DOI: http://dx.doi.org/10.4314/gjer.v14i1.5

GLOBAL JOURNAL OF ENGINEERING RESEARCH VOL 14, 2015: 33-45
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URBAN DEVELOPMENT IN THE THIRD WORLD AND THREAT TO WETLANDS: THE CASE STUDY OF CALABAR, NIGERIA

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(Received 26 March 2015; Revision Accepted 23 June 2015)

ABSTRACT

Wetlands constitute only two percent of the world's land mass. Yet, a total of 10% of the world population live in wetlands. Also, about 13% of global urban settlements are found in wetlands. Coastal ecosystems are among the most productive in the world and are among the most threatened. A significant global response to this threat was the 1971 Convention held in Ramsar, Iran, to save the world's wetlands. Unfortunately, most developing countries are not signatories to the convention, and those that are have paid passive attention to its articles; leading to massive loss of wetlands in these countries. Cities along water ways and basins (such as Calabar) are known for their rapid growth. Calabar has witnessed a rapid urban growth of recent. This growth has led to severe encroachment into the city's wetlands formed by the Great Kwa and Calabar Rivers with the attendant degradation of the ecosystems. This paper examines the danger posed by the spread of the city to these wetlands and proffers solutions that would check the incursion into these pristine natural habitats. The paper also recommends the development of eco-tourism resort as part of the larger Calabar urban landscape architecture. This will add to the tourism potentials of the city as envisaged by Cross River State.

KEYWORDS: Calabar, Coastal ecosystem, Kwa River, Ramsar Convention, wetlands

INTRODUCTION

Human habitations and civilizations have been known to flourish in the depressions between highlands and along the course ways of water. The valleys provide fertile plains for agriculture while the waterways provide the routes for communication and transportation. These plains and water margins, having more than their fair share of hydrologic constitution, form the world's wetlands, with peculiar vegetations and habitats. Wetlands, with their unique ecosystems, constitute only two percent of the world's land, contain 10% of its population, and 13% of its urban settlements (McGranahan et al, 2007). According to Millennium Ecosystem Assessment, coastal ecosystems, both onshore and offshore, are among the most productive in the world and among the most threatened (MEA, 2005). It is the realization of this threat of recent that the world responded by holding a conference in 1971 in the Iranian city of Ramsar to chart a way forward to save the world's wetlands (Matthews, 1993 and MEA, 2005).

This paper first examines existing literature on wetlands, including the contemporary world views on such lands as well as their multiple ecologically relevant functions. The paper also specifically examines the threat posed by population growth and the attendant urban development on the existing Calabar city wetlands, against the backdrop of the potential of the architectural development of these wetlands for ecotourism resorts. At the end, the paper recommends a policy change towards the conservation of wetlands amongst others.

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1.1. The Contemporary Worldview on Wetlands

The relationship between man and wetlands began at the point of conflict. From prehistoric times man has viewed wetlands as wastelands, disastrous realms, custodians of diseases and obstacles to meaningful development (Matthews, 1993; Barbier et al, 1997 and EPA, 2006). Consistent with this perception, it was presumed that the most appropriate action for wetlands was reclamation, which actually resulted in the destruction and loss of several hectares of wetlands. In the course of the 20th century alone, wetlands were exposed to massive degradation and destruction, as a consequence of which about 50 % of the wetlands were lost. On the whole, wetlands have been threatened with degradation and destruction more than any other ecosystem of the world (MEA, 2005 and UN-HABITAT, 2009).

Notwithstanding the persistent negative and hostile attitudes to wetlands, man has consistently enjoyed the immense benefits that wetlands offer, since the establishment of the earliest urban conurbations in Mesopotamia nearly five millennia ago (UN-HABITAT, 2009). The realization of this truth has led to changes in man's attitudes to wetlands in the present day. The worldview about wetlands has changed very dramatically since the second half of the 20th century; they are now regarded among the most biologically productive ecosystems, being comparable only to tropical rainforests and coral reefs in the diversity of biological species that they contain (EPA, 2006). Much of the present change in attitude towards wetlands of the world is attributable to the work of the Ramsar Convention of 1971 (full title: Ramsar Convention on Wetlands of International Importance). The Convention came into being following the international treaty that was signed on 2 February 1971 by the representatives of 18 nations at the little Iranian town of Ramsar (Matthews, 1993 and MEA, 2005). The extent of the change of attitude to wetlands is demonstrated by the fact that, in many countries of the world, there is outright prohibition of degradation of wetlands in the present day (Barbier et al 1997).

