SURVEY ON MAJOR ANTHROPOGENIC ACTIVITIES TRIGGERING THE DEGRADATION OF NIGER DELTA WETLAND ECOSYSTEM ENVIRONMENT

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Abstract

Wetland ecosystem stands as an area of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters. A cross-sectional and historical research design was adopted in the study. The study used a simple random sampling technique. The study population was 2,780,494 but, for the purpose of this study, the population of the study area was carefully and randomly selected, two L.G.As in each state of study (Akwa-Ibom State, Bayelsa State and Rivers State), whereas 18 communities in the study area where sampled. A total of 400 respondents was administered questionnaire to across each category. Data generated from the questionnaire were imported from the Microsoft Excel software and coded into SPSS for analysis. For reliability of the questionnaire, the Cronbach's alpha method was used and it indicated a correlation coefficient of 0.91. Both primary and secondary data sources were employed in the study. The satellite imageries were also employed using GIS and Remote Sensing techniques for our digital map production. The result of the study indicated that 68.3% of the respondents agreed that the wetland ecosystem is exposed to urbanization. Considering the water retention capacity of wetland ecosystem, 58.5% of the respondents agreed that wetland is unable to retain excess water due to various anthropogenic activities. On reducing greenhouse gas (GHG) emissions, 61.3% of the respondents agreed that wetlands help in reducing GHG, 34.3% disagreed with wetlands help in reducing. The study concludes that, to halt further degradations of wetland ecosystem, it is mandatory to conserve and restore wetland ecosystems through novelties in climate change adaptation and mitigation measures, integrated wetland resource management, and people sensitization towards cultural practices.

Keywords: Wetland, Ecosystems, Anthropogenic, Degradation, Environment.

Introduction

Wetland is an ecosystem that ascends when gathered water produces soils dominated by anaerobic processes, which in turn, forces the biota, particularly rooted plants, to acclimatize to flooding (Keddy, 2010). Under the Ramsar International Wetland Conservation Treaty (Ramsar, 2010), wetlands are defined as follows: Article 1.1: … "Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters." Article 2.1: …"Wetlands may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands." (Ramsar Iran ,1971; RCS, 2007; RCS, 2016; Wali *et al.,* 2018a).

Hence, as defined by the Convention, wetlands include a wide variety of inland habitats such as marshes, peat lands, floodplains, rivers and lakes, and coastal areas such as salt marshes, mangroves, intertidal mudflats and sea grass beds, and also coral reefs and other marine areas not deeper than six meters at low tide, as well as man-made wetlands such as dams, reservoirs, rice paddies and wastewater treatment ponds and lagoons (Ramsar, Iran, 1971; RCS, 2007; 2016). In addition, Ramsar convention on wetlands (Article 2.1) also provides that they may integrate riparian and coastal zones nearby to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetland (Ramsar Iran, 1971; RCS, 2007; 2016; Wali *et al.,* 2018a).

Climate change is considered as one of the most important natural factors which affect wetland landscape patterns (Su *et al.,* 2012). The Intergovernmental Panel for Climate Change (IPCC) has provided regular assessments on the consequences of climate change on ecosystems based on thorough assessments of published information. The Fifth Assessment Report (IPCC, 2014) has documented information about the impact of change in climate on natural systems including wetlands, both inland and coastal/marine, as well as on the quality and quantity of the hydrological systems that are so important for wetlands. Projected changes in the global climate are expected to increase temperatures, modify precipitation, raise sea levels, and increase extreme climate events with large impacts on wetlands (Junk *et al.,* 2013), as well as the livelihoods and wellbeing of the people that depend on the wetlands and their ecosystem services (Finlayson *et al.,* 2006; Horwitz *et al.,* 2011). Some changes in wetland species have already been observed with both freshwater and marine species shifting their geographic ranges, seasonal activities, and migration patterns (Finlayson *et al.,* 2006). At the same time, it has been recognized that some wetlands store and emit greenhouse gases with their degradation and destruction contributing to greater releases of such gases and negative implications for atmospheric temperatures (Lloyd *et al.,* 2013; Finlayson, 2016).

Wetland ecosystems are among the most important in the world, providing a diverse range of ecosystem services vital to human well-being (Barbier *et al.,* 1997; RCS, 2007). They gave rise to the first modern global nature-conservation convention (Matthews, 1993) and remain the only single group of ecosystems with their own International Convention (Turner *et al.,* 2000; Ramsar, 2010). It has prominent significance not only in maintaining the regional and global ecological balances, but also providing a living environment for wild animals and plants (Yin *et al.*, 1988; Laga, *et al.,* 2014; Elekwachi *et al*.,2021). On a global scale, wetlands are estimated to cover 5–10% of the earth's terrestrial surface (Mitsch and Gosselink, 2007; RCS, 2007; Elekwachi *et al*.,2021), some 1,280 million hectares, although, it is believed that this is an underestimation (MEA, 2005; Elekwachi *et al*.,2021).

