Coastland Degradation and Threat to Livelihood in Ayetoro Community, Ondo State, Nigeria

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Abstract: The study appraised coastland degradation and threat to livelihood in Ayetoro community, Ilaje Local Government Area, Ondo State, with a view to improving the livelihood of inhabitants. The research was conducted using Questionnaire, interview guide and Geographic Information System (GIS) tools. The study was a survey design that adopted a mixed method that combines qualitative and quantitative approaches, while 180 copies of questionnaire were administered on selected households in the study area. Systematic Random Sampling Technique was used to select the needed samples for questionnaire administration in the study area. The questionnaire were analyzed using SPSS 8.1, while all geo-processing operations and analyses were carried out in ILWIS 3.1 and ArcGIS 10.2 software. Landsat satellite imageries TM of 1991, ETM+ 2000 and OLI 2019 of Ilaje LGA were used. Each of these was vectorised and polygonised, and then converted to raster to have 10m pixel resolution size to make overlaying possible for the analysis of the coastal erosion. The Digital Shoreline Analysis System (DSAS) was used for the coastal erosion analysis. Findings revealed that, majority of the respondents depended mainly on fishing activities and other aquatic resources trading, water transportation, boat construction and fishing net production businesses as means of livelihood. Findings ascertained the prominence of coastal degradation in Ayetoro community between 1991 and 2019. It showed that, increase in sea level, sea incursion, unprotected coast, nature of the soil and high-water waves hitting the coast, were the major causes of coastal degradation in the study area. Coastal erosion/degradation had resulted to carrying away of buildings, destruction of coastal biodiversity and washing away of coastal sand, as it had great economic, psychological and social impacts on the livelihood of residents. The study recommends: Engagement in empowerment programmes and provision of grants to Ilaje LGA residents; Adoption of Structural and Engineering measures for Coastal Protection and Management; Adherence to Town Planning Laws/Building Regulations; Waterfront Renewal Strategy (WRS); Declaration of coastal communities of Ilaje as Environmental Area for Community Regeneration Programme; and Relocation.

Keywords: Coastal area, coastland degradation, integrated coastal management.

1. Introduction

Coastal areas are attractive environments to settle and live or pursue economic activities [6]. Coastal areas are very important for human beings, as they witness culture and economic exchanges between different nations. Coastal area is defined as the ground region, which is within 10 kilometers from the ground boundary. Coastal areas include coastal flood plains, coastal forests called mangroves, marches and tide flats [12]. Coastal degradations are the deterioration through destruction of the land, as this occurs mostly as coastal erosion in the coastal area. Coastal erosion is the process by which local sea level rise, strong wave action and coastal flooding wear down or carry away rock, soil and sand along the coast.

Environmental degradation, is basically caused by man's intervention to the existence of the environment. This claim was corroborated by [4] that, the main threats to coastal ecosystems are described as habitat loss, or conversion due to coastal development, agriculture, aquaculture, habitat degradation due to eutrophication, pollution, and contamination and consequent changes in sediment and water supply due to human activities along the coast and the upstream water sheds.

Globally, the main threats to coastal ecosystems are described as habitat loss or conversion due to coastal development, agriculture or aquaculture habitat degradation due to eutrophication, pollution, contamination and consequent changes in sediment and water supply due to human activities along the coast and in the upstream watersheds [4].

In Nigeria, certain settlements possess the characteristics of waterfront communities and are being faced by such enormous degradation. The coastal communities of Southern Nigeria revolve around the Niger Delta region and is presently composed of nine states. These states are Akwa-Ibom, Bayelsa, Cross-River, Rivers, Delta, Edo, Abia, Imo and Ondo. The areas are characterized by wetlands and water bodies with large mangrove forests and a network of creeks and rivers crossing the entire region, with an aquatic splendor. The large expanses of mangrove forests are estimated to cover approximately 5,000 to 8,580km2of land and they remain very important to the indigenous people of Southern Nigeria as well as to the various organisms that inhabit these ecosystems. In spite of the fact that the region produces the bulk of the nation's oil wealth, its people live in abject poverty and squalor [17].

Oil exploration has over the last four decades impacted disastrously on the socio-physical environment of the Niger Delta communities, massively threatening the subsistent peasant economy and the environment and hence the entire

livelihood and basic survival of the people. Livelihood is a process by which people make a living through specific capabilities, assets, and activities [8]. Earlier anthropological study showed that livelihood extends beyond basic life necessities to include information sharing, social relationships management and identity maintenance. Obviously, with an overlap of different layers of social life based on resources and their utilization, thus, livelihood is a holistic phenomenon. The situation in the coastal area of Ondo State is critical, tragic and devastating, environmental degradation, especially, flooding and coastal erosion have impacted the livelihood of the residents in this area, Ayetoro community in particular. In May 2019, a surge from the Atlantic Ocean threatened four communities in Ilaje Local Government Area of Ondo State, as the residents of the communities have raised alarm over the impact on the livelihood of the residents, due to the destruction of property by the ocean surge. The affected communities included Ayetoro, Mese, Abereke and Gbagira communities. According to the people of the area, the frequent surge had caused coastal erosion which eventually destroyed several houses, rendering many people homeless [9]. Also, in September 2019, a torrential rain wreaked havoc in the Ayetoro community, with the effect of the rain taking its toll in the community which was ravaged by flood with many people rendered homeless, several houses and public facilities affected. In addition, socio-economic activities of the community were paralyzed as most people in the community who were engaging in fishing had to abstain from the river and the ocean while some shops were destroyed [5].

