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The Roles of Land Information Systems (LIS) and Geodetic Spatial Reference Frames In Property Taxation and Revenue Drive in Rivers State:

A Case Study of Portharcourt Cadastre

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Abstract

Land management is becoming more recognized as a community-wide if not global need. Landed assets are an important source of government revenue in Rivers state, and they necessitate a land information systems infrastructure. The creation of LIS of Port Harcourt property layouts is critical to realizing that ambition. Results of this research paper has lots of potential in providing sustainable land relationships and information to decision makers (land administrators and revenue drivers) in Rivers state so that they can make decisions that are beneficial to sustainable development in the context of efficient land administration and management. This study used geospatial methodologies to document, create, and populate land information in Trans-Amadi and GRA phases 1 and 2 of Port Harcourt's cadastral layouts. According to the findings of this study's analysis, discussions, and queries, effective usage of the LIS, which is driven by many aspects of services supplied by government Ministries, Departments, and Agencies, will increase efficiency and productivity in property taxation in capital city of Port Harcourt.

The following recommendations were made as a result of this research: Information decentralization to make it easier to keep track of and recollect data. Fees charged for various services given are published and displayed. Official procedures should be simplified, and a faster and more efficient method of moving files should be established. In Rivers state, there has been a reduction in the time it takes to complete title paperwork for landed properties. All occupants of government lands in Port Harcourt will get a formal allocation of encroached lands and a certificate of title. A chart for employee training, particularly in ICT, should be prepared. External consultants should be taught customer service, change management, time management, project management, supervisory management, and systems administration. The state's Ministry of Lands and Survey should develop a website that enables for e-payment of grand rents, C of O applications, and land mapping. Finally, the LIS of cadastral layouts in Port Harcourt as a pilot project should be implemented in major towns and cities across the LGAs of Rivers state for efficient land administration, property taxation, and revenue generation, in line with the Federal Government of Nigeria's current land reform programme.

Keyword: Taxation, Information, Land, Systems, Cadastre, Revenue

1. Introduction

Man has profoundly affected the Earth's surface, which has had a tremendous impact on the natural environment, resulting in a discernible pattern in land usage across time. Man continues to explore and use the natural resources in his environment, which has resulted in significant changes in the landscape. "Land use encompasses both the method by which the land's biophysical features are modified and the goal behind that manipulation — the reason for which the land is used" (Turner et al. 1995). Land is man's habitat, and he uses it in a number of ways to promote his economic, social, and environmental goals. Land is the foundation of all human activities; it is from it that we receive our food. Humanity's most valued possession is land. It is also a valuable resource for any country. There can be no country without land. Because the nation's riches and economic progress are dependent on the state of the land and its use, any prudent investment in the land for its protection and sustenance is warranted. According to Turner et al. (1995), we have a responsibility to protect our land through proper management so that we can pass it on to future generations. The benefits of successful land resource management are numerous, ranging from environmental preservation to improvements in agriculture and food supply, among other things. Tax collection determines the amount of money available. As a result, it is clear that any knowledge about land is valuable information that may be used to make financial investments, trade, industry, and agriculture. Despite the fact that land is a part of man's natural inheritance, access to it is limited due to ownership patterns. Land is divided into parcels for administrative and commercial reasons, and it is used and modified in a variety of ways. Land information is essential for making land investment, development, and management decisions. By assisting in the identification and analysis of problems, information minimizes uncertainty. (Enermark, 1999) (Enermark, 1999) (Enermark, 1999). It is also acknowledged that digital land information systems (LIS) must be adopted to allow an efficient land market as well as effective land-use administration, thereby promoting economic development, social cohesion, and long-term sustainability. This study identified information system as a tool for proper land management and income generation, utilizing Trans-Amadi and GRA phases 2 and 3 layouts as a case study in Port Harcourt, Rivers State.

2. Literature Review

From a global viewpoint, the last several decades have seen experts attempt to impose the Western paradigm of individual real property rights and cadastre in developing or partner countries. For a variety of reasons, the efforts have not yielded the desired results. One possibility is that cadastral processes conflict with end users' preferences and habits, such as the huge number of owners, leaseholders, tenants, mortgagees, and so on. This is particularly true where the general economy and the structure of professions and university departments make it difficult to find skilled and impartial staff (in the public and private sectors) who can mediate between the wishes of right holders and the technicalities of property rights, transactions, and other issues.

One or more worldwide networks, which include university departments, central and local governments, nongovernmental organizations (NGOs), and international organizations, are likely to provide resources for such cadastral development. For instance the UNU-IIST, the International Institute for Software Technology, enables software technologies for

development, and UNU-WIDER, which analyzes property rights and registration from the perspective of development economics, are also part of the United Nations University (UNU), (Rabiu et al., 1998). The International Institute for Geo-Information Science and Earth Observation (ITC), situated in the Netherlands, has also joined UNU as an associated institution where cadastre for taxes is the first public sector item addressed, partly for historical reasons, but primarily because the cadastre's operation costs money. The list of tasks or functions in a single country may comprise more or less of the following;

1. Assisting entities in need of property portfolio recording and management, such as utilities, road, railroad, and harbor agencies, defense, property owners' associations and hunting societies, charitable trusts, and ecclesiastical property, assisting with antenna site selection for wireless networks.
2. Assisting owners in restructuring the shape of and rights in the property unit and its surrounds in accordance with existing private and governmental constraints, such as easements and zoning, to support property development. Expertise in border conflicts that is objective.
3. Assisting organizations that need to measure and record location-specific themes with legal ramifications, such as cultural and natural heritage and opencast mining.
4. Promote the adoption of both open source and proprietary GIS software by tailoring it to local requirements.

