Biodiversity of Mangalajodi Wetlands and Socio-Economic Status of People Living Around: Challenges and Opportunities

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Abstract. The pace of biodiversity degradation of Mangalajodi wetland in Odisha has been very high and has a direct impact on the local livelihoods. A large part of the people living around depend on the wetland and nearby Chilika Lake for their food and other requirements. However, the nature and extent of the relationship between the wetland and local livelihoods has been changing and a conflicting scenario between the wetland biodiversity and local livelihoods has been aroused. This paper attempts to address the following two objectives: to assess the socio-economic conditions of the households living around the wetland and its linkage with the state of biodiversity, and to ascertain the consequences of biodiversity loss on the livelihoods of local people. The paper relied on both secondary and primary data to accomplish its objectives. A mix of quantitative and qualitative designs was adopted for the study. The primary data was collected from different stakeholders including 320 sample households of Mangalajodi gram panchayat. The sample was drawn based on simple random sampling. It is found that there is a significant positive correlation between the status of biodiversity and the state of livelihood condition of the local households. However, the discharge of chemical affluence into the nearby waterbodies, the practice of extensive synthetic fertilizer-based agriculture, overexploitation of mangroves, and commercial aquaculture in adjacent areas accelerate the loss of biodiversity and put pressure on local livelihoods. Finally, the changes and the possible opportunities are discussed in this paper.

Keywords: Biodiversity, Chilika Lake, Livelihood, Stakeholders, Wetland.

1 Introduction

Biodiversity plays a critical role in supporting people's livelihoods, especially in developing countries such as India, where 64% of the population lives in rural areas

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and many of these people depend on natural resources (World Bank Development Indicators Group, 2021),

India is a country rich in diversity with diverse ecosystems ranging from the Himalayas in the North to the tropical rainforests of the Western Ghats in the South. More than 45,000 plant species and 91,000 animal species are found in the nation, many of which are endemic and unique to it (Rani et al., 2021). This rich biodiversity supports a wide range of livelihoods including agriculture, fisheries, forestry, and tourism. The majority of India's issues with biodiversity loss are caused by the country's growing population. With a population of 1.41 billion, India makes up around 17.7% of the world's population. (United Nations Department of Economic and Social Affairs, 2022).

Mangalajodi is one of the areas near Chilika and is a hotspot of biodiversity for a diverse group of organisms with wetlands, marshes, and lakes supporting a wide range of species including migratory birds that travel long distances to spend their winter period in this area. The local communities that depend on these natural resources for their survival benefit greatly from the high biodiversity of the wetland. Many depend on fishing, farming, gathering forest products, and hunting birds for their livelihood, and some also participate in unorganized ecotourism activities. Wetlands and the associated biodiversity have cultural significance for local communities that possess traditional knowledge and practices for their sustainable management (National Skill Development Corporation, 2018). However, the livelihoods of the locals are threatened by the biodiversity loss in the Mangalajodi. Commercial use of the study area and habitat destruction in the wetland are major drivers of biodiversity loss in the region. The consequences of this loss are being felt in several ways, including reduced fish catch, declining agricultural productivity, and loss of income from tourism. The relationship between biodiversity and livelihoods becomes complex. The following research inquiry is attempted in this paper: how do the socio-economic conditions of the households living around Mangalajodi wetland get affected by the declining biodiversity status of this wetland?

2 Materials and Methods

In connection with the research question posed, the following research objectives are framed: To assess the socio-economic conditions of the households living around the wetland in Mangalajodi and to ascertain the consequences of biodiversity loss on the livelihoods of local people. The paper has analyzed both secondary and primary data to address the research questions and find out the relationship between biodiversity degradation and livelihoods. A combination of quantitative and qualitative methodology was adopted for the study. To triangulate the results from the household survey, focus group discussions (FGDs) were conducted. The sample size of households was 320. The relevant policy documents and secondary data were collected.

3 Results and Discussion

3.1 Study Area

Mangalajodi is one of the villages near Chilika Lake, which is situated in the lake's northeastern region and belongs to the Tangi block in Khordha district (Figure 1). Mangalajodi is one of the richest biodiversity hotspots in India. However, it is on the verge of extinction due to the rapid pace of biodiversity destruction. The Mangalajodi Wetland, which has been designated an important bird nesting area, is home to more than three hundred thousand migratory birds from October to March every year. Around five thousand population live in the Mangalajodi village with a sex ratio of 937. The literacy rate of the village was 67.01% against 72.87% in Odisha as a whole (2011 Census). Similarly, the female literacy rate was found to be much lower (59.12%) as compared to that among males (74.46%).