Throughout human history, settlements have emerged along the coastline whether for food, livelihood, transport, recreation, or ambience. The coastal areas are recognized as zones subject to intensive human activities, fishing, shrimp culture, salt production and oil exploration. Coastal areas also comprise sites of Export Processing Zones (EPZ), airports, land ports, harbours and tourism. Moreover, being World Heritage sites and ecological critical areas such as mangrove and coral ecosystem they have attracted the attention of environmentalists [1]. Unfortunately, these areas are highly vulnerable to some environmental challenges such as coastal flooding, storms surges, salinity, erosion and pollution [13]. In view of this, the study aims at appraising coastland degradation and threat to livelihood in Ayetoro community Ondo State, Nigeria. The main objective of the study is to investigate the impact of coastland degradation on the livelihood of inhabitants of Ayetoro community, Nigeria.

2. The Study Area

Ondo State has its boundaries within Latitudes 3°0' N and 6°41'N and Longitude 3°9'E and 3°28'E. It also lies in Southwestern Nigeria on the Atlantic coast. Ayetoro is one of the communities in Ilaje LGA, which is one of the 18 Local Government Areas in Ondo State (Figure 1) while Igbokoda, is the Ilaje Local Government Headquarters. It has a population of 290,615 [16]. The surge on September 24th 2019, which left the tales of devastation across the entire Ayetoro community, hence the awareness of the environmental challenges their

facing [9]. The Ilajes are a distinguished, distinct linguistic group of the Yoruba stock made up of four geopolitical entities namely Ugbo, Mahin, Etikan and Aheri. The coastline stretches for 853 km, comprising of inshore waters, coastal lagoons, estuaries and mangroves especially in the Niger Delta [10]. Ilaje LGA falls within the Mahin mud coastal area, and it has a shoreline covering about 180 km thereby making Ondo State a state with the longest coastal shoreline in Nigeria. The natural environment of Ilaje land is particularly suitable for the development of large-scale rice plantation and salt industry; however, the main occupational activities of the Ilajes include: fishing, canoe making, farming and trading.
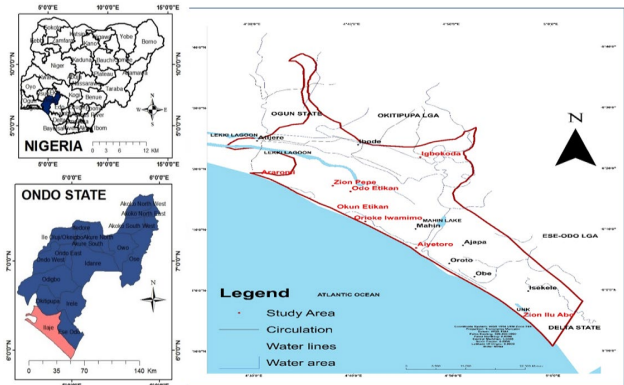

Fig. 1. Map of Ilaje Local Government Area showing Ayetoro community
Source: GIS Map Extract, digitized by the Authors, 2022

3. Conceptual Issues and Literature Review

Integrated Coastal Zone Management (ICZM) or Integrated Coastal Management (ICM) is a concept for the management of the coast using an integrated approach, regarding all aspects of the coastal zone, including geographical and political boundaries, in an attempt to achieve sustainability. This concept was born in 1992 during the Earth Summit of Rio de Janeiro. The European Commission defines the ICZM as a dynamic, multidisciplinary and iterative process designed to promote sustainable management of coastal zones. It covers the full cycle of information collection, planning (in its broadest sense), decision making, management and monitoring of implementation. ICZM uses the informed participation and cooperation of all stakeholders to assess the societal goals in a given coastal area, and to take actions towards meeting these objectives. ICZM seeks, over the long-term, to balance environmental, economic, social, cultural and recreational objectives, all within the limits set by natural dynamics. 'Integrated' in ICZM refers to the integration of objectives and also the integration of the many instruments needed to meet these objectives. It means integration of all relevant policy areas, sectors, and levels of administration. It means integration of the terrestrial and marine components of the target territory, in both time and space.

