THE IMPACT OF ENVIRONMENTAL AND SOCIO-ECONOMIC ACTIVITIES ON LAND COVER/LAND USE PATTERNS OF AUCHI, EDO STATE, NIGERIA.

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ABSTRACT

The un-controlled land use/land cover activities in the urban center of Auchi have generated some environmental problems in the area. The land use/land cover structure of the area is defective due to indiscriminate acquisition and allocation of urban lands among various uses. This study made use of remotely sensed image and GIS approach for the manipulation and analysis of the captured data. Quickbird image of the area was obtained and up-dated using Hand –held GPS and through informal interview. The image was geo-referenced and digitized using ArcGIS 9.3 software. Database was designed and created. Various analyses such as geometric data analysis, attribute database query, statistical computation and thematic mapping were carried out. In Auchi, only about 2.4% of the total study area is used for commercial activities, industrial 0.43%, public services 3.08%, transportation 1.21%, while built up area occupies 36.83% of the total land cover. The results showed that the land use/land cover activities in the study area are not controlled and as such as led to environmental pollution, poor circulatory system, erosion and flood in notable areas of the urban center. Analyses further showed that there have been tremendous land use activities with residential dominating. As part of the recommendations made, it was suggested that database should be created and master plan developed to show in detail how the entire land in the area should be utilized, also in view of the absence of virile land use/land cover policies and coupled with poor implementation, models for effective land use/land cover policies were recommended

KEYWORDS: Land Use, Land Cover, Remotely Sensed Image, and GIS.

INTRODUCTION

The land use and land cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Due to immense agricultural activities and demographic pressures on land, it is becoming a scarce resource; hence information on land use/land cover and possibilities for their optimal use is essential and relevant to the selection, planning and implementation of land use/land cover scheme to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use/land cover resulting out of changing demands of increasing population. Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes.

Land use and land cover change plays an important role in global environmental change. It is one of the major factors affecting sustainable development and human responses to global change. The scientific community has now come to recognize diverse roles of land use and land cover change (Lambin and Geist 2003, Turner et al.., 1995). Consequently, the need for an understanding of land use/land cover change has been increasingly recognized in global environmental research (Lambin and Giest, 2003). The extent and rates of change in land cover and some land uses are known with some certainty (Turner and Meyer, 1994). According to Turner et al 1993, most of

the earth's surface is already modified, except those areas that are peripheral in location or are fairly inaccessible.

The use of land is referred to as land use. Land use is a description of how people utilize the land. Land is a valuable possession to man. Man's activities for survival since creation have been on land where he inhabits and feeds from. He has learnt many ways and means of use, misuse, control and management of land. Land use is the human use of land. It involves the management and modification of natural environment or wilderness into built environment such as fields, pastures and settlements. It has also been defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce change or maintain it (FAO, 2012). Land cover is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground, water, etc. There are two primary methods for capturing information on land cover: field survey and analysis of remotely sensed imageries. Land cover is distinct from land use despite the two terms often being used interchangeably.

As a result of expansion, residential encroachment and unnecessary dumping of wastes, there is occasional flood and erosion. Such flood and erosion have created problems for other land use activities, particularly traffic and residential from where properties are often affected. There is need to map the pattern of existing land cover/land use status of the study area as this aims at

presenting the impact of the environmental and socio-economic activities on the land cover/land use patterns of the study area. The objectives of this study include: identification of the land use/land cover type, creation of land use/land cover database, presentation of the results using maps and evaluating the effect of the existing land use/land cover pattern on the environment and socio-economic activities in the area.

THE STUDY AREA

The study area-Auchi is the Administrative headquarter of Etsako West local government area in Edo state, Nigeria. It lies between latitudes 7° 14^1 North and 7° 34^1 North of the equator and longitudes 6° 14^1 East and 6° 43^1 East of the Greenwich Meridian. Auchi is bounded by Jattu to the East, Aviele to the South, Warrake to the West and Iyuku to the North. Its fast expansion has been attributed to its centrality. It is a transit town which lies along Benin-Okene-Abuja highway. It is a gateway to the Northern part of Nigeria for people from the Eastern and Southern part of the country. The town lies on a depressed site with few valleys and it is highly susceptible to erosion effects due to its depressed nature.

The people of Auchi are known to have originated from ancient Bini kingdom from where they migrated to their present settlement. The founding father of Auchi known as Uchi was said to have migrated with his five children (sons) namely, Utsogun , Akpekpe, Aibotse, Iyekhei and Igbei. The present five quarters are named after the five sons of Uchi (Figure 1.1).