The purpose of this research is to create a Land Information System (LIS) and a Fiscal Cadastral System in Port Harcourt, Rivers state, using GIS as a tool for effective Land Administration and income production.

The following objectives will help to achieve the stated goal: (1). To convert all survey beacons coordinates in the GRA layout from NTM to UTM (Universal Traverse Mercator) coordinate system; (2). To digitize GRA's analogue layout plan and the locations of all existing beacons in the design; (3). To gather all of the relevant spatial and attribute data; (4). To Query the database that has been built and execution of the geospatial analysis.

Rivers State is one of the 36 states of Nigeria. Tropical rainforest covers the state's inland areas, while the typical Niger Delta environment includes many mangrove swamps along the coast. Rivers state, called after the numerous rivers that run through it with capital in portharcourt city, was a part of the Oil Rivers Protectorate from 1885 to 1893, when it was absorbed into the Niger Coast Protectorate. In 1900, the territory was combined with the Royal Niger Company's chartered territories to form the colony of Southern Nigeria. The Eastern Region of Nigeria was separated in 1967, resulting in the formation of the state. Until 1996, the state included the territory that is currently part of Bayelsa State as shown in figures 1, 2 and 3 below.

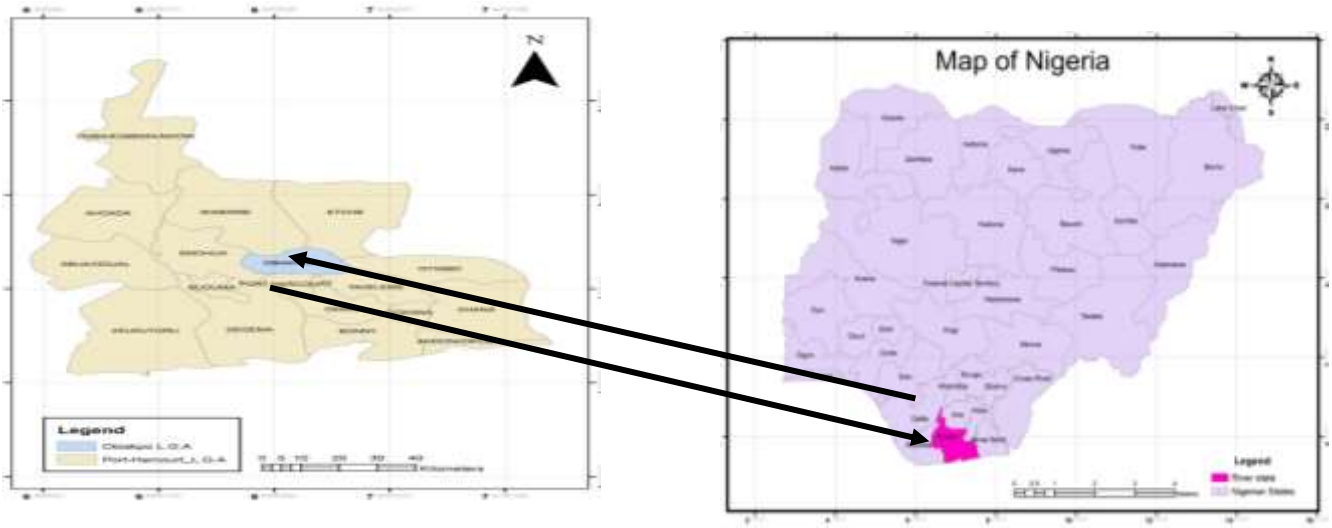


Fig. 1: Administrative Map of Rivers state showing Portharcourt City Local Government Area