A. The Coastal Areas

The coastal areas/zones of the world, with their vast resources of food, energy and minerals, are not only composed of various fragile ecosystems, they are scenes of a variety of

different uses. The uncontrolled development of the coastal zones and the haphazard exploitation of its natural resource threaten to turn the promise of economic prosperity into an environmental nightmare that poses great dangers for present and future generations [3]. The total length of the world's coastline is approximately 504,000 kilometres, the coastal areas comprise 20 per cent of the earth's surface yet contain over 50 per cent of the entire population [20]. The Nigerian coastline is about 850km of the Atlantic Ocean between the Western and Eastern borders of the country with the Republic of Benin and Cameroon respectively [18]. By 2025, Coastal populations are expected to account for 70 per cent of the world's mega cities. Half of the world's cities with more than one million people residing around the coastal zones. Average human population density in coastal areas is 80 persons per square kilometer, twice the global average population [7]. One-third of the European Union (EU) population is concentrated near coasts, it is projected that Western and Central African Coastal population will double 50 million over the next 25 years. Throughout human history, settlements have emerged along the Coastline, whether for food, livelihood, transport, recreation, or ambience. Human beings always live where sea/ocean meet the land. The coastal areas are recognized as zones subject to intensive human use, activities such as fishing, shrimp culture, salt production and oil exploration [11]. Coastal areas also comprise sites of Export Processing Zones (EPZ) airports, land ports, harbours and tourism. Moreover, being a World Heritage site and ecological critical areas such as mangrove and coral ecosystem they have attracted the attention of environmentalists [1]. Unfortunately, these areas are highly vulnerable to natural and human-induced hazards as well as disasters like coastal flooding, coastline erosion, cyclones, storm surges, salinity, erosion and pollution. In addition to different hazards, increasing population growth, unemployment, low-income levels, poor housing and sanitation conditions have increased the vulnerability of coastal communities.

Vulnerability in the coastal zone is increasing as more people have migrated to the coast. Consequently, the natural buffers such as wetlands and mangrove forest are lost to development and erosion. High coastal population density coupled with projected increases in storm frequency and severity may exacerbate the impact of coastal hazards as well as slow subsequent recovery and community rebuilding efforts [15]. With the likelihood of such events, private citizens and public officials are questioning how coastal communities can better prepared for potential hazards. Proactive measures must be taken to reduce vulnerability and increase community's capacity to absorb and bounce back from coastal hazards, in concept of coastal coping mechanism is a new way of thinking about how to better protect coastal communities.

B. Environment Degradation

The United Nations international strategy for disaster reductions defines environmental degradation as "the reduction of the capacity of the environment to meet social an ecological objective and needs. Environmental degradation is the disintegration of the earth or deterioration through consumption

of assets such as air, water and soil, the destruction of the environment and the eradication of wildlife [12]. It is the process by which the environment i.e air, water and land, is progressively contaminated, over exploited and destroyed. When the environment becomes less valuable or damaged, environmental degradation is said to occur. In specific term, environment degradation is the deterioration of the environment through depletion of resources such as air, water, soil and forest; the destruction of eco-system and the extinction of wildlife. In fact, there are many forms of environmental degradation. Some of the major causes of environmental degradation include land disturbance, pollution and over population.

C. Livelihood

Livelihood is a process by which people make a living through specific capabilities, assets, and activities [8]. Earlier anthropological study showed that livelihood extends beyond basic life necessities to include information sharing, social relationships management and identity maintenance. Obviously, with an overlap of different layers of social life based on resources and their utilization, livelihood is a holistic phenomenon.

D. Coastal Erosion (Retreat)

The coastal zone is continually experiencing dynamic waves and winds interaction, causing the changing effects between the oceans and the land. Coastal zone otherwise referred to as the coastal area or spatial zone is where the interaction between land and sea occurs. Consequently, it remains the world's most favored high concentration of human population and activities [2]. Coastline retreat, otherwise referred to as shoreline change refers to the gradual movement of coastlines (shorelines) and dune features in a landward direction, though not necessarily with any decrease in size or perceptible erosion. Coastline erosion due to sea level rise along the shoreline is becoming alarming especially in developing countries such as Nigeria [14]. The causes of coastline change are both natural and human-induced [19]. The most important factors that caused these changes are: Human activities; lack of sand deposits in the shore area; increase in tropical storm occurrence in the vicinity of the island; local wave regimes; flood events of all magnitudes and frequencies; and the presence of submarine canyons. Coastlines with their cliffs, beaches, headlands and bays are constantly changing shape and eroding. It is important to understand the processes because if you prevent erosion in one place this may lead to reduced deposition in another. There is usually a knock-on effect somewhere else when people try to control the shape of a coastline.

4. Research Methodology

The study adopted a survey design and a mixed method that combines qualitative and quantitative approaches. The various sources of data employed for the study include primary and secondary data. The Primary data were collected through copies of structured questionnaire, semi-structured interview guide and the Geographic Information System (GIS) which was used

to acquire and analyze satellite imageries of the study area. The questionnaire and the interview guide were used to obtain information from the residents of Ayetoro on issues related to the coastal erosion and livelihood. In Ayetoro community 180 copies of questionnaire were administered to the residents. The secondary data were obtained from journals, newspapers, theses, unpublished research works, reports, articles in a periodical, conference proceedings, etc. The study obtained historical Landsat imageries from the Global Land Cover Facility Website and a high-quality Landsat imagery spatially to access the coastal erosion (Table 1). The buildings in the study area constituted the research population. Systematic Random Sampling was used to select 0.5% of the buildings in the study area, and a mature individual was chosen in each building for survey. SPSS Random Number Generator was used to select the first sample, then every 6th building was selected for questionnaire administration. The retrieved copies of the questionnaire were analyzed using SPSS 8.1 while a qualitative assessment was conducted on the interview guides to ascertain from the residents the causes and the extent of impacts of coastal erosion on livelihood in Ayetoro community in Ilaje LGA.

