Development Projects in Terms of Land Use on Converted Wetland Sites in Port Harcourt Municipality, Rivers State

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Abstract
Urban expansion and growth is one of the basic characteristics of urbanisation process. This expansion has telling effects on available land space in urban areas. The continuing reduction in available land space has led to the encroachment on wetland areas and its subsequent development. This study was carried out in Port Harcourt Municipality Rivers State. The aim was to assess development projects in terms of land use on converted wetlands. Purposive sampling technique was used to select four sites out of twenty four reclaimed sites identified within the study area.Three hundred and eighty (380) household heads from eight proximate communities to the four selected reclaimed sites was arrived at with the aid of Taro Yamane formulae and were interviewed using purposive sampling technique.The extent of wetland loss to physical development in the study area was ascertained by running a time series analysis using the Geographic Information System (GIS) technique. Data on physical development projects presently sited on the reclaimed wetlands were identified and their coordinates collected using handheld Global Positioning System (GPS), a process known as ground truthing. The coordinates of the different development projects presently sited on reclaimed wetlands so collected were interfaced with Google earth images of the different locations using the place-mark device available on Google earth software.The study revealed that predominant land use in site A (Eastern Bypass) is industrial land use and a growing competing administrative land use; in site B (Borikiri Sand field), the predominant Landuse is residential with a growing competing commercial land use; In Site C (Eagle Island), the predominant land use is residential and in Site D (Ibeto), the predominant land use is residential with a growing commercial and industrial hubs. The study therefore recommends that reclaimed wetlands in the study area be properly plan and the different development projects earmarked for such site be fully implemented;Government should strictly enforce the land use control measures utilizing sub-division regulation, zoning ordinance, building and housing codes including site and service approach to ensure proper utilisation of reclaimed sites.
Key Words: Wetland, Land Use, Development, Geographic Information System (GIS)

I.   Introduction

Wetlands all over the world are very important subsystems of the general ecosystem of the environment which play vital roles in the sustenance of both the surface and ground water resources of the earth. They also provide significant social and economic values to the society.The continual increasing demand for land space for physical developments and agricultural uses and other resources to meet the needs of the ever growing population has continued to impact negatively on wetland ecosystems most especially within the built-up environment (Agbasi & Odiaka, 2016). Urban areas in developing countries of the world have pull factors of employment opportunity, security, better life conditions, education, health care services, etc. which attracted population growth and urbanisation with shrinking land space. Port Harcourt City Local Government Area of Rivers State, Nigeria within its municipal boundaries has been experiencing similar growth both structurally and demographicallyin various spatial dimensions..

Between 1990 and 2020, about 30.5% of the wetland ecosystem has been lost to physical development in various forms (Akue, 2022). According to the National Population Commission (NPC, 2006), the population of Port Harcourt City Local Government Area alone (within its municipal boundary) grew from 7,000 residents in 1921 to 703,420 persons in 1991 indicating an increase of 696,420 persons in 70 years. The projected population in 2022 using the exponential projection model with 6.5% annual growth rate is 4,955,102 persons. This dramatizes the unprecedented phenomenal growth of the city's population over the years.

The increasing rate of urbanisation within the city has put much pressure on available land space for various forms of physical developments to accommodate the pace of expansion of the city. As the city increased in size (demographically) and urbanized structurally, land space for different forms of developments shrinks, leading to encroachment into wetland areas. Encroaching into wetland areas implies converting, reclaiming and sand-filling wetland areas to create dry land to accommodate the ever increasing population and the different forms of development as witnessed in the city.Hectares of wetlands are being converted for various forms of developmental needs and uses including road constructions, housing development, markets, construction of dams, drainages, waste dump sites, industrial development and agricultural uses. The increasing rate of conversions and reclamations of wetlands for different forms of development as witnessed in the study area have resulted to massive destructions and the subsequent disappearance of the available wetlands within the study area. This study therefore assess developmentprojects in terms of land uses on converted wetland sites in the study area.