The definitions and terminologies of the Ramsar Convention offer useful guidance towards the sustainable and beneficial use of wetlands. According to the Millennium Ecosystem Assessment of 2005 (MEA, 2005), wetlands have been defined in Article 1.1 of the Convention text of the Ramsar Convention as "areas of marsh, fen, peat land 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" (Barbier et al, 1997 and MEA, 2005). Article 2.1 of Ramsar Convention further provides that wetlands "may incorporate riparian and coastal zones adjacent to wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (Barbier et al, 1997 and MEA, 2005). The ecological character of a wetland is "the combination of the ecosystem components, processes and services that characterize the wetland at a given point in time" (MEA 2005). The wise use of wetlands involves "the maintenance of their ecological character within the context of sustainable development and achieved through the implementation of ecosystem approaches" (MEA, 2005).

Wetlands are simply described as the interfacial ecosystem located between terrestrial ecosystems and aquatic ecosystems. They are also described as ecotones, being that they manifest as transitional elements between terrestrial and aquatic ecosystems (Greb et al 2006). The wetland ecosystems cover 6 percent of the land area of the world (Bullock and Acreman, 2003 Schuyt and Brander 2004) - put together this amounts to as much as 1,280 million hectares; a territorial mass that is equivalent to 50 % the land area of Brazil or 33 % the land area of USA (MEA 2005). Within the context of the contemporary worldview on wetlands, they make very significant contributions to the human environment, namely: food, water supply, water purification, flood control, climate regulation, coastline protection, recreation and tourism (EPA 2001 and MEA 2005). In addition, they perform a wide range of beneficial functions in the human environment and also make very significant contributions to human well-being (Horwitz et al 2012). They have also become important elements in freshwater management at international as well as local levels.

The economic contributions of wetlands constitute another significant consideration pertaining to wetlands; these contributions can be better understood through the application of some environmental resource valuation frameworks. In the determination of the economic uses of wetlands distinction is usually made between two sets of values, namely: use values and non-use values. Use values include the direct use of wetland goods (such as food, fuel

wood et cetera) and also indirect uses (such as: water retention, flood control, mitigation of climate-change impacts etc). Non-use values include aesthetics, cultural interpretations, amongst others (Schuyt and Brander 2004). In the determination of the economic values of wetlands the framework that has been adopted as most appropriate is the *total economic value (TEV)*. This framework distinguishes between present use and potential future use. Within the framework of TEV the current use of the wetland is estimated; and also, in addition, the future use is computed. TEV takes into consideration the fact that in the event of the degradation of the ecosystem, the loss is the aggregate of the current value together with its potential future use (if the ecosystem has been allowed to remain intact) (Barbier et al 1997). On the whole, the median economic wetland values of two types of wetlands (that are most relevant to this work) as computed for the year 2000 are: freshwater marsh (US$145 per hectare per year) and mangrove swamps (US$120 per hectare per year) (Schuyt and Brander 2004). In Schuyt and Brander (2004) the estimate for the total economic value 63 million hectares of wetlands located in various regions of the world has been computed and placed at 3.4 billion US dollars per year. For Africa, this computation has placed the total economic value of its 5.5 million hectares of wetlands at US$256.7 million per year (at year 2000 values) (Schuyt and Brander 2004).

It must, however, be recognized that although the economic value of a wetland is a good indicator, it is only a part of its actual value. In addition to the economic value, other values also come into reckoning, such as: “biodiversity, scientific, climate regulation, socio-cultural and other important wetland values ....” (Schuyt and Brander 2004).

1.2. Principal Functions of Wetlands

Water quality improvement is one of the principal functions of wetlands. Wetland ecosystems act in the improvement of water quality through the purification and detoxification of waters that issue out of terrestrial ecosystems in the form of storm waters. As the storm water that flows into the wetland spreads out around the plants within ecosystem, it experiences reductions in the velocities of flow; and corresponding reduction in the kinetic energy of flow forces silt and sediments to precipitate out of the water and drop to the floor of wetland. Nutrients that are introduced to storm waters from agricultural sites and municipal wastes are picked up by the roots of wetland plants, thus eliminating the risks of eutrophication in the adjacent aquatic ecosystems. Some wetlands have been known to have reduced the concentrations of nitrogen in water by as much as 80 percent. In the rhizosphere regions of the wetland plants, other pollutants and harmful microorganisms are filtered out of water. This process of using the roots of plants to absorb, extract or precipitate pollutants from ground waters is also referred to as rhizo-filtration. Through the process of bio-filtration, micro-organisms present in wetlands act as bio-filters; breaking down complex organic compounds contained in pollutants into non-toxic components (OECD 1996; EPA 2001; Bullock and Acreman 2003; Schuyt and Brander 2004; MEA 2005; Greb et al 2006; UN-HABITAT 2009; RCS, 2010a and RCS 2010b).