Geographic Information Systems and Remote Sensing (GIS & RS) techniques were adopted to perform a geospatial analysis in order to determine the incidence of coastal degradation to coastal erosion. Geo-processing operations and analyses were carried out in ILWIS 3.1 and ArcGIS 10.2 software. Landsat satellite imageries TM of 1991, ETM+ 2000 and OLI 2019 of Ilaje LGA were used. Each of these was vectorised and polygonised, and then converted to raster to have 10m pixel resolution size to make overlaying possible for the analysis of the coastal erosion. The Digital Shoreline Analysis System (DSAS) was used for the coastal erosion analysis.

Fig. 2. Socio-economic Activities in Ilaje LGA
Source: Authors' Fieldwork, 2022

A. Evaluation of Coastal Degradation in the Study Area

The study ascertained the occurrence of coastal degradation through coastal erosion in Ilaje LGA which is prominent in Ayetoro community. Remotely Sensed Landsat Satellite Imageries for different periods were used to capture coastline changes in previous years in the area under investigation. The

stretch of the extracted coastline for 1991, 2000 and 2019 and the baseline are shown in Figure 5. Visual inspection of the boundaries signature shows that, there is remarkable change in the shape of the coastal boundary over time. Figure 3 shows the overlay of coastline position for 1991 as overlaid on the coastline position for 2000 of Ilaje LGA (Ondo State) to analyze the variation in the coastline position between these two years (Table 3). It revealed that, between 1991 and 2000, the rate of coastal erosion (land loss) was averagely at -21.19 m/year, while the rate of coastal accretion (land gain) was averagely 13.92 m/year. This reveals that, the coast land lost to the sea was more that which was gained (deposited) at the coastal area of Ilaje LGA. Furthermore, Figure 4 shows the overlay of coastline position for 2000 as overlaid on the coastline position for 2019 of Ilaje LGA to analyze the variation in the coastline position between these two years (Table 3). It revealed that, between 2000 and 2019, the rate of erosion (land loss) was an average of -12.07m/year, while the rate of coastal accretion (land gain) was averagely 11.12 m/year. This also shows that, the coastland lost to the sea was more than that which was gained (deposited) at the coastal area of Ilaje LGA. The overall coastal erosion between 1991 and 2019 was analyzed as revealed in Table 3. As shown in Figure 4, the overlay of coastline position for 1991 as overlaid on the coastline position for 2019 of Ilaje LGA. It reveals that, between 1991 and 2019, the average rate of erosion was -8.59m/year. Accretion was also recorded along the coast at an average of 5.06 m/year. This corroborated the findings in Figures 3 and 4, as revealed that coastal erosion was prominent between 1991 and 2019 in the study area. The implication of the above analysis is that, coastal erosion was one of the environmental menace prominent in Ilaje LGA, Ayetoro community in particular, as this therefore, resulted to coastal degradation.

Table 4 identified the causes of coastal degradation in the study area. These include: Sea Level/sea incursion, high water waves hitting the coast, unprotected coast, nature of the coastal soil, coastal sand mining, crude oil mining, waste disposed into water body and disregard to planning regulations. It was revealed that, majority of the respondents posited that, increase in sea level/sea incursion (65%), unprotected coast (61.7%), nature of the soil (56.7%) and high-water waves hitting the coast (54.9%) were the major causes of coastal degradation in Ilaje LGA, Ayetoro community in particular. It was gathered that, the coastal area of Ondo State has been witnessing incessant degradation due to the unprotected nature of the coast, as this allows easy sea incursion in this region, thereby degrading the coast (Figures 6 and 8).

Table 5 revealed the distance of Ayetoro community to flood plain/coast, majority (38.9%) of the respondents claimed that

Table 1
Data set and sources

Data type	Usage LGA	Date	Source	Spatial resolution
Landsat TM P190R056	Ilaje LGA	11-12-1991	www.glcf.com	Pixel Size 28.5m
Landsat (ETM+) P190R056	Ilaje LGA	03-12-2000	www.glcf.com	Pixel Size 28.5m
Landsat (OLI) P190R056	Ilaje LGA	17-12-2019	www.glcf.com	Pixel Size 28.5m
GPS	Ilaje LGA	Dec. 2022	Field Work	-
Survey (Questionnaire)	Ayetoro community	Dec. 2022	Field Work	-

Source: Authors, 2022

the community was located between 500-1000 m. The implication of this is that, Ayetoro community is very close to the Atlantic Ocean (Figures 6 and 8). In fact, this is one of the reasons the community has been suffering from incessant Ocean surge and coastland degradation than any community in Ilaje Local Government Area.

