



Remote Sensing and GIS Application in Land Administration in Nigeria

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Abstract

Land administration in any human society has been bedevilled with one form of maladministration or the other wittingly or unwittingly. This has caused untold hardship on most community and even nations in the form of boundary dispute as it is presently in countries like Nigeria. Remote sensing and GIS as a geospatial technological application tools have transformed in no small measure the land use/land cover administration and management of developed and developing countries that adopt them. This chapter assesses the various existing property right and levels of eminent domain in Nigeria, the concept and needs for e-government. Case studies of RS and GIS application in Land Administration were also examined; in which, Spatial Data Infrastructure (SDI), the National Geographic Information System (NAGIS) and African Initiatives (AFRICAGIS, OSS, AARSE, AOCRS) were discussed. In conclusion, it is obvious that most states of the federation are lagging behind in the use of this modern technology; therefore, all government land administrators must acquire the required skill in geospatial analysis while leveraging on the resources available at NASDA and other centres.

Keywords

Property right; E-Governments; Remote sensing; GIS; Spatial data; Infrastructure information system

Introduction

The emergence of democracy in most part of the world including African countries like Nigeria with its sharp practices even in public institutions with high incidences of corruption, transparency in land administration has taken centre stage. Training is one of the vehicles whereby tools that may help fight and/or prevent land corruption could be provided. The gains of training are well worth the money spent when those who benefited from the training 'spread the word' and produce a kind of domino effect, (Training on Transparency in Land Administration in Nigeria, online). This was first launched from 22-24 of January 2008 at Kwame Nkrumah University of Science and Technology (KNUST), in Kumasi, Ghana.

The major objective of any technological transformation is to enhance the quality of human life which can be achieved through gradual adoption of these technological innovations by the society. In fact, e-government, e-governance, e-business and e-commerce are now a common operational system in the world of information and communication technology advancement.

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Land by way of definition in the law of real estate term, including the surface of the earth, the land beneath the surface to the centre of the earth, and the air above. Land generally defines the relationship between man and nature in terms of spatial developmental activities and social pleasure derivatives that is highly subjective. The term also includes property permanently affixed to the soil, such as water collected in wells, houses, and fences. The ownership of land may be classified according to the various types of interests, the principal of which are estates in fee simple, life estates, reversions, remainders, and leaseholds, while the word administration or management can be seen as running, supervising, controlling or directing the affairs of something.

Historical background of land use and ownership

The concept of property can be traced to the primeval times since when societies apparently held most property rights - such as right to communal natural endowment which does not preclude some private owners of personal property, such as domestic animal and cooking utensils, existed, but real chattel seems to have been communally owned. The ownership of parcel of land only came to be at the expiration of the middle ages. Under feudalism, real estate could be held in trust, not owned and such holdings go with series of obligations. In the current sense of ownership, only the monarch and the church owned land [1].

The advents of trade groups or unions in the medieval social system gradually change the relative importance of real estate ownership. Personal asset had in the ancient time has been accorded minor importance in comparison to the land itself. Thus, little legislation on the ownership, transfer, and inheritance of personal property existed. This inadvertently gave rise to the possibility of the middle class amassing wealth and transferring same it at will, the rising middle class could be with comparative ease. In Nigeria for instance, during the pre-Colonia and Colonia era, when agriculture was the principal source of revenue, land served as a symbol of status and wealth [2]. After the independence, economic focus shifted from agriculture to revenue-producing stocks and bonds, and personal property became as important as real property or commodity that could be transacted like anything else.

Property and political philosophies

The theory of private property has been keenly contested among the communist and socialist movements. For instance, during the Cold War, the Soviet Union and the United States had different political and economic systems. The Soviet system was called communism. There is the fear by the United States and its allies that communism may be globalized by the Soviet Union which they disliked. The goal of communism was to end private ownership of property. Under communism, the people would own everything communally (jointly). They would make decisions as a group. But things didn't work out that way in the Soviet Union. Instead, the country became a dictatorship under the control of the Communist Party. The Communist are of the opinion that ownership of real property and most personal property should be public; that is, state ownership of the means of industrial production, as well as all wealth-generating personal properties. Although, typical Communist societies retained some private property, just as capitalist

governments own some property publicly. Socialist societies do not in totality negate the private ownership of properties.