Water storage is another major ecological function of wetlands. In this respect they act as natural sponges which store water and release it afterwards. The processes of water retention and detention enable high water tables to be maintained within the wetland ecosystems while at the same time reducing the propensities for flooding in the directly contiguous terrestrial ecosystems (EPA 2001; Bullock and Acreman 2003 and Greb et al 2006). The reduction of floods in adjacent terrestrial ecosystems is a very valuable contribution of wetlands to the economies of human settlements; in that it amounts to savings on potential flood damage (that otherwise would amount to large sums of money) (EPA 2001and Greb et al 2006). In addition the retention and detention of water in wetlands enable groundwater recharge (EPA 2001; Schuyt and Brander 2004 and Greb et al 2006). Not all wetlands are capable of facilitating groundwater recharge, since some of them are located on top of impervious rock strata (EPA 2001; Bullock and Acreman 2003 and Greb et al 2006). Nevertheless, groundwater recharge is another very significant ecological contribution of wetlands, since ground waters provide potable water to about 1.5 to 2.0 billion of the world’s population (MEA 2005; UN-HABITAT 2009; RCS 2010a and RCS 2010b).

Wetlands play beneficial roles in climate regulation and mitigation of the impacts of climate change. Although peat lands cover only 3-4 percent of the land surface of the earth, they are responsible for about 1.5 percent of total global carbon storage (about 540 gigatons of carbon),

amounting to 25-30 % of the global carbon storage in terrestrial ecosystems (MEA, 2005). A major form of climate change impacts on human settlements comes in the form of sea level rises and floods. The impacts of these effects on terrestrial ecosystems are mitigated by wetlands (such as mangrove swamps) which act as buffers that sponge up the excess flood waters (Schuyt and Brander 2004; MEA 2005; UN-HABITAT 2009; RCS 2010a and RCS 2010b).

1.3. Urbanization and Wetlands

The impacts of urbanization pressures on wetland ecosystems have been discussed in Expert Workshop Report on Urban Development, Biodiversity and Wetland Management, Naivasha, Kenya (of 16-17 November 2009). The UN-Habitat Report has drawn appropriate attention to these trends and impacts: "The hypothesis that urbanization can have direct and indirect impacts on the environment, and that wetlands are particularly susceptible to negative change, has long been proven….. Yet despite this, the march of urbanization continues to destroy and degrade natural capital." (UN-HABITAT 2009).

In furtherance of the age-old mindset by which wetlands were considered as wastelands, reclamation of wetlands for the purpose of making room for urban development has long been taken as acceptable practice. Studies have revealed that this trend is turning out to be very expensive, both economically and ecologically. The ecological costs begin with the loss of wetland benefits and biodiversities in the present and the future. Flood prevention through the water retention service of wetlands is one other major wetland benefit that is lost in urban sectors located in reclaimed wetlands; and this ends up in drastic consequences to the urban sectors so created. Recent experiences are already showing that occupants of such urban sectors as well as governments are already being exposed to very enormous economic costs, which would not have arisen, had wetland ecosystems been kept intact and allowed to perform their very beneficial ecological functions.

The Mississippi Basin in USA has been cited as an example of the usefulness of wetlands in mitigating flood damage. The 1993 flood incident that occurred in the basin claimed 33 lives and destroyed property estimated at billions of US dollars. In the course of the history of this basin "20 million acres of wetlands in this area had been drained or filled for agricultural purposes (EPA 2001)". It has now been realized that "if the wetlands had been preserved rather than drained, much property damage and crop losses could have been avoided." (EPA 2001).