Table 5
Distance from the shore

Distance (m)	Frequency	Percent (%)
< 500	65	36.1
Between 500 -1000	59	32.8
Between 1000-1500m	38	21.1
> 1500m	18	10.0
Total	180	100.0

Table 1
Socio-economic characteristics

Variables on socio-economic activities

SEX	Frequency	Percent (%)	INCOME	Frequency	Percent (%)
Male	78	43.3	< N30,000	45	25.0
Female	102	56.7	N30,000-N60,000	93	51.6
Total	**180**	**100**	N60,001-N120,000	37	20.6
AGES	**Frequency**	**Percent (%)**	N120,001-N240,000	2	1.1
18-28	50	27.8	> N240,000	3	1.7
29-39	75	41.7	**Total**	**180**	**100.0**
40-50	25	13.9	**MARITAL STATUS**	**Frequency**	**Percent (%)**
51-60	20	11.1	Single	39	21.9
61 and above	10	5.6	Married	111	61.4
Total	**180**	**100**	Divorced	18	9.8
EDUCATION	**Frequency**	**Percent (%)**	Widowed	12	6.9
No formal educ.	37	20.6	**Total**	**180**	**100.0**
Primary	69	38.3	**FAMILY SIZE**	**Frequency**	**Percent (%)**
Secondary	65	36.1	Less than 4	21	11.6
Post-Secondary	9	5.0	5-8	127	70.6
Total	**180**	**100.0**	9-12	3	1.7
OCCUPATION	**Frequency**	**Percent (%)**	Can't specify	29	16.1
Fishing	104	57.7	Total	180	100.0
Arable farming	12	6.9			
Trading/Business	33	18.5			
Artisan	16	8.7			
Corporate/Comp.	3	1.8			
Civil service	12	6.5			
Total	**180**	**100.0**			

Source: Authors' Fieldwork, 2022

Table 3
Coastal erosion, accretion and net change statistics of Ilaje LGA (1991-2019)

	1991 – 2000		2000 – 2019		1991 – 2019	
	Accretion	Erosion	Accretion	Erosion	Accretion	Erosion
Minimum	0.02	-80.61	0.37	-27.6	0.25	-38.25
Maximum	33.18	-0.06	19.5	-0.15	28.04	-0.11
Mean	13.92	-21.19	11.12	-12.07	5.06	-8.59
Standard Deviation	8.67	22.14	6.21	5.98	6.15	9.24

Source: Authors' Fieldwork, 2022

Table 4
Causes of coastal degradation

Causes of Coastal Degradation	Yes	%	No	%	Don't Know	%	Mean
Sea Level rise/sea incursion	117	65.0	27	15.2	36	19.9	1.55
High water waves hitting the coast	99	54.9	46	25.7	35	19.4	1.64
Unprotected coast	111	61.7	47	25.9	22	12.5	1.51
Nature of the coastal Soil	102	56.7	46	25.4	32	18.0	1.61
Coastal Sand Mining	32	17.6	64	35.4	84	47.0	2.29
Movement of Fast Ferries- Ships	61	34.0	41	22.8	78	43.2	2.09
Crude oil mining	167	21.3	58	7.4	560	71.3	2.50
Disregard to Planning Regulations	66	36.9	51	28.3	63	34.8	1.98

Source: Author's Fieldwork, 2022

Table 6
Impact of coastland erosion/degradation

Impacts	Yes	%	No	%	Don't Know	%	Mean
Washing away of coastal sand/deposits	95	52.6	41	22.7	44	23.9	1.71
Destruction of coastal biodiversity	96	53.1	39	21.5	45	25.4	1.72
Destruction of valuable land	82	45.7	51	28.2	47	26.1	1.80
Carrying away of buildings	109	60.5	27	15.2	44	24.3	1.64
Death of Residents	24	13.4	109	60.5	47	25.7	2.12
Relocation of communities' dwellers	34	18.9	80	44.5	66	36.7	2.18
Water pollution	86	47.8	37	20.6	57	31.6	1.84

