

MANAGING THE IMPACT OF URBANIZATION ON BIODIVERSITY IN EMERGING URBAN FRINGE SETTLEMENTS: THE CASE OF SATELLITE TOWN, CALABAR, NIGERIA

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(Received 20, November 2008; Revision Accepted 24, April 2009)

ABSTRACT

Biodiversity is an important part of a complex urban ecosystem and provides significant ecosystem services. It benefits urban communities environmentally, esthetically, recreationally and economically. Variations in land use and development have generated green spaces of different distribution and composition. While the development has continued, the infrastructure and urban areas being developed have substantial impact on biodiversity. The paper examined the types of urban green space and the level of sustainability that has been achieved within its setting in terms of biodiversity conservation in the midst of developing infrastructure in Calabar, Cross River State. The aim is to determine the type and spatial context of urban green space in the study area, the number of developmental activities and managing strategies in sustaining biodiversity. To achieve these objectives, observations, data collection and analysis were carried out; ortho-photographs were used to determine the spatial attributes of the green spaces. The result showed that infrastructure projects have a dramatic impact on biodiversity. If the contribution of urban green spaces to future generation is to be justified, then urban environmental asset will always be deemed to be poor substitutes. Land use planning, environmental impact assessment and contracting supervisory role to credible companies or individuals with good asset base are the principal tools for avoiding or minimizing the adverse impacts of infrastructure development on biodiversity. The ability to maintain and make the most beneficial use of biodiversity depends on using and managing biodiversity sustainably in other activities where the production of goods and services for human consumption is the principal objective.

KEYWORDS: Biodiversity, Green Space, Satellite Town, Sustainability, Urbanization,

INTRODUCTION

Nigeria, according to Filani (2008) has a long history of urbanization predating the colonial period. However, noting that the country witnessed rapid urbanization during and post-colonial period. The series of geopolitical restructuring of the country since political independence in 1960, in terms of states and Local Government Areas creation, has increased the tempo of urbanization and its geographical spread. Filani (2008) noted that the total percentage of urban centers with population of more than 20,000 inhabitants increased from less than 15 per cent in 1950 to 23.7 per cent in 1975 and 43.3 per cent in 2000. Projection shows that by the year 2010, more than half of the countries population will be living in urban centers. He further pointed that this rapid

urbanization has been accompanied by series of environmental problems in addition to socio-economic problems.

Rapid urbanization can create enormous stress on the natural environment. These stresses extend beyond the land that urban areas actually occupy. As urban areas expand, so does their environmental impact. The extent of urban environmental impact increases not only as population grows but also as per capita demand for resources rises.

Land-use and land-cover change due to sprawl is currently a leading cause of biodiversity loss in many parts of the world (Hansen et al. 2005). The infrastructure and urban areas of growing societies do have substantial impact on

biodiversity. Deleterious effects of roads and other aspects of residential development and the spatial dynamics have long been the subjects of study (Bell and Slade, 2004). Geographic variation in number of species per unit area is one of the most conspicuous patterns in biodiversity.

Most cities in developing countries with increasing population have great difficulties in coping with the impact of infrastructure on biodiversity. Urban centers have substantial daily fresh water needs, and indiscriminate abstraction can have serious effects on species diversity and composition. Common phenomenon near and within urban areas, such as channelization, could drastically alter the physical characteristics and reduce habitat diversity of riparian vegetation. Obviously urbanization contributes to biodiversity loss; the loss of habitat.

Human settlement is biased toward water and agricultural land, resulting in clustered spatial distributions (Margules and Pressey 2000; Sanderson et. al 2002). As settlements expand with time, the general level of human activity at broader spatial scales increases, and human influence grows throughout the landscape by selecting more biodiversity rich habitats and fragmenting landscapes with roads (Theobald 2003). This results in increasing conflicts with biodiversity.

Within the context of managing the impact of urbanization on biodiversity in a developing urban settlement such as Satellite Town in Calabar, Cross River State the following objectives has been the main focus of this paper.

