

DEVELOPMENT OF AUTOMATED LAND INFORMATION MANAGEMENT SYSTEM (A Case Study of Bajabure Housing Estate, Yola, Adamawa State).

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Abstract

This paper focuses on the creation of a database management system through which information on a particular parcel of land in the study area can readily and easily be accessed. Most of our public agencies responsible for managing the environment (Town Planning Authority, Ministries of land and Survey, and environment.) have very limited data about the environment, where such data are available they are scanty and kept in paper files which age with time. An existing map of the area produced from the conventional ground survey method was used as the base map. Data collection was carried out using field techniques –taking inventories of the developed and undeveloped parcels, the state of the parcels (plots or buildings) and their present uses. Information on land ownership, and method of acquisition were obtained from the Urban Planning Department in Yola. The map used was obtained from the Ministry of Land and Survey, Yola-Adamawa State. This was scanned, digitized and Imported into the Arc view GIS (version 3.2) software package for manipulation. A database was created with the attributes linked to the spatial data using the text tool. An attempt was made to compare the digital database created with the analogue system of data storage. It revealed that any parcel of land can easily and readily be queried. The potential of the database was also tested by querying the data for some randomly selected parcels. Recommendation and suggestion on further research in this area of study include the establishment of a well equipped spatial information unit, checking activities of land speculators through monitoring, addressing “in field:” syndrome- that is, allocation of space provided for adequate ventilation in between adjacent plots, etc. Tracing the history of any disputed plot from the initial allocation was suggested as a means of establishing true ownership of parcel (s).

Introduction

Ground survey method is a technique in which positional data recording devices are land based as against aerial survey method in which information is aerielly acquired from aircraft platforms. However, the concern of this study is on the ground survey method. There are various methods, these include:

- (a) The theodolite traverse- in which the theodolite instrument is used for measurement of bearings and angles, and the distances chained out with a tape.
- (b) The compass traverse – in which the ordinary compass is used for reconnaissance survey, that is, preliminary survey of low order of accuracy.
- (c) The GPS – where the geographic coordinates of points can be ascertained and processed either in real time or post time to give rectangular coordinates.
- (d) The total station (electronic tacheometer) - in which bearing and distances, and elevation of points are recorded electronically.

Each of these methods would lead to the production of a map or plan, plotted based on computed coordinates from the measurements carried out. Details of all the features on the map or plan would be plotted. These maps or plans are normally useful for cadastral and commercial purposes. Information about survey data in the form of maps or plans, transaction details, coordinates, etc are normally kept on shelves in the ministries, subject to

rust, obliteration, shrinkage, mutilation and or loss of information(data). The geographic information system (GIS) is a computerized tool for acquiring, analyzing, manipulating, retrieving, displaying and management of geo- referenced information.. GIS has the advantage of storing information that can hardly be tampered with through obliteration, mutilation, shrinkage or loss of documents if well protected.

This study is concerned with the integration of ground survey data, specifically data obtained by the use of the theodolite instrument and GIS for spatial information management. Spatial information is information that occupies space and can be referenced to the earth surface.

Study Area

The Saleh Michika Administration of Adamawa State, for the then state legislators acquired the Federal Housing Estate, Bajabure from the Federal Ministry of Works and Housing in 1992. It is on an expanse of land that covers about 2km² in size, it is located along the Viniklang- Girei road. The latitude/ longitude coordinate range from 09° 19' 02"N in the south to 09° 19' 06" in the north. In the east- west axis, it ranges from 12° 28' 05"E to 12° 28' 08" E (Germin 12 personal Navigation GPS). Although the Legislators accepted these houses, they refused to occupy them as they claimed the estate is at the outskirts of the town. The control and administration of the estate was entrusted to Urban Planning Authority, Yola. However the surveying aspect is handled by the State Ministry of Land and Survey. This means that both Ministries have interest or stake in matters concerning the estate and this resulted in land speculating from the staff of the two bodies. Officers in charge of the estate are hardly identified, as any of them can easily pass for a land speculator.

