Application of Geographic Information System (GIS) in Tenement Rates Collection

Felix IYIOLA, Ekpo EFFIONG and Mohammed Bello ABUBAKAR, Nigeria

Key words: Tenement, GIS, Database, Ratable Value

SUMMARY

Local Government councils are faced with difficulties in the sourcing of adequate revenue from Federal government, State government and internally generated revenue. The expected internally generated revenue is not realizable due to lack of appropriate records, dishonesty on the part of officers collecting revenues and faulty machinery put in place for revenue collection. Revenue generation by local government in Nigeria comes from various sources such as tax, statutory allocation from state government, local rates on markets and shops, permits and fines charged by customary courts, tenement rates, naming of streets, signboard and advertisement permit fees, marriage registration fees, birth and death registration fees, radio and television licence fees, wrong parking charges, motor park levies, merriment and road closure levies, etc. The aim of the study was to apply Geographic Information System (GIS) for the effective collection of tenement rates at Local Government level. Methodology adopted included database design, acquisition of geometric data through ground survey methods, acquisition of attribute data, database creation, and spatial analyses. The study suggested others sources of revenue generation for local government and ways of improving on internally generated revenue.

ABSTRACT

Local Government Area councils have many departments which perform various functions and manage different revenues such as tenement rate on properties within their geographical areas. It is obvious that the present system of tenement rate administration in the country is based on manual method which is inefficient, time-consuming and prone to error and abuse. The manual method adopted by our administrators is due to lack of awareness of benefits offered by GIS in tenement rate administration and their refusal to apply GIS for various reasons. This study examines the use of Geographic Information System (GIS) for efficient and effective tenement rate administration in Local Government Area councils, it also highlight various functions of local government. The methodology adopted in this research work involved database design, geometric and attribute data acquisition, spatial database creation in ArcGIS 9.3 and various spatial operations to demonstrate the use and application of GIS for revenue generation at local government level. The results showed land use classification in the study area, land value and land ownership. The capability of spatial database for providing accurate and reliable information to town planners and decision makers was also demonstrated and the study made useful recommendations for policy makers.

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1. INTRODUCTION

Local government can be regarded as a sub-unit of government by a local council which is authorized by the central government to pass ordinances having a local application and levy taxes within limit specified by the central government. One of the functions of local government councils is assessment of privately-owned houses or tenements for the purpose of levying rates. Local government should be seen as an instrument of development at the grassroots level and what is required is to plan resources mobilization and translate these into services. The major functional areas that could generate revenue for the local government are rates and TV licenses, market/park or tenement rates or property tax. Markets are the major sources of internal revenue in the rural areas while property rating, markets or parks are for urban centers. Local Government Area councils have many departments which perform various functions and manage different revenues like tenement rate on properties within their geographical areas. It is obvious that the present system of tenement rate administration in the country is based on manual method which is inefficient, time-consuming and prone to error and abuse. Tenement rate collection and administration can be done with the tools available in Geographic Information System (GIS). Geographic Information System is an integration of computer hardware, software and data for capturing, managing, analysing and displaying all forms of geographically referenced information ESRI (2012). GIS allows users to view, understand, interpret and visualize data in many ways to reveal relationship, patterns and trends in the forms of maps, reports and charts. GIS is very useful and applicable in Local Government administration, most especially in tenement rate collection.

2. STATEMENT OF PROBLEM

The present system of tenement rate collection in the country is based on manual method which is inefficient, time-consuming and prone to error and abuse. This study intends to use Geographic Information System (GIS) for effective tenement rate collection for development at the grassroots.

2.1 Aim of The Study

The aim of this research work is to apply Geographic Information System (GIS) for the effective collection of tenement rates at Local Government level.

2.2 Objectives of The Study

The objectives of the study include:

i. Database design

ii. Geometric data acquisition using Ground Survey methods

iii. Attribute data acquisition using social survey

iv. Database creation

v. Spatial analyses

vi. Analysis of Results

vii. Ways of improving Local Government Revenue Generation

2.3 Study Area

The study area is part of Busari Olarinre Scheme in Atiba Local Government Area, Oyo State, Nigeria. The site is along Oyo – Ogbomoso road in Oyo town and it lies between latitudes 07° 51' 17" N and 07° 51' 42" N and longitudes 03° 57' 16" E and 03° 57' 54" E.