The case of Lagos in Nigeria is also very pertinent. Metropolitan Lagos is situated in a narrow coastal territory which once consisted of wetland ecosystems (mangrove swamps). Before national independence in 1960, Lagos (the Federal Capital at the time) supported a population of less than 1 million people. By the year 2000, the estimated population of Lagos was 13.5 million people (O'Meara 1999). According to UN-Habitat Report (citing Adelekan 2009) "to facilitate city development, rapid and unplanned land reclamation have been achieved by infilling coastal swamps and floodplains" (UN-HABITAT 2009). The final effect of the enormous wetland loss that occurred in the Lagos has been the incessant and excessive incidents of floods that have continued to manifest in the coastal parts of the metropolitan region of Lagos ever since.

On the whole, there is a very confounding paradox pertaining to these scenarios of wetland degradation towards the purposes of coping with urbanization pressures. To the generation that perpetuates the wetland degradation, it is taken as an expedient and pragmatic means of coping with urbanization pressures. On the other hand, the future generations that are compelled to face the gruesome consequences are often unprepared for the enormity of the ecological consequences and the colossal economic costs needed for remediation.

2.0. Wetlands in Nigeria

It would appear that, for Nigeria, the new era of new consciousness about the benefits that accrue to mankind from wetlands did not dawn very early. Although the country was already an independent nation by the time of the inauguration of Ramsar Convention on 2 February 1971, it did not join the Convention until 30 years later. Nigeria was enlisted as the 123rd contracting party of the Ramsar Convention on 2 February 2001 (RCS 2013a). Today, the country has 11 Ramsar sites, which all add up in area to a total of 1,076,728 hectares (10,767.28km^2 or 1.2 percent of the country's land area of 923,768 km^2); the largest of Nigeria's.

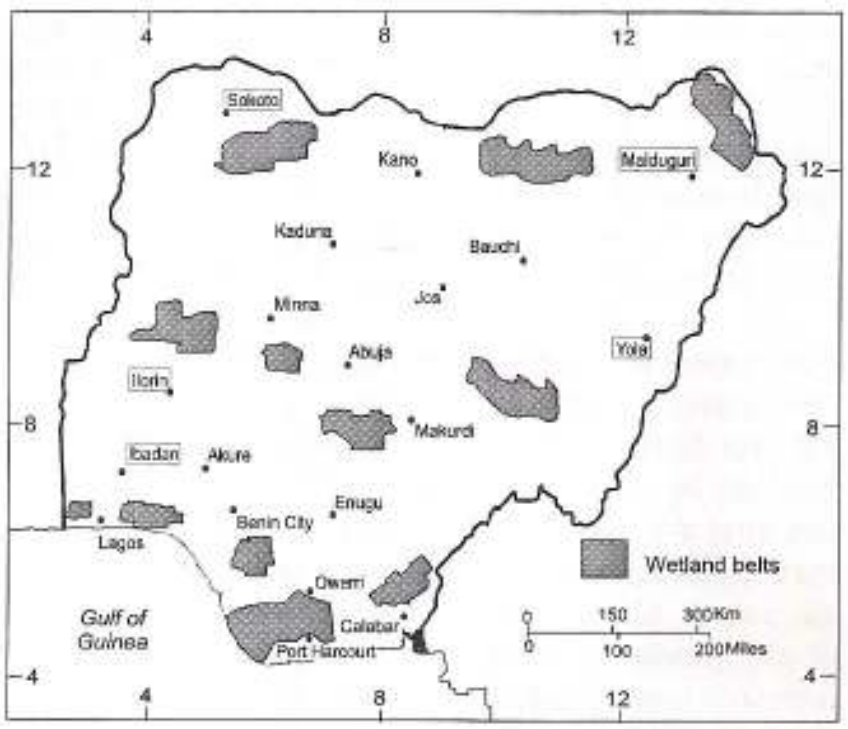

Fig. 1: Map of Nigeria Showing Wetland Belts (Source: Uluocha & Okeke, 2004).