It has been observed that these wetlands have been degraded over time. Numerous factors have been identified to be responsible for the degradation of natural wetlands ecosystems in Nigeria especially in the Niger Delta region (UNEP. 2011; Wali *et al*, 2019). The most important among them are, climate change scenarios, land demand by a large population, inadequate understanding of wetland values, misguided policies, inadequate environmental laws and regulations, and water diversion needed because of rapid economic growth (Ohimain *et al.,* 2002; Wali et al, 2019; Elekwachi *et al*.,2021). In 2011 UNEP's reports shows that wetlands around Ogoni land in the core Niger Delta communities are highly degraded and facing disintegration (UNEP, 2011; Wali *et al.,* 2019). In other words, Wetland degradation is a serious ongoing problem due to urbanization, industry activities, intensive agricultural practices, deforestation, use of chemical-based fertilizers, pesticides, and emissions from fossil fuel consumption are the main factors causing environmental degradation. Some researchers lists human activities and biophysical effects, including positive population growth rate, urbanization / industrialization, emissions from industrial activities (such as mining, oil and gas activities), unrestricted farming crops Soil cultivation, grazing, logging / logging, unprecedented land reclamation, dam construction, physical infrastructure, erosion, sea level rise, alien invasion, sandstorms, desertification, drought, poverty, overfishing, etc. threatening wetland resources in a key factor of the Niger Delta (Uluocha and Okeke, 2004; Nwankwoala, 2012; Nwankwoala, *et al*., 2021).

Some of the contemporary studies on wetlands in the Niger Delta have identified, displayed or monitored wetlands and their alterations, degradations and spatial changes in specific locations in the region (James *et al.,* 2007; Olalekan *et al.,* 2011; Akachi ,2011; Ajibola *et al.,*2012; Mmom *et al.,* 2013; Enaruvbe *et al*., 2014; Ayanlande,2014; Okonkwo *et al.,*2015; Ayansina *et al*.,2015; Izah et al.,2017; Izah ,2018; Wali *et al*., 2019). James *et al.,* (2007) assessed the extent and changes in the mangrove ecosystem of the Niger Delta. Others have tried to forecast the future pattern of land use and land cover change in the wetland ecosystem of the Port Harcourt metropolis of the region (Wali *et al.,* 2018b). In addition, Umeuduji *et al., (*2018) studied changes in land use and land cover from 1985-2016 with emphasis on wetland conservation and protection in urban fringe area of Port Harcourt. Also, Eludoyin *et al.,* 2015; Elekwachi *et al*.,2021) studied spatio –temporal analysis of wetlands modifications and its characteristics in Niger Delta region, using geo-information techniques.

Hitherto, none of these studies have provided information that will guarantee the survey on the major anthropogenic activities triggering wetland ecosystem degradation in the Niger Delta leaving a gap in knowledge. Therefore, there is need to close this gap by surveying degradation of wetland ecosystem in the Niger Delta environment which the background focuses.

2.Conceptual Framework

Nigeria has a total of 11 Ramsar-listed wetland areas comprising coastal and freshwater wetlands, these together cover an area estimated to be 1, 076, 730 ha (Table 1). Two of the Ramsar –listed sites are found in the Niger Delta region. The Niger Delta Region of Nigeria itself is a complex of wetlands covering about 76,000sq km. It is very rich in biodiversity and it is considered as the largest mangrove forest ecosystem in Africa (11,134 sq km) and the third largest in the world (Spalding *et al.,* 1997; Wali *et al.,* 2019; Elekwachi *et al*.,2021) with a unique vast floodplain area (Ebeku ,2004; Elekwachi *et al*.,2021). The wetland area of the Niger Delta has also been noted as one of Africa's most valuable biodiversity hotspots, it provides living ground for numerous endemic species e.g the Niger Delta red Colobus Monkey and Sclater's guenon (Ebeku 2004; Phil-Eze and Okoro 2009). The two Ramsar-listed wetlands of the Niger Delta are Upper Orashi Forest Reserve and Apoi Creek Forest (Fig.1). They are considered to fulfil Ramsar Listing Criteria Nos 1, 2 and 7. This is because they contain a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region. The Apoi Creek Forests located in Bayelsa state for example is estimated to be 29 213 ha and contains mainly mangrove forests, marshes and freshwater swamps (Ramsar Convention Secretariat 2007; Ayansina, *et al.,* 2015; Elekwachi *et al*.,2021). It has high ecological value given its high flora and fauna composition such as the aforementioned Niger Delta red colobus monkey (Procolobus epieni) and the vulnerable African dwarf crocodile. It is also an important breeding and nursery ground for fish. It supports vulnerable, endangered, or critically endangered species or threatened ecological communities through the provision of habit or important ecosystem services (MEA, 2005; IUCN and UNEP-WCMC 2014; Ayansina *et al.,* 2015; Wali *et al.,* 2019; Elekwachi *et al*.,2021). It supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity' (Ramsar Convention Secretariat 2007, 2010*a; Wali et al.,*2019). Apoi Creek Forest (ACF) contains ecosystems that are common in the Niger Delta, such as marshes, mangroves and freshwater swamps, and thus represents an important reference site for the region. There are equally other wetlands that are not Ramsar-listed but are considered to be of significant local importance including the Olague Forest Reserve (OFR). It is estimated to encompass, 32 970 ha and primarily consist of mangroves and was established to ensure the sustainable use of the forest resources (FAO 1999; IUCN and UNEP-WCMC 2014; Ayansina *et al.,* 2015; Wali *et al.,* 2019; Elekwachi *et al*.,2021).

