

**URBAN DEVELOPMENT AND LAND USE CHANGES AROUND THE EKITI STATE UNIVERSITY (EKSU), ADO-EKITI NIGERIA**

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**ABSTRACT:** *Urban ecological systems are characterized by complex interactions among institutional, socio-economic and environmental variables. These interactions generate complex human-dominated landscapes, which significantly influence effective functioning of local and global earth ecosystems and the services they provide to humans and other life on earth. Changes in ecological conditions that result from human actions in urban areas ultimately affect physical morphology and structural outlook. Using Survey Research Design (SRD) via questionnaire administration, observation and personal interview for data collection, authors investigate the impact of urban growth on the environment as occasioned by the existence of a university; essentially, the effects that the growth has on the ecological system of the community. Findings in the study revealed that urban development affects the spatial heterogeneity of the landscape; especially the patterns of variation in land cover and changes in land use over time. The authors propose that effective monitoring agent to guide the direction and coherence of development in the study area is needed to forestall the haphazard pattern of development that is rampant in the area. Also, essential services like power supply in the area need urgent attention so as to facilitate adequate and regular electricity supply in the area.*

**KEYWORDS:** Urban Growth, Land-Use Pattern, EKSU

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## **INTRODUCTION**

Change of use as a concept tiptoed into development control arena by the fact that it is now regarded as development following an official endorsement or approval of the relevant development control department for any land development (Hald, 2009). But the cogent question still remains: 'what constitutes change of use?' From broad perspective the construction of a new building can be said to be a change in use of the land because the building is for a purpose which is different from the purpose for which the land was last used. Land use changes are common phenomenon in city development process, which can happen within and or outside the city. Most often, residential areas are susceptible to land use changes due to characteristic of the neighborhoods, accessibility, renting/business factors and government policy (Yuri, 2009).

Change in economy and spatial distribution of population can occur through conversion from one land use to another. For instance, converting farm lands into residential, industrial, commercial or recreational use or vice versa. The land owners play key role in whatever will take place on his land and, therefore, their decisions identify the direction and quantity of changes (Ettema et al, 2010). Consequently, different land owners decide in different ways according to land types and parameters. The owners have to supply the financial investment

of land change; thus, their awareness of the economic situation controls the speed of the changes and the final decision to be taken. In other words, the landowner may decide to leave the land at its current circumstances, develop the land by changing the land usage and exploit it, develop the land by changing the land usage and sell it or dispose it. The options vary with the preferences of different land owners. For instance, a farmer is not able to develop his land into a residential area if he does not have the required investment power and skills.

Ettema, et al (2010) differentiates between three different types of land owners according to their preferences. For example, farmers' preference is to exploit, sell or buy lands. Government's interest, on its own, is to maintain and sell or to develop and maintain while developers preference is to develop and sell or redevelop and exploit or sell. The eventual decision will depend on the expected value of each option to the owner. In case of commercial owners, utility will match with profitability; action will be taken on whichever delivers the highest profit. In case of government, social benefits might play a significant role whereas to the farmers, personal and emotional interest may influence their decision. The market price is a valuable index in deciding whether or not to sell a land with or without developing it (Ettema et al, 2010; Koomen et al, 2010).

The tendency of any change in land use began as penetration process of commercial activities, which then continue to increase and dominate within an area. The occurrence of land use changes bring out questions on how the change took place and what are strong factors that cause them to happen. To answer the questions, it is important to analyze the structure and pattern of the changes and the causative factors. In this study, however, there is one special characteristic of the changes where most of the actors are academicians of who majority are students tenants with few staffs of the institution living among the host community. This seems to be a motivating factor that speeds up the rate of development and changing land use pattern around the university community. The thrust of this paper is unguided rapid development around the Ekiti State University (EKSU), Ado-Ekiti with a view to examine planning implication on the environment.

Universities can be valuable contributors to city's economy. They are immobile institutions fairly resistant to business cycle fluctuations. They tend to attract revenue from outside the immediate quarter through tuition, endowment income or state tax allocations which attract significant human capital, both students and employees from national market that contribute to the development in area of economic growth. The increase in population of student admitted every year since inception of the university up till date keep increasing as well as the demands in various ways. There are great needs of accommodation hostels and business centres where to photocopy reading materials and print assignments, market where to buy food stuffs, beverages, banks for money transactions etc. All these are essential needs to be met in the university environment and the services require spaces for all their activities. The trust of this study, therefore, is to investigate the implication of land use changes occasioned by the establishment of the university and the expansion of Ado-Ekiti on the livelihood of residents around the study area.