II.   Literature Review
2.1 Organic Pattern Theory
The irregular pattern model was developed to explain the nature of urban structures in the third world or countries of the Global South. Boundless (2016) propounded this model to explain the arrangement of public space in geographic space. The model depicts that the arrangement of public space is characterized by its stage of transition from village to city especially in developing countries of the world where it occurs without a set pattern. The model noted that there is no clear-cut plan for expansion as it just happens on its own when the population grows especially in an exponential pattern.

This model according to Boundless (2016) examines the deficiency of planning that exists in several fast growing cities of the Global South in which city form can take on all sorts of appearance, with a mix of land uses and development, which are carried out on wetland areas and floodplains. Thuo (2013) noted that this model consists of development blocks with no predetermined form, showing that urban arrangement is also not connected to the Central Business District (CBDs) or areas; and that there is still a separation between high and low income areas. Thus the utilization of this model in this research provide the express explanation to the very reasons behind excessive reclamation and conversion of wetland areas for urban expansion (growth) and subsequent physical development especially in areas that are not planned and have been dominated by indigenous people. The relevance of the model to this study is that most reclamation is carried out by indigenous city dwellers without cognizance to planning, preservation and conservation principles.

2.2 Related Review
In urban centres in countries of the developing world, where there are notable increases in human population, and the corresponding increase in development and space utilization, there are bound to be spatio-temporal changes in land use and land cover within the affected areas. Satellite/ land sat imageries containing land use /land cover changes as a result of the activities of man as well as the processes of urbanisation, urban sprawl and expansion, infrastructures and facility development and several others as found in Port Harcourt metropolis have been properly documented in the literature.

Mmom and Fred-Nwagwu (2013) have noted that significant changes exist in the land use/ land cover in Port Harcourt City and its environs, and this is basically as a result of rapid urbanization and other anthropogenic activities as evident in the decline of agricultural land and rise of built-up areas. Mmom and Fred-Nwagwu (2013) further reiterated that Port Harcourt City since its inception in 1912 has witnessed remarkable growth in population, expansion and developmental activities that have resulted in increased land consumption and alteration of the earth's surface, especially the wetland areas within the city.

According to Eludoyin and Akinola (2015), activities leading to industrialization and urban development are land clearing and land reclamation, which often result in loss of wetlands in the affected regions. The UN-Habitat (2010) noted that rapid urbanization generates negative impacts on the environment that can result in changes in landscape patterns, ecosystem functions and the capacity to perform other functions in support of human population and development.

The impacts of urbanisation pressures on wetland ecosystems have been discussed in expert workshop reports on urban development, biodiversity and wetlands management, noting that urbanisation has direct and indirect impacts on the environment; and that wetlands are particularly vulnerable to negative changes, resulting from inhabitation process, yet, the march of urbanization continues to destroy and degrade natural habitat (UN-Habitat, 2010; Horwitz & Finlayson, 2018).

Savard, Clergau and Mennechez (2000) and Gupta (2002), observed that the biggest and the most prominent threat to wetland ecosystem is from urban sprawl while the United States Environmental Protection Agency (USEPA, 1994; Eludoyin and Akinola (2015), noted that urbanisation is a major driver of wetlands degradation as more land space is needed to accommodate the rising pace of physical development in the city. It should be noted that the continuous increase in built-up areas in Nigerian urban centres is as a result of the

increase in urban population that places heavy demand on the available space needed for development and thus resulting in a greater increase in the size of settlements in both the city centre and the peripheral regions (Suleiman; Saidie; Abdulrazag; Hassan & Abubaka, 2014).

Obia, Itam and Archibong (2015) posit that the reclamation of wetlands for settlements mainly for urban growth and development has long been taken as an acceptable practice, noting that this trend is turning out to be very expensive, both economically and ecologically. Obia *et al.*, further opines that the ecological cost begins with the loss of wetlands benefits. Although cities along water bodies are noted for their rapid growth, mostly because of flourishing commerce and industry due to ease of transportation, their development is faced with a number of problems. Obia *et al.*, (2015) in their study observed that apart from the general problems posed to the ecological integrity of wetland ecosystems by physical development, there are also very significant challenges that face buildings and infrastructural developments in wetland ecosystems. Obia *et al*. reiterated that buildings in wetland areas are usually characterized by hazards arising from poor ambient condition, soil instability and poor safety conditions for occupants.

