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Articles

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Administration of Land use Charge in Lagos State, Nigeria

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***Abstract*:** The Land Use Charge Law of Lagos State was enacted in year 2001 with a view to increasing the State's internally generated revenue as a result of the dwindling federal government allocations and the need to meet increasing demand for the provision of infrastructures. Since its inception, the enactment of the law has generated diverse controversies. Hence, this research is aimed at assessing the administration of land use charge law in Lagos State. Data collection for the study was through structured questionnaires administered on one hundred and eighty randomly selected Estate Surveying and valuation firms operating within Lagos metropolis, and the results were presented using factor analysis and descriptive statistics of mean score and ranking. Findings revealed that the inherent problems associated with the administration of the land use charge include the method of assessment, payment of charges by Estate Surveyors & Valuers and penalty. This is evidenced by a mean score of 4.6200, 4.4667, and 4.3467 thereby ranking 1st, 2nd and 3rd respectively. It is concluded that the law should be amended to make annual return the basis of assessment.

***Keywords*:** Land administration, land use charge, revenue generation, taxation

1.0 Introduction

Land use charge is a form of taxation, whose objective is to increase the generation of internal revenue for financing public spending. According to Harvey (2000), it is a tax levied on property and its basis of assessment could

either be, Net Annual Value (NAV), Capital Value or Site Value. Oni (2010) expressly stated that the tax is based on an annual income obtainable from a property and not on capital value in the case of income that is receivable in perpetuity. It is also based on profit rent in the case of income receivable for limited period. Accordingly, land use charge as a form of taxation is expected to be fair and equitable; set in simple clearly understandable language; consider the ability of an individual to pay based on income; politically acceptable to the payers to avoid incurring hostility; and consistent with goals of promoting stable economy (Kuye, 2002; Ogbuefi, 2004).

The migration of people from the rural areas into cities such as Lagos, Abuja, and Port Harcourt impose adverse challenges on the available infrastructures, whereas, funds allocated for improvements in these areas are far from being enough for managing them. Sequel to the rapid population growth and decrease in available funds, the standard of maintenance of public infrastructure was reduced to the barest minimum. There have been concerted efforts by all tiers of governments in Nigeria to increase internally generated revenue bases through various forms of taxes on land and landed properties. This problem which is most pronounced in Lagos State, has influenced the action of the State government to eliminate multiple taxes imposed on residents through the enactment of Land Use Charge Law. The main objective of the law by the Lagos State Government is to generate additional revenue needed to enhance the standard of the state in terms of physical and social infrastructure (Oserogho, 2002). Based on foregoing, this research seeks to assess the administration of Land Use Charge law in Lagos State with a view to enhancing government revenue without undue hardship on the tax payers.

2.0 Literature Review

2.1 Provisions of the Land Use Charge Law

The Land Use Charge Law was promulgated by the Lagos State Government on June 22, 2001 and made applicable throughout the state as the sole legislation for the collection of land based rates and charges. The law consolidates all property and land based rates and charges into a new property land use charge, to make provision for the levying and collection of the charge and for connected purposes, as the stated objective. The law was introduced to generate more revenue for both the State and local governments by establishing a new regime as a means of eliminating the malpractices under the old law through an overhaul of the old tax payment procedure. The law was an attempt by the Lagos State Government to control and regulate the collection of levies on all real property in the state. According to Section 1(1) and (2) of the law, the charges shall be payable on all real

properties within the state with the local government area empowered as the only body to levy and collect the charge within its territory. Nevertheless, Section 1(3) of the law stipulates that the local government authority could delegate its function with respect to property assessment and collection of rates by written agreement to the State. According to Section 5 (1) of the law, the formula for determining the annual amount payable is:

$$LUC = M \times \{(LA \times LV) + (BA \times BV \times PCR)\} \quad (1)$$

Where,

LUC = annual amount of land use charge in Naira

M = the annual charge rate expressed as a percentage of the assessed value of the property. The assessed value in this case may vary between owner-occupied residential and commercial properties at the discretion of the State Government. Commercial property refers to those that are revenue-generating.

LA = the area of the land parcel in square metres

LV = the average value of a land parcel in the neighborhood, per square metre in Naira

BA = the total developed floor area of building on the plot of land in square metres, or the total floor area of apartment unit in a building where apartment has a separate ownership title

BV = the average value of medium quality buildings in the neighborhood, per square metre in Naira

PCR = the property code rate for the building and which accounts for the building being of higher or lower value than the average buildings in the neighborhood and which also accounts for the degree of completion of construction of the building.

$$(LA \times LV) + (BA \times BV \times PCR) = \text{the assessed value of the property} \quad (2)$$

The Lagos State Land Use Charge (LUC) has consolidated all property and land-based rates and charges payable under Lands Rates, Neighbourhood Improvement Charge and Tenement Rates Laws in the State.

However, the implementation and enforcement of the LUC have continued to raise dust. The modus operandi of the law has been generating controversies since its introduction and some residents of the State are still at loss as to what the LUC is all about as it does not apply to all properties in the state. Examples of properties that are exempted from the operation of the law include government-owned properties and those used for public, religious and charitable activities. This exemption can however only be granted where an application for exemption is made to the State Government through the State Commissioner for Finance. The

Local Government Authority in the jurisdiction/locality where the property is located constitutes the authorized collecting authority. In order for there to be compliance with the constitutional requirements on the division of powers between the State and the Local Governments, the Land Use Charge Law is predicated on the principle of mutual delegation of authority between the Lagos State Government and each of the Local Governments in the state.

Under the Land Use Charge law, properties are assessed per unit by the government and the cost of assessment is free to property owners as they are not expected to pay for assessment of property. For any two similar properties, the physical appearance, aesthetic features and age will determine the property class rate (i.e. high, medium and low) to be adopted in the valuation of the property. However, it is possible for same property type in the same location, occupying the same size of land to be charged different rates because of the usage and status. Property assessment under land use charge is classified into three broad categories - commercial, industrial and residential land uses. Commercial property attracts a rate of 0.5 per cent of the assessed value while Industrial properties, where the property owner is the occupier of the property, are assessed at a rate of 0.5 per cent of the assessed value. Assessments of residential properties are further categorized into three, with each at different rates. Properties which are solely occupied by the owners as resident purpose only are charged at a rate of 0.15 per cent, while a similar properties occupied by the property owners and tenant(s) or third parties are charged at a rate of 0.15 per cent. The third category consists of investment properties fully occupied by tenants or third party/parties for revenue generation which are charged at a rate of 0.5 per cent. Land use charge does not provide for installment payments particularly since 15 per cent discount is granted for early payment. However, any amounts left unpaid are carried over to the following year and attracts with its full interest compliment (LUC, 2001).

The charge is statutorily imposed on the owner of a property but where the owner is not in occupation of the property, the Law authorizes the collecting authority to appoint the occupier, usually the tenant, to be assessed and pay for the tax while the tenant in turn is to offset such payment from monies that may be due to the owner of the property. There is thus an indemnity in favour of the tenant/occupier against the owner, where a property owner did not receive the First Demand Notice. In cases where property owner is confirmed to have received Land Use Charge bill notice for the first time and are yet asked to pay arrears, demand notices issued with arrears are reviewed against proof of delivery of the Land Use Charge

demand notices on such properties for the previous year(s) for necessary correction. In a situation where the property owner received the tenement rate demand notice and has accordingly made payment before receiving the LUC demand notice for the first time, the amount paid is to be deducted from the LUC (if it is higher than the tenement rate), then pay the outstanding balance. Evidences of payment of both tenement rate and LUC are to be forwarded to the LUC office. However, if payment is made within 15 days of the delivery of the demand notice, a discount of 15 per cent is applicable.

2.2 Empirical Studies

Oni (2010) assessed the provisions of the Lagos State Land Use Charge Law and determined the effects on stakeholders. In doing so, a process of inferences, interviews and evaluation of the law were carried out. The study found great disadvantages of the law, and recommended appropriate basis to determine fair and equitable charge. Oni (2010) further attempted to determine the short and long- term effects of the law on housing delivery which is one of the thematic areas of Vision 20:2020 for Nigeria, by surveying 120 estate surveying and valuation firms, using desktop inferential review of literature. The process of inference revealed that the basis for calculating the land use charge was inappropriate, and that the provision for penalty for delayed settlement of the land use charge was considered too harsh and that Estate Surveyors and Valuers should not be held liable to make deductions for the Charge from rents collected on behalf of their clients, and also that the burden of land use charge should not be too much so as to encourage investment in provision of housing, and prevent neglect of proper maintenance of existing housing stock.

Oserogho (2002) in assessing of the land use charge law maintained that the delegation of authority to State Government has led to the institution of various litigations in Lagos State. The paper cited the decided case of Knight, Frank & Rutley v. A.G of Kano State [1990] 4 NWLR (Pt 143) 210 where the Nigerian Court of Appeal had expressed the view that 'it was not constitutional for a tier of government to delegate its constitutional powers to another tier. This case was affirmed by the Supreme Court as reported in [1998] 7 NWLR (Pt. 556) 1; [1998] 4 S.C. 251. Egwuatu and Egwuatu (2016) examined the imperatives of valuation as a prerequisite for effective assessment and enforcement of property based taxation in Nigeria. Using a process of inferences and evaluation, it concluded that though the government generates much revenue from Land use Charge, the taxation exercise is not effective because of the raging controversies of over assessment of properties which resulted to high charge; and that the inconsistency in the assessment

process impinges on the integrity of the process. The determination of appropriate values for property taxation requires expert opinion hence Estate Surveyors and Valuers should be involved in the assessment and allowed to apply suitable method for the valuation of assessed property.

3.0 Research Methods

One hundred and eighty five (185) firms of Estate Surveyors and Valuers practicing in Lagos metropolis were randomly selected for use in this study. Structured questionnaires drawn up on a 5-point Likert scale, was subsequently administered on them. However, one hundred and fifty questionnaires representing 82% response rate were retrieved and used. Both descriptive and inferential statistics of weighted mean and factor analysis respectively were employed for data analysis

4.0 Data Analysis and Discussion

Table 1: Details of Respondents' Bio Data

Qualification/Experience	Option	Frequency (%)
Academic	BSc/HND	132(88)
	MSc/MBA/M.Tech	18(12)
	PhD	0
Professional	Associates	120(80)
	Fellow	27(18)
	RICS	3(2)
Experience	Below 5	4(3)
	6-10 years	10(7)
	11- 15 years	70(47)
	16-20 years	46(30)
	Above 20	20(13)
	Above 20	20(13)

Source: Field Work (2017)

In order to determine the reliability of the respondents' opinions, their academic and professional qualifications and their work experience were examined. As shown in Table 1, out of one hundred and fifty respondents, 88% have the first degree (B.Sc.); about 80% are Associates of the Nigerian Institution of Estate Surveyors and Valuers, while about 27% are Fellows; and about 3% of the respondents also belong to the Royal Institute of Chartered Surveyors. In respect of work experience, 70 (about 47%) of the respondent have been practicing for more than ten years. This implies that the respondents possessed the capacity to understand the questions and that their opinions and the research findings are reliable.

Table 2: Respondents Opinion on the Inherent Problems associated with Administration of Land Use Charge

	Estate Surveyor & Valuers							
	SA	A	UD	D	SD	Mean	Std. Dev.	Rank
Ability to pay tax liability	39.3	19.3	22	13.3	6	3.7267	1.27388	11th
Acceptance of the LUC	-	-	16.7	38	45.3	1.7133	0.73582	16th
Administration of the Law	42	22	12.7	16	73	3.44	1.37806	15th
Consistency in administration	-	-	16	28	56	1.6	0.75084	18th
Expert Opinion	52.7	32	-	15.3	-	4.22	1.0483	5th
Fair & Equity	33.3	30	26.7	30	33.3	3.8667	0.99439	9th
High incidence of tax	42	22	12.7	16	73	4.0667	1.06605	8th
Information about the Law	40	20	13.3	16.7	10	3.6333	1.40668	13th
Integrity	-	-	-	20.7	79.3	1.2067	0.40627	20th
Litigation	50.7	26.7	10	12.7	-	3.86	1.34628	10th
Local Government Autonomy	-	2.7	6.7	38.7	52	1.6	0.73274	18th
Method of assessment	62	38	-	-	-	4.62	0.48701	1st
Owner occupier acceptance of demand notice	52	12.7	26.7	8.7	-	4.1533	1.04744	7th
Payment of LUC by Estate Surveyor and Valuer	60	24	8	8	-	4.4667	0.69192	2nd
High Penalty	48.7	15.3	18	9.3	8.7	4.3467	0.95529	3rd
Qualification of Appeal tribunal	50.7	34.7	10	4.7	-	4.3133	0.83655	4th
Role of commissioner in setting values	-	-	10.7	42	47.3	1.6333	0.66974	17th
Status of Assessor	46.7	32.7	16	4.7	-	4.2133	0.87919	6th
Tax avoidance	58	30.7	11.3	-	-	3.6733	1.38301	12th
Understanding of the Law	36.7	23.3	14	9.3	16.7	3.54	1.47748	14th

Source: Field Survey, 2017. Where SA: Strongly Agree; A: Agree; UD: Undecided D: Disagree; SD: Strongly Disagreed

The inherent problems associated with the administration of land use charge are enormous. Various problems identified in the literature were assessed and presented in Table 2. The research revealed that all the problems identified

are associated with the administration of the land use charge. The method of calculating the assessed value, payment of charges by estate surveyors and valuers and penalty are identified as the major problems associated with the administration of land use 1st, 2nd and 3rd respectively.

4.1 Analysis of the Inherent problems of Land Use Charge using Factor Analysis

Table 3: KMO and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.942
Bartlett's Test of Sphericity	Approx. Chi-Square	6860.567
	Df	190
	Sig.	.000

The Bartlett's test of sphericity was used in the test for the appropriateness of the sample from the population and the suitability of factor analysis. It tests for the adequacy of the sample as a true representation of the population under study (Alese and Owoyemi, 2004). The Bartlett's test in Table 3 shows a chi-square of 6860.567 and a significant level of 0.000, which is an indication of the adequacy of the sample. The Kaiser-Meyer-Olkin (KMO) test is another measure of sample adequacy. It is an index for comparing magnitudes of the observed correlation coefficients between all pairs of variables. It is small when compared to the sum of the squared correlation coefficient. A KMO value of 1 represents a perfectly adequate sample. A KMO of O represents a perfectly inadequate sample. The KMO value in Table 3 above is 0.942, which shows that the sample is reasonably adequate.

4.2 Communalities

The communalities are shown in Table 4 It shows the proportion of the variance explained by the common factors. The communalities are in the range of 0 and 1, with 0 indicating that the common factors explain all the variance in the variable. It could also be expressed as a percentage. For instance, the ability of pay tax liability provided which indicates that 94.8% of the variance is accounted for by the common factors while the remaining 5.2% is accounted for by unique (unexplained) factors. The initial communalities are always 1.00 before the extraction of factors because at that initial stage every variable is regarded as a factor with a mean of 0 and standard deviation of 1.

