

APPLICATION OF GROUND SURVEY AND GEOGRAPHIC INFORMATION SYSTEM (GIS) IN PRODUCTION OF DIGITAL MAP OF ABUBAKAR TATARI ALI POLYTECHNIC, MAIN CAMPUS, BAUCHI, BAUCHI STATE

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Abstract

This study employed GIS techniques to produce a digital map of Abubakar Tatari Ali polytechnic, Bauchi. A total station was used to obtain rectangular coordinates (Easting, Northing and Height) of natural and artificial features within the polytechnic. These features include; building, electric poles, roads, streams, sport heights, etc. The coordinates were later typed in notepad and exported to AutoCAD software for plotting (script plotting). Each feature was plotted as independent thematic layer. The layers were exported to ARCVIEW software for generation of contour lines and compilation. The map was produced indifferent layers, namely; boundary, building, contour, road, stream and utility. The layers were superimposed on one another to form a composite map. From the study, the digital map of Abubakar Tatari Ali polytechnic, Bauchi was produced and hence is recommended that digital mapping should be embraced because of its flexibility to handle data in layers and assurance of dimensional stability of storage medium, eliminates loss of data or details in transfer from one medium to another and maintains positional accuracy since the data are held in digital form.

Key Words: Ground survey, GIS, digital map

Introduction

Geographic Information System (GIS), as multi-disciplinary tool, is attracting professionals from many disciplines. Lack of digital and up to date maps, for proper planning and environmental management has been the problem with most tertiary institutions in Nigeria.

Most of the early map making was done by laborious field surveys traversing, plane table, triangulation etc for recording of field data, obstacle in sighting targets, taking of off-sets were some of the problems encountered. In the 1980s, the use of computers to scan and redo existing maps significantly reduced the time required to produce and update maps in areas of rapid growth.

As a result of this revolution, surveying activities have been expanded through the process of digital mapping. Ndukwe, (2001) describes digital mapping as computerized compilation and production of maps using information in a digital format. In other words, digital mapping is a computer-based mapping process involving production of maps from spatial data held in numerical form rather than in graphical or analogue form.

Digital mapping is one of the new opportunities offered by Geographic Information Systems (GIS). Geographic information system is an orderly assemblage of computer-based hardware, software, geographically referenced data, procedures, and personnel configured to handle all forms of spatial data to satisfy the geographic information needs of the user (Uluocha, 2007). Geographic information

system, as a computerized system for the collection, storage, retrieval and presentation of spatially referenced data, is becoming a tool for every profession dealing with spatially referenced data (Zarzcki, 1992).

Old maps were produced using classical surveying instruments like theodolite, EDM etc. Today, maps are prepared using data collected from Global Positioning System (GPS), total stations and photogrammetric interpretations of aerial photography. Recent developments in electronic computers, digital technology and survey instrumentation have revolutionized surveying and mapping profession in a way that has never been seen before. These developments have, in turn, led to a dramatic change from analogue mapping methods to digital methods in theory and practice (Ndukwe, 2001).

In a similar development, Musa (2008) has produced a digital topographic map of Abubakar Tafawa Balewa University Senior Staff Quarters (Kari Estate), Bauchi through the use of digital surveying instruments and GIS software. The map so produced was in four different layers well superimposed on one another forming a composite map.

Furthermore, Musa (2009) produced a revised township map of Jimeta-Yola using Satellite Remote Sensing (SRS), Geographic Information System (GIS) and Global Positioning System (GPS) technologies. Four layers were generated and overlaid on each other. The layers include for road networks, streams and the satellite image formed the

background. Areas of change since the town was last mapped were identified and registered onto the new map.

From literatures, a maximum of four layers are enough to form a map. This study intends to produce a digital map of Abubakar Tatari Ali polytechnic, Bauchi by ground survey and the use of Geographic Information System (GIS) techniques with layers that are sufficient for proper environmental planning and management for infrastructural development. This became necessary because the school has not been mapped and new structures are sited unplanned.

