THE GEOGRAPHICAL ANALYSIS OF GREEN BELT ON URBAN CLIMATE OF ADO-EKITI, EKITI STATE, NIGERIA

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ABSTRACT

This study is on geographical analysis of green belt on urban climate of Ado-Ekiti, Ekiti State, Nigeria. The study looked critically at the impact of urban green space on the climate of Ado-Ekiti where the urban heat island (UHI) is seen far warmer or has a higher temperature than the rural areas. Secondary data for this study were collected from journals, articles and print resources. Primary data was sourced from global land cover website, Landsat images as well as Google earth. Result from the study shows the total land cover of Ado Ekiti describing the classification of vegetation cover, areas cleared by constructions such as building, roads and other infrastructure and as well as the water body in the area. The study recommends that in other to protect the urban climate of Ado Ekiti through vegetation, there should be implementation of good government policies tackling illegally clearing vegetation within the area as well as embarking on planting of trees to improve urban green space of the study area.

Keywords: Green Belt, Heat Island, Rural Area, Urbanization, Urban Heat Island, Urban Climate

{**Citation**: Owolabi, J.T. The geographical analysis of green belt on urban climate of Ado-Ekiti, Ekiti State, Nigeria. American Journal of Research Communication, 2020, Vol8(9): 1-14} www.usa-journals.com, ISSN: 2325-4076.

INTRODUCTION

Urban climate can be defined as climatic conditions in an urban area that differ from neighboring rural areas, and are as a result of urban development. Urbanization impacts has significant changes on the landscape which ultimately leads changes in an area's air. Urban areas are among the most highly altered landscapes apart from natural ecosystems and processes (Sanderson and Boyer, 2009). Hence, it is not surprising that cities have altered microclimates which among other effects, significantly elevates the surface and air temperatures.

With rapid advance of urbanization across many cities, the intensity and adverse effects of urban heat island (UHI) effect can be significant (Chen and Wong, 2006). In the urban climate, calorifics, optics, and the geometrical properties of urban surfaces affect heat absorption and radiation characteristics which also create the UHI effect. Increase in temperature in urban areas affects the health, economic activities, and even the welfare of residents.

Urban warming can also contribute to air pollution, such as increased surface ozone concentrations, which ultimately affects human health. Previous studies have shown that urban green spaces, such as parks, can effectively alleviate hazardous UHI effects. Green plants has been known to provide many environmental services such as carbon storage, air pollution reduction, and also serve as habitats for various living organisms. The integration of green spaces in urban planning and architectural design is therefore essential for adapting to and mitigating the negative effects of local and urban heat island processes (Xiang *et al*., 2018).

The elevation in temperatures due to urban heat island processes is most generally explained in terms of the basic surface energy balance processes of shortwave and long wave radiation exchange, latent, sensible, and conductive heat flows (Oke, 1987). With respect to shortwave, or solar, radiation, surface albedo refers to the reflectivity of a surface to visible light and is measured from 0 to 100 percent reflectivity. The regional albedo of urban areas is significantly lower than natural surfaces due to the results of various domestic and industrial activities. These urban features have typical albedo values below 15 percent (Rosenzweig *et al.,* 2006).

Urban green space (which includes green space includes parks and reserves, sporting fields) provides a wide range of ecosystem and human benefits that could help combat many urban ills and improve life for city dwellers especially (Wolch *et al.,* 2014). Such urban green space is usually diverse, varying in size, vegetation cover, species richness, environmental quality, proximity to public transport and other facilities (Dahmann *et al.,* 2010; Fuller and Gaston, 2009; Sister *et al*., 2010).

Urban green space may also provide other benefits such as filtration, pollution removal, noise attenuation, cool temperatures, filtration of storm water and groundwater replenishment. (Escobedo *et al.,* 2011). Over the past two decades, the uneven accessibility of urban green space has become recognized as an environmental problem whose importance to public health has become recognized (Jennings *et al.,* 2012). There are various reasons why green space is differentially distributed within the urban landscape such the philosophy of park design, history of land development, evolving ideas about leisure and recreation, histories of class and ethno-racial inequality and state oppression (Byrne, 2012).