According to Wali, Phil-Eze and Nwankwoala (2013), urban development in wetland ecosystems for human settlements, transport networks, exploration of natural resources, agriculture and industrial development is one of the biggest menaces to wetlands change and management and for the sustainability of the environment. These trends of events need to be properly guided, managed and controlled.

III.   Methodology
This study was carried out in Port Harcourt Municipality, Rivers State. The study area lies along the Bonny river, an eastern tributaries of the lower Niger, 41 miles (66km) upstream from the Gulf of Guinea in Nigeria Niger Delta area (Oyegun, 2007). It is located approximately on latitude 4^0 17' 98" – 4^0 47' 21" E and longitude 6^0 09' 99' – 6^0 59' 55" N of the Greenwich Meridian (Oyegun, 2007).

The study area have twenty-four (24) reclaimed sites (see Fig. 3.1). Out of the twenty-four reclaimed sites identified within the study area as shown in fig, 3.2, four (4) sites were purposively chosen for sample. The four sites purposively selected for study include; Eastern Bypass, Borikiri Sandfilled, Eagle Island and Ibeto.
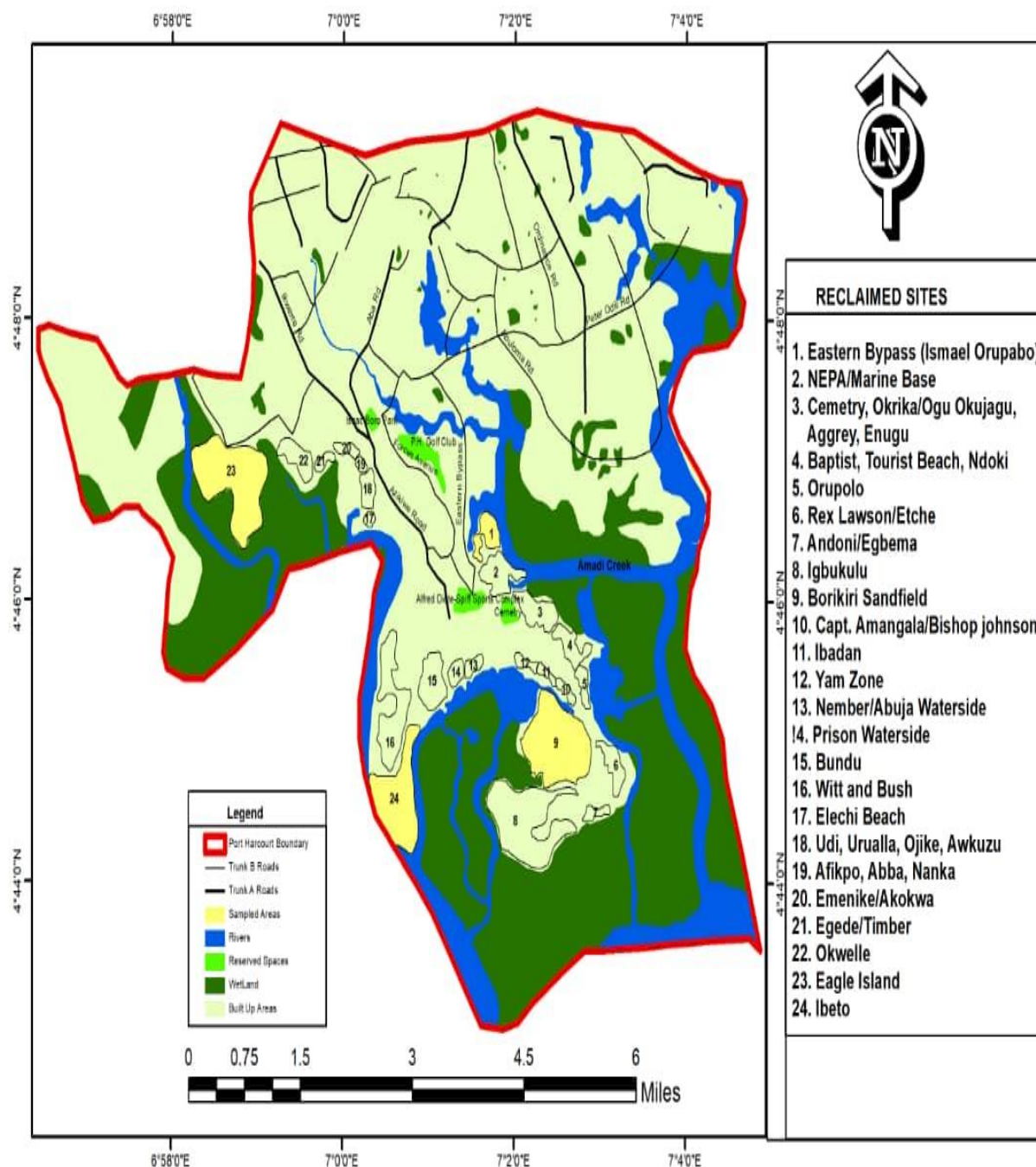
RECLAIMED SITES

