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Design of GIS User Interface For Land Management On Some Selected Residential Layout In Nguru Town

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ABSTRACT
Geographic Information System (GIS) is a computer based software that is specifically designed to capture, store, analyze, manipulate, edit, retrieve and display spatially referenced data. The GIS technology being a robust, dynamic, consistent, flexible and versatile in nature; has the capability of managing both spatial and attribute data. This paper hypothesizes that the current manual system of land management in Nguru town can no longer withstand or resist the contemporary growth of economic and information technology. It has instead created over 85 litigations in Nguru local government in 2019. This paper therefore focused on the creation of a GIS database so as to mitigate and sanitise land hitches and pave way for sustainable development. The procedure adopted invite the use of spatial and attribute data; such as lot details, GPS coordinates, digitisation of layout map and the formulation of excel file. The GIS database is flexible and retrieval of information is much faster and easier. The database system allowsfor spatial and attribute queries via the data embedded in the system. The GIS system if properly implemented will generate revenue to the local authority such as quests' fee, verification fee, update fee and tax. This database will create a consistent registry that makes land transactions much cheaper, timely and certain, lessen corruption, mitigate snags, provide tenure security and a support tool for policy formulations.
Keywords: Geographical Information System, Land Management, Database

I. INTRODUCTION:

Geographic Information System (GIS) is a technology or computer software that provide the ability to capture and analyse spatial and geographic data. It is characterized of spatial and attribute data. The Spatial data describes location of a feature with respect to earth surface while attribute data defines the characteristic or quality of the spatial feature. The GIS software is versatile in nature, reliable, time saving, with high precision in managing land record.

Land is one of the most valuable natural resource endowed to mankind. It forms the basis for living, working and shelter. Today Land as a valuable asset owned and controlled by individuals, public and private sectors and thus warrant it transformation into a myriad of uses; therefore Land becomes a fixed and scarce commodity. In addition to that the needs and population growth result in an illegal transactions, conflicts, partitions, grabbing and snatching etc. It is apparent, therefore, any information concerning land becomes a valuable key to land management.

This software would provide easy access to land for development because it increases efficiency in land use management, promote social equity, revenue generation, conservation of environmental quality and promote security of tenure.

II. LITERATURE REVIEW

Land is one of the most essential natural resource endowed to mankind. According to (Pindiga & Orisakwe, 2013) and (WGEA 2013) it is a source of materials needed and the platform or basis on which human activities take place; thus, it served as a basis for living, working and shelter.

Land is the ultimate resource of the biosphere which refers to a specific area of the earth surface with physical entity in terms of its topography and spatial nature, and one of the characteristics of space that is widely recognised as significant for planning and management purposes. Idowu Innocent et al. (2014). It is an important asset that determines a country's wealth. The economic development of a country depends upon

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the availability of land and its usage (Ndukwe E. C. & Vincent O. O. 2013) as well as proper tax collection. Land is considered to be fixed and scarce in nature. Thus it is essential to survey and manage effectively and efficiently for the use and good of mankind. It is apparent, therefore, any information concerning land is valuable key to financial investments, commerce, industry and agriculture (Musa et al., 2016). Land is depicted to include land of any tenure, tenements, hereditaments, corporal, or incorporeal, an undivided share in land, houses, other buildings and anything attached or permanently fastened to earth but does not include minerals (Yusuf Y. D 2009). Land as a valuable asset is owned and controlled by individuals, public and private sectors. Thus land becomes a necessity of life. These needs warrant the transformation into a myriad of uses. And thus land becomes a scarce commodity. This of course, is due to the rapid population growth of man on earth and his desires to explore land in myriad of ways (Usman & Sc, 2013). The consequence of this growth affect environmental quality (Williamson, I. P 1994).

Land Management is the process of managing the use and development of land resources (Snyder P. K (2005) these resources may include water, land, mountains etc. Managing the uses of land maybe residential, commercial, Agricultural industrial etc. The management may have both positive and negative effect on the environment. Land management is the process by which the resources of land are put into good effect. Professor StigEnemark (2005). Managing land encompasses all activities carried out on land both natural and human. He further explains that land management differ widely between countries and regions throughout the world, and reflect local cultural and judicial settings. According to The World Bank report (2006) Sustainable land management refers to practices and technologies that aim to integrate the management of land, water biodiversity, and other environmental resources to meet human needs while ensuring the long-term sustainability of ecosystem services and livelihoods. The main aid of sustainable land management is to ensure environmental protection through proper use of these resources without jeopardising the needs of the future generations.

According to (ObayomiAbiola Benjamin)A computerised LIS will help address issues such as multiple allocations of the same plot of land to more than one applicant, rampant cases of land records forgeries, theft of files and illegal smuggling of forged land documents into the land registry; unauthorized persons within the land management system allocating lands contrary to the provisions of the Land Use Act.