The Study Area

Ado-Ekiti, the study area, is situated at about 48 kilometres north of Akure, Ondo state capital, about 344 kilometres north of Lagos (Nigeria) and about 750 km south-west of Abuja, the Federal Capital Territory (FCT). Ado Ekiti is the Ekiti state capital and a Local Government Headquarter in one of the sixteen Local Government Area in Ekiti state. It lies within Latitude 7°10' and 7°45' north of the Equator and Longitudes 5°10’ and 5°28’ east of the Greenwich meridian. The town is situated on a fairly high level with about 390 meters above sea level in the south-eastern part of Ireje stream and about 540 meters above sea level in the north-eastern limits of the town.

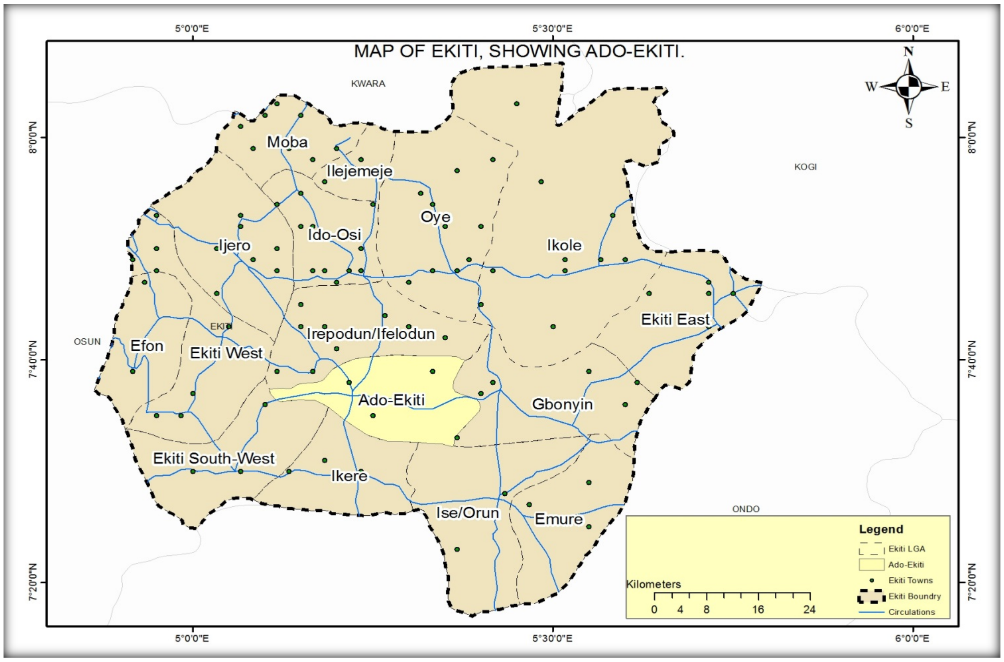

Figure 1: Ekiti Map Showing its Capital Ado Ekiti.

The Climate of Ado Ekiti

The graph shows the rainfall distribution of the study area. The graph shows that precipitation is the lowest in January, with an average of 9 mm**.**

