

GEOSPATIAL MAPPING AND ANALYSIS OF DEVELOPMENT TRENDS IN THE FEDERAL CAPITAL CITY (FCC) ABUJA, NIGERIA FROM 1990 TO 2014

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Abstract- the Federal Capital City (FCC) was created in 1976 and physical development of both the city and its region started in earnest in 1980. As a result, there has been a remarkable change in the physical development of the city. There is therefore the compelling need for timely accurate data on the physical development in the FCC. Presented in this study is an approach for mapping the physical development trends in the Federal Capital City (FCC) Abuja. This paper used multi-temporal satellite imageries of 1990, 2002 and 2014. Multi-temporal analysis was performed to derive the extent of physical development in the FCC, Abuja. Land Use/Land Cover maps of 1990, 2002 and 2014 were produced by using the supervised maximum likelihood classification algorithm in ERDAS Imagine 9.1. Post-classification comparison was used for producing growth/change map. Results show that for the past 24 years, 1990-2014, FCC Abuja has been undergoing extensive land cover change. The built up area in the city has grown from 14,693.85hectares in 1990 to 34,425.90hectares in 2002 and to 50,964.21hectares in 2014. The highest rate of urban growth is observed during the first period of urbanization (1990 to 2002) in which the built up area increased more than twice (40.17%) within 12 years, and in the second period of urbanization there was a change of 19.37%. In total, 36,270.36hectares of non-built up land has been converted to urban area. In this study it has been possible to successfully capture the changing subtleties of physical development patterns and trends in the FCC, Abuja. However it is recommended that further studies be carried out about development trends of other areas of the FCT, Abuja, so that a comparative analysis can be made between the FCC and other areas of the FCT, Abuja.

Keywords: Change Detection, Land cover / Land use, Remote Sensing, Urban Development

I. INTRODUCTION

Understanding the phenomenon of development and analyses of development trends would help in addressing the needs of the present and future needs of a region. This plays a key role in planning for infrastructure and becomes crucial in regional planning especially when resources are scarce (Sudhira et. al., 2000). The physical development of both the city of Abuja and its region started in earnest in 1980 after its creation in 1976. As a result, there has been a remarkable change in the level of physical development in the FCT. This is primarily due to the introduction of a large number of socio-economic infrastructures and developmental institutions through the activities of both the public and private sectors. These, which are indeed innovations, consequently induced a modern development of its urban environment, with very profound effects on the social and economic well being of the residents of the FCT. Also since the early 1980s, there has been an influx of a large number of Nigerians of diverse ethnic origins into the FCT as employees in the public and private sectors, and as entrepreneurs in the informal sector (Balogun, 2001).

This is a very strong response to the ongoing socio-economic and physical development in Abuja. There is therefore, a need for a continuous geospatial mapping and analysis of the development trends in the FCC in order to be able to plan for the future.

II. STUDY AREA

The study area Abuja the Federal Capital City (FCC) is located in the Gwagwa Plains, in the north-eastern "pan-handle" of the Federal Capital Territory (FCT). The FCC lies within latitude $9^{\circ}15'N$ and $8^{\circ}56'N$ of the equator and longitude $7^{\circ}09'E$ and $7^{\circ}34'E$. It occupies about 535sq km that constitute about seven percent (7%) of the total 8,000 km² land area of the FCT. see Figure 1.0.