GIS is a Geographic Information System that served as a tool for managing and analyzing any geographic feature. GIS is a peculiar technology with the essential features of spatial references and data analysis. (Akeh & Mshelia, 2016). GIS has Spatial and Attribute data. The Spatial data describes the location with respect to earth surface while attribute data defines the characteristic or quality of the spatial feature. GIS technology has developed quickly, and has been widely applied in the land resource administrations. This new technology of mapping land - with satellite positioning systems and remote sensing - are powerful tools for planning and can help tackle problems related to land use. (WGEA 2013). The application of GIS technology has aroused interest and concern of government and professionals in policy and decision making and using natural resource in a more optimal way. The GIS is multifunctional in nature, time saving and high precision. It is a robust, reliable and versatile technology that can be used in managing land records (Akeh & Mshelia, 2016). According to WGEA (2013) the technology provide the means for viewing less accessible area, deliver current and up to date changes. GIS technology provide accurate and integrated information that serves as a base for planning, research and decision making (Abd-AllaGada& R. Alib 2010). Fu Yang et al. (2008) were of the view that GIS and remote sensing (RS) techniques have proved useful for land management.

In New Zealand Local authorities, central government agencies, and research institutes all use spatial technology to identify, manage and protect ecosystems on land and water, used in regional and district plans, the protection of outstanding natural features and landscapes from inappropriate subdivision (WGEA 2013). He also added that in United Kingdom (UK); The Department for Environment, Food and Rural Affairs relies on GIS in decisions and policy formulations. In addition; The National Audit Office of China trialed GIS technology for its 2011 national land resources audit project. GIS technology and ArcGIS were used for trial audits in the fields of land supply, land use and land treatment

The Benefit of GIS in land Management

The GIS software, being a computerized system, has the capabilities to handle huge data not only effective but also efficient, secured, faster, and transparent. It is versatile in nature, reliable, time saving, with high precision in managing land

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record. These benefits have been summarised as below: -

- It will facilitate land registration processes, data processing, storage and retrieval as well as reduce time, cost and space required for land record and management
- It will enhance academic research as access to information will be easy
- Guarantee tenure security and transparency among land owners. This will enhance sustainable development
- Revenue proliferation to government via consent fee, title authentication fee, deed of assignments, Mortgage, Lease, update fees, Map for site plans, building plan, etc.
- Since the GIS technology has the capability of allocating a distinct geographical coordinates to piece of land, thus, issues regarding multiple transactions and double allocations, illegal transactions will be phased out.
- The GIS technology will reduce dispute among land owners thus, mitigate court cases.
- It will sanitised the system of land transactions in general
- Provide security for credit from banks and thus, enhance efficient land market, housing, construction and financial institutions.
- GIS database system for land management guarantee data backup in the event of system breakdown
- GIS database can provide previous and up to date Maps, layout, plans with details if require at fingertips
- GIS database can accept updates easily
- Since the database is embedded with information, every potential buyer will want to authenticate whether the land is genuine and free from stains.
- GIS allow information sharing by different users at different time.
- GIS is being used to identify hazard areas/zones, and predict the effects of climate change on sea level rise. (WGEA 2013)

Study Area

Nguru town is the head-quarter of Nguru local government area. It is one of the major five local governments in Yobe State. It is located along the Hadeja River with an approximate area of 916 sq. km. It is purely a grid iron pattern, the local government is divided into 10 ward; six (6) outside the head-quarter and the other four within the town; which fall under the Urban area. They are namely: Hausari, Tsohon Nguru Bulabulin and SabonGari Kanuri ward.

The study area is a portion of YBTP 101 residential layout (Nayi-Nawa) of Tsohon Nguru ward. Figure 2 below shows a satellite image of two Blocks of houses in NayiNawa District. The first Block has a total area of 536.84sqm (1761.3) with 50 parcels out of which 45 were developed and 5 were vacant plots. The second Block has a total area of 513.47sqm (1684.61ft) with 45 parcels out of which 43 developed while 2 undeveloped. The first block has the Following Universal Transverse Mercator (UTM) Coordinates (Point 1) 12°52'43.30"N, 10°26'38.00"E (Point 2) 12°52'44.26"N, 10°26'36.23"E (Point 3) 12°52'49.85"N, 10°26'40.22"E (Point 4) 12°52'48.81"N, 10°26'41.85"E. Similarly Block 2 has (Point 1) 12°52'44.49"N, 10°26'35.91"E, (point 2) 12°52'45.44"N, 10°26'34.27"E, (Point 3) 12°52'50.75"N, 10°26'39.00"E and (Point 4) 12°52'50.16"N, 10°26'39.89"E"N.

