Developing a Cadastral Information System for Proper Land Administration in Tudun Salmanu Area of Bauchi Metropolis, Bauchi State, Nigeria

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Abstract

Population growth and economic activities in Tudun Salmanu area of Bauchi metropolis have not only led to an increased demand for land to cater for the various land uses but also pose challenges on proper and efficient management of layouts. Information and new strategy for sustainable land administration in the area are increasingly required. However, collation/retrieval of cadastral information has remained analogue leading to difficulties in litigations over resolution of land boundary matters with economic losses. This realization led to the utilization of geographic information system (GIS) in this study as an approach aimed to resolve the problems and improve the situation for economic motives. The methodologies adapted were the determination of coordinates, digitization of maps, relational database and user interface creation. The results obtained were the cadastral information database functionally connected with user interfaces as a system. This led to results obtained on queries and function for editing, update and retrieval of information in faster and easier ways. The proposed system will serve as a dependable automated approach to collation/retrieval of cadastral information as well as monitoring the trends of land parcels for effective land administration. It is therefore recommended that the authorities concerned with the collection and management of spatial and cadastral information should adopt this for land administration in the area and the state at large.

Keywords: GIS, Land Administration, Cadastral Information System, Database

INTRODUCTION

Land is commonly known to be the most valuable resource that enables the existence of man on the earth. It supports the agricultural, residential, cultural, educational and other activities for the main's dominion over some portion of the earth. However, the administration and management of this very vital resource in some parts of Nigeria, is faced with some challenges such as: lack of transparency in the processes of land acquisition and registration with delays that makes it cumbersome through manual procedures. Also, there appears to be perceived corruption; dishonesty on the part of customary land owners which is a hindrance in the area to Land Administration (LA) as a Geographic Information Systems (GIS) that supports a database on land records such as: land parcel boundaries, ownership, resources and value which aid successful management (Dale and Mclaughlin, 1988; Ndukwe, 2001). This is evident from the poor conditions of service, poor remuneration, poor records management that generally became apparent and prevalent. These from inception resulted to lack of collaboration and cooperation between agencies with technical expertise to use new technologies available for the development of an effective LA despite that cadastre started in the country since 1883 (Usman 2010 and Osabuohien 2013). Therefore, creating an information system that capture and store information about land ownership, value, land assessment, allocation, records and registration through Cadastral Information System (CIS) is vital to Land Management (LM) which ensures the process of managing the use and development of land resources FAO (2002) and fundamental to the development, both at individual, community and national levels (Ojigi *et al.*, 2011).

The choice of CIS is on two bases: firstly, it contains and provides a comprehensive register of mates-and-bounds real properties of an area usually kept in text and maps and sometimes in conjunction with other records, such as a title register to guide LA (Ojigi *et al.*, 2011). Also, it can be updated and hence accurate and reliable (Dale and Mclaughlin, 1988). Secondly, in Nigeria, the Land Use Act No. 6 of 1978 vested the control and management of all urban land with the governor of the state in which the land is located (LFN, 2004). This control is exercised through the ministries that supervise the survey, demarcation and allocation of land parcels to those who applied for them. Thus, the custody and management of cadastral information has been the responsibility of the land registries in the ministries. However, despite that recent advancements in computing and geospatial applications, the Bauchi State Ministry of Land, Housing and Environment that is the custodian of cadastral information in Tudun Salmanu area of Bauchi metropolis operates on analogue records keeping. This file cabinet paper-based record keeping is slow, unsafe and complicated. This paper intends to develop a computer-based record keeping based on cadastral information system for the study area.