The Study Area

Abubakar Tatari Ali polytechnic, Bauchi is one of the tertiary institutions established, owned and manned by the Bauchi state government. The polytechnic is situated in the Bauchi-Jos road and bounded by Wuntin Dada Quarters to the north, Tambari Housing Estate to the east, Rafin Tambari village to the south

and Bauchi State Television Authority (BATV) to the west. In fact, the study area is geographically located in the Bauchi metropolis.

Bauchi is geographically located by latitude $10^{\circ}18'57''$ N of the Equator and longitude $09^{\circ}50'39''$ E of Greenwich meridian which lies also on the Port Harcourt – Maiduguri railway line and covers an area of 3,687 km². It is connected through good roads and bounded by Kano and Jigawa to the north, Yobe and Gombe to the east and Kaduna State to the west and Plateau and Taraba State to the south. Its central location and hospitable nature with peaceful coexistence between its inhabitation has made it both an educational center and tourism environment in the country due to the influx of people from all the neighboring states for safety, and tourism to Yankari Game reserve and Tomb of late Sir Abubakar Tafawa Balewa the first Prime Minister of Nigeria. See fig.1 for more details.

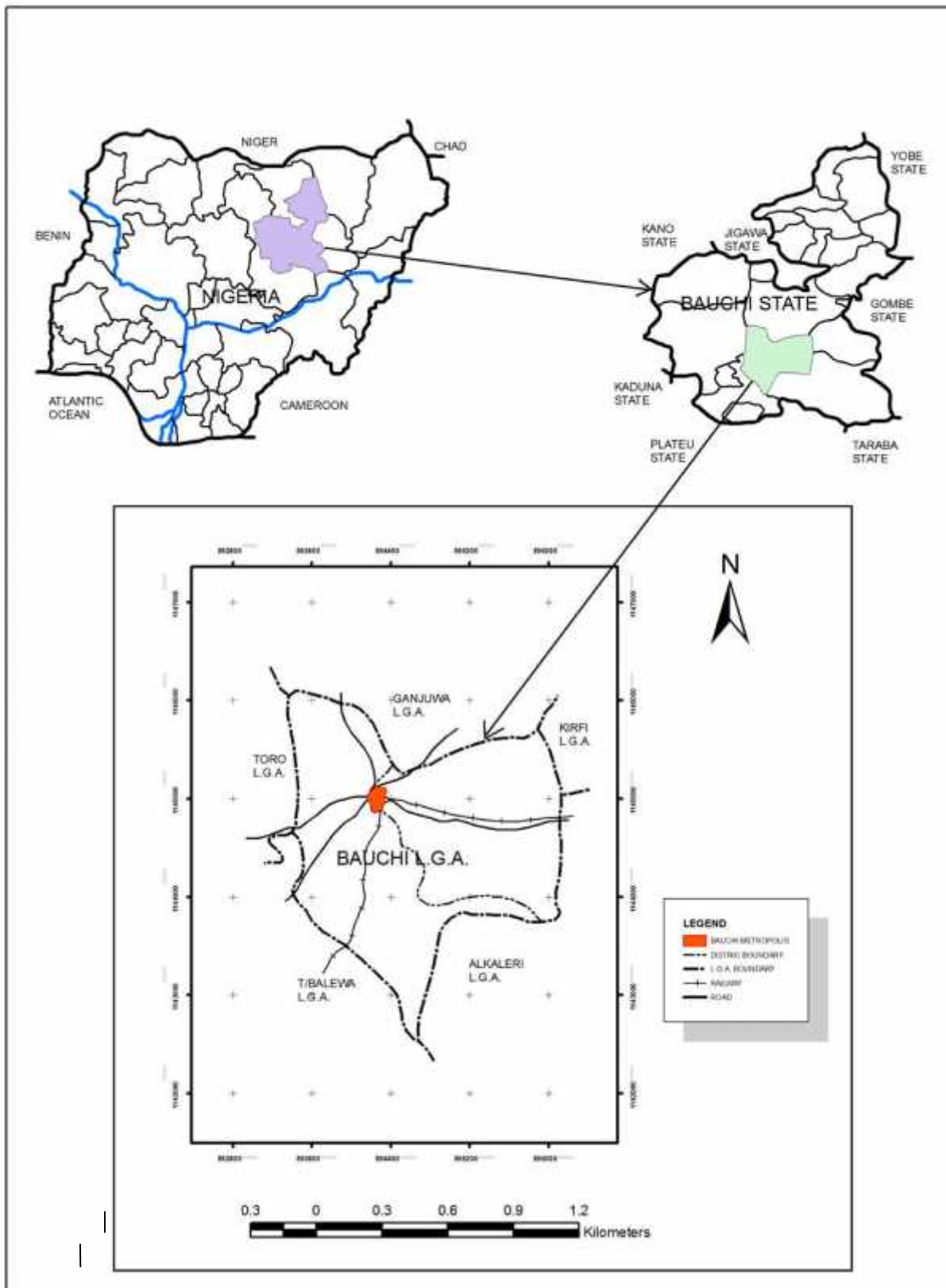


Fig.1: Map of study area.
