Examination of the Existing Land Tenure Systems and Land Information System on the Geographic Information System (GIS) in Abuja, Nigeria

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Abstract- ***This study examined the existing land tenure systems and the Land Information System (LIS) within the framework of Geographic Information Systems (GIS) in Abuja, Nigeria. Simple descriptive statistical techniques, including frequency analysis, percentage distribution, and content analysis, were adopted for the study. Data were collected through structured questionnaires administered using a simple random sampling technique, which ensured that all members of the population had an equal chance of being selected. The findings revealed that well-established land tenure systems exist within the Abuja Geographic Information Systems (AGIS) and that these systems are generally well-defined and easy to understand. The results further showed that the current land tenure arrangements promote equal access to land, while traditional land tenure systems were perceived to be more effective than statutory systems in the management and resolution of land-related disputes. In addition, the Land Information System integrated with GIS was found to be reliable and largely up-to-date. Based on these findings, the study recommends the need to enhance public awareness and simplify land administration procedures through regular community sensitization and public enlightenment campaigns to educate stakeholders on the clarity and benefits of land tenure systems. It also emphasizes the importance of improving the accessibility and reliability of the Land Information System through sustained investment in upgrading LIS infrastructure to enhance efficiency and stakeholder access. Furthermore, expanding training programs tailored to diverse user groups is recommended to strengthen capacity building, increase system usage, and address identified technical and financial constraints. Finally, the study highlights the need to tackle corruption and promote affordability in land administration by implementing robust anti-corruption measures within land management agencies, including transparent fee structures and effective accountability mechanisms.***

Keywords—Existing Land Tenure Systems, Land Information System, Geographic Information System (GIS), Nigeria

I. INTRODUCTION

Nigeria is characterized by a weak and inefficient land administration system (Ukaejiofo, 2020). Several scholars have observed that, despite being endowed with a vast landmass of approximately 924,768 square kilometres, the country lacks the appropriate institutional and technical infrastructure required to derive optimal benefits from land administration. Although Nigeria possesses abundant land resources, the potential of land as a critical driver of sustainable development has not been fully harnessed. Mabogunje (2016) argued that effective land administration remains unattainable in Nigeria because over 70% of land parcels are neither surveyed nor registered within State Ministries, while only about 3% of the estimated 20% of land located in urban areas has been properly mapped. Similarly, Ukaejiofo (2019) earlier noted that between 2010 and 2015, less than 10% of the total land area in Nigeria could be linked to comprehensive and well-documented records of land use and ownership. This situation implies the absence of comprehensive cadastral maps for most cities and towns, leaving a significant proportion of land currently under use outside the formal government land management system. Streudler (2014) emphasized that open and transparent land administration systems can significantly reduce the reliance on court litigation for dispute resolution by promoting simple, evidence-based administrative mechanisms. Geographic Information System (GIS) plays a critical role in modern urban planning and land administration. Access to reliable and adequate geo-information is widely regarded as the driving force behind sustainable growth and development in any nation. In most developed countries, more than 80% of rational planning, land allocation, and environmental

management decisions are based on accurate and high-quality spatial information. Achard et al. (2015) asserted that the application of GIS in monitoring environmental changes such as deforestation and urban expansion not only saves time but also reduces operational costs. They further highlighted that GIS enables environmental changes to be measured at multiple scales and at regular intervals. This view is supported by Anastatsio and Bodzin (2006), who described GIS as a valuable tool for understanding environmental processes and making informed and responsible environmental decisions. According to them, without GIS, the measurement and assessment of forest resources and land cover would be less accurate and considerably more time-consuming. Wilkie and Finn (2016) further noted that Remote Sensing and GIS provide powerful tools for analyzing land use and land cover changes, as well as terrain characteristics. The superiority of GIS over traditional methods lies in its ability to analyze spatial relationships between land use patterns and physical geography within a single image capture. Additionally, GIS facilitates the derivation of important information products such as elevation, slope, and aspect from digital terrain models (DTMs). Remotely sensed data also enable synoptic analyses of Earth system functions, spatial patterns, and changes across local, regional, and global scales over time, thereby linking localized ecological research with broader conservation and land management initiatives.

From a geographical perspective, the twentieth century is widely regarded as the century of urbanization. Although urban migration began earlier in some regions, it evolved into a global phenomenon during this period. Urban populations worldwide have been growing at nearly twice the rate of the general population, with approximately half of the world's population residing in urban areas by 2010, compared to less than 5% in the 1800s. This rapid transformation has been driven largely by the transition from agrarian-based economies to service- and market-oriented systems (Knox et al., 2023). A notable shift in urbanization patterns occurred in the latter half of the twentieth century, as urban growth increasingly became concentrated in developing countries rather than developed nations. In fact, the pace of urban expansion in many developing countries represents the fastest urban growth ever recorded globally. While 20 of the world's 30 most populous cities were located in developed countries in the 1950s (Knox et al., 2023), by 2010, 18 of these cities were situated in developing countries (Demographia World Urban Areas & Population Projections, 2010). Projections indicate that global urban populations will continue to rise, nearly doubling between 2010 and 2050, when about 6.4 billion people are expected to reside in urban areas. This growth is projected to occur predominantly in developing regions of the world (World Urbanization Prospects, 2017).

Statement of the Problem

The persistent underdevelopment observed in many third-world countries, including Nigeria, can be attributed to several interrelated factors such as poor data collection, inadequate organization and management of land information, and insufficient technical capacity to plan and manage the environment sustainably. The consequences of these challenges are evident in widespread air and water pollution, environmental degradation, public health challenges, and increased mortality rates. These issues underscore the fundamental problems associated with land information and data management in Nigeria. In response to these challenges, this study seeks to examine the role of Geographic Information Systems (GIS) in land information management and assess its effects on land administration.

