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A DYNAMIC E-LAND PRICING MECHANISM FOR MANAGING RESIDENTIAL DENSITIES IN A MEDIUM SIZED CITY IN SOUTH WEST, NIGERIA

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ABSTRACT: *This paper assesses dynamics of e-Land pricing mechanism for managing residential densities in a medium sized city in South West, Nigeria. Objectives of the research include assessment of e-land pricing interface, land price prediction and e-land pricing reform among others. Total number of buildings in the selected residential estates was counted using GIS and IKONOS Imagery, in Oke Ogba, Obele and Alagbaka with 2,723, 2,117 and 264 buildings respectively all amounting to 10% of the building count in the study area. Regression analysis was used to present, interpret and discuss research findings. The findings showed the main factors responsible for land pricing. The paper developed an electronic pricing interface for pricing policy formulation and implementation. Duly tested, the model was recommended for adaption by Ondo State Government in a joint effort with the land buyers, sellers, families and government to enhance the management of residential densities in the study area.*

KEYWORDS: *Dynamics, e-Land pricing, Residential, Factors and Policy.*

INTRODUCTION

Background to the study

E-land pricing for residential development entails the mapping out of various categories of density in the residential estates using Geographic Information System (GIS) and allocates land charges based on land location. It relies on encrypted digital signatures identifying the location of land with its associated price. Land prices vary directly with the level of expectation concerning future residential demand. Higher price for land prompts developers to use less land in the construction of housing, substituting other inputs for land. Density of residential development on land that is developed (and not withheld) may vary directly with land prices concerning future residential demand. Ironically, a fast growing city like Akure, with more sprawls, calls for a pragmatic planning approach in its development. The traditional assumption of employment being concentrated in a city center has become less tenable with the decentralization of commercial and industrial activities in most large urban areas. Research on the dynamic of e-land pricing mechanism for managing residential densities in Akure is a means of ensuring proper density development. It is also an avenue to ensure orderliness with accurate planning standards that promote healthy environment for the inhabitants of the city.

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In the past, especially after the independence, residential density zones were fairly identifiable. This was as a result of creation of Government Reserve Areas (GRAs) and Housing Estates (HEs) based on density categories. However, the gradual decline of the economy has led to the collapse of proper planning of most cities in Nigeria (Gabriel, 2017). Nigeria with a burgeoning population of nearly 200 million now has a myriad of cities characterised by haphazard residential development without clear cut density divisions. Planning regulation failure is partially responsible for this trend.

This paper looks into the residential density and profiles of Akure; a medium-sized city in the Southwest Nigeria. Southwest itself, is reputed to be the most urbanised geopolitical zone in Nigeria. The paper analyses the ratio of the basic densities in the three residential zones of the city, especially the periphery, where development is fastest. The paper purposes to use land prices electronically simulated to adjust the density formations in the city to clear cut zones for better or orderly development. The model developed achieved this objective when tested within the research milieu. It is data management digital model that will compliment others developed in recent times for the city.

The kind and prices of housing produced, the population groups served, and the cost and problems of providing public services are all determined by the workings of the development process. An understanding of this process requires an examination of the relationships between land prices, location and density of development. In this paper, the process of electronic land pricing in residential estates of an urban center (Akure) was carried out. The study developed a computer framework, used in specifying land prices in selected residential estates in Akure. It made use of master plan and layouts to identify the estates and ensure appropriate density development for pricing of land in the estates by electronic means. The paper produced a framework for each residential density development. It further provided a reliable framework for e-land pricing for residential estates in Akure which could be adopted in Nigerian towns and cities for the management of residential densities.

LITERATURE/THEORETICAL UNDERPINNING

Residential density development

Residential Density is used as a measurement of the spatial concentration of populations. There are a number of definitions of residential density within urban areas. Definitions used in the analysis of settlement densities in Sydney's urban areas (Cardew, 1996) range from site density to metropolitan density. National State of the Environment report, defines the concept as the area of land within urban centres designated for 'residential land use' divided by total population resident in those centres (Newman and Jeffrey, 1999). The human settlement environment is strongly influenced by settlement density. Both high density and the high per capita land consumption rates associated with low density development can have negative environmental consequences. Higher settlement densities can concentrate pollutants within the urban environment, but can reduce the impact of residential development on surrounding ecosystems and productive agricultural resources, and reduce energy and resource use. The low density settlement typical of urban fringe or peri-urban areas may result in the removal of remnant vegetation and consequent loss of biodiversity, convert agriculturally productive areas to less productive residential development, exacerbate the spread of weed and animal pests and increase energy consumption and infrastructure provision costs (Lewyn, 2012).

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Housing density mix in settlement planning

Governments often set targets for residential density to assist with targets for growth and to achieve sustainable outcomes for a city, region or suburb. Housing density is calculated by either the number of dwellings per hectare or by the number of people per hectare. Providing residential density through a mixture of low, medium and high densities is a way of achieving these targets. As part of the Land Use Plan, definitions of existing land uses are provided to indicate the current status of properties within the planning area. The plan also applies the same definitions to express future land uses for every parcel area to clearly state future expectations for development. The utilization of common definition for both existing and future conditions permits comparison between today's conditions and expected conditions at build-out.

