

# Developing A Property Information System for the Effective Management of 777 Housing Estate Maiduguri, Borno State, Nigeria

\*Gabriel Igbe AKEH

Department of Estate Management & Valuation, School of Environmental Studies  
Ramat Polytechnic Maiduguri, Nigeria

Alfred Dika MSHELIA

Department of Geography, Faculty of Science and Science Education, Adamawa State University, Mubi, Nigeria

## Abstract

Given the acute shortage of housing in Nigeria, most states governments' have been making attempts to reduce the housing deficit through direct public housing construction. The 777 Housing Estate is one of such estates currently under the control and management of Borno State Housing Corporation. The efficient management of these housing estates is dependent on the availability of good, reliable and timely information, which is not feasible under the current manual method of record keeping by the Borno State Housing Corporation. This study essentially developed a Property Information System using GIS techniques. It involved the scanning of the layout plan of the study area and then geo-referencing in ArcGIS 10.2 using GPS coordinates of reference points obtained from prominent positions within the Housing Estate. All housing units and other features within the Housing Estate were digitally delineated (digitized). Records of tenancy of house owners were extracted from their personal files domiciled at the Borno State Housing Corporation to create an attribute database, which was later, integrated with the digitized house parcels. In addition, a digital camera was used to capture the passport photograph of each house owner and hyperlinked to the digitized house parcels to create a robust and reliable GIS-based property information system. Since the system is comprised of both spatial and attributes data for each housing unit in digital form, it is possible to edit, maintain, rectify and keep property records up-to-date with minimum efforts. The system created was able to support query analysis to aid the effective and efficient management of the 777 Housing Estate by the Borno State Housing Corporation. It is recommended that the Borno State Housing Corporation (BSHC) should establish a GIS unit that would see to the computerization of all its analogue data into digital formats.

**Keywords:** Housing, Records, Database, Information system, Management

## 1.0 INTRODUCTION

The role of housing to man's existence can hardly be overemphasized. Yet Nigeria has a housing affordability problem. In general, access to adequate shelter is estimated at 40% of the total population while home ownership is less than 25% as compared with 75% international benchmark (Akin, Tosin and Abolade, 2014). This scenario is occasioned by rising levels of poverty, urbanization and increased population growth, which has made housing affordability difficult to most Nigerians (Akeh, 2016).

In response to the growing housing deficit in Nigeria, which according to Eleh (2010) is estimated to be in the region of 16 million units, Federal and States' Governments have over the years evolve different strategies geared towards housing delivery as part of its social responsibility towards its citizenry. The management of these housing units has always been entrusted in various agencies of government.

Efficient and effective management of public housing is hugely dependent on the availability of good, reliable and timely information. Hence, Molen (2001) asserted that any effective landed property administration begins with a land information system. It is no surprise therefore, that most government's housing organizations and agencies particularly in the developed countries have embraced information technology and are developing effective information management systems to provide accurate information relating to government landed property assets (Donlon, 2007).

Babalola and Kardam (2011) indicated that computer technology has come to play a vital role in keeping landed property records by making it possible for information to be assembled in any desired manner by individuals, ministries or parastatals that are directly involved with land related matters in meeting their required needs. They argued that the manual system of handling property information/records was becoming inefficient due to its slowness in updating, retrieving and storing of information as well as its inability in performing both spatial and non-spatial analysis.

Unfortunately, most land and housing administration agencies in Nigeria have continued to rely heavily on the manual system of filing, recording, storing and retrieval of information relating to land and buildings within their jurisdictions. According to Ali and Shakir (2012), this practice can no longer be sustained in an era of

emerging information technology. There is therefore the need for an automated, more organized and integrated housing information system that includes spatial and non-spatial data for effective management of public housing estates. Since geographic location is fundamental to many residential real estate practices, most public and private organizations are increasingly realizing the contribution which geographic information system can make in organizing and managing information as well as decision making and service delivery (Belsky, Can and Megbolugbe, 1998).

The Borno State Housing Corporation, which is the body that is statutorily vested with the responsibility of managing all public housing estates developed by the state government, operates the manual method of information handling and management. It is therefore highly required that an integrated system that supports digital mapping and creation of Geo-spatial database be implemented in order to overcome the inherent weaknesses of the current practice and provide timely, accurate and reliable information for prudent decision making and effective service delivery. Akeh and Mshelia (2016) have advocated the use of Geographic Information System (GIS) as a robust, reliable and versatile technology for managing land related records.

This paper therefore attempts to develop a Property Information System using GIS techniques for the 777 Housing Estate, Maiduguri, Borno state, North-east Nigeria. It will essentially create a geo-database for the Estate as well conduct spatial queries on the property database created for the Estate to aid decision making processes by the Borno State Housing Corporation.