Statement of the Problem

With the increasing demand for plots and buildings within the estate and its surrounding areas, certain problems were identified. Most of the buildings have either no documents or have duplicated documents, which means the real owner of a plot or building within the estate is hardly ascertained. Records kept by the Land and Survey Department are usually in conflict with that of Urban Planning Authority These include the lack of proper documents to show who owns what building / plot in the area. This has resulted in difficulties in any case of dispute thus making litigation difficult. Litigation often arises whenever structures, to be precise buildings need to be erected by the acclaimed owner of a plot in the estate.

Secondly, pillar positions demarcating adjacent boundary of plots/ buildings are normally shifted by dubious owners to increase the size of their plots leading to quarrels.

Thirdly, information about the land (estate) cannot be easily obtained, and if there are, it would either be in a mutilated form and or prone to loss of information due to shrinkage or rust.

Urban Planning Authority has also failed in its role in controlling development of structures in the area leading to inadequate ventilation and poor sanitary condition in the estate. If the above problems are not properly addressed, the consequence would be that at the end of the day, no information on land in the estate would be taken seriously –there would be no reliable data for use either within the estate or outside it. This hampers physical development.

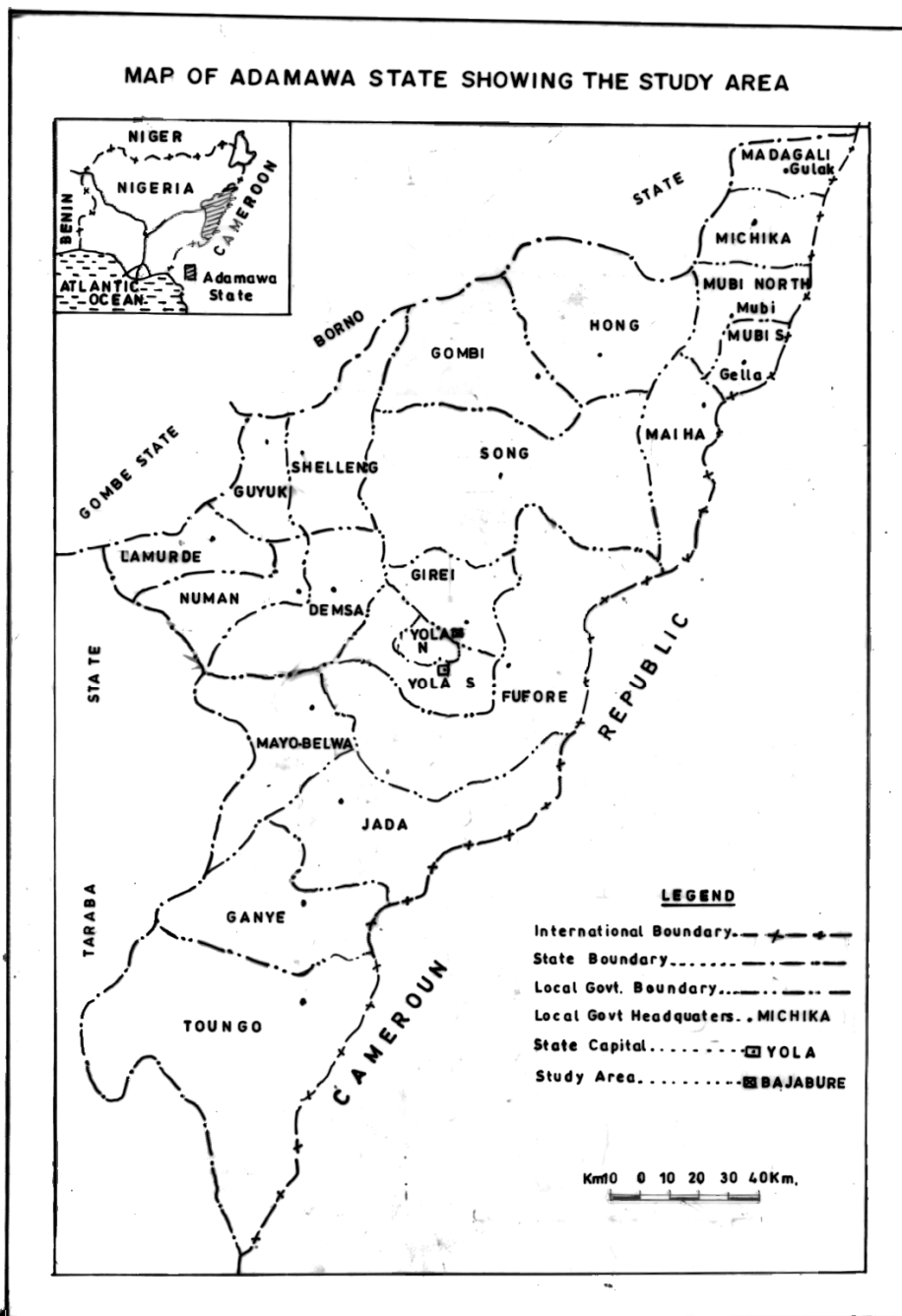


Fig.

Source Ministry of Land and Survey Yola

1.0 MAP

SHOWING LOCATION OF STUDY AREA

AIM AND OBJECTIVES

The aim of this study is to develop a reliable information management system so that management of spatial information and its associate attributes within the study area can be made with maximum ease. The information stored in the computer would be database management information that can easily be accessed by any user of information related to the estate

The objectives would be to provide such information like;

- (a) Who owns what plot / building in the estate?
- (b) What is the location number of plot / building and their use?
- (c) What is the extent of the plot / building?
- (d) What is the mode of acquisition (allocation / purchase?)

This research is with the view to obtaining a database management system for dealings in land in the estate and for subsequent application in other projects on it in similar area.

A Review of GIS Spatial Information Management

Many researches have been carried out recently on the use of GIS integrated data for modeling of the environment. The availability of spatial data which can save time and cost of data capture for study have encouraged the modeling of urban land use of Seberang Perai Tengah in Malsysia which resulted in the provision of several digital parcel plots, public facilities, and road network with many attributes (Faris and Rainis, 2002).. Remotely sensed data combined with ground reconnaissance have been used to produce spatial and non-spatial information like coordinates, area, location, land use pattern, and environmentally fragile areas in Delhi region of India. A map of scale 1:5000 was scanned and raster to vector conversion was carried out, each feature of the point, line and polygon digitized was labeled. These labels were used as identifiers to link the attribute data to each feature and the digitized thematic maps were then imported into Arc /INFO as coverage (Kaur, et al, 2002).

