Impacts of Urban Expansion on Natural Vegetation in Uyo Metropolis

by

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Abstract
In this paper, the impacts of urban expansion on natural vegetation in Uyo metropolis was assessed using a combination of two years remote sensing data in a geographic information system and field survey. The study revealed that disturbed forest reduces by 26.25% at the annual rate of 2.63%, bush by 12.74% at 1.27% rate annually and farmland reduces by 11.01% at 1.10% annual rate, while built-up/bare land (urban) increases by 50% at 5% annual rate of change between the year 1986 and 2016. It was further gathered from respondents that population growth with 49.6% as a major factor responsible for urban encroaching into natural vegetation followed by economic growth with 28.2% in Uyo metropolis. Also, 32.1% and 24.6% of respondents were of the opinion that urban expansion leads to loss of natural environment (deforestation) and loss of farmlands respectively in the study area. It was concluded that massive natural vegetative cover has been transformed to urban land due to human impacts on the environment have led to deforestation, environmental degradation, loss of farmland and reduction in crop yield. It was, therefore, recommended that the remaining fragments of vegetation in Uyo metropolis by properly protected and managed and that appropriate master plan should be developed for this fast expanding urban area.

Key word: Uyo, Urban expansion, remote sensing, natural vegetation

1. Introduction
The increase in employment potentials and business opportunities in urban cities due to the concentration of economic activities and expansion of industries (Dierig, 1999), has always attracted persons from rural areas, towns and countries thereby increasing the proportion people living in the urban areas. At the turn of the twenty-first century, about half of the world’s population (roughly three billion people) lived in urban areas. In the early 1950s, about 66 percent of the entire world’s population lived in the countryside
Currently, about half of the world’s population lived in urban areas, and according to UNFPA (2004), about 60% of the population will live in cities in 2030.

As the population increases in urban centres, there is also a corresponding need for expansion in human settlement to accommodate the ever increasing urban population. This growth of urban settlement (urban expansion) has been described by Ifatimehin, Musa and Adeyemi (2009) as one of the most remarkable developments in human settlements in the world. It is a process that always initiates the continual transformation of land from one use to the other. It represents the most profound human alteration of the natural environment through a spectrum of urban land use activities (Ifatimehin and Ufuah, 2006) which include, but are not restricted to transportation, commercial, industrial, residential, institutional and recreational land uses. The expansion that happens as a result of increase in the demand for these land uses explains the underlying and fundamental cause of urban expansion which is population increase. This growth has been phenomenal from the turn of the 20th century (Lambin, Geist and Leper, 2003), especially in developing countries such as Nigeria.

One of the most unavoidable processes in the world is Urbanization. Pathan (1989, 1991) and Kumari (2008) described urbanization as the process through which the productive agricultural lands, forests, surface water bodies and groundwater prospects are being irretrievably lost. According to the United Nation (UN), more than 90% of urbanization is taking place in the developing world (UN-Habitat, 2006). The urban populations in the developing countries will reach 2 billion in the next 20 years, increasing about 70 million per year, which is more than one million per week. The populations in the urban areas of Africa and Asia will be doubled at that time. By 2030, 80% of the total world’s urban population will be living in developing countries. UNFPA (2004).

While the urban centres are growing in population and extent, the peri-urban areas are undergoing a two-fold transformation: with arable land coming under increasingly intense cultivation and both arable and non-arable land being increasingly built over to provide space for commercial, industrial and residential establishments (Ifatimehin and Ufuah, 2006). That urban expansion provides economic benefits is undisputable, but there are also serious negative impacts. Conversion to urban uses is largely irreversible as rural land uses once converted to urban seldom revert to rural (Udoh and Ituen, 2004). Also, continued encroachments of new urban areas into agricultural regions create tension between the new inhabitants and the agricultural production operative that struggle to survive in the same location.

