Geospatial Analysis of Land Use Conformity to Master Plan of Uyo Urban, Akwa Ibom State.

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Abstract:

One of the areas of achieving sustainable development is through the effective planning of urban space. Master plan serves as a tool for planning, design and implementation of development programs. It offers the framework for urban land use planning. This study, therefore assesses the conformity of urban land uses to the designed master plan of Uyo urban. The study utilized Geographic Information System (GIS); where the land use map of Uyo was produced from Landsat ETM imagery of 2016 using Erdas imagine software; while the land uses from the master plan obtained from the state's Ministry of Lands was analysed in ArcGIS 10.3 Software. The two land uses were compared in ArcGIS to ascertain their differences. The result indicated that some land uses such as the residential, commercial, agricultural and institutional land uses deviated from the master plan. Commercial land use was proposed to occupy an area of 10.01 sq.km but by 2016 it occupied an area of 8.132q.km and deviated from its original location. Residential areas for low, medium and high density housing are situated irregularly, displacing other land uses such as industrial and recreational uses proposed in the master plan. The residential area proposed to cover 126.41sq.km only occupied 73.4sq.km after more than 30 years for the plan. The institutional land uses also deviated from proposed their locations. Conversely, there was no provision for agricultural land use in the master plan but currently occupying a land area of 6.21sq.km. No provisions for district and sector centre in the current land use as in the master plan. Hence, it concluded that the current land uses do not keep pace with the proposed master plan. Thus, it is recommended that master plan review should carried out at least every 10 years to ensure conformity of development.

Keywords: Geospatial, Master Plan, Conformity, Land uses, Planning, GIS

Introduction

The growth and expansion of urban areas have generated considerable concern to urban planners and practitioners for some time now. This is because the quest for better life expressed in new technologies and consumption patterns as well as movement of people from rural to urban centres put more pressure on land which is fixed by nature. This has generated changes in the land use pattern of cities all over the world. The demand and utilization of land resource for residential, industrial, commercial and other purposes require careful analysis and planning. As the earth's population increases and national economies continue to move away from agriculture-based systems, cities grow and spread, resulting to changes in land use and alteration in their master plans.

The reasons for the alteration of land uses on master plans differ between the developed and developing countries. In developed countries, land use change is based on economic reasons such as large-scale farming or urban development and an increasing need to conserve biodiversity and environmental quality for current and future generations (Bouma, Varallyay, Batjes, 1998). In the developing countries, rapid population growth, poverty and the economic situation are the main driving forces (Meertens, *Fresco, Stoop,* 1996; Ramankutty and Foley, 1999; Lambin, *et. al*., 2003). It has also been estimated that 90 per cent of the population growth expected to occur in the next century will take place in developing countries (World Resources Institute, 2012).

In addition, the urbanization process in the developing countries is as a result of rapid development, modernization and industrialization which most times re-order plans. Also, the agglomeration of people which usually results from rural-urban drift increases the pace of development that alters original developmental framework. Urbanization therefore is a

consequence of the “push” of the rural areas and the “pull” of the urban centres (Aluko, 2010). Nigeria is one of the developing countries that have experienced rapid population growth since 1960 (Ernest, Mbakwe & Leke, 2010). Presently, Nigeria is among the 12 most populated countries in the world, others being China, India, Pakistan, United States of America, Indonesia, Brazil, Bangladesh, Ethiopia, Iran, Mexico and Russia.

One of the implications of uncontrolled population growth is its impact on planning and deviation from master plan. Urbanisation and high population density have engulfed other land uses especially in most parts of the developing countries. This rising demand for urban land tends to be reflected primarily in the congestion of the central areas of cities, rise in land values and in the conversion of rural land at the peripheries of cities to urban use. (Eni & Ukpong, 2014).

As it is in other cities, rapid population growth in Uyo means more people to feed, more infrastructural development, increased provision of facilities and amenities such as hospitals, schools, water, electricity, telecommunication, among others. The provision of these amenities means putting intense pressure on urban land, resulting in the stiff competition for scarce land and the modification of the master plan. The need to achieve a balance between man’s developmental needs and the sustainability that is essential for the preservation of the natural environmental system is not only imperative, but also very important.

