GEOSPATIAL ASSESSMENT OF WETLAND LOSSES IN COASTAL URBAN UNIVERSITY CAMPUSES: THE CASE OF THE UNIVERSITY OF LAGOS, AKOKA CAMPUS, NIGERIA

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ABSTRACT

Wetlands are essential components of the ecosystem and play significant roles as habitats and are reservoirs of biodiversity. This paper was an attempt to inferentially study the degradation and devaluation of marshland in a rapidly developing coastal area like the University of Lagos, Akoka Campus. Object based classification of high-resolution imagery and aerial photography of the Akoka area was used to determine the degradation and of the marshland and wetland in the study between 1983 and 2015. The result showed a significant change in the natural marshland from the 1980's till date in response to the extensive alterations of the campus landscape to meet with the rapid population increase. The result is the degradation of marshland which serves as habitat to numerous organisms that are vital to the ecosystem of the area. The study recommends the preservation of the marshland habitat by the promulgation and implementation of legislation and policies that allows for protection of selected wetland area against urbanisation.

Keywords: Geospatial methods, University Campus, Wetland changes, Nigeria

INTRODUCTION

Wetland is perhaps the most essential ecosystem on the planet providing a variety of ecosystem services vital to the planet in general and humans assistance in particular (Mitsch *et al.*, 2015; Adekola & Mitchell, 2011). They serve as the habitat and reservoir of biodiversity. This is however the least of the benefits and importance of wetland to the planet Earth. Wetlands are sometimes referred to as the *kidneys of the landscape* as they function as the downstream receivers of anthropogenic and natures water and waste (Mitsch & Gosselink, 2015). In addition to these, wetlands are essential to both the surface and groundwater resources (Olusola *et al.*,2016); carbon sequestration and coastal protection (Li *et al.* 2017). In all, wetland provides numerous economic, social and ecological benefits that are invaluable and unquantifiable (Ekebuike & Igbokwe, 2013).

Literature is abound with numerous and contradictory definitions of wetland, but for the purpose of this paper, wetland is defined as areas of marsh, fens, 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 (Ramsar, 2004). They are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetland generally include swamps, marshes, bogs and similar areas (USACE, 1987).

Wetland is estimated to cover between 5-10% of the Earth's terrestrial landscape, occupying about 12.8 km^2 (Adekola & Mitchell, 2011). Over the years, the global wetland has continued to decline at an alarming rate majorly due to anthropogenic activities of steady degradation of this unique ecosystem (Olusola *et al.,* 2016). Although there is no reliable records on quantification of these loss, however over half of the global wetland area has been lost due to anthropogenic activities (hydrological alteration, urbanisation, agriculture, lumbering, mining, industrialization) in North America, Europe and Australia (Millennium Ecosystem Assessment, 2005).

Some studies on wetland database and change have been done using the remote sensing and GIS technique because of the ability for wetland identification, classification, change detection and biomass identification (Rundquist *et al.*, 2001; Guo *et.al*, 2017; Kumar *et al*, 2013). The multi-dated nature of remotely sensed images allows for monitoring the dynamic features of landscape environments and thus provides a medium for detecting major landcover changes and quantification of the observed rate of change (Kumar *et al.*, 2013)

The Convention on Wetland (Ramsar Convention; an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and sustainable use of wetlands and their resources) is the oldest multilateral international conservation convention and the only one dealing with wetlands and has resulted in the protection of over 200 million ha of wetland globally covering over 2,000 sites, 11 of which are in Nigeria.

There is general lack of information on wetland in Nigeria and most African countries which thus inhibit the management and use of the wetland resources as well as the promulgation of policies and regulations that would ensure her

sustainable use. This notwithstanding, Nigeria is endowed with both freshwater and coastal saline wetlands, covering about 14 wetland belts across the country They include the Sokoto-Rima, Komadugu Yobe, Lake Chad, Upper Niger Lake, Kainji Lake, Middle Niger (Lokoja wetlands, Jebba wetlands), Lower Kaduna wetlands, Lower Benue (Makurdi Wetlands), trans boundary wetlands of the Upper Benue and the Cross River. Others are the Lower Niger, Niger Delta, Benin (Owena River and the Okomu River), Lower Ogun River, Yewa Creeks, Badagry Creeks, Ologe Lagoon Lekki Peninsula and the Lagos Lagoon (Olalekan *et al.,* 2014).