Table 4: Communalities

Communalities		
	Initial	Extraction
ATPL	1	0.948
AXEPTLUC	1	0.924

ADMLUC	1	0.944
APPTR	1	0.903
STASSE	1	0.777
TAXAVO	1	0.965
METOASS	1	0.822
ROCOM	1	0.828
CLUC	1	0.655
ESVL	1	0.861
EXPOPI	1	0.933
F&EQ	1	0.91
INFOLUC	1	0.968
INT	1	0.835
LG	1	0.841
LITI	1	0.974

4.3 Extraction Method: Principal Component Analysis

The criticality of the twenty identified inherent problems from the literature was also explored using Factor Analysis. Factor analysis was used to assess the multivariate relationship among the inherent problems associated with the administration of land use charge in Lagos State based on frequency of occurrence. The analysis was conducted using Principal Component Analysis (PCA) (extraction method) to determine possible cluster relationships of the inherent problems associated with the administration of land use charge and Varimax with Kaiser Normalization (rotation method) to make factors easily interpretable. The number of factors to be retained was specified on the basis of social science rule which state that only the variable with a loading equal to or greater than 0.4 in absolute terms and percentage of Variance greater than 1 should be considered meaningful and extracted for factor analysis. The result presented in Table 5below was obtained based on this rule.

	Factor Groupings (Components)	
	1	2
' to pay tax liability	.938	
istration of the law	.901	

ication of Appeal tribunal		.947	
of assessor		.834	
oidance		.938	
d of assessment		.822	
f commissioner in setting values		-.854	
tency in administration		-.451	
opinion		.966	
equity		.887	
nation about land use charge		.934	
ty		-.891	
Government autonomy		-.905	
ion		.973	
y		.975	
occupier acceptance of the demand notice		.975	
ncidence of tax		.916	
standing of the law		.938	
tance of the law			-.952
tent administration			-.672
nt of LUC by Estate Surveyors and Valuers			
Eigen value	15.534	2.352	
Percentage of variance explained	77.669	11.762	
Cumulative % of variance explained	77.669	89.431	
Rotation Sums of Squared Loading		14.565	3.321
Percentage of variance explained		72.827	16.604
Cumulative % of variance explained		72.827	89.431

Note: Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
Rotation converged in 3 iterations

All factor analysis produced two factor groupings with Eigen values of 2.35 to 15.53as shown in the Figure below, and variance cumulative percentage of 89.43%as shown in Table 5 above. Rotation converged in 3 iterations.

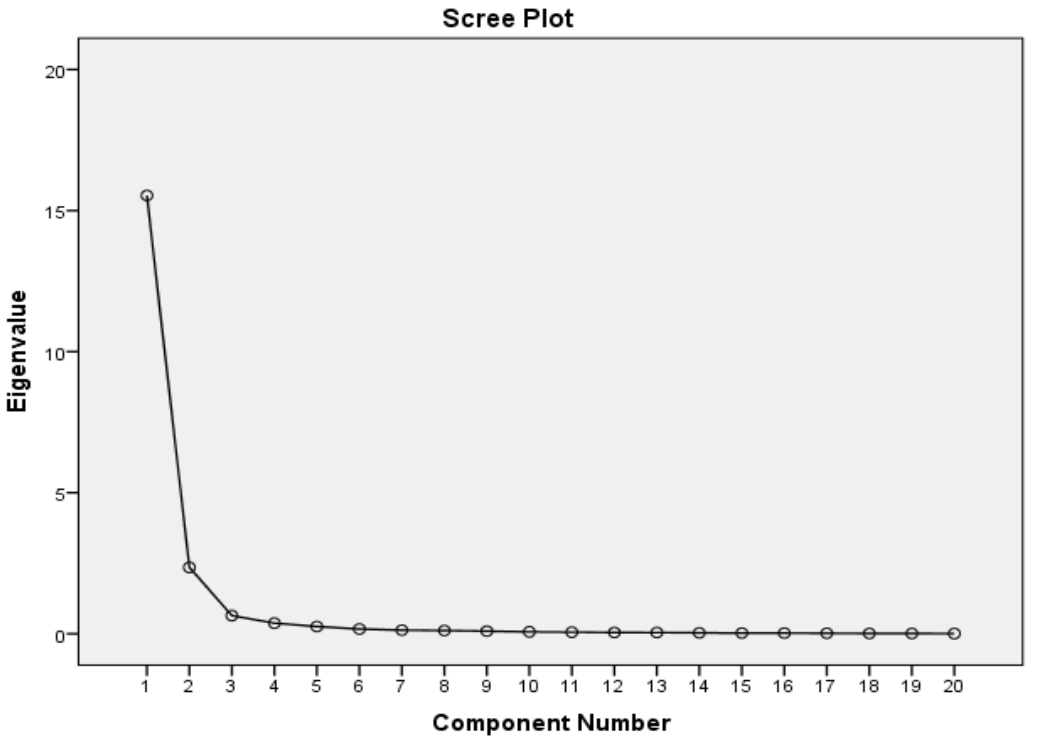

Fig. 1: Scree plot showing the Eigen value

From the factor loadings in Table 5, it could be observed that all the variables of factor 1 contribute 72.83% to administration of land use charge, while acceptance of land use charge, consistency of the law and payment of charges by Estate Surveyors and Valuers factors contribute 16.60% respectively. The two factors contribute a total of 89.43% while the remaining 10.57% is accounted for by extraneous factors which are unique to the variable and other variables outside the control of the research. The two factor groupings are:

Factor Grouping 1: Expert Opinion

This factor grouping comprise Ability to pay tax liability (.938), Administration of Land Use Charge (.901), Appeal Tribunal (.947), Status of Assessment (.834), Tax Avoidance (.938), Method of Assessment (.822), Role of Commissioner in setting value (-.854), Consistency of the Administration (-.451), Expert Opinion (.966), Fair and Equity (.887), Information about Land Use Charge (.934), Integrity (-891), Local Government Authority (-905), Litigation (.973), Owner Occupier (.975), Penalty (.975), High Rate of Tax (.916), and Understanding of Land Use Charge (.938). These represent 77.67% of the variance in the inherent problems associated with the law. These factors have high occurrence and cluster together because the problems associated with law are high due to the negligence of expert opinion in the administration of the law. These factors are high and cluster together because owner occupier's acceptance of the demand notice, penalty and litigation attached to the law can lead to the termination of the revenue expected by

the state government and hence incur more debt for the state government. These have high occurrence because of the non-involvement of the expert in the administration of the law which was the cause for tax avoidance, different cases of litigation, non-compliance with the provision of the law by the Lagos residents. From the factor loadings in Table 6, it could be observed that the variables of factor 1 contributes 72.83% to administration of land use charge, while acceptance of land use charge, consistency of the administration and payment of charges by Estate Surveyors and Valuers factors contribute 16.60% respectively. The two factors contribute a total of 89.43% while the remaining 10.57% is accounted for by extraneous factors which are unique to the variable and other variables outside the control of the research.

Factor Grouping 2: Inconsistent Administration

This grouping constitutes 11.76% of total variance which explained the inherent problems associated with the administration of land use charge. The inherent variables in this factor grouping are acceptance of land use charge (-.952), consistency of the law (-.672), and payment of charges by Estate Surveyors and Valuers (.927). These variables cluster together because consistency in administration is required in the administration of land use charge law in Lagos State. The relative newness of the Law coupled with high expectation from the law necessitated the need for consistency so that the law can be generally accepted by the Estate Surveyors and Valuers and the entire resident of Lagos State. The problem associated with the acceptance is relatively high because the law did not meet up to its expectation as expected by the Lagos populace. Also, the Estate Surveyors and Valuers should not be held for the payment of the land use charge.

5.0 Conclusion and Recommendation

The persistent criticism of land use charge from property owners and estate surveyors and valuers who accused the LUC officials of arbitrary valuation and imposition of exorbitant charges which are sometimes are in excess of the annual rental income on the properties necessitated the need to re-examine the mode of administration of the land use charge law. The provision of the law on the method of assessment of value is inappropriate. The Law should however be amended to make the net annual rental income as the basis of valuation. The Law neither provided nor gave allowance for risk of tenants' default in rent payment which has become common tales amongst Estate Surveyors and Valuers. Estate Surveyors and Valuers should not be held liable to make deductions for the Charge from rents collected on behalf of their clients; rather the Lagos State Government should appoint Estate Surveyors and Valuers to determine the appropriate annual values, collect and remit the Charge to the Government. Also, the penalties imposed for delaying settlement of the Charge which is too harsh should be readdressed against tenants falling into arrears of rent payment of up to twelve months or more. If Lagos State Government insists on prompt payment of the Charge, there should be provisions to protect the owners against rent defaults by tenants.

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Statistical Modeling of the Service Life of External Paint Finish in Public Residential Buildings in Savannah Climatic Design Zone of Nigeria

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***Abstract*:** The performance of building materials used for exterior finish cannot be ascertained precisely through simulation or laboratory experiments, however, it requires that the materials are applied on substrates and placed under natural environmental condition to experience the actual changes possible over a period of time. However, universal usage of paint for walls in public and private buildings for decorative and protective functions remains the most aesthetic expression in Nigeria. The planning of maintenance works is based on predictions of the time when the critical elements of the built assets will reach degradation levels that exceed acceptable values. This paper employed the use of statistical model in determining the service life of external paint finish in Wuse Housing Estate, Abuja which falls under savannah climatic zone for architectural design in Nigeria and developing a guide for maintenance planning of external paint finish. The study is a survey research type conducted in the Government Residential Estate that use paint as external finish in Abuja. The total number of buildings in the study area is 1,000 and a sample size of 114 buildings was used. Data was collected through structured questionnaires. Findings revealed that the average service year for the external paint finish in savannah climatic zone in Nigeria is 2 to 5 years. These findings also contradicted the established lifespan of paint in the temperate region put between 5 and10 years.

***Keywords*:** Degradation, service life, external paint, savannah zone, maintenance, building component

1.0 Introduction

Building materials, especially those used in the building envelope, are exposed to physical, mechanical, chemical, biological weathering and other factors acting in combination, or

at the same time. The principal climatic elements that affect the external finishes are rainfall, solar radiation, wind and moisture which lead to rapid deterioration and ultimately reduce the life span of the finishes, especially in the tropics, necessitating frequent maintenance and have impeded the performance of these materials. The degradation of the exterior surfaces of buildings is one of the major concerns of building owners and maintenance managers since in most cases maintenance actions are often based on the outward appearance of the buildings (Balaras, Droutsa, Dascalaki, and Kontoyiannidis, 2005). This has culminated into spending a lot of money on such maintenance activities.

Current global reality about climate change is exerting a negative influence on the built environment but since buildings cannot be divorced from the environment, the effect of climate change is indeed obvious on the external surface of buildings. A growing demand has been the provision of suitable quantitative tools to predict the occurrences of defects and the ensuing damage to the external finishes. The prediction of service life of external finishes is therefore the cornerstone of any such quantitative tool as it helps to establish the planning horizon over which the various costs, that arise during the intended lifetime of the finishes, are incurred (Teo, Chew and Harikrishna, 2005) and since the degradation of exterior finishes is dictated by material selection criteria, method of application and environmental factors. The paper identifies the different nature and influence of these factors and particularly their degradation on the external paint finish and comes up with a maintenance guide arising from the service life studies of the paint used as external building finish.

2.0 Service Life Studies and Degradation of Building Components

The durability of constructions is essential to the quality of everyone's life and is a critical component of the social and economic stability of contemporary societies (Wekesa, Steyn and Otieno, 2010). In general, an attitude of "build and let decay" is adopted in construction and this result to the loss of building's performance. Marie (2013) summarises a building's life cycle into three phases: design, construction and operation or service, which represents 95% of the life time of a building. Rikey and Cotgrave (2005) further report that the process of building decay starts as soon as they are built. ISO 15686-1 (2000) defines durability as the capability of a building or its parts to perform above a required critical limit over a specified period of time, for a set of in-use conditions deemed to apply in terms of materials, design, indoor and outdoor environment, use and maintenance

Data on building material durability can be obtained through accelerated ageing laboratory tests which follow an analytical methodology, in which the full complexity of natural ageing phenomena is subdivided into degradation agents that are individually studied to a high level of accuracy. However, the processes are generally complex, time and resource-consuming that provides results that are not easily transposed to real life in-use situations. Other techniques are statistical, accelerated or non-accelerated techniques to simulate the deterioration processes.

The performance of building materials used for exterior finish cannot be

ascertained precisely through simulation or laboratory experiments. It requires that the materials are applied on substrates and placed under natural environmental condition to experience the actual changes possible over a period of time. The best alternative is to assess the changes through users who have lived with the changes over a long period of time. A good number of such users may not even take notice of the situation until questions are posed to them. The survey method that gathers data from such people that is used for this research is the best alternative (Morcillo, 1999; de la Fuente, 2006 and Yang Wang and JU, 2012).

Service life, as defined in accordance with ISO 15686, is the period of time after construction during which buildings and their materials equal or exceed the minimum performance requirements. Service life is defined as the period during which an element is in 'service' and fulfils all necessary performance requirements (Sarja and Vesikari, 1996). A service life prediction method involves an understanding of the deterioration pattern. According to Clifton (1993), such prediction methods can be classified into estimations based on experience; deductions from performance of similar materials; accelerated or non-accelerated testing; modelling based on deterioration processes; deductions from performance of similar materials; and application of stochastic concepts.

2.1 Methods of Estimating Service Life of Building Finishes

Predicting the service life of a building or its components can be a complex and time-consuming process especially in respect of the quality of material, the level of design and execution, the interior and exterior environmental conditions, the in-use conditions and the maintenance level (Hovde, 2004; ISO 15686-1:200). In the last few years, many international codes and regulations have been published in order to establish methodologies that allow the evaluation of the durability of and their service life prediction.

Durability data can be obtained on buildings through accelerated ageing laboratory tests or field work assessment of existing buildings and structures (Gasper and Brito, 2008). Laboratory testing follows an analytical methodology in which the full complexity of natural ageing phenomena is subdivided into degradation agents that are individually studied to a high level of accuracy. Such research processes are generally complex, time- and resource-consuming, and they provide results that are not easily transposed to real life in-use situations. Such tests therefore, lead to high costs (Shohet, Rosenfeld, Puterman and Gilboa 1999). However, field work assessment of existing buildings and structures depends on the atmospheric conditions at the time of the inspection, e.g. the difficulty of detecting anomalies in smooth and dark claddings when sunshine is hitting the buildings directly. Even though the method is easily grasped, visual inspections, nonetheless, have some limitations, since their accuracy depend significantly on the experience/ background and classification criteria of the surveyor. A straightforward visual inspection is enough to evaluate the degradation state of a building or its elements, and it is sufficient for the surveyor to collect, in situ, the data on the anomaly type, its intensity and extension.

There are several methods of assessing the degradation state of buildings and their components and these vary in accordance with the importance rating of the construction elements, the rating of the anomalies and the definition of the condition parameters associated with the anomalies. A number of authors have established classification systems for defects and degradation ratings in order to express the physical and functional degradation of the elements under analysis (Roy, Thye and Northwood, 1996; Shohet, Rosenfeld, Puterman and Gilboa, 1999; Shohet, Puterman and Bilboa, 2002, 2003; Teo, Chew and Harikrishna, 2005; Balaras, Droutsa, Dascalaki and Kontoyiannidis, 2005; Teo and Harikrishna, 2006). Most classification systems consist of rating the anomalies according to a scale of discrete variables that vary from the most favourable condition level (no visible degradation) to the least favourable one (extensive degradation or loss of functionality).

William and Feist (1993), NAHB (2000); ASTM (2005); Bliss (2006) carried out various researches in United States of America and put the life span of paint used as external building finish between 5 and 7 years. Gaspar (2009); Chai, Brito and Silva (2015) researched into the lifespan of paint used as external finish in buildings in Portugal and the output of the study revealed 7 to10 years. Roy, Thye and North wood (1996) found that the lifespan of paint used as external finish in Singapore was 5 to 7 years in Singapore in line with Branz (2007) findings too in New Zealand.

