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Electronic Land Administration in Federal Capital City Abuja, Nigeria Using GIS Approach

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Abstract
This study is to explore the potentials of electronic Land Administration for efficient and effective management of land matters in the Federal Capital Territory of Nigeria with the purpose of assessing the system of land allocation in Abuja between 2006 and 2015; The FCC Cadastre is divided in to four phases namely; Phase I, II, III and IV with 10, 20, 23 and 42 Cadastral zones. Existing allocation cadastral maps of 2006 and 2015 as well as Quickbird Imageries 2006 and 2015 was used to assess the extent of land allocation in the Federal Capital City (FCC). The datasets were subjected to processing and analysis using ArcGIS 10.7.1 (ArcMap 10.7.1) software. The result showed consecutive increase in land area from Phase I-Phase IV (8002; 8608; 16740; and 21,819) hectares. The results indicate that, a total number of 13,156 allocations occurred with an area of 7,482 hectares out of the 8,002 hectares land area in Phase I. However, a total number of 14,839 allocations occurred with an area of 6,231 hectares out of the 7604hectare land area in Phase II. In Phase III, a total number of 3,659 allocations occurred making an area of 1,896 hectare out of the 9,503 hectares land area of Phase III and no allocations was revealed in Phase IV up to 2006 and in 2015; allocations are completed for Phase I to III with Phase IV not allocated. The study concluded that information flows, technical procedures associated with land and sharing of existing datasets amongst other land related department is uncoordinated, costly process of land acquisition has made access relatively unaffordable and lack of transparency by bureaucracy and corruption in AGIS which includes all kinds of informal payment to obtain and speed up service that has been already paid for and as well not brought people into the processes of land management.

Introduction

Nigeria has a very poor land administration system (Ukaejiofo 2010). Among many other authors, he observed that although Nigeria is endowed with a vast land mass of about 924,768 sq km, it does have the appropriate infrastructure to enable her reap optimum benefits from its administration. It is endowed with enviable land resource yet the potentials of such land as a veritable means of sustainable development have not been fully explored. Mabogunje (2010) argued that because more than 70% of lands are not surveyed and registered in the State Ministries and that because only about 3% of the 20% in the urban areas is mapped, there can be no proper land administration in the country. Ukaejiofo (2009) had earlier identified that as at

2009, less than 3% of the total land area can be tied to a well documented record of the use and user, that is there are no comprehensive cadastral map of our cities and towns and therefore a substantial part of the land under use is yet to come under the purview of government system, the ones in charge of managing it. Open and transparent land administration systems can help to reduce the need for court resolution in instances of dispute by simple, evidence based, administrative dispute resolution processes (Streudler, 2004).

Since the inception of the Federal Capital Territory (FCT), manual record keeping has been in use by all the land related departments of the former Ministry of Federal Capital Territory (MFCT) and the Federal Capital Development Authority (FCDA). The city and its surroundings have been expanding rapidly beyond projections. With this rapid expansion, manual record keeping became inefficient, time consuming and prone to abuses. Subject land policy file move from table to table before it is due for issuance of the certificate which sometimes gets missing and the available alternative then is to open a temporary file. This then was perceived to be cumbersome and time consuming; most importantly information relating to land was not protected as it should be. Several unsuccessful attempts were made in the past to solve the problem. The attempts generally failed because of gross under estimation of the gravity of the problem and the ill-defined scope of the project. These and other reasons led to the conception of the computerization exercise.

Electronic Land Administration is a major part of e-government and can be considered as a strong fundamental for legal, administrative and technological structure for the entire public administration (Schennach, 2004). E-government encompasses the integration of information and Communication Technology (ICT) in external government processes with the purpose to externalize government and enable citizens, public and private sector agencies to access government services through diversified communication channel (Mclver and Elmagarmid, 2002). E-government involves the delivery of public sector data, information and services using the internet and other digital or computerized systems (Navarra, 2010). E-government is considered as the backroom engine which will run good governance that will drive social and economic transformation (Obasanjo, 2004).

Computerization of cadastral and land records through GIS is recognized as a solution to the problems associated with manual land records keeping in the Federal Capital Territory and this can be traced back to 1979 when the need to quickly develop a computerized information system to implement the Abuja Master Plan was proposed (Jatau, 1991). However, all effort made to computerized cadastral and land record in the 1980s failed and one of the factors leading to failure was lack of political will (MFCT, 2004). The computerization of cadastral and land registry of the Federal Capital Territory, Abuja commenced in 2003. The computerization was conducted under the platform of a Geographic Information Systems (GIS) and Land Information System (LIS). The completion of the computerization gave birth to the Abuja Geographic Information Systems (AGIS), which is responsible for developing the geospatial information infrastructure of the FCT.