1. Eastern Bypass (Ismael Orupabo)
2. NEPA/Marine Base
3. Cemetry, Okrika/Ogu Okujagu, Aggrey, Enugu
4. Baptist, Tourist Beach, Ndoki
5. Orupolo
6. Rex Lawson/Etche
7. Andoni/Egbema
8. Igbukulu
9. Borikiri Sandfield
10. Capt. Amangala/Bishop johnson
11. Ibadan
12. Yam Zone
13. Nember/Abuja Waterside
!4. Prison Waterside
15. Bundu
16. Witt and Bush
17. Elechi Beach
18. Udi, Urualla, Ojike, Awkuzu
19. Afikpo, Abba, Nanka
20. Emenike/Akokwa
21. Egede/Timber
22. Okwelle
23. Eagle Island
24. Ibeto

Legend

- Port Harcourt Boundary
- Trunk B Roads
- Trunk A Roads
- Sampled Areas
- Rivers
- Reserved Spaces
- WetLand
- Built Up Areas

Fig. 3.1: Port Harcourt Municipality Showing Reclaimed Sites and Sampled Locations
Source: GIS Lab. Department of Urban and Regional Planning, Rivers State University, 2022

To obtain the study population, proximate communities to the chosen sampled sites within the study area was identified as contain in Table 3.1.

Table 3.1 Sample Sites and their Proximate Communities within the Study Area

S/N	Sites	Name of Sites		Proximate Communities
1	A	Eastern Bypass	1.	Ismael Orupabo
			2.	Ogbunabali
			3.	Amadi-Ama
			4.	Nkpogu
2	B	BorikiriSandfilled	5.	Borikiri
3	C	Eagle Island	6.	NkoluOroworukwo
			7.	Mgbundukwu
4	D	Ibeto	8.	Bundu

Source: Researchers' Computation, 2022

In all, eight communities were identified within the study area to be proximate to the four selected sites chosen for sample.Three hundred and eighty (380) household heads from the eight proximate communities was selected with the aid of Taro Yamane formulae and were interviewed using purposive sampling technique.The extent of wetland loss within the study area was ascertained by running a time series analysis using the Geographic Information System (GIS) technique

Landsat imageries of 1990, 2000, 2010 and 2020 of Port Harcourt Local Government Area were acquired from Google Earth. The imageries have a resolution of 1116m $\times$ 671m and were captured from 10km above ground level. The imageries so acquired were processed and used to determine the extent of wetland loss to physical development in the study area between the years 1990, 2000, 2010 and 2020. Geographic Information System (GIS) software analytical techniques ArcGis10.4.1 was used to run a time series analysis of land use land cover changes in Port Harcourt Municipality with a view to ascertain the extent of wetland loss and the level of physical developments on reclaimed wetlands and also to see the extent of urban encroachment to wetland areas in Port Harcourt Local Government Area, Rivers State.