Source: Author's Fieldwork, 2022
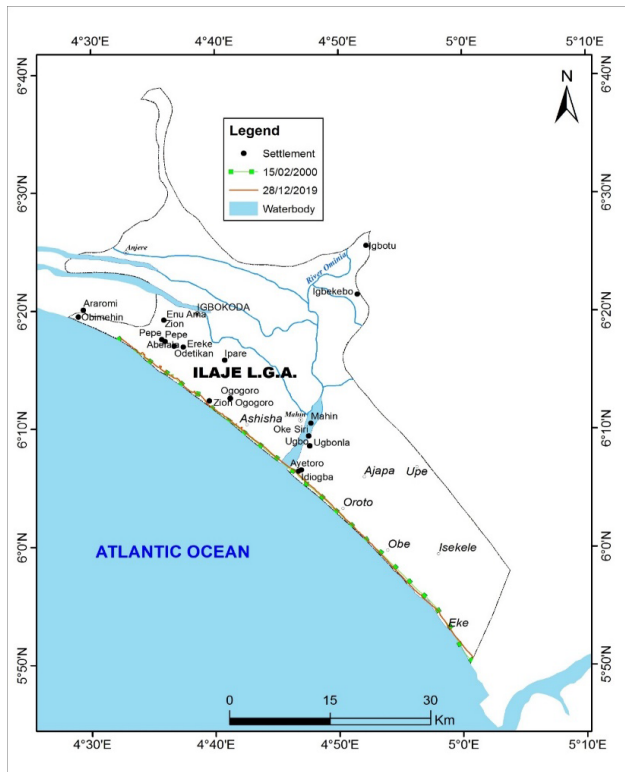
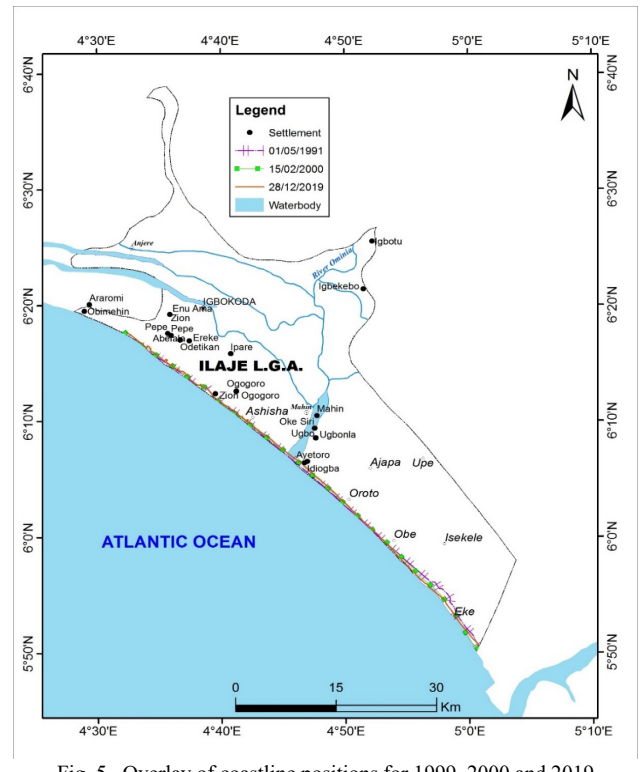Fig. 3. Overlay of coastline positions for 1991 and 2000
Source: http://www@googleearth.com (Digitized by the author, 2022)

Fig. 5. Overlay of coastline positions for 1999, 2000 and 2019
Source: http://www@googleearth.com (Digitized by the author, 2022)
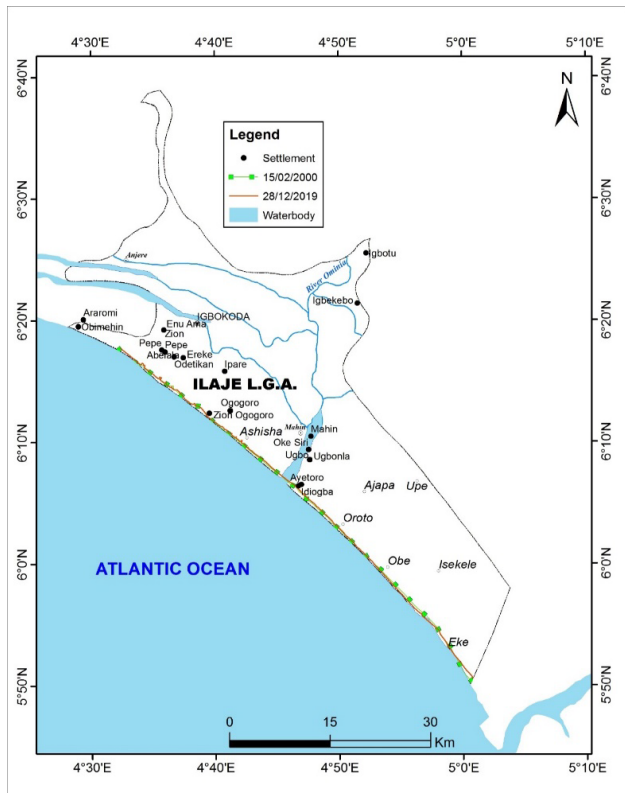
Fig. 4. Overlay of coastline positions for 2000 and 2019
Source: http://www@googleearth.com (Digitized by the author, 2022)

Fig. 6. Proximity of Ayetoro community to the Atlantic Ocean
Source: Author's Fieldwork, 2022

B. Impact of Coastal Degradation on the Livelihood of Ayetoro Residents

Table 6 identified the impact of coastal erosion which resulted to coastland degradation in Ayetoro community. The identified impacts include; washing away of coastal sand/deposits, destruction of coastal biodiversity, destruction of valuable land, carrying away of buildings/gradual disappearance of the island and its historical values, death of residents and water pollution. It was found that, majority of the respondents claimed that, coastal erosion/degradation had resulted to carrying away of buildings (60.5%), destruction of coastal biodiversity (53.1%), and washing away of coastal sand/deposits (52.6%) in the study area (Table 6).