Types of property

Properties can be grouped into two viz; landed and un-landed property. Landed property, according to English legal tradition, is the land and anything firmly attached to it, such as structural buildings and the permanent fixtures, and the raw materials beneath the surface of the earth. While the un-landed property is anything that can be owned that is mobile other than real estate. Privately own property can be divided into palpable and impalpable property. Palpable property exists physically such as automobile, fittings, etc. While impalpable property has no physical existence but nevertheless can be legally owned; an example is patent rights. Ownership of other gift of nature such as the atmosphere and the high seas, are time and place related.

Public interest and land uses (Eminent Domain)

The principle of Eminent Domain in public law and in its widest sense is the political or governmental power to take private property for public use. More precisely, it is the right of the nation, or it agencies/ parastatal, such as railroads and public utility companies, to appropriate, by due process of law, the ownership and possession of private property, haven justly compensate the affected owner. Eminent domain differs from taxation in that the exercise of the right affects the owners of specified properties, whereas taxation always involves the principle of the distribution of a public burden among a number of persons.

Eminent domain is an integral and essential feature of autonomy, and it has dominion over all private property rights as widely used in the United States. The Federal Government under the right of eminent domain as a sovereign state where necessary acquisition land for numerous public projects. However, the Fifth Amendment to the Constitution of the United States provides that “private property [shall not] be taken for public use, without just compensation.” These limitations have theoretically safeguarded excessive, capricious use of eminent domain power by the government.

Levels of eminent domain

The states also possess the right of eminent domain within their borders provided they do not exceed the limits on their powers as defined by the constitution. Most state constitutions specifically give a state this right. States may through their own constitution and laws redefine the use of eminent domain within their territory. The states commonly delegate the right to local administrative bodies such as city/county council for the purpose of making public improvements. Exercise of such delegated power by a local government requires separate enactment by the state legislature.

The states have employed such power to provide public works such as roads, toll roads, ferries, canals, railroads, and public parks. The states have also delegated such power to private corporations for public utilities, railroads, and telegraph and telephone companies, to acquire land.

Cities have used eminent domain power to foster urban renewal projects. In the 1950s and 1960s many inner-city neighbourhoods were condemned as blighted and razed via eminent domain to build new “public works projects,” including public housing projects in cities such as Baltimore, Chicago, Detroit, St. Paul, and Washington D.C. These projects uprooted predominantly lower-income and minority communities. In subsequent decades most of these “slum clearance” projects were deemed complete failures.

Human advancement and dynamism of land value system

Global Industrialization and Urbanization has totally transformed the use and the value system of land in every society as pressure on the finite land increases. The term urbanization as conventionally measured by demographers is urban population divided by total population for a region [3,4] also defines urbanization as the processes of transformation that affects geographic regions when they become more urban, and that during the processes of urbanization, a growing share of a region’s land and people become included in cities, suburbs and towns. He further referred to the term as the processes of cultural and sociological change caused by the transformation of rural life style into that of the urban.

According to the UN World Urbanization Prospects [5,6] virtually all the population growth expected during 2000-2030 will be agglomerated within the urban areas (Figure 1). During that period, 2 billion persons expected to be added to the whole world population will be in the urban centres. The world urban population as at now is about 2.9 billion and 4.9 billion are expected in 2030, although the world total population is estimated as 6.1 billion inhabitants, it is expected to have 8.1 billion by 2030.

The demand by both the public and private users of land that is finite in nature by the present and future population for various uses such as residential, industrial, recreation, transportation, commercials, institutional and agricultural in both urban and rural centres require that land should be made available at the right time, quantity, quality, and place [7]. Thus, the issue of ‘who controls what and where’ is the basis for land administration and good governance. This also calls for the re-evaluation of the quality and quantity of land information available and the managerial principles and policies. The dept and accurate knowledge of natural resources and the description and record of such are the prerequisite to their rational use and conservation.

Sustainable development

Development can be seen as a rational utilization of local resources for the improvement of living condition of all and sundry in the local, state and nation levels. This means that development is for the people and it involves exploitation of natural resources. Oriola [8] saw the development at all levels as depending strongly on awareness and understanding of the extent and nature of the endowed natural resource as well as the method of exploitation. One fundamental premise for sustainable development is the recognition that environment and development are not exclusive of one another but are complementary and intertwined. It has been contested that the principle of sustainable development is not unconnected to the fact that the non-sustainability forms of economic development compromised the environment in the name of economic growth [9].

