTICIPATORY RISK ASSESSMENT (PRA)	This manual explains in detail the six steps of PRA, which consists of three sections with the related tools: 1) context analysis, 2) hazard and vulnerability assessment, and 3) risk reduction plan. The assessment aims to create a basic understanding of the community in its context. Used in Ganjam District in Odisha & Saharsa in Bihar	PfR
3	HVCA tool	Identifies ecosystem protection and restoration areas to attract public and private sector investments in project countries.	PfR
4	4R	It provides a snapshot of the landscape on natural, social, inspirational and financial returns that helps design strategies and interventions for holistic restoration of the landscape.	4R Accelerating Landscape Regeneration at Scale

5	ESSVA - “Ecosystem-Service Shared Value Assessment	It provides an opportunity for populations around ecosystems to evaluate their ecosystem on current and future status & values, helping them to shape a shared vision and common understanding of the issues and challenges facing the watershed	PfR & Eco-DRR
6	RAWES- "Rapid Assessment of Wetland Ecosystem Services"	Used in the preparation of the management plan of Tampara	Wetlands International South Asia
7	A Guidebook on Building with Nature	With this Volume, inspirational applications Of Building with nature have been shared. The Interdisciplinary design approach creates sustainable development solutions for our coasts, rivers, deltas and cities. It harnesses the forces of nature to add value for both nature and humans.	Building with nature
8	ECOSYSTEM-BASED DISASTER RISK REDUCTION - A HANDBOOK FOR PRACTITIONERS	Eco-DRR is the use of holistic and sustainable approaches that utilise biodiversity, ecosystem functions and services to manage the risks of climate-related impacts and disasters, and can be very effective in reducing the effects of various climatic disasters such as landslides, flood protections, coastal hazards, fires, etc	Eco-DRR
9	Nature-Based Solutions for Reducing Disaster Risk	Water-related risks, which are attributed to complex interactions in the ocean-atmosphere land process cascade, cause extensive damage to lives and assets as well as to life-sustaining ecosystems	Eco-DRR
10	Chilika Manag. Plan	Chilika Development Authority and Wetlands International – South Asia, in collaboration with the network of organisations, are committed to implementing the management plan to ensure the conservation of rich biodiversity and secure the provision of ecosystem services. Therefore, this plan would serve as an instrument to guide future investment into the wetland system and as a means to communicate with the diverse stakeholders. The plan also provides a basis for mainstreaming conservation and wise use of Chilika into developmental planning, particularly those addressing water-food and energy nexus.	Management of Chilika

11	Health Card	The health report card of an ecosystem is an effective tool to communicate the complex volume of data and information in a simple, communicable format that is understandable to a wide audience, including the local communities, policymakers, and stakeholders. The Chilika Lagoon was studied scientifically to develop the health report card for better ecosystem management.	Health Card tool by CDA
12	The Partnership for Environment and Disaster Risk Reduction (PEDRR),	Opportunity mapping tool used to offer a cross-mapping of ecosystem distributions and human exposure to hazards at a global scale	PfR
13	Integrated Risk Management Law and Policy Checklist	This Integrated Risk Management (IRM) Policy checklist has been developed for Partners for Resilience (PfR) Alliance partners and their in-country counterparts to identify areas for improvement within current legislation, policies and implementation of PfR's IRM approach.	PfR

The best-fit method, tool, or approach is context- and stakeholder specific. The W4R model approach and above tools and approaches would be able to support resilience both directly and indirectly, a feature that ultimately translates into a more comprehensive estimation of the resilience capacity of the landscape and sounder policy indications. Furthermore, the W4R model approach will provide new depth and breadth to achieve the W4R programme goal of upscaling wetlands safeguarding to enhance resilience. It will support decision-makers and other stakeholders to better understand the dynamics of positive trends in resilience and thus to develop strategies that will yield positive results. This will lead the way to upscale healthy, biodiverse, and well-managed wetland landscapes globally by 2030, contributing to climate resilience and environmental, social and economic sustainability.

4.9 Summary of workshop on a shared understanding of W4R-4R framework on Mahanadi Delta

The "Wetlands for Resilience" and "4 Returns" initiatives, facilitated by Wetlands International South Asia and the global office, conducted a comprehensive workshop spanning November 27th and 28th. The event gathered diverse stakeholders, including Chilika Development Authority (CDA) representatives, local NGOs, and private partners. The workshop aimed to cultivate a shared vision for the Mahanadi Delta through the Wetlands for Resilience (W4R) initiative and 4R framework.
Delving into the interrelated realms of environment, culture, and economics, the

workshop addressed critical aspects, including interventions for the habitat conservation of saltwater crocodiles, the challenges faced by endangered dolphins, and the broader implications for local livelihoods. Emphasising holistic development for resilient communities, the discussions underscored the potential returns on investment.

The workshop spotlighted notable initiatives, such as APOWA's impactful work in enhancing landscape resilience through mangrove afforestation. Updates from the Chilika Development Authority highlighted ongoing efforts to manage and conserve Chilika for its sustainable use.

Furthermore, the workshop featured insights from the ECO-DRR (Ecosystem-based Disaster Risk Reduction) and PfR (Partners for Resilience) program by NetCoast, focusing on raising awareness among communities in and around the delta. Interactive activities like stakeholder mapping and power and context analysis were incorporated, highlighting the importance of collaborative efforts and synergies in a roundtable discussion. These exercises showcased the Delta's remarkable resilience, emphasising its ability to bounce back and thrive even in challenging situations.