Source: Bauchi State Ministry of Lands, Housing and Environment (2012).

Population

The population of the study area according to 2004 census was determined to be 316,173 but in 2006 population census, the result ascended to 493,810. The Hausa-fulani are the major inhabitants of the city while others include; the Gerawa, Jarawa, Sayawa, kanuri, Ngas, Yoruba, Igbo and host of others. These groups have two main religions Islam and Christianity which they practiced. Inter-marriage between the groups is very common and they have similarities of culture including joking relationships between certain tribes like Fulani and Kanuri, Jarawa and Sayawa. Agricultural practices for production of both food and cash crops have captured the life of the

inhabitants of the city. Also the city now witnessed economic boom due to the present of industries and new markets available for investors including the politically enabling ground.

Climate and Rainfall

The climate condition of the study area is very hot in the months of April and May while December and January are the coldest months. Mean daily temperature ranges from 28.2°C in August to 36.6°C in April maximum while from about 13.3°C in December to about 22.1°C in April and May minimum. See Fig. 2

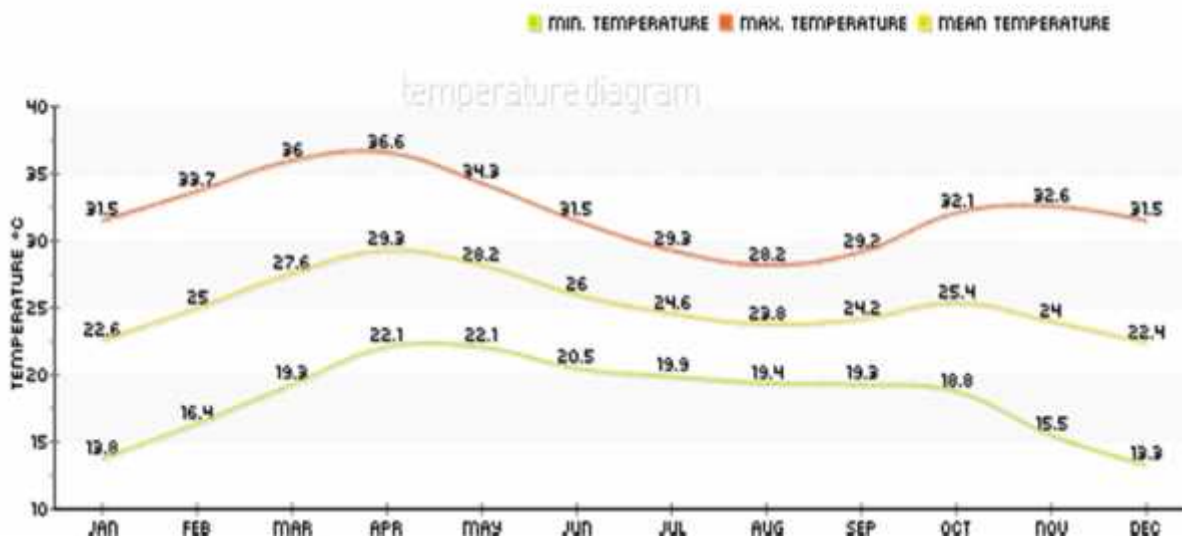


Fig. 2: Temperature Diagram of Bauchi Metropolis. Source: Climate-data.org (2013).