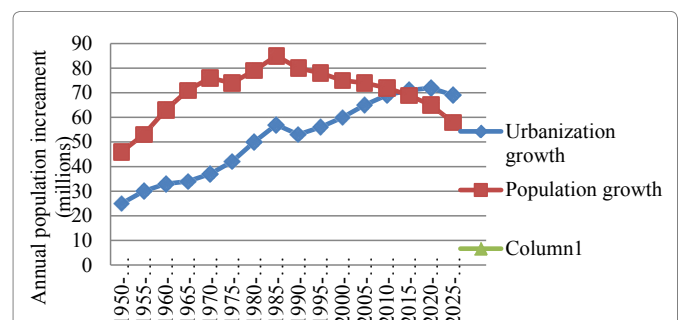


Figure 1: Annual increments of the world population and of the world urban population, 1950-2030.

International Institute for Sustainable Development (IISD) is of the view that there are plethora definitions of sustainable development, but the most repeatedly quoted definitions is one coined from "Our Common Future" (the Brundtland Report): "Sustainable development is development the meets the needs of the present without compromising the ability of future generations to meet their own needs".

Jonathan in 2000 said that promoters of sustainable development distinguish social development as an integral part of the paradigm. The key prominent areas includes: Human Development Index, Per Capita Index, GNP/GDP, Gender Equity, Poverty, etc. He concluded that: "true sustainability means a major shift from existing techniques and organization of production (in areas as Agriculture, Energy, industry, renewable resource system) to newer techniques that will practically address the real issues without Jeopardizing the future, but instead, presence it".

In another vein, Lele [10] explained sustainable development as "a modern way of life and style to socioeconomic activities for all categories of people that is able to preservation the environment [1]. Sustainable development can summarily be referred to as efficient management of resources for human survival taking into consideration both the present and future generation and land is the playground on which all human activity players are displayed.

Land Administration (Management) in Nigeria

Land Management (administration) by way of definition according to Olusola quoting Dale and McLaughlin is the process of controlling property development [11] the use and conservation land, revenues generation from land sales, leasing and taxation, and the conflicts resolution on use and land ownership.

Customary laws have been the definer of land administration in every community in Nigeria prior to what may be called modern or colonial rule, that is, the land tenure system is guided by the custom of the people. For instance, prior to the promulgation of the Land Use Act of 1978, there was no uniform land management system. While land was communally owned and administered by the Emir in the northern part of the country, there was a kind of dualism in the ownership and regulation of land in the south in which some land were owned by the individual family and some part by the Oba or Chief.

The land administrative process after the years of military rule seemed parlous in approach. Most of the offices responsible for the operation are too porous and susceptible to water or fire damage or even insect attack. Secondly, the registries are highly prone to unscrupulous activities aimed at destroying, altering or simply purloin documents. Uncertainties surrounding the state of land documentation and the red-tapes actually burg down the development of formal property markets and lending difficult to advance [12]. The Land Use Act (LUA) was therefore "the culmination of government effort to streamline the land tenure system" in the country [13,14].

Land administration under the LUA

Under the Land Use Act (LUA) [15], the State Governors holds the entire state land in trust for the benefit of the inhabitants, they can therefore grant statutory rights of occupancy in any part of the State, whether urban or rural. But the Local Government's power to grant customary rights of occupancy is confined to rural areas only. In this circumstance, should the State Governor decide not to designate non-urban areas, the Local Governments Authority will constitutionally have no role to play in land administration in that State [16]. More so,

a holder of statutory right of occupancy under the LUA has superior interest over the parcel of land and it override any existing right or documents. Also, any alienation or transfer of a statutory right of occupancy requires the consent of the State Governor. Consequently, any person who holds a customary right of occupancy is still required to apply in the prescribed manner to the State Governor for a certificate of occupancy [17].

The local governments

The 1999 Constitution of Nigeria approved the creation of 744 Local Government areas with their elected councils as a separate and independent arm of government, but s. 2 (1) (a) of the same LUA does not expressly conferred on them the power to issue any proof of the right of occupancy. As a result, the power of the Local Governments under the LUA has been deeply eroded and therefore unenviable.

Federal government

Prior to the establishment of the LUA, the Federal Government does not have any difficulty in accessing for public use. The main purpose of the LUA is to ease individual access to land in any part of the country which hitherto has been problematic. Therefore, the LUA seemed not played any significant role in federal land administration.

