



APPLICATION OF TOPOGRAPHICAL SURVEY FOR ASSESSMENT OF ISUNJABA GULLY EROSION SITE IN ISU LOCAL GOVT. AREA OF IMO STATE

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Abstract: *Topographical survey has been a useful tool to better understand the undulation of terrains (terrain relief), and in particular serve as a planning tool on how to remedy eroded terrains to avoid further degradation/deformation. In the past decade, more cases of gully erosion and flood has been witnessed or experienced in most parts of the world, this paper presents a case of Isunjaba gully erosion site, Isu local govt. Area of Imo state. The topographical survey was carried out using Trimble Differential Global Positioning System (DGPS), Real-time kinematic (RTK) GPS receiving unit was used to survey the site within the range of 4,593,200 Sq. Mts. Permitting the collection of 14,800+ survey points giving a mean density of 0.032 points per square metre. The result is presented using ArcGIS 9.3 and AutoDesk Land development 2009.*

Keywords: *undulation, terrain relief, degradation/deformation, erosion, DGPS, RTK.*

I. INTRODUCTION

Topographical surveying is the process of determining the positions of man-made features such buildings, roads, railways, utility structures, etc and natural features such as water bodies, hills, gully or ravines, vegetations etc on the earth's surface and determining the terrain configuration, [4], [5] stated that Topographical surveys are sometimes referred to as Contour survey as it is used to identify and map the contours of the ground and existing features on the surface of the earth and slightly beneath the earth's surface. If the purpose of the survey is to serve as a base map for the design of structures of some type, administration guide, planning, or for curbing of erosion/flood menace as in this case, it is deemed necessary to show the perimeter boundary lines.

In general, topographical survey is used to determine the location of selected ground natural and manmade features of a given area, and the configuration of the terrain. The location of the feature is known as planimetry and the configuration of terrain is referred to as topography or hypsography [1], [2]. The transformation of topographic data into a graphic representation using conventional symbols is known as topographic map/plan, it shows both horizontal distances between the features and their elevation above a specific datum. The representation of the difference in elevation is called relief [2] and is usually represented using various relief representation method such as spot heights, altitude tints or layers, shading, hachuring and contouring [1]. Contouring can be combined with any of the other method. Topographic survey is carried out by either of ground survey method, aerial photogrammetry and satellite imagery (remote sensing) or by combination of any two of the methods. Ground survey method which was adopted for this project could be accomplished by using any of theodolite, level, total station, DGPS or combination of two. According to [3], Topographical survey of any given area consists:

- 1) Establishing over the area a system called horizontal and vertical (3D) controls and
- 2) Locating the details, including the selected ground points by measurements from the control stations.

Topographical surveys are classified according to map scale, viz: large scale (1/2,500 or less), medium scale (1/2,500-1/50,000) and small scale (1/50,000 or above). Because of the different uses of topographic maps and variations in character, some are simple in plan and execution and cover few acres while others are complex in plan and difficult in execution and cover large acres. [2]

II. STUDY AREA

Isunjaba lies between latitude 6 35 47.41 N – 6 36 6.26 N and longitude 8 9 27.98 E - 8 9 49.64 E. It is located in Isu Local Government Area of imo state, (formally isu-njaba local Government Area). The site is bounded by Orlu L.G.A. at the north, Njaba L.G.A. at the west, Mbaitoli L.G.A. at the south while nwangele and Nkwere L.G.A. at the east. The topography of Isu-Njaba gully site according to an in-depth site appraisal and spot height acquisition, is a steep type. According to the slope analysis of the area carried out with the aid of ArcGIS 9.3 and suffer 11 software respectively, with the acquired data from GIS/topographic survey, the orientation of the

site is steep towards the westward end (towards the Njaba River) with an average slope of about 33° . The gully started about 50 years ago from the popular Njaba river and has developed bigger towards the east, where it is threatening residential buildings. The slope of the area together with the sandy nature of the soil, relative intense rainfall, man-made interferences and lack of drainage system are the main causes of the gullies at Isunjaba. The physical relief of the area is characterized by undulating terrain and the vegetation is generally made up of rain forest and farmland. It is mostly dominated with the rainy season from late April to September and dry season from October to early April. Isunjaba is predominantly a farming area since the soil is fertile especially during the rainy season. Most population of the area engages in farming and petty trading of finished farm produce.