LA is concerned with the processes of determining, recording and disseminating information about the ownership, value and use of land when implementing land management policies (UNECE, 2005). These processes or functions are organized into different agencies that are

committed to serving a broad range of citizens with intensive interaction between government and citizen (Kalantari *et al*, 2005). LA also provide land information and related data that are fundamental in political, economic and legal decision for the best use of land and its management (**Lemmen *et al*, 2004). e-land administration (e-LA) is established by using ICT/geo-ICT to provide opportunities for better service delivery, customer satisfaction and citizen participation and decision making (Steudler,2004). In order to realize e-government concept, e-LA not only uses ICT/geo-ICT but considers changes in organization and legal framework taking stakeholders' needs into account.

The growth of Internet and Web technologies in the 1990s facilitated the development of electronically-enabled LAS. Online access to cadastral maps and data became possible, with digital delivery of cadastral data and e- conveyance (Williamson *et al*., 2006). Integration of GIS into LA is an important implication for the development of LAS to support e-government (Enemart et al., 2010). Specifically, the development of graphics on the Web in 1994 led to a definition of e-LA as the transformation of LA through the use of ICT (Aldrich *et al*., 2002; Williamson *et al*., 2010a). Eddowes (2004) noticed the lack of technology or web staff, financial resources, technology or web expertise and security are some of the barriers to adoption of e-Government

In Abuja, the immediate past and the current administration have delved into the use and application of the ICT for service delivery to the citizens, However, it has been observed that over the years, the problem of infrastructural development particularly in the areas of energy supply and sustainability, human and computer ratio and the deployment of internet facilities throughout the nooks and crannies of the country and lack of fund have negated the smooth operation and delivery of the system. Generally, access to the internet remains low in the country and very little or nothing has been done to expand the effective use of e-land administration. For instance, websites provided by the FCT administration are still limited in disseminating some information about the services being provided from organizations, some legal documents, and forms required for some services etc. In view of this, the study focuses on evaluating the efficacy of e-LA in the FCT.

Land Administration in the FCT Abuja

The law establishing the Federal Capital Territory (FCT) was promulgated on the 4th of February,1976 via the FCT Act, CAP 503 Laws of the Federation of Nigeria (LFN) 1990.The act provides for the establishment of the Federal Capital Development Authority (FCDA), a body charged, inter alia, with the responsibilities of provision of municipal services within the FCT, including urban management and the establishment of infrastructural services in accordance with the master plan referred to above, and by implication the monitoring of general compliance with the said document.

Given this mandate, the initial period was spent on the planning process, which includes physical and socio-economic studies culminating in the preparation of the city master plan and territory regional plan.

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(MFCT) and the Federal Capital Development Authority (FCDA). The city and its surroundings have been expanding rapidly beyond projections. With this rapid expansion, manual record keeping became inefficient, time consuming and prone to abuses.

Subject land policy file move from table to table before it is due for issuance of the certificate which sometimes gets missing and the available alternative then is to open a temporary file. This then was perceived to be cumbersome and time consuming; most importantly information relating to land was not protected as it should be. Several unsuccessful attempts were made in the past to solve the problem. The attempts generally failed because of gross under estimation of the gravity of the problem and the ill-defined scope of the project. These and other reasons led to the conception of the computerization exercise.

Zahir and Muhammed (2012) worked on Implementation of GIS-Based cadastral and land information system in Pakistan. They studied all the constraints and limitations that will be encountered in the process of integrating legal and geometric cadastral information to develop a new digital cadastral system

The computerization of cadastral and land registry of the Federal Capital Territory, Abuja commenced in 2003. The computerization was conducted under the platform of a Geographic Information Systems (GIS) and Land Information System (LIS). The completion of the computerization gave birth to the Abuja Geographic Information Systems (AGIS), which is responsible for developing the geospatial information infrastructure of the FCT.

Consequently the rapid expansion of the city cannot be sustained with manual record keeping, uncoordinated operations of the land related departments within the FCT could no longer support an efficient land management and administration, therefore there was the need to move with time and be up-to-date. Decisions were taken by the Federal Government and a taskforce on the computerization of the cadastral and land registry of the FCT was set up and inaugurated on 24th September 2003 to embark on complete computerization of the cadastral and land registry of the FCT. This led to the establishment of an agency known as Abuja Geographic Information Systems (AGIS).