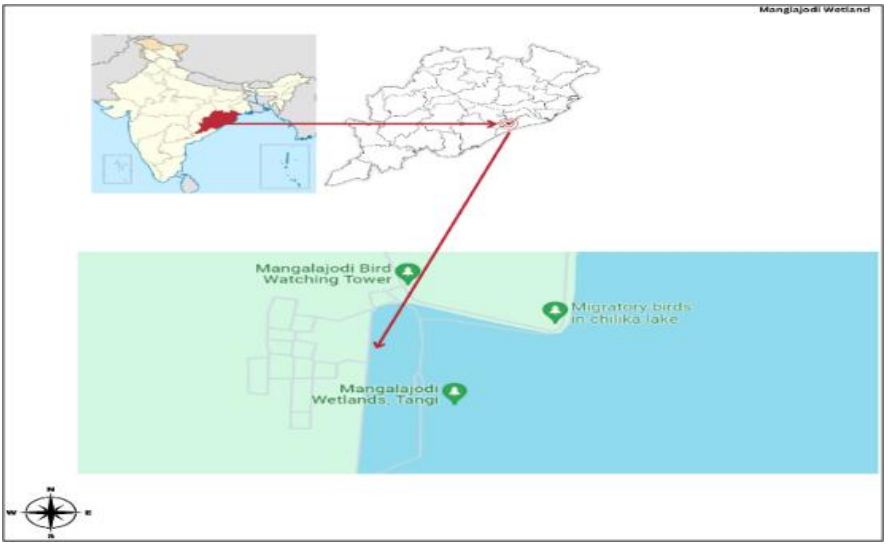

Figure 1. Mangalajodi gram panchayat map by Chilika lake in Odisha

3.2 Socio-Economic Conditions

3.2.1 Access to Basic Amenities

Overall 85% of households reside in either pucca or semi-pucca dwellings. Due to financial constraints for concrete roofing, some homes under initiatives like the Indira Awas Yojana opt for asbestos or tin roofing. Despite this, kutcha houses still constitute around 15% of the village's total housing.

Access to Drinking Water: Emphasizing the significance of water distribution as outlined in the 2007 State Water Policy of Odisha, the National Family Health Survey (NFHS) 5 report indicates that 91.1% of total households (89.8% in rural areas) in

Odisha have access to improved sources of drinking water. However, only 37% of surveyed households reported having individual water sources, with the remaining 63% relying on community-owned and other safe water sources.

Access to Toilet: As per the NFHS 5 (2019-21), 60.5% of households in Odisha (72.3% urban and 58% rural) use improved sanitation facilities. ONGC intervened in the Mangalajodi cluster, aiming to provide toilet facilities to every household. Despite 81% reporting access to personal restrooms, 19% do not have on-property facilities. Notably, 4% of households with toilets do not use them.

Access to Electricity: Approximately 99% of surveyed households have electricity connections, with only 1% lacking access.

Access to Cooking Fuel: NFHS-5 data (2019–21) reveals that 34.7% of Odisha households use clean fuel for cooking. Khordha and Nayagarh districts report higher access, with 63.3% and 42.3%, respectively. Despite improved availability of clean fuel and 39% having LPG connections, firewood (61%) remains the primary cooking fuel. This suggests that while Ujjwala has increased access, a behavioural shift is still in progress. Investigation shows that LPG, despite its benefits, is more expensive than traditional cooking fuels like dry leaves, straw, or firewood.

Table 1. Structure of households

Structure of Households	Data (%)
Pucca	49%
Semi-Pucca	37%
Kachha	14%
Others	NA
Main Source of Drinking Water	
Own safe-drinking water	37%
Community safe-drinking water	62%
Others	1%
Access to Toilet	
Own toilet	81%
HHs have access to their toilet	96%
Access to Electricity	
HHs having access to electricity	99%
Cooking Fuel Sources	
HHs using wood/straw/leaves	91% (of 320 HHs)
HHs using electricity	NA
HHs depending on LPG	58% (of 320 HHs)

Source: Primary household level survey

3.2.2 The main occupations of the households of the Mangalajodi

Based on the survey, cultivation (37%) emerges as the primary occupation for the majority, followed by non-agricultural labour (24%). Out of the 1137 individuals aged 15–59, 57.8% are employed, while 42.2% are not. Private jobs contribute 16.2%, and

business and government services collectively make up 13.8% of all occupations. Among the 658 employed individuals, 52.7% rely solely on one occupation, with wage labour, private employment, and agriculture being the most prominent sources. Only 29.4% reported having a secondary occupation, including activities like wage labour and fishing. For the youth (15-34 years), non-agricultural labour is the primary occupation for the majority (72 individuals, 12%).

