MAPPING AND CREATION OF DATABASE FOR THE NIGERIAN ARMY POST SERVICE HOUSING SCHEME, BAUCHI

BY

KASHIMGA, JOHNSON OSAH
PGD/SV/09/0305

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF SURVEYING AND GEOINFORMATICS,
MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY,YOLA,
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF POST GRADUATE DIPLOMA IN THE DEPARTMENT OF SURVEYING AND GEOINFORMATICS, SCHOOL OF ENVIRONMENTAL SCIENCE

Supervisor: Dr. T.O. Idowu

AUGUST, 2012

DECLARATION

I hereby declare that this Project was carried out by me and it is a record of my own research work. It has not been presented before in any previous applications for a higher degree. All references cited have been duly acknowledged.

Sign…….. ……

Kashimga, Johnson Osah Date.

DEDICATION

This project is dedicated to all my fellow Nigerians, who believe in the unity of this great country and are ready to fight for its peace and unity.

APPROVAL PAGE

This Project entitled "Mapping and creation of database for the Nigerian Army Post Service Housing Scheme, Bauchi", meets the regulations governing the award of Post Graduate Diploma in Surveying and Geoinformatics of the Modibbo Adama University of Technology, Yola, and is approved for its contribution to knowledge and literacy presentation.

……. .	……
Supervisor	Date
……	……..
Internal Examiner	Date
……..	……..
External Examiner	Date
…….	…….
Head of the Department	Date
…….	……...
Dean, Post-graduate School	Date

ACKNOWLEDGEMENT

I am quite grateful to God Almighty for giving me the opportunity to go through this course successfully. I am also grateful to my Supervisor, Dr. Timothy Idowu, for the thorough job he did in guiding and directing me in the course of this Project..My sincere appreciations also goes to Surv. Isah Suleiman, Mal Pindiga Makama and Mr Ibochi Andrew Abah for their contributions towards the successful completion of this Project. Finally, I thank all the lecturers in the Department of Surveying and Geoinformatics, Modibbo Adama University of Technology , Yola for trying their best to give me a sound knowledge in surveying and Geoinformatics. May Almighty God reward all of you now and for ever more.

ABSTRACT

This Project is aimed at mapping and creation of database for the Nigerian Army Post Service Housing Scheme, Bauchi. In order to achieve this aim, certain objectives were defined and these included mapping the layout plan, converting the hardcopy layout plan to softcopy and designing and creating a database for the Scheme. These were achieved by scanning and importing the layout plan of the site into AutoCAD environment. The scanned plan was georeferenced using ground coordinates obtained through field observation. Several layers were created and used for digitizing the respective features. The respective layers were taken into G.I.S software (ArcView 2a) and a database was created for the building layer using the attribute information collected through questionnaire and interviews. The database was tested and found to respond to queries such as query by location, query by attribute, query by hotlink etc. The result was the obtaining of the composite digital map of the site. The maps were printed to form hardcopy maps of the site. It is recommended that all the sites under the scheme in Nigeria should be mapped and a comprehensive database be designed and created as well as networking the entire scheme sites for better management.

TABLE OF CONTENT

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The Nigerian Army Housing Scheme, otherwise known as the Nigerian Army Post Service Housing Scheme was established by the Authority of Army Council Memorandum No. Act (95) of March, 1996. The objective of the scheme is the procurement, allotment, sale of land and houses and estates for serving and retiring/discharging service personnel and other interested persons.

The scheme has sites in many state capitals in Nigeria including the Federal Capital Territory, Abuja. So far, many military personnel and civilians alike have benefited from the Scheme. Despite the lofty objectives for which the scheme was established, it soon began to face a number of problems.

1.2 STATEMENT OF THE PROBLEM

The Nigerian Army Post Service Housing Scheme Bauchi, like other sites of the Scheme, is faced with a number of problems which have made many of the contributors to the Scheme to withdraw from it. Prominent among these problems are:

a. Incomplete mapping of the site.
b. Lack of adequate information that can be assessed by the contributors or any interested persons.
c. Lack of complete, up-to-date and reliable cadastral record.
d. Lack of a database for each of the layout of the scheme.
e. Land use violations on the side of the beneficiaries of either the plots or the houses.

1.3 AIM AND OBJECTIVES OF THE STUDY

The aim of this project is to complete the mapping of the Nigerian Army Post Service Housing Scheme (NAPSHS), layout Bauchi and to create a spatial database .This will be achieved through the following objectives:

a. Mapping of the layout.
b. Converting of the existing hardcopy layout map to softcopy.
c. Designing and creating a spatial database for the scheme.

1.4 SCOPE OF THE PROJECT

This project deals with the process of collecting spatial data using Total Station Instrument for the NAPSHS in Bauchi.. It also treats the method of converting the hardcopy layout plan of the area using on-screen digitizing in an AutoCAD environment.

This report also explained the processes of designing and creating a spatial database of the area using Geographic Information System (GIS) software (ArcView 3.2a). The entire process is restricted only to the NAPSHS, Bauchi.

1.5 LOCATION OF THE STUDY AREA

The study Area is situated at the Western side of Bauchi Town along Bauchi – Jos Road. The site is bounded from the North- West by Guru Village, from the North by Shadawanka Army Cantonment and from the South- East by Zaranda Hotel. The location of the study area can be seen in the following figures below: Figure 1: map of Nigeria with an arrow showing Bauchi State i.e. the state where the study area is located. Figure 2 : map of Bauchi State showing Bauchi Local Government Area in magenta color, which is the local government containing the study area and figure 3 : map of Bauchi L.G.A. showing the study area in red.