The provision of houses to meet housing demand has impinged on other land uses, changing the pattern of development as given in the master plan of the city. Although there is a considerable level of development, the setting of most infrastructures has contravened the original plan of Uyo City creating most areas as mixed uses of residential with commercial, industrial or institutional land uses. The preliminary analysis of cross matching the current

scenario with the master plan indicates displacement of some of the land uses and replacement by residential uses.

Many studies have been carried out on land use changes in relation to population or other factors in many cities and regions. However, these studies failed to address the non-conformity of land uses with the master plan and within the period of massive development. For instance in Uyo, Essien and Akpan (2013), as well as Njungbwen and Njungbwen (2011) studied the impact of urban expansion on arable land use; while Udoh (2010) worked on the effect of population on land use change. These studies carried out between 1972 to 2002, failed to consider the period of massive development in Uyo between 2007 and 2013, and was also unable to compare the current land use scenario with the master plan.

Aim of study

The study is aimed at analysing land use conformity in the uyo master plan.

The study is specifically aimed at:

1. Examining the spatial distribution of land use in Uyo urban
2. Analysing the conformity of current land use change in Uyo uban from 1998 to 2016, to the Uyo Master plan.
3. Evaluate the extent of displacement of the different land uses by others.

Materials and Method

The study Area

Location

Uyo urban is situated between latitudes $4^0$59’ and $5^0$05’ North and longitudes $7^0$54’ and $8^0$00’ East. Its location relative to some urban centres in the State shows that it is 51 kilometres from Ikot Ekpene, 70 kilometres from Eket, 16 kilometres from Abak and 90 kilometres from Calabar, Cross River State. It is relatively at the centre of the State and easily accessible to any of the south Eastern and South South States (figure 1). It is bounded on the

West by Abak LGA, East by Uruan LGA, North by Ikono LGA, Ibiono Ibom and Itu, on the South by Etinan, Ibesikpo/Asutan and Nsit Ibom Local Government Areas (Udoh, 2010).

Uyo urban has, a total land area of 187,467 square kilometres and is made up of three residential clans namely, Oku (9 villages), Etoi (17 villages) and Offot (19 village). (Udoh, 2010).

The 2006 population and housing census figure for Uyo LGA was a total of 275, 939 persons (NPC, 2006). For this research, the study area covered some communities in Oku, Offot and Etoi clans that make up Uyo Urban. Uyo, has been a provincial headquarters and divisional headquarters since 1967 (Udoh, 2010).

Improved infrastructural facilities and high prospects for jobs have made Uyo a destination of choice for many. Expectedly this leads to population increase, and to handle the rising immigration challenges, the State government adopted modern town planning considerations, market re-settlement, housing schemes and policies, flood control projects, and civic aesthetics to make Uyo appealing and comfortable for all. The government is remodeling the city through a comprehensive urban renewal programme; the first phase of the project is focusing on city aesthetics, traffic management, and environmental protection.

Uyo is home to many notable housing districts such as the Ewet Housing Estate, Osongama Estate, Shelter Afrik, and other estates located in various parts of the city. There are also private estates and other residential districts. Highbrow residential areas in Uyo include the prestigious Ewet Housing Estate, Osongama Estate, Shelter Afrik, and a host of other choice areas in the city and its environs. Uyo has two major industrial estates, which are Itam and Mbiabong Industrial estates.

The city boasts of recreational facilities such as the Ibom Connection, the prestigious Meridien Ibom Hotel and Golf Resort, and the Ibom Tropicana Resort, which is a 16-story 4-

star hotel, a dome, a cinema, a shopping area, water parks, and other recreational facilities. The uses of land in Uyo urban depend on the prevailing social, economic, and physical environment.

Figure 1: Akwa Ibom State showing Uyo (The Study Area)

Type and source of data

The data that were used in the study included data on:

a) Distribution of land uses in Uyo urban.

b) Conformity of Uyo urban master plan with current land use change in Uyo uban from 1998 to 2016.

Sources of Data

Data on master plan which was obtained from the Ministry of Lands and Housing. Data on land use changes were obtained through satellite imageries from the National Airspace Research and Development Agency (NARDA) and Aerial photographs of Uyo for 1998, 2007 and 2016. This showed land use changes that existed over the study period.

Data Set

The data set include othorectified LANDSAT Thematic mapper (TM) imageries of 1998, 2007 and enhanced thematic mapper (ETM) imageries of 2016 at 28m resolution and 3 color bands resolution were used. Moreover, the master plan was digitized in ArcGIS to different land uses.