With rapid urban expansion and population growth, traditional manual record-keeping systems have become inefficient, time-consuming, and highly susceptible to errors and abuse. Although several attempts have been made in the past to address these challenges, most efforts were unsuccessful due to the gross underestimation of the complexity of the problems and the poorly defined scope of such initiatives. One of the primary obstacles to the computerization of cadastral and land registry records in Nigeria has been the lack of strong political will on the part of relevant authorities.

Effective land information management systems are expected to provide timely, accurate, and accessible land title and ownership information to stakeholders. However, the prevailing land administration practices

in most states of the federation and within the Federal Ministry of Works, Lands, and Housing remain largely analogue in nature. These systems are characterized by bureaucratic bottlenecks and human-induced inefficiencies that significantly delay the completion of land title registration processes. Consequently, prospective investors are often discouraged, thereby undermining national economic development. Although some states and federal agencies have initiated the computerization of cadastral records, the extent of implementation remains far below the standards required for an efficient land information management system.

Ifeanyichukwu et al. (2022) lamented that despite the well-documented benefits of computerized land information systems, only about 20% of Nigerian states have commenced the application of information and communication technology (ICT) in land administration. The need to strengthen and modernize land information management systems is therefore critical, particularly in the context of today's ICT-driven global economy. Computerized land administration systems can facilitate faster processing of land titles, prevent unnecessary duplication of records, improve access to land-related data, and introduce built-in quality control mechanisms. However, land title registration in Nigeria remains largely opaque, discouraging both local and foreign investment in real estate. Access to land information is still highly restricted, leading to significant revenue losses for the government. Even in states where partial computerization has been implemented, only limited segments of the land administration sector have been automated, resulting in continued delays and inefficiencies in land title processing (Zevenbergen & Ploeger, 2019). There is therefore an urgent need to reduce the time required for land title processing and documentation in Nigeria. Given that Ministries of Lands and Urban Development operate through multiple interdependent departments, improving interdepartmental coordination is essential for enhanced service delivery. However, such improvement must be preceded by a comprehensive review of existing processes to identify gaps and areas requiring reform. This study therefore seeks to assess the effectiveness of GIS-based land information systems in promoting efficient land administration in Abuja.

Research Questions

This research work seeks to address the following questions:

i. What are the existing land tenure systems?
ii. What are land information systems?

Objectives of the Study

The objectives of this research work are to:

i. identify and examine the existing land tenure systems;
ii. evaluate land information systems;

II. RELATED WORK

Conceptual Framework

Significant improvements have been recorded over time in the study and application of Cadastral Information Systems. In several countries, deliberate efforts have been made to extend traditional cadastral systems to address emerging needs and contemporary challenges. Such initiatives include the automation of administrative tasks, the development of software applications for managing cadastral registers, the creation of analytical tools for producing digital cadastral maps and plans, the automation of land management processes for land consolidation, and the full implementation of integrated land information systems. These advancements have contributed to more efficient, transparent, and reliable land administration practices. According to Elayachin and El-Hassane (2015), the design and implementation of a digital cadastral system require a structured approach that supports the integration of cadastral operations with GIS packages while ensuring usability within a multipurpose system. They identified three critical levels in this process. The first level involves understanding existing cadastral applications and critically analyzing ongoing and completed projects aimed at modernizing cadastral systems. The second level focuses on outlining and evaluating different methods for linking cadastral data models with GIS software, including a discussion of the strengths and weaknesses of existing approaches. The third level

addresses the practical implementation of the proposed system, emphasizing operational efficiency and system sustainability. Buragohain et al. (2012) developed a land information system using integrated remote sensing and GIS technologies for Guwahati City in India, with the objective of establishing an advanced database management system (DBMS) for urban management. In their study, maps of Guwahati City and its surrounding areas were digitized, while industrial data incorporated information on drainage networks, road and railway systems, and urban infrastructure. Satellite imagery was processed and classified using supervised classification techniques to generate land use and land cover maps. Spatial and temporal changes in urban growth patterns were identified from the digital datasets. Ultimately, a plot-wise urban land use map was produced, with detailed ownership attributes assigned to each plot. The study culminated in the development of a decision support system that provided comprehensive information on individual plots and their attributes. The database was subsequently converted into a web-based format and customized to allow online queries for quick and efficient information retrieval.

In Turkey, the cadastral system was initially established by the state in 1925 and subsequently underwent several legal and organizational modifications. These changes resulted in a lack of standardization and inconsistencies in the geometric components of cadastral data, including cadastral maps without coordinate systems or with varying coordinate references. Challenges related to data standardization, data quality, inconsistencies, digital archiving, and slow cadastral service delivery necessitated reforms toward a computer-based cadastral information system. In response, researchers analyzed the requirements of a cadastral database and designed a spatiotemporal database capable of handling spatial, temporal, and spatiotemporal queries. The system employed a Spatiotemporal Entity-Relationship (STEP) model combined with the Enhanced Entity-Relationship (EER) model. Oracle 8i Spatial was selected for its spatial data handling capabilities, while MapInfo 6.0 GIS software was used for data retrieval, visualization, manipulation, and analysis due to Oracle's limited graphical functionality. The outcome was a functional database containing cadastral and land registry data for the study area (Tella & Rably, 2021). Reghavendran (2022) demonstrated how an automated cadastral mapping and land information system could be developed, identifying two key components necessary for its implementation. These include the spatial component, which describes parcel boundaries and spatial disposition through cadastral maps, and the non-spatial component, which captures ownership details, tax values, and related attributes. Spatial Database Engine (SDE) was used for managing spatial data, while MicroStation Geographic handled non-spatial data. For customized queries and report generation, the database was implemented using Oracle. The study concluded that the analytical capacity of the cadastral information system was extensive and largely dependent on the quality of input data and specific user requirements.