A complementary term is mixed land use which describes a variety of land uses co-locating side by side in a street or one above the other, such as shops at ground level with residential development above or mixture of residential densities within a mixed land use development. High densities are located near activity centers and along public transport routes to maximize access and convenience to services. Predominantly medium density development locate in areas of high amenity, which may coincide with activity centers or neighbourhood parks, such as open space corridors, nature reserves, lake/ water side, as well as in close proximity to public transport routes. The remaining residential areas are often allocated to lower density housing, with the lowest density located at the fringes of an estate bordering non-urban areas (CSIRO, 2008). Mixed housing density refers to residential development that contains a mix of housing types such as single dwellings and multi units and a variety of development forms such as size and height (LEED, 2006). Mixed residential density development is encouraged as it provides housing choice, which promotes a more diverse community and caters for various stages of life, maximizes infrastructure and land, and supports the provision of public transport. A mixed housing density development can support:

i. improvements in public transport usage and the integration of transport services
ii. development of high density housing at strategic locations near transit centres
iii. opportunities for increased private investment and business innovation
iv. improving the overall quality and surveillance of places
v. provision of opportunities for walking and cycling
vi. provision of a range of housing choices for various lifestyles and age groups, and
vii. building communities that offer fair access for all to services and employment opportunities.

Effects of residential density on urban settlement

Literature has shown that mixed density is one of the built environment features that contribute to increased active transport, along with mixed land use planning and increased connectivity (Gebel *et al,* 2005). At the regional and city wide scale, increasing housing density can improve the proximity between homes and destinations. This is a major factor influencing active transport. Concentrating residential density in compact and well designed urban areas allows the city to provide infrastructure and services more efficiently and cost-effectively. As new settlements emerge and existing settlements change, promoting higher density living is one of the main ways we can manage population growth. A diversity of housing choices is a key characteristic of 'complete settlement'.

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Settlements that demonstrate a mix of housing types (i.e., ranging from single family homes to apartment complexes), are often more stable and attract longer-term residents. While some parts of the city are best suited to higher density living (i.e. apartments and condominiums) due to shortages of space and high cost of land, other areas are amenable to lower density housing choices such as single detached homes. Maintaining a mix of housing choices serves all members of the community while also adding diversity to the urban landscape – both architecturally and socially (Richmond State of the Environment, 2001). Mixed housing density developments should be integrated with surrounding development, in areas with connected street networks, mixed land uses, public transport and with supporting infrastructure including walkways, public areas and cycle paths.

Review of residential density development in Akure, Nigeria

Previous findings on urban dynamics in Akure indicate that at the moment urban planning has very little influence over the process of housing density mix as changes in land use patterns are the result of series of ad-hoc solutions. For instance, Ondo State is one of the 13 beneficiary states in Nigeria under the World Bank Assisted Community Based Urban development project. Thus, two communities: Oke-Aro, Eyinke and Irowo/Odopetu were identified in Akure to benefit from the project. Under the project, infrastructure and municipal services such roads, water supply, and waste management scheme were upgraded and provided in the selected communities (Aribigbola, 2006).

Cities are the main focus of land problems and the threshold population for their classification varies from one country to another and over time, even within the same country. More critical than population, is the function a metropolitan area performs. One of the distinguishing characteristics of a metropolitan area is that, its work is largely divorced from soil related activities, that is, its people are dominantly not primary food producers. Furthermore, it is unrealistic in Nigeria to classify all cities as metropolitan areas because of their peculiar functions. However, their roles in development in most instances result in increase in land prices which affects housing density distribution (Shulz and Wereatz, 2004). According to the Bid Rent Model, land value increases as one moves towards the city center; and tend to be lower towards the urban fringe. But this theory seems not applicable in most parts of Akure. The urban fringe increases as a result of the complexity of the cores or Central Business Districts where value tends to move on account of several factors.

Unfortunately, the private sector is saddled with numerous problems which always make supply fall far short of demand and lower production quality (Nubi, 2008). The problem of qualitative housing has been a concern for both the government and individuals. Both public and private sector developers make effort through various activities to bridge the gap between housing supply and demand, but the cost of building materials, deficiency of housing finance arrangement, stringent loan conditions from mortgage banks, government policies amongst other problems have affected housing provision or delivery significantly in Nigeria (Raji, 2008). The problem can be solved if housing is used only for shelter need. The general belief is that housing is also a produced commodity, consumer good, assurance for families, means used for reproducing social relations and an investment tool protecting the value of money against inflation. Moreover, it is important to note that house is a building block which allows mutual interaction among people and increases the quality of its environment when it is considered as a part of the city. In this context, a large housing stock is made available as a result of new production processes.

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However, the existence of this stock shows that the housing policies are planned depending mostly on production.

Table 1: Residential development corridors in Akure

S/N	Name of Corridor	Location	No of Layouts
1.	Obele-Ireakari	Ijare Road	33
2.	Odanikin-Ajimokun	Irese Road	12
3.	Ughele-Emure Camp	Ado/Owo Road	33
4.	Adesida-Oodo	Igbatoro Road	3
5.	Oladigbo-Jigba	Oda Road	136
6.	Asafinrin-Isafinrin	Idanre Road	192
7.	Fagbamila-YeostaAlphine	Ondo Road	92
8.	OkeOgba-OgunleyeOladogba	Agagu Road	3
9.	Ilupeju-Ifelere	Awule Road	103
10.	Alaba-Apatapiti	FUTA Road	6
11.	Zion-Wesco	Ilesa Road	180
	Total		**787**

Source*:* Adapted from (Olamiju, 2014), Micro Management Issues in Private Residential Layout Akure, Nigeria. Pp. 23

The informal private sector; in Akure comprising people of different income background resorted to self-help housing strategy. This sector has taken the risk of buying untitled land from informal market dominated by a cabal popularly referred to as "Omo-Onile''. This effort is more pronounced in areas like Odanikin-Ajimokun, Ilupeju, Asafinrin, Ifelere, Oke-Ogba, Oke-Odu and many other suburb of the town (see table 1). After the purchase of land, majority of these people take it upon themselves to construct their own roads, provide water and extend electricity to their neighbourhoods. Lager percentage of housing supply in Akure recently is from this sector with the resultant effects of lack of standardization and distorted urban planning system.