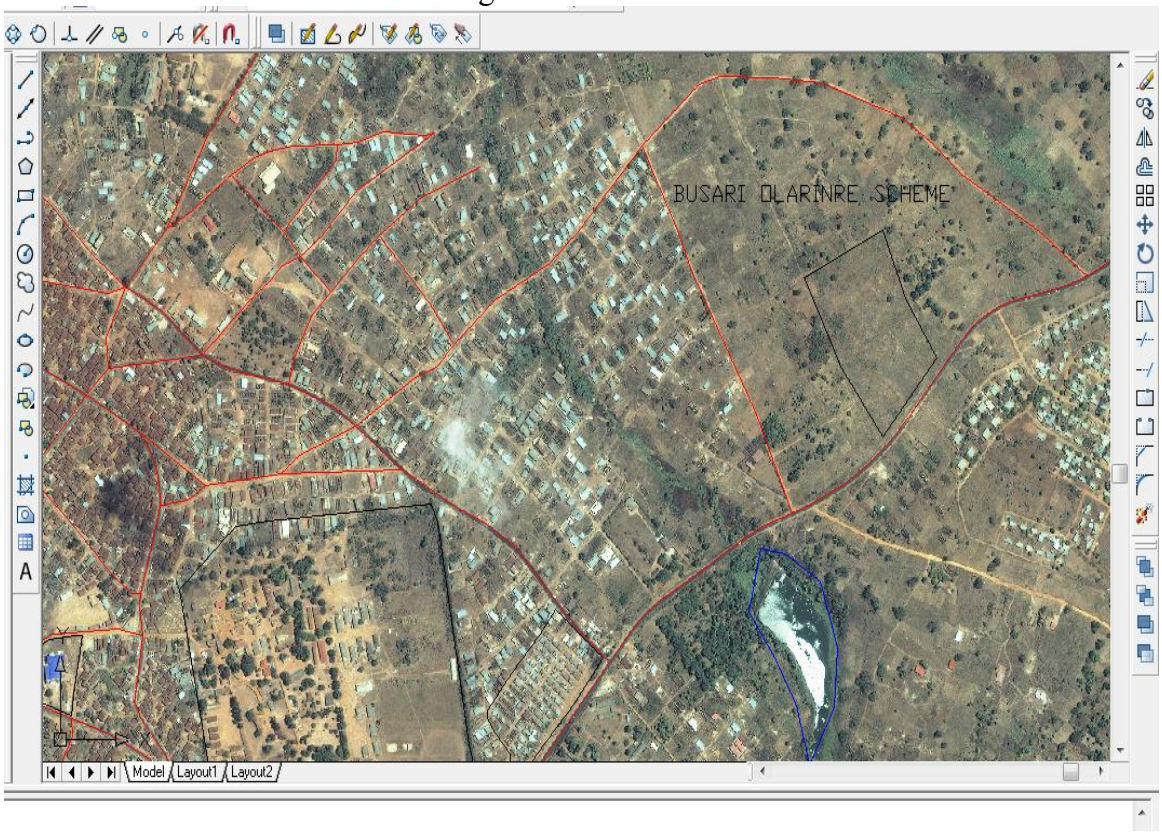

Figure 1: Map of Study Area plotted on IKONO image

3. METHODOLOGY

This section deals with database design, collection of geometric and attribute data and database creation.

3.1 Database Design

Digital database design is one of the core tasks in developing any GIS application, it is also called data modeling which is the process by which the real world entities and their inter-relationships are analyzed and modeled in such a way that maximum benefits are derived while utilizing a minimum amount of data Kufoniyi (1998).

This section focused on the step by step approach to design and create the digital database for the study area.

This process involves two phases. These are:

- The design phase
- The construction or implementation phase

The design phase consists of three stages namely:

- Conceptual design
- Logical design
- Physical design

Conceptual Design: This has to do with the representation of human conceptualization of reality and the objective is to determine the basic entities, the spatial relationships among the entities and attributes of each entity. Entities in the study area and their relationships were identified and appropriate data model chosen to represent them, the entities are land parcels and access roads. Vector data model was employed where entities were represented as lines and polygons.