## **CONCEPTUAL ISSUES AND LITERATURE APPRAISAL**

Urbanization is an inevitable process that goes along with economic development and rapid population growth. The expansion of residential and commercial land uses into rural areas at

the periphery of metropolitan areas is considered to be a sign of regional economic liveliness whose benefits are increasingly unbiased against ecosystem impacts (Rimal, 2011). This includes degradation of air and water quality, loss of farmlands and forests, social fragmentation and infrastructure outlay (Squires, 2002; Yuan et al, 2005; Rimal, 2005 and 2011; Oduwaye, 2015). It is generally believed that urbanization has both direct and indirect impacts on land use transformation such as urban sprawl and urban degradation. Urban areas and their urban-rural linkages are characterized by high dynamics of human influence and the associated land use patterns. In order to effectively address the issue of land use change process, a well-founded knowledge of underlying causes and driving factors is needed (Rimal, 2011; Oduwaye, 2015). Spatially explicit land use modeling techniques have successfully been applied to sculpt the present and likely future land use patterns of urban areas (Lakes and Lautenbach, 2008; Bhalli and Ghaffar, 2015; Hegazy and Kaloop, 2015). The report of World Urbanization Prospect (2009) showed that Northern America, Latin America and the Caribbean, Europe and Oceania are highly urbanized with proportion urban ranging from 70.0% in Oceania to 82.0% in Northern America. The level of urbanization is expected to continue rising to about 84.0% in all these areas by 2050. In contrast, Africa and Asia remain mostly rural, with just 40.0% and 42.0% of their respective population living in urban settlements in 2010; and even by 2050, they are expected to be significantly less urbanized than the other major areas, reaching a proportion urban of 62.0% in Africa and 65.0% in Asia (United Nations, 2009).

*Land Use Concept*, according to Environmental Literacy Council (2002), is used to describe the various ways in which land and its resources are been utilized by different people, such as farming, mining, building, and grazing. Choices of how land is being used (or is to be used) are made by those who own or control the land. But the choices are limited by the physical and biological characteristics of the land, which include climate, soil and topography as well as institutional and economic factors. Urban land uses are classified into different parts such as residential, commercial, industrial, institutional, public, open space, infrastructural, and mixed land uses. *Land Cover*, on the other hands, refers to the physical and biological cover over the surface of land which includes water, vegetation, bare soil, and/or artificial structures.

Land use is a more complicated term which is defined by the natural scientists in terms of syndromes of human activities such as agriculture, forestry and building construction that alter land surface processes including biogeochemistry, hydrology and biodiversity (Adebayo, 2010; Ellis, 2010). Changes in land use and land cover date to pre-historical milieu have both direct and indirect consequences of human actions to secure essential resources. This may first have occurred with the burning of areas to enhance the availability of wild game and accelerated dramatically with the birth of agriculture, resulting in the extensive clearing (deforestation) and management of earth's terrestrial surface that continues till date. More recently, industrialization has encouraged the concentration of human populations within urban areas (urbanization) and the depopulation of rural areas accompanied by the intensification of agriculture in the most productive lands and the abandonment of marginal lands. According to Ellis (2012), all of these causes and their consequences are observable simultaneously around the world with its attendant consequences in form of biodiversity loss, climate change and population growth.

Rapid growth of cities in most African countries is traceable to rural-urban migration. It appears that large number of migrants to cities originates from smaller urban centres, and

