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Urbanisation and Deforestation using GIS in Bwari Area Council Abuja

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Abstract

This study examined the relationship between urbanisation and deforestation in Bwari Area Council of Abuja from 2007 through 2017. Satellite images of the study area for 2007 and 2017 were retrieved and measured four parameters; water bodies, grassland, forest and built up area. The mean and standard deviation of the parameters were calculated while Pearson Correlation was used to analyse the relationship forest size and built up area. Results show that a 65599ha increase in built up area coincided with a reduction of 56888ha of forest size. Correlation result further showed a significant relationship. It recommends therefore that the government should mainstream forest management in its mass housing scheme programme.

Keywords: Urbanisation, forests, grassland, water, population

1.0 Introduction

Forests play a foremost role in climate regulation by dropping the levels of carbon dioxide and other greenhouse gases in the atmosphere. Forests also provide other conservation goods and services such as watersheds and biodiversity protection and feature benefits.

The introduction of urbanisation is simply population shift from rural areas which leads to the gradual increase in people. Developing countries are experiencing a rapid rate of urban growth (Ogunleye, 2013). This is manifested more in Africa where African cities are currently experiencing an urban transition at an extraordinary scale and pace; with an estimated population growth rate of 5% per year, the proportion of Africans' urban residents double every 15 years (UN, 2002). Urbanisation comes with it housing, roads, gazetted reserves for holidaying and other infrastructures. Housing as a unit of the environment has profound influence on the health, efficiency, social behaviour, satisfaction and general welfare of the community. It reflects the cultural, social and economic values of a society, as it is the best physical and historical evidence of the civilization of a country (Omole, 2010). Adequate shelter has always been one of the very basic human needs. Overtime, its provision has been met in the

form of dwellings which are temporary or permanent, natural or adapted (Ojo, 1998). However, housing is more than shelter (Wahab, 1983; Oladapo, 2006). It is a permanent structure for human habitation, and has become a critical component in the social, economic and health fabric of every nation. Its past is thus intimate from the social, economic, cultural and political development of man (Listokin and Burchil, 2007). Studies have shown that the provision of appropriate housing, particularly for the urban poor constitutes a major challenge to development in most African and developing nations at large (Okoye, 1990; Lawanson, 2005).

According to Geist and Lambin (2002) demographic and economic factors which is inclusive of urbanisation as a result of population growth due to migration, could lead to timber extraction, other forms of devegetation and agricultural expansion.

Over the years world over, Geographic Information System (GIS) has been in use for urbanisation and deforestation investigation. Ahmadi (2018) agrees that deforestation has been recorded to the most serious threat to environmental diversity and that the use of GIS in its analysis has helped to reduce this threat. To this end, Achard *et al* (2005) believe that the use GIS to monitor environmental changes like deforestation and urbanisation saves time and money. They pointed out some benefits of GIS use which includes that environmental change be measured on many scales and regularly. Anastatsio and Bodzin (2006) supports this by asserting that overall GIS is described to be a valuable tool in understanding the environment and making responsible environmental decisions. They concluded by saying that without GIS, the measurement and assessment of forest and land cover would be less accurate and take up much more time.

Wilkie and Finn (1996) Remote Sensing and Geographic Information System (GIS) is a powerful tool in the study of changes in Land use and Land cover, as well as terrain analysis. The advantage of GIS over former approaches is in its ability to analyse spatial relationship between land use and forest geographies over an area in a single image capture. It can also be used to assess data Information products such as elevation, slope, and aspect which can quite easily be derived from digital terrain models (DTM).Remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and change at local, regional and global scales over time; such data also provide an important link between intensive, localized ecological research, regional, national and

international conservation and management of biological diversity.