3.0 Study Area

The study area for this study is Federal Capital Development Authority (FCDA) Housing Estate, Abuja. FCDA Housing Estate is one of the earlier public residential buildings that were constructed in Abuja, Nigeria. It occupies a total land area of 800 square kilometres. It is bounded by Kaduna State in the North, South-west by Kogi State, on the West by Niger State and in the East and South-east by Nassarawa State. Abuja experiences three weather conditions annually. These include a warm, humid rainy and an extremely hot dry seasons. In between these seasons, there is a short period of harmattan accompanied by the North-East trade wind, with the main feature of dust haze, intensified coldness and dryness.

The rainy season begins from April and ends in October of each year when daytime temperature ranges between 28 and30°C and night time ranges between 22 and 23°C. In the dry season, daytime temperatures do soar to 40°C and night time temperatures do drop to 12°C, resulting in chilly evenings. Even the chilliest nights can be followed by daytime temperatures well above 30°C. The high altitudes and rolling terrain of the FCT act as moderating influence on the weather of the territory. Rainfall in the FCT reflects the territory's location on the windward side of the Jos Plateau and the zone of rising air masses. The annual total rainfall ranges between 1100 mm and 1600 mm.

4.0 Research Methodology

The study is a survey research type conducted in the government residential estate that use paint as external finish in Abuja under savannah climatic zone for architectural design in Nigeria. The sampling frame for the study comprised of heads of households and the paint manufacturing companies. Stratified random sampling technique was adopted for the study because of the

different types of housing units that were within the housing estate. The estate was stratified based on the number of building typologies that were present. Each sub-stratum was then randomly sampled and grouped into households. The heads of households were the basic focus of questionnaire administration. The research population was 962 and a sample size of 120 was obtained using sample size calculator. The structured questionnaire dwelt on the characteristics of buildings that cause external paint degradation. The extent of defect shown on the surface was the dependent variable while the independent variables included building age, façade orientation, building layout, road proximity, nearness to water body, proximity to vegetation, proximity to industrial facilities, closeness of other buildings, wind effect, rain effect, surface preparation of the painted surface, paint type, colour of paint applied, type of paint applied, number of storey height and portion of the defect. Each question addressed a research variable in this study

Out of the 110 questionnaires administered, 96, which accounted for 87% success rate were returned. However, only 84 questionnaires were found suitable for statistical analysis for the study. The questionnaire for the paint manufacturing industries were effectively administered on 5 different manufacturers to know the lifespan of their products in other to validate the result of the study.

5.0 Data Analysis, Findings and Discussions

The variables that caused degradation of external paint finish were characterised as age of building, layout of building, distance of building from the road, distance of building from the water body, distance of building to the forest/vegetation, level of exposure of building to wetness/dampnessIs, building near any industrial facility, how many sides is a building surrounded by other residential blocks, effect of wind action, effect of rain action, description of surface after the paint had been applied, type of paint used, description of the colour of paint after it had been applied, how was the paint applied, number of storeys, the extent of defect(s) shown on the external surface of the building and the portion of the external surface where the defect is shown.

Ordinal Regression Analysis was carried out to estimate the factors responsible for the extent of defects of external paint finish. Accordingly, model fitting information and pseudo R^2 were generated as shown in Table 2. The dependent variable which measures the extent of defect of external paint finish is DEFECT_EXTENT. DEFECT_EXTENT which is equal 1 if the respondent perceives the extent of the defects as no visible defects, 2 as few signs of defects, 3 as general defects and 4 as severe defects. Since dependent/outcome variable is ordinal and building characteristics (independent/predictors) are ordinal/nominal variables, the ordinal regression model was used to estimate the building characteristics that are responsible for the extent of defects of external paint finish. A total of sixteen predictor variables were fed into the model.

Table 2 shows the regression coefficients of the building characteristics responsible for the extent of defects of external paint finish. The coefficients are based on scale model, which depends on the main and

interaction effects. The table reveals that all the selected building characteristics of age of building (coef=.197, ρ = 0.000 < 0.05), façade (coef = -.635, ρ = 0.001 < 0.05), layout (coef = 1.855, ρ = 0.012 < 0.05), wind effect (coef = -.200, ρ = 0.001 < 0.05), rain effect (coef = 4.355, ρ =0.005 < 0.05), surface after repaint (coef = -.497, ρ = 0.000 < 0.05), type of paint (coef = .173, ρ = 0.049 < 0.05, colour of paint (coef = 1.354, ρ = 0.005 < 0.05) and paint application (coef = 1.485, ρ = 0.033 < 0.05) significantly predicted the extent of defect of external paint finish. However, distance to road (coef = -.372, ρ = 0.093 > 0.05), distance to river (coef = .505, ρ = 0.142 > 0.05), distance to vegetation (coef = -1.016, ρ = 0.184 > 0.05), distance to industry (coef = 0.201, p = 0.359 > 0.05), surrounded by other buildings (coef = .321, ρ = 0.621 > 0.05), number of storeys (coef = -.760, ρ = 0.507 > 0.05) and portion of defect (coef = .234, ρ = 0.073 > 0.05) did not have significant prediction on the extent of defect of external paint finish.

Table 2: Summary of Ordinal Regression Analysis Showing the Effects of Building Characteristics on External Paint Degradation

Variables	Coef.	Z	ρ
Age	.197	0.46	0.000
Façade	-.635	-0.97	0.003
Layout	1.855	0.66	0.012
Distance to road	-.372	-0.60	0.093
Distance to river	.505	1.36	0.142
Distance to vegetation	-1.016	-2.15	0.184
Distance of industry	0.201	0.46	0.359
Surrounded by buildings	.321	0.49	0.621
Wind effect	-.200	-0.28	0.001
Rain effect	4.355	3.20	0.005
Surface after repaint	-.497	-0.49	0.000
Type of paint used	.173	0.16	0.049
Colour of paint	1.354	1.78	0.005
Paint application	1.485	1.58	0.033
Number of storeys	-.760	-1.96	0.507
Portion of defect	.234	0.30	0.073

[The result ρ = 0.0000 < .05], Pseudo R^2 = .6004 implied that 60% of the variance in the degradation of external paint finish is accounted for by the selected independent variables of age of building, façade, layout, wind effect, rain effect, surface after repaint, type of paint, colour of paint, paint application and portion of defect.

The step-by-step (Stepwise) method used to define the explanatory variables. In this method, the basic regression assumptions were revised and the variables that were not significant or explanatory of the dependent variables were excluded. According to Leung, Tam, Liu (2001) the multicollinearity effects were also eliminated. Multiple linear regression allows identifying the

characteristics that influence the durability of paintings and also establishes a hierarchical distinction between the different characteristics, evaluating which variables are more relevant to the degradation of painted surfaces. The model presents a very strong correlation between variables, deemed appropriate to model the durability of painted surfaces.

Eight independent explanatory variables analysed using this model were façade, distance to river, effect of wind, effect of rain, type of paint used, colour of paint, paint application and portion of external surface where defect is visible as shown in Table 3. SPSS (Statistical Package for Social Science, version 16) was used to run the analysis.

The result which is statistically significant at 0.05 (95%) confidence interval indicates that as the ratings of the building characteristics increase, the extent of defects of external paint finish increases. Table 3 reveals that building characteristics of wind effect, colour of paint, age of building, rain effect, distance to river, façade, paint application, type of paint and portion of defect had significant prediction on external paint degradation in the selected locations

Table 3: Summary of regression analysis showing the effects of defect factors on external paint degradation

Variables	**Coef.**	**Z**	ρ
Façade	**-.635**	**-0.97**	**0.003**
Layout	**1.855**	**0.66**	**0.012**
Wind effect	**-.200**	**-0.28**	**0.001**
Rain effect	**4.355**	**3.20**	**0.005**
Surface after repaint	**-.497**	**-0.49**	**0.000**
Type of paint used	**.173**	**0.16**	**0.049**
Colour of paint	**1.354**	**1.78**	**0.005**
Paint application	**1.485**	**1.58**	**0.033**
Portion of defect	**.234**	**0.30**	**0.073**

Table 4 shows the residual statistics of the multiple linear regression for the predicted service life in FCDA Housing Estate at Wuse, Abuja in Savannah climatic zone for architectural design in Nigeria while Table 5 provides the summary of the statistical indicators for the reference service life estimated, which includes a maximum value, a minimum value, a range and a standard deviation of the reference service life for the Savannah climatic zone of Nigeria. The estimated reference service life (5 years) is given by this model. The minimum reference service life is 2 years, while the maximum service reference life is 5 years.

Table 4: Residuals Statistics of the Multiple Linear Regression for the Predicted Service Life in FCDA Housing Estate Wuze, Abuja (Savannah Zone)

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.87	4.76	3.47	.907	84
Residual	-3.312	1.437	-.087	1.069	84
Standard Predicted Value	--1.971	2.112	.000	1.000	84
Standard Residual	-2.863	1.929	-069	.977	84

Table 5: Summary of the Statistical Indicators for the Reference Service Life Estimated Using the Proposed Multiple Linear Regression Model in FCDA Housing Estate Wuze, Abuja (Savannah Zone)

Statistical Indicator	Values(Years)
Average of the reference life	3.47
Maximum reference service life	4.76
Minimum reference service life	1.87
Range of reference service lives	2.89
Standard deviation of the reference service life	.907
Variance of the reference service life	1.0

5.1 Maintenance Guide for Paints in Savannah Region

The cost differential rate or consumer price index (CPI) in Nigeria is calculated monthly by the National Bureau of Statistics, based on the consumption habits of Nigerian households (based on monthly expenditure on food, housing, education, health, transport, and so on). In this study, a discounted rate of 12% is adopted for the cost differential rate (an average computed by the CBN between 1980 and 2015 is 11.38%). The difference between CPI of one month in a preceding year over the CPI of the same month in the current year is known as inflation rate. Based on this, the average inflation rate computed between 2001 and 2005 was 0.27, between 2006 and 2010 was 0.52 and between 2011 and 2015 was 1.03 from the information supplied by Nigeria Historical inflation rate for period 2006 to 2017. This implies that the inflation rate doubles every 5 years. Therefore, for this study, the inflation rate between 2010 and 2015 was used as the basis to project the inflation rate for the next 20 years.

Paint, in most cases in Nigeria, is applied on rendered surfaces hence its removal may aggravate their degradation. Due to this, repair of the renderings needs to be well thought-out every time paint is removed. In the maintenance plan being considered, it is expected that rendering is in perpetuity.

Present-value cost of the maintenance plan over a period of 20 years is thus determined as maintenance every 5 years in accordance with the results in terms of the paint estimated service-life for quality paint. The repair and maintenance costs presented in Table 6 for quality paint were calculated with the help of a Quantity Surveyor in accordance with Nigerian reality.

Table 6: Cost of the Maintenance Works

Periodicity (Years)	Maintenance Actions	Cost in year 0 (N/m^2)	Current cost (N/m^2)	Present Value cost (N/m^2)
5	Material (Paint)	900.00		
	Scaffolding	78.28	1369.63	777.11
	Labour	117.42		
	Profit and Overhead (25%)	273.93		
10	Material (Paint)	900.00		
	Scaffolding	78.28	2534.38	815.99
	Labour	117.42		
	Profit and Overhead (25%)	273.93		
15	Material (Paint)	900.00		
	Scaffolding	78.28	4623.84	895.23
	Labour	117.42		
	Profit and Overhead (25%)	273.93		
20	Cleaning and Repair	58.70		
	Material (Paint)	900.00		
	Scaffolding	117.42	10.395.67	1114.54
	Labour	273.93		
	Profit and Overhead (25%)	337.51		

6.0 Conclusion

The estimation of the service life of external paint finish for the savannah climatic zone for architectural design in Nigeria presented in this study is based on the field appraisal of the anomalies, rate of degradation, quantification and transportation of the results into statistical model. In the analysis of the degradation factors, the most influential factors were age of building, facade, layout, distance to road, distance to river, distance to vegetation, distance to industry, number of surrounded building, rain defect, wind effect, surface after repaint, type of paint used, colour of paint, paint application, number of storeys, and portion of defect. These data make it possible to conclude that, given similar circumstances to those of the sample analysed, the average service life of external paint coatings in the savannah climatic zone of Nigeria is 5 years given by this model. The minimum reference service life is 2 years while the maximum reference service life is 5

years. These findings also contradict and are more frequent than established lifespan of paint in the temperate region based on earlier studies by Roy, Thye and North wood (1996).; NAHB (2000); Bliss (2006); Chai, Brito, Gasper, and Silva (2015) which put same between 5 and 10 years where all elements of climate are in action.

The service-life prediction method can therefore be of use to the stakeholders in the building industry. Since maintenance has substantial economic repercussions on the lifecycle of constructions, an accurate knowledge of the expected service-life of a building's components is necessary. This process allows for more valuable maintenance strategies to be devised since the works can be better planned, and unnecessary expenditure can be avoided.

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Building Collapse in Lagos State, Nigeria: Towards Quality Control in Materials, Batching and Placement of Concrete

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Abstract: The collapse of buildings is not a new phenomenon in Nigeria and other developing countries. Evidence from Nigeria has shown that the occurrence of building collapse is mostly prevalent in the informal sector of the building construction industry in Lagos State. Several studies revealed that building collapse is mainly caused by failure of the structural components of a building. Concrete is a dominant material for building structural components in Lagos State, Nigeria and has often been identified as the major cause in many instances of building collapse. This study evaluates the quality control aspects of concrete used especially with respect to its constituent materials, batching and placement in the informal building construction sector of Lagos State, Nigeria using structured questionnaires administered to building construction practitioners working on construction sites in the study area to gather data for the study. Data was analysed using frequency and percentages. Findings were qualitatively discussed. The study found that while the practitioners were conversant with quality assurance aspects of concrete, issues relating to quality of materials used for concrete, trial mix of concrete however, the challenges associated with outsourcing of concrete batching and placement still pose serious threats to concrete quality within the study area. The study recommends that professionals in the construction industry should be involved in all aspects of building procurement and, at the same time, subscribe to quality control measures before and after concrete casting to improve the quality of building construction.

Keywords: building collapse, concrete batching, informal construction, quality control.

1.0 Introduction

The issue of quality control and assurance are very central to the production of any man-made object as its objective is to ensure that the product meets both the specification and expectations of the users. Quality assurance is a planned process aimed at ensuring that products and services conform to established requirements (Okereke, 2003). The construction industry is very important as it delivers the bulk of the fixed capital formation of any country especially in the areas of buildings and infrastructure. Quality assurance, in the building construction industry, is necessary to ensure that such huge national capital is kept durable, safe and serviceable all through their estimated life cycles. Quality assurance can also be described as a subset of overall quality management in the construction industry, the highest form of which is total quality management (TQM). Quality management, in construction, ensures that the quality of construction is maintained at a specified acceptable level which implies timely and cost effective delivery in addition to the product complying with specification and performance expectations (Ozaki, 2003). TQM on the other hand focuses on the processes leading to the making of a product and ensures that the processes are right and that the product is right (Polat, Damei and Tatar, 2011). The assessments of some aspects of the building construction industry in Nigeria indicate that the adoption of quality management strategies is still rudimentary. For example, Oludare and Oluseye (2016) in their study of construction firms in Lagos, Nigeria, found that the most prevalent system in place, for construction quality, was the supervision of workers and work processes. Hence, the level of quality achieved is totally dependent on the expertise of the supervisor, a development that is usually counter-productive especially when the supervisor lacks requisite knowledge and experience. Similarly, Opoko, Ezema and Ediae (2014) opined that the utilisation of low impact building materials in the Nigerian context could be traced to non-existent quality management processes for their production.