- i. Identifying of type of green spaces in the study area
- ii. Assessing the level of species erosion
- iii. Proffering management strategies in sustaining biodiversity in a growing settlement

STUDY AREA

Satellite Town is a new residential outlay in Calabar metropolis with a landmass of about 1245 hectares (figure 1). It lies on an eastward-sloping coastal land on which Calabar is built. The land gently slopes to the river, and is well drained although there are several depressions, which are waterlogged during the rainy season. The local relief and surface configuration is that of a gradual slow ascent below 15metres; the deep porous red soils derived from sandy deposits constitute the main soil type on which agriculture is done, mainly for production of subsistence crops. The obvious distinguishing feature is the newly built-up area that is compact but only 25 per cent planned. In

the bid to create alternative growth centers for the diffusion of socio-economic activities in Calabar, the Government acquired the land to build residential quarters that will be leased on owner-occupier basis. For the period the land was fallow, it became breeding ground for many plants, birds, mammals, amphibians and reptiles. Currently, as development continues, planning for the future is essential; some of the remaining land has been highlighted by city planners as ecologically sensitive spaces: fragile, rare or valuable natural areas that are good for preservation as parks, wilderness or open space. The indigenous people live mainly in old detached houses and are engaged mainly in agriculture and trading. Many of the immigrants unable to get accommodation within the urban centre settle on adjacent areas.

The study area has been chosen because apart from fulfilling the operational definition of this paper, it will continue to attract more immigrants from the already overcrowded urban centre due to its locational advantages. This study is therefore expected to generate interest towards making new settlements more habitable to accommodate biological diversities along side with developmental activities.

Satellite Town is one of the fastest growing settlement zones in Calabar, spreading rapidly into the Great Kwa River valley. The sprawl process leads to higher levels of human activities at broader spatial scales. Eventually higher level of settlement is associated with higher level of species endangerment.

METHOD OF STUDY

The 1998 Cadastre map and 2003 Aerial Photograph of Calabar were used as base maps to take inventory of the existing green spaces. The green spaces were visited in order to identify the current land uses of these spaces; personal observation included a programmed census of houses in the study area while the area of land occupied by the green space types was calculated from a base map after delineation of the built-up areas. Further, the study area was divided into neighbourhood units based on whether the units are self-contained, homogenous residential, industrial or mixed development neighbourhood. The physical planning officials in charge of planning control in Calabar metropolis and residents in Satellite Town were interviewed as regard their knowledge about the uses and significance of the green spaces in their neighborhood.