BAUCHI STATE OF NIGERIA

Fig. 1. Map of Nigeria with an arrow indicating Bauchi state

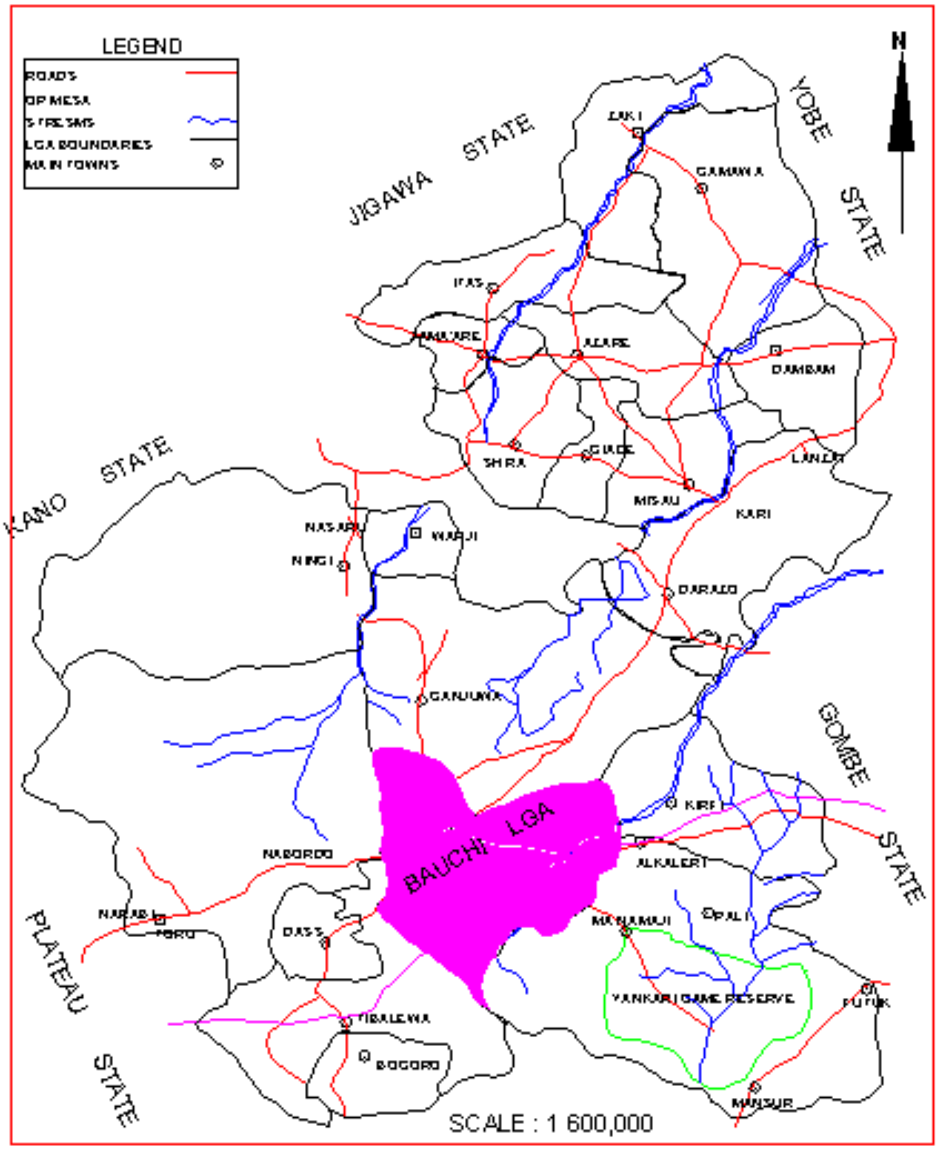


Fig.2 Map of Bauchi State Showing Bauchi LGA in Magenta color

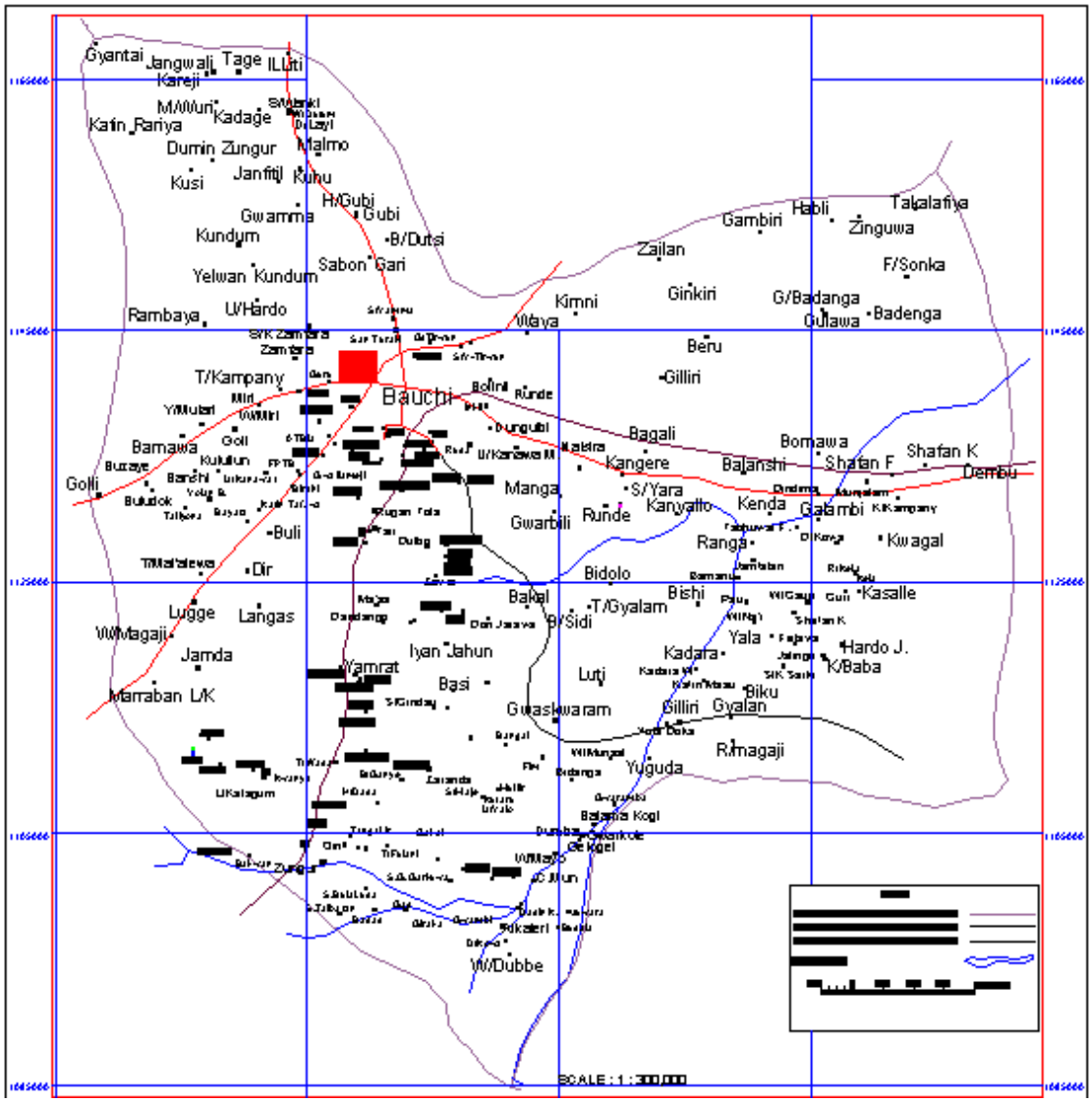


Fig. 3: Map of Bauchi Local Government Area Showing the project site in red

CHAPTER TWO: LITERATURE REVIEW

2:1 BASIC CONCEPT OF MAPPING AND DATABASE CREATION

2.1.1. **Mapping**

Mapping surveys are made to determine the locations of natural and cultural features on the earth surface, and to define the configuration (relief) of that surface. Once located, these features can be represented on maps. Natural features normally shown on maps include vegetation, rivers, lakes, oceans, etc. Cultural (artificial) features are the products of people and include roads, railways, buildings, bridges, canals, boundary lines, etc. The relief of the earth includes its hills, valleys, plains and other surface irregularities. Features shown on maps are depicted by using lines and symbols. Names and legends are added to identify the different objects shown (Carter, J. 1988).
Two different types of maps, planimetric and topographic, are prepared as a result of mapping surveys. The former depicts natural and cultural features in their plan (x-y) views only. Objects shown are called planimetric features, but in addition they show the configuration of the earth's surface. Both types of maps have many applications. They are used by engineers and planners to determine the most desirable and economical location of highways, railroads, canals, pipe lines, transmission lines, reservoirs and other facilities; by geologists to investigate mineral, oil, water and other resources; by foresters to locate access or haul roads, fire control routes and observation towers., etc. According to Wolf, P.R. et al (2000), maps are used extensively in Geographic Information System (GIS) applications. Conducting the surveys necessary data, are the mainstay of many surveying businesses. Relief is shown on maps by using various convention and procedures. For topographic maps, contours are most commonly used, and are preferred by surveyors and engineers. Digital Elevation Models (DEMs) and three –dimensional perspective models newer methods for depicting relief , made possible by computers, color, hachures, shading and tinting can also be used to show relief but these methods are not quantitative enough and thus are generally unsuitable for surveying and engineering works.

According to Zimmer, R. (1998), traditionally, maps were prepared using manual drafting methods. Now however, the majority of maps are produced using computers, Computer Aided Drafting (CAD) software and data collectors. Mapping surveys are conducted by one of two basic methods; aerial (photogrammetric) or ground (field) techniques, but often a combination of both is employed. Refined equipment and procedures available today have made photogrammetry very accurate and economical. Hence almost all mapping projects covering large area now employ this method. However, ground surveys are still commonly used in preparing large scale maps of smaller areas. Even when photogrammetry is utilized, ground surveys are necessary to establish control, and to field check mapped features for accuracy.

2.1.2 Spatial Database Creation

Many geomatics researchers have discussed the basic principles of designing spatial databases.

Nielsen (1994) provided five major steps for the pre-design phase of geographic databases:

1. Providing a comprehensive framework of the database.
2. Allowing the database to be viewed in its entirety so interaction and linkages between elements can be defined and evaluated.
3. Permitting identification of potential bottlenecks and problem areas so design alternatives can be considered.
4. Identifying the essential and correct data to be included in the database and filtering out the irrelevant data.
5. Defining update procedures so newer data can be incorporated in the future.

The National Center for Geographic Information and Analysis in the United States suggested that the design of the GIS database include the three major elements which are conceptual design, the logical design and the physical design.

2.1.2.1 Conceptual Design

Conceptual design of spatial databases involves determining the application requirements and specifying the end user of the database. This phase outlines the end-user goals. Conceptual design involves five major steps:

1. Specifying the use of spatial database.
2. Specifying the LOD.
3. Specifying the spatial elements of GIS databases.
4. Specifying the type of non-spatial elements to be exploited in the database, including labels, text and attributes.
5. Other considerations, including availability and source of spatial and non-spatial data, age of data and type of coordinate system; however, these considerations do not seem to be an issue given the advances in GIS data capture as well as software and hardware capabilities.

2.1. 2.2. Logical Design

The second stage of designing spatial database is identifying the type of database system and GIS products appropriate to the particular application. The coordinate system for databases is one important aspect to be considered in the logical design of spatial databases. Database tolerances specify the acceptable error-level associated with each spatial element.

2.1.2.3. Physical Design

The physical database design refers to the process of identifying the hardware and software characteristics for a particular application. In this stage, consideration of basic system components is important. These components include:

• file structure.
• data formats.
• memory.
• disk space.
• processing speed.
• graphic cards.

The disk space and memory requirements are no longer a major concern for GIS database designers; this is because of the recent developments in GIS software technology. The three major issues to be addressed, in particular with the Advanced Deployable Day Night Simulation (ADDNS) project, are:

• the load of the database, i.e., its ability to retrieve information in a timely fashion.
the volume of data estimates in each spatial element.
• the access speed requirements for managing large satellite imagery (rather than the processing time involved).

