Wetland Change and its Implication on the Livelihoods of Coastal Community Dwellers in Apoi Creek of Bayelsa State

OMODEHIN, Adenike Oluwakemisoye[1]; IDRIS, Omeiza David[2]; ADENIYI, Rachael Adetoyosi[1]
[1]Department of Urban and Regional Planning, The Federal University of Technology, Akure, Nigeria
[2]Department of Urban and Regional Planning, Abubakar Tafawa Balewa University, Bauchi, Nigeria
E-mail: idrisod@atbu.edu.ng

ABSTRACT: *Wetland change is a process of altering the physical, ecological, and biological composition of a wetlands ecosystem through human activities. This paper aims to give researchers a thorough grasp of the extent of wetland change and its implication for Apoi Creek Coastal Community in Bayelsa State, Nigeria. A mixed method of geospatial and survey research design was used for the study. The study employed a random sampling method to select one hundred and sixty-eight dwellers living in communities situated within a 100-metre buffer zone surrounding Apoi Creek, utilizing a carefully structured questionnaire. The data shows significant changes in land use and land cover in Apoi Creek from 1992 to 2022. Decrease in water bodies significantly contributes to changes in wetland ecosystems in the study area. Human activities for survival such as farming, lumbering, fishing and others have significant effects on wetland change. To tackle these issues, various suggestions were put forward. These included safeguarding and revitalizing wetlands, advocating for sustainable land use methods, enacting conservation and management plans, and increasing public awareness about the detrimental effects on the natural environment.*

KEYWORDS: wetlands, coastal, livelihoods, change, implication

INTRODUCTION

Wetlands are characterized by the presence of water on or near the soil surface throughout the year or during specific seasons (Hammer & Bastian, 2020). These unique ecosystems are often referred to as "earth's kidneys" because of their remarkable capacity to retain and filter pollutants from the water that flows through them for extended periods (Yu *et al.*, 2023). It is for these reasons that they are referred to as wetlands. The soil substrate is mainly undrained and hydric, with occasional support for a majority of hydrophytes throughout the growing season each year (Berkowitz *et al.*, 2021; Wang *et al.*, 2022). Wet

prairie, sedge meadows, fens, seeps, marshes, mangrove swamps and bogs are some of the several types of wetlands (Feierabend, 2020). Wetlands are typically found around coastal communities and coastlines. Coastal communities are rural and urban areas bordering the coast where land meets water, fostering interconnected ecosystems and human activity (Rahman *et al*., 2021). As these settlements grow, wetlands often vanish, erasing natural benefits for ecosystems and people. However, with proper coastal planning, wetland degradation can be prevented; enhancing wetlands' urban protection and ecosystem services (Stein *et al.*, 2020). Developing coastal areas impacts wetlands through direct habitat loss from the constructions of houses, additions of suspended solids like silt and organic matters, reduced water quality and hydrological changes (Kundu *et al.*, 2021).

The alteration of a wetland ecosystem's physical, ecological, and biological makeup through human activities is known as wetland change. Throughout the world, the quantity of wetlands has been decreasing as they were drained by humans for agricultural use, unaware of their environmental significance. Sea level rise, acidity, restricted sediment supply, localized land subsidence, and climate change are some of the natural hazards that threaten coastal wetlands, which are found between land and sea. A century ago, the area covered by mangroves and salt marshes worldwide was at least 100% larger (Scott *et al*., 2014). Nineteen per cent of the world's coral reefs are dead, according to the most recent assessment (Starke, 2006). The primary reasons of this reduction are rising sea surface temperatures and growing ocean acidity. It is challenging to determine the exact acreage lost to sea grass because sea grass patterns are still unclear in many locations. Still, it was obvious that the devastation of the coastal environment had consequences.

Lotze *et al.* (2006) identified seven categories of human impacts on coastal communities: prehuman, hunter-gatherer, agricultural, market-colonial establishment, market-colonial development, global market 1900–1950, and global market 1950–2000. The growth of human economic activities has significantly harmed marine creatures, coastal birds, fish, reptiles, invertebrates, flora, water quality, and invasive species since the start of the global market economy in the 1900s. After 2000, the decline continued, with occasional and inadequate restoration efforts at various locations.

