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Research Paper

As-Built Assessment Mapping Of Eagle Island Layout, Port Harcourt, Nigeria: A Remote Sensing And Gis Techniques

EZE, PROMISE I. AND GODWILL, PEPPLE T.
Department of Surveying and Geomatics, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Nigeria

Abstract: *Eagle Island layout master plan was originally designed in 1979 by the Rivers State Government of Nigeria and was later reviewed in 1982 by the office of the Surveyor General, Rivers State to accommodate key interest. The layout was acquired and designed solely for residential purposes. The layout presently has been seriously encroached and tampered from its original designed by illegal occupiers, land buyers and developers which prompted the need for this study. The study tends to examine the extent of these encroachments, illegal acquisition and alteration of the layout from its original design. The study adopted the remote sensing and geospatial information techniques, the Eagle Island layout/master plan was overlaid on the geo-referenced and vectorized satellite imagery of the study area and land parcels as well as roads were digitized accordingly with the use simple spatial tools for line and polygon features. Ground truth data observed during reconnaissance survey assisted greatly in identifying areas that were heavily encroached and tampered. The research findings revealed a very high percentage of encroachments especially in Land parcels reserved for public uses, Land parcels reserved for markets, car parks and police station were encroached by 100% respectively, whereas Land parcels reserved for recreational centers, school buildings and neigbourhood car parks were encroached by 82.79%, 81.60% and 57.84% respectively. The study recommends immediate removal of all structures erected by illegal occupiers, land buyers, developers as well as restoration of the original design of the layout.*

Key words: *As-Built, Geospatial, Encroachments, Neighbourhood*

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I. Introduction

The term mapping in the context of surveying entails all process involves in determining and positioning of objects in space and representing such objects visually in a map which is the end product of mapping. A map is a visual and symbolic depiction emphasizing relationships between elements and features of some space, such as objects, regions, land use, land cover, etc. some maps are static, fixed to paper where as others are interactive and dynamic (NSSDA, 1998)

As-Built mapping is carried out to determine the conformity between what was designed and what is built. It shows continual improvement to the land as they appear at a particular point in time during and after construction. This type of mapping also helps to determined if the construction is following built-to-plan standards and weather there are deviations from it. As-built maps are needed to examine and record variations from original architectural or engineering plans with respect to what is actually built on site. Several communities, organizations and agencies needs this map for actual locations and visualizations of up-to date structures in their sites and layouts, this enables them to ascertain if what is built is according to what was designed. As-built maps can also assist the engineers to evaluate what was built and ensure that it was built into applicable tolerance. The accuracy of as-built location of structures is critical and will greatly assist the clients in the management of such site and structures (Masiri *et al*, 2020)

Geospatial Technology has application virtually every aspect of surveying and geomatics. GIS application in land information system is indispensible. A GIS merges conventional database management software with software for manipulating spatial data. This combination enables the simultaneous storage; retrieval, overlay, and display of many different spatially related data sets. These capabilities coupled with sophisticated GIS software to analyze and query data sets that result from different overlay and display combinations, provide answers to questions that never before were possible to obtain. As a result, GIS have become extremely important in planning, design, impact assessment, predictive modeling, and many other

applications. The successful implementation of GIS and LIS relies on people with backgrounds and skills in many different disciplines, but none are more important than the contributions of those engaged in surveying and geomatics (Ghilani and Wolf 2008). By taking the advantages of remote sensing and Geospatial Information System (GIS) technology, the fast development of society has been hastening the application of technologies especially in land information system (LIS) and technology in land administration.

Statement of the Problem

Eagle Island layout master plan was originally designed in 1979 by the Rivers State Government but was later reviewed in 1982 by the office of the Surveyor General. Rivers State to accommodate key interest. It was acquired and designed solely for residential purposes, prior to the acquisition by State Government; the area was covered by vegetation, farmland, mangroves, and wetland (daminabo, 2013). The layout presently cannot be said to be intact and free from alteration and encroachments, it has been characterized by encroachment and illegal acquisition and development by individual, government personnel, and the native with all the reserved areas for public use (Schools, Recreational area, Market and Police Station) all affected. This study tends to examine and assess the extent of this encroachment, illegal acquisition and alteration of the layout from its original design.