Land advisory bodies: These bodies comprises of the Land Use and Allocation Committee (LUAC) and the Land Allocation Advisory Committee (LAAC). The functions of the LUAC are clearly defined in threefold by the LUA as:

- (i) advising the State Governor on any matter connected with the management of land in an urban area,
- (ii) advising the State Governor on any matter connected with the resettlement of persons affected by the revocation of rights of occupancy on the ground of overriding public interest and
- (iii) Determining disputes as to the amount of compensation payable for improvements on land.

Similar to the Local Government authorities' condition in the LUA, the roles of the LAAC are not well defined in the LUA other than advisers to the Local Governments on any matter connected with the management of land in a non-urban area. The grassroots application of the LUA may then be lacking and the intended solution to land administration bottlenecks may be a mirage as in other developing countries of the world.

Barriers to effective land management in Nigeria

Farvacque and Mc Auslan [18] have identified a number of problems militating against successful land policies in their studies, which includes:

- i. Over centralization of management and administration
- ii. Complex and incongruous regulatory and legal frameworks
- iii. Lack of appropriate use of resources and political will to tackle problems
- iv. Lack of appropriate man power and probity
- v. Inappropriate technical-how and coordination
- vi. Fragmentations of land and loss of information
- vii. Distorted and fuzzy land uses policy formation.

The problems mentioned above and many more therefore call for a more effective and current land administrative principles and techniques. According to Anthony [19] only few areas of the economy do not rely directly or indirectly on spatial data for planning or managing their activities. He opine that virtually all human activities in housing delivery, resource control, transport planning, tourism, commerce and service delivery to the community can only be achieved through consistent geo referenced land management system readily accessible to the private and public sectors as well as the community at large. All human land based activities need spatial information in order to be sustainable. Most have a large number of data but are hampered by their inability to combine them in a meaningful way. The search for effective management support tools that will provide information to decision-making is now made possible in the effective use of E-Governance, Remote Sensing (RS) and Geographical Information System (GIS).

According to Dale [20] the major objectives of any ideal land administration reforms are to ensure that:

- a. There are secure and transparency in all land dealings.
- b. The cost of transactions is kept reasonably low.
- c. There is easy access for all participants, (poor or rich).
- d. Minority rights are protected.
- e. Environmental sustainability is supported and upper most.

The goal of an “ideal” land management system is to create an enabling open market economy in which land is transformed into economic goods. There seem not be any African countries whose land tenure system satisfies any of the above objectives. These may be attributed the reason why the majority of the rural dwellers remain poor, even though they have assets (land).

Geospatial technology

Geospatial technologies embrace all the processes involved in the measurement, analysis, and visualization of features or phenomena that occur on the earth. It is a tool for the integration of diverse datasets on the basis of their spatial attribute thereby allowing for holistic analyses. It has become very relevant in the modern land management in the areas of: land use/land cover, soil types, topography, hydrography, rainfall, demographic, infrastructure, suitability maps, yield statistics, etc. The technology is a combination of three different systems that are co-related in mapping earth surface features which are:

- i. Global Positioning Systems (GPS)
- ii. Geographical Information Systems (GIS)
- iii. Remote Sensing (RS)

The GPS is a network of orbiting satellites, transmitting signals to ground based electronic receiver devices that may be fixed or mobile to determine locations, and directions.

GIS on the other hand is a system for capturing, storing, integrating, processing, analyzing and retrieving geo reference data. The system is designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data. The acronym GIS is sometimes used for geographical information science or geospatial information studies to refer to the academic discipline or career of working with geographic information systems. GIS according to The United State Geological Surveys (USGS) is:

“A computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system.”

The National aerospace agency (NASA) also defines it as: “An integrated system of computer hardware, software, and trained personnel liking topographic, demographic, utility, facility, image and other resource data that is geographically referenced.”

In a general sense, the term describes any information system that integrates stores, edits, analyzes, shares, and displays geographic information. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations

While Remote Sensing on the other hand is the science of acquiring and measurement of spatially organized (distributed) data of some property (ies) (spectral; spatial; physical) using electronic sensor devices placed on a fixed or mobile platform without physical contact with the object of interest or phenomena under surveillance. The techniques involve utilizing electromagnetic radiation, force fields, or acoustic energy through employing cameras, radiometers and scanners, lasers, radio frequency receivers, radar systems, sonar, thermal devices, seismographs, magnetometers, gravimeters, scintillometers, and other sensing instruments (Figure 2).