Table 1 Nigeria's 11 Ramsar Site (1,076,728 Hectares)

S/N	Site	Date of Designation	State (s)	Area (ha)	Coordinates
1	Nguru lake (and Marma Channel) complex	02/10/2000	Jigawa & Yobe	58, 100	10^0 22′ N 012^0 46′ E
2	Apoi Creek Forests	30/04/2008	Bayelsa	29, 213	05^0 47′ N 004^0 42′ E
3	Baturiya Wetlands	30/04/2008	Kano	101, 095	12^0 31′ N 010^0 29′ E
4	Dangona Sanctuary Lake	30/04/2008	Yobe	344	12^0 48′ N 010^0 44′ E
5	Foge Islands	30/04/2008	Kebbi & Niger	4, 229	10^0 30′ N 004^0 33′ E
6	Lake Chad Wetland	30/04/2008	Borno	607, 354	13^0 04′ N 013^0 48′ E
7	Lower Kaduna-Middle Niger Floodplain	30/04/2008	Kwara & Niger	229, 054	08^0 51′ N 005^0 45′ E
8	Maladumba Lake	30/04/2008	Bauchi	1, 860	$10^0$24′ N 009^0 51′ E
9	Oguta Lake	30/04/2008	Imo	572	$05^0$42′ N 006^0 47′ E
10	Pandam & Wase Lake	30/04/2008	Nasarawa	19, 742	08^0 42′ N 008^0 58′ E
11	Upper Orashi Forests	30/04/2008	Rivers	25, 165	04^0 53′ N 006^0 30′ E

(Source: Asibor, 2009)

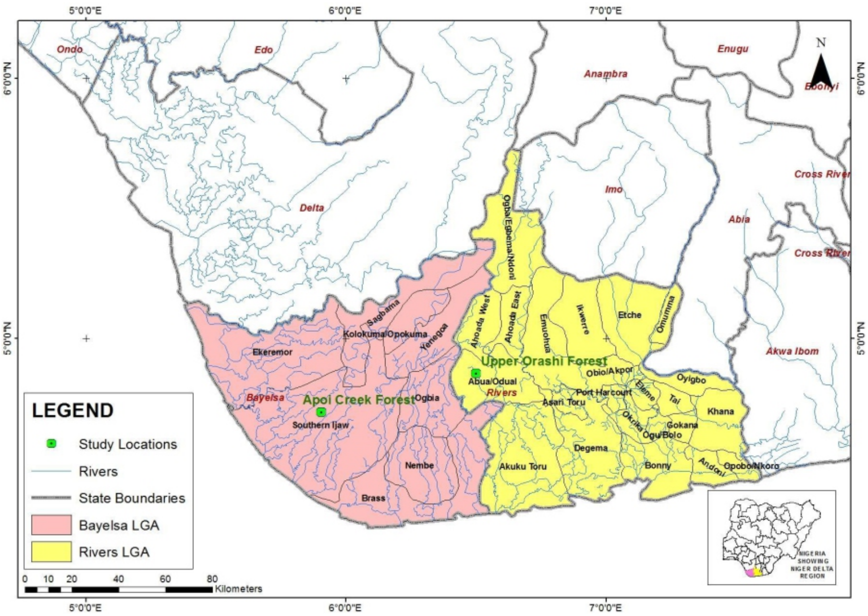

Fig. 1: Niger Delta Showing Two Ramsar Designated Wetland Sites (Source: Cartography and GIS Unit, Dept. of Geography and Env. Mgt. UNIPORT, 2023)

3. Methodology

3.1 Study Area

From Geographical positioning, Niger Delta region of Nigeria is located along the Gulf of Guinea (Enaruvbe *et al.,* 2014). It is the world's third largest and Africa's largest Delta. It is also West and Central Africa's most extensive wetland (Akegbejo -Samsons & Omoniyi, 2009). The region extends from Aboh (5°33′49″ N and 6°31′38″ E) in the North to palm point (4°16′22″ N and 6°05′27″ E) in the South. The East-West limit is between Benin River estuary (5°44′11″ N and 5°3′49″ E) in the West and Imo River estuary (4°27′16″ N and 7°35′27″ E) to the East (Niger Delta Environmental Survey (NDES), 1997). From Niger Delta region, three States were selected for the study which include Rivers, Bayelsa and Akwa Ibom State (Fig.2). The area cover of the states in the region is about 28,191 km^2 representing 37.6% of the total land area of the region (NPC, 2006, Wali *et al.,* 2021).

