Analysis of Topographic Patterns of Greater Yola Using Geographic Information System (GIS)

ADAMU, AISHA IBRAHIM[1], GAMBO H. GUNDIRI[2]
[1]*Department of Urban and Regional Planning, School of Environmental Sciences, Adamawa State, Polytechnic Yola, Nigeria*
[2]*Department of Urban and Regional Planning, Modibbo Adama University, Yola, Nigeria.*

Abstract- By combination of digital elevation models (DEM) with digital geological maps within GIS environment, it is possible to detect the topographic analysis in relation to the site analysis of the study area. This technique has been S demonstrated on Jimeta metropolitan DEM map. From a topographic point of view, large relief defines mountains essentially. Thus, digital elevation models (DEM) usually form the base data for any mountain geoinformation system and any spatial model. The DEM is the digital representation of continuous changes of relief within space (Burrough 1986, 39). Information generated From the DEM is of critical importance within many GIS applications and is used to produce contours and many other types of information including; indivisibility, slope, profiles, watersheds, aspect and the concavity and convexity of a surface. Shuttle radar topographic mission (SRTM) help in obtaining digital elevation models on a near global scale.

Indexed Terms- Digital Elevation Model (DEM), Shuttle Radar Topographic Mission (SRTM) Contour, Topography, Hill Shade

I. INTRODUCTION

A recent review of the use of Geographical Information Systems (GIS) quoted a British Government report, which stated that the impact of GIS on spatial analysis was as significant as, "the invention of the microscope and the telescope were to science, the computer to economics and the printing press to information dissemination. It is the biggest step forward in the handling of geographic information since the invention of the map." (Harris and Lock, 1990).

Topography is often considered as a narrow bandwidth of features covering the form or shape of the surface (Erofeev, 2012). Topography as stated by Bonetti (2018), it's the study of the forms and features of land surfaces. Pomazkova & Aakumova (2018) went further to state that analysis of topographic patterns involves using Geographic Information System (GIS) to study the elevation, relief, slope, and aspect of a land surface to understand its influence on natural processes and human activities. After detailed study of many measurements, we consider that as well as the possibility of a dominant range of features there is always an underlying random structure and where undulations in surface height continue over as broad a bandwidth as the surface size will allow. We consider this a result of many physical effects each confined to a specific waveband but no band being dominant. We invoke the central limit theorem and show through Gaussian statistics that the variance of the height distribution of such a structure is linearly related to the length of sample involved. In another form, the power spectral density, this relationship is shown to agree well with measurements of structures taken over many scales of size, and from throughout the physical universe (Li & McCarty, 2019). It is the shape of Earth's surface and its physical features, such as mountains, valleys, canyons, and other landforms.

II. AIM OF THE STUDY

To analyze the nature/relief of the study area (greater Jimeta) and to proffer good recommendations.

III. MATERIALS AND METHODS

Study Area:

Jimeta, a twin city to Yola town, is the capital of Yola North Local Government and Adamawa State of Nigeria. The city is located at the bank of River Benue, between latitude 90 10' to 90 15'N and longitude 120 11' to 120 17'E. The area has a Sudan type of vegetation and a tropical climate marked by wet and

dry seasons. The minimum temperature recorded is about 15 0C and a maximum of about 40 0C. The city has been experiencing an increasing population explosion since it assumed a status of Adamawa State capital in 1976. Like any other Nigerian cities, Jimeta comprises of so many land use types ranging from institutional, commercial, and residential. The city is clearly stratified in terms of population densities (Ilesanmi, 2019).

These are low, medium and high-density areas. The low-density areas are well planned units where government officials reside while medium and high-density areas are made up of common people with little or unplanned streets and buildings.

In recent times, Jimeta has risen as the premier commercial, industrial and transportation urban area of the northeastern Nigeria. The rapid growth of Jimeta, particularly within the past 30 years, has made it one of the fastest growing metropolitan areas in Nigeria. For instance, the population of Jimeta increased significantly by 69% between 2019 and 2020 and 58% between 2020 and 2023 (NOA 2018). Concomitant with this high rate of population growth has been an explosive growth in retail, educational, commercial and administrative services within the area.