Materials and Methods

The Study Area

The study area is the Federal Capital City (FCC), Abuja which is one of the six area council in the Federal Capital Territory (FCT) and it covers a total land area of 385.59square kilometers while the rest of the territory of the city region covers about 7,065 sqkms. Abuja is the capital city of Nigeria. It is located between latitudes 8° 50’ and 9°10' N; and between longitudes 7° 15' -- 7° 32' E. FCC is a planned city, and it is the heart of the FCT as it was built in the 1980s and officially became Nigeria's capital on 12 December 1991, replacing the role of the previous capital Lagos (**Wikipedia, 2008). Federal Capital Territory (FCT) was carved out of then, states of Niger, Plateau, and Kwara. The F.C.T (Abuja) is almost predominantly underlain by high grade metamorphism and igneous rocks of Precambrian age generally trending NN-E-SS-W, these rocks consists of gneiss, migmatites, granites and schist belt outcrops along the eastern margin of the area. The lowest elevation in the Federal Capital Territory (Abuja) is found in the extreme southwest where the flood plain of the river Guraja is at an elevation of about 10m

above sea level from there, the land rises irregularly eastward, northwards and north westwards. The highest part of the territory is in the northeast where there are many peaks over 760m above sea level.

Rainfall of the study area

The F.C.T (Abuja) has 2 main seasons, rainy (April – October) and dry (November – March) seasons. The high altitude and undulating terrain of the territory act to provide a regulating influence on its weather. During the dry season, the typical month being March, the temperature varies between 30^0 C in the north east to about 37^0 C in the southwest. This period is characterized by high diurnal ranges when drops as low as 17^0 C may be recorded between the highest and lowest temperature in the dry season. During the rainy season, temperature drop considerably due to dense cloud cover. The annual range also drops to around 7^0 C, especially between July and August. The F.C.T records a relative humidity in the dry seasons of some 20% in the afternoon at higher elevations and at more northern locations but also 30% in the extreme south.

Soil of the study area

The soils of territory (Abuja) are generally shallow and sandy in November, especially on the major plains such as iku-Gurara, Roboes and Roubochi. The high sand content makes the soils to be highly erodible. The shallow depth is a reflection of the presence of strong lower horizons. Those on the famous Gwagwa plains are however deep and clayey, perhaps reflecting the influence of parent materials gabbro and fine to medium textured biotite granite. Thus, the soils rich of the Gwagwa plains are the most fertile and productive. In addition, their being more or less from all exposed interfluves summits, makes them ideal for urban development. The F.C.T (Abuja falls within the guinea savanna vegetation zone of Nigeria. The 2012 estimates the population of the FCC Area Council is 979,876 (NPC, 2012). Figure 1 shows the map of study area.

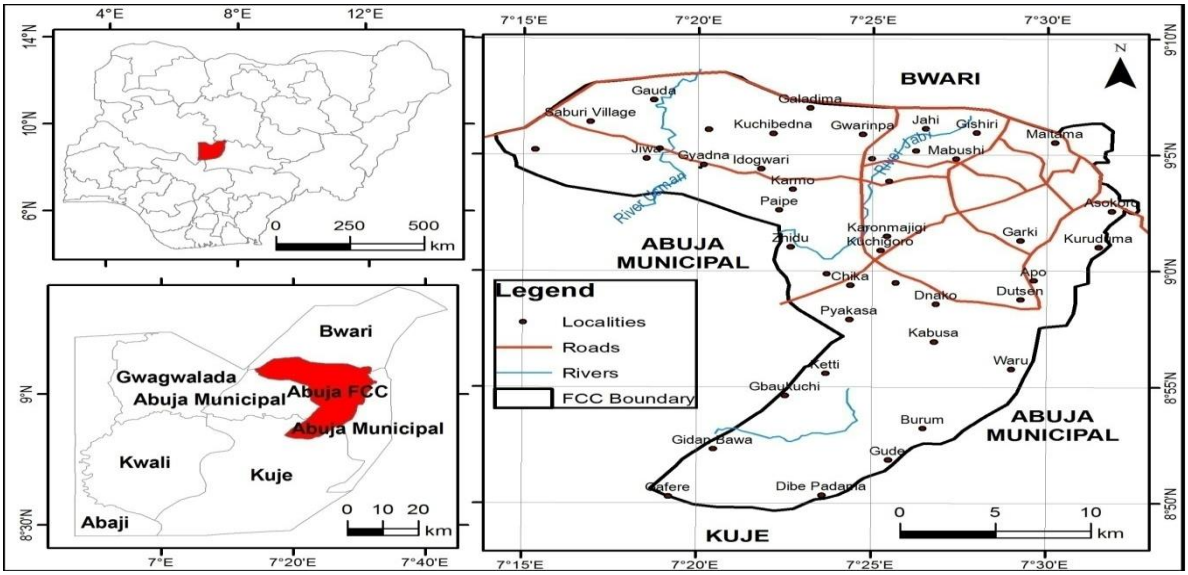


Figure 1: Location Map of the Study Area

Data Sources

This study used secondary data. Details of the data sources is summarized in Table 1 below