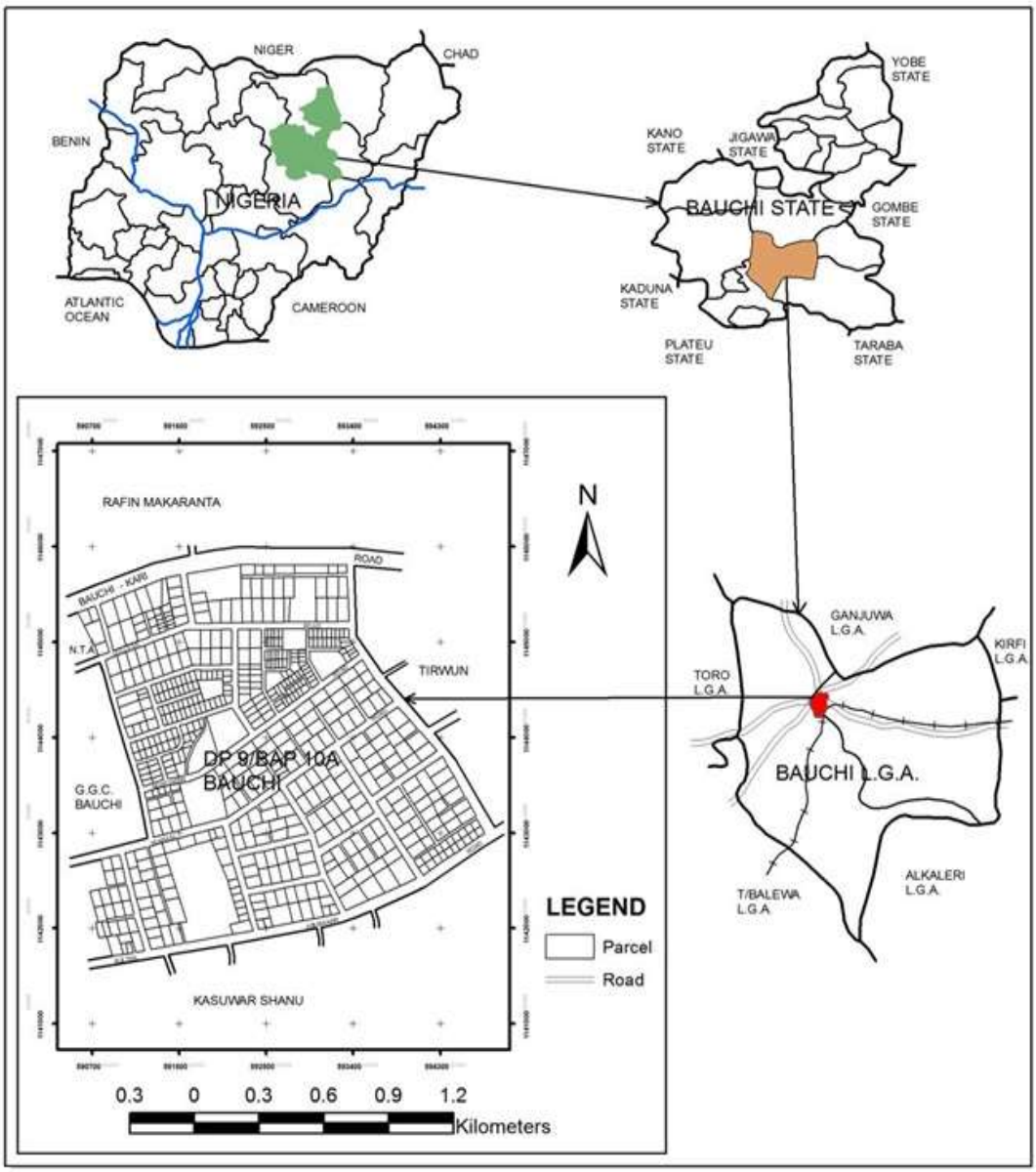

Figure 1: Tudun Salmanu area of Bauchi metropolis

Study Area

Tudun Salmanu area is located in the north eastern part of Bauchi metropolis, the capital of Bauchi State, Nigeria. The area lies between latitudes [10° 19′ 55″-10° 20′ 58″] and longitudes [9° 50′ 50″-9° 51′ 29″] and occupies a total land area of 2.550km². The area comprises of two layouts, namely;

Development Plan No. 9 (DP 9) and Bauchi Area Plan No. 10A (BAP 10A) with a total of five hundred and eighty five land parcels. It is bounded by Rafin Makaranta quarters to the North, Tirwun quarters to the East, Kasuwar Shanu to the South and Government Girls College (G.G.C.) Bauchi to the West as shown in Figure 1.

DATA AND METHODS

Data

The data needed for the research include: the layout plan of the study area; attribute data such as parcel information, ownership details, land use and tax records; the photographs of the buildings on the parcels of the study area and coordinates of points for georeferencing. The layout plan of the study area and attribute data were obtained from the Bauchi State Ministry of Land, Housing and Environment. Coordinates of the identifiable points (Table 1) in UTM were obtained using Garmin 72 GPS receiver. The software used are ArcGIS 9.3, CorelDraw X3 and Microsoft Visual Basic 6.

Table 1. GPS Coordinates of Some Prominent Points in UTM.

S/N	POINT DESCRIPTION	EASTING (m)	NORTHING (m)
1	Isawa Road Junction along Bauchi-Kari Road	592732	1143915
2	Dambam Road Junction along Bauchi-Kari Road	593131	1144059
3	Danruwata Road Junction along Bauchi-Kari Road	593911	1144100
4	Yankari Road Junction along Danruwata Road	594122	1143457
5	Danruwata Road Junction along Sultan Abubakar Road	594561	1142868
6	Bakari Dukku Road Junction along Sultan Abubakar Road	594235	1142650
7	Waziri Kwara Road Junction along Sultan Abubakar Road	593470	1142403
8	Turaki Abdu Road Junction along Sultan Abubakar Road	592966	1142310
9	Dangikka Road Junction along Yankari Road	592980	1142830
10	Yana Road Junction along Dangikka Road	592882	1143284

Methods

The research design employed is described in Figure 2. The hard copy layout plan of the study area was converted into digital format through the following stages: the plan was scanned using A0 scanner (Colartract Smartif CX 40) and CorelDraw X3 software and then imported into ArcMap software and geo-referenced using the UTM coordinates obtained from the field. Two features (parcels and roads) within the study area were digitized (traced) from the plan using on-screen method, and each of the two groups of features was traced as independent thematic layer.

A relational database was created by integrating different entities and linking them to their attributes. This was achieved in two stages, namely; creation/populating of tables, and joining the tables. A multimedia database that hosts primary media files (photographs) in 'JPEG' format, was also created by colligating all the developed parcels within the study area to their photographs through hot linking. The design/creation of the database was achieved in three stages, namely: conceptual design or data modeling (Patricia and George, 2006) that was used to identify all entities and attributes stored in the database (see Figure 3). Others are the logical design which transform the Figure 3 into Tables 2 to 6 and physical design which was carried out in the ArcGIS 9.3 environment.

The visual interface is a program that allows the user to have access to the database. It was purposely developed to ease data entry, ease editing as well as updating of information. This was achieved essentially in eight stages, namely; creation of user interface comprising all the fields of the database, adding codes to the user interface, creating a login form, adding codes to the login form, creation user interface table for editing, adding codes to the user interface table, creating a login form for editing, and adding codes to the login form for editing (Figure 4).