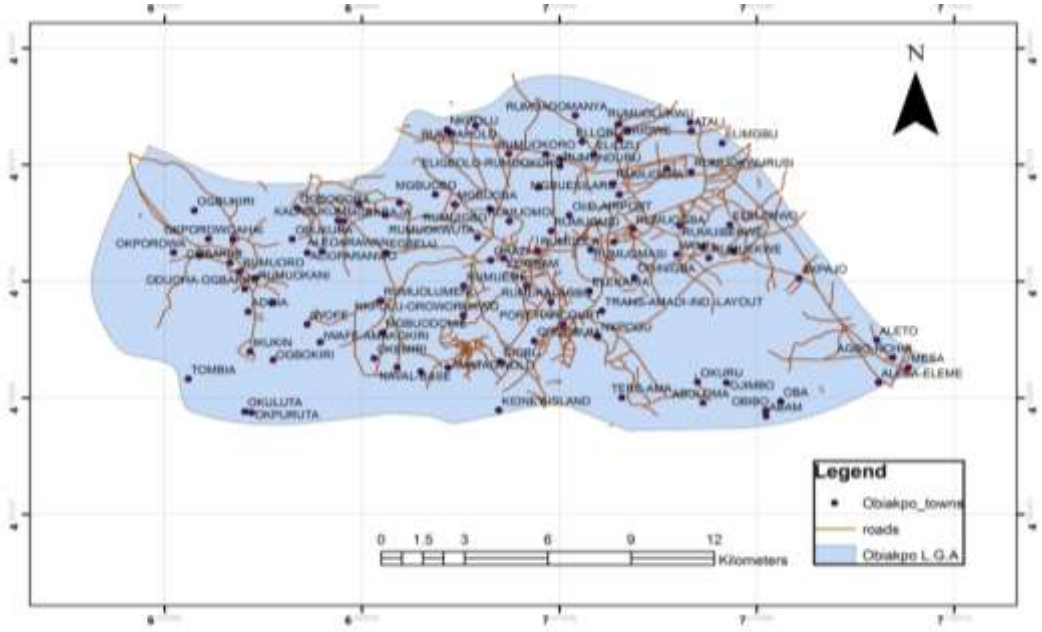


Fig. 2: Administrative Map of Rivers state

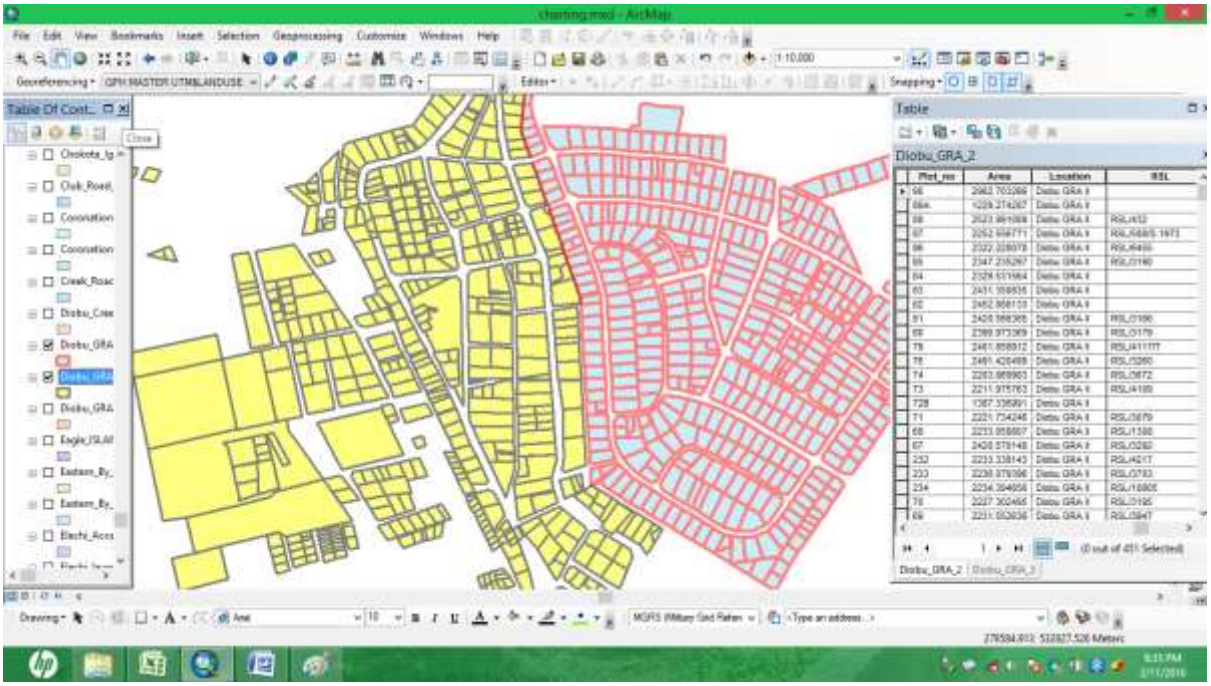


Fig. 3: Digital Cadastral Map of GRA Phases 2 & 3 Port Harcourt Rivers State.

2.1 Framework for Geodetic Spatial Reference

The Earth's center and rotating axis, as well as the Greenwich meridian, serve as a reference frame for the placement of things on the planet's surface. A map projection also connects three-dimensional places to two-dimensional coordinates on a map plane. In the cadastral field, the abilities of a geodesist and a land surveyor are used to record agreed legal borders between property units, with the belief that such recordings will significantly reduce the frequency of boundary disputes. Even if the assumption may be largely proved, applying the above-mentioned "fixed-boundary" method causes major complications. In the case of landslides and land drifting caused by streams, the solution is unconcerned about the expense to the owner of gaining access to all portions of the property. Furthermore, the solution does not account for future, more accurate border measurements. The line may have been moved years ago for reasons that have grown too costly to elicit, especially given the significance of the disputed region and the possibility that justice would not be served. As a result, some jurisdictions permit "adverse possession or the formal acknowledgement of neighbors' agreement on the current occupational border, even if it differs from historical cadastral records. Similarly, a legal emphasis on mere stones and other boundary markers, as well as the recording of terrain features that create permanent and relatively clearly defined boundary sites, may be used to supplement the pure fixed-boundary method.

The reference frames used by geodetic surveyors identify points in terms of coordinates, but the naming and labeling of these points is a different story. The cadastral identifier is a technical term that is related to town, route, parish, and topographic feature names. Property units can be located using hierarchically structured administrative units or jurisdictions and their names. Even if the ordinal structure of a jurisdiction through place names is imprecise in

comparison to the metric precision of measured boundary locations, it allows for sufficient localization of economic activities in many circumstances and eliminates the need on specialized and expensive knowledge.

The linguistic method of localization uses the human body as a spatial reference frame rather than the Earth. When giving instructions, the daily phrases "left" and "right," "up" and "down," all refer to the speaker's or listener's body. When giving instructions to tourists or describing where to buy the best deals of the day, this is how it is done. The balance of nominal, ordinal, and metric ways of localization, as well as the study of interactions among diverse spatial reference frames, is important research fields.