2.2. Database Concepts

Bédard [1999] has defined a spatial database as "any set of data describing the semantic and spatial properties of real-world phenomena, including temporal properties." With this concept in mind, such databases can be implemented in GIS with a database management system (DBMS. These databases can be used in spatial database engines (SDEs) and accessed through an application program interface (API). Spatial databases can use standard file structures with a GIS viewer to
visualize, edit and analyze spatial data.

2.2. 1.Database Types

In the past, databases were developed in the form of paper, flat-file databases. The relational Database model is one of the advanced database models that came into existence in the 1980's. The object-oriented database model appeared in the 1990's. These two major database models are as discussed below:

2.2.1.1 Relational Database Model

The relational database model, an extremely popular model, solves many of the problems encountered in other models, such as linking multiple records and assigning a unique identifier for each field. The relational database model is different from other database models, including the object-oriented model, because in this model all of the databases and their components are equal. Data can be stored in any number of separate databases and these databases are then connected by a key field. All of the databases can be used to hold different types of data. This type of database model makes it easy to search for and extract data from the databases.

2.2.1.2. Object-oriented Database Model

Object-oriented databases can store photos, sounds, videos and graphics. This a very advanced database model that can integrate multiple data formats. Shekar and Chawla [11] identified the base model of spatial databases as a model that focuses abstract spatial information into distinct, identifiable and relevant items, or entities, called objects. This distinction demonstrates the ability of the object-oriented database model to handle multiple data formats.

2.3. REVIEW OF RELATED LITERATURE

Land is a very important resource to mankind. Man obtains his food from land, he lives and builds his shelter on land, he works on the land and into the land he is committed whenever the ultimate call comes for him to go back to his divine creator. It therefore becomes necessary for man to highly value such a great resource. This is particularly necessary since man has come to realize that land is exhaustible and destructible. When left uncared for, it is squandered and wasted and seriously depreciated in value. It is for this reason that men have began to thoughtfully and carefully offer good stewardship of the land, together with the more intensive use and management of its resources. Furthermore, this has led to a re-evaluation both of the need for information about land and of the strategies and programmes that may provide it. Increasingly, it has been recognized that policy makers, planners and administrators and individual citizens all make significant use of spatial data on a day-to-day bases (Dale et al, 1990).

Connolly, (2005), noted that, “In both the private and public sectors, land information is a prime requisite for making decisions related to land investment, development and management. Information reduces uncertainty by helping to identify and analyze problems. Strategies to

overcome them may then be prepared and implemented. The value of the information and the effectiveness of the decision-making process are directly related to the quality of the information and the manner in which it is made available. The responsibility for providing the information is being taken on by complex, diverse groups of individuals and institutions, which make up what may be described as the land information management community. It is a community which includes surveyors, geographers, cartographers, foresters, valuers and others who traditionally played a leading role in the land information field, as well as systems engineers, computer scientists, record managers, land use planners, lawyers and resource specialists. It is a community which is increasingly interested not only in the technology for gathering and processing information and in the design and development of land information systems, but also in the policies and strategies for their effective use.

In order to adequately provide the required information on land to interested parties, there must be a good land information system. A land information system is a "tool for legal, administrative and economic decision making, and an aid for planning and development which consists of a database containing spatially referenced land related data for a defined area and of procedures and techniques for the systematic collection, updating, processing and distribution of that data.(Mclaughlin, et al 1987).

Elements of land registration and land reform are intrinsic to new town development, urban planning, communication corridors and agricultural rural development. The use of Information Technology-based data collation solutions in project in the UK and worldwide have illustrated the importance of information and retrieval to improve the decision making capability.(Poortner, et al 1984).

GIS, particularly land resources and development related projects that have a land reform registration requirement, are becoming daily tools for planners in Europe, and North America. As the pressures for land increase in developing countries, and traditional tenure systems are eroded, abandoned or undermined, the need for a formal system becomes insistent. Many land, survey/cadastral and local government/housing agencies in developing countries have recognized this and are gradually embarking on the lengthy process of judicial, tenure and socio-economic reforms which create the appropriate formal environment.(Atkinson, et al 1989).

John and Simon (1997); highlighted that, "The multidisciplinary nature of GIS is a significant advantage in developing solutions to the real issues facing many planners in the area of land

reform and registration. Frequently, especially in the UK and Europe, much data is already available, although it is often in need of extensive updating and validation before it can be processed or analyzed. However, traditionally these data are held in what is termed “multi-purpose cadastre”, this gradually related specifically to records based on a proprietary land parcel and might include the followings:

(a) Land parcel definition.
(b) Land tenure.
(c) Land use.
(d) Building and infrastructure.
(e) Population and census data.
(f) Administrative information.

GIS, on the other hand, may contain additional and useful information. The input of physical information such as soils, hydrogeology, rainfall and human or socio-economic information such as retable value, communication and utilities results in a system that offers planners and decision makers the ability to invent, monitor and plan more efficiently and cost-effectively. Such a holistic approach supports the management of both data and human and physical resource at all administrative levels".

The implementation of GIS results in decreased land disputes, increased revenue generation through traditional avenues such as tax and rates, but also in new areas such as up-to-date map production and publication, improved responsiveness to public enquiry and cost savings in comparison to existing procedures.

Indeed, the importance of cadastral records and GIS, include:

(a) Access to land and use of land are fundamental to life as we know it i.e. food, shelter, recreation, and so forth.
(b) Land parcel is the basic unit for access and control of land, land use decisions.
(c) Current, reliable land information necessary for many public programs for example:
    i. Land planning.
    ii. Infrastructural development and maintenance.
    iii. Environmental protection and resources management.
    iv. Social service programs.
(d) Basis for land market, development and other economic activities.

Legal cadastre – parcel based description of interest or rights in real property, typically supported by titles or deeds and registration.

Functions of legal cadastre are to:

(i) define properly rights (often in conjunction with formal and case law)

(ii) describe the extent (spatial) of property rights

(iii) support land transfer

(iv) provide evidence of ownership (e.g. using land as collateral)

(v) Program administration (e.g. enforcement of laws, targeting of incentives.

(vi) Public land administration.

Fiscal cadastre – property valuation and land taxation: The functions of fiscal cadastre are:

(i) Information base for property taxation.

(ii) Distribution of funds from public programs.

(iii) Monitoring and supporting land markets.

(iv) Information for growth management and land use planning.

The need to have up-to-date information on land parcels brought about the registration of titles normally called parcel records. A register of titles normally contains two elements; a record of the attributes associated with each parcel and a description of the land to which they refer.

(a) **Parcel Attributes:**

The attributes that may be recorded in the registers include the following:

(i) The name of the owner.

(ii) The nature of the tenure (such as freehold or leasehold)

(iii) The price paid for the land on transfer.

(iv) Any restriction on the use of the parcel (such as restrictive covenants or chargers where the land is subject to mortgage.

(v) Any exclusion of rights to mineral below the soil.

(vii) Any caveats or cautions which may require a third party to be informed if any dealings in the land are proposed.

(b) **Parcel Descriptions:**

The function of a cadastral plan is first and foremost to identify the parcel of land which has been transferred to in the written parts of the registers. This may of course, be achieved by a simple parcel reference number relating to the house, street and town in which the property is located,

e.g. 23 Murtala Mohammed Way, Yola, would identify a parcel whose limits maybe determined by inspection on the ground. Frequently, however, this is insufficient and the parcel description should provide additional information such as the shape and size of the property and at least the approximate location of its boundaries. It should also show the relative location of the property by providing some details about adjoining parcels. The description should enable the boundaries to be relocated in cases of dispute or uncertainty, enable sub-division to take place within or up to the limit of the existing plot and permit areas to be calculated for the purposes of planning or assessment. Parcel description may be:

1. Verbal description e.g. the land between Modibbo Adama University of Technology Yola and Boni Haruna Hostel:

(a) If by coordinates i.e. eastings and northings, or latitude and longitude.

(b) By bearing and distance between corner movements.

2. Graphical Plans: Graphical methods are the most effective and easy to comprehend. They communicate quickly and cheaply most of the relevant information. A cadastral plan should be at a scale that is large enough for every separate parcel to appear as a recognizable unit. However, the larger, the more expensive in general it becomes,(Watson, 2002).

Geographical Information System (GIS) is a collection of geo-referenced data sets, presented in such a manner as to illustrate their mutual relationships. A standard topographic map can be said to be a Geographical Information System (GIS) that are subject of so many conferences, journals and marketing drives. The paper map presents a carefully selected and generalized set of data at fixed scale and in fixed format at a fixed time. A computer hosted Geographical Information System (GIS) allows the interrelationships of numerous very large data sets at such a speed and combination that is never possible with simple paper maps (manual GIS).