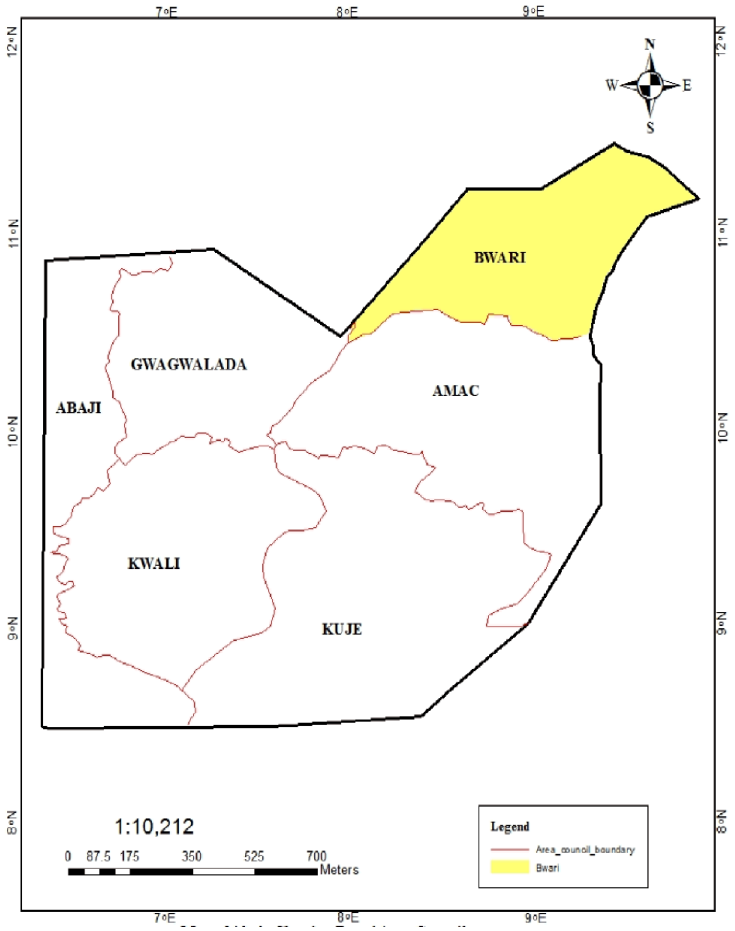
Bwari is one of the six Area Councils in Abuja. It comprises of 66 satellite towns with Kubwa, Bwari, Dutse and Mpape as the main towns. Bwari is one of the area councils with significant increase in urban sprawl in line with the government policy of changing the face of the capital city. According to the National Population Commission (2010), a total of 50,109 housing units exist with 40,335 of them built with cement in line with the housing policy. Of the 50109 households enumerated by the NPC, 105,593 of them use fuelwood for cooking. The government in other to fulfil its mandate for mass housing scheme has also removed large expanses covered by trees and other forms of vegetation. To what extent this removal of trees for infrastructure and the use of fuelwood for cooking have affected vegetal removal is what this research seeks to find out.

1.1 Study Area

Bwari is a town in Abuja the Federal Capital Territory of Nigeria located within $9^{o}10'55"$ and $9^{o}26'15"N$ and $6^{o}13'45"$ and $7^{o}42'30"$ E as shown in Figure 1. It covers a total of about 2,300 square kilometres, and lies in the north – eastern part of the Federal Capital Territory (FCDA, 2004). The Bwari area features an interesting terrain, which combines rounded hills and bunches of rock outcrops divided by river valleys, as well as gentle rolling plains. It falls within the Abuja hills and dissected zone of the Jema'a Platform. Generally viewing the study area, the hilly areas are found towards the eastern part, posing constraint to physical development while the plains occupy the central and western areas. The study area is the highest part of the FCT with several peaks that are about 760 meters above sea level (Balogun, 2001).

The original inhabitants of Bwari are the Gbagyi speaking people however; the Hausa, Igbo, Yoruba, Nupe and Gwandara tribes are also resident within the study area. The Area Council is highly undulating and very rich in mineral deposits. The main land use types in the study area include built-up, residential, commercial, institutional, administrative, roads and industrial settlements. It houses major government establishments like the Joint Admission and Matriculation Board, the Law School, General Hospital, Usuma dam and private establishments like the Dorben Polytechnic and Veritas University. These establishments have led to the increase in population and as such a lot more housing units and significant

degree of urbanisation. The indigenes are however hunters and farmers.