## 1.2 LITERATURE REVIEW

Abbas, Ben-Yayork and Muhammad's (2014) study of the development of an efficient cadastral information system for Tsaunin Kura residential layout in Chikun local government area of Kaduna state used topographical maps of the study area, which were scanned and geo-referenced to UTM 32 projection in a GIS environment. The study was able to achieve efficient and effective management of land in the study area with the ability to identify the layout parcels, map it and generate data from the database that was created by the system thus enhancing data collection, storage, manipulation, retrieval and dissemination of information at precise and short time and eventually able to query the database.

Kemiki, Odumosu, Ayoola and Popoola (2015) demonstrated the possibility for the efficient implementation of a cadastral information system for M.I Wushishi Housing Estate in a GIS environment. The study adopted the Entity-Relational model to create a database for all buildings within the study area, which allowed for simple multi-criteria queries to be executed based on the database created.

Orisakwe and Bakari (2013) on the other hand developed a parcel-based cadastral information system for part of Kofare Government Residential Area of Jimeta-Yola using GIS techniques. The methodology involved the acquisition, scanning, digitizing and geo-referencing of the analogue layout plan and topographical sheet of the study area. ArcView 3.2a software was used to polygonize the parcel theme and its conversion to shapefile. Spatial and attribute database were created and linked together with an identifier number. The system developed was able to produce a composite map of the study area. The study showed different queries that were carried out using different criteria, which proved the efficiency and efficacy of the cadastral information system. In addition, the study found that GIS was capable of building, editing and analyzing land and property information.

Usman (2010) on the other hand, studied the application of cadastral information system for title management in Nigeria. He argued that population growth and economic development has created an exponential increase in the demand for land for various purposes consequently increasing the information requirements for land title administrators. He further stated that given the current system of information collation and retrieval, which has remained unchanged, in the face of the increasing information requirements, development of land resources were haphazardly done with serious legal, planning, economic and environmental impacts. He therefore advocated for the adoption of information technology tools to improve the manner of information collation, analysis, retrieval and monitoring of land to achieve efficiency in land title management in Nigeria.

Bulus (2014) carried out a study on cadastral mapping using remote sensing and Geographic Information System in Banjiram, Adamawa state with a view to developing a digital cadastral information system which had the ability of integrating the map of the study area with records of ownership and use. The methodology used for the study involved the scanning and geo-referencing of the layout plan of the study area in ArcGIS 10.1. Parcels were then digitized and given unique identification numbers. GIS was majorly used to build a digital cadastral database using the data obtained from the field and those generated from the layout plan. The cadastral database allowed for the entry, updating, display and generation of results and report.

Shauibu (2008) conducted a study on cadastral land information system for sustainable land conveyance in Bauchi state. The existing analogue map of the study area was converted into digital format using a digitizing tablet in ILWIS environment, while an automated attribute database for the spatial database was created in ArcView. The database created was subjected to query and analysis. The results of the study showed those properties that were covered by certificate of occupancy, number of plots for residential, recreational and

commercial purposes in the digital visual map that was produced by the system.

Ali and Shakir (2012) on their part proposed a GIS-based system for cadastral and land information system in Pakistan. The main purpose of the cadastral was to keep record of all land parcels and their ownership so as to form an accurate, transparent and efficient system for property taxation.

Babalola and Kardam (2011) developed a land (cadastral) information system for part of Fadama-Mada, one of the developmental layouts in Bauchi metropolis. The study integrated and updated the entire Fadama-Mada area with a comprehensive digital map and cadastral data. The methodology used in the study involved the collection of cadastral layout blocks survey plan and record of ownership from the Ministry of Land and Survey, updating the record with field survey and building a spatial database of all parcels. Queries were generated for retrieval and displaying of parcel information using ArcView 3.2a. The outcome of the study showed the efficiency of the use of GIS in managing land and property registers.

Chiemelu and Onwumere (2013) conducted a study on land information system for efficient land administration and revenue generation using Trans-Amadi industrial layout, Port Harcourt, Nigeria. Existing land related information was converted to digital formats. Feature class layers such as parcels, boundary pillars, roads, buildings, river and railway were created with ArcGIS 9.2. The results of the study showed the capability of the system to conduct necessary queries and analysis, thus making it an effective and efficient tool for proper land and property administration and revenue generation.

Buragohain's (2002) study developed a land information system using integrated remote sensing and GIS technology for Guwahati city, India. The methodology used involved the collection and digitization of the map of Guwahati city and its surrounding areas. The result of the study showed that GIS could be used to create a Decision Support System for providing information regarding every plot of landed property and its attributes.

Available literature appraised for this study reveals that empirical studies relating GIS to housing management in Nigeria and particularly to the study area are unavailable. Most studies on GIS applications tend to focus on the development of cadastral land information with emphasis to land administration. Some of the studies are limited in scope dealing with specific issues such as land titling or distributional pattern of facilities.

This present study addresses the gap in the above studies. It does not only create a digital composite map for the 777 Housing Estate, but a geo-database using the ArcGIS 10.2 version, that can serve as an effective Property Information System capable of executing search operations and queries that will facilitate the effective management of 777 Housing Estate by the Borno State Housing Corporation.