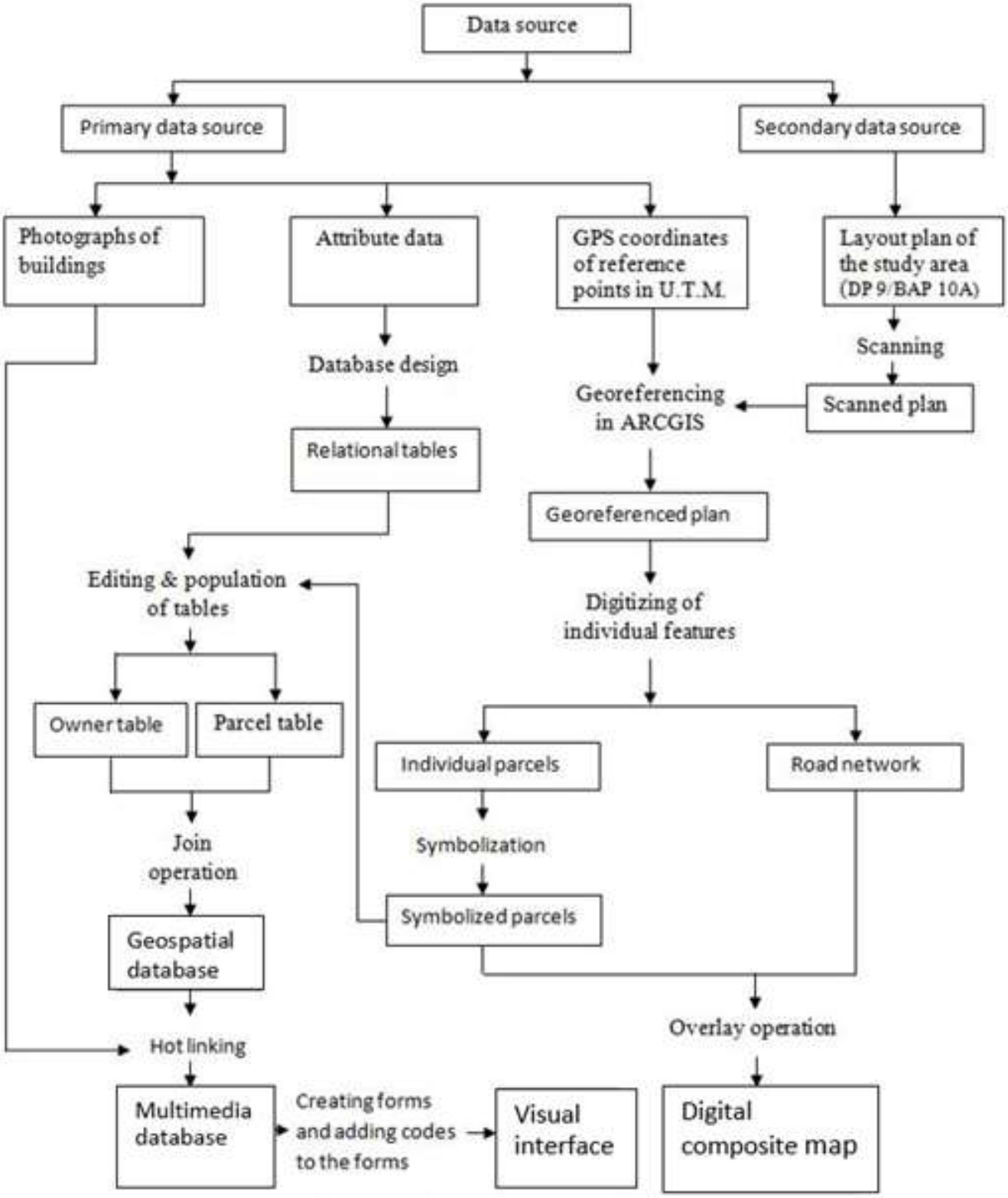

Figure 2: Flowchart of Methodology

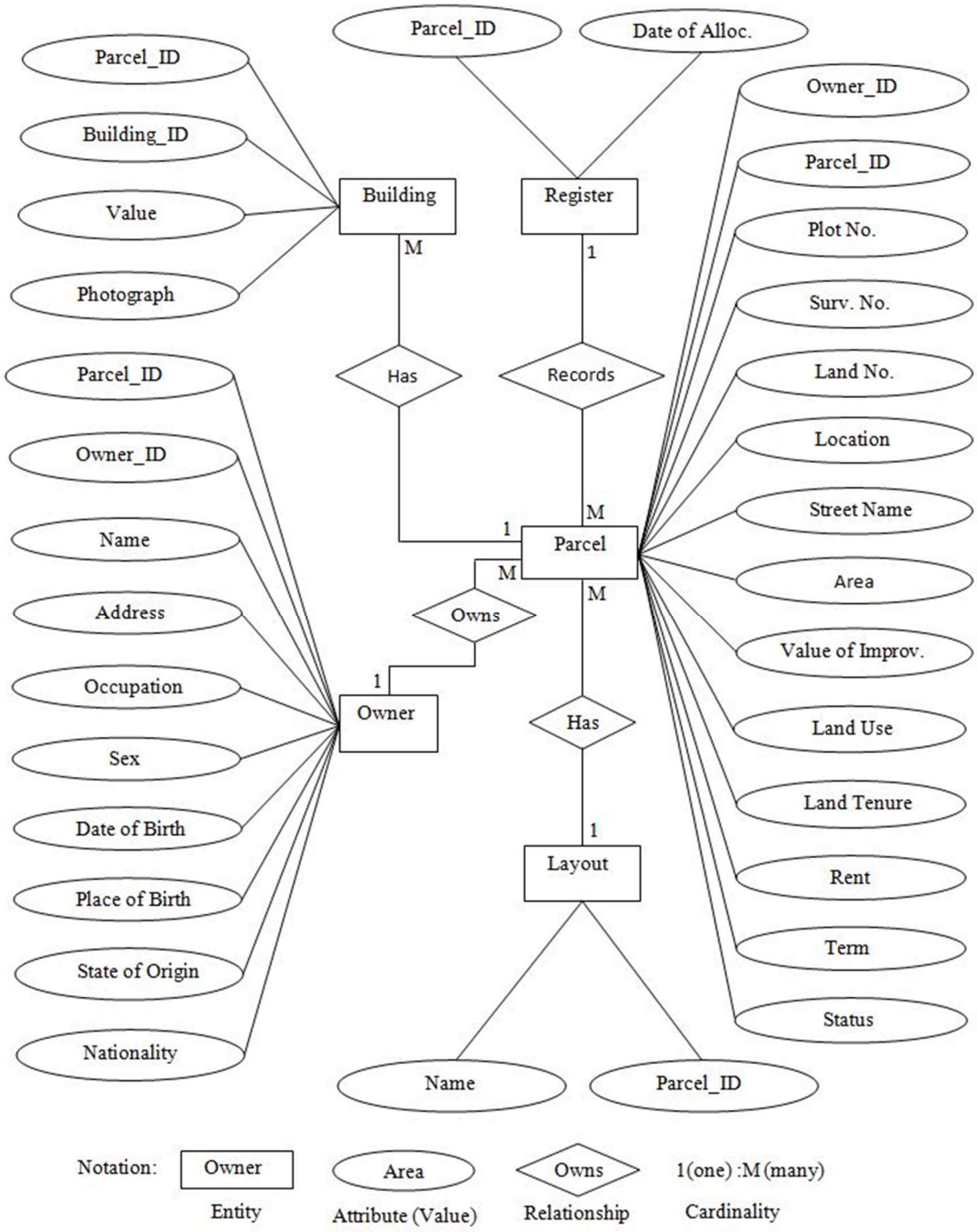

Figure 3: A formal representation of basic entities in a simple Entity Relation Diagram (ERD)

Table-2. Owner Table.

SK	PK								
PARCEL ID	OWNER ID	NAME	ADDRESS	OCCUPATION	SEX	DATE OF BIRTH	PLACE OF BIRTH	STATE OF ORIGIN	NATIONALITY

Table-3. Parcel Table.

SK	PK												
PERCEL ID	OWNER ID	PLOT NO.	SURV. NO.	LAND NO.	LOCATION	STREET NAME	AREA (Sqm)	VALUE OF IMPROV.	LAND USE	LAND TENURE	RENT (NAIRA)	TERM (YEARS)	STATUS

Table-4. Building Table.

SK/FK	PK		
PARCEL ID	BUILDING ID	VALUE	PHOTOGRAPH

Table-5. Register.

SK/FK	
PARCEL ID	DATE OF ALLOCATION

Table-6. Layout Table.