In the manual Geographical Information System (GIS) therefore, the space occupied by stored data and information is quite large compared to automated GIS. The labour force is high at lower cadre and decreases upwards, more time is needed and there may be duplication in data acquisition and management. The reverse is the case in computer-housed GIS,(Riccardo ,et al 2001).

Another ‘buzzword’ is Synergy, which is the concept of a whole being greater than the sum of the parts. The combination of the many different types of map and images may reveal

relationships and trends that were never apparent when examining any of the data sets in isolation.

There is thus nothing fundamentally new about the concept of Geographical Information System (GIS); it is just the scale and speed of data handling which has changed. The application now, is unlimited as long as enough data and instruction is provided to the computer,(Idowu, 2010).

2.3 JUSTIFICATION FOR THE STUDY

Information about land is always very important and crucial for planning and developmental purposes. The NAPSHS, is certainly not different in the quest for good and reliable information. In order to have this reliable information, it therefore became necessary to design and creates a comprehensive and automated spatial database for an effective land administration for serving/retired military personnel. There is no doubt that if a spatial data of the area is authentically developed, it will be used as a tool for developing the area and even serve as a model for controlling future developmental plans for the entire military in their quest to provide affordable houses to its personnel.

CHAPTER THREE: METHODOLOGY

3.1 GENERAL STATEMENT

In creating a comprehensive database for the Nigerian Army Post Service Housing Scheme, certain procedures and methods have been carried out. These procedures can be called methodology which makes up this section of the project. In achieving the stated goals, the certain processes were adopted:

3.2 DATA ACQUISITION

3.2.1 HARDWARE USED

The instruments that were used for data capture include the following:

(a) Total station Instrument

(b) Scanner (AO)

(c) hp laptop PC

(d) 50m tape

(f) Digital camera (Gx 200)

(g) Desk jet printer P Jet 9600)

(h) Field note book

3.2.2 SOFTWARE USED

The software used for data processing include the followings:

(a) Arcview GIS 3.2a

(b) Microsoft Word 2007

(c) AutoCAD Land development.

3.2.3 DATA TYPES

The data types captured include the followings:

The Primary Data Source: These are the data that were captured in the field through field survey. In this case, the coordinates of the existing structures were captured using a Total Station Instrument.

The Secondary Data Source: The secondary data obtained in the form of paper maps were from the following sources:

(i) Digital administrative map of Bauchi State.

(ii) Layout plan of the Nigerian Army Post Service Housing Scheme Bauchi collected from the Directorate of the NA Post Service Housing Scheme

(iii) Map of Nigeria sourced from Encarta 2010.

(iv) Parcels attribute information collected through questionnaire, interview and physical inspection.

3.2.4 RECONNAISSANCE

This is the preliminary inspection and planning of the site work using available information where necessary. In any survey work, it is always necessary to carry out reconnaissance before the actual field work. Reconnaissance before any survey work commences, is very important as it is aimed at getting familiar with the nature of the job and situation on the site.

The reconnaissance for this project was conducted on two phases. These are the office and field reconnaissance. The specific factors to be considered include the nature of the terrain, inter-visibility between stations and the method to be adopted as well as the general information available about the task at hand.

a. Office reconnaissance: The office reconnaissance comprises of the office planning aspect of project, the collection of necessary information, organizing the field party, collection and testing of the instrument.

b. Field reconnaissance: This involves going to the field to examine the area before the actual commencement of field observations in order to determine how the project can be executed. The sketch of the reconnaissance diagram is as shown below:

3.2.5 IN- SITU CHECK

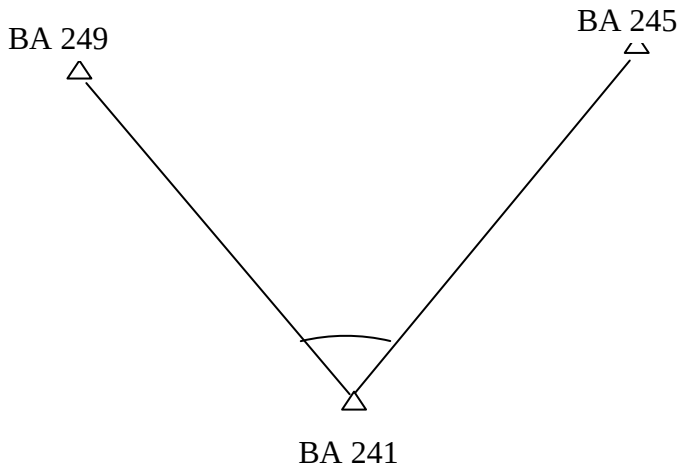


Fig. 5: Sketch showing the Controls used for In- Situ Check

The IN- SITU check was carried out using the above controls. Angle Φ as shown in the figure above was measured using a Total Station Instrument and found to be 66°16'46.88". Distances between BA 241 – BA 249 and BA 241 – BA 245 were measured and found to be 273.886m and 206.873m respectively. The computed distances between BA 241 – BA 249 and BA 241 – BA 245 were 273.936m and 206.943m respectively. Thus the angular difference between the computed and observed was -00° 00' 20" and the linear differences between BA 241 – BA 249 and BA 241 – BA245 were 0.05m and 0.07m respectively. The errors in distance and bearing are within the acceptable limits.

The above result shows that the coordinates are In-situ, because the condition for in-situ is that the angular difference should not exceed 30" while the linear differences should not exceed 0.30m.

3.2.5.1 Coordinates Used for the In –Situ Check

Table 3.2.5.1.1; List of coordinates used for In-situ check

CONTROL	COORDINATES	
	EASTINGS (M)	NORTHINGS (M)
BA 249	587152.173	1140295.640
BA 241	587307.850	1140070.239
BA 245	587416.416	1140246.417

Observed Distance:

$d(BA_{241} - BA_{249}) = 273.886m$ (1)
$d(BA_{241} - BA_{245}) = 206.873m$ (2)

Observed Bearings:
$\alpha(_{BA241} - \alpha_{BA249}) = 325^0\ 22'\ 11.59''$ (3)
$\alpha(_{BA241} - \alpha_{BA245}) = 31^0\ 38'\ 18.29''$ (4)

Table **3.2.5.1.2** Showing Existing and observed distance and their variances

Line	Existing distance	Observed distance	variance
$BA_{241} - BA_{249}$	273.936	273.886	0.05
$BA_{241} - BA_{245}$	206.943	206.878	0.07

STANDARD Error (S.E) $= \sqrt{(-0.05)^2 + (0.07)^2}$ (5)
$\sqrt{0.0074}$
± 0.086

The Adjusted Observed Distances:

Table **3.2.5.1.3**Shows the adjust ted distance

Line	Observation – Corrections	Adjusted Distance
$BA_{241} - BA_{249}$	273.886 – 0.086m	273.800m
$BA_{241} - BA_{245}$	206.943 – 0.086m	206.857m

Table **3.2.5.1.4**: Shows Existing and Observed Bearing and their variances :

Line	Existing Bearing	Observed bearing	Variance
$BA_{241} - BA_{249}$	325 22 06.41	325 22 11.59	-0^0 0^0 5.18"
$BA_{241} - BA_{245}$	31 38 33.29	31 38 18.29	0^0 0^0 15"

Standard Error (S.E) = $\sqrt{(-05.18)^2 + (0.15)^2}$

$= \sqrt{0.000019432}$

$= 0.004408119$

$\pm$ 0^0 0^0 15.87"

Table **3.2.5.1.5**: Shows observed and adjusted bearings:

Line	Observation	Corrections	Adjusted Bearings
$BA_{241} - BA_{249}$	325^0 22' 11.59"	$+ 0^0$ 0^0 15.87"	325 22 27.4"
$BA_{241} - BA_{245}$	31^0 38' 18.29"	-0 0 15.87"	31 38 2.42"

Adjusted coordinates of control points used for in-situ check.

1. Coordinate of BA_{249}:

   $N_{BA249} = N_{BA241} \pm L_{241\text{-}249} \text{ Cos } Brg_{241\text{-}249}$ (6)

   $= 1140070.239 \pm 273.800$ Cos 325^0 22' 27.4"

   $= 1140295.543m$

   $E_{BA249} = E_{BA241} \pm L_{241-249}$ Sin $Brg_{241-249}$ (7)

   $= 587307.850 \pm 273.800$ Sin 325^0 22' 27.4"

   $= 587152.273m$

2. Coordinate of point BA_{245}

   $N_{BA245} = N_{BA241} \pm L_{241} - 245$ Cos $Brg_{241} - 245$ (8)

   =114007.239 $\pm$ 206.857 Cos31^0 38' 2.42"

   $= 1140246.360$

   $E_{BA245} = E_{BA241} \pm L_{241-245}$ Sin $Brg_{241-249}$ (9)

   =587307.850 $\pm$ 206.857 Sin 31^0 38" 2.42"

   $= 587416.345$

3.3 DATA QUALITY

Data quality determines how precise and accurate those data used in there project. They data used in this project were measured by the precision and accuracy of the observations and the instrument used. South (NTS 350 series) total station used for this project has an angular

accuracy of ± 3 seconds the distance accuracy is ± (3mm + 3ppm) measurement time 3.2 seconds.