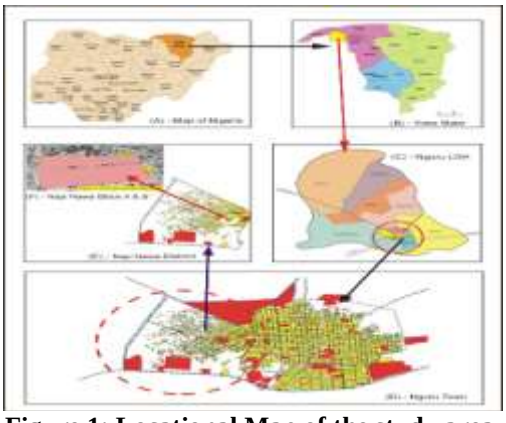

Figure 1: Locational Map of the study area

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Figure 2: Part of YBTP 101 NayiNawa District

Methodology (Software and Method)

Software: The following software were used in developing the GIS database: -

- ✓ ArcMap 10.3
- ✓ AutoCAD 2018
- ✓ GPS software/smart phone
- ✓ MS Excel 2013.

Methods

The Map of the study area was generated via the use of ArcMap software. Other maps such as ward map, District map, and Block map were also produced using the ArcMap. The maps were further symbolised. The required layout Image was scanned at 1200 dpi and imported into the AutoCAD. The scanned layout was digitised and positioned on to an imported satellite images of the existing study area of the township. This was further exported into the ArcMap and georefenced using UTM coordinates that were obtained from the field via GPS software. Details such as allocation number, name of owner, location, size, land use, etc. were inserted.

These attribute data that were obtained from the field via primary survey using questionnaire were used to form tables in MS Excel. The tables created accommodate other details such as address, sex, ward, neighbourhood, value of purchase if any, list of witnesses, transaction date etc. After all these procedures and processes, a rational database was created by integrating the different entities and linking them to their respective attributes.

Finally the User interface (database) was developed so that users of the program can have access to the database. Data can easily be entered, edited and updated

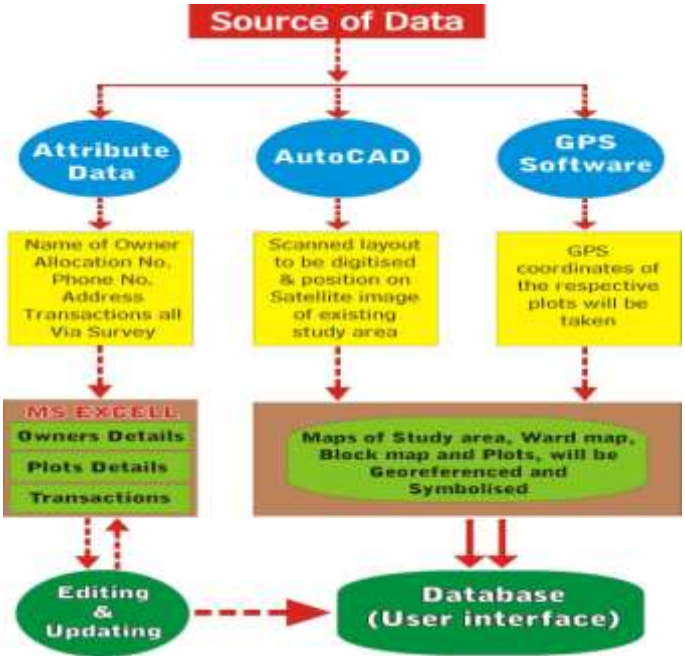

Figure 3: Flowchart of Methodology.

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III. RESULT AND DISCUSSION

Figure 1; shows the locational map of the study area; from the same figure 1 above, map "C" figured out Nguru Local government area; the local government is divided into 10 wards out of which 6 wards were located outside the local government headquarter. The area circled red are the remaining 4 wards which falls within the urban area (15km radius). From map (D) NayiNawa District was curved out.

Map (E) show NayiNawa District which represent the YBTP 101 residential layout.The study area (Map F) was demarcated out of NayiNawa District and represented by Block 1 and 2 and can be seen in figure 2 above.

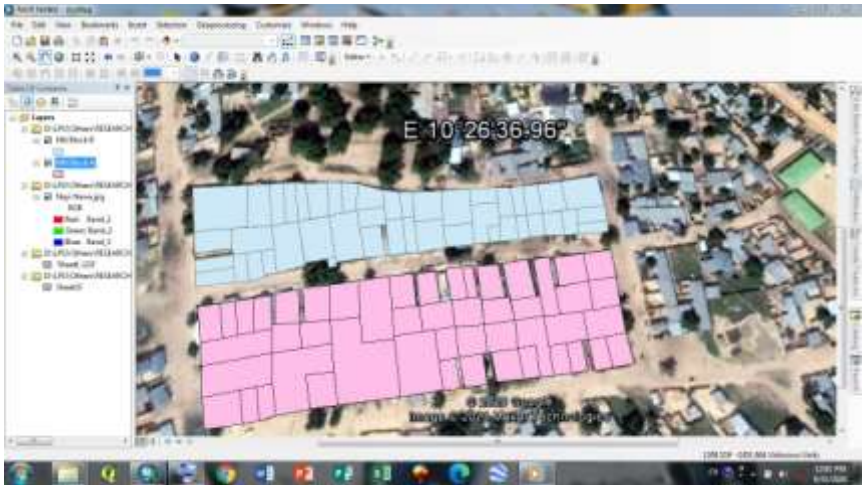

Figure 4: Geo-referenced and digitised Block A & B

The figure 4 shows the geo-referenced and digitised blocks A & B of NayiNawa district.