Table 1: Some characteristics of the Data

S/N	Data	Scale	Source
1.	Federal Capital City (FCC) cadastral zones map	1:25,000	Abuja Geographic Information System
2.	Cadastral Plan of Federal Capital City (FCC)	1:25,000	Abuja Geographic Information System
3.	FCC Plots with Identified Allocation 2006 and 2015	1:25,000	Abuja Geographic Information System
4.	QuickBird Satellite image of Federal Capital City (FCC) 2006 and 2015	0.65m	Purchase from Digital Globe
5.	FCC Detailed Land use Map	1:25,000	Abuja Geographic Information System

Method of assessing the extent of land allocation in the FCC between 2006 and 2015

The extent of land allocation in the Federal Capital City (FCC) was assessed using existing allocation cadastral maps of 2006 and 2015 as well as Quickbird Imageries 2006 and 2015 of the study area. The datasets were subjected to processing and analysis using ArcGIS 10.7.1 (ArcMap 10.7.1) software. The cadastral maps of the FCC zones and land use map of the study area were scanned using 300dpi. The cadastral and land use map together with the QuickBird image of the study area were imported into the ArcCatalog in ArcGIS. The data were organized and maintained by projecting each of the data using the projected coordinate system- WGS 1984 UTM Zone 32N. On-screen digitizing was done to extract layers from the datasets and attributes were assigned to each layer. The attributes of these data include owner name, sex, address, assessed value and property characteristics which can be displayed or queried.

The cadastral map of 2006 and 2015 was digitized and parcel boundary was extracted. The digitized layer extracted from the cadastral map was overlaid on the QuickBird image of 2006 and 2015 respectively. This showed the variation in allocation of land parcels in Abuja which is necessary.

Results and Discussions

Extent of Land Allocation in the FCC

The extent of land allocation for Federal Capital City (FCC) up to 2006 (3 years after the inception of Abuja Geographic Information System (AGIS)) to 2015 were analyzed using information derived from the acquired cadastral map. The FCC Cadastre is divided in to four phases namely Phase I, II, III and IV with 10, 20, 23 and 42 Cadastral Zones respectively (Figure 2).

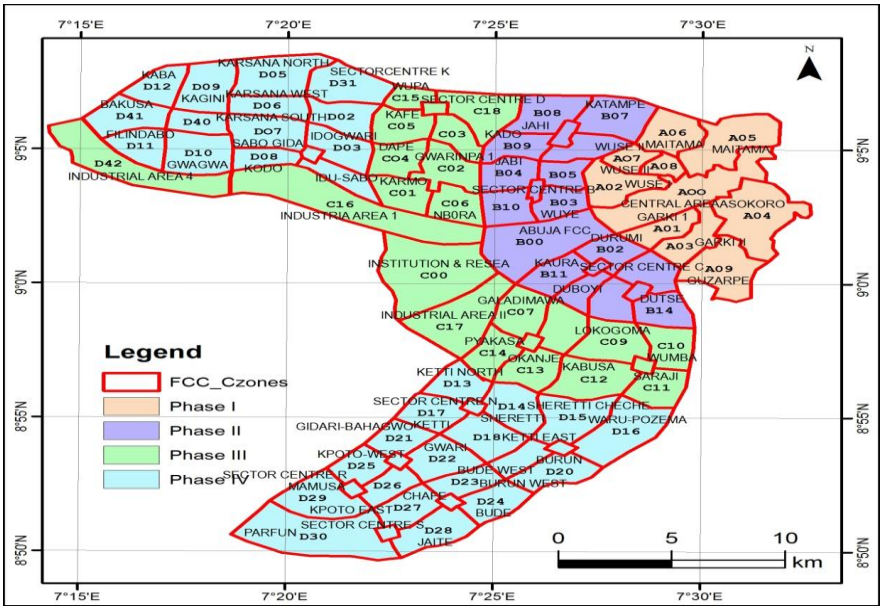


Figure 2: Cadastral Zones of the Federal Capital City, Abuja

To determine the extent of allocation in the phases, first this effort conducted land area analysis for each zone. Zones with the largest and least area in hectares (ha) were identified. (Tables 2 – 5).

Table 2: Land area analysis of Phase I Cadastral Zones

Code	Name	Land Area (ha)	%
A08	Wuse II	228	3
A07	Wuse II	305	4
A01	GarkiI	466	6
A03	Garki II	597	7
A06	Maitama	672	8
A02	WuseI	697	9
A09	Guzarpe	975	12
A05	Maitama	1093	14
A04	Asokoro	1351	17
A00	Central area	1617	20
	Total	**8002**	**100**