Software

Erdas Imagine software version 10.0 and ArcGIS Version 10.1 were used. Erdas were used for land use classification from the identified land use classes, while ArcGIS is suitable for calculation of area coverage of land uses. The map of Uyo urban as the study area were geo-referenced in ArcGIS 10.1, the study area shape files were re-projected to World Geodetic System (WGS) 1984, Universal Transverse Mercator (UTM) Zone 32 North coordinate system to march with the orthorectified LANDSAT image. This allowed extraction of area of interest from the image.

Creation of Area of Interest (AOI)/Reprojection:

Sub-setting of a portion of the imagery by super imposing the Uyo LGA map and Coordinates on the imagery. The Uyo Local Government map was overlaid on the imageries to create the areal coverage of Uyo urban (the study area) to ease data analysis.

Classification

Supervised classification which involves ground verification of the land use/land cover was carried out in which coordinates of different land uses were acquired. The data acquired from ground truthing were interpolated on the imageries to ease identification of features. Thus, the images were processed using the supervised image processing technique. Based on the prior knowledge of the study area for over 15 years, a brief reconnaissance survey was carried out, and a classification scheme was developed for the study area after

Anderson et al (2001) and Effiong-Fuller (1988). The modification of the classes was done keeping in view the area under investigation for detailed analysis. Ten (10) classes of land use emerged from the analyses. The land use categories include residential, recreational, agricultural, institutional, degraded area, secondary forest, industrial, commercial, and transportation and water body (Table 1).

Table 1

Land use classification scheme and their sub-categories in Uyo urban

S/NO	Level I	Level II
1	Residential	a) Detached houses b) Semi-detached houses c) Single storey houses d) Blocking of flat
2	Recreational	a) Parks b) Hotels
3	Commercial	a) Super markets b) Open markets c) Shops (retail and wholesale) d) Filling Stations
4	Industrial	a) Factories b) Petrol storage tank c) Power stations
5	Transportation	a) MotorParks b) Roads c) Airport
6	Agricultural	a) Farm land b) Poultry farm c) Orchards d) Plantations e) Gardens f) Fallow land
7	Institutional	a) Educational b) Religious facility c) Military facility d) Government offices e) Public establishment
8	Degraded area	a) Ravine b) Eroded lands c) Beaches
9	Forest	a) Tropical forest b) Secondary forest c) Riparian forest
10	Water body	a) Stream and canals b) Lakes and ponds c) Estuaries d) Open marine waters

Source: Adapted and modified from Effiong-Fuller, (1988) and Anderson, Hardy, Roach, and Richard, (2001).

Results and Discussion

The changes in land uses also flouted the master plan. For instance most of the land uses such as residential, commercial, agricultural, institutional among others have deviated from the master plan. Commercial land use was proposed in the master plan to occupy an area 10.01sq.km, however by 2013 it occupied 8.13sq.km. The commercial area is not also located in its strategic location as proposed in the master plan. The residential land use has developed towards the proposed site for other land uses such as industrial and recreational but has not occupied all the earmarked area in the master plan. Area allotted for residential land use (low, medium and high density) in the master plan was 126.41sq.km and the 2013 scenario was 73.4sq.km. There was still 52.94sq.km proposed for residential land use in the master plan which was yet to be used, however, it is occupied by other land uses such as institutional and degraded areas. The institutional areas likewise developed outside the proposed areas among others (Table 2).

Table 2

Conformity of Recent Land uses to Master Plan in Uyo urban

Land uses	Area in master plan (sq.km)	Current scenario 2013 (sq.km)	Differences	conformity to master plan
Commercial	10.01	8.13	1.88	No
Industrial	13.48	2.01	11.47	No
Transportation	6.32	4.22	2.10	No
Institutional	22.65	16.00	6.65	No
Agricultural		6.21		No
Forest		4.61		No

Degraded		0.26		No
Recreational		4.14		No
Residential	126.41	73.47	52.94	No
Water body		0.63		No
Open space	5.47			
Governmental	4.87			
Sector centre	2.43			
District centre	0.95			
Mixed commercial Housing	7.08			
Housing reserved area	38.31			

Source: Author's GIS Analysis, 2017.

Figure 2 shows the master plan of Uyo as reviewed in 1988. The master plan as proposed build among other land uses residential land use category which include high density, medium and low density area. The other features include commercial centres at the middle that can be accessible from all locations. Within the commercial area is the industrial zone. There were provisions for open space, governmental area, sector centre, district centre, mixed-commercial housing and housing reserved area in master plan. Network of roads connect different areas while the highway connecting other cities was to be at the extreme of the city.