The wetland in Nigeria is inhabited by about 8,000 plant species and over 22,000 vertebrates and invertebrate's species (20,000 insects, 1,000 birds, I,000 fishes, 247 mammals and about 120 reptiles) including about 1,500 species of micro-organisms (Izah, 2018). Most of which are under threat of being drained and reclaimed to meet the rapid and continuous increase in population and humans need for housing, food and sustenance. The lack of political will as well as disregards to laws and regulations governing wetland management in Nigeria has further worsen the state of the wetland resources in the country. This paper focuses on the wetland loss in a coastal university like the University of Lagos, Akoka, Lagos as an inferential study of the degradation and devaluation of wetland ecosystem across Nigeria's coastal region.

THE STUDY AREA

The University of Lagos (UNILAG), Akoka Lagos Nigeria located in Yaba Local Government Area, one of the densely populated area in Lagos and perhaps in Nigeria. The University of Lagos, Akoka is located between Latitudes $6^{o}31'30"$ and $6^{o}30'10"$ North and Longitudes $3^{o}23'0"$ and $3^{o}24'30"$ East (Fig. 1). The campus is dominated by marshland composed of mangrove and freshwater swamps (Ayolabi, 2004). The Lagos Lagoon is a major feature of the campus which stretches from South through to the East of the campus (Aina & Oshunrinade, 2016). The entire western part of the campus is bounded by a canal while the Northern is bounded by marshland with an opening to the Lagos Lagoon (Oyedele & Momoh, 2009).

