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GEOGRAPHICAL INFORMATION SYSTEM APPROACH TO URBAN REFORM: A CASE STUDY OF MAKWALLA AREA OF BAUCHI, BAUCHI STATE, NIGERIA

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ABSTRACT

The associated impacts of the dynamic and complexity of urbanization on the environment is much destructive to our safe living in so much that urgent proactive measure is highly desired if we are to preserve sustainable environment. This paper investigates violations to environmental standards and bylaws in Makwalla Area of Bauchi, Bauchi State, Nigeria using Geographical Information System technique and classical surveying methods. The data generated were manipulated and analyzed in ArcGIS 9.2 version environment. The analyzed and processed data were employed for the creation of a comprehensive database and the topographic map of the study area which can be very useful to Urban Planners, Environmentalists, estate developers and other stakeholders in order to successfully accomplish the laudable task of urban reform in Nigeria. The results of this study revealed gross violations to international standards for environmental practices and habitation (shelter) developmental standards, as highlighted in this paper. In view of the adverse effects of these violations on the environment and its health related impacts on human lives, it is recommended that stakeholders' participation, capacity building and development, technical framework; legal framework must be taken into consideration in order to ensure the success of the envisaged urban reform program.

Keywords: *Urbanization, Violation, Geographical Information System, Urban reform, Sustainable environment*

INTRODUCTION

The level of world urbanization today and the number and size of the world's largest cities are unprecedented. At the beginning of the twentieth century, just 16 cities in the world (the vast majority are in advanced/industrial countries) contained a million people or more. Today, most commercial capitals and administrative capitals of many countries contain a minimum of million and about seventy percent of them are found in the developing world. The World population has grown exponentially in the 20th century from around 1.6 billion in 1900 to around 6.1 billion today, with each additional billion people being added more rapidly than the last. The vast majority of this growth occurs in the developing world. According to Barney (2006), by 2007 for the first time in human history, more people in the world will be living in cities and towns than will be living in rural areas and by 2017 the developing world is likely to have become more urban in character than rural. He went on to say that the available data suggested that in a large number of the world's poorest countries, the proportion of urban poor is increasing faster than the overall rate of urban population growth and has it that an estimated 72 percent of the urban populations of Africa now live in slums.

There is an unequal urban growth, which is taking place all over the world, but the rate of urbanization is very fast in the developing countries (Rahman et al 2011). The speed and scale of the urban transformation of the developing world presents formidable challenges. Rapid urban growth throughout the developing world has seriously outstripped the capacity of most cities to provide adequate basic services for their citizens. Nevertheless, each year cities attract new migrants who together with the increasing native population, expand the number of squatter settlements and shanty towns, exacerbating the problems of urban congestion and sprawl and hampering local authorities' attempts to improve basic infrastructure and deliver essential services. The urban air is in most cases are very much polluted because in addition to the jam-packed population, industries, automobiles and other phenomena, green plants which naturally help clean up air, by taking in the polluted air and releasing fresh oxygen into the atmosphere has very much been insignificant as the pattern of urbanization in much of the world, leaves very little or no space for vegetations and plant life. Buttressing this point with the view of Igbokwe et al (2010) which in line with economic sense, says high population density typically implies lower per capita cost of providing infrastructure and basic services while Ravindra, et al (2011) says the positive aspects of urbanization have often been overshadowed by deterioration in the physical environment and quality of life caused by the widening gaps between supply and demand for essential services and infrastructure. Lagos Nigeria is a clear example of urban decay with high cost of living and polluted air in so much that black greasy patches are common on vehicles and structures.