Table 2. Occupation-wise person-days spent (In % of sample households)

Sl. No.	Occupations	Below 90 person days	Between 91-180 person days	Between 181-270 person days	Between 271-365 person days
1	Cultivation	0.63	66.56	2.50	7.19
2	Animal Husbandry	0.63	0.31	0.00	4.69
3	Agri-Labor	16.88	5.63	0.63	0.63
4	Non-Agri Labor	8.75	19.38	8.75	16.25
5	Tourism Based	0.31	0.00	0.00	0.00
6	Fishing	0.00	0.63	0.94	2.50
7	Pisciculture	0.00	0.00	0.00	0.00
8	Fish/ Dryfish	0.00	0.00	0.00	0.31
9	Other Business	0.63	0.94	0.31	17.50
10	Private Job	0.00	1.56	4.06	20.00
11	Government Job	0.00	0.00	0.00	7.50
12	Other	0.00	0.00	0.00	3.44

Source: Primary household level survey

As per the survey, in terms of person-days, cultivation stands as the primary occupation, with almost 66% of households dedicating around 180 (49%) person-days annually. Non-agricultural labour follows, with a substantial number allocating approximately 270 (74%) person-days. Private service ranks as the third most significant occupation, with individuals spending around 330 (90%) person-days on average per annum. Fishing, business, and agricultural labour are also notable occupations, with people investing around 270 (74%) person-days on average.

3.2.3 Household Income

The survey, despite hesitancy in revealing earnings, outlines income groups for surveyed households in the project area. Notably, 39% earned below 1 lakh, while 47% fell within the 1 to 2 lakh range, and 16% earned more than 3 lakhs annually. Among the 320 households surveyed, 78% derive income from cultivation. Within this group, 43.3% earn between Rs.10,000 to Rs.30,000, 40% earn Rs.50,000 to Rs.1,00,000, and only 7.2% surpass Rs.1,00,000 annually. For households relying on non-agricultural labour, approximately 70% reported an income below Rs.1,00,000, while 30% earned above Rs.1 lakh annually. Private services contribute to an annual income of over Rs.50,000 for 90% of households, with only 10% earning less. Moreover, merely 8.75% reported an income below Rs.50,000.

Table 3. Income range of surveyed households

Income Range of Households		
	NO	%
Less than 50000	28	9
50000 - 1 Lakh.	95	30
1-2 Lakhs	98	31
2-3 Lakhs	50	16
3-4 Lakhs	23	7
4-5 Lakhs	9	3
5-7 Lakhs	9	3
Above 7 lakhs	8	3
	320	100

Source: Primary household level survey

Figure 2. Income range of surveyed households

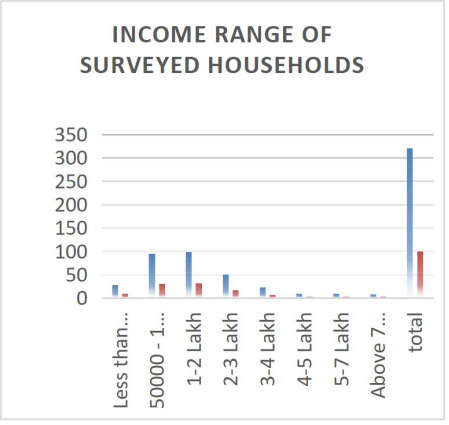

Table 4. Distribution of sample households (in%) by income groups and sources of income

Sl. No.	Sources of income	Below 10000	Between 10001-30000	Between 30001-50000	Between 50001-01 lack	Above 1 lakh	Total Sample	Percentage
1	Cultivation	9.64	43.37	19.68	20.08	7.23	249	100
2	Animal Husbandry	33.33	33.33	5.56	0	27.78	18	100
3	Agri-Labor	28.95	40.79	13.16	11.84	5.26	76	100
4	Non-Agri Labor	1.78	13.02	23.67	31.95	30.18	169	100
5	Tourism	0	0	0	0	100	1	100

	Based							
6	Fishing	0	8.33	16.67	25	50	12	100
7	Pisciculture						0	100
8	Fish/ Dryfish	0	0	100	0	0	1	100
9	Other Business	1.59	14.29	3.17	39.68	41.27	63	100
10	Private Job	0	1.2	3.61	27.71	67.47	83	100
11	Government Job	0	4	4	28	64	25	100
12	Income From Assets						0	100
99	Other	0	0	0	0	100	2	100

Source: Primary household level survey

3.3 Biodiversity Services

Through household surveys, focus group discussions, and interviews with key informants for the Mangalajodi wetland, a total of 24 important biodiversity services were identified. Of them, eleven provided services, six regulated, two supporting, and five cultural services.