### **1.3 STUDY AREA AND METHODOLOGY**

#### **1.3.1 Study Area**

Maiduguri, the capital of Borno state is one of the cosmopolitan cities in Nigeria with a population of 732,696 (NPC, 2010). It lies between latitude 11°40'N and 11°44'North and longitude 13°04'E and 13°14'E. (See figure 1) The city sits along the seasonal River Ngadda and it is bounded by Konduga and Mafa local government areas to the south, west, east and north respectively. It is about 350m above sea level and covers a total area of 543 square kilometers. The population of Maiduguri was estimated at 732,696 by the National Population Commission, 2010). The population of Maiduguri is cosmopolitan in nature with Kanuri being the dominant ethnic group. Other major ethnic groups found in the city include Babur, Shuwa Arab, Fulani and Hausa. English is the official language of the state.

Maiduguri is linked to the national grid and has good road networks and water supply. There is a major highway connecting the town to Yobe state. The area has two specialist hospitals, a teaching hospital and a number of primary health centres and private clinics. In addition, there are a number of public housing estates in the area. They include the 202 Housing Estate, the 303 Housing estate, the 777 Housing estate, the 505 Housing estate as well as the Legacy Housing estate currently at the verge of completion. There are also a number of tertiary institutions in Maiduguri namely the University of Maiduguri, Ramat Polytechnic, College of Agriculture, Kassim Ibrahim College of Education and the College of Legal and Islamic Studies. In addition, there is an International Airport in Maiduguri. The city is accessible by road, rail and air, which serve north-eastern Nigeria and parts of Niger, Cameroon and Chad. Maiduguri has an international airport (Ibrahim, 2015).

There are a number of public housing estates in Maiduguri namely the 777 Housing Estate, 202 Housing Estate, 303 Housing Estate, 1000 Housing Estate, 20 Housing Estate etc. The management of these Estates is vested in the Borno State Housing Corporation.

#### **1.3.2 Methodology**

The two types of data used for the study were spatial and non-spatial (Attribute) data. The spatial data consisted of the layout plan of the study area as well as the UTM coordinates of the study area taken from five prominent points within the housing estate. On the other hand, the non-spatial (attribute data) comprised of all data generated from tenancy records extracted from the files of house owners domiciled in the Borno State Housing Corporation. Such information included demographic data such as name of house owner, gender, state of origin, local government area, House Number, house type, date of allocation, rent paid on the property and rent status of

owner.

The layout plan of the housing estate was obtained from the Ministry of Land and Survey and scanned using HP DESIGNJET T2300eMFP scanner with 200dpi resolution. The scanning produced a TIFF format suitable for ArcGIS environment. The scanned layout plan was exported into ArcMap environment for geo-referencing using UTM coordinates of five selected points within the Housing Estate obtained from a hand-held Garmin GPSmap 76CSx device. After the map was geo-referenced, digitizing of features was then performed in ArcMap environment using the on-screen method. House parcel boundaries were extracted by pointing and tracing the cursor along house parcel boundaries. All features within the study area were digitized as independent thematic layers.

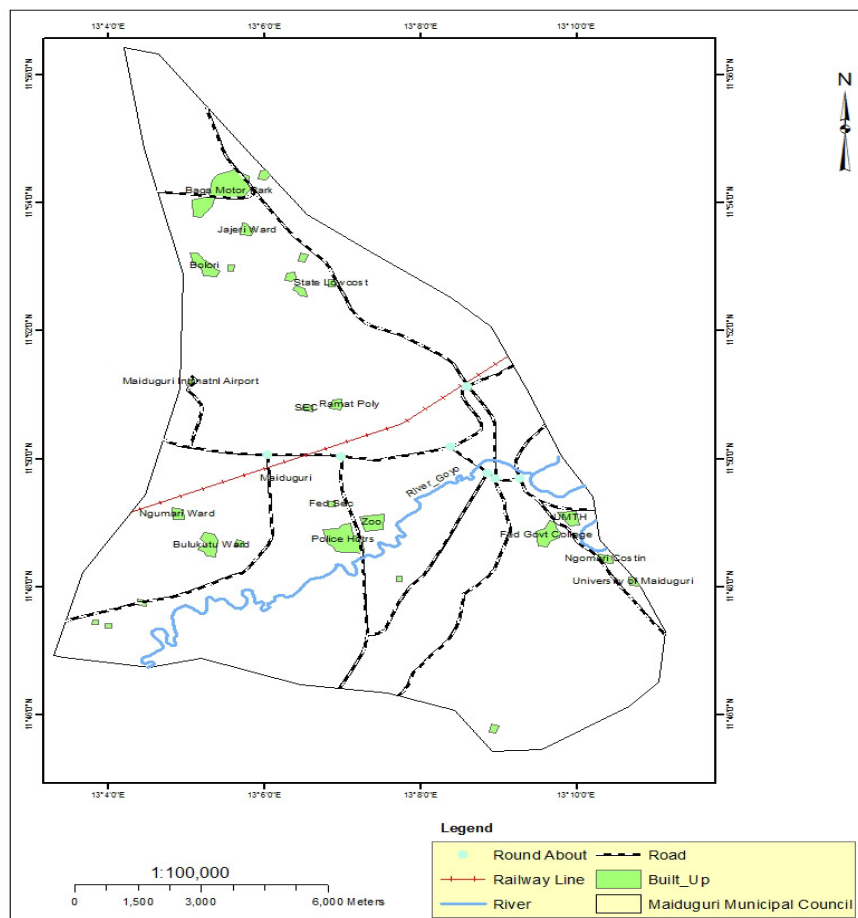


Figure 1: The study area.  
 Source: Field work, 2016.