Ramsar site is the Lake Chad Wetlands in Nigeria, which covers a total of 607,354 hectares (RCS 2013a and RCS, 2013b). Although Ramsar Convention is about wetlands of international importance in the first instance, it actually enjoins contracting parties to ensure the "wise use of all wetlands" located within their respective domains by promoting their conservation and sustainable development, that is, "to work towards the wise use of all wetlands by ensuring that Contracting Parties develop, adopt and use the necessary and appropriate instruments and measures" (RCS 203a and RCS, 2013b). It has thus become the obligation of Nigeria, as a contracting party to the Ramsar Convention to ensure sustainable development of all its wetlands

According to Uluocha and Okeke (2004), wetlands occupy 2.6 percent of Nigeria's land area (24,017 km^2); showing that about 45 % of the total area of wetlands in the country has already been listed as Ramsar sites (see Fig 1). The wetlands of Nigeria's Niger Delta constitute the largest wetland region in Africa and the third largest in the world. Furthermore, Nigeria has "recently identified 14 additional wetland sites" with the hope of presenting them for inclusion in the list of Ramsar sites (Uluocha and Okeke 2004). So far, the zeal that is being shown by Nigeria at Ramsar Convention over conservation of wetlands has not been backed up by concrete plans of actions at home; and no meaningful attention has so far been given to wetland loss and degradation in the country.

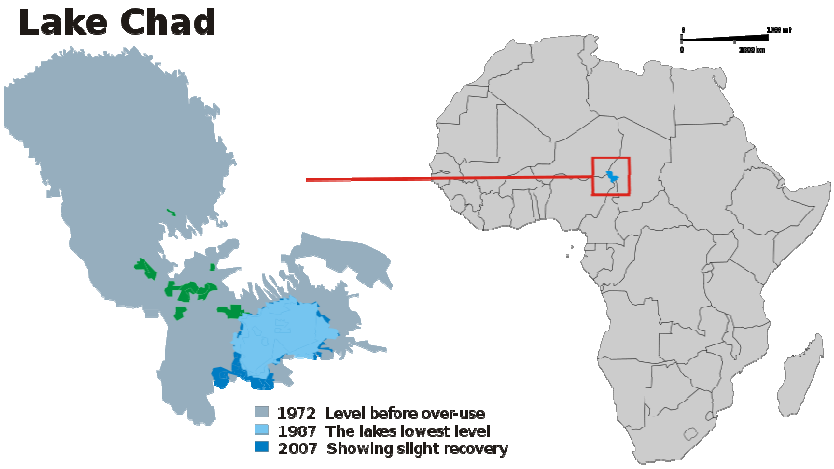

Fig 2: The map showing Lake Chad (Source: Wikimedia Commons - in the public domain)

Nigeria is not among the group of nations in which degradation of wetlands has been prohibited outright. No concrete plan of action has been put in place to prohibit their degradation, forestall their loss and ensure their sustainable development. The comprehensive inventory of the states of Nigeria's wetlands is yet to be compiled and published. Public enlightenment programmes about the benefits of wetlands to mankind are virtually nonexistent; and wetlands are shrinking very rapidly. According to Uluocha and Okeke (2004), with reference to Lake Chad, "multi-temporal satellite remote sensing images" have revealed that the lake has shrunk from 25,000 km^2 that was its area in 1963 to the present size of only about 2000 km^2. Figure 2 shows the changes the lake has undergone. The wetlands of the country are vanishing at an "alarming rate", and the push factors for wetland degradation and loss have been enumerated: "population pressure, rapid rate of urbanization, mining, oil and industrial waste pollution, uncontrolled tilling for crop production, over-grazing, logging, unprecedented land reclamation, construction of dams, transportation routes and other physical infrastructure ..." (Uluocha and Okeke 2004). The wetlands of Nigeria's Niger Delta have been placed under persistent threat from oil pollution; and "between 1976 and 1998 a total of 5,724 incidents of oil spillage were recorded in the region, resulting in the discharge of a total of about 2,571,113.90 barrels of oil into the environment"; and all these have led to the loss of more than 4000 km^2 of "green forests, including freshwater swamps, mangroves and lowland rainforests" (Uluocha and Okeke 2004). On the whole it is so far a story of continuous degradation and loss of Nigeria's wetlands; while very little is being done to prevent destruction and promote their conservation.

3.0. The Wetlands of Calabar and the Challenge of Urbanization

Cities along water bodies are noted for their rapid growth, mostly as a result of flourishing commerce due to ease of transportation. Calabar, in south eastern part of Nigeria, is one such city. The city of Calabar is situated in the sub-equatorial region of southeastern Nigeria at latitude 4.9500° N and longitude 8.3250° E (see fig. 3a). It is the political headquarters of Cross River State, one of the six states that form the geo-political region of South South in Nigeria. Calabar is drained by two major water bodies, the Calabar River and the Big Kwa River; both connect and empty themselves into the Atlantic Ocean through Cross River Estuary, a 24-km wide but relatively shallow estuary (see fig. 3b). The two rivers create a large wetland in between them at the point of confluence. Calabar landscape is undulating (rolling land) with pockets of wetlands, often at drain basins of rivulets.