Statement of the Problem

The major problems associated with urban centre in Nigeria is that of unplanned expansion, fragile implementation and crippled enforcement of institutional and legal standards and bylaws, inappropriate technology that can efficiently handle large volume of spatial data and the dynamics of urbanization process. The appalling environmental conditions associated with the process of urbanization and settlements constitute a major threat to the health and well-being of urban life. In a way urbanization is desirable for human development. However, uncontrolled urbanization has been responsible for many of the problems, our cities experiences today, resulting in substandard living environment, acute problems of drinking water, noise and air pollution, disposal of waste, traffic congestion (Ravindra, 2011). Sometimes, underlying the poor management situation is the lack of appropriate information base or the phenomenon of planning without facts (Ayeni 2003). Despite being in the information age, there are still problems getting the appropriate information to help in making the right decisions. Poor decisions are frequently made because we do not know who holds the information we require and how to get hold of it. In emphasizing this importance Olaleye et al,(2003) quoted Egerton (1905) that 'Give me roads- good, broad and straight right through the jungles from one tribal area to the next- then we can let in the light'. In Bauchi a parcel of land is generally $15m^2$ which is definitely too small for proper housing development. People in most cases fully developed their land and often encroach to the right of way by erecting different structures on them and in some cases the buildings extend into the road. This made most of the local government roads very narrow and difficult for

vehicles to pass through as experienced often by emergency vehicles especially the fire brigade. In view of this, many properties worth millions of naira have been lost in fire accident. There is therefore the need for proper need for adequate mapping of the area for proper replanning.

AIM AND OBJECTIVES

The aim of this project is the application of Geographical Information System in urban reform in the Makwalla areas of Bauchi, Bauchi State, Nigeria.
The specific objectives of the paper are as follows:

i. Examining the spatial pattern of urban settlements distribution in the study area
ii. Determining settlements located on the Right of Ways (ROW) of urban road networks
iii. Identifying existing facilities in the study area
iv. Highlighting urban violations to environmental practice standards and bylaws
v. Producing the map of the study area to aid the implementation of the urban reform programme

THE STUDY AREA

Bauchi State lies between latitude 09° 52^{I} and 09° 86^{I} North of the Equator and longitude 10° 45^{I} and 10° 45^{I} East of the Prime Meridian. The study area is located in the heart (centre) of Bauchi metropolis.

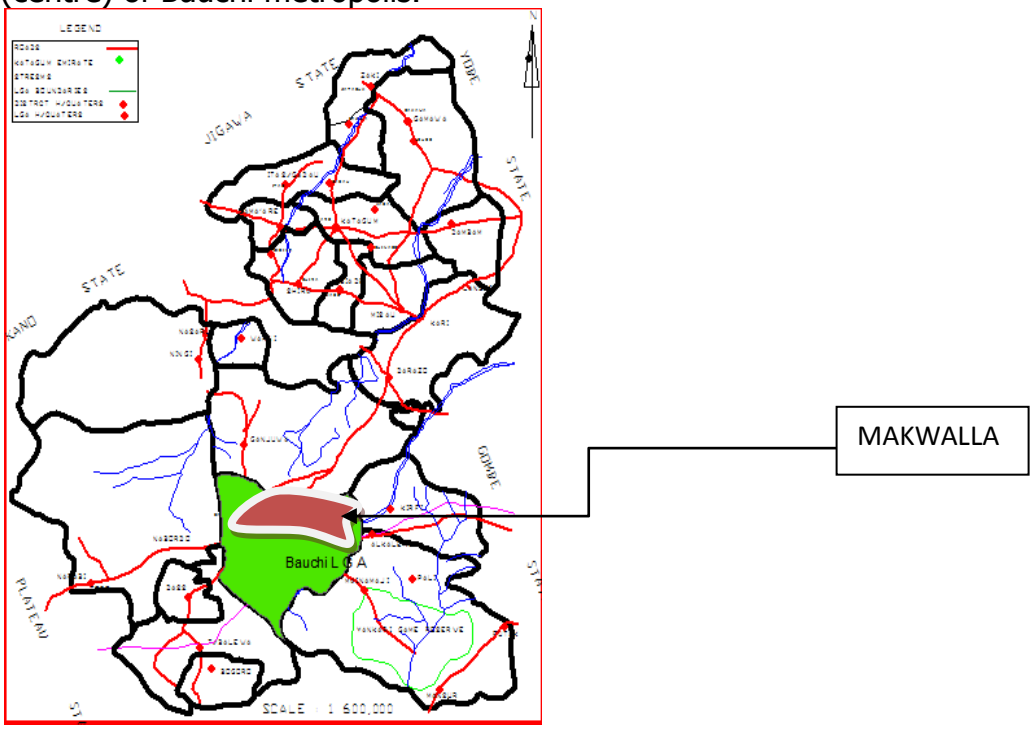

Fig.1 Map of Bauchi State highlighting the study area within Bauchi Local Government Area.