Auchi is located on a slightly undulating terrain with elevation of about 300meters above sea level. The residential buildings mainly occupy the lowland. Slopes and valleys predominantly disrupt the landscape of Auchi. The physical characteristics of the study area have influenced human activities in terms of transportation network, agricultural and commercial activities as well as population distribution thus affecting the land use patterns. These accounts for the type of land use in Auchi as the people are being restricted to building on low areas, which are already choked up with dwelling structures. The physical features of the place account for the scarcity of water, poor drainage condition, and erosion's problem.

Auchi has a tropical climate characterized by two distinct seasons, the wet and dry seasons. Despite its location it has an average annual rainfall of 800-1500mm.

Its leeward position at the feet of kukuruku hill (Akoko-Edo hill) has greatly affected its local climate thus accounting for its low annual rainfall compared to other towns which lies along the same latitude (Oguntoyinbo, 1983). The wet season occurs between April and October with a peak in August and an average rainfall of 150cm. The dry season lasts from November to April with a cold harmattan spell between December and January. The temperature average is about 25^0c in the raining season and 28^0c in the dry season. The climate is sub-humid in Auchi. The vegetation cover of the Guinea Savanna part of the town supported luxuriant vegetation cover, the type that is found in Tropical Rainforest, but had been removed and disturbed by construction, farming and urbanization processes.

The soil type in the study area is classified as soils on loose sandy sediment, which are mainly brownish. They suffer from excessive internal drainage and intense leaching giving them a very strong acid reaction. The structural stability and productivity of the soil is low as a result of the low forest vegetation. The forest vegetation if thick supplies and maintains soil organic matter, and protects the soil against dislocation and erosion (Areola, 1983). As a result of low productivity rate of the soil, farmers move to areas as far as Warrake to farm since places like upper Iyekhei which has better soil and has been used for agricultural practices have been converted into residential areas.

The inhabitants of Auchi are largely farmers (especially the indigenes). However, as an administrative center, white collar jobs are available. A large number of the women are engaged in trading especially street trading and other commercial activities. Auchi has a central market called Uchi market, which is busy most days. Apart from being an administrative center, Auchi provides higher order services such as educational facilities up to tertiary level. With recent development in the political area in Nigeria coupled with ever increasing population of the area (natural increase and migration), the town has witness tremendous changes in the internal structure. Omuta (1983) pointed out that the rapid urban popularity growth in the town which has increased from 35,000 in 1979 to an estimated value of 68,000 in 1991 must have resulted in changes in the physical environment of Auchi.
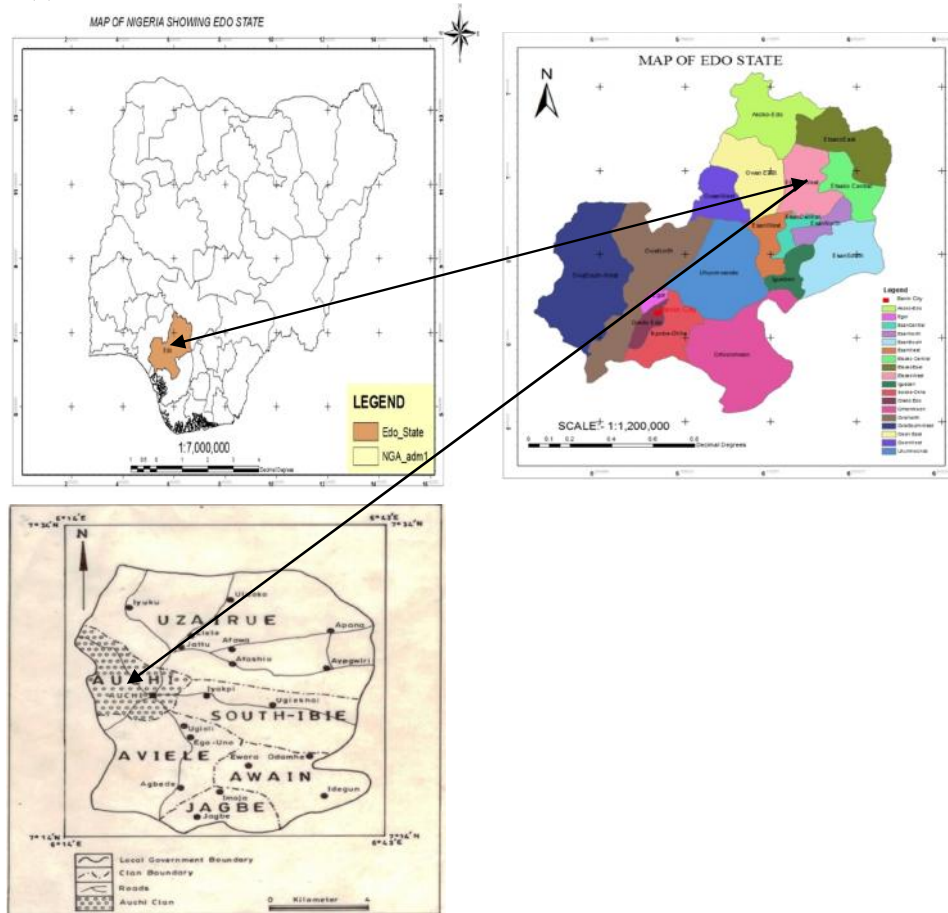
Figure 1.1 Map of the Study Area
Source: State Ministry of Lands and Surveys, Benin City, Nigeria.