SK/FK	
PERCEL ID	NAME

PK=Primary Key, SK=Secondary Key and FK=Foreign Key

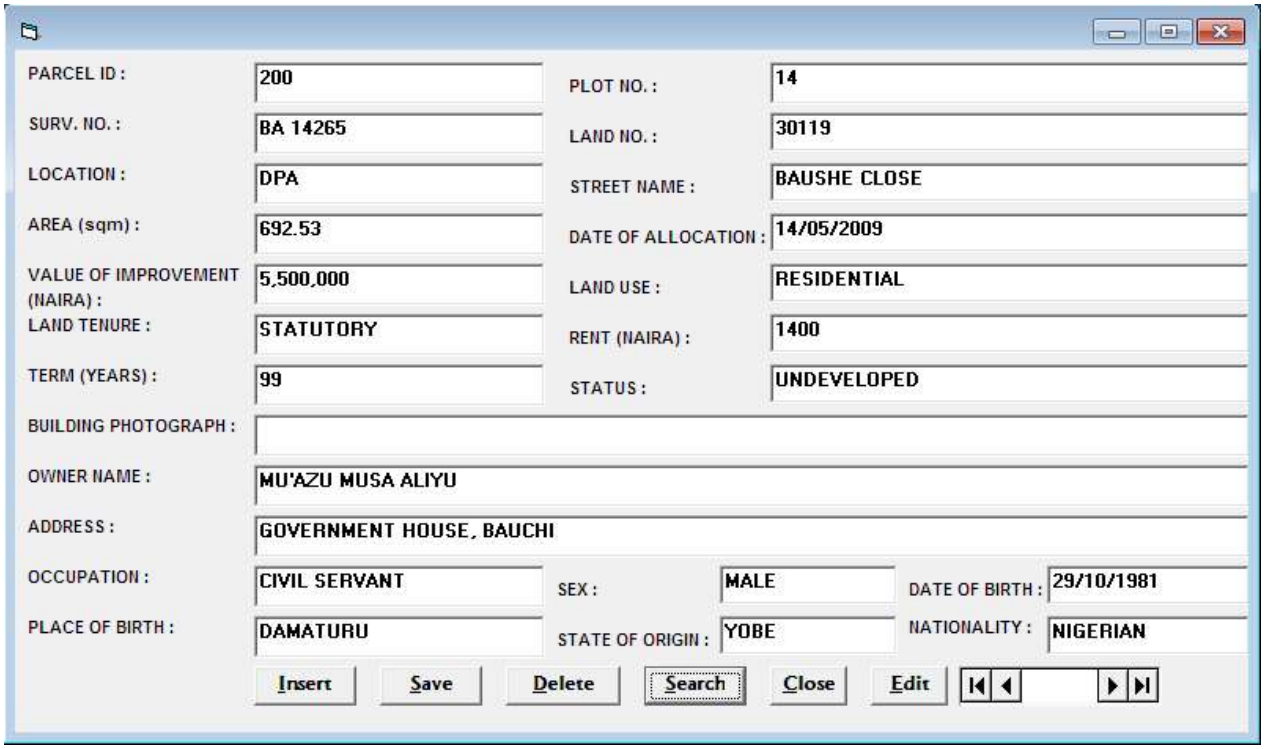

Figure 4: The User Interface

RESULTS AND DISCUSSIONS

Figure 5 shows a digital form of hard copy layout plan of the study area. Seven land uses were identified and differently symbolized. Residential land use is the largest in term of area coverage while religion is the least. Others are: commercial, educational, estates and access roads respectively.

Figure 5:Digital Layout Plan of the Study Area.

Figure 6 shows a result of query by attribute from the database created. The factor was the ability to query the database from the attribute table for information search.

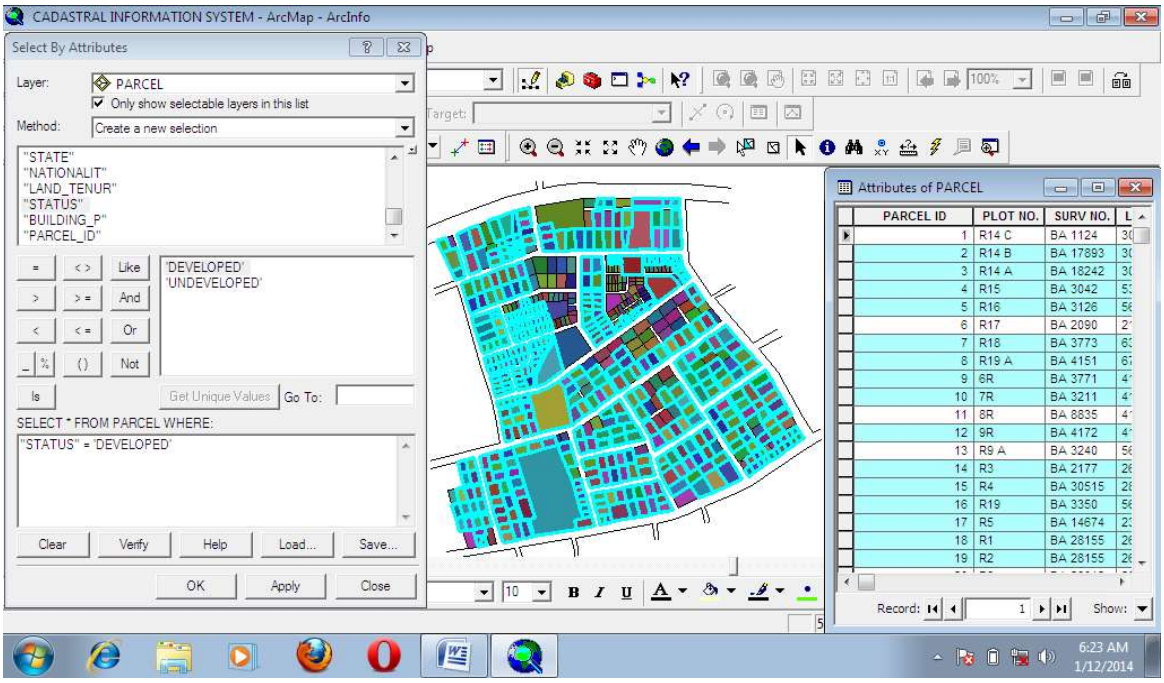

Figure 6: Query result showing developed parcels and their records.

Figure 7 indicates photograph of the existing structure correctly linked to the corresponding parcel in a layout. This shows the power of hot linking for real visualization of development as they actually existed.