Logical Design: It is the representation of the data model, designed to reflect the recording of data in computer system. The phase translated the conceptual design into data structure using the hierarchical, network or relational approach. For the purpose of this project, the relational data model was adopted. Burrough (1986) stated that in relational database structures data are stored in simple records known as Turple (row) containing a set of attribute values that are grouped in two dimension tables known as relations. Each table contains items or data called field about some objects. The objects are found along rows and field or attribute values along columns.

Road Table (R_ID, R_Length, R_Status)

Parcel Table (P_ID, O_Name, P_Use, P_Status, P_Per, P_Area)

Table 1: Entities and their attributes

S/NO	ATTRIBUTE	DESCRIPTION
1	R_ID	Road Identity Number
2	R_Length	Road Length
3	R_Status	Road Status
4	P_ID	Parcel Identification Number
5	O_Name	Owner's Name
6	P_Use	Parcel Use
7	P_Status	Parcel Status

8	P_Per	Parcel Perimeter
9	P_Area	Parcel Area

3.2 Dataset Required

Secondary data was used for this study, the layout plan with Autocad Drawing file of the scheme were collected from the Survey Unit of the Local Government. Attribute data for the scheme were simulated.

3.3 Hardware Declaration: Hardware for this study included:

i. HP Laptop

ii. HP 1280 deskjet printer (A3 size)

3.4 Software Declaration: The software used included

i. Autodesk Map 3D 2009
ii. ARCGIS 9.3

Physical Design
This stage has been described by Kufoniyi (1998) as the representation of the data structure in the format of the implementation software and it is usually done at the beginning of the database creation.

Table 2: Road attribute data

Attribute	Data Type	Width	Dec
R_Id	Integer	3	
R_Length	Numeric	8	3
R_Status	Text	8	

Table 3: Parcel attribute data

Attribute	Data Type	Width	Dec
P_ID	Integer	3	
P_Name	Text	20	
P_Use	Text	20	
P_Status	Text	20	
P_Per	Numeric	10	3
P_Area	Numeric	10	3

3.5 Database Creation

The tables were created and populated in ARCGIS 9.3 and the attribute tables were linked with geometric data.
Table 4: Sample of Parcel table created in ArcGIS 9.3