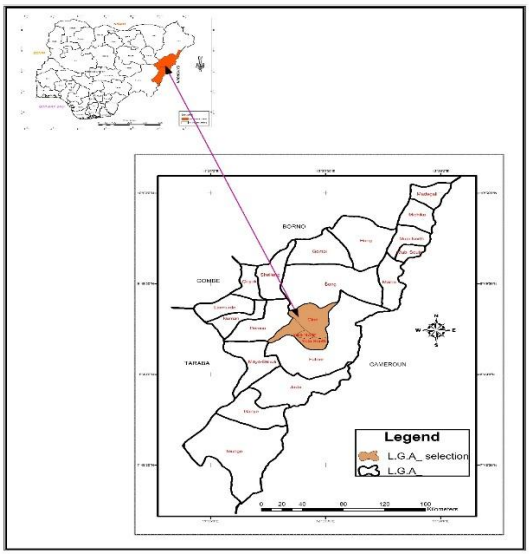
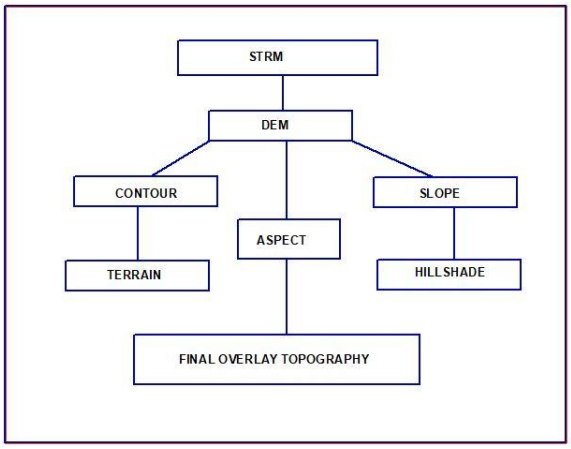


Fig1: Locational Map of the study Greater Yola Consist of Yola South, North and Girei Local Government Area

METHODOLOGICAL FLOW CHART



Data acquisition:

DEM was acquired through processes of downloading online in website of http://www.earthexplorer.usgs.gov. http://www.gdem.ersdac.jspacesystems.or.jp/ etc. it can also be acquired manually by using google earth and tcx converter.

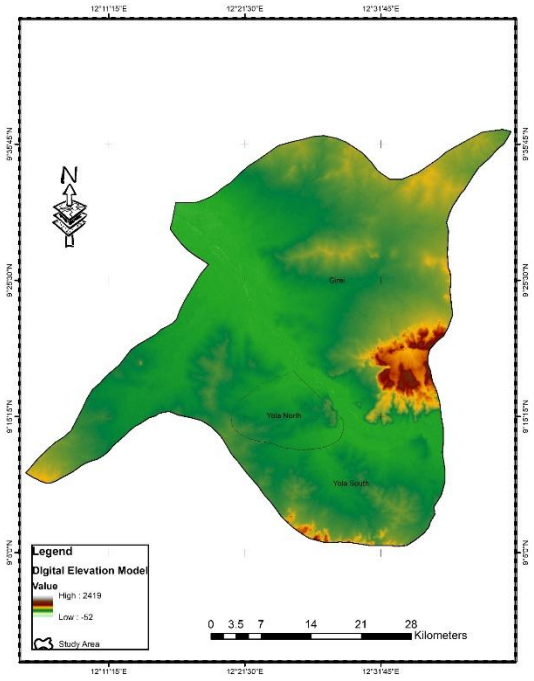


Fig. 1.2 Digital Elevation Model (DEM) of the study area Greater Yola

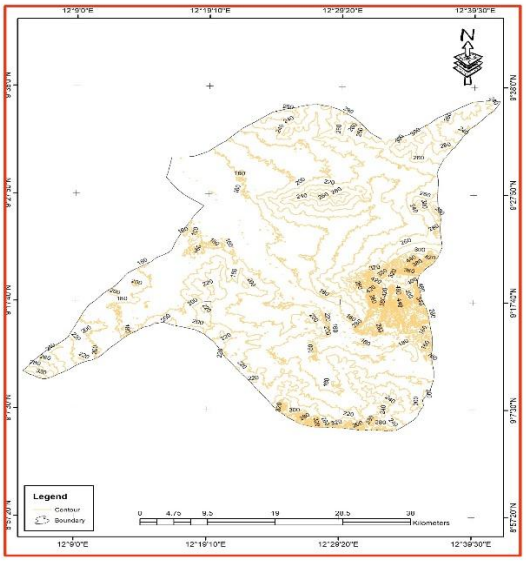


Fig. 1.3 showing contour of the study area Greater Yola.

Contouring: Creates a line feature class of contours (isolines) from a raster surface. Contours was used to estimate slope, aspect, and curvature alone. Elevation was read directly from contour labels, and the spacing or the change in spacing among contours indicates changes in slope and profile curvature, respectively. An orthogonal vector was defined by two nearby contours on a map yields aspect, and the curve of the contour itself shows the change in aspect or plan metric curvature.