In Nigeria, Shuaibu (2008), in his study titled *"Cadastral Land Information System for Sustainable Land Conveyance in Bauchi State,"* converted existing analogue maps into digital format using a digitizing tablet within the ILWIS environment. An automated attribute database was developed in ArcView and subjected to query and spatial analysis. The study successfully demonstrated the spatial distribution of land covered by certificates of occupancy, as well as the number of plots allocated for residential, recreational, and commercial uses. Similarly, in 1996, the Government of New Zealand mandated Land Information New Zealand (LINZ) to develop a proposal aimed at automating the country's survey and title systems, integrating survey and title processes, digitizing records, reducing compliance costs, and leveraging technological advancements to meet growing public demand for high-quality cadastral services (Bevin, 2019). In Nigeria, the establishment of the Abuja Geographic Information System (AGIS) marked a major shift in land administration practices within the Federal Capital Territory. The analogue cadastral system was converted to a digital format, and new certificates of occupancy were issued to existing title holders. Prior to the creation of AGIS, land transactions in Abuja were characterized by title duplication, delays in land searches, and poorly documented land conveyance processes.

Land Administration

Despite the absence of explicit recognition for customary land administration within the Land Use Act of 1978 (LUA) and the 1999 Constitution of the Federal Republic of Nigeria, customary land administration systems remain resilient across the country. While the LUA provides a legal framework for land administration in urban areas (Babalola & Hull, 2019a; 2019b), it does not adequately address land administration in rural and peri-urban regions. In these areas, land occupation and use are largely governed by African customary law, which encompasses long-established, reasonable, and widely observed practices (Ndulo, 2011). Rural communities primarily rely on traditional authorities for land access and allocation, even though customary law occupies an informal legal status due to its lack of constitutional recognition. Consequently, Nigeria operates a hybrid land administration system in which statutory and customary institutions function in parallel with minimal coordination or mutual recognition. Effective land administration systems supported by appropriate legal frameworks are essential for ensuring tenure security (Subedi, 2016; Ghebru & Okumo, 2016; 2017; Otubu, 2018). In land reform initiatives, scholars and practitioners emphasize the need to understand country-specific land administration contexts through conceptual frameworks that guide cadastral system development (Hull & Whittal, 2019). The 3S conceptual framework—success, sustainability, and significance—was developed to ensure that cadastral systems align with human rights principles, pro-poor policies, and good governance, particularly in the recognition of customary land rights.

Nigeria's land administration system has evolved over time, shaped by diverse stakeholder perspectives, including those of service providers, beneficiaries, and professionals. These perspectives influence perceptions of what constitutes an effective land administration system in terms of design, implementation, and operation. However, historical policy choices have created significant gaps in service delivery, compounded by dynamic social, cultural, political, legal, and economic environments. Land administration institutions in Nigeria face numerous challenges, including outdated organizational structures, bureaucratic procedures, and high service fees. As a result, only a small proportion of the population engages with the formal land sector, with estimates indicating that just about 3% of land in Nigeria has formal title registration. This situation disproportionately affects women and low-income groups, undermines the business environment, and constrains economic development. The absence of proper land title also limits access to credit, as land cannot easily be used as collateral, while the lack of comprehensive land records restricts government capacity for effective land use planning and revenue generation. Although the Land Use Act of 1978 sought to unify land laws and formalize property rights through certificates of occupancy, its implementation has varied across states due to differing interpretations and the coexistence of pre-existing land laws. Several studies, including those by the World Bank, consistently rank Nigeria among the most difficult and expensive countries globally for property registration. Many of these challenges stem from poor interpretation and implementation of the LUA, leaving landowners vulnerable to competing claims. In response, the Presidential Technical Committee for Land Reforms (PTCLR) was inaugurated in 2009 to propose reforms aimed at improving land registration, dispute resolution, cadastral demarcation, valuation mechanisms, and the establishment of a national land title depository. Subsequent studies commissioned by the PTCLR assessed land administration practices across selected states and the FCT, focusing on service delivery, institutional roles, revenue generation, technology adoption, and capacity development, with the aim of creating a unified and sustainable national land administration framework.

The Concept of Geographic Information System (GIS)

Geographic Information System (GIS) refers to a computer-based system designed to capture, store, manage, analyze, and display information related to features on the Earth's surface (James, 2014). GIS facilitates the acquisition and management of spatial data associated with physical and human features such as roads, settlements, and infrastructure, enabling real-time monitoring, retrieval, visualization, and mapping of spatial information. GIS relies extensively on remote sensing technologies, which involve the detection and classification of Earth surface features

using sensors mounted on satellites or aircraft (Ahmed & Salihu, 2013). It also incorporates geographic profiling techniques, where spatial locations are digitally analyzed using algorithms to generate probability surfaces that indicate likely target locations (Rossmo, 2018). Emerging from advances in computer technology, GIS has proven effective in addressing complex social, economic, and environmental challenges, including crime analysis in advanced societies (Radoff, 2023). In recent decades, GIS technology has gained widespread acceptance and application across earth sciences, environmental studies, and numerous other disciplines. It represents a rapidly growing global industry with increasing demand for spatial data, analytical expertise, and GIS software solutions. Many contemporary global challenges—such as pollution, overpopulation, deforestation, and natural hazards—possess strong geographic dimensions that can be effectively analyzed using GIS. Similarly, local-scale problems, including agricultural land suitability, wildlife habitat assessment, waste disposal planning, disease mapping, and infrastructure location, can be addressed through spatial analysis. GIS enables precise analysis of spatial data, providing insights that support informed decision-making and sustainable solutions (Kabiru, 2021).