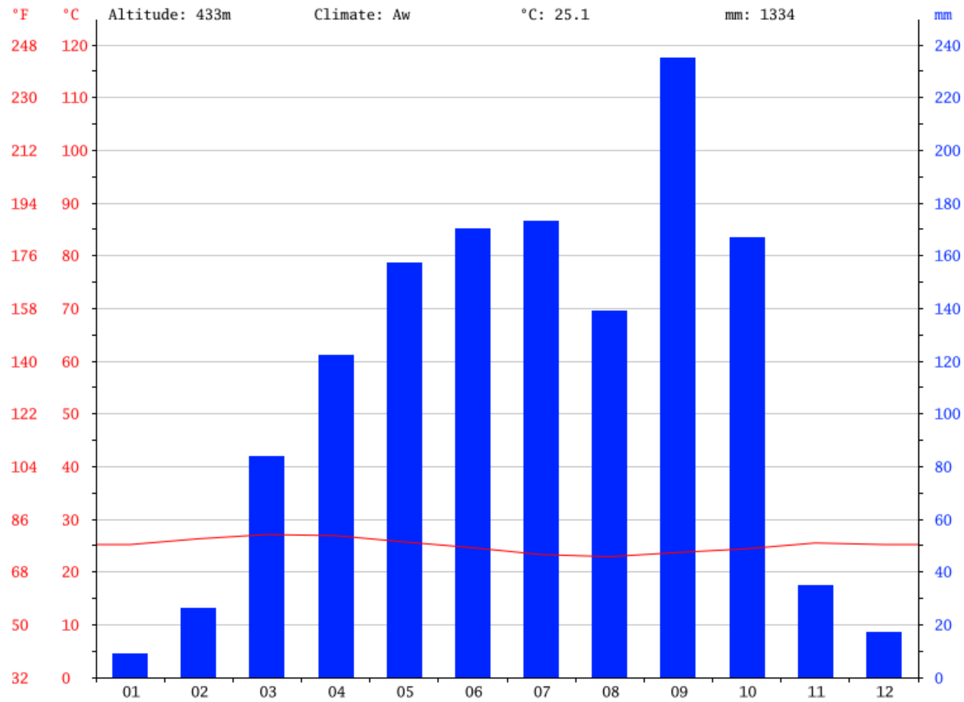

Figure 2: Climate Graph of Ado Ekiti (SOURCE: climate-data.org).

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	25.2	26.3	27.1	26.9	25.7	24.6	23.3	22.9	23.7	24.4	25.5	25.2
Min. Temperature (°C)	19	19.9	21.5	21.8	20.8	20.5	19.7	19.4	19.9	19.9	19.9	18.6
Max. Temperature (°C)	31.4	32.7	32.8	32.1	30.7	28.8	27	26.5	27.6	28.9	31.1	31.8
Avg. Temperature (°F)	77.4	79.3	80.8	80.4	78.3	76.3	73.9	73.2	74.7	75.9	77.9	77.4
Min. Temperature (°F)	66.2	67.8	70.7	71.2	69.4	68.9	67.5	66.9	67.8	67.8	67.8	65.5
Max. Temperature (°F)	88.5	90.9	91.0	89.8	87.3	83.8	80.6	79.7	81.7	84.0	88.0	89.2
Precipitation / Rainfall (mm)	9	26	84	122	157	170	173	139	235	167	35	17

Figure 3: Climate Table / Historical Weather Data of Ado Ekiti Between the driest and wettest months, the difference in precipitation is 226 mm. (Source: Climate-Data.Org)

Methodology

Creation of Geo Database

To prepare the base map for Ado-Ekiti, Remote Sensing and GIS techniques were employed. To obtain reasonable precision in the mapping process, a 10mm resolution imagery of Ado-Ekiti was obtained from global land cover website, USGS website for different years {1985, 2000, and 2015} for the exact Ado-Ekiti using path and roll of p191 and r55. Indifferent Band 1, 2, 3 which are of different years, and it was of 15 years interval and 3 various years was picked respectively.

GIS Data Input and Preparation on ARCGIS

Data captured from the Global Land Cover and USGS was imported to the ArcGis 10.4 environment. This process involve importing of Raster images from the file to the ArcGis environment through add data tools, after it was imported, data was projected to Universal Traverse Mercator Minna 31 in Nigeria. The images was viewed and different information about the area was revealed. However different raster imagery of different bands, band 1, 2, 3 was imported for raster compositing.

Generation f Geo Database

After the importation of the images from the global land cover through add data tool or through the catalog window. Different shapefile was created to add different information as database, point shapefile for structures, line shapefile for roads and polygon shapefile for boundaries. Vectorization or digitization; which is moving around the feature for vector generation. However the sub stage two; I combined the different landsats downloaded which involve lansat1,2,3 for built-up area or ladsat 1,4,5 respectively. I used composite band tool in the Arctools box of Arcmap 10.4 (Arctools box ------→ Data Management tools ------→ Rasta ------→ Rasta Processing --------→ Composite bands and on the window I added the rasta imageries and clicked on the processing tools for action. And the end result was a single combined image. At this point I analyzed the rasta image using image classification and raster calculator and symbolized the difference features for geographical classification.

Data Analysis

The methodology adopted has three stages of map preparation, attribute data generation, GIS data input and analysis. Image Classification, Raster calculator and symbology was equipped in the analysis and Maps of different year was achieved.