Study Area

The study area is a Rivers State Government covering part of Eagle Island, of Port Harcourt City Local Government Area, Rivers State of Nigeria. It is situated on projected coordinate of 528175.43mN & 275303.08mE – 529488.65mN, & 276709.19mE in (WGS-84) datum, (UTM) Zone 32N coordinate system. The layout covered a total area of 62.26 hectares consisting of 621 parcels of different parcel area (square meters) including parcels reserved for recreational and commercial purposes. It is bounded in the north by the Rivers State University, in the west by Diobu communities, east by the Nigerian Agip Company Limited, and in the south by Rivers and wetlands that provide sites for many companies.

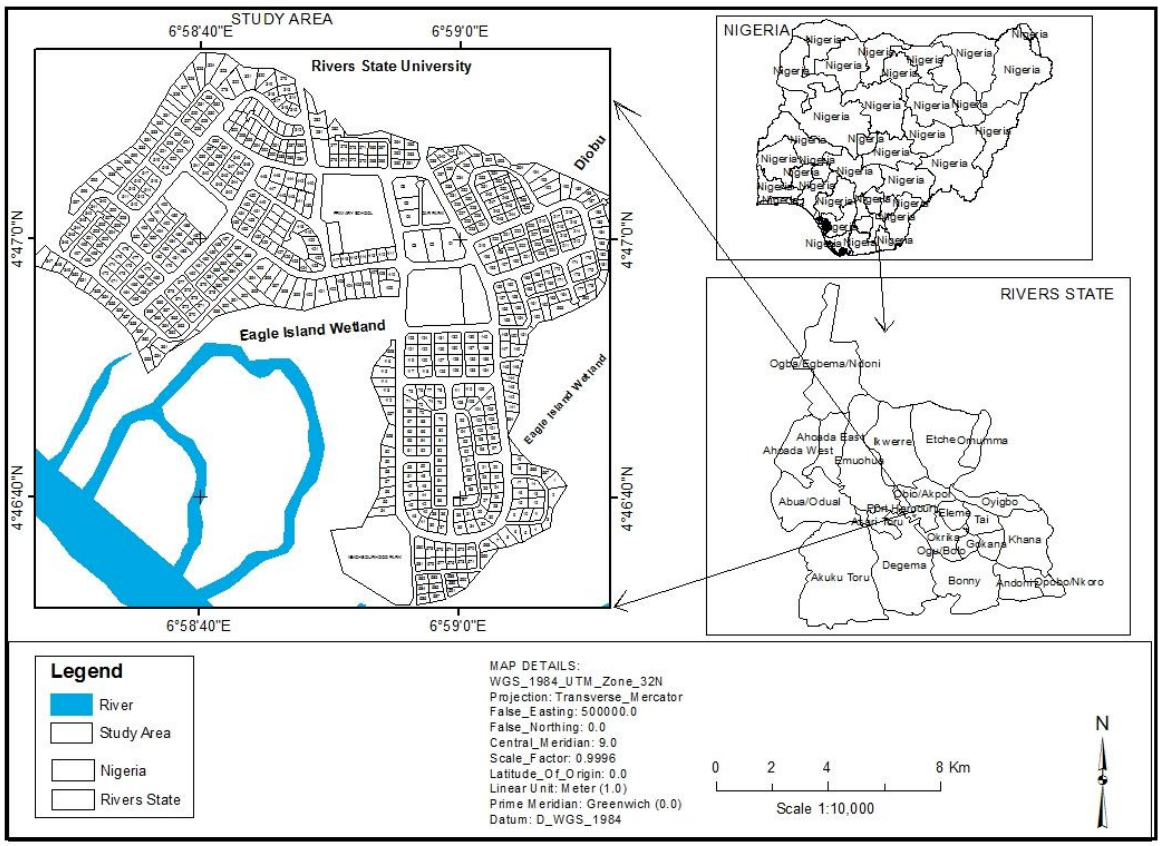

Figure 1.0. Study area map showing Eagle Island layout.

Aim of Study

The aim of the study is to carry out an As-built Mapping of Eagle Island layout using ground truth survey data and Remote sensing Techniques.

