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KADUNA STATE UNIVERSITY ENVIRONMENTAL SCIENCES JOURNAL (KESJ)

The KASU Environmental Sciences Journal (KESJ) is a peer reviewed academic journal published by the Faculty of Environmental Sciences, Kaduna State University, Kafanchan Campus. The Journal aims at publishing quality scientific and original research in the various disciplines of the built and natural environment. A broad outline of the Journal's scope includes: peer reviewed original research articles, case studies, meta analysis, reviews, short communications, and note to the editor.

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- Methodology/Research Instruments
- Results/Findings & Discussions
- Conclusions, Recommendations, Appendices
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SPATIAL DISTRIBUTION AND PERCEIVED ENVIRONMENTAL HEALTH IMPACTS OF PETROL FILLING STATIONS IN EDE, OSUN STATE, NIGERIA



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Abstract

The environmental health risks associated with petrol filling stations (PFSs) requires maximum compliance with planning standards in siting them. However, people's awareness of the effects of PFSs on health and environment is germane to achieving efficient urban environmental health. This study, therefore, examined the spatial distribution of PFSs and the people's perception of the health and environmental implications of PFSs in Ede, a traditional city in Nigeria. Cross sectional survey design and simple random sampling technique were used for data collection. A structured questionnaire was used in collecting information from the residents. GPS was used in obtaining the coordinates of the PFSs while speedometer was used in determining the distance of the PFSs to each other and residential land use. Fifteen PFSs were identified and sampled in the entire township. The information was obtained from the managers of the PFSs through questionnaire. Also, a total of 150 pretested structured questionnaires were administered to randomly selected residents of adjoining neighbourhoods to the PFSs. Descriptive statistics (frequency and percentages) was used to obtain the residents' perception of the effects of PFSs on the environment and human health. ARCGIS 10.2 and Nearest Neighbour Analysis were used to establish the spatial distribution of PFSs. The people's perception of the PFSs effects was low. With the nearest neighbour index of 0.71, the PFSs were linearly clustered along the major roads that dissect the town. There was less compliance to planning standards by majority of the PFSs. Embarking on awareness programme among the residents and enforcement of planning standards in siting PFSs and other land uses will go a long way in addressing the problems of low perception and non compliance with planning standards.

Keywords: Development control; Petrol filling station; Planning standards; Spatial distribution.

Introduction

The phenomenal increase in urban population in Nigeria which can be traced to the post-independence economic boom occasioned by the discovery and exploitation of crude oil in commercial quantity has triggered unabated growing demand for petroleum products. This is as a result of increase in car usage due to lack of effective

urban public transport system, increase in domestic use due to ineffective public power supply and increase in small and medium scale industrial activities (NBS, 2018). For instance, the demand for petrol in Nigeria increased from 20 million litres in 2001 to 35 million in 2011 and further increased to 50 million litres in 2018 (DPR, 2019). To effectively meet the growing demand, both public and private enterprises have been

involved in the distribution of petroleum products to the citizens by establishing petrol filling stations in available locations of most urban centres (Blamah, Vivan, Tagwi and Ezemokwe, 2012).

Petrol filling station according to Ayodele (2011) refers to any land, building or equipment used for the sale or dispensing of petrol or oil for motor vehicles and includes the whole of the land, building or equipment whether or not the use as a petrol station is the predominant use or is only a part thereof. Similarly, Nieminen (2005) defined Petrol filling station as an area including fuel equipment and piping, storage tanks, forecourt and possible building premises for the sale of fuel (inflammable liquids) to customer's vehicles. Most petrol filling stations (PFSs) sell petrol or diesel; some carry specialty fuels such as liquefied petroleum gas (LPG), natural gas, hydrogen, biodiesel, kerosene, or butane while the rest add shops to their primary business (Hamid, Iman, Suriatini and Martin, 2009). Some of the variables considered when selecting location for any utility or some activity are proximity to population centers, distance from neighboring (PFSs), the easements of using existing utility, and the magnitudes of environmental pollution parameters. Other factors to take into account when making a decision about the location of business include customers, transport, the neighborhood, finances and the longer term future (Hamid et al., 2009; Mohammed, et al., 2014). All the highlighted factors point to one important consideration – location. As earlier observed by Mudambi (1994), location affects many aspects of petrol station operation. The observation of Mudambi appears to be supported by Sidaway (1998) when the author opined that, petrol stations are very vulnerable to closures resulting from petrol price competition, regulatory pressure and nonstrategic locations. However, in an

attempt to achieve strategic location for petrol stations, economic interests are usually placed above environmental effects (Sule, Shebe, Bichi, and Atiyong, 2006). Though the Federal Government and individual State Governments through their environmental protection institutions and agencies as well as urban and regional planning establishments have evolved their own planning standards and principles to guide petrol stations establishment, the incessant violation of these planning standards have been observed in recent times (Gbadamosi, 2014). A number of studies have identified the risks associated with location of petrol stations. As pointed out by Nieminen (2005), the release of petrol vapour into the air during the filling of the storage tanks by tanker delivery personnel and when customers refuel their vehicles pollutes the air and makes the inhabitants susceptible to a number of airborne infections. In addition, it is capable of releasing polluting agents into soil and water thereby destroying the neighbourhood ecosystem (Isabel et al., 2010). Studies have equally focused on the spatial distribution of petrol filling stations especially in urban centres (El Faleet, 2017; UBA, 2015).

However, despite the enormous risks associated with location of petrol stations as highlighted above, perception of the people who undoubtedly bear the consequences of petrol station location on these risks appear to have received less research attention. Risk perception refers to people's subjective judgments about the likelihood of negative occurrences such as injury, illness, disease, and death (Hove & Paek, 2015). It determines which hazards people care about and how they deal with them. Risk perception has two main dimensions: the cognitive dimension, which relates to how much people know about and understand risks, and the emotional dimension, which relates to how they feel about them (Oh et al., 2015). Risk

perceptions are important precursors to health-related behaviors and other behaviors that experts recommend for either dealing with or preventing risks. When people are conscious of the health and environmental implications of existence of certain facilities in their neighbourhood, attempts to minimise this effects will be high, thereby reducing the impact on the people and the environment. Thus, this paper examines the spatial distribution and perceived health and environmental implications of petrol filling stations in Ede.

Literature Review

The issue of health and environmental hazards associated with sitting of PFSs features within the literature. Volatile Organic Compounds including benzene and toluene along with toxic gases such as carbon monoxide and traces of soot has been observed to have deleterious effect on general health particularly on the respiratory system (Alam, et al., 2014). Volatile organic compound emission by PFSs was found to be responsible for groundwater contamination in the USA and Europe as a result of fuel spills and leaks that have actually been happening for several decades (EFOA, 2002). As observed by Nwanjo and Ojiako (2007), petroleum products contain aliphatic and aromatic organic compounds that are highly flammable causing fire hazards and air pollution. According to the Australian Transport Safety Bureau (ATSB) (2005), between 1993 and 2004, there were 243 reported incidents of fires breaking out at petrol stations. Also, some airborne organic compounds such as benzene which increases the risk of cancer have been recorded at PFSs at levels above the average for urban areas where traffic is the primary source of emission. (Miñarro et al., 2010).

One aspect of literature relevant and very significant for this study is the planning standards and principles, environmental criteria and conditions formulated by regulatory agency on siting of petrol stations. This is important because public's perception on the location of filling stations can be viewed with regard to the knowledge that the public has on standards and guidelines on filling stations locations. DPR (2010) stated that PFSs should be located within a growth centre or an urban area except in circumstances where it can be shown through appropriate studies that the need exists or otherwise. The criteria for the locations of PFSs by DPR among others include;

- Stations should be located at a minimum of 100 m from any public institution such as schools, churches, public libraries, auditoriums, hospitals, public playgrounds, etc.
- Distance between one petrol station and another should not be less than 1000m.
- Area of land to be developed should be sufficient to allow manoeuvring of vehicles within its cartilage but should not be less than 112 square meters with a minimum frontage of 91.44 meters on the primary street.
- Petrol Filling station not to be allowed on residential street, dead-end street and loop streets (crescent).
- Filling Stations shall not be allowed in any area where the traffic situation is such that it will cause obstructions in entering or leaving a station or on tight curves where visibility is not adequate.
- Buildings are to be located a minimum of 12m from road property boundaries to provide adequate area for manoeuvring of vehicles in the service area.

- Petrol pumps shall be located a minimum 100m from any residential building.
- Where the site adjoins the side or rear boundary of a residential lot, a solid wall 3 m in height should be constructed and maintained along that lot boundary.
- Signs should be in accordance with the Advertisement Regulations and should be located so as not to reflect the sun into the face of motorists and should be large enough so that they can be seen from a reasonable distance at a reasonable speed.
- Stations are to be equipped with fire-fighting and fire protection equipment installed in accordance with the national policies formulated by Federal Environmental Protection Agency and the Ministry in charge of disaster management.
- All volatile flammable liquid storage tanks shall be installed below ground in compliance with the requirements of the Ministry of Trade and Industry.
- Proper facilities for storage and disposal of used and waste oil and gas must be provided.
- Normally no access to or from a filling station shall be closer than 45m to any road intersection or 75 m from the intersection of two main roads.
- A minimum distance of 30 m should be maintained between Underground Storage Tank (UST) and water source.

Table 1: Setback of Petrol Filling Station

Type of abutting road	Set back in m from the centre of the road (m)
Outside city limit	
Trunk 'A'	30
Trunk 'B'	22.5
Trunk 'C'	18
Within city limit	
Major road	30
Collector road	21
Other road	15

Source: Obateru (2003)

The Study Area

The study setting is Ede Township in Osun State, Nigeria. Ede is one of the oldest towns of the Yoruba people. It was founded around sixteen century by Timi Agbale, a warrior from the old Oyo Empire. Located at

latitude 7 °15" to 7 °30" N and longitude 4 °32" to 4 °7" E. It lies about 180km southwest of Lagos (Figure 1). With the 2006 population of 80, 515 (N.P.C, 2006), the township's 2019 population stands at 274000. Ede is made up of two local government areas i.e.Ede North and Ede

South. The study covered the two local government areas.

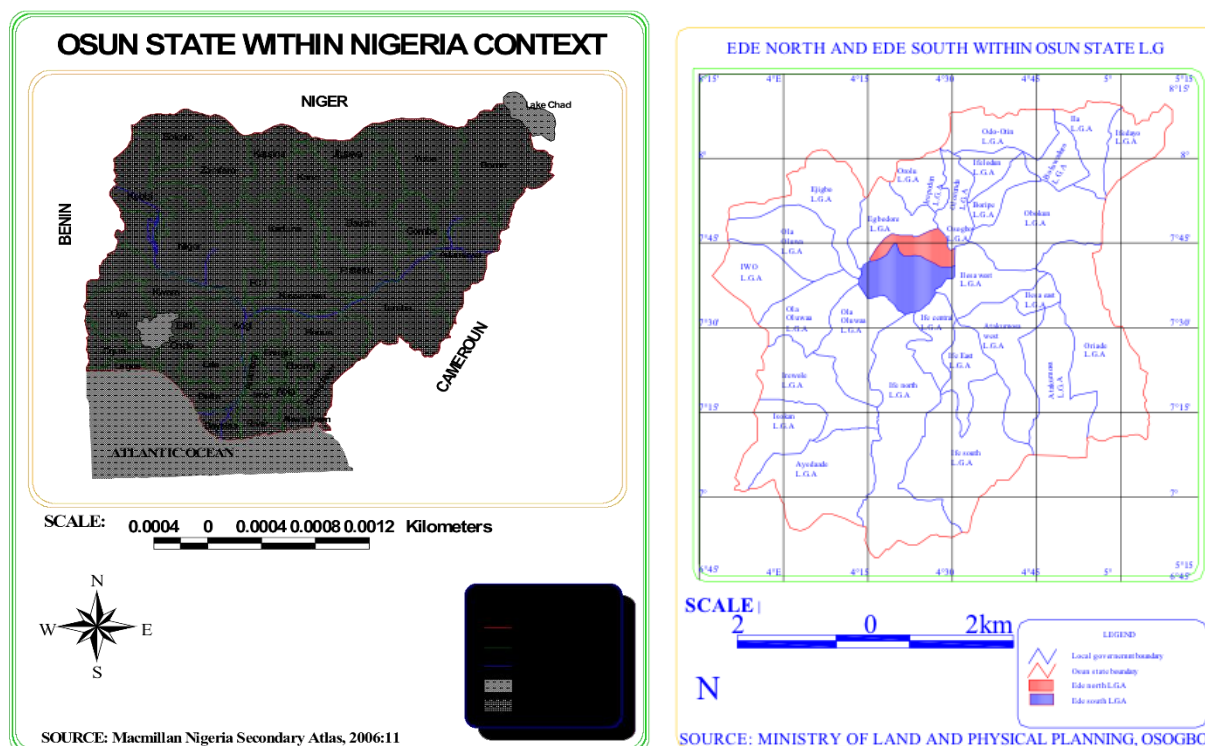


Fig. 1: Osun State within National Context Fig 2: Ede North & South LGAs within Osun State

Methodology

Primary and secondary data were used for the study. Primary data utilized comprises of both spatial and attributes. The attribute data such as socio-economic and land use data were obtained through a structured questionnaire while spatial data which include location of petrol station, setback to roads and other developments as well as the distance between filling stations were respectively obtained with the aid of Global Positioning System, Meter Rule and Speedometer. As a result of reconnaissance survey, fifteen petrol filling stations (PFSs) were identified in the study area. A total survey approach was adopted, thus, coordinates of all PFSs identified were obtained. Also, a set of pretested structured questionnaire (15 copies) was administered

to operators of the PFSs. To obtain information from residents, 200 meters was delineated around each identified filling station (considering the recommended minimum distance between petrol pumps and any residential building which is 100 m). Consequently, a total of 1484 houses fell within the demarcated area and 150 houses (10%) were randomly selected for survey. This falls within the purview of Neuman's (1994) postulation that a 10% sample size for a homogenous population of more than 1000 is suitable for a survey at 95% confidence level, assuming a $\pm 5\%$ error margin. Another set of pretested structured questionnaire was administered to adult members of the sampled houses. The distribution of the questionnaire across the

sampled neighbourhoods is presented in Table 2.

Descriptive statistics (frequencies and percentages) were used to analyse the data while Nearest Neighbour Analysis was

used to statistically determine the spatial distribution of the PFSs. Secondary data such as Development Regulations for PFSs was obtained from the Department of Petroleum Resources, Osogbo, OsunState.

Table 2: Questionnaire Distribution in the Study Area

S/No.	Name of the area	No. of filling stations	No. of questionnaires
1.	Oke Gada	4	40
2.	Total	4	40
3.	Oja-Timi	3	30
4.	Ode-Oke	1	10
5.	Agip Area	1	10
6.	Oyatoki	2	20
Total		15	150

Source: Authors' field survey, 2019

FINDINGS AND DISCUSSIONS

Socio-economic Characteristics of Respondents

Evidence as summarized in Table 3, revealed that, 53.3% of the respondents were traders (engaging in hawking and petty trading at nodal areas and filling stations), while 10% of the same were farmers and 10% were students. Analysis of the income structure of the respondents indicated that majority were low income earners with 54.0% earning below ₦20,000 monthly while 26.7%, 8% and 11.3% respectively earn between ₦21,000 – ₦40,000; ₦41,000–₦60,000 and above ₦60,000. The low income status of the respondents reflected in their house ownership status as 54.7% were tenants, while 45.3% of the respondents were landlords (Table 3). Literacy level among the respondents was low as 34% had no formal

education, 28% had primary (basic) education, 22.7% had secondary education while 15.3% had tertiary education (Table 3). Majority of the respondents had lived more than ten years in the area with 32.7% living between eleven and twenty years, 18.0% living between twenty-one and thirty years, while 13.3% had lived above thirty years in the area (Table 3). This relatively long residency of the respondents makes them ideal candidates from whom information can be obtained. The low socio-economic status of these respondents makes them more vulnerable to economic shocks and consequently susceptible to sale of their houses which may give room for emergence of incompatible physical developments, such as petrol filling stations in residential neighbourhoods. It should be noted that such commercial developments can effectively compete for land in such built-up areas.

Table 3: Socioeconomic Characteristics of Respondents

Variables	Frequency	%
Educational Qualification		
Tertiary education	23	15.3
Secondary education	34	22.7
Primary education	42	28.0
No formal education	51	34.0
Total	150	100
Income Level		
Below 20,000	81	54.0
21,000- 40,000	40	26.7
41,000- 60,000	12	8.0
Above 60,000	17	11.3
Total	150	100
Occupation		
Civil servant	15	10.0
Trader	80	53.3
Student	15	10.0
Farmer	40	26.7
Total	150	100
House Ownership Status		
Landlord	68	45.3
Tenant	82	54.7
Total	150	100
Duration of Stay Within the Area		
Below 10 yrs.	54	36.0
11-20yrs	49	32.7
21-30yrs	27	18.0
Above 30yrs	20	13.3
Total	150	100

Source: Authors' field survey, 2019

Ownership and Services Rendered by the Petrol Filling Stations

As stated earlier, fifteen (15) standard filling stations were identified and examined in the study area. All the filling stations were owned by private individuals, therefore, their principal interest will be to attract customers

and maximise profit. In order to optimise the land utilization and open other sources of income, 80% of the filling stations used the remaining parts of their land for other commercial developments that to some extent complimentary to petrol filling station. These include shopping centres, mini marts

and auto alignment workshops. Only 20% solely sold petroleum products such as petrol, diesel, kerosene, cooking gas.

Land Use Characteristics around Petrol Filling Stations

Residential development constituted the dominant adjoining land use to the filling stations by accounting for about 60% of the total adjoining land uses to the filling stations. This is distantly followed by mixed

land use (24.7%) which was a combination of residential and light commercial developments, while commercial land use accounted for 15.3% of the total adjoining land uses to the filling stations (Table 4). From the foregoing, it is evident that petrol filling stations were located within residential areas hence potential source of hazard for residents.

Table 4: Adjoining Land Use to Petrol Filling Stations

Land Use	Freq.	%
Residential	90	60.0
Commercial	23	15.0
Mixed	37	24.7
Total	150	100.0

Source: Authors' field survey, 2019

Compliance with Planning Standards

As revealed in Table 5, 63.3% of the filling stations have a setback below 50 meters to adjoining land use while 29.3% have a setback of between 50 and 100 metres. Thus 92.6% of the sampled filling stations did not comply with the planning standards on setback to adjoining land use (Plates 2 and 3). Note that the minimum setback to residential land use is 100 m while to other public and semi-public uses is 900m. Also, 93.3% of identified filling stations maintained a setback of 30 meters from the road intersection, against the prescribed

minimum standard of 100 meters (Table 6) (Plate 4). The non-compliance of most of sampled the petrol filling stations to physical planning standards calls to question the effectiveness of development control officials in the town. More occurring are questions bordering on the granting of development permit for such development. This prompted the researchers to ask the filling stations operators whether necessary planning approvals, were obtained from Osun State Ministry of Physical Planning before the commencement of development. All of them answered in affirmative.

Table 5: Distance of Filling Stations to Adjoining Landuse

Distance (m)	Freq.	%
Below 51	95	63.3
51 – 100	44	29.3
101 – 150	10	6.7
Above 150	1	0.7
Total	150	100.0

Source: Authors' field survey, 2019

Table 6: Setback from the Road Intersection

Plot size	Freq.	%
Below 30m	14	93.3
31 – 60m	1	6.7
Total	15	100.0

Source: Authors' field survey, 2019

Internal Spatial Organization of Filling Station

Space is an important element in Petrol filling station. It includes parking space, garage, service area and fuel loading units which makes the overall size of the filling station. With an average plot size defined as 30 meters by 30 meters (900m²), more than half (53.3%) of the sampled filling stations have a land area that is less than 1800m² (two plots) (Table 7). Considering

the recommended land area of 12,000m² for PFSs, majority of the PFSs had limited land area for efficient and convenient service delivery. This explains the existence of vehicular queues for fuel along the roads leading to some of these filling stations because they lack adequate space to accommodate a substantial number of vehicles during operation as observed by the researchers during field work.

Table 7: Plot Size of the Petrol Station

Plot size	Freq.	%
Below 2 plots	8	53.3
3-5 plots	5	33.3
6-9 plots	2	13.3
Total	15	100.0

Source: Authors' field survey, 2019

Spatial Analysis of Petrol Filling Stations in Ede

Having acquired the spatial information (latitude, longitude) and distance (Table 8) of all Petrol filling stations in the

study area, the distance parameters were first used to calculate the spatial pattern of the filling stations in the town using First Order Nearest Neighbor Analysis. The analysis is presented below.

Table 8: Distances between Filling Stations

Petrol Filling Station	Nearest Filling Station	Distance (m)
Kasoil station	Lord's Glory	478
Lord's Glory station	Nayog	30
Nayog station	Akaje	97
Akaje	Fatson	1236
Fatson station	Omo- ade	22
Omo- ade station	Total	1467
Total station	Naacons	1583
Naacons station	A.P	1365
A.P station	Admus	130
Admus	M- ruthad	118
M-ruthad	Mascot	303
Mascot	Mabjay	932
Mabjay	Oando 1	1046
Oando 1	Oando 2	511

Source: Authors' compilation, 2019

$$\text{Mean Distance} = \frac{\text{Total mean distance}}{\text{Number of the stations}}$$

$$\frac{478+30+97+1236+22+1467+1583+1365+130+118+303+932+1046+511}{15} = 621.2 \text{ m}$$

$$\text{Density of a point in the area} = \frac{\text{total number of petrol filling stations}}{\text{Total area of Ede town}}$$

$$\frac{15}{42765469.4} = 0.0000003508$$

$$\text{Expected Mean Distance} = \frac{1}{\sqrt[2]{0.0000003508}} = \frac{1}{2 \times 0.0005923} = \frac{1}{0.001185} = 843.88$$

$$\text{Nearest Neighbour Index (Rn)} = \frac{621.20}{843.88} = 0.74$$

It should be noted that the decision values for Nearest Neighbour Analysis ranged from 0.1 – 2.15.
Where: 0.1 – 1.0 =

Thus, with the nearest neighbour index of 0.74, it is evident that filling stations are clustered within the central area of Ede town. To have a visual knowledge of the exact locations of the filling

stations in space, geospatial data ((latitude, longitude) were analysed with the aid of Archview GIS software. The result of the analysis is presented in the map below.

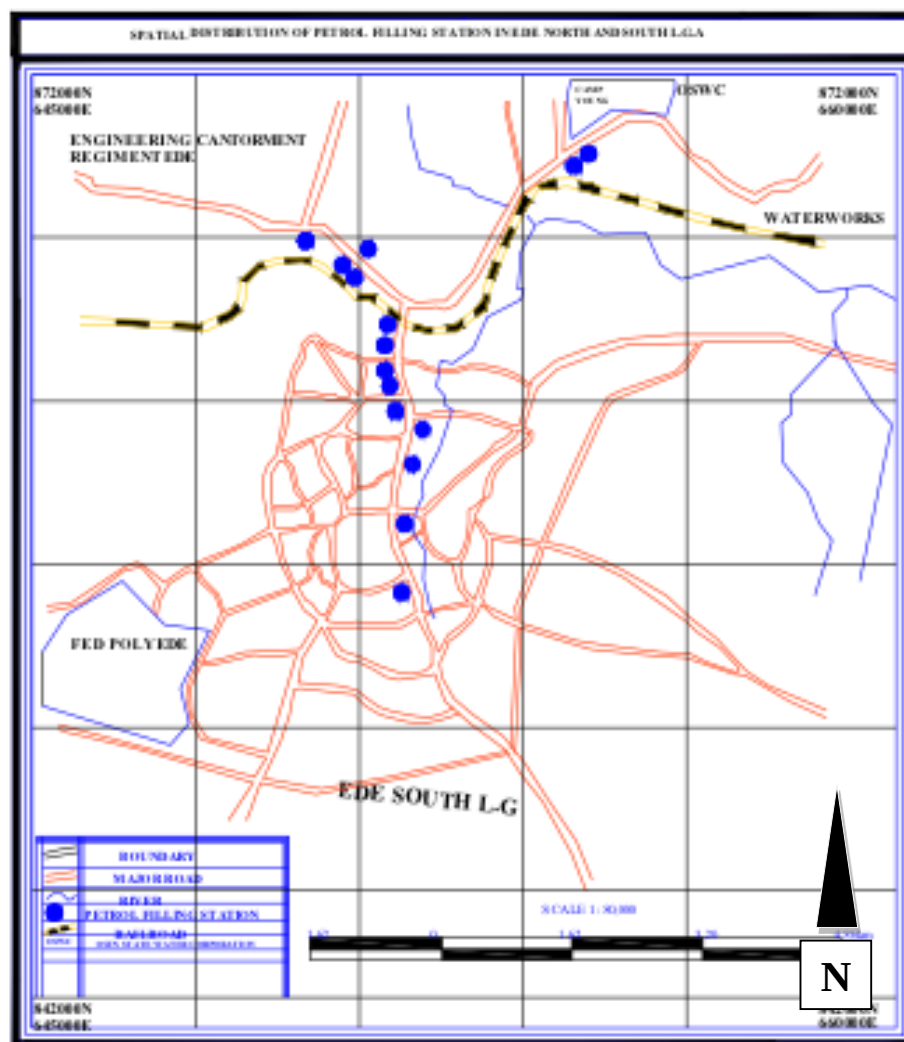


Figure 1: Spatial Distribution of Petrol Filing Stations in Ede

SOURCE: Authors' Fieldwork, 2019

However, as evident in Figure 4, petrol filling stations are located in linear form along the major roads that delineate the town. Attempt by the petrol filling stations' owners to enjoy maximum sales and accessibility appears to have influenced this location pattern of the filling stations. Moreover, as observed during the field survey, the proximity of the petrol filling stations to each other influenced high

traffic volume on the roads. This may create debilitating effects on the roads and the neighbourhoods such as traffic congestion (Plate 1), automobile accident, crime, noise etc. For instance, traffic congestion leads to man-hour loss and a potent source of automobile accidents if not well managed. Such heavy traffic equally exerts pressure on the roads infrastructure and roads' pavements thereby reducing the durability of the roads.

There is also the possibility of criminal activities such as theft and dispossession of valuables belonging to motorists and other commuters during traffic congestions. A

number of scholars have partly linked transport crime to traffic congestion and poor road infrastructure (Odufuwa, 2015).



Plate 1: Traffic congestion as a result of petrol filling station's trailer dispensing fuel on road setback

Source: Authors' fieldwork, 2019

Residents' Perception of Environmental Effects of Petrol Filling Stations

This section discusses residents' perceived effects of petrol filling stations on the environment. The parameters considered are noise, fire outbreak, road accidents, traffic congestion, water contamination and fuel odour irritation. Analysis of the respondents' responses on this indicates that 93 % of the respondents considered noise pollution as the major problem associated with petrol filling stations in their neighbourhoods (Table 9). The noise was reported to have emanated from horns and engines of different automobiles that patronise the petrol stations in the area. The intensity of noise pollution from automobiles is particularly high and disturbing during fuel

crisis. This is the time intense struggle to buy fuel in the petrol stations by motorists lead to unbearable noise in their neighbourhoods. Other source of noise pollution by the filling stations as indicated by the residents include electric generators being used as alternative source of power by the petrol stations during public power outage as well as noise associated with petty trading in the filling stations. However, only a very few percentage of the respondents considered the existence of petrol stations as having any significant association with fire outbreak, road accidents, traffic congestion and contamination of surrounding water. For instance, just 8.7% of the respondents reported the fire outbreak effects of filling stations, about 22.7% related occurrence of

road accidents to filling stations, 32.7% linked traffic congestion to the existence of filling stations, only 24.7% believed petrol stations in their neighbourhoods contribute to ground water contamination while only 18.0% of the respondents indicated fuel odour irritation as the effect of petrol stations in their neighbourhoods (Table 9).