MATERIALS AND METHODS
The systems used for this research include the hardware and software components: The Hardware Components include the physical equipments used for the execution of the research and these include: Handheld GPS (Garmin-76S), HP Laptop Personal Computer with the following configuration 120 GB Hard disk size, 2 GB RAM Size, Dual Core processor, HP LaserJet 4100N (black), and HP LaserJet 4100N (colored). The Software Components MapSource Software for the Garmin GPS60 data download, ArcGIS 9.3 was used for vectorization and analysis. Microsoft word 2007 for report typing.

Two types of data are required for this research. These include primary and secondary data. The primary data include satellite imagery of the study area which was gotten via Google Earth on the 26th of April, 2013. Image source is Quickbird with resolution of 0.61m. It was saved in Joint Photographic Expert Group (JPEG) format. Ground truthing was carried out to up-date the imagery. Primary data were equally collected through field observation using Global Positioning System (Garmin-76S Handheld GPS) to acquire co-ordinates of control points used for geo-referencing of the imagery. Secondary and attribute data were acquired through personal interview conducted within the study area. Attribute data such as building type, building name, building use, road name, road type and so on within the study area were obtained through field observation and informal interviews.

The methodology of this research involves the following aspects:
(i) Database design- this involves conceptualization of reality
(ii) Data acquisition-this has to do with capturing data for geo-referencing using Global Positioning System (GPS)
(iii) Database creation-this is conversion of data into the application software for easy processing, manipulation, analysis and retrieval of data.
(iv) Presentation of results- this involves visual display, digital and tabular format.

The satellite imagery was exported to ArcGIS 9.3 environment for geo-referencing. Geo-referencing of each image scene was ensured. The computed geo-referenced parameters were stored in 'table file' of ArcGIS. The processes of image pre-processing and data editing were not necessarily carried out, since the image was gotten via Google Earth which is a Quickbird satellite imagery that provides sufficient accuracy, high spatial resolution (o.61m) and optimum usage for land use and land cover studies.   The controlled approach of mosaicking was adopted whereby a composite picture was made by piecing together two or more images to provide a continuous view of a large geographical area.

FIELD VALIDATION AND CLASSIFICATION SCHEME DEVELOPMENT

Field validation also known as field checking or field verification was carried out to ascertain the accuracy of the interpretation done. This process involves determining in reality the actual presence or not presence of the features sensed. The features that were correctly interpreted were confirmed, while those confusing or uncertain during the interpretation stage were corrected and ascertained. Relevant information not available on the image such as inability to ascertain exactly the type of land use or land cover and extent in regard to area coverage of identified land use or land cover types were obtained by visiting the area in question and through interaction with people in the neighborhood. Also names of places and their particular locations were confirmed by visiting the site in order to accurately assign the appropriate land use/ land cover type. Cases of multiple land use were equally resolved during field validation whereby the predominant land use sufficed.

This exercise was embarked upon for field validation, checking and editing. After the exercise was completed, classification scheme was developed for the study area based on the purpose of the study. The different land uses and land covers identified in the area were well spelt out and categorized into individual layers. Classification scheme was developed. It was developed based on the Researcher's prior knowledge of the area, aim and objectives of the study, source of the satellite imagery, spatial resolution, detail ground truthing exercise and secondary data obtained. This was accomplished through visual interpretation. Layers were created based on the developed classification scheme of the study area. For this research, layers were created for residential, commercial, transportation, shrub land and so on.