In Akure, there are clearly evolved and evolving residential densities. The core (traditional area that developed without planning is evidently high density development. Immediate residential area to the core are mostly high density especially areas near the core. However, there are numerous private layouts outside the transition zone where land is sold indiscriminately without standardize plot size and infrastructure. Housing density in these areas are totally unpredictable.it is informal housing that exhibits various forms of human occupation and accommodation indices. Density distribution or pattern is irregular land in the study area, thereby creating an appearance of urban sprawl. This research is concentrated on these areas to discover if any pattern or mix of densities could be characterized in absolute percentages.

It is envisaged their increasing prices of land in the periphery may leads to lower densities if industrial and commercial activities are not superimposed in them. Therefore, all things being equal, it is posited that, in areas of higher price of land, lower residential densities may emerged. The use of price can then be used ultimately to control density development in private layouts to bring some order to city form.

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Zoning to control residential density is the planning intervention that the city requires. However, this is completely missing. The initiative is inevitably left for natural private provision process to evolve some "order of zoning" into the city. Government should be noted has residential areas designated as GRAs in the suburb of the city. One is mostly (Alagbaka) low-density development by regulation, while the other two are medium densities (Ala), while the third has clearly turned to a high residential area (Shagari Estate)

The crucial questions to answer in this study among others are: what is the role of increasing price of land in the evolvement of lower density development at the transitional and peripheral zones? Why were lands sold cheap at the beginning of development in most suburbs giving rise to high density development? (Gabriel, 2017). What percentage of the study area falls into this category? Then, how could the price of land be regulated to bring some order to residential density development in Akure. It is possible for government to regulate access to development when approving layouts to create each zone of higher prices for land to create an order. Government may revert to acquisition of vast tract of land and pay compensation to realize the goal of bringing some order to the density distribution and city form in Akure. A tall order will appear to be, the use of pricing is the key to this development form to be able to pay adequate compensation and to bring about lower density development based on higher land prices.

Conceptual frameworks for the research

It is widely recognized that many theories have been formulated in the study of urban systems. These theories are both descriptive and quantitative in nature. Among the models that have helped to explain city morphology are the Burgess (1925) Concentric Zones Model; Hoyt's (1933) Sector Model; and Harris and Ullman's (1945) Multiple Nuclei Model. These three models are described as ecological models. Other models include the Social Area Analysis and Factorial Ecology. Some of the models are not so general but deal with specific urban features. Wingo's (1961) in Harvey (1973) and Alonso's (1964) land use models are micro economic models of urban land value. While earlier works of Richardo and Von Thunen (1893), presented some notable theories on agricultural land use, while other theories include, least effort principle, formulated to explain urban mobility; role of culturally rooted values and social behaviour in the determination of the city structure; spatial variation in land values in cities among others. Concepts adopted for this study are the classical land use models, residential zoning and neighbourhood concept.

Residential zoning concept

Local attitudes toward development and zoning may also vary cyclically and from one suburb to another. These attitudes affect the time and expense of development and are likely to be capitalized into land prices. However, they may be difficult to detect in a study of land values throughout a metropolitan area (Shiller, 2007). The theoretical analysis of this research focuses on the cross-section determinants of land value. Hedonic analysis is used to explain land prices through the impact of various site, location, neighborhood, and macroeconomic characteristics. These characteristics influence the rent that firms can afford to pay for space, as the present value of future rent determines land value. While the impact of location, site characteristics, and other factors on rent may differ among firms of the same industry and even more so among firms of different industries, we expect differences to be most apparent across different land uses (Shulz and Werwatz, 2004).

This concept is preferred for explaining evolving urban growth and how certain functions that are normally found in the Central Business District can be moved to the evolving settlements

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(such as shopping malls, hospitals, schools, etc.). These functions diminish the importance of the Central Business District and instead create distant realms that accomplish approximately the same thing (Schulz, 2003). The model represents basis of methodology that was used in this study since the evolving residential estates (study zones) provide the shelter backing for the central business district. Most of the identified residential estates of the periphery at Akure lack basic amenities and exhibit different class of density with haphazard development of buildings and structures. The non-uniformity of land prices in these zones also contributes to the city physical and socio-economic imbalance which occurs due to poor management and planning.

The neighbourhood concept

Most urban analysts agreed that neighbourhood quality is an important element of the housing bundle. But there is little agreement, however, regarding the measurement of neighbourhood quality (Mabogunje, 2007). The choice of neighbourhood quality is based primarily upon data availability and hence little justification is given for the choice of variables. Perhaps because neighbourhood is difficult to measure, and more difficult to model, housing researchers have often asserted that, it does not make much difference. In this case, the observed ethnic and racial enclaves that obviously exist have no economic meaning. This assertion implies that realtors, home buyers, and the general public are misguided or misinformed in their statements to pay premium for at least some neighbourhood amenities.