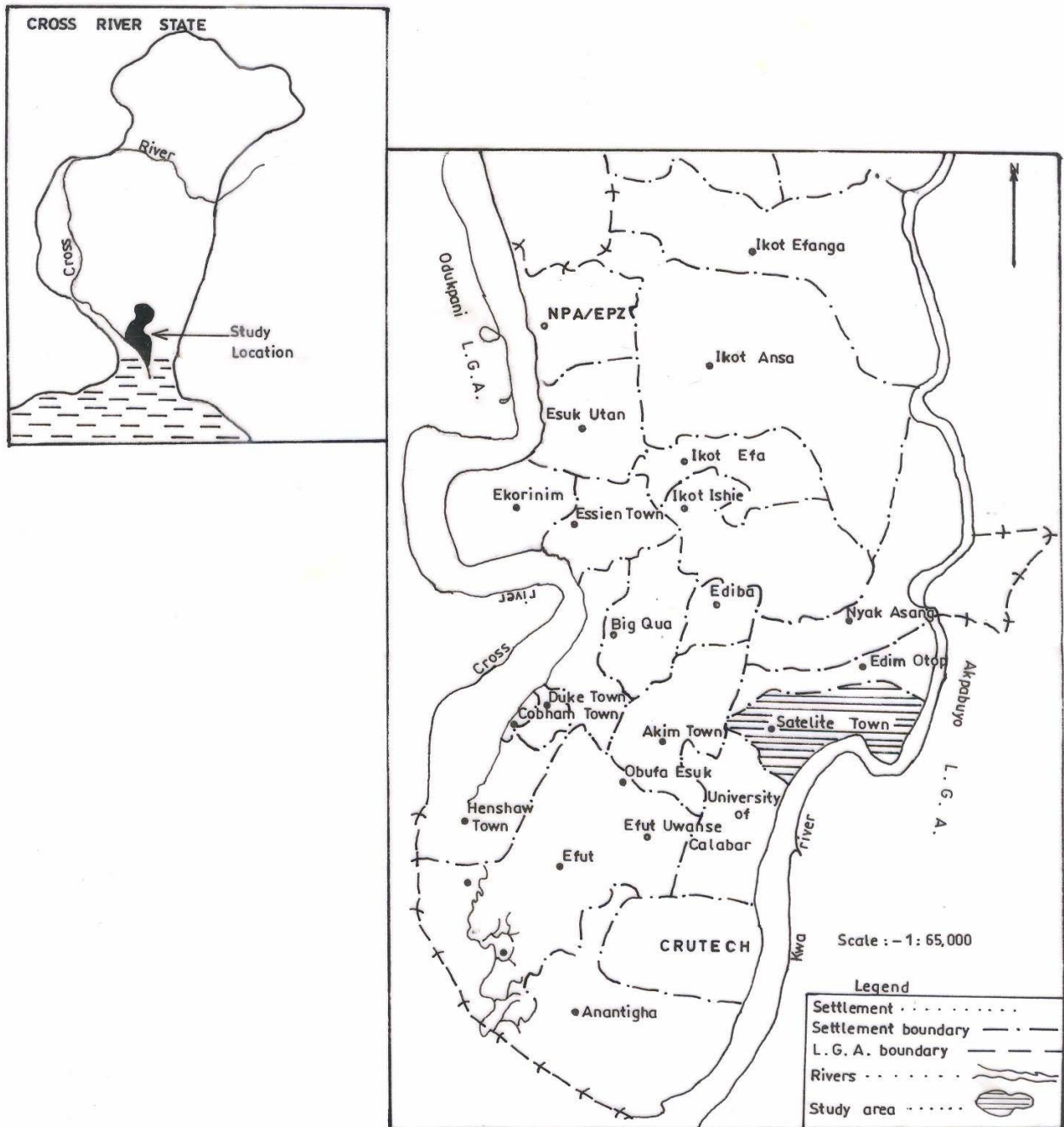


FIG.1: Map of Calabar metropolis showing study area

**RESULTS AND DISCUSSION
SETTLEMENT AND RESIDENTIAL
DEVELOPMENT**

The pattern and form of settlements in the Eastern States of Nigeria have been in a state of flux, having been continually influenced by the changing response of people to the physical, economic and social environment. Generally,

landforms influence the pattern of settlement; rugged landscapes and coastal swamps have influenced settlement sites in Calabar. The increasing technology has gradually undermined the influence of the physical environment.

Housing complexes were part of Cross River State Government welfare system in the suburbs of major towns in the state and were regarded as symbols of economic revitalization.

One of the feature of Satellite Town that was used to emulate Western and modern ideal living was creating green spaces. Residential buildings have taken up, surprisingly, a large portion of the total area. Over 75 per cent of the entire area is totally built up indicating lack of control in its development.

The study also shows that most of the wall elements are made of mud. This material although serviceable is known to deteriorate very easily because the walls have structural defaults disintegrating and crumbling due to age and poor maintenance, posing serious hazards to life and property. The fact that areas with renovated buildings have continued to maintain and attract new immigrants presupposes that humanity has lost some sense of value of choice of settlement,

becoming insensitive to the danger that such environment portends.

GREEN SPACES AND BIODIVERSITY SUSTAINABILITY

Green spaces were intended to shield the habitat that supplies food, water and cover for a variety of wildlife from urban encroachment that existed before the new settlement was built. These green spaces serve as ecological corridors but over pruning of trees have eventually affected their aesthetics. Green spaces have come to be seen as a way of compensating for the loss of indigenous species diversity, as a way of maintaining the integrity of the area's ecosystem and as a way of conserving vascular landscapes. Table 1 below highlights the types of green spaces and their status in the study area.

Table 1: Green space status in the study area

Types of urban Green space	Present	Absent
Municipal park		√
Botanic garden	√	
Zoological garden		√
Wildlife corridor		√
Urban common	√	
Business parks	√	
Streams & pond buffers	√	
Nature centre		√
Vacant lots	√	
Nature reserves		√
Domestic gardens	√	
Roadside verges		√
Green ways		√
Cemetery	√	
Street trees	√	
Urban forest		√

Source: Author's fieldwork, 2008.

In 1998 the built-up area was about 360 hectares representing about 28.91 per cent. The remaining 885 hectares was made up of open space representing 71.09 per cent and just 75 per cent of the open space was actually green space. The importance of the green space within the built-up areas was that it provided refuge for urban wildlife, reduce storm water runoff and flooding, improve local air quality, reduce stream channel erosion and improve soil and water quality.