One of the most important contributions of ground survey data according to Ashok and Porti (2000) is its basis for the provision of cadastral information that is, demarcating land extent and ownership. Information on existing land use condition is useful for determining land potentials available for development. This has encouraged orderly growth of cities and regions in the developed countries. Land information is crucial for planning and development, the rapid pace of development in many of the world's cities, while bringing high growth rates also brings with it heavy burden on land. To ensure that the high growth rates can be sustained, it is imperative to plan for an effective land information system (LIS).

Several countries in Asia have advocated for the establishment of land information system units, like Computer Assisted Land Survey System (CALs), Computerized Land Registration System (CLRS) and National Infrastructure for Land Information System (NILIS) (Aziz, et al, 2002).In the USA., the geographic information North Carolina has provided a National Database-a corporate geographic database; which showed and displayed Federal lands at different locations on a digital map (GINC, 2003). In Australia, about 70% of the land has been classified as forests, National Parks and other purposes (Clorke, 1989), this information is useful to tourists visiting Australia.

A cursory look at the reviewed studies shows developments in the acquisition of geo-spatial data in the west and Asian countries Africa at large is yet to make remarkable impact in the field of land information system (Dale and Mclaughlin, 1989).However, recent developments have shown that efforts are being made on the African continent for the development of mechanism for geo-spatial data acquisition. In Nigeria, the National

Geographic Information Infrastructure (NGII) is geared towards obtaining current information on land and geographic information. The already started/ on going digital documentation of lands within the Federal Capital Territory under the auspices of AGIS, Abuja Geographic Information System, is a right step in the right direction. Many countries in Africa have established National Spatial Data Information (NSDI) centre for effective collation, processing and management of spatial information .Ghana for instance has established the National Framework for Geo-spatial Information Management (NAFGIM). South Africa has adopted the name National Spatial Information Framework (NSIF) (Adeoye, 2004). All aimed at achieving the same objective of providing information on land and its related resources for meaningful planning and development. Though much has been said about digital spatial and non-spatial data, it is not 100% error free. In short, it only provides a better form of storage of spatial and non-spatial information; digital data management has the ability to translate project efficiencies into project cost savings (CEI, 2003).