Fig 3a: Map of Cross River State showing Calabar close to the Cross River Estuary (Source: Google images - in the public domain)

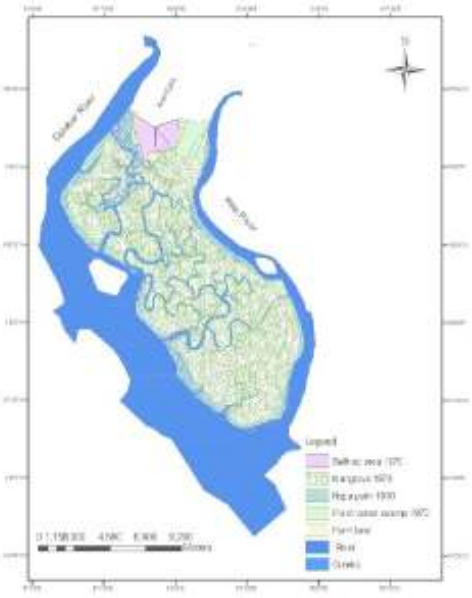

Fig 3b: Calabar showing the two major drains – Calabar and Kwa Rivers (Source: Google images - in the public domain)

Starting as a fishing settlement along the Calabar River where the Portuguese explorers anchored their ships in the 15th century, Calabar has grown both spatially and demographically,

with a population edging towards half a million inhabitants. A rapidly expanding city that straddles large bodies of water will likely encroach into wetlands that had hitherto served other multiple end uses. The rapid growth of the city of Calabar constitutes a threat to both the mangrove ecosystem of the Cross River Estuary as well as the underground aquifer.

The scenarios of rapid rates of expansion of the national population that have been playing out in Nigeria over the past 53 years have been enacted in diverse measures in the cities of the country; leading to rapid increases in urbanization and urban growth. Neglect of regional development has been a major push factor in the rural-urban migration factor; and this migration has also continued to add impetus to the exploding urban populations. The combination of the two factors has made the expansion of urban populations to outstrip the capacities of urban management systems to provide adequate urban services. Calabar became the capital city of South Eastern State (now Cross River State of Nigeria), following the first nation-wide state-creation political dispensation that occurred on 27 May 1967. In the first master-plan report of the city (under its new dispensation as state capital) "Calabar Survey and Development Plan" of 1970, prepared by Tesco-Kozti of Budapest, the population of the city was estimated at between 70,000 and 80,000 people (Tesco-Kozti 1970). Today, 43 years later, the estimated population of the city is in the region of half a million people. Another factor that has drastically reduced the capacities of urban management systems in coping with rapid urbanization is poor urban development control mechanisms, which do not usually act proactively to pre-empt urban disorder. One major reference point within this context of Calabar is the Eastern Highway project. A part of the western sector of the University of Calabar sprawls across the original pathway of the Eastern Highway. There are, today, several private buildings that are located on the southern segment of the pathway of the Eastern Highway that was once expected to be located between the campus of the University of Calabar and the main campus of Cross River University of Technology (CRUTECH). All these distortions in the urban development process have occurred by reason of weak and ineffective urban development control mechanisms in the face of intense urbanization pressures. These conditions of gross weakness and ineffectiveness (poor institutional capacity) of the urban development control mechanisms in Calabar have very greatly impacted on the city's wetland ecosystems.

Wetlands constitute very major sections of the extreme western and southern sectors of Calabar. The wetlands that constitute these parts of the city are located on the west bank of the Great Kwa River as the river rolls into the Cross River Estuary (Fig. 3b). They act as retention and detention basins that collect, filter and purify the water that emanates from the city. A part of the water so collected flow through the wetlands into the river, while another part help in recharging the underground aquifers. Disturbance of these wetlands will ultimately result in serious dislocations of the hydrological and hydrographical systems of the city. In the course of this study, it has been revealed that these disturbances are already occurring in the wetlands of Calabar. Although Nigeria became the 123rd contracting party of the Ramsar Convention on 2 February 2001, there is as yet no national framework for protection of wetlands in the country. In the absence of a national framework for protection of wetlands, the urban development control mechanisms of Calabar have not offered any guidance towards the conservation of wetlands or the regulation of physical developments in wetlands. Meanwhile, driven by intense housing pressures and rapidly increasing high costs of land, citizens are resorting to buying lands and erecting houses in the very precarious environments that wetlands offer.