There are two major seasons in Bauchi i.e. rainy and dry seasons. The rainy season months are May to September, when humidity ranges from about 37% to 68%. Onset of the rains is often in March while they end virtually by October while the dry season starts from November to May (Weather-bug, 2013).

Topography and Vegetation

The topography of Bauchi metropolis is mountainous and they rose over 600m to 650m above sea level (OnlineNigeria.Com, 2013). In Bauchi, most prominent mountains are the Wambai and Warinje hills located to the northeast of the metropolis, the Jahun and Gudum hills to the south and the Kobi hill that dominates the centre of the old walled town. This area is situated within the belt of open Sudan savannah characterized by sparse trees of up to 20ft or more. The vegetation is less uniform and grasses are shorter than what grows due to considerable human interference through cultivation, grazing and burning. This may not be unconnected with the vast fertile soil in the area as an advantage for cattle

rearing and other agricultural products such as guinea corn, rice, millet, groundnut and maize (BASG, 2012).

Water Resources

Bauchi urban has rivers and water-shed with many streams from its uplands and plains. The rivers that drained the urban area are; the Burkumbo River which drains the eastern part of the metropolis, and Shadawanka River drains the north and north-western parts. The rivers have numerous headwaters and tributaries within the metropolis. This pattern of drainage has produced extensive fadama land almost surrounding the metropolis. The Gubi dam lies to the northeast of the metropolis, about six kilometers away and provides good source of water for urban uses.

Methodology

Data

The data used are the rectangular coordinates of both natural and artificial features found in the study area

and were obtained through the use of total station (see table 1).

Table 1: Sample of field book showing the coordinates of some selected features

Easting	Northing	Height	Point	Remark
583997.023	1139974.110		1	Boundary
584183.209	1139998.907		2	„
584455.463	1139986.011		3	„
584701.333	1139930.210		4	„
584615.113	1139803.711		5	„
583944.124	1138836.412		6	„
583967.998	1139488.510		1	Stream
584125.112	1139536.001		2	„
584349.718	1139991.626		1	Gate
584368.256	1139987.884		2	„
584511.408	1139250.221		1	Deans Office Sch. Of Engr.
584523.915	1139250.221		2	„
584523.915	1139257.532		3	„
584537.338	1139257.532		4	„
584537.338	1139250.221		5	„
584548.929	1139250.221		6	„
584548.929	1139238.645		7	„
584511.408	1139238.645		8	„
584394.114	1139280.018			Electric pole
584100.000	1139834.432	622.012		Spot height
584452.213	1139279.546			Electric pole
584250.432	1139822.221	625.333		Spot height
584521.111	1139855.215	626.478		Spot height
584277.771	1139590.997		3	Stream
584502.332	1139280.456			Electric pole

Equipment used

The equipment used includes hardware and software.

1. Hardware

- Total station (TOPCON GST 213).
- Acer (Aspire 3680) laptop computer (Celeron M).
- HP Photosmart (C5500 Series) printer, scanner and photocopier.

2. Software

- AutoCAD 2002.
- ARCVIEW 3.2 a.

Data processing

The features within the study area were plotted by typing their coordinates in notepad and running them as script in AutoCAD software (see figure 3). Each feature was plotted as independent thematic layer. After the plotting, the layers were exported, in Data Exchange Format (DXF), in to ARCVIEW software for generation of contour lines and compilation of the map.

