Effects of Urbanisation on Lagos Wetlands

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Abstract

The study considered the effects of urbanisation on Lagos wetlands. Exploratory approach was employed in carrying out the study. The study established that urbanisation in the metropolis results from influx from the rural areas which had resulted in the quest for more spaces to provide accommodation or employment for the teaming population. Primary causes of wetland loss in Lagos Metropolis are human activities which include incessant sand filling and conversion of wetland environment to economic uses (construction) and perennial flooding that are common and regular occurrences in the metropolis. These had resulted into direct habitat loss, suspended solids additions, hydrologic changes, altered water quality, increase runoff volumes, diminished infiltration; reduce stream base flows and groundwater supplies, prolonging dry periods to mention just a few. The study therefore recommends that human activities (both individuals and government) should be reduced while efforts should be on those activities that encourage wetland conservation and preservation. Also focus should be shifted from the immediate benefits derived from wetland conversion to future/sustainable benefits derivable from proper wetland management.

Keywords: Lagos Metropolis, Market Failure, Wetland, Urbanisation, Urban Wetlands

1.0 Introduction

Urbanisation is a major cause of loss of coastal wetlands. Urbanization impacts wetlands in numerous direct and indirect ways. For example, construction reportedly impacts wetlands by causing direct habitat loss, suspended solids additions, hydrologic changes and altered water quality. Indirect impacts include changes in hydrology and sedimentations which substantially alter wetlands. It also exerts significant influences on the structure and function of coastal wetlands, mainly through modifying the hydrological and sedimentation regimes, and the dynamics of nutrients and chemical pollutants.

Natural coastal wetlands are characterised by a hydrological regime comprising concentrated flow to estuarine and coastal areas during flood events, and diffused discharge into groundwater and waterways during the non-flood periods. Urbanisation, through increasing the amount of impervious areas in the catchment, results in a replacement of this regime by concentrating rain run-off. Quality of run-off is also modified in urban areas, as loadings of sediment, nutrients and pollutants are increased in urban areas. While the effects of such modifications on the biota and the physical environment have been relatively well studied, there is to date little information on their impact at the ecosystem level.

There has been a renewed focus on the study of urban systems in the last few years, as urbanisation remains a major development challenge exerting awesome pressure on social, economic and environmental sustainability (Pickett et al., 2001). Cohen (2004) was of the view that in developing countries, urbanisation is associated with natural population growth, rural–urban migration, convergence in rural and urban lifestyles, and the economic and political processes associated with globalisation. Though urban areas currently account for about 3% of the Earth's surface, the ecological footprint associated with urban expansion has important environmental consequences especially on wetland ecosystems. According Ehrenfeld and Schneider (1991) wetlands commonly occur in human-dominated landscapes such as agricultural and urban regions. Studies have shown that negative effect on wetland species and ecosystem functioning can be expected in such areas due to human activities (Ehrenfeld, and Schneider, 1991; Morris, 1991).

Nigerian cities such as Lagos, Kano, Ibadan, Enugu, Port-Harcourt, Kaduna and Calabar grow mainly through rural-urban migration. This urbanisation process has outpaced the existing urban management system. 1996 World Bank reports on Nigeria indicated that the growth rate of urban areas increased from 20 percent in 1970 to 33 percent in 1993. It is also projected that by the year 2025, estimated 75 percent of Nigeria's population of about 245 million persons would be expected to live in towns and cities.

2.0 Study Area

Braimoh and Onishi (2007) were of the view that nowhere in West Africa is the rate of urbanisation in the last few years as unprecedented as Lagos City-State, the economic focal point of Nigeria. Lagos occupies a unique position in the economic processes of the West African sub-region for several reasons. As the economic and financial nerve-center, it accounts for over 70% of Nigeria's industrial and commercial establishments that account for up to 70% of the country's manufacturing value-added. It has extensive infrastructural facilities—the busiest international airport, seaport, and the most extensive road and telecommunication networks in Nigeria. It is also the host to the most active Stock Exchange in West Africa. These same reasons have made the conurbation of Lagos the hub of intense settlement, and the prime destination of local and international migrants. The remarkable population growth translates to ever increasing pressure on land for housing and business premises with profound environmental implications.

Lagos is generally assumed to be the largest city in Sub-Saharan Africa and the largest city on the entire continent after Cairo. The current demographical estimate (2006) of the population of the Lagos urban area (urban agglomeration) is 8,100,000, covering an area of approximately 775 square kilometers (300 square miles) for a density of 10,400 per square km or 27,000 per square mile. A comparison of Lagos metropolitan population figure in 1991 and 2006 (a period of 15 years) showed an increase of 2,753,656. This is shown in Table 1 below.