A pivotal component of the workshop included a field visit to Manglajodi and Satpada, offering firsthand insights into the rich bird diversity and the captivating presence of Irrawaddy dolphins. Engagement and awareness initiatives by crab farmers and traders were explored.

One of the significant takeaways from the workshop involved piloting the integration of the W4R / 4-Returns framework into the Chilika management plan, a decision agreed upon by various stakeholders. Plans are underway for a landscape proposition for the Chilika Catchment making use of the W4R / 4 Returns framework. The successful implementation of these initiatives will be upscaled to various other wetland landscapes within the delta and across India. Additionally, plans are to integrate the framework into a Wetlands 4 Resilience program in Sundarbans, Bangladesh. The workshop is a testament to collaborative efforts to secure the future of vital ecosystems and the communities dependent on them.

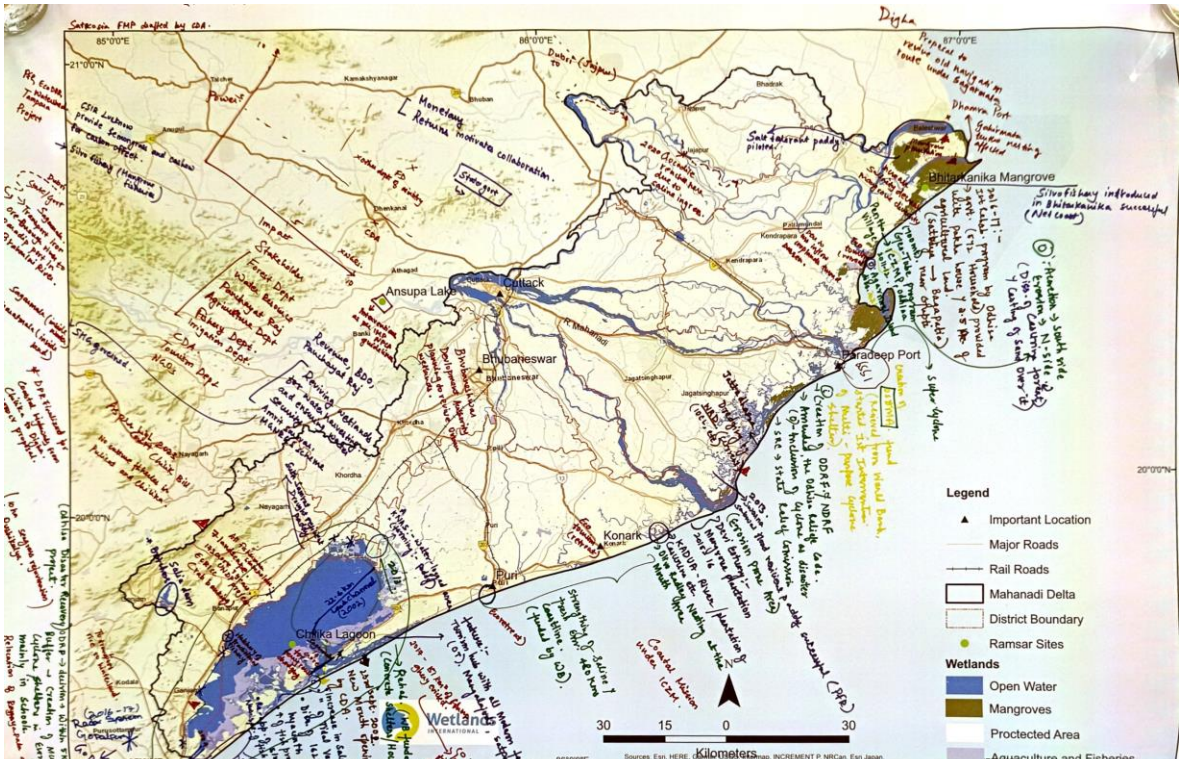


Figure 21: Mapping existing and potential interventions in the Mahanadi Delta to resilience building

5 WAY FORWARD

In Mahanadi Delta, Wetlands International South Asia, through its years of engagement with landscape partners and stakeholders at the National, State District, and Site levels, aims at enabling a shared understanding of the crucial role of wetlands for resilience building. The following recommendations for upscaling the outcomes of programmes in the landscape are:

- Build convergence between relevant developmental programs and government schemes to secure political leverage, funds, and cross-sectoral support for building resilience in the Mahanadi Delta.
- Establish proof of concepts through research on the role of healthy wetland ecosystems for resilient communities.
- Establish and advocate a plausible business case for W4R/4R, which could be done through the valuation of medium- and long-term advantages of the 4 returns (natural, social, financial, inspirational) in conservation and management planning.
- Generate knowledge products and policy recommendations on W4R/4R model approach to pursue its upscaling in relevant policies and programs.
- Develop interventions in an inclusive manner that are aligned with project goals of gender mainstreaming wherein women SHGs, CBOs and local indigenous communities are central to the planning and implementation process.

Wetlands International's resilience work will continue to improve based on experiences from the W4R lighthouse landscape of the Mahanadi Delta. For upscaling and replicating the W4R model approach in the Sundarbans, Bangladesh, WISA will strengthen its approach and the purpose of the action for the W4R initiative to be applied in Sundarbans based on the learning captured from what has been done over the years (tools, methods, and approaches, building a multi-stakeholder collaboration). Subsequently, we would like to apply our learnings, insights and considered best practices to address risks, vulnerabilities and resilience in the aimed geography of Sundarbans to a conceptual understanding of practical application.

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