Objectives of the Study

i. Digitized land parcels and roads altered from the original design.
ii. To determine the geometrical characteristics of parcel reserved for public use
iii. To detect the change and percentage loss of land parcel reserved for public use.

Significant of study

i. The study will examine the extent of alteration of the layout from the original design.
ii. The research findings will assist the Government and relevant authorities to act and adopt the best way to revoke illegal title that has affected all reserved land parcels.

II. Materials and Methods

Dataset Used

The dataset used for the study are (i) Eagle Island layout master plan and 0.2m x 0.2m spatial resolution orthophoto aerial imagery of Rivers State which was collected at no cost from the office of the Surveyor General Rivers State (OSGRV). The layout master plan and image were collected in soft copy and they were referenced to WGS84, UTM Zone 32N coordinate system.

The study was carried out using a set of dell Laptop computer with processor Intel® Core (TMi3) Duo CPU P9700, 4.00GB RAM, and 64-bit operating system. The computer contained all the applications used in this work. The software used is ESRI's ArcGIS 10.3 vector based GIS software. ArcGIS was used to process the acquired satellite imagery, digitized parcels and road altered from the original design and to compile maps.

The choice of ArcGIS was based on the ability to support vector based analysis which is necessary to achieved study aim using stated objectives.

iii. Instrument used was Garmin 78Sc GPS receiver to collect primary data (coordinates) used for geo-referencing and geo-rectification of the satellite imagery of the study area.

III. Methodology

Remote sensing technique was adopted to achieve the aim of the study using stated objectives. This technique is a non-contact classical surveying method that is used to observe and measure the characteristics of objects on the earth surface from a distance without having contact with the scene; it is fast, reliable and cost effective. Ground truth survey data will be used to calibrate remotely sensed data during image processing. Remotely sensed data offers alternative and accurate measurements of objects characteristics on the earth surface and provides a more synoptic view of the remote terrain (Olaleye, 2017).

Research Methods

Reconnaissance: In the course of this research, the site was visited to examine the physical outlook and the state of the layout. This assisted greatly in planning, data acquisition and execution of this research work.

Primary Data Acquisitions: Ground truth survey was carried out; Ground coordinates of four identifiable points on aerial image were obtained with the use of Garmin 78sc GPS Receiver. The collection of ground-truth data will enable geo-referencing and calibration of remote sensing data, and aids in the interpretation and analysis of what is being sensed.

Geo-Referencing: The Othorphoto imagery were geo-referenced in World Geodetic System (WGS-84) datum, Universal Transverse Mercator (UTM) ZONE, 32N coordinate system to orient the satellite imagery based on its arbitrary state to correspond with the true ground positions, focusing its proper stages to correct the tilt in the relative co-ordinates on the map which is due to the altitude, motion, focal length and relief of the terrain (Eze & Richard, 2008).

Vectorization: vectorization in Geospatial Information System (GIS) is the process determining the position, horizontal distances and directions from one point, object to the other. Simple spatial tools such as polygon and line tools were used to delineate all land parcels and access roads in the layout, land parcel perimeter and size (area) were computed in meters simultaneously. The ARC-GIS vector based GIS software uses similar algorithms in plane surveying for computing horizontal distances and magnetic bearings between two points. In plane surveying, the horizontal distance between two points is a straight line, let us consider two points (X) and (Y) on the earth surface, in a straight line A(x,y) to B(x,y)

$B y - A y = \Delta y$ …3.1
$Bx - Ax = \Delta x$ …3.2
$\sqrt{(\Delta x + \Delta y)^2} = L$ …3.3
$\tan^{-1} (\Delta x / \Delta y) = \square$ …3.4
but; $L\cos\square = \Delta y$ …3.4
$L\sin\square = \Delta x$ …3.5

Where; x is the eastings coordinate of point A and B, y is the northings coordinate of point A and B, Δx is the change in easthings, Δy is the change in northing, L is the horizontal distance between point Aand B, □ is the magnetic bearing of line AB.