Vegetation Analysis

NDVI (normalized difference vegetation index**)** calculation process------→for ndvi on arcmap 10.4 -----→ geo processing unit-----→windows-----→image analysis and the raster image - output-----→click on vegetation liter tools NDVI tools.

Results

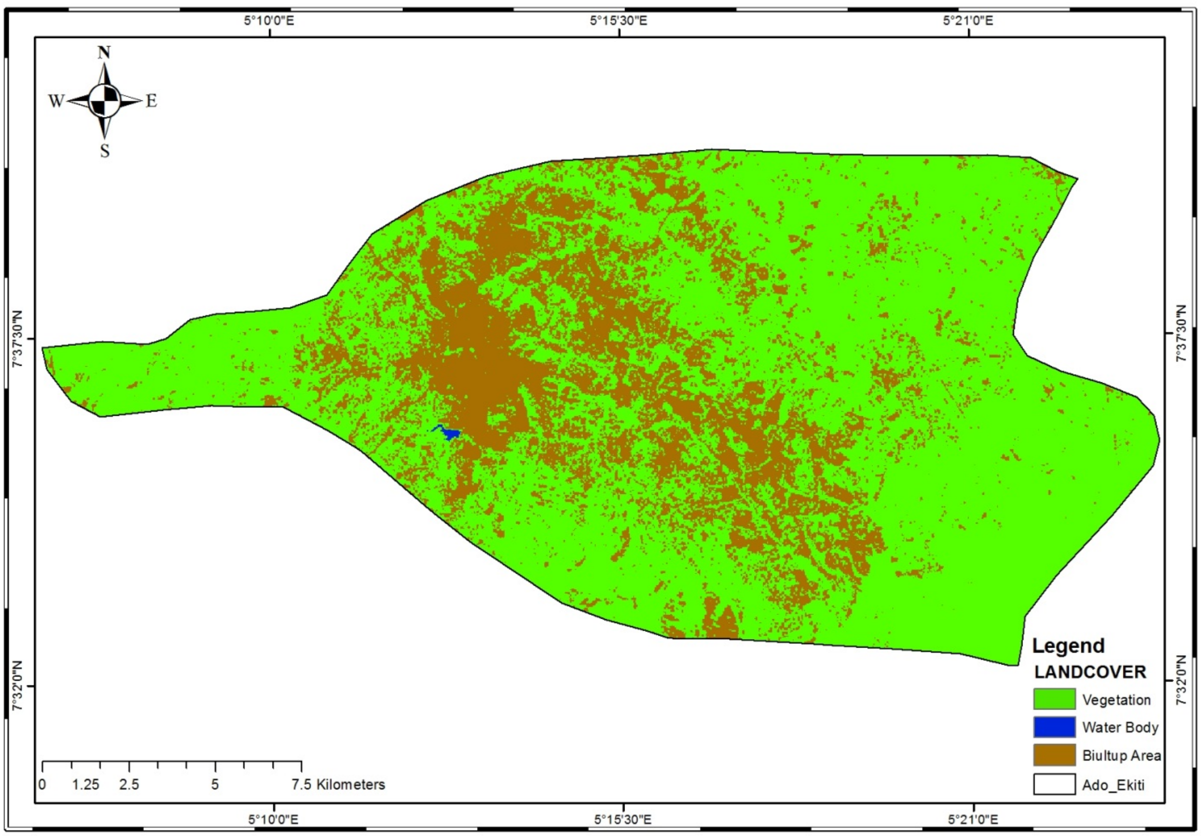

Figure 4: Classified Map of Study Area, 1985.

NDVI, Ado Ekiti 1985 (Source: Geographic Information System, 2017).

NDVI (normalized difference vegetation index) is used to analyze remote sensing measurements, typically but not necessarily from space platform, and assess whether the target being observed contains live green vegetation or not. Live green plants absorb solar radiation in the photo-synthetically active radiation (PAR) spectral region which they use as a source of energy in the process of photosynthesis.