The expansion of urban land has direct effect on the available agricultural land in and around the urban area, which in turn affects food supply, food security and this increasing losses of agricultural lands have become an issue of global concern (Brown, 1995, Bender, 1997, Crosson, 1997 and Gajraj, 1981). The continued increase in human population, a decrease in fresh water supplies, loss of croplands and the changing global climate are all factors that may influence the ability of societies to produce sufficient food to feed the world’s inhabitants.
As noted by Ifatimehin and Ufuah (2006): The growth in urban areas leads to diminishing yields and worsening food insecurity in rural areas mostly at the fringe of the rapidly growing urban settlements due to the conversion of arable land to build environment to incorporate growing residential and industrial estates. Thus, faced with the problem of sustainable agriculture mainly practiced in the rural areas, there is a high rate rural-urban migration propelled by economic development, which exacerbates the problem of food shortage and food security particularly in the underdeveloped and developing countries (Odudu, 2003).

Human activity is vastly altering the Earth’s vegetative cover. Such changes have considerable consequences for the health and resilience of ecosystems and for human welfare. They also contribute to anthropogenic climate change through a variety of processes. These include the growth or degradation of surface vegetation, which produces changes in the global atmospheric concentration of carbon dioxide; and changes in the land surface, which affect regional and global climate by producing changes in the surface energy budgets (Gregg, 2003). It affects several components of the earth environment such as climate change. In assessing this, Gupta, Thapliyal, Pal, and Joshi, (2005) analysed microclimates, regional climate and global climate as affected by tropical deforestation. The authors state that vegetation removal has changed the global energy budget not only through the micrometeorological processes but also by increasing the concentration of carbon dioxide in the atmosphere since carbon dioxide absorbs thermal infrared radiation in the atmosphere. Moreover, vegetation removal was also reported as increasing the albedo of the land surface and hence affects the radiation budget of the region (Gupta, Thapliyal, Pal, and Joshi, 2005). Chomitz, Buys, Luca, Thomas, and Wertz-Kanounnikoff, (2007) report that vegetation removal affects wind flows, water vapour flows and absorption of solar energy thus clearly influencing local and global climate. Studies by Lawton, Nair, Pielke, and Welch, (2001) showed that deforestation on lowland plains moves cloud formation and rainfall to higher elevations. Vegetation removal by deforestation is said to disrupts normal weather patterns creating hotter and drier weather thus increasing drought and desertification, crop failures, melting of the polar ice caps, coastal flooding and displacement of major vegetation regimes (WHO, 2002).

Uyo, the Akwa Ibom State capital has grown in numbers and sizes since its creation in 1987, has accommodated the high influx of people and satisfy their infrastructural needs; has expanded to surrounding suburbs and have led to widespread changes in land use/cover (Ekpenyong, 2008). This has given rise to the depletion of the natural vegetation as the urban centres grow, continued destruction of the natural vegetation has resulted. In the past, monitoring urban land use/cover change was met with limited access to adequate information and appropriate technology (Ituen, 2007). But in recent times, the integration of Remote Sensing (RS) and Geographic Information System (GIS) has been widely applied and recognised as a powerful and effective tool in detecting urban land use/cover change. Hence, in order to effectively monitor urban growth, it is not only necessary to have the information on existing Land Use/Cover Change (LUCC) but also the capability to monitor the dynamics of land use/cover
resulting from both changing demands of increasing population and forces of nature acting to shape the landscape. Consequently, this paper utilised a combination of remote sensing data and field survey in assessing the impacts urban expansion on natural vegetation in Uyo metropolis over a 32-year period (1984-2016)

2. **The Study Area**

Uyo metropolis is located in the central part of Akwa Ibom State. It lies within latitudes 4°50’N and 5°7’N and longitudes 7°45’E and 8°05’E. It extends to Ibiono Ibom and Itu local government areas on the north, on the South to Ibesikpo Asutan, Nsit Ibom and Etinan local governments, on the East to Uruan local government area and on the West it terminates Ikono in Uyo local government area.
Fig. 1: Akwa Ibom State showing Location of Uyo Metropolis

Originally, Uyo was a village in Offot Clan before the advent of colonial administration. From around 1914, Uyo Village gradually developed into a commercial town which possessed certain attributes required by the colonial administrators. As a result, it later became a District Administrative Headquarters for the former Calabar
Province. It continued to grow such that it became the headquarters of the defunct Uyo province. Following the creation of Local government areas in 1967, Uyo Local Government Area was created and its headquarters remained at the Uyo village. But on 23rd September, 1987, Uyo, as a local government added another dimension to its political status and relevance as it became the capital city of Akwa Ibom State. The situation still remains till date when Uyo is mostly known as a state capital and less so as a Local Government. Following its status as the state, Uyo Capital City Development Authority (UCCDA) marked out a 10km radius with the centre at Itiam Etoi as Uyo metropolis for the control of development in the area.