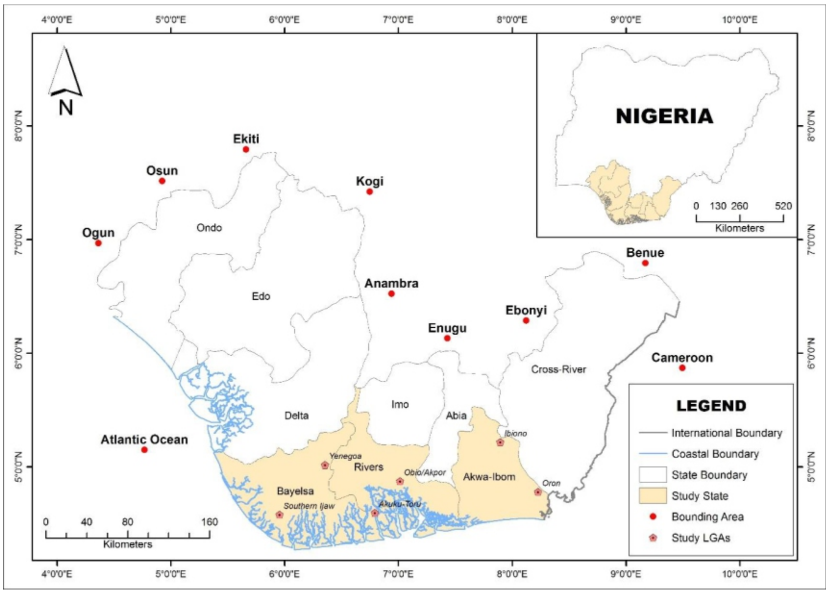

Figure 2: Niger Delta Region Showing Study States and Sampling LGAs.
(Source: Cartography and GIS Unit, Dept. of Geography UNN, 2023).

3.2 Data Analysis

This study used reconnaissance survey to help the authors familiarize themselves with the study area. GARMIN Etrex hand held Global Positioning System (GPS) was deployed during reconnaissance survey to obtain the coordinates of the following wetlands in the Niger Delta (Fig.3): Upper Orashi Forest in Rivers State, Apoi Creek in Bayelsa State, Akassa Coastal Wetlands in Bayelsa State, Stubbs Creek in Akwa-Ibom State, Kolo Creek Wetlands in Bayelsa State, Eagle's Island Wetland in Rivers State, Qua Iboe and Itu Wetland in Akwa Ibom State.

A cross-sectional and historical research design was adopted in the study. The study used a simple random sampling technique. The study population was 2,780,494 but, for the purpose of this study, the population of the study area was carefully and randomly selected, two L.G.As in each state of study (Akwa-Ibom State, Bayelsa State and Rivers State), whereas 18 communities in the study area where sampled. The questionnaire was designed and validated by two experts namely; a staff of Department of Geography, University of Nigeria, Nsukka, and a staff of Department of Geography /Environmental Management University of Port-Harcourt. A total of 400 respondents was administered questionnaire to across each category. Data generated from the questionnaire were imported from the Microsoft Excel software and coded into SPSS for analysis. For reliability of the questionnaire, the Cronbach's alpha method was used and it indicated a correlation coefficient of 0.91. Both primary and secondary data sources were employed in the study. The maps were projected using Universal Transverse Mercator (UTM) projection system and datum World Geodesy System (WGS) 84 of zone 32. The United States Geological Survey (USGS) satellite data were used to generate high resolution images that are useful for this type of study. The satellite imageries were also employed using GIS and Remote Sensing techniques for our digital map production.