The issue of construction quality assurance is very central to achieving an effective building delivery system. In the Nigerian building construction industry, attempts have often been made towards ensuring construction quality right from the project design stage up to project implementation stage. Hence, some level of stability has been achieved in the design and consultancy stage with legal backing from professional bodies such as Architects Registration Council of Nigeria (ARCON), Council for the Regulation of Engineering in Nigeria (COREN), Quantity Surveyors Registration Board of Nigeria (QSRBN) and Council for Registered Builders of Nigeria (CORBON). In addition, building laws and regulations exist in all the States of the country for achieving effective development control. However, the construction implementation side falls short of expectation due to a number of reasons which include unethical contract practices coupled with weak regulatory framework (Longtau, Justina, Majidadi and Makwin, 2016; Fernandez, 2014).

Observations show that the Nigerian building construction industry is dominated by informal construction activities which often do not follow laid down procedures. Also their activities cannot be fully monitored due to the informality of their operations. As a

result, instances of quality breaches in the building construction industry abound with several examples of building structural failures leading ultimately to building collapse. Often the collapse is attributed to a number of factors prominent of which is poor quality of materials and construction processes. In this respect, the central position occupied by concrete, as a structural material and as a culprit in many instances of building collapse, deserves some serious consideration. Hence this study is aimed at examining the use of concrete, in some informal and semi-formal construction sites in Lagos State, Nigeria with a view to identifying practices that have quality implications on concrete.

2.0 Literature Review

The Nigerian construction industry constitutes a critical aspect of the economy of the nation. This is because it plays important roles in both employment generation and economic development. In the area of employment generation, the construction industry provides direct and indirect employment to about 25% of the Nigerian working population (Danwata, 2017). In the area of economic development, sustained economic growth has always been associated with increase in construction related activities (Isa, Jimoh and Achuenu, 2013). Also, the construction industry's contribution to GDP has been estimated to be up to 16% (Danwata, 2017). However, one of the major challenges of the industry is the preponderance of informal activities. According to the International Labour Organisation (ILO), the informal sector in Sub-Saharan Africa, of which Nigeria is a prominent part, is regarded as the largest concentration of informality worldwide (ILO, 2002). The implication of this is that a lot of what goes on in this sector is not fully captured in national economic accounting. This situation presents a huge challenge to both planning and implementation of government programmes. The informality is also largely responsible for the high rate of building collapse.

Incidences of building collapse in Nigeria are fairly well documented in literature. There has been incessant collapse of buildings in all parts of the country but it is more prevalent in the urban areas where there are relatively high levels of construction activities. Hence, more collapse of buildings has been recorded in Lagos State than in any other part of Nigeria (Windapo and Rotimi, 2012; Ebehikhalu and Dawam, 2014). It is pertinent to note that majority of the collapsed buildings were residential buildings, thus emphasizing the culpability of the informal sector in building collapse in Nigeria (Ebehikhalu and Dawam, 2014; Fagbenle and Oluwunmi, 2010). The major causes of building collapse have been attributed to structural failure, poor supervision and workmanship as well as the use of substandard materials (Windapo and Rotimi, 2012). Akinyemi, Dare, Anthony and Dabara (2016) however grouped the causes of building collapse into three namely: types and quality of materials used, operational and personnel problems, while Oloyede, Omoogun and Akinjare (2010) identified poor design, incompetent contractor, faulty construction methods, poor development control strategies, non-compliance with specifications, substandard building materials, poor supervision and conversion of existing building to other uses as the causes of building collapse in Nigeria. However, Arum (2008), in his study of causes of

building collapse in Nigeria, pinpointed poor quality control as the major reason for building collapse in the country. Where the immediate cause of collapse has been traced to concrete, the fault is usually associated with silty fine aggregates and cement of substandard grade (Olanitori, 2011; Adewole, Oladejo and Ajagbe, 2014).

Given the preponderance of reinforced concrete structures in the study area, almost all the structural failures had something to do with either concrete or steel reinforcement or both. For example, Olanitori (2011) linked building collapse in Akure to poor concrete caused by the use of silty sand and inappropriate placement of steel reinforcement. However, Adewole et al. (2014) further identified the use of low grade cement as a cause of low quality concrete that may eventually result in building collapse. In addition, Akinyemi et al. (2016) pointed out that poor concrete mix ratio can also lead to building collapse. The foregoing underscores the critical role of concrete in building structures and that its inappropriate use may result in building failure and ultimately collapse.

Concrete is the most versatile structural material that offers flexibility of form not found in other structural materials. Concrete structures are also easy to analyse as they benefit from the huge data available on concrete performance (Arum, 2008). Concrete is made up of Portland cement, fine aggregates (sand), coarse aggregate and water with optional additives which are used to improve the performance of the concrete. When freshly mixed, concrete tends to be flexible and as such can be used to form any shape. However, on solidifying, concrete becomes a dense solid mass with good compressive strength. The process of transformation from the flexible to the hardened state is referred to as setting. After placement, concrete gains strength rapidly especially within the first seven days which are very critical for the attainment of the required strength. For purposes of determining the strength of concrete, the compressive strength at 28 days is usually considered. The strength of concrete primarily depends on the quality of constituent materials namely cement, aggregates and water. In addition to the quality of the constituent materials, the strength of concrete is also dependent on the quality of supervision and quality control mechanisms that attends its preparation and placement. As a result, the eventual strength of concrete produced on site is a random variable (Arum, 2008). An examination of the main constituents of concrete as well as other factors that affect the quality of concrete becomes necessary at this point.

Portland cement is one of the most prolific building materials in the study area. Cement acts as a binding agent in the preparation of concrete. Cement-based structures, of which concrete is a major part, constitute the largest surface area of all man-made structures the world over (Odigure, 2009). Cement production in Nigeria is dominated by Dangote Cement Company which controls about 65% of the market as at the end of 2017 (News Agency of Nigeria, 2017). The other major cement manufacturer in the study area is Lafarge Africa.

Cement grade is an important factor that contributes to concrete quality. It is critical in determining the compressive strength of concrete. The cement grades used generally for concrete-based production in Nigeria are grades 32.5,

42.5 and 52.5 (Ali, 2014). The Standards Organisation of Nigeria (SON) approves grade 32.5 for plastering work, grade 42.5 for general concrete works while the 52.5 grade is for special projects. As a confirmation, Adewole, Olutogbe and Habib (2014) investigated the effects of these cement grades on concrete compressive strength and the investigation revealed that the compressive strength of concrete produced with cement grade 42.5 is generally higher than that made with cement grade 32.5. In fact, if the standard 1:2:4 concrete mix is to be used, the minimum cement grade would be 42.5.

Adewole, Oladejo and Ajagbe (2014) pointed out that surveys conducted by the Standard Organization of Nigeria (SON) revealed that during construction of most privately owned buildings, where concrete trial mixes were not conducted, the standard 1:2:4 mix ratio was used irrespective of the cement grade/strength class. The survey further revealed that when concrete cubes were made with Portland cement grade 32.5 using 1:2:4 and 1:1.5:3 mix ratios, the compressive strength was less than the 25MPa and 30MPa cube strengths generally recommended for building superstructures and foundations respectively. Hence, with effect from May, 2014, the Standards Organization of Nigeria implemented the grade 42.5 for cement in Nigeria as the minimum cement grade to be used for structural components of buildings.

In a comparative study carried out to assess the compressive strength of concrete produced using different brands of cement indicated that the best compressive strength at 28 days for the 1:2:4 mix was achieved with Ibeto cement (38.8N/mm^2) while Elephant cement came second with a compressive strength of 27.9N/mm2 (Bamigboye et al. 2015). Dangote cement came third but was just able to achieve the required strength of above 25N/mm^2. Also Purechem cement was just able to achieve the minimum compressive strength while Unichem cement did not attain the required strength of 25N/mm2 for structural concrete made from the 1:2:4 category.

Aggregates which constitute about 60 to 80% of concrete volume are inert granular materials such as sand, gravel, or crushed stone that make up concrete alongside cement and water. They strongly influence freshly mixed concrete as well as its hardened properties, mixed proportions and economy (Gashemi, 2017). In order to get a good concrete mix, aggregates need to be clean, hard and strong materials and free of absorbed chemicals or any fine material that can cause deterioration of the concrete. According to Adewole et. al., (2014), the use of poor quality aggregates has been emphasized as one of the reasons for the low quality of concrete used for building construction in Nigeria.

Fine aggregates or sand are mined from water courses and peat (land) in locations around Lagos and Ogun States. However, fine aggregates from Ogun State are generally preferred for structural concrete works as it contains little or no salt and the silt content is also low. Coarse aggregates are mostly crushed granite stones obtained from quarries located at Abeokuta, Ogun State and Ibadan, Oyo State. In some instances, granite quarry dust is often partially substituted for sand in varying proportions to achieve acceptable concrete strengths. This helps to reduce intensity of sand mining which has

adverse environmental implications in the study area.

Low quality of concrete, that is, concrete with low compressive strength, can be traced to high silt content of fine aggregates even when the mixing ratios and cement grades are strictly adhered to (Olanitori, 2011). Sometimes, sharp sand is partially substituted with crushed stone dust in certain proportion to reduce the impact of sand mining.

The quality and quantity of water used in concrete is also important. Roy (2015) affirms that the quality of hardened concrete is strongly influenced by the amount of water used in concrete; as it influences compressive and flexural strength, permeability, workability of concrete as well as the bond between concrete and reinforcement. The water for concrete must be clean and free from salt and other chemicals likely to impair the quality of the concrete.

Common concrete mix proportions (cement: sand: crushed stones) include 1:3:6, 1:2:4 and 1:1.5:3 which may correspond with compressive strengths of 20N/mm2, 25N/mm2 and 30N/mm^2 depending on quality of aggregates and grade of cement. The mix ratios are volume ratios and are closely monitored during batching of concrete. The ratios are subject to adjustment based on the type of constituent materials available and the expected strength. In new projects, it is advisable to determine the mix proportion that would deliver the required strength through a number of trial mixes. For example, 1:2:4 mix ratio with cement grade of 42.5 can give a compressive strength of 25N/mm^2 after 28 days while a 1:1.5:3 mix ratio would be needed to deliver the same strength if 32.5 cement grade is used (Adewole, Ajagbe and Arasi, 2015).

Chemical admixtures are constituents of concrete other than water, cement and aggregates that are added to the mix either before or during mixing. The American Concrete Institute (2013) reckons admixtures as important components of concrete used to improve its performance. This could include adjusting setting time or hardening, modifying the properties of the hardened concrete, reducing water required in the concrete, reducing the cost of concrete construction. This is done to ensure that the quality of the concrete is maintained during mixing, transporting, placement and curing, to increase workability, and to overcome certain emergencies during construction. Successful usage of admixtures depends on using appropriate methods of batching and concreting; and a good knowledge of the rate of reaction between cement and water. Chemical admixtures are used in extremely small quantities and can pose a threat to the quality of the concrete when they are not added properly. The use of blended cement, that is, ordinary Portland cement blended with some cementitious materials, is gaining ground but not very popular in the study area.

Concrete is a brittle material, hence, its porosity primarily governs its strength. Concrete has air/water permeable properties and this has a great influence on its strength as well as its durability. The presence of pores and air voids influences concrete permeability. Kim et al. (2014) pointed out that deteriorating agents that can cause steel corrosion, like chloride ions and carbon dioxide, intrude into concrete through pores or their connectivity. Naik (1997) identified factors that can affect concrete porosity to include water to cement ratio, air content, and

consolidation, use of admixtures, degree of hydration, the aggregates and the mixture proportioning.

Curing refers to the maintenance of moisture inside the body of the concrete during the early days of concrete placement (Kulkami and Pereira, 2011). This is done to develop its properties in terms of strength and durability. It should begin as soon as possible after the concrete has been placed. Curing of concrete allows the concrete to gain strength gradually and attain improved durability. It also enhances its serviceability, improves its microstructure, and decreases its porosity. (Kulkarni and Pereira, 2011). Also, Ayuba, Olagunju and Akande (2012) opined that curing of concrete is probably the most abused aspect of the concrete construction process. This is usually as a result of stringent construction deadlines resulting in hasty construction. However, concrete requires an adequate amount of time to cure, usually 28 days, at proper temperature and humidity before it is loaded. If curing is not done effectively, the concrete may not develop the characteristics that are expected to provide necessary durability.

There are six major types of conventional curing for concrete. They include shading of the concrete to reduce the rate of evaporation of moisture from the concrete as well as covering the concrete surface with wetted gunny bags. Other methods include sprinkling of water on the concrete, ponding, membrane curing and steam curing. In some studies of the Nigerian context, ponding is adjudged to be the best type of curing, followed by wet covering and sprinkling (James, Malachi, Gadzama and Anametemfiok, 2011; Bamigboye et al. 2015).

Given the in-situ nature of most construction projects, the human factor is also important for the strength and durability. This refers to the human resources involved in construction that need to be monitored and supervised for better construction outcome. When these persons are not trained and supervised, it poses a great threat to the construction work. This is especially so in the informal building construction sector where concrete batching is often carried out manually mainly by poorly trained and unskilled workers. In a study of concrete batching behaviour of artisans in the informal construction sector in Ghana, Hedidor and Bondinuba (2017) observed that concrete batching was done using visual measurement instead of the standard measurements recommended. As a result, cement to aggregate ratios often revealed insufficient cement content.

Closely related to the above is the issue of supervision. This is an act of critically watching, directing, overseeing the work performed by the workers at each stage of construction in a site by a qualified professional. A concrete construction job not well supervised or supervised by a half-baked professional could lead to failure in the concrete. Akeju (1984), cited in Adenuga (2012), affirms that competent professionals must not only be engaged to design and plan a project, but must also be involved in the supervision at every stage.

3.0 Methodology

The survey focused on practicing professionals, such as the architects, site engineers and builders, in Lagos State who are directly involved with the construction of buildings. Primary data was gathered with the use of structured questionnaires distributed to the above

mentioned stakeholders. The questionnaire investigated the extent of the precautionary measures taken by the professionals to ensure good quality control for concrete. Fifty (50) copies of questionnaires were administered but forty-three (43) were returned and used for the analysis which is presented in a table format.

Two local government areas were selected for the study because of the preponderance of new building construction activities therein. They are Alimosho and Ibeju Lekki local government areas. While Alimosho is on the outskirts of Lagos on the mainland side, Ibeju Lekki is on the outskirts on the island side, in the area now referred to as the New Lagos. These areas are also dominated by privately owned building construction projects. Ongoing construction projects were identified in the study area and the questionnaire was administered to the professionals and supervisors working on the construction sites. Some critical construction activities were also observed on site and certain clarifications were sought from the supervisors and the skilled and unskilled workers.

4.0 Data Analysis

Detailed analyses of data gathered are as shown in the following tables with their discussion in subsequent paragraphs.

The structural failure rate of materials from the experience of professionals in the study area was investigated to corroborate or to annul findings from literature as to which structural material fails the most in Lagos, Nigeria. The results are as shown in Table 1.

Table 1: Structural Failure Rate of Material

Material	Frequency	Percentage
Concrete	14	93.3
Steel	0	0
Wood	1	6.7

From Table 1, it is evident that concrete is the structural material that experiences the most failures. This is understandable given the preponderance of concrete related structures in the study area. 93.3% of the respondents who have experienced structural failures on sites they have worked on indicated that the structural material that experienced failure was concrete.

The Portland cement brand used was investigated to know which brand(s) is/are widely used or specified in the study area by the professionals. The results are as shown in Table 2.