2.2. Standardization and communication

National information systems (cadastre, land registration, and organizational structure of real property information systems) rely on databases and related archives, which must be updated in order to provide reliable minutes of the spatial and legal state of property units. Theoretical foundations for these structures and tasks are provided by computer and communication sciences. However, until recently, the methods provided in terms of systems analysis and design, data modeling, and other similar techniques addressed the information system within a single decision body, whereas the situation involving real property information is dependent on collaboration between ministries, local governments, and the private sector. The term "geospatial data infrastructure" is used to characterize the scope of this project. This infrastructure's modeling is comparable to that of this infrastructure modeling is similar to the modeling of an industrial sector for e-business, an emerging research topic that includes the development of domain vocabulary and ontology resources.

The property unit's specification is a crucial consideration. Often, the unit is supposed to be under individual ownership, but state or other public ownership, as well as various types of collective ownership, are prevalent enough to warrant discussion. Collective ownership is achieved by assigning rights and obligations to a legal entity, which can be an association, a limited liability company, or another social construct sanctioned by law or custom. According to comparative studies, the property unit itself can be specified in a variety of ways: Is the unit defined as a single continuous piece of land or as a collection of one or more of these entities? Other techniques to specify relationships between parcels of land include: In Northern and Central Europe, a structure exists in which the current owners of a number of other property units possess a portion of a property unit. Such a unit is said to be owned by the share-holding property units in cadastral terms. Furthermore, while land and the building placed on it can form a single unit, the building can also be considered a separate unit under certain circumstances. There are also variations. It’s just as important to keep property registrations up to date as it is to keep unit specifications up to date. A survey of the information flows in what has been dubbed the "geodata network" from the perspective of informatics may uncover disorganized, and sometimes duplicated, efforts to obtain information, as well as other suboptimal practices. However, from the perspective of the end users, what occurs is a transfer of property rights and related activities, such as subdivision of property units. The updating of property registrations is a by-product of the transaction from this perspective.

A formal, ontology-based technique was created and deployed for the systematic description and comparison of property transactions. The methods devised were practical, and preliminary national accounting of transaction costs was prepared. However, guidance on the

best solutions is unlikely, partially because many of the actors engaged, both in the commercial and public sectors, have other priorities beyond lowering transaction costs. Furthermore, property transactions are frequently restricted for a variety of political reasons, such as municipal preemption powers or spatial planning.

2.3. The Most Important Applications

The fundamental application of cadastre is the formal identification and recording of information on geographical objects, such as pieces of land, structures, pipes, and so on, as well as papers and extracts from these on rights and constraints relating to the geographical items. Cadastral knowledge is used not just in the governmental sector, but also in private businesses, as the following list of services demonstrates:

1. Facilitation of revenue inflow to central and local government by defining property units and giving information on identification, size, and boundaries, as well as providing uniform property unit assessments (mass-appraisal).
2. Assistance for the real estate market by providing accurate records of title, mortgages, and limitations.
3. Assistance in the development of sustainable land use (urban, rural, and environmental issues) by providing data for decision-making and implementing the results.
4. Provision of data and related services to the construction and utility industries, as well as collaborating on the provision of statistics.
5. Assistance in continuous administration improvement, also known as "good governance," by: – Considering data definitions and data flows with other government and industry bodies, by mutually relating post addresses, property units, small-area statistics and spatial planning units, as well as road segments and other topographic elements

2.4. Making use of low-cost technology

Participating in national high-level commissions aimed at changing the institutional structure of real property rights, housing, and land use to contribute to good governance. Practice Formalization

Much cadastral knowledge is still kept under wraps. As a result, eliciting this knowledge and integrating it with applicable current conceptual frameworks and ontologies would be a major challenge. Cadastral work is governed by legal guidelines and technical specifications. The idea supported by institutional economics is that the needed formalization can be performed more effectively by observing and analyzing human routine behavior rather than by analyzing legal prescripts or developing computer models. In addition, formalization is required not only for the creation of cadastral services, but also for the articulation of the complex structure of process objectives or functions. The description of realized functions and function clusters is influenced to some extent by local expertise, which is evident. The International Federation of Surveyors (FIG) serves as a platform for professional and academic exchanges. At the International FIG Congress in Munich in October 2006, commission 7 on Cadastre and

Land Management adopted a Work Plan 2007–2010. Land administration in post-conflict situations

1. Land administration and land management in the marine environment
2. Innovative technology and ICT support in land administration and land management
3. Institutional aspects of land administration and land management

Current collaborations with UN agencies will be maintained, including the UN Habitat Global Land Tool Network (GLTN).

3. Materials and Methods

The office of the Surveyor General of Rivers state provided the analogue layout design with its Pillar coordinates. The layout was surveyed on September 29, 1975, and the survey's provenance is PHCIS. It consists of 222 plots with arterial highways running through them. The digital layout plan was created using the pillar coordinates. Land records (cadastre) were obtained from the Ministry of Lands and Survey, Rivers State's lands and register departments. The orthophoto imagery that covered the study area was sourced from the office of the surveyor general, Rivers state.