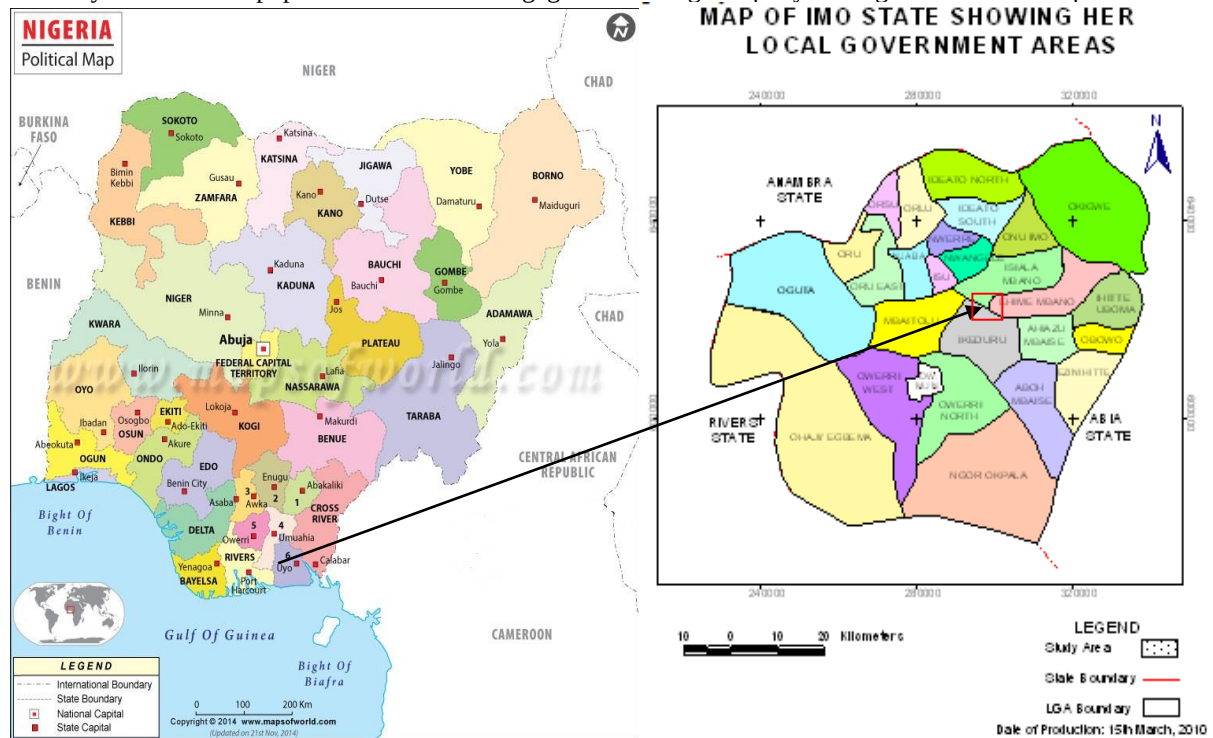


Figure 1: Maps of Nigeria showing Imo state and Isu L. G. A. showing the study area

III. METHODOLOGY

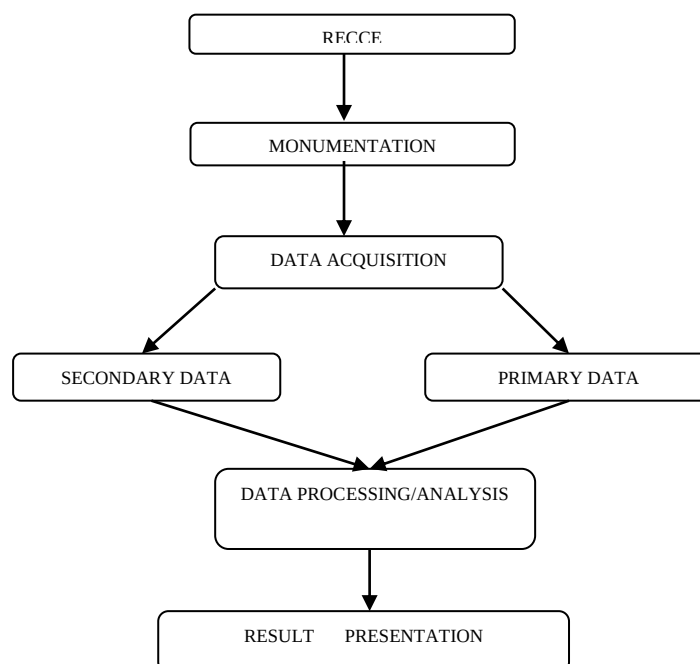


Figure 2: Methodological flow chart

The methodology adopted for this study is outlined in figure 2. Some key considerations for carrying out a topographical survey depend on the map scale, intended use of the map and the area to be surveyed. The first stage of this study is to carry out a reconnaissance survey, then monumentation of the study area, Data capture, Data processing and analysis, then finally result presentation. The following hardware and software were used for the execution of this project;

- Differential Global Positioning System (DGPS) and accessories
- Total Station instrument and accessories
- Computer system and accessories
- ArcGIS 9.3 software
- Autodesk Land development 2009 software and
- Surfer 10 software

A. BENCHMARK (BM) ESTABLISHMENT

After monumentation, (Ground control station establishment) DGPS was used to transfer coordinates from an existing control to the established control stations.

Nine (9) BMs were established within the project area. In establishment of these BMs, coordinates were transferred from EEU-GPS001 at Imo State University, Owerri to the BMs. The established BMs in WGS1984 UTM zone 32N were used to control the ground survey. Table1 shows the established BMs, their coordinates and description while figure 3 is a satellite imagery showing the established polygon area and the BMs locations.

