DRAINAGE BASIN OF LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY (LAUTECH), OGBOMOSO, NIGERIA

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ABSTRACT
The application of Geographical information system (GIS) and Remote sensing (RS) have become essential and effective tools in development of drainage pattern of the study area. This method can be used for the identification of hydrological features and properties of basin. The topographic map of the study area was scanned and geo-referenced before it was exported into ArcGIS 10.0 software. The digitized map was edited, and saved as line coverage in ArcGIS Software. This paper aimed at applying GIS and RS for the development of drainage system for LAUTECH, Ogbomoso in order to prevent or reduce the persistent occurrence of flood. Geographical Information System (GIS) and Remote Sensing (RS) techniques were used to analyse the hydrological drainage basins of the study area. Google Earth and LANDSAT 7 sensor of 2019 ETM+, path 191 and row 55 of VHS were used to acquire the satellite imageries of the study area. Using high resolution imageries, a Digital Elevation Model (DEM) was developed with Surfer 8 and ArcGIS 10.0. The drainage, watershed, flow direction, flow length and flow accumulation maps of the study area were generated by using the Digital Elevation Model. Result obtained indicated that studied basins exhibits high, medium and low spatial variations in their hydrological properties. The results revealed that the used of remotely sensed data and ArcGIS 10.0 software provide an effective approach to develop accurate drainage pattern with a minimum amount of time, effort, and cost. This approach creates easily read and accessible techniques that facilitate the identification and development of drainage pattern of the study area. This study would help the people to utilize the resources for sustainable development of the basin area.

Keywords: Geographic information system, remote sensing & drainage basin.

1. INTRODUCTION
The occurrence of floods have been on the increase as a result of improper data collection and planning, poor waste management, climate change, conscription of river channels and poor drainage system as well as maintenance have rendered most of our preventive measures ineffective. The historical update shows that flooding management have become the major issues to contend with in this study area, especially whenever there is a serious rainfall. This underscores the need for this study because it will facilitate a good management of the situation. Little has been done to ensure that the hazard is prevented and its associated risk reduced to the nearest minimum (Jeb and Aggarwal, 2008). Reduction of risk depends on the availability of qualitative information and knowledge of the study area (Ishaya *et al*., 2009).

Drainage basins which represent the areas where all surface water flowing on the terrain flow out from a common or s single outlet. Drainage of the study area indicates watershed boundaries and represents the main river and its attributes assisting in seeing the direction of flow of water.

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The areas with high drainage have dense vegetation, low relief region and high resistance while the areas with low drainage have sparse vegetation and mountainous relief. The reason for this is because of sufficient aeration is available in the area of high drainage whereas little aeration is available in the area of low drainage. Drainage basin area has been identified as the most important of all the morphometric parameters controlling runoff pattern of the study area (Nabegu, 2005). This is because, the larger the basin, the greater the volume of rainfall it intercepts, and the higher the peak discharge that result (Jain and Sinha, 2000). Hydrological response of a drainage basin is the production of runoff against a given rainfall, which in turn is characterized by basin morphometric properties, soil characteristics and land use pattern (Okoko and Olujinmi, 2003). And the soil characteristics and land use pattern control the infiltration loss, the distribution of excess rainfall is controlled by basin morphometric properties.

2.MATERIALS AND METHODS

Description of the Study Area

Ladoke Akintola University of Technology is located in Ogbomoso between latitude $8^{o}\ 8^{'}\ 00^{''}$ N and longitude $4^{o}\ 16^{'}\ 00^{''}$ E, in the South Western Zone of Nigeria. The school has a population of 20,000 (FGN Official Gazette, 2009) and has total area coverage of 160 km^2.

Remote Sensing Data

The satellite images of LANDSAT ETM+ $8^{o}\ 8^{1}\ 00^{11}$ N, Longitude $4^{o}16^{1}\ 00^{11}$ E was obtained from Global Land Cover Facility (GLCF).

TopographicMap

A topographic map (scale: 1:250,000) of LAUTECH of Latitude $8^{o}\ 8^{'}\ 00^{''}$ N, Longitude $4^{o}\ 16^{'}\ 00^{''}$ E obtained from the Department of Urban and Regional Planning, LAUTECH, Ogbomoso was used. The topographic map of the catchment area was scanned and geo-referenced before it was imported into ArcGIS 10.0 (Mitasova *et al.,* 1996).

Data Processing and Analysis

Data were processed and analysed in ArcGIS to generate digital elevation model, triangulated irregular network, slope map, aspect map, contour map, land use map, normalized difference vegetation index map, flow accumulation, flow direction, flow length, watershed, drainage map, erosion risk and flood risk maps for this research.