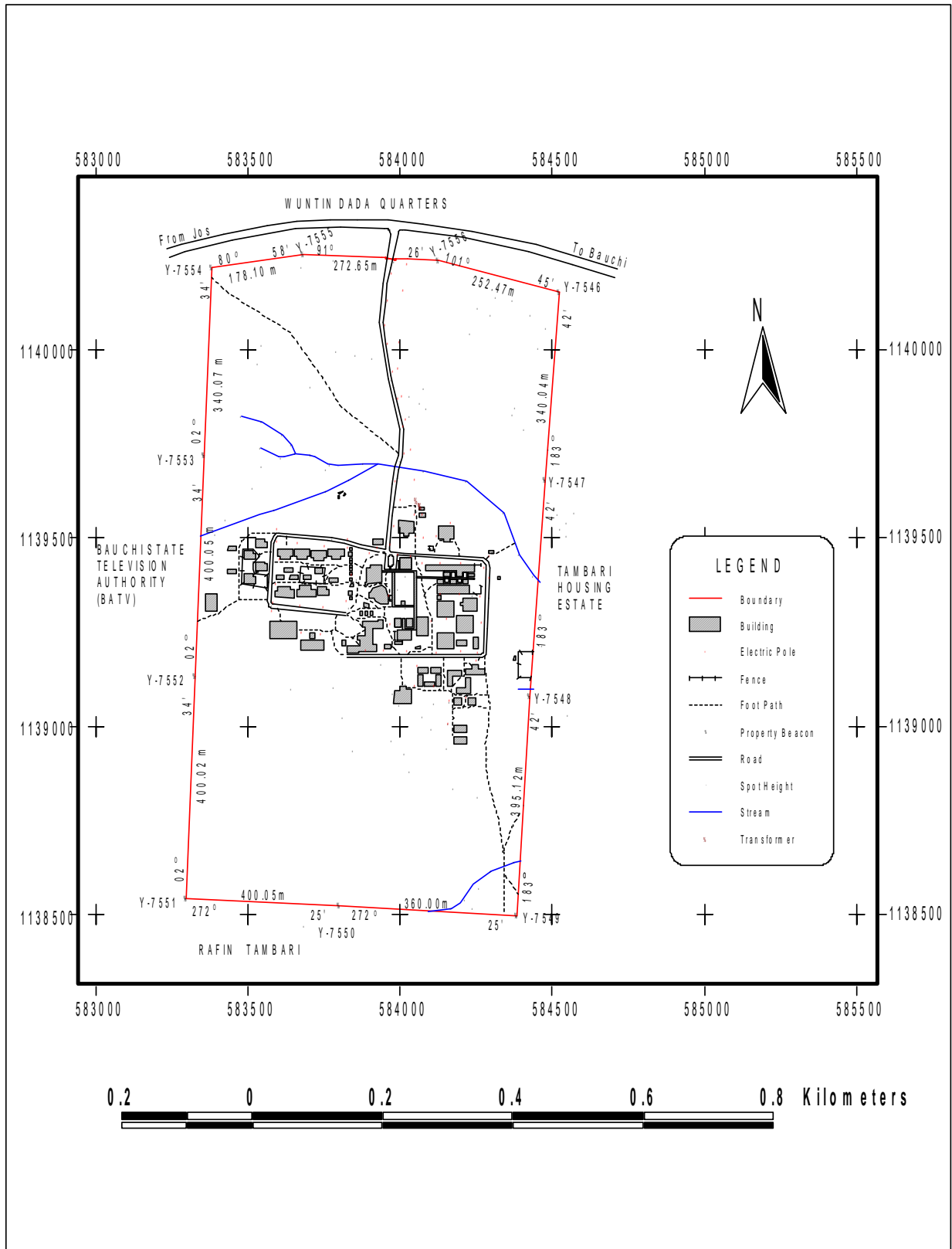


Figure 3: Digital map of Abubakar Tatari Ali Polytechnic showing the plotted features.

Generation of contour lines

The layers were imported into ARCVIEW software after which the contour lines of the study area were generated by the use of spot height initially plotted in AutoCAD software (see figure 4).