E-Governance and land management

E-government is a term referring to all governmental activities that utilizes information and communication technology and services in the delivery of services to members of the public and internally in her day-to-day operations among different governmental department and agencies within the jurisdictional political structure. E-government is an ingredient of the concept of good governance and SMART (Simple, Moral, Accountable, Responsive and Transparent) government. The concept is simply the adoption and assimilation of the devices information and communication technology in the operating system of the process of the governance with the aim of achieving an efficient, transparent, accountability and user friendliness in all the citizens and business transactions with the government agencies. It encompasses digital interface in the Government to Citizen (G2C) and Government to Business (G2B) interactions [21].

The land management system and the project aim define the spectrum band, the payload, spatial and spectral resolution of the imaged product. For instance, the QuikBird images can be rectified to orthophotographs and modelled in combination with Digital Elevation Model (DEM). It can be seen in Figures 3 and 4 that the high image resolution can guarantee the geometric precision of landed property. The Nigeria Sat-1 with 32 meter resolutions can be use for regional studies, while Nigeria Sat-X will 2.5 meter, 5 meter resolution panchromatic (P) and multispectral (MSS) respectively for detail land administration and other applications.

The distinctiveness of RS techniques in environmental issues like land management, the following advantages are obvious among others:

- i. Real-time data-information collection.
- ii. Conceivable for direct electro-transmission to receiving stations and action areas.