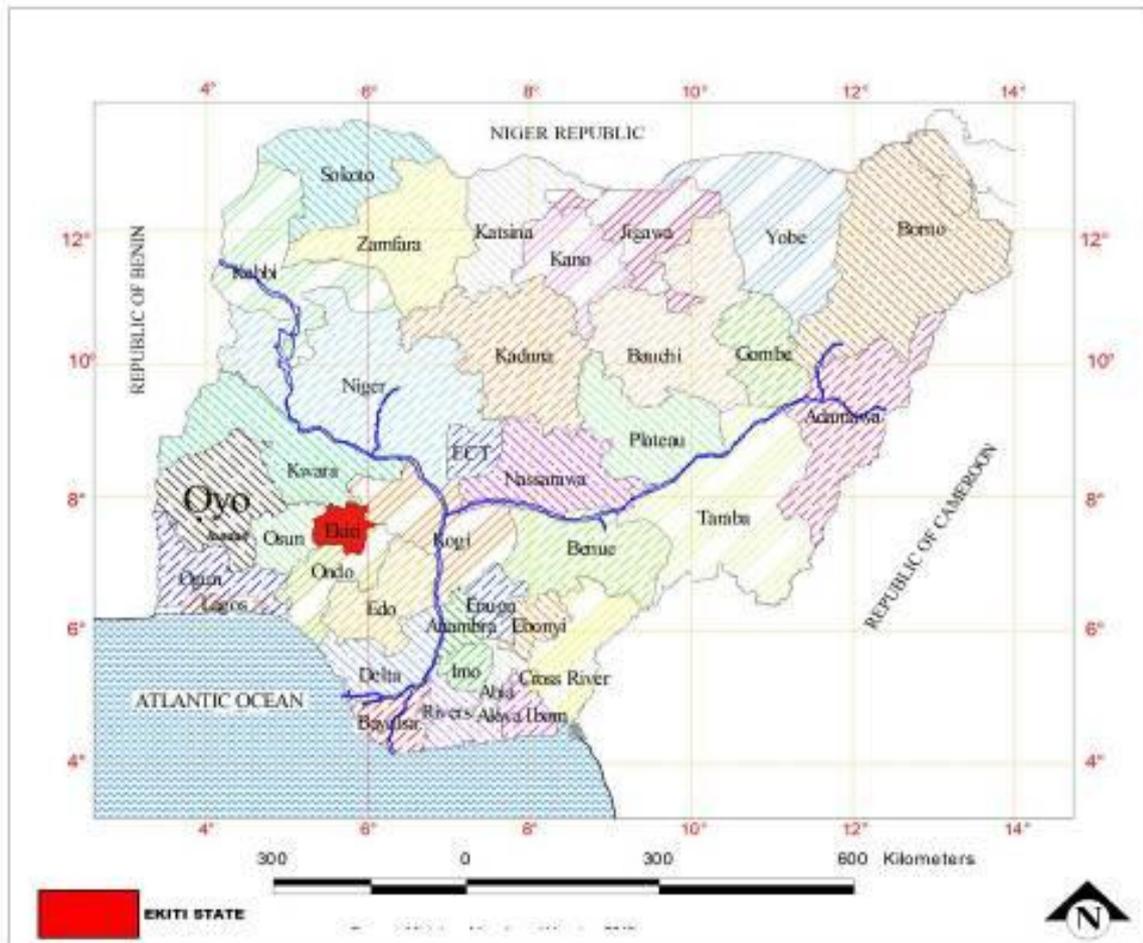
particularly from rural areas, leading to urban expansion. Consequently, Udo (1987), Oyinloye (2010), Ellis (2012) and Owoeye (2013) observed some factors that encourage physical expansion of urban centres to include natural population increase, job-creating investment, industrial development, infrastructural development, housing provision and quality as well as level of commercial activities in cities. The effect of these factors is profound on rural lands changing into urban land uses.

## **MATERIALS AND METHODS**

### **Research Site**

Ekiti State University, Ado-Ekiti is located within the neighborhoods of Iworoko Ekiti. It is about 15 kilometers away from Ado-Ekiti metropolis but less than a kilometer to Iworoko Ekiti thereby making it the closest community. Iworoko is strategically located and very accessible to other neighboring towns within the axis. For instance; Are and Afao are located to the east, Iyin and Igede to the west, Ifaki to the north and Ado metropolis (the state capital) is about 15 kilometers to the south. The land area is relatively flat with lush grassy vegetation and sparse forested area. While heading towards Afao and Ifaki, the land is thickly forested and mountainous which wall up the community on both sides. The residence of Iworoko can be classified into four categories - the artisans, farmers, civil servants and students (essentially the students of the university). Before the inception of the university, the people in the community were mainly farmers and into other related jobs. As the community continues to witness growth in terms of infrastructure and socio-economic development, their daily jobs become diversified. Lots of commercial activities, small scale industries, transport ventures and several government establishments begin to spring up with ample job opportunities for the residents, both skilled and unskilled.

The university was founded in 1980 but did not commence academic activities until 1982. It was initially named Obafemi Awolowo University, Ado-Ekiti. Since then, it has gone through a lot of transformations and changes in terms of the naming, students' population, incorporation of new disciplines and establishment of skill acquisition centres. Different governments at certain period of time have influenced the university since its inception till date. (Figures 1-3 shows the study site in both the national and local settings).