The Apoi Creek wetland in the Niger Delta region of Nigeria is essential for maintaining the balance of the local ecosystem and providing habitats for various species. Recent research indicates that the wetland is experiencing significant changes, depicted in Figure 1, that are negatively impacting both the ecosystem and the communities that rely on it (Stein *et al.*, 2020).

Figure 1: Sediments, oil polluted and degraded swamps in Apoi Creek, Bayelsa State, Nigeria
Source: Researchers' Observations (2024)

Human activities have been the main cause of wetland losses and gains over the past few centuries, leading to numerous environmental stresses such as erosion, land subsidence, droughts, sea level change, and storms. When wetlands are lost, the ecological services they provide are also lost, except for those who benefit from aquaculture or other land uses. The conversion of coastal wetlands into other land uses has resulted in significant alterations, often due to activities like hunting, farming, fishing, commercial deforestation, and housing development in coastal areas. (Edo & Albrecht, 2021).

These activities have resulted in the alteration of the wetlands' physical and organic features. The changes have also impacted the local communities that rely on the wetland for their livelihoods, as they face reduced access to resources and increased risks of ecological degradation (Olu-Owolabi *et al.*, 2014). However, recent studies such as Odubo *et al.* (2023); Okonkwo *et al.* (2015) and Edo and Albrecht (2021) have focused on the factors leading to wetland change and not on the implications of such change on the communities that depend on it. For example, the changes in the wetland have reduced access to resources and increased the risk of environmental degradation for coastal communities. This paper aims to give researchers a thorough grasp of the extent of wetland change and its implication for the livelihoods of Apoi Creek Coastal Community in Bayelsa State.

CONCEPTUAL CLARIFICATIONS AND REVIEW

Wetland loss is the irreversible destruction or alteration of a wetland ecosystem, resulting in the loss of its important ecological functions and species diversity (Ballut-Dajud *et al.*, 2022). This unfortunate event can be attributed to anthropogenic activities such as agricultural practices involving drainage and recharge, manipulation of waterways for irrigation purposes, pollution and excessive nutrient enrichment

(Davidson, 2014). However, wetland modification or change involves changes to the wetland ecosystem that, while not necessarily leading to the complete disappearance of the wetland, can still negatively impact ecosystem integrity and function. Wetland changes include, but are not limited to, fluctuations in water quality and quantity, changes in vegetation composition, disruption of hydrological or sedimentary processes, and introduction of non-native species (Spencer *et al.*, 2016). Although wetland loss is usually permanent, wetland change can be reversible or adaptive, depending on the extent and nature of change (Dixon, 2016). It is important to distinguish between these two concepts in order to develop effective wetland protection and management plans.

Human livelihood refers to the means by which coastal dwellers or households secure their basic needs and improve their well-being. This includes skills, assets, and activities that enable people to survive, thrive, and maintain dignity. Livelihoods are shaped by socio-economic and environmental factors and are particularly influenced by access to resources such as land, water, climate, income and employment opportunities (Barakagira, & de Wit, 2017). The concept of human livelihoods recognizes that people's lives are complex and multifaceted, and that their well-being is influenced by a variety of factors that go beyond purely economic considerations (Yousuf & Kibria, 2017). The impacts of human activities have far-reaching effects, including loss of biodiversity and ecosystem resilience, declines in water quality and fish stocks, loss of cultural and spiritual significance, and increased vulnerability to natural disasters and climate change effect (McCartney *et al.*, 2015). It is important to address these impacts through sustainable management, conservation and restoration efforts to protect and maintain wetland ecosystems.