Institutional Framework

Institutional framework is defined as the systems of formal laws, regulations and procedures, and informal conventions, customs, and norms that broaden, mould, and restrain social economic activities and behavior (Atilola, 2011). Currently, many small cities lack the necessary institutional capacity to be able to manage their rapidly growing populations. As cities grow and evolve, the task of managing them becomes ever more complex. For urban reform to be successful it has to be hinged on a formidable institutional framework that underscores stakeholders' participation. The institution should be such that will enhance regular monitoring and strict enforcement of environmental standards and specifications for a sustainable reform.

Technical Framework

Technical issue is one of the major challenges in urban reform programme in Nigeria and most developing nations of the world. Nigeria is poorly mapped, large areas of the country is currently unmapped at relevant scales (Atilola, 2011). This is because of the absolute lack of 'up to date' pre-requisite maps, inadequate geoinformation, and insufficient technology that properly define whether or not the possessory rights of urban parcel owners are in excesses or in conformity with the environmental practice standards and bylaws. The envisaged urban reform should be based on a sound technical framework, in order to enhance the acquisition and access to reliable geoinformation and cadastral.

The need for sound scientific knowledge and technical expertise in the formation of well urban policy in Africa is clear, a recent comprehensive review of the state of urban research in Africa found that in many parts of Africa urban research has been in serious decline both in quantity and quality since the 1970s (Cohen, 2006)

Conceptual Framework

To begin to deal with these challenges will, at a minimum, require accurate projections of urban reform policies and strategies which in turn must be based on the prime indicator of successful and sustainable approaches, is the identification of 'best practices for improving the living environment". The concept of urban reform sought in this paper is based on stakeholders' participation, capacity building and development, and a sound technical and legal approach aimed at:

(i) Assessing and evaluating the current situations that exist in the urban areas
(ii) Identifying the excess of the urban dwellers, in terms of their possessory rights and violations of such rights
(iii) Exploring sustainable options in order to adopt the best options that meet the requirement for sustainable reform.
(iv) Formulating plans and strategies that will bring about the desired changes.

Benefits of Urban Reform

The envisaged urban reform programme if well implemented, would

(i) Offer important opportunities for economic and social development.
(ii) Become focal points for economic growth, innovation, and employment.

(iii) Provide natural advantage in transport or raw material supply.
(iv) Offer vast modern productive activities visa vise employment opportunities
(v) Promote modern living which would consequently result in general health and wellbeing
(vi) Offer important social and cultural centers that house museums, art galleries, film industries, theaters, fashion houses, and other important cultural centers.

METHODOLOGY

Research Materials and Resources

The resources used in this paper are classified into two categories namely: - the research tools and the research data. The research tools refer to the system hardware and software used, whilst the research data, refer to the information/data used.

Research Tools

The research tools consists of the hardwares and softwares used for this study include:
The hardware components used in this project include;

- Intel Pentium, CPU, 1.60GHz Processor, 512MB RAM ,60GB HDD
- HP Printer.

The following softwares were adopted in this study:

- ESRI's Arc GIS 9.2 GIS Software
- Microsoft Excel 2003
- Microsoft Word 2007
- Window 7 Ultimate Operating System

RESEARCH DATA

Table 1: Data sources

Data	Source
Quickbird Image of Bauchi State	Dept. of Surveying and Geoinformatics, Federal Polytechnic, Bauchi
Map of Bauchi Road networks	Dept. of Surveying and Geoinformatics, Federal Polytechnic, Bauchi

Data Acquisition

This paper adopts the field survey and social survey methods for the acquisition of spatial and non spatial data of the study area. The spatial data were acquired using Garmin 75XL handheld GPS receiver and the on-screen digitizing tool of ArcGIS 9.2 software version, whereas the non spatial data were obtained from interview and the existing map of Bauchi state.

FIG 2 Showing the Satellite image of the Study area

RESULTS ANALYSIS

The data gathered were analyzed in ESRI ArcGIS 9.2 application software, subsequently the analyses of the results include the proximity buffering, and spatial queries of the urban violations to environmental practice standards and bylaws.