**Figure 1: EKITI State in its National Settings**

*Source: Ekiti State Ministry of Lands and Physical Planning, 2014*

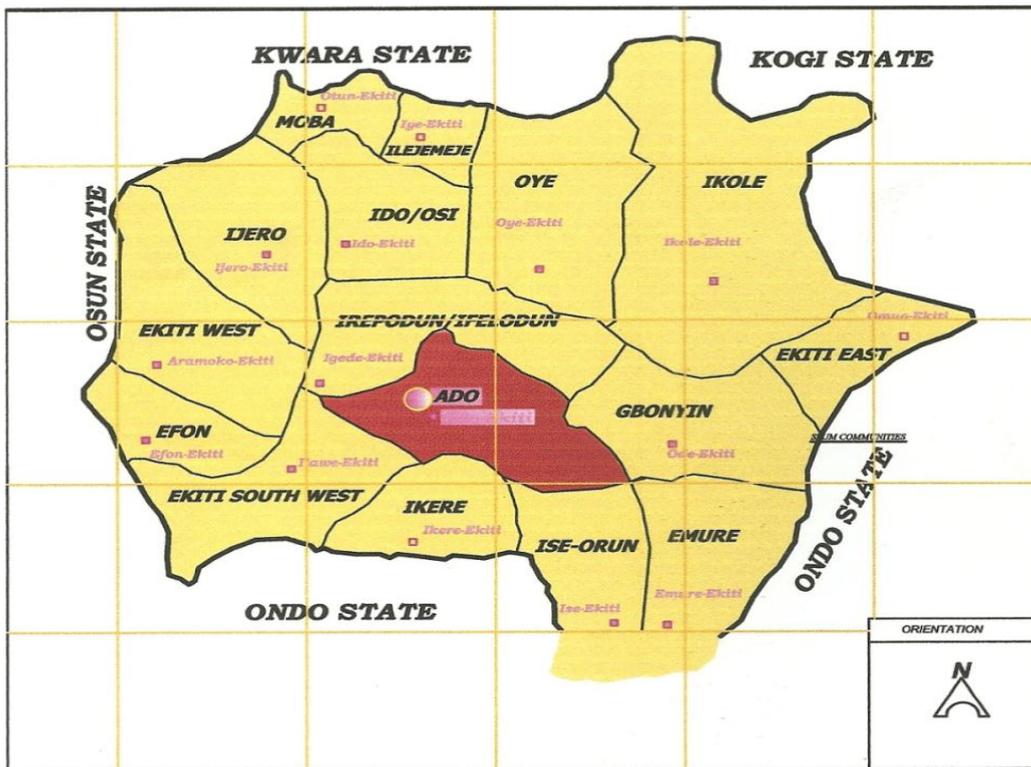
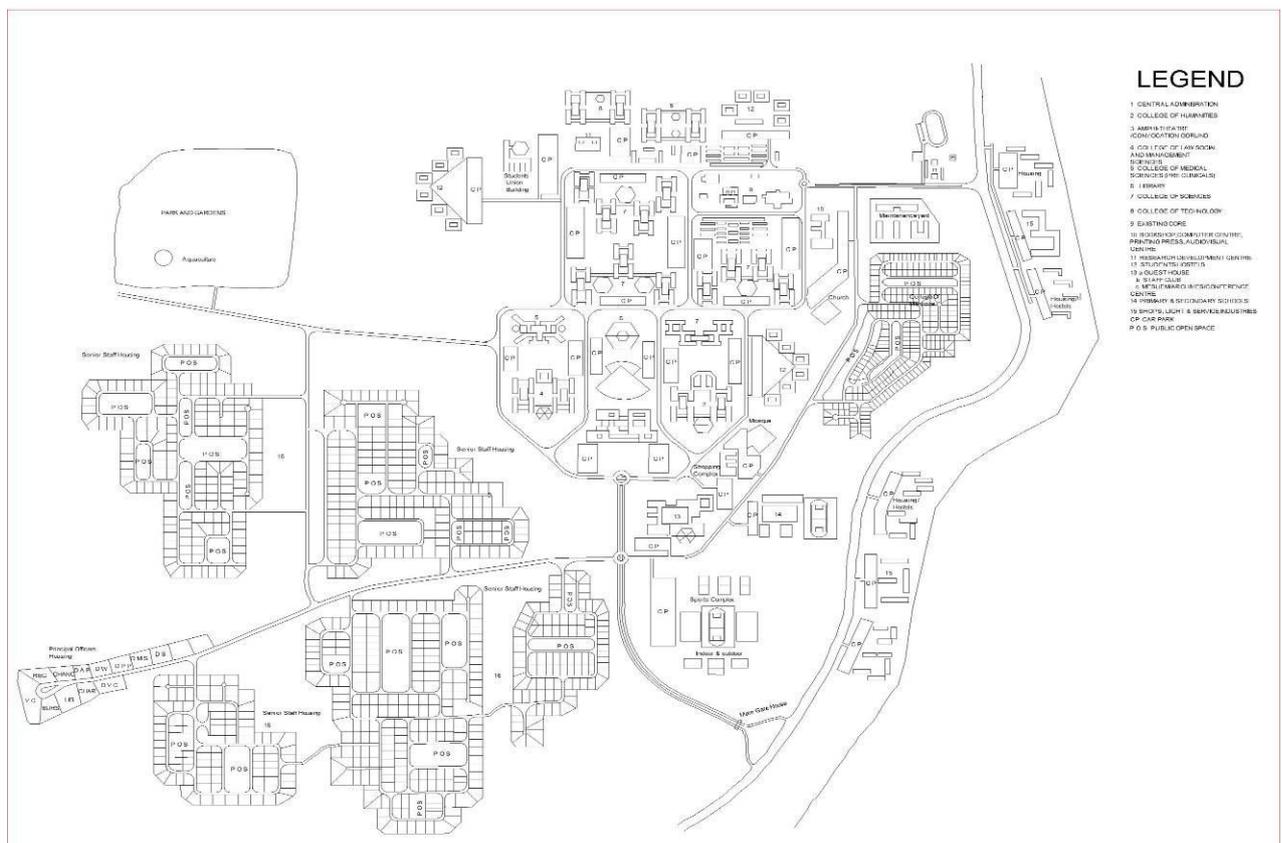


