



Full Length Research Paper

Biodiversity loss: A threat to urban landscape

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Human creative and productive activities take place in the environment and as population grows, pressure on biodiversity arising from higher consumption levels elicit implications. ecosystems transformation in urban infrastructural development and attendant depletion of natural resource stock of contiguous hinterland with little concern for site and species of conservation interest manifest in land decline as well as urban decay. In the federal capital territory (FCT), the influx of people and disturbance of the environment are exacerbated by the deliberate policy to open an extensive low density area for administration and ensuring physical imperatives for a new capital for Nigeria. Establishment of ex-situ conservation schemes such as parks, biological gardens and arboreta, and some measures of landscape architecture would serve as tools for sustainable development of sites of scientific interests, urban recreation, conservation and preservation of species for posterity.

Keywords: Biodiversity, Urban development, Landscape, Impact and Conservation.

INTRODUCTION

Most of humans' creative and productive activities take place in the environment and as population grows, pressures arising from higher consumption levels elicit significant ecological implications. These impacts range from biodiversity loss to decline in soil fertility, deforestation and desertification. Demographic surge translates into multiplicity of needs that brings about accentuated demands on the environment's productive capacity. An insatiable appetite for consumer goods and services beyond immediate survival requirements and thus wasteful consumption of resources by privileged as well as the underprivileged segments in the society exacerbates this stress (Mc Neely, 2006).

Land in most parts of the developing world through age-long traditional practices, provides communities with the desired sustenance. Market-driven intensive agricultural production designed to keep pace with growing rural and urban population enhances income. This places land and land-based resources under pressure in the bid to secure settlements, food and medicines thus seriously jeopardizing the capacity of ecosystems to sustain such activities.

Landscape degradation most commonly describes the central process in environmental degradation (IFAD, 1992). It emanates from related factors and socio-economic exigencies influenced by continuous rise in human population figures and associated demand on environmental resources. The phenomenon of

degradation poses a threat to the livelihoods of millions of people. As a primary implication that reduces productivity, the process fundamentally affects vegetation, wildlife, agricultural crops, livestock, forests, non-timber forest products and water resources conservation (IFAD 1992). Urban development for instance, has been on the increase since colonial era when ethnic rivalry paved way for civil administration. The urban centers have served as focal points for commerce, defense and civil governance, which resulted in growth at the expense of environmental quality and conservation of natural resources. In spite of this scenario, scientists only started using the term "biological diversity" in the mid 1980's that flowed into the mainstream when the Conservation on Biological Diversity (CBD) entered into force in 1993.

Justification

The decision to develop Abuja as a Federal Capital for Nigeria was one of those bold ventures symbolizing a commitment to national growth. Through the Federal Capital Territory (FCT) Act No. 6 of 1976, the Federal Government set the dream in motion. The promulgation of the Act was a culmination of decades of agitation by the people to move the Federal Capital out of Lagos, south east Nigeria. The physical development

commenced in 1980 after a four-year hiatus dedicated to commissioning background studies to produce Master and Regional development plans. Modifications, adjustments and tampering with the biological resources of the region in line with the provisions of the development plans for the realization of set administrative and political goals deploying modern construction technology, elicit impacts on the landscape. The approach involves both constructive and destructive measures in harnessing biodiversity.

It is pertinent to express concerned about the rate of biological resource degradation without adequate conservation steps to ensure sustainable progress in socio-economic development. This is because loss of biodiversity and land degradation, erode potentials for such socio-economic development (WCED, 1987). However, the adverse implications to some extent could be avoided and regulated through adequate planning. Impact assessment of new large scale projects therefore becomes increasingly recognized as an essential adjunct to economic and technical evaluation since, according to Zimmerman, 1982, lack of concern for environmental consequences may prove costly.

Scope of study

The Federal Capital Territory (FCT) covering an area of 8,000 square kilometers is divided into six (6) Area Councils, viz: Abaji, Bwari, Gwagwalada, Kuje, Kwali and Abuja Municipal. Physical infrastructure development is concentrated in the Municipal Area Council, which accommodates the Capital city. The research was designed to evaluate the threat of loss of forests, forestlands, wildlife and biodiversity to the vast landscape. It assembled information on the changing ecology of species as well as the changes in environmental characteristics.