Table 2: Portland Cement Brand Used/Specified

Cement Brand	Frequency	Percentage
Dangote	30	76.9
Elephant	11	21.6
Lafarge	10	19.6
Reagan	0	0.0
Eagle	0	0.0

The study indicated that 76.9% of the respondents use or specify Dangote Portland cement brand for their concrete construction as against 21.6% and 19.6% of respondents that specified or used Elephant and Lafarge Portland cement brands that are very common in the study area.

The cement grade used was investigated to find out to what extent the professionals in the study area have knowledge about the different cement grades available and what grade is recommended by the Standards Organization of Nigeria (SON). The results are as shown in Table 3

Table 3: Cement Grade Used/Specified

Cement Grade	Frequency	Percentage
22.5	12	30.8
32.5	23	59.0
42.5	22	56.4
52.5	0	0.0
62.5	0	0.0

Cement grade 32.5 accounted for 59% of the used or specified grade of cement by the professionals. The prevailing national standard, as prescribed by SON, restricted the use of grade 32.5 cement. The relatively high proportion of grade 32.5 in use may be as a result of plastering works being executed. It is also possible that the difference between the two cement grades may not be fully understood by the site supervisors. However, the cement brands and grades in use vary with most of the respondents using the Dangote brand of cement which is mostly produced in the 42.5 grade category. This is partially in line with the recommendations of the Standards Organization of Nigeria (SON) that all structural concrete in Nigeria must be with grade 42.5 cement since lower grade cement grade of 32.5 is recommended for plastering works only.

The practices of professionals on construction sites were investigated to ascertain the extent to which the procedures and processes involved in concrete construction were adhered to by the professionals in the study area. The results are as shown in Table 4.

Table 4: Professional Practices on Construction Sites

Professional Practice	Never	Rarely	Sometimes	Often	Always
Presence of the Professional on site during concrete batching and placement	1(2.7%)	0(0.0%)	9(24.3%)	9(24.3%)	18(48.6%)
Measuring of aggregate on site	6(15.0%)	13(32.5%)	9(22.5%)	6(15.0%)	6(15.0%)
Testing of fine aggregate for salt	10(25.0%)	6(15.0%)	11(27.5%)	7(17.5%)	6(15.0%)
Conducting concrete trial mixes	0(0.0%)	7(17.5%)	11(27.5%)	14(35.0%)	8(20.0%)

Carrying out batching locally on site	2(5.4%)	5(13.5%)	9(24.3%)	13(35.1%)	8(21.6%)
Outsource batching	6(16.7%)	9(25.0%)	13(36.1%)	4(11.1%)	4(11.1%)
Vibrating wet concrete after placement	2(5.4%)	1(2.7%)	1(2.7%)	13(35.1%)	20(54.1%)

From Table 4, 72.9% of respondents indicated their regular presence on site during concrete batching and placement. This shows the importance the supervisors accorded the concrete component of their work. However, only 30% of the respondents took extra precaution to measure the size of their coarse aggregates when brought to site to ensure compliance. Likewise, 32.5% of the respondents regularly tested the fine aggregates for salt, which if present in the fine aggregate, could create problems in concrete strength and durability. It may also create a highly corrosive environment for steel reinforcement.

Table 4 further shows that 55% of the respondents frequently carried out concrete trial mixes to ensure that the actual strength of the concrete to be used meets the strength specified by the Structural Engineer. However, the study showed that 45% of the respondents were not keen on repeatedly ensuring the strength of the concrete used oat different sites they work on were adequate, which implies that they made use of concrete mixes they were used to or that had worked previously.

Furthermore, the study showed that 56.7% of the respondents carried out their batching locally on site regularly as against 22.2% who indicated that the batching were more often outsourced. On further inquiry, it was found that most of the concrete works in the study area were outsourced to independent concrete sub-contractors operating as a guild in many parts of Lagos. Patronage to the big concrete batching companies such as Lafarge and SPG was limited because of the size of project and/or cost of such sophisticated batching. Also, the road network in and around the construction sites may not permit the use of large mobile concrete batching plants.

The independent concrete sub-contractors belong to an umbrella organisation – Concrete Workers Association of Nigeria. The association is fairly well organised into contract, head-pan, vibrator and gang leader departments. However, they often pose problems to concrete quality as they use visual assessment to monitor concrete quality and workability instead of using measurements. Also, their main volumetric measuring tool is the head-pan which, in most cases, is often disfigured and dented by frequent usage to the extent that the volume measures cannot be relied upon. They also tend to put in more sand (fine aggregate) than necessary to improve workability while impairing the strength and durability of the concrete.

Another important activity, when placing concrete, is the vibration of the freshly placed concrete to ensure there are no air gaps. The study showed that 89.2% of the respondents habitually vibrate their wet concrete after placement. However, the vibrator is usually applied intermittently to the placed concrete with the result that the vibration may not be uniformly applied.

In addition, horizontal structural elements, such as slabs as well as strip and pad foundations, were not often vibrated. There is reliance on the concrete workmen to manually vibrate the concrete placed in such horizontal members.

The length of curing specified was investigated to know for how long professionals in the study area carried out curing on freshly placed concrete to allow it achieve its maximum strength. The results are as shown in Table 5.

Table 5: Length of Curing Specified

Period	Frequency	Percentage
Less than 3 days	1	2.5
4-7 days	10	25.0
8-14 days	3	7.5
15-24 days	22	55.0
25-35 days	4	10.0

When it comes to curing of the concrete after casting, 65% of the respondents indicated that they specified a minimum of 15 to 24 days while 25% indicated 4 to 7 days as being sufficient. On further discussion with the supervisors, the predominant method of curing was the sprinkling of water on the setting concrete.

Testing of hardened concrete to check the end product performance was investigated to know how often the professionals in the study area ensure that the concrete that has been cast achieved the desired concrete strength to function optimally. The results are as shown in Table 6.

Table 6: Testing the Hardened Concrete to Check End product performance

Assessment	Frequency	Percentage
Never	1	2.6
Rarely	11	28.2
Sometimes	9	23.1
Often	11	28.2
Always	7	17.9

However, after curing, just 46.1% of respondents frequently test the hardened concrete to check the end product performance and ensure that the desired concrete strength was achieved. Ordinarily, there were no plans in place to test the compressive strength of the concrete being placed. It is generally assumed that once the volume batching ratios are adhered to, the required strength would be achieved. This would have been so if the constituent materials were all in excellent state but that is not always the case. Sometimes, concrete cube samples are taken by the Lagos Materials Testing Laboratory. However, such interventions are few, are occasional and are also fraught with irregularities.

5.0 Findings of the Study

The study found that, first, the professionals in the construction industry in the study area have sufficient experience in the use of concrete. Second**,** concrete with 93.3% score was the structural material that experienced the most failures. This is understandable

given the preponderance of concrete related structures in the study area. Third, 76.9% of the respondents use or specify Dangote Portland cement brand for their concrete construction while fourth, the relatively high proportion (59%) of grade 32.5 in use, in the study area, may be as a result of plastering works being executed. The study also found that 55% of the respondents frequently carried out concrete trial mixes to ensure that the actual strength of the concrete to be used meets the strength specified while most of the concrete works in the study area were outsourced to independent concrete sub-contractors.

6.0 Conclusion and Recommendation

It can be concluded from the study that presence of the professionals during concrete works is encouraging but it is still very important that they subscribe to quality control measures before and after the casting of concrete. Hence, concrete-related structural failures may not be associated with projects where competent professionals are engaged. It could be mostly ascribed to buildings where the relevant professionals are not engaged. This thus brings up the need for relevant professionals to be involved in all aspects of building procurement.

On the measurement of coarse aggregates and the testing of fine aggregates for silt and salt, there may be need to create a method of ensuring these quality control measures are carried out. It may be possible to accomplish the aforementioned through effective collaboration between the government development control agency and relevant professional bodies. This is necessary as the relevant government agencies appear not to be adequately staffed, hence the need to collaborate with the relevant professional bodies. Some aspects of the materials testing aspect of construction monitoring have been outsourced but the conduct of the service providers often leaves much to be desired. Also, the enforcement of the stage certification component of development control should be enhanced so that areas of compromise in construction quality would be identified on time.

The important role played by the independent concrete subcontractors in the study area cannot be glossed over. Given the informal status of the construction industry, this group of workers would continue to thrive. Efforts should therefore be made to train them regularly to enable them give value added services to the local construction industry. With all stakeholders focused on improving quality of building construction, the incidence of structural failure and building collapse will be curtailed.

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Modern Approach to Property Development Appraisal

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***Abstract*:** This research evaluates the appraisal techniques employed by property developers in Lagos metropolis with a view to addressing the basic problems involved in investment appraisal as well as the adoption of modern appraisal techniques. Structured questionnaires were administered on a total sample size of 190 Estate Surveying and Valuation firms in Lagos while 129 were retrieved. The study found that payback period, accounting rate of return and internal rate of return were the most used traditional methods of appraisal techniques. Also, a low level of usage of the modern appraisal techniques was noted. The study revealed that the choice of viability techniques were based on appropriate viability criteria, ability of the method to consider basically the returns inherent and the simplicity of the technique were the major reasons influencing the choice of development appraisal techniques. Issues associated with wrong use of development appraisal techniques included performance deviating from investor's objectives; actual returns in variance with expected returns. The study concluded that there is a need for the adoption of more appropriate development appraisal techniques in the evaluation of projects so as to improve the performance of the investment and development market thereby restoring investors' confidence. The study therefore recommends that Estate Surveyors and Valuers should embrace modern techniques that incorporate risks to further enhance the accuracy of appraisals in line with global best practice. Also, the Nigerian Institution of Estate Surveyors and Valuers should organize seminars and conferences on modern appraisal techniques now in vogue.

***Keywords*:** Property developers, Development appraisal, Estate Surveyors and Valuers, modern Appraisal Techniques.

1.0 Introduction

According to Oyetunji (2016), the complexities of the property development process, involving numerous professionals and the expenditure of large sums of money, have resulted in different attitudes to property development especially in the face of inevitable uncertainty. Due to the nature of property development, quite a lot of people's savings, equities and borrowings, insurance policies and pension funds are tied up in this potentially risk taking activity. In a bid to mitigate or curb the resultant effect of loss of capital, incessant abandonment of projects, failure of projects amongst others, development appraisal therefore becomes significant.

Development appraisal is an evaluation of the attractiveness of an investment proposal using various investment techniques as appropriate. According to Sangster (1993) development appraisal technique is one of the regularly used methods under investigation areas of financial management practices. Though there are number of issues in investment appraisal and appraisal techniques are the starting point for management. Development appraisal contains a variety of concerns; the most significant is the type of technique to be used which is the starting point to be considered by the management (Morgan and Tang, 1992; Cowton and Pilz, 1995).

A number of tools/techniques are available to determine the extent of viability or otherwise of a project (Remer and Nieto, 1995a, 1995b and Akalu, 2001). Dramodaran, (1994); Laitinen, (1997) and Akalu (2001) however asserted that the continuous application of some of the techniques reveals significant limitations in their capacity to address the basic problems of investment appraisal. In addition, some of these methods involve complex decision making processes that property developers are not familiar with. This has also resulted in property developers' resolve not to carry out comprehensive investment appraisals on projects to determine its worthwhileness. Oyetunji (2016) further opined that the constant failure of development projects in Nigeria is no doubt a major concern to all the participants in the real property and construction sector as a result of inappropriate methods adopted by the professionals involved. According to Darlow (1999), the development appraisal techniques being used by professionals had been criticized on the basis of their simple assumptions about incidence of cost and finance charges. This study evaluates the appraisal techniques employed by property developers in Lagos, Nigeria with a view to reviewing the basic problems of investment appraisal and the adoption of modern appraisal techniques.

2.9 Literature Review

According to previous research, the most common investment evaluation methods were the payback period, net present value and the internal rate of return (Ross, 1986; Pike, 1988; 1996; Carr and Tomkins, 1996, 1998; Arnold and Hatzopoulos, 2000; Graham and Harvey, 2001; Sandahl and Sjögren, 2003; Tuomaala and Virtanen, 2011). Simple payback rule-of-thumb decision-rules are common with property investments. Companies feel that the complexity of measuring investment's future savings makes the payback period an adequate method for financial investment evaluation (Jackson, 2010). Modigliani and Miller (1958) argue that managers should ignore financing and dividend decisions as irrelevant and focus on positive net present value

(NPV) investment opportunities that would maximize the value of the firm. The classical theory by Modigliani and Miller (1958) identifies sophisticated evaluation methods as a tool for maximizing the profitability of the small firms.

Hastie (1998) also regarded the financial theory that recommends the utilization of sophisticated techniques such as net present value to improve decision making and maximize the value of the firm, as unwarranted. He also noted that the use of incorrect assumptions has been a more significant source of bad investment decisions than the use of simple measurement techniques. He was of the opinion that investment decision making could be improved significantly if the emphasis were placed on asking the appropriate strategic questions and providing better assumptions rather than on increasing the sophistication of measurement techniques.

Adler (2006) argued that discounted cash flow (DCF) should be removed from financial theory as it is increasingly irrelevant to contemporary business practice and can be dangerous in evaluating proposed projects. He concluded that DCF is meaningless and as such should not be applied in evaluating capital budgeting decisions or rather should be replaced with less restrictive and more optimistic methods.

Halttunen (2012) studied the role of investment appraisal methods and versatility of expertise in energy efficiency investment decisions by examining the decision-making in Finnish industrial companies with regards to energy efficiency investments with focus on investment appraisal methods and the investment process participants influencing the investment decision-making. Using descriptive statistics the study observed that the most commonly used financial investment appraisal method for operational and energy efficiency investments is the payback period method followed by the internal rate of return and net present value methods. This study did not look at real estate investment.

Hunjra *et al.* (2011) studied investment appraisal techniques and constraints on capital investment in Pakistani corporate sector. The study employed descriptive analysis and it was observed that corporate managers are well aware about the worth of investment appraisal techniques for the assessment of project risk and consider these techniques are important for long term profitability and survival of the company. However, a substantial number of firms in Pakistani corporate sector were not following these practices. This study targeted Chief Financial Officers (CFOs) of companies that are involved in oil and gas, engineering but failed to look at the real estate sector.

Milis, Snoeck and Haesen (2012) evaluated the applicability of investment appraisal techniques for assessing the business value of information management services. Using descriptive statistics, the study observed that the traditional capital investment appraisal techniques (CIAT's) such as payback period or net present value were by far the most used techniques for assessing the feasibility of ICT investments. Nevertheless, serious doubts about the fitness of these techniques in a service based value net environment arose. However, none of these studies focused on real property investment.

Ezeokoli, Adebisi and Olukolajo (2014) carried out a research on the practice of investment viability appraisal in Akure, Nigeria. The study examined the role played by estate surveyors and valuers in choosing the right viability appraisal technique for an investment appraisal. Structured questionnaire was administered on twenty-one Estate Surveying and Valuation firms. The data obtained were analyzed using descriptive statistical tools such as frequency tables and weighted mean score 3 and 4-point likert formats. The result of the analysis revealed that Valuers mostly made use of Payback Period, NPV and IRR, which are deterministic in nature. This was as a result of the estate surveyors and valuers basing their appraisals mostly on economic and financial criteria only without fully analyzing the prevailing inflation rate in the economy and the level of risk tolerance of their client.