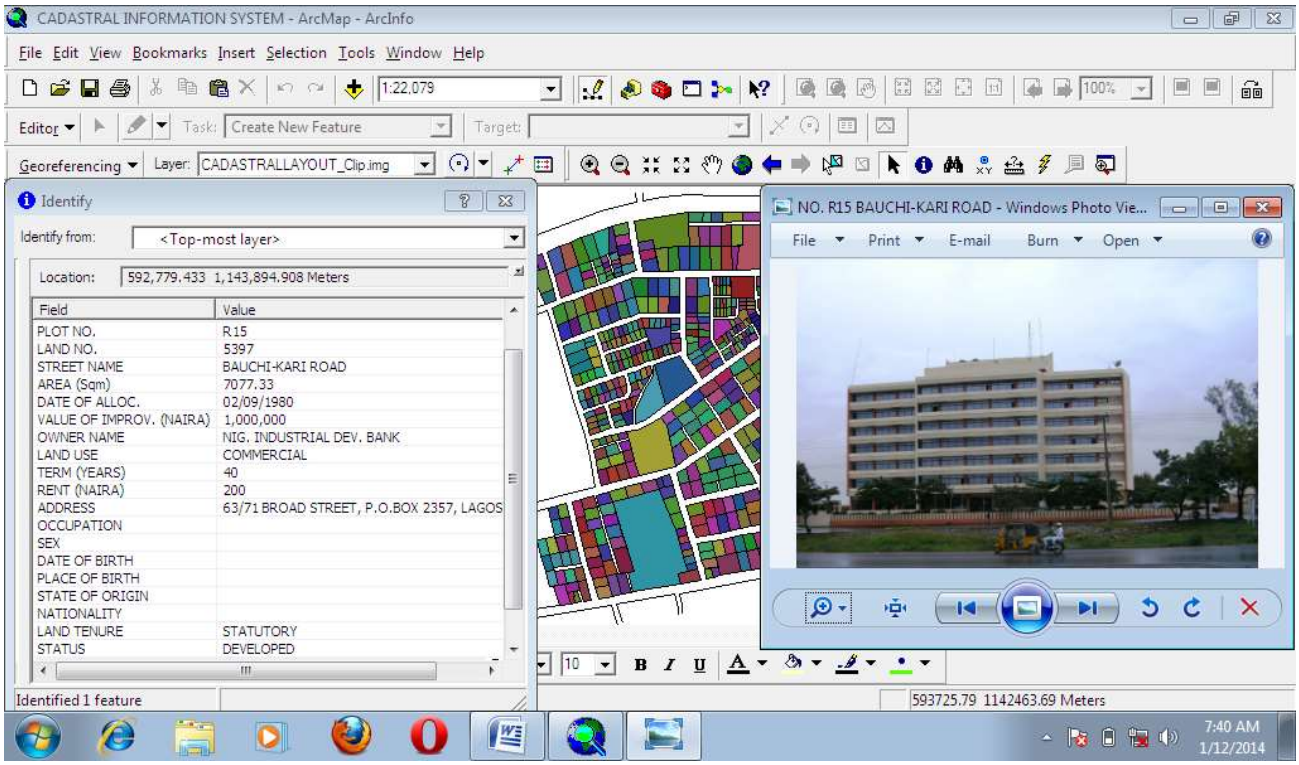

Figure-7. Query result showing details and photograph of Plot No. R-15 (N.I.D.B.).

The records attribute table that (Figure 8) are accessible through a common identifier 'PARCEL ID'. Information related to a particular parcel or owner of the parcel can be accessed from editing using the user interface, by clicking 'Search' button, writing the 'PARCEL ID' of the parcel (on the dialog box that appeared) and clicking 'OK'. The information related to that parcel will be displayed on the user form. This information is for both the parcel and the owner of the parcel.

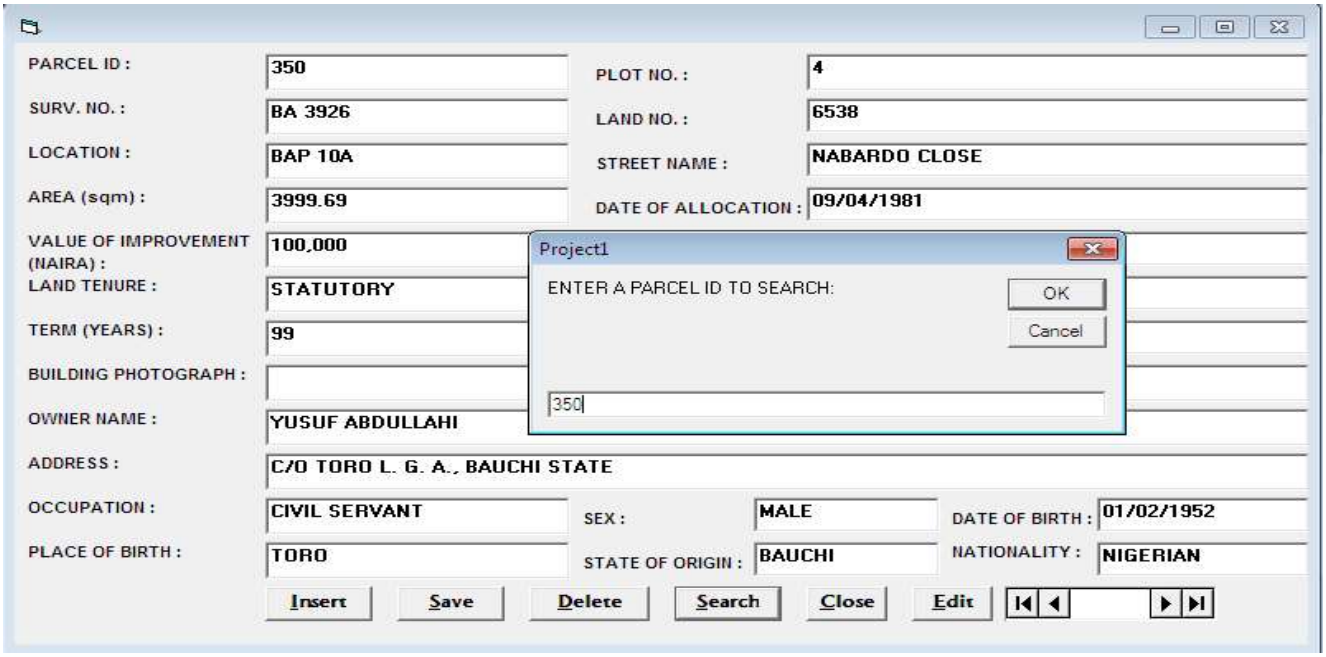

Figure 8: The User Interface showing Parcel and Owner Information.

A login form (Figure 9) that comprises user name and password provided as security to allow access to the database. The database can only be accessed when correct user name and password are provided and OK clicked otherwise cancel.