Fig. 4a: Building developments in wetlands with pools of stagnant water trapped immediately outside the fence of a compound at Anantigha, Calabar South LG. Headquarters

Fig. 4b: Buildings in wetlands usually occupy space and display ecosystem that aids natural waste water management (see this example in Anantigha Wetland)

Fig 5a: A natural undisturbed wetland at Akai Efa along Calabar - Ekang

Fig. 5b: A wetland that is being degraded for the purpose of physical development along Atimbo Road

Fig. 5: Typical views of the wetland ecosystems of Calabar

First, in the south of the city, the creation of Calabar South Local Government in the last decade of the 20th century created the impetus for accelerated urbanization in that sector of the city. It would be correct to say that all the building and infrastructural developments that have occurred in this urban sector of Calabar, to the south of Palace Road, have actually taken place on wetlands (see Fig. 4). Second, on the road to Akpabuyo (in the segment located between the former Strabag Station and Atimbo Bridgehead) there are large stretches of wetlands to the north and south (Fig. 5b). Until the end of the 20th century, these stretches of wetlands were virtually undisturbed. Today, rapidly advancing ribbon housing developments are already visible on both sides of the road. The impetus for this development has been created by a combination of several urban development factors: (a) the creation of Akpabuyo Local Government Area in the suburb of the city in the late 20th century; (b) the creation of Bakassi Local Government Area (out of Akpabuyo) in the late 20th century; (c) the development of the Police Secondary School at Akpabuyo in the late 20th century; (d) the location of the Nigerian Navy Secondary School at Akpabuyo in the early 21st century; and (e) the development of the new Cross River State

housing estate at Akpabuyo in the early 21st century. A proactive urban development control mechanism would have interpreted these scenarios to mean that persons who lack personal cars that would enable them to shuttle rapidly between Calabar and Akpabuyo would prefer to settle in between the two urban conurbations. Since this trend was not properly interpreted and intercepted, the pressures that have ensued on the wetland ecosystems of this sector of Calabar appear to have taken the city development authorities unguarded. The third scenario is the one that is developing along the northern segment of Eastern Highway, as the road borders the wetlands (on its eastern side) at Akai Efa urban sector (see Fig.5a). Here also private housing developments are beginning to grow rapidly; and it would be desirable to place controls and restrictions before it would become too late. On the whole, rapid and sporadic building developments that are occurring in the wetland ecosystems of Calabar are taking place by reason of the absence of a national framework for protection of wetlands, coupled with weak and ineffective urban development control mechanisms within the city.

4.0. Problems Associated with Building Developments in the Wetlands of Calabar.

Apart from the general problems posed to the ecological integrity of wetland ecosystems by physical developments (and the resulting limitations of the benefits that accrue to the inhabitants of the city from the wetlands), there are also very significant challenges that face building and infrastructural developments in wetland ecosystems. In Figs. 5a and 5b two contemporary phases of the wetland ecosystems are portrayed: an undisturbed wetland and another wetland that is being degraded for the purpose of physical development. With respect to physical developments in wetland ecosystems, the following principal challenges have been selected for discussion in this paper: (a) health hazards arising from poor ambient conditions; (b) soil instability; and (c) poor safety conditions for building occupants

Buildings developments in wetlands are usually characterized by such problems as: stagnant pools of water surrounding buildings or water tables that are very close to the surface. In the former case, the stagnant pools of water could become breeding grounds for disease vectors and this could result in health hazards such as malaria, schistosomiasis, etcetera. In the latter case, the upward ingress of water through the substructure of the building would result in permanent dampness in the interior atmosphere of the building (see the line of dampness at the base of the wall in Fig. 4b). This could similarly result in other health hazards such as tuberculosis, In either case, the water-saturated soil conditions of wetlands make safe treatment of human wastes (by the combination of septic tanks and soak-away pits) impossible. Thus, where housing developments occur in wetlands, there is a very high risk of pollution of the waters, which may turn out to be the only dependable sources of potable water. Thus, water and sanitation could emerge as principal issues where urban development control mechanisms are ineffective in controlling building and housing developments in the water-saturated soils of wetland ecosystems (see Figs. 4a and 4b).