Meanwhile, juxtaposing the responses of the residents on the effects of petrol stations on their environment and health with findings of scholars who have

objectively determined the effects as highlighted earlier, one will conclude that the residents have little understanding of these effects and may not be able to effectively link certain illnesses to the proximity of their residences to petrol stations. Low literacy level among the residents appears to be responsible for the lack of awareness of the environmental and health implications of petrol stations in their neighbourhoods.

Table 9: Perceived Environmental Impacts of Petrol Filling Stations

Perceived Impact	Yes		No		Total	
	Freq.	%	Freq.	%	Freq.	%
Noise	140	93.3	10	6.7	150	100.0
Fire outbreak	13	8.7	137	91.3	150	100.0
Road accident	34	22.7	116	77.3	150	100.0
Traffic congestion	49	32.7	101	67.3	150	100.0
Water contamination	37	24.7	113	75.3	150	100.0
Fuel odour	27	18.0	123	82.0	150	100.0

Source: Authors' survey, 2019



Plates 2 and 3: Petrol filling stations without setback to residential building

Source: Author's fieldwork, 2019



Plate 4: Petrol filling station without setback to road

CONCLUSION

From the foregoing, it has been established that petrol filling stations are springing up in the study area with little compliance with the existing physical planning standards, hence, posing threat to the environment and public health. Unfortunately, majority of the residents were not aware of the health implications of the non-compliance of the petrol stations with the planning standards. To safeguard public health and ensure health urban development in the study area, it is imperative for the Osun State Ministry of Physical Planning and Ede

North and South Local Planning Authorities to ensure strict enforcement of planning standards and regulations in petrol stations development as well as any other physical developments in the area. There is also the need for public sensitisation programmes by the relevant authorities on the environmental and health problems associated with such physical developments. Such sensitisation programmes can be achieved through mass media and partnership with the traditional rulers and home town associations.

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URBAN RENEWAL AS A TOOL FOR THE SUSTAINABLE DEVELOPMENT OF KADUNA URBAN AREA



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Abstract

The high rate of urbanisation in developing countries which is considered as an outcome of rapid urban growth, has continued to impact negatively on the sustainable development of most urban areas. This has subsequently resulted in tremendous pressure on existing public infrastructure systems, multifarious decay of urban areas, urban slums and housing problems, deficient infrastructures, environmental degradation, traffic congestion, proliferation of criminality and other social vices. Hence, this brings about the need for a proactive approach, such as urban renewal, which plays a crucial role in the sustainable development of most urban centres. Therefore, this study aims to examine the various urban renewal strategies that serve as a tool for the sustainable development of Kaduna city in Nigeria. This is achieved through an empirical review that relies on literature and documentary reports of various urban renewals strategies as an assessment tool for each project. The study explores the major urban renewal components of Kaduna city, their strategies as well as some of the projects executed in the city in order to achieve sustainable development. The study revealed that appropriate and effective urban renewal strategies like redevelopment, rehabilitation, revitalisation, and heritage preservation are inevitable in our contemporary urban centres in achieving sustainable development. As such, such strategies can be replicated in other urban areas in Nigeria through the effective implementation of policies, strategies, and projects that conscientiously seeks to address infrastructural decay and attain sustainable development. The study concluded by recommending good and effective strategies, development of sustainable infrastructural plan as well as public-private partnership as a way of achieving a successful urban renewal.

Keywords: City, Sustainable Development, Urban, Urban Area, Urban Renewal.

1.0 Introduction

The rapid rate of urbanisation of cities has been one of the most remarkable developments of developed and developing countries since the 1980s and has subsequently become a global challenge due to the growth of large urban agglomerations (Agbola, 2007). The United Nations Human Settlements Programme (2004) reported that about half of the global population presently lives in cities and estimated that this would increase to about sixty percent by 2030. Similarly, the United Nations Department of Economic and Social Affairs (UNDESA), (2018), stated that the current urban population of the world had overgrown from

a previous 751 million in 1950 to about 4.2 billion in 2018. This population signifies about 55% of the world's population to be living in urban centres, a percentage that is expected to increase to about 68% by 2050. Estimates also revealed that urbanisation which is the gradual shift in residence of the human population from rural to urban centres, coupled with the increasing population growth rate could increase another 2.5 billion people to the world's urban population by 2050, with almost 90% of this increase concentrated in Asian and African countries (UNDESA, 2018). Otoo (1982) is of the opinion that most of these towns and cities with increasing growth rates

are in developing countries, which have been rapidly expanding, with the total number of urban inhabitants nearly multiplying every ten years.

In Nigeria, a country with one of the world's highest urban growth rates of about 5.3%, as described by Omole (2009) and other developing countries, the urban population is expected to rise from about 1.9 billion in 2000 to approximately 3.9 billion in 2030. This is primarily due to rural to urban migration, which is consequent upon the dichotomous planning and development that many developing countries adopted, particularly after independence. Hence, the deprivation of rural areas and endowment of urban centres, which translates to the improvement of amenities and economic opportunities in urban centres than rural areas, thereby increasing the urban population. This subsequently results in the built environment of most urban centres in developing countries like Nigeria to be fast decaying with unabated gross dilapidation and decay of all its constituent fabrics (Ahianba, Dimuna, & Okogun, 2008). Nigeria's urban population has rapidly grown, such that the estimated urban population which was far less than the rural population had nearly equalled the rural population in 2015. The estimate that followed indicated that in 2018, the urban population of Nigeria was approximately 98.6 million as compared to the rural population, which was around 97.2 million. This is a significant increase in the urban population. Similarly, Kaduna, with a population of 8.11 million, has continued to witness a high rate of urbanisation that is similar to the scenario in Nigeria. According to Abdullahi et al., (2009), the population structure of Kaduna indicates that majority of the populace live in urban or semi-urban towns such as Kaduna city, which is the state's capital and one of the largest cities in

Northern Nigerian and other urban and semi-urban areas like Zaria, Kafanchan, Makarfi, Birnin Gwari, Zonkwa, Zangon Kataf and Kagoro. The current rate of urbanisation in Kaduna has resulted in the city's metropolis exceeding its original boundary and the expansion of other native settlements around the edge of the city. Hence, Kaduna city has grown continuously having sporadic and unplanned developments with inadequate infrastructures and services that have resulted in various consequences like urban slums and housing problems, infrastructure decay, environmental degradation, traffic congestion, and other social vices (Bununu, Ludin, & Hosni, 2015). As a result of this, the city of Kaduna is in urgent need of urban renewal that seeks to maintain a balance between environmental, social, economic, and cultural development through the expansion and upgrade of critical public infrastructures like roads, parks, markets, housing, industries, and other public facilities which have been neglected over time. This will lead to vast opportunities for economic rejuvenation and improving environmental integrity, which will serve as the basis for the sustainable development of the city. It is against this background that this study aims to examine the various urban renewal strategies that serves as a tool for the sustainable development of Kaduna city in Nigeria.

The objectives of the study are:

- i. To study the concept and relationship between urban renewal and sustainable development.
- ii. To study Kaduna city and its urban renewal process.
- iii. To examine the various components and strategies of urban renewal in Kaduna.

2.0 Urban Renewal and Sustainable Development

2.1 Concept of Urban Renewal

The concept of urban renewal is similar with that of urban regeneration, urban rehabilitation, and urban redevelopment but are significantly different in terms of scale with urban renewal consisting of a relatively large scale work that mainly aims at achieving a physical change (Zheng, Shen, and Wang, 2014). Urban renewal has an American origin and started as a concept of urban redevelopment. According to Buissink (1985), the concept of urban renewal primarily aimed at clearing and restructuring the land use of the inner American city, which had transformed into slums, and also to develop a comprehensive plan for a new residential and non-residential developments in the city. Roberts (2000) described urban renewal as a normative concept that is rooted in the British urban policy, which seeks to improve the physical, environmental, social, and economic conditions of an urban area and remedy the problem of urbanisation. Urban renewal transforms the urban environment through comprehensive large scale control of the existing urban environment to improve both the present and future operations of urban inhabitants (Dimuna & Omatsone, 2010; Osuide, 2004). Similarly, Zienlenbach and Levin (2000) defined urban renewal as the physical redevelopment of shattered areas, an improvement of public infrastructures, the eradication of undesirable individuals or private organisations, and the creation of additional jobs. Urban renewal is primarily an act of uplifting a decaying urban area in order to restore its economic vitality which is vital to sustainable development and improving the overall safety of people living in such urban areas (Norris & Redmond, 2007). Gbadegesin and Aluko (2010) conclude that urban renewal overhauls the congestion in urban centres, helps to

stimulate economic growth, creates environmental friendly opportunities for private investments as well as improve and expand developmental opportunities for sustainable development (Planning and Land Bureau, 2001). Urban renewal aims at re-planning and re-structuring concerned urban areas; designing effective and environmental friendly transportation networks; providing public and recreational facilities; providing timely building/road maintenance and rehabilitation; providing purposively built housing for different groups of people that includes groups with special needs like the elderly and the disabled as well as preserving buildings, structures, and sites of historical and cultural value among others (Urban Renewal Strategy (URS), 2011). Therefore, urban renewal is regarded as a comprehensive approach in encouraging land values, improving environmental quality, resolving the problem of urban decay, and meeting the various socio-economic objectives for sustainable development (Zheng et al., 2014). In summary, urban renewal improves the physical, environmental, and social-economic aspects of urban areas through various strategies like redevelopment, rehabilitation, revitalisation, and heritage preservation (Gulli & Zazzi, 2011).

2.2 Concept of Sustainable Development

Sustainable development concept can be defined in several ways as viewed differently by numerous researchers. However, the main idea common to all definitions involves the exploitation of resources without causing damage to future generations. The definition of sustainable development as published by the Brundtland report of 'Our Common Future' refers it as a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (World Commission on Environment and

Development (WCED), 1987). Similarly, Akinbode (1995) described sustainable development as the provision of affordable and adequate basic needs of life for the current generation without endangering the prospects of future generations. It focuses on the provision of cost-effective and self-reliant development, which facilitates access to food, shelter, potable water, and healthcare through people-oriented initiatives (Tolba, 1987). Fri, (1992) and Toman (1992) are also of the opinion that the concept of sustainable development coupled with economic and environmental development meets the needs of the present generation without compromising that of the future generations to meet their needs. Blackwell, Goodwill, and Richard (1992) further described sustainable development as a process of change in which resource exploitation, investment direction, technological orientation as well as institutional change are all in harmony with each other and improve both the present and future potential to meet up with human needs and aspirations. Sustainable development, therefore, is a concept that has generated global concerns as it relates to environmental protection and economic development with an overall objective of long-term environmental and economic stability. Hence, the components of sustainable development involves environmental integrity, social equity and economic growth (Emas, 2015; Zheng et al., 2014). In addition, Goal 11 of the Sustainable Development Goals (SDGs) as articulated by the United Nations 2015 - 2030 agenda seeks to make cities inclusive, safe, resilient and sustainable. This goal directly addresses developmental and environmental problems which poses a serious threat to the well-being and the development of urban centres through various initiatives and strategies which makes the environment a better place

to live for both the present and future generations.

2.3 Relationship between Urban Renewal and Sustainable Development

There is a universal consensus that the term 'sustainable development' generally dates back to the 1970s; however, it became prominent in the context of urban renewal around the 1990s, with a strong relationship existing in the literature between sustainable development and urban renewal (Bromley, Tallon, & Thomas, 2005). Urban renewal has been a recent and popular approach to achieving a more sustainable urban environment. The concept of urban renewal corresponds to sustainable development in terms of social, economic, and environmental sustainability. It seeks to improve the built environment of urban areas, especially that of old cities with rapid population growth, having numerous urban challenges like environmental dilapidation, deteriorating infrastructures, insufficient housing, transportation problems, the problem of waste management, and other essential services (Lee & Chan, 2006). It is considered as an appropriate approach to remedying the problem of urban decay and meeting the various socio-economic objectives (Lee & Chan, 2008); encourages land values and improves environmental quality (Adams & Hastings, 2001); as well as promotes the inclusion of vulnerable groups, enhances existing social networks and changes the adverse impacts of urban growth to the environment (Chan & Yung, 2004). The various components of urban renewal also facilitates the improvement of public infrastructures and the provision of good-quality housing that reduces health risk to the community (Krieger & Higgins, 2002); improves the effective use of land resources and building standard in urban centres (Ho, Yau, Poon, & Liusman, 2012); and encourages the renovation of dilapidated

buildings (Ho et al., 2012). As such, with the consideration of the various components of urban renewal, urban renewal significantly contributes to achieving goal 11 of the Sustainable Development Goal, which seeks to make cities and human settlements inclusive, safe, resilient and sustainable. Hence, the various strategies of urban renewal can be utilised in proffering solutions to urban problems.

3.0 The city of Kaduna, Nigeria

3.1 Overview

The city of Kaduna was established in 1912 during the British colonial administration and was headed by Lord Frederick Lugard. It was initially recognised as a garrison town and subsequently, the regional capital of the then British Colonial Protectorate of Northern Nigeria (Haruna, 2012). The state as a whole covers a land area of 46,053 square kilometres (National Population Commission (NPC) and ICF Macro, 2009), representing about 4.6% of the total land area of Nigeria, making it the twelfth largest state in Nigeria (Kaduna State Government, 2017a). The city of Kaduna has a unique political history of being at various times, the seat of the defunct government of Northern Nigeria, then of the former North-Central state, as well as the capital of the old Kaduna State when it comprised of the defunct Zaria and Katsina provinces. Kaduna is also one of the most industrialised urban centres in Northern Nigeria, having most of its industries particularly the garment and textile industry in existence since the colonial and early independence periods. Other industries within the Kaduna urban areas include the refinery and petrochemical plants, vehicle assembling plants, fertiliser processing plants, breweries industries, defence industries and divisions, among others. It is evident that since the creation of Kaduna, the city has had the attribute of an urban area

with many opportunities and as such, has attracted much populace. The population of Kaduna according to the 2006 National Population Commission (NPC), stood at 6,113,503, making the state the third most populous state in Nigeria after Kano and Lagos. With an assumed population growth rate of 3.18 percent as estimated by the National Population Commission, the population of the state grew to about 8,103,075 in 2016, and by 2020, the state's population is expected to be around 9,476,053 with a further rise to 12.96 million by 2050. The high rate of urbanisation and urban agglomeration in Kaduna, where over 21% of the population are expected to live in urban centres by 2020, further reiterates the need for urban renewal projects to curtail the expected pressure.

3.2 Location

The Kaduna city is located between latitudes 10 and 11 degrees north and longitude 7 and 8 degrees east at an altitude of 645m above sea level (Bununu et al., 2015). The city is uniquely and strategically situated almost at the geographic centre of Nigeria. Kaduna, the seat of the state government service other Northern states in Nigeria and the Federal Capital Territory (F.C.T). Consequently, the city has become a major transportation hub and a trade centre in Nigeria (Kaduna State Government, 2017b). In playing this role, it has a network of roads that link it with other parts of Nigeria. The major roads include the Kaduna to Abuja road (linking the Kaduna to the Southern parts of Nigeria), the Kaduna to Zaria to Kano road, and Kaduna to Saminaka to Jos road. Figure 1 shows the map of Kaduna State within Nigeria bounded by Kano, Katsina and Zamfara states to the North; Bauchi State and Plateau State to the East; Nassarawa State and the Federal Capital Territory (F.C.T) to the South and Niger State to the West.

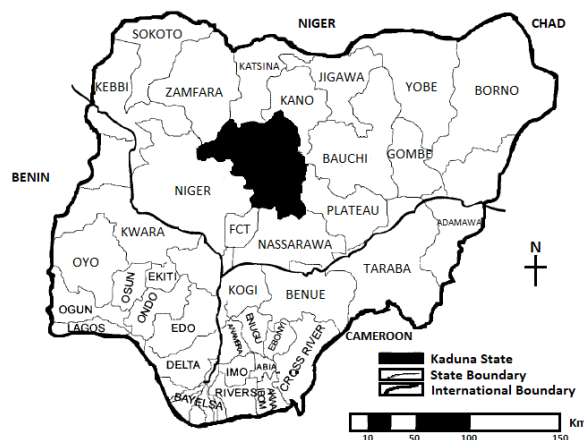


Figure 1: Map of Nigeria showing Kaduna State

3.3 Administrative Areas

Kaduna, the capital of Kaduna state, was created by the colonial authorities as an administrative centre for the then Northern Nigeria and had since the 1940s attracted people from all over Nigeria to the state. The state as a whole has a total of 23 Local Government Areas (LGAs) with headquarters in Birnin Gwari, Kujama, Giwa, Turunku, Kwoi, Kafanchan, Kachia, Doka, Makera, Kagarko, Kajuru, Kaura, Kauru, Anchau, Hunkuyi, Saminaka, Makarfi, Sabongari, Gwantu, Maigana, Zaria and Zonkwa.

4.0 Findings and Discussion

4.1 Urban Renewal in Kaduna, Nigeria

Due to the numerous pressure on existing infrastructures as a result of the increasing urban growth in Kaduna, the state government acknowledged the imperative need for the development of infrastructural projects to serve as a tool for the sustainable development of the city. Thus, revived the activities of the Kaduna State Urban Planning and Development Agency (KASUPDA), which was established in 1985 via Edict No. 10 and saddled with the responsibility of ensuring proper planning and development of the city's urban area. This agency initiated

various urban renewal projects which are executed by the Kaduna State Government under the Kaduna State Urban Renewal Programme and covers the various sectors that include but not limited to public infrastructure, transportation, housing, lands, urban restoration, and development, as well as waste management. Some of the specific projects of the Kaduna State Urban Renewal Programme includes the construction of new roads and bridges to expand and connect various parts of the city's metropolis, the expansion, and maintenance of existing roads, the provision of mass transit buses, the improvement of the land-use system, the construction of new markets and neighbourhood centres, the provision of street and traffic lights, the provision of road markings and road signage, the provision of solar kiosks, street naming, the construction of parks and recreational centres, the construction of neighbourhood sports centres, the conversion of Murtala square to a modern sports centre as well as the implementation of a modern waste management system. Table 1 shows the various components of urban renewal in Kaduna city alongside the list of on-going major urban renewal projects executed by government in order to, create orderliness

and ensure the city function effectively; harness the potential of the city as an engine of socio-economic growth and development

as well as promote tourism and enhance the urban economy of the city for sustainable development.

Table 1: Urban Renewal Projects in Kaduna, Nigeria.

Urban Renewal Component	List of Urban Renewal Projects in Kaduna, Nigeria.	Coverage	Urban Renewal Strategy
1. Roads	Kabala Costain to Aliyu Makama Road	2.84km	Redevelopment
	FRCN Road, Malali to College Road by Legislative quarters	2.73km	Redevelopment
	Rabah Road to Nnamdi Azikwe Road (Western Bypass)	37km	Redevelopment
	Nnamdi Azikwe Road (Western Bypass) to Rigasa Train Station	5.95km	Redevelopment
	Umaru Musa Yar'adua Way (Millennium City) to Eastern By-pass	5.73km	Redevelopment
	Urban Shelter Road (Off Umaru Musa Yar'adua Way) to Patrick Yakowa Way	3.5km	Redevelopment
	Dualization and Junction Improvement of Waff Road, from NEPA roundabout to Essence Junction	2.5km	Revitalization
	Dualization of Katuru Road, from Isa Kaita to Rabah Road	0.6km	Revitalization
	Dualization of Yakubu Gowon Way to Barau Dikko Teaching Hospital - Waff Road	2.2km	Revitalization
	Construction of an Underpass at Leventis Roundabout	-	Redevelopment
	Upgrade of Alkali Road with Street and Traffic Light	1km	Rehabilitation
	Dualization of Tafawa Balewa Way - Waff Road (GOC Roundabout)	2.5km	Revitalization
	Expansion of Swimming pool Road from Police roundabout to Almanar Mosque	2.3km	Revitalization
	Dualization of Poly Road to Dutsenma Road via Kasuwan Bacci Roundabout	2.9km	Revitalization
	Dualization of Existing Dutsenma Road to Poly Road via Shema Petroleum	2km	Revitalization
	Expansion of Gov't House Roundabout to Nnamdi Azikwe Bypass via Gamagira Road	3.7km	Revitalization
	Dualization of Existing Rabah Road from Arewa House to Junction to Water Board	4.2km	Revitalization
	Expansion of existing Laminu Road, Unguwan Rimi from Total to Ramat Road	0.9km	Revitalization
	Kakuri to Nasarawa Floor Mill Road	4km	Rehabilitation
	Expansion of Kinshasha Road, Unguwan Rimi	1.6km	Rehabilitation
	Dualization and Junction improvement of Racecourse road from Independence way to Tafawa Balewa Way	1.2km	Revitalization
2. Housing & Improved Land Use	Construction of 2,000 housing units	Kaduna North	Redevelopment
3. Street Lights	Provision of Solar Street Lights	Kaduna North	Rehabilitation
	Provision of Traffic Lights	Kaduna North	Rehabilitation
	Street Naming	State-wide	Rehabilitation
4. Parks & Recreational Centres	Construction of Centenary Park	Kaduna North	Revitalization
5. Markets & Neighbourhood Centres	Construction of Kaduna Galaxy Mall	Kaduna North	Redevelopment
	Construction of Central Market Car Park	Kaduna North	Redevelopment
	Construction of Kasuwan Magani Ultra-Modern Market	Kasuwan Magani	Redevelopment

Findings from the various on-going urban renewal projects in Kaduna city presented in Table 1 indicate that about eleven (11) projects are undergoing redevelopment, twelve (12) projects are undergoing revitalisation while six (6) projects are undergoing rehabilitation. These projects are located within Kaduna metropolis, across four local government areas which are Kaduna North, Kaduna South, Chikun and Igabi. These urban renewal projects are expected to be completed within 24 months. The completion of the various road components of the urban renewal project is expected to open up Kaduna city's urban area, connect communities as well as create alternative routes that will considerably help in reducing travel time, from north to south, and east to west of the city. This conforms to the assertion of the World Bank (2012) which stated urban transport as a key component of sustainable urban development. As such, plays an integral role in achieving Goal 11 of the Sustainable Development Goals (SDGs) which seeks to make cities inclusive, safe, resilient and sustainable through safe, affordable, accessible and sustainable transport systems. Similarly, the provision of traffic lights, solar street lights and the further development of public transit system, such as the mass transit buses, will help in reducing the use of *tricycles, shared taxis and mini-buses within Kaduna city*. This will subsequently reduce the human and traffic congestion as well as sound and air pollution in parts of Kaduna city. Also, the construction of 2,000 housing units, Centenary Park and Kaduna galaxy mall within the urban area of Kaduna will contribute to Goal 11 of the Sustainable Development Goals which seeks to ensure access to adequate, safe and affordable housing and basic services as well as provide universal access to safe, inclusive and accessible, green and public spaces. This will

overall enhance economic vitality of the city and improve the living condition of people. Hence contribute to the overall sustainable development of Kaduna city.

4.2 Urban Renewal Strategies in Kaduna Urban Area

The fundamental concept of the urban renewal in Kaduna is the upgrading of the physical, social and economic status of the city through the utilisation of various strategies of urban renewal that include redevelopment, rehabilitation, revitalisation, and heritage preservation. These strategies serve as an essential tool in dealing with the environmental, social, and economic problems related to the rapid urban growth of the city, which have resulted in urban decline, uneven and unbalanced growth of urban areas, and other negative impacts. These four strategies of a successful urban renewal are further discussed below.

4.2.1 Redevelopment

It is a strategy in which the government works either individually or in partnership with private developers to enhance the physical, social, economic, and environmental vitality of the urban centre within some identified project areas. Redevelopment usually involves the demolition or removal of existing buildings, structures and infrastructures as well as the re-use of cleared land for the development of new projects. It impacts positively on the growth of urban centres because it promotes improvement and restoration that focuses on the sustainable development of such areas. Miller (1959) believes that the positive effects of redevelopment are beyond every project boundaries. As such, it improves the overall city's image as well as the social and economic environment.

4.2.2 Rehabilitation

Rehabilitation, which is also referred to as preservation or conservation, is a strategy that seeks to preserve, repair, and restore the

natural and built environments of urban centres. It is generally appropriate for urban centres in which buildings, structures, or infrastructures are in a state which are structurally sound but have deteriorated over time due to lack of maintenance. Duzcu (2006) believes that urban rehabilitation improves the conditions of existing buildings and infrastructures as well as preserves the original character of the urban fabric in addition to the removal of any physical impediment that causes urban decline. Rehabilitation of urban areas contributes significantly to sustainable development by improving the built environment and reducing the need or urgency for redevelopment through proper and regular maintenance, which is an essential aspect of old cities regeneration.

4.2.3 Revitalisation

It is a comprehensive urban renewal strategy that combines the best approaches to rehabilitation and redevelopment. Roberts and Sykes (2000) are of the view that urban revitalisation is a new way of tackling urban problems that focuses on an integrated and combined approach. It involves the rehabilitation of what can be saved realistically and the reconstruction of buildings, structures, and infrastructures that are beyond feasible rehabilitation. A revitalisation strategy is a flexible approach that leads to the resolution of urban problems by preserving the urban environment and promoting the improvement of the physical, environmental, and socio-economic conditions of urban centres.

4.2.4 Heritage Preservation

This is an urban renewal strategy that involves the preservation and restoration of buildings, structures, and sites of historical, cultural, or architectural importance as well as the retention of the historical character of urban centres alongside the local identity of the community. Heritage buildings and

places of local interests serve as an important asset for most urban centres. Hence, heritage preservation as a strategy of urban renewal contributes significantly to enhancing the uniqueness of urban centres for sustainable development by preserving buildings of heritage value and enhancing places of historical, cultural, or architectural interest.

5.0 Conclusion

The decay of urban areas as an outcome of rapid urbanisation and population growth has continued to be a severe contemporary challenge in most urban centres in Nigeria, especially in cities like Kaduna that has a growing urban population and also considered to be a gateway to Northern Nigeria. Due to its strategic location, it is clear that urban centres like Kaduna need urban renewal due to the increasing urban problems arising from population growth as well as unplanned and dense infrastructures. Hence, urban renewal is inevitable for the sustainable development of such urban centres due to the overwhelming impact it has on the overall quality of lives. Therefore, the study examined the various urban renewal strategies in Kaduna, which serves as an appropriate mechanism for the sustainable development of the city. This is demonstrated by the current findings, which revealed urban renewal as a holistic and comprehensive approach to rejuvenating Kaduna city's urban centre by way of redevelopment, rehabilitation, revitalisation, and heritage preservation. As such, the findings of this study suggest that urban renewal strategies serve as an appropriate tool for the best possible outcomes in urban renewal projects, while urban renewal itself is one of the feasible solutions to the sustainable development of urban centres like Kaduna in Nigeria. The study has enhanced our understanding of the various components and strategies of urban renewal that can efficiently transform our urban centres in

Nigeria. Thus, renewed cities would ensure not only physical, environmental, and socio-economic development but also improve sustainable development that is safe, secure, and healthy with a qualitative urban life for both the present and future generations. The current study was limited to exploring the strategies of the major ongoing urban renewal projects within the urban areas of Kaduna. Therefore, further research is needed upon the completion of these projects to determine the outcome of urban renewal in Kaduna.