The Normalized Difference Vegetation Index (NDVI) is a measurement of the amount and vigor of vegetation at the surface. The reason NDVI is related to vegetation is that healthy vegetation reflects very well in the near infrared part of the spectrum. The value is then normalized to -1<=NDVI<=1 to partially account for differences in illumination and surface slope. The index is defined by equation below. NDVI = NIR−RED
NIR+RED (1) where: NIR and RED are the reflectance in the near-infrared (band4) and red (band3) portion of Electromagnetic spectrum respectively.

Figure 4. shows and explain the variations of vegetation and built up areas with in urban Ado-Ekiti in the year 1985 the image shows the count in which the blue having a count (159) shows a major water body in Ado-Ekiti while the brown having a count of (118,180) shows the built up Areas and the green having a count of (435,133) shows the vegetated area or the thick forest area as at 1985. Around the built up area there are also scattered cultivation and partially cleared area.

Table 1: Land classification extent in percentage and km^2 in 1985

Year of study	1985 Land area in km^2	%
Built up	62.40	21.95
Vegetation	230.30	78.00
Water bodies	0.08	0.05
Total land area	293.00	

Source: Author field survey (2018).

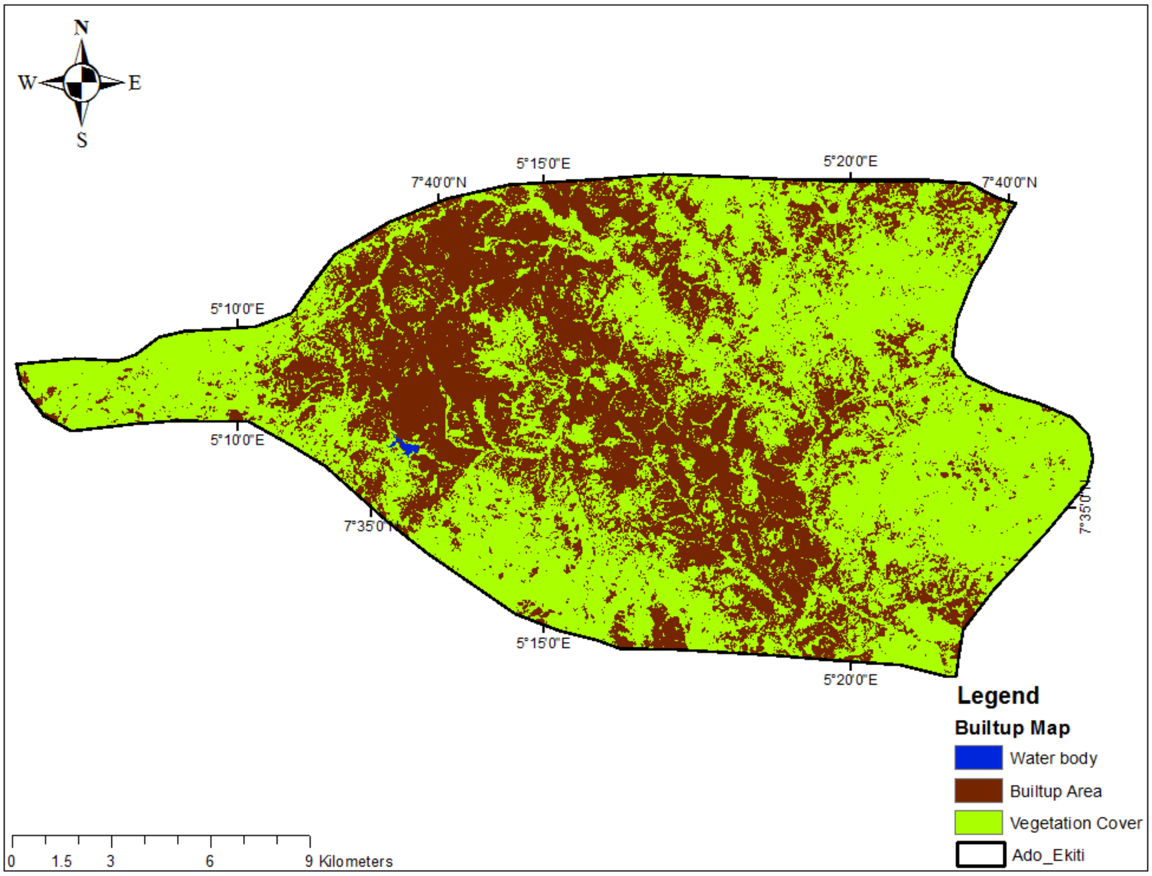

Figure 5: Classified Map of Study Area, 2000.