RESEARCH LOCALE AND METHODOLOGY

Study Area

Apoi Creek is situated in Nigeria's Niger Delta. One of the biggest wetland ecosystems in Africa is the Niger Delta, a huge delta created by the Niger River and its tributaries. Situated in the southern part of Nigeria, the region spans over 70,000 square kilometres. Apoi Creek is surrounded by a mosaic of freshwater swamp woods, salt marshes, and mangrove forests. It is located on the coastal plain of the Niger Delta. Several rivers and streams that empty into the Gulf of Guinea, which is situated south of the Niger Delta, feed the Creek. The area has a tropical environment all year round, with high temperatures and lots of rainfall.
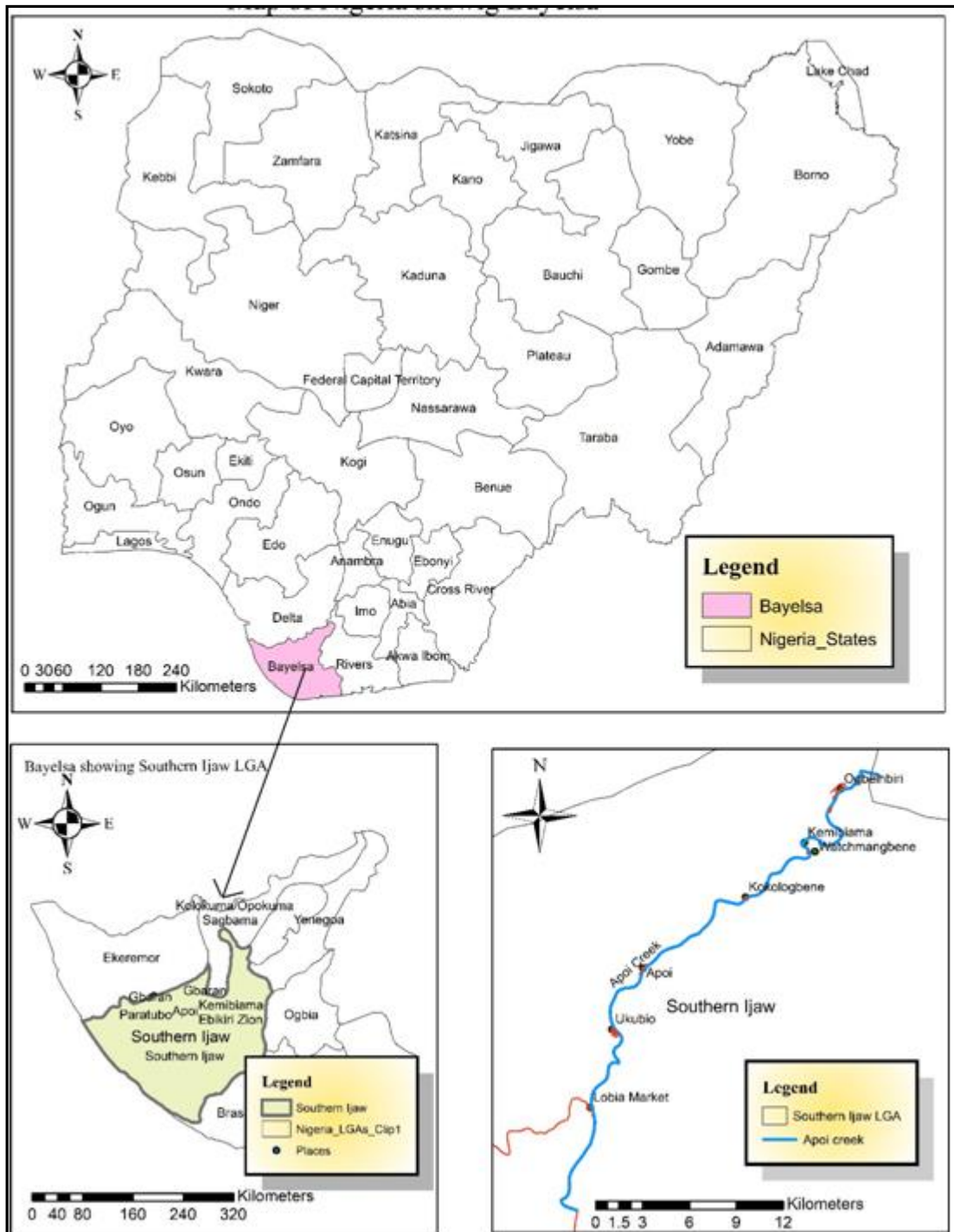
Figure 2: *Study Area*
Source: Researchers' GIS Map Extract (2022)