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A REVIEW OF UNETHICAL PRACTICES AMONG CONSTRUCTION PROFESSIONALS AND MEASURES TO CURB THEM



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ABSTRACT

The construction industry is fraught with unethical practices traceable to construction professionals which have affected the performance of the industry negatively especially the negative image it projects the construction industry. Extant studies on unethical practices focused on the effects and types of unethical practices with some going further to study measures that can be adopted to curb unethical practices. In the Nigerian construction industry, limited studies exist on measures to curb unethical practices. The aim of this study is to identify the most prevalent unethical practices among construction industry professionals and suitable measures adopted to curb them. This study conducted a desktop literature review of literature from 2003 to 2019 on unethical practices, prevalent unethical practices and measures adopted to curb unethical practices within the construction industry. The major findings of this study are: although unethical practices are difficult and challenging to contain, they can be curbed; 23 prevalent unethical practices within the construction industry were found and the most prevalent ones are bribery, collusive tendering, bid cutting, conflict of interest and fraud. The study found that most measures adopted to curb unethical practices are responsibility-based in nature. These responsibilities are expected of all stakeholders – Governments of countries, professional bodies/institutions, construction organizations and construction professionals. The most advocated measures to curb unethical practices are leadership by example, zero-tolerance policy for unethical practices, implementation of code of ethics and training/retraining construction professionals on codes of ethics, promotion of ethical construction culture and appropriate prosecution of professionals involved in unethical practices.

Keywords: Code of ethics, Construction industry, professionals, unethical practices, contract administration

INTRODUCTION

The construction industry is vast, diverse and fragmented with several professionals collaborating to execute projects (Aigbavboa Oke & Tyali, 2016; Chartered Institute of Building, 2013). In order to practice their trade, these professionals need to be morally responsible to not just individuals but other professionals (Bayles, 1989 in Abdul-Rahman, Wang & Yap, 2010) within the industry, making professional ethics a requisite. Extant studies have also assessed the importance of professional ethics not just to the professionals but majorly, the entire construction industry. Some of the

importance of ethics to the construction industry includes: it influences the quality of construction projects (Abdul-Rahman et al., 2010), it enhances the construction industry to attain success worldwide, it enables optimal performance within the industry, and generates lasting economic returns. Hence, there is a growing demand for ethical practice within the construction industry (Vee & Skitmore, 2003).

The uniqueness of the construction industry particularly with regards to several professionals (with individual interests) working together to execute projects, makes the industry susceptible to unethical

practices. Extant studies including Lee & Cullen (2018), Shah & Alotaibi (2017) and Bowen, Edwards & Cattell (2012), revealed that the construction industry is enmeshed in unethical practices and is traceable to construction professionals (Aigbavboa et al., 2016). By definition, unethical practice is any act that has harmful effects on others and is legally/morally unacceptable to a larger community (Gino, 2015). The existence of unethical practices within the construction industry is not just limited to certain countries but is rather, a global phenomenon (Lee & Cullen, 2018; CIOB, 2013) with devastating outcome on the economy of countries.

There are extant studies on unethical practices within the construction industry conducted in Australia (Vee & Skitmore, 2003), China (Zou, 2006), UK (Stansbury & Stansbury, 2018), South Africa (Aigbavboa et al., 2016), Malaysia (Adnan, Hashim, Yusuwan & Ahmad, 2012), and several countries. These studies not just outlined the types and effects of unethical practices within the construction industry but also proffered strategies on how to contain unethical practices among construction industry professionals. These solutions need to be explored as Stansbury & Stansbury (2018) opined that unethical practices could be prevented whereas Vee & Skitmore (2003) stressed that curbing it could be difficult. In Nigeria, there are extant studies like that of Oyewobi, Ganiyu, Oke, Ola-Awo & Shittu (2011), Usman, Inuwa & Iro (2012), Adeyinka, Jagboro, Ojo & Odediran (2014), Inuwa, Usman & Dantong (2015), Olatunji, Oke, Aghimien & Ogunwoye (2016), Adeniyi, Adegbelembo & Ojo (2018) and Akinrata, Ogunsemi & Akinradewo (2019), on unethical practices within the Nigerian construction industry. However, most of these studies focus more on code of ethics implementation, existence, effects and outcomes of unethical practices with limited

studies on how to contain unethical practices within the industry.

The construction industry consists of several construction professionals who are required to execute their distinct roles professionally (Aigbavboa et al., 2016; CIOB, 2013). A typical construction project team is made up of Architects, Interior Designers, Surveyors, Civil / Structural Engineers, Quantity Surveyors, Mechanical Engineers and Electrical Engineers. These professionals deal with time, money, equipment, technology, people, and materials in the course of managing construction projects (Hussin & Omran, 2009). The divergent interests of these professionals lead to competitive behaviour among them resulting to unethical practices considering the fact that they have direct influence on construction projects (Aigbavboa et al., 2016). In the Nigerian construction industry, construction professionals, according to Olatunji et al. (2016) and Oyewobi et al. (2011) get entangled in unethical practices due to the challenging economic situation of the country exposing them to the temptation of being involved in unethical practices to make ends meet.

This research is aimed at identifying the most prevalent unethical practices among construction professionals within the construction industry and the suitable measures adopted to curb them based on existing literature. This is with the view to identify measures that can be adopted to curb unethical practices among construction professionals in the Nigerian construction industry in subsequent research. The dearth of research on measures that can curb unethical practices within the Nigerian construction industry makes this study important.

LITERATURE REVIEW

Unethical Practices

Unethical practices in extant studies like Vee & Skitmore (2003), Zou (2006), CIOB

(2013), Stansbury & Stansbury (2018) is portrayed as corruption within the construction industry. Their occurrence cut across all countries and no construction project is immune to unethical practices (Stansbury & Stansbury, 2018). Unethical practices reportedly takes place at all stages of construction projects – planning and design, pre-qualification and tender, project execution, operation and maintenance with lasting and detrimental effects (Stansbury & Stansbury, 2018; CIOB, 2013; Adnan et al., 2012; Oyewobi et al., 2011; CIOB, 2008). However, extant studies like Ameh (2018) reported that contractor pre-qualification, tendering procedure and award of contract are the construction project stages most prone to unethical practices.

Extant studies revealed that unethical practices exist in the construction industry for several reasons. According to Aigbavboa et al. (2016), the prevalence of unethical practices within the construction industry is due to greed, favouritism, political influence, and monopoly of bigger companies over smaller and emerging companies and pressure to meet unrealistic company objectives and deadlines. While Shah & Alotaibi (2017) opined that unethical practices exist in the industry due to conflict of interest among the various professionals and stakeholders. CIOB (2013) also reported cultural practices and the economic climate as the reason for unethical practices within the construction industry. Meanwhile, Auoad (2018) posited that unethical practices exist in the industry due to nepotism and self-interests. From a different perspective, Usman et al. (2012) in a study on unethical practices in the Nigerian construction industry opined that the absence of punishment for corruption is the major cause of unethical practices.

Effect of Unethical Practices

It is noteworthy that no extant study on unethical practices within the construction

industry reported any merit associated with unethical practices rather; they all reported its negative impact on the industry. Generally, unethical practices have lasting impact detrimental to the construction industry (Akpomiemie, Adedokun & Aje, 2018). For instance, Maseko (2017) reported that unethical practices give the industry a bad reputation; while Aigbavboa et al. (2016) and Olatunji et al. (2016) further opined that unethical practices affects the economic development of countries and their human resources. Olatunji et al. (2016) also reported that unethical practices distorts the entire construction process, hinder free play of market forces, and even discourages investors from investing in the construction industry. Other effects of unethical practices reported by Akinrata et al. (2019) and Aigbavboa et al. (2016) includes poor quality infrastructure, reduction in building lifespan, low productivity/efficiency by project team, clients' dissatisfaction, conflicts between stakeholders and loss of public trust. Meanwhile, Akpomiemie et al. (2018) also reported wasted tender expenses, tendering uncertainty, increased project costs, economic damage, blackmail, criminal prosecutions, fines, blacklisting and reputational risks as effects of unethical practices. Unethical practices also leads to loss of income by clients and governments, continuous insecure practices that risks lives and properties, needless and baseless expenditures raising poverty levels and reducing quality of life (Shah & Alotaibi, 2017). According to Stansbury & Stansbury (2018), unethical practices could also costs ethical organizations and professionals their jobs to those willing to indulge in unethical practices. Furthermore, unethical practices makes completed construction projects vulnerable to frequent maintenance work

due; whilst causing delays and cost overruns as well (Inuwa et al., 2015).

RESEARCH METHODOLOGY

Research papers on ethics, unethical practices and measures to curb unethical practices were searched using GOOGLE SCHOLAR search engine, with outputs restricted to English and construction-related articles. Google Scholar

was used as it provided the option to assess free published articles online. The articles retrieved were critically reviewed, and most prevalent unethical practices within the construction industry and measures to curb unethical practices were identified. The figure below depicts the research design for the study.

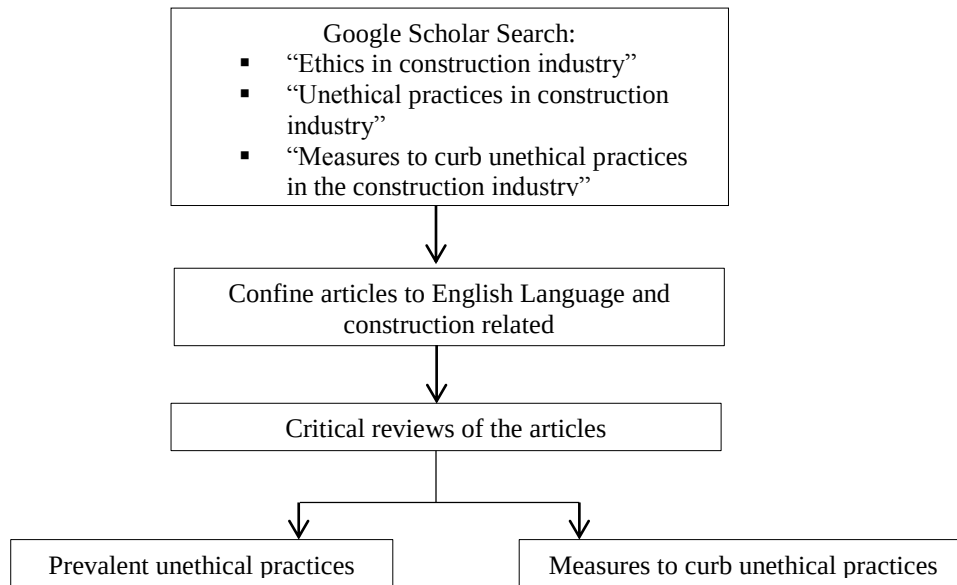


Figure 1: Research Design

RESULTS AND DISCUSSIONS

Prevalent Unethical Practices within the Construction Industry

The desktop review of articles reveals that there are several unethical practices within the construction industry. However, prevalent unethical practices vary within the industry from country to country. From the articles reviewed, 23 prevalent unethical

practices within the construction industry were reported and the numbers of occurrence were recorded for each prevalent unethical practice. As depicted in the table below, the five most prevalent unethical practices were bribery, collusive tendering, bid cutting, conflict of interest and fraud.

Table 1 Prevalent Unethical Practice within the Construction Industry

S/N	Prevalent Unethical Practices	Freq.	Source
1	Cover pricing	2	Adnan et al. (2012), Bowen et al. (2012)
2	Bid cutting	5	Lee & Cullen (2018), Shah & Alotaibi (2017), Kang et al. (2017), Adnan et al. (2012), Abdul-Rahman et al. (2010)
3	Poor documentation	1	Adnan et al. (2012)

4	Late and poor payment	1	Adnan et al. (2012)
5	Subcontractors' lack of safety ethics	1	Adnan et al. (2012)
6	unfair treatment of contractors in tender/final account negotiations	1	Adnan et al. (2012)
7	Illegal award of tenders	1	Aigbavboa et al. (2016)
8	falsification of experience and qualifications	2	Aigbavboa et al. (2016), Adnan et al. (2012)
9	Capital flight	1	Oyewobi et al. (2011)
10	Government policy	1	Adnan et al. (2012)
11	Conflict of interest	5	Shah & Alotaibi (2017), Ameyaw et al. (2017), Adnan et al. (2012), Bowen et al. (2012), Vee & Skitmore (2003)
12	Collusive tendering	8	Ibrahim et al. (2019), Lee & Cullen (2018), Ameyaw et al. (2017), Aigbavboa et al. (2016), Adnan et al. (2012), Bowen et al. (2012), Stansbury & Stansbury (2005), Vee & Skitmore (2003)
13	Bribery	9	Lee & Cullen (2018), Shah & Alotaibi (2017), Kang et al. (2017), Ameyaw et al. (2017), Aigbavboa et al. (2016), Oyewobi et al. (2011), Abdul-Rahman et al. (2010), Stansbury & Stansbury (2005), Vee & Skitmore (2003)
14	Corruption	2	Ibrahim et al. (2019), Abdul-Rahman et al. (2010)
15	Fraud	4	Ameyaw et al. (2017), Aigbavboa et al. (2016), Stansbury & Stansbury (2005), Vee & Skitmore (2003)
16	Deception	1	Stansbury & Stansbury (2005)
17	Unfair conduct	2	Ibrahim et al. (2019), Vee & Skitmore (2003)
18	Negligence	3	Ibrahim et al. (2019), Abdul-Rahman et al. (2010), Vee & Skitmore (2003)
19	Favouritism	1	Ibrahim et al. (2019)
20	Confidentiality and propriety breach	1	Vee & Skitmore (2003)
21	Kickbacks (Extortion)	2	Ameyaw et al. (2017), Bowen et al. (2012)
22	Violation of environmental ethics	3	Ibrahim et al. (2019), Oyewobi et al. (2011), Vee & Skitmore (2003)
23	Gifts	1	Shah & Alotaibi (2017)

Source: Author's Compilation

Curbing Unethical Practices

Although a difficult venture fraught with challenges, unethical practices according to Stansbury & Stansbury (2018) can be prevented within the construction industry. One of such challenge is the lack of information on unethical practices across several construction industries making it difficult to assess and address its prevalence (CIOB, 2013).

Literature reviewed on ethics and unethical practices within the construction industry revealed that some studies proffered numerous measures on how to curb unethical practices within the industry. These measures are responsibility-based in nature; responsibilities on the part of construction industry stakeholders and regulatory bodies. In curbing unethical practices among construction professionals, all hands (including that of leaders of government, professional institutions, contractors, consultants and all organizations) must be on deck (Stansbury & Stansbury, 2018).

Governments' role in curbing unethical practices: the role of leaders of government according to Stansbury & Stansbury (2018) is to lead by example, have zero-tolerance policy on unethical practices, refuse to participate in any unethical practice, have transparency policy regarding public sector projects, and implementation of preventive measures against unethical practices. According to CIOB (2008), Government of nations need to be dogged in curbing unethical practices considering the huge amount spent annually on government procurement worldwide. Although CIOB (2013) reported that governments are not doing enough to curb unethical practices.

Professionals' role in curbing unethical practices: curbing unethical practices amongst construction professionals is a difficult task (Vee & Skitmore, 2003). Aouad (2018) and Akinrata & Ogunbile (2018)

both opined that professionals (especially the leaders) need to lead by example in order to achieve high ethics and standards within the construction industry. While Inuwa et al. (2015) suggested adherence to professional ethics, and transparency and professional accountability among professionals in order to curb unethical practices. However, Aigbavboa et al. (2016) and Chilipunde & Kaima (2015) reported that most construction professionals hardly adhere to their code of ethics. In Nigeria, Akpomiemie et al. (2018) recommended the development of an ethical compliance culture by professional bodies among professionals to enhance ethical conduct.

Professional institutions' role in curbing unethical practices:

Professional bodies/institutions have a great role in curbing unethical practices. They are saddled with the responsibility of dictating how members behave ethically through their code of ethics (Adnan et al., 2012). Professional bodies play the role of enhancing construction professionals' integrity and respectability as they practice their trade (Blythe, 2018; Vee & Skitmore, 2003). In curbing unethical practices, Stansbury & Stansbury (2018), Ameh & Odusami (2010) and Vee & Skitmore (2003) suggested the implementation of ethical guidelines and policies by professional bodies via technical sessions and public lectures about the costs and risks of unethical practices. While Olatunji (2007) recommended consistent training and retraining of professionals on current trends in ethical issues, and record keeping of members' ethical issues by professional bodies for future reference. Oyewobi et al. (2011) further opined that laws be enacted to strengthen professional institutions to punish erring construction professionals. However, Olatunji (2007) further reported that these recommendations are only feasible where professional bodies

do not deliberately cover up unethical practices to increase membership as is obtainable in most developing countries.

Construction organizations' role in curbing unethical practices: Stansbury & Stansbury (2018) opined that stakeholders like companies, governments, project owners and funders need to develop a zero-tolerance policy on unethical practices, refuse to participate in any unethical practice, and set up organizational controls to prevent unethical practices. Furthermore, Ameh & Odusami (2010) recommended prompt and adequate remuneration for services rendered by construction professionals to eliminate the temptation to participate in unethical practices. Zou (2006) recommended three strategies to organizations to prevent unethical practices - develop honest and ethical construction cultures, institute random and regular checks of officials involved in construction projects, and supervise processes and work over project life cycle.

The general measures for curbing unethical measure according to Adeniyi et al. (2018), Shah & Alotaibi (2017), Aigbavboa et al. (2016), Chilipunde & Kaima (2015) and Oyewobi et al. (2011) are:

- Transparency
- Whistleblower protection
- Reducing incentives for corruption
- Taking action on ethical violation
- Legislative laws spelling out punishments for unethical practices
- Reviewing, monitoring and reporting unethical behaviour
- Development of honest and ethical construction culture
- Establishment of annual ethics training for employees and employers
- Punish offenders / rigorous prosecution
- Initiation of constant and random ethics checks
- Constant supervision of ethics

- Verbally promote ethical environment
- Good whistle-blowing mechanism
- Avoid conflicts of interest by managing projects under a single authority
- Increase employees benefits
- Banning erring professionals

CONCLUSION

In conclusion, the aim of this study is to identify the most prevalent unethical practices among construction within the construction industry and the suitable measures adopted to curb them. The study found that unethical practices are not limited to certain countries but cuts across several countries globally. Findings of the study also revealed that the most prevalent unethical practices are bribery, collusive tendering, bid cutting, conflict of interest and fraud. The study found that even though unethical practices are difficult to contain, they can be prevented when the right measures are put in place. The role of construction industry stakeholders in preventing unethical practices within the construction industry according to the findings of this study is very crucial. Some of the outstanding measures found to curb unethical practices include Governments, construction professionals and construction organizations leading by examples, a zero-tolerance policy for unethical practices among stakeholders, and ethics implementation and training/retraining of professionals about ethics by professional bodies. Finally, the study found that there is a dearth of research on measures to curb unethical practices in the construction industry of some developing countries like Nigeria.

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APPLICATION OF MODIS-NDVI FOR VEGETATION CHANGE DETECTION ACROSS NIGERIA FROM 2000 TO 2019



by
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ABSTRACT

Nigeria's vegetation has been facing serious challenges from both natural and human factors. These challenges have influenced researchers to investigate the causes and nature of the changes. Previous researchers used Normalized Difference Vegetation Index (NDVI) at 1km, which is considered a low spatial resolution for vegetation quantification at local level. Moreover, those studies were conducted ten years back, hence need for update. Therefore, this research adopted NDVI from Moderate-resolution Imaging Spectroradiometer (MODIS) at 250m spatial resolution and assesses vegetation change across Nigeria from 2000 to 2019 using Simple Image Differencing technique on Idrisi software, the Taiga edition. The result shows that the Southwest and Southeast regions of Nigeria experience negative change, while the Northern Nigeria experiences no change in vegetation greenness. It is recommended that the Federal Government and relevant stake holders should focus on Nigeria as a whole, not Northern region alone in combating desertification. Niger Delta Development Commission (NDDC) should incorporate afforestation programme in its projects to combat environmental challenges in the region. Appropriate field measurement was recommended to refine and improve on the result.

Keywords: Vegetation; NDVI; Spatial resolution; Simple image Differencing; Nigeria

INTRODUCTION/LITERATURE REVIEW

The vegetation of a place is an outcome of natural and socio-economic factors and the utilization by humans in time and space. Nigeria's land falls within the equatorial region with diverse vegetation types, ranging from Mangrove Forest from the south to Sahel Savannah to the north. Nigeria's vegetation has been facing serious challenges from both natural and human factors (Abdul, 2003). This influenced some researchers to investigate the nature of these changes. Studies by previous researchers that used Normalized Difference Vegetation Index (NDVI) at 1km spatial resolution which is considered low at local level, include Eniolorunda (2007) studied vegetation on Upper Niger River Valley using NDVI at 1km spatial resolution. Similarly, Yelwa, (2008) used NDVI with coarse spatial

resolution (1km) to detect vegetation change across Nigeria. At local level, 1km resolution will not provide sharp spatial discrimination on vegetation characteristics (Yichun, Zongyao, & Mei, 2008). According to Statistics Solutions (2019), an appropriate sample size can produce accuracy and validity of results with minimum error. With the advent of moderate and high spatial resolution satellites, adequate ground samples can be obtained for proper spatial observation. Moreover, these researches were considered obsolete (10 years back), hence, the need for update.

The NDVI model, according to GIS Geography (2020), is a quantitative measure that correlates highly with the quantity of living vegetative matter in any region. The

index is derived quite simply using the red and near infrared wavelength bands of electromagnetic energy. In green vegetation, the presence of chlorophyll causes strong absorption of red wavelengths while leaf structure will tend to cause high reflectance of near infrared of wavelengths. As a result, areas with a dense and vigorous vegetation canopy will tend to show a strong contrast in the reflectance in these two regions. The index is calculated as follows: $NDVI = (\text{infrared} - \text{red}) / (\text{Infrared} + \text{red})$.

To overcome the challenge of spatial resolution, this research adopted the NDVI at 250m resolution from Moderate-resolution Imaging Spectroradiometer (MODIS) on Terra satellite. This data is sharper and collects more ground samples (Zhongfei, Xiaobing, Dandan, Xu, and Hong, 2010). The research asks if significant changes in Nigeria's vegetation occurred over the study period (2000 to 2019). If so, what areas are mostly affected? These were achieved using Simple Image Differencing technique on Idrisi software, the Taiga edition.

MATERIALS AND METHODS

The Study Area

The study is on Nigeria, which shares boundaries with Republic of Benin in the west, Niger Republic in the north, Chad in the northeast, Cameroon in the east and Gulf of Guinea in the south. The area is geographically located between latitudes 4° and 13.9° north, and between longitudes 2.5° and 15° east, occupying about 923,768 km² (figure 1). The vegetation of Nigeria reflects its climatic and topographic characteristics.

Paramount influences are the rainfall gradient, the relative humidity, and the seasons. Thus, dominant vegetation types range from Forest of the south to the Savannah of the north (Tijjani, Crane, Upton, Dochartaigh, and Bellwood-Howard, 2018). Nigeria is endowed with arable land and fresh water resources when viewed as a whole with approximately 61 million hectares of the land cultivable while the total renewable water resources is about 280 km³/year which include river Niger, river Benue, lake Chad, Osun river, Hadejia River, Bonny river and a host of others. The different soils are a function of prevailing climatic condition, vegetative cover, and topography of the area, among others (FAO, 1995).

Nigeria, like the rest of West Africa and other tropical lands, has only two seasons. These are the dry season and the rainy season. The dry season is accompanied by a dust laden air mass from the Sahara Desert, locally known as Hammatan, or by its main name, The Tropical Continental (CT) air mass, while the rainy season is heavily influenced by an air mass originating from the south Atlantic ocean, locally known as the south western wind, or by its main name, The Tropical Maritime (MT) air mass. These two major wind systems (trade winds) modify climate of Nigeria especially rainfall, which is the key climatic variable. Topography plays a significant role in local climate only around the Jos Plateau and along the eastern border highlands (Helen, 1991).

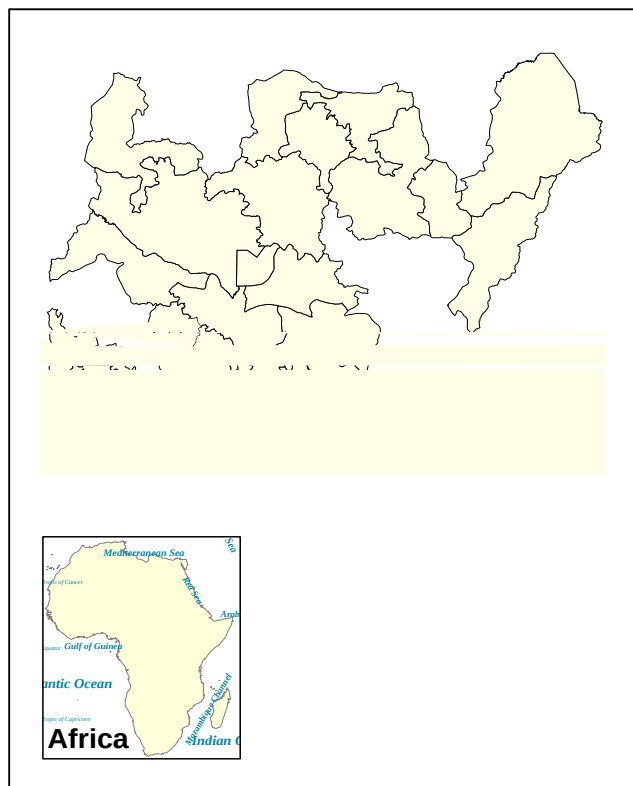


Figure 1: The Study Area

Source: FAO, (1995)

Data Processing and Analysis

The vegetation data for this research was from satellite observations obtained from Moderate-resolution Imaging Spectroradiometer (MODIS) on Terra satellite as Normalized Difference Vegetation Index (NDVI). Due to its spatial resolution (250m), discrimination between various vegetation characteristics was observed. The NDVI data was downloaded free from Land Processes Distribution Active Archive Center (LP DAAC) from National Atmospheric Systems Administration (NASA) via the website (<https://search.earthdata.nasa.gov>). The two downloaded images (first and second) were observations on 18th of February, 2000 and 18th of February, 2019 respectively. The choice of February as the date of observation was to overcome the challenges of cloud and vapor contaminations. The January/February is the driest period in Nigeria. The following

four tiles that cover Nigeria are: h18v07, h18v08, h19v07 and h19v08. The downloaded data were on HDF format, thereby importing and converting them to Idrisi raster format. The images were also mosaicked and reprojected from sinusoidal to Latitude Longitude projection and finally windowed to focus on the study area. The data has been adjusted to correct for residual factors using regression parameters. The spatial vegetation distribution in Nigeria shows that areas of high elevation appeared greener compared to low elevations. The high elevations include North-central highlands, Obudu Plateau and Western Uplands (figure 2 and figure 3). The change detection approach called Simple Image Differencing (SID) was used as utilized by Yelwa, (2008). The images have been subjected to 0.5% stretch on maximum value for clear view of the spatial variations of vegetation greenness.