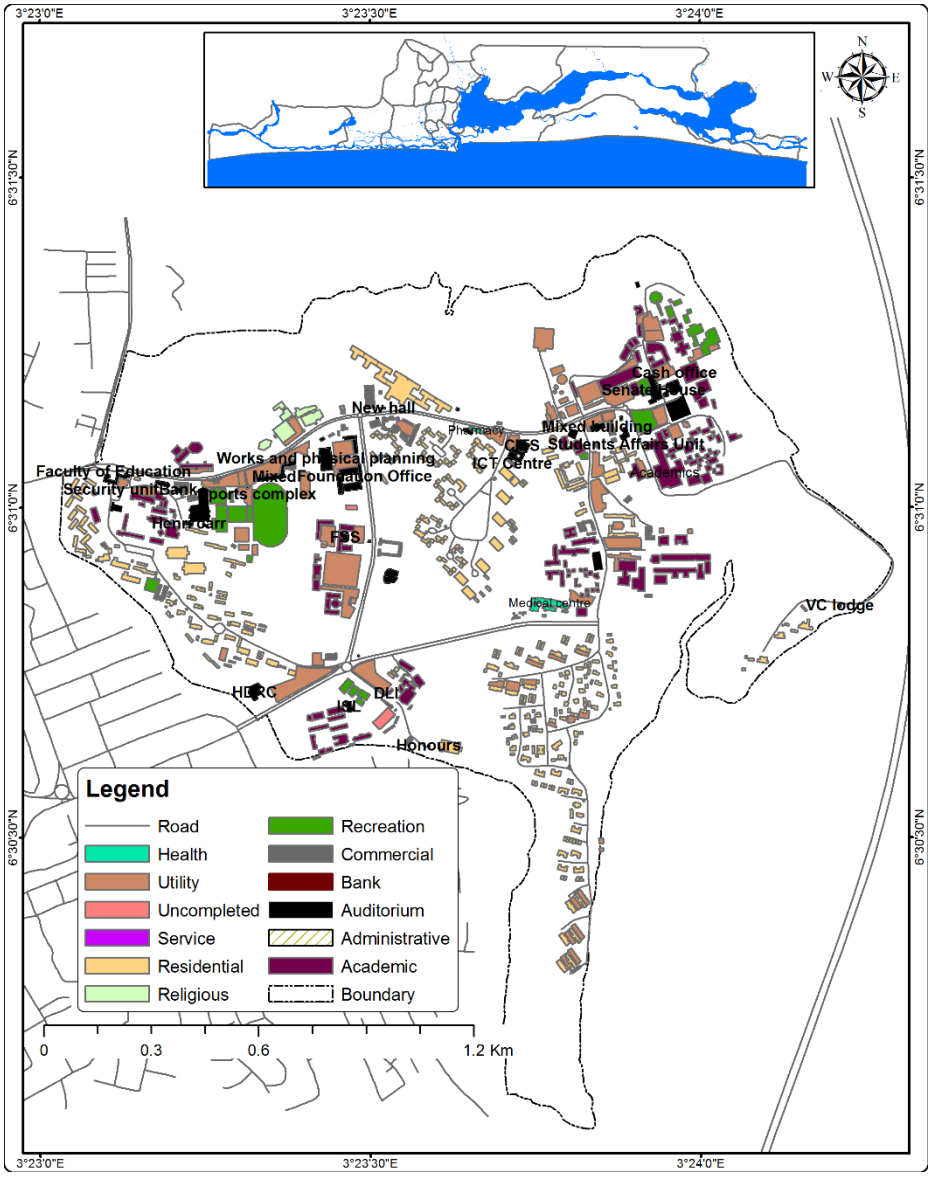

Figure 1: University of Lagos, Akoka Campus

METHODS

The geospatial analysis of the wetland loss in a coastal university campus like the University of Lagos was developed through analysis of three (3) ranges of high-resolution satellite and aerial photograph imagery sourced from numerous vendors (Figure 2). As also shown in Table 1, aerial photographs taken in 1983, high resolution satellite imagery for 2000, and 2017 high resolution drone

imagery of the study area all sourced from the Laboratory for Remote Sensing and GIS (LRSGIS) Department of Geography, UNILAG was used for static landuse/landcover (LULC) detection and mapping for 1983, 2000 and 2017 respectively.

The interactive Remote Sensing and GIS techniques was preferred for this study not just because remote sensing is a major source of spatial information about the Earth surface's cover and constitution but majorly because of the high cost, temporal and topographic limitations of traditional methods (like field surveys, literature reviews, collateral and ancillary data analysis etc.) (Xie *et al.*, 2008). Aerial photography is a very essential source of wetland identification and mapping through visual interpretation but because of the complexity of wetland ecosystems, plant species identification could be cumbersome but still attainable (Guo *et al.*, 2017).