Attributes of Parcel

OBJECTID *	SHAPE *	SHAPE_Length	SHAPE_Area	O_NAME	P_USE	P_VALUE	T_RATE
245	Polygon	110.33921	704.202031	VICTORIA ADELEKE	RESIDENTIAL	$70,420.20	$3,521.01
228	Polygon	111.427738	681.639006	UGWU ELEWECHI	RESIDENTIAL	$68,163.90	$3,408.20
207	Polygon	106.493955	623.756616	TOLULOPE ADEMOLA	COMMERCIA	$62,375.66	$3,118.78
217	Polygon	108.58523	719.523162	TOLU OLALEKAN	RESIDENTIAL	$71,952.32	$3,597.62
204	Polygon	109.837022	696.604197	TEMILOLU ADEJOKE	RESIDENTIAL	$69,660.42	$3,483.02
201	Polygon	106.042638	651.747123	SOLA TOLU	RESIDENTIAL	$65,174.71	$3,258.74
206	Polygon	103.009414	599.126148	SIMON ARIKE	COMMERCIA	$59,912.61	$2,995.63
203	Polygon	108.494038	680.164856	SIDIKATU ARIKE	RESIDENTIAL	$68,016.49	$3,400.82
233	Polygon	105.646989	669.8401	SALAMI OYEWUMI	RESIDENTIAL	$66,984.01	$3,349.20
220	Polygon	101.333393	573.669407	RISIKATU OLUWAFEMI	RESIDENTIAL	$57,366.94	$2,868.35
357	Polygon	165.717876	1742.983054	P.O.W	RELIGIOUS	$174,298.31	$8,714.92
398	Polygon	252.126085	3397.827495	P.O.W	RELIGIOUS	$339,782.75	$16,989.14
240	Polygon	153.992787	1339.15655	P.O.W	RELIGIOUS	$133,915.65	$6,695.78
258	Polygon	224.566708	3010.106625	OPEN SPACE	RECREATION	$301,010.66	$15,050.53
323	Polygon	351.843709	6362.491146	OPEN SPACE	RECREATION	$636,249.11	$31,812.46
238	Polygon	118.619907	391.677291	OLUFEMI JAMES	RESIDENTIAL	$39,167.73	$1,958.39
234	Polygon	103.909084	610.778499	OGINNI JAMES	RESIDENTIAL	$61,077.85	$3,053.89
243	Polygon	106.819576	636.603927	N/A	RESIDENTIAL	$63,660.39	$3,183.02
230	Polygon	163.333747	1580.859423	N/A	RESIDENTIAL	$158,085.94	$7,904.30
232	Polygon	152.308972	1481.93826	N/A	MATERNITY	$148,193.83	$7,409.69
236	Polygon	107.979344	681.277721	N/A	RESIDENTIAL	$68,127.77	$3,406.39
226	Polygon	103.37106	639.467813	N/A	RESIDENTIAL	$63,946.78	$3,197.34
242	Polygon	113.98877	738.813531	N/A	RESIDENTIAL	$73,881.35	$3,694.07
244	Polygon	104.897792	661.312144	N/A	RESIDENTIAL	$66,131.21	$3,306.56
239	Polygon	121.529959	976.021608	N/A	RESIDENTIAL	$97,602.16	$4,880.11
210	Polygon	110.557839	702.283026	N/A	RESIDENTIAL	$70,228.30	$3,511.42
223	Polygon	99.735573	557.760047	N/A	RESIDENTIAL	$55,776.00	$2,788.80
222	Polygon	100.110471	561.297024	N/A	RESIDENTIAL	$56,129.70	$2,806.49
241	Polygon	117.318695	772.717081	N/A	RESIDENTIAL	$77,271.71	$3,863.59
219	Polygon	99.946937	544.815248	N/A	RESIDENTIAL	$54,481.52	$2,724.08
235	Polygon	107.819914	678.084004	LYNDA MARK	RESIDENTIAL	$67,808.40	$3,390.42
208	Polygon	106.628013	619.389597	KEMI AREGBE	COMMERCIA	$61,938.96	$3,096.95
213	Polygon	107.917664	678.268806	JOKE ELEWURO	RESIDENTIAL	$67,826.88	$3,391.34
227	Polygon	102.762113	604.019264	JAMES ADICHE	RESIDENTIAL	$60,401.93	$3,020.10
221	Polygon	103.840978	619.543841	IYINLOLA ADEWALE	RESIDENTIAL	$61,954.38	$3,097.72
211	Polygon	109.91229	698.912153	IBUNKUN ADEKOLA	RESIDENTIAL	$69,891.22	$3,494.56
229	Polygon	124.907402	845.804542	IBRU BLESSING	RESIDENTIAL	$84,580.45	$4,229.02
218	Polygon	100.301674	546.501379	HAMEED SIKIRU	RESIDENTIAL	$54,650.14	$2,732.51
205	Polygon	110.394159	700.155208	FEMI ADELOLA	RESIDENTIAL	$70,015.52	$3,500.78
237	Polygon	107.739405	678.033592	EFFIOK ARCHIBONG	RESIDENTIAL	$67,803.36	$3,390.17
212	Polygon	108.741605	685.676942	DADA ADEMOLA	RESIDENTIAL	$68,567.69	$3,428.38

Record: 0 Show: All Selected Records (0 out of 220 Selected) Options

3.6 Spatial Operations

Spatial Analytical functions of Geographical Information System (GIS) distinguish it from other information system, GIS capabilities use the spatial and attribute data in the spatial database to answer questions and solve spatial problems. The main objective of spatial data analysis is to transform and combine data from various sources into useful information for decision makers.