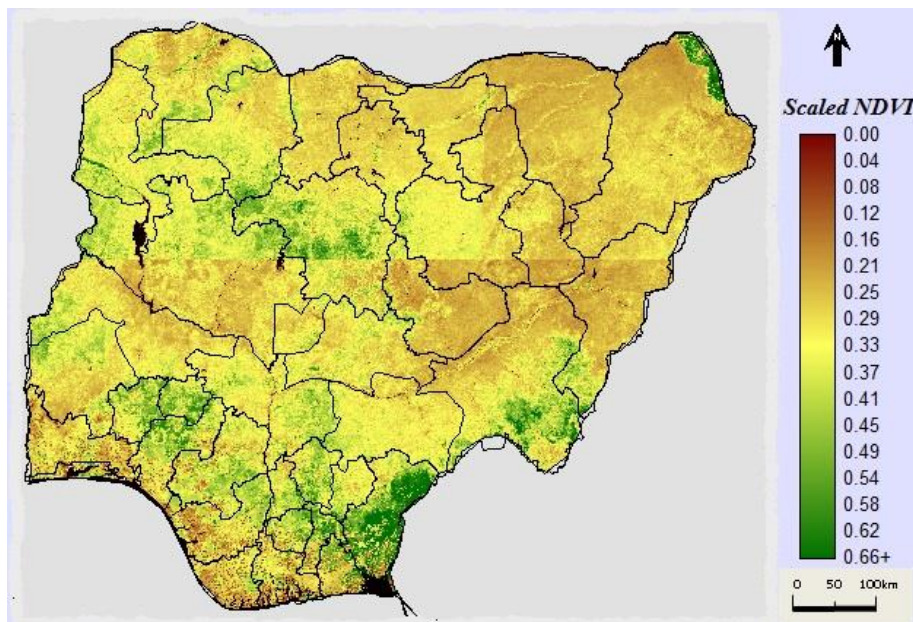


Figure 2: Vegetation Characteristics (February, 2000)

Source: LP-DAAC/NASA, (2019)

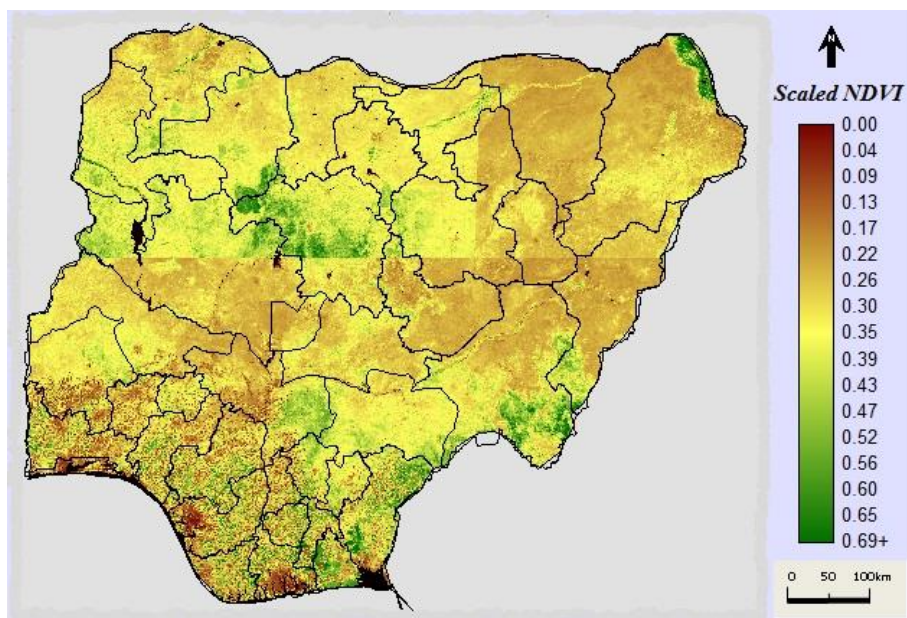


Figure 3: Vegetation Characteristics (February, 2019)

Source: LP-DAAC/NASA, (2019)

To detect vegetation change in Nigeria, Simple Image Differencing (SID) was used on two 16-day composite images of NDVI on 250m spatial resolution. This technique creates a difference image between the first

and second images by subtracting earlier image from the later image (Feb. 2019 minus Feb. 2000). This leads to negative and positive NDVI values (see figure 4). With Thresholding technique, the upper and lower limits to normal variation were determined.

The mean and standard deviation were used to isolate unusual changes. This was achieved using HISTO module where histogram

displayed mean and standard deviation, with normal distribution. To create the thresholded image, the module RECLASS was used.

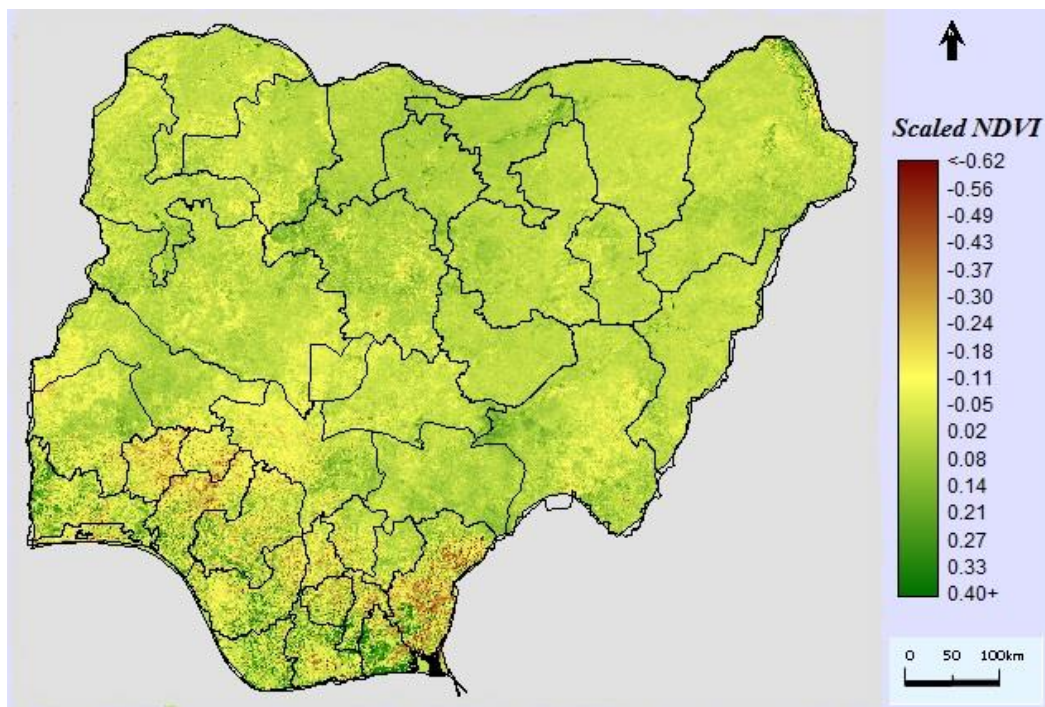


Figure 4: Images Difference (Feb. 2019 – Feb. 2000)

Source: Adapted and modified from LP-DAAC/NASA, (2019)

RESULTS AND DISCUSSION

Vegetation Change Detection

The resulting image has three classes with different colors (light grey for no change; bright red for negative change and bright green for positive change) (see figure 5). Generally, the result shows that the negative changes in vegetation were on Southwest and Southeast regions of Nigeria. Specifically, the affected states comprises: Akwa Ibom, Rivers, Delta, Cross River and Edo, Abia, Imo, Osun, Lagos, Ekiti and Ondo States.

States with positive changes are Bayelsa, and Ogun. The Savanna zone (Northern region) has no change in vegetation cover (see figure 5). This finding contradicts previous findings which stated that northern states are the frontline for desertification (Usman, Yelwa, & Gulumbe, 2012) and (Rim & Mehrez, 2011). This might be attributed to efforts by the Government of the said Frontline States, Federal Government of Nigeria and relevant stake holders in tackling the challenges of desertification in those areas.

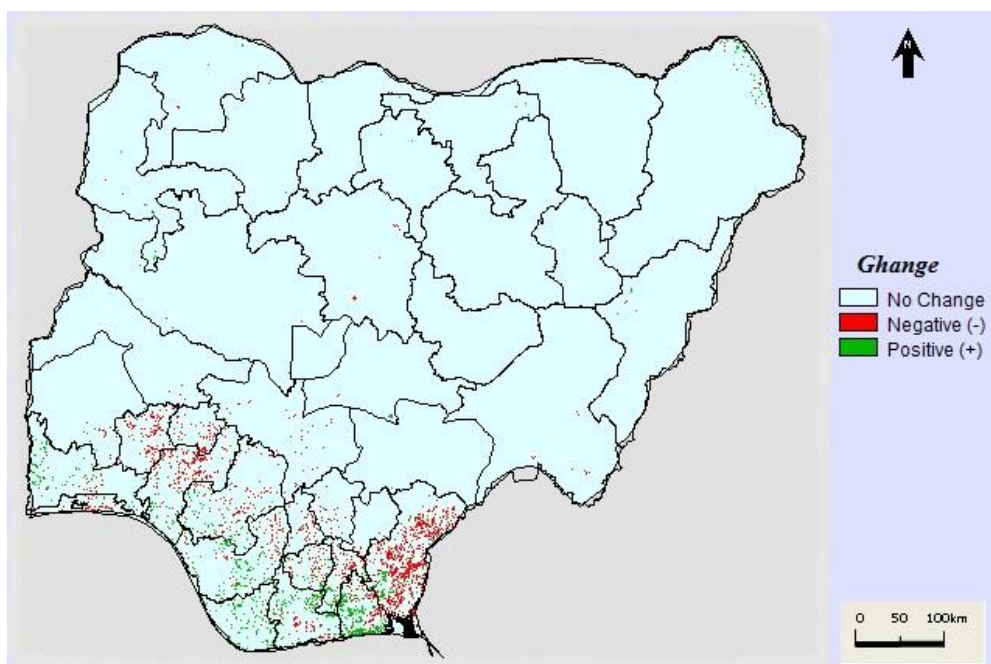


Figure 5: Classified Vegetation Changes

Source: Adapted and modified from LP-DAAC/NASA, (2019)

To verify the validity of the identified changes, the correlation analysis among the two images was performed using REGRESS module. The 1st and 2nd images were set as the independent and dependent variables respectively. This helps to know whether the difference was due to change in vegetation or other residuals such as atmospheric or instrumental effects. Since the relationship between the two images is significant ($r =$

0.78) with coefficient of determination (62.39%) (see figure 6), it is concluded that variation on the images was as a result of variation on vegetation by 62% which is statistically significant. Thus, the finding is considered valid following the studies of Barbara and Susan, (2019) and Deborah, (2019).

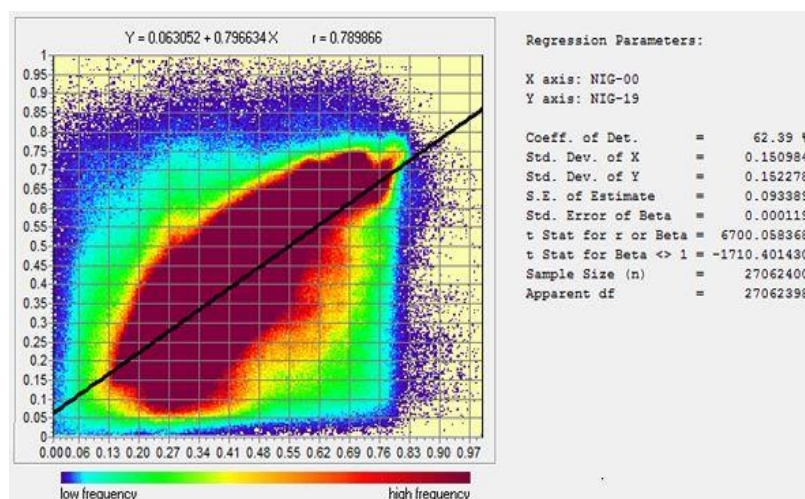


Figure 6: Images Correlation

Source: Author's Analysis (2019)

CONCLUSION AND RECOMMENDATIONS

It is observed that Northern Nigeria experiences no change in vegetation which is attributed to government effort in combating the menace of desert encroachment. Conversely, the negative change was detected around the Southwest and Southeast regions of Nigeria. It is observed that even forested area could be affected by desertification if not treated on a sustainable manner. It is recommended that the Federal Government and relevant stake holders should focus on Nigeria as a whole, not Northern region alone in combating desertification. Niger Delta Development Commission (NDDC) should incorporate afforestation programme in its projects to combat environmental challenges in the region. High spatial resolution data is recommended to detect species of plants under threat. Appropriate field measurement was recommended to refine and improve on the result.

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AN ASSESSMENT OF PLANNING STANDARDS AND COMPLIANCE LEVEL OF PETROL STATIONS IN KADUNA METROPOLIS



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ABSTRACT

The present location of petrol stations in towns and cities of Nigeria hardly reflects the approved criteria for their location, thereby posing environmental problems. This study therefore analyzed the planning standards and compliance level of petrol stations in Kaduna Metropolis. The list of petrol stations was collected from the Department Petroleum Resource [DPR]. Field survey was also carried out through which the geographic coordinates of petrol stations were captured using Global Positioning System receiver. Data were analyzed using Overlay, Nearest Neighbour Analysis and Proximity Analysis (Buffering) in ArcGIS 10.2 environment. The study revealed that only 16% of the petrol stations satisfied the 400 metres distance apart from the nearest petrol station, only 3.6% met not more than four petrol stations within 2 kilometres radius while 47% were sited away the 50 metres buffer radius to the built-up areas. The nearest neighbour index of 0.399 with z-score of -19.129 indicated that the petrol stations in Kaduna metropolis have a clustered pattern distribution. The study concluded that the distribution of petrol stations was uneven and that petrol stations did not comply with planning standards. It therefore recommends that the Kaduna state government should enforce the relocation of petrol stations that did not meet the planning standards or should provide indemnity for buildings within 50 metres radius in case of fire outbreak

Keywords: Compliance, Distribution, Petrol Station, Planning, Standards.

INTRODUCTION

The expression, petrol station (expression commonly used in Nigeria) is synonymously understood differently in different countries of the world. Petrol station otherwise known as petrol station, gas station, refuelling station, or service station across the world is a facility which sells fuel and lubricants for motor vehicles, generators and other machine (Oloko-oba et al., 2016). In Nigeria, the first petrol station was established in Lagos by Total in 1956. Thereafter the number multiplied to other regions of the country. However, their

classification and standard slightly differs from that of the other parts of the world. According to the Department of Petroleum Resources [DPR] (2007), In Nigeria based on specification, purpose, capacity and location, petrol station could be classified into either category A or B. Category “A” petrol stations refer to industrial petrol stations. That is, petrol stations located within the premises of institutions, establishments, companies and industries for their local consumptions. These petrol stations have few facilities and have small capacities. Category “B” petrol stations are commercial petrol stations located on

sites along major highways and streets within towns, cities, outskirts of towns/cities and in villages en route major highways to dispense fuel/oil to public at payment of regulatory price (DPR, 2007).

Several variables are considered in the selection of location for petrol stations (Oetomo and Sesulihatien, 2012). Among the precautionary measures considered in locating petrol filling station required distance from places of public assembly such as markets, hospitals and schools and areas of high traffic congestions and residential buildings (Mshelia, John and Emmanuel, 2015) hence the location of petrol station deserves adequate planning standards and adherence due to its significance to the health and safety of the people. In Nigeria, the Directorate of Petroleum Resources is the agency saddled with the responsibility of ensuring that planning standards are adhered to when siting a petrol filling station.

According to the DPR manual (2007) before operating petrol station one has to certify some physical planning standards. Foremost, land in which a petrol station must be sited should have been zoned for commercial/industrial use or be designated specifically for the purpose of a filling station in a sub-division. The prospective land, which a petrol station is envisaged should not be less than 33 x 33 square meters or equivalent of two plots of land to allow for the free flow of traffic. A petrol station should be sited 400 metres away from the next petrol station. A petrol station should be sited 50 metres away in all angles of the built-up areas in order to create a buffer zone for the residential house-the buffer zone can be devoted to any non-residential land use. In addition, the distance from the edge of the road to the nearest pump should not be less than 15 metres; and the total number of stations within 2 kilometres radius of the site should not be more than four (4) including the ones under construction. Petrol stations

should not be located less than 100 metres from school, hospital, theatres, clinics and other public and semi-public buildings. Lastly, the site for a petrol station should not lie within Nigerian National Petroleum Corporation [NNPC] and Petroleum Products Marketing Company [PPMC] pipelines right of way or Power Holding Company of Nigeria [PHCN] transmission or railroad lines (DPR, 2007). However personal observation revealed that despite the availability of these planning standards regulating the location of petrol stations, most petrol stations are still located in a manner that is chaotic.

Several authors have through their findings shown the failure in compliance to standards of siting filling stations in many parts of the world and Nigeria in particular. For instance, Ujjwal and Sokhi (2006) applied GIS for petrol station vulnerability assessment in New Delhi, India and found that many of the petrol stations failed to comply with the standard of distance 200 meter buffer from residential areas, adequate firefighting equipment and distance from the road. The study of Ioş and Tudor (2011) revealed that about 17% of gas stations were located in residential areas which were against the standard with the number of residential areas located in 15m and 50m buffer zone increased by 55.6% and 24.1% between the years 2005 and 2008 respectively in Bucharest suburban, Romania. It was found that in Minna only 34% complied with the 30 metres distance away from residential buildings and 66% did not comply with the 30 metres distance from the edges of the road (Ahmed et al., 2014). Similarly, Samuel, Ogoro and Amanoritsewo (2015) study showed that regarding conformity to 400 metres required distance from one petrol station to another was met by only 23% whereas 33% conformed to the required 15 metres distance from the road in Obio Akpor LGA, River State. In the same

vein, Olusola (2017) examination on the spatial distribution of gas filling stations in Ilaro town, Ogun state showed that with respect to threshold land size of 1188m², 41.2% of the filling stations complied while only 17.7% were in conformity with 9 metres setback from the road. Also, 50% of the petrol filling stations have their nearest neighbour filling station on either side of the road locating outside the radius of 300 metres and 32.4% of the petrol filling stations comply with the minimum setback of 100 metres from places of worship.

Kaduna State Urban Planning and Development Agency [KASUPDA] In Kaduna affirmed that the high demand for land use has resulted into deliberate location of petrol stations in unsuitable areas that are highly vulnerable to hazards (KASUPDA, 2009). Several problems have come to be associated with these poorly located filling stations. Today, this has become an important social issue requiring the attention of social critiques and researchers alike. Samuel (2011) acknowledged the significant contributions of petrol filling stations location to traffic congestion, pollution, and fire outbreak. However, the dimension and extent of these petrol stations compliance to planning standards such as distance between two petrol stations, not having more than four petrol stations within 2 kilometres radius and distance away to built-up areas. It is relatively common to see petrol stations located within residential areas. The potential implications of the location of these petrol stations and its disregard to planning standards have raised concern in recent times. Therefore, it is

needful to study the compliance of petrol stations with the DPR planning standards in Kaduna metropolis.

STUDY AREA

Kaduna metropolis is located between Latitudes 10°26'0"-10°38'0"N of the Equator and Longitudes 7°22'0"-7°32'0"E of the Greenwich Meridian (Figure 1). It comprises of Kaduna North Local Government, Kaduna South Local Government, part of Igabi Local Government, and part of Chikun Local Government. According to Ayoade (1988), Kaduna state has a tropical continental climate type characterized by wet and dry season. The tropical continental is more pronounced in the dry season particularly in December and January. The dry season is dominated by the north-east trade wind called Harmattan which prevails between November-February. The wet season is dominated by the tropical maritime trade wind which starts around May to October. The area has a mean daily temperature showing a major peak in April. The maximum temperature seldom falls from about 36°C as in April to about 27°C in the heart of rain season (August-October). The annual rainfall is about 1000mm (Ayoade, 1988). The population of the four Local Government Areas [LGAs] that made up the Kaduna metropolis is at 1,570,331 as of the 2006 Nigerian census (National Population Commission [NPC], 2009) and was projected to 2018 with inter-census growth rate 3.18% for Kaduna State, which gave a total of 2,299,948 population size.

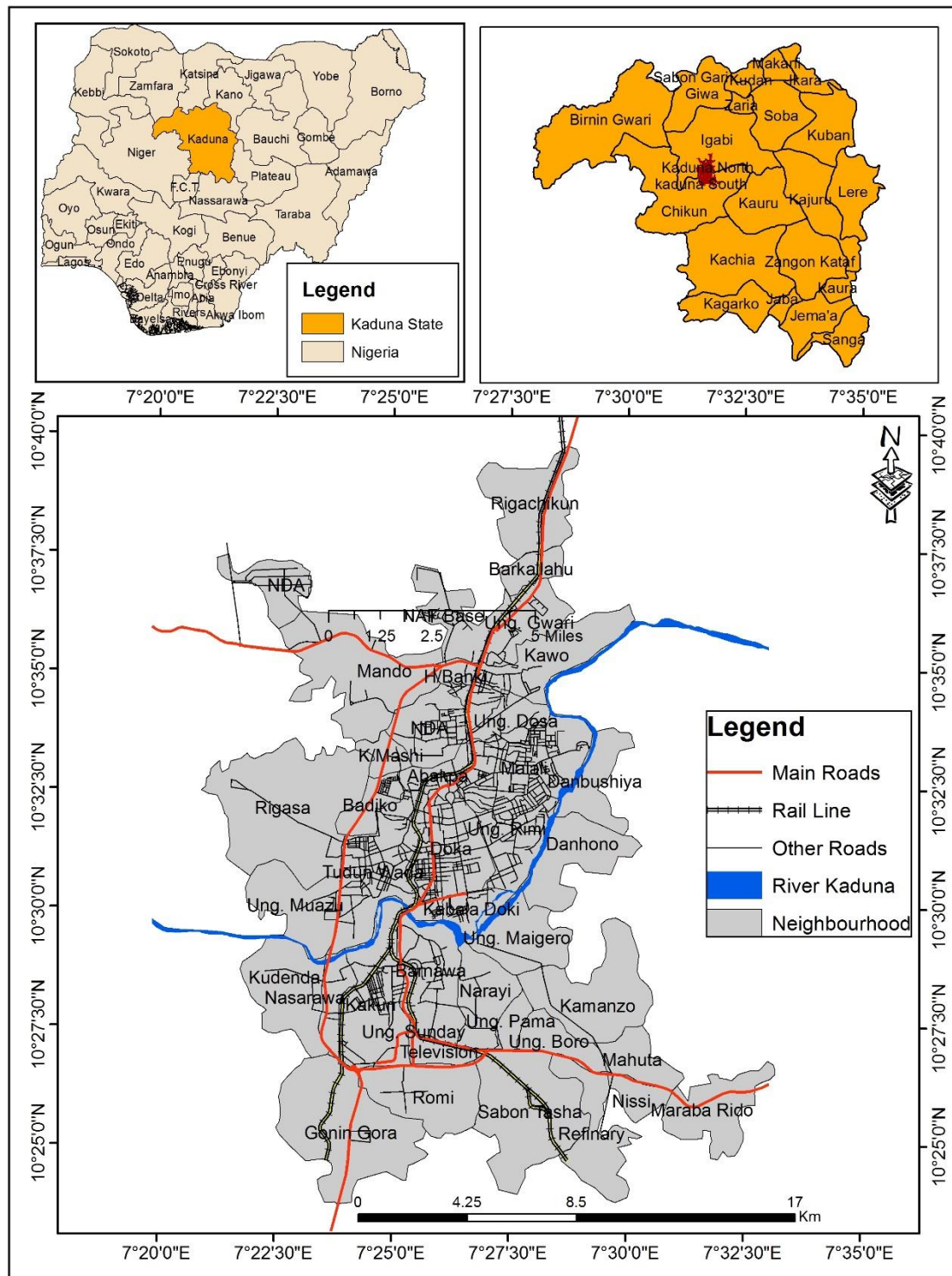


Figure 1: Kaduna Metropolis
Source: Google Map, 2019.

MATERIALS AND METHOD

The list of petrol stations in the year 2018 was collected from the records of Department of Petroleum Resources [DPR] Kaduna State. The absolute geographical location of the petrol stations was acquired using a handheld Global Positioning System [GPS] receiver. The geographic coordinates of the petrol stations were imported into ArcGIS 10.2 environment which was overlaid on the road network shape file obtained from the Open Street Map of Kaduna metropolis. This was used to create map showing the distribution of the petrol stations. The pattern of the distribution of petrol stations was determined using the Nearest Neighbour Analysis [NNA]. According to Lawal (2017), the index/ratio is interpreted as follows: $R = 0$: the distribution is clustered; $R = 1$: the distribution is random and $R = \text{Greater than } 1$: the distribution is dispersed. Proximity Analysis (Buffering) in ArcMap environment was used to determine the level of compliance of petrol filling stations in Kaduna Metropolis with respect to the minimum 400 metres distance between petrol filling stations and that the total number of stations within 2 kilometres radius

of the site should not be more than four petrol stations including the one under construction and siting of petrol station 50 metres away in all angles of the build-up areas according to DPR standard.

RESULTS AND DISCUSSION

Distribution of Petrol Station along the Roads in Kaduna Metropolis

Table 1 show the uneven spatial distribution of petrol station along twenty four (24) roads in the study area, as Nnamdi Azikiwe Road (36.9%) had the highest proportion, followed by Sabo Tasha-Kachia Road (14.2%), Zaria Road (6.7%) and Abuja-Kaduna Road (6.2%). These four roads accounted for 64% of the entire petrol stations in Kaduna Metropolis. This result is not surprising because these are the major roads linking the study area with other major cities in Nigeria hence serve as exit roads. This finding corroborate with the assertion of Mohammed (2014) that filling stations are not built in town centres but rather on exit roads. Also in support is Samuel (2011)'s findings that petrol stations in Kaduna North LGA were unevenly distributed and were mostly concentrated along major roads.

Table 1: Distribution of Petrol Stations along the Roads in Kaduna Metropolis

Road Location	Number of Petrol Stations	Percentage
Abuja-Kaduna Road	14	6.2
Ahmadu Bello Way	5	2.2
Ali Akilu Road	8	3.6
Aliyu Makama Road	6	2.7
Constitution Road	2	0.9
Dutsima-Ribadu Road	2	0.9
Golf Course Road	1	0.4
Junction Road	4	1.8
Kachia Road	7	3.1
Karaye Road	1	0.4
Kano Road	2	0.9
Lagos-Mando Road	7	3.1
Link Road	6	2.7
Mohamadu Buhari Way	2	0.9
Murtala Mohammed Road	3	1.3
Nnamdi Azikiwe Road	83	36.9
Nuhu Aliya Crescent	2	0.9
Polytechnic Road	2	0.9
Rigasa Road	4	1.8
Sabo Tasha-Kachia Road	32	14.2
Shagari Road	1	0.4
Television Garage Road	5	2.2
Television Bye-pass Road	11	4.9
Zaria Road	15	6.7
Total	225	100

Source: Authors, 2019

Also, roads like Television Bye-pass, Ali Akilu, Kachia, Lagos-Mando, Aliyu Makama and Link do have a significant number of petrol stations. The least number of petrol stations in the study area was along Golf Course, Karaye and Shagari roads with each having one petrol station. These roads

being of minor road classification type might be the possible explanation of the relatively low number of petrol stations situated in them. Figure 2 gives a graphical representation of the distribution of petrol station along the roads.