Figure 2: EKITI State showing its 16 Local Govt. Areas

Source: Ekiti State Ministry of Lands and Physical Planning, 2014



**Figure 3: The Location of the Study Area (EKSU Master Plan)**

*Source: The Physical Planning Unit; Ekiti State University, Ado-Ekiti*

On physical structure, the university has made tremendous impact on the environment through her various contributions, particularly in the area of population increase. It serves as growth centre which attracts influx of people from different part of the state as well as other parts of the country. The institution has also influenced the daily activities of the host community, i.e. Iworoko Ekiti, from a mono (agrarian) activity to more diversified activities. Of course, it has metamorphosis the community from 'village' to a status of 'Town' due to its tremendous population growth and infrastructural improvement. Nonetheless, the developments come with penalties both on the host community and the university itself. For instance, the effects on the host community include irregular urban structures; derelict or substandard dwellings, houses and structures that were put up in haste to serve the pressing demands of students; agricultural lands being converted to residential and commercial land uses thereby forcing farmers, labourers and people in the community to hunt for white collar jobs as well as limiting lands for farming activities. On the other hands, however, the development has paved ways for people to encroach into the university's acquired lands leading to several alterations on her proposed master plan. This change in land uses brought about by the location of the university, no doubt, requires in-depth understanding and prompt intervention to ameliorate the possible negative impacts of the perceived irregularities in the urban structural arrangement of the community with a view to achieve harmonious and sustainable environmental management.

**Sources and Methods of Data Collection**

Data collection for this study was essentially through *Survey Research Design (SRD)* with the aid of personal interviews, structured questionnaires, photo-snaps and observation. Other sources include government ministries and establishments, journals, textbooks and internet facilities. For the purpose of this study, a percentage representation method was adopted to obtain a quota sample of residents around the university environment. The residents were categorized into three zones following the developmental levels in the study area. This involves the *core*, the *peripheral* area of Iworoko community towards the university site and the *immediate surroundings* of the university area. Thus, the residents of houses in these three zones become the target population for the study. In all, there are 1,354 buildings out of which 15.0% (amounting to 203 of the buildings) were randomly selected for questionnaire administration using systematic random sampling technique at every 5<sup>th</sup> buildings on household basis. Owing to invalidation of 3 out of the total questionnaires administered due to observed inconsistencies, 200 (representing 98.50% of the 203 questionnaires administered) were analyzed using both descriptive and inferential statistics.

**RESEARCH FINDINGS AND DISCUSSION****Socio-Economic Characteristics of Respondents.**

As shown on Table 1, majority (40.0%) of the sampled respondents were within the age bracket of 18–35 years out of which 22.5% were students of the university, followed by those within 26-35 years (25.5%). Respondents above these ages (i.e. 36 years and above) who are

either staff members of the university, landlords or other residents of houses in the study area, altogether were about 34.5% of the sampled respondents.

**Table 1: Socio-economic Characteristics of Respondents**

<b>Variables</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Age Distribution</b>		
- 18 - 35 years	80	40.0
- 26 - 35 years	51	25.5
- 36 – 45 years	21	10.5
- 46 – 55 years	5	2.5
- Above 56 years	43	21.5
<b>Total</b>	<b>200</b>	<b>100.0</b>
<b>Gender Distribution</b>		
- Male	112	56.0
- Female	88	44.0
<b>Total</b>	<b>200</b>	<b>100.0</b>
<b>Period of Residency</b>		
- Less than 5 years	105	52.5
- 5 - 10 years	27	13.5
- 11 – 15 years	38	19.0
- 16 – 20 years	14	7.0
- 21 – 25 years	7	3.5
- Above 25 years	9	4.5
<b>Total</b>	<b>200</b>	<b>100.0</b>
<b>Occupational Distribution</b>		
- Artisan	52	26.0
- Trading	41	20.5
- Professional	44	22.0
- Students	45	22.5
- Public Servants	18	9.0
<b>Total</b>	<b>200</b>	<b>100.0</b>

*Source: Authors' Field Survey, 2014*

The period of residency in the area was investigated to ascertain relevance and genuineness of information given by the respondents. Majority (52.5%) live in the area in less than 5 years who were mainly students of the university while those with higher period of tenancy were mainly native of the community. This information gives a fair representation of the target population for the study.

### **Building Characteristics and Neighbourhood Infrastructure**

Table 2 shows the characteristics of buildings in the study area and the condition of neighborhood infrastructures. As shown on the table, majority of the buildings are Brazilian types. This accounts for about 52.0% of the buildings in the area which are very common in the core of the community. Blocks of flats and bungalows are building types that are common around the university which are mostly occupied by the students and some staff of the university. Larger percentage of these buildings is newly built which are in good conditions. Over 50% were built in less than 10 years, usually within the vicinity of the university. Only

about 22.5% were built above 40 years which are buildings at the core area, some of which are in bad conditions.