The reviewed texts have also shown that the use of ground survey for integration with GIS is gradually becoming less prominent as aerially acquired data are gradually gaining ground. It is clear that with the lukewarm attitude of government towards the development of a viable remote sensing institution for obtaining information(aerially) for planning purposes, one cannot but attempt to use the ground survey data and GIS for planning and management of spatial information at the micro-level. This I believe would trigger a further study in this area of geo-informatics and hence the need for this study.

Methodology

Data Collection

The method adopted for the collection of data was that which took into consideration the complexity of the data required. Inventories of the spatial and attribute data were taken simultaneously in order to avoid misrepresentation of facts on the base map used. The results of the two were harmonized with the information collected from the Ministry of Land and Survey and Urban Planning Authority to produce a refined data for use in the subsequent processing of data information.

Field Technique

Prior to going to the field, the map of the estate was obtained from the Ministry of Land and Survey. This was a map produced earlier using the conventional ground survey method, precisely the theodolite traverse. This map was reduced from a scale of 1:1500 to a scale of 1:2000, the map reduction became necessary in order to fit into the scanner size and also for its portability when used for taking inventories of spatial and non-spatial data .The land parcels were given identity name for easy recognition. This served as the base map for this study. The nature of the physical features on ground was identified (plots, buildings, e. t. c.) and their positions marked on the map. The use to which these facilities were put was also noted. Information on owners and the initial use for which the buildings and plots were intended and mode of acquisition were obtained from the Urban Planning Department. The sum of information gathered, that is, that gotten from Urban Planning, Ministry of Land Survey and from the field inventory were put together and evaluated.

Spatial data (plots/building) were identified based on the function they serve, Individuals plots and buildings were allowed to carry their names as the identifier, places of worship like churches and mosques were given the identifier name "social facility". Other facilities other than the two mentioned above were given the identifier public building/facility-post office, nursery/primary schools etc.

The reduced map was scanned and imported into the Arc view GIS software package which was appropriately geo-referenced and rectified. On-screen digitization was carried out using the standard mouse. Land parcels were digitized into vector polygons. For each polygon digitized a new record is created automatically on the theme table. Appropriate attribute data will later be inserted into the relevant field within the record while the roads were digitized as vector line data. Labels for each of these spatial data were inserted using the text tool. Three layers were created: the entire frame of the parcel, the buildings and plots and the road network. These were overlaid to produce the digital map of the estate, the spatial data.

The logical procedure for scanning and the digitization process is shown below

Digital Database Creation

The acquisition of spatially referenced data in a computer –compatible form is a fundamental importance to any GIS project. This requires the design of a database structure-the representation of data model designed to reflect the recording of the data in a computer. This is called logical design of data or data structure (Kufoniyi, 1998).

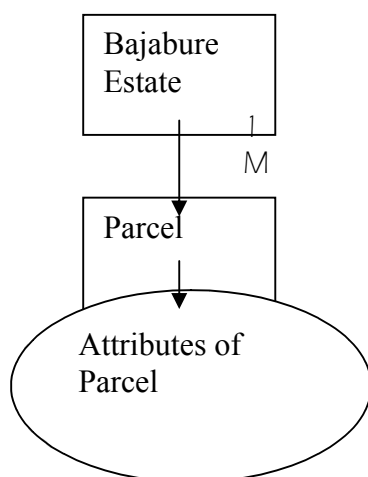


Fig. 2.0 ENTITY RELATIONSHIP DIAGRAM

The number 1 and M above stand for "one for many". This is a relationship between tables, whereby one record in one table is linked to many records in a second table. In Arc view, the process of digitizing vector polygons automatically creates and updates the theme table to reflect changes in the spatial data. A theme table is the table that is directly linked with the spatial data.

Six fields were created – parcel ID, owner, state of facility, area, present use and initial use. The shape of the field was created automatically as polygons in the spatial data.