Table 5. List of biodiversity services identified in the study area

Biodiversity Services	Biodiversity Services recorded
Provisioning (11)	Fuel-wood, Fish, grazing livestock, medicine, NTFP, water for agriculture, feed, hunting, timber, thatch.
Regulating (6)	Nutrient cycling, regulation of the climate, purification of air, pollination, siltation control water regulating
Cultural (5)	Bird watching, tourism, educational and research, recreational visit, spiritual/inspirational value
Supporting (2)	Habitat for wild flora and fauna, Fish nurseries

Source: Primary household level survey, focus group discussions

3.3.1 Status and Causes of Biodiversity Loss in Mangalajodi

According to the study of household surveys, FGDs, and community workshops, biodiversity services in Mangalajodi have changed due to several direct and indirect causes. The indirect causes of change include population increase, the market, and the absence of a wetland management plan. On the other hand, direct agents of change threatening the wetland ecosystem include pollution from agricultural land from fertilizers and pesticides, wetland aquaculture effluents, encroachment, unmanaged tourism, sanitation, over-exploitation, and fish poisoning. The decline of biodiversity in Mangalajodi is mainly due to the following reasons:

(i) Pollution

The contamination of land in Mangalajodi results from a combination of natural and human factors. Agricultural practices contribute to soil degradation and biodiversity loss due to the use of chemical fertilizers, herbicides, and insecticides (Jadon et al., 2022). The fields in Mangalajodi village face significant pollution, posing a threat to the local ecosystem. One of the major challenges is the absence of an effective waste management plan for urban garbage reaching Mangalajodi village and its surroundings (Shukla, 2021). This leads to the accumulation of both biodegradable and non-biodegradable pollutants. Plastic bags, bottles, and persistent solid debris, including shredded nylon nets, have become prominent hazards to the local biodiversity (Masese et al., 2012). The presence of litter, especially plastic, has severe consequences on biological interactions. It can lead to the death of fragile benthic organisms and habitat destruction. Given that resident and migratory birds rely on benthic organisms as a food source, the accumulation of plastic litter directly affects the avian population in this vital area (Mishra et al., 2021).

(ii) Habitat loss/alteration

The push to convert wetlands in Mangalajodi for aquaculture ponds, industrial, and recreational development poses a significant threat. Wetlands play crucial roles as feeding, spawning, and nursery areas, along with being vital hunting grounds for reproductive fisheries. The degradation of wetlands is identified as one of the major dangers to terrestrial life in these ecosystems, standing alongside overexploitation and pollution as key contributors to biodiversity loss (Pattanaik, 2007). The habitat loss is amplified by wetland development manifesting through urbanization, increased agricultural production, erosion, and filling (Shukla, 2021). The transformation of wetlands and mangrove forests further exacerbates this challenge, emphasizing the pressing need for conservation measures to preserve these critical ecosystems and their diverse inhabitants.

(iii) Over exploitation

The over-exploitation of land resources in Mangalajodi diverts to a significant threat, particularly evident in the increased felling of mangrove trees. These trees, essential for biodiversity and as nesting places for birds, are being cut down for fuel and construction purposes in daily life (National Foundation for Skills Development, 2018). Additionally, the intensification of shrimp farming compounds the issue. This practice not only pollutes agricultural lands but also contributes to the spread of viral diseases. Furthermore, the cultivation of shrimp leads to groundwater pollution, underscoring the multifaceted impact of certain land use practices on the ecological balance in Mangalajodi (Jadon et al., 2022).

(iv) Aquaculture conversion

The practice of aquaculture in Mangalajodi involves the modification of natural wetlands through sequestration, often incorporating foreign materials like fertilizers or fish food (R. Kumar and Pattnaik, 2012). This alteration is not without

consequences, as effluents laden with organic matter and solids from forage waste are introduced to the wetlands. This influx leads to the flooding of the liquid layer and subsequent deoxygenation of the water (Ramachandra and Solanki, 2007).