**Table 2: Building Characteristics and Neighbourhood Infrastructure**

<b>Variables</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Building Types</b>		
- Brazilian Style	104	52.0
- Blocks of Flats	66	33.0
- Bungalows	21	10.5
- Storey Building	9	4.5
<b>Total</b>	<b>200</b>	<b>100.00</b>
<b>Age of Buildings</b>		
- Less than 10 years	102	51.0
- 10 – 20 years	17	8.5
- 21 – 30 years	15	7.5
- 31 – 40 years	21	10.5
- Above 40 years	45	22.5
<b>Total</b>	<b>200</b>	<b>100.00</b>
<b>Uses of Buildings</b>		
- Residential	131	65.5
- Commercial	35	17.5
- Religious	16	8.5
- Mixed-use	18	9.0
<b>Total</b>	<b>200</b>	<b>100.00</b>
<b>Sources of Power Generation</b>		
- PHCN	133	66.5
- Power Generating Set	55	27.5
- Inverter	12	6.0
<b>Total</b>	<b>200</b>	<b>100.00</b>
<b>Adequacy of Power Supply</b>		
- Very Good	2	1.0
- Good	61	30.5
- Fair	48	24.0
- Poor	48	24.0
- Very Poor	41	20.5
<b>Total</b>	<b>200</b>	<b>100.00</b>

*Source: Authors' Field Survey, 2014*

Considering the uses of buildings, over 60% are used for residential purpose followed by commercial uses (17.5%), mixed uses (9.0%) and religious uses (8.5%). As usual, about 66.5% of these buildings are connected with Power Holding Company of Nigeria (PHCN) for source of power generation. The level of adequacy and regularity of PHCN source of power supply was investigated. Over 60% are of the opinion that the power supply through PHCN is fair, poor or very poor which shows the level of problem the residents (including students) faced regarding electricity supply in the area. This is the reason why 27.5% and 6.0% make use of generating set and inverter as supplement respectively.

### Pattern of Land Use Changes and Level of Development

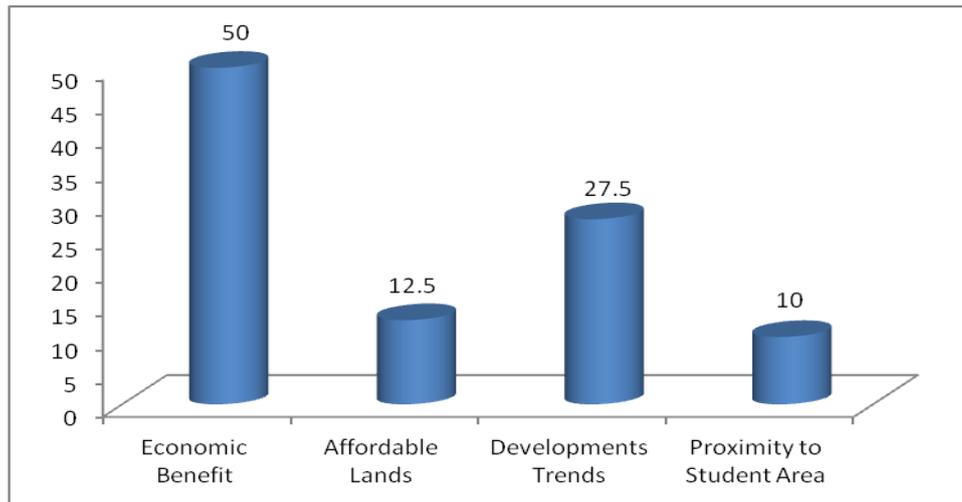
Land use change is the alteration in the initial use to which a piece of land is subjected to; one of the end results of urban development. Plate 1 depicts the common occurrence in newly open up sites of the community, portraying the evasive characteristics of residential land use in the university environment, as the demands for housing units by individuals and cooperate bodies increases. This infringes on farm lands and consequently has effects on the evolvement and pattern of land use in the area.