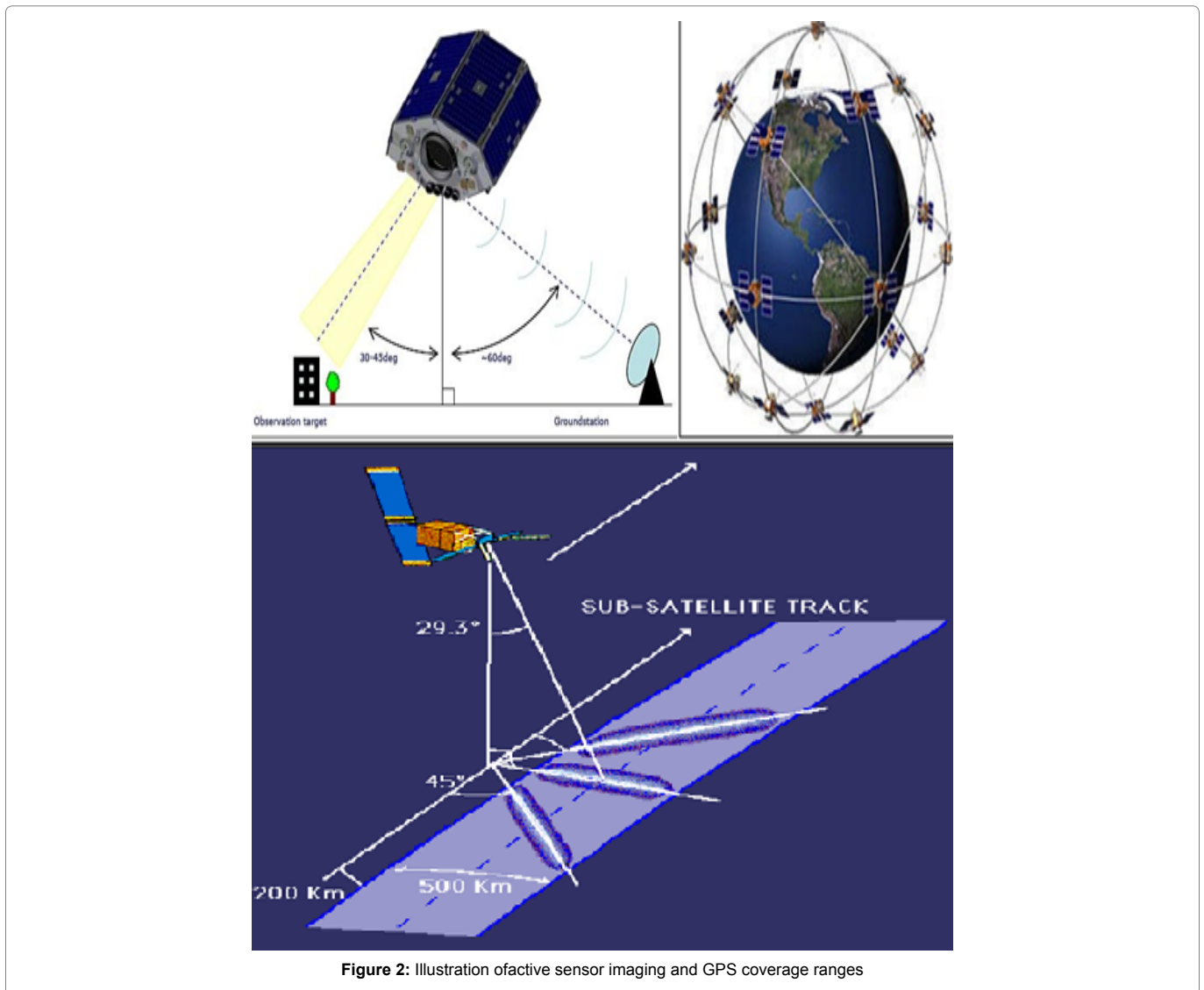


Figure 2: Illustration of active sensor imaging and GPS coverage ranges

- iii. Relatively low-cost of large area coverage.
- iv. Proficiency in operating day and night via thermal infrared and microwave sensors.

Geographic information or spatial information are earth feature information that are tied to a given position on the earth's surface whether on the land or sea. Vegetal cover, minerals, asset location, property ownership, soils, air quality, population and facility distribution are all within the domain of spatial information data analysis. With spatial information, it is possible to address and resolve national issues such as boundary disputes, urban renewal, forest management, land administration, coastal zone management, defence, drought and ecological management, and emergency planning. Ojigi [22] and Larsson [23] described Land Information System (LIS) as an analytical device for legal, administrative and economic decision-making and as Spatial Decision Support System (SDSS) for development planning. It consist of spatially referenced land-related data for a defined area, and the procedures and techniques for the systematic collection, updating, processing and distribution of land related information to the end users, see Figure 5

for the flow chart of the data computerization and Table 1 for some of the uses of GIS in land management.

National Space Data Infrastructure (NSDI)

National Space Data Infrastructure is defined as the infrastructure needed to support the collection, maintenance and utilization of geographic information in a particular country. In another word, according to Anthony [24] it is a term that describes the fundamental spatial datasets, the standards and policies that will enable the infrastructure to be integrated in the sustainable development of the country.

The primary aim of NSDI is to ensure the availability of accurate land and geographic data, of national coverage at the right time and to the right users even though the data is collected and maintained by different jurisdictions.

Different countries adopted different acronyms for their spatial data infrastructure, for instance, while Nigeria adopted National Geographic Information Infrastructure (NGII), America adopted National Digital Geospatial Framework (NDGF) and Ghana adopted



Figure 3: Ahmadu Bello Stadium area of Kaduna town as at 2009.