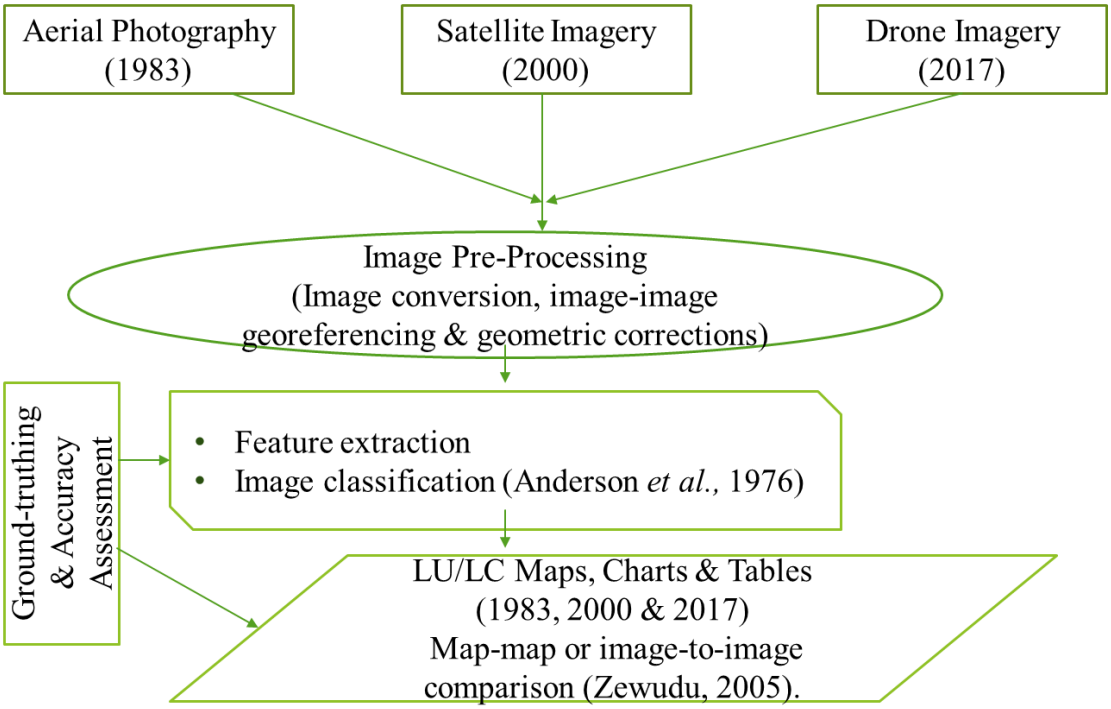

Figure 2: Methodology flow chart

Table 1: Source and characteristics of data

Data	Year of acquisition	Bands/ Colour	Resolution	Source
Aerial Photograph	1983	P	10 m	Federal Surveys (Office of the Surveyor General of the Federation), Lagos Office
Satellite Imagery	2000	XS	1m	Laboratory for Remote Sensing and GIS (LRSGIS), Dept of Geography, UNILAG
Drone Imagery	2017	XS	50 cm	LRSGIS, Dept of Geography, UNILAG
UNILAG map	2019	Digital		LRSGIS, Dept of Geography, UNILAG

The study adopted three (3) LU/LC classes modified from United States Government Survey (USGS) Classification Scheme to delineate the study into Built-Up, Lawn and Wetlands, using the object-based classification technique within an ArcGIS environment to map out the classes within the University of Lagos, Akoka. Of the numerious techniques of LU/LC change detection, the post classification comparative analysis of independent product classifications from different time periods were adopted, this allows for map-map or image-to-image comparison (Zewudu, 2005).

Area analysis technique was adopted to determine the LU/LC changes for the study for the three (3) epochs and are further plotted into percentages and annual rates of change. The LU/LC matrix table was used to express the changes witnessed in for each class and to depict the change of one class over the others.

RESULTS AND DISCUSSION

The static characteristics of the LU/LC generated from remotely sensed imageries for 1983, 2000 and 2017 shows an area extent of about 250 ha. Three dominant classes were identified including Built-Up Areas, Lawns/Parks and Wetlands. The magnitude and direction are shown in Figure 3 with emphasis on the extent of the built-up and wetland areas. They show steady increases in the Built-up area from 1983 to 2000 and declines in the others.

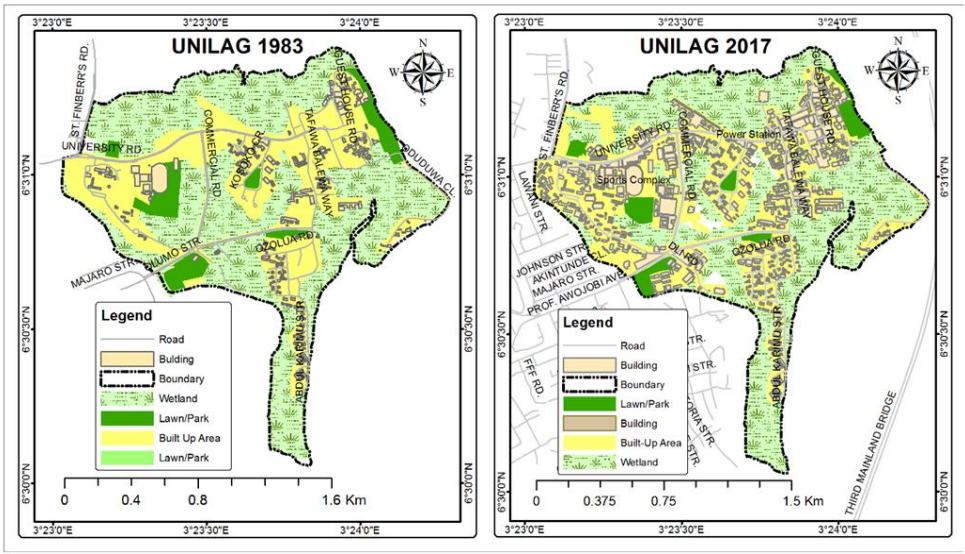

Figure 3: LU/LC of UNILAG

The wetlands declined from 135 ha (54%) in 1983 to 127 ha Km^2 2000, while the built-up area increased from slightly below 100 ha in 1983 to 111 ha in 2000 (Table 2 and Figure 4). The changes are mostly attributed to the development around the International school/ second gate axis, adjacent the Dan Fodio Boulevard, behind the Power Station and Faculty of Arts block. By 2017, the built-up area has increased to over 121 ha (50%) of the total land mass of the campus. With the 5% coverage by lawns and parks, the campus wetlands shrunk to 109 ha (45%) with a net reduction by 26 ha. This is about 12% of the total campus land mass.