DIGITIZATION

The processes of geo-referencing and digitization were embarked upon after layers were created for each of the identified theme. Each classified layer was digitized by on screen digitizing. Prior to digitization, the process of geo-referencing was carried out to register the geographic data set to an accepted coordinate (UTM) system. Geometric and statistical data analyses were conducted and the result shown below (table 1.1).

Table 1.1: Land use/land Cover Distribution of the Study Area.

Object ID	Shape	Shape Length	Area(KM^2)	Landuse/Landcover Class	Area (%)
1	Polyline	216345.4678	216.3454678	Transportation	0.402980138
2	Polygon	785.72704	37.64560361	Local Govt. Secretariat	0.070121323
3	Polygon	1963.5215	20.31886173	Financial	0.037847327
4	Polygon	2230.315101	75.35877126	Security Services	0.140368496
5	Polygon	758.959808	40.11144232	Royal Palace	0.074714366
6	Polygon	2150.473987	77.18089324	Industrial	0.143762508
7	Polygon	20288.98519	428.7915228	Commercial	0.798696957
8	Polygon	1166.108981	42.09433966	Cemetery	0.078407849
9	Polygon	666.888662	15.80336618	Recreational	0.029436451
10	Polygon	11024.14336	3273.899837	Farm Land	6.098193876
11	Polygon	104993.6815	10194.75103	Residential	18.98945337
12	Polygon	22963.58567	2618.289618	Educational	4.877008616
13	Polygon	18227.85333	551.4352915	Public Services	1.027141783
14	Polygon	9146.853947	244.4138513	Religious	0.455262264
15	Polygon	1469.218651	52.55953138	Judiciary	0.097901044
16	Polygon	84184.1761	13184.5366	BUILT-UP AREA	24.55843622
17	Polygon	59619.85849	3750.822074	LESS DENSE FOREST	6.986542452
18	Polygon	45246.14951	1305.412902	BARREN LAND AFFECTED BY EROSION	2.431552999
19	Polygon	7370.818313	571.6196925	VACANT LAND	1.064738655
20	Polygon	121852.6168	13587.88034	SCRUB LAND	25.30973236
21	Polygon	69656.8899	3397.113885	GRASS LAND	6.327700944

Figure 1.1 Land use/Land cover Map of Auchi

DISCUSSION OF RESULTS

In land use planning, adequate allocation of land to the various land uses must be aimed at for an ideal urban development. For this to be achieved, the standard land use requirement for modern land use rationalization principle should be implemented (Imimole, 2005). A major problem of disproportionate allocation of land to different land use is that some very important sections of the system will be ill provided for. Such areas often neglected include transportation, recreation and open spaces. It could in one way or the other lead to erosion problem (Mabogunje, 1997).

Residential Land Use accounts for 1019.48 Km^2 (57.99%) while road, recreational facilities, utilities, commercial and industry are poorly developed in the study area. This accounts for poor road network, lack of basic social infrastructure (e.g. pipe borne water) and erosion problem in the study area.

Commercial Land Use: Commercial land use also constitutes a very important component of urban land use. This is because commercial activities are important aspect of any urban economy. Commercial activities take place mostly in areas of maximum accessibility and visibility since they are project oriented. Consequently the Central Business District CBD (often centrally located) is the home of commercial activities. Here are located stores of all kinds, shopping centers and most often, central markets. Small-scale commercial activities also take place along major tarred roads. While for this research, the in-effective land use zoning of the town has led to the mixed commercial and residential activities. For instance, most of the residential dwellings have been converted into commercial or commercial cum residential uses. These activities occurred mostly at the central area and the Polytechnic environment of the town. Such activities include shopping centers, supermarkets, fuel stations, restaurants, bar/beer parlours, canteens etc.

In Auchi, only about 2.40% of the total study area is used for commercial activities. Increase population coupled with upsurge in the demand for goods and services and the general lack of land use zoning scheme in Auchi rather tend not only to perpetuate this habit, but also for its sustenance. This practice is very rampant especially along tarred roads as found along traffic roads, such as Igbe road, Warake road. Ironically, these areas are characterized by high buildings densities.

Industrial Land Use:
It is evidently clear that Auchi is not noted for industrial activities. Nonetheless, about 0.43% of the urban land area is used for industrial activities. Hartland Haulage Company, Edo State Fertilizer Company and printing press dominate the industrial sections. These are more or less located at the outskirts of the town. Other light industries like bakeries, cottage industries, roadside mechanics and so many other artisans abound.