Figure 3 shows the general outlook of land use deviation from the master plan. For instance, Plaza and Akpan Andem markets are now located in areas earlier proposed for high residential areas. The stadium is located where low density residential areas were proposed to situate. However, where Tropicana is sited is where the commercial hub of Uyo was

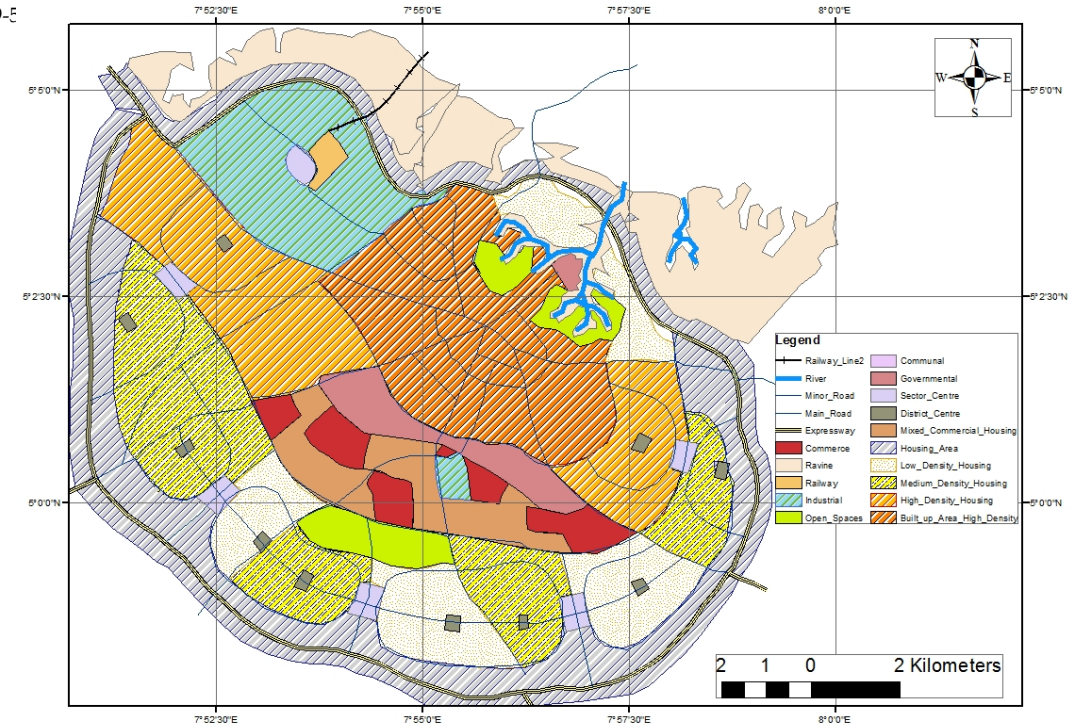

Figure 2: Uyo Master Plan
Source: Akwa Ibom State (AKS) Ministry of Lands and Survey, 2017.