IV. Results and Discussion

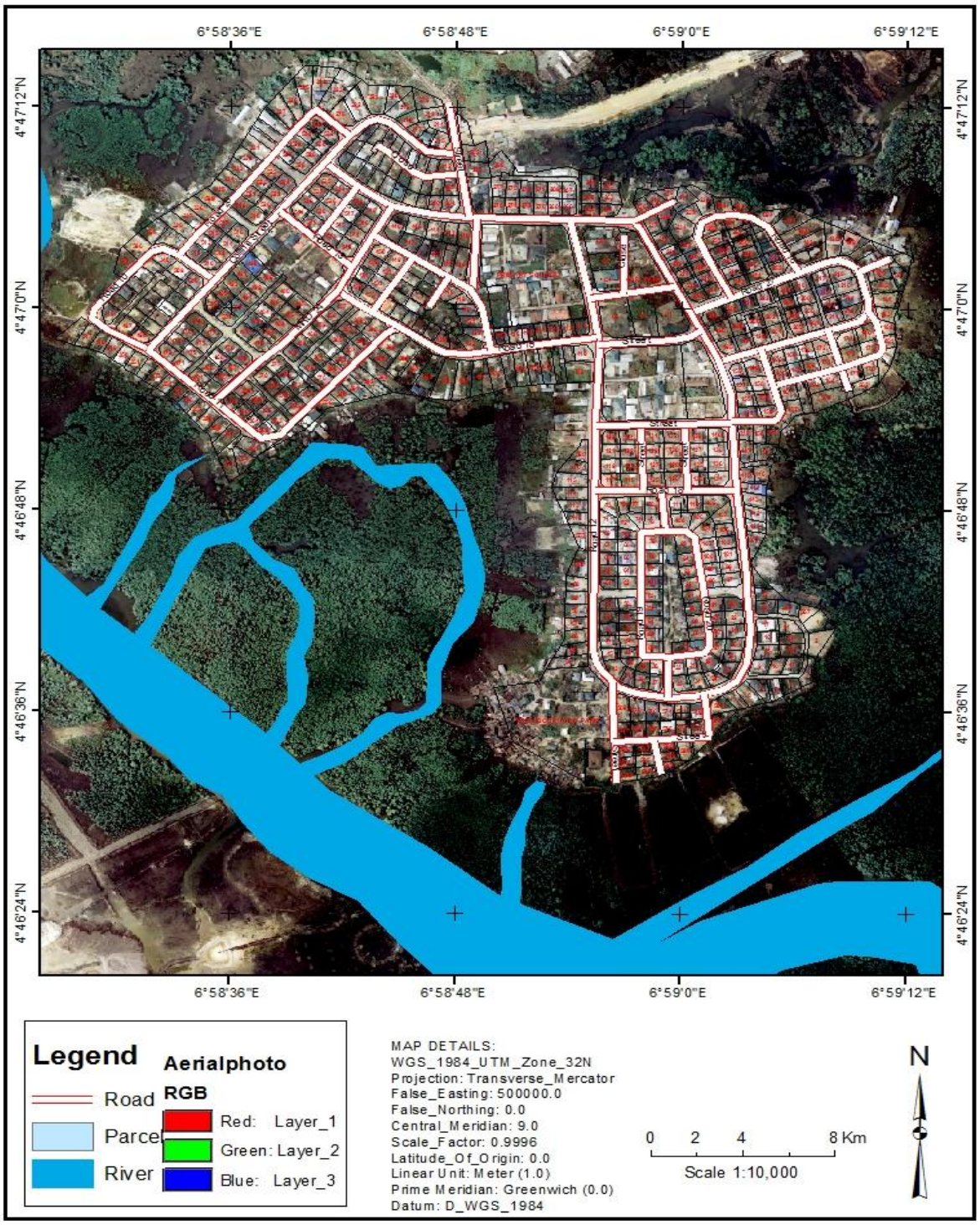

Figure 3.1: Overlay of Eagle island layout on aerial photograph.