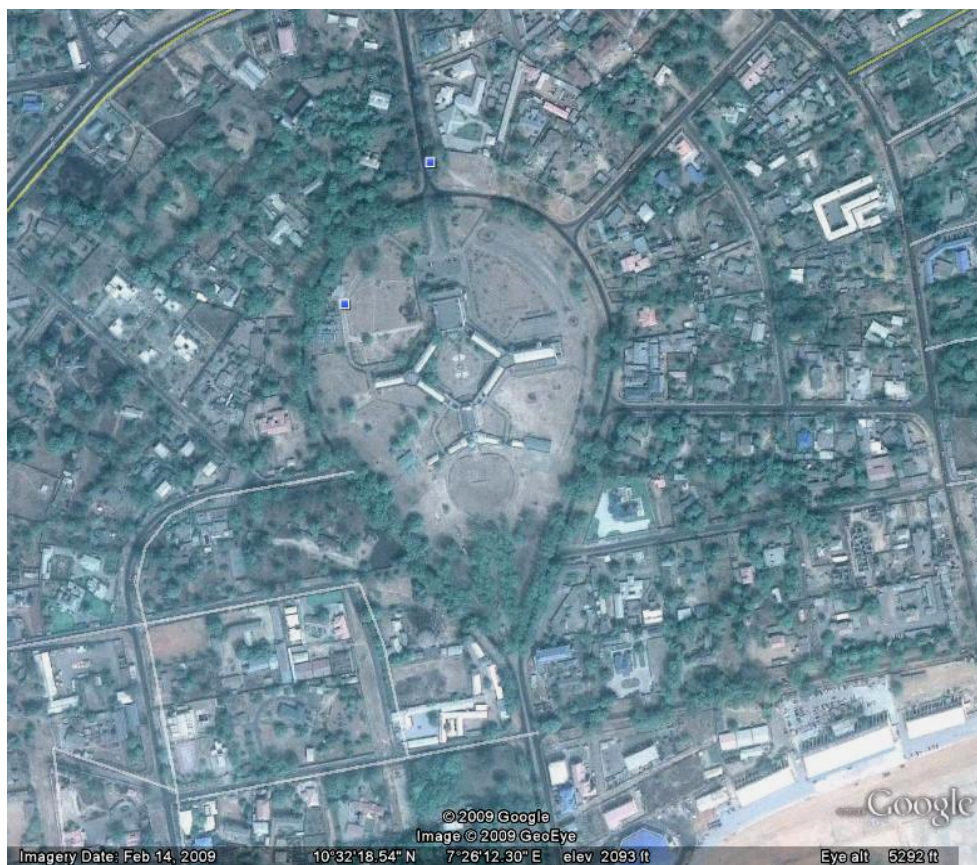


Figure 4: Lugard Hall area of Kaduna as at 2009.

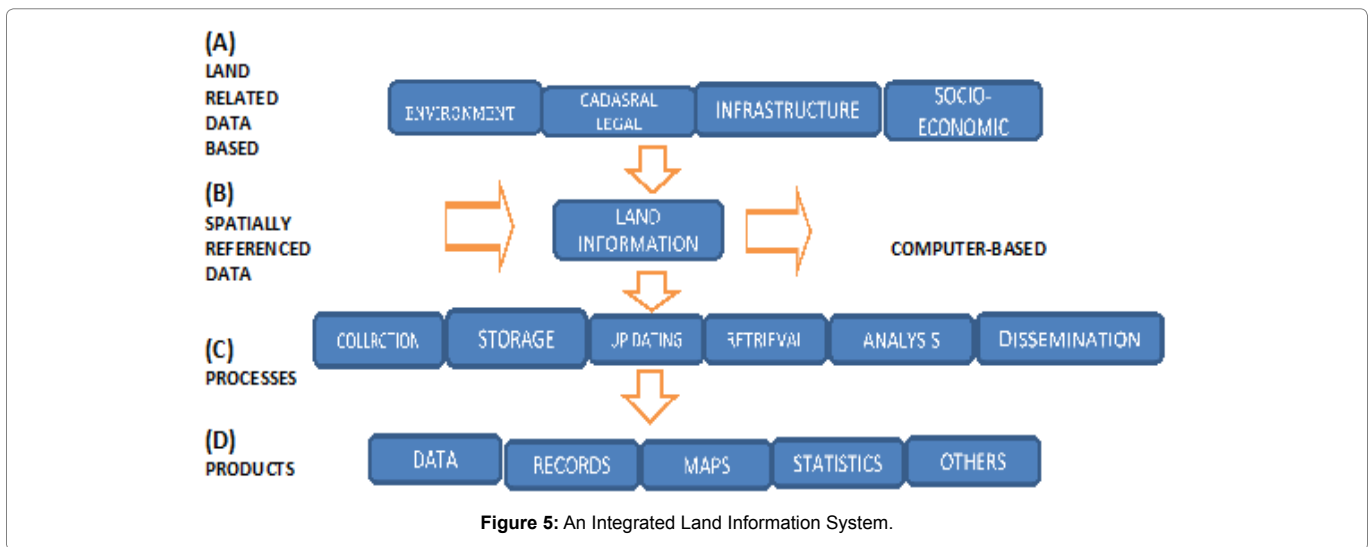


Table 1: Typical uses of GIS products.