3.1. Layout Plan Conversion to Digital Format.

The NTM coordinates were entered into Ms-Excel and translated to the UTM coordinate system, Minna Datum, using GeoCalc software, Kufoniyi (1998). In Notepad, the coordinates were organized in the following format: _Northings and eastings of points (for the pillar point) Text Eastings, Northings, Text Size, Text Rotation (90) and Pillar No.

The two files (scripts) were saved with the.scr extension and later imported into AutoCAD as points and text, with each point containing a pillar number inscription. The pillar points are connected with polylines to generate plots, which are then auto labeled with bearings, distances, and areas. The completed layout is then exported as a DXF file in ArcGIS. The conversion utility converts the Autocad DXF file to a Shapefile. This serves as the Parcels' shapefile. Roads, Buildings, Rivers, Railways, and Boundary Pillars are parts of the shapefiles created with ArcGIS software as shown in figure 3 below.

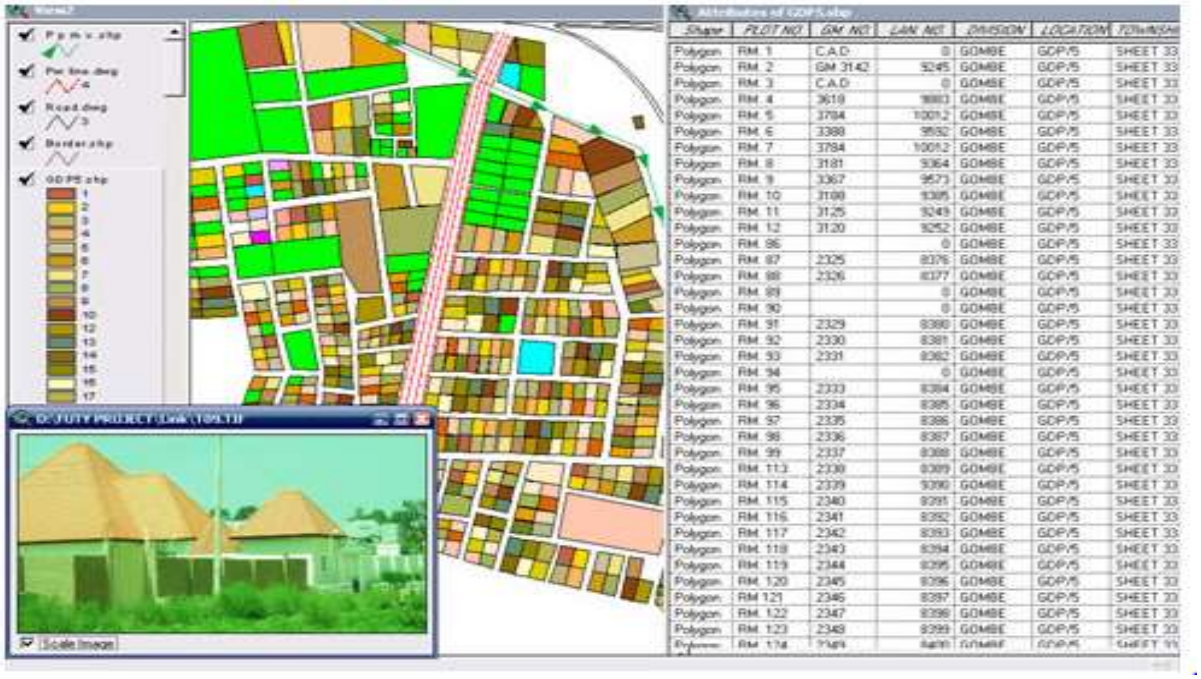


Fig. 4: Creation of Geospatial Database with Attributes of Trans-Amadi Layout

Creating layers, editing attributes, and digitizing In ArcGIS, all of the produced shapefiles as well as the Ikonos imagery encompassing the research area were imported into various layers.

In the Attribute Table of the Parcel Shapefile, two new fields "Plot No" and "Area" were added. Type the plot No and use the Geometry Calculator to calculate the area of the parcels.

All of the buildings and roads on the plan, as well as the railway and rivers outside of it, were digitized.

3.2. Microsoft Access and Database Creation

In Ms-Access, a form was constructed as an interface for data entry into the database.

The following fields (columns) are available in the parcel database: Volume No., File Reference No., Grantor, Owner, Date of Registration, Instrument, Plot No., Land Use, Nature of the Parcel, Plan No., Registration ID (Reg. ID), Volume No., File Reference No., Grantor, Owner, Date of Registration, Instrument, Plot No., Land Use, Nature of the Parcel, Plan No., Registration ID (Reg. ID), Registration ID (Reg. ID), The following fields can be found in the rent database: Owner of the parcel, plot number, monthly rent per plot, and annual rent per plot. Plot No was used as the primary key to link them to the second table.

4. Results and Discussion

4.1. Queries in LIS Database

The following queries and analyses were run on the Land Information Database in order to meet the project's objectives.

Query #1 is for information on ownership.

Query #2 is on property identification: Plot number, plan number, file number, volume number, and registration number.

Query #3 is about land use.

Query #4 is about Instruments or Title over Property.

Query #5 is about the Hyperlink of the Parcels Survey Plan and Title.