Digital Elevation Model

LAUTECH, Ogbomoso was delineated in Google earth and their coordinates(longitude and latitude) and elevations were tabulated in a Microsoft excel spread sheet and combined with an exported image of the study area from the Google Earth application, and used to create a geo-referenced map in the geographic coordinate system. Several points within the study area were marked within Google earth and their coordinates and elevations were recorded in the notepad. The X, Y and Z point data were exported to Surfer 8 where the data were re-sampled. The re-sampled data was blanked from the blank file and then digital elevation model was generated. Interpolation process was carried out, using the spatial analyst tool to create a digital terrain model. The DEM was reclassified into high risk, moderate risk and low risk using equal interval of separation based on elevation (Muhammad and Iyortim, 2013).

Figure 1: Satellite Imagery of LAUTECH, Ogbomoso
Source: Google Earth of 2019

Filling of Sinks

This is a function in the spatial tool box of hydrology analysis which fills the sinks in a grid. In order to carry out hydrology analysis on DEM, all depressions have to be filled. Such depressions are called sinks. If cells with higher elevation surround a cell with lower elevation, the water movement is obstructed in that cell and cannot flow. The fill sinks function regulates the elevation or depression value to solve these problems (Olaniyan, 2015).

Flow Direction

Flow direction which represents the direction of flow of water across the surface was generated by using the flow direction function in the spatial analyst tool box.

Flow Accumulation

The flow accumulation which represents the cell within the catchment area where water accumulates as it flows downwards was developed by using the flow accumulation function in the spatial analyst tool box.

Flow Length

Flow length which represents the distance at which water flows in the catchment area was generated by using the flow length function in the spatial analyst tool box (Noha, 2009). However, the depressionless DEM was used to generate a flow direction raster. The flow direction shows the possible direction of runoff on the elevation model.

Drainage Basin

The drainage represents the main river and its attribute was developed by using basin function in the spatial analyst box.

3.RESULTS AND DISCUSSION

Digital Elevation Model (DEM)

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The coordinates and elevations of the study area were recorded as X, Y and Z in Table 1. The digital elevation model in Figure 2 revealed that LAUTECH, Ogbomoso consists of areas with high, medium and low elevation within the terrain. Figure 2 represents the DEM of the LAUTECH, Ogbomoso which ranges between 314 – 354 m. The values within 314 m indicate the lowest point on the map while the areas with values within 354 m represent the peak of the study area. Values from 354 - 342 m show areas of high elevation which was less susceptible or vulnerable to flooding while the values from 342 - 330 m show areas of medium elevation which are moderately vulnerable or susceptible to flooding while values ranging from 330 - 314 m represent areas of very low elevation which are highly vulnerable to flooding.