Source: Department of Land Surveying, FCDA – Abuja

Fig 1: Abuja showing Bwari Area Council

2.0 Methodology

This study considered the period between 2007 and 2017. Satellite images of Bwari Area Council for 2007 and 2017 were retrieved from United States Geological Survey site via GLOVIS portal with relative cloud cover of less than 30% at 30m resolution. Map the FCT showing Bwari Area Council was got from the department of Land Surveying, Federal Capital Development Authority (FCDA). The data retrieved was analysed using ArcMap 10.2. The analysis recognised image registration, error correction, image classification, layering *et cetera*. The images show four parameters; water bodies, forest size, grassland size and built up areas. The areas of these parameters were measured in hectares and duely correlated at 5% confidence level using Pearson Correlation: the mean and standard deviation and the percentage change were also calculated.

3.0 Results and Discussion

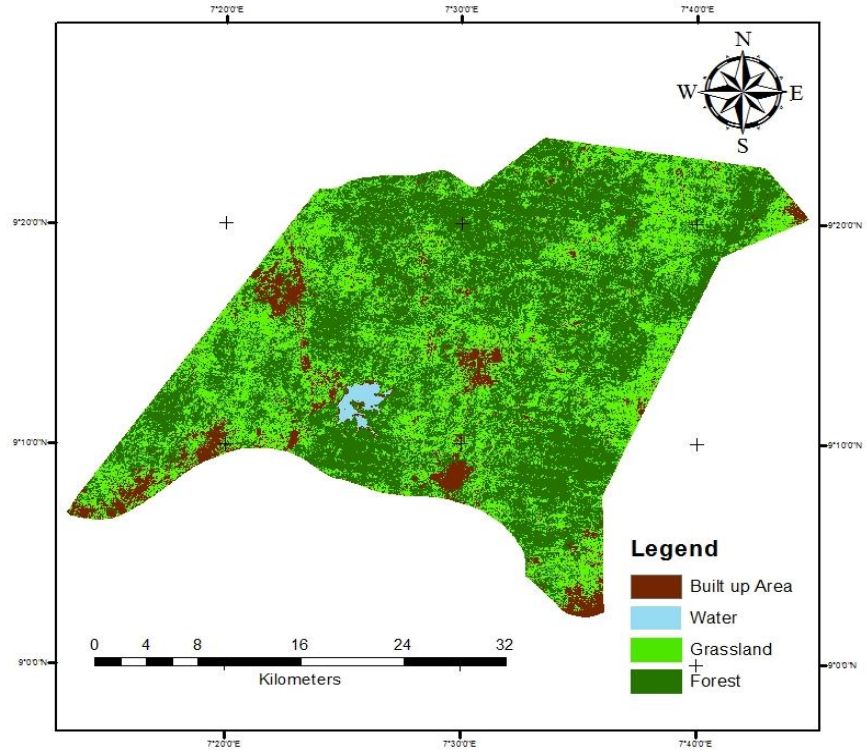


Fig 2: Bwari showing built up area and vegetation for 2007

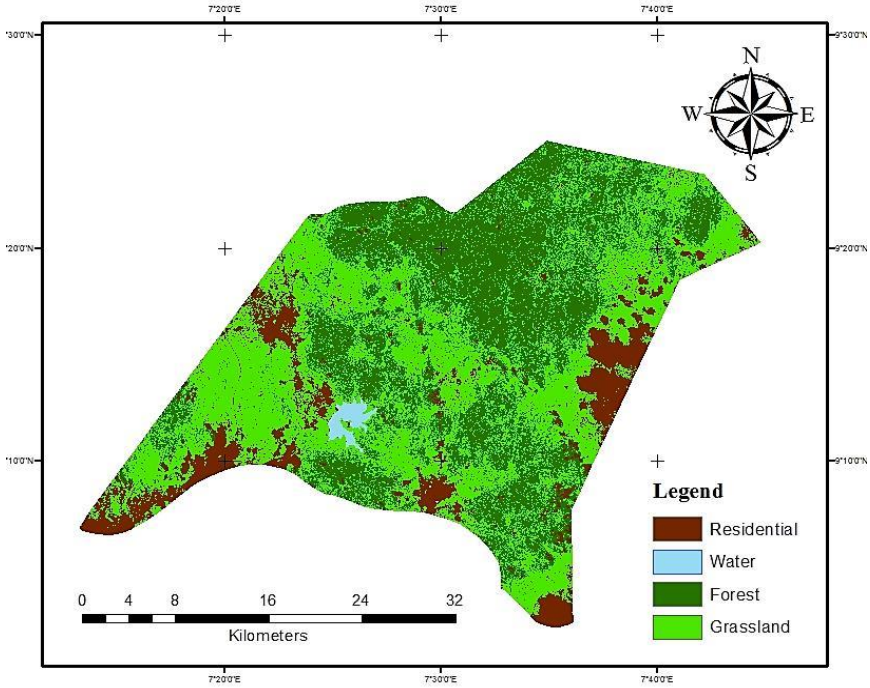


Fig 3: Bwari showing built up area and vegetation for 2017

Table 1: Measured parameters in hectares

Parameter	2007 (ha)	2017 (ha)	% change	t = -1.0 r = 0.96
Built up area	94818	160417	69.18	
Water	9334	9786	4.84	
Grassland	483113	473950	-1.89	
Forest	654978	598090	-8.69	
Total	**1242243**	**1242243**		

Table 2: Mean and Standard deviation of measured parameters

	BUILT UP AREA 2007	**BUILT UP AREA 2017**
MINIMUM	1.00	45.00
MAXIMUM	26.00	81.00
MEAN	1.24	61.37
STD DEVIATION	2.45	4.54
	WATER 2007	**WATER 2017**
MINIMUM	17.00	1.00
MAXIMUM	22.00	26.00
MEAN	18.81	12.97
STD DEVIATION	0.73	1.33
	GRASSLAND 2007	**GRASSLAND 2017**
MINIMUM	50.00	1.00
MAXIMUM	60.00	26.00
MEAN	55.50	14.86
STD DEVIATION	2.78	2.42
	FOREST 2007	**FOREST 2017**
MINIMUM	30.00	1.00
MAXIMUM	79.00	26.00
MEAN	53.39	17.72
STD DEVIATION	3.88	3.09

From table 1 and supported by the standard deviation result in table 2, the urban space shows an expansion in the urban sprawl between the study years in Bwari Area Council. The built up area increased by 69.18% having increased from 94818 to 160417 hectares. The water body increased from 9334 to 9786 hectares amounting to a 4.84% rise. This is also