ArcGIS analysis toolbox provides a powerful set of tools to perform various spatial operations such as buffering, spatial query, overlay operation, proximity analysis, network analysis and much more. ArcGIS software was used for landuse classification of the study area (Figure 2)

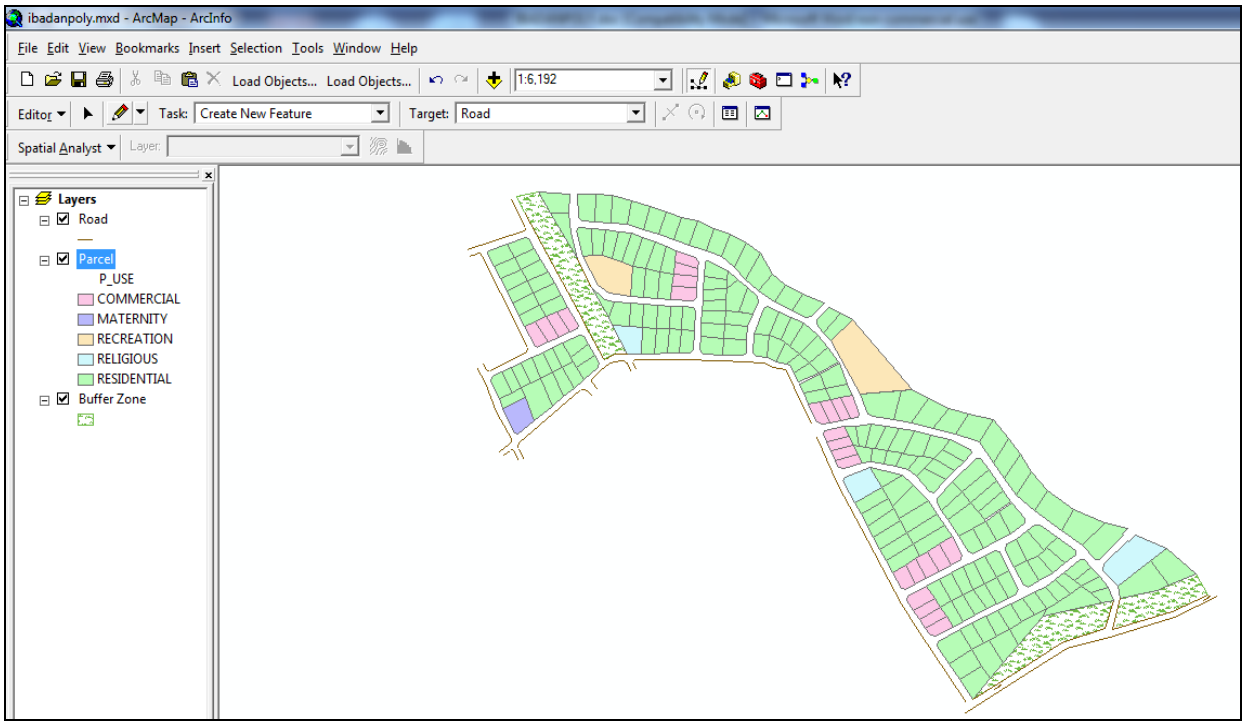

Figure 2: Land use Map of study area

Table 5: Land use table

S/NO	LAND USE TYPE	NO OF PLOTS
1	COMMERCIAL	25
2	RESIDENTIAL	189
3	RECREATIONAL	2
4	MATERNITY	1
5	RELIGIOUS	3
	TOTAL	**220**

