Spatio-temporal Analysis of Wetland Ecology of Ijebu-ode, Southwest Nigeria

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Abstract

Wetlands are critical habitats providing fish and other wildlife resources in support of the country's economy. In the context of climate change, it is feared that these ecosystems are faced with enormous threat from possible impacts of anthropogenic activities that may result in widespread loss of these habitats. Land use changes around wetlands increase the impacts of climate change on these ecosystems and may be disastrous for the welfare of wetland communities due to its potential impacts on property, water and food security. Remotely sensed imageries obtained from National Space Research and Development Agency (NASRDA), Abuja was used for this study. The first is a SPOT-MS of 1984, while the second is also a SPOT-MS of 2007, thereby covering 23 years. The method of supervised classification was adopted for the classification of land-use within the area. Thereafter, ground-truthing exercise was carried out to verify and ensure that the land use was appropriately classified. The projection used for the image registration and final map production was Universal Transverse Marcator (UTM), zone 31.

The paper observed that the wetland in Ijebu ode had witnessed tremendous change due to infilling of wetland, loss of biodiversity, alien invasion and pollution of wetland areas. Thus, it was posited that in order to enjoy the ecological services performed by wetlands, impact of anthropogenic activities should be managed sustainably.

Keywords: wetlands, land use changes, wetland sustainability, Remote sensed imageries, land use classification

Introduction

Wetland, a collective term used to describe land where excess of water dominates, is essentially designed by nature to catch, clean and preserve any unused surface water. Wetland are characterized as having a water table that stand at or near the land surface for a long enough season each year to support aquatic points (Ramsar Convention, 2010). It also is an area of land whose soil is saturated with moisture, either permanently or seasonally, with

heavy growth of aquatic or semi – aquatic plant and relatively thick organic deposits. Such areas may also be covered partially or completely by shallow pools of water.

Locally, they may form anywhere drainage is impeded – in quarries, grave puts and along highway and railroads. Wetland soils are among the most maligned soil in the world because they are too wet for agriculture, too unstable for buildings and are often associated with pest and diseases. The traditional response is to drain and fill them. Inland, most wetlands are fresh. However, wetlands with brackish or of intermediate salinity from the mixing of fresh water and salt water can be found close to coast. Wetlands are among the richest biological habitats on earth (Costanza et al., 1997) and are the most biologically diverse of all ecosystems. Ecosystem is a fragile, highly organized and structured environment in which all part exists in a delicate balance.

Wetlands contain numerous goods and services that have economic value, not only for the local people, but also to people living outside the periphery of the wetland. They are important sources of water and mittens' necessary for biological productivity and often sheer survival of people. Wetland also reduces storm damage by adsorbing waves, it slows down floodwater and permit nutrient rich particle to settle out. In addition, wetlands can act as reservoir and release water slowly into lake, streams or aquifers, thereby preventing floods (Enger and Smith, 2002). Human and physical factors have shaped the ecosystem and have contributed to increased pressure on the environment in recent years as a result of expansion of urban areas which has lead to residential construction, sand filling and wetland farming (flood plain Agriculture). In return, this has led to loss of habitats by organisms, modification of the local hydrology, invasive species encroachment, salt water intrusion and water quantity and quality reduction.

There exists significant evidence that ecosystems around the world are declining in terms of the species that live in them and the services that they provide for humans (Daily, 1997; World Resources Institute, 2002) and experts have therefore concluded that within a few decades, virtually all of the world's ecosystems will have suffered significant negative impacts from human activities. There are immediate causes of this trend, but underlying these causes is the fact that humans give a relatively low value to ecosystems compared with the value given to activities that potentially degrade them. Many economists and ecologists argue that this lack of clarity about human dependence on the environment is a major force underpinning environmental decline (Pearce and Moran, 1994). It also limits public support for better environmental management. For example, experts can agree that ecosystem of all sorts around the world are in poor and declining condition with respect to the purification and delivery of water (World Resources Institute, 2002), but the majority of people do not understand what this means for them in their day-to-day decisions and thus, ecosystems continue to be given low value in economic decision and there is limited political will to address the issues.