The creation of the database would only be complete if the attribute data are entered against the spatial data. The “add/ start/ stop “editing modes were used. Row and columns were created, the columns show the attributes of the plots and buildings, while the rows show the created polygons through which the plots and building can be identified. Each of the attributes entered against the spatial data was saved by clicking the “yes of the save mode to save the entered data. This was done for all the spatial data.

Results and Discussions

The result obtained was the creation of automated land information management system for the estate. The created database shows a spatial management information system through which information on a particular parcel of interest in the estate can be readily made available by querying the database.

Information displayed will either show the spatial data or its attributes, the database can be queried using its structure, location or some other forms.

Table 4.1 shows a displayed attribute data of some parcels, a scan through would enable one to obtain the necessary information related to the displayed parcels of a particular polygon or polygons (building /plot) - representing the spatial data in this case.

The spatial data can also be queried to show the attributes for a specific parcel as the case may be.

Shape	Parcel ID	OWNER	STATE OF FACILITY	AREA(sq.m)	ACQUISITION	PRESENT USE	INITIAL USE
Polygon	186	Tsandu Ismail	Building	1000	Purchase	Residentia	Residential
Polygon	185	Dike Samuel	Building	1000	Purchase	Residentia	Residential
Polygon	183	Shallangwa John	Plot	1000	Purchase	Vacant	Residential
Polygon	184	Zubairu Ahmad	Building	1000	Purchase	Residentia	Residential
Polygon	182	Ayuba Muva	plot	1000	Purchase	Vacant	Residential
Polygon	180	Habu Saidu	Plot	1000	Purchase	Vacant	Residential
Polygon	181	Tagwi Nurva	Building	1000	Purchase	Vacant	Residential
Polygon	178	Malum Haruna	Building	850	Purchase	Vacant	Residential
Polygon	179	Emma John	Building	850	Purchase	Vacant	Residential
Polygon	176	Peter Buba	Plot	850	Purchase	Vacant	Residential
Polygon	177	Jabu Tiya	Building	850	Purchase	Vacant	Residential
Polygon	174	Not Certain	Plot	850	Purchase	Vacant	Residential
Polygon	175	Not Certain	Plot	850	Purchase	Vacant	Residential
Polygon	172	Not Certain	Plot	900	Purchase	Vacant	Residential
Polygon	173	Not Certain	Plot	850	Purchase	Vacant	Residential
Polygon	134	Public Facility	Parking Lot	0	Allocated	Parking Lo	Parking Lot
Polygon	171	Not Certain	Plot	890	Purchase	Vacant	Residential
Polygon	168	Haruna Ali	Plot	1080	Purchase	Vacant	Residential
Polygon	170	Hilary Malla	Plot	1000	Purchase	Vacant	Residential
Polygon	169	Kaka Philip	Plot	1110	Purchase	Vacant	Residential
Polygon	144	Not Certain	Plot	1200	Purchase	Vacant	Residential
Polygon	143	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	142	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	141	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	139	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	140	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	137	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	138	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	135	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	136	Not Certain	Plot	1100	Purchase	Vacant	Residential
Polygon	119	Paul Taumi	Building	1010	Purchase	Residentia	Residential
Polygon	118	Not Certain	Plot	1010	Purchase	Vacant	Residential
Polygon	117	Bawa Garba	Building	1010	Purchase	Residentia	Residential
Polygon	116	Mumini Abdul	Building	1050	Purchase	Residentia	Residential
Polygon	115	Sadii Stabu...	Building	1000	Purchase	Residentia	Residential

Table 1.0 ATTRIBUTE DATA OF SOME PARCELS

Fig. 4.2 shows the output when the database is queried for a particular parcel structure, I. D. 187. Parcel 187 when highlighted and clicked with the mouse, would reveal the content of the attributes – the owner, the state of facility, the area extent, the present use, and initial use. The data may also be queried in some complex form. Fig. 4.3 shows all

parcels with area extent equal to or less than 860 square meters. This form of query is useful when carrying out ample studies.

The above discussion shows that the power of the GIS created database is very enormous, it has been able to access at glance and with ease the attributes of the spatial database for the estate; it has also been able to access with ease information on any specific parcel of interest in the estate. It also with ease has been able to achieve data grouping or association in the database.