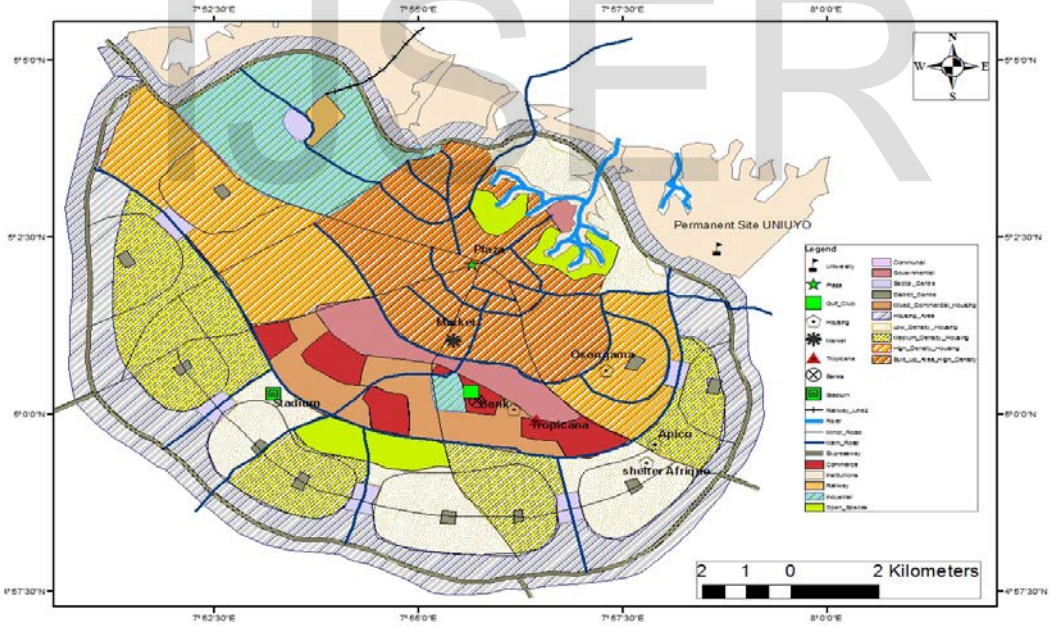

Figure 3: Deviation of some features in Uyo urban from the Master Plan
Source: AKS Ministry of lands and survey and Author's GIS Analysis, 2017

proposed in the master plan among others. Features such as district centres have been totally displaced.

The residential area presently has displaced other uses such as commercial and industrial areas. Everywhere tends towards high density area. The city is rather expanding towards Oron road. Whereas in the original plan, the city was to rather include Itam and develop towards Itu (Figure 4). Commercial land use currently appear as pockets of land uses in core residential areas with total deviation from original areas earlier proposed for the commercial hub of the city (Figure 5). Agricultural land use is currently in pockets of areas within the residential areas. In the master plan, there was no plan for agricultural land use; however this has appeared in some areas partially close to the institutional areas such as the permanent site of University Uyo (Figure 6).

Figure 7 rather depicts that institutional land use are scattered within the residential zone. This shows that institutional land use is without a plan. For example, some people build schools such as crèche and nursery within core residential areas.

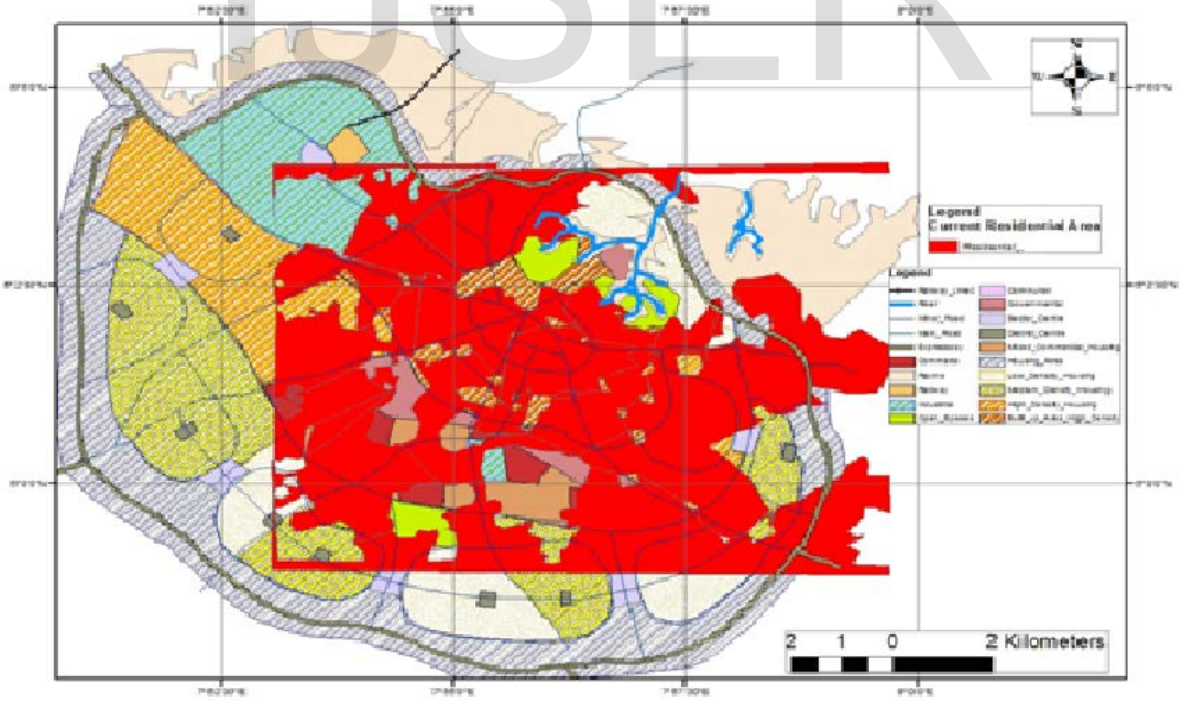

Figure 4: Deviation of 2013 Residential land use map from Uyo Master Plan
Source: AKS Ministry of lands and survey and Author's GIS Analysis, 2017