People seek multiple and different services from ecosystem and thus perceive the condition of an ecosystem in relation to its ability to provide the services desired. The ability of ecosystems to deliver particular services can be assessed separately with various method and measures. An adequate assessment of the condition of ecosystems, the provision of services, and their

implications for human being well-being require an integrated approach. With such an assessment in hand, a decision process can then determine which set of services are valued most highly and can manage the system in a sustainable way.

In a narrow sense, the sustainability of the production of a particular ecosystem services can refer simply to whether the biological potential of the ecosystem to sustain the yield of that services (such as food production) is being maintained. Thus, a fish provision services is not degraded by human activities. More generally, however, sustainability is used in the context of "sustainable development" to refer to a pattern of development that meets current needs without diminishing prospects for future generations. Sustainability and sustainable management refer to this goal of ensuring that a wide range of services from particular ecosystem is sustained. Therefore, information about the condition and sustainability of each category of ecosystem services is of great importance. This study is designed to provide information about the state of wetlands in metropolitan Ijebu Ode. Lambin *et al*, (2003) has reported the need to understand land-use/cover changes and its effect on the overall ecosystems. Understanding local patterns and processes is important since land-use and ecosystem change is closely linked to the sustainability of socio-economic development (Lambin *et al*. 2003). There is increasing evidence that variables interacts across spatial and temporal scales to cause changes and result in varied clusters, which vary across regions and time and that areas affected by degradation can be identified and mapped in order to cope with the variability. There is then the need to understand the past and present pattern of land-use/cover so as to device appropriate adaptive mechanisms for enhanced sustainability. Therefore, this study seeks to assess the extent and trend of wetland ecosystem in Ijebu Ode.

Study Area

The study was conducted in Ijebu-Ode Local Government Area (LGA) of Ogun State. In actual sense, the study area falls within two LGAs in the State; Ijebu Ode and Odogbolu Local Government Areas. The wetland area is really the boundary that separated the two LGAs, but because of the nature of urban development in the area, the entire place is still classified as Ijebu Ode. The area can be located between latitudes 6^0 47'N and 6^0 52'N and between longitudes 3^0 53'E and 3^0 59'E (Figures 1 and2). Ijebu-Ode is an ancient city, which is centrally located in relation to other human settlements around it.

Geologically, southwestern Nigeria rests wholly on basement complex structure of old crystalline rock which in turn is overlaid by deeply weathered sedimentary rock units that include Abeokuta, Ewekoro and Ilaro Formations, in addition to the Coastal Plain Sands. Occurring in different parts of the study area are the Basement Complex rocks, Abeokuta and Ilaro Formations, as well as the Coastal Plan Sands.

Generally, Ijebu-Ode's climatic condition is of alternate wet (April to October) and dry seasons from (November to March). The mean annual rainfall is between 1523 mm and 2340 mm, while the temperature ranges between 25^0C and 32^0C with the average annual temperature of about 27^0C.