During an organized interview session by the researchers with the residents of Ayetoro community, where the impacts of coastal erosion/degradation was obviously prominent. It was found that, several buildings in this community had been destroyed as a result of coastal erosion (Figure 8). The sea incursion in the community had great negative impacts on the buildings, valuable land, road infrastructure and on coastal

biodiversity. Personal observation by the researchers confirmed the impacts of this great environmental menace, in the coastal region of Ondo State, Ayetoro community in particular. This environmental challenge had great economic, psychological and social impacts on the livelihood of residents. Economic impact in the sense that, when their houses were destroyed due to coastal erosion, they lost their buildings and properties to the sea, the affected residents had resulted to squatting in another area during relocation. Psychologically they are in state of trauma, pains and emotional stress due to the coastal degradation effect, while socially, they were impacted due to breakage in initial social ties with their neighbours and forced movement to other communities.

The categories of people vulnerable to coastal erosion/degradation in the study area was investigated and it was found that, people between the ages 0-17 and above 60 years were mostly vulnerable to water degradation (Figure 7). The reason for this could be as a result of their body immune system. People within the ages of 18-60 years have very active immune system which could fight against diseases than children and the aging.
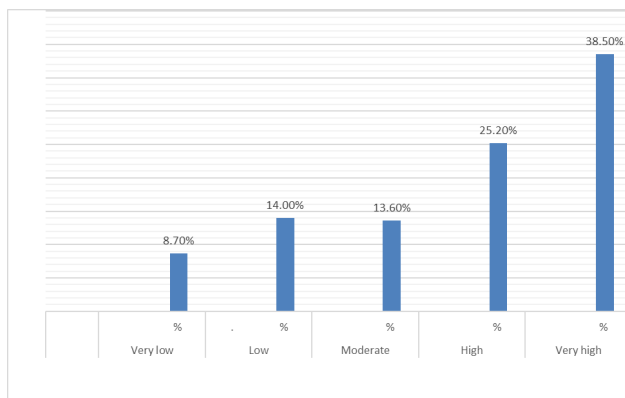

Fig. 7. Vulnerability to coastal erosion impact
Source: Author's Fieldwork, 2022

Fig. 8. Sea incursion and impact of coastal erosion on coastal biodiversity in Ayetoro
Source: Author's Fieldwork, 2022

5. Conclusion and Recommendations

The study has shown the level of coastal degradation in the coastal area of Ondo State, Ayetoro community in particular, while its impacts on the livelihood of the residents were also revealed. Therefore, the following recommendations were made in line with the findings of the study:

1) Economic revitalization and empowerment programmes

Ayetoro residents depended mainly on fishing activities as their major source of income. Government should provide grants and empowerment programmes for them to expand their fishing operation, as this would increase their outputs. This would invariably increase their income, thereby positively affecting the economic livelihood of individuals and Gross Domestic Products (GDP) of Ayetoro and Ilaje LGA as a whole. It is believed that when economically stable preaching of environmental awareness to the residents will be made easier.

2) Adoption of structural engineering for coastal protection and management

The adoption of soft and hard engineering techniques would help to manage the coastline in combating coastal erosion/degradation. The soft engineering technique includes: Beach nourishment (adding sand and shingle to a beach from elsewhere); Dune regeneration (creating or restoring sand dunes, to help stabilize the dune which then provide a barrier and absorb wave energy; and Coastal realignment (allowing the sea to breach an existing defence and flood the land behind it. The hard engineering technique involves the use of artificial/man-made elements to manage the coastline. It includes: Sea walls, Offshore reef; Tidal barriers; Breakwaters; Revetments, Groynes; Rock armour (Riprap) and Gabions.

3) Adherence to town planning laws and building regulations

Adherence and strengthening Town Planning legislations will mitigate disasters caused due to coastal erosion/degradation in the coastal areas. Legislation should require urban and local bodies to adopt participatory approaches in preparing and monitoring the implementation of urban land use management tools. The legislation guiding the growth of cities at the coastal area, urban land use, building control, environmental protection, decentralization, and regional cooperation. All these would prevent the loss of buildings and other valuable properties to sea incursion which resulted to land degradation. The Ministry of Physical Planning and Urban Development, Ondo State should set clear guidelines and planning standards for minimum set back to the ocean and ensure compliance by water front communities in Ondo State.

4) Collaboration with the international bodies

Government is encouraged to adopt this strategy to prevent coastal degradation in this region. To achieve this, there is need for collective efforts of state and local government to seek assistance for international funding for the engineering solutions proposed in this study. Namely, the United Nation Habitat (UN-Habitat), United Nations Development Programme (UNDP), African Development Bank (AfDB) and other related funding agencies.

5) Declaration of coastal communities of ayetoro community as environmental area and proposed for community regeneration programme

In line with Urban and Regional Planning Law of 1992, section 86 on Urban Renewal Programmes. It is suggested that, communities in Ilaje be declared as Environmental Areas and designed for a 3-year community Regeneration Programme, with focus on Clean Water, Coastal Erosion Management and

Livelihood Improvements, and Ayetoro as the pilot community.