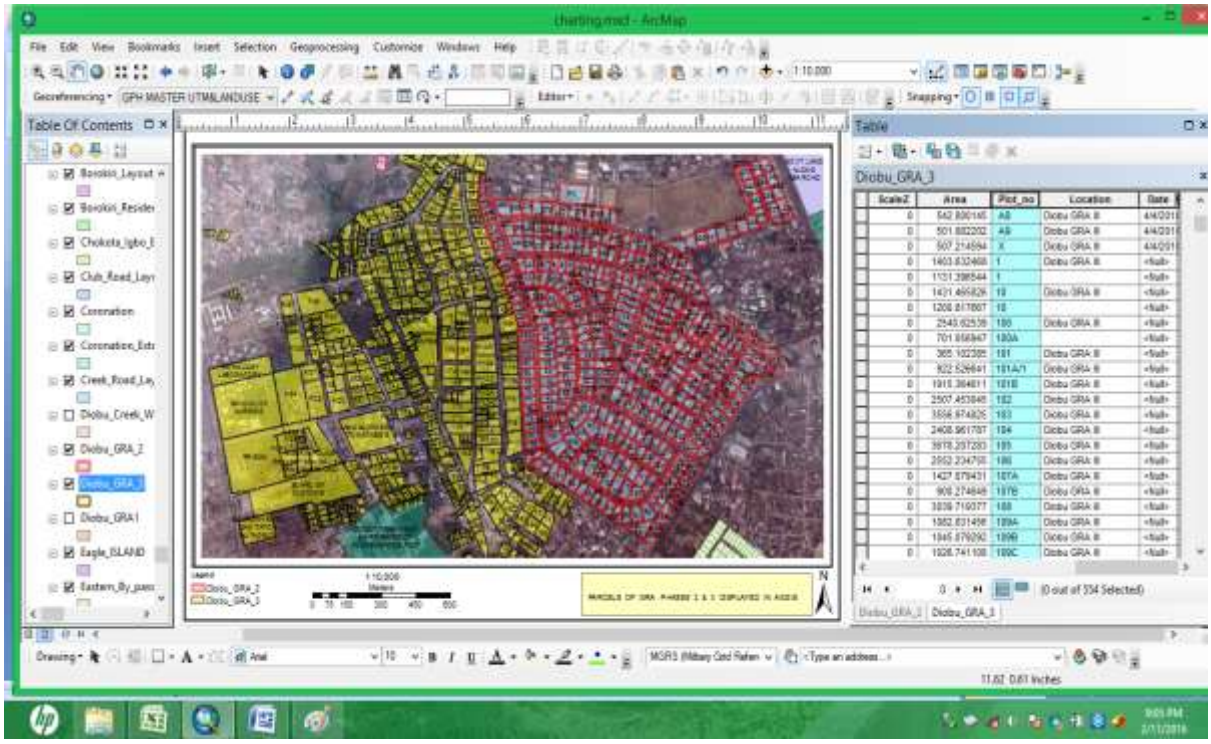


Figure 5: Parcels, roads, imagery, in layers displayed in ArcGIS

4.2. Summary of Results

By evaluating its creation and implementation, this study identified information system as a tool for proper land management and income generation, utilizing Trans-Amadi and GRA phases 2 and 3 layouts as a case study in Port Harcourt, Rivers State.

Benefits of implementing a land information system include ensuring ownership and security of tenure, assisting with land and property taxation, providing credit security, developing and monitoring land markets, protecting state lands, reducing land disputes, improving urban planning and infrastructure development, and producing statistical data. The parcel database was constructed with MS-Access for a good database management system, and the feature class layers such as parcels, boundary pillars, road, building, river, and railway were created with ArcGIS.

Some database queries and analysis were performed to demonstrate how land information can be used as a tool for land administration and revenue creation; the queries and results are as follows:

QUERY 1: Shell Petroleum Nigeria Limited owns which parcels?

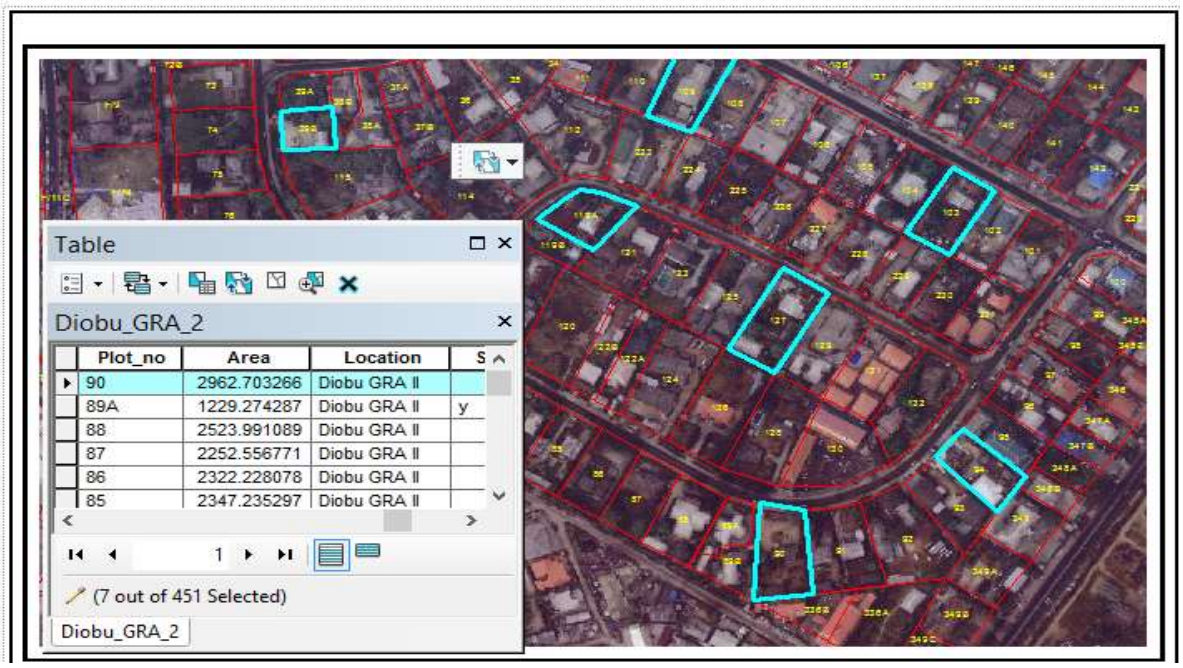


Figure 6: Shell Petroleum Nigeria Limited owns plots 24, 25, 26, 58, 59, 91, and 92.