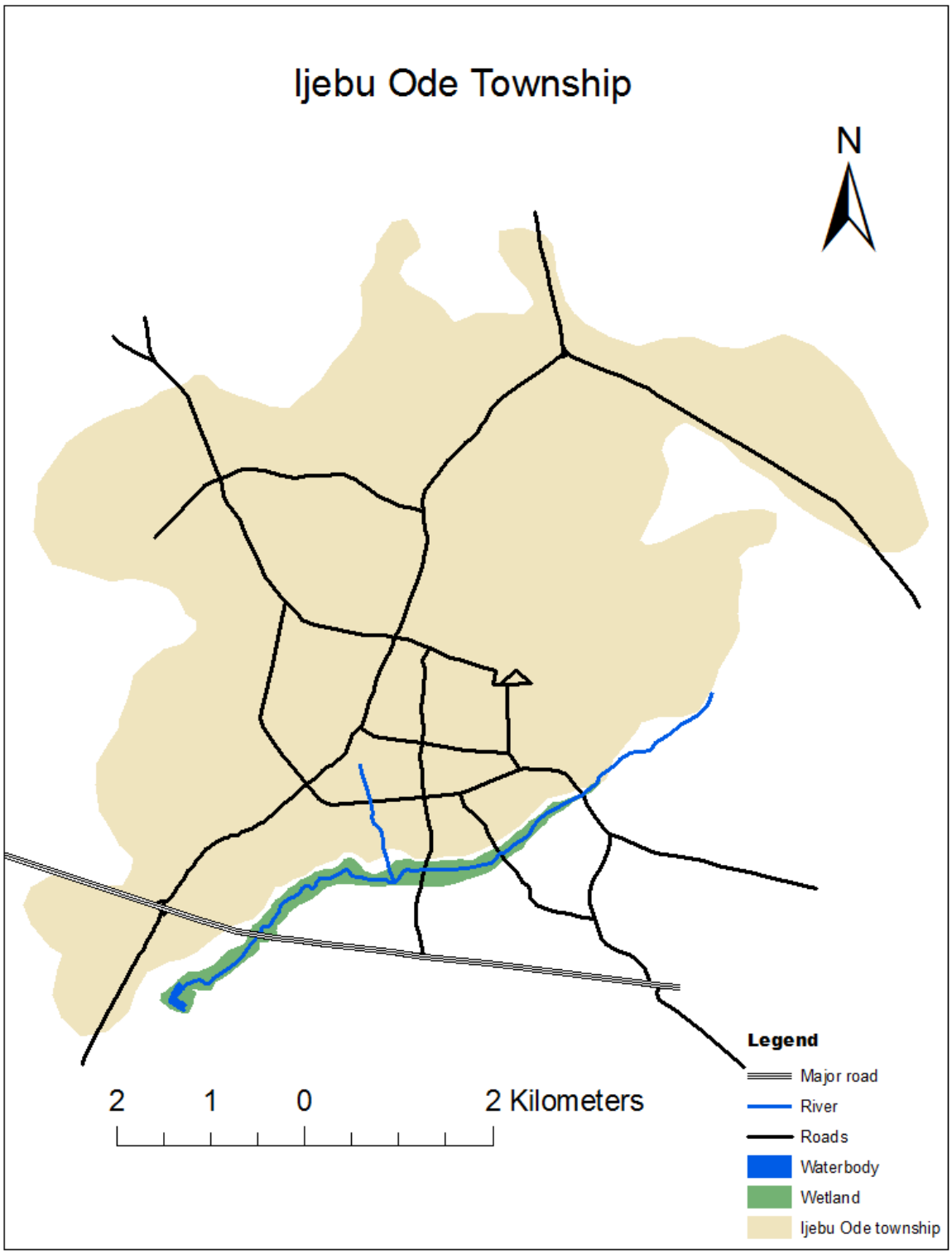

Fig. 1: Map of Ijebu-ode township

The alternate season of wet and dry is responsible for fluctuation in the volume of surface water bodies, such as rivers and streams in Ijebu-Ode (Ogunnowo, 2004). Ijebu-Ode region is well drained by some rivulets/streams that are historically connected to the founders of Ijebu Kingdom. The rivers include Osun, Yemoji, Okanmiayan, Aye, Atikiriji, Ona while the streams include Yemule, Owa and Eriwe.

Research Method

Data Source

Two remotely sensed imageries were obtained for this study. The first is a SPOT-MS of 1984 while the second is also a SPOT- MS of 2007. Accordingly, the study period covered about 23 years. The two imageries were obtained from the National Space Research and Development Agency (NASRDA), Abuja. The imageries were trained accordingly while the method of supervised classification was adopted for the classification of land-use within the area. Thereafter, groundtruthing exercise was carried out to verify and ensure that the land-use was appropriately classified. The projection used for the image registration and final map production was Universal Transverse Marcator (UTM), zone 31.

Table 1: Land use classification scheme

Code	Land use classification
1	Wetland
2	Built-up area
3	riparian forest
4	Water body

Method of Data Analysis

Two methods of data analysis were adopted in this study.

(i) Calculation of the land-use area in kilometers for each study year and subsequently comparing the results.