SECTOR	USAGE OF NGIS PRODUCT
Planning	Urban and Regional planning, Urban Renewal, Change studies, land use mapping, development control.
Environment	Environmental Inventory and Monitoring, Flood and Erosion Monitoring, Land degradation, Impact Assessment studies.
Political/Administration	International and national boundary delineation and settlement.
Transport and Aviation	Airport facility management, Search and Rescue Operation
Petroleum Resources	Oil and Gas Exploration, Pollution control, National Geo-database.
Geology and Solid Minerals	Photo Geology, Solid Mineral Exploration.
Security	Defence, Crime Prevention and Monitoring, Rescue operation.
Population census	Planning, Enumeration areas, Demographic studies.
Tourism	Communication network maps, Tourist centres and Hotel location.
Local Government	Taxation, Tenement rate, Utility services and Land use plan.
Health	Epidemic Location and forecasting, Facility location and management.
Education	Facility planning and location, Institutional location and distribution.
Archaeology	Historical location and planning.
Agriculture	Soil distribution study, Crop inventory and distribution, Vegetation cover, Crop yield and diseases monitoring.

Source: Adapted from Anthony (2001).

National Framework for Geo-spatial Information Management (NAFGIM). Typical National Spatial Data Infrastructure comprises of four major components via: Institutional framework, Technical standard, Basic dataset and Clearing house network.

Institutional framework: [Leadership (policy formation, coordination, custodian agencies, Sponsorship). Educational training (in-house, on-the-job, international conferences/workshop)]

Technical Standards: Standardization of reference systems, data model, data transfer and Metadata.

Basic dataset and integration: These are the dataset produced by the institutional agencies

Within the framework of the technical standard. The leadership and institutional framework are to identify data priority from various sectors of the nation.

Clearing house: The clearing house is the final product centre where dataset are made available to the end users in accordance to the institutional framework. The products custodians will hold datasets on a number of independently maintained systems which can be linked physically through a range of mechanisms including: Local and wide area network, dedicated telephone lines and integrated services network.

African initiatives: AFRICAGIS was first inaugurated in Tunisia in 1993 by the Observatory of Sahel Sahara (OSS) and the United Nations Institute for Training and Research (UNITAR). Since then other consortium include the EIS-AFRICA, the African Association of Remote Sensing of the Environment (AARSE), and the African Organisation for Cartography and Remote Sensing (AOCRS) which organised the Kenya (2001) series.

Case study of GIS application in land administration in Nigeria

Abuja, the Federal Capital Territory of Nigeria is the pacesetter of GIS application in land administration in Nigeria. Abuja Geographic Information System (AGIS) is the computerisation of the land records in The Ministry of the Federal Capital Territory (MFCT). The maladministration of land and landed properties in the territory is the bases for the computerisation of landed properties.

Urban governance as a decision-making and implemented process, AGIS therefore focuses on the major stakeholders in land administration processes in order to develop an inclusive comprehensive land policy for Nigeria in such a way that will reduce poverty and enhance socio-economic growth by improving security

of tenure, simplifying the process of acquiring land by the public and fostering prudent land management for a good governance.

Benue Land Information Management System (BenLIMS).

In an effort to curb the incidents of fraud and sharp practices in land administration in Benue State, the then Governor (Gabriel Suswam) led administration initiated the automation of land administration in line with that of Abuja AGIS with the sum N500 million as take off. According to the State Commissioner for Lands and Survey (Mr Sam Dura), the project has completely changed the face of land management in the state, and is the best thing to have happened to our state since its creation in 1976. And that the first phase of the project had completely checked incidents of fraud in the sector and boosted the revenue profile of the ministry since no one handles cash in the ministry as all payments are made at the banks.

Federal Land Information System (FELIS)

FELIS is the automation of Land administration in the Federal Ministry of Housing and Urban Development using GIS. The system offers valuable improvements to land-property registration in Abuja which include the following:

- i. Improvement in land security
- ii. Reduction in the falsification of land documents
- iii. Physical reorganization of land documents
- iv. More secured property registration
- v. Rationalization of land administration processes
- vi. Increase in revenue generation

Challenges to GIS adoption in land administration in Nigeria

GIS applications in spatial issues in Nigeria are not new, but it is not without some impediments as listed below:

- i. Low expert rate in the country comparatively
- ii. Low level of awareness among the supposed end users
- iii. Fear of job insecurity
- iv. Low patronage and low cost recovery
- v. Payment of lip-service to global technology

Conclusion

The world is a global village and the spirit of integration is the mother of harmony and progress, hence the need for the adoption of GIS at all levels of human activities. Nigeria cannot be said to be too far from the Web race with the level of the National Geographic Information Infrastructure in the country, there is much to be achieved in the area of public utilization of the GIS products.

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