METHODOLOGY

Sampling technique

The existing six administrative area councils defined the strata used in the study. A 3-stage stratified random sampling designed was used in data collection. In each selected settlement, a reconnaissance survey of the land area was carried out to assess the housing patterns. Based on the understanding of the settlements pattern, each of the settlements was divided into strata of 100 households for convenience. Out of these, 10% of the total number of strata of 100 households was randomly selected to the nearest units from each settlement for data collection. A 12¹/₂% sampling intensity was applied to select households from the selected strata in each settlement. The heads of families in selected households

were identified and interviewed using a structured questionnaire.

In addition to the selection of respondents from the various settlements in FCT, respondents were also drawn from institutions within the stakeholder sectors, which include officials of the Ministries of Agriculture, Education, Environment and Health as well as National Planning Commission (NPC) and Non Governmental Organizations (NGOs).

These respondents constitute samples in the formal and informal sectors of the urban and rural communities living in the selected settlements. This examined the social, ecological and cultural issues with specific focus on socio-economic evaluation of infrastructure development, environmental degradation, forestry practices and ecosystem changes in urbanization.

Field observations were also carried out on various activities and features to:

- Identify the socio-economic development projects in the major satellite settlements;
- Assess ecosystems and vegetation status in relation to population growth and increasing human activities; and
- Determine the variation in terms of infrastructure development between and within the area councils.

Besides the use of questionnaires and field observations, discussions with key members and individuals in the settlements, data were also obtained from available relevant literature, files, publications and other documents. These include the Nigerian Land Use and Vegetation maps (LUV) derived from 1976-1978 and 1993-1995 Land sat Imageries.

Analysis of data

A total of 520 of the two types of questionnaires were administered. The data collected were subjected to statistical analysis. This involved computations and test of hypotheses at 0.05, level of significance. Three hypotheses were tested. The statistical tools used in the analyses are:

(a) Chi- Square Distribution

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Where:

χ^2 = Chi - Square

O_{ij} = Observed frequency in $i - j$ cell

E_{ij} = Expected frequency in $i - j$ cell

$$E_{ij} = \frac{(\text{Row total})(\text{Column total})}{\text{Overall total}}$$

χ^2 = Value of random variable whose sampling distribution is approximated by Chi-square distribution.

(b) Student's t-distribution

$$t = \frac{\bar{X}_a - \bar{X}_d}{\sqrt{\frac{S^2 \bar{X}_a - \bar{X}_d}{n}}}$$

Where:

 $\bar{X}_a = \text{mean of yes}, \bar{X}_d = \text{mean of no}$

$$n = \text{Sample size}, S^2 = \text{Variance}$$

$$\sqrt{\frac{S^2 \bar{X}_a - \bar{X}_d}{n}} = \text{Standard error for differences between mean}$$

Data were also analyzed using statistical techniques that involved classification of respondents' disposition, and computation of simple percentages and means.

RESULTS AND DISCUSSION

Exceptionally landscaped by nature prior to 1980, the Federal Capital Territory (FCT) located in the vast bowels of a virgin arid savanna has undergone over two decades of human husbandry. At creation by Act No. 6 of 1976, four years was dedicated to conducting background studies to evolve comprehensive development plans. The structural designs were aimed at putting in place mechanisms for guiding envisaged monumental infrastructure development. About 80.7% of the sampled population expressed pervasive mutation of the concept to a range of 40% to 60%. Under the military regime, which terminated in 1999, changes inimical to desired socio-economic and ecological balanced fraught the master plan. Land allocation encroached on designated green areas, floodplains and fragile marginal ecosystems with little consideration for ecological principles. Apparent violation of the development plans hinged on faulty political will and commitment have implications on biological diversity.

Large-scale destruction of forests and vegetation though worthwhile in the evolving circumstances, deliberate reconfiguration of a mixture of high forest and savanna-a repository of biological diversity- for urban infrastructures predisposes the land resource base to flood and degradation. In the view of 10.9%, 39.1% and 48.4% of respondents, land subsidence, flood and erosion respectively are becoming prominent ecological features. Physical field observation confirmed these indicators of landscape degradation. It is however noteworthy that certain biological fact is fundamental to growth and development. In daily contact with the biosphere, the society cannot modify the environment with total disregard to structural relationship of the ecosystems. Great risks are associated, but when resources are bountiful and population low, gradual

manipulation and application of conservation principles ensure balance in ecosystem functioning (Bosselman, 1979). A Chi-square analysis, ($\chi^2_{\text{cal}}=1.828 < \chi^2_{\text{tab}} = 5.991$) of 87.8% of respondents on the adverse impacts of concentration of development facilities and high population density indicates that such scenarios degrade the landscape (Table 1). And in consonance with Girardet (1996), concentration of facilities, economic activities and population culminate in consumption levels and pressures to the detriment of the environment. Physical development concentrating of facilities and population attract costs. Nevertheless, a concentration of enterprises serves as development poles, which radiate socio-economic advantages to adjoining areas. These areas in turn experience growth in both population and socio-economic activities and expand into focal nodes where the practice of subsistence agriculture, expansion of settlements, hunting, wood extraction, exploitation and infrastructure development, have implications on biodiversity (Okali, 1990). New settlements as well as expansion of the old ones conflict with conservation interests.