METHODOLOGY

The survey research design of the ex-post facto type was used for the study. The study made use of both primary and secondary sources of data. Primary sources were obtained from field surveys and observations, while secondary sources of data were obtained from journals, thesis, unpublished research works and reports. Imageries of the study area were obtained from historical satellite imageries (Landsat) from the United States Geological Survey (USGS) and Google Earth. For the 1992 image, Landsat 5 was used with the following band combination for change detection of the Apoi Creek wetland: Band 3 (0.63-0.69 mm) for the red channel, Band 4 (0.76-0.90 mm) for the near-infrared channel, and Band 5 (1.55-1.75 mm) for the shortwave infrared channel. For the 2022 image, Landsat 8 was used, providing 30 metre spatial resolution data. The band combination used for change detection was: Band 4 (0.63-0.69 mm) for the red channel, Band 5 (0.85-0.88 mm) for the near-infrared channel, and Band 6 (1.57-1.65 mm) for the shortwave infrared channel. The satellite imagery of communities along Apoi Creek were obtained using Google Earth software for twenty years (1992 -2022). The imagery showed the creek and buildings in the communities' were digitised using ArcGIS v10.6. As such, all the shape files of the relevant data layers such as the buildings and facilities were identified. The study sampled dwellers in communities who are located within the buffer of $\leq$ 100 metres around Apoi Creek. One household head per building was sampled for the questionnaire survey. The simple random sampling technique was adopted where every member of the communities located along the creek had equal opportunity of being selected for the sample. Simple random sampling was adopted to administer one hundred and sixty eight (168) copies of structured questionnaire. This sample size is derived from the 15 per cent sample of the buildings located within 100 metres buffer from the Creek. The data collection instruments that were used in collecting data were structured questionnaire, camera, ArcGIS 10.6 Mapping software.

Table 1: Landsat needed for the study

Datasets	Years	Instruments
Landsat 8	2022	Operational Land Imager (OLI)
Landsat 5	1992	Thematic Mapper

Source: Researchers' Fieldwork (2023)

Table 2: Sample size for the Study

Communities	Buildings	$\leq$ 100m from the Creek	15%
Lobia Market area	344	301	45
Ikubio	366	227	34
Apoi	130	106	16
Akpobeleiowei	84	76	11
Watchmangbene	124	63	9
Ogboinbiri	602	349	52
Total	1,650	1,122	168

Source: Researchers' Fieldwork (2023)

RESULTS AND DISCUSSIONS

The data shows significant changes in land use and land cover in the Southern Ijaw region of Nigeria from 1992 to 2022. Water bodies increased from 8.62% to 9.63%. This may be as a result of surface flooding. Built-up lands increased from 3.19% to 13.63% of total land area, indicating substantial development and urbanization likely due to population growth and urban expansion. This can have environmental consequences like habitat loss, pollution, and increased flooding. Sparse vegetation rose from 29.35% to 47.92%, possibly due to deforestation, grazing, and agriculture. This may reduce biodiversity, alter soil and water patterns. Wetlands decreased from 41.59% to 26.45% of land area. As wetlands provide services like water filtration, habitat, and carbon sequestration, this loss can impact biodiversity, water quality, and increase flooding. Dense vegetation like forests decreased from 10.98% to 1.40%, potentially from deforestation, land use changes, or forest burning. This can reduce habitat, carbon sequestration, and biodiversity. Bare lands decreased from 6.27% to 0.97%, possibly from changes in land use for housing development.