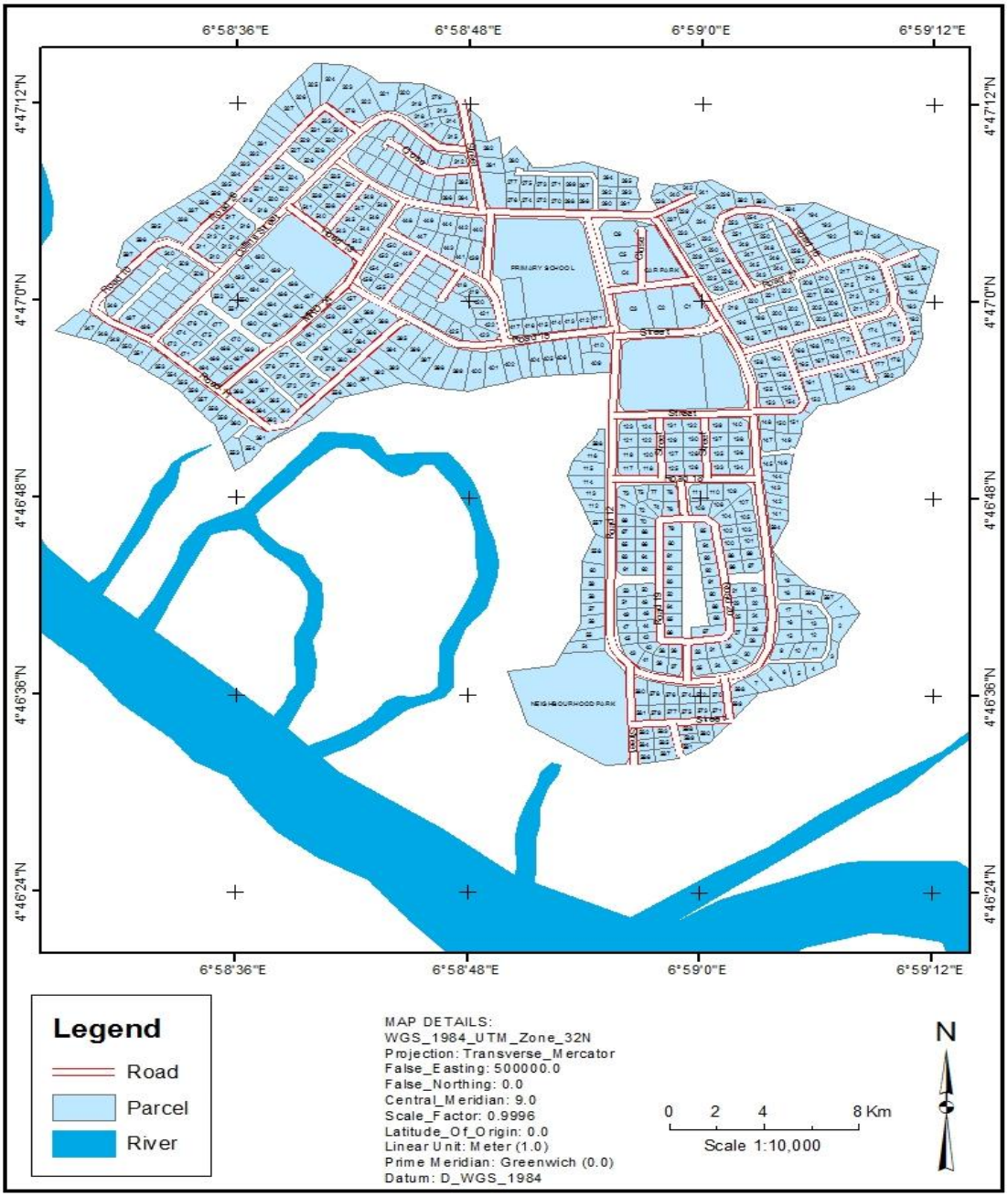

Figure 3.2: Eagle island layout master plan and the adjoining water body

Table 3.1: Spatial and Geometrical Characteristics of Land Parcel Reserved for Police Station

Point ID	Coordinates of parcel vertices		Perimeter of parcel(m)	Area of Parcel (sq.mtrs)	Remark
	Northings(m)	Eastings (m)			
P1	529172.08	275639.61	412.10m	9,288.94sq.mtrs	
P2	529216.40	275680.16			
P3	529126.76	275777.16			
P4	529108.51	275778.71			
P5	529066.91	275741.82			

Table 3.2: Spatial Geometrical Characteristics of Land Parcel Reserved for School building

Point ID	Coordinates of parcel vertices		Perimeter of parcel (m)	Area of Parcel (sq.mtrs)	Remark
	Northings(m)	Eastings (m)			
P1	529200.71	276038.64	603.56m	16,637.70sq.mtrs	
P2	529195.97	276140.68			
P3	529057.35	276167.16			
P4	529044.85	276046.31			