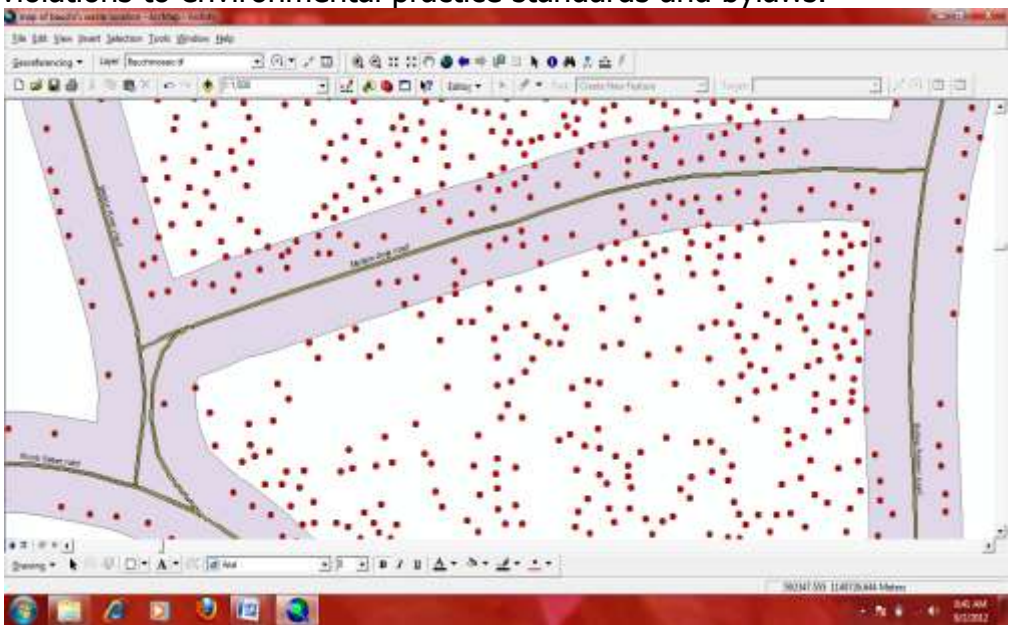

Fig.3: A 25m proximity buffer of road networks in the study area showing buildings on the road's ROW

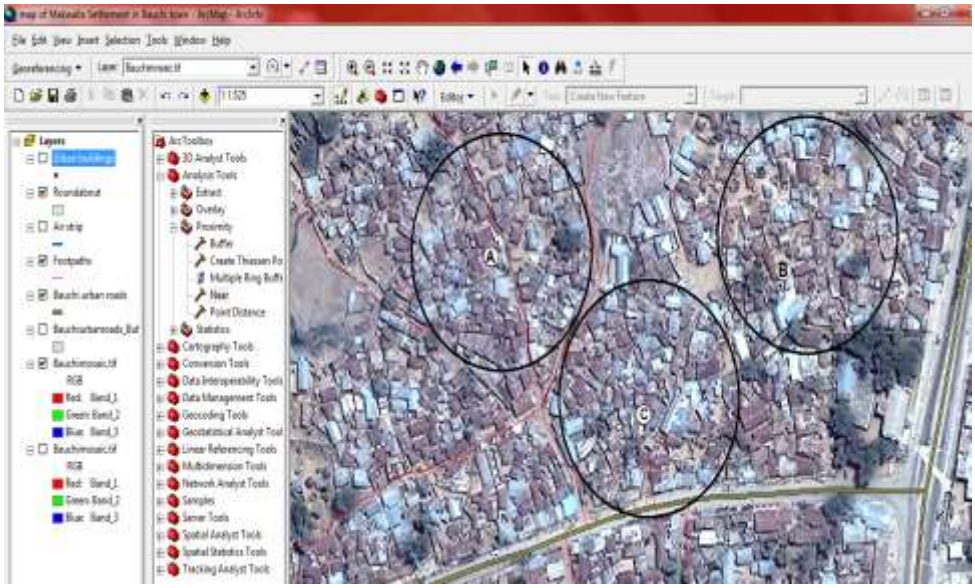

Fig.4: A 50m radius buffer showing buildings within an approximate area of 7857.14m^2, on the satellite image of the study area.