		Water bodies	Built-up area	Wetlands	Sparse vegetation	Dense vegetation	Bare lands
1992	Hectares	20,295.40	7,512.40	97,902.70	69,098.40	25,837.90	14,764.90
1992	%	8.62	3.19	41.59	29.35	10.98	6.27
2021	Hectares	22,739.50	32,207.70	62,479.10	113,221.20	3,317.60	2,300.00
2021	%	9.63	13.63	26.45	47.92	1.4	0.97
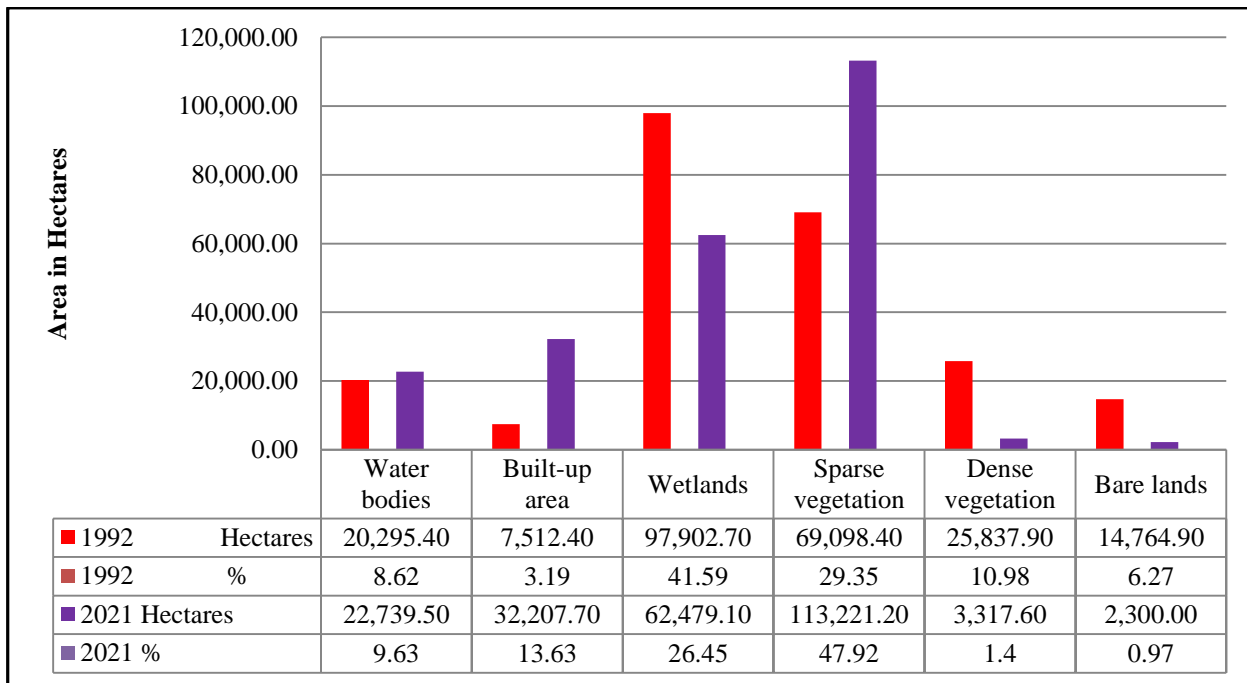
Figure 3: Land use and land cover change in Apoi Creek for 1992 and 2022
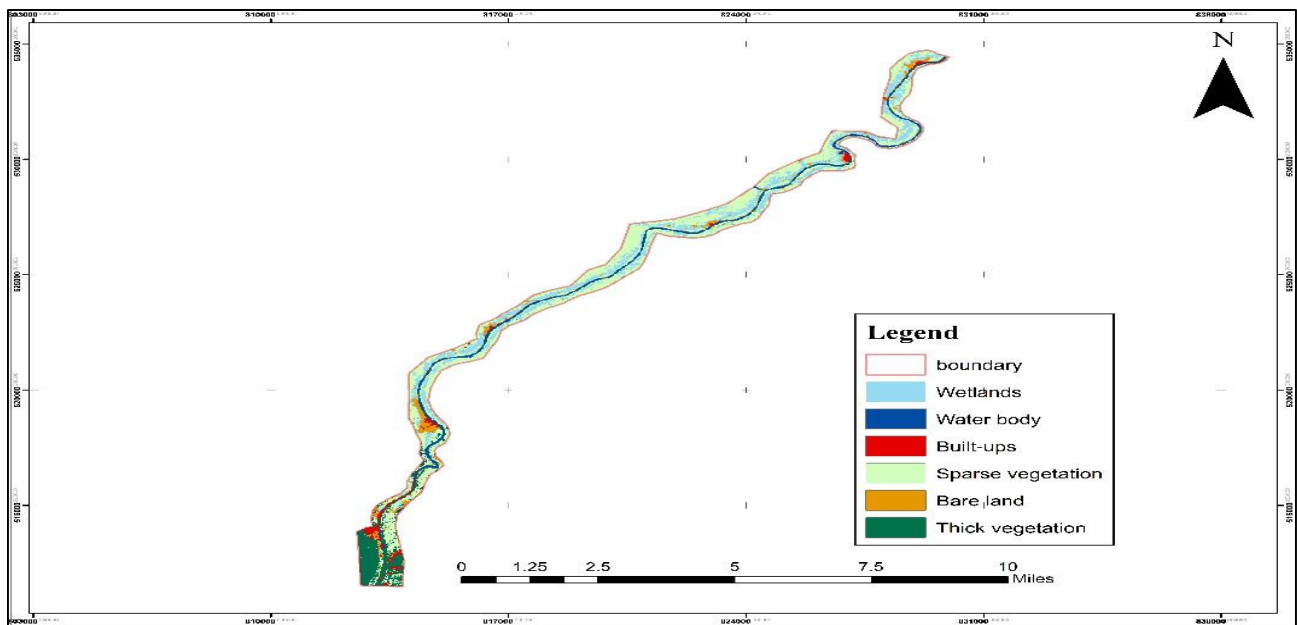*Source*: Researchers' Analysis (2023)