3.4 **DATA PROCESSING**

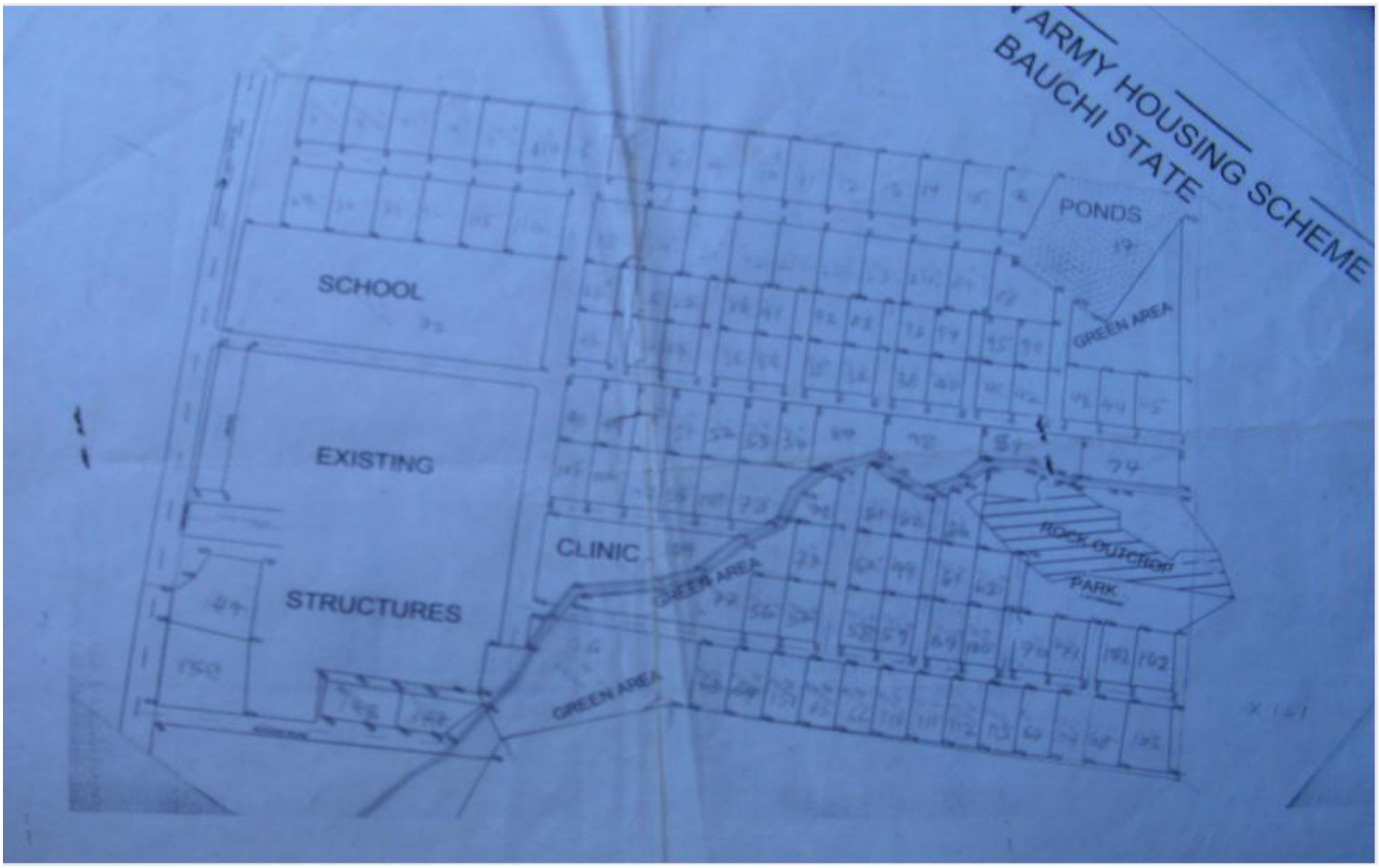
The data processing involved all the activities that enabled the data acquired to be processed into spatial databases. These activities include: data conversion, geo-referencing, digitizing, table creation and manipulations. The organography outline shown in the figure below gives a brief methodology of the entire process.

3.4.1 Adjusted Perimeter Survey Data:

Points	Easting(m)	Northing(m
BA_{346}	586903.758	1140637.349
BA_{347}	587339.688	1140979.227
BA_{348}	5871617.801	1140708.032
BA_{349}	587160.047	1140282.676

3.4 .2 DATA CONVERSION

The Nigerian Army Post Service Housing Scheme layout plan was scanned and brought into AutoCAD environment. This can be seen in the figure below.



Fig, 7: Showing the scanned layout plan of the Nigerian Army Post Service Housing Scheme Bauchi.

3.4.3 GEOREFERENCING

The layout map was geo-referenced to known locations on the earth's surface. The essence of the geo-referencing is to enable the scanned map to have a geodetic reference. The coordinates used for the geo-referencing were picked from the U.T.M grid coordinates on the map. These are shown in the table below.

Table 3.4.3.1: List of adjusted coordinates used for Geo-referencing

Points	Easting(m)	Northing(m
BA_{346}	586903.758	1140637.349
BA_{347}	587339.688	1140979.227
BA_{348}	5871617.801	1140708.032
BA_{349}	587160.047	1140282.676

3.4.4 DIGITIZING

Digitizing was carried out through the use of on-screen method. This is a method whereby the computer cursor was used to trace out the required features from the layout map.. The individual layers were created such as parcel layer, building layer, stream and road layer. To digitize in each layer, the layer is made current and the command for plotting the corresponding feature was selected. E.g. poly line for parcel and building layers while line command for stream, road, e.t.c. See the figure in the next page for the digitized layers

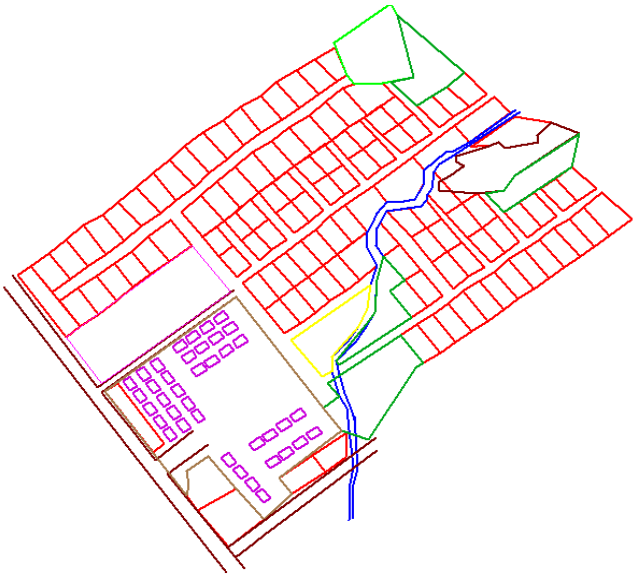


Fig. 8 Showing the different digitised layers.of the NAPSHS Bauchi.

3.4.5 EXPORTING TO ARCVIEW ENVIRONMENT

The various layers created within AutoCAD environment were exported to a GIS software (ArcView) environment using dxf extension. While in the ArcView environment, the layers was converted to shape files. The parcel layer, which is the layer of interest, was brought into Arcview environment as a polygon layer. Therefore the legend of the same parcel layer was edited with respect to the serial number of each parcel.

3.4.6 TABLE CREATION

Table creation specifically involved editing the parcel table which was automatically created when the parcel layer was brought into the ArcView environment. Therefore, the editing involved deleting unwanted fields created by ArcView and .inserting or creating new fields into the parcel table. These new fields are from the table that was formed from the information extracted from the questionnaire and interview sessions.

3.4.7 GENERATION OF QUERIES

Queries were generated to test the genuiness of the database. The queries were generated either through the attribute table i.e. query by attribute or query by location of parcels i.e. query by location. The query by location was simply achieved by double clicking each parcel while query by attribute was achieved through the query builder.

The following queries were tested and generated

1. Query on the retired civil servants through the query builder
2. Query by location on a parcel belonging to Major Hamisu Garba
3. Query by attribute on record about Cpl. Zakari Alhassan
4. Combine query by hot link and by location on Lt col. J O. Kashimga

Querying the database refers to the different types of questions raised for the database to answer. For this purpose, Structured Query Language (SQL) commands was employed for the queries of interest. A database query language allows interactive access to and modification of the database. Thus, the accuracy of the work was ascertained through the queries.