The city is perceived as a mosaic of social network comprising different neighbourhoods with distinct traits in terms of size, heterogeneity, density and ways of life. Neighbourhoods as local communities in the city comprise of a wide range of families who gather to share common views and attend to issues of mutual concern. The role of neighbourhood for people's sense of community, their identifications and categorizations through the lens of the imagined community and the role of the place of residence in these, still need to be theorized. It is, therefore, necessary to examine both the modelling and the empirical concerns of neighbourhood as part of the housing purchase (Morenikeji, 1998). That is, give more attention to neighbourhood characteristics as determinants of housing prices. No doubt, urban public infrastructure and private development are organized into neighbourhoods which in turn produce the city structure. As conceived by Plater-Zyberk and Donnelly (2010), the characteristics of the neighbourhood, consequently, include:

(i) compact, pedestrian-friendly and mixed-use fabric;
(ii) a pedestrian shed, reflecting the distance people will willingly walk;
(iii) a continuous street grid laid out so that local traffic can avoid arterials, in a pattern that respond to local topography, climate and history.
(iv) a role of building types and uses that include dwellings and business quarters with sufficient density to justify conveniences within walking distance;
(v) respect for historic buildings, neighbourhood and landscapes;
(vi) environmental practices, open spaces, parks and infrastructure that are adjusted to the intensity of the urbanism and that promote natural methods of climate control and water conservation;
(vii) recognizable types of civic open spaces molded by urban building; and
(viii) urban design regulated through graphic design and or zoning codes.

The neighbourhood concept has emerged as a way of adding value to the city and makes meaningful reflections of a range of urban communities to ensure coherence and encourage

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personal contacts among the inhabitants. The selected residential estates in Akure consist of distinct neighbourhoods within them, this guides the determinations of price related motive in land purchasing as well as density distribution among the dwellers.

Electronic models of land management in Nigeria and Ondo State

Globally, agencies in advanced market economies that are involved in land administration rely on technology to drive their services. Technology enhances administrative efficiency through Web-enable systems and e-government. The United Nation Economic Commission for Europe UNECE – land Administration Guidelines (1996) defines land administration as "the process of recording and disseminating information about ownership, value and use of land when implementing land management policies". The essential feature of land as a commodity is the bundle of rights, restrictions and responsibilities that are attached to it. Commoditized rights in land are abstract which exist as ideas verified by the record base. Commoditization of land brought the role of cadastre to the front burner in land administration theory. The U.S National Research Council (NRC) in1980 published a study titled "the need for a multipurpose cadastre" which integrated cadastral survey and mapping functions through the use of geometric reference framework. This introduced possibility of effective cadastral system capable of multiple uses most especially in land tenure and value records. However, Cowen and Craig (2003) when commenting on this development noted that the NRC vision was so idealistic and proved practically impossible to implement across Europe.

The modern European model of multipurpose cadastral was, however, developed by the International Federation of Surveyors (FIG) in 1995. It focused on land information. It is "a parcel-based and up to-date land information system consisting of a record of interest in land (e.g rights, restriction and responsibilities)''. It normally includes geometric description of land parcels linked to other records describing the nature of interest, ownership and often, the value of the parcels and its improvements. The need for a national approach to cadastral led the United State to commission a two-year NRC study titled 'Land Parcel Databases: A National Vision" (NRC, 2007). The study developed multipurpose cadastres as a fundamental land management tool with continental acceptance to the exclusion of those countries in Europe with private land registries.

In developing nations where there are lack of surveying and technical skills their cadastral construction relies in other options like aerial photos, satellite images, hand drawn drawings combined with area maps. Cadastral developments in many nations are in continuum reflecting their different stages of evolution. It sometimes reflects nature, social, institutional, legal and economic circumstances of such nation. Besides, what makes multipurpose cadastral function is the spatial data infrastructure (SDI). It is the enabling platform for linking people to information. SDI supports integration of natural (Topographic) and built (Land parcel or cadastral) environment with environmental data as a basis for sustainable development.

In Nigeria, we are still struggling to develop rudimentary land administration system (LAS) to support integrated framework to aid decision makers in arriving at improved land administration. The application of Information and Communication Technology (ICT) to land administration was enhanced by engagement of spatial science and other businesses in the construction of land information products. This service is delivered via the internet and facilitated through inter-organizational workflows rooted in e-land administration. e-land administration means utilization of ICT capabilities to deliver land administration functions and services online.

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The electronic land management system

Electronic land management is a recent development in Nigeria that was introduced by president Obasanjo when his government realized the deficiencies of the manual system of record keeping on land matters. The president in 1999 directed that all land operations at the Federal level be computerized. This gave birth to Abuja Geographic Information Systems (AGIS) and Federal Land Information Systems (FELIS). The Federal Ministry of Housing and Urban Development is responsible for the management of all land belonging to the Federal Government of Nigeria in all the 36 states of the Federation while the Ministry of the Federal Capital Territory (MFCT), is responsible for all land belonging to the Federal Government of Nigeria in the Federal Capital Territory, Abuja only.

The AGIS has two components: Geographic Information Systems (GIS) and land information system (LIS). The GIS is the graphic aspect where all Cadastral information such as the Master plan, Land Use plans, detailed site development plans, engineering infrastructure and all survey information are captured and stored in digital form. The LIS constitutes the land attribute such as records of allocation (named allottes, plot numbers, plot size, uses and locations). It also includes records of all transaction such as power of attorney, deed of assignment, mortgages, sublease, releases, devolution and others.

The mission of the project is to provide a comprehensive, all inclusive foolproof and state of the art computerized geospatial data infrastructure for the Federal Capital Territory Abuja. The computerization of Federal Capital Territory Cadastral and land registry was in response to sanitize Land administration system in the Federal Capital Territory (FCT). AGIS other programmes include:

- Faster updating and presentation of data (Spatial and Non-spatial)
- Planning of revenue generation
- Land acquisition and development
- Existing Development and planning of new structures
- Allocation of land for different uses like residential, commercial, industrial etc
- Generation of reports for higher officials/management with adequate maps.