The results indicate that all independent variables considered in this analysis (built-up area, sparse vegetation, dense vegetation, bare lands, and water bodies) collectively explain or contribute to 50% of the wetland area. Upon model analysis, the p-values of four independent variables such as built-up area, sparse vegetation, dense vegetation, and bare lands are not statistically significant. Only water bodies (p-value < 0.05) show statistical significance, suggesting it is the main factor contributing to the wetland change in the study area.

Table 3: Multiple regression coefficients of wetland land uses in Apoi Creek

|	Unstandardised coefficients		Standardised Coefficients	t	sig
	B	Std. Error	Beta		
Constant	-29252.733	55032.405		-.532	.603
Built up area	3.989	2.652	.350	1.504	.155
Sparse vegetation	-.072	.142	-.128	-.507	.620
Dense vegetation	-.266	.237	-.247	-1.126	.279
Bare lands	-.162	.486	-.078	-.333	.744
Water bodies	-.333	.146	-.494	-2.286	.038

    a. Dependant variable: wetlands

Source: Researchers' Analysis (2024)

Figure 4: 1992 Land use and land cover of Apoi Creek
Source: Researchers' GIS Analysis (2023)
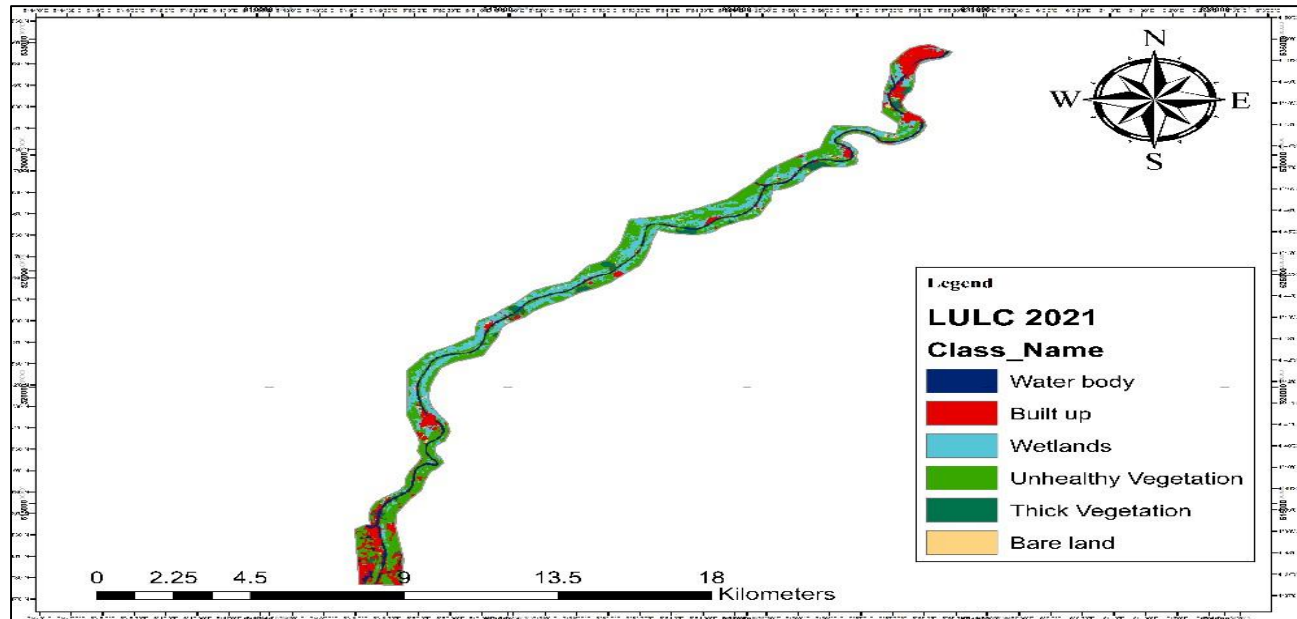
Figure 5: 2022 Land use and land cover of Apoi Creek (2023)
Source: Researchers' GIS Analysis