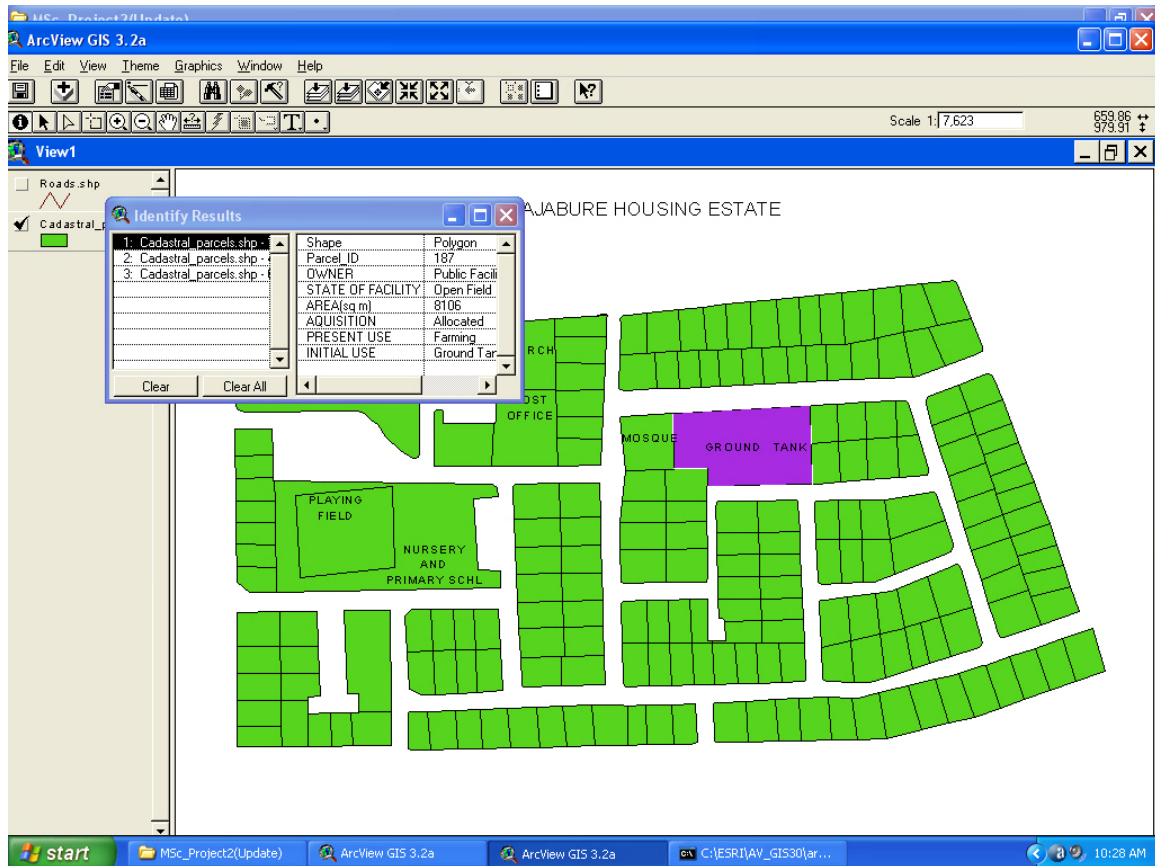


Fig. 3.0 Queried parcel ID 187

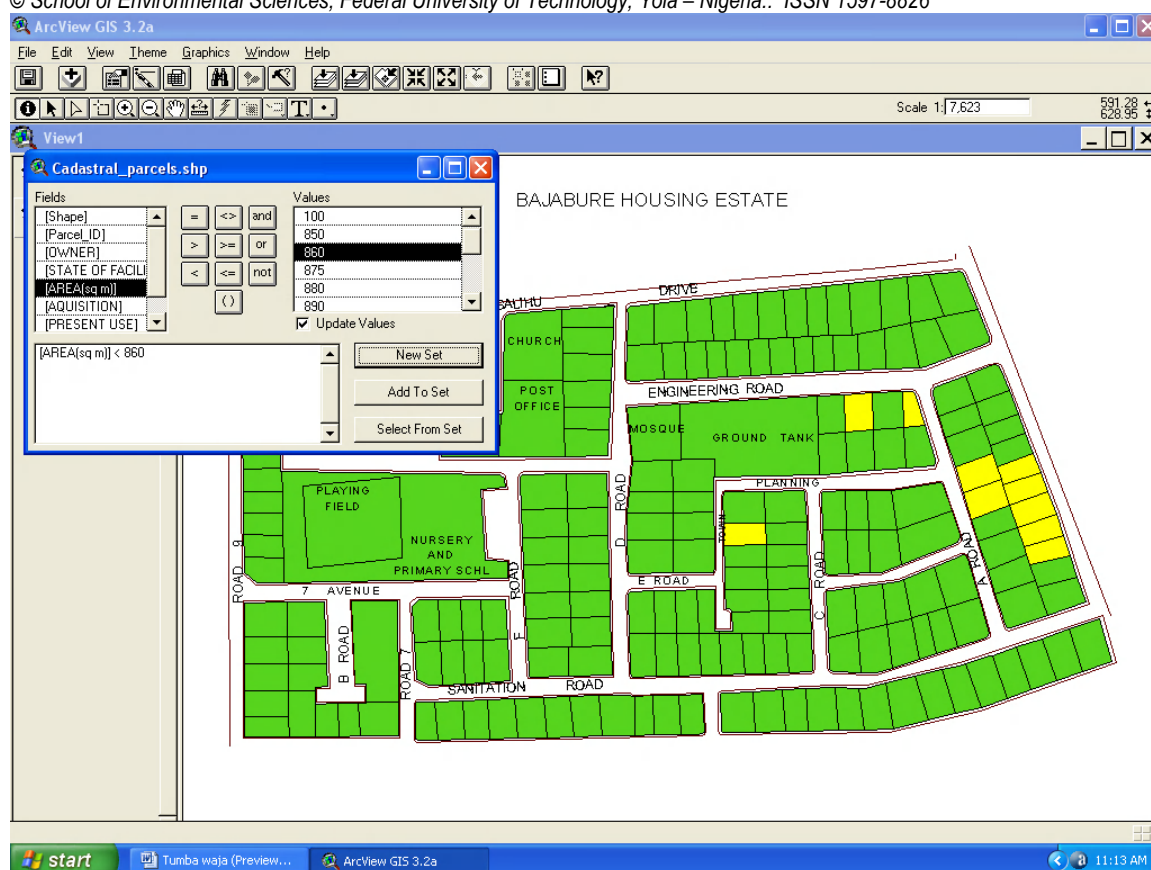


Fig 4.0 Parcels with area less than 860 sq m.

Analogue and Digital Information: A Comparison

Analogue information refers to one in which the information obtained is derived from measurements or operations carried out based upon the quantitative physical behavior of its components. An example of this is the measurement carried out on a map to obtain the distance between one or two points. A cord and or ruler as the case may be are stretched between the points and the distance noted by human judgment. This is then placed on a linear scale and the actual distance on the ground determined. This is an analogue measurement.

In digital measurements, information is represented or coded in numbers (numerals from 0-9). Electrical signals that are conveyed via electric wires to electrical chip perform the operations in digital information. The conveyance of information in digital system is fast, so also is the output or expected result.

It is also a known fact that paper can not withstand moisture, this causes it to shrink, loose its form and size and also its contents. Paper is also easily subjected to obliteration leading to loss of information. Most analogue information is kept in paper form.

They are normally kept in stores or offices, and at best when taken care of are kept on shelves or filing cabinets. Apart from its lack of security, the storage capacity in its self is inadequate when compared with the storage of information in digital form. Apart from the computer's primary storage capability- which is inbuilt, information can also be stored in a floppy disk, compact disk (CD) and flash disk. There is also the flexibility with which digital data can be manipulated. The files in a database are linked and information retrieval is fast,

unlike the analogue, which involves going from one office to the other to check for information related to a particular file.

The digital information is relatively secured by the use of pass words compared to analogue information, which is open to all who can have access to the stores or filing cabinets. However, in spite of all these advantages over the analogue system, the digital information system is capital intensive - both in equipment procurement, personnel training and management.