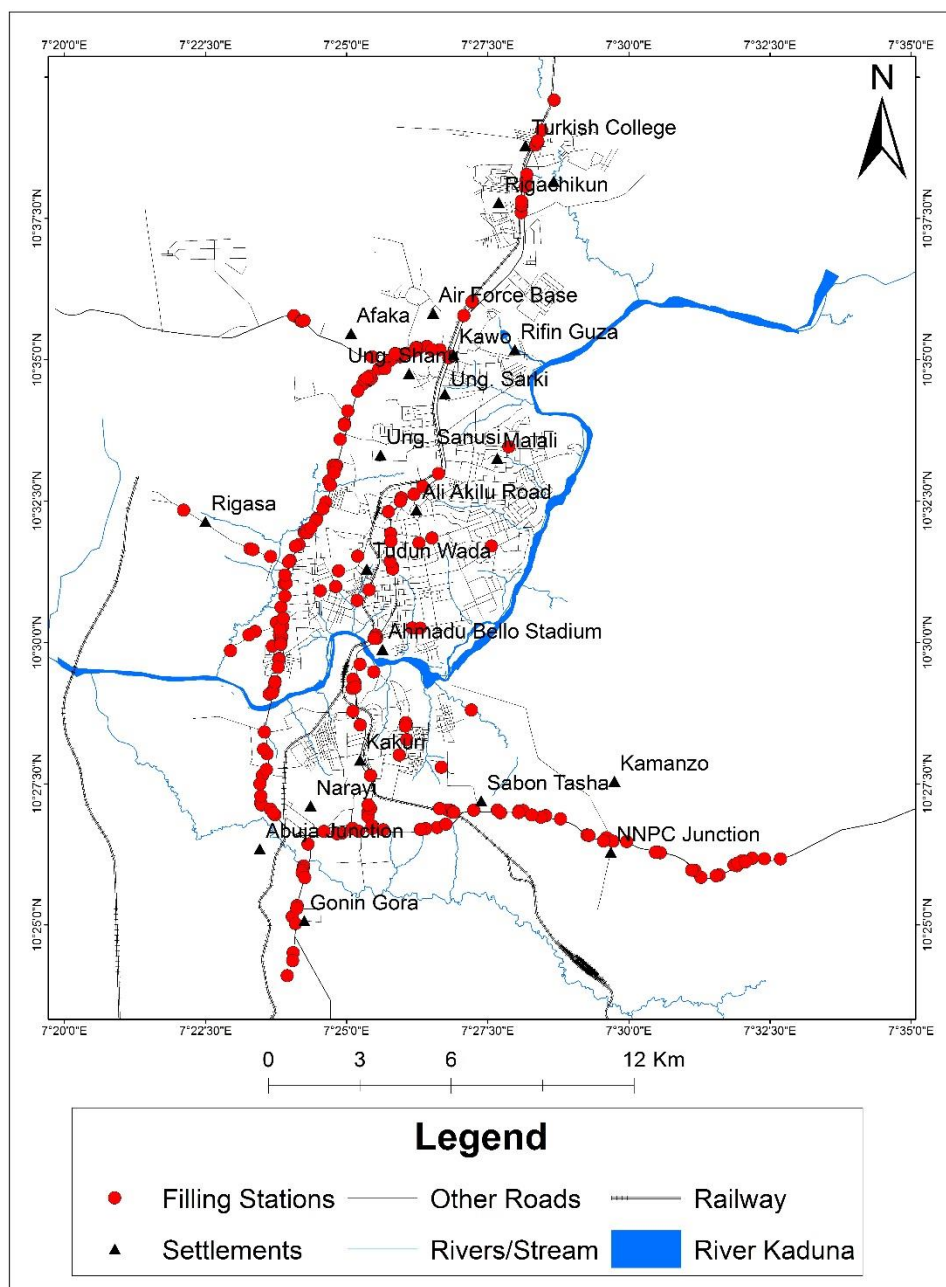


Figure 2: Distribution of Petrol Stations along Selected Roads in Kaduna Metropolis
Source: Authors, 2019

Distribution Pattern of Petrol Station in Kaduna Metropolis

Table 2 shows the nearest neighbour index of 0.399 with z-score of -19.129 for the

petrol stations in Kaduna metropolis hence, the distribution of petrol stations in the area tends towards clustered pattern.

Table 2: Distribution Pattern of Petrol Stations in Kaduna Metropolis

Statistics	Kaduna Metropolis	Remark
Observed Mean Distance	230.405 Meters	
Expected Mean Distance	679.159 Meters	
Nearest Neighbor Ratio	0.339	Clustered
Z-score	-19.129	
p-value	0.001	

Source: Authors, 2019

Figure 3 shows the graphical representation of the average nearest neighbour index of petrol stations.

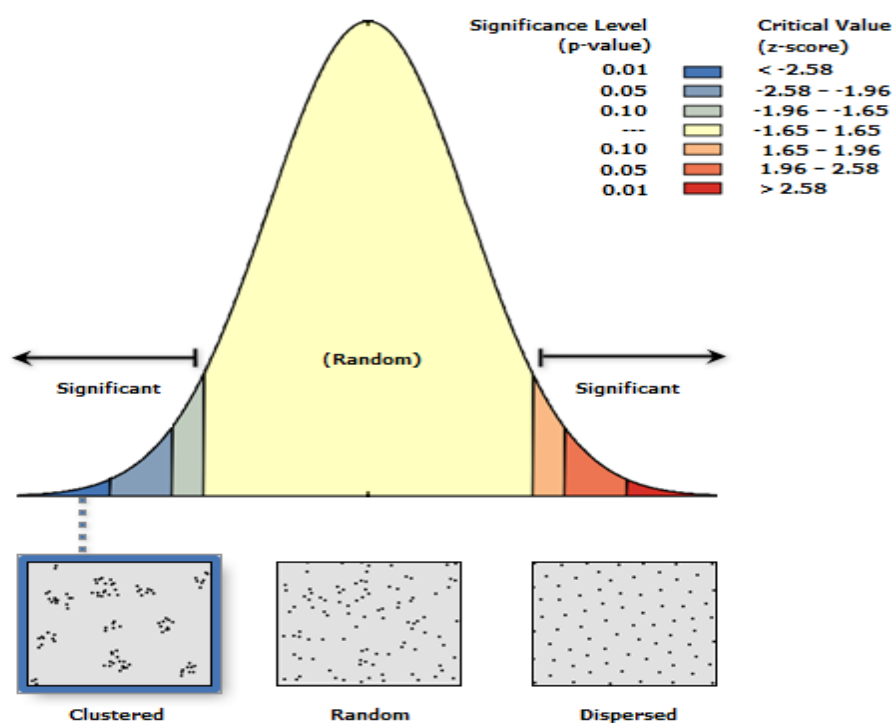


Figure 3: Pattern of Distribution of Petrol Stations in Kaduna Metropolis

Source: Authors, 2019

This result is an indication that most of the petrol stations were located close to each other rather than been uniformly distributed in the study area. The clustering pattern of petrol station might hinder the free flow of traffic along the roads. This is so because queues of vehicles at the petrol stations often result into serious traffic hold-up on adjoining road. This corroborates the

finding of Oloko-oba et al. (2016) that shows a clustered pattern of petrol stations distribution in Ilorin, Kwara State. However, it disagrees with Abdullahi (2012)'s finding which revealed that petrol stations were randomly distributed in Agege Local government Area of Lagos State.

Distance between Petrol Stations

Table 3 revealed that about 84% of the petrol stations in Kaduna metropolis did not satisfy the 400 metres distance apart from the nearest petrol filling station standard

while only 16% met the standard. This implies that distance apart standard for sitting petrol stations has not been complied with by the petrol stations operators in Kaduna metropolis.

Table 3: Conformity to 400 metres Distance between Petrol Stations

Distance	Number of PFS	Percentage
Less than 400m	188	83.6
Greater than 400m	37	16.4
Total	225	100

Source: Authors, 2019

Figure 4 indicated the graphical representation of the petrol stations compliance to 400 metres distance standard.

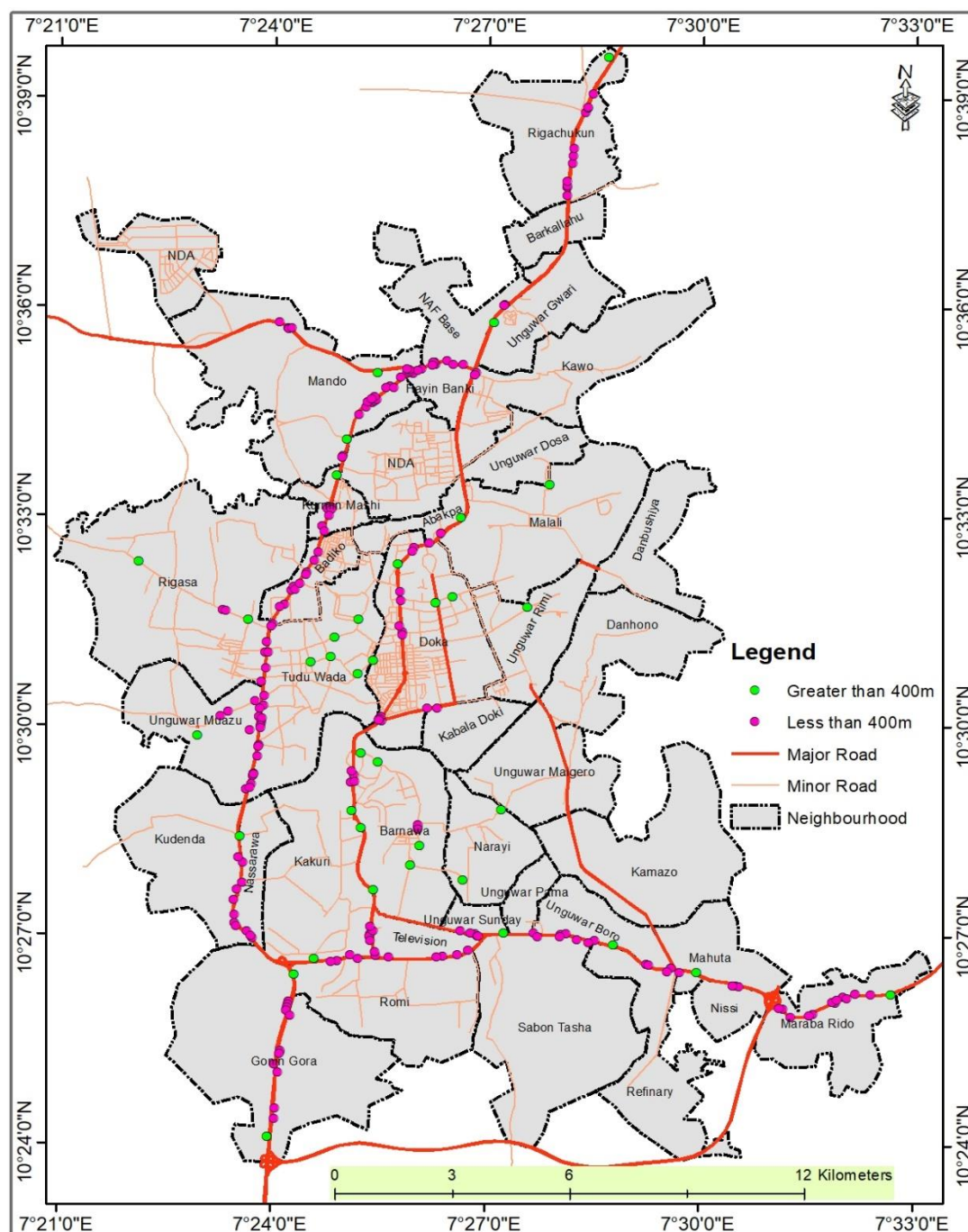


Figure 4: Petrol Stations Compliance with 400 metres Distance to Nearest Station
Source: Authors, 2019

This violates the fundamental objective of planning which provides the right site for right use at the right time for right purpose in order to achieve spatial functionality, efficiency and aesthetics. This result is similar with Samuel, Ogoro and

Amanoritsewo (2015) findings which revealed that conformity to 400 metres required distance from one petrol station to another was only met by 23% of the petrol stations in Obio Akpor Local Government Area of River State. Also Oloko-oba et al.,

(2016) discovered that 97.3% of the petrol stations did not satisfy the 400 metres distance apart from the nearest station criterion in Ilorin, Kwara state.

Petrol Stations within 2 kilometres Radius

The tabulate intersection tool in ArcGIS was used to obtain the number of petrol stations in each buffer of 2 kilometres

radius on both sides of the road (Figure 5). The result revealed that only 3.6% met the not more than four petrol stations in every 2 kilometres buffer radius while 96.4% had more than four petrol stations. The graphical representation of the buffer radius is as shown in Figure 6

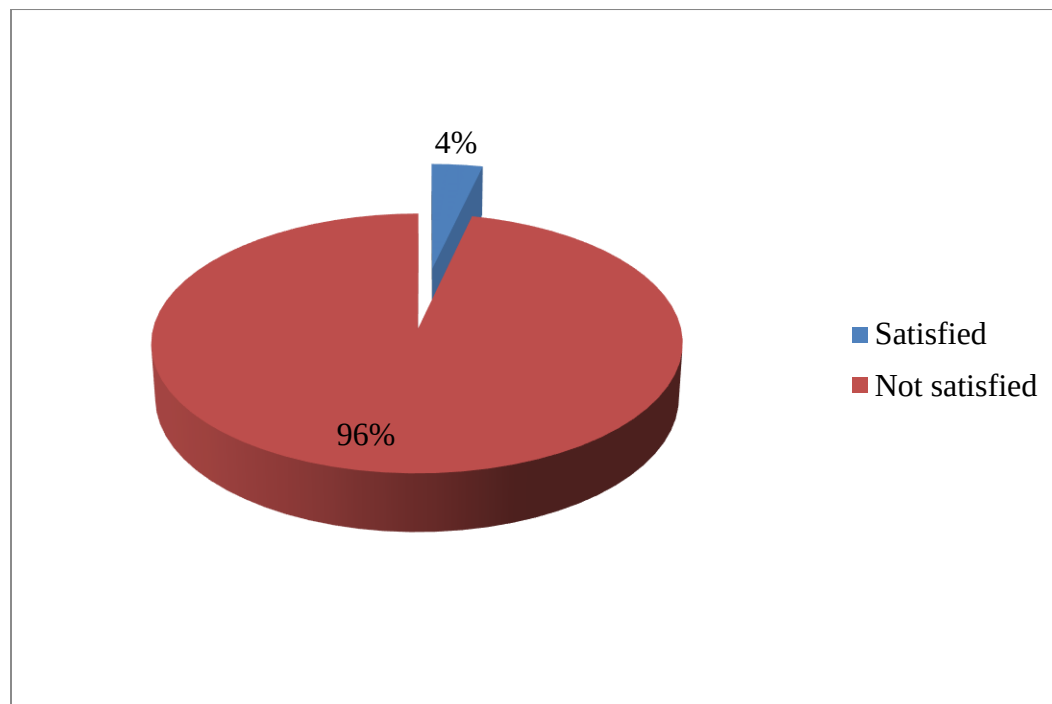


Figure 5: Compliance with Maximum Four Petrol Stations within 2 kilometres Radius
Source: Authors, 2019

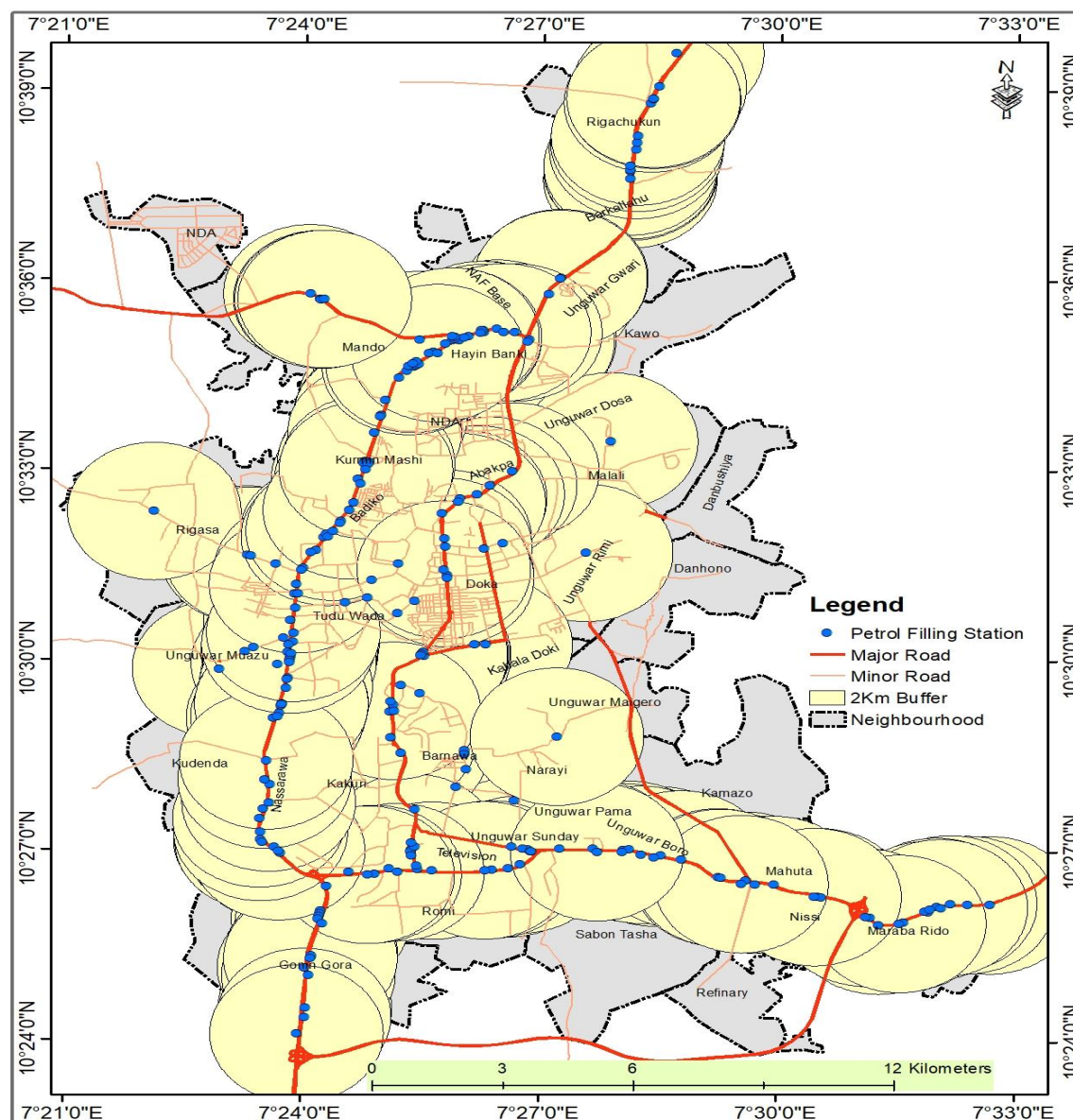


Figure 5: Compliance with Four Petrol Station within 2 kilometres Radius
Source: Authors, 2019

It could be inferred that petrol stations are not suitably sited as the locations contravene DPR standards. To that effect, this will increase the threats on the health and safety of users and residents in the vicinity of the petrol stations. This result agrees with Oloko-oba et al. (2016)'s findings which showed that only 1.3% satisfied the 2 kilometres stretch while 98.7% had more than 4 petrol stations observed in every 2 kilometres buffer radius in Ilorin, Kwara state.

Petrol Stations Distance away in all Angles of the Built-up Areas

According the criterion set by the DPR, petrol filling stations are not allow to operate within the built-up areas to create a buffer zone for the residential areas. Figure 6 indicated that 53% of the petrol filling stations were located within the 50 metres built-up areas while 47% were sited away the 50 metres buffer radius to the built-up areas.

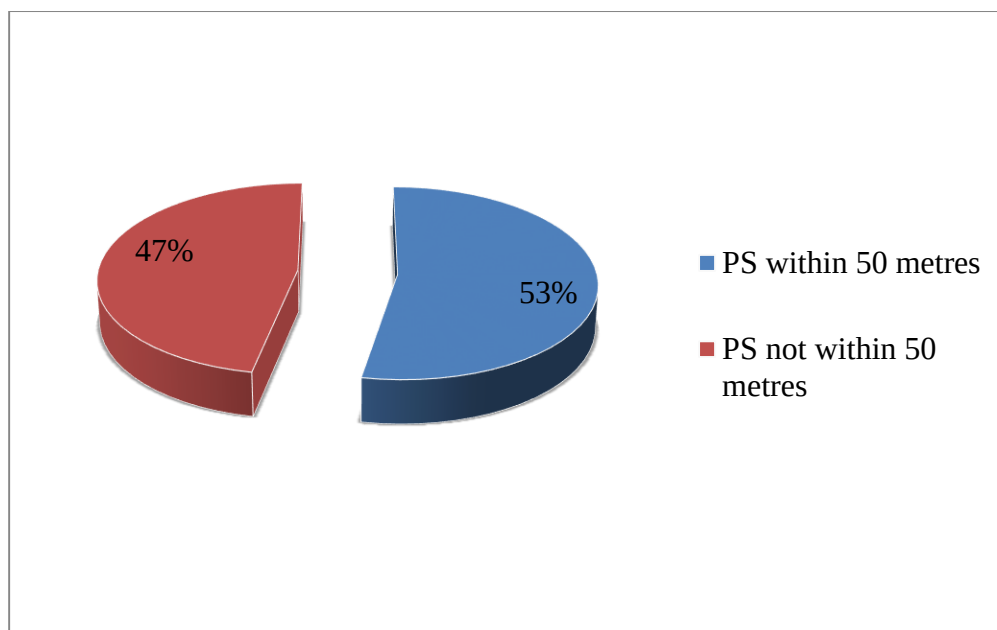


Figure 6: Compliance with Away 50 metres Location to Built-up Areas
Source: Authors, 2019

The graphical distribution of the petrol stations compliance to 50 metres buffer radius to the built-up areas is as shown in Figure 7.

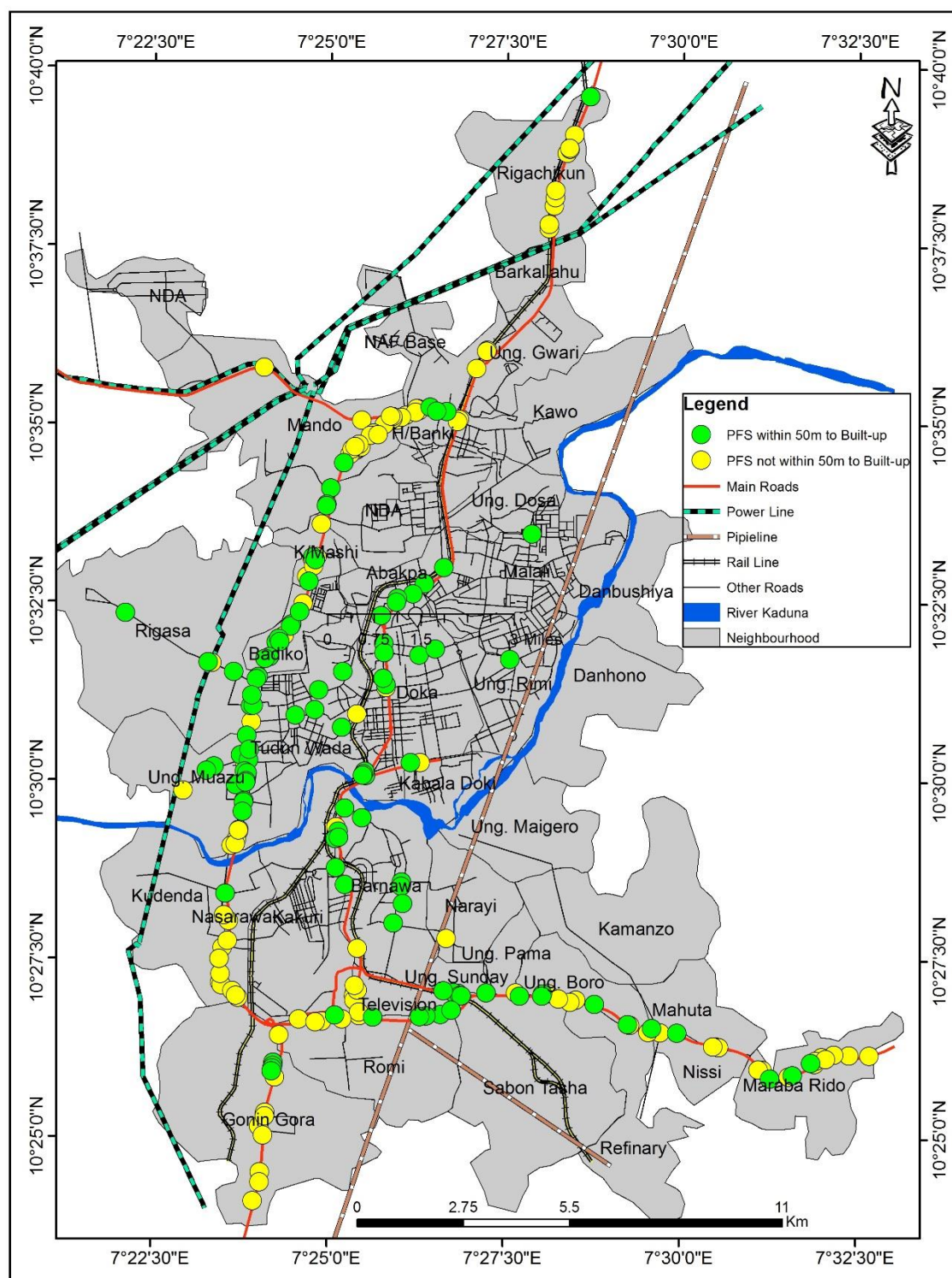


Figure 7: Distribution of Petrol Filling Stations Compliance with 50 metres Distance Away in all Angles of the Built-up Areas

Source: Authors, 2019

This result is an indication that more than half of the petrol stations in Kaduna metropolis were sited within the residential areas. A high proportion of the petrol stations that were sited within residential areas were observed in Abakpa, Badiko, Tudu Wada and Unguwar Muazu neighbourhoods. This implies that these neighbourhoods will feel the implications of petrol stations distribution pattern when compared with the other neighbourhoods in the study area.

CONCLUSION/RECOMMENDATION

The location of petrol stations among other things is expected to be guided by definite planning standards. The study has shown the uneven spatial distribution of petrol stations in Kaduna metropolis. There is low level compliance of petrol stations to the 400 metres distance apart to the nearest petrol filling station, not more than four petrol stations within 2 kilometres radius and 50 metres in all angles of the built-up areas. Therefore urgent actions should be taken to arrest this ugly trend in the pattern of development. Therefore it is recommended that the Kaduna state government should enforce the relocation of petrol stations that did not meet the established planning standards. Alternatively, the petrol station owners should provide indemnity for buildings within 50 metres radius in case of fire outbreak. Also regulatory agencies like DPR, National Environmental Standards and Regulations Enforcement Agency, (NESREA) saddled with environmental protection should intensify their periodical inspection and fine petrol stations operators that violates the standards.

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Identification of key barriers against implementation of Lean Principles in Construction Projects in Edo State



BY

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ABSTRACT

The construction industry is congested with many types of project management systems to control and manage construction projects, but there's inadequate research done on the maximization of workflow and minimization of waste. The implementation of the lean construction principles into the construction industry can improve on the identified problems. However, lean construction is complex and can be risky if not properly managed. To implement lean construction principles and to increase the chances of success in eliminating waste, a thorough investigation of the barriers is essential. The aim of this study was to identify the barriers of lean construction in construction industry in Edo State. A questionnaire was distributed among construction Managers. The data thus obtained was analysed using mean and standard deviation in order to identify the key barriers to implementing Lean construction principles in the construction industry in Edo State. It was concluded that, Fragmentation and subcontracting, culture and attitudinal issue, lack of adequate lean awareness and understanding, unclear strategic goals and lack of top management commitment are the most significant barriers hindering the implementation of Lean construction in the construction industry in Edo State. Furthermore, this study made professionals and practitioners aware of Lean construction.

Keywords: *Lean construction, barriers, implementation, construction industry, Edo State*

INTRODUCTION

Construction which takes a big portion in a Nation's total employment and revenue generation still has chronic problems such as low productivity, poor safety, inferior working conditions, insufficient quality, lack of timely communication and coordination amongst project stakeholders, and rising litigation (Howell & Koskela, 2000). Waste such as waiting time, material handling, over production, inventories, re-work and movement of workers which are considered to be a major challenge of the construction industry have been discovered to form about

30% of construction cost (Howell & Koskela, 2000). Similarly, Idrus and Sodangi (2007) asserted that the Nigerian construction industry produces nearly 70% of the nation's fixed capital, yet its performance within the economy has been, and continues to be, very poor. Among other criticisms facing the industry are time and cost overruns, inadequate planning and budgetary provisions, contract sums inflation, inefficient and poor service delivery (Kuroshi & Okoli, 2010).

The need for greater co-ordination and integration within the industry has led to

the adoption of various concepts from other industries, for example; partnering, concurrent engineering, technological innovations in design and construction processes such as 3D, CAD and Building information modelling (Abubakar, 2012). Lean Construction principles are one of such innovative processes that bring about the much needed continuous improvement, increase productivity through elimination of activities that seem to generate waste in the process of construction and desired change in the construction industry (Abdullah, Abdul-Razak, Abubakar & Mohammad, 2009). Lean construction is understood as a new paradigm for project management, thereby challenging the traditional thinking about construction and project management (Ballard & Howell, 2004). The application of lean construction concept in a construction project will bring change in approach to construction activities which will forcibly alter the traditional approach to construction project management (Ballard & Howell, 2004).