The changes were driven by the encroachments and construction around the present day Faculty of Social Science, the DLI complex, UBA Park and Behind the Faculty of Environmental Science, behind the faculty of Science, Engineering, the power station, beside the UNILAG Guest House as well as the small scale farming in and around the residential blocks at the Kosoko Drive.

Table 2: Areal extent of the LU/LC of the University Campus (1983, 2000 and 2017)

	1983		**2000**		**2017**	
LU/LC Class	ha	%	ha	%	ha	%
Built-Up	98	39	111	44	124	50
Lawn/Parks	16	6	15	6	14	5
Marsh	136	54	12	50	111	45
Total	250	100	250	100	250	100

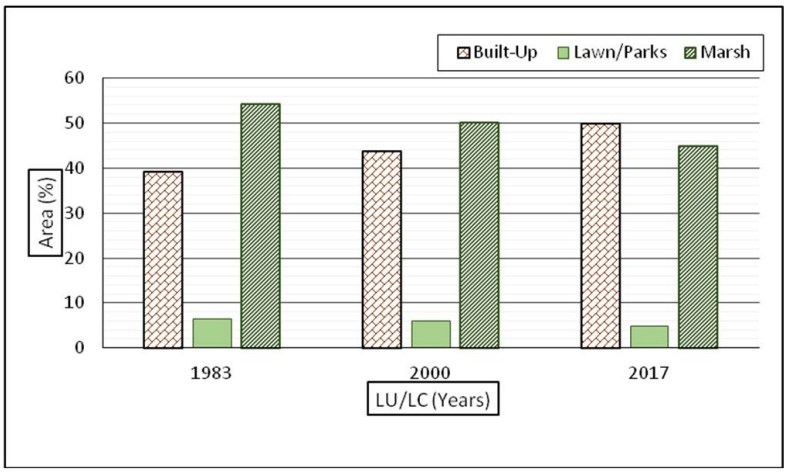

Figure 4: LU/LC of UNILAG

Table 3: Area extent of the Net LU/LC change (in Ha)

LU/LC Class	**1983-2000**	**2000-2017**	**1983-2017**
Built-Up	12.99	9.94	22.93
Lawn/Parks	-1.51	-2.92	-4.43
Marsh	-7.40	-18.41	-25.80

Other than the loss of the marshland, the consequence of these findings are numerous, including the increase in extent of imperviousness, thus reducing the water infiltration capacity of the area, increasing the heat retention capacity of the area (causing an unnatural increase in local temperature) as well as the loss in bio-diversity that are essential in maintaining the ecological balance of the area. The significant wetland loss would greatly impact the carbon sequestration capacity of the area as studies have shown that wetland ecosystems sequesters 20 times more carbon than forest ecosystems (Li *et al.*, 2018). In addition, the wetland degradation in a typical coastal locality of the University of Lagos and the state would allow for vulnerability to sea level rise and attendant impacts because the wetland vegetation is a natural barrier to ocean currents and landward flooding of the lagoon (*ibid*).

CONCLUSION

The study showed a consistent encroachment of the marshland within the campus boarders by anthropogenic activities, confirming that man remain the dominant threat to wetland ecosystem on the University of Lagos Campus in particular and Lagos state in general. Construction activities which are related to the population increase of students and staffs of the university resulting in the reclamation of land for the building of classes, and dwellings, including the disposal of waste material into the marshland around dwellings and hostels are the major contributing threats to the Marshland. The fact that a reputable higher institution of learning like the University of Lagos, inhabited by highly educated and qualified members have continually degraded the marshland within the campus with little interest in sustaining the marshlands shows the dire situation of wetland across the country where the wetland resources are often exploited with little consideration to sustainability. The study thus encourages the conservation of the wetland ecosystem within the campus, through modern wetland ecosystem management techniques. It emphasizes vertical development of the campus in favour of the horizontal development favoured at the moment and. This would ensure the sustainability of diminishing and invaluable wetland resources.

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