Table 1: Population Figures (1991 and 2006) of the sixteen Local Government Areas in Lagos Metropolis

Local Government	1991 Population	2006 Population
Agege	417,981	461,743
Ajeromi-Ifelodun (Ajegunle)	593,561	687,316
Alimosho (Ikotun)	430,890	1,319,571
Amuwo-Odofin (Festac Town)	225,823	328,975
Apapa	154,477	222,986
Eti-Osa (Ikoyi)	157,387	283,791
Ifako-Ijaye	233,341	427,737
Ikeja	203,383	317,614
Kosofe (Ogudu)	412,407	682,772
Lagos Island	165,996	212,700
Lagos Mainland (Ebute-Metta)	273,079	326,700
Mushin	539,783	631,857
Ojo	215,837	609,173
Oshodi-Isolo	449,781	629,061
Shomolu	358,787	403,569
Surulere	462,261	502,865
Total	**5,294,774**	**8,048,430**

Source: National Bureau of Statistics (2010)

Fig. 1: Map of Lagos Metropolis
Source: Bohr (2006) Barata and Silva (2006)

Table 2: The Sixteen (16) LGAs of Metropolitan Lagos

Local Government Area	Land Area (in km^2)	Population (2006 Census)	Density (Inhabitant per km^2)
Agege	11.2	459,939	41,071
Ajeromi-Ifelodun	12.3	648,105	55,474
Alimosho	185.2	1,277,714	6,899
Amuwo-Odofin	134.6	318,166	2,364
Apapa	26.7	217,362	8,153
Eti-Osa	192.3	287,785	1,496
Ifako-Ijaye	26.6	427,878	16,078
Ikeja	46.6	313,196	6,785
Kosofe	81.4	665,393	8,174
Lagos Island	8.7	209,437	24,182
Lagos Mainland	19.5	317,720	16,322
Mushin	17.5	633,009	36,213
Ojo	158.2	598,071	3,781
Oshodi-Isolo	44.8	621,509	13,886
Somolu	11.6	402,673	34,862
Surulere	23.0	503,975	21,912
Total	**1000.2**	**7,937,932**	**7,941**

Source: Wikipedia (2006a) Barata and Silva (2006)

World Urbanization Prospects (2007) projected the population of Lagos metropolis from 305,000 in 1950 to 10,572,000 inhabitants and this shows a consistent increase over the preceding years. The growth in the population is due to migration from rural areas and high fertility rate. Migration to the city does not seem to decrease rather it is on the increase. The population growth in the last ten years was highest than ever and the growth in the future is estimated to be even higher (World Urbanization Prospects, 2007)

3.0 Causes of Wetland Loss in Lagos Metropolis

Many wetland losses, the world over, are direct result of economic activities engaged in by man. These activities range from agriculture, construction, water diversion and a host of others. It is estimated that around 5 percent of agricultural land globally (264 million ha) is irrigated, with South Asia (35%), Southeast Asia (15%) and East Asia (7%) showing a high dependency on irrigation. China and India have 39 percent of the global irrigated area and Western Europe and United States have 13 percent, while sub-Saharan Africa and Oceania have less than 1 percent of their agricultural land irrigated (Pilot Analysis of Global Ecosystems P.A.G.E, 2000). Irrigation accounts for approximately 70 percent of the water withdrawn from freshwater systems for human use. Only 30 – 60 percent is subsequently used downstream, making irrigation the largest net user of freshwater. Estimates also show that the share of cropland that is irrigated has grown by 72 percent from 1996.

Millennium Ecosystem Assessment (2005) stated that the degradation and loss of inland wetlands and species has been driven by infrastructure development (such as dams, dikes, and levees), land conversion, water withdrawals, pollution, overharvesting, and the introduction of invasive alien species. While there had been studies on wetland loss in places such Louisiana, USA, one cannot categorically say that such studies had been conducted on wetland loss in Lagos Metropolis however all the factors contributing to wetland losses are highly noticeable in the metropolis. In USA, Wetland losses in the lower Mississippi delta have been the subject of intensive investigations ever since the magnitude of wetland loss problem and its potential economic and social impacts were first recognized (Gosselink and Baumann, 1980; Gagliano, Myer-Arendt, and Wicker, 1981). Literally hundreds of reports have been written about the complex physical and biogeochemical processes and their interdependencies that are responsible for wetland loss (Day et al., 2000 and Penland et al., 2000). Despite the multitude of prior studies, there still are controversies and unanswered questions regarding the primary importance of natural versus induced environmental changes that have caused the most recent dramatic losses in wetlands.