According to Howell (1999), managing construction under Lean is different from typical contemporary practice because it; has a clear set of objectives for the delivery process; it is aimed at maximizing performance for the client at the project level; it designs concurrently product and process, and it applies production control throughout the life of the project. According to Johansen and Walter (2007), the application of the lean concept in the construction industry is still very restricted and sluggish, although various countries gained large benefits by adopting Lean Construction concepts, there seems to be little implementation of lean because there appears to be some barriers preventing its successful implementation (Mossman, 2009).

The aim of this research is to identify the barriers that may prevent its successful

implementation and to propose a strategy for overcoming the barriers identified.

To achieve this, the principles of Lean construction, the common barriers of implementing lean construction culture and measures to bridge the implementation gaps were assessed.

This study conducts a survey among construction managers to disclose the barriers against the implementation of Lean construction applied to Engineering and Execution processes of a construction project and to avail the benefits of lean construction in terms of project management triangle (cost, time and quality).

Lean Construction

Koskela & Howell (2002) states that lean construction is a way to design production systems so as to minimize waste of materials, time, and effort in order to generate the maximum possible amount of value. Lean construction is concerned with the alignment and holistic pursuit of concurrent and continuous improvements in all dimensions of the built and natural environment (Abdelhamid et. al., 2008). Lean construction manages and improves construction processes with minimum cost and maximum value by considering clients' needs.

Lean Construction is about the elimination of flow activities (wastes or non-value adding) and improving the efficiency of transformation or conversion activities (value adding) in any process (Koskela & Howell, 2002) thus, overall increasing the performance and productivity of the system and ultimately reducing the cost. The important point to be considered is that Lean Construction is not a new tool but a new philosophy for construction focusing mainly on customer requirements.

The principles of lean construction are essentially about getting the right things to the right place at the right time, in the right quantity whilst minimizing waste and being

open and responsive to change (Kempton, 2006). Lean production has an underlying philosophy that, by eliminating waste, quality can be improved, and production times and costs reduced (Kempton, 2006).

Barriers to the Successful Implementation of Lean Construction

Projects in the construction industry are one-off based, complex, unique and features lots of uncertainties (Salam et. al., 2006). There is a repeated claim that the construction industry is very different from manufacturing because every construction project is unique and therefore rejects many thoughts from manufacturing sector (Koskela & Howell, 2002). According to Egan (1998), the construction industry has two options: to ignore all this in the belief that construction is so unique that there are no lessons to be learned; or seek improvement through re-engineering construction, learning as much as possible from those who have done it elsewhere.

In a research by Bashir et al. (2010) these barriers were classified into six different categories: Management issues, Technical issues, Educational issues, Financial issues, Governmental issues, and Human attitudinal issues. Based on a careful and comprehensive literature review relating to the barriers in implementing the Lean construction approach, this study classifies barriers to the successful implementation of Lean construction into six different categories, as shown below.

Culture and Attitudinal issues

Ankrah (2007) in looking at the different orientations of culture in relation to project performance identified that different dimensions of culture were significantly associated with project performance outcomes. Lean thinking on the other hand requires employees to change the way they execute their work in order to remove “waste” create “continuous flow” and

radically enhance value to the customer (Liker, 2004). This is often seen as a cumbersome task and in most cases threatening for construction workers to change their status-quo from a somewhat dysfunctional system which they have operated relatively successfully to a new system. However, changing old traditions and behavior is a necessary prerequisite for implementing Lean Construction tools (Mossman, 2009).

The perceived root causes of cultural issues include: lack of commitment to the Lean implementation, lack of experience on Lean, unethical practices, partial or late implementation of Lean, bad work ethics, lack of ability to work in group.

Resistance to Change

The successful implementation of Lean Construction requires the support of the organization and the top management (Sarhan & Fox, 2012). Bashir *et al.* (2010) indicated that it is usually the top managers that provide sufficient resources, time and commitment to develop plans that will sustain and manage changes that occur from the implementation process. The perceived root causes are; lack of top management support, short-term vision, organizational resistance, and unclear strategic goals.

Design/Construction Dichotomy

Design and planning are recognized as leading contributors in lean construction strategy. Disregarding the value of these concepts may lead to a considerable loss of time and significant loss of revenue (Common et. al., 2000). Design and its application are often unlinked and treated separately because of traditional ways of doing things (Banki & Orumchi, 2007). This creates friction among two points which leads to deficient or incorrect designs, unnecessary overhaul in design and construction, lack of efficient constructible designs, a significant disconnect between the conceptual design and its implementation and

work schedule delays due to late adjustments performed by designers. Rooke et. al. (2007) found production considerations were often not considered by the designers whose designs required implementation. There are additional challenges which need to be addressed such as how sustained quality can be guaranteed. While some consider reaching the goal to be good relationships and coordination, others focus on strict adherence to specifications and codes (Shammas – Toma et al., 1998).

Fluctuation and Variation

Fluctuation and variation serve as major barrier to Lean implementation. Dulaimi and Tanamas (2001) indicated that for the successful implementation of Lean Construction, some common financial barriers that need to be carefully addressed include: lack of stakeholders' support, inflation, inadequate funding of projects and unstable markets for construction. Additionally, Bashir *et al.* (2010) recognized that political instability could cause fluctuations and pose barriers to the successful implementation of Lean Construction tools.

Lack of Subcontractor's involvement

Adversarial relations between contractor and subcontractors tend to undermine the application of Lean techniques within construction projects (Sarhan & Fox, 2012). Similarly, fragmentation and poor contracting or legal issues, delay from suppliers and subcontractors and lack of collaboration are grouped as the perceived root causes to lack of subcontractors' involvement. These adversarial relationships create transaction costs, delays and stoppages. These are all considered as 'waste' thus opposing the notion of Lean Thinking (Mossman, 2009). Johansen and Walter (2007) added, stating that fragmentation separates the design from the

construction process; and therefore misses the Lean aim of collaboration and integration.

Poor supervision and Quality control

The implementation of any new process requires skilled and professional workers to drive the change process. However, poor supervision and quality control issues hamper the application of Lean construction (Bashir *et al.*, 2010). Studies by Sarhan & Fox (2012) indicated that the root causes of poor supervision and quality control issues are management related and they include: incompetent project managers, lack of skilled and professional workers, poor planning, logistics' problems, absence of look-ahead planning and poor coordination.

METHODOLOGY

This study adopts a survey research design using structured questionnaire. The questionnaire was used to solicit professional opinions. A quantitative approach of data analysis was employed using mean and standard deviation tools on the statistical package for social science version 21 (SPSS 21). The questionnaire prepared for this study consisted of three sections. The first part collected personal information about respondents, the second part investigated potential barriers to implementing lean construction and the third part asked questions about the list of measures to promote lean construction. In order to ascertain the priority of individual barriers and measures, participants were asked to rank barriers and measures on a scale of 1-5 based on their importance, where 1=highly disagree and 5=highly agree. Simple random sampling technique was used and the questionnaire were distributed to construction managers-Architects, Builders, Quantity surveyors and Civil engineers, registered with their professional bodies in Edo State.

The sample size of 85 was obtained using the Taro Yamene's formula as used in

a study by Nwankpa (2011) as seen in the following section.

The Taro Yamene formula is:

$$n = \frac{N}{1+N(e)^2}$$

Where: n = sample size sought
N = Population size (215)
e = Level of significance (0.05)

RESULTS AND DISCUSSIONS

Respondent Profile

From the construction managers surveyed, it is evident that majority had experience between 16-20years which implies that majority of the respondents had significant experience in the building industry.

Table 1: Respondents years of experience

	Frequency	Percent	Cumulative Percent
less than 5	15	17.6	17.6
6 to 10	10	11.8	29.4
11 to 15	11	12.9	42.4
16-20	40	47.1	89.4
21 to 25	5	5.9	95.3
more than 25	4	4.7	100.0
Total	85	100.0	

Barriers to lean construction implementation

The respondents were asked to evaluate ten barriers gathered from the literature based on their level of agreement. Mean scores and standard deviation of the barriers are presented in Table 2.

Table 2: The significant barriers to the successful implementation of Lean Construction

	Fragmentation and subcontracting	culture and attitudinal issues	Fluctuation and variation	lack of adequate lean awareness and understanding	design/construction dichotomy	unclear strategic goals	lack of top management commitment	resistance to change	lack of skilled and professional workers	lack of organizational resistance
Mean	4.00	4.25	3.84	4.00	3.87	4.13	4.00	3.94	3.65	3.33
N	85	85	85	85	85	85	85	85	85	85
Std. Deviation	1.282	.987	1.387	1.309	1.242	1.242	1.134	1.228	1.360	1.491

These findings of the analysis as shown in Table 2, demonstrate that all the key barriers identified by this study were recorded by respondents. It was found that five barriers out of the ten obtained a mean score of four and above, namely, Fragmentation and subcontracting, culture and attitudinal issue, lack of adequate lean

awareness and understanding, unclear strategic goals and lack of top management commitment. In several studies, the level of significance was represented by a score of „4“ on a five-point Likert scale (Chan, 2003; Abdullah et al., 2009). This seems to be a common threshold in most construction research (Lam et al., 2007). Within this

context, these five barriers were classified as the significant barriers to the successful implementation of LC.

Measures to bridge the knowledge gap of LC

The respondents were asked to identify the ken measures to bridge the knowledge gap for a successful implementation of LC.

Mean scores and standard deviation of the measures are presented in Table 3.

Table 3: Measures to bridge the knowledge gap of LC

	firms to change organizational culture	promotion of the concept to firms, professional bodies and major stakeholders	workshop and research conferences	training of employees at all levels	engagement of competent and skilled site operatives	working on improving performance when carrying out projects	construction managers should be committed to changes
Mean	3.68	4.33	3.91	4.16	4.61	4.53	4.45
N	85	85	85	85	85	85	85
Std. Deviation	1.365	.851	1.315	1.233	.490	.502	.500

These findings of the analysis as shown in Table 3, demonstrate that all the key measures listed, five measures out of the seven obtained a mean score four and above, namely, promotion of the concept to firms, professional bodies and major stakeholders, training of employees at all levels, engagement of competent and skilled site operatives, working on improving performance when carrying out projects and construction managers should be committed to changes. In several studies, the level of significance was represented by a score of „4“ on a five-point Likert scale (Chan, 2003; Abdullah et al., 2009). This seems to be a common threshold in most construction research (Lam et al., 2007). Within this context, these five measures were classified as the significant measures to the successful implementation of LC.

CONCLUSION AND RECOMMENDATIONS

The structured questionnaire survey has shown the existence of some level of awareness among professionals in the construction industry in Edo State on the concept of lean construction. Majority of the

construction professionals surveyed are knowledgeable of lean principles, and are also of the opinion that the transfer of lean construction principles into the construction industry would bring a lot of benefits including improvement of project delivery methods and delivery of products or services that enable clients to better accomplish their goals.

This study can be useful to professionals by evaluating and identifying the critical barriers to lean construction implementation. In order to bridge the knowledge gap, it is suggested among others that promotion of the concept to firms, professional bodies and major stakeholders, training of employees at all levels, engagement of competent and skilled site operatives, working on improving performance when carrying out projects and construction managers should be committed to changes. The study's recommendations were made based on the findings, with a view to implementing lean construction in the construction industry in Edo State:

- More awareness of lean construction principles and its potential benefits via education and training

- b. Competent and skilled site operatives should be engaged to meet up with optimum productivity and construction managers should aim at improving performance
- c. Further research is suggested on the perceptions of construction clients of the lean construction philosophy.

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EVALUATION OF MARKET PRICES OF BUILDING MATERIALS FOR PROACTIVE COST MANAGEMENT IN NIGERIA



BY

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ABSTRACT

Material input is a major cost component in construction. Material has higher cost implication when compared to labour and equipment. Poor management of materials can easily lead to projects cost and time overruns. Better material management systems should therefore be employed if improvement in success level of construction projects is needed. Proactive management has been found to be capable of improving the system significantly if employed, yet reactive management still dominates the sector. Proactive cost management of materials is yet to be widely adopted in construction. This study evaluated market prices of 19 building materials such as cement, aggregates, sand, paint, reinforcements, etc., in the view of proactive cost management. The evaluation considered the volatility to market forces, effect of seasonal changes on prices, groupings of materials based on responses to changes in prices and the reflection of price changes on building cost. Historical cost data was collated from quarterly publications of the NIQS magazine over ten years. ANOVA was used to determine the level of significance in changes in prices. Graphical representation of prices compared the response rates of materials to market forces. Descriptive statistical Analysis revealed how changes in material prices reflect in building cost. Key findings showed that some building materials are more volatile to market forces than others as basis of classifying the materials into two groups. Significant price changes occurred within short period and the cost of construction at the 2nd, 3rd and 4th quarters of the year are 2.52%, 6.44% and 6.32% above the 1st quarter respectively, which indicate the effect of seasons. The choice of inventory and consumption time including sequence of activities should considered these factors along other practices for proactive management efficacy.

Key words: Building Materials, Cost Management, Prices, Proactive, Seasonal Changes

INTRODUCTION

Due to growing competition in the construction sector, materials management has become one of the frontiers for cost reduction (Napoleon, Eugene, Asubonteng, Tom and Alubokin 2018). Material constitutes substantial portion of the total

project cost, and can account up to 50 to 60% of the total cost of construction projects (Suma, Asadi and Bhanu, 2017, Hasnain, Khan, Shah and Khan, 2019), this therefore, becomes a target for cost reduction efforts. The success of a project is dependent on efficient material management (Hasnain et

al., 2019). Suma *et al.* (2017) supported that to improve construction projects performance, materials must be properly managed. Material management helps reduce bulk materials surplus and the management manpower, and improve labour productivity, thus increases cash flow savings and profitability (Suma *et al.*, 2017). However, Cunningham (2017) studied the causes of cost overruns in building projects. Several factors called “risks factors” were identified. The key factors identified related mainly to poor management of materials. Construction projects therefore, continue to experience overruns (Abdulhussein and Shibaani, 2016; Ahmed, Memon, Memon, Laghari, Akhund and Imad, 2018; Hasnain, Khan, Shah and Khan, 2019) because such identified factors exert direct pressure on materials and cause overruns (Oyegoke, 2006).

On a general note, researchers evident that the practice of resource management in construction projects, including materials management, guarantees high impact of risks on projects, which leads to overruns. The management has not improved over the years. It still remains essentially traditional in nature, which is an ineffective and inefficient system (Johnson, 2005, Kim, Lee, Lee & Choi, 2016). The traditional management system is reactive by virtue of responding to flaws only after they occur (Bal, Bryde, Fearon & Ochienh, 2013; Charles, Wanigarathna & Sherratt, 2015). This system therefore cannot contain construction challenges sufficiently (Schonmann, Greitemann & Reinhart, 2016). Knowledge based management system is suggested in material management of construction projects where a “comprehensive understanding of field issues and problems form the bases of response to flaws” (Veronika *et al.* 2006). The concern of this research therefore, evaluates the changes in the market prices of building materials in Nigeria with the view to determine the extent of their reflections in

building costs. Also, could materials be grouped according to the extent of change in prices and how does the season of the year affect the prices, vis-à-vis cost of buildings? Inadequate research efforts along this line has created a knowledge gap in which this study fills. Knowledge of these pieces of information can offer an opportunity to manage material in a proactive manner. Therefore, in line with the objectives, the following research questions were answered:

1. To what extent is inflation affecting prices of building materials in Nigeria?
2. In what ways could the changes in prices of building materials be classified?
3. How is inflation in prices of materials reflected in cost estimates of projects?
4. What is the cost implication of buildings at different seasons of the year along changes in prices of materials?

2.0 Literature search

Hasnain *et al.* (2019) used a questionnaires survey in a study of material management in the construction industry in Pakistan. The researchers set out to identify key factors exerting significant influence on material management. The essence was to help project managers anticipate more reliably those weak areas of material management causing cost impacts so that precise approaches can be practiced with a view to minimise cost overruns. A checklist of key factors as cost impostors was presented to serve as warner to managers during project implementation. It is hoped that project managers can predict and give due diligence to the factors which exert significant impact on cost variation. Akanni, Oke and Omotilewa (2014) observed a threat to the performance of the Nigerian construction sector due to sustained increase in prices of materials. The researchers then assessed the implications of the rising cost of

building materials in Lagos State Nigeria. Empirical cost data from secondary sources were collated between 2003 and 2012 and price indices as well as rates of inflation on building materials were computed using descriptive statistics. An average inflation rate between 5% and 21% affected various materials during the 10-year period of the study. Sharp sand and soft sand experienced the highest inflation rate of about 21.3 and 18.7% respectively within ten years. The researchers found exchange rate, transportation and scarcity among the most significant factors causing inflationary trend. Napoleon *et al.* (2018) became perturbed with the problems of material management in the construction industry; especially in the developing economies. Using empirical data obtained from a set of questionnaires, material management techniques were identified and assessed in construction firms in Ghana. Findings revealed the main problems as poor use of ICT, poor planning, poor security outfits and too much delay in the supply of materials on site.

One key factor affecting material management that is common in literature is delay in material supply (Napoleon *et al.*, 2018; Hasnain *et al.*, 2019). Ahmed *et al.* (2002) since concluded that delay is a universal phenomenon causing significant cost and time overruns of construction projects. Sambasivan and Soon (2007) identified main causes of delay and their effects on construction projects. Morris (1990), cited in Cantarelli *et al.* (2010) established the magnitude of cost overruns in a large scale transportation projects and found it to be 82%. The study found about 20 - 25% in cost increase was due to price inflation on materials and 70-75% was explained in terms of various forms of delay. This finding only underscore anomalies associated with material management. Delay, to a larger extent, has often been associated with the late deployment of material (Hasnain *et al.*,

2019). Chinyio (2009) has recommend how best to manage stakeholders in construction projects to reduce delay and achieve efficiency. Hao *et al.* (2008a) addressed the issue of managing change associated with materials, the change occasioned by stakeholders in a project and contributing immensely to process delay. While industrialisation is making gradual incursion into construction business (Yang, 2012), most building construction works are still in-situ in nature and are done in the open environment, especially in the third world. Inclement weather conditions disrupt smooth flow of site assembly process. Intergraph Corporation (2012) recognized that wind, rain, frost, and temperature do affect productivity with consequence on market prices also. Patel and Vyas (2011) identified six areas for proper attention when managing construction material as:

- i. Material estimation, budgeting, planning and programming
- ii. Scheduling, purchasing and procurement
- iii. Receiving and inspection
- iv. Inventory control, storage and warehousing
- v. Material handling and transport
- vi. Waste management

Steps for effective management related to these components were presented by Patel and Vyas (2011) which include benchmarking process, proper planning, purchasing steps, receiving from suppliers, inspection, stacking and storage and inventory control. The recommendation was not based on any empirical research and still reflected more of reactive tendencies. Patel and Vyas' (2011) research did not captured key issues raised in this research. The underlined issue is that material management is still yielding below expectations. According to Hasnain *et al.*, (2019), the

management of material as related to planning and inventory management has remained the same for long despite new challenges in construction business. It was suggested that a state-of-the art resource management system is essential in achieving project objectives (Nagaraju *et al.*, 2012). This should take a proactive manner in both planning and implementation (Hasnain, *et al.*, 2019). This study therefore evaluated the volatility of various materials to market forces, effect of seasonal changes on prices, groupings of materials based on responses to changes in prices and the reflection of price changes of materials on building cost.

3.0 METHODOLOGY

This research adopted a quantitative approach. Historical cost data (HCD) consisting of market survey of prices

magazines published between 1998 and 2007. Despite the limitation of timeframe of the data, one key strength of the research is the establishment of a research paradigm for which a more recent data will be used in the future and parallels drawn to establish a trend in the research construct. Historical Composite Unit Rates (HCUR) for each material were computed that covered the 10years of the data for the study.

3.1 Significance of changes in market prices of building materials

In order to achieve the first objective, the HCUR were tested using analysis of variance (ANOVA). The test was to find out if there exists any statistical significance in the changes observed in the market prices of materials over a short (2years), medium (3 -5 years) and long (5-10years) periods in Nigeria. The hypothesis is as follows:

Table 1: ANOVA Table (single factor) for two years

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	807770216	28	28848936	284.0107	3.1493E-130	1.541161
Within Groups	17674388	174	101576.9			
Total	825444604	202				

covering array of building materials was collated from secondary sources. The data was obtained from quarterly reports of the market survey section of the Nigerian Institute of Quantity Surveyors (NIQS) magazine.

For this kind of research to be able to depict the desired cost history more reliably, the cost data within the research period should be consistent and share the same characteristics which can best be achieved if collated from a single source. From the archives of the authors, this study obtained a consistent cost data from quarterly publications of the NIQS

H0: There is no significant changes in market prices of materials over a short period.

H1. There is significant changes in market prices of materials over a short period.

The same statements apply to the medium and long periods tested. The tests results are reported in Tables 1, 2 and 3. Table 1 shows the result of the ANOVA test for short period. The value of F is 284.0107 while F_{crit} is 1.51161. Since F is greater than F_{crit} , the value 284.0107 then falls outside the accepted region. In other words, it falls within the

rejection region of H_0 which states that there is no difference. Therefore, we reject H_0 and conclude that changes exist in the prices of materials over short period. Still, the p-value measures the level of significance of the differences noticed. On whether the changes established are significant or not is a point of concern. The p-value is $3.1493E-130$ which is almost zero and is less than 0.05. This indicates significance and we conclude also that the changes in prices are significant.

In conclusion, it is established that within a short statistical period, changes in market prices of building materials in Nigeria exist and the changes in prices are significant. Tables 2 and 3 report similar tests for medium and long periods respectively. The results also show the same findings and interpreted similarly as in Table 1. This finding is logical and expected since the changes are found to be significant within a short period.

Table 2: ANOVA single factor for five years

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5.6E+09	2	2E+08	224.7691	0	1.4893
		8	88905			28
		87	6.4			
Within Groups	7.73E+08	0				
		89				
		8				
Total	6.37E+09					

Table 3: ANOVA single factor for ten years

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.02E+10	28	3.64E+08	217.6929	0	1.486329
Within Groups	1.89E+09	1131	1670101			
Total	1.21E+10	1159				

3.2 Classification of materials

Since all the materials in question were subjected to the same market forces within the same period, the research sought to establish the rate and extent of changes in items under consideration. It is important to know the more volatile materials that reacted to market forces faster and how far the changes in each went.

The findings here enabled materials to be classified in accordance to the extent of response to market forces (level of price changes) in the market. To achieve this the changes in prices was expressed in ratio in order to depict the extent as follows:

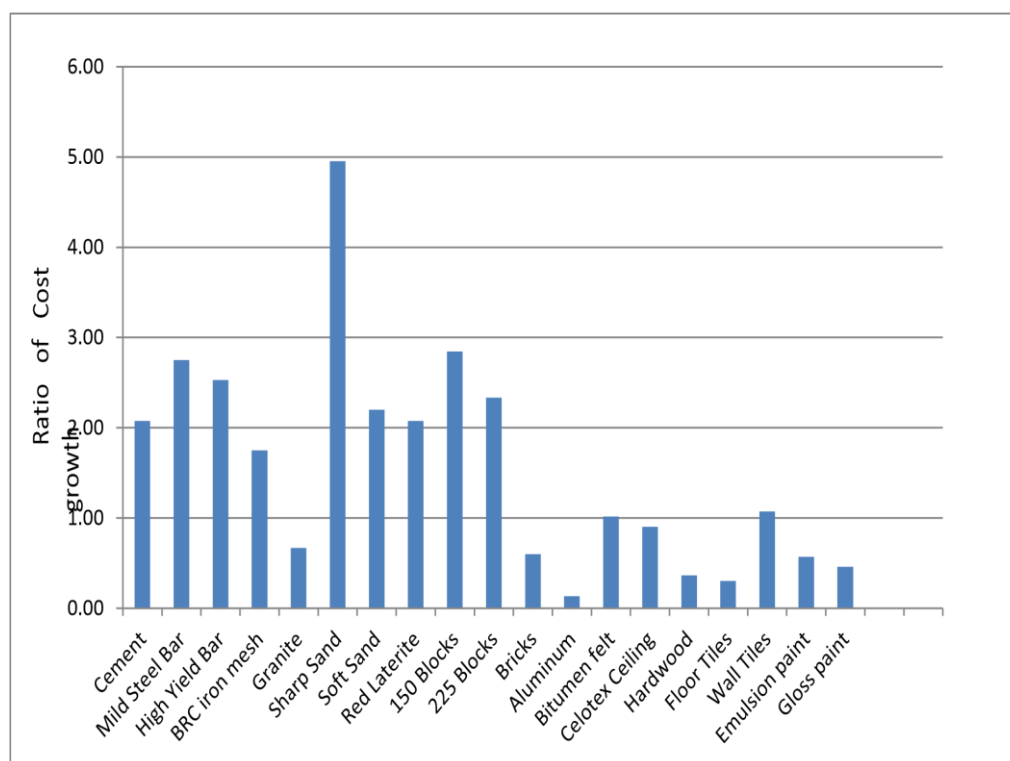


Figure 1: Extent of cost changes

$$\text{Extent of market price changes} = \frac{(X_2 - X_1)}{X_1}$$

Note: for a particular material, X1 is the earliest data point, X2 is the latest data point

Extent of market price changes in the materials under study were then plotted in a

extent in which prices of materials changed in ten years.

bar graph. Figure 1 therefore compares the Figure 1 indicates that all materials experienced positive changes in prices within the ten years period under study, however, the volatility differed. The changes in the prices were at different levels. It can be concluded that, construction materials change in market values and in the upward trend, noting that the change is significant within short period as earlier established. It is also important to note that materials respond to market conditions differently. The

percentage increase as indicated in this research differ from material to material. The extent of change forms the bases of classification of materials, also depicted in Figure 1. The items highly sensitive to market forces acquired high ratio of growth over the base value, while those less sensitive acquired low ratio. By common observation, it reveals that about half of the bars crossed over the 2.0 mark and the other half below 2.0. It is therefore interpreted that the change in prices of some items

exceeded twice the base value considered here as high, while others less than twice the base value within ten years considered as low. Aluminum, floor tiles, hardwood and granite were the four materials that least increased in prices respectively in ten years. On the other hand, sharp sand, 150mm

blocks, mild steel bar reinforcement and high yield bar reinforcements were the highest respectively. It can be concluded that economic pressure affects building materials at varying degree and can be classified into high and low sensitive items and classified in Table 4.