Table 3: Land Area Analysis of Phase II Cadastral Zones

Code	Name	LandArea (ha)	%
B17	Sector Centre C	72	1
B16	Sector Centre B	82	1

B18	Sector Centre D	97	1
B15	Sector centre A	133	2
B12	Duboyi	339	4
B05	Utako	380	4
B03	Wuye	443	5
B02	Durumi	465	5
B01	Gudu	475	6
B14	Dutse	484	6
B09	Kado	494	6
B06	Mabushi	512	6
B10	Dakibiyu	522	6
B04	Jabi	523	6
B11	Kaura	539	6
B08	Jahi	709	8
B07	Katampe	799	9
B00	Kukwaba	1540	18
	Total	**8608**	**100**

Table 4: Land Area Analysis of Phase III Cadastral Zones

Code	Name	Land Area (ha)	%
C21	Sector centreG	81	0
C22	Sector Centre H	85	1
C19	Sector Centre E	91	1
C15	Wupa	286	2
C03	Gwarinpa2	445	3
C04	Dape	539	3
C06	Nbora	540	3
C01	Karmo	543	3
C14	Pyakasa	556	3
C11	Saraji	571	3
C08	Dakwo	571	3
C10	Wumba	586	3
C05	Kafe	597	4
C13	Okanje	611	4
C07	Galadimawa	659	4
C02	Gwarinpa 1	678	4
C09	Lokogoma	791	5
C18	Sector Centre D	816	5

C12	Kabusa	890	5
C17	Industrial Area 2	1278	8
D42	Industrial Area 4	1412	8
C00	Institution & research	1953	12
C16	Industrial Area 1	2162	13
	Total	**16740**	**100**

Table 5: Land area analysis of Phase IV Cadastral Zones

Code	Name	Land Area	%
D37	Sector Centre Q	71	0
D36	SectorCentre P	74	0
D34	Sector Centre N	77	0
D39	Sector Centre S	77	0
D38	Sector Centre R	77	0
D35	Sector Centre O	81	0
D08	Kodo	375	2
D19	Burun West	377	2
D40	Abuja West Central	387	2
D04	Idu-Sabo	418	2
D26	Kpoto East	424	2
D23	Bude West	447	2
D25	Kpoto-West	472	2
D21	Gidari-Bahagwo	473	2
D06	Karsana West	505	2
D12	Kaba	529	2
D13	Ketti North	530	2
D11	Filindabo	544	2
D27	Chafe	550	3
D17	Ketti	566	3
D24	Bude	575	3
D02	Karsana South	611	3
D03	Idogwari	618	3
D20	Burun	623	3
D22	Gwari	673	3
D14	Sheretti	708	3
D41	Bakusa	709	3
D28	Jaite	717	3

D18	Ketti East	727	3
D07	Sabo Gida	746	3
D09	Kagini	786	4
D31	Sectorcentre K	803	4
D10	Gwagwa	846	4
D15	SherettiCheche	860	4
D29	Mamusa	860	4
D05	Karsana North	960	4
D16	Waru-Pozema	1102	5
D30	Parfun	1767	8
	Total	**21819**	**100**

From table 2, it was observed that the Central Area has the largest land area with 20% while Wuse II code A08 has the least with 3%. The total area for phase II is 8608ha, the zone code named B00 (Kukwaba) occupies the largest coverage which represents 18%. Sector Centers A, B, C, D, E has the least coverage with 1%. For the phase III, cadastral zones land assigned for industrial areas and institutions and research organization has the highest land area with 13% for Industrial area I, 12% for Institution and Research Area I, Industrial area II has 8% while Sector Centre G has the least with less than 1%. In the Phase IV, it was observed that Parfun had the highest with 8%. All in all, the distribution of land area across the Phases of FCC is shown in Figure 3. From the chart, the least area is Phase I (14%). The area increase as follows: Phase II (16%) , Phase III (30%) and Phase IV (40%).