Geographic Information Systems are widely regarded as one of the most accurate and versatile information technologies. They consist of integrated software, hardware, data, and procedures designed to collect, store, retrieve, analyze, and display geographically referenced information. GIS supports the integration of spatial and non-spatial data in an efficient and organized manner, functioning as a database system, a computer-assisted cartographic tool, and a comprehensive spatial analysis platform (Jebur, 2022). Although mapping and geographic analysis predate GIS, the technology has significantly enhanced the speed, accuracy, and accessibility of these processes, making spatial analysis available to a broader range of users beyond specialized experts. Today, GIS employs hundreds of thousands of professionals worldwide and is taught at secondary and tertiary educational institutions, reflecting its status as a multi-billion-dollar global industry. Research on GIS applications spans diverse fields, including education, healthcare, transportation, environmental management, and urban planning. This study therefore builds on existing literature by reviewing research that has examined the applications and uses of GIS in areas such as site selection, route optimization, disease mapping, and the spatial distribution of social services (Ahmed, 2019).

Applications of Geographic Information Systems: Overlay of Layers

One of the core strengths of GIS lies in its ability to integrate multiple data layers representing different features within a given area. These layers can be overlaid and analyzed within a single system to support informed decision-making. Overlay analysis is widely used for site selection, environmental impact simulation, emergency response planning, and disaster risk assessment. For instance, integrating road networks with geological and environmental data can help assess the potential impacts of natural hazards such as earthquakes (Kabiru, 2022). GIS also plays a critical role in land information management by enabling the creation, storage, updating, and retrieval of land-related data for planning and administrative purposes. Compared to traditional paper-based systems, GIS facilitates easier access to land records, tax information, land-use plans, and zoning regulations. Common applications of GIS in land administration include land registration, title documentation, cadastral mapping, land-use planning, and zoning analysis. GIS also supports the management of political and administrative boundaries, soil cover, and transportation networks, thereby enhancing the efficiency and transparency of land administration processes (Jebur, 2021).

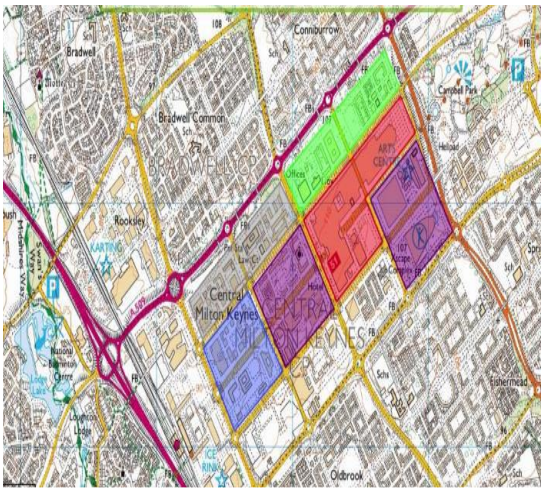

Fig. 1: A plan of land-use and cadastral mapping

Source: Abuja Geographic Information System (AGIS, 2024).

Technologies of geographic information systems are widely used for the planning and management of public services (as shown in the figure below). The typical uses of geographic information systems involve the management of the following utilities: gas, electric, water, telecommunication, roads, sewering network (as shown in the figure below), facilities of TV/FM, analysis of hazards, dispatch, and services emergency. Typical data that input involves a street network, demographic data topographic data, and boundary of the local government (Jebur, 2021).

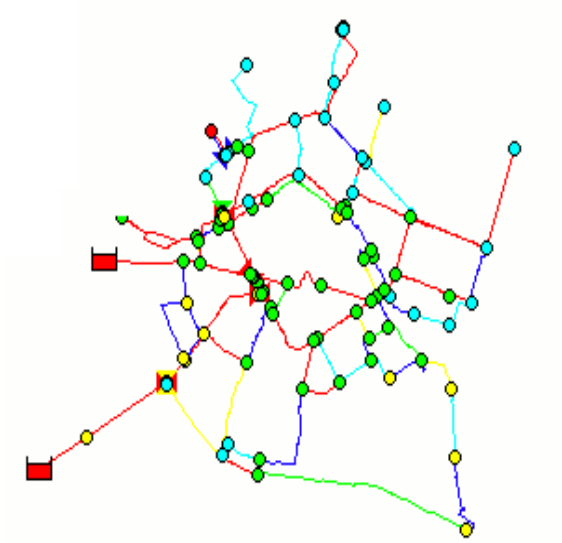

Fig. 2: A plan of sewering network.

Source: Abuja Geographic Information System (AGIS, 2024).

The geographic information systems have the ability for applying a variety of applications of the environmental field that extend from the simple query, inventory, analysis of map and overlay, to decision-making systems that be complex. Include such as modeling of the forest, monitoring, air/water quality modeling, mapping of the environmental zones, analysis of the interaction economic, change geological & hydrological, and meteorological. The data environmental that must be input into geographic information systems involve elevation, the cover of the forest, hydrogeology coverage, and soil quality (Jebur, 2021).

Archaeology has used geographic information systems in a variety of ways as a spatial system, where, use the applications of geographic information systems as database management for records archaeological, with the added advantage of being handy to design instant maps in the simplest level, It has been performed in the management of cultural contexts, where sites of archaeological are foretold using statistical models based on-site locations that previously identified. Also, it has been used as a tool in intra-site analysis and to simulate changes in past landscapes (as shown in the figure below) (Ahmed, 2019).