Oyetunji (2016) also carried out a research on the assessment of the reliability of techniques employed in feasibility and viability appraisal. The study focused on Estate Surveyors and Valuers in Akure. Questionnaires were administered to 22 practicing Estate Surveying and Valuation firms out of which only 16 were retrieved and valid for analysis. Findings revealed that 43.75% of the respondents rarely secure instructions to carry out feasibility and viability appraisal on most developmental projects, while NPV was the most adopted in feasibility appraisal. The study revealed that most of the Estate Surveyors and Valuers were aware of the availability of other modern appraisal techniques that incorporate risk but did not use it.

3.0 Study Area

Lagos State is one of the most populous cities in the world. It is a megapolis with an estimated population of 15 million experiencing an annual growth rate of nearly 6%. The State is home to Nigeria's principal commercial sea and airports with over 45% of the country's skilled workforce resident in the State. Lagos State is located at latitude 6°34′60″N, 3°19′59″E along the West African coast and was the capital city of the country before it was replaced with Abuja on 12th December, 1991. However, Lagos remains the commercial nerve centre of Nigeria to date. The city is a typical example of the history of growth and development of urban areas in Nigeria. The 180km long Atlantic coastline forms the southern boundary of the State while its Northern and Eastern boundaries are shared with Ogun State. On the Western side, the Republic of Benin borders the boundary (Balogun *et al.* 1999). Lagos State is the smallest State in Nigeria with highest population over 5% of the National estimate with an area of 356,861 hectares out of which 75,755 hectares are wetlands (Lagos State Government, 2014).

4.0 Methodology

The population of this study comprises of estate surveyors and valuers working in Estate Surveying and Valuation firms in Lagos metropolis. The 2017 National directory of the Nigerian Institution of Estate Surveyors and Valuers shows that there are three hundred and sixty-three (363) practicing Estate Surveying and Valuation Firms in Lagos State. Structured questionnaires were administered to all the randomly sampled 190 Estate Surveying and Valuation firms in Lagos State to elicit the relevant information on the

development appraisal techniques adopted in Lagos State property market. 129 questionnaires were completed and retrieved representing 67.89% performance rate. The retrieved questionnaires were used for the analysis. The study employed the weighted mean score, based on a 3 and 5-point Likert scales, because of its simplicity and ease of communicating the result of the research. Data presentation was structured towards the method of appraisal often employed, reasons for the choice of appraisal techniques and the problems associated with the use of development appraisal techniques.

5.0 Analysis of Data

Table 1: Development Appraisal Techniques employed in the evaluation of projects

Development Appraisal Techniques	MU	U	UD	UN	MUN	Mean	Std. Dev	Rank
Traditional Methods								
Payback period	91(70.5)	38(29.5)	-	-	-	4.7054	.45763	1st
Accounting rate of return	52(40.3)	74(57.4)	3(2.3)	-	-	4.3798	.53318	2nd
Internal rate of return	70(54.3)	28(21.7)	15(11.6)	15(11.6)	1(0.8)	4.1705	1.08343	3rd
Net present value	63(48.8)	20(15.5)	44(34.1)	2(1.6)	-	4.1008	.98302	4th
Discounted payback period	9(7.0)	35(27.1)	17(13.2)	61(47.3)	7(5.4)	2.8295	1.10485	5th
Residual valuation met	30(23.3)	13(10.1)	18(14.0)	58(45.0)	10(7.8)	2.9612	1.34282	6th
Discounted probability index	9(7.0)	35(27.1)	4(3.1)	81(62.8)	-	2.7829	1.06772	7th
Net terminal value	-	2(1.6)	4(3.1)	105(81.4)	18(14.0)	1.9225	.47783	12th
Modern Methods								
Certainty equivalent cash flow	11(8.5)	21(16.3)	18(14.0)	13(10.1)	66(51.2)	2.2093	1.42891	8th
Risk Adjusted NPV	-	14(10.9)	6(4.7)	93(72.1)	16(12.4)	2.1395	.76795	9th
Sensitivity analysis	-	2(1.6)	10(7.8)	101(78.3)	16(12.4)	1.9845	.51515	10th
Stochastic decision trees	12(9.3)	15(11.6)	12(9.3)	4(3.1)	86(66.7)	1.9380	1.44023	11th
Weighted Average Approach	6(4.7)	12(9.3)	16(12.4)	8(6.2)	87(67.4)	1.7752	1.24524	
Monte Carlo Simulation	-	-	5(3.9(	71(55.0)	53(41.1)	1.6279	.55999	13th
Risk adjusted discount rate	3(2.3)	3(2.3)	7(5.4)	8(6.2)	108(83.7)	1.3333	.86903	14th

Source: Field Survey, 2017

The research examined various appraisal techniques used in the evaluation of projects. Various traditional and modern appraisal techniques based on the mode of use as opined by the practicing Estate Surveying and Valuation firms in Lagos. As revealed in Table 1, majority of the respondents opined to the use of traditional methods of development appraisal techniques. The use of payback period, accounting rate of return and internal rate of return were the most used traditional methods of appraisal techniques with mean scores of 4.7054, 4.3798 and 4.1705 which have been ranked 1st, 2nd and 3rd respectively. The research also showed a low level of usage of the modern appraisal techniques. Monte Carlo simulation and the use of risk adjusted discounted rate were the least used methods of development appraisal techniques as opined by the practicing Estate Surveying and Valuation firms in Lagos.

The findings of this study are in agreement with the researches of Ezeokoli *et al.* (2014) and Oyetunji (2016) on the low level of adoption of the modern appraisal techniques. The findings of this study imply that Estate Surveyors and Valuaers in Lagos are still concentrating their practice on the use of traditional methods of development appraisal. Several literature and researches such as the works of Baum and Crosby (1988); Baum *et al*. (1997); Ojo (2006); Ezeokoli *et al.* (2014) revealed that these traditional methods might not be in tune with the present day economic reality.

Modern methods of appraisal that incorporate measurement of risk and uncertainty such as Monte Carlo Simulation, Risk Adjustment Discounted Rate technique, Certainty Equivalent technique and Sliced Income technique are not yet embraced in practice despite experts' view that these are the best methods that are more applicable under conditions of risk and uncertainty as is experienced in Nigeria today.

Table 2: Respondents' reasons for choice of techniques employed

The reason for the choice of techniques employed	Mean	Std. Dev.	Rank
Appropriate viability criteria	4.4419	.75939	1st
The Method that considers basically the returns inherent	4.3643	.99167	2nd
Simple to Use	4.2558	.90380	3rd
simple assumptions about incidence of cost and finance charges	4.2403	.90808	4th
Ability to Incorporate Risks	4.2403	.63462	5th
No too much mathematical calculations	4.2171	.59897	6th
Ability to estimate the variable inputs used in the appraisal	4.2171	.91823	6th
lack of awareness or preference for a particular method	4.1860	.83636	8th
Based on the perception and tolerance of risk of the investor.	4.1628	.82718	9th
The Method that aids project selection	3.5504	1.46821	10th
Changes in rate of interest	3.4884	1.11184	11th
Investor's level of risk tolerance	3.4574	1.23749	12th
Investor's objective(s)	3.3101	.97467	13th
complex decision making processes	2.2868	.92866	14th

Source: Field Survey, 2017

Reasons for the choice of specific development appraisal techniques in developers' appraisals were further examined by the research. The research revealed that the choice of viability techniques were based on appropriate viability criteria, ability of the method to consider basically the returns inherent and the simplicity of the techniques were the major reasons influencing the choice of development appraisal techniques with mean scores of 4.4419, 4.3643 and 4.2558 respectively. The least choice of selection of appraisal

techniques as revealed in the research were investors objectives and complex decision making processes which were ranked 13th and 14th with mean scores of 3.3101 and 2.2868 respectively. The findings of the study are in agreement with the works of Ezeokoli *et al.,* (2014) and Oyetunji (2016).

Also, personal interviews with the respondents revealed that despite the availability of the various development appraisal techniques, there was a low level of understanding and awareness of the modern appraisal techniques therefore contributing to the high degree of avoidance of using the method. Most of the Estate Surveyors and Valuers in the study area executed feasibility and viability appraisal adopting appraisal techniques that they were conversant with. The modern appraisal techniques were not adopted due to their sophisticated nature, complex and often requiring rigorous mathematical calculations which are far beyond the comprehension of most of the Estate Surveyors and Valuers. Furthermore, it was revealed that most of the Estate Surveyors and Valuers were not exposed to the modern appraisal techniques as they were not taught in school or in other training sessions.

Table 3: Problems associated with Wrong Use of investment appraisal techniques

Problems associated with investment appraisal techniques	**Mean**	**Std. Dev.**	**Rank**
Performance deviating from investor's objectives	4.6279	.48525	1st
Actual returns in variance with expected returns	4.5814	.63366	2nd
Cause the management to pass up valuable investment opportunities,	4.5504	.49939	3rd
Exposure of clients to more risk	4.4031	.49243	4th
Reduction of the value of investment of the developer	4.3953	.65453	5th
Difficulty in loan amortization	4.3798	.97783	6th
Faulty Decisions	4.3256	.54719	7th
Longer void periods in developed properties	4.1240	.41472	8th
Wasteful use of resources and financial investment	4.0620	.49611	9th
Underestimate the value of the investment project	4.0310	.32925	10th
Foreclosures of mortgage properties by lenders	3.8760	.66153	11th

Source: field survey, 2017

Table 3 examined the problems associated with wrong use of investment appraisal techniques. The research revealed that the basic problems associated with wrong use of development appraisal techniques include performance deviating from investor's objectives; actual returns in variance with expected returns and causing the management to pass up valuable investment opportunities with mean scores of 4.6279, 4.5814 and 4.5504 which have been ranked 1st, 2nd and 3rd respectively. The least problems inherent were underestimating the value of the investment project and problems of foreclosures of mortgage properties by lenders which were ranked 10th and

11th respectively with mean scores of 4.0310 and 3.8760. Considering the values of the mean score, it could be deduced that all the identified problems are significant in the wrong use of investment appraisal techniques with significant effect on the development project itself and the investor.

On a general note, the use of the traditional methods of development appraisal techniques do not consider the effect of risks, inflation, economic situation and other factors as may affect the development. The traditional methods are however also referred to as deterministic appraisal techniques as they do not incorporate risk in their computation, especially in an economy that is very susceptible to inflationary changes and uncertainty. These traditional methods can no more be relied upon in a situation where the economy is unstable, inflation is high, and there are high interest and exchange rates as is the case in Nigeria.

However, in the face of economic instability, the common probabilistic approaches such as sensitivity/scenario analysis, the risk-adjusted discount rate, risk adjusted cash flows (the certainty equivalent technique and the weighted average approach), and Monte Carlo simulation are rarely used. Since investors are risk averse and would be more interested in the accumulation of profit, the implication of the adoption (by the appraiser) of a more optimistic risk attitude than that considered appropriate by their clients is that development appraisals might not be adequately addressing the client's lower risk tolerance. In other words, the appraiser using best estimates might recommend a project with high profits but a high standard deviation of returns as viable while their client might not be willing to accept high developer's profits if they are accompanied by a relatively high degree of uncertainty.

6.0 Conclusion and Recommendations

Considering the significance of development and viability appraisal as the bedrock of any successful investment development; attention should be paid to the use of appropriate development appraisal techniques in the evaluation of projects so as to restore investors' confidence and improve the performance of the investment and development market. In Nigeria, the application of appropriate modern appraisal method may be a difficult task for most investment appraisers as it requires critical analysis of various tools requiring rigorous mathematical applications. Based on the findings from this study, first, Estate Surveyors and Valuers should embrace modern techniques that incorporate risks to further enhance the accuracy of appraisals in line with global best practice. Second, the Nigerian Institution of Estate Surveyors and Valuers should organize seminars and conferences on modern appraisal techniques and the need to adopt them in development appraisals. Third, practicing Estate Surveying and Valuation firms should ensure that staffs adopt the best development appraisal techniques while carrying out their services in other to ensure clients' confidence as well as improve investment performance in the economy. Fourth, appraisers should consider the unstable nature of the economy while carrying out the feasibility studies. Fifth, the challenges posed to investment appraisal decision should be borne in mind to avoid misleading clients. Finally, appraisers should endeavour to upgrade themselves

academically by ensuring that the tools employed for investment analysis should be able to cope with modern day technology and situation.

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Property Rental Value Classification Model: A Case of Osogbo, Osun State, Nigeria

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Abstract: Residential property rental value forecasting has an impact on property investment decision. This necessitates the need for a study to forecast residential property rental value considering all associated variables including presence of cultural sites in the study area. Data for the study were gathered from the record of recent lettings in the study area. For the purpose of precision, this study adopted three artificial intelligence models. These are artificial neural network, logistic regression and support vector machine as models of classifying the rental value of residential property in Osogbo. The study considered relevant input variables among which are distance to cultural site, age of building, state of exterior/interior of building. Findings from the study revealed that the three adopted forecasting models had over 80% of the forecasted properties correctly classified thus making the residential property rental forecasting very reliable. Also, it was established that, in the study area, distance from cultural site is the property attribute with the highest negative impact on rental value.

1. Introduction

Residential subsector of the real estate markets contributes significantly to national economy. This assertion was corroborated by Wilson et al. (2002) who established that real estate markets contributes significantly to the United Kingdom national economy. Previous studies have shown that a relationship exists between the property market and

the economy (Dang and Low; 2011; Peng et al., 2008). In addition, empirical evidence has also demonstrated that changes in macro-economy have significant impact on residential property rental values and housing supply (Baharoglu, 1996; Zheng et al. 2012). However, though statistical data on the contribution of the Nigerian real estate market to national economy is lacking; there is no evidence to suggest that this sector is one of the main pillars of the economy.

Fluctuations in residential property rental values have an impact on investment decisions in new construction projects and the economy. This assertion was corroborated by Jiang et al. (2013) who linked the global financial crisis experienced in the 2000s to problems in the real estate sector. The cyclical behaviour of residential property rental value creates a negative impact on the economy as it leads to job losses, failure of construction business organisations and loss of productive capacity in the construction sector (Ofori et al., 1996; Lam and Oshodi, 2015; Liang and Cao, 2007). Chaphalkar and Sandbhor (2013) and Morano, Tajani and Torre (2014) reiterated the need for accurate residential property rental value prediction models hence, it has become increasing important to develop models that can accurately and reliably predict residential property rental value. This is vital for forward planning decision that can reduce uncertainties associated with residential property rental values.

Several academic studies focused on developing predictive models for residential property rental value. Stevenson and Mcgarth (2003),Tsolacos (2006) and Lam et al., (2008) are examples of such studies. Previous studies on residential property rental value forecasting can be categorized into two groups. These are property value by Lam et al., (2008) and rental price by Donovan and Butry (2011). The ability to reliably and accurately predict residential property rental value is important for real estate investors, government and relevant stakeholders. For instance, the real estate investors need reliable models so as to be able to evaluate investments in new purchases or development of new residential properties. In this study, three artificial intelligence modeling techniques, namely artificial neural network, regression and support vector machine were used to predict classifications of residential property rental values.

2. Literature Review

(i) Property attributes affecting residential *property rent*

Different scholars had adopted different property attributes for predicting rent. Abidoye and Chan (2017) adopting Artificial Neural Network considered the following property attributes in predicting residential property rental values in Lagos: number of bedrooms, number of toilets, number of bathrooms, property type, number of boys quarters, number or parking lots, age of building, number of floors, availability of security fence, availability of sea view and location of property. The study established that the predicting ability of the Artificial intelligence model is higher than other traditional valuation models.

Li and Li (1996) adopting Analytical Rent Model and Neural Network considered rent passing, number of bedrooms, cooking facilities, parking facilities, security, privacy, dwelling appearance, landscaping, outdoor lighting and support services, as

attributes for consideration in rental forecast model in Townsville, Australia. The scholars adopted different intrinsic and extrinsic variables for developing property price, rental and value models.