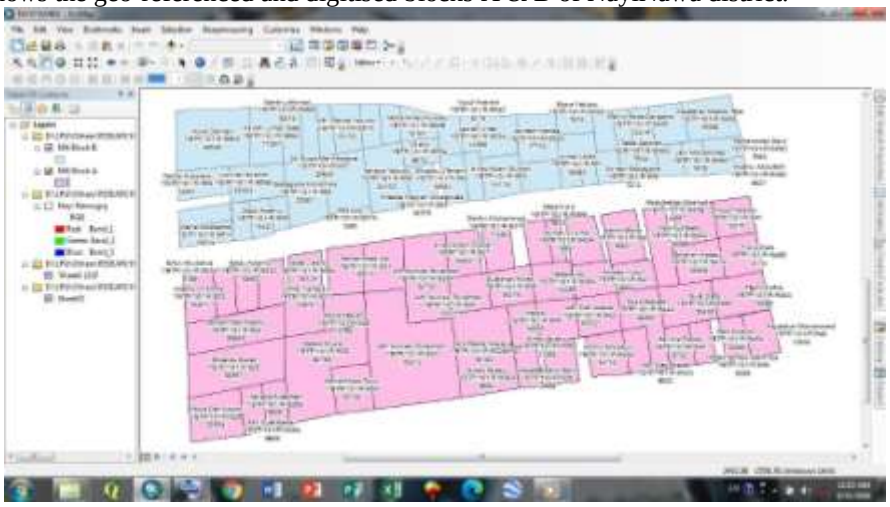

Figure 5: Labeled Parcels

Figure 5 shows the two blocks have been labeled with the names, allocation number and the approximate size in square meter. Other attributes can also be shown based on the intended work at hand

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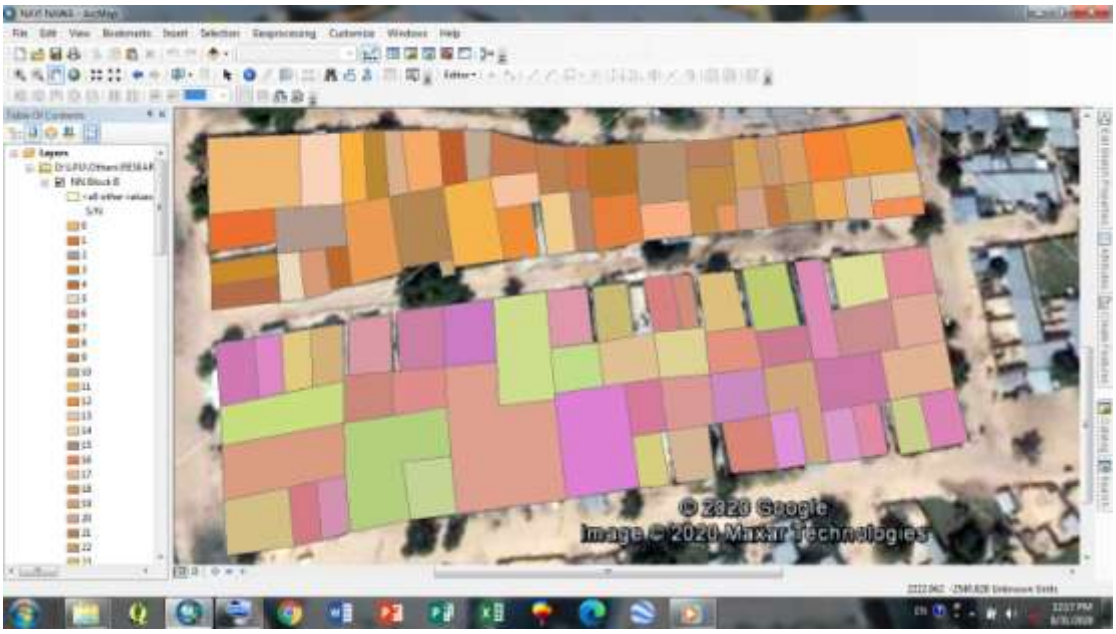

Figure 6: symbolised Parcels

The two blocks here (Figure 6) were symbolised with different colours. Symbolisation can be used to indicate or show land uses, population distribution, concentration of activities etc. For this study it shows the different plots and their respective boundaries.