(v) Overgrazing

The consequences of overgrazing in Mangalajodi are evident in the altered structure and composition of plant species. This change significantly affects the availability of essential plants for migrating birds, impacting both their breeding and food sources (Kothari et al., 2015). The disruptions extend to insect species, vital for many birds, as alterations in vegetation structure affect their diversity (Tscharntke et al., 2008). Moreover, increased human activity and habitat loss resulting from overgrazing lead to disturbances during bird migration seasons.

(vi) Eco-tourism

Mangalajodi's popularity as a tourist destination in Odisha, driven by its biodiversity and the abundant migratory bird population, is well-recognized (Kummitha, 2020). However, the influx of visitors and recreational activities in the area brings about adverse effects. Recreational uses contribute to pollution and disturbance, leading to harm, disturbance, and displacement of plant and animal species, particularly affecting perching and nesting birds (Bhattacharya, 2016). While tourism generates employment, income, and opportunities for the local community, the challenges posed by excessive visitors and increased waste from hotels and restaurants contribute to the degradation of the landscape and a decline in biodiversity (PEOPLES, 2012).

Polluted water

Loss of Grassland

Dead Fish and Snake

Polluted Soil

Figure 3. Loss of biodiversity in the Mangalajodi
Source: Field visit

3.3.2 Consequences of biodiversity loss on Mangalajodi livelihoods

"The intricate interdependence between biodiversity and livelihoods is a global phenomenon, particularly crucial in rural areas where natural resources form the cornerstone of people's livelihoods. Farmers depend on the health of soil, water, and a diverse array of plant and animal species for crop cultivation and livestock raising. Fishers rely on robust fish stocks for their livelihoods, and Indigenous communities draw upon biodiversity for sustenance, medicine, and cultural practices."

The wetland biodiversity in Mangalajodi faces numerous threats, including unsustainable farming practices, escalating population density, weak government policies, and the absence of awareness agencies. These practices contribute to biodiversity degradation, directly impacting the livelihoods of the population. Resultantly, Mangalajodi experiences significant habitat loss, widespread pollution, and the spread of diseases. Deterioration of mangroves, critical environments for biodiversity, has led to the loss of bird nesting and breeding areas for essential fish and crustaceans, affecting water quality due to the loss of dense roots. Groundwater degradation in Mangalajodi has direct consequences on habitats during drought periods, impacting rare and endangered species and hindering crop irrigation. The degradation of pastures has negative implications for soil disintegration and erosion, affecting organisms reliant on these lands for sustenance. Another crucial effect is the decrease in vital insects, leading to an imbalance in the ecosystem. These insects play a crucial role in soil aeration, water regulation, and drainage, and their decline affects the pollination of crops, fruits, and vegetables, typically fulfilled by insects like bees.

The declining biodiversity in Mangalajodi has led to significant challenges, primarily manifesting as habitat degradation. This directly affects the livelihoods of the local population who depend on these resources for their daily needs. The following are the important causes of livelihood loss attributed to biological degradation in the Mangalajodi:

The people of the area use land grasses for hay and also use wood as fuel and building materials (reeds for mats and roofing, most of the residents live in traditional houses built from building materials collected in wetlands) and people also collect firewood for their livelihood.

Poor families in Mangalajodi catch fish from ponds and canals as well as other waterways using poles and lines, as well as some fisheries, as the loss of these ponds due to the increase in the proportion of chemicals and pollutants leads to a direct impact on livelihoods.

The Mangalajodi area is an important tourist attraction which is a vital point for migratory birds, and many families depend on this element for their income, and its loss leads to the loss of this resource for families in this area.

Hunting is a significant activity for some of the residents of the wetlands in the Mangalajodi district, and they also rely on it. The degradation of wetlands and biodiversity has led to the loss of this resource.

People use the roots, leaves, and bark of many plants for medicinal purposes and their loss is affecting the population. Cattle grazing is also an important activity to support the livelihood of Mangalajodi village.

The deterioration of the wetlands located in Mangalajodi negatively affects agricultural lands, due to the birds losing their habitats in the wetlands and moving to feed on seeds and plants found in crops, and this causes great losses that are directly reflected in livelihoods. of the people who depend on these crops.

4 Challenges

1. Limited access to essential services

Cooking fuel: Although the community has access to better fuel and UJJWALA has been successful in providing at least 60% of households with liquid petroleum connections, there is still a forced reliance on solid fuel, with wood making up 80.9% of the most frequent fuel for cooking.