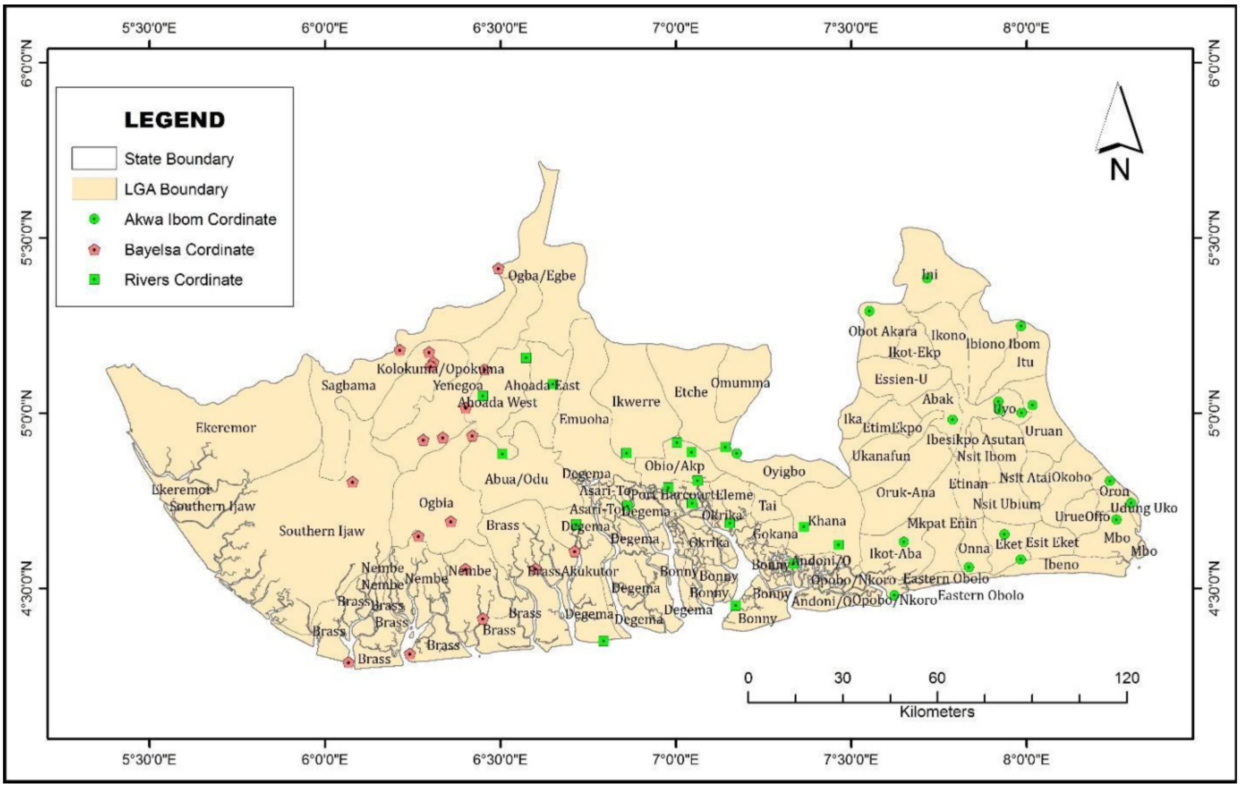

Fig. 3 Study Sampling Locations

4.Results and Discussions

4.1 Socio-Economic Characteristics of the Respondents

The socio-economic characteristics of the respondents were presented in Table 2. The outcome of the finding revealed that 54.9% of the participants are male while 45.1% are female which indicated that majority of the participants are males. The- age of respondents showed that 19.1% of the participants are aged 18-29 while 40.2%, 26.3%, 9.0%, 3.9% and 1.6% represented aged 30-40, 41-50, 51-60, 61-70 and above 70 respectively. The age ranges revealed that majority are within the age range of 30-40 which represented 40.2% of the sampled population. Most of the participants are married (211) which represents 59.3% of the respondents while 23.7% (92) are single, 13.4% (52) are divorced and 4.9% (16) are widowed. The religion of the respondents revealed that most of the respondents are of Christian religion and it represents 248 (63.9%) of the sampled population while 70 (18.0%) are Islams, 49 (12.6%) of the respondents are Traditionalist while 21 (5.4%) are other forms of religion. Many of the respondents had a primary level of education which represented 36.3% (141) of the sampled population, 26.0% (101) had no form of education, 24.0% had secondary education while 13.7% of the respondents had tertiary level of education. The finding showed that majority of the respondents engaged in the study their primary occupation is farming which represent 29.1% of the sampled population, 20.4% of the respondents are involved trading/Commerce, 19.1% are into fishing, 12.6% of the respondents are civil servants, 13.9% of the respondents are students while 17.8% of the respondents are into other forms of occupations.