AGIS is building corporate spatial databases results to improve decision – making, operational efficiency, and to reduce duplication in the FCT. The AGIS is divided into three major components for efficiency namely: data capture and maintenance, system administration and development, and customer services. The success recorded by AGIS and FELIS in Abuja have prompted Ondo state and other states of the federation to embark on land data captures and the development of their SDIs. Ondo State Land Record Bureau was established in 2012 with the mandate to address the delay in land titling process and management. The bureau has recorded issuance of over 15,000 Certificate of Occupancy (C of O) for parcel of land; created a platform for online application and e-archived over 750,000 legacy land documents spanning over ten years. This Agency, in collaboration with the Presidential Technical Committee on Land Reform and UK Department for International Development GEMS-3 Programme has embarked on a flexible and cheap process of systematic land title registration in three pilot local government areas of the state.

In the land market economy, the most critical activities for land administrators include how to monitor fluctuations in land prices, reveal behavior of property market, identify parcels of land

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which violate development standards, how to monitor dereliction, and environmental impact of any development. For better land management, land records need to be organized in a manner that will ensure synergies of information between various ministries and the public. The approach in creating this is by land information system (LIS) from available land records by computering the records..

METHODOLOGY

It is almost a convention that, there must be a sample size drawn for a population. The size is a quantum or number. There are various ways of deriving sample sizes. Some of them are: i) Use of statistical formulae. ii) Recommended proportion from literature. iii) Comparison to sample size used in similar studies. The ratio is a proportion of the size to the aggregate population. Usually, the bigger the population, the lower the ratio and vice versa. The more uniform the characteristics, the smaller the ratio and vice versa (Fasakin, 2010). In order to determine enumeration area for the study, the maps of the three residential estates were produced showing the number of buildings. Grid method was employed to divide each map into equal squares. Total numbers of buildings in the selected residential estates were counted using GIS and IKONOS Imagery and Oke Ogba had 2,723 buildings, Obele 2,117 buildings and Alagbaka 264 buildings. 10% of the total number of buildings on each of the maps was selected resulting to 272 buildings, 212 buildings and 26 buildings for Oke Ogba, Obele and Alagbaka housing estates respectively. The random number generator with the aid of Graph Pad Software was used to select grids. Graph Pad Software (Quick Calcs), which is scientific software was used to create a table of random number. Using the table of random numbers, for Oke Ogba, the numbers selected were 9, 13, 14, and 15 (grids) for 97 buildings, 44 buildings, 60 buildings and 71 buildings respectively. For Obele estate, the numbers selected were 7, 17, 15, and 3 (grids) for 54 buildings, 82 buildings, 37 buildings and 39 buildings respectively. While at Alagbaka housing estate, the numbers selected are 2 and 7 (grids) for 20 buildings and 6 buildings respectively.

The process of sampling or the selection of part of the population, from which the characteristics of the larger population can be inferred, has long been accepted as a legitimate and expeditious method of research (Odeyinka, 2003). For the purpose of this study, simple random sampling with replacement was adopted. Further relevant information for the study was collected from in-situ observations, photographs, informal interviews and discussions with the respondents. Random sampling technique with replacement was used to select buildings in the study area. Where the selected buildings on the map were discovered to be buildings for commercial, religious or/and industrial purposes on ground, they were replaced with the residential buildings nearest to it. Furthermore, the choice of respondents was not restricted to the head of household, given that the study is not strictly on household heads. Regression technique was used to achieve the analysis of e-land pricing for the study area.

RESULTS AND DISCUSSION

Introduction

E-land pricing system**:** Accessibility to efficient service in the e-land pricing application depends on the three basic system requirements viz: hardware, software and network connectivity. The hardware represents the infrastructure on which the predictive system for e-land pricing was developed; that is, a computer system with Windows operating system. The software is the

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application package which is used to develop the system such as PHP, MYSQL, APACHE among others. The e-land pricing application is separated into two main parts. First, is the administrative section which was developed with Javascript/CSS/HTML, mysql and PHP. Second, is the client or proposed land buyer's section set up with Javascript/CSS/HTML while mysql was used to develop the backend. Network connectivity which is crucial, concerns practices and facilities, such as active internet service or intranet service ready for the users, so as to enable the proposed land buyer and administrator access the e-land pricing application without restriction to location and time. The program was developed with a Dell Vostro core i3 4gb RAM 500gb Hard disk system. However, the following software and hardware configuration are the minimum requirements for proper running of the application. Minimum hardware requirements**:** 2 GB RAM size, 25 GB Hard disk space and an EDGE internet connection WiFi, while the Minimum software requirements**:** Windows XP, Apache, MySQL, PHP, JAVA Script, HTML and CSS.

E-Land Pricing Interface

Client or Proposed Land Buyer Interface: This interface helps the proposed land buyer to supply his information based on the already stipulated criteria like annual income, family per plot, household size, land price etc. After the user has supplied the relevant information, a click on search for land axis (density zone), enables the application to predict the appropriate density zone for the buyer among high, medium and low. Client or Proposed Land Buyer Output Interface: This interface shows the hypothetical result of land prediction to the proposed land user based on the information supplied in the interface above. In this particular case, opportunity is provided to choose from different locations of the high density districts predicted.

Administrative Log in Interface: This interface allows only approved users to have access to the administrative part of the application in which the variables or criteria for predicting land axis can be setup and updated for system dynamics. Income Per Annum Interface: This interface allows the administrator to add or update the income per annum range variable or attribute in e-land pricing application to make it dynamic. Like #100,000 – #500,000; above #500,000 among others. Land Price Interface: Here, the administrator can set up the different price range for different categories of land per plot. The interface also allows the administrator to change the price of the land category dynamically.