Table 4: Sensitivity of building materials to market forces

	High sensitive items	Low sensitive items
1	Cement	Granite
2	Mild steel bar	Bricks
3	High yield steel bar	Aluminum
4	BRC Mesh	Bitumen felt
5	Sharp sand	Celotex ceiling
6	Soft Sand	Hard wood
7	Red laterite	Ceramic floor tiles
8	150 blocks	Ceramic wall tiles
9	225 blocks	Emulsion paint
10	Gloss paint	

3.3 The reflection of changes in market the cost of a typical building was replicated **prices on building cost** using the HCUR to get the history of the total This section assesses how changes in market cost (HTC). The building is a 4-bedroom, 2prices of materials are reflected in the cost of storey prototype design. The HTC of the buildings and the season of the year the effect prototype

is spread quarterly over the ten is most felt. Using the spread sheet, historical years period (which gives 40 estimates of the composite unit rates (HCUR) of the materials same building) in accordance with the data identified were first computed from the collation. The estimates are reported in Table market prices. The quantity surveying 5. estimation technique was also employed and

Table 5: Quarterly cost of the standard design

Years	1st quarter	2nd quarter	3rd quarter	4th quarter
1998	5543490.752	5777803.975	5785450.037	5331888.104
1999	5170569.647	5671886.964	5717674.642	5609369.325
2000	5908175.046	5928254.521	5802757.02	5802757.02
2001	5802757.02	5802757.02	5802757.02	5710840.399
2002	6091356.852	6091356.852	6091356.852	6091356.852
2003	6471873.305	6701752.075	9393062.355	9393062.355
2004	10004692.4	10965973.85	10965973.85	10965973.85
2005	11679391.48	11416180.27	11416180.27	11284574.67
2006	11814493.98	12171932.14	12171932.14	12369340.55
2007	12369340.55	12369340.55	12919278.21	13408343.32

Table 6: Descriptive statistics of historical total cost

	1st Quarter	2nd quarter	3rd quarter	4th quarter
Mean	8085614.1	8289723.822	8606642	8596751
Standard Error	944849.951	948277.2806	964618.5	1015717
Median	6281615.08	6396554.464	7742210	7742210
Mode	#N/A	#N/A	5802757	#N/A
Standard Deviation	2987877.89	2998716.06	3050391	3211978
Sample Variance	8.9274E+12	8.9923E+12	9.3E+12	1.03E+13
Kurtosis	-1.8838374	2.080566194	-2.07606	-1.9081
Skewness	0.56434997	0.510780646	0.267955	0.315503
Range	7198770.9	6697453.586	7201604	8076455
Minimum	5170569.65	5671886.964	5717675	5331888
Maximum	12369340.6	12369340.55	12919278	13408343
Sum	80856141	82897238.22	86066422	85967506
Count	10	10	10	10
Largest(1)	12369340.6	12369340.55	12919278	13408343
Smallest (1)	5170569.65	5671886.964	5717675	5331888
Confidence Level (95.0%)	<u>2137399.08</u>	<u>2145152.238</u>	<u>2182119</u>	<u>2297711</u>

In order to capture the effect of the seasons on the cost, the estimates were grouped on quarterly bases (see Table 5). The cost in each quarter of the year were grouped together so as to analyse their characteristics. The **1st quarter (1Q)** covers January, February, March; **2nd quarter (2Q)**-April, May, June; **3rd quarter (3Q)**-July, August, September and **4th quarter (4Q)**-October, November, December. Descriptive statistics is then used to analyse the data.

Table 6 is the descriptive statistics of the quarterly cost in Table 5. Each set of values is analysed separately as reported. The mean values indicate how high the cost went up within the period. The mean at the 3Q of the year is highest with value N8606642.00, which is about 6.44% above the cost in the 1Q. The next is the 4Q with N8596751.00

mean, which is about 6.32% above the 1Q. Lastly the 2Q is N8289723.82, about 2.52% above the 1Q. The trend depicts cost increases as the year progresses from the first month and peaks at the 3rd quarter before dropping down back to its lowest again. The minimum value was experienced during the 1Q (5170569.65) to confirm that the prices reached the lowest by the year beginning before picking up within the year again. In support to this, the prices attained a maximum value of 13408343, which was also the largest value in the 4Q and the minimum value found in the 1Q. The implication is that prices increased into the 4Q before dropping sharply by 1Q. The range is highest (8076455) in 4Q suggesting that prices were more volatile within the period. The standard deviation measures the degree

of dispersion of the prices from their mean which is 3050391 and 321198 for the 3Q and 4Q respectively, both higher than the 1st and 2nd quarters. It supports also a greater volatility of prices within 3Q and 4Q and more in the 4Q, this possibly caused by the less friendly weather conditions.

Furthermore, the highest SD is found in the 4Q to confirm greater variability of prices at this period. Again, at 95% confidence level, the cost of the building is highest at the 4Q also and followed by the 3Q (2297711 and 2182119) respectively. By implication there is a possibility of continuous cost increase into the 4Q before it finally drops to its lowest at the beginning of the year. The skewness is positive for all the groups indicating that the data is positively skewed, or skewed to the right. There is consistency in the results proving that the 3Q and 4Q of the year are more challenging in terms of cost volatility compared to the cost at the 1Q and the 2Q. Possibly the challenges of the seasons bear on cost of materials and labour during these periods. Comparing the 1Q and 4Q, it is possible that the effect of the drop in 1Q bears on the 4Q, therefore the volatility of the prices in 4Q is mainly influenced by the sharp drop in 1Q. it can be concluded that the 3Q is most likely to reflect the real cost challenges in construction business. The 3Q is a period when rain is most experienced in Nigeria and followed by the 4Q.

4.0 DISCUSSIONS ON THE RESULTS

This research was set to evaluate the prices of building materials in the view of availing information for proactive material management of construction projects. It was established that prices of materials in Nigeria do change upward and at significant level within short periods. It also follows that the medium and long periods experience the

same. This is similar to Akani, Oke and Omotilewa (2014) who found an upward trend in material market prices in Nigeria influenced by inflation. This information is important to estimators who should allow for such changes in building estimates even on projects with short contract periods. Cantarelli *et al.* (2010) established the reflection of material price changes on building projects causing cost overruns which also tallies with findings in this research, the changes in market prices reflected on building cost.

Prices of materials change at different levels despite found in the same market conditions. Some materials change faster than others and are grouped into two categories. Material managers that keep inventory should consider the volatility of each material on the length of time to keep. The entire materials were classified and those more volatile were identified. The 3Q of the year poses greater cost challenges to construction works followed by the 4Q. The cost of a prototype building was found to exhibit more unstable cost characteristics compared to other two periods of the year at the 3Q and 4Q. These periods often experience greater inclement weather condition in Nigeria, possibly affecting price stability in which Edward (1991) also found that weather is among cost impacting factors on projects.

5.0 SUMMARY OF FINDINGS AND CONCLUSIONS

This work was set to achieve a set of objectives towards better material management. Along the aim of the research, the following findings are summarized as:

1. Market prices of building materials do change significantly and positively within a short period in Nigeria. It means that construction project can

experience significant cost growth within short statistical period.

2. Some materials respond rapidly to the forces of change while others respond slowly.
3. The changes in prices are reflected in the estimates of proposed projects. It means the risk of any change in market value of an item is borne by one party in the contract, i.e. either by the contractor or client.
4. The seasons of the year affect the cost of construction projects. The third quarter of the year experiences higher construction cost challenges followed by the fourth, then the second, while the first quarter is least. This suggests the cost of construction being higher at raining seasons when compared to dry seasons in Nigeria.
5. Increase in cost of materials within the year is most likely to reach 2.52%, 6.44% and 6.32% for 2nd, 3rd and 4th quarters respectively above the 1st quarter.

In conclusion, this work has answered the research questions asked at the beginning. It therefore avails vital information regards the level of significance of market prices of building materials, how they reflect in a building project and classified according to level of response to market forces, and also the effect of seasonal changes. The information enabled recommendation on how materials can be managed proactively. This fills the knowledge gap created due to inadequate research attention on the subject.

6.0 RECOMMENDATION

To be proactive in the management of materials, managers should:

1. Put in mind that inflation in market prices of materials and labour are reflected in building construction cost and the cost must be borne by one party in the contract which must be captured and appropriately apportioned during contract implementation.
2. Make provisions for cost increase in contracts with short duration. Contractors and cost experts should not assume otherwise when estimating the cost or managing projects with short contract periods. Failure may result to claims which could be more expensive and time consuming.
3. Keep inventory of materials that are most volatile to market forces as classified. The choice of inventory to cushion the effect of inflation should consider this, and more on projects with long contract periods.
4. Obtain the key materials for construction works earlier and prepare against the rainy season due to its effect on cost of materials. Also sequence the construction activities to consume materials most likely to response more readily to market forces because the longer it takes, the more likely their prices will grow.

7.0 AREAS OF FURTHER RESEARCH:

1. Volatile materials have been identified but the behavior of individual materials under market forces should be modeled to assist further in better understanding of the materials for the choice of inventory.
2. The kind of difficulties experienced during the third and fourth quarters of

the year leading to higher cost of materials should be studied so as to shed more light on key cost influences.

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Simulation of Courtyard Buildings for Effective Thermal Performance in Temperate-Dry Climate of Nigeria



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ABSTRACTS

Scholars have used the simulation method to confirm that the courtyard thermal performance of the high-rise building is better than that of the mid-rise, while the single-storey has the worst scenario. But, the indoor thermal performance of the high-rise, mid-rise, and single-storey courtyard building typologies requires investigation. Therefore, this study aimed to study the indoor thermal performance of the single-storey, mid-rise and high-rise courtyard building typologies by comparing the thermal performances of their ground floors. The Integrated Environmental Solution and Virtual Environment (IES-VE) simulation software was used for the experiment. Prior to the simulation experiment, the IES-VE software was validated by comparing it with data obtained in a field measurement using the Hobo Weather Data Logger (HWDL). This study shows that the indoor thermal performance of the high-rise courtyard building was better than that of the mid-rise, and the single-storey was the poorest. The air temperature of the high-rise courtyard building is 0.5°C less than in the mid-rise, and 1°C in the single-storey. The relative humidity shows 1%, and 2% discrepancy as well. It was concluded that architects should use the courtyard concept in their design proposals of high-rise buildings more than in the single-storey because of the shading benefit which improves their indoor thermal performance. However, more simulation studies are required because the indoor thermal performance of the subsequent floors was not considered. Also, the impact of air movement and day-lighting were not studied.

Keywords: *Simulation, Thermal Performance, Courtyard Buildings*

1. INTRODUCTION

Simulation is a method that uses software to develop a digital model of something for the purpose of a detailed study (Nasrollahi *et al.*, 2017; Lim, 2008). It is a method in scientific research that enables scholars to test numerous hypothesis and make scientific predictions (Havel, 2016; Begnaid, 2006). The professionals also use it for their energy-efficient design proposals.

This method has been used by scholars to understand the thermal performance of the courtyard in a building (Markus, 2018a; Muhaisen, 2006a).

Hot thermal discomfort is a challenge faced in buildings and the courtyard building in particular. The challenge is worst, especially in the tropical regions of the globe and Nigeria inclusive. But, the courtyard has been advocated as a passive architectural

design concept to mitigate the challenge (Reynolds, 2002). Its ability to mitigate hot discomfort in buildings has been confirmed via simulation (Mohammad, 2018; Muhaisen, 2006b; Markus, 2018b). However, its thermal performance varies in different building typologies (Hyde, 2000).

Further simulation studies towards understanding the thermal performance of the building typologies: single-storey; mid-rise and high-rise courtyard building typologies have been advocated by Al-Hemidi *et al.* (2001) and Berkovic *et al.* (2012). The advocacy was necessary because such will further help the practicing architect to have a better knowledge of which type of building does the courtyard performs better. Tablada *et al.* (2005) insisted that the awareness of how the courtyard performance in various building heights (the single-storey, mid-rise, and high-rise) is essential. They further opined that such knowledge is required for mitigating hot thermal discomfort in courtyard buildings. The micro-climate modifying potential of the courtyard in buildings can be utilized effectively if the knowledge of the architect is enhanced. The architect will be able to apply such knowledge in his architectural vocabulary by rightly deciding which of his design proposal should have the courtyard.

The purpose of this paper is to investigate the indoor thermal performance of three courtyard building types; the single-storey, mid-rise, and high-rise. The objective is to compare the thermal performances of the ground floor of each of the three buildings to ascertain the most conducive among the three. This was accomplished through the simulation method. The scope of the paper is to consider the thermal performance of the ground floors of the three courtyard buildings.

2. LITERATURE REVIEW

The challenge of hot thermal discomfort in buildings has affected the efficiency and well-being of building occupants due to the harsh weather conditions. The weather conditions occur seasonally in some of the climes while others may experience continuous conditions all through the year (Abdulbasit *et al.*, 2015; Fatma *et al.*, 2016). Locations close to the equator such as Malaysia, for instance, experienced only one season (Abdulbasit *et al.*, 2015). But, hot thermal discomfort seems to be more severe in tropical regions than in the Polar Regions (Olutoa, 2015). According to Olutoa (2015), the tropical region is defined as the geographical landmass within latitude 23°C north of the equator (Tropic of Cancer) and latitude 23°C south of the equator (Tropic of Capricorn). Scholars have contributed towards mitigating hot thermal discomfort in buildings by advocating the use of passive design strategies which has little or no dependence on artificial energy to cause conducive indoor thermal comfort (Berkovic *et al.*, 2012; Manio and Oral, 2015; Markus, 2018a).

Akande (2010) suggested appropriate orientation of buildings to alleviate thermal distress in building, particularly, buildings in the hot-dry climatic region of Nigeria. Kabiru (2011) opined that a greater design awareness among architects is required if delivery of architectural design of buildings that could guarantee thermal comfort is required. He further stated that climate-responsive architectural design should be clearly understood by architects. Other scholars have highlighted that the courtyard is a climate-responsive design element and its application from the onset should not evolve as a coincidence or due to solving the day-lighting issue alone but, as a means to enhancing conducive indoor thermal

conditions (Muhaisen, 2006a; Aldawoud and Ray, 2008).

According to Fahad (2005), the courtyard has been used in architectural design due to its ability to induce cooling in buildings, especially in tropical regions because hot thermal discomfort is a challenge common to all building types within the region. The courtyard has survived extinction from all civilizations due to its thermal impact on indoor thermal comfort in buildings (Das, 2006). It is applicable to all building types (Adetokunbo *et al.*, 2013). However, its performance in different building heights such as the single-storey, mid-rise and high-rise may not be the same (Aldawoud and Ray, 2008). Therefore, a review of such building types is required for this study.

The thermal comfort performance of the courtyard building has become an area of interest and researchers have made some contributed in this regard. Begnaid (2006) studied the thermal comfort performance of the mid-rise courtyard building typology. Begnaid (2006) defined a mid-rise building as that which ranged from more than one-floor to four-floors. His study focused on the indoor thermal performance of the courtyard building. He used the simulation method to compare the thermal performance of the mid-rise courtyard building with that of non-courtyard mid-rise. The simulation results revealed that the thermal comfort status of the mid-rise courtyard was more favorable than that of the non-courtyard mid-rise. He concluded that further simulation experiments to compare the thermal condition of other courtyard building heights with the mid-rise is required to enhance the architect's design awareness and to better his choice.

Markus *et al.* (2017a) compared the thermal behavior of two types of courtyard

buildings. They studied the semi-enclosed and fully-enclosed with the aim of ascertaining the most conducive among the two. Two Hobo Weather Data Logger (HDL) were used in the field measurement. The study revealed that the semi-enclosed type performed better than the fully-enclosed. But, Markus (2017a) focused on the courtyard space alone. Further research effort towards investigating the indoor thermal conditions of the courtyard building is required because such will inform the intuitive potential of the professionals in the built environment. The occupant performs most of their daily activities in the indoors of the building and not on the outdoors alone.

Researchers have debated that the courtyard thermal condition influences the indoor thermal condition of the entire building also (Manio and Oral, 2015; Berkovic *et al.*, 2012; Fahad, 2005; Mohd *et al.*, 2014). Berkovic *et al.* (2012) argued that the courtyard thermal condition can impact on the indoors of the courtyard building only when the relationship between the courtyard and the window-to-wall ratio is understood. Fahad (2005) opined that the thermal state of the courtyard is directly proportional to that of its indoors. Mohd *et al.*, (2014) insisted that the courtyard can enhance the thermal condition of both spaces. The Iranian courtyard house was investigated by Farzaneh *et al.*, (2016a). The result shows that the courtyard improved the indoor thermal comfort of the courtyard buildings. Markus *et al.* (2017b) have confirmed Fahad (2005) opinion.

Farzaneh *et al.* (2016b) suggested further studies towards examining the thermal comfort performance of different courtyard buildings via the simulation approach. They argued that most of the studies conducted (Berkovic *et al.*, 2012; Fahad, 2005; Mohd *et al.*, 2014; Markus *et*

al., 2017b) used the field measurement method and the findings of such studies may require further simulation for validation. Bagneid (2006) concurred that simulation studies on comparing indoor thermal comfort conditions of the single-storey, mid-rise, and high-rise courtyard buildings are important. It is important because the findings of such studies may not require further validation (Bagneid, 2006). Secondly, such knowledge will help both the architect and the client to decide on whether the courtyard is necessary for the design proposal at all. The IES-VE software is one of the frequently used tools for simulation experiments in buildings, most especially the courtyard building (Attia, 2009). The indoor thermal performance of different courtyard building heights could be investigated via the IES-VE simulation software (IES-VE 2010).

Consequently, this inquiry adopted the simulation method by using IES-VE software to achieve its research aim because such a research approach is the most appropriate for studies of this sort (Bagneid, 2006). The study focused on the first-floors of the single-storey, mid-rise, and high-rise courtyard building types. Further studies in the future should focus on the remaining floors for all-inclusive investigations.

3. METHODOLOGY

The study adopted the simulation approach because it is the most appropriate for experimental investigations in courtyard buildings (Bagneid, 2006). The IES-VE simulation software was adopted and validated before the commencement of the experiment. For the validation task to be accomplished, the field measurement of the thermal comfort parameter in an existing building was required (Leng *et al*, 2012). The validation was achieved by using the benchmark of 0-20% discrepancy between the field measurements with the simulation experiment result. The details of the field measurement, validation, and simulation experiments are discussed in the subsequent sections.

3.1 The Study Area

Kafanchan, being the study area is located in the temperate-dry climate of Nigeria. As revealed in Figure 1, Kafanchan is geographically positioned on latitude 9°58'N and longitude 8°29'E. These coordinates fall within the temperate-dry climatic zone of Nigeria. Consequently, the study area is sited within the temperate-dry climatic region of Nigeria.

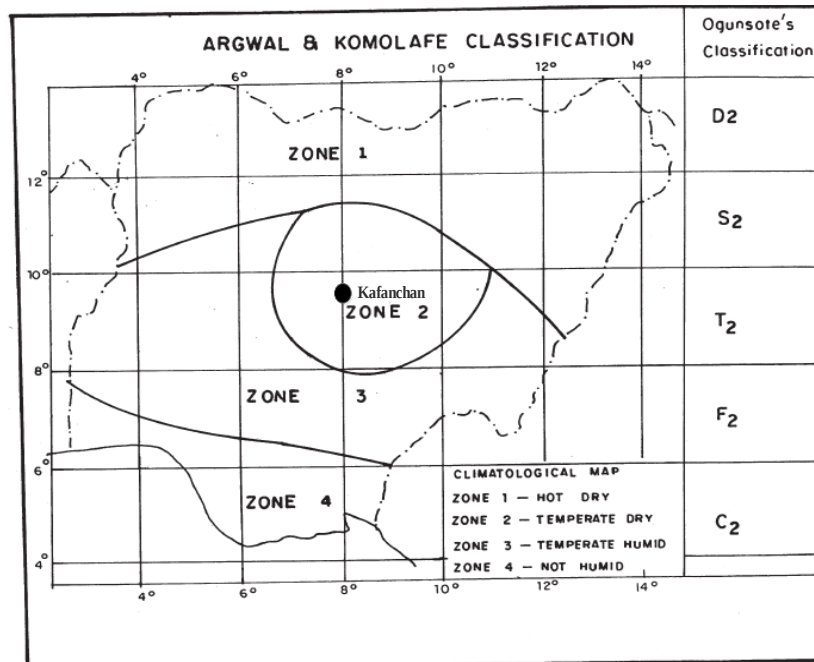


Figure 1. Nigerian climatic zone (Komolafe and Agarwal, 1988)

3.2 Field measurement

Figure 2 shows the Hobo Weather Data Logger (HWDL) used during the field measurement. An office courtyard building in the faculty of civil engineering in Universiti Teknologi Malaysia (UTM) was used for the field measurement. Figure 3 shows the floor plan of the building. The HWDL was used to measure indoor air

temperature in the case study courtyard building. It was placed 1.2m above the floor level as illustrated in Figure 2. The HWDL was set to measure air temperature readings at 60 minutes time intervals for six (6) hours, starting from 10: 00 am to 4: 00 pm. Subsequently, the tool was read out and interpreted

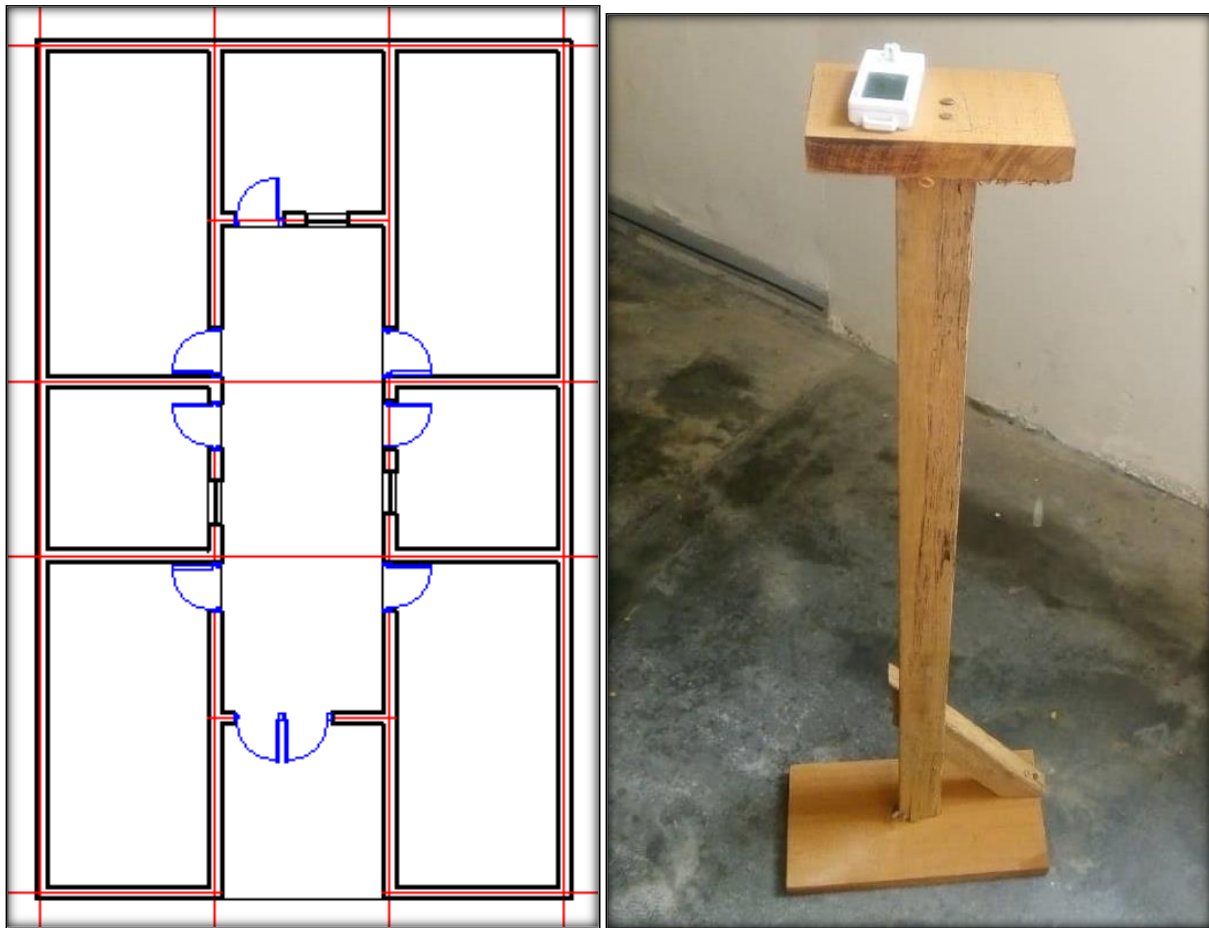


Figure 3. The Case study Building **Figure 2.** The HWDL during Field Measurement

3.3 Validation of IES-VE Software

The validation of simulation software is to ascertain the accuracy of the tool for experiments. It is achieved by comparing the discrepancy between the field measurement results with the digital model simulation result. A digital model of the case study

courtyard building is required. The Model-It application of the IES-VE software was used to develop the model. The digital model is of the same pattern as that of the case study. Figure 4 shows the model. The benchmark adopted by Prasanthi *et al.* (2011), Markus (2018b) and Maamera *et al.* (2006) was used for the analysis of the validation results.

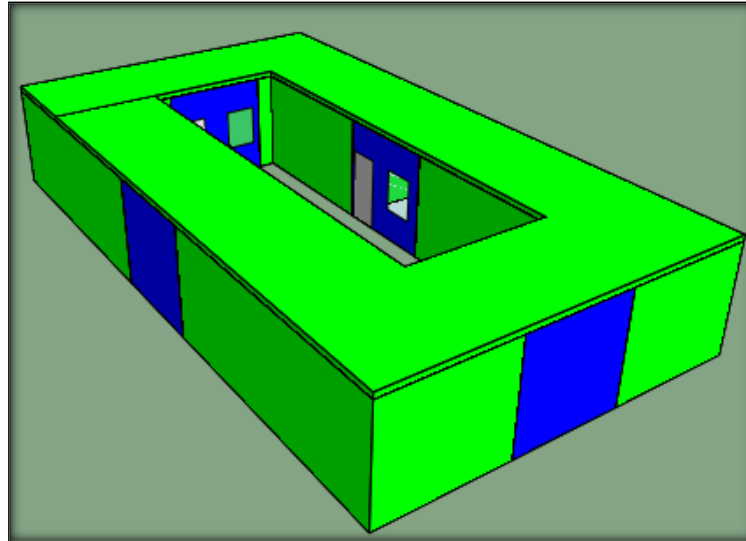


Figure 4. The Base-Case Model

The results revealed a discrepancy of 8.2%. This discrepancy falls within the accepted benchmark of 0-20% as revealed by Prasanthi et al. (2011) and Maamera et al. (2006). The results established the fact that

the software is suitable for simulation experiments. Figure 5 shows the field measurement and the digital model simulation results.

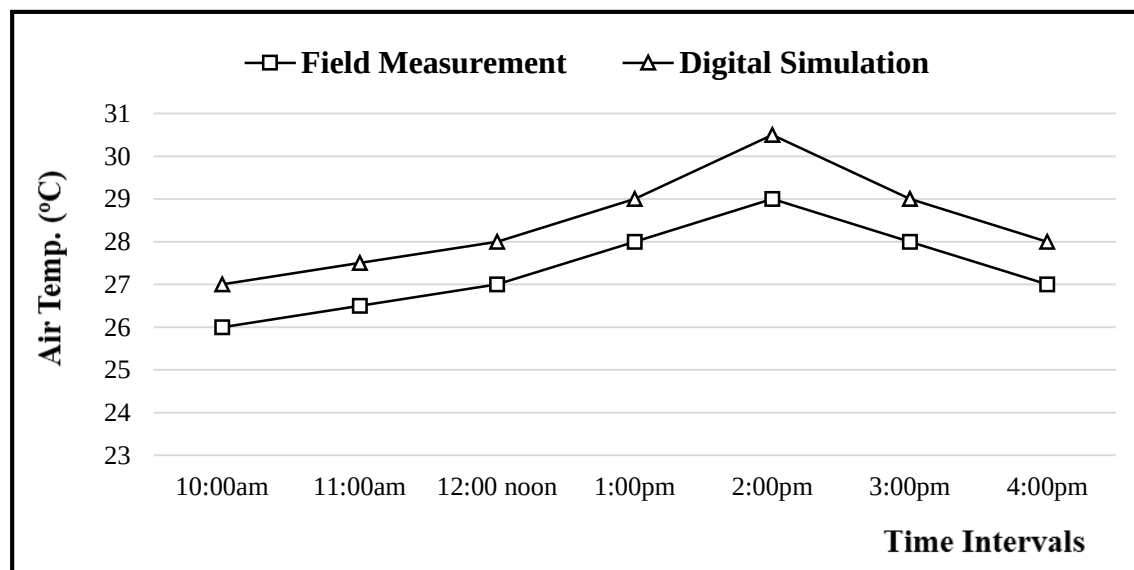


Figure 5. Validation Results.3.4

3.4 Procedure for Simulation Experiments

Three types of Courtyard models were developed for the simulation experiment. A courtyard building of 3m height which represents the single-storey, 12m and 18m representing the mid-rise, and high-rise were constructed by using the Model-It application of the IES-VE software. The first floor of the three models was simulated using the same simulation settings to study their indoor thermal performances. Air temperature and relative humidity were the two thermal comfort parameters considered. The simulations were run at thirty minutes time-intervals for twelve hours (7:00 am – 7:00 pm).