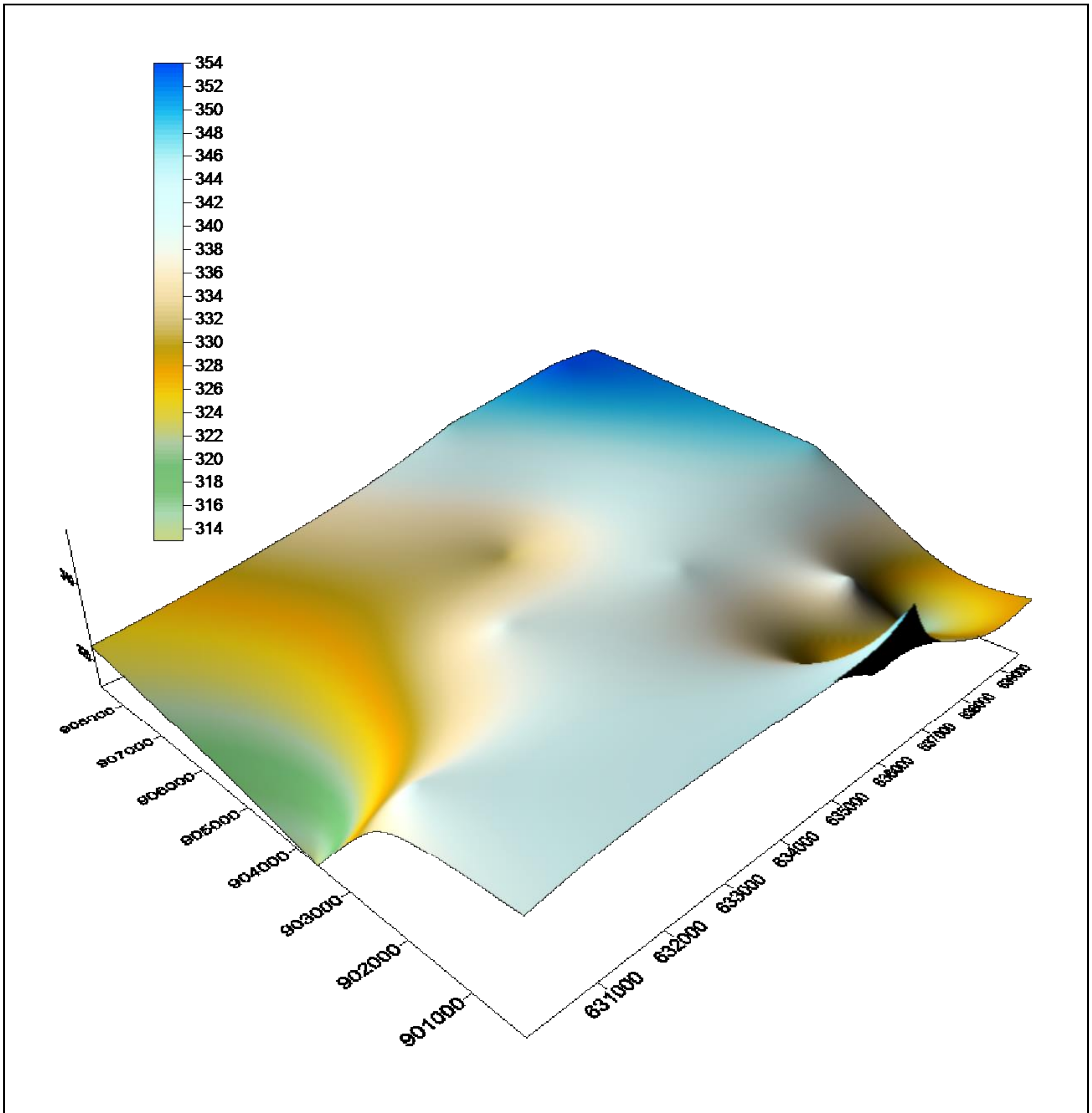

Figure 2: Digital Elevation Model (DEM) showing a 3D view developed from Surfer 8

Table 1: Coordinates and Elevations of LAUTECH, Ogbomoso

X	Y	Z
638104.01	90144o.40	352
636359.20	908611.85	347
635120.20	905972.89	331
639564.43	903952.63	348
633332.60	904044.19	339
637278.74	901678.40	340
636606.61	900751.85	326
638406.24	901335.17	319
630466.30	902387.39	340
636272.71	900219.53	351
630024.95	903588.77	313
636272.71	901219.53	323
638686.92	908396.59	354
635791.80	903348.03	341
636272.71	901219.53	323

Drainage Basin

The drainage which represents the main river and its attribute was developed by using basin function in the spatial analyst box. Drainage basins which represent the areas where all surface water flowing on the terrain flow out from a common or s single outlet as shown in drainage of LAUTECH, Ogbomoso indicates watershed boundaries and represents the main river and its attributes assisting in seeing the direction of flow of water. The areas with high drainage have dense vegetation, low relief region and high resistance while the areas with low drainage have sparse vegetation and mountainous relief. The reason for this is because of sufficient aeration is available in the area of high drainage whereas little aeration is available in the area of low drainage. The drainage basin shows that the streams are deflected from their original (straight) path and follow transitional course. Steep rocky catchments with less vegetation produce more runoff while flat areas with more vegetation produce less or no runoff. The longer the length of a basin, the lower the chances that such a basin will be flooded when compared with a more compact basin. This is because, the longer the basin, the lower its slope. Not only this, time of concentration (lag time) in such a basin will be higher than a more compact basin which produces sharp hydro graphic peak due to high bifurcation ratio. This led to rapid withdrawal of water from such a basin. High concentration time thus exposes the water intercepted by drainage basin to longer duration of infiltration and evaporation process, hence reduction in runoff volume.

4.CONCLUSION

Drainage works are very vital instruments in combating flood which is a great nuisance to the developing countries like Nigeria, especially the south eastern parts of the country. This part of the country characterized by loose soils (laterite soil) has been devastated by flood and erosion. The results show that the longer the length of a basins, the lower the chances that such a basin will be flooded when compared with a more compact basin and the longer the basin, the lower its slope while the time of concentration (lag time) in such a basin will be higher than a more compact basin which produces sharp hydrographic peak due to high bifurcation ratio. High concentration time thus exposes the water drainage basin to longer duration of infiltration and evaporation process, hence reduction in runoff volume. The shorter the basin length, the closer to the circulatory ratio.

As a result of these environmental effects or impacts if not well managed, it will render most of the infrastructures ineffective. Care should be taken to avoid a situation whereby infrastructural and social, health and other amenities may be destroyed by floods as a result of poor drainage system. The failed and deterioration drainage system have impacted negatively on the environment and the health of people around the study area should be taken seriously. Afforestation programme to reduce flood incidents during rainy season by promoting infiltration process which will help in conserving water supply for dry season usage and efficient waste management techniques to reduce flooding due to channel blockage and debris is pile-up. These management techniques will not only aid in the improvement of river regime by retaining greater volume of rainfall intercepted by the basins on the land, but will also help in solving problems of soil erosion, sediment generation and water supply.

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