In 2007 the built-up area increased to about 933.75 hectares representing about 75 per cent of the total landmass of the study area. The remaining 25 per cent was distributed among botanic gardens, urban common, business parks,

stream buffers, vacant lots, domestic gardens and cemetery; forming urban habitat islands. These urban habitat islands are not only inherently weaker due to their size and large amount of edge, they are being subjected to threats as a result of chemical, physical and biological pressures coming from the surrounding area. Rodents, especially the giant rats popularly known as 'Okon Calabar' and birds are indicator species that the indigenous people have used to assess the impacts of urbanization on pre-urban ecosystem, apart from changes in plant communities. Table 2 highlights estimated change in green space types in Satellite Town 1998 to 2007.

Table 2: Estimated green space change in the study area 1998 to 2007

Green Space Type	1998 Estimated Area (hectares)	1998 Percentage Representation	2007 Estimated Area (hectares)	2007 Percentage Representation
Botanic garden	17.7	2.67%	0.5	0.16%
Urban common	44.25	6.67%	5.00	1.61%
Business park	44.25	6.67%	10.00	3.21%
Stream buffer	88.5	13.33%	65.00	20.88%
Vacant lots	177	26.67%	9.50	3.05%
Domestic gardens	290.47	43.76%	219.70	70.59%
Cemetery	1.55	0.23%	1.55	0.50%
TOTAL	663.72	100%	311.25	100%

Source: Author’s fieldwork, 2008

CAUSAL EXPLANATIONS OF BIODIVERSITY LOSS IN THE STUDY AREA

Table 3: Percentage representation of major factors that threaten biodiversity in the study area

THREAT FACTOR	PERCENTAGE REPRESENTATION
Communities alteration	5%
Population pressure	20%
Landscape alteration	65%
Removal of keystone species	10%

Source: Author’s fieldwork, 2008

Table 3 highlights the causal explanation on the major factors that threaten biodiversity in the study area. Among the four factors listed, landscape alteration accounts for 65 per cent, population increase 20 per cent, removal of keystones species 10 per cent and community alteration 5 per cent impact on biodiversity.

The principal cause of the loss of biodiversity in the study area is the alteration of the ecosystem (landscape alteration). Further observation shows that activities that have jointly led to this include agricultural clearing, urban expansion (new residential houses) and urban renewal; as farmlands, forest and pasture in the suburbs are developed, natural habitats are fragmented and biodiversity is compromised.

One major determinant of species distribution that remains to be mentioned is the distribution of other species. Biogeographers have long been aware that the distribution of animals is greatly dependent on plants; the dependence of plant on plants, of plants on animals, and of animals on animals is equally well documented (Myers and Giller, 1991). This dependence is not simply a matter of parasitism. Relationship between species may be subtly constructed in space and time.

It is no longer necessary to provide a gentle and reticent exposition of the problems associated with a rapidly increasing population. Expanding population in the study area have destroyed habitats and communities and

overcrowded the fragile parks and wilderness areas at a rate that has frightened biodiversity.

Landscape alteration stands out as the most prominent, single factor that has threatened natural communities of biodiversity in the study area. Many of the activities that affect the ecosystems involve direct destruction of the physical and biotic environment.

Before the expansion of residential area in Satellite Town, the clearing of land for cultivation was responsible for most landscape alternation. This process has largely ceased and has been overtaken by urban expansion and public works projects.

The steady increase in population caused by continued migration, the increase in per capita requirement of land, agriculture, urban expansions altering the landscape and assortment of massive engineering ventures that usually fall under the heading of “urban renewal” which include construction of road networks and excavations to lay pipes for urban water supply, have affected the fate of land in the study area. These enterprises are justified by their proponents in terms of urban and agricultural needs but in considered measure serve the purpose of destroying habitats and biodiversity; in essence, there are widespread alteration of the landscape that support biodiversity.

Some animal and plant species in the study area hold central positions in the network of interrelationships that form a community. Plant

species richness influence animal species richness in multiple ways. It has been accepted universally that a great variety of plants would lead to a greater variety of trophic levels, which in turn could lead to a greater variety of consumers. Because plants are primary producers and provide food, shelter, nesting sites and refuge from predators, it is reasonable to hypothesize that plant diversity has association with the diversities of different major groups of animals and hence influence animal diversity to certain extent (Qian, 2002, 2007). The selective removal of these species has caused the community structure to collapse. Crow (*carvard spp*) breed on iroko (*Clorophora excelsa*) and the removal of the later has caused the former in their large numbers to migrate to other regions.