Summary, Conclusion and Recommendations

This research highlighted the use of ground survey data and GIS for spatial information management and planning for Bajabure Housing Estate, Yola. It is an attempt to create a database management system that could mitigate the problem associated with the conventional method of keeping data in analogue form.

Already produced map using the conventional method of ground survey was used as the base map for the study. Field studies were carried out to delineate the attributes of the spatial data. The data collected were evaluated and the necessary adjustments and refinements carried out to make the data usable without ambiguity.

Scanning was done and the result imported into the GIS Arc view (version 3.2) for onscreen digitizing. The attribute data were linked with the spatial data and a database created from which the database could be queried to display its contents on any information required.

From the comparison made between analogue and digital information, the result showed an improved system of data storage that could be easily retrieved and manipulated. Queries were carried out for some selected parcels of interest to demonstrate the capability of the GIS in efficient management and provision of information that could be used in future planning of infrastructure in the estate.

Basically, the research has been able to achieve its aim and objectives in the provision of information on who owns what in the estate, how it was acquired, and the state of the facility and the extend of development in the estate, and the use to which these facilities are put. These pieces of information when properly managed and supported with the right decision would go a long way in solving the problem stated in the research.

The research has been able to prove that the use of ground survey data and GIS is relatively better than the use of the conventional ground survey method alone in information management and planning for the estate.

Based on the discourse above, the following recommendations are pertinent;

- (a) That a spatial information management unit be established in the Ministry of land and Survey equipped with the necessary modern facilities- computers, scanners, digitizers, and so on to man information on land resources.
- (b) Activities of land speculators should be checked through continuous monitoring of physical developments and the database to confirm the legality of interest in the estate.
- (c) Government should adequately address the syndrome of "in field" - allocation of space between existing layout plots in the estate as this would hamper proper ventilation and sanitary condition of the estate.
- (d) Urban Planning Authority should redouble its efforts in monitoring and controlling of developments in the estate to save guard alteration of the master plan.
- (e) The expected spatial information unit as a matter of convenience should be handled by the planning authority.
- (f) Proper public enlightenment campaign should be carried to avail the public and other interest groups with interest in land of the opportunity provided by this information system.

- (g) In order for the entire setup to work, staff training in the use and maintenance of the facilities provided should be of priority to the stakeholders.
- (h) Government should support this setup with clearly stated decision on the integration of automation technology in all aspects of land resources management and planning.
- (i) It is recommended that in order to ascertain the true owner of a parcel of land the history of initial allocation should be traced to the current owner of the plot.

References

- Ashok, G. and Potti, K. R. (2002): Building land information system from cadastral maps, [www.gisdevelopment.net](http://www.gisdevelopment.net/applications). Net/applications.
- Aziz, W., Majid, K. and Sahrin, S. (2002): Cadastral reform in Malaysia; A Vision into the 2000s. [www.gisdevelopment.net](http://www.gisdevelopment.net/application) Net/application
- CEI (2003): Surveying, CEI. Inc. Oklahoma. www.Cadinalengineers.com/services/surveys.
- Cloke, P.J. (1989): Rural Land use Planning in Developed Nations. Unwin Hyman Ltd, London.
- Dale, P. F. and McLaughlin, J. D. (1989): Land Information Management .Clarendon Press Oxford.
- Faris, M.and Rainis, R. (2002): An application of GIS to model Commercial land use development. [www.gisdevelopment.net](http://www.gisdevelopment.net/application) /application
- GINC (2003): National Database; www.cast.Uark.edu/local/catalog/national.
- Kaur, A., Dutta, V. and Chandha, D. K.(2002): Application of Remote Sensing and GIS tools in Delineating Environmentally fragile- areas for sustainable land use planning. A case study of Delhi region. www.gisdevelopment.net/appliaction
- Kufoniya, O. (1998): Database Design and Creation, Principles and application of GIS; Ezeigbo(ed). Panaf press Ltd, Lagos.
- Adeoye, A.A. (2004): National Geographic Information Infrastructure for sustainable Development in Nigeria in Geo-information for Sustainable Development in Africa, Ayeni et al (eds). AARSE