The results of the implication of wetland change on the livelihoods of dwellers in Apoi Creek are presented in Table 4. Fishing is the major source of livelihood in the study area according to 46.4% of the respondents. It could be implied that this figure may suggest depletion in the fishing activities in this coastal region due to changes in the extent of the wetlands. Furthermore, the oil production activities in the area, may have affected the quality of aquatic resources and the engagement of more fishermen in the harvesting of aquatic-related resources. Oil exposure can have detrimental effects on fish, particularly adults and early life stages like eggs and larvae (Agaton *et al.*, 2023). Adults may suffer reduced growth, enlarged livers, altered heart and breathing rates, eroded fins, and reproductive issues. Meanwhile, fish eggs and larvae are highly sensitive to both lethal and sublethal impacts from oil. In the same vein, oil spills can reduce the quality of water, negatively impacting fish production and reproduction (Siliko *et al.*, 2023). Over time, there is a decrease in aquatic-related occupation by community members in the affected area.

According to the survey, approximately 21.3% of respondents stated that lumbering is their main source of income. This suggests that changes in the Apoi Creek wetlands may have encouraged the growth and prevalence of certain economically valuable tree species. As Aust *et al.* (2020) noted, significant wetland loss is as a result of the growth in forest-related occupations/

Hunting is another source of livelihood in Apoi creek according 12.1 per cent of the respondents. It can be implied that activities of hunters in the study area can help in promoting a balanced wildlife population

in wetlands. Overpopulated species may destroy habitat, deplete resources, and spread disease. Through regulated hunting, people can promote wetland health by keeping animal numbers in check. Chatterjee and Bhattacharyya (2021) and Ramachandran *et al.* (2017) reiterated the current concerns of threats and disturbance to wetlands and the importance of conversation partnership between hunters and government agencies for the protection of wetlands.

Farming was considered the fourth source of livelihood to the dwellers in the coastal region of Apoi which claimed a 10.9 per cent response according to the survey. Farming has increased in along the Apoi creek due to loss of water bodies. Hence, dwellers have found an alternative to water-related livelihoods to land-related livelihoods. As Sekaranom *et al.* (2021) noted, wetlands face considerable pressure from agriculture due to land conversion and the excessive utilization of nutrients and pesticides. On the contrary King *et al.* (2021) is of the opinion that crops can adapt to a changing climate, and increasing soil carbon storage through agricultural practices can help mitigate the effects of climate change.

According to the survey, only 9.3 percent of the dwellers in the study area considered the brewing of fermented wine from the abundant palm trees along Apoi creek as their least source of livelihood. In coastal regions, where palm trees are common, it is not uncommon for dwellers to brew natural palm wine for personal consumption and for sale. Roy *et al.* (2023) have also emphasized the importance of regulating coastal brewing activities to minimize the pollution of surface water caused by the effluents from these breweries.

Table 4: Livelihoods of coastal community dwellers in Apoi Creek

Livelihoods	Community Dwellers	Per cent
Fishing	78	46.4
Lumbering	36	21.3
Hunting	20	12.1
Farming	18	10.9
Brewing of fermented drinks	16	9.3
Total	168	100

Source: Researchers' Fieldwork (2023)

CONCLUSION AND RECOMMENDATIONS

A decrease in wetlands and an increase in human-induced activities will alter wetland ecosystem and the resultant implications include habitat loss, decreased biodiversity, and decreased ecosystem services. To address these implications, several recommendations can be made, including the protection and restoration of wetlands, promotion of sustainable land use practices, implementation of conservation and management strategies, and the raising of public awareness on the negative impact of wetland loss on the physical

environment. These recommendations require a multifaceted approach that balances economic development with environmental protection, and ensures a sustainable future for a region's ecosystems and natural habitats

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