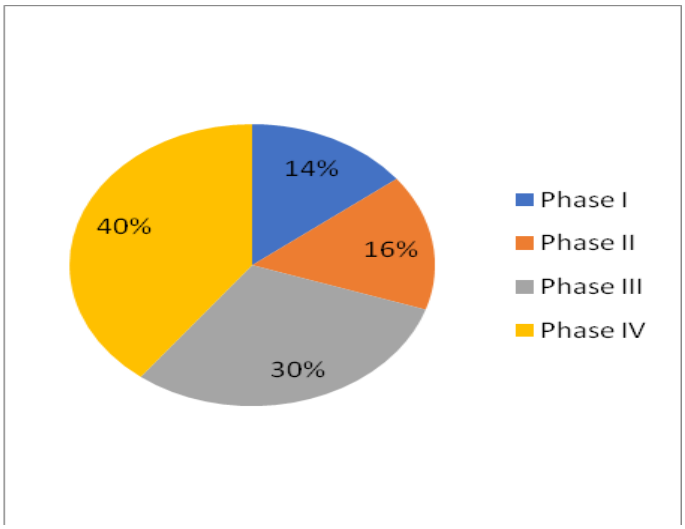
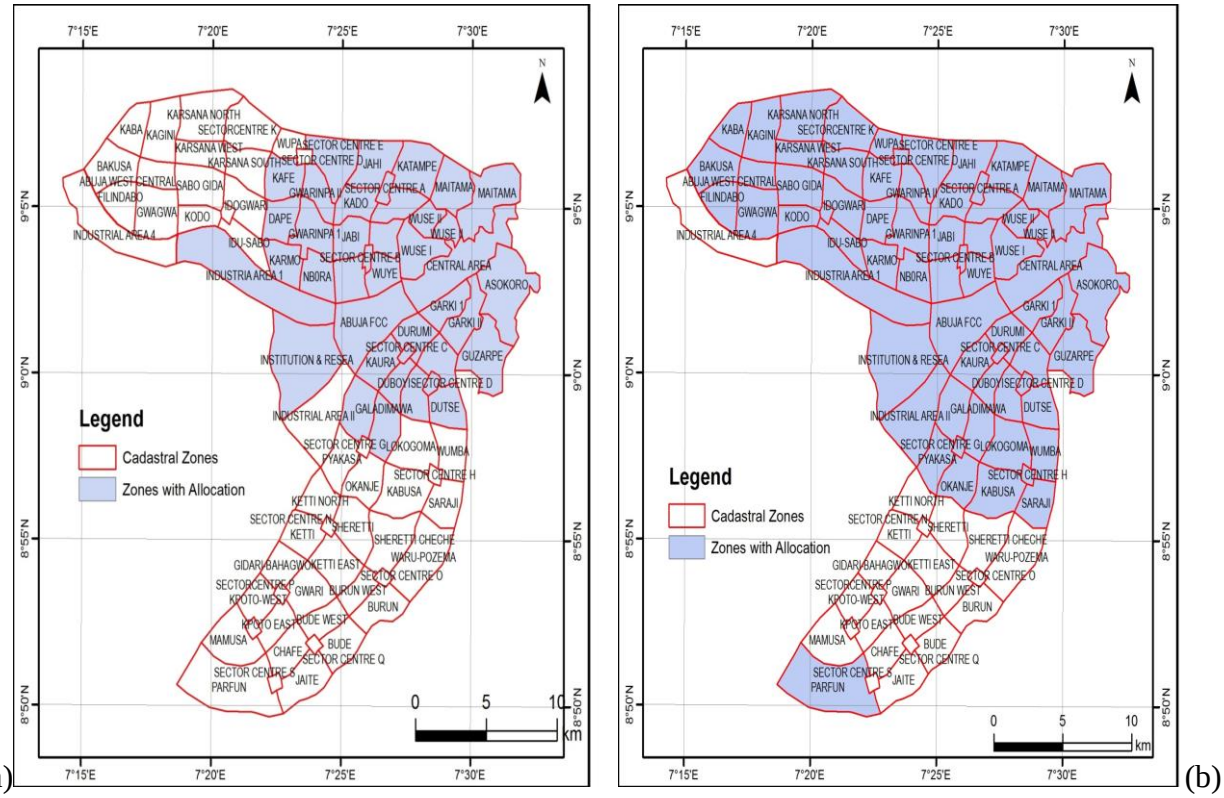


Figure 2: Land area analysis of Phases I-IV of FCC

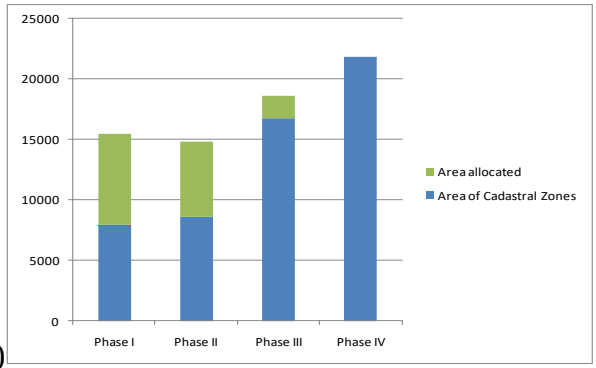
Following the digitization of land parcels allocated up to 2006 and the overlay on the previously digitized FCC Zones. A GIS query operation was used to select the Cadastral Zones that has at

least 1 allocation by using the Select by location tool to select Cadastral Zones that contain allocations up to 2006 (Figure 4 and 5). The Figure below represents this information.