By their very nature as eco-tones that occur at the interface between terrestrial and aquatic ecosystems wetland ecosystems have soils that are generally unable to bear heavy superimposed loads from buildings and urban infrastructures. The total collapse of the subsoil in this instance has resulted in deep gulley erosion. Reclamation of wetlands requires very expensive civil engineering works that private developers are unable to undertake. Attempting to apply make-shift unscientific methods for reclamation in this environment is likely to result in serious ecological disasters. In Figs. 6a and 6b the fates of roads and other urban infrastructures constructed in the poorly reclaimed wetlands are revealed.

Fig. 6a: Collapsed urban infrastructures in reclaimed wetlands along Atimbo Road

Fig. 6b: Collapsed urban infrastructures in reclaimed wetlands, Atimbo

Fig. 6: The fate of urban infrastructures the disaster zones of poorly reclaimed wetlands

Fig. 7a: Buildings balancing precariously on the sides of a ravine created by collapsing wetland soils that have been exposed to excessive superimposed loads at Atimbo Road

Fig.7b: Buildings balancing precariously on the sides of a ravine created by collapsing wetland soils that have been exposed to excessive superimposed loads

Fig. 7: The fate of buildings in the disaster zones of poorly reclaimed wetlands

In Figs. 7a and 7b three of the buildings in the same development sector of the poorly reclaimed wetlands are captured for more detailed study. The question is not if these buildings will collapse into the ravine; it is actually when this impending disaster will occur. Even if a disaster such as this occurs at the end of a very heavy rainstorm, it would still be absolutely incorrect for it to be labeled as a natural disaster; it is in reality a man-made disaster that is awaiting its moment of occurrence. The occupants of the buildings and the entire neighbourhood shown in Figs. 3a, 3b, 4b and 4b are exposed to very acutely unsafe conditions. Public safety in urban infrastructures and buildings ought similarly to be very important issues in urban development control.

The experiences illustrated in Figs. 6 and 7 notwithstanding, building developments are still proceeding unabated in various sectors of the wetland ecosystems of Calabar (Figs. 6a and 6b); but in virtually every sector it is very evident that signs of effective urban development control are conspicuously absent. It would appear that man does not usually pay appropriate attention to ecological threats and actual disasters; except he

is compelled by strict regulations and controls to do so. Certainly the scenarios of impending ecological disasters that are presently germinating in the wetlands of Calabar demand prompt intervention by the city's urban development control authorities.

5.0. SOLUTIONS

The most appropriate urban planning responses to these impending ecological disasters in the wetlands of Calabar should include;

1. the outright prohibition of all forms of physical developments in these ecologically sensitive wetland ecosystems of the city. Since urban development falls constitutionally within the premise of the state government, it has become a matter of supreme urgency for the Government of Cross River State of Nigeria to establish the necessary framework for the prohition of physical developments in the wetlands of the city, and also for the conservation of the city's rapidly shrinking wetland ecosystems.
2. The conversion of these areas into wetland eco-tourism spots. When properly designed, the eco-tourism resort would merge with, and form an integral part of the overall architecture of the urban landscape. This will be in tune with, and promote the tourism agenda of Cross River State Government.

CONCLUSION

This study of wetland ecosystems has led us to the following conclusions.

1. The contemporary worldview about wetlands is that they are very beneficial ecosystems that ought to be protected for the benefit of mankind.
2. It has been shown that in Nigeria there are no national or local frameworks for the protection of wetlands and this has exposed the wetlands of Calabar and elsewhere to intense scenarios of degradation.
3. By reason of this omission, diverse types of developments are now proceeding in the wetlands of Calabar; but private developers who are being attracted by cheap lands available in wetlands do not have the funds needed to reclaim them appropriately.
4. This study has shown that lack of understanding of wetland ecosystems is resulting in bad professional judgments that pose diverse kinds of dangers to the occupants of buildings located in poorly reclaimed wetlands.
5. In the present scenarios of sea-level rises that are constantly being induced by climate change, wetlands perform very beneficial functions of protecting terrestrial ecosystems from floods.
6. In the absence of a national framework, there is the urgent need for the development of a local framework that would protect the wetlands of Calabar and save the residents from impending large-scale ecological disasters.
7. The paper recommends the development of the wetlands as eco-tourism spots to diversify the economy of Cross River State and chart a new path of revenue generation in Nigeria thereby reducing the Nation's over-dependence on oil.

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