Table 1: Established bench marks

BENCH MARK	NORTHING	EASTING	HEIGHT (m)
ISU/BM-001	285300.842	632715.201	145.366
ISU/BM-002	285858.237	633594.789	154.626
ISU/BM-003	286795.015	634317.336	192.599
ISU/BM-004	287045.434	634458.915	195.326
ISU/BM-005	287477.021	634200.189	193.517
ISU/BM-006	287431.726	633926.016	195.971
ISU/BM-007	287625.021	633382.201	198.241
ISU/BM-008	287310.972	632476.912	173.373
ISU/BM-009	286074.445	632642.54	150.713

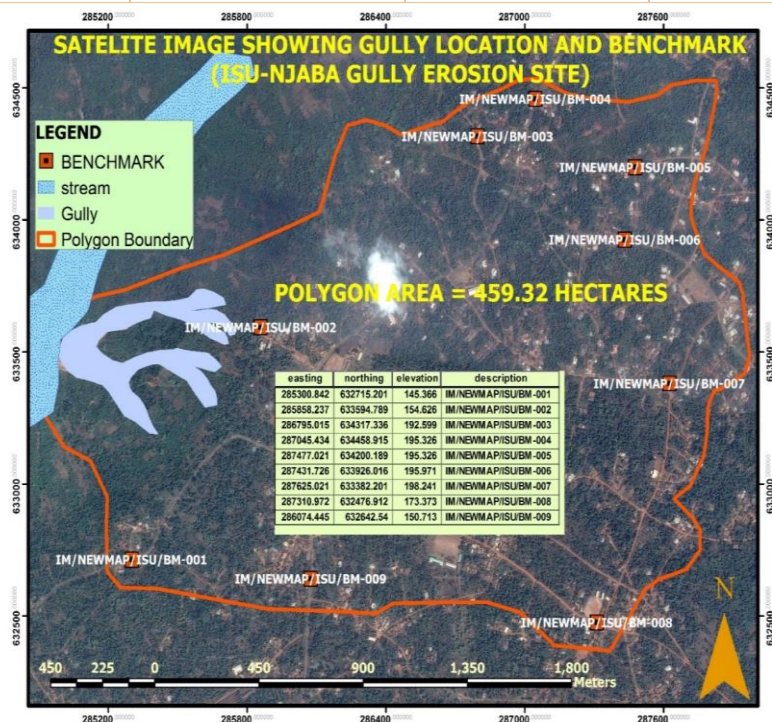


Figure 3: Satellite imagery showing the polygon area and established bench marks

B. DATA ACQUISITION

In addition to the satellite imagery obtained, About 14,800+ survey points were observed within the project area in the range of 2-4 meters using DGPS (Trimble R4) and Trimble Total station (Trimble M1). The data was later transferred to ArcGIS 9.3 and Auto desk land development 2009 for interpolation of the inaccessible area. The survey of the main erosion gully carried out entailed the establishment of the gully cross-sections, profiles, maximum depth and length, average top and base width at not more than 25meters interval. In cases where critical points or sharp curves were identified along the gully, observation was made at interval of 5-7meters in order to capture these points and give a good representation of the area. Road profiles data were also captured in order to ascertain placement of proposed intervention structures such as drains to be constructed along major roads.

IV. RESULTS AND DISCUSSION

The gully layout, profiles and sections were prepared using auto desk land development software. Also, profiles and sections of roads with the contributory catchment areas were prepared using this software.

The result of the data acquired from the site with the aid of Trimble R4 Differential Global Positioning System (DGPS), Trimble M1 Total Station and interpolation with AutoCAD Land Development Software were checked and found to be acceptable with an accuracy of 1/195,000.

The data acquired was retrieved from the instrument in excel format, from which it was imported into AutoCAD Land Development 2009 where all the observed points was displayed with respect to their actual position on ground. The general layout of the study area was prepared using same software and ArchGIS 9.3. On the process, some important structures, gully perimeter and roads were modeled. Other buildings that were not captured on site was digitized with ArchGIS 9.3 through Google image for a better detailing. A contour map was generated with the aid of suffer 11.0 at interval of 1m to provide adequate information for a good hydrological analysis, hydraulics and structural designs. A closer look at the contour map shows that the study area sloped down towards the west (gully area). The longitudinal profile and cross section of all the roads within the study area and the gully as well was prepared using AutoCAD Land Development to show difference in elevation at 25m interval which would be useful to the engineers during design and construction work. Since the primary aim of this exercise was to provide information necessary to control the erosion menace at Isunjaba depicting what is on ground on paper or digital format, outputs such as vector map, contour map, and road cross sections were produced to serve as tools for planning the remediation measures of the gully engulfed area.

V. CONCLUSION

Topographic maps remain the most popular and effective source of deriving information for preventing and solving terrain issues. Great care must be taken not only to undertake topographical survey but also to preserve and utilize its product. Though they are many methods of carrying out a topographic survey as earlier stated in the introduction, the ground survey method and the instruments used as stated in the methodology has yield the required result. It can be concluded that the topographic map produced to depict the problem area should be utilized to remedy the erosion menace in Isunjaba community.

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