Table 3.3: Spatial and Geometrical Characteristics of Land Parcel Reserved for Recreational centers

Point ID	Coordinates of parcel vertices		Perimeter of parcel(m)	Area of Parcel(sq.mtrs)	Remark
	Northings(m)	Eastings (m)			
P1	529191.66	276158.11	652.86m	24,708.48sq.mtrs	
P2	529197.18	276246.86			
P3	529018.10	276343.57			
P4	529000.38	276336.18			
P5	528991.91	276199.16			

Table 3.4: Spatial and Geometrical Characteristics of Land Parcel Reserved for Central Car Park

Point ID	Coordinates of parcel vertices		Perimeter of parcel(m)	Area of Parcel (sq.mtrs)	Remark
	Northings(m)	Eastings (m)			
P1	528986.51	276320.27	398.81m	8,372.65sq.mtrs	
P2	528988.31	276357.18			
P3	528943.42	276383.16			
P4	528845.69	276389.69			
P5	528844.78	276326.39			

Table 3.5: Spatial and Geometrical Characteristics of Land Parcel Reserved for Central Market and Mall

Point ID	Coordinates of parcel vertices		Perimeter of parcel(m)	Area of Parcel (sq.mtrs)	Remark
	Northings(m)	Eastings (m)			
P1	528986.51	276320.27	554.44m	19,168.56	
P2	528844.78	276326.69			
P3	528840.73	276196.35			
P4	528977.42	276201.65			

Table 3.6: Spatial and Geometrical Characteristics of Land Parcel Reserved for Neighbourhood Car Park

Point ID	Coordinates of parcel vertices		Perimeter of parcel(m)	Area of Parcel (sq.mtrs)	Remark
	Northings(m)	Eastings (m)			
P1	528256.81	276129.08	340.72	7,730.35	
P2	528266.26	276147.85			
P3	528259.85	276216.26			
P4	528175.04	276221.95			
P5	528158.39	276201.10			
P6	528208.02	276125.68			

Table 3.7: Change Detections of Land Parcels Characteristics between 1979 and 2010

Parcel Reserved for	Parcel Area (sq.mtrs) in 1979	Parcel Area (sq.mtrs) in 2018	Change in Area(sq.mtrs)	% Lost
Police station	9,288.94	NIL	-9,288.94	100
School Building	16,637.70	3,061.32	-13,576.38	81.60
Recreational Centers	24,708.48	4,252.11	-20,456.37	82.79
Car park	8,372.65	NIL	-8,372.65	100
Market/Malls	19,168.56	NIL	-19,168.56	100
Neighbourhood Car Park	7,730.35	3,258.73	-4,471.62	57.84

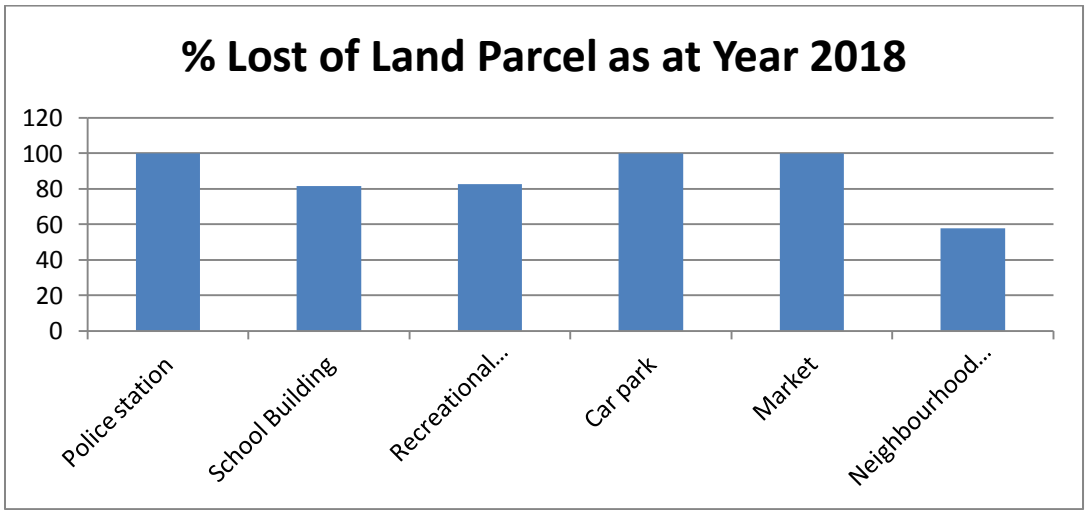

Figure 3.3: Statistical model showing percentage lost in land parcels reserved for public use