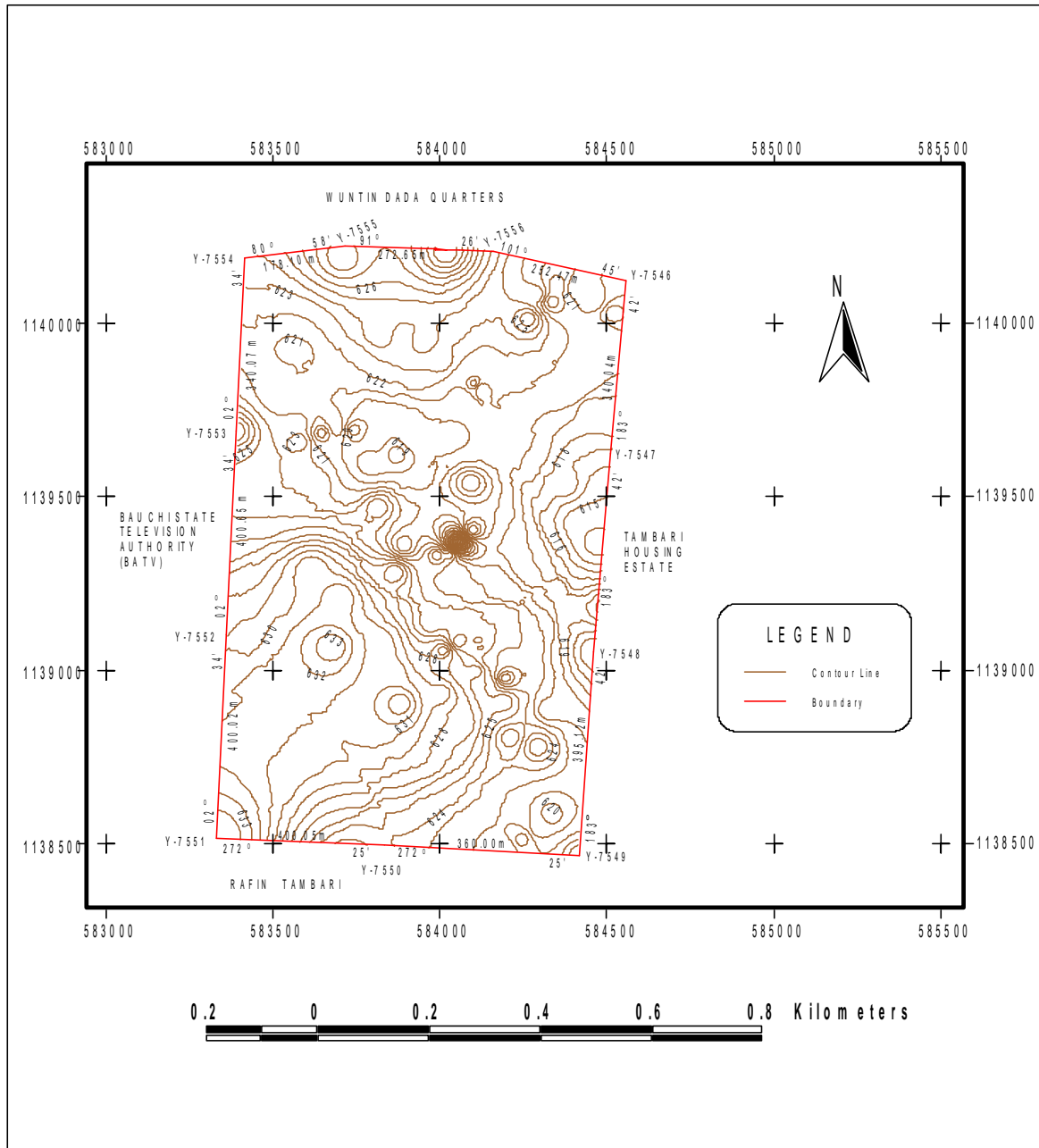


Figure 4: Digital map of Abubakar Tatar Ali Polytechnic showing contour lines.

Map compilation

The map was produced in layers such as boundary, building, road, stream and utility and compiled by

superimposing all the layers on one another to form a composite map (see figure 5).