#### 1.4 FINDINGS AND DISCUSSION

Given the inherent weaknesses of the manual method of handling property-related records, the study sought to create a digital composite map of the 777 housing estate. This was achieved by converting all analogue data both spatial and non-spatial into digital formats and processing such data in the ArcGIS software to achieve the above objective. The result is shown in figure 2. The digital composite map shows the different blocks of flats in the 777 housing Estate consisting of one bedroom, two bedroom, three bedroom and four bedroom flats. In addition, all other facilities available in the Estate were also identified. They included the Estate's boundary, administrative office, a bore hole, a transformer, a fire service station, access roads, worship centre (Mosque), a police post, school and shops. The undeveloped parcels within the estate have also been identified. Each of these features has been stored in the computer system as separate individual themes and can be used for other purposes relating to infrastructure developments within the Estate whenever the policy of government changes as to whether to sale the housing units on owner-occupier basis. The map will assist in delineation of boundaries for the various estate occupiers.

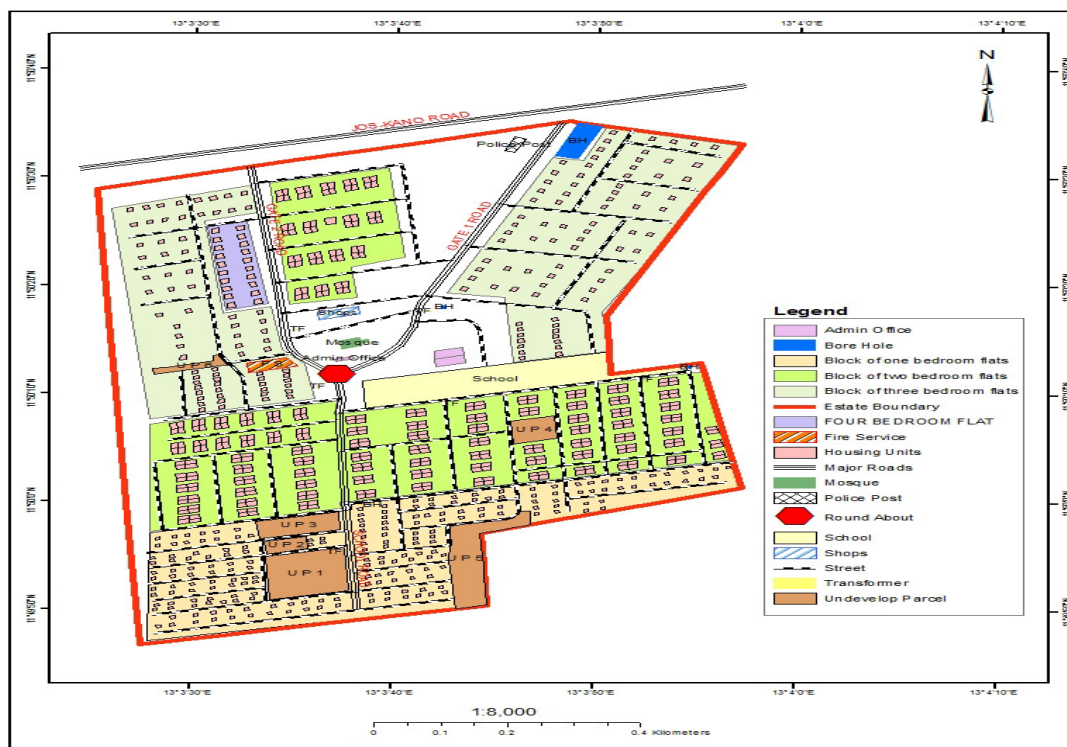


Figure 2: A Digital Composite Map of 777 Housing Estate, Maiduguri  
 Source: Author's Analysis, 2016.

The study also sought to create a geo-database for all housing units in the study area. This was necessary so as have a comprehensive database of not only tenants of the housing units, but also the details of specific housing units they occupy. Figure 3 shows a geo-database for 777 Housing Estate, Maiduguri.

The database was comprised of all attribute (non-spatial) data of house owners integrated with the spatial data of individual housing units. With this property database, a comprehensive list of all house owners can be ascertained at any time including details relating to individual house owners. More importantly is the fact that this computerized method allows both graphics and attribute data to be easily edited unlike the analogue method where such flexibility is very difficult.