QUERY 2: Identify a lot that hasn't been developed?

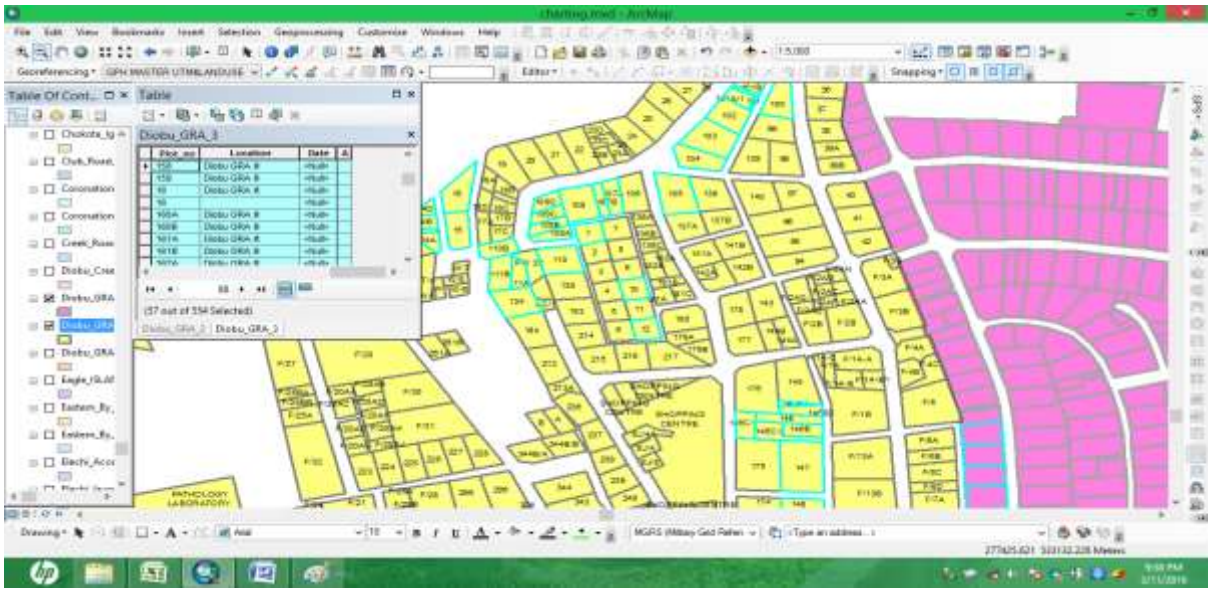


Figure 7: Plot numbers 16, 87, 89, and 94 are not developed parcels.

QUERY 3: Identify the parcels occupied by Oil and Gas companies?

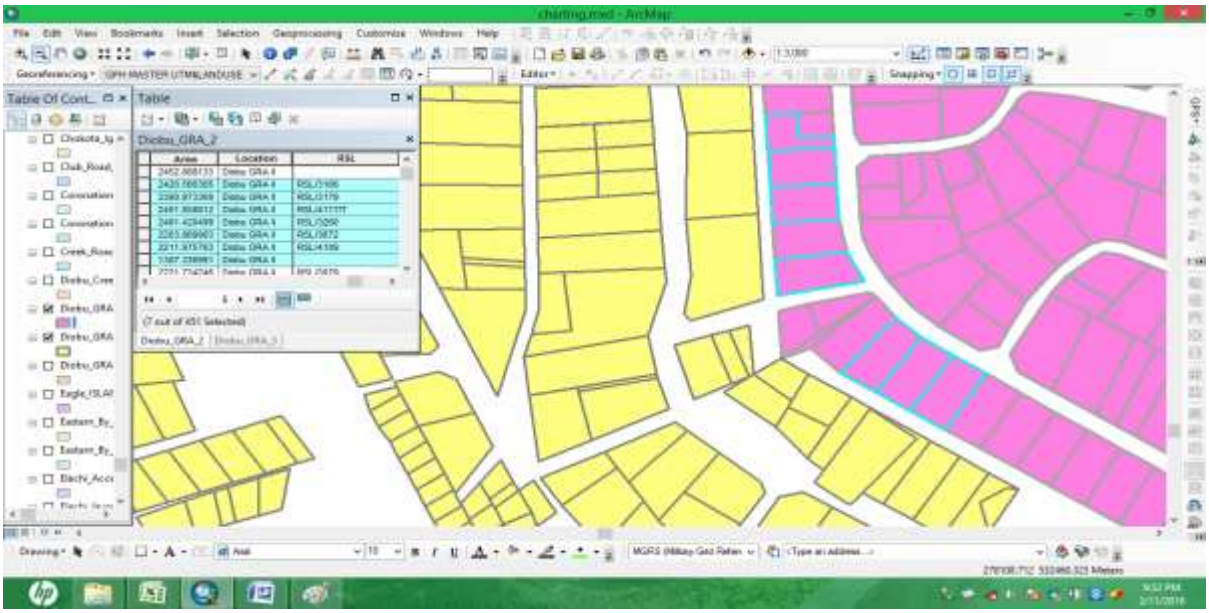


Figure 8: The parcels highlighted are occupied by Oil and Gas companies?