Ecosystems transformation in urban growth and infrastructure development, and depletion of resource stock of bordering hinterlands with little concern for issues of conservation interest manifest in land decline, urban decay and collapse, Forester (1969), however holds the view that growth and stagnation of an urban area require no changes in the environment as a cause. In contrast to Forester (1969) and in support of the opinion of the respondents, Tolba (1992) expressed that infrastructure development and urbanization impact on the environs through pressure on ecosystem resources, flow of materials, products, energy, water, and wastes. Forester's (1969) dissenting view is not unrelated to periods in historical trends when the activities of man were in harmony with ecological processes. Thus, pressures on the environment as evident in FCT shift biological equilibrium whereby the rate of regeneration no longer matches the rate of exploitation and manipulation. The effect manifests in diminishing biodiversity, which in the coming decades pose threats to soil fertility and land productive capacity.

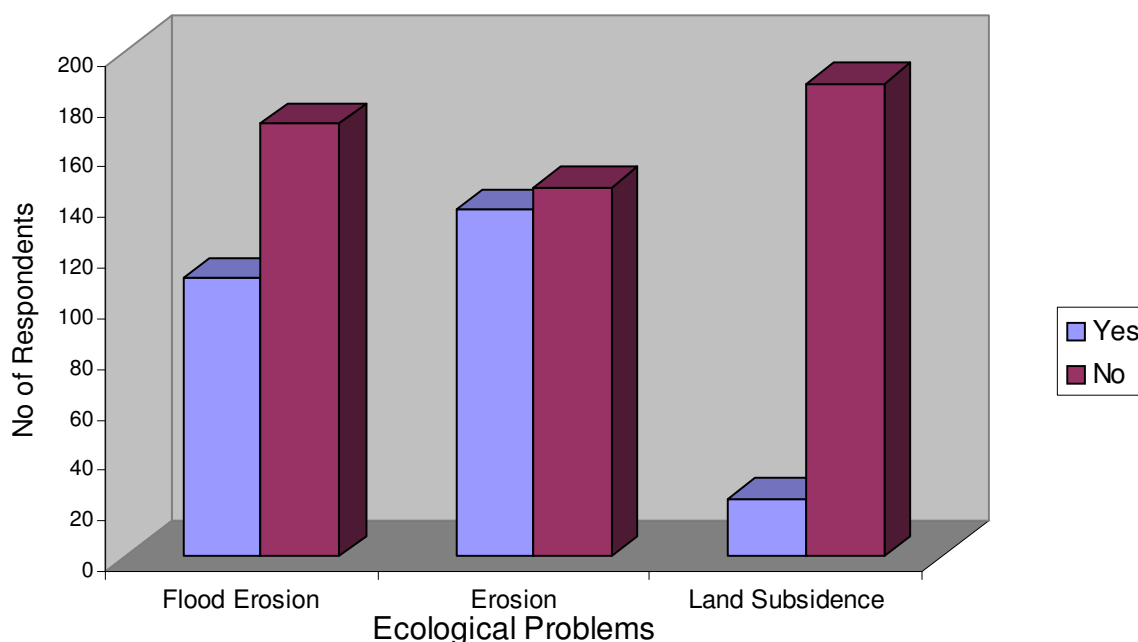
Construction of roads, dams, airports and erection of buildings, all lead to biodiversity loss and impairment of ecological cycles. Concentration of people indeed introduces elements such as modern transportation mechanisms, drainage systems and infrastructures. In response to the needs of the modern administration and economy, the process initiates physical structures for industrial complexes, commerce and communication. Such service infrastructures in agreement with Mc Loughlin (1969) in a short time offset an ecological relationship between biotic and abiotic communities that evolve over centuries. The changes in environmental features are therefore functions of interactions as locating infrastructures guide spontaneous movement and

Table 1. Effects of concentration of development facilities on the environment

STATEMENTS	RESPONDENTS' OPINION		
	AGREE	UNDECIDED	DISAGREE
The Concentration of urban infrastructure in the municipality degrades the environment.	100	78	65
The Concentration of urban infrastructure in the municipality does not degrade the environment	46	28	34

Source: Field Survey, 2000.