The query builder lets you query data according to tabular attributes by building a query expression. When working on a view, the builder lets one to select features in the active theme. To make a theme active, click on its name in the view's Table of Contents. Features selected by

query are highlighted in the view. If you are working on a table, lets you select records in the table. Records selected by query are highlighted in the table, and, if the table represents features in a theme, the features represented by the selected records will also be highlighted in a view containing this theme.

The query was generated as follows:

- Current Layer was clicked
- Click on query builder. From the dialog, select the required query. In this case, the first query was to bring out all the retired service personnel who benefited from the scheme, either through plots or houses. A yellow color appeared on all the affected persons.
- Click on new set. Plan showing a query on all retired military personnel is shown in fig 6. Their names are highlighted in yellow color in the diagram.

3.4.8 LAYOUT MAP GENERATION

The various themes were overlaid and annotation was added Such as north arrow, graphical scale, grids etc to form a composite plan of the Nigerian Army Post Service Housing Scheme layout. The composite plan was generated in the Arcview environment through the “view” and “layout” menu and submenu.

Figure 9: SHOWING COMPOSITE MAP

3.4.9 LINKING OWNER PHOTOGRAPHS TO THE PARCEL LAYER

Photographs of parcel owners were linked to the individual parcels via the hotlink function of the Arcview software. The important aspect of this process is that a column is created in the table parcel whose record is the description of the location of the photograph of the owner of that record. For example, the photograph of the owner of a parcel with serial number 160 is written as C:\photo\scan 32.tif. It should be noted that the extension of the image has to be indicated such as .tiff.

CHAPTER FOUR: PRESENTATION AND ANALYSIS OF RESULT

4.1 PRESENTATION OF RESULTS

The results in this research were borne out of rigorous works, tests, and verifications of their functionalities.

In the same vain, the digitized parcel layers of the study area and other theme layers were prepared in a layout frame with the appropriate map components, the north arrow, grids etc. The meta- data being added to form the final composite map of study area as produced and presented here. Having created the composite digital map of the area and also created a spatial database for it, one needed to check the efficiency of the work done. This was achieved in this project through several queries.

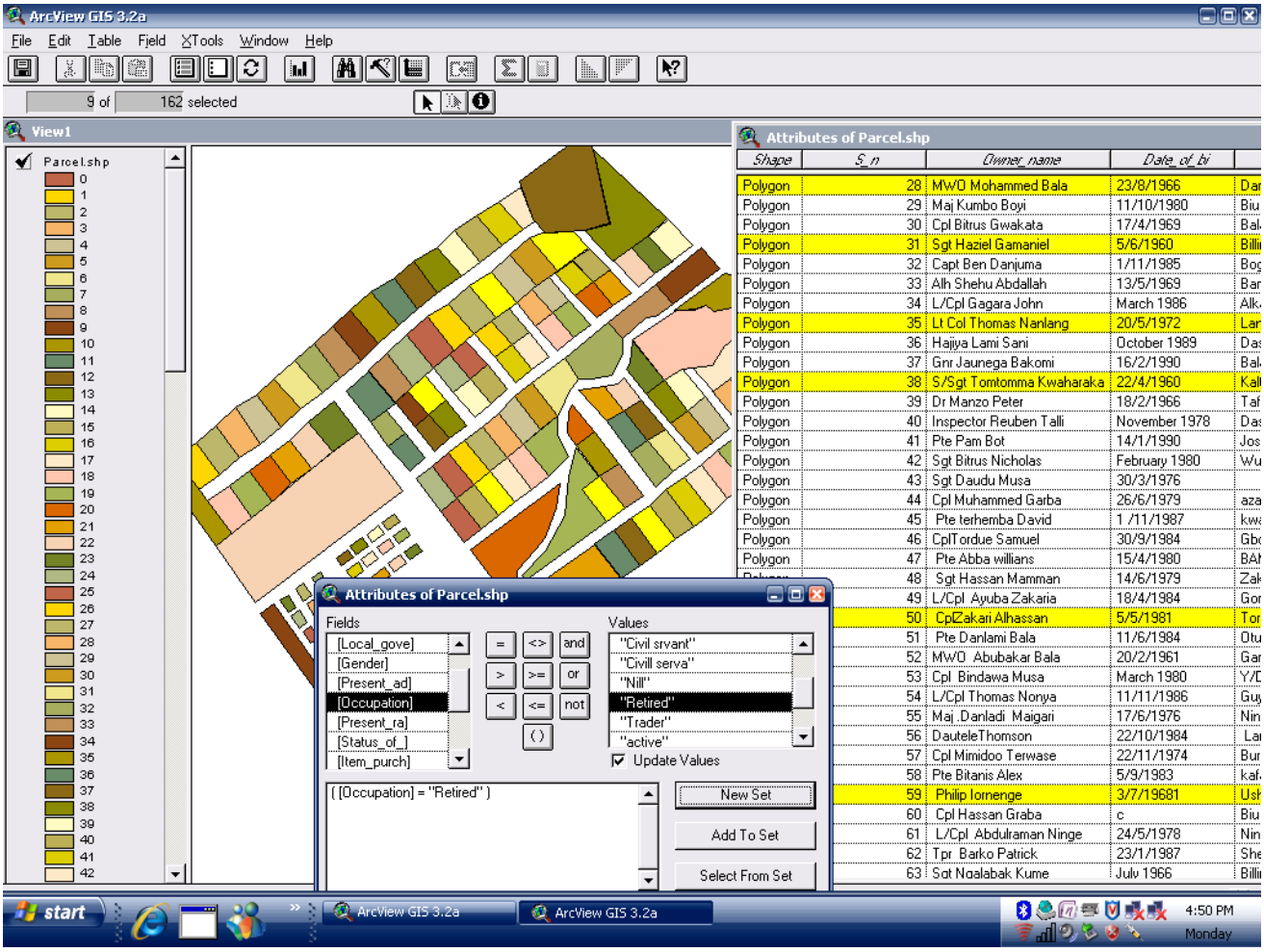


Fig.10. Showing Query on the retired civil servants through the query builder.

The above query was aimed at testing whether the database can response to a query through query builder i.e. by typing the correct syntax in the query builder. The result as can be seen in the figure above proves that, the database responds appropriately.

4.2. RESULT OF QUERY BY LOCATION

Another query on location was generated to locate a parcel belonging to Maj Hamisu Garba. This was done by using the query builder to click on the name of Maj Hamisu Garba. The parcel belonging to him was highlighted in black color as shown in the diagram on the next page.