Uyo metropolis lies within the humid tropic which is characterized by two distinct seasons: dry and wet seasons. The temperature is constantly high with a mean monthly value of approximately 27°C. Relative humidity is at a constant high value of between 70% and 90% all year round. The annual rainfall ranges from 1905mm to 2668.7mm with an average value of 2248.2mm. It is within the equatorial rain forest belt often characterized by tall trees and shrubs with thick ground cover. Unfortunately, today human induced pressure and unsustainable practices on the environment has really transformed the area. The area is relatively flat with 60 meters mean elevation above sea level exception of the ravine that existed in the North-Eastern part. The area is drained by the Ikpa River and some of its minor tributaries which flow in a south-Eastern direction, finally emptying into the lower Cross River.

3. Materials and Methods

Landsat satellite images for 1984 and 2016 used for the study were obtained from the United States Geological Survey (USGS). The images were layer stacked, mosaic (since the study area comprises parts of both the northern and southern images of Akwa Ibom State), and the study area (Uyo Metropolis) extracted using subset menu after defining the area of interest (AOI). The supervised classification method in Erdas Imagine 9.2 software was used to classify the images into four land cover classes namely: thick bush, cultivated land, farmland and built up/bare land following modified Anderson’s land use classification and the area of each classes generated in hectares. The resulting four land cover classes were reclassified into two (urban lands and vegetation) classes. Change analysis was carried out for each of the classes generated to detect the changes occurring in the study area within the periods under investigation. For accuracy assessment, the output of the 1984 image classification was compared with the result of the 1978 land use assessment of urban expansion into agricultural lands in Uyo by Udoh and Ituen, 2004 which reflected exactly the same. While for that of 2016, 20 GPS coordinate locations across the various existing land covers were captured, downloaded and superimposed on the classified image to verify the classification. Information on impacts urban expansion on vegetation in the study area were acquired through the administration of 390 questionnaires across the eleven sampled communities (Afaha Etok, Afia Nsit no.1, Eniong, Ika Ikot Ubo, Ikot Ebido Oku, Ikot Obio Ama, Ikot Udo Ekop, Mbiabam, Mbierebe Obio, Nung Udoe Ediene and Okobo Ibiono) representing 10% of the 113 communities that makes up the study area.
4. **Analysis and Results**

Based on the analysis of the satellite images, the areal coverage of land covers in the study area in 1984, indicated that disturbed forest occupied 9567.97 hectares representing 28.41%, bush 8583.70 (25.48%), farmland 6830.70 (20.28%), and built-up/bare land occupied 8702.45 representing 25.83% while in 2016 thick bush covers 10.53%, cultivated land 16.81%, farmland 12.78% and built-up/bare land 59.88%. (See table 1 and figures 2 and 3). Based on the analysis, the changes between the based year 1984 and the later year 2016 indicated as follows; disturbed forest reduces by -6,019.99 hectares (26.25%) at the annual rate of 2.63%, bush reduces by -2,921.17 hectares (12.74%) at 1.27% rate annually and farmland reduces by -2,527.34 hectares (11.01%) at 1.10% annual rate, while built-up/bare land (urban) increases by 11,468.5 hectares (50%) at 5% annual rate of change.

Table 1: **Inventory of Land Use/Land Cover Status**

<table>
<thead>
<tr>
<th>Land use Classes</th>
<th>Statuses</th>
<th>Area covered as at 1984</th>
<th>%</th>
<th>Area covered as at 2016</th>
<th>%</th>
<th>Change in hectares</th>
<th>% change b/w 1984 &amp; 2016</th>
<th>% Annual change b/w 1984 &amp; 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disturbed Forest</td>
<td></td>
<td>9567.97</td>
<td>28.41</td>
<td>3547.98</td>
<td>10.53</td>
<td>-6019.99</td>
<td>26.25</td>
<td>2.63</td>
</tr>
<tr>
<td>Bush</td>
<td></td>
<td>8583.70</td>
<td>25.48</td>
<td>5662.53</td>
<td>16.81</td>
<td>-2921.17</td>
<td>12.74</td>
<td>1.27</td>
</tr>
<tr>
<td>Farmland</td>
<td></td>
<td>6830.70</td>
<td>20.28</td>
<td>4303.36</td>
<td>12.78</td>
<td>-2527.34</td>
<td>11.01</td>
<td>1.10</td>
</tr>
<tr>
<td>Built-up/Bare Land</td>
<td></td>
<td>8702.45</td>
<td>25.83</td>
<td>20170.95</td>
<td>59.88</td>
<td>11468.5</td>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>33684.82</td>
<td>100</td>
<td>33684.82</td>
<td>100</td>
<td>22937.00</td>
<td>100</td>
<td>50</td>
</tr>
</tbody>
</table>
Figure 2: Uyo Metropolis Land Cover Map for 1984