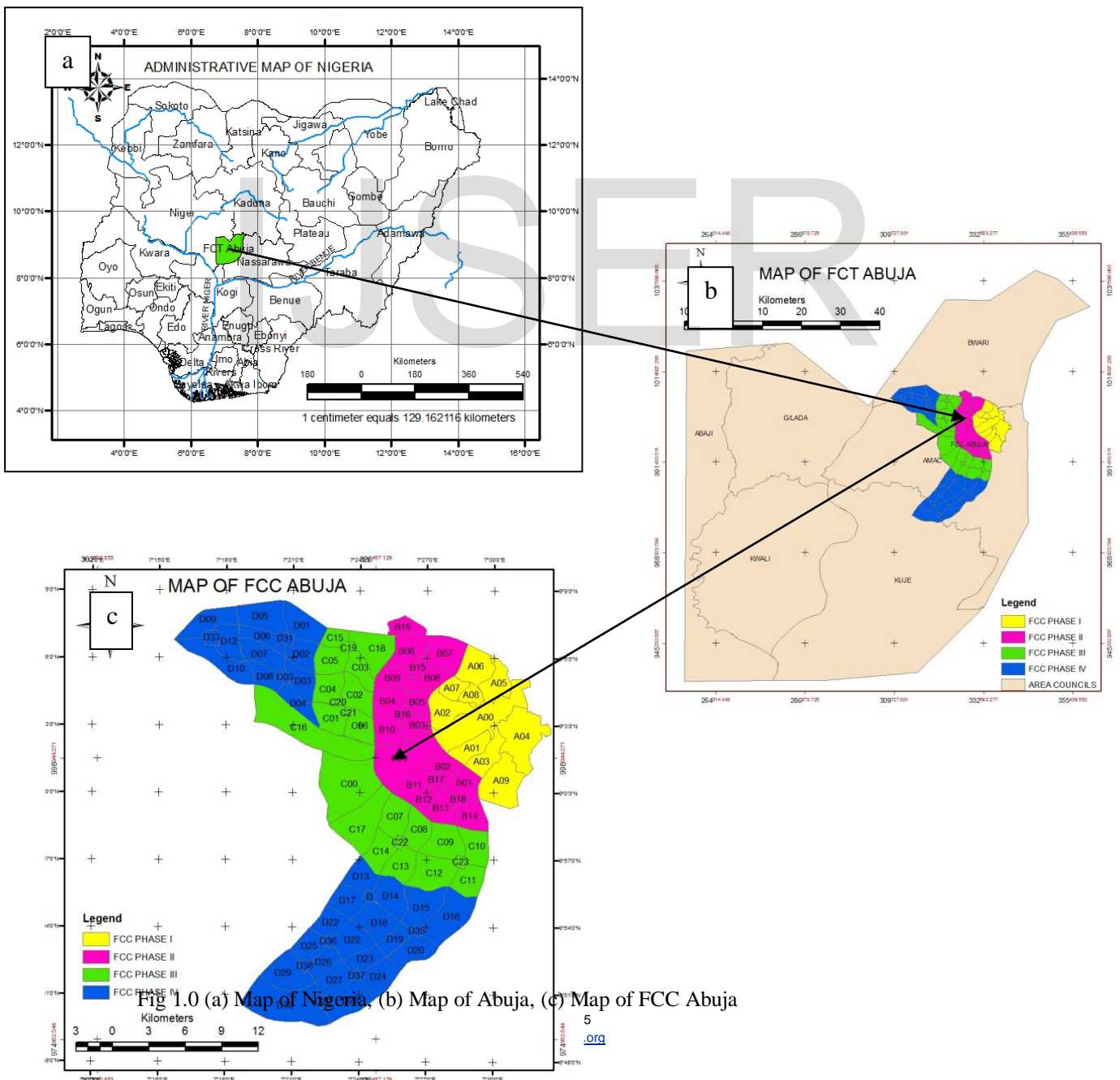


Fig 1.0 (a) Map of Nigeria, (b) Map of Abuja, (c) Map of FCC Abuja

III. METHODOLOGY

Three Landsat images, Landsat 5 TM (1990), Landsat 7 ETM+ (2002) and Landsat 8 OLI (2014) were acquired, from (<http://glovis.usgs.gov>), sub-mapped and classified into four classes namely Built up Areas, Rock and Bare Surfaces, Vegetation and Water bodies using supervised maximum likelihood classification algorithm. Then the classified images of the different years were overlaid together and post-classification change detection analysis was performed to determine the multi-temporal urban changes between the years.