The ability to combine all the spatial and attribute data of the 777 Housing Estate in digital format implies that the entire database can be stored in a single Compact Disk or flash share thus making it portable to be carried from one place to another, whereas a similar quantity of information when converted into analogue form will be too voluminous to be carried from place to place.



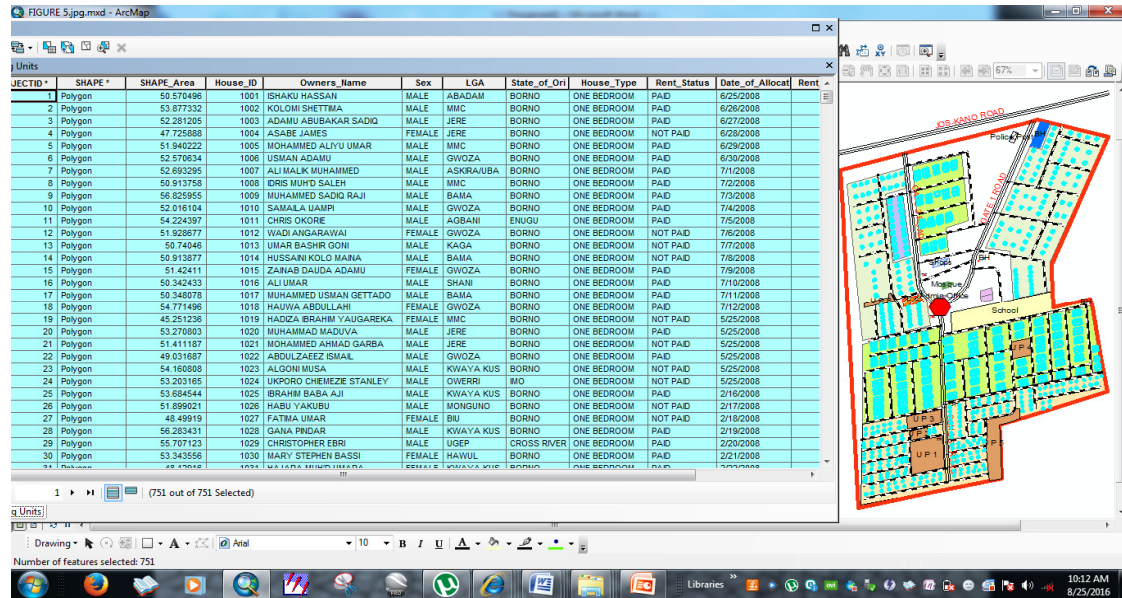


Figure 3: A GIS-based property database showing particulars of house owners of the 777 Housing Estate  
 Source: Author's Analysis, 2016.

Different types of queries were then conducted on the geo-database created for the 777 Housing Estate to aid decision making processes. The queries were necessary to determine the efficiency of the geo-database. Some of the queries are shown below:

#### 1.4.1 Query to display a house belonging to a particular owner

QUERY: SELECT\*FROM BUILT\_UP: WHERE: "OWNERS\_NAME"=ABANA MUSA.

After the query, the selected house belonging to the owner was displayed on the map with a sky-blue outline while the attributes were highlighted in the Attribute table in red colour as shown in figure 4.

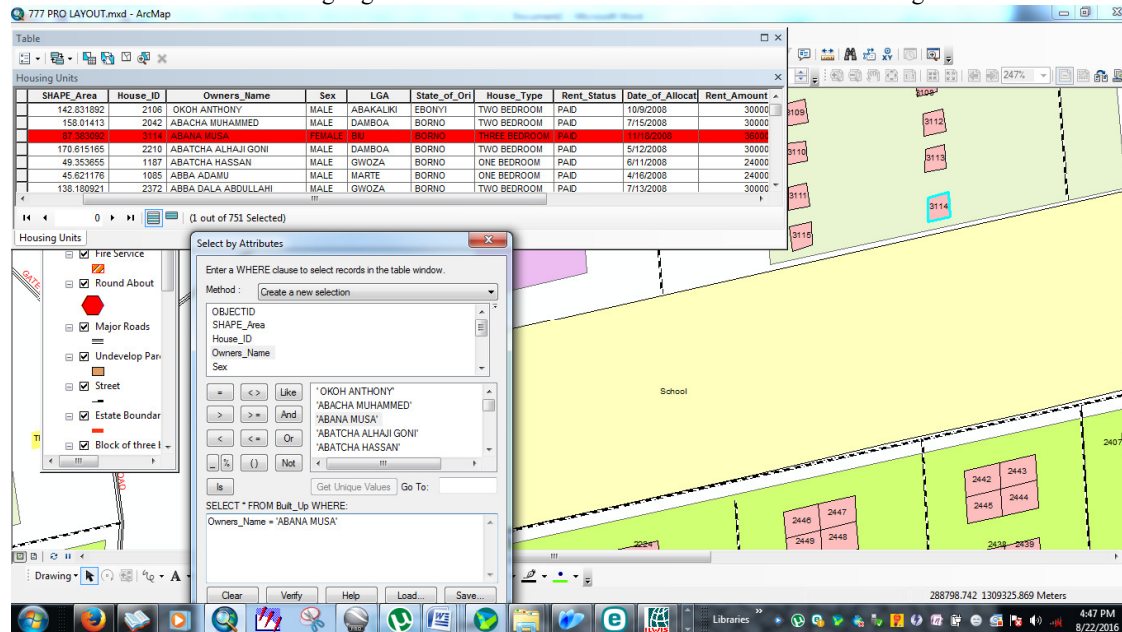


Figure 4: House belonging to a particular owner  
 Source: Author's Analysis, 2016.