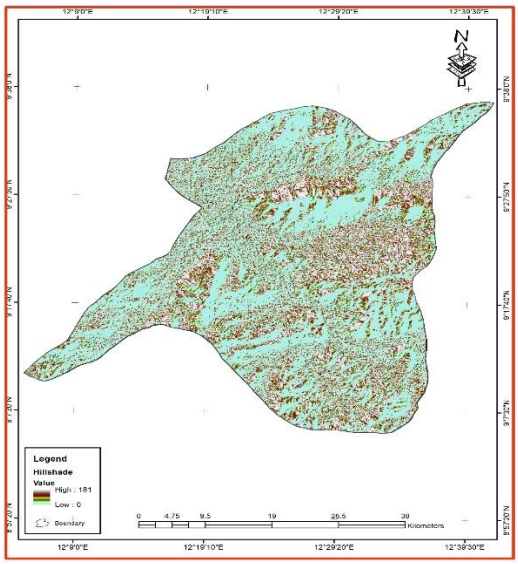


Fig. 1.4 Hillshade Map of the study area Greater Yola.

IV. CREATING A HILL SHADE

A hill shade was shaded relief raster created by using an elevation raster and setting an illumination source (typically the sun) at a user-specified azimuth (the angular direction of the illumination source, in positive degrees from 0 to 360) and altitude (the angle of the illumination source above the horizon). The visual effect of a hill shade was dramatic when was displayed under other layers with transparency set in ArcMap display. The Hill shade tool was run to view and explore the output of the tool with the rest of the input data.

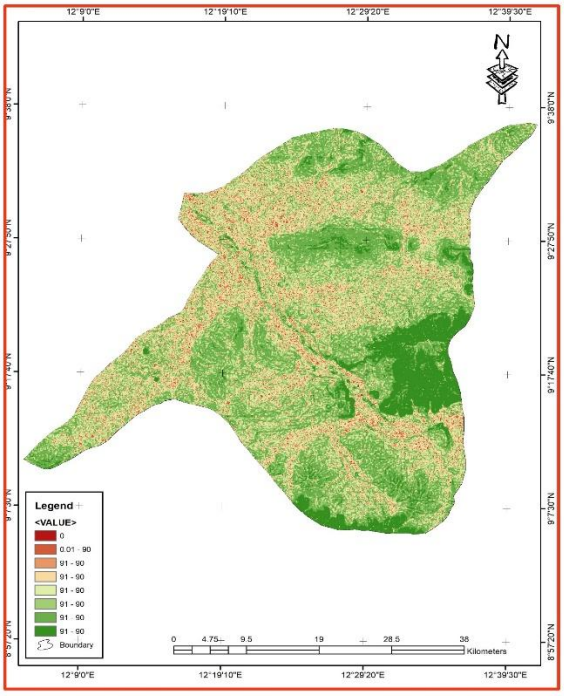


Fig. 1.5 showing Slope of the study area Greater Yola.

Slope: Identifies the slope (gradient, or rate of maximum change in z-value) from each cell of a raster surface.

- Slope is the rate of maximum change in z-value from each cell.
- The use of a z-factor is essential for correct slope calculations when the surface z units are expressed in units different from the ground x, y units.
- The range of slope values in degrees is 0 to 90. For percent rise, the range is 0 for near infinity. A flat

surface is 0 percent, a 45-degree surface is 100 percent, and as the surface becomes vertical, the percent rise becomes increasingly larger.

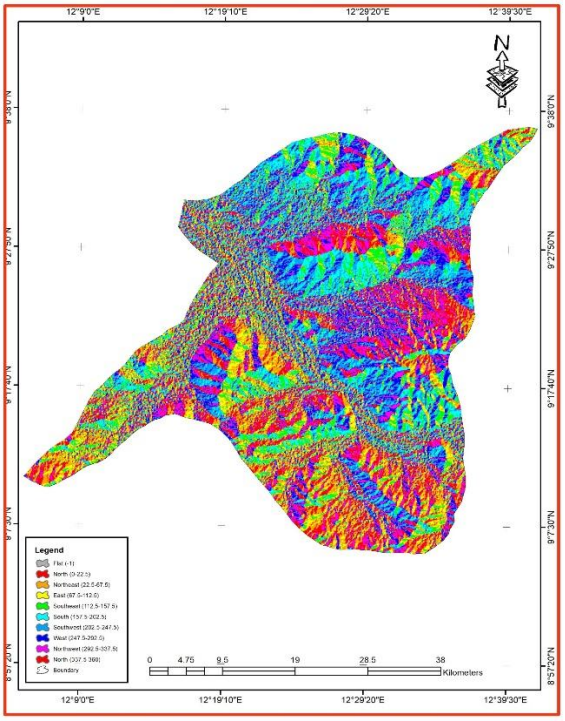


Fig. 1.6 showing Aspect Map of the study area Greater Yola

V. ASPECT

Identifies the downslope direction of the maximum rate of change in value from each cell to its neighbors. It can be thought of as the slope direction. The values of each cell in the output raster indicate the compass direction that the surface faces at that location. It was measured clockwise in degrees from 0 (due north) to 360 (again due north), coming full circle. Flat areas having no downslope direction are given a value of -1.