**Plate 1: Farmlands being cleared and prepared for building construction around the study area**

*Source: Authors' Field Survey, 2014.*

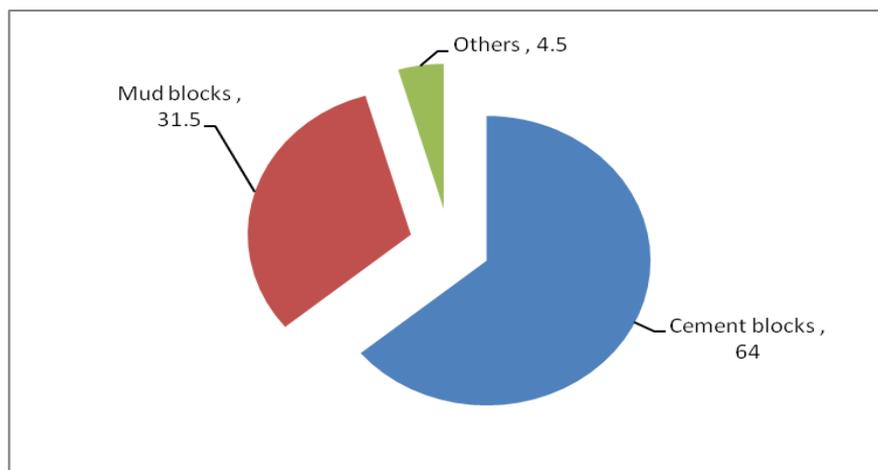
Investigating into major reasons for the changes in land uses in the study area; about 50.0% was of the opinion that the latter uses, which are either residential or commercial use, have high economic benefit to the owners and the community at large than the initial uses like agriculture. About 27.5% agreed that the change in land use in the area is resultant effects of development trend emanated from the location of the university while 12.5% are of the opinion that it is as a result of availability of affordable lands in the area. The remaining 10% posit the proximity to student area. This result is illustrated in Figure 3. The general observation made on urban development trends in the area focuses on high demands for land and increase in development of residential buildings, leading to congestion in the university environment. Hence, the need for adequate measure to mitigate the trend to forestall any environmental degradation and its attendant consequences in the area become pertinent.



**Figure 3: Reasons for Land Use Changes in the Study Area**

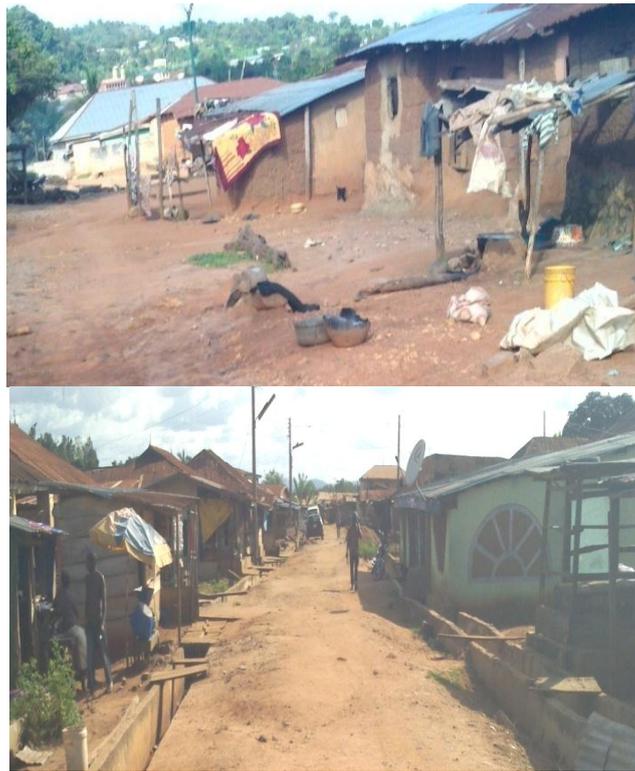
Source: Authors' Field Survey, 2014

The level of development regarding building materials used for construction was examined. Figure 4 shows major materials used. Arising from the investigation, larger percentage (64.0%) make use of cement blocks; essentially for modern buildings around the university environment whose occupants are mostly the university's students. The 31.5% of the sampled buildings constructed with mud blocks are those at the core of the community and probably nearby huts at the peripheries occupied by the 'Ebiras' (people from Kogi State who mostly specialized in farm work). Typical examples of such buildings are shown in Plate 2. About 4.5% are those constructed with planks and bamboo which are mostly used as temporary sheds for road workers. Buildings found in these areas are generally substandard for human habitation.



**Figure 4: Material Used for Building Construction in the Study Area**

Source: Authors' Field Survey, 2014



**Plate 2: Building Types at Ebira Community and at the Periphery of Iworoko Town respectively**

Source: Authors' Field Work, 2014

## **RECOMMENDATIONS AND POLICY IMPLICATION**

This study provides insight to urban development and land use changes as determined by individual property owners at certain time or the other depending on the trend of socio-economic development around a university community. This, without any doubt, influences the pattern and direction of the development in the area. One of the major findings was that the immediate environment of the university campus is the most developed area, leaving the rest of the study area (i.e. Iworoko community) with a minimal but yet tangible effects of the presence of the university. Secondly, there are lots of higher order services still not available at the community despite the presence of the university. For instance, the facilities available in the two medical centres in the community are owned by the state government (i.e. Iworoko community health centre and Egulusi medical centre). Looking at the level of these facilities, they cannot handle major medical cases. Thus, patients are forced to go to either the Ekiti State University Teaching Hospital (EKSUTH), Ado-Ekiti or visits the Federal Medical Centre, Ido-Ekiti; a far distance town from the study area. Besides, another very important finding is the erratic nature of power supply in the area which needs government attention due to high population of students.