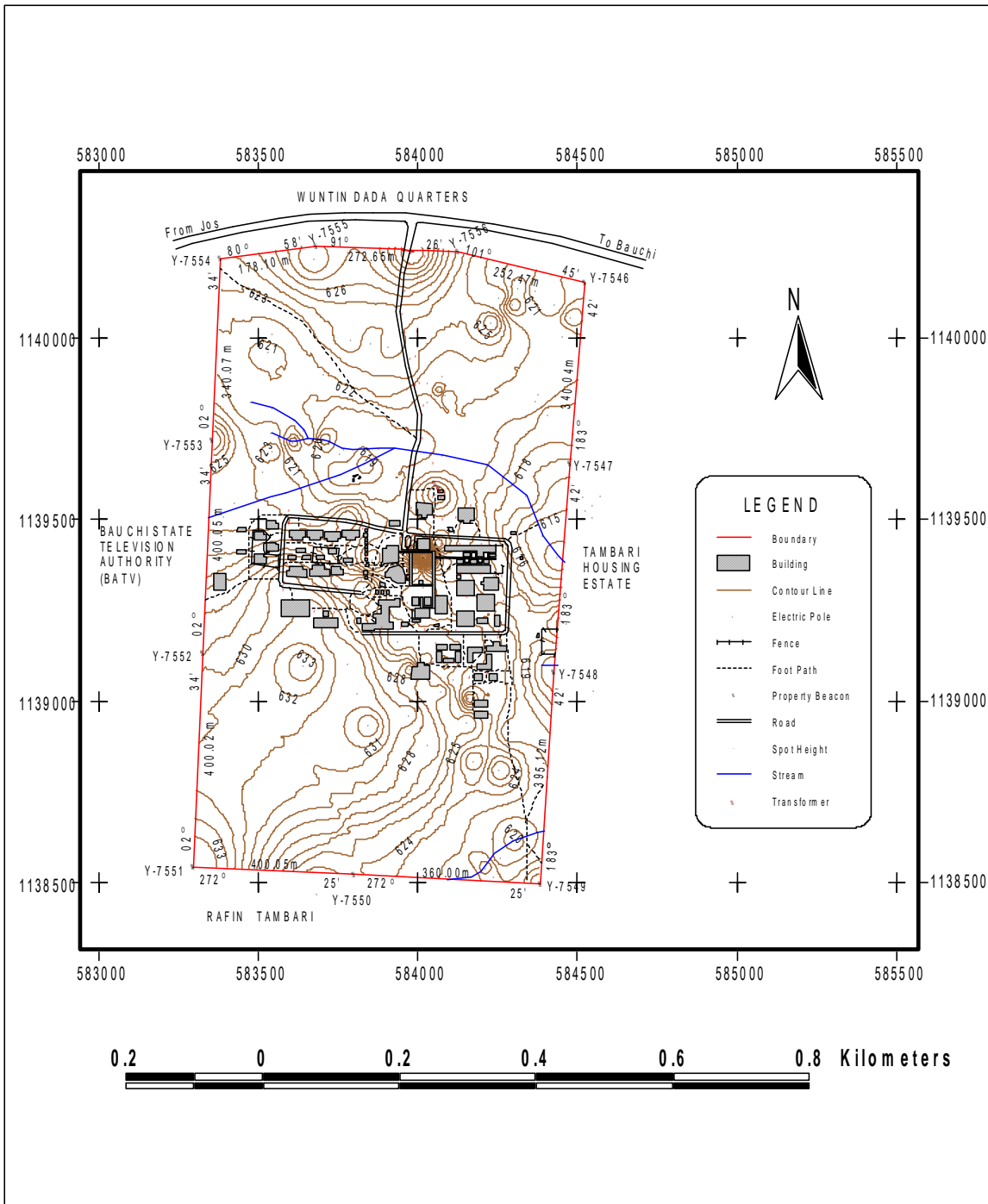


Figure 5: Composite digital map of Abubakar Tatar Ali Polytechnic produced by superimposing all the eleven layers on one another.