IV. RESULTS

The classified maps for 1990, 2002, 2014 was generated shown in figure 4

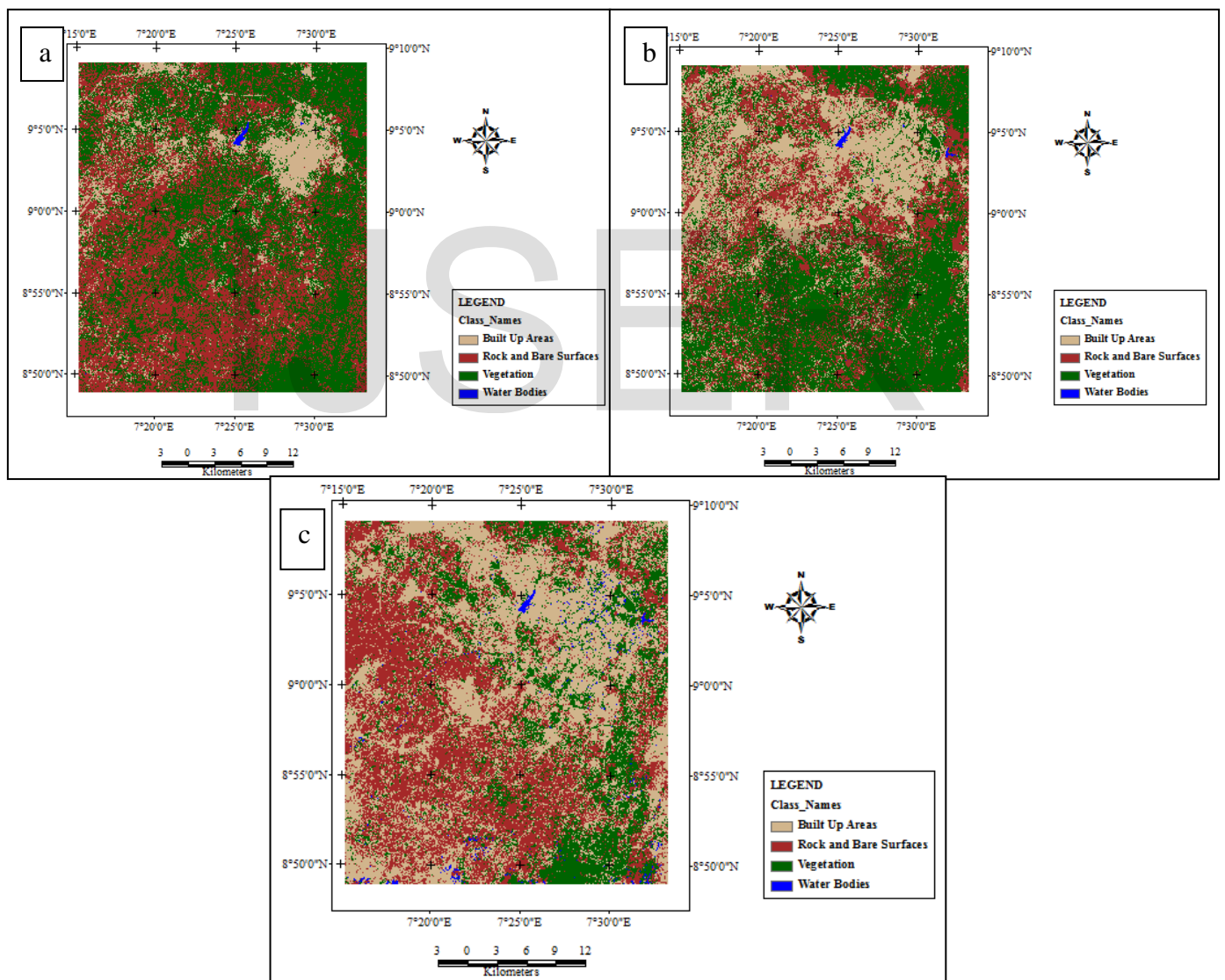
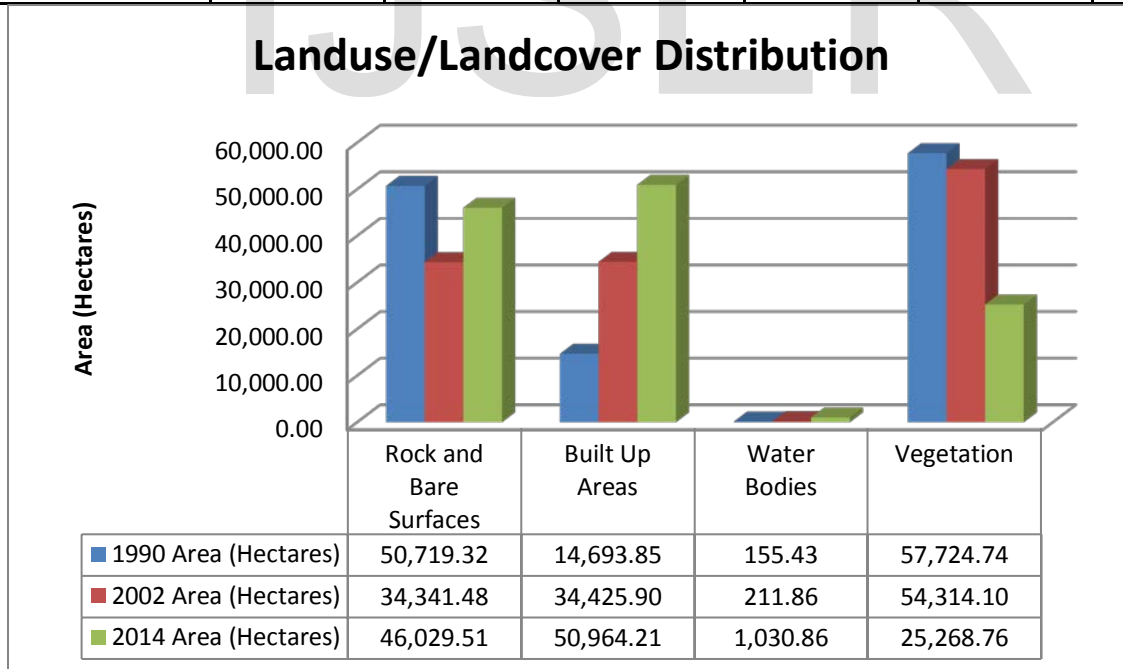