Drinking water: The community's health and well-being are at risk since just 34.3% of Mangalajodi homes have access to an improved supply of drinking water, and only 24.9% have access to indoor water. Few households filter the water before consuming it, and most families just use a cloth to filter the water from open wells for drinking.

Sanitation: While 81% of households in Mangalajodi have access to indoor toilet facilities, a significant portion of the population lacking land faces challenges in accessing these facilities within houses.

2. In Mangalajodi, the primary livelihoods encompass fishing, wage labour, agriculture, and tourism. Migration is driven by challenges such as lake shrinkage, land ownership restrictions, protection of migratory birds, and the seasonal nature of these activities. Paid labour emerges as the predominant income source for 88.3% of households, fostering a common practice of seasonal mobility within the community.

3. Insufficient awareness about skill development initiatives, diverse skill sectors, and potential employment/entrepreneurship opportunities stands as a significant

hindrance to accessing vocational and technical training (National Skill Development Corporation, 2018).

4. The low literacy rates in Mangalajodi pose a significant challenge to both livelihoods and biodiversity. This lack of understanding contributes to unsustainable practices, including fishing and agriculture, that exploit natural resources without considering long-term environmental consequences. Residents' insufficient knowledge also results in a limited understanding of the impact of human activities on birds, causing disturbances in nesting sites and foraging areas. These unsustainable practices further impact the nutrition of the community, creating challenges in adapting diets and agricultural practices to changes in biodiversity. Additionally, reduced access to alternative livelihood opportunities compounds these challenges.

5 Opportunities

5.1 Pollution Empowering stakeholders involved in preserving biodiversity resources in Mangalajodi

Empowering stakeholders in Mangalajodi for biodiversity conservation involves various strategies. Education and training programs can enhance their knowledge and skills, focusing on sustainable farming practices and conservation techniques. Tourists and visitors should be educated on responsible tourism practices and the importance of biodiversity preservation. Capacity-building initiatives can provide stakeholders with the skills and resources necessary for active participation in conservation, including equipment and tools for conservation activities and community-led initiatives. Involving stakeholders in decision-making processes ensures their concerns are addressed and their voices heard. Strengthening local institutions is vital, as locally-based conservation organizations tend to be more successful than externally designed schemes. Empowering stakeholders fosters a sense of ownership and responsibility, promoting effective and sustainable conservation efforts in Mangalajodi.

5.2 Pollution Implementation of the integrated management approach for wetland resources

Implementing integrated wetland resource management in Mangalajodi is crucial for the sustainability of wetlands and the biodiversity they support. This approach considers the benefits to people, wildlife, the ecosystem, and industrial growth. Involving all stakeholders in integrated land and water development and management is essential for the sustainable development of wetland resources, as highlighted by Jansen et al. (2007). By adopting an integrated landscape approach to wetland management, the quality of life and well-being of Mangalajodi residents can be significantly improved, as suggested by Menbere and Menbere (2018).

5.3 The informal training that young people receive and the possibility of recognition of previous education

In Mangalajodi, where traditional activities like fishing, boat building, and carpentry are predominant, there is an opportunity to develop the informal/traditional skills of the youth. This can empower them to find employment or venture into their businesses. Despite the interest in farming among the youth, the lack of contemporary skills hampers their productivity. Providing instruction in modern farming techniques, as well as crafts related to processing, packaging, and storage, could be beneficial. Skills such as boat and furniture construction are available in the community, but with proper instruction and access to better tools, these crafts can be significantly improved.

6 Conclusion

The symbiotic relationship between biodiversity and livelihoods in Mangalajodi is pronounced. The diverse ecosystem in the region serves as a crucial source of income for the local community, encompassing revenue generated from ecotourism and traditional activities such as fishing and agriculture. The annual migration of birds to the area serves as a significant draw for tourists, presenting new economic opportunities. Unfortunately, mounting threats, including chemical pollution, population growth, development, deforestation, over-exploitation of resources (birds, fish, and plants), and excessive grazing, pose substantial risks to the ecological equilibrium and diversity of the region.

To address these challenges and ensure the preservation of Mangalajodi's biodiversity, a comprehensive approach is imperative. This involves diversifying livelihoods, promoting awareness, and providing ecology and biodiversity education to the local populace. The formulation and implementation of integrated policies, strategies, and management plans that span political, economic, and social dimensions are crucial for effectively safeguarding biodiversity and water resources. In summary, the intricate interdependence between biodiversity and livelihoods in Mangalajodi underscores the urgent need for conservation efforts, crucial not only for the sustained well-being of local communities but also with far-reaching implications for global biodiversity conservation endeavour.

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