#### 1.4.2 Query to display details of a particular house unit by identifying the house ID

QUERY: SELECT\*FROM BUILT\_UP: WHERE: "HOUSE\_ID=2444"

After the query, the details of the particular house were displayed in the attribute table as shown in figure 5. The details show that House 2444 belongs to Isah Abubakar who is male from Kwaya-Kusar LGA in Borno and is a two-bedroom flat with rent status "NOT PAID".

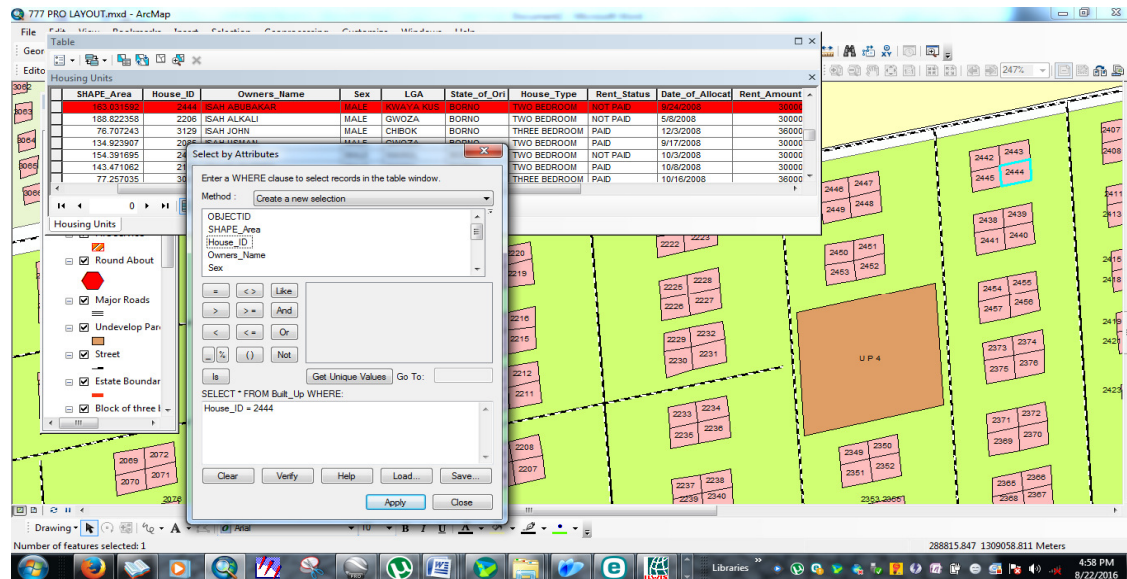


Figure 5: Details of a particular housing unit identified by house ID.  
 Source: Author's Analysis, 2016.

#### 1.4.3 Query to display owner's photographs and his record in the housing unit.

After carrying out the query and process in figure 4, the photograph of the selected house unit was displayed by picking the hyperlink tool and clicking the house unit of interest. This is shown in figure 6. The analysis shows that house number 2444 is a two-bedroom flat belonging to Isah Abubakar, a male from Kwaya-kusa local government area of Borno state. It further reveals that the property was allocated to him on the 24/9/2008 and has a rental value of N30,000.00, which has not been paid by the tenant. The tenant is therefore in arrears of rent.

The photograph provided by the system will help the Borno State Housing Corporation to ascertain at any time, the bona fide owner duly allocated to the house and check cases of undue alienation by way of sale, mortgage and lease without official consent as contained in the tenancy agreement. This is important because paragraph 3 of the Tenancy Agreement stipulates that a tenant must not assign, underlet, sublet or part with the possession of the said premises or any part thereof without the written consent of the General Manager. Similarly, paragraph 10 states that tenant must not leave the premises vacant or put any other person in the same without the written consent of the General Manager.