Fig 4.0 (a) Abuja Land use Map 1990, (b) Abuja Land Map use 2002, (c) Abuja Land use Map 2014

The classification results indicates the land cover/land use classes in 1990 as: Rocks and Bare Surfaces (41.10%), Built Up Area (11.90%), Water Bodies (0.20%) and Vegetation (46.80%) respectively. In contrast, from 1990 to 2002 Rocks and bare surfaces decreases from 41.10% to 27.90%, with built up area increasing from 11.9% to 27.90%, water bodies remained at 0.2%, while vegetation decreased slightly from 46.80% to 44.00%. Then from 2002-2014, Rock and bare surfaces stood at 37.30%, Built up area increased by 13.5% to stand at 41.4%, while water bodies increased to 0.8% vegetation decreased further to 20.5%.

Table 4.0 Abuja Land use Distribution from 1990-2014

Class Type	1990		2002		2014	
	Area (Hectares)	Percentage %	Area (Hectares)	Percentage %	Area (Hectares)	Percentage %
Rock and Bare Surfaces	50,719.32	41.1	34,341.48	27.9	46,029.51	37.3
Built Up Areas	14,693.85	11.9	34,425.90	27.9	50,964.21	41.4
Water Bodies	155.43	0.2	211.86	0.2	1,030.86	0.8
Vegetation	57,724.74	46.8	54,314.10	44	25,268.76	20.5
Total	123,293.34	100	123,293.34	100	123,293.34	100



a. Change Detection between 1990 and 2002

Post classification change maps were generated in order to determine the changes that may have occurred between the years. Fig 4.1 and 4.2 below shows the Change that took place between 1990-2002 and between 2002-2014 respectively.

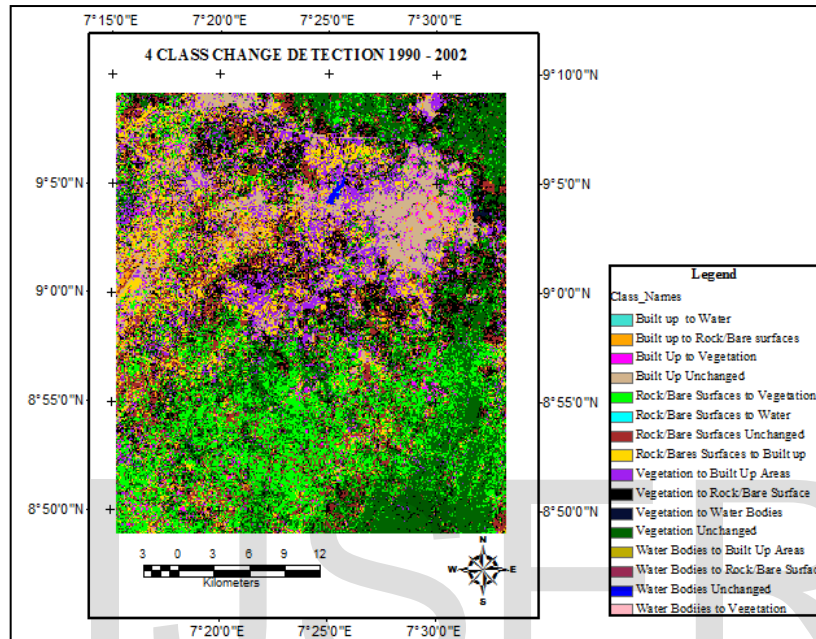


Fig 4.1 Post Classification Change Detection Map from 1990-2002

b. Summary of Change between 1990 and 2002

Water bodies and built up area rarely changed to other landuse/landcover types, an indication that the two landuse/land cover were relatively stable over the first study period of (1990 - 2002) study period. Rock and bare surfaces landuse/landcover changed to Built up and vegetation, a total area of 9.66% and 18.31% of rock and bare surfaces respectively. The rate of change from rock and bare surfaces to vegetation can be seen to be very high (a total of 22,580.19 hectares changed to vegetation whereas 11,908.35 hectares to built up areas) especially when compared with other changes. This can be attributed to the fact that many of the rocks are of the metamorphic type and are easily colonized by grasses and shrubs. Vegetation landuse/landcover changed to rock and bare surface at the rate of 12.52% whereas it is 10.52% for the built up landuse/landcover. A total of 12,971.16 hectares of former vegetation changed to Built up area while 15,439.05 hectares of vegetation changed to rock and bare surfaces, The

implication of this is that a total area of 24,894.27 hectares of other landuse/landcover type (Including rocks and bare surfaces, water bodies and vegetation) changed to built up area between the periods of 1990 – 2002.