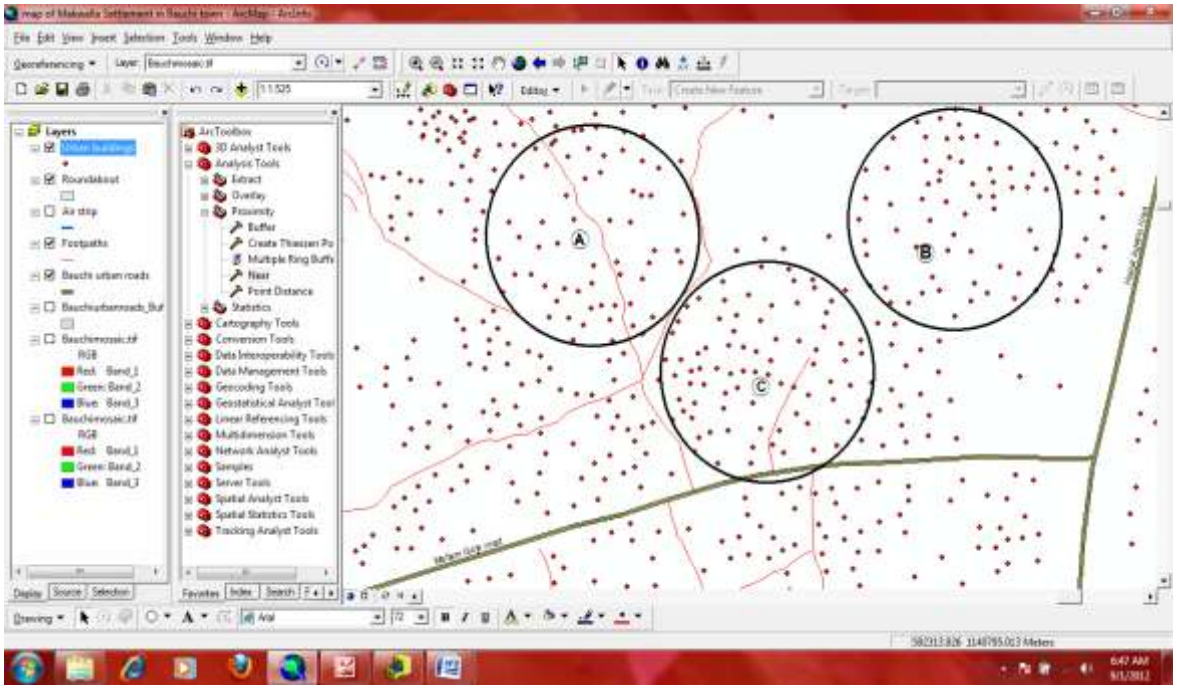

Fig.5: A 50m radius buffering analyses showing buildings within an approximate area of 7857.14m^2, in the study area.