MANAGING IMPACTS OF URBANIZATION ON BIODIVERSITY

Our ability to maintain and make the most beneficial use of biodiversity depends on using and managing biodiversity sustainably in activities where the production of goods and services for human consumption are the principal objectives. To meet the demands of a growing population in a new or expending settlement and simultaneously maintain biodiversity requires measures that:

- i. Conserve genetic diversity in existing domesticated plants and animal varieties,
- ii. Identify and conserve wild species that can improve agricultural productivity and adaptability to agricultural change, and
- iii. Minimize the adverse impacts of developmental practices on other ecosystems.

However, real-world environmental issues rarely lend themselves to strictly disciplinary solutions. Thus, the knowledge needed for the solution of environmental problems needs to be defined by issues, not by the discipline, if it is to contribute effectively to policy formation and implementation. We need to break through disciplinary and interdisciplinary boundaries if we are to make much progress in policy research for conservation of biodiversity in the midst of urbanization. Answers to biodiversity loss should embrace the tools of the appropriate discipline, but not to be limited by them.

Infrastructure projects, whether road networks, power projects or pipelines can have a dramatic impact on biodiversity. Land-use planning and environmental impact assessment are the principal tools for avoiding or minimizing the adverse impacts of infrastructure development on biodiversity. There is consequently need for more

legal incentives that promote voluntary action to complement legal restriction through legislative process. Essentially there is the need to confer jurisdiction and powers on public bodies and local communities for conservation, establishing and enforcing procedures such as environmental impact assessment; and providing legal bases for conservation contracts and for equitable sharing of benefits.

Public involvements in urban green space planning and management scheme have come to play an increasingly important role. Planning and management should involve the attention of the private sector. An adequate urban green space planning and management framework, which ensures successful partnership between residents and public sector, should be the key factor in managing the impact of urbanization on biodiversity to maintain an ecologically sound environment.

The Convention on Biological Diversity recognizes the link between indigenous communities embodying traditional life-style and sustainable use of biodiversity. The Convention - Article 8 (j) - calls upon contrasting parties to respect, preserve and maintain the knowledge, innovation and practices of these communities relevant to the sustainable use and conservation of biodiversity. Customary laws and legal systems share a number of characteristics that set them apart from the modern legal orders. Customary laws concerning biotic resources can often be found where land, water and their resources support a broad array of activities.

Indigenous people with a historical continuity of resources use practices often presses valuable knowledge about the behaviour of complex and transiting ecological systems in their own localities. The Quas who predominantly reside in the area designated "Satellite Town" have accumulated knowledge through a series of observations on local environment for the provision of resource. Such knowledge is vital as it relates to biodiversity management. The areas in which indigenous people can participate include information gathering, consultation, decision-making, initiating action and evaluation.

CONCLUSION

The world today is economically richer and environmentally poorer than before. Enormous economic activities have had its most visible effect on the urban green spaces. One of the consequences of the destruction is the accelerating loss of species. A recent study estimates that 11 per cent of the bird species in the

urban areas in Nigeria are threatened by developmental activities within the urban setting (Esspee 2006).

The fact is that with the advances in the knowledge of ecology, the environment and the effects of human actions upon it, we do not have the excuse of collective ignorance anymore. Man in the quest for economic growth, paid little or no attention to the environment. In pursuit of settlement rejuvenation, infrastructure development were established for their benefits without due regard to their impact on the urban green spaces.

The concern for biodiversity protection against all manner of development has reached maturity in Nigeria. However, the complexities of the issues involved call for special solution that recognize the differences in developmental levels of states as well as how people relate to the environment. Sustainable development is by far most appealing way of urbanization that preserves the biodiversity. The campaign is specifically designed to popularize concrete action for government, business communities, private organizations and individuals to help support the initiate.

It has been suggested that the nation's research for a new approach to urban planning must emphasize and incorporate indigenous participation in decision-making and planning. According to Ayeni (1998) people's involvement in urban administration must increase not in a cosmetic way but in ways that identify and incorporate the views of all stakeholders in the planning and management process and seriously address their problem. The analysis of location and the development of operational location strategies should provide views that are more comprehensive for understanding, planning and managing biodiversity in new urban settlements.

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