Results and Discussion

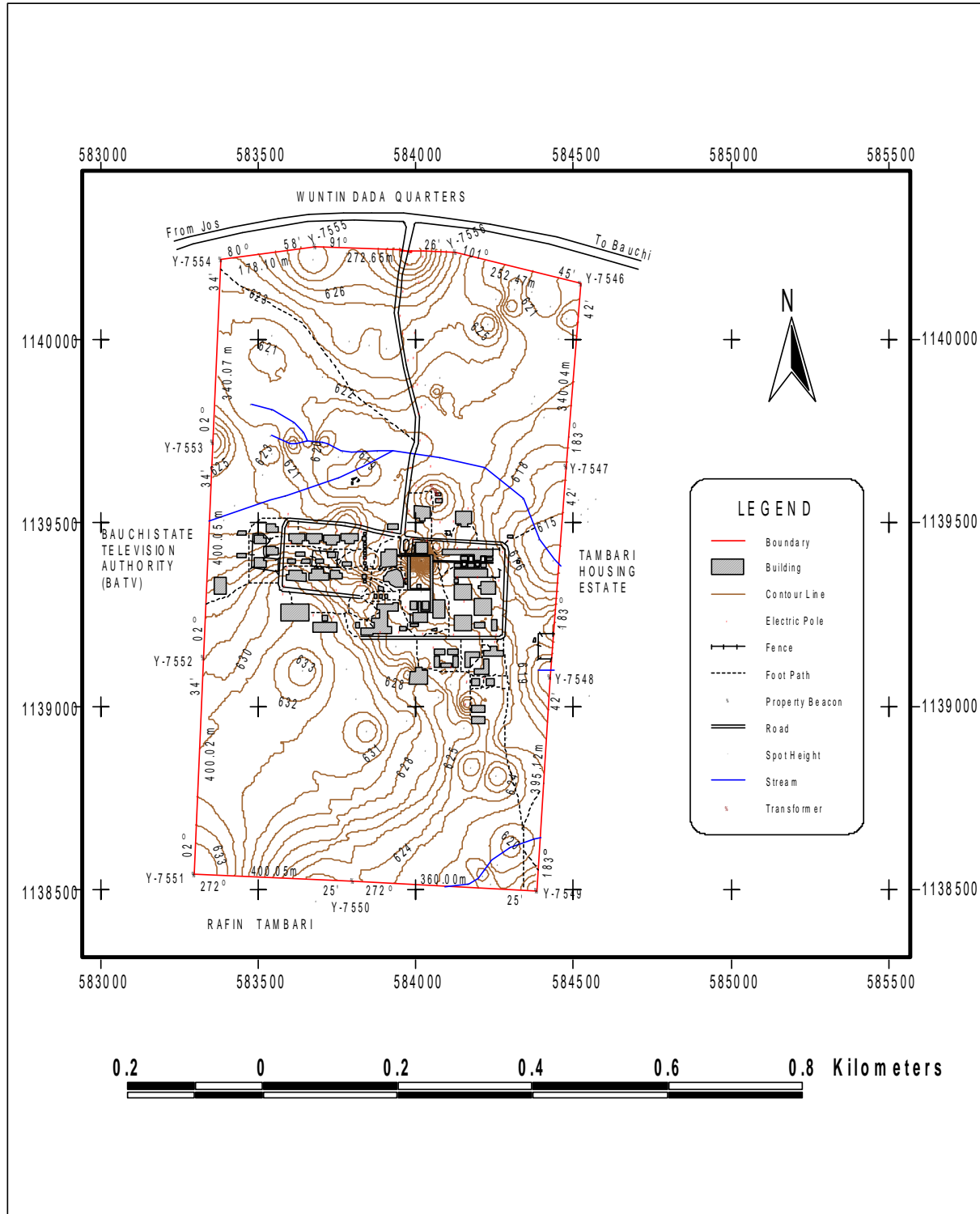
The digital map of the study area was produced and is in different layers such as building, road and utility from which mono-thematic maps can be produced at any required scale very quickly and cheaply for

different applications (see figure 6). The applications include preparation of Land Information System (LIS), provision of refuse collection centers, proper placement of structures and utilities, etc. Therefore, the digital map will serve as a tool for proper and

effective environmental management and infrastructural development within the polytechnic. It can be seen that the final map consisted of grid lines (represented by tick marks). The values of the grid lines are as a result of registering the map onto a Universal Transverse Mercator (UTM) Projection

System. The grid lines will make it possible to compute bearings and distances between points or features on the map and another point or feature outside the map (if the UTM coordinates of that point or feature are known). The map is available in soft and hard copies for future reference and update.

Figure 6: Digital Map of Abubakar Tatar Ali Polytechnic produced in eleven layers.



Conclusion and Recommendations

In this study, the production of digital map of Abubakar Tatari Ali Polytechnic, Bauchi is achieved using GIS and ground survey method. It can be seen that digital mapping, as one of the new opportunities offered by geographic information system techniques, has made production of maps easier and

less costly when compared with the conventional methods. It is therefore recommended that digital mapping should be embraced because of its assurance to storage and retrieval, elimination of loss of data details due transfer from one medium to another, and maintenance of positional accuracy since the data are held in numerical form.

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