The study reclaimed sites were mapped out on google map and the imageries containing different forms of developments were acquired and used as guide for further investigation. Data on physical development projects presently sited on the reclaimed wetlands were identified and their coordinates collected using handheld Global Positioning System (GPS), through a process known as ground truthing. The coordinates of the different development projects presently sited on reclaimed wetlands so collected were interfaced with Google earth images of the different locations using the place-mark device available on Google earth software with a view to ascertaining their spatial locations.

IV.   Results and Findings

4.1 Development Projects in Terms of Land Uses Presently Sited on Converted Wetlands in the Study Area

Data on different development projects in terms of land use presently sited on the converted wetlands in the study area was gathered and analysed and the data presented in table 4.1. The analysis revealed that in Site A (Eastern Bypass); industrial, administrative, religious and residential land uses have 35%, 18.7%, 12.5% and 10% respectively; while transportation, commercial, recreational and farming have 8.7%, 6.3%, 6,3% and 2.5% respectively. In Site B (Borikiri Sandfield); residential, transportation, religious and commercial land uses have 50%, 11,4%, 11.4% and 7.1%, respectively; while administrative, industrial, recreational, and farming have 7.1%, 5.7%, 4.3%, and 2.9%, respectively. In Site C (Eagle Island); residential, commercial, administrative and transportation land uses have 55%, 12.5%, 9% and 7.5% respectively; while religious, recreational, industrial and farming have 6.5%, 5%, 2.5% and 2%, respectively. In Site D (Ibeto); residential, industrial and religious land uses have 46.7%, 23.3% and 3.3% respectively; while commercial, administrative, transportation and recreational land uses have 6.7% each. The implications of the data as shown in table 4.1 are that different Landuses exist on the reclaimed sites in the study area.

Table 4.1: Development Projects in Terms of Land Use Presently Sited on the Converted Wetlands

S/No.	Development Projects in Terms of Land Use	Reclaimed Site A Eastern Bypass		Reclaimed Site B BorikiriSandfield		Reclaimed Site C Eagle Island		Reclaimed Site D Ibeto	
		Freq	%	Freq	%	Freq	%	Freq	%
1	Residential	8	10	35	50	110	55	14	46.7
2	Commercial	5	6.3	5	7.1	25	12.5	2	6.7
3	Farming	2	2.5	2	2.9	4	2.0	0	0
4	Transportation	7	8.7	8	11.4	15	7.5	2	6.7
5	Industrial	28	35.0	4	5.7	5	2.5	7	23.3
6	Recreational	5	6.3	3	4.3	10	5.0	2	6.7
7	Administrative	15	18.7	5	7.1	18	9.0	2	6.7
8	Religions	10	12.5	8	11.4	13	6.5	1	3.3
	Total	80	100	70	100	200	100	30	100

Source: Researchers' Field Survey, 2022

4.2   Predominant Land use on the Reclaimed Wetlands

The data in table 4.2 revealed the predominant land use on the reclaimed wetlands in the study area. The analysis of data from the respondents have shown that in Site A (Eastern Bypass), the predominant land use is industrial 50% followed by administrative 22.5%; while in Site B (Borikiri Sandfield), the predominant Land use is residential 58.6% followed by transportation and administrative (11.4% and 10%) respectively. In Site C (Eagle Island), the predominant land use is residential 65% followed by commercial and administrative (12.5% and 10%) respectively; while in Site D (Ibeto), the predominant land use is residential 46.7% followed by

commercial and industrial having 16.7% each, while administrative and religious have 6.7% each. Here, there is indication of mixed land uses.

Table 4.2: Predominant Land use on the Reclaimed Wetlands

S/No.	Predominant Development Projects and Land Use	Reclaimed Site A Eastern Bypass		Reclaimed Site B Borikiri Sandfield		Reclaimed Site C Eagle Island		Reclaimed Site D Ibeto	
		Freq	%	Freq	%	Freq	%	Freq	%
1	Residential	5	6.3	41	58.6	130	65	14	46.7
2	Commercial	3	3.8	5	7.1	25	12.5	5	16.7
3	Farming	0	0	0	0	0	0	0	0
4	Transportation	5	6.3	8	11.4	12	6.0	2	6.7
5	Industrial	40	50	2	2.9	2	1.0	5	16.7
6	Recreational	2	2.5	2	2.9	3	1.5	0	0
7	Administrative	18	22.5	7	10	20	10	2	6.7
8	Religious	7	8.7	5	7.1	8	4.0	2	6.7
	Total	**80**	**100**	**70**	**100**	**200**	**100**	**30**	**100**