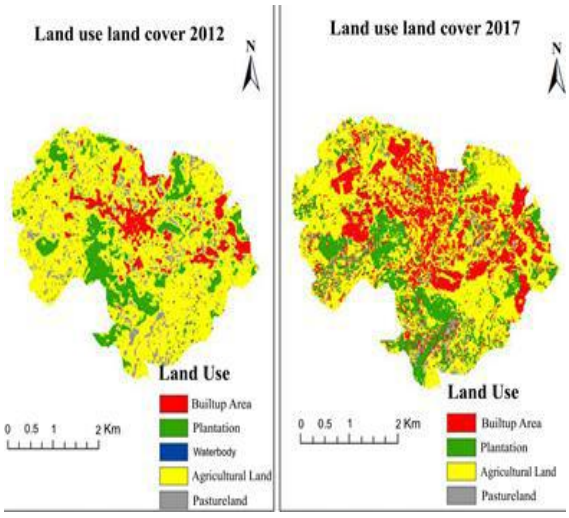

Fig. 3: Changes in past landscapes for five years

Source: Abuja Geographic Information System (AGIS, 2024).

The geographic information systems can study areas exposed to floods (as shown in the figure below),

earthquakes, storms, cyclones, fire, drought, volcano, soil erosion, and landslides, therefore, it can accurately predict future accidents.

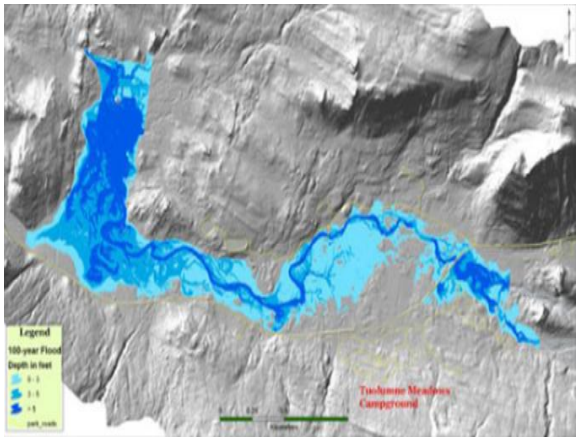

Fig. 4: Areas exposed to floods

Source: National Emergency Management Agency (NEMA, 2024).

Geographic information systems offer a practically unique ability to combined geographical data and analyze them, which further enhances and develops the intelligence base for operations of defense.

Geographic information systems enable the study of the change of sea-level (as shown in the figure below), the temperature of the sea surface, marine population, and coral reef ecosystem.

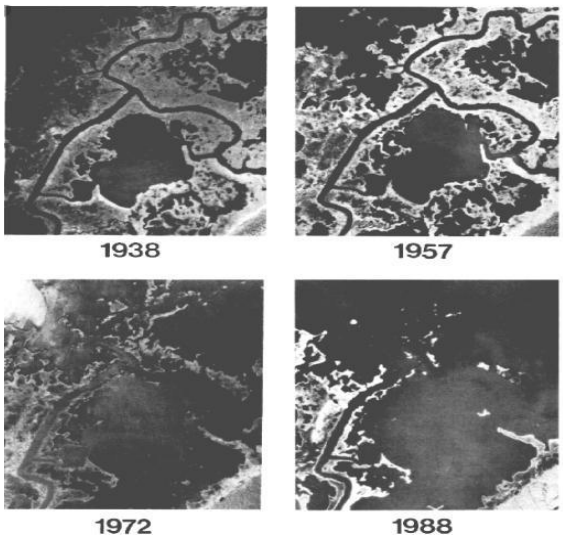

Fig. 5: Sea-level for deference years

Source: Global Sea Level Change Map (1938-1988).

Geographic information systems enable the spatial representation of resources of groundwater, quality of waste, management of the watershed, water pollution, and surface water management (Jebur, 2021).

The use of geographic information systems and GPS in the production of agriculture. Exactness agriculture is a catch-all expression that describes using technologies of geographic information systems and GPS to manage specific field areas. Technologies of exactness agriculture use information from various sources to aid farmers in decisions making about crop production and management based on the variability of the potential of production inside fields.

III. THEORY/CALCULATION

Modernization Theory

Modernization theory explains urbanization in the developing world as a process driven by industrialization, innovation, and economic growth that originates and spreads from urban centres (Pacione, 2015). According to this theory, cities serve as focal points for modernization, where new technologies, institutions, and economic activities emerge and gradually diffuse to surrounding regions. The theory places strong emphasis on economic development, structural transformation, and increased productivity as key indicators of societal progress. In the context of Geographic Information Systems (GIS), modernization theory is particularly relevant, as GIS supports development through advanced spatial analysis, mapping, and planning tools that enhance infrastructure development, land administration, and efficient resource allocation. By enabling planners and policymakers to visualize and analyze spatial patterns, GIS contributes directly to informed urban planning and sustainable development strategies. Modernization theory also focuses on broader social and economic progress, and GIS provides a powerful means of tracking such progress through the spatial analysis of data related to health, education, poverty levels, population distribution, and access to basic services. Technological advancement is a central pillar of modernization theory, and GIS represents a major technological innovation in the acquisition, management, analysis, and visualization of spatial

data. The use of GIS enhances institutional capacity, improves administrative efficiency, and strengthens planning processes, all of which are essential components of modernization. Furthermore, modernization theory emphasizes efficient resource allocation as a prerequisite for development. GIS facilitates spatial planning and land management by enabling optimal allocation and utilization of resources, thereby supporting sound decision-making processes. Another key aspect of modernization theory is its advocacy for evidence-based and data-driven decision-making. GIS provides an integrated platform for collecting, analyzing, and presenting spatial information in a clear and accessible manner, thereby supporting informed policy formulation and implementation. Through its analytical and visualization capabilities, GIS bridges the gap between data and decision-making, reinforcing the core principles of modernization theory.