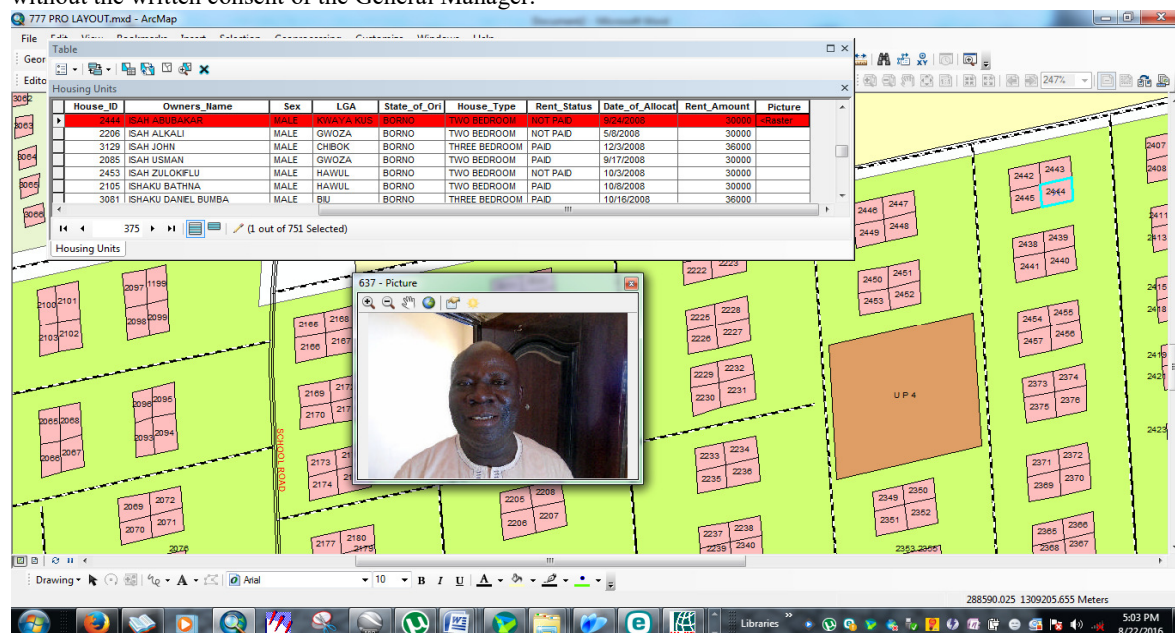


Figure 6: A house owner's photograph and record in the housing unit  
 Source: Author's Analysis, 2016.

#### 1.4.4 Query to display records of tenants that have not paid their rents

QUERY: SELECT \* FROM BUILT\_UP: WHERE: "RENT\_STATUS"=NOT PAID.

After the query, the details of all tenants of the Housing Estate that have not yet paid their rents as well as the particular house units were displayed on the map as shown in figure 7. The particulars of such tenants are highlighted in red on the attribute table while the respective house units are highlighted with a sky-green on the map.

The analysis from the property Information System created by the study indicates that out of the 751 tenants in the 777 Housing Estate, 226 tenants have not paid their rents. It can be inferred from the above that since it is faster and quicker to query the system in order to extract such tenants that are in arrears of rent, timely rent recovery approaches can be put in place to recover such rents by the Borno State Housing Corporation. Furthermore, the total amount of rent in arrears can easily be ascertained and monitored to check malfeasance by rent collectors and rent evasion by tenants.

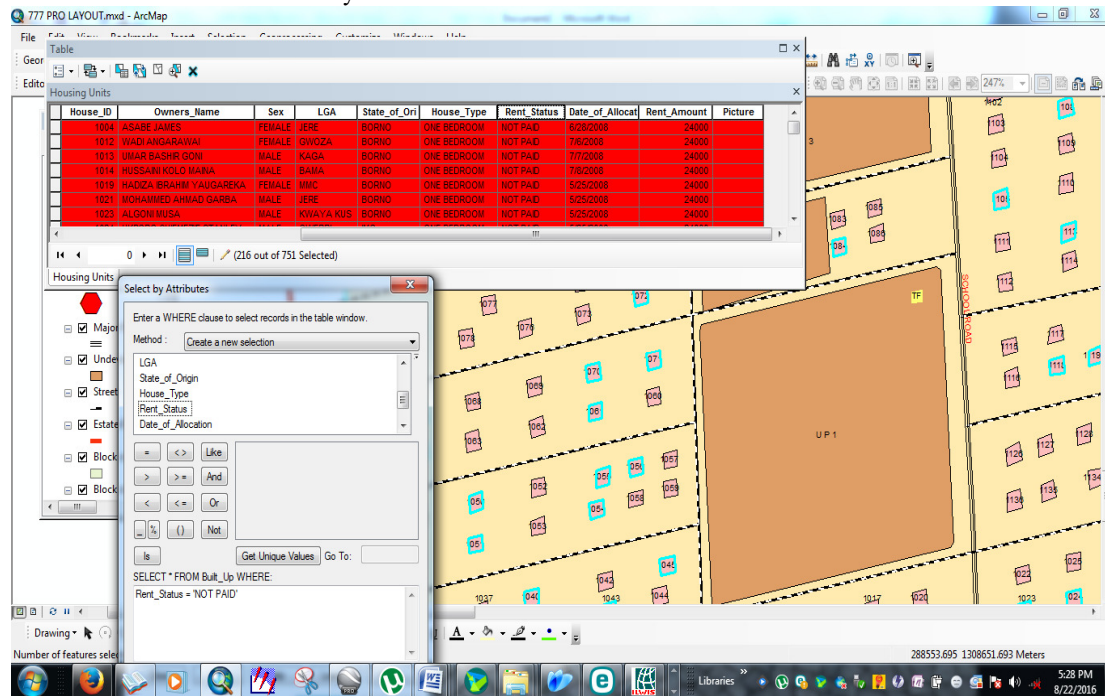


Figure 7: Records of tenants that have not paid their rents in digital form.