$\chi^2_{cal}=1.828$, $\chi^2_{0.05}=5.991$ df=2

**Figure 1.** Ecological problems in the territory

interference with ecosystems. Human populations retained or kept out of specific areas aptly demonstrates one of the tools used in ensuring efficiency in development investments, service provision and conservation of renewable resources.

Flood, erosion and land subsidence as indicators of ecosystems degradation prevail in the territory. A large proportion of the respondents are unaware of emerging ecological problems. However, 10.9% of respondents attested to occurrence of land subsidence while 39.1% and 48.4% indicated that flood and erosion respectively are prominent (Figure 1). Field observation confirms land subsidence in construction and excavation sites and denuded catchments.

Development in all intent and purpose enhances human well being and comfort yet degrades the environment under unfriendly scenarios. Impact assessment reduces or mitigates potential adverse effects while ensuring harmony between the need for more infrastructure development, resource conservation and environmental protection. The lure to postponed

preventive measures of less obvious and more invidious impacts spell disaster that prove costly for any meaningful intervention. Empirical field observations reveal that 92.2% of 295 respondents acceded to the imperatives of conducting EIA in the execution of major projects (Table 2). The observations agree with the views of Baoteng (1990), Devuyt (1993), Lefcoe (1979) and Zimmerman, (1982). A lapse indeed exist in monitoring and enforcement of EIA Act No.86 of 1992 and this has been one the major factors responsible for undesired anthropogenic activities that elicited the on-going painful demolition in the study area.

Furthermore, ecosystems degradation and soil erosion relate to deforestation and the processes in the view 79.9% of the respondent (Table 3) lead to biodiversity loss. The unfolding severity of the consequences requires utmost attention.

Urban growth and development contribute to deforestation and decline in life-sustaining ecosystems. Removal of vegetation leads to loss of regenerative capacity of land through erosion, loss in soil fertility and

Table 2. Respondents' opinion on the relevance of EIA in development

DEVELOPMENT AREAS	NUMBER OF RESPONDENTS		TOTAL RESPONSE
	EIA ESSENTIAL	EIA NOT ESSENTIAL	
Federal Capital Territory	93	9	102
Other Urban Centres	90	7	97
Industrial Establishments	89	7	96
Total	272	23	295
%	92.2	7.8	100

Source: Field Survey, 2005

Table 3. Severity of infrastructure development problems

S/NO	ENVIRONMENTAL PROBLEMS	NO OF RESPONSES	%RESPONSE
1	Deforestation	448	33.4
2	Land degradation	331	24.7
3	Soil erosion	293	21.8
4	Water pollution	115	8.6
5	Bush burning	154	11.5
	TOTAL	1341	100

Field survey, 2005

instability in hydrological cycles. Biodiversity loss caused by extensive forest removal combines with soil erosion, nutrients deficiency and pollution to degrade ecosystems. A dormant vegetation comprising of savanna, riparian, undisturbed patches of tropical high forest covering 39.4% of the FCT in 1976/78 imaginary dwindled to 21.1% in 1995. The imageries indicate that over 55% of the forest resources have been liquidated; a development that threatens the landscape.

CONCLUSION

A deliberate socio-political policy to transform an extensive low-populated biodiversity rich region neglected before the late 1970's, altered hydrological cycles and forest composition. Biological diversity loss arises from deforestation, habitat fragmentation and re-configuration of land resource base in the quest to meet human exigencies. The process of urbanization interferes with ecosystems because people who are the principal players in the process introduce interventions that have adverse implication on biological diversity. Opening areas in the heart of a mix of tropical forest and savanna for the administration of Nigeria exacerbates the impacts. Its physical development elicits pressures and adjustments which influence the people with impacts on the environment and biological diversity that constitute a threat to landscape. Population movements and putting in place service infrastructures imply planned and

unplanned measures on inter-related biological processes eliciting adversities on forests and wildlife, water and soil resources conservation.

Inadequate measures to stem floods and landscape degradation signal disasters. In urban growth and development, unavoidable forests destruction, alteration of hydrological regimes as well as pollution and resource degradation, occur (Mc Loughlin, 1969; Spears, 1982). Establishment of ex-situ conservation schemes such as parks, biological gardens and arboreta, and some measures of landscape architecture would serve as tools for sustainable development of sites of scientific interests, urban recreation, conservation and preservation of species for posterity.

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