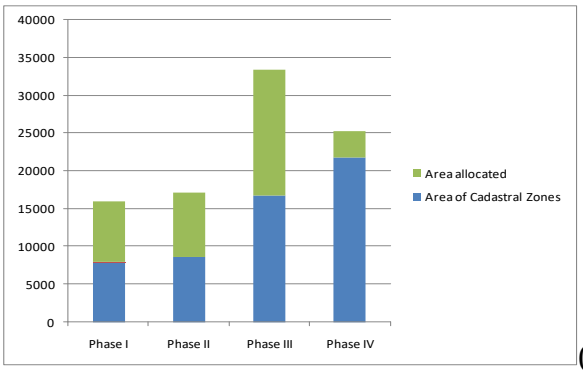


(a) (b)

Figure 3: Cadastral Zone with at least 1 allocation up to 2006 (a) and 2015 (b)



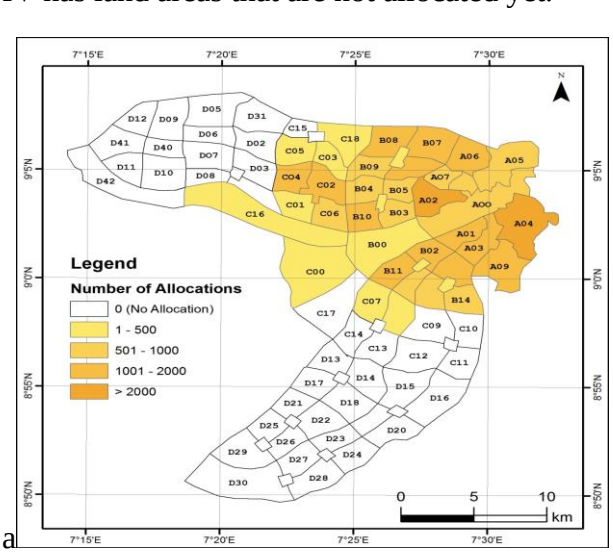
(a)



(b)

Figure 4: Area allocated versus area of cadastral zones 2006 (a) and 2015 (b)

An analysis of the allocations up to 2006 done by carrying out a spatial join of allocations up to 2006 with the Cadastral zone reveals that for Phase I, a total number of 13,156 allocations had occurred with an area of 7,482 ha out of the 8,002ha land area of Phase I. Details of the allocation in Phase I is shown in the table 3. For Phase II, a total number of 14,839 allocations had occurred mwith an area of 6,231 ha out of the 7604ha land area of Phase II. Details of the allocation in Phase I1 are shown the table 4. For Phase III, a total number of 3,659 allocations had occurred with an area of 1,896 ha out of the 9,503ha land area of Phase III. Details of the allocation in Phase 111 are shown the Table 6. No allocations had occurred in Phase IV up to 2006. However, an analysis of the allocations up to 2015 done by carrying out a spatial join of allocations up to 2015 with the Cadastral Zone reveals that for Phase I, a total number of 15,346 allocations had occurred with the whole area of 8,002ha. Phase II has had a total number of 18,666 allocations covering the total 7604ha land area of the Phase II. Phase III has a total number of 33,659 allocations covering the entire Phase III of 16.740ha while Phase IV has a total number of 3,456 allocations covering 3,446ha out of the 21,819ha total area of Phase IV. Phase IV has land areas that are not allocated yet.