Table 2: The Socio-Economic Characteristics of the Respondents

Variable	Options	Frequency	Percentage (%)
Gender	Male	213	54.9
	Female	175	45.1
	Total	388	100
Age of Respondents	18-29	74	19.1
	30-40	156	40.2
	41-50	102	26.3
	51-60	35	9.0
	61-70	15	3.9
	Above 70	6	1.6
	Total	388	100
Marital Status	Single	92	23.7
	Married	225	58.0
	Divorced	52	13.4
	Widowed	16	4.9
	Total	388	100
Religion	Christian	248	63.9
	Islam	70	18.0
	Traditionalist	49	12.6
	Others	21	5.4
	Total	388	100
Level of Education	None	101	26.0
	Primary	141	36.3
	Secondary	93	24.0
	Tertiary	53	13.7
	Total	388	100
Primary Occupation	Student	54	13.9
	Civil Servant	49	12.6
	Farming	113	29.1
	Trading/Commerce	79	20.4
	Fishing	74	19.1
	Others	19	4.9
	Total	388	100

Source: Author's field work, 2023

4.2 Investigate Various Anthropogenic Activities Involving Wetland Ecosystem in the Study Area

The respondents' descriptions of various anthropogenic activities involving wetlands ecosystem in the study area were presented in Table 3. The outcome indicated that 68.3% of the respondents agreed that the wetland ecosystem is subjected to urbanization while 21.4% and 10.3% of the respondents disagreed and undecided respectively. The weighted mean of 3.7 indicated that many of the respondents agreed that wetland ecosystem is subjected to urbanization. Also, 68.6% of the agreed that toxic chemical and industrial wastes are emptied into the wetland ecosystem while 24.7% and 6.7% of the respondents disagreed and undecided respectively. The weighted mean of 3.8 indicated that many of the respondents agreed that toxic chemical and industrial wastes are emptied into the wetland ecosystem.

It was deduced that 71.9% of the respondents agreed that sand-filling activities are carried out on wetland ecosystem is for construction, 24.5% of the respondents disagreed about such activities while 3.6% were undecided about the activities. The weighted mean of 3.8 indicated that many of the respondents agreed that sand-filling activities are carried out on wetland ecosystem is for construction purposes. The finding revealed that 59.8% of the respondents agreed that wetlands ecosystem is subjected to reclamation for housing or infrastructural development while 35.8% and 4.4% of the respondents disagreed and undecided about the wetland's ecosystem been subjected to reclamation for housing or infrastructural development respectively. The weighted mean of 3.7 indicated that many of the respondents agreed that wetlands ecosystem is subjected to reclamation for housing or infrastructural development.

Among the respondents, 63.9% agreed that there is disposal of non-biodegradable wastes from markets into wetland ecosystem while 29.4% and 6.7% of the respondents disagreed and undecided about disposal of non-biodegradable wastes from markets into wetland ecosystem; however, the weighted mean of 3.6 indicated that many of the respondents agreed that there was disposal of non-biodegradable wastes from markets into wetland ecosystem. 61.6% of the respondents agreed that dredging activities are carried out on wetland ecosystem, 34.3% of the respondents disagreed that dredging activities are carried out on wetland ecosystem while 4.1% of the respondents are undecided. The weighted mean of 3.6 showed that respondents agreed that dredging activities are carried out on wetland ecosystem. The outcome revealed that 63.4% of the respondents agreed that wetlands ecosystem is converted to agricultural land while 29.6% and 7.0% of the respondents disagreed and undecided. However, the weighted mean of 3.7 indicated that many of the respondents agreed that wetlands ecosystem is converted to agricultural land.

Table 3: Anthropogenic Activities Involving Wetlands Ecosystem in the Study Area

Anthropogenic Activities Involving Wetlands	A	D	UD	Total	Weighted Mean	Remark
Wetland ecosystem is subjected to Urbanization	265 (68.3%)	83 (21.4%)	40 (10.3%)	388 (100%)	3.7	Agreed
Toxic chemicals and industrial wastes emptied into wetlands ecosystem	266 (68.6%)	96 (24.7%)	26 (6.7%)	388 (100%)	3.8	Agreed
Sand-filling activities are carried out on wetland ecosystem is for construction	279 (71.9%)	95 (24.5%)	14 (3.6%)	388 (100%)	3.8	Agreed

Wetland's ecosystem is subjected to reclamation for housing or infrastructural development	232 (59.8%)	139 (35.8%)	17 (4.4%)	388 (100%)	3.7	Agreed
Disposal of non-biodegradable wastes from markets into wetlands ecosystem	248 (63.9%)	114 (29.4%)	26 (6.7%)	388 (100%)	3.6	Agreed
Dredging activities are carried out on wetland ecosystem	239 (61.6%)	133 (34.3%)	16 (4.1%)	388 (100%)	3.6	Agreed
Wetland's ecosystem is converted to agricultural land	246 (63.4%)	115 (29.6%)	27 (7.0%)	388 (100%)	3.7	Agreed

Source: Author's field work, 2023
Key: A-Agreed, D-Disagreed and UD-Undecided

The outcome of the study indicated that various anthropogenic activities involving wetlands ecosystem in the study area includes urbanization, discharge of toxic chemical and industrial wastes into the wetland ecosystem, sand-filling activities for construction, reclamation for housing or infrastructural development, disposal of non-biodegradable wastes, dredging activities and wetland being converted to agricultural land. The finding of the study corroborates with that of Ajibola, Adeleke, and Ogungbemi (2016) which asserted that urbanization, construction activities and land reclamation are part of the contributing factors to the loss or degradation of wetland in Lagos state. According to Dauda (2014) the negative impacts of the human activities influenced the overall wetland ecosystem through land-use activities and waste discharge which resulted to wetland degradation and/or loss. Similarly, the study corroborated with that of Rahman (2016) which indicated building, agricultural practice, overexploitation of natural resources, road networking and fishing activities as the major human activities on the wetland.