QUERY 3: Identify all parcels with C of O?

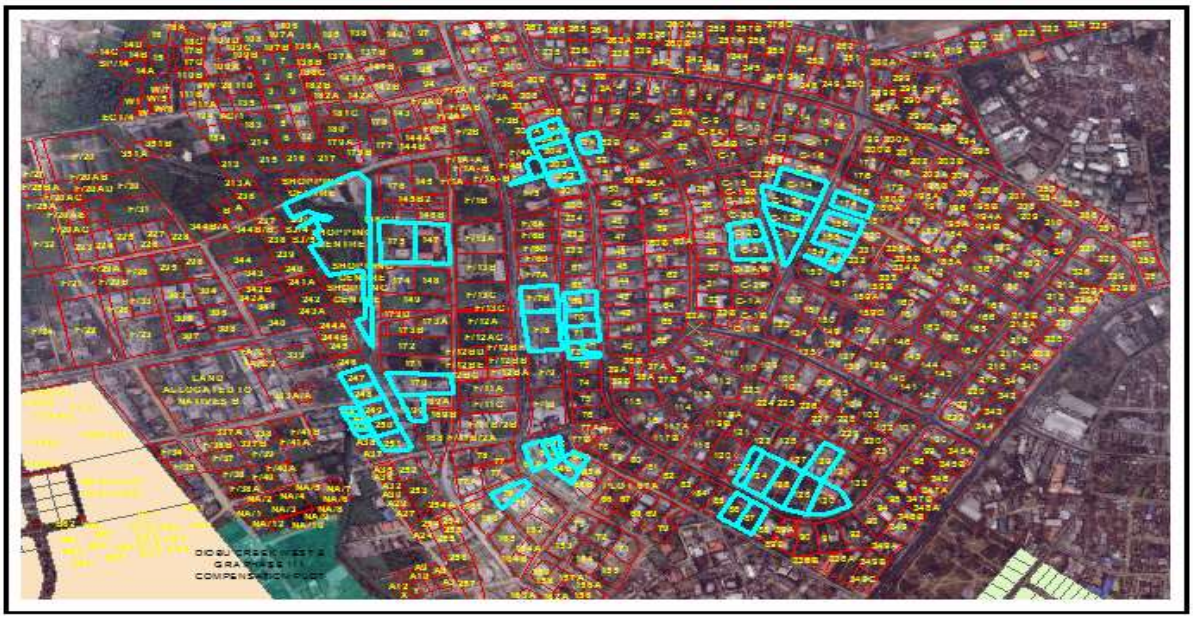


Figure 9: The parcels highlighted have with C of O?

QUERY 4: Display the C of O and Survey Plan of Plot No 5?



Figure 10: Displayed C of O and Survey Plan of Plot No 5?

5. Conclusions

Land administration is becoming increasingly recognized as a community-wide and perhaps global need (Adeoye 2006). Trans-amadi industrial layout, which is the state's industrial hub and a major source of land revenue, necessitates the implementation of a land information system. The establishment of a LIS for the Trans-amadi industrial layout is crucial to realizing that objective. The knowledge shared in this reseach has a lot of potential to help the people of Rivers state by providing information about the human-land relationship and enabling decision-makers (land administrators) to make decisions that promote sustainable development in the context of efficient land administration and management, Oboli (2008).

In light of the conclusions drawn from the preceding discussions and results of queries and analysis, the adoption of the LIS would gradually improve efficiency and productivity in all sectors of Ministry of Lands and Surveys services, and it is now recommended that:

To make it easier to keep track of and recall information, decentralization of information should be established. All land dealings should be transparent, with due procedure and accountability being the watchwords. In accordance with this, the ministry will publish and show the fees charged for various services. Official procedures should be simplified, and a faster and more efficient method of moving files should be established. The length of time it takes to get information on land concerns should be kept to a bare minimum. A "Registration Procedure Booklet" should be published by the Survey and Registry. The length of time it

takes to get information on land concerns should be kept to a bare minimum. To communicate the requirements for each of their Registration Procedures, the Survey and Registry should produce a "Registration Procedure Booklet." Customers and users will have more faith in the Registry if a state-of-the-art security and fire alarm system with security monitors is installed in strategic positions throughout the facility. For easy identification, all guests should wear badges.

Users of the Registry will be able to contact a call center for questions and concerns. Progress should be made in the construction of digital base maps in tandem with the establishment of the LIS to give accurate and up-to-date information. A culture of employee training should be established, with computer training being a top priority. Customer service, change management, time management, project management, supervisory management, and systems administration should all be taught to external consultants.

The Ministry of Lands and Survey should create a website that allows for e-rent payment, C of O applications, and land inquiries in the state.

Finally, it is critical to note that this LIS of Trans Amadi l/out is a pilot project that should be adopted throughout Rivers state for effective land administration and revenue generation in keeping with the Federal Government of Nigeria's present land reform initiative.

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