Applications of Modernization Theory in GIS

Urban Planning and Development: GIS supports the design and management of efficient urban infrastructure, transportation networks, housing layouts, and public service delivery systems.

Resource Management: GIS enables the optimization, monitoring, and sustainable management of resources in sectors such as agriculture, water supply, forestry, and energy.

Disaster Management: GIS facilitates risk assessment, emergency preparedness, response planning, and post-disaster damage assessment, thereby reducing vulnerability and enhancing resilience.

Environmental Sustainability: GIS supports environmental monitoring, conservation planning, impact assessment, and the implementation of sustainable development initiatives.

Economic Development: GIS aids business location analysis, market assessment, investment planning, and regional development strategies, contributing to economic growth and competitiveness.

IV. EXPERIMENTAL METHOD/PROCEDURE/DESIGN

Study Area Location and Size

Abuja is the Federal Capital Territory (FCT) of Nigeria and occupies a total land area of approximately 7,315 square kilometres. The Federal Capital City (FCC), which constitutes the core of the territory, is planned to cover about 250 square kilometres, while the remaining city region extends over approximately 7,065 square kilometres (AGIS, 2024). The territory is geographically located between latitudes 8°50′ and 9°10′ North, and longitudes 7°15′ and 7°32′ East. The FCC is a purpose-built and well-planned city, developed in the 1980s, and officially assumed its status as Nigeria's capital on 12 December 1991, replacing Lagos (Wikipedia, 2018). The Federal Capital Territory was carved out from the former states of Niger, Plateau, and Kwara. Geologically, the Federal Capital Territory is predominantly underlain by high-grade metamorphic and igneous rocks of Precambrian age, which generally trend in a north–northeast to south–southwest (NNE–SSW) direction. These formations consist mainly of gneisses, migmatites, granites, and schist belt outcrops, particularly along the eastern margin of the territory. In terms of topography, the lowest elevation within the FCT is found in the extreme southwestern part of the territory, where the floodplain of the River Gurara lies at approximately 10 metres above sea level. From this area, the land rises irregularly towards the east, north, and northwest. The highest elevations are located in the northeastern part of the territory, where several peaks exceed 760 metres above sea level.

Land administration in Abuja encompasses key processes such as land registration, cadastral mapping, land valuation, and land inventory management (AGIS, 2024). Traditionally, land administration practices relied on manual and analogue approaches, which often resulted in lengthy project design and implementation timelines. However, the introduction and adoption of innovative technologies, particularly Geographic Information Systems (GIS), have significantly transformed land administration practices in the territory. The establishment of the Abuja Geographic Information System (AGIS)

represents a unique and strategic opportunity to address longstanding inefficiencies and to harness previously underutilized and untapped land administration potentials in Nigeria through improved accuracy, transparency, and efficiency.

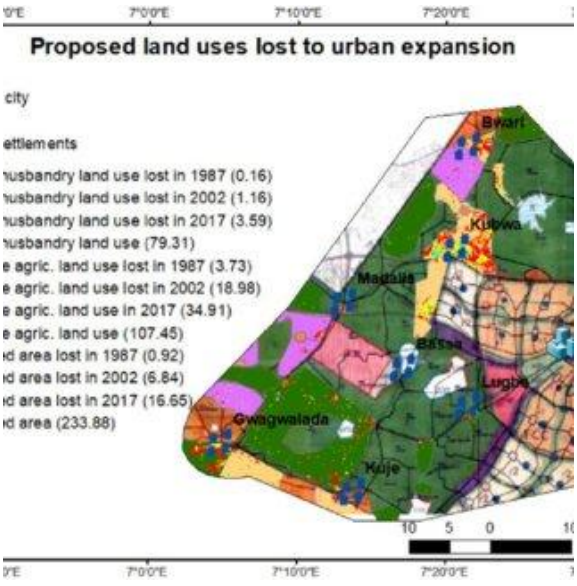

Fig. 6: Map of the Study Area
Source: Abuja Geographic Information System (AGIS, 2024).

Climate and Rainfall

Abuja experiences three distinct seasonal conditions over the course of the year. These include a hot and rainy season, which extends from April to October; a dry season that lasts from October to April; and a brief transitional windy period known as the Harmattan season, characterized by the influx of dry, dusty West African trade winds accompanied by cooler temperatures. During the rainy season, average daytime temperatures typically reach about 86°F (30°C), while nighttime temperatures remain relatively warm. In contrast, the dry season is marked by much higher daytime temperatures, which can rise to as high as 104°F (40°C), while evenings and early mornings can be noticeably cool, with temperatures dropping to approximately 54°F (12°C). Under the Köppen climate classification, Abuja is categorized as having a tropical wet and dry climate (Aw) (tripreport.com, 2024). During the peak of the rainy season, particularly between July and August, temperatures decline considerably due to persistent cloud cover, and the annual temperature range reduces to around 20°C. Relative humidity levels in the Federal Capital Territory vary spatially and seasonally, with dry season afternoon humidity averaging about 20% at higher elevations and in northern locations, and rising to approximately 30% in the southern parts of the territory.