NDVI, Ado Ekiti 2000

Source: Geographic Information System 2018

Figure 5 shows and explain the variations of vegetation and built up areas with in urban Ado-Ekiti in the year 2000 the image shows the count in which the blue shows the water body extent in Ado-Ekiti while the brown shows the built up areas and the green shows the vegetated area or the thick forest area as at 2000. Around the built up area there are also scattered cultivation and partially cleared area.

Table 2: Land classification extent in percentage and km² in 2000

Year of study	2000 land area in km²	%
Built up	95.41	32.95
Vegetation	197.48	67.00
Water bodies	0.11	0.05
Total land area	293.00	

Source: Author field survey (2018).

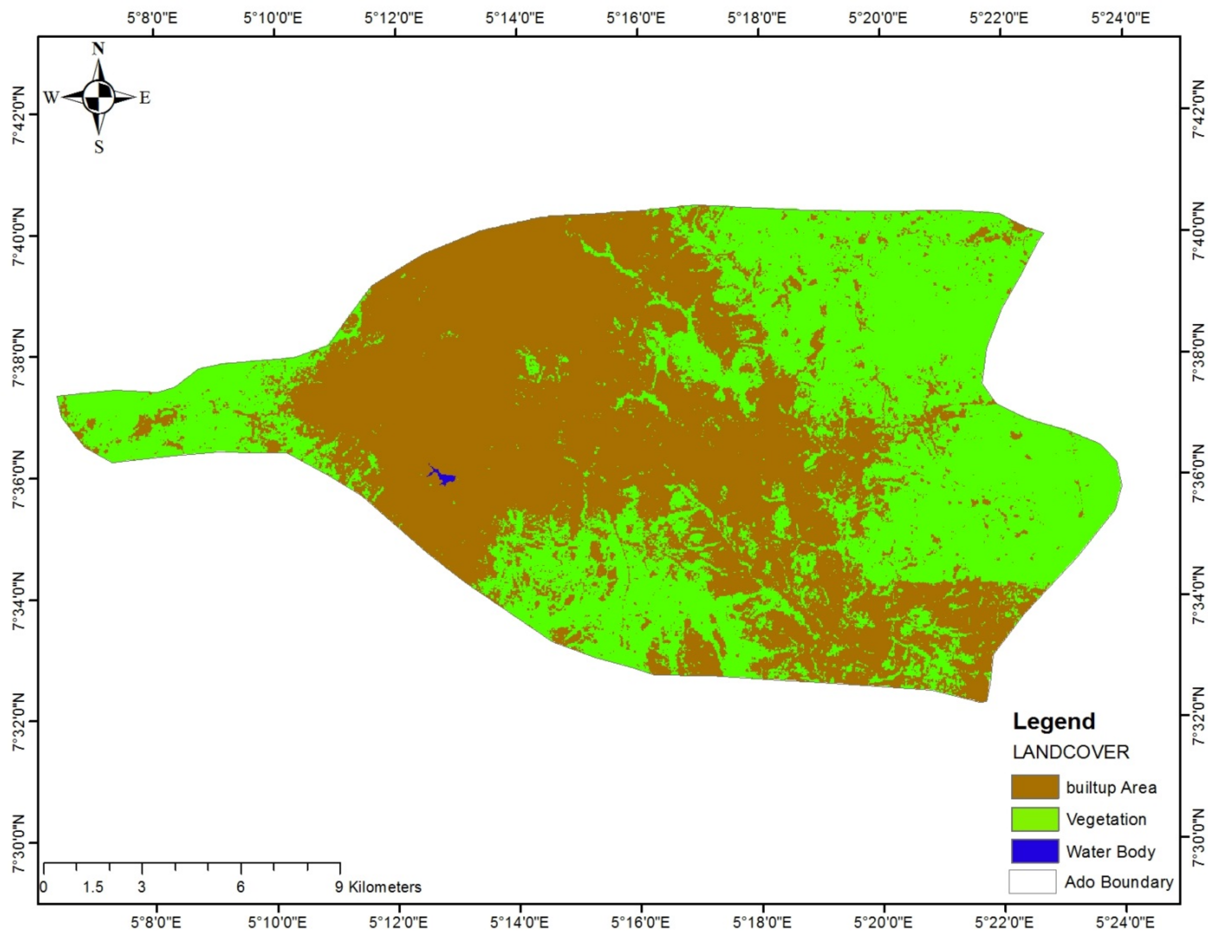

Figure 6: Classified Map of Study Area, 2015.