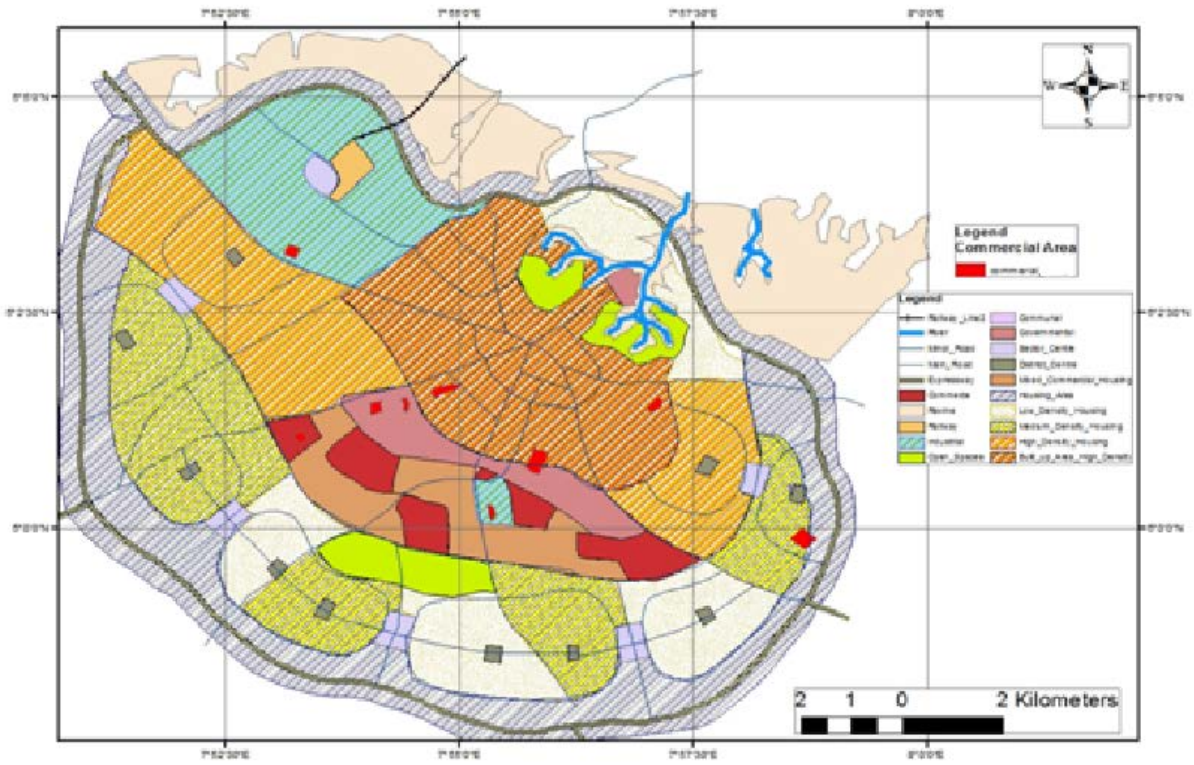

Figure 5: Deviation of 2013 Commercial land use map from Uyo Master Plan.
Source: AKS Ministry of lands and survey and Author's GIS Analysis, 2017