The primary causes of wetland loss in Lagos Metropolis could be identified with perennial flooding usually associated with the release of water from dams (Oyan and Asejire) along the course of Ogun/Osun Rivers and Benin/Owena Rivers; the two river basins that drain the whole South-Western landscape. Degradation of coastal wetlands through land development and water management reduces the capacity of wetlands to provide significant ecosystem services that reduce the risks of living and working in coastal landscapes. Human activities intended to reduce damage to life and properties from climate extremes have unintentionally increased the vulnerability of coastal areas to climate change by altering the natural hydrologic functions of wetlands. Disturbances that directly change the structure of wetlands can be so severe that the wetland is destroyed. Filling or draining a wetland can so alter the water regime that the land can no longer support the wetland vegetation and maintain hydric soils. For example, if a wetland is lost, most if not all of its wetland functions are also lost.

4.0 Effects of Wetland Loss

The loss and degradation of wetlands has resulted in increased risks from coastal storms and tidal surges, leading to unintended consequences for both human and natural systems. Everyday at least, one national daily always report about devastating effects of flood on properties. For example, Punch Newspaper reported that whenever Oyan Dam is opened, the storm usually affects the floodplains and wetlands covering 2,800 hectares of River Ogun catchment within Lagos comprising Ikosi-Ketu, Mile 12, Agiliti, Thomas Laniyan Estate, Owode-Onirin, Agboyi, Owode-Elede, Maidan and Isheri North Scheme (Punch Newspaper August 2, 2010). Also, Ogun Osun River Basin Development Authority (OORBDA), confirmed the impending flood along Ogun River Course, as a result of the storm to be released from Oyan Dam (Punch Newspaper, August 23, 2010) and went further to warn residents around the river catchment. All these are the outcome of unconcerned attitude of both the people and government of Lagos State to protect the wetlands, which are incessantly converted to uses with economic gains.

5.0 Effects of Economic Activities on Wetlands

As earlier state many wetland losses, the world over, are direct result of economic activities engaged in by man. However, some of the established effects of agriculture on wetlands, as identified by Mironga, (2005), include:

i. Direct loss of wetlands due to draining and conversion to agricultural land;
ii. Indirect loss of wetlands area due to water withdrawal from rivers and streams for irrigation;
iii. Loss of wetland area and function due to damming for water storage;
iv. Loss of seasonal wetlands due to changed hydrologic cycle from water storage;
v. Loss of wetland function due to salinisation, sediment deposition, erosion, eutrophication;
vi. Pollution from use of pesticides and other chemicals; and
vii. Creation of wetland.

Water withdrawals for irrigation in some cases can act to exacerbate the effects of other stressors on the wetland ecosystems, resulting in effects that exceed those that would be expected from dewatering alone. Altinsacli and Griffiths (2001) identify Lake Kus in Western Turkey to be under stress from a growing use of the lake by the local human population. One of these stresses is the increasing pollution of the lake by organic materials. This, in conjunction with dewatering for irrigation, has resulted in the increasing eutrophication of the lake and changes in the aquatic biota toward an assemblage more characteristic of nutrient rich systems. Wildlife responses to the implementation of irrigation schemes can, in turn, result in stress to wetlands. Water withdrawal was also identified as a source of stress around Lake Kus. There is no known mechanically operated irrigation activity past or present in Lagos Metropolis. The major pressure is wetland reclamation and conversion to development purposes. In and around the Waza National Park in Cameroon, Tchamba, Drijver and Njiforti (1995) report that dewatering of the Logone River resulted in the loss of prime grazing habitat for wildlife. Populations of some ungulates such as reedbuck and kob have been lost or severely reduced. Elephants have been displaced from their traditional areas, resulting in damage to wetland habitats and more frequent interactions with farmers.

Tanner (1992) in a study conducted on Dune Lakes in Northland, New Zealand identifies the direct effects of livestock grazing on wetland ecosystem to include:

i. Consumption of plant biomass;
ii. Trampling of plants, including below-ground parts and soil;
iii. Nutrient inputs and bacterial contamination from dung and urine;
iv. Introduction and dispersal of seeds and other propagules.

The effects of livestock grazing on species composition have been found to ultimately affect the structure and function of wetland vegetation. In a study conducted in Southern Wisconsin, Middleton (2002) found that sedge meadows that were recovering from cattle grazing structurally changed into a dense shrub carr while sedge meadows that had never been grazed had a different species composition to grazed meadows but were still similar structurally. Several other studies report the effects of livestock grazing on wetland birds. These include the negative effects of tramping on nests (Beintema and Mueskens, 1987; Popotnik and Giuliano, 2000) and removal of vegetation biomass and structure which degrade bird habitats values (Moore, Ogle and Moynihan, 1984; Popotnik and Giuliano, 2000).