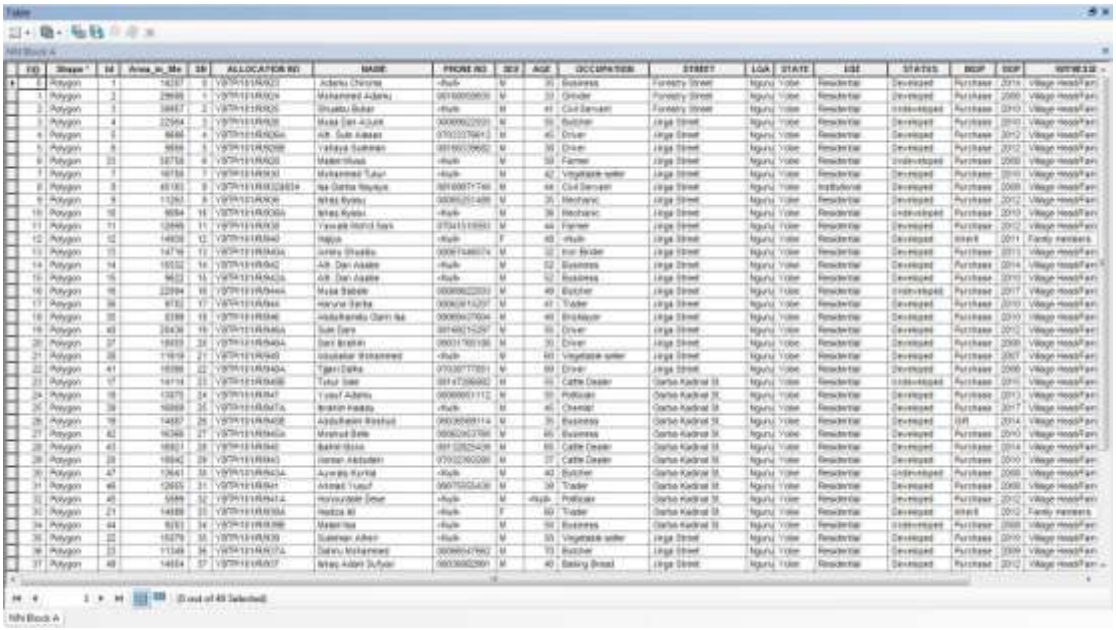

Figure 7: Attribute table of Block A

Figure7 and8show the attribute tables for the two blocks in figure 6 above that has been symbolised. The attribute table gives details such allocation number, Owner's name, Area of parcels in square mater, address, mode and date of possession (MOP/DOP) etc. The attribute table can be defined based on the require data. For this research work, details pertaining the plot, the owner and transaction were generated.

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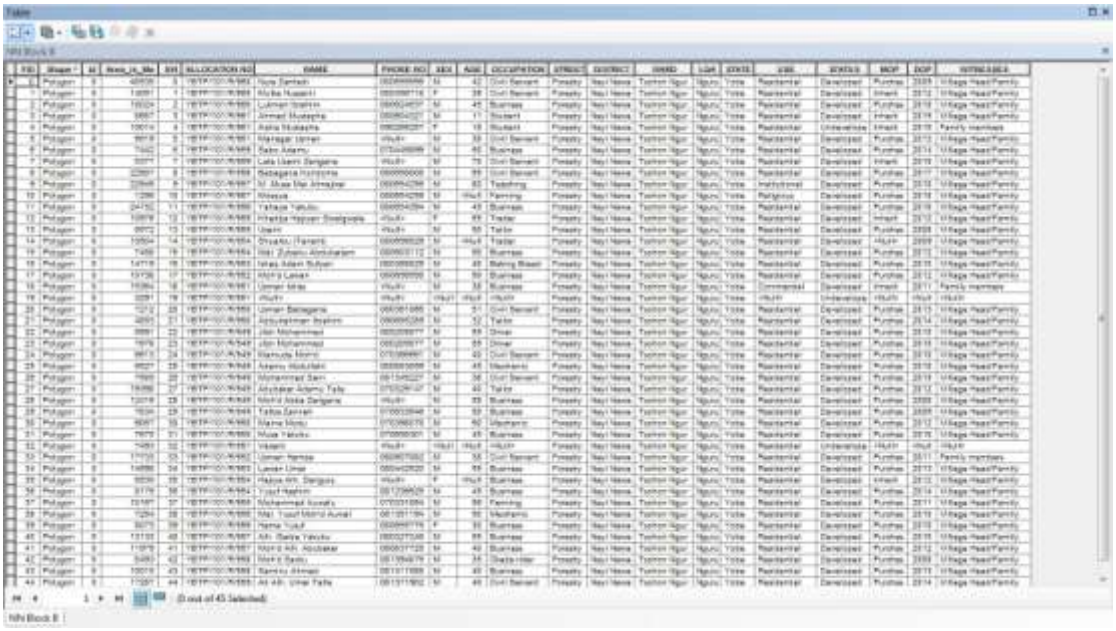