4.3 Examine the Impact of Anthropogenic Activities on Wetland Ecosystem

Table 4, presented the respondents' description of impact of anthropogenic activities on the wetland ecosystem. Only 47.9% of the respondents agreed that anthropogenic activities impact on wetland leads to diversion of water flow to or from the wetland, 37.9% of the respondents disagreed while 14.2% were undecided about the attribute. The weighted mean of 3.4 implies that the respondents agreed with the attribute. Among the respondents, 55.4% agreed that wetland is impacted through introduction of non-native organism that increase competition in the ecosystem due various anthropogenic actions while 38.9% and 5.7% of the respondents disagreed and undecided on the impact respectively. The weighted mean of 3.6 implies that the respondents agreed that wetland is impacted through introduction of non-native organism that increases competition in the ecosystem due various anthropogenic actions.

Slightly above three-fifth (63.4%) agreed that extinction/losses of wetland biodiversity is part of wetland impact responding to unsustainable anthropogenic activities, 33.0% of the respondents disagreed and 3.6% were undecided about. However, the weighted mean of 3.6 indicated that the respondents agreed that extinction/losses of wetland biodiversity is part of wetland impact responding to unsustainable anthropogenic activities. Considering the water retention capacity of wetland ecosystem, 58.5% of the respondents agreed that wetland is unable to retain excess water due to various anthropogenic activities engaged while 37.9% and 3.8% of the respondents disagreed and undecided respectively. The weighted mean of 3.3 indicated that the respondents agreed that anthropogenic activities impact wetland leading to its inability to retain excess water.

66.8% of the respondents agreed that anthropogenic activities altered the wetland ecosystem chemistry while 26.8% of the respondents disagreed and 6.4% are undecided; however, weighted mean of 3.3 deduced that the respondents agreed that anthropogenic activities altered the wetland ecosystem chemistry.

Among the respondents, 69.6% agreed that anthropogenic activities introduce harmful substance into the ecosystem, 24.5% of the respondents disagreed about such introduction while 5.9% of the respondents are undecided about the introduction of harmful substance to wetland. The weighted mean of 3.2 indicated that the respondents agreed that anthropogenic activities introduce harmful substance into the ecosystem. Most of the respondents 73.5% agreed that anthropogenic activities impact wetland through pollution of the habitat, 19.8% disagreed that pollution of habitat is part of the wetland impact while 6.7% of the respondent's undecided. The weighted mean of 3.7 indicated that the respondents agreed that anthropogenic activities impact wetland through pollution of habitat.

Table 4.: Impact of Anthropogenic A ctivities on Wetland Ecosystem

Impact of Anthropogenic Activities on Wetland	A	D	UD	Total	Weighted Mean	Remark
Diversion of water flow to or from wetland	186 (47.9%)	147 (37.9%)	55 (14.2%)	388 (100%)	3.4	Agreed
Introduction of non-native organism that increase competition	215 (55.4%)	151 (38.9%)	22 (5.7%)	388 (100%)	3.6	Agreed
Extinction/Losses of wetland biodiversity	246 (63.4%)	128 (33.0%)	14 (3.6%)	388 (100%)	3.6	Agreed
Unable to retain excess water due to various engagement	226 (58.3%)	147 (37.9%)	15 (3.8%)	388 (100%)	3.3	Agreed
Alteration of wetland biogeochemistry	259 (66.8%)	104 (26.8%)	25 (6.4%)	388 (100%)	3.3	Agreed
Introduction of harmful substance	270 (69.6%)	95 (24.5%)	23 (5.9%)	388 (100%)	3.2	Agreed
Pollution of wetland habitat	285 (73.5%)	77 (19.8%)	26 (6.7%)	388 (100%)	3.7	Agreed

Source: Author's field work, 2023

Key: A-Agreed, D-Disagreed and UD -Undecided

The finding deduced that the impact of anthropogenic activities on the wetland ecosystem includes diversion of water flow to or from the wetland, introduction of non-native organism that increase competition in the ecosystem, extinction/losses of wetland biodiversity, inability to retain excess water, alteration of the wetland ecosystem chemistry, introduction of harmful substance into the ecosystem and pollution of the habitat. According to Desta et al., (2012) wetlands are one of the ecological systems that are highly vulnerable as a result of human activities which are aggravated by climate change. The finding showed similarity to that of Elekwachi *et al.,* (2021) which indicated that activities such as aquaculture and sewage discharge affect wetland water quality in the Niger Delta Region. Also, there was corroboration with the study of Awelewa (2016) which noted that various anthropogenic activities on Niger Delta wetland have led to change in primary mangrove and deprivation of biological abundance of the ecosystem.