Land Price Prediction

The study developed an electronic evaluation model for land pricing in Akure using Oke-Ogba, Orita-Obele and Alagbaka as case studies representing high, medium and low density regions respectively. The factors that are mainly responsible for land pricing derived from literature include household size, income, distance from city centre, plot area, year of purchase, number of persons per building, number of buildings per plot and number of families per plot. These factors were used as predictors of land price in this research. Household size identifies the number of persons that live in the same dwelling and share meals.

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This was done across the 3 densities. Results showed that households made up of 1 to 3 persons were primarily found in low density regions; 4 to 7 persons in middle density regions; while above 7 in high density regions. Income plays a significant role in the housing market dynamics because people with high income will be able to purchase expensive land in choice areas unlike the low-income earners. Research findings revealed that the high income earners tend to live in low density areas and vice-versa for the low-income earners. However, an increase in income of residents might be responsible for the willingness to purchase land at high prices.

Distance from city centre: as obtained from fieldwork showed that prospective land buyers will prefer to purchase land in regions that are not too far from the city centre. Indeed, the farther the plot of land from the city centre, the more attractive it becomes to the buyer. Plot area is critical in the model evaluation. The standard plot size is 648sqm otherwise referred to as high density plot. The second category is the medium density plot that is 864sqm, while the low density plots cover an area of 1080sqm. The plot size required by prospective land buyer, always determines the amount that would be paid. Indeed, it could be hypothesized that the low density plots will be more expensive than the middle density plots just as the middle density plots are expected to be higher in price than the high density plots. Year of purchase: is a great determinant of land price as obtained from the field study. The farther the years, the lower the prices of land also the recent the years, the higher the prices of land for any geographic area.

Number of persons per building is an important variable in determining land price in a region. A higher number of persons per building could suggest that is a high density zone, hence, the region might not be attractive to high income earners who would prefer a quieter environment. The number of buildings per plot as a factor envisages more buildings in a high density zone where it plays a crucial role in determining land prices. This is closely connected with the number of families per plot as more families on a plot also result in high density. These variables form the independent variables that determine land prices in the study areas, while land price forms the dependent variable. Regression analysis was employed to model the contribution of each variable when other variables are held at a constant. The highest observed correlation is less than 0.80 – an indication that collinearity or multi-collinearity does not exist among the variables. This, therefore, confirms the true independence and reliability of the variables and parameter estimates used in this analysis. The regression model can be expressed as follows:

$$Y(\text{LandPrice}) = b_0 + b_1(\text{Household\_Size}) + b_2(\text{Income}) + b_3(\text{Distance}) + b_4(\text{PlotArea}) + b_5(\text{Year\_Purchase}) + b_6(\text{Persons\_Building}) + b_7(\text{Buildings\_Plot}) + b_8(\text{Family\_Plot}) + e$$

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Table 1: Regression analysis of e-land pricing variables

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.833	0.769		2.385	0.017
	hhsize_rec	0.094	0.041	0.109	2.321	0.021
	income_rec	0.114	0.045	0.110	2.509	0.012
	distance_rec	-0.556	0.250	-0.096	-2.229	0.026
	plotarea_rec	0.194	0.092	0.091	2.110	0.035
	noperson_rec	-0.030	0.048	-0.034	-0.624	0.533
	nobldgperplot_rec	-0.018	0.046	-0.018	-0.386	0.700
	familyperplot_rec	0.006	0.040	0.008	0.141	0.888
	yearpurchase_rec	0.229	0.043	0.234	5.293	0.000

a. Dependent Variable: buyplot_rec

With household size variable, results indicate that a unit increase in household size will lead to a corresponding increase in land price by 9.4%. In this study, a unit increase in household size is between 1 and 3 persons (i.e. when $X_1 = 1$) to between 4 and 7 persons (i.e. when $X_1 = 2$) A 2-unit increase is between 1 and 3 persons to above 7 persons (i.e. when $X_1 = 3$) which will lead to a corresponding increase by 18.8% in land price. This could be true as land speculators can capitalize on this factor to increase land price in the zone. Income of land owners is critical in the determination of land prices. Low income earners will likely be able to purchase land where they are relatively cheap, hence, their willingness to purchase high density plots. Our analysis revealed that if all other variables are held constant, and there is a general increase in income of prospective buyers such that the lower income earner appreciating to the category of middle income earners (which we term here as a unit increase), then, the price of land will correspondingly increase by 11.4%. If there is a 2-unit increase, the land price will increase by 22.4%. Hence, a general increase in fortunes will ensure that the housing market dynamics is affected thus prompting an increase by land speculators. Therefore, if a plot of land costs #1,000,000, a general increase in income which could come about through many factors such as increase in minimum wage will trigger land prices to increase by ₦114,000 thus amounting to ₦1,114,000. A 2-unit increase would amount to ₦1,228,000 for the plot of land.

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Distance to city centre is a variable that was considered to be very important in this analysis. It was gathered from the fieldwork that some land buyers would prefer to live close to the city centre while others do not. The classification was done in 3 categories. First, are areas that are less than 1 km, second, are areas between 1 and 6 km, while the last are areas father than 6 km from the city centre. Holding all other variables constant, the model predicts that a unit increase in distance from the first category to the second will lead to a corresponding decrease in the willingness to pay for such plot of land at the specified price. Indeed, a unit increase will lead to 55.6% decrease in the land prices of such a plot and a 2-unit increase will ensure that land prices reduces by 111.2%. Hence, if the land price in the first category is ₦1,000,000 then farther away to second category could mean a decrease in land price to ₦444,000. However, there are special cases, where the high income will prefer to live far away from the city centre (for example a Government Reservation Area - GRA), which will invariably play a significant role in determining the land price for such an area.