Tabales, Ocerin and Carmona (2013) conducted research on property price forecasting in a medium sized city in South of Spain. The scholars classified property attributes considered in the study into internal and external attributes. The internal attributes were further classified into: basics, general, orientation and economics. The basic attributes are: area, bedrooms, bathrooms, complimentary bathroom, terrace, communications, wardrobes, garage, storage room and climatization. The general attributes are: number of floors, type of window, interior, kitchen furniture and reformation. The external attributes are classified into: general, extras and location. The general classifications are: building year, lift and laundry and the extras are: pool, tennis and garden. Location is all about the zone. The scholars considered large number of attributes, some of which are numerical.

Rossini (2000),in a study on residential property rental value forecasting in Australia, adopted land area, equivalent area, year built, sale date, zone, wall, roof, style, rooms, condition and improvements as attributes necessary for predicting residential property rental values. The scholar classified the attributes into major value determinant and value adjustment. The major value determinants are: land area, equivalent building area, year of construction and building style. Also, the value adjustment attributes are: land area, equivalent area, year built and conventional. The study revealed how practitioners can adopt property attributes for residential property rental value forecasting.

(ii) Residential property rental value prediction: A review of modelling techniques

Different forecasting models have been developed to forecast the property market. However, Hepsen and Vatansever (2011) broadly categorized forecasting models into multivariate forecasting models and univariate forecasting models. Multivariate forecasting models try to explain changes in a variable by references to the movements in the current or past values of other explanatory variables. Whereas, univariate forecasting models constitute a class of specifications in which one attempt to model or predict time series variables using only information contained in their own past values and current and possibly, past values of an error term(Brooks and Tsolacos, 2010; Bonner, 2009). Multi-variate forecasting models can be described as the resultant effect of all property attributes on property value. Univariate forecasting models are structured around trend analysis. Examples of uni-variate forecasting model are ARIMA models and SESMA models. Also examples of multi-variate models are: Artificial neural network, support vector machine and logistic regression.

Peng and So (2002) posited that Logistic regression is well suited for studying the relationship between a categorical or qualitative outcome variable and one or more variables. The scholars asserted further that logistic regression does not require that data be drawn from multivariate normal distribution with equal variances and co-variances for all variables hence it is less restrictive than linear discriminant

function analysis for modelling categorical outcomes. The model can also be used for estimation, classification and forecasting.

NunezTabales, Caridad and Rey (2013) emphasized the usefulness of Artificial Neural Networkwhere there is enough statistical information. The scholars forecasted residential property value in a medium sized city in southern Spain using exogenous variables which include each dwelling's external and internal data (both numerical and qualitative) and its surrounding. Alternative models were estimated for several time intervals, enabling the comparison of the effects of the rising prices during the bull market over the last decade. Sensitivity analysis of the model allows the evaluation of the influence of each exogenous variable considered in the study. Building area was identified as the most important variable that influenced value, followed by location index and common expenses.

Lam, Yu and Lam (2008) established that integration of entropy and artificial neural network can give desirable result in housing price forecasting. The study reviewed micro and macro factors that affect housing price. Also, an entropy-based rating and weighting model was presented with the aim of providing objectives and reasonable weighting of the considered variables. Then based on the key variables, the predictive ability of artificial neural network (ANNs) was examined. Various networks were designed to examine the performance of ANN towards different parameters. Different sample sizes and different sets of input variables, together with different net structures and net types were undertaken to test the accuracy of ANN. From the comparison of the results of the R squared, as well as the mean absolute errors, the authors found that ANN performed well in forecasting with smaller sample size and standard net type. Also, the overall result of the research revealed that integration of Entropy and Artificial Neural Network can serve as a desirable function in house price forecasting.

Al-Marwani (2014) forecasted residential property price considering types of residential properties. The study applied Geographical Information System (GIS) and socio-economic modelling and the study revealed that higher property prices were awarded to real estate with more green spaces, residents with higher disposable incomes, lower council tax bands, fewer tax benefits claimants, and better health services.

Jadevicius and Houston (2015), in a study that compared simple and complex property market forecasting models, asserted that vector auto-regression was among the best fitting models out of the five forecasting models considered. However, the study revealed that the accuracy of the model to forecast out-of-sample data was poorer than some less complex models and that the adoption of a model is not a function of types of data available, quality of data, expertise on adopted tools and the precision level of the tools.

Significance of residential property rental value prediction model

Property price forecasting has been at point of extensive research and empirical analysis over the decades (Chaplin 1998; 1999, Stevenson and Mcgarth, 2003; Tsolacos, 2006). Barras (2009) posited that it primarily developed within the academia before it was adopted by the practitioners. Rinclumphi et al., (2012) found that

property price usually comprises of physical, economic, location, environment and branding characteristics. The scholars explained further that these characteristics and many more make it cumbersome to evaluate the exact value of properties using conventional methods. However, residential property rental price prediction model makes it possible to forecast the impact of each of these characteristics on residential property value and consequently make property valuation less cumbersome.

Chaphalkar and Sandbhor (2013) emphasized the need for prediction models as a means of reducing the inaccuracies that characterized the traditional methods of valuation. The scholars also attributed the development of property price prediction models to the level of sophistication expected from users of property valuation. Studies (Ogunba, 1997; Babawale, 2008; Ayedun, 2009 and Oyedeji and Sodiya, 2016) in Nigeria have shown high level of inaccuracy in property valuation thus confirming the need for innovative valuation techniques to reduce valuation inaccuracy and variance in assets' valuation in Nigeria.

Previous studies have been identified artificial intelligence as innovative valuation models with high accuracy. Do and Grudnitski (1992) in a study conducted in United State of America established that ANN performs two times better than other valuation methods. Wong, So, and Hung (2002), in a study conducted in Hong Kong, posited that artificial intelligence models are good alternative appraisal techniques to the traditional approaches. Özkan, Yalpır, and Uygunol (2007) in a study conducted in Turkey, established that estimates from artificial intelligence models are close to actual market value of property. Lai (2011), in a study conducted in Taiwan, posited that Artificial Neural Network performs better than other appraisal techniques.

Methodology

A review of past studies on the built environment related problems identified the use of survey, experiment, literature survey, case-study, modelling, archival research and grounded theory (Laryea and Leiringer, 2012). Wing et al., (1998) affirmed that the choice of research method largely depended on the problem addressed by the study. In addressing the objectives of this study, two AI models: artificial neural network (ANN) and support vector machine (SVM) were compared with multiple ordinal logistic regressions (MOLR). The variable to be included in an Artificial Intelligence (AI) model are rarely known beforehand. However, because the present research is focused on how close a property is to a tourist site influence annual rental property value, the variables included in the model are limited to those related to property attributes as identified in literature (Lam et al., 2009). Measures of accuracy were used to evaluate and compare the predictive power of AI with other conventional models. The dataset used in development of the model were gathered from Oshogbo, Osun State, Nigeria.

Artificial Neural Network (ANN) – is a computational model based on the structure and functions of biological neural networks. Information that flows through the network affects the structure of ANN. ANNs is a non-linear statistical data modeling tools where the complex relationships between inputs and outputs are modeled. It has many advantages but one of the most

recognised of these is the fact that it can actually learn from observing data sets.

Support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis. Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns new examples to one category or the other, making it a non-probabilistic binary linear classifier. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall. In addition to performing linear classification, SVMs can efficiently perform a non-linear classification using what is called the kernel trick, implicitly mapping their inputs into high-dimensional feature spaces.

Logistic regression is a statistical method for analysing a dataset in which there are one or more independent variables that determine an outcome. The outcome is measured with a dichotomous variable (in which there are only two possible outcomes). The goal of logistic regression is to find the best fitting (yet biologically reasonable) model to describe the relationship between the dichotomous characteristic of interest (dependent variable = response or outcome variable) and a set of independent (predictor or explanatory) variables. Logistic regression generates the coefficients (and its standard errors and significance levels) of a formula to predict a *logit transformation* of the probability of presence of the characteristic of interest.

Modeling Development Process

The first stage of the study involved identification of a list of property attributes often associated theoretically with residential property rental values. This phase of the study was carried out using a comprehensive literature search. Data on these property attributes were collected from property owners in the study area. This is because the property rental market in Osogbo, Osun State is largely controlled by the informal sector. These data were collected and stored in a computer for further analysis. The property attributes served as input and independent variables for the AI and MOLR models respectively. The use of similar input in the three models ensured that the predictive accuracy of the models was compared. At the second stage, the collected data was divided into training and test data sets. The independent dataset was used to evaluate the forecast accuracy. This means that the predictive capability of the three models was tested on a dataset that was not used during the model training process. Finally, the computation of the prediction error of the three models was carried out thus allowing for the comparison of the forecasting accuracy of the developed model.

The property attributes that influence the rental value of residential real estate properties have been identified in several studies (Li and Li, 1996 and Lam, Yu and Lam, 2008). Previous studies showed that the determinant of residential property values vary from one country to another (Li et al., 2011). Since the determinant of property values

are unique and location specific, DFCS-Distance From Cultural Site, House Types, Age of Building, State of exterior, State of interior, Availability of water, Road Network, Availability of neighbourhood security and Rent p.a. were considered as the property attributes for the purpose of this study. The models were utilized to capture the relationship between these indicators and rental property values (output). The rental values of the residential properties have been classified into four groups (less than ₦50,000 p.a.; between ₦51,000 and ₦100,000 p.a.; between ₦101,000 and ₦200,000 p. a.; and between ₦201,000 and ₦300,000 p.a.).

Results and Discussion

Table 1: Showing property price classification by AI models

AI Models	Correctly classified %	Correctly Classified Frequency	Incorrectly Classified %	Incorrectly Classified Frequency	RMSE
ANN	89	148	10.30	17	0.1875
SVM(C1)	87.27	144	12.73	21	0.3284
SVM(C2)	89.70	148	10.30	17	0.3253
Logistic Regression	86.06	142	13.94	23	0.2112

Source: Artificial Intelligence models analysis

(i) The application of Artificial Neural Network showed that 89.70% of the analysed data were correctly classified which translates into 148 correctly classified data with 17 incorrectly analysed data. The Root Mean Square Error (RMSE) of the Artificial Neural Network model was 0.1875 thus translating into 18.75%

(ii) Support Vector Machine with a Slack variable of C = 1 has 87.27% of the analysed data correctly classified. This translates into 144 correctly classified data with 21 incorrectly classified data. The RMSE of Support Vector Machine with Slack variable of C=1 as 0.3284 translates into 32.84%.

(iii) Support Vector Machine with a Slack variable of C= 2 has 89.70% of the analysed data correctly classified. This also translates into 148 correctly classified data with 17 incorrectly classified data. The RMSE of Support Vector Machine with Slack Variable C= 2 is 0.3253 which translates into 32.53%.

(iv) The Logistic Regression has 86.06% correctly classified data translating into 142 correctly classified data with 23 incorrectly classified data. The RMSE of Logistic Regression is 0.2112 which translates into 21.12%.

The study showed that the errors associated with classifications are relatively low except the RMSE of the Support Vector Machine that is above 30%. These classifications can therefore be adopted for predicting residential rental property value in the study area. Also, ANN has the highest predictive capability among the three artificial intelligence models.

Confusion matrix of the artificial intelligence models

(a) Confusion Matrix of ANN of this study is:

a	b	c	d	
57	4	0	0	a
2	52	1	0	b
0	2	28	3	c
0	0	5	11	d

Based on the ANN classifications, 61 houses fell within the zero to ₦50, 000 annual rental value range. Out of these 61 houses, rental values of 57 houses were correctly classified. Also, 55 houses were within the ₦51,000 and ₦100,000 annual rental value group, out of which 52 houses were correctly classified. Furthermore, 33 houses fell within the rental price range of ₦101,000 and ₦200,000 p.a. out of which 28 houses were correctly classified in terms of rental value. Finally, 16 houses were categorized in the ₦201,000 and ₦300,000 annual rental value range, out of which 11 houses were correctly classified. It can therefore be inferred, that based on the property attributes considered, the incorrectly classified houses had their rental values either overvalued or undervalued by the landlords or their estate agents.

(b) Confusion Matrix of SVM 1
C = 1

a	b	c	d	
55	6	0	0	a
4	51	0	0	b
0	2	26	5	c
0	0	4	12	d

Based on SVM1 with Slacked variable C=1, rental values of 61 houses were within the zero and ₦50,000 range with 55 houses being correctly classified. Also, 55 houses were categorized between the ₦51,000 and ₦100,000 annual rental value range, out of which 51 houses had their rental value correctly classified and 4 houses have their rental value incorrectly classified. Furthermore, within ₦101,000 and ₦200,000 annual rental value range, 26 houses have their rents correctly classified, and 7 houses have their rents incorrectly classified. Finally, 16 houses falls within the ₦201, 000 and ₦300, 000 rental value range with 12 houses correctly classified and 4 houses incorrectly classified.

(c) Confusion Matrix of SVM 2
C = 2

a	b	c	d	
57	4	0	0	a
4	51	0	0	b
0	2	27	4	c
0	0	3	13	d

From the SVM2 with Slacked variable = 2, 61 houses fell within Confusion Matrix of zero and ₦50,000 annual rental value range, out of which 57 houses were correctly classified and 4 houses are incorrectly classified. Also, 55 houses were classified in the ₦51, 000 and ₦100, 000 annual rental value range and 51 houses were correctly classified and 4 houses were incorrectly classified. Furthermore, 33 houses were within the ₦101, 000 and ₦200, 000 annual rental value range, out of which 6 houses have their rental values incorrectly classified. Finally, 16 houses were classified within the ₦201, 000 and ₦300, 000 annual rental value ranges. 3 houses out of the 16 are incorrectly classified and 13 houses are correctly classified.

(d) Confusion Matrix of Logistic Regression

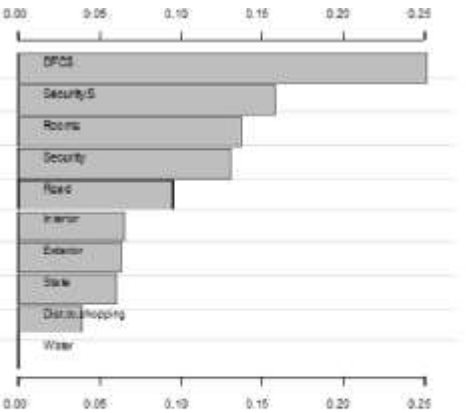
a	b	c	d	
57	4	0	0	a
6	46	3	0	b
0	1	27	5	c
0	0	4	12	d

From the logistic regression, 61 houses fell within the zero and₦51, 000 rental

value p.a., 57 houses out of these 61 are correctly classified. Also, 49 houses fells within the ₦51, 000 and ₦100, 000 price range p.a., 46 houses out the 49 are correctly classified. Furthermore, 33 houses were within annual rental price range of ₦101, 000 and ₦200, 000 with 27 houses out of these 33 correctly classified. Finally, 16 houses were within the price range of ₦201, 000 and ₦300, 000 p.a. with 4 out of the 16 houses incorrectly classified.