4.4 Assess the Perceived Implication of Wetland Ecosystem to Climate Change

The respondents' descriptions of the perceived implication of wetlands to climate change in the study area were presented in Table 5. 54.9% of the respondents agreed that wetland is perceived to support natural water cycle, 38.1% of the respondents disagreed with the attribute while 7.0% of the respondents were undecided about such perceived implication of wetland to climate change. The weighted mean of 3.6 indicated that the respondents agreed that wetland is perceived to support natural water cycle. On biodiversity, 56.4% of the respondents agreed that wetlands help in maintenance of biodiversity, 40.0% disagreed with wetlands help in maintenance of biodiversity while 3.6% are undecided about it; however, the weighted mean of 3.7 indicated that the respondents agreed that wetland is perceived to help in maintenance of biodiversity. On reducing greenhouse gas (GHG) emissions, 61.3% of the respondents agreed that wetlands help in reducing GHG, 34.3% disagreed with wetlands help in reducing GHG while 4.4% are undecided about it. The weighted mean of 3.4 indicated that the respondents agreed that wetland is perceived to help in reducing GHG. 66.8% of the respondents agreed that wetland is perceived to provide buffer for excessive water during rainfall, 24.7% of the respondents disagreed while 8.5% were undecided. The weighted mean of 3.6 deduced that the respondents agreed that wetlands provide buffer for excessive water during rainfall.

68.3% of the respondents agreed that wetlands are perceived to support carbon sequestration and storage, 26.3% of the respondents disagreed while 5.4% of the respondents were undecided about the carbon sequestration and storage of wetland; however, the weighted mean of 3.3 deduced that the respondents agreed that wetlands are perceived to support carbon sequestration and storage. 51.3% of the respondents agreed that wetlands are perceived to provide critical bio-shield against rising sea level, 42.5% of the respondents disagreed with the attribute while 6.2% of the respondents were undecided about the attribute. The weighted mean of 3.3 deduced that the respondents agreed that wetlands is perceived to provide critical bio-shield against rising sea level.

Table 5: Perceived Implication of Wetland to Climate Change

Implication of Wetland to Climate Change	A	D	UD	Total	Weighted Mean	Remark
Wetlands support natural water cycle	213 (54.9%)	148 (38.1%)	27 (7.0%)	388 (100%)	3.6	Agreed
Wetlands help in maintenance of biodiversity	219 (56.4%)	155 (40.0%)	14 (3.6%)	388 (100%)	3.7	Agreed
Wetlands help in reducing greenhouse gas emissions	238 (61.3%)	133 (34.3%)	17 (4.4%)	388 (100%)	3.4	Agreed
Wetlands provide buffer for excessive water during rainfall	259 (66.8%)	96 (24.7%)	33 (8.5%)	388 (100%)	3.6	Agreed
Wetlands support carbon sequestration and storage	265 (68.3%)	102 (26.3%)	21 (5.4%)	388 (100%)	3.3	Agreed
Wetlands provide critical bio-shield against rising sea level	199 (51.3%)	165 (42.5%)	24 (6.2%)	388 (100%)	3.3	Agreed

Source: Author's field work, 2023

Key: A-Agreed, D-Disagreed and UD -Undecided

The outcome on the perceived implication of wetlands to climate change in the study area indicated that wetland is perceived to support natural water cycle, help in maintenance of biodiversity, help in reducing GHG, provide buffer for excessive water during rainfall, support carbon sequestration and storage and provide critical bio-shield against rising sea level. The finding corroborated with the opinion of Tijani, Olaleye and Olubanjo (2011) which stated that the importance of wetlands is found within their functions in the water cycle, flood abatement and plant and animal waste production, sanctuary for wildlife, filtration activities, nutrient availability, biogeochemical etc. Similarly, Okonkwo, Kumar and Taylor (2015) linked the importance of wetland to such flood abatement, infiltration of water, refill and maintain underground water, controlling and directing water flow and sedimentation process.

Conclusion /Recommendations

Wetland is one of the natural systems that are extremely vulnerable as a result of anthropogenic activities which are intensified by climate change. To stop further degradations, it is mandatory to conserve and restore wetland ecosystems through novelties in climate change adaptation and mitigation measures, integrated wetland resource management, and people sensitization towards cultural practices.

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