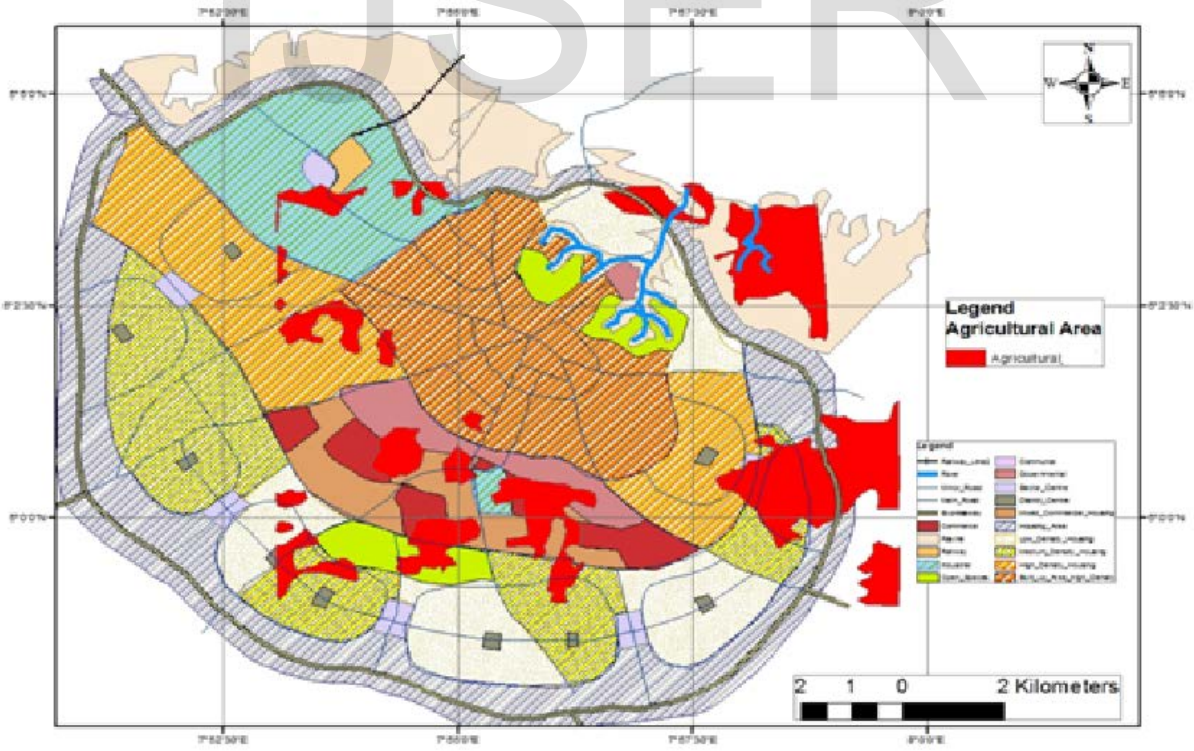

Figure 6: Deviation of 2013 Agricultural land use map from Uyo Master Plan.
Source: AKS Ministry of lands and survey and Author's GIS Analysis, 2017.