NDVI, Ado Ekiti 2015, Source: Geographic Information System 2018

Figure 6 shows and explain the variations of vegetation and built up areas with in urban Ado-Ekiti in the year 2015 the image shows the count in which the blue shows the water body extent in Ado-Ekiti while the brown shows the built up areas and the green shows the vegetated area or the thick forest area as at 2015. Around the built up area there are also scattered cultivation and partially cleared area, it shows how heavily vegetation has been cleared in Ado Ekiti.

Table 3 Land classification extent in percentage and km^2 in 2015

Year of study	2015 land area in km²	%
Built up	160.50	54.95
Vegetation	132.20	45.00
Water bodies	0.15	0.05
Total land area	293.OO	

Source: Author field survey (2018)

Table 4: Land classification extent in percentage and km^2 between 1985, 2000 and 2015

Year of study	1985 land area in km²	%	2000 land area in km²	%	2015 land area in km² %	%
Built up	62.40	21.50	95.22	32.95	160.50	54.95
Vegetation	230.30	78.00	197.48	67.00	132.20	45.00
Water bodies	0.08	0.05	0.11	.0.5	0.15	0.05
Total land area	293.00		293.00		293.00	

Source: Author field survey (2018)

In this research work, three classifications were considered which include built-up, vegetation, and water bodies. The built-up in this regard include the rock outcrops as well as anthropogenic built-ups.

The process involved in analyzing this data include the calculation of the area in km of the resulting land use, land cover type for each year to see the rate of changes and subsequently comparing the result to level changes over time.

The growth dynamics of change in Ado-Ekiti from 1985 to 2015 was digitized from classification of image within the study area. A GIS overlay which show growth extent of Ado-Ekiti between 1985, 2000, and 2018 as well as changing in pattern of land vegetation in the above years intervals mentioned which are shown in fig 4, 5, 6 and summarized in table 1, 2, 3 and 4. It is now understandable from the above that the urban sector of any state or country is never static, but changes with time and space. However as the year goes by it change the structural topography of the urban area as well as the developmental growth.

From the analysis above, there is a significant trend of urban growth in many ways in the city and environs such as clearing of natural vegetation and it replacement with other activity. There has been a remarkable decrease in vegetation which was observed due to urban growth. Vegetation clearing is a major threat to biodiversity and may cause species extinction by reducing the habitat as well as causing lack of defenses against harsh climatic problems and the tackling of UHI (urban heat island) problems.

Conclusion

Vegetation is seen as a very vital part of the environment which helps regulate the climate of an area. Hence the integration of Geographic Information System and remotely sensed satellite imagery has provided an effective technics for analyzing vegetation distribution, and how urbanization has affected the study area. Thus it was seen that greening is gradually fading out in the study area due to clearance of vegetated areas in replacement of man-made facilities, buildings e.t.c and the negligence of afforestation after deforestation also the in flock of people in the urban area into white-collar jobs and neglecting farming (agroforestry). Finally the study provides proofs that Geographic Information System provide opportunity for view and preview of plans, arrangement and re-arrangement of the plan. It however serve as catalyst in monitoring development at its best capacity which is cost and time effectiveness.

Recommendations

There should be complete urban renewal or reform in the study area which will screen out unethical vegetation clearance and the likely problems. The use of modern environmental technology like Geographical Information System (GIS) which is capable storing spatial data, process the spatial data and provide maps for proper design and monitoring and watching of vegetation should be utilized. Also, there should be implementation of good government policies tackling illegally clearing vegetation within the area as well as embarking on planting of trees to improve urban green space of the study area.

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