The value of each cell in an aspect dataset indicates the direction the cell's slope faces.

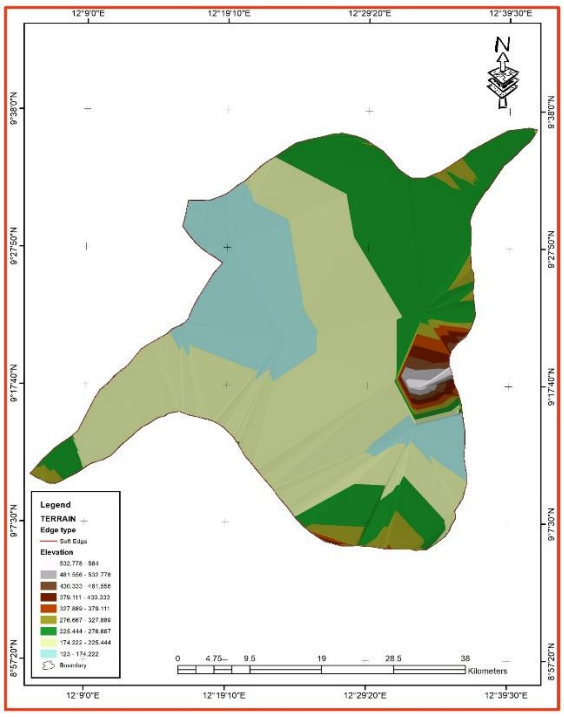


Fig. 1.7 showing Terrain Pattern of the study area Greater Yola.

VI. RESULTS AND DISCUSSION

The result of the contour, slope and the hill shade show the site analysis and how the shape of the study area looks like. It also shows the topographical analysis of the area. The result also illustrates how the highest surface is reflected by sun, the highest surface is suitable for telecommunication mast location, for recreational activities etc. The lowest part of the city is disaster prone and also it is very important to the community, because most of the activities of the city take place there. The lowest area includes residential areas, farmlands and also the river Benue, which is the primary source of water supply and irrigation to farmers in the area.

CONCLUSION

The result illustrates how the highest surface is reflected by sun, the highest surface is suitable for telecommunication mast location, for recreational activities in Greater Jimeta for revenue generation to the Government.

RECOMMENDATIONS

As a planner there is need to ensure maximum decree of safety, security, convenience and aesthetics.

The analysis will create options for the planner to choose the best place that can accommodate, secure, and ensure security of the beneficiaries. For example, the people living in the riverine areas should be relocated to safer places that are resistant to flooding. Also, the river basin should be used as agricultural and irrigation purposes.

Also, the area should be used as recreational purposes because of the nature of the area, also people around Bachure area are at high risk zone flood due to low elevation more concentration should be given to the area in order to minimize loss of lives and biodiversity.

REFERENCES

[1] Bonetti, S. (2018*), Analysis and Modeling of Landscape Topography: Statistical Description and Evolution Under Natural and Disturbed Conditions*. Dissertation, Duke University.

[2] Burrough P.A. (1986). Principles of Geographical Information Systems for Land Resources Assessment. Clarendon Press: Oxford.

[3] Edan, J. D., Idowu, T. O. and Zango I. S. (2018). Views and Analysis of M T N Telecommunication Network in Jimeta Metropolis, Adamawa State, Nigeria.

[4] Erofee, A.A. (2012), Landscape – ecological analysis of the basins of small rivers based on geoinformation modeling. *Extended Astract of Cand. Sci. (Geogr.) Dissertation, Tomsk, 2012*

[5] Harris T.M. and Lock G.R., (1990). The diffusion of a new technology: a perspective on the adoption of geographic information system within UK archaeology. In Allen K.M., Green S.W. and Zubrow E.B.W. (eds.) Interpreting space: GIS and archaeology, London, pp. 33-53.

[6] Ilesanmi, F.A. (2019) Urban Settlements in Adebayo, A.A. and Tukur, A.L. (eds) Adamawa State in Maps, Department of Geography, FUTY and Paraclett Publishers, Yola.

[7] Li, X. & McCarty, G. W. (2019). Application of Topographic Analyses for Mapping Spatial Patterns of Soil Properties. Researchgate.net

[8] National Orientation Agency (NOA, 2018). Details of the breakdown of the national and state provisional for National Orientation Agency.

[9] Pomazkova, N.V. & Abakumova, V.Y. (2018), Analysis of the Role of Topography in the Spatial Differentiation of Landscape Using Geoinformation and Statistical Methods. Contemporary Problems of Ecology, 11, 137-149.

[10] Sayles, R. S. & Thomas, T. R. (2013). *International Journal of Environment, Ecology, Family and Urban Studies* (IJEEFUS), 3 (2), 99-106.