Public Services:
These activities include Public Utility Board, Power Holding Company of Nigeria (PHCN), hospitals and the Nigerian Postal Service. This land use account for 3.08%. There has been general increase in this land use which may be due to the presence of few bore holes and private hospitals within the urban center of the study area.

Transportation: This land use is very small compared to the area of land occupied by the built-up land. It includes motor parks and right of ways which accounts for 1.21%. The difference between the standard coupled with the population growth accounted for the traffic land use problem within the township area. A host of the aforementioned roads within the study area can hardly accommodate any physical expansion without demolition of existing physical structure (Plate 1). Considering the land cover category, built-up area occupies 36.83% of the total land covers while scrub land is about 1.12% more than built-up area. Less dense forest occupies about 10.48%, grassland 9.49% and scrub land about 37.96%. This shows that the vegetative cover of Auchi can be best described as being a savanna and that the area is highly prone to erosion putting barren land caused by erosion at 3.6% while vacant land is just 1%. This simply reveals that for the area to develop there is need for land reclamation programme to be embarked upon by concern authorities and the erosion menace quickly checked.

EFFECT OF ENVIRONMENTAL AND SOCIO-ECONOMIC ACTIVITIES ON LAND USE/LAND COVER PATTERNS OF AUCHI

From the highlights of the research findings vis-à-vis the various land use policies, it is evident that much deviation and very few correlation exists between the research findings and the various land use policies. Improper planning coupled with poor implementation of the existing Land Use Policies brings about this anomaly. The effect of the present land use pattern on the physical and socio-economic development of Auchi cannot be over-stated. Auchi is situated on a depression almost surrounded by hills. From the foregoing exposure of the topographic features of Auchi, a picture of rugged terrain is created. It is pertinent to relate this to the land development that has taken place in this area, which originates from the lowland areas, specifically Usogun, Akpekpe and Iyekhe meeting point. Today, these areas of Auchi constitute the Central Business Area. The highest densities of commercial, residential and other supporting land uses (apart from industrial land use) occur here.

However, recent changes in the status of the settlement have brought much population to bear on this limited easily developable area such a situation that the area could not accommodate further development. Thus, the adjoining hillside slopes have been brought into the main stream of development in Auchi. Much of these developments have been disproportionately used for residential purpose and had largely been uncontrolled, uncoordinated and unplanned.

As expected, a number of problems have been created by this development. The hitherto vegetated hillsides have been cleared for development thereby exposing the land to the menace of soil loss through the process of erosion. The major type of erosion found in this area is gully which excavates both the top-soil and sub-soil through the process of scooping which are visible in notable areas like Warake road, part of Water Board to mention a few. Buildings are being threatened (Plates 3, 4, 5 and 6). Associated lowland flooding of Usogun, Akpekpe and some Iyekhe areas is prevalent.

Plate 1: Erosion threat to residential land use at Iyekhei quarters

Plate 2: Erosion threat to residential land use at   Usogun Quarters

Plate 3: Residential Land Use Totally Destroyed By Soil Erosion At Akpekpe Quarters

Residential development has suffered the greatest impact of soil erosion in the study area. Soil erosion has created untold hardship on the inhabitants of the town. Many of the residential houses are in bad conditions. There are cracks in the walls of some houses due to the damage done to their foundation by soil erosion (Plates 2, 3, and 4). As a result of these damages, lives and properties of the inhabitants are seriously threatened.

Plate 4: Cracks on Residential Land use at Igbei Quarters

Presently, there is one main market in Auchi; the Uchi market. People from the surrounding communities come and buy their needs in this local market. The commercial area either lack drainage facilities or the existing ones are not maintained (Plate 5). Thus existing drainage system and the roads are blocked with refuse and debris from the market. As a result during the raining season a lot of perishable goods are damaged by the run-off water. In some cases, the commercial activities are completely paralysed for a greater part of the day. Some parts of the market have been eroded and completely abandoned by the traders during the raining season as a result of the gullies caused by soil erosion. Majority of the stalls in this market are threatened due to the damages done to their foundation and structural components. Some of these stalls or stores were abandoned and the traders rent private shops in the market and residential buildings around the markets and along major roads. Consequently, the high cost of renting private shops is subsequently transferred to the consumers who now buy their needs at fairly high prices.