Figure 8: Attribute table of Block B

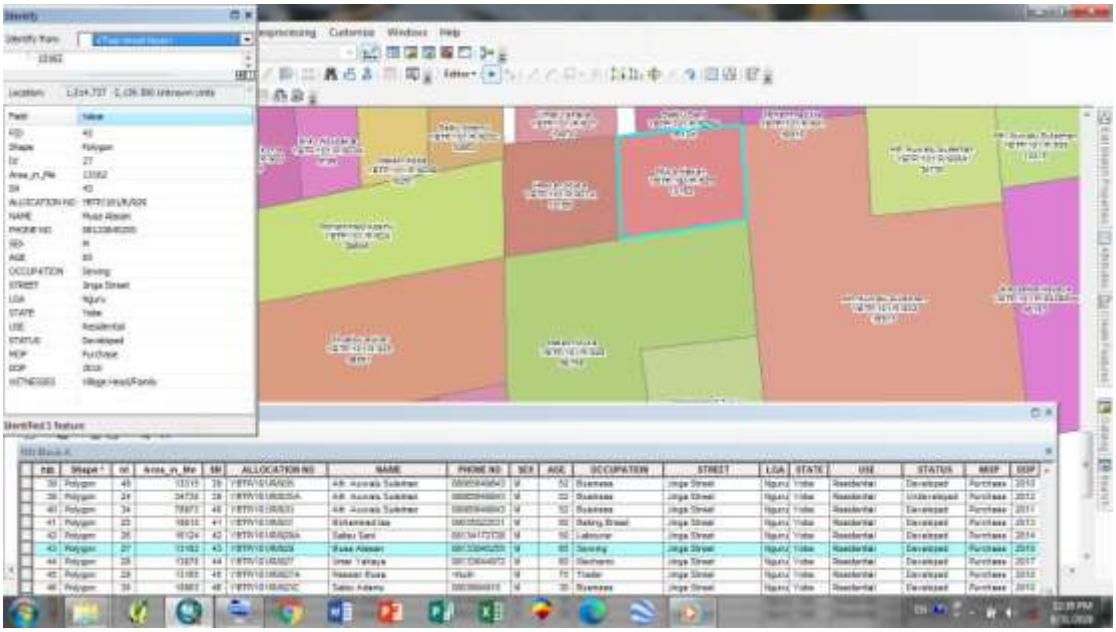

Figure 9: Query result showing details of parcel with allocation number (YBTP/101/929)

Figure 9 above gives the details of parcel with allocation numberYBTP/101/929 namedMusa Alasan. This can easily be access through the use of the Identifier icon by clicking on the parcel; as you can see on the left hand side of the figure. The identifier gives all the information stored regarding the parcel. This information regarding the each parcel can easily be edited via the attribute table by removing it from the "join and relates" field, then edit in the excel environment and finally update it by rejoining it to the "join and relates" field. Another way of editing or updating a parcel information is through the "User Interface". This will be discuss later in figure 13.

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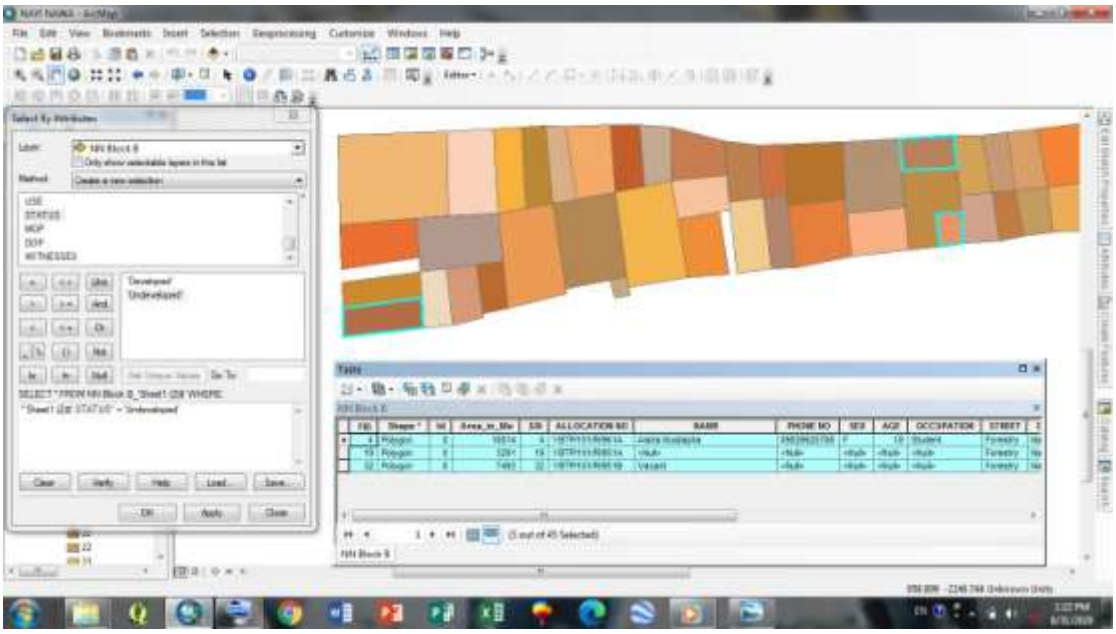

Figure 10: Query result showing undeveloped plots with their attribute tables

Figure 10 shows the result of undeveloped plots. This is to test the ability of the database created via query "by attribute". The result shows 3 undeveloped plots on the attribute table highlighted by light blue colour and same on the map. Similarly figure 11 below displayed the result of 15 plots highlighted in light blue colour that were less than 7500 sqm. This information can aid government and individuals in search of parcel for development.