Soil and Vegetation

The Abuja region is geologically underlain by crystalline basement rocks, predominantly granites and gneisses. Vegetation across the territory is largely characterized by savanna grassland with limited forest cover (Pop, 2016). The soils of the Federal Capital Territory are generally shallow and sandy, particularly across major plains such as the Iku–Gurara, Roboes, and Roubochi plains. The high sand content of these soils makes them highly susceptible to erosion, while their shallow depth reflects the presence of hard and resistant lower soil horizons. However, soils found on the well-known Gwagwa plains differ significantly, as they are deeper and more clayey in nature. This variation is likely influenced by underlying parent materials such as gabbro and fine- to medium-textured biotite granite. As a result, soils in the Gwagwa plains are among the most fertile and agriculturally productive in the territory. Furthermore, their relatively level topography and occurrence on exposed interfluve summits make them particularly suitable for urban development. The Federal Capital Territory falls within the Guinea Savanna vegetation zone of Nigeria. Population estimates from the 2012 census indicate that the Federal Capital City Area Council had a population of approximately 979,876 (NPC, 2012).

Research Design

To enhance the reliability and clarity of the study, a descriptive cross-sectional survey research design was adopted. The study relied primarily on primary data sources. In line with this approach, a structured questionnaire was designed and administered to obtain first-hand information from legally recognized landowners within Abuja, as well as from relevant GIS-related ministries, departments, and agencies involved in land administration.

Types of Data Sources

Both qualitative and quantitative data collection approaches were employed in this study. The qualitative approach enabled direct interaction between the researcher and respondents, allowing participants to freely express their views and experiences without restriction. On the other hand, the quantitative approach facilitated systematic data analysis by providing measurable variables and standardized scales, thereby enhancing objectivity and comparability in data collection.

Data Collection Method

Questionnaires were used as the primary instrument for data collection. The adopted methodology followed a descriptive cross-sectional approach, with data analyzed using charts, graphs, and measures of central tendency to summarize and interpret respondents' views effectively.

Population of the Study

According to Macrotrends (2024), the current population of Abuja is estimated at approximately 3,840,000 (three million, eight hundred and forty thousand). A representative sample was drawn from this population, and the research instruments were administered primarily to legally recognized landowners, as well as staff of land administration ministries and agencies within the Federal Capital Territory.

Table 1: Population

Serial Number	Name of Target	Number of Questionnaires Allocated
1	Federal Ministries Associated with GIS and Land administration.	80
2	Legal Land Owners	160
3	Licensed Land Consultants and Agents	60
4	TOTAL	400

Sample Size and Sample Technique
Taro Yemeni's formula is been used to draw the sample. The derivation goes thus:

N= n/(1+n(e)2)

Where; N= Sample size, n= population under study, e= margin of error (0.05).

Therefore:

N= 3,840,000/(1+3,840,000(0.05)2)

= 3,840,000/9600.0025

= 399.999998

= 400

Four hundred (400) questionnaires were administered to the respondents and all were retrieved. On this note the researcher decides to distribute the questionnaires as scheduled below:

Serial Number Name of Target Number of Questionnaires Allocated

Federal Ministries Associated with GIS and Land administration. 80

Legal Land Owners 160

Licensed Land Consultants and Agents 60

TOTAL 400

Method of Data Processing
The data will be process by the use of structured design questionnaire which was administered to the respondents in the study area to solicit relevant/useful information in relation to the research topic from various stakeholders and sources.

Method of Data Analysis

Data collected was analyzed using descriptive statistics. These best suits non-experimental survey research.

V. RESULTS AND DISCUSSION

The Existing Land Tenure Systems

Table 2: Responses on the Existing Land Tenure Systems

S/N	Statement	Percentage (%)
1	Existing land tenure systems are well-defined and easy to understand	22
2	Current land tenure systems ensure equal access to land for all	16
3	Traditional land tenure systems are more effective than statutory systems	22
4	Government provides adequate support for land tenure systems	16
5	Existing land tenure systems protect vulnerable groups (women and youths)	24

Source: Author's Survey (2024)

The study identifies and examines the existing land tenure systems and their significant impact on the application of Geographic Information Systems (GIS), as reflected in the responses obtained from individuals directly involved in land tenure administration. The findings reveal a strong relationship between the existing land tenure systems and the use of GIS in land management. Specifically, 22% of respondents indicated that the land tenure systems in the study area are well defined and easy to understand. In addition, 16% of the respondents agreed that the current land tenure arrangements ensure equal access to land for all members of society. Furthermore, 22% of the respondents revealed that traditional land tenure systems are more effective than statutory systems in the management and resolution of land disputes. Another 16% stated that the government has provided adequate support for the implementation of land tenure systems. Meanwhile, 24% of the respondents pointed out that the existing land tenure systems adequately protect the rights of vulnerable groups, such as women and youths. These findings are consistent with the work of Adeniyi (2023), who emphasized that when communities are well informed about existing land tenure systems and the processes involved in land acquisition, both women and youths are empowered with equal rights, thereby promoting equitable access to land for all.

Fig. 7: The Existing Land Tenure Systems

Source: Author's Survey (2024)

Land Information Systems

Table 3: Responses on Land Information Systems

S/N	Statement	Percentage (%)
1	Land information systems contribute to efficient land management	75
2	Land information systems are reliable and up-to-date	40
3	Land information systems are easily accessible to stakeholders	45
4	Land information systems have reduced land disputes	50
5	Training programs on land information systems are adequate and effective	60

Source: Author's Survey (2024)

The results reveal a positive trend in the effectiveness and reliability of land information systems within the study area. A substantial majority of respondents (75%) agreed that land information systems contribute significantly to efficient land management, underscoring the vital role these systems play in enhancing and streamlining land administration processes. In addition, the findings indicate that 40% of respondents believe that the land information systems are reliable and regularly updated, while 45% noted that the systems are easily accessible to all relevant stakeholders. Moreover, 50% of the respondents acknowledged that the introduction of land information systems has led to a reduction in land-related disputes. Collectively, these results suggest that the existing land information systems are positively influencing land administration by improving efficiency, transparency, and accountability. However, despite these encouraging outcomes, the results also show that although a majority of respondents (60%) consider the current training programs on land information systems to be adequate and effective, there remains considerable room for improvement. This highlights the need for continuous training and capacity-building initiatives to ensure that all stakeholders possess the necessary skills and knowledge to fully and effectively utilize land information systems.