In the same vein, Mironga (2005), in a study conducted on Kisii District of Kenya, points out that drainage and other forms of disturbance associated with agriculture are the main contributors to wetland loss. Williams (1990) states that globally, wetlands are been drained, primarily for agriculture and food production. In a study conducted in Zimbabwe, Madebwe and Madebwe (2005) conclude that growth in population, high drought incidence rates, national and economic developmental challenges resulted in many gardens being established on the fringes and within wetlands. Wetlands are exploited more during the dry months. Households take advantage of the wetlands' moist conditions to grow a variety of vegetables and root crops for sale or for own consumption. That drainage and other forms of disturbance affect Lagos wetlands is an understatement. Ogun-Osun and Benin-Owena River Basins drain into the City-State and the effects of this is better imagined.

Conducting a study in Delhi, India, Kumar, Love, Sharma and Rabu (2003) conclude that pressure for conversion of wetlands for developmental purposes is very high especially in case of urban riparian wetlands. These wetland ecosystems provide many tangible and intangible benefits on a sustainable basis not only to the urban society but also to the associated dependent ecosystems. Wetland areas on the fringes of river channels in a city are looked upon as a precious property resource with different potential land uses such as agriculture, site for human settlements, industries, civic construction and waste dumping sites, to mention just a few. All the literature sited above showed that economic activities such as grazing and draining wetlands for agricultural purposes have great effect on wetland ecosystems. Lagos wetlands have been variously affected by conversion to developmental uses such as residential and commercial purposes. This is pronounced in Apapa, Lagos Island and Eti-Osa Local Government Council Areas. Wetlands along Lekki-Ajah axis are mostly devastated and degraded by continuous sand filling and conversion to uses with economic gains against conserving the wetlands.

6.0 Effects of Market Failure on Urban Wetlands

The market system is a powerful, relatively inexpensive, self-adjusting and responsive mechanism for resource allocation. Yet market failures occur when the price mechanism fails to come up with the social optimum in resource allocation. Environmental resources, such as wetlands, become difficult to value when they do not pass through regular pricing mechanisms (the market). Wetland values are often not taken into account properly or fully in decision making, or are only partially valued, often leading to degradation or even destruction of a wetland. The reasons why wetlands are undervalued and/or overused according to (Vorhies 1999; Stuip, Baker and Oosterberg, 2002) include:

- **Market failure: public goods**. Many of the ecological services, biological resources and amenity values provided by wetlands have the qualities of a public good; i.e., many wetland services are seen as "free" and are thus not accounted for in the market (e.g., water-purification or flood-prevention);
- **Market failures: externalities.** Another type of market failure occurs when markets do not reflect the full social costs or benefits of a change in the availability of a good or service (so-called externalities). For example, the price of agricultural products obtained from drained wetlands does not fully reflect the costs, in terms of pollution and lost wetland services, which are imposed upon society by the production process;
- **Perverse incentives** (e.g., taxes/subsidies stimulating wetland over-use). Many policies and government decisions provide incentives for economic activity that often unintentionally work against the wise use of wetlands, leading to resource degradation and destruction rather than sustainable management (Vorhies 1999). An example might be subsidies for shrimp farmers leading to mangrove destruction;

- **Unequal distribution of costs and benefits**. Usually, those stakeholders who benefit from an ecosystem service, or its over-use, are not the same as the stakeholders who bear the cost. For example, when a wetland is affected by pollution of the upper catchment by runoff from agricultural land, the people living downstream of the wetland could suffer from this. The resulting loss of value (e.g., health, income) is not accounted for and the downstream stakeholders are generally not compensated for the damages they suffer (Stuip, Baker and Oosterberg, 2002);
- **No clear ownership**. Ownership of wetlands can be difficult to establish. Wetland ecosystems often do not have clear natural boundaries and, even when natural boundaries can be defined, they may not correspond with an administrative boundary. Therefore, the bounds of responsibility of a government organization cannot be easily allocated and user values are not immediately apparent to decision-makers.
- **Devolution of decision-making away from local users and managers**. Failure of decision-makers and planners to recognize the importance of wetlands to those who rely on them, either directly or indirectly.

In Lagos Metropolis, the villagers along Lekki-Ajah axis were not involved in the decision to sand fill and convert the wetlands to uses backed by economic gains. They suffered acquisition without adequate compensation.