(ii) Overlay Operations

The two methods mentioned above were used for identifying change in the land-use types with time. The comparison of the land-use land cover statistics assisted in identifying the percentage change, trend and rate of change between 1984 and 2007. In achieving this, the first task was to develop a table showing the area in kilometres and the percentage change for each year (1984 and 2007) measured against each land-use land cover type. Percentage change to determine the trend of change can then be calculated by dividing observed change by sum of changes multiplied by 100. Furthermore, a Markovian chain analysis was used to describe land-use change from one period to another, and this was used as the basis to project future changes. Finally, an overlay operation was carried out which was presented in map format. Overlay operation shows the area where changes have occurred over time. In other words, the vector extracted from 1984 imagery was superimposed on that of 2007, and by so doing the

areas of change were clearly identifiable pictorially while the statics obtained were subsequently used for the computation. The rate of change obtained was thereafter used to project the change in wetland area that is likely to occur by year 2020. Also during the groundtruthing and field observations, certain biological species that are peculiar to wetland environments were identified. The areas/communities under the influence of this wetland include Oke-Owa, Imoru, Ondo and Ijagun road axis. These areas constitute a major landscape or basin that drains major rivers that dissect Ijebu-Ode Township.

Results and Discussion

Using Geographical Information System (GIS), remote sensing and habitat assessment techniques, Figure 2 depicts the state of wetland in Ijebu Ode between year 1985 and 2007 and based on this, the following inferences are discussed.

Ecological Dimension of Wetland Uses in Urban Ijebu-Ode

Due to socio – economic and environment purposes, Ijebu-Ode urban wetland is being put to different use. The habitat assessment and ground truthing techniques revealed the havoc that has been done on urban wetland of Ijebu Ode. Figure 2 reveal changes that have occurred on the wetland between year 1985 ad 2007. While there was an observed expansion of the cities of Ijebu ode, the wetland which was tailed toward the eastern part of the city in 1985 was experiencing sand filling as at 2007, showing great anthropogenic impact. While the area covered by wetland in the year 2007 was 1.04 km^2 with a perimeter of 11.56 km, in 1985 the perimeter was 17.4 km and the wetland covered area was 1.38 km^2. About 0.34 km of the wetland area has been lost to different uses such as construction between the year 1985 and 2007. Within the 22yrs, it means that the wetland is reducing at the rate of 1.5% (0.02 km) per year. What that implies is that by now (2011), it would have been depleted to about 0.39 km. This shows that the wetland is being used by people thereby preventing the continuous natural enjoyment of the natural services played by it. Thus, the uses of wetland for cultivation, settlement and infrastructural development, solid waste disposal as well as fishing have had ecological consequences on the sustainable functioning of wetland.