Figure 3: Uyo Metropolis Land Cover Map for 2016
On the overall assessment of urban expansion into vegetation, the spatial extent to which vegetation has been taken by urban expansion in the study area is shown on table 2 and figure 4 result in loss of 11,468.5 hectares of natural vegetation. The changes tended to follow the major roads with the highest trend of expansion toward the South-Eastern part of the study area. Although this result corresponds with that of Udoh and Ituen (2004), Okon (2008) and Njungbwen, (2010), the analysis showed that the rate of alteration of the natural vegetation was much faster than predicted by others.

Table 2: Status of vegetation and built up/bare land (Urban Expansion)

<table>
<thead>
<tr>
<th>Year</th>
<th>1984</th>
<th>%</th>
<th>2016</th>
<th>%</th>
<th>Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation</td>
<td>24982.37</td>
<td>74.2</td>
<td>13513.87</td>
<td>40.1</td>
<td>-11468.5</td>
<td>50</td>
</tr>
<tr>
<td>Urban Area</td>
<td>8702.45</td>
<td>25.8</td>
<td>20170.95</td>
<td>59.9</td>
<td>11468.5</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>33684.82</td>
<td>100</td>
<td>33684.82</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4: Land cover map showing extent of Urban Expansion into Vegetation

From the questionnaires administered, 97.8% respondents affirmed to the occurrence of changes in the vegetation of the study area revealed. On the negative effect of the observed pattern of changes on natural vegetation, the study revealed that 40.77% of the respondents strongly agreed, 23.85% agreed, 17.18% disagreed while 18.21% of the respondents strongly disagreed on the pattern of changes having effect on natural vegetation. This implied that, observed significant changes respondents in the study area

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imposes serious negative effect on the natural vegetation and this corresponded with the result of land cover analysis which built-up/bare land had taken up about 50% of the vegetation within the period under investigation.

Still, it was gathered that about half of the respondents 49.6% stated agreed to population growth as the factor responsible for urban encroaching into natural vegetation in Uyo metropolis, 28.2% cited economic growth as the major factor, 9.3% attributed urban expansion into natural vegetation in the study area to physical constraint and 12.9% lack of affordable housing as many who cannot afford the cost of rent in the city moved to nearby suburbs and shuttle to the city for their businesses and jobs. Also, on the impacts of urban expansion on vegetation, it was gathered from the 390 copies of the questionnaire administered that 32.1% of respondents were of the opinion that urban expansion leads to loss of natural environment (deforestation), 11% for environmental degradation (development of flood and erosion) and 24.6% for loss of farmlands. While 16.2% and 16.1% were of the opinion means of livelihood and crop yield respectively in the study area.

5. Conclusion and Recommendation

The study which mainly used satellite images and questionnaire revealed a serious increase in built-up/bare land (Urban) from 25.83% in 1984 to 59.88% in 2016 suggests that a massive natural vegetative cover in the study area has been transformed to urban land due to human impacts on the environment as a result of rapidly growing population. The residents respond on the impacts of urban expansion in the area which generally indicated a loss of farmland, reduction in crop yield, deforestation and environmental degradation are complete indications of food insecurity in the study area as the have to depend on supply from the rural and other areas, complete alteration of the natural ecosystem and susceptible to health hazard. From the study, the necessity for a proper protection and management of the remaining fragments of vegetation in Uyo metropolis is highly recommended. Appropriate Master plan should be developed for this fast expanding urban area and legislations should be made effectively put to use for proper development control and defaulters severely made to face the wrath of law.

References


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