7.0 Impacts of Urbanization on Wetlands

Urbanisation impacts wetlands in numerous direct and indirect ways. For example, construction reportedly impacts wetlands by causing direct habitat loss, suspended solids additions, hydrologic changes, and altered water quality (Darnell 1976). Indirect impacts, including changes in hydrology, eutrophication, and sedimentation, can alter wetlands more than direct impacts, such as drainage and filling (Keddy 1983). Urbanisation may affect wetlands on the landscape level, through loss of extensive areas, at the wetland complex level, through drainage or modification of some of the units in a group of closely spaced wetlands, and at the level of the individual wetland, through modification or fragmentation (Weller 1988). Various impacts already identified include the ones discussed below:

Hydrologic Impacts

The changes on wetlands by hydrologic impacts had been far more dramatic than other impacts. Hydrologic changes have large and immediate effects on a wetland's physical condition, including the depth, duration, and frequency of inundation of the wetland. The changes in hydrology caused by urbanisation can exert complete control over a wetland's existence and characteristics. Hopkinson and Day (1980) predicted that urbanization bordering a swamp forest would increase runoff volumes by 4.2 times. Greater surface runoff is also likely to increase velocities of inflow to wetlands, which disturb wetland biota and scour wetland substrates (Stockdale 1991). Increased amounts of storm water runoff in wetlands alters water level response times, depths, and duration of water detention (US EPA 1993). Reduction of watershed infiltration capacity is likely to cause wetland water depths to rise more rapidly following storm events. Diminished infiltration in wetland watersheds can also reduce stream base flows and ground water supplies to wetlands, lengthening dry periods and impacting species dependent on the water column (Azous 1991). All these are glaringly effects of Lagos urbanization on the wetlands. In the past few years, the rate of water runoff has increased within the metropolis, to an alarming rate. Every slight rain has resulted into devastating effects in the metropolis due high rate at which wetlands are still being converted into economic uses.

Impacts to Vegetation

Impacts on wetland hydrology and water quality can, in turn, affect wetland vegetation. Horner (1989) stated that emergent zones in Pacific Northwest wetlands receiving urban runoff are dominated by an opportunistic grass species, Phalaris arundinaceous, while non-impacted wetlands contain more diverse groupings of species. There have been numerous reports on the tolerance to flooding of wetland and non-wetland trees and plants (e.g. US EPA 1993).

Impacts to Wetland Fauna

Just as hydrologic changes affect Wetland plants they also affect wetland animal communities. Increased imperviousness in wetland watersheds can reduce stream base flows and groundwater supplies, prolonging dry periods in wetlands and impacting species dependent on the water column (Azous 1991).

Many amphibians require standing water for breeding, development, and larval growth. Amphibians and reptile communities may experience changes in breeding patterns and species composition with changed water levels (Minton 1968 in Azous 1991). Water Quality Impacts to Wetland Fauna -- Pollutants can have both direct and indirect effects on wetland fauna. Portele (1981) reports that road runoff containing toxic metals had an inhibitory effect on zooplankton, in addition to algae. The increase in impervious surface associated with urban land conversion also leads to a decrease in infiltration and an increase in surface runoff, sedimentation, and eutrophication of wetlands. Uncontrolled urban expansion also leads to the fragmentation of landscapes, destruction of wildlife habitat, and reduction in biodiversity. These impacts make an understanding of the factors driving urban expansion essential to global environmental change research.

8.0 Conclusion and Recommendations

The study considered the effects of urbanization on Lagos wetlands. Lagos metropolis is a wetland region, with the dominant vegetation of tropical swamp forest, comprising fresh waters and mangrove swamp forests. Urbanisation in the metropolis results from influx from the rural areas and increase in fertility rate and these had resulted in the quest for more spaces to provide accommodation or employment for the teaming population. Primary causes of wetland loss in Lagos Metropolis are human activities which include incessant sand filling and conversion of wetland environment to economic uses (construction) and perennial flooding that are common and regular occurrences in the metropolis. These had resulted into direct habitat loss, suspended solids additions, hydrologic changes, altered water quality, increase runoff volumes, diminished infiltration; reduce stream base flows and groundwater supplies, prolonging dry periods to mention just a few. To prevent further degradation and diminishing wetland ecosystems in the metropolis, it is recommended that human activities (both individuals and government) that degrade wetlands should be reduced while efforts should be on those activities that encourage wetland conservation and preservation. Also focus should be shifted from the immediate benefits derived from conversion to future/sustainable benefits derivable from proper wetland management.

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