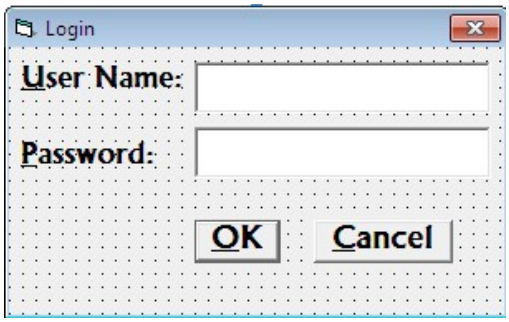

Figure 9: The Login Form

Information table for both the parcel and the owner of the parcel in the database are shown in figure 10. The user interface table, which is a table that allows the user to add, deletes or updates existing records. The user can also search the bulk of data by scrolling up and down and side by side to see the entire table for information retrieval. Information related to a particular parcel or owner of the parcel can be accessed for editing, from the user interface table, by clicking 'Search' button, writing the 'PARCEL ID' of the parcel (on the dialog box that appeared) and clicking 'OK'. The information related to that parcel will be displayed on the user interface table.

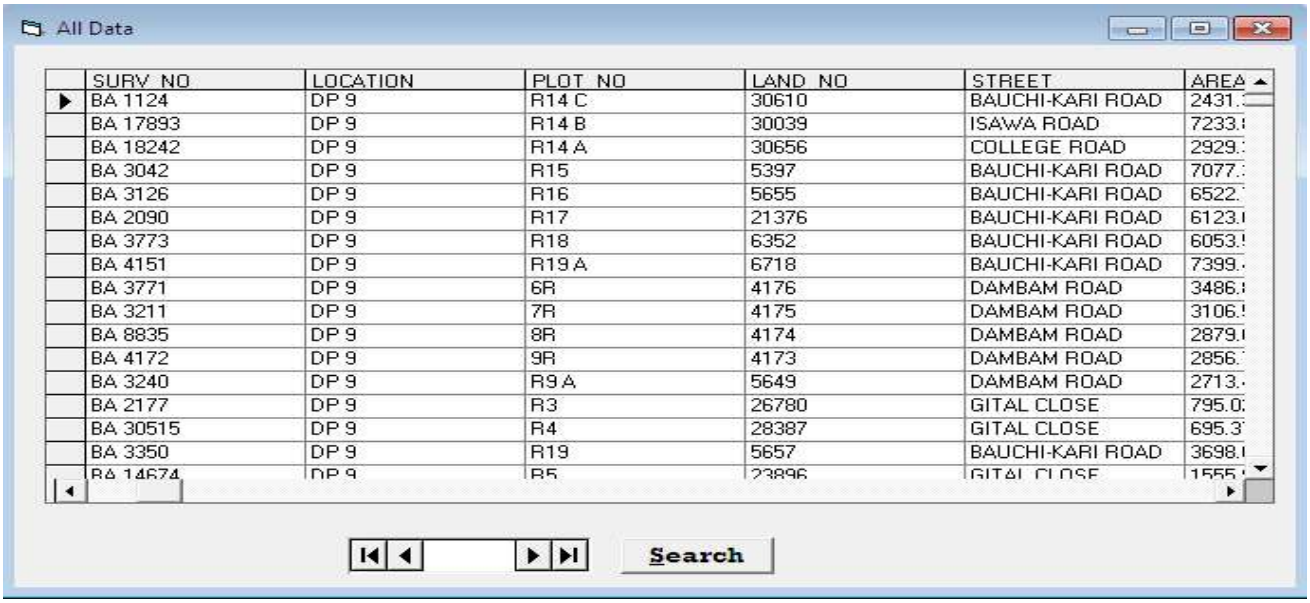

Figure 10: User Interface Table

Figure 11 shows the login form in order that the editing table (User Table) can only be accessed, after pressing the edit button and a correct password is provided. This restriction to editing task was to safe guard the database for unauthorized editing.

Figure 12 shows a composite map of the study. It can be seen that the 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 bearing and distance between any point or feature on the map and another point or feature outside the map (if the UTM coordinates of that point or feature are known). From the map, mono-thematic maps can be produced at any required scale very quickly and cheaply for different applications. The applications include provision of refuse collection centers, proper placement of infrastructures and utilities, etc. Therefore, the map will serve as a tool for proper and effective environmental management and infrastructural development within the area.