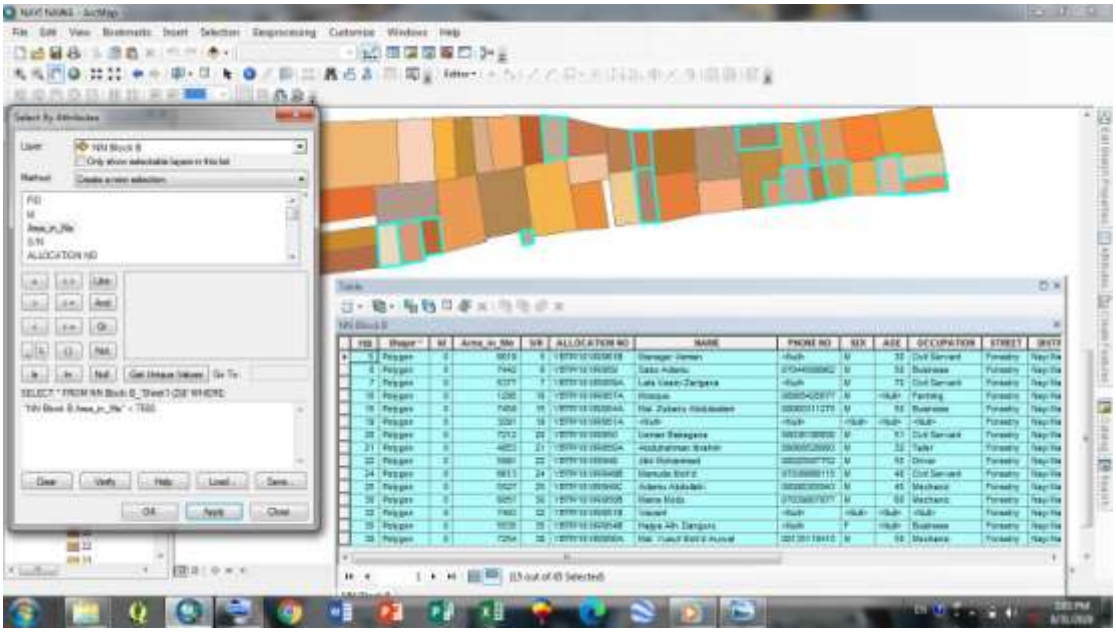

Figure 11: Query result showing plots less than 7500 square meter

The query result in figure 12 below gives information of 15 plots purchased from 2010 to 2011. This information help resolves court cases as per date of possession and the like.

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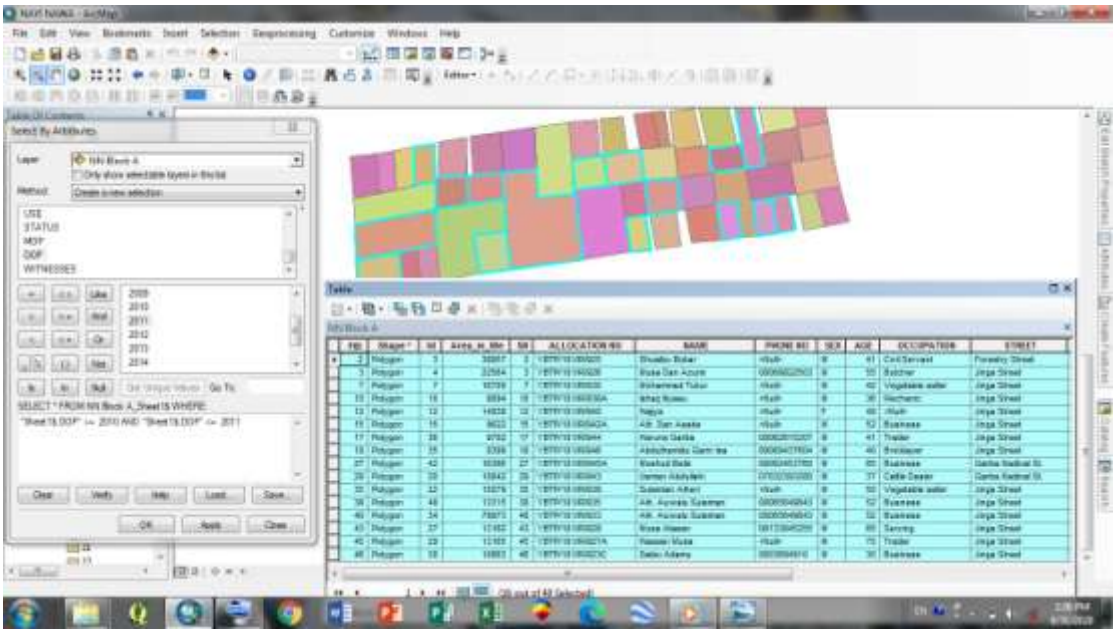

Figure 12: Query result showing plots purchased between 2010 & 2011

Expected outputs/Results (The GIS database/User interface)

The user interface serves as the database entry form that generate all the information regarding the parcels. All the fields require to enter the information will be provided and can be transfer directly to the excel file for further processing. Data can easily be enter and by pressing the "Enter" key button, and this will automatically generate the next form for subsequent parcels. The data generated can later be attach to the parcel in the ArcGIS via "join and relates" field.