Sensitivity Analysis of Property Attributes

Fig 1: Importance of property attributes in the artificial intteligence models



After using the three artificial intelligence models (Artificial Neural Network, Support Vehicle Machine and Logistic Regression) to classify residential property rental value according to property attributes developed for prediction, a sensitivity analysis was carried out. Sensitivity analysis is a technique used to extract additional information on the importance of each independent variable in predicting the dependent variable in machine-learning models (Cortez, Cerdeira, Almeida, Matos & Reis, 2009; Tinoco, Correia & Cortez, 2011). Figure 1 shows the importance attributed by the property attributes considered in the study. As can be seen from the figure, it is evident that the most influential input property attributes is distance from cultural site, followed by neighbourhood security. The neighbourhood security attribute can also be linked to the ritualistic activities going on in the cultural site. The sensitivity analysis revealed that distance from the cultural site is the most important property attribute that influence residential property value in the study area.

Conclusion

In the face of uncertainty that characterises property price forecast, it becomes imperative to adopt different advanced forecasting tools to predict annual property rentals hence the

adoption of the three artificial intelligence models for the forecast of annual residential property rental value in Osogbo in this study. The study showed that adopting the three models would ensure that a larger percentage of the considered variables would be correctly classified. In addition, the sensitivity analysis of the property attributes employed in the study revealed that distance from cultural site has the highest impact on residential property rental value.

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The Role of Education towards Achieving Sustaining Housing and Environmental Development in Nigeria

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Abstract: Education constitutes the most effective means that the society needs to confront the challenges of the world. Succinctly put, the sustainable progress of man depends wholly on educated minds in every walk of life. It is the major factor that can be used to create enduring relationships among people and foster greater respect for the needs of human beings in any situation on earth. The paper examines the possible ways of sustaining existing low-cost housing estates in Lagos State, Nigeria. Lessons from experiences of developed nations on low-cost housing estates welfare mechanisms as it relates to the basis of allocation, usage, periodic maintenance, transferability and social cohesion were ascertained from literature and compared with existing situations in Lagos State. Findings showed that there is need for continuous life learning efforts to be embarked upon and sustained by the three tiers of government in Nigeria towards achieving sustainable housing and environmental development. The study recommends that the three arms of government need to embark on educational re-orientation of Nigerians on sustainable home ownership built on equitable, social, economic and political fair play.

Key words: Education, Sustainable, Low-cost Housing, Masses, Nigeria

1. Introduction

All human activities, no matter the status of those concerned, do take place on land. Before the advent of western education in Nigeria, indigenous peoples respect and love the land as a mother, treating it as sacred, believing that people, plants, animals, water, the

land and the sky are all part of the same on-going cycles of life. Ethnic societies lived in harmony with the natural world as much as possible and there was relative peace as a result of indigenous systems of education through natural ecology. The traditional beliefs and the knowledge that flows from them has been passed down from the generations through a wide range of cultural practices, including direct instruction, stories, dances, ceremonies and art as well as networks of sacred places. Such indigenous approaches to education linked people to the land through culture. The subsequent disregard for land and culture, since colonization of Nigeria by the British, coupled with western education, meant that knowledge; values and skills for peaceful co-existence were underplayed over the years in contemporary education.

The success of Nigeria in attaining independence in October, 1960 was followed rigidly by a focus on economic development to provide basic necessities of life for the populace in the hope of making higher standards of living attainable for all irrespective of the geo-political base of each person. This focus of time was re-interpreted as achieving peaceful co-existence, freedom of speech, even development across regions and the liveable environment. With the rapid emergence of towns and cities and the creation of more States, the provision of residential housing for the teaming population, especially in the State capitals and their surrounding towns, came up as issues and aspirations, more from the low-income earners within the society.

Since the environment is where we live and its development is what leads to improvement in our abodes, it is mandatory, on our part, to pursue neighbourhood developments that will not compromise the ability of future generations to meet their own needs. This can only be achieved if social progress, human well-being, social justice, equity, and poverty alleviation are pursued vigorously and collectively by all and sundry. Proper education of the masses can only be achieved through a combination of formal and informal means of transferring knowledge in the world. It is only through these means that certain fundamental values such as the freedom to live where a person desires, equality of opportunities for better men and women, respect for each other's beliefs, culture and language, prudence in managing nature, and collective responsibility in managing the country's economic, social and political variables can be achieved with less stress.

2. Literature Review

Joseph (2006) acknowledged housing as an important sector of a nation's economy because a vigorous and buoyant housing sector is an indicator of a strong program of national investment and is the first step towards achieving future economic growth and social development in a country. In the same vein, ICESCR (1966) inserted Article 11 of the International Covenant on Economic, Social and Cultural Rights that recognized the right of everyone to adequate standard of living for himself and his family, including adequate housing. Yates and Milligan (2007) identified three core groups of potential household risks. These are, first, trapped renters because of increase in rents ahead of increases in income; second, aspirant purchasers as a result of either increase in rents or house prices ahead of increases in incomes and third,

stretched purchasers caused by both increase in interest rates and house prices. These conditions occur because of the inability of households to save and bridge the deposit gap needed to rent or purchase a home. Such situations frustrate human aspirations. Such an unexpected happening eventually leads to household stress which in turn leads to frustration.

Rescher (1969) noted that sustainability of the built environment relies more on the battle to win heart and mind of man through the appreciation of things of the mind that have to do with the vision people have for themselves and their fellow human beings. This manifests, first, in the ways that people talk and act; second, in the pattern of their expenditure of time and effort and third, in their choices in the marketplace.

Dunn (2006) found that values are central to human daily life because societal values shape psychology and agency and influence human behaviour while Bok (1995) was of the opinion that human values, such as survival and responsibility, are common to all human beings. Milbrath (1989) opined that value is fundamentally about what standards human beings ought to live and enjoy quality life within a built environment. Trainer (1995) posited that pursuing a change in societal value is difficult but crucial for ensuring a peaceful transition into a sustainable society.

3. Residential Housing for the Masses

The concept of shelter differs from individual to individual depending on culture, tradition, profession and way of living. Besides, being a basic necessity, it is also a source of identity that has significant effects on the overall psychological well-being of the inhabitants. It also differs from country to country depending on their levels of exposure to happenings in other countries, commitment and peaceful co-existence (Nair et al., 2005).

Residential housing progress has also been ideologically linked with economic growth (Guo, Vale and Vale, 2008). Economic growth is synonymous with progress while its end purpose is to increase the quality of life of a country's citizens. However, Meadows et al., (1972) noted that there are limits to growth and, in reality; unlimited residential housing growth cannot be sustained in a finite planet. There are rent and ownership based affordable housing schemes which are mostly owned and managed by local authorities mostly in developed countries such as UK. The rents are set under a national rent regime, usually below market levels and are normally based on relative property values, local earning levels and property size. Such a scheme provides a subsidized/ below market housing rate to the less privilege members of the society with their landlords usually being non-profit organizations (Priemus, 2000). Ownership based affordable housing scheme, according to Watson, Beazley, and Joiner (1995) enables the occupants, after purchase, alter their homes according to their personal needs, culture and socioeconomic backgrounds. Newman (2002) viewed sustainability with respect to housing as ensuring that (i) there is a roof overhead for the housing disadvantaged; (ii) ensuring housing is more eco-efficient and (iii) housing is well located or is part of a project to improve locational amenity. UNDES (2005) sees sustainable development as far from being a burden but as an exceptional economic opportunity to build markets and create jobs; socially, to bring people

in from the margins; and politically, to give every man and woman a voice, and a choice, in deciding their own future. Alao (2009); Barton (2000) and Porter and Platt, (2000) found that sustainability seeks to meet the social needs of affordable housing through equity and choice in terms of access to all social groups; community development; neighbourhood social balance and continuity, as well as, valuing and protecting diversity and local distinctiveness thereby strengthening local community and cultural diversity.

Rescher (1969) further proposes four ways to change values, value change induced by a change of information through persuasion and social learning, value change induced by ideological and political change, value 'erosion' induced by boredom, disillusionment and reaction as too much choice may make people bored with being consumers, and value change induced by changes in the operating environment of a society (lifestyle changes). With better education of the masses, the four ways of influencing human values could be better appreciated by the masses, if and when such a need arises.

Green and Rojas (2008) and Wakely and Riley (2011) found that the poverty levels vary from country to country, often resulting in low-quality and overcrowded housing that lacks various services and infrastructures with, self-help housing, which is mostly practiced incrementally, often as a result of poverty. Urban growth in Nigeria, and in other developing countries, demands high-capacity housing delivery systems for low-income groups occurring through self-help and institutional housing schemes.

Self-help housing is based on individual decisions on building quality, time and construction capacity (Bredenood and Lindert, 2010 and Bredenood and Lindert, 2014). Due to its prominence, self-managed housing in developing countries is a phenomenon of great importance and thus should be facilitated by formal housing policies (Connolly, 2006). Individual housing projects are realized at the local level, through the involvement of residents, municipal organizations, building companies, housing cooperatives and banks. As housing shortage is a problem of great proportions, housing, including self-building, is a promising source of employment generation (Erguden, 2001). With the economic downturn in Nigeria within the past few decades, residential housing provision, through self-help approach, has suffered setbacks in the areas of quality, quantity and poor neighbourhood environmental facilities. Its widespread became a concern both to the various arms of government and residents as such areas had sub- standard layouts, very poor housing designs, no electricity, poor drainage system in addition to lack of open spaces (public market, motor garages). All these lapses are traceable to the level of illiteracy prevailing in such neighbourhoods.

4. The Challenges of Mankind Towards Sustainable Development

Parekh (2013) re-iterated that in an effort to perform within available potentials, there is always the need to closely examine the four major spheres that make-up peoples' life but if anyone of these is out of balance, there is bound to be frustration, boredom, disenchantment and decrease in peoples' enthusiasm for life.

Continuous life learning efforts need to be embarked upon vigorously by the three tiers of government in Nigeria. This is necessary to ensure citizens operate on the same frequency if sustainable living must be achieved. First, individuals must, as a necessity, be able to analyze the extent to which he has developed his realism, self-awareness, and self-dignity. Inadequate development in these areas of human beings will dampen an individual's enjoyment of life. It takes the combination of being responsible and light hearted to meet a high level of self-dignity. Second, one needs to attain financial success and integrity to attain a strong sense of purpose by working diligently at a job that a man enjoys doing. It is not the quantity of funds but its quality through a fair, honest and equitable manner. Third, it takes respect, mutual benefit, and trust to build healthy relationships and thus avoid stress, unhappiness and even ill-health. Fourth, people need to examine their inner being, using various resources for personal wisdom. With humility, external and internal peace is attained while integral fulfilment would lead to contentment as someone work to improve life for self and those around them. Attainment of fulfillment in life performance comes with the right combination of feeling contentment and empowerment.

In the words of WCED (1987) towards achieving holistically, the importance of protecting the environment through proper education of school children from their first day in school must be given a priority. Through environmental education, the society would appreciate the need to conserve resources while pursuing individual or national economic growth. Seeking such a 'balance' between environmental conservation, economic growth and social development is the basic thinking underlying the sustainable development concept. In the process of developing sustainably, we need to make people understand and act in accordance with the spirit of sustainable development. Once the thinking and action taken by the people become habitual, in the long run, these habits will turn into a culture of sustainable development (Komiyama and Takeuchi, 2006). Through education, the society will inculcate awareness of development within the environment; slowly cultivate interests and commitments of people to participate in the agenda for sustainable development.

The educational process has five fundamental elements namely conscience, knowledge, attitude, aptitude and involvement. Conscience guides members of the society in making choices as consumers of those choices have multiple implications on the environment. Knowledge will guide people in their relationships with living nature thereby assisting in predicting what problems may come their way later in life. Attitude aids in the selection of personal alternatives in specific environmental situations. Aptitude, which represents the abilities, talents and motivation that an individual have, can be translated in practice as the "efficiency and competency in doing and solving, with success, some specific tasks and activities." (Ages 2010–2013). Involvement would encourage people to apply the knowledge gained.

5. Environmental Education

According to Danger (1983), the term 'environmental education' was first used in Paris in 1948 whereas in Britain, the first recorded use of the term 'environmental education' was traceable

to a conference held in 1965 at Keele University, Staffordshire. The first conference in UK led to the establishment of the Council for Environmental Education (CEE), which first met in July 1968. IUCN/UNESCO International Working Meeting on Environmental Education in the School Curriculum' held m 1970 at the Foresta Institute, Carson City, Nevada, USA and defined the term 'environmental education' as 'the process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among man, his culture, and his bio-physical surroundings Environmental education also entails practice in decision-making and self-formulation of a code of behaviour about issues concerning environmental quality'' (IUCN, 1970). Palmer (1985) reported that as a follow up to the 1972 United Nations Conference on the Human Environment which held in Stockholm, Sweden, it was declared that "Education in environmental matters for the younger generation as well as adults is essential and should therefore be given due consideration for the underprivileged".

Palmer (1998) further noted that environmental education, within both formal and non-formal education sectors, should be an integral and essential part of every citizen's upbringing since he found that, in the long run, nothing significant will happen to reduce local and international threats to the environment unless widespread public awareness is aroused concerning the essential links between environmental quality and the continued satisfaction of human needs. Human action depends upon motivation, which depends upon widespread understanding. That is why it is so important that everyone becomes environmentally conscious through proper environmental education.

6. Theoretical Frameworks on Environmental Education

Around the globe, environmental education has become a popular strategy for promoting the conservation of biological diversity. Across scales, from the grassroots to the international, and across sectors, from non-profits to governmental ministries, education has been embraced as a strategy to reduce environmental destruction.

It is frequently assumed that people are behaving in environmentally unfriendly ways because they lack knowledge about the ecological consequences of their actions. Increasing knowledge would lead to a corresponding change in attitude, which in turn leads to the desired behaviour (Matthews and Riley, 1995). In other words, awareness must precede knowledge, which in turn determines attitudes, which then influences actions.

Research conducted in the 1970s in the United States illustrated that a person's level of education is strongly related to, and can even predict, a person's level of concern for the environment (Buttel and Flinn, 1978).

Attitudes refer to the state of mental or emotional readiness for some form of activity but Bennett (1989) found that attitudes, like values, reflect our feelings toward objects, both tangible and intangible. Outdoor education can improve attitudes (Yerkes and Haras, 1997) and unsurprisingly that the media plays a powerful role in the development of environmental attitudes and values (Shanahan and Katherine, 1999).

Applying the political ecology approach to conservation education highlights the imperative need for environmental education programs to be informed by both the cultural, political, economic and environmental contexts in which they work. Understanding the needs, goals, opportunities and constraints facing the participants in educational programs, and how these factors influence their knowledge, attitudes, and behaviours related to resource use and conservation should strengthen these programs.

Sterling (1996) noted that education for sustainability should nurture, first, a sense of responsibility to the environment and to other people. Second, have the will, knowledge and skills to translate this responsibility into action personally and publicly. Third, it should respond positively to change and uncertainty. Fourth, it must have a capacity to link individual and group actions to external events. Fifth, it must be interdisciplinary and holistic while sixth, it must have the ability and freedom to be creative. Seventh, there must be a balance of rationality with intuition. Finally, education for sustainability must have a sense of self-worth combined with respect for other individuals and cultures. Pursuing increased educational efforts will lead to more informed attitudes, which in turn will lead to a desired change in behaviour.

7. Conclusion and Recommendation

The advancement of any nation is dependent on the ability of those in government to collectively and sincerely pursue and achieve a continuous formal and informal education of her citizens towards ensuring a stable political climate, wise use of the biophysical environment, as well as, a social system that respects human rights and dignity. This study therefore recommends that the three arms of government in Nigeria should embark an educational re-orientation of Nigerians on sustainable home ownership built on equitable social, economic and political fair play.

Government should recognise environmental education as a critical factor for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and for effective public participation in decision-making. Both formal and informal educations are indispensable to changing people's attitudes so that they can have the capacity and wherewithal to assess and address their environmental concerns.

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