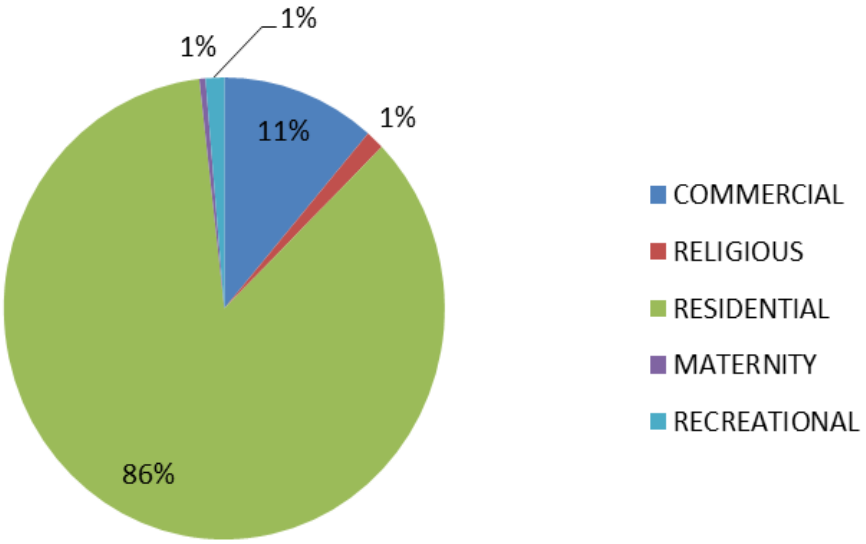

Figure 3: Landuse Chart

3.7 Analysis of Results

Figure 3 shows landuse percentage in the study area as follows: Residential (86%), Commercial (11%), Religious (1%), Maternity (1%) and Recreational (1%).
Tables 4 shows land values, ownership and tenement rate the local government could generate per annum. The total land Value is nineteen million twenty six thousand five hundred and seventy seven Naira forty nine Kobo **(₦ 19,026577.49 K)**.
The local government would be able to generate tenement rate of nine hundred and fifty one thousand three hundred and twenty eight Naira eighty seven Kobo **(₦ 951,328.87 K)** per annum in the study area.

3.8 Other Sources of Internally Generated Revenues

The local government councils can also generate internal revenues from slaughter slab fees, liquor licence fees, marriage registration fees, birth and death registration fees, street naming fees, right of occupancy fees on rural lands, signboard and advertisement permit fees, radios and television licence fees, shops and kiosks rate, wrong parking fees, merriment and road closure levies, etc.

3.9 Ways of Improving Local Government Revenue Generation

i. Use of Geographic Information System: This is a digital database of tax payers' location and other useful attribute data about them

ii. Provision of good infrastructure: The local government should use the generated revenue for the provision of social amenities like good roads, potable water,

well-equipped health centers, etc. This will encourage people to pay tax faithfully, the people will change their attitude of tax evasion and more revenue will be generated.

iii. Staff motivation: Local government staff should be encouraged through appropriate training and good welfare package. This is to enhance effective revenue management and to discourage embezzlement and revenue mis-management.

4. CONCLUSION

Internally generated revenue in local governments has enabled people to enjoy a lot of benefits such as well-equipped health centers, potable water, good roads, quality education, etc. The capabilities of analytical tools in Geographic Information System (GIS) have been demonstrated to enhance effective revenue collection and administration at local government level.

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BIOGRAPHICAL NOTES

Felix Iyiola is a Lecturer at Federal School of Surveying, Oyo, Nigeria. He is the Coordinator of SIWES and Practicals Unit of the school. He holds the following qualifications: PGD (GIS), PGD (Surveying and Geoinformatics) and Msc (Surveying and Geoinformatics in view). He is a registered surveyor and full member of Nigerian Institution of Surveyors (mnis).

Ekpo Effiong is a Senior Lecturer at Federal School of Surveying, Oyo, Nigeria. He is the Head of Department of Geoinformatics of the school. He holds B.Sc. Hon. (Surveying), PGD (Remote Sensing) and M.Sc. (Surveying and Geoinformatics). He is a registered surveyor, full member of Nigerian Institution of Surveyors (mnis) and member of Nigerian Environmental Society (mnes).

Mohammed Bello Abubakar is the Rector at Federal School of Surveying, Oyo, Nigeria. He is a Chief Lecturer in the school and he holds B.Sc. (Geography), M.Sc. (Urban and Regional Planning), Professional Diploma (Surveying) and PGD (GIS). He is a registered surveyor, a registered town planner and full member of Nigerian Institution of Surveyors.

CONTACTS

Felix Iyiola
Department of Geoinformatics
Federal School of Surveying, Oyo, Nigeria.
Mobile: +234 803 3955 301
e-mail: felixiyiola@yahoo.com

Ekpo Effiong
Department of Geoinformatics
Federal School of Surveying, Oyo, Nigeria.
Mobile: +234 805 2322 164
e-mail: ekpoeff@yahoo.com

Mohammed Bello Abubakar
Federal School of Surveying, Oyo, Nigeria.
Mobile: +234 803 5749 636
e-mail: abubakarbello31@yahoo.com