Based on these findings in the study, the following measures are recommended as policy guidelines toward a sustainable urban land use management in the study area. There should be in place a monitoring agent to guide the direction and coherence of development in the

study area. This will forestall the haphazard pattern of development that is rampant in the area. Aside, there should be tremendous investment to provide adequate funds in building of resourceful environment focusing on standard housing units to enhance productivity of residents. Higher order services should be made available in the community to check incessant trips made to the state capital by all the residents of the community. The medical facilities in the environment should be upgraded to handle emergent medical cases rather than sending all to EKSUTH. Besides, essential services like power supply in the area need urgent attention. Government should provide transformer to facilitate adequate electricity supply that will curb erratic nature of power supply in the area. This will boost the level of socio-economic activities in the area.

## REFERENCES

- Adebayo M.A. (2010). Impact of Urban Land Use Changes on Property Values in Metropolitan Lagos. *The Soc. Sc.*, Medwell Publishing; 4(1):111-117
- Bairoch Paul (1991). *Cities and Economic Development: From the Dawn of History to the Present*. Chicago; University of Chicago Press
- Bhalli, M.N and Ghaffar, A. (2015). Use of Geospatial Techniques in Monitoring Urban Expansion and Land Use Change Analysis: A Case of Lahore, Pakistan. In *J. of Basic and Applied Sci.*; 11, 265-273
- Bureau of Rural Sciences (2002). *Land use mapping at Catchment Scale: Principles, procedures and definitions (2<sup>nd</sup> Edition)*; Bureau of Rural Sciences, Canberra.
- Ellis Erle (2010). Land-use and land-cover change. In *Cutler J. Cleveland (Eds.) Encyclopaedia of Earth*; Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment. (Retrieved on August 30, 2012 at: [http://www.eoearth.org/article/Land-use\\_and\\_land-cover\\_change](http://www.eoearth.org/article/Land-use_and_land-cover_change))
- Ettema, J., van den Broeke, M. R., van Meijgaard, E., and van de Berg, W. J. (2010). Climate of the Greenland ice sheet using a high resolution climate model – Part 2: Near-surface climate and energy balance, *The Cryosphere*, 4:529–544.
- Hald M. (2009). *The Chinese Eco-City Concepts, Strategies, Policies and Assessments*; Bureau of Rural Sciences, Canberra.
- Hegazy, I.R., and Kaloop, M.R. (2015). Monitoring Urban Growth and Land Use Change Detection with GIS and Remote Sensing Techniques in Daqahlia governorate Egypt. *Inter. J. of Sust. Built Envir.*, Elsevier (in press); <http://dx.doi.org/10.1016/j.ijsbe.2015.02.005>
- Hippu S; Kristle N. and Sudhakara B. (2012). A Conceptual Framework for Development of Sustainable Development Indicators. Indian Gandhi Inst. of Devel. and Research, (IGIDR), India
- Koomen GJ, Den Blaauwen T, Hellingwerf KJ, Ungaro R, Mobashery S (2010). Fighting microbial resistance through development of new antimicrobial agents, directed against new specific targets. IUPAC Project 030-1-300
- Oduwaye, Leke (2015). Urban Land Use Planning and Reconciliation; *Inaugural Lecture Series 2015*, University of Lagos, Nigeria
- Owoeye J.O. (2013). A Study on Environmental Habitability of Core Residential Neighbourhood in Akure, Nigeria; *American J. of Res. Comm.*; 1(2): 140-153. (Available at: [www.usa-journal.com](http://www.usa-journal.com)).

- Oyinloye. M.A. (2010). Spatial Analysis of Urban Growth in Akure, Nigeria; Unpublished PhD Thesis, Federal University of Technology, Akure
- Rimal B. (2005). Application of Remote Sensing and GIS, Land use/land cover change in Kathmandu Metropolitan city, Nepal. *J. of Theor. and Appl. Info. Tech.*; 3(4):80-86 ([www.jatit.org](http://www.jatit.org))
- Rimal B. (2011). Application of Remote Sensing and GIS, Land Use/Land Cover Change in Kathmandu Metropolitan City, Nepal. *J. of Theor. and Appl. Info. Tech.*; 23(2): 80-86.
- Rob Leslie (2011). *Concepts, Terms and Classification Principles*; Bureau of Rural Sciences, Canberra
- Squires G.D. (2002). Urban sprawl and the uneven development of metropolitan America; In Squires G.D (edited): *Urban Sprawl - Causes, Consequences, and Policy Responses*; Urban Institute Press, Washington, DC: 1–22.
- Yuan F; Sawaya K.E; Leoffelholz B.C. and Bauer M.E. (2005). Land Cover Classification and change analysis of the Twins cities by Multi-temporal Land-sat RS. (Retrieved April 13, 2012 at: [http://rsl.gis.umn.edu/ Document/TCMA.change-detection-RSE.paper-3.pdf](http://rsl.gis.umn.edu/Document/TCMA.change-detection-RSE.paper-3.pdf)).
- Yuri Fernandez (2009). Effects of land use change and urban development on biodiversity and traditional ecological knowledge in a Maya community in Yucatan. *J. of Sust. Urban Devel. and Human Ecol.*, Italy; 2(5): 53-69.