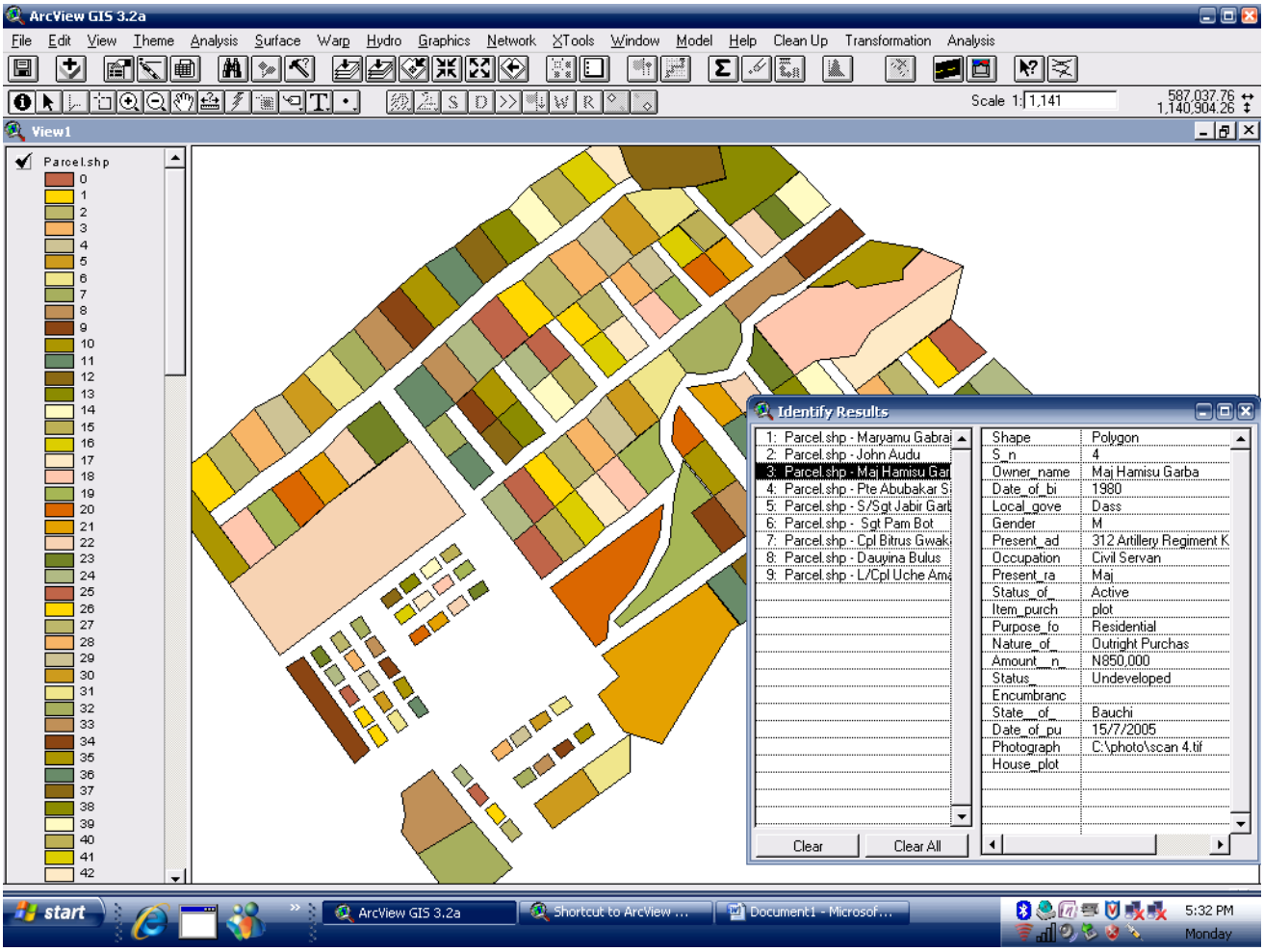


Fig.11 showing Query by location on a parcel belonging to Major Hamisu Garba.

The result of query by location was generated to check (analyze) whether the parcels were correctly linked with their respective records in the attribute table. The result above therefore, indicates that the database was in conformity with their respective parcels.

4.3 RESULT OF QUERY BY ATTRIBUTE

In order to further ascertain the authenticity of the database, a query by attribute on the record of Cpl Zakari Alhassan was generated. The attribute query builder was clicked on the record of Cpl Zakari and all information in the database on him was displayed in yellow color. This is shown in fig 8 below.

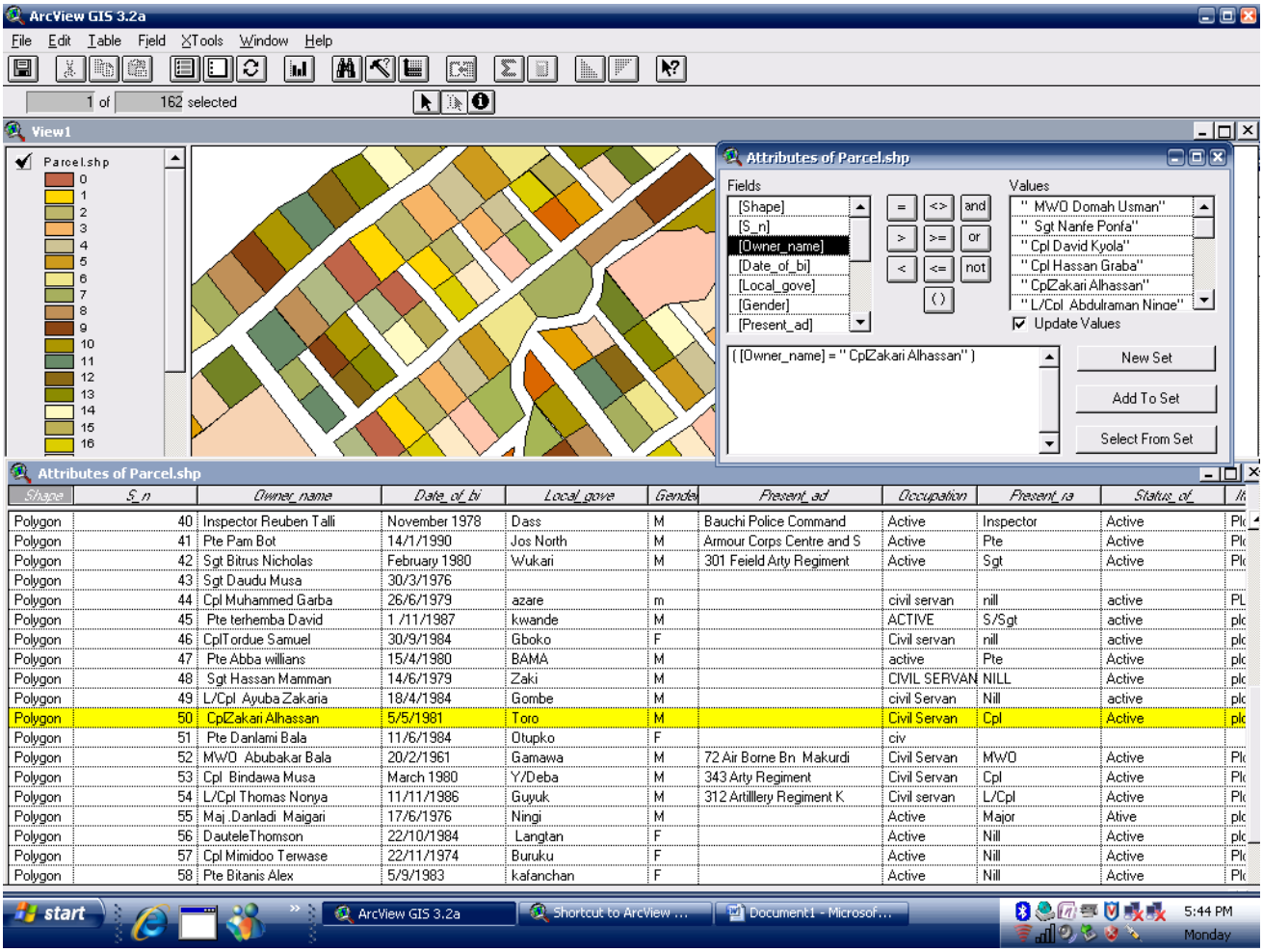


Fig. 12 Showing Query by attribute on record of Cpl. Zakari Alhassan

4.4 RESULT OF QUERY BY HOT LINK

Query by hotlink was generated by simply selecting the hotlink icon and double clicking the parcel of interest. In the diagram on the next page, the parcel owned by Lt Col J.O Kashimga (rtd)was queried by double clicking the respective parcel.