Plot Area/Size is variable that assesses the effect the size of plot will have on land price. The standard plot size also known as high density plot is supposed to be cheapest, the medium density plot sizes are more expensive, the most expensive are the low density plot sizes which are normally purchased by high income earners. Regression analysis conducted indicates that if in a neighbourhood where the three density plots exist, a unit increase in plot size i.e. deciding to purchase a medium density plot rather than a high density plot, the land price will increase correspondingly by 19.4%. Hence, if a high density plot values ₦1,000,000, a unit increase to a medium density plot size will be valued at ₦1,194,000, while a 2-unit increase to a low density plot will attract a value of ₦1,388,000.

Year of purchase is an important factor in determining land prices. As land available becomes recent the higher the land price but the more distant it is to the present the lower the land price. The three categories adopted for this study include land bought before 1990, land bought between 1990 and 2009, and land bought between 2010 till date. Results indicate a 22.9% increase between each of the periods. However, in reality, land prices have increased astronomically especially in the last 10 years in Akure being a state capital. Results on number of persons per building indicate that as the number of persons living in building increases by 1, there is a corresponding decrease of land prices by 3% in such neighbourhood. The association with number of building per plot reveals that if residents in the neighbourhood decide to increase the number of buildings that occupy a plot of land probably for commercial purposes or rental purposes, the neighbourhood will be viewed as a high density neighbourhood, hence, ensuring the reduction in value of land. Hence, an increase in number of buildings per plot by 1 unit will lead to a corresponding decrease of land prices by 1.8% while a 2-unit increase of buildings per plot will amount to a 3.6% decrease in land prices. This, thus, means that if a plot containing 1 building is valued at ₦1,000,000 increasing the number of buildings in the plot will ensure that land prices are reduced to ₦982,000 and with 2 buildings per plot, land prices could reduce to ₦964,000.

The number of family per plot also plays a role in determining land price. Results indicate that if number of families occupying a plot of land increases by 1 unit, then there will be a corresponding increase in land price by 0.6%. This indicate that if 1 family occupies a plot of land valued at N1,000,000 then a plot of land that occupies 2 families will be valued at N1,006,000.

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POLICY IMPLICATIONS, RECOMMENDATION AND CONCLUSION

Policy Implications

The collective strengths of the explanatory variables used in evaluating the e-land pricing model are critical to the objectives of study and are quite significant. It is, therefore, evident that the subsequent recommendations will be useful in suggesting sustainable improvements in the residential densities of Akure. They will also help in the design of suitable policies that will enhance the location of residents for possible mutual relationship within the city. The model adopted in this study has been tested and found reliable. It directs prospective residential developers appropriately to right location where the desired government attention can be focused. It ensures adequate provision of essential facilities and services and regulates activities that are likely to have serious negative impact on the environment. A great deal of the land used for residential development in Akure are owned by the families and intermixed with government residential layouts. The scope is magnificent to advocate for the e-land pricing mechanism that will enhance a land use balance through density zoning. The impact-lag of this policy is inevitable as the desired regulatory change will be gradual. The complexity of the client's choice and identification of the various neighbourhoods and land owners will take some time. While the policy is tempting to be strange in land acquisition process in Akure, it is providing technical assistance to the MLI and MPPUD.

Recommendation

Density arrangement will continue to be a topical issue in city development. The difference in prices of land has resulted in abnormal mix of densities culminating in unplanned residential districts in a fast-growing city like Akure. This study was carried out on "Dynamics of e-Land Pricing Mechanism for Managing Residential Densities in a Medium Size City in South West, Nigeria" The research has identified certain factors such as distance, plot area and number of persons per building as major determinants of land price and housing density in the city requiring government planning intervention. To address this development, Ondo State Government needs to put in place a strong framework for e-land pricing policy formulation and implementation. There is a need for a joint effort by the land buyers and sellers including families and government. It is anticipated that the prospective land buyers, upon awareness will visit the Land Services Unit (LSU) portal of the Ministry of Land and Infrastructure (MLI) website and supply all relevant data for prediction of a suitable site. The list of neighbourhoods/layouts provided will guide choice making (site selection) and identification of the custodians of land at the core, transition and peripheral zones of the city. Traditionally, public land administration is apparent in MLI and the Ministry of Physical Planning and Urban Development (MPPUD) as well as the Ondo State Development and Property Corporation (OSDPC). Those lands on which families lay claims are disposed privately.

The current means of acquiring land and processing building plans and Certificate of Occupancy (C of O) on private and public layouts in Akure are quite distinct. On private neighbourhood layouts, families prepare the design, deposit copy in the Area Urban and Regional Planning Office (AURPO), sell and allocate land to buyers. Subsequently, the approval of building plan takes place at the AURPO while the issuance of C of O on such land is handled by the Deemed Right Unit (DRU) of MLI. As for public land, the MPPUD prepares the design (in the form of Housing Scheme), keeps copy in the LSU for land allocation and issuance of C of O to buyers while the AURPO approves the building plans. The OSDPC stands out as an autonomous agency that handles everything concerning land administration on its housing schemes. This ranges from

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the layout design, allocation of land to buyers to processing of building plan approval and issuance of "Deed of Sublease" which is equivalent of the C of O.