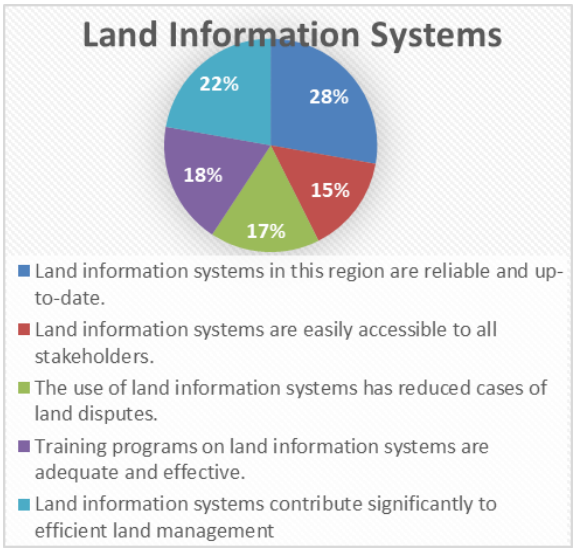

Fig. 8: Land Information Systems

Source: Author's Survey (2024)

VI. CONCLUSION AND FUTURE SCOPE

Conclusion

Based on the findings of the study, it is concluded that the existing land tenure systems are generally well defined and relatively easy to understand. Nevertheless, a considerable proportion of the population still perceives these systems as complex or unclear, indicating gaps in awareness and comprehension. Equal access to land under the current land tenure arrangements also remains a major concern. Although some respondents acknowledged noticeable improvements, the high number of undecided and negative responses points to persistent inequalities and challenges in the effective implementation of land tenure policies.

Furthermore, traditional land tenure systems were identified as more effective than statutory systems in resolving land-related disputes. This underscores the continued relevance and importance of customary practices in land administration and management within the region. With regard to government support and the protection of vulnerable groups, including women and youths, some respondents recognized existing efforts; however, the overall responses suggest that these areas require significant improvement. The prevalence of undecided responses further reflects limited awareness or inconsistent experiences with government interventions. Therefore, a deliberate and coordinated approach aimed at strengthening public engagement, institutional support, and policy implementation is essential to enhance the effectiveness of land tenure systems.

Recommendations

Based on the foregoing research findings, the following recommendations are proposed:

Enhance Public Awareness and Simplify Procedures: Regular community sensitization and awareness campaigns should be organized to educate stakeholders on the structure, clarity, and benefits of existing land tenure systems. In addition, land registration and documentation procedures should be further simplified to accommodate varying literacy levels and encourage wider public participation.

Improve Accessibility and Reliability of LIS: There is a need to invest in upgrading Land Information System (LIS) infrastructure to improve system reliability and accessibility for all stakeholders. Training programs should be expanded and tailored to the needs of different user groups in order to build capacity, increase system utilization, and address identified technical and financial constraints.

Contribution to Knowledge

This study contributes to the existing body of knowledge by providing empirical evidence on stakeholders' perceptions of land tenure systems. With 55% of respondents indicating that the systems are clear and accessible, the study highlights the relative effectiveness of the current frameworks, while also revealing significant room for improvement, as reflected by the 25% who perceive the systems as complicated.

The findings further offer valuable insights into the effectiveness of traditional land tenure systems in dispute resolution. A substantial proportion of respondents believe that traditional systems perform better than statutory arrangements, suggesting the importance of integrating customary practices into formal land administration frameworks. Moreover, the study reveals shortcomings in ensuring equal access to land and protecting the rights of vulnerable groups, particularly women and youths, thereby emphasizing the need for more inclusive land policies.

Additionally, the research identifies a critical gap in institutional and government support for the effective implementation of land tenure systems. The high proportion of undecided respondents indicates limited awareness and understanding of land tenure processes, highlighting the necessity for sustained public education and sensitization programs to improve stakeholder engagement and participation.

Suggestions for Further Studies

Based on the outcomes of this study, the following areas are suggested for future research:

Future studies should focus on a comparative analysis of traditional and statutory land tenure systems, examining their respective strengths, weaknesses, and potential areas of synergy. Such studies should also explore the cultural, legal, and socio-economic factors influencing the effectiveness of these systems, particularly in relation to dispute resolution and equitable land access.

Further research is recommended on the role of government support in the implementation and improvement of land tenure systems. This could include an assessment of policy frameworks, resource allocation, capacity-building initiatives, and infrastructural support aimed at protecting the rights of all stakeholders, especially vulnerable groups such as women and youths.

In addition, future studies should investigate the level of public awareness and understanding of existing land tenure systems, with a view to identifying barriers to information dissemination. Research focusing on improving accessibility—both in terms of procedural simplicity and clarity of information would provide

practical solutions to address the concerns of undecided or dissatisfied stakeholders.

Author's Statements – Disclosures

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Data Availability- Data for this study were collected using structured questionnaires. The adopted methodology was a descriptive cross-sectional approach, and data were analyzed using charts, graphs, and measures of central tendency.

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