Source: Researchers' Field Survey, 2022

V.   Discussion of Findings

5.1   Development Projects in Terms of Landuse presently Sited on Converted Wetlands in the Study Area

In an attempt to know the different uses to which the converted wetlands have been put in to in terms of land use, data on different development projects presently sited on the converted wetlands in the study area was gathered and analysed and the data presented in table 4.1. From the analysis, it is discovered that in Site A (Eastern Bypass), the different development projects sited on the reclaimed wetlands are industrial, administrative, religious, residential, transportation, commercial, recreational and farming. In Site B (Borikiri Sandfield), the different development projects sited on the reclaimed wetlands are residential, transportation, religious, commercial, administrative, industrial, recreational, and farming. In Site C (Eagle Island), the different development projects sited on the reclaimed wetlands are residential, commercial, administrative, transportation, religious, recreational, industrial and farming. . In Site D (Ibeto), the different development projects sited on the reclaimed wetlands are residential, industrial, religious, commercial, administrative, transportation and recreational land uses. However, it should be noted that the different land uses identified in the different sampled locations as presented above differs in its dominance, hence some are mere components of the predominant existing land uses in the sampled reclaimed sites. This implies that there are predominant land uses on the sampled reclaimed sites although other components of uses exist. These different developments sited on the reclaimed sites are shown in the different plates below.

at Site A (Eastern Bypass)

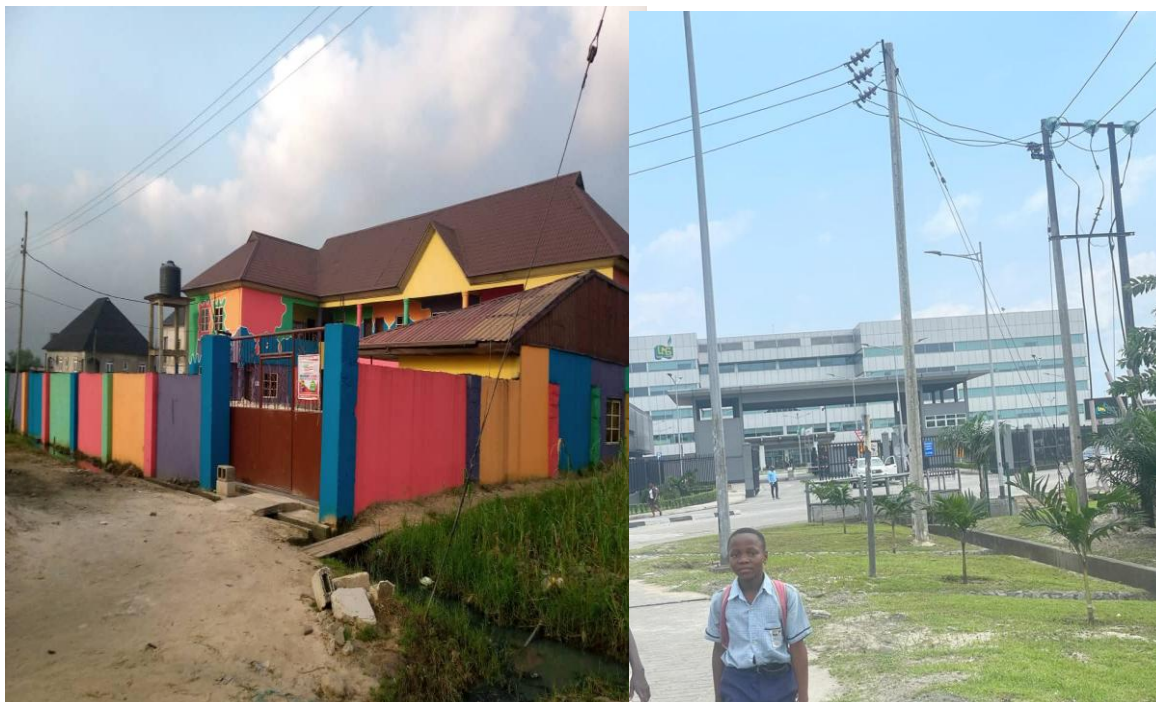Source: Researchers' Field Survey, 2022

Plate2: Residential and Administrative Buildings at Site A (Eastern Bypass)
Source: Researchers' Field Survey, 2022