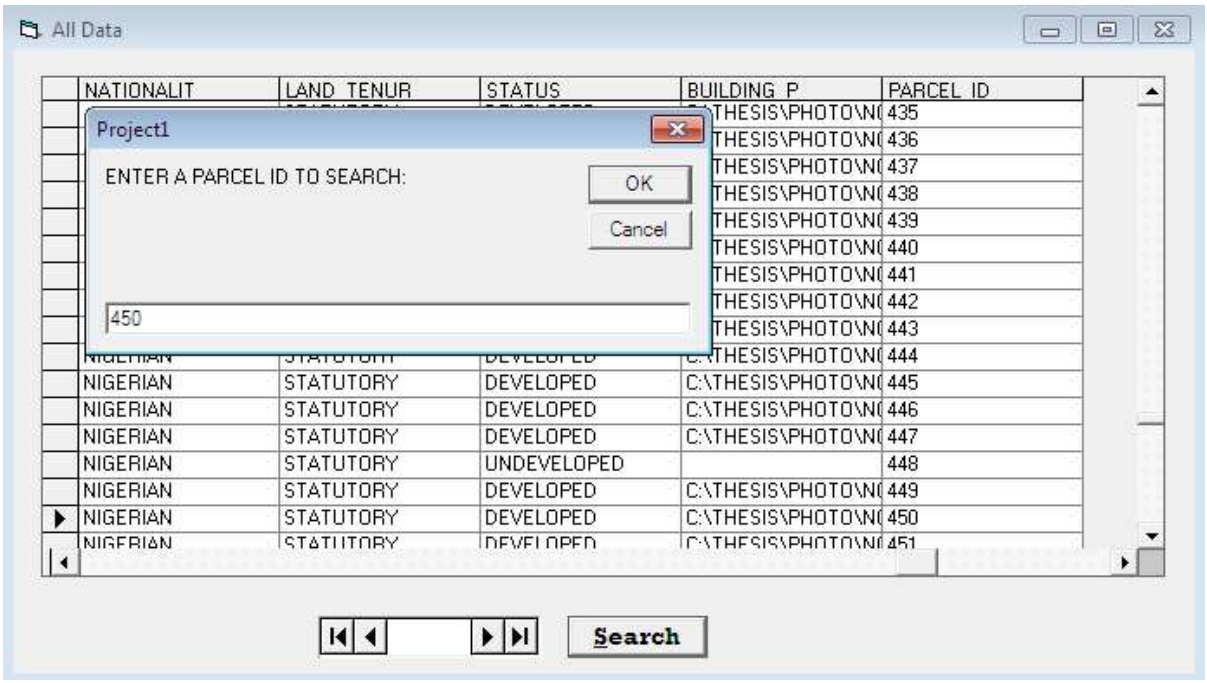

Figure 11: The User Interface Table for Editing showing Parcel and Owner Information.

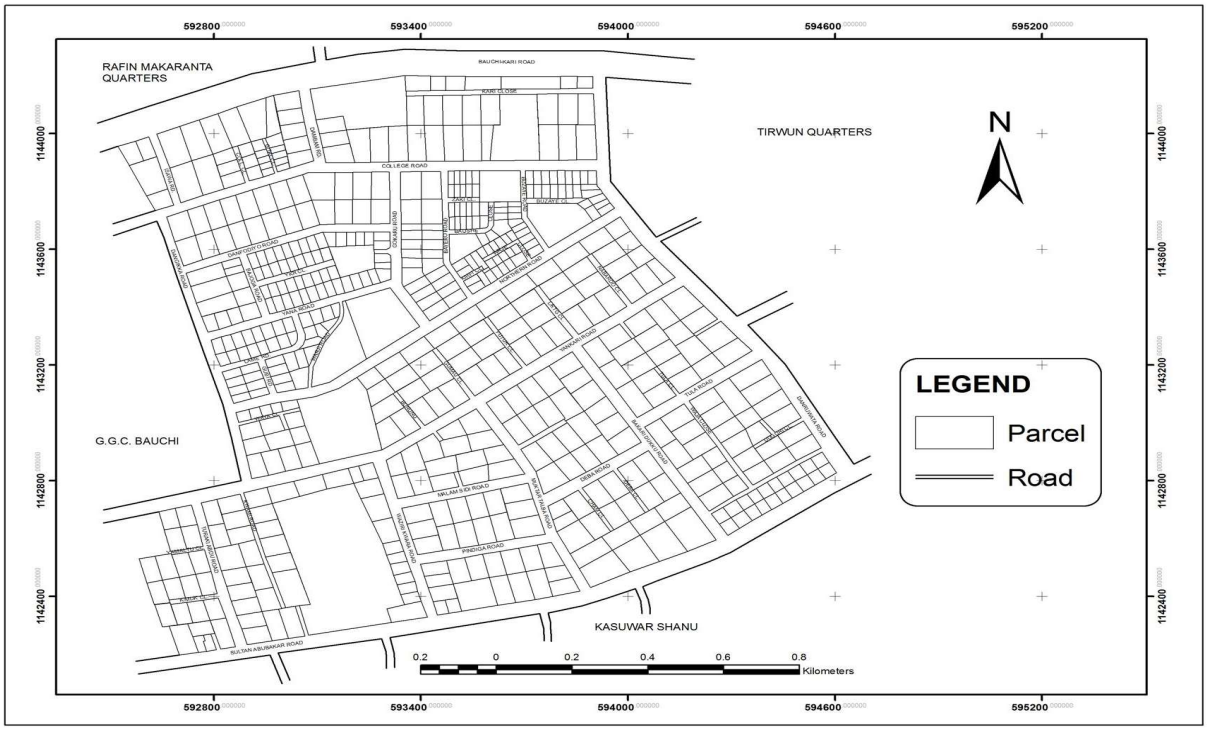

Figure 12: Digital Composite Map of the Study Area.

CONCLUSION AND RECOMMENDATIONS

The study shows that the use of GIS and RS in synergy provides a sufficient tool for managing land and its resources because of their easy, simple and automated operations as well as their ability to capture large amount of data within a short period of time. Hardcopy materials can also be digitized and stored in digital form, making easy access, editing and printing at will. It is possible to change all file cabinet hardcopy materials into digital database.

Spatial database shows both ownership, location, size of plot, the status of the plot, use, as well as the value of the structure erected on site etc. When this information is properly

managed and supported with the right decision, implementation would go a long way in addressing the problems associated with landed properties.

This research uncovers the non-adoption and implementation of GIS techniques in collecting and managing spatial information by Land and Survey ministries, agencies and similar organizations. Therefore, it is recommended that the bodies concerned should adopt the current trend in the use of geospatial technology in order to rescue the large amount of valuable hard copy maps, plans and other related data that are slowly decaying in offices. This study recommends such institutions to apply this database in a network to allow concerned office holders have access to it at will.

Acknowledgements

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