An administrative structure that can ensure management of the proposed e-land pricing reform measure is hereby suggested for effective management of residential areas in the city. With this structure, the MLI through its LSU should set a framework of Centralized Land Administrative System (CLAS) in which both private and public residential layouts will be co-ordinated for district planning and management of land acquisition. The LSU ensures registration of all residential layouts at the core, transition and periphery of the city and engages the landowners and relevant stakeholders in sensitization programmes on the e-land pricing initiative. Further efforts should be made to host an e-land pricing portal on MLI website to intending housing developers to consider land in specific densities that match their available capital. The e-land pricing policy should be given wide publicity on the social media through advertisement to create the "entry point" awareness on land acquisition. Training programme (workshop and seminar) must be conducted regularly to remind the staff of their obligations in this regard. The MLI must also collaborate with the MPPUD, OSDPC and Ministry of Justice (MJ) and ensure that land owners and new developers comply with the policy and other practices that have significant impact on land administration in the city.

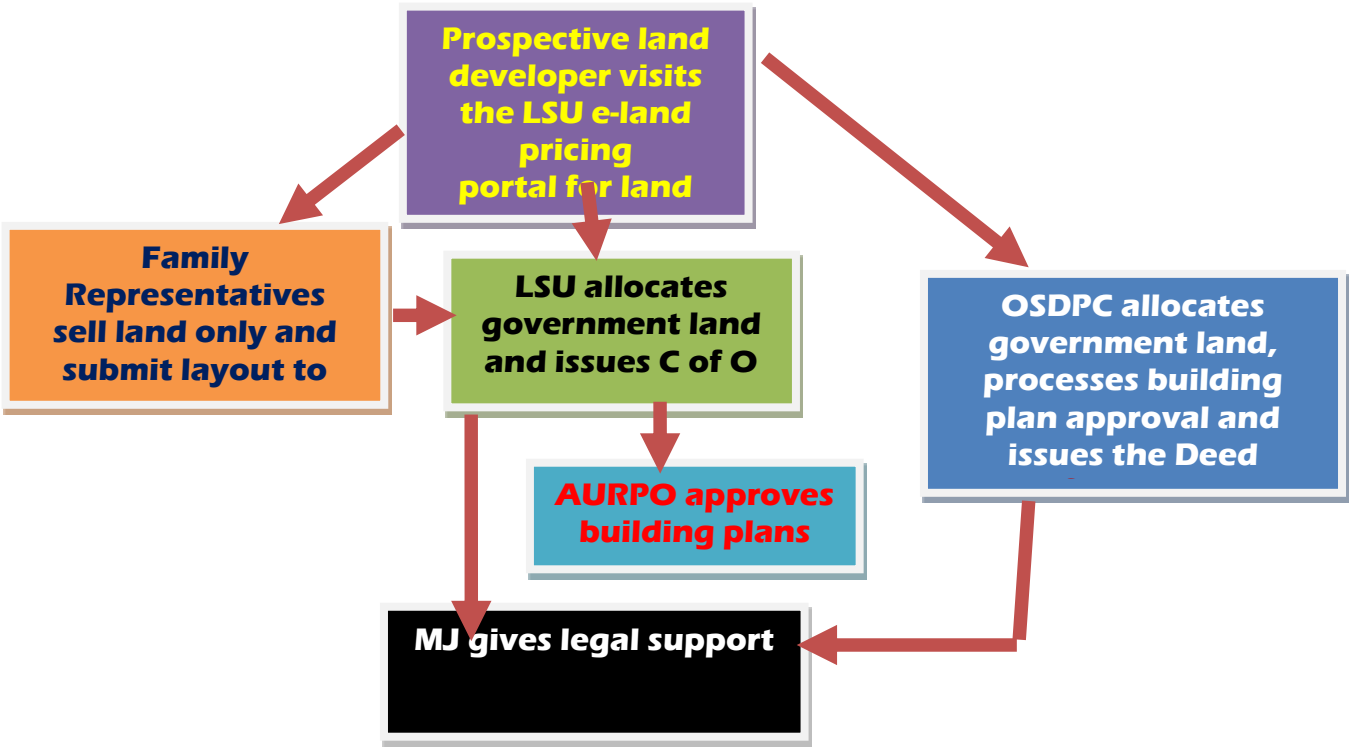

Fig 1: The Suggested Administrative Structure for the Proposed e-Land Pricing Reform.
Source: Authors, (2019).

Under the new structure, the MLI stands as an autonomous entity like other civil service ministries, thus allowing staff mobilization, land price regulation and appropriate residential density mix in Akure. With the e-Land Pricing Model, the Ondo State Government will be able to provide well organized accommodation in Akure while granting priority attention to the density zones for a decent living.

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Conclusion

The rapid expansion of Akure calls for effective management of its land resources. Many of these have been differently administered by the private and public sectors to result in a density mix where residents hardly share common interest and attend to issues of mutual concern. No doubt, most land in Akure are under the control of families who dispose at unregulated prices. The study has examined the factors associated with land acquisition vis-à-vis the roles of the private and public sectors in the development zones of the city to establish the need for an e-land pricing model. The model is anchored on some basic concepts of urban development which include the concentric, sectoral and multi-nuclei models of urban landuse. Data collection was carried out using the planning institutions and households in selected neighbourhoods of Akure as the research population. Information on households revealed the behaviour of land developers while those on planning institutions disclosed their operations. From the research findings, a high level of unregulated pricing was observed particularly by the private sector that controls vast areas of the city land. The closer a private landed property to the city centre or a government housing scheme, the higher the price irrespective of the plot size. In view of the foregoings, policy implications of research and recommendations are situated within a management framework that emphasizes e-land pricing mechanism that advocates density zoning within Akure. This holds some promises for the land buyers, Ondo State Government and Nigeria as a whole.

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