5.3.1   Predominant Landuse on the Reclaimed Sampled Sites

Moreso, data on the predominant Landuse on each of the sampled reclaimed sites were also obtained and the results presented in table 4.2. The results obtained from the analysis revealed that in Site A (Eastern Bypass), the predominant land use is industrial having 50% of the sampled respondents of the study area; followed by administrative with 22.5%. In Site B (Borikiri Sand field), the predominant Landuse is residential having 58.6% of the sampled respondents. In Site C (Eagle Island), the predominant land use is residential having 65% of the respondents and in Site D (Ibeto), the predominant land use is residential having 46.7% of the respondents followed by commercial and industrial having 16.7% each. From the data presented and analysed in table 4.2, it is observed that although industrial land use is predominant in Site A (Eastern Bypass), there is a growing competing emerging administrative land use in the site. Notable among them are the Nigeria Natural Liquefied Gas NNLG administrative office, the Niger Delta Development Commission NDDC administrative office, etc. whereas in Site B (Borikiri Sandfield) and Site C (Eagle Island), it is discovered that the predominant land use is residential. Nevertheless, there are components of other land uses that are making these areas functional. The study has shown that the functionality of these areas is a reflection of the combination of existing different land uses that support the growth of the predominant land use. Also, the analysis as contained in table 4.2 have shown that in Site D (Ibeto), there are growing mixed land uses such as residential, commercial and industrial including administrative and religious land uses. This shows that the patterns or dimensions of land uses on each of the sampled reclaimed site differs from one another and are influenced by their major individual activities.

VI.   Conclusion and Recommendations.

6.1 Conclusion

Urban areas, because of its pull factors and characteristics keeps increasing in size demographically and structurally but the land space to accommodate these growth remain static and shrinking leading to the encroachment in wetland land areas. Encroaching in to wetland areas implies total depletion and removal of wetland to provide space for the ever increasing rate of urbanisation besieging the city.

This study has revealed the different types of development projects presently located on the different reclaimed sites in the study area. As noted by the study, the predominant land use in site A (Eastern Bypass) is industrial land use and a growing competing administrative land use; in site B (Borikiri Sand field), the predominant Landuse is residential with a growing competing commercial land use; In Site C (Eagle Island), the predominant land use is residential and in Site D (Ibeto), the predominant land use is residential with a growing commercial and industrial hubs. The study has shown that although different land uses exist on reclaimed sites in the study area, there are components of uses that has help the growth and sustenance of the predominant land use on the reclaimed sites as found in the area.

6.2Recommendations

The study therefore recommends as follows:

i.   That reclaimed wetlands in the study area be properly plan and the different development projects earmarked for such site be fully implemented. This should be done by the Rivers State government through the Ministry of Urban Development and Physical Planning.

ii.   Government should strictly enforce the land use control measures utilizing sub-division regulation, zoning ordinance, building and housing codes including site and service approach. These measures will help to guide growth and the development of different land use on reclaimed wetlands in the study area.

iii.   The policy of urban containment should be properly advocated and adhered to. This policy guides growth patterns and development in urban areas. This should be carried out by the development control unit of the Ministry of Urban Development and Physical Planning. The whole essence is to guide and direct growth patterns on reclaimed wetland areas.

iv.   There should be the review of the Port Harcourt City Master Plan to reflects the propose land use to be sited on reclaimed wetland where necessary.

v.   Development Control Department of the Ministry of Urban Development and Physical Planning should ensure that proposed land usesas spelled out in the Master Plan are strictly implemented.

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