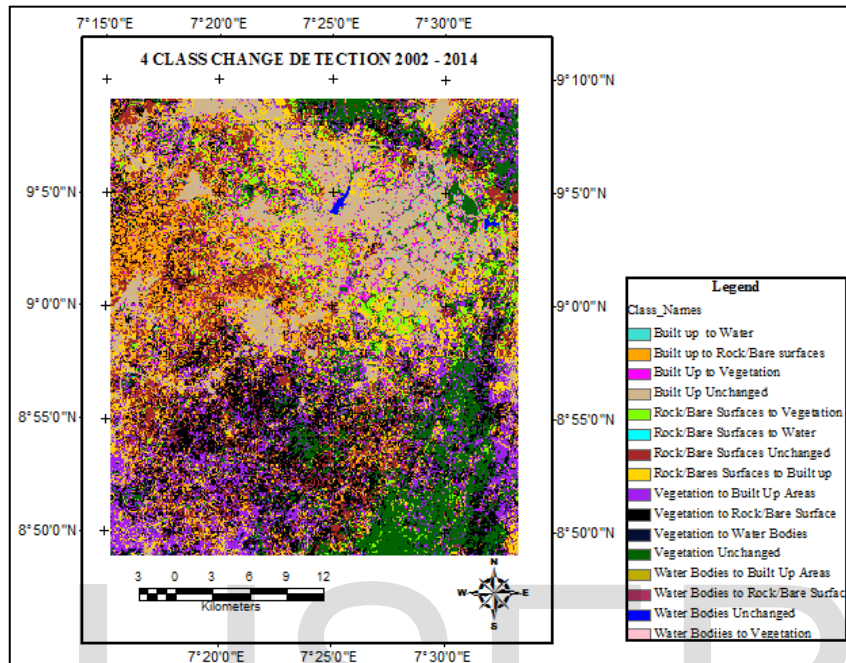


Fig 4.3 Post Classification Change Detection Map from 2002-2014

c. Summary of Change between 2002 and 2014

Water bodies rarely changed to other landuse/landcover types, there was a significant leap for the water bodies landuse/landcover (from 211 hectares to 1,030 hectares) especially in many parts of the study area, many of these can be attributed to building of swimming pools and other development projects. Generally this landuse/ land cover (water bodies) was relatively stable during the study period of 2002 – 2014.

A total land area of 12,772.98 hectares of Rock and bare surfaces landuse/landcover changed to Built up and 4,954 hectares changed to vegetation. A total land area of 17,432.37 hectares of former vegetation changed to Built up area during this period while 19,337.85 hectares of vegetation changed to rock and bare surfaces,

The implication of this is that a total area of 30,221.46 hectares of other landuse/landcover type (Including rocks and bare surfaces, water bodies and vegetation) changed to built up area between the periods of 2002 – 2014.

V. CONCLUSION

For the past 24 years, 1990-2014, FCT Abuja has been undergoing extensive land cover change. The classification of multi-temporal satellite images of three different time periods, i.e. 1990, 2002, and 2014, into built-up and non-built up land cover classes on hand and into Rock and bare surfaces, Built up areas, water bodies and vegetation on the other hand has resulted in a highly simplified and abstract representation of the study area. These maps show a clear pattern of increased urban expansion prolonging both from the city centre to adjoining non-built up areas in all directions mainly in the north - west, and north-east direction and alongside major transportation corridors. The synoptic analysis of spatio-temporal land cover change revealed that physical development has significantly transformed the urban landscape of FCT, Abuja. The built up area in the city has grown from 14,693.85 hectares in 1990 to 34,425.90 hectares in 2002 and to 50,964.21 hectares in 2014. The highest rate of urban growth is observed during the first period of urbanization (1990 to 2002) in which the built up area increased more than twice (40.17%) within 12 years and in the second period of urbanization there was a change of 19.37%. This indicates a more rapid urbanization has been taking place in the study area during the period of 1990 to 2002 compared to the period of 2002 to 2014. In total, 36,270.36 hectares of non-built up land has been converted to urban area. Thus, as per sub-objective-1 this research paper has successfully analysed and quantified the extent and directions of spatio-temporal physical development in the study area.

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