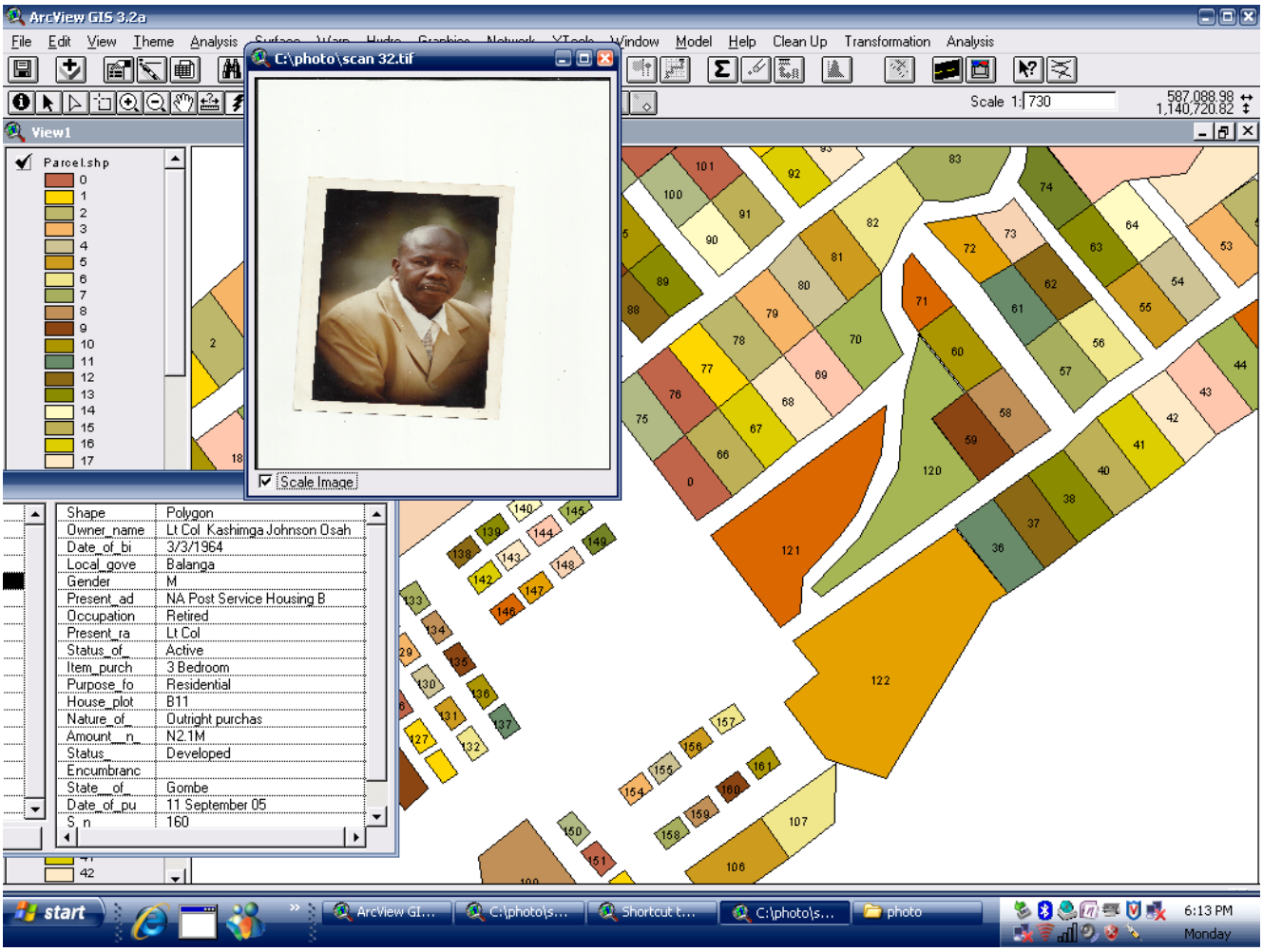


Fig. 13 Showing a query by hot link and by location on Lt col. J Kashimga

The hotlink query was aimed at analyzing the ability of the software to query and display the photograph of the respective owners by querying the parcels location. Therefore, the result of the analysis above proved that the aim has been achieved.

4.5 FINAL COMPOSITE MAP

Data presentation involves the use of either computer graphic techniques for visual display or electronic methods for transmitting the data or information to other users. The data presentation was done in Arcview 3.2a environment. This was achieved through the layout facility.

From the diagram below which displays the composite map of the Nigerian Army Post Service Housing Scheme Bauchi, it will be observed that, annotations such as north arrow, grid coordinates, graphical scale, heading and other information were added to the map which improves the physical appearance of the map.

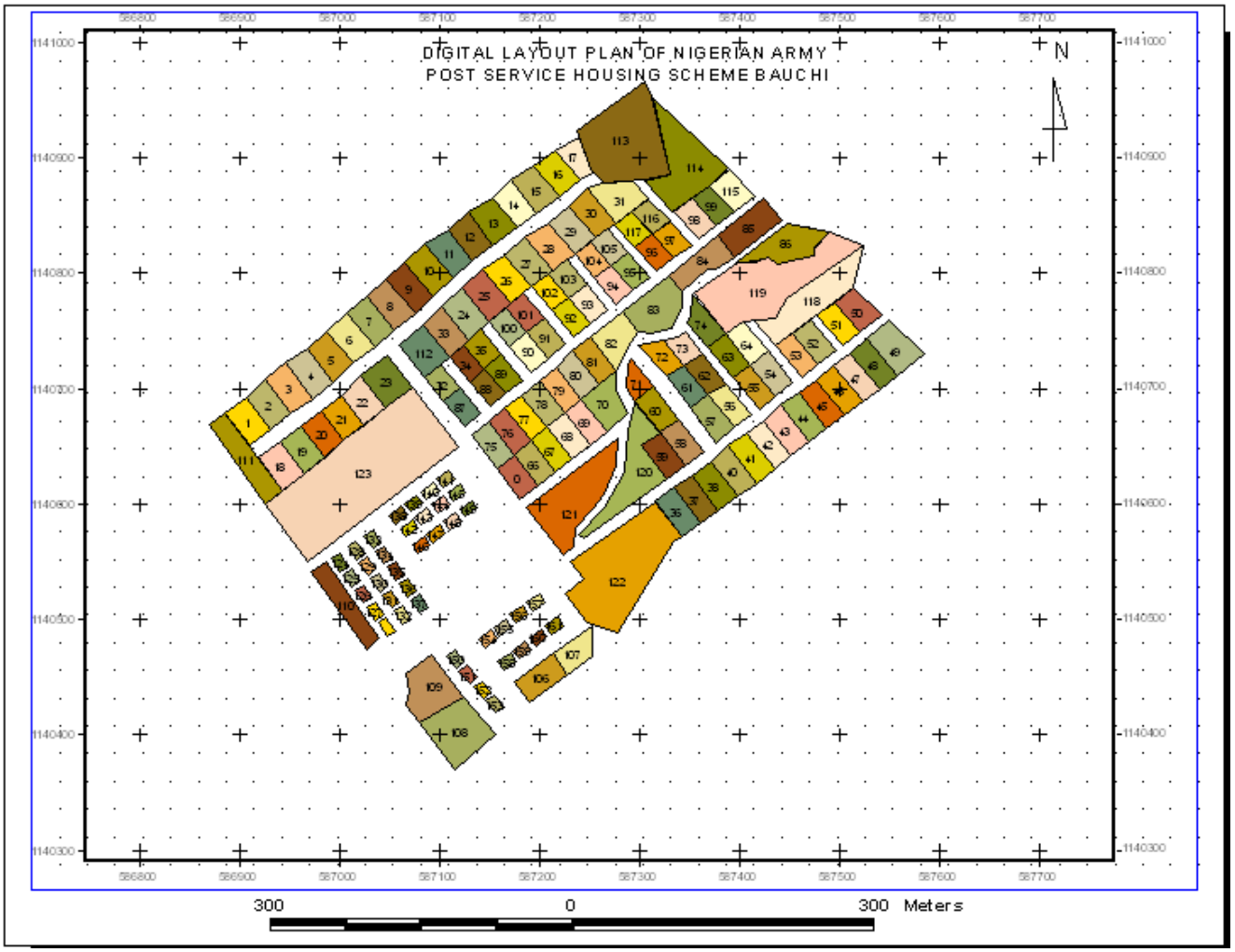


Fig. 14 Showing the composite plan of NAPSHS Bauchi.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

This Project is aimed at creating a Composite digital map of the Nigerian Army Post Service Housing Scheme Bauchi and also creating a spatial database for it. The various methods mentioned in the methodology were used to achieve the aim and objectives of the project. A composite digital map and hardcopy map of the site were produced as shown in the fig 11 below: The result of the analysis of the analysis being carried out in this project reviewed a substantial and effectiveness of the software employed (Arcview 3.2a) for effective planning and management of the mapping and database creation.

Secondly, a spatial database for the study area was created which can be of great use to the authorities of the Nigerian Army Directorate of Post Service Housing Scheme. This project may also serve as a model for other units in the scheme. Furthermore, the previously unmapped portion of the scheme site has now beMen properly mapped and this implies that whole layout of NAPSHS Bauchi has been properly mapped.

Despite several setbacks such inability of some beneficiaries to provide answers pertaining their plots or houses, coupled with great reluctance of the Authorities of NAPSHS to provide me with certain details about the site at Bauchi, it can be concluded that the aim of the project has been achieved.

5.2 CONCLUSION

This study has thrown more light to the efficiency of GIS software in the area of mapping and database creation. It has also demonstrated and proven that the use of GIS techniques can effectively proffer solutions to inherent problems of insufficient data and its processing power. The overwhelming ability of spatial data handling capacity of GIS software in data acquisition, processing and presentation in an optimal performance rate to produce the digital map of the area as presented, was also achieved. The mapping and creation of a database can now put to rest the confusion that had earlier arisen in the minds of the contributors and the beneficiaries of the scheme at Bauchi. However, this will be possible only if the authorities of the Scheme can adopt the database. Though the process of executing the project was long and tortuous as certain

information about the scheme could not be disclosed to me, nevertheless, a comprehensive, reliable and up-to-date cadastral record can now be kept with the Scheme managers at Bauchi. This can help in the reduction of land disputes. It can also stimulate land market, facilitate land reform and support land taxation.

5.3 RECOMMENDATION

It is therefore recommended that:

a. GIS techniques should be used to properly plan and manage data in order to preserve its integrity and update.

b. A comprehensive database should be established by the authorities of Nigerian Army Post Service Schemes in Nigeria to support management by furnishing planners with up-data and relevant data.

c. The authorities of the Nigerian Army Post Housing Scheme should give priority to adequate creation of database to serve as basis for planning and decision making.

d. The Department of Surveying and Geoinformatics, Modibbo Adama University of Technology Yola, should make this database available to the Nigerian Army Authority so that all other scheme sites can have similar database. This may serve as source of revenue generation to the Department.

f. Project topics should be given to students as early as possible to enable them complete their projects within the stipulated time given for the programme.

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