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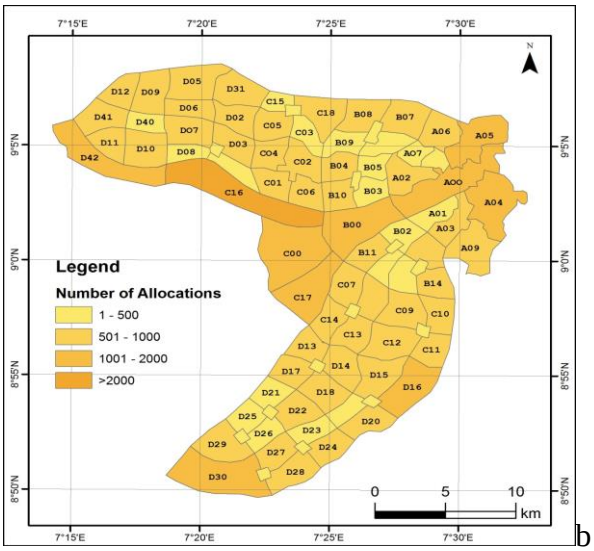
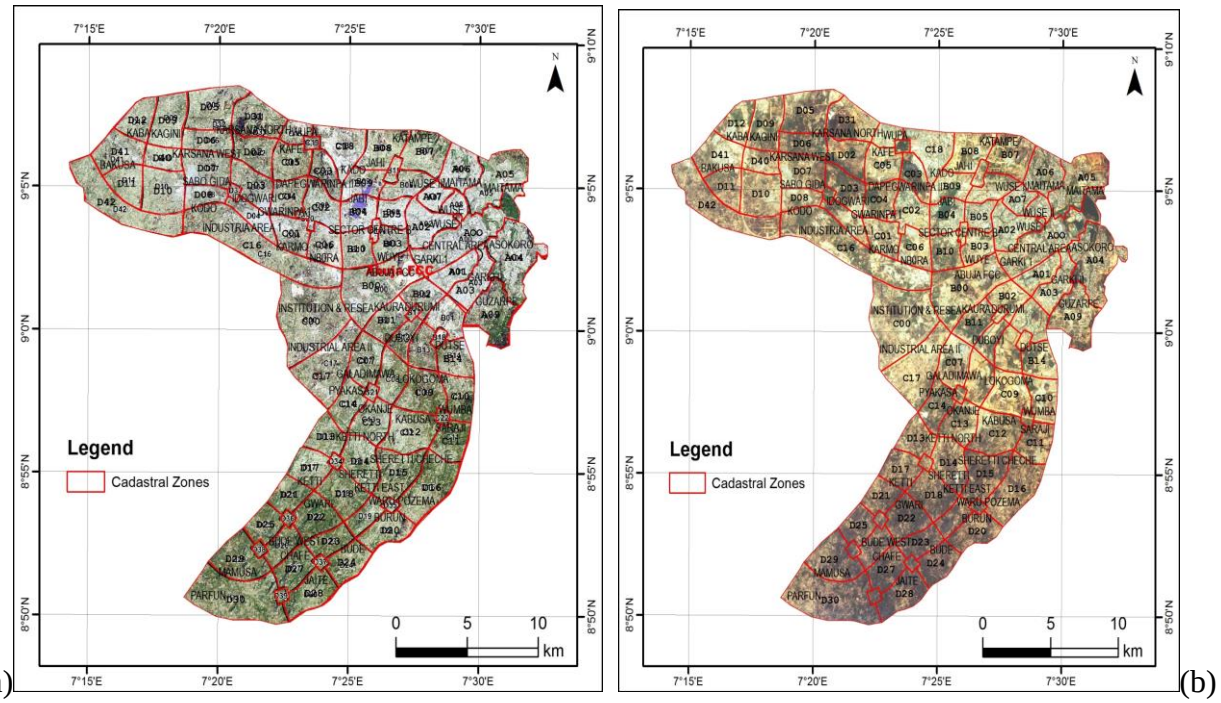


b

Figure 5: Spatial distribution of number of allocations in 2006 (a) and 2015 (b)

Following the digitization of land parcels allocated between 2006 and 2015 and the overlay on the previously digitized FCC Zones. GIS query operations was used to select the Cadastral Zones that has at least 1 allocation by using the Select by location tool to select Cadastral Zones that contain allocations up to 2006 and 2015. The Figure 5 below represents this information.



(a) (b)

Figure 6: Overlay of Cadastral Zones on 2006 (a) and 2015 (b) Quickbird Imagery.

Conclusion

This study has evaluated the electronic Land Administration of FCT. GIS has been used as the best tool to assess the extent of the allocation between 2006 and 2015. AGIS has been an integral part in the realization of the vision of the implementation of e-LA in Nigeria. The Abuja Geographic Information System information revolution has considerable potential to support society' s evolving humankind/land relationship by providing information for decision makers that will enable them to make decisions favourable to sustainable development in the context of e-land administration. The finding from this study established that Abuja Geographic Information System (AGIS) procedures do not engender equality and fairness. Also, information flows, technical procedures associated with land and sharing of existing datasets amongst other land related department is uncoordinated.

Decisions inland management is not done following established rules and regulations. Checks and balances for enforcement of good governance are lacking. In the Federal Capital Territory (FCT), informal rather than formal systems anchor land supplies. The study has established

costly process of land acquisition that has made access relatively unaffordable. Lack of transparency is explained by bureaucracy and corruption in AGIS which includes all kinds of informal payment to obtain and speed up service that has been already paid for.

However, it is also established from the study that, people are not brought into the processes of land management. Major stakeholders in the city such as the public sector, the private sector including developers both formal and informal, professional such as (surveyors, planners, and lawyers, estate developer; and financial institutions are not identified and brought together in a forum to develop a vision of an inclusive city. This study therefore recommend much still needs to be done in order to improve upon the e-Land administration in the FCT by having an alternative power supply and also (instead of just for servers), provide high capacity UPS for AGIS. And as well a continuity in government policies, daily routine maintenance for efficiency and purchase of high capacity computers and should be carried out no cutting of corners in terms of hardware quality, slow procurement. Government should provide updated programs and user training, adoption of new technologies. There should be avenue to discourage sentiments that could lead to disconnect in workflows. Concerns should be about data integrity and interoperability. System privileges should have monitoring and tracking system for workflows. There should be upgrade of staff pay and provision of incentives as well as frequent meetings with sister agencies .

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