Plate 5: Drainage Blocked by Solid Waste

The need to maintain the existing road network against all forms of deterioration particularly in a town like Auchi with no other means of communication is very necessary. During the problem identification, it was observed that most of the roads are not tarred. The roads are exposed to, and susceptible to soil erosion. There are pot-holes on the tarred roads and most of the streets are now covered with refuse. The tarred roads are cut and washed away by soil erosion. Since some of the roads are not tarred coupled with blocked drainage systems, interaction is hindered, particularly during raining season.

The various physical structures in the educational sectors are not left out of the menace of soil erosion. In some schools, the playground has been completely watershed away and cut by sheet and gully erosion. In others some of the buildings and part of the fences are

seriously damaged. Still in others, the gardens and the crops in them are also affected.

Soil erosion is a constant threat to the health, lives and properties of the people of Auchi. The health of the people is indirectly affected by soil erosion. The surface run-off water with its debris feed the Orle River, which is one of the main sources of water for the people. The people are exposed to health hazards and diseases as they continue to use water from the river. The run-off water also pollutes the pipe-borne water from the cuts and leakages in the system. Water collected in open places act as a breeding ground for pests such as houseflies, which are vectors of many diseases (dysentery, malaria and fevers, which are killer diseases).

However, there is virtually no master plan for the development of Auchi, no land use zoning scheme is adopted and individual claim to land is still very high. All these provided the framework for the haphazard development of the city. Thus, a good number of the land use problems in Auchi are caused by lack of proper planning and monitoring of development. The above research finding is that the land use activities and land covers in the study area are un-controlled.

The products from this project will assist the local government, state and nation at large to have adequate and proper planning regarding the use of land. The composite plan will serve as a guide to the visitors coming to the study area. Decision makers will know better the occupied land, unused land and the different land covers for effective land planning and management. The products from this research work will be of immense assistance to the local government of the study area and the nation in general in-terms of adequate and proper planning regarding the use of land. The composite plan will serve as a guide to the inhabitants and visitors in the study area while the decision makers both government and individuals will have better understanding and information of the occupied lands, unused lands, open or vacant lands, different land cover types available in the area and so on for effective land management.

CONCLUSION AND RECOMMENDATIONS

Remote Sensing techniques for data acquisition and Geographic Information System approach for data manipulation has proven effective in solving spatial problems within a short time. Land use and land cover Database of the study area was designed and created to answer some generic questions such as what is where? The poor socio-economic situation in the developing countries of the world especially in Sub-Sahara Africa has compelled the people to show little or no concern for their environment in their struggle to survive or get their daily needs (Akingbade, 2001). One of the most devastating consequences of this is soil erosion, uncoordinated land use activities, environmental pollution and generally poor physical environment among others. Auchi lacks evidence of physical planning and insufficient budgeting for land use/land cover. It is therefore easy to deduce the imbalance in the land use/land cover structure of Auchi. If the recommendations proffered are strictly adhere to by all, the study area and other urban centers will be conducive for human living.

The need to curtail the imbalance in the land use structure of Auchi cannot be over-emphasized. The responsibility for the control falls on the Government, Non-Governmental Organizations (NGOs) and individuals. However, apart from the urban issues as recommended above, the following policy implication and recommendations proposed below will be helpful in checking the abuse of land in Auchi.

1   Integration of all physical development activities through a comprehensive database of the study area. The State Government through the Department of Land and Surveys and GIS experts should undertake the preparation of the master/structure plan as well as the database for Auchi. The master plan and database created should show in detail how the entire land in the study area should be utilized. Development in Auchi should be controlled with the help of the existing bye-laws and codes concerned with land use development.

2   The community leaders should educate their subjects on the implication of improper planning.

3   The Local Government Authority should embark on a programme of educating the inhabitants of Auchi on the need to avoid indiscriminate land use. They should be made to know that it is one of the major causes of erosion problem in Auchi.

4   The Local Government Authority and other Government agencies should notify the people of the penalties for flouting government's laws concerning physical planning.

5   The Town Planning Authority should embark on aggressive campaign on the need for building plan to be approved before embarking on any development. Defaulters should be prosecuted.

6   Before developmental projects are executed, environmental impact assessment studies should be carried out to ascertain whether such projects could have positive or negative impact on the environment. Developmental projects include the building of houses, road construction, pipe-laying etc.

7   Finally, a digital land use /land cover database of the country should be created and an organization set up to be a custodian of the information which will make it available to intended users with payment of some affordable fees.

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