Source: Author's Analysis, 2016.

#### 1.4.5 Query to display records of tenants that are females

QUERY: SELECT \* FROM BUILT\_UP WHERE: "SEX"=FEMALE

After the query, the selected houses belonging to female tenants were displayed on the map encircled in sky-blue colour while the attributes were highlighted in the Attribute table in red colour as shown in figure 8. The result showed that 122 out of the 751 tenants in the Housing Estate were females. The implication of this finding is that such information may assist the Management of the Borno State Housing Corporation in taking timely decisions particularly in relation to gender in on its allocation processes since a balance is often required for both male and female civil servants in the state.



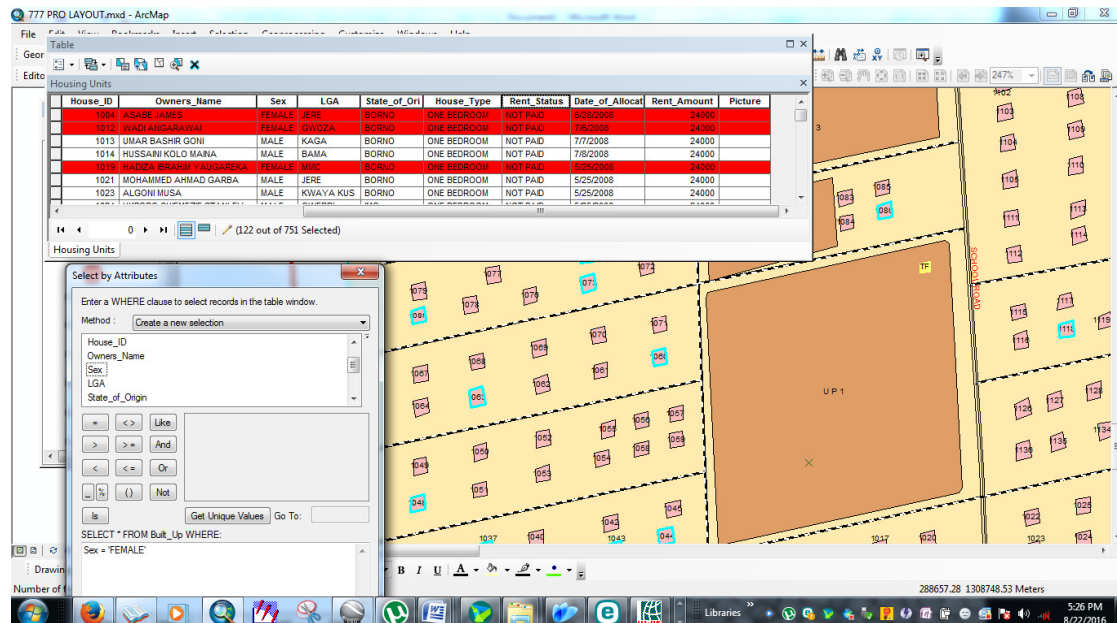


Figure 8: Records of tenants that are females.  
 Source: Author's Analysis, 2016.

## 1.5 CONCLUSION AND RECOMMENDATIONS

Efficient and effective management of public housing depends on the availability of good, reliable and timely information. Advancement in information and communication technology has reduced the burden of carrying about large papers in the form of maps and plans as well as saving the stress of searching through dusty cupboards for map or plans which may sometimes not be found. Geographic Information System (GIS) has been used in this paper to develop a Property Information System that supports decision making in housing administration and management. The study provided an integrated system that supports digital mapping and creation of spatial database that can be used to overcome the inherent weaknesses of the current manual practice of keeping property records of public housing estates thereby providing timely, accurate and reliable information for prudent decision making and effective service delivery by the Borno State Housing Corporation.

The following recommendations have therefore been made based on the findings of the study:

- i. The Borno State Housing Corporation (BSHC) should establish a GIS unit that would see to the computerization of all its analogue data into digital formats. This is necessary since majority of the respondents support the computerization of their property records.
- ii. There is the need to procure GIS hardware, software and other accessories for the smooth implementation of GIS technology in the Borno State Housing Corporation to facilitate the computerization of its analogue data.
- iii. The high rate of paper work involved in the management of Housing Estates should be reduced by the adoption of property information systems. This will also help in overcoming other challenges associated with manual methods of record handling.
- iv. There is need to employ a GIS expert in the Borno State Housing Corporation that would supervise GIS operations such as the digitization of property records and conversion into digital formats.

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