The interface in figure 13 below has a "delete" button for removing any unwanted data from the database. The parcel can be selected and simply pressing delete to erase it out. On the event of mistake the "restore" button can be used. The "find previous" and "find next" buttons are searching buttons. The "criteria" button can be used to search for any information by inserting the search item i.e. owners name, allocation number, etc. Finally the "close" button is use to exit the form.

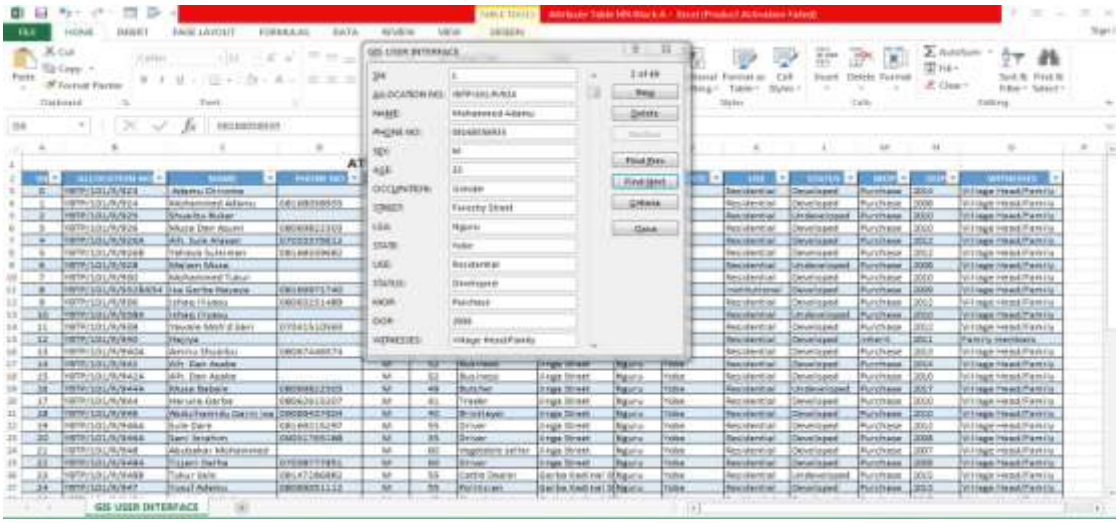

Figure 13: GIS User Interface

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Recommendations

For effective land management through the use of GIS, the following recommendations were necessary: -

I. There is need for Yobe state government to established its GIS office that will create a geospatial database for land management
II. Adequate fund should be budgeted for the acquisition of the necessary hardware, software and other peripheral devices required for the successful establishment of the system
III. Capacity training for staff members in the Ministry of land and other professionals such as planners, estate managers, valuers, etc. that are directly and indirectly involved in the implementation of the new system.
IV. Capacity training, orientations, workshops, seminars and certifications should also be required from time to time to other personnel who were engaged in land transactions such as property dealers, land owners, village/ward heads, stewards or brokers etc.
V. The property dealers and land brokers should be registered with the relevant authorities. And such persons should pay an annual tax and vat on every transaction.
VI. There is the need for an enlightenment campaign to the general public on the relevance of this GIS system and its benefits in reducing land disputes.
VII. It is also recommended to issue right of ownership certificate (C of O) to all the developed parcels within the existing area which have been documented in the GIS database; this will authenticate and guarantee tenure security and transparency among land owners as well as sanitised the system of land transactions in the future.
VIII. It is recommended to rescue the large amount of valuable data such as hard copy maps, plans and other related data that are slowly decaying in offices into the GIS database.
I. To be build much trust and confidence and to avoid forging of illegal document in land transactions, it should be made mandatory to every potential buyer and seller of land to authenticate from the GIS office whether the parcel is genuine and free from stains.
II. All land brokers and anyone who contract in the name of land should pay for authentication of parcel from the GIS office. This will generate revenue to the government.
III. Similarly after every transactions of land, those concern should update such information from the GIS office so as to effect such changes of ownership into the database. And such updates should attract charges for revenue purpose.

IV. CONCLUSION

This studies revealed that the GIS User Interface is an effective and efficient tool for land management. The current system or manual record can no longer phase with the contemporary system of information. The user interface can capture and digitised large amount of data within a short period of time; thus it is timely, reliable, simple, user friendly and easy to update.

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