V. Results Discussions:

Figures 3.1 and 3.2 shows the overlay of eagle island layout on the vectorized satellite imagery of the study area as well as the vectorized master plan of the study area, Figure 3.2 shows the initial state (as-designed) of the layout with land parcels, (residential and commercial/public land), access roads and water bodies with all parcels and roads intact, whereas figure 3.1 shows the state of development in terms of built-up, adjoining vegetation, wetlands and water bodies, the image clearly shown massive encroachment by illegal occupants and land developers as land parcels reserved for public use have been encroached and tampered with in all directions. Table 4.1, to table 4.6 consists of the geometrical and spatial characteristics of land parcels reserved for public use with parcel reserved for police station is defined by four coordinates points with a perimeter and an area of 410.10m and 9,288.94sq.mtrs, school building defined by four coordinate points with a perimeter and an area of 603.56m and 16,637.70sq.mtrs, Recreational centers defined by five coordinate points with a perimeter and an area 652.86m and 24,708.48sq.mtrs, Car parks defined by five coordinate points with a perimeter of 398.81m as well as an area of 8,372.65sq.mtrs, also Land parcel reserved for the purpose of constructing a Central Market and Malls has for coordinate points with a perimeter of 554.44m and an area of 19,168.56sq.mtrs, whereas land parcel reserved for Neighbourhood Car parks is defined by six coordinate points with a perimeter 340.72m and an area of 7,730.35sq.mtrs respectively. It was also noted in course of this study that Land parcel reserved for the purpose of constructing a police station, car park and Central Market and Mall were 100% encroached and tampered by illegal occupants, land buyers and developers, whereas land parcels reserved for the purpose of constructing a School Building, Recreational centers, and Nieghbourhood car parks were also encroached by 81.60%, 82.79% and 57.84% respectively. The study also noted that some access roads an de-signed were tempered with some access roads now closed road. Reasons for these illegal encroachments on public land were not known but may be attributed to human's so much interest when it comes to land and total negligence of duty by authorities responsible for physical planning and urban development in Rivers State.

VI. Conclusion

Developing countries will have difficulty addressing many land encroachment issues facing them while at the same time maintaining a viable economy, if they do not manage effectively, their land resources and associated land related information. This demands that they engage professionals in the built environment sector whose trainings are basically on the acquisition of spatial data, design, planning, usage and management of land related resources. The research findings has clearly justify the important of this study with the ground truth survey data and remote sensing techniques well utilized to achieve the study aim and stated objectives. The rate of encroachments especially on land parcels reserved for constructing public buildings and car parks were very high. Immediate removal of all illegal structures on these reserved landed properties is recommended and relevant authorities for physical planning and urban development as well as professionals in the built environment sector should ensure that all necessary requirements, checks and precautions are considered before approval is given to private and public developers from building constructions.

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About the Authors:

Corresponding Author – Eze, promise I. email: ezepromise4christ@gmail.com

Eze, Promise Ikenda is a Research Scientist in Academics, He is presently a lecturer at the Department of Surveying and Geomatics, Faculty of Environmental Sciences, Rivers State University, Nigeria. He holds a Bachelor of Technology and Masters of Science in Surveying and Geomatics Degrees and His Research interest is in Surveying and Environmental Mapping, Remote Sensing, Land Administration, Photogrammetry and Numerical and Analytical Methods.

Godwill, Pepple T. is also a Research Scientist in Academics, He holds a Master of Science (M.Sc) Degree in Environmental Mapping and presently a Ph.D student. He presently lectures in the Department of Surveying ang Geomatics, Rivers State University, Port Harcourt, Nigeria. His research interest is in Surveying and Environmental Mapping, remote sensing and GIS, and Land information management.