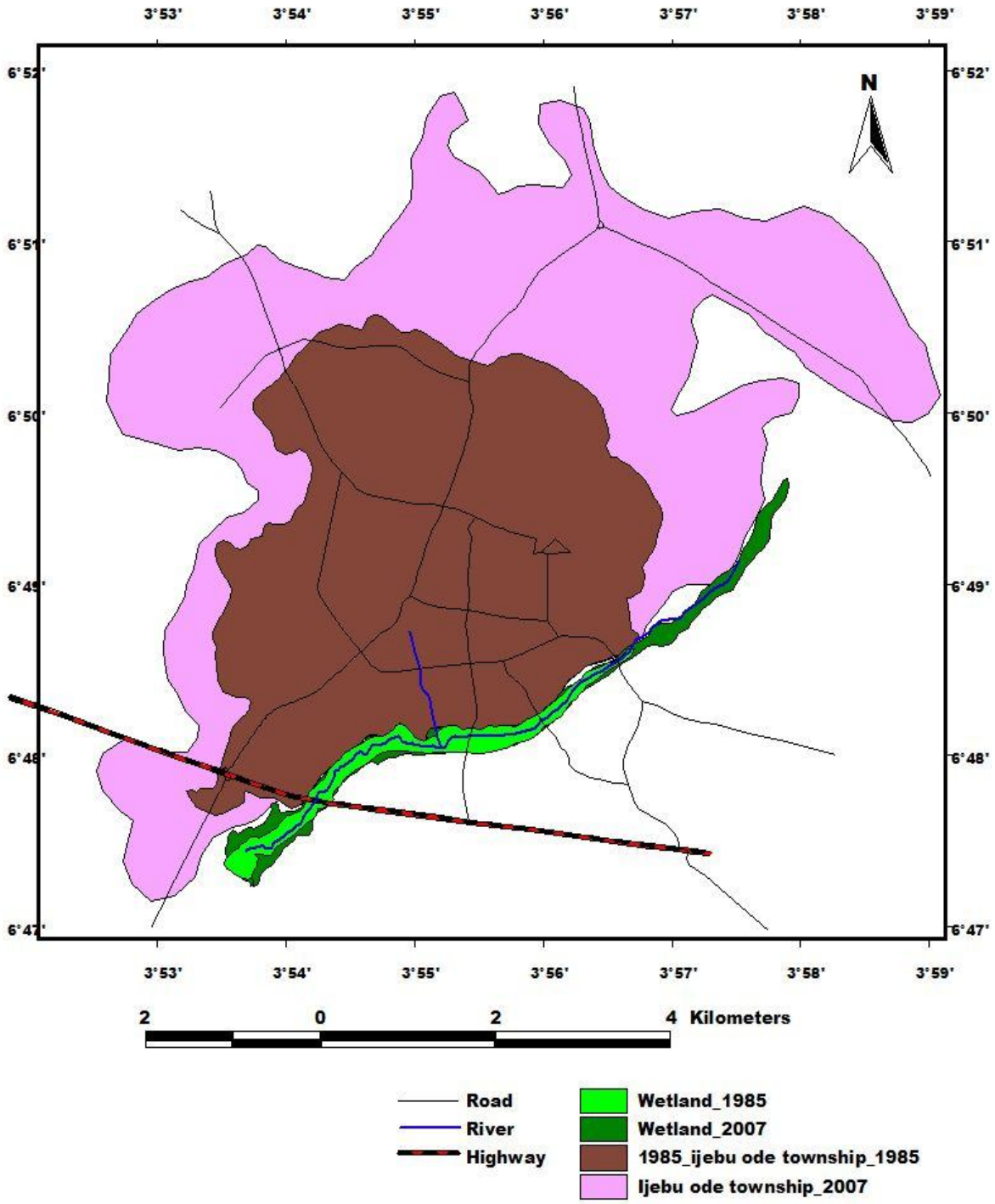

Fig. 2: Changes in wetland areas of Ijebu-ode between 1984 and 2007

The use of wetland for cultivation has lead to the problem of infilling of the wetlands which have also led to the reduction of wetlands. Intensive ploughing and harrowing close to the wetland area have accelerated soil erosion leading to infilling of the wetlands by deposition of soil and organic materials carried through surface runoff or overland flow.

Alien Invasion in Wetland

The use of wetland for cultivation has also disturbed the species composition in the area. The disturbance of the area has attracted rooted plants. The sea hen plant species common in this area have now entered the wetlands and are now out-competing the wetland species. As a result the ecology of the area has changed. The presence of the hen species is also leading to the reduction of water in the wetlands. The presence of rooted plant (a hen species) in the wetlands has strong negative effect on the habitat value of wetland. Increased shading caused by the presence of trees cover has decreased the vigour of indigenous plant, such as sedges, bulrushes and reeds, which were not adapted to this condition, with the possible extinction challenges.

Loss of Biodiversity

The use of wetlands for settlement and infrastructural development has led to the destruction of most of wetlands plant species such as reeds, sedge and grasses. In the absence of these plant species, the wetland is failing to play their important functions such as trapping of sediments, removal of waste material and purification. This loss is leading to total destruction of the wetland and this has impacted the ecology of the areas. This is mostly observed at Ondo road axis.

Pollution in Wetland

People see wetland as a waste land for the disposal of solid and sewage waste, which is rampant in urban wetlands. As a result of this, the water's natural purification process in the wetland has ceased to operate as more and more solid wastes and sewage are been disposed into the wetlands. The waste has discolored the water, thus reducing the penetration of sunlight that is essential to biological activities. This in turn greatly lowered the quality of water. As a result, this foul-smelling water is no longer home of fish and other aquatic organism; it becomes unsafe for human consumption. It also makes the area to become an eye sore and unattractive for human being. Greater impact on the fish and aquatic animals are noticeable. Reduction in the magnitude of wetland due to water diversion was also observed.

Conclusion

The wetland in Ijebu ode had witnessed interference of human activities in the form of infilling of wetland, loss of biodiversity, alien invasion and pollution of wetland areas. It is posited that in order to retain the ecological value and enjoy the ecological services rendered by wetland, urban wetland should be sustainably used. Advocacy is therefore necessary for more environmental education, public orientation while favourable policies and planning programmes toward wetland sustainability in Ijebu Ode and its environs should be put in place.

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