6) Community relocation

Findings from the study revealed that, some communities in Ilaje LGA were very close to the Atlantic Ocean while some are directly on the creeks, making these communities highly vulnerable to coastal challenges such as water and coastal degradation. Although, interaction of the researcher with the residents of Ilaje LGA showed that, many of them did not want to relocate despite incessant threats from sea level rise, coastal erosion and other coastal hazards, this was because of the economic benefits (from fishing and water transportation) they are deriving from the Atlantic Ocean. They refer to the Atlantic Ocean as their pot of wealth (source of income, fortunes and wealth). For this reason, National Orientation Agency (NOA) should be involved to give proper orientation to residents of Ilaje LGA on the need to relocate their buildings minimum of 100m away from the coastline but can still visit the coast for their economic activities on daily basis.

References

[1] Agrawala, S., Ota. T., Ahmed, A.U., Smith, J and Aalst, M.V (2008): Development and climate change in Bangladesh focus on Coastal flooding and the Sundarbans. Organization for Economic Cooperation and Development, 34 Paris, France.

[2] Aledare, K.D., Olayiwola, K.O., Olaseni, A.M. (2014). Climate Change Awareness among Residents of Lagos Island, Nigeria. American Journal of Social Issues and Humanities, 4(1), 12-25.

[3] Angela, 2007: Coastal settlement and climate change, the effects of climate change/sea-level rise on the people of Awoye on Ondo State. Presented at the FIG working week, 13-17 May in Hong Kong SAR, China.

[4] Argaudy, L., Ferry, T., Le, Q. H., Marfisi, A., Ciorba, D., Achache, P. & Robert, D. (2005). Short- and long-term outcomes of heatstroke following the 2003 heat wave in Lyon, France. Archives of Internal Medicine, 167, 2177-2183.

[5] Babajide, A. (2019). Flood renders 500 people homeless in Ondo. In Daily Post Online, published online on 17th September, 2019. Retrieved from https://dailypost.ng/2019/09/17/flood-renders-500-people-homeless-ondo/ on 15th September, 2019.

[6] Barbara Denson (2010): Environmental health safety journal. http:/ehsjournal.org/barbara-denson/introduction-to-green-roofs-2/2010/

[7] Baud, I. S. A and Hordijk, M. A (2009): Dealing with Risks in Urban Governance: What can we learn from Resilience Thinking. The 4th International Conference of Forum on Urbanism, Amsterdam.

[8] Ellis, F. (2006). Rural Livelihoods and Diversity in Developing Countries. Oxford University Press.

[9] Gbadamosi (2019). Ocean surge sacks four communities in Ondo. Nigerian Tribune Online, published on May 12, 2019. Retrieved from https://www.tribuneonlineng.com/211148/ on 15th May, 2019.

[10] Ibe, A.C., (1988): Coastline Erosion in Nigeria. Ibadan University Press, Ibadan Nigeria.

[11] Islam, M and Sado, K (2000): Flood hazard map and land development priority map Developed using AVHRR and GIS data. Accessed from http://gisdevelopment.net/application/naturalhazards/floods/floods002pf.htm on 3rd Nov. 2018.

[12] Jiboye, J. O., Ikporukpo, C. O. and Olatubara, C. O. (2018). Causes of Environmental Degradation in the Coastal Areas of South West, Nigeria. European Journal of Sustainable Development Research.

[13] Lagos State Ministry of Environment (2007): Drainage services office of the drainage services. www.lagosstate.gov.ng.developmentdiaries. Accessed online 15th October, 2015.

[14] Milne, G. A., Gehrels, W. R., Hughes, C. W. and Tamisiea, M. E. (2009): Identifying the causes of sea-level change, Nature Geoscience, 2(7).

[15] National Emergency Management Agency (NEMA) (2010): National disaster management framework. Abuja, NEMA. Accessed online from https://www.preventionweb.net/english/professional/policies/v.php?id=21708 on 29th Nov. 2018.

[16] National Population Commission (NPC), (2006): Population and housing census, Population distribution by Sex, State, LGA, and Senatorial district", http://www.population.gov.ng/images/Vol%2003%20Table%20DSx%20LGAPop%20by%20SDistrict-PDF.pdf [Accessed 18th January, 2016].

[17] Nwilo, P. C. (2014), Environmental and management issues in Nigerian coastal and inland waters. 7th annual lecture of the School of Environmental Technology, Federal University of Technology, Akure, Nigeria, 24th July, 2014.

[18] Olaniyan E. and Afiesimama, E.A. (2002): On marine winds, waves, and swells over West African Coast for effective coastal management- a case study of Victoria Island Beach in Nigeria. In: OCEANS 2002 IEEE/MTS Conference Proceedings 1. Piscataway, New Jersey: IEEE (Institute of Electrical and Electronics Engineers/Oceanic Engineering Society) and Marine Technology Society (MTS), pp. 561-568.

[19] Oyinloye, M. A; Ajayi, G. E & Olanibi, J.A (2016). Assessment of shoreline changes in Victoria Island Eti-Osa Local Government Area, Lagos State Nigeria. Journal of Earth Sciences and Geotechnical Engineering, 6(1), 47-62. United Kingdom.

[20] United Nations Human Settlements Programme (UN-Habitat) (2011): Global report on human settlements: cities and climate change. Earthscan, London.