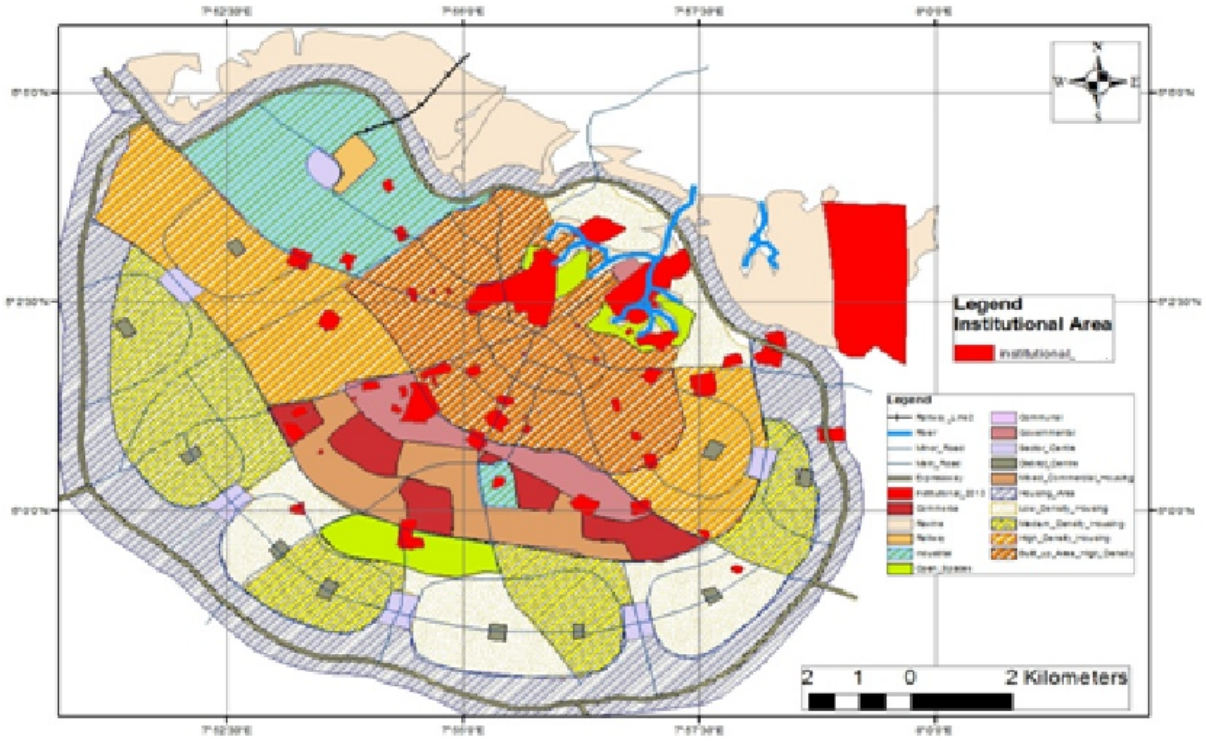

Figure 7: Deviation of 2013 Institutional land use map from Uyo Master Plan.
Source: AKS Ministry of lands and survey and Author's GIS Analysis, 2017.

A comparative analysis of the current land use scenario with the proposed pattern in the master plan was carried out. Apart from the extensive changes in terms of size, the land uses, internal deviation of the land uses from the proposed plan is significant. The changes in residential patterns shows that part of the areas earmarked for industrial and commercial purposes have been used for residential purpose leaving a greater portion of the residential areas undeveloped. As observed by Zhou, Li & Kuban (2008) land use and land cover change (LULC) is a good indicator that reflects the interface of human - environment interaction. There are many studies on land use change in Nigeria.

Moreover, location of some facilities such as the international stadium, and Tropicana are in the core low density residential area while the Plaza is in the high density residential area. Furthermore, some reserve areas such as open space/green belts, sector/district centres, government reserves, mixed commercial housing are absent in the current land use scenario. The area earmarked as Uyo Urban in the master plan was larger than what is obtainable

presently. Up to 45 per cent of the residential areas are yet to be developed, excluding the housing reserve areas. Also, the master plan needs to be reviewed at least every ten years. It was observed that the plan has stayed for thirty years which is too old. One of the main points here is that even relatively isolated land use systems are increasingly dominated by events and decisions from distant locations, and global interconnectedness has become a highly influential phenomenon driving land use changes (Plieninger & Bieling 2012). Abiodon, Olaleye, Dokai and Odonaiya (2011) studied the land use change in relation to uncontrolled physical development in Lagos and showed that uncontrolled development affect master plan of the state.

Summary, Recommendation and Conclusion

The land uses were classified into 10 classes. Comparison was carried out in two dimensions. Firstly, land uses across the years of study and secondly comprising current land uses with the Master Plan.

Summary

In relation to the Master Plan of Uyo urban, significant change and deviation was noticed in the area. For instance, residential area was proposed to occupy 126.41km^2 but only 73.47km^2 have been used, industrial area now occupy 2.01km^2 against 13.48km^2 of its total area in the master plan. Most land uses have been displaced such as district centres, government reserved areas, open space, among others. Hence, present land use scenario does not conform to the Master Plan.

Recommendation

1. Monitoring of environmental change: Changes especially in urban settlement pattern and vegetation cover should be encouraged to ascertain the pattern of changes in order to curtail negative impacts on the environment.

2. The master plan should be reviewed at least once in ten years to capture the different scenarios in accordance with the changes in the environment and compared with global standards for urban place. Moreover, the different plans of various administrations are not captured on “black and white”, the review of master plan will enable such changes to be captured.

3. Planning laws that restrict urban sprawl and other forms of anti-planning regulations such as building codes, development control edicts that limits control within the approved plans should be put in place by government.

4. Land use planning to cover the entire area under the jurisdiction of Uyo should be put in place, that is commercial, industrial and residential areas should be separated.

Conclusion

Uncontrolled urbanization is a serious problem to contend with; human induced changes are likely to cause marked changes in the system. The rate of population drift to Uyo and the increase in development of infrastructures have contributed to the change and distortion in the master plan. The areas earmarked for district centres for entertainment spot has been overtaken by the development of residential areas and other infrastructures.

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