supported by the result in table 2; this increase in size is as a result of the Usuma Dam dredging and expansion in other to meet with the portable water demands of the Capital Territory, it however was a one-off activity. The grassland size reduced by 1.89% whiles the forest size also reduced by 8.69%. This forest loss amounting to 56888ha is very significant, thus a 65599 ha increase in urbanisation coincided with a decrease of 56888 ha in

forest size. Uzonu and Bala (2016) agree that the government is the greatest agent of deforestation in Abuja amongst six others. They also agreed that 56% of the cooking fuel used in Abuja as a result of population explosion and demands comes from timber.

Butler (2012) asserted that urban and residential area growth cause significant forest loss, both in the consumption of building materials and as a source of land. While urbanization can reduce direct burdens on forests by the movement of rural residents to population centers, urban and suburban sprawl can be damaging when they occur in frontier settlements and boomtowns. He strongly pointed that centrally planned urban trials has resulted in great forest loss in parts of the world. Indonesia's massive transmigration program moved some 730,000 families—more than six million people—to the outer islands of New Guinea, Borneo, Sumatra, and Sulawesi in an effort to reduce population burdens on the crowded central islands of Java and Bali.

From this result analysis, especially the correlation result; t = 1.0 and r = 0.96, I can conclude that a significant relationship exist between urbanisation and deforestation in Bwari Area Council.

Conclusion

This study having looked at the degree of urban sprawl and deforestation in Bwari Area Council from 2007 through 2017 found out that there is significant relationship between the two; as urbanisation was increasing, forest size was on the decline. Government has been fingered to be the greatest agent of deforestation by clearing extensive area for housing and roads' construction and other infrastructures that characterise urbanisation without considering the negative effects. It is therefore necessary that mass housing policies should mainstream forest management and sustainability.

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