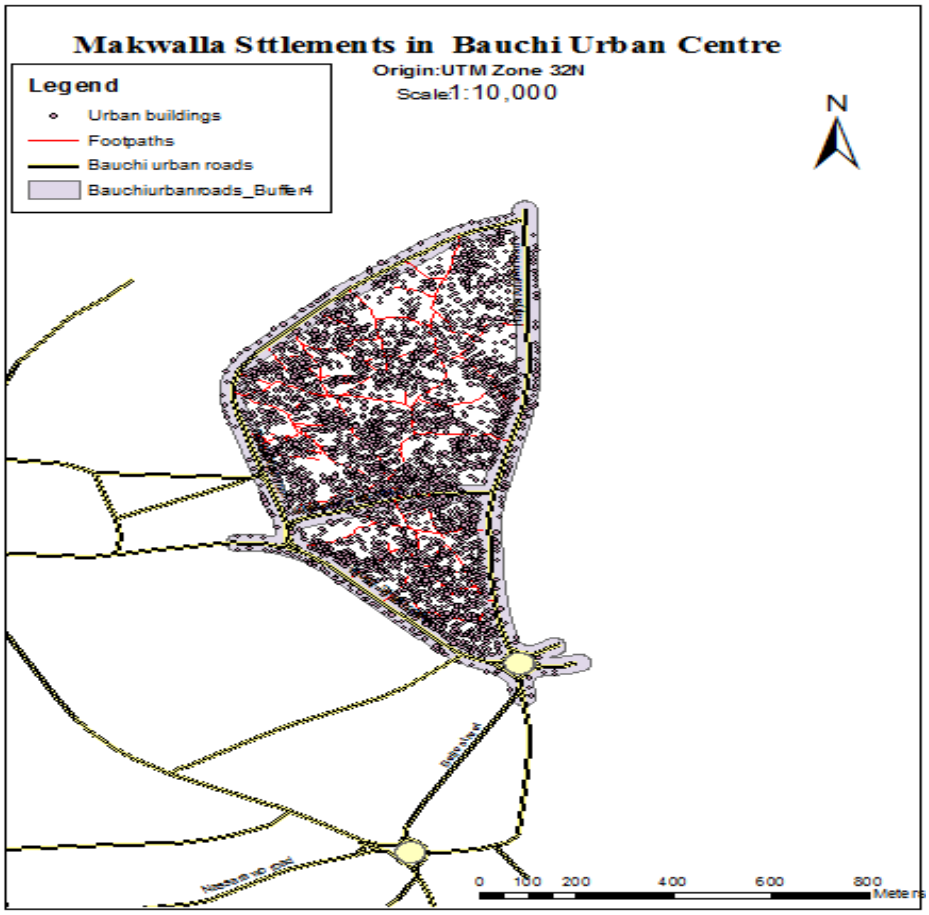

Fig.6: Map showing the study area as compiled by this researcher from the satellite image

DISCUSSION ON FINDINGS

The results of the analyses and findings in this study would form the benchmark for sustainable urban reform that would consequently enhance environmental sustainability. The results of the spatial analyses revealed the following urban violations to environmental standards:

1. Reference to the proximity buffer of 25m of the only road networks that enclosed the study area depicts a reasonable number of buildings are on the right of ways (ROW).This is a gross violation to specified setback of the right of ways (ROW) of township roads
2. Building line specifications of 16metre were grossly violated. In fact in most cases there were no setbacks completely.
3. Reference to the 25, 50metre buffer analyses at three locations in the study area revealed about 57 and 79 buildings respectively within an area of about 7857.14sq m at those locations.
4. Lack of proper road networks, drainage and sewage system in the study area are the situations which will obviously hinder emergence services in case of disaster.
5. The study area is overcrowded with compacted buildings which made it extremely difficult to clearly define property lines in the study area

CONCLUSION

It is evident from the foregoing study that major urban environmental problems occur here due to the high population growth with the uncontrolled and mismanaged urban expansion which has led to the doubling of this densely built-up area during last decade in this area. Not surprising as this is common to almost all the urban centers in Nigeria. The high density of urban population and its attendant fringe areas of the solid waste dump sites caused pollution loads which thus affected the air, water and the adjoining land in this area.

The modern technology of remote sensing coupled with GIS technique as used in this project have proved its ease of access to physical data with speed on repetitive basis and has helped in no small way to analyze the data spatially thereby offering possibilities of formulating various options optimizing the urban reform process.

RECOMMENDATIONS

- The officials of various government departments should be given thorough exposure and training of Remote Sensing and GIS for its application and implementation in the urban environmental management plans. This is because social survey indicated that many planners cannot effectively use GIS facilities.
- The governments at the federal and state levels should continuously review and update existing legislation with respect to urban planning, building standards, infrastructure, and environmental regulations in order to make them more realistic, attainable, and compatible with local conditions.
- Various monitoring and regulatory agencies and authorities should provide more enlightenment, encourage stakeholders full participation in the reform process, as well as providing appropriate and flexible regulatory framework that is compatible with local conditions and that will enhance sustainable environmental.
- The government should provide supportive and enabling environment in order to ensure an enhanced security of land and housing tenure for the poor and give them a sufficient stake in and incentives to improve the quality of houses as means of preserving the sanctity lives and environmental sustainability.
- The government should develop a comprehensive institutional capacity to be able to manage the growing urban populations through a sound scientific knowledge and technical expertise in the formation of Urban policy and programme in Nigeria

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