4. RESULTS AND DISCUSSION

Air temperature and relative humidity were the two thermal comfort parameters investigated in this study. The results and discussion are presented in the subsequent sections.

4.1 The Air Temperature

The air temperature performance results of the three models are shown in Figure 6. The model representing the high-rise courtyard building type performed better, the model represents the mid-rise courtyard building type came second while the model representing the single-storey was the poorest..

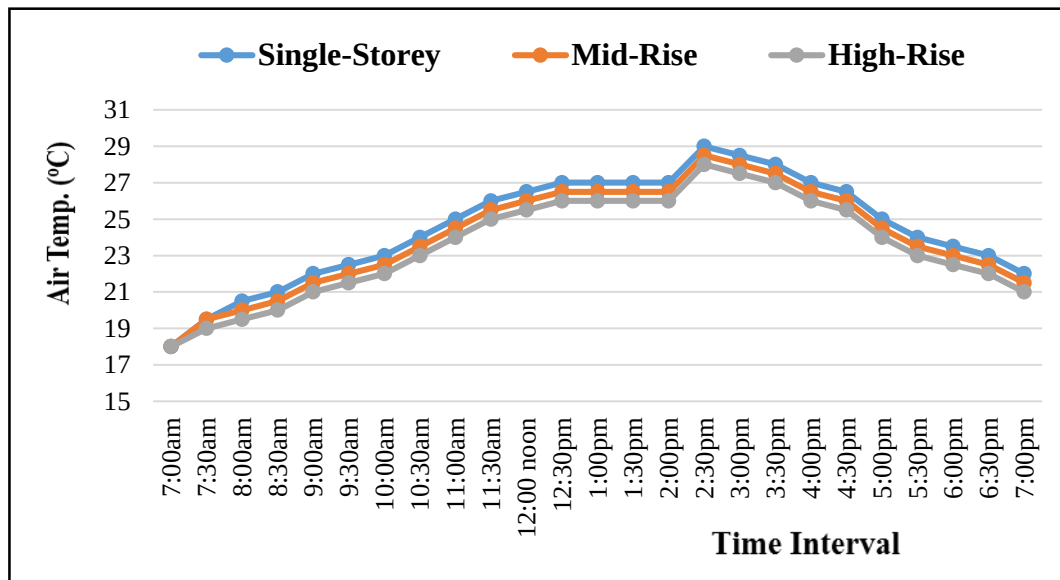


Figure 6. Effect Courtyard Height on Air Temperature

Table 1: Minimum and Maximum Air Temperature Performances

	High-rise	Mid-rise	Single-storey
Max. Air Temp. (°C)	27.5	28.0	28.5
Time	3:00 pm		
Min. Air Temp. (°C)	18.00	18.00	`18.00
Time	7:00 am		
The discrepancy between High-rise, Mid-rise & single-storey is 0.5°C			

A discrepancy of 0.5°C occurred between the models. The outcome means that the high-rise courtyard buildings have favorable air temperature. The results agreed with Berkovic *et al.* (2012) assertion that the effect of shading is much in deeper courtyard than in the shallow ones. They did not study the impact of shading on the indoor thermal performance of the courtyard building. However, Muhaisen and Gabi (2006a) opined that the thermal condition of the courtyard space impact on the indoor of the courtyard building. The findings of this study have confirmed Muhaisen and Gabi (2006a) opinion because its emphasis is on the indoor of the courtyard building and not the courtyard space.

Muhaisen and Gabi (2006b) asserted that courtyard shading is the key determinant of conducive thermal performance in courtyard buildings. The high-rise courtyard building is higher than the mid-rise, and the single-storey is the lowermost. Therefore, shading impact will be greater in high-rise courtyard building than in the mid-rise and the single-storey respectively. Consequently,

4.2 The Relative Humidity

The relative humidity performance results of the three models are as shown in Figure 7. The model representing the high-rise courtyard building type performed

the thermal performances of the respective building types are justified.

Table 1 shows the maximum and minimum air temperature performances with their respective time. The three buildings had their maximum and minimum readings at the same time. The maximum readings occurred at 3:00 pm while the minimum happened at 7:00 am in the morning. As revealed in the Table, all the maximum readings were above the thermal comfort range. This connotes that optimization studies are required to enhance the thermal comfort performance of such buildings.

However, these findings may not be enough to draw any serious conclusion because the effect of ventilation was not considered. Secondly, the thermal condition of the other floors of the high-rise and mid-rise courtyard buildings was not investigated too. Edward *et al.* (2005) opined that shading and ventilation are critical to the thermal performance of the courtyard buildings. Therefore, further simulation experiments are required in that regard.

worse, the model represents the mid-rise courtyard building type followed while the model representing the single-storey was the most favorable.

The findings of this study connote that the single-storey courtyard building has lower relative humidity than the mid-rise and high-rise. This result is the opposite of the air

temperature. The height of the building impact on its relative humidity. A discrepancy of about 1% of relative humidity as shown in the buildings.

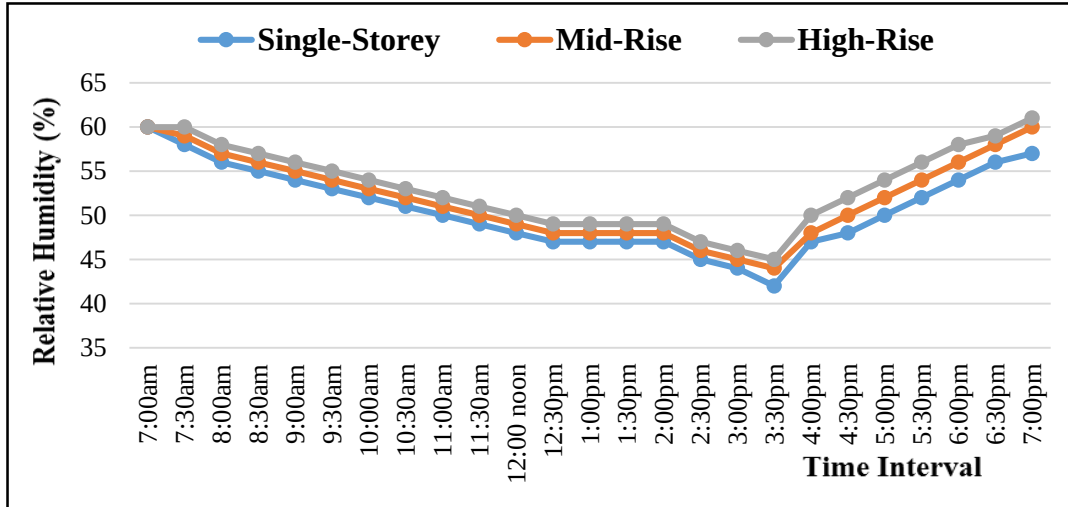


Figure 7. Effect of Courtyard Height on Air Temperature

The analysis of results is shown in Table 2. The relative humidity result concurred with Farzaneh *et al.* (2006a) assertion. Farzaneh *et al.* (2006a) asserted that when the air temperature increases, the relative humidity also decreases proportionately. Because of the opposite relationship that occurs between the two thermal comfort parameters, a balance between the two may be difficult to achieve in the tropical climes (Farzaneh *et al.*, 2006b). Abdulbasit *et al.* (2013) also confirmed that a balance between them may be achieved within the Polar Regions because extreme cold thermal distress is being experienced in such areas. According to Abdulbasit *et al.*, (2013), the air temperature is the most critical thermal; comfort parameter to be considered in the tropical climates, most especially in the hot-dry climatic region. Because of the moderate relative humidity that is experienced in such climes, a design approach that influences the air temperature should be given more consideration (Markus, 2018b).

Table 2: Minimum and maximum relative humidity performance

	High-rise	Mid-rise	Single-storey
Max. Relative Humidity. (%)	42.00	43.00	44.00
Time	3:00 pm		
Min. Relative Humidity. (%)	60.00	60.00	60.00
Time	7:00 am		
The discrepancy between High-rise, Mid-rise & single-storey is (1%)			

CONCLUSION AND RECOMMENDATIONS

This paper investigates the indoor thermal performance of high-rise, mid-rise, and single-storey courtyard building typologies in the temperate-dry climate of Nigeria. The study discovered that the high-rise courtyard buildings have conducive indoor thermal performance than the low-rise. Its main contribution lies in the fact that the high-rise building requires the courtyard concept more than the low-rise, and the architect should remember to use the courtyard where it is required most.

Based on the findings of this study, the architects should use the courtyard concept in their design proposals of high-rise buildings more than in the single-storey because of the shading benefit which improving their thermal performance. The study made the following suggestions:

- i. Future studies should simulate the entire floors of the high-rise and mid-rise courtyard buildings to investigate their thermal performances.
- ii. Further study of the air-flow pattern to investigate its impact on the thermal comfort of the high-rise and mid-rise courtyard buildings should be considered.
- iii. Optimization studies on the single-storey courtyard building are required because such are the most common typology used in residential buildings.
- iv. Simulation experiments to examine day-lighting issues in high-rise and mid-rise courtyard buildings should be considered in future research endeavors.

However, more simulation studies are required because the indoor thermal performance of the subsequent floors was not

considered. Secondly, the impact of air movement and day-lighting were not studied.

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**AN ANALYSIS OF RAINWATER INFILTRATION ON THREE
AGRICULTURAL LAND USE SURFACES IN PERI URBAN AKWANGA,
NASARAWA STATE, NIGERIA**



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Abstract

The paper examines rainwater infiltration on three agricultural land use surfaces in peri urban Akwanga, to determine its variability on the different agricultural land use types of the study area. Six (6) sites were established to measure infiltration and run off amount with 2 sample sites on farmland, fallow plot and orchard land use types. Data was collected using 17 rainfall events in 3 months (July-September, 2012) to cover ten (10) variables: infiltration amount, runoff from plot, rainfall, slope, land use coefficient, soil porosity, soil moisture, sand, silt and clay. Data obtained were subjected to analysis of variance, coefficient of variation, correlation and regression analysis. From the results, total infiltration amount did not vary significantly between the land use types. The infiltration model has a coefficient of determination of ($r^2 = 0.99$) that can predict infiltration amount in the study area with an error margin of only 0.01 (2975.71mm). It is recommended that the use of surface ameliorants such as conservation tillage, use of high residue crops, cover crops, compost manuring and mulching be incorporated into farming systems to increase organic matter build-up and subsequently soil aeration and porosity.

Keywords: Landuse, Infiltration, Agriculture, Soil moisture and Run off.

1. INTRODUCTION

Infiltration generally refers to the movement of water into the soil. Ayoade (1988) further stressed that infiltration as a process is restricted to the entry of water through the surface layers of the soil, while percolation which is slightly a different term is used to describe the downward flow of water through the zone of aeration towards the water table. The term was first used by Horton (1933) in a seminal paper to describe the process by which water soaks into or is absorbed by the soil. Other scholars in this subject matter are Duley (1939) and Jordan (1987) whose works built upon Horton's concept, focused on surface factors affecting the rate of intake of water by soils. The nature of soil, vegetative cover and land use are critical to

understanding infiltration. Other factors especially those related to the soil surface also affect the infiltration-runoff processes and soil moisture (Chowdary, Damodhara and Jaiswal, 2006; Kutilek and Nielsen, 2004).

Over the years, researchers have used infiltration rates to assess effects of land use on soil properties and watersheds in different parts of the world (Wang, Fu, Qiu, and Chen, 2003; Nord, 2008; Okelo, Onyando, Shivoga and Miller, 2008; Basche and Delongs, 2019). In Nigeria, studies on infiltration rates started in the early 1970's to identify land uses and their impact on the environment (Akintola, 1974; Ayanni, Ayan and Tunji, 1991; Idike, 2002; Adoga, 2005; Osuji, Okon, Chukwuma and Nwarie, 2010;

Akingbile, 2010; Ahaneku, 2011; Ime, Ehuchaogu and Etuk, 2015). In Nasarawa State, Akwanga in particular, studies on soil infiltration are not only necessary but imperative due to different land use types emerging as a result of urbanization and the accompanying environmental problems arising from the conversion of farmlands, orchards and forest to urban landuse such as housing projects, markets, road construction and hospitals; population pressure has also led to intensive farming activities and less fallow period for those who still practice it. There is scarce research information on the effect of these practices on infiltration characteristics in Nasarawa State as a whole. Thus, this paper is interested in the analysis of rain water infiltration among different agricultural land use surfaces in peri urban Akwanga with a view to providing a baseline study at the local level of the town. This paper seeks to determine infiltration variation on the different agricultural land use types, establish the parameters that influence infiltration on the different agricultural land use types and predict infiltration capacities of the different agricultural land use surfaces in the study area.

2.0 MATERIALS AND METHODS

2.1 Study location and Data

This work was carried out at Akwanga local government area of Nasarawa State Nigeria, which is located between latitude $8^{\circ} 34^1$ north and $8^{\circ} 47^1$ north and longitude $8^{\circ} 17^1$ east and $9^{\circ} 04^1$ east (figure 1). Three different agricultural land use types in the study area and six sites (figure 2) were selected for this work, based on different landuse criteria (table 1). These agricultural landuse types are

farmland, fallow plot and orchard. For each landuse type, 2 sites were used, to give a total of 6 runoff sites (Plots). The runoff measurement was taken for each of the plots selected. The data was collected over 3 months' period starting from July to September, 2012. The measurements were taken after each rain storm that produced runoff of 20mm and above; and a total of 17 rain storms were recorded. In September 2012, soil samples were also taken from the six sites for laboratory analysis.

Data was also collected on other parameters such as soil moisture, slope, rainfall, and runoff plots and infiltration capacity. The soil characteristics that were measured in the laboratory include soil texture (sand, silt and clay), porosity and moisture content.

This paper made use of rainfall, 6 runoff plots on the 3 agricultural landuse types (2 on each) were selected (Li, Contreras, Sole-Benet, Canton, Domingo, Lazaro, Lin, Wasemael, and Puigdefabregas, 2011), a mixture of cement and sand was used to delineate the runoff plot (Johnston, Elsayy and Cochrane, 1980; Hoogmoed, Klau and Brouwer, 1991; Shouse, Ellsworth and Jobes, 1994; Heeren, Fox and Storm, 2014). Six runoff collectors were used to collect the volume of water passing down slope border of the plot (Hoogmoed *et al.*, 1991) and six cans to collect rain water, one for each runoff plot (Hoogmoed *et al.*, 1991). Soil samples were analyzed using gravimetric method in the laboratory (Reynolds, 1970) and a Pantometer for measuring the slope of runoff plots (Blong, 1972).

Table 1: Land Use Types and Sites

Land use Type	Sites	Remark
Farmland	Site 1	Maize farm beside Nacaps Polytechnic (Along Lafia-Wamba road bye pass)
	Site 2	Yam farm behind, Football field, College of Education, Akwanga
Fallow land	Site 1	Fallow plot near Sports Field, Sports Academy (Kurmin Tagway). Km 3, Wamba road
	Site 2	Fallow land behind J.S 1 block, Mada Hills College
Orchard	Site 1	Mango Orchard, Gwanje (km 4, Jos road)
	Site 2	Oil Palm Orchard, Nsakpe (km 3.5, Keffi road)

Source: Authors field work

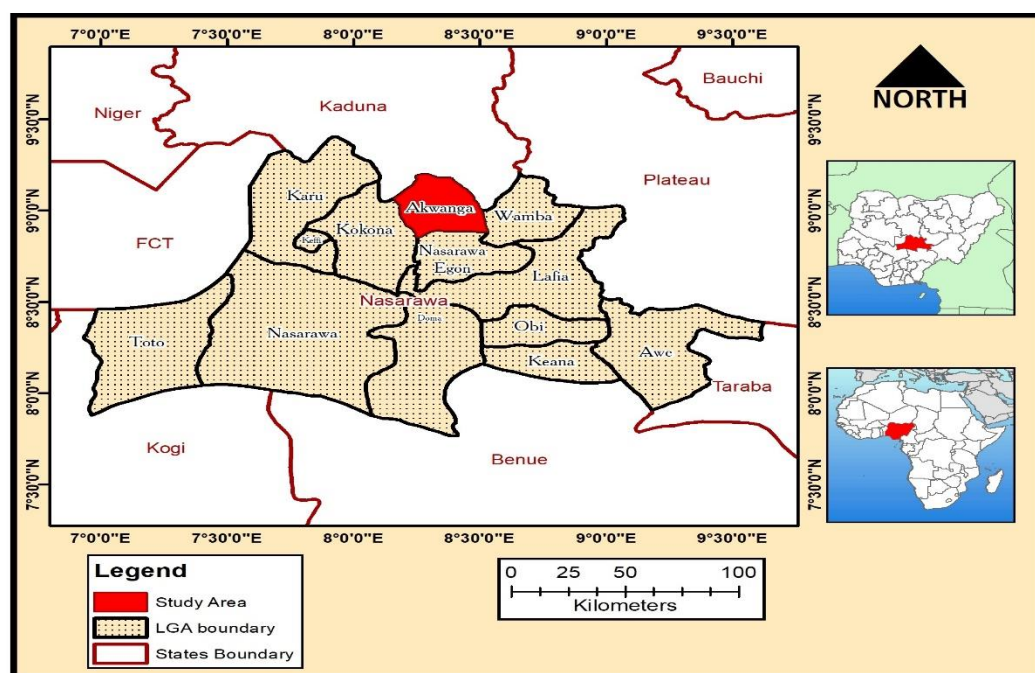


Figure 1: Nasarawa State showing Akwanga Local Government Area.

Source: Lands and Survey, Works Department, Akwanga L.G.A

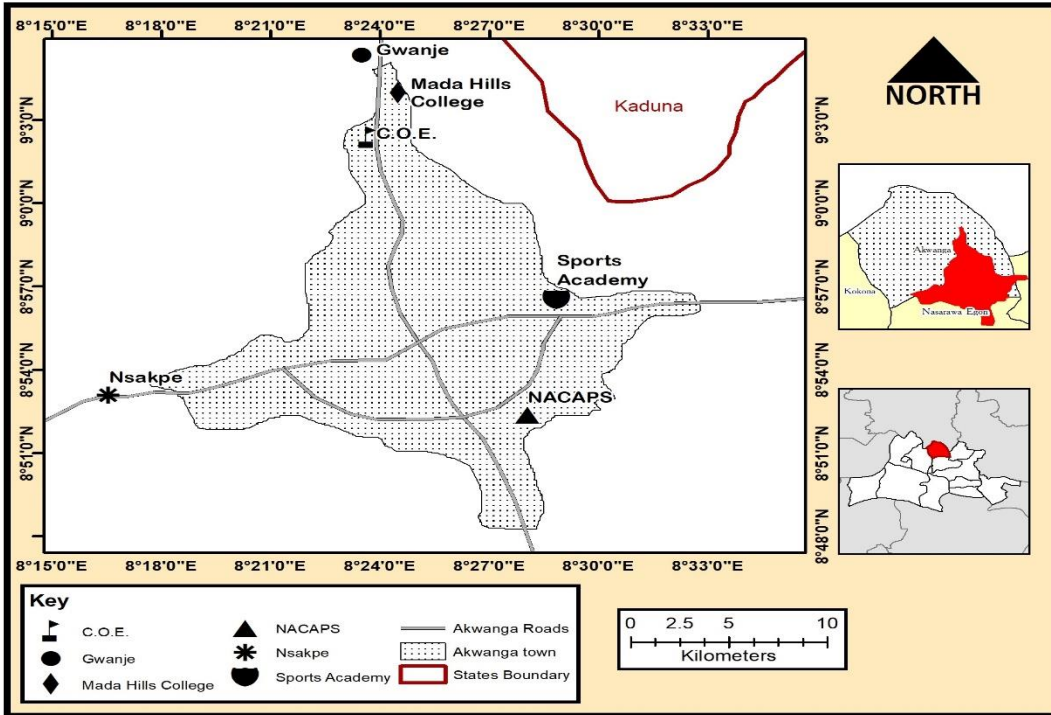


Figure 2: Akwanga Town showing Sample and Experimental Sites.
Source: Lands and Survey, Works Department, Akwanga L.G.A

2.2 Measurement of Infiltration Capacity

The infiltration capacity was measured with the aid of the improvised runoff plots. A simple USDA Soil Conservation Service (1957) equation was used for calculating infiltration by using the improvised runoff plots measurement. Mathematically written as:

$$I = P - R \dots \dots \dots (1)$$

Where, P = Precipitation

R = Runoff, which was determined by the improvised runoff plots

I = Infiltration

The infiltration above was calculated as the excess of rainfall over runoff. This does not account for evaporation, which is especially high in the tropics. Therefore, these results should be interpreted conservatively.

The runoff plots were constructed on the six selected sites using a mixture of cement and

sand. A totatiser was used to collect all the runoff; this was fixed at the mouth of the runoff plot constructed while the rain-gauges were used to collect rainfall. The slope was measured using pantometer.

This was gotten by using the method of irregular shape.

$$\begin{aligned} \text{Full square} &= 32 \\ \frac{1}{2} \text{ square} &= 19 \div 2 = 9.5 \\ \text{Total} &= 41.5 \end{aligned}$$

$$\begin{aligned} \text{One complete square is } 10 \text{ cm} \\ \text{Therefore, } 41.5 \times 10 &= 415 \text{ cm}^2 \end{aligned}$$

$$\text{Converting cm to m} = 415/100 = 4.15 \text{ m}^2$$

Area l Precipitation over the plot was calculated using the formula of the area of a cylinder

$$\text{Area} = \left(\frac{1}{3}\right) \pi R^2 H \dots \dots \dots (2)$$

Where, $\pi = 22/7$ (Constant)

R = Radius ($\frac{1}{2}$ of a diameter)

H = Height

The laboratory analysis of soil was done at the soil and water laboratory in the Department of Geography, Bayero University Kano. One hundred grams of soil was taken from the 6 sites as samples in September 2012 and was tested in order to determine the soil moisture content, texture and porosity.

To get the moisture content fifty grams (50g) soil sample was used out of the 100g taken from the study area. This was oven dried at 105°C for 24 hours and reweighed. The moisture content was then obtained using the gravimetric method as follows:

$$M = \frac{W_w - W_d}{W_d - W_c} \times 100 \dots \dots \dots (3)$$

Where,

M = moisture content (%)

W_w = the weight of soil including moisture content

W_d = the weight of the soil after oven-drying

W_c = the weight of the container holding the soil sample

The particle size analysis was determined using dried soil sample was also sieved through a 2mm diameter mesh, after which the hydrometer method was used to determine the soil texture of sand, silt and clay.

Soil porosity was determined with the oven dried six samples by first determining the Bulk density through the formula.

$$BD = \frac{W}{V} \dots \dots \dots (4)$$

Where,

BD = Bulk Density

W = Weight of oven dry soil

V = Volume of oven dry soil

Then the result will be computed to find the pore space by

% pore space is

$$100 - \frac{\text{Bulk density} \times 100}{\text{Particle density}} \dots \dots \dots (5)$$

The land surface characteristics this study evaluated are those of slope and vegetation.

The slope angle of the six sample sites was measured with the use of a pantometer.

Slope angle ($^{\circ}$) = $90 - \theta$

Where,

θ = Actual angle measured on the field

90° = Constant (Angle on a straight line)

The data collected from the field work was analyzed using coefficient of variation, multiple correlations and multiple regressions.

The landuse types in this study area are categorized based on the vegetation cover for each of the study sites. Runoff coefficients of the different vegetation covers were used to represent different vegetation surfaces and land use in the parameters that were used for analysis. The standard landuse coefficient was used taking into cognizance the vegetation, soil type and slope for each landuse type stated as follows: Orchard 0.23, Fallow plot 0.23, and Farmland 0.25 (table 6).

3. RESULTS AND DISCUSSION

3.1. Rainfall in the Study Area

Table 2 presents the monthly rainfall total of the study area. The analysis shows that even though the rain started in March, it's peak was in August with 496mm. The relief of the study area gives it a high rainfall amount compared to other areas in Nasarawa state (Agidi, Hassan, Baleri and Yilgak, 2018). These results also revealed a high seasonality of rainfall and this rainfall is concentrated in the months of June to October.

Table 2: Monthly Rainfall of the study area in 2011

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Rainfall (mm)	-	-	8	58	144	189	221	496	240	213	-	-	1569

Source: Department of Geography, College of Education, Akwanga.

3.2 Variability of Infiltration Amount in the Study Area

The variability of infiltration among the different land use types in the study area was analyzed using the coefficient of variation (CV) and analysis of variance (ANOVA). The coefficient of variation was used to bring out the individual variation of infiltration amount in the different land uses while the analysis of variance was used to establish the infiltration variation between the different land uses in the study area.

$$CV = \frac{\sigma}{\bar{x}} \times 100\% \dots\dots\dots (6)$$

Where,

CV = coefficient of variability,

σ = standard deviation of the distribution,

$\bar{x}$ = mean of the distribution.

$$\sigma = \frac{\sum(x-\bar{x})^2}{n-1} \dots\dots\dots (7)$$

Where,

σ = standard deviation,

x = infiltration amount,

$\bar{x}$ = mean of infiltration in a landuse type,

$\sum$ = summation,

n = number of measured infiltration events

From table 3, orchard 2 has the lowest infiltration variation of 59.12% and farmland 1 is the land use with the highest variation of 60.08%. It can also be inferred from the table that infiltration variation among the 6 different land use types in the study area is insignificant.

Table 3: Spatial variability (CV) of Infiltration

s/n	Land use sites	Total infiltration	Mean infiltration $\bar{X}$	Standard deviation σ	CV (%)
1	Orchard 1	3246537	190972.76	114597.5748	60.01
2	Orchard 2	3249864	191168.47	113017.1744	59.12
3	Fallow 1	3249102	191123.65	113649.478	59.46
4	Fallow 2	3248489	191087.58	114186.438	59.76
5	Farmland 1	3247107	190518.06	114468.075	60.08
6	Farmland 2	3246614	190976.36	113649.478	59.62

Source: Authors field work

This is further supported by the analysis of variance (ANOVA) of the same data in table 4.

The value of F (0.00), deduces that there is no significant difference in infiltration amount among the 6 selected land uses in the study area.

Table 4: ANOVA table of infiltration amount

	Sum of Squares	Degree of freedom	Mean Square	F
Between Groups	949978.273	5	189995.655	0.000
Within Groups	6.892E11	96	7.179E9	
Total	6.892E11	101		

Source: Authors Anova result

3.3 Summary of the Results

Table 5 presents the summary of the results of the study. The results show the mean value of the infiltration amount (R_i), runoff (R_o) and rainfall (R_f) of the respective land use types identified in the study area. It reveals that orchards have a lower amount of rainfall (R_f) of between 191144.12mm and 191388.2mm that gets to the ground probably due to trees intercepting the rain, and much of it infiltrates into the ground having infiltration amount (R_i) of between 190972.76mm and 191168.47mm and also recorded the lowest runoff amount (R_o) in the study area (between 171.35mm and 219.76 mm). Meanwhile, farmlands recorded the highest value of runoff (between 381.94mm and 411.88mm) while fallow plots has a better infiltration capacities with an infiltration amount of between 191123.65mm and 191087.58mm. The results also show the degree of sloppiness (S_p) landuse coefficient values (C_l), as well as soil moisture (M_w),

soil textural classes of sand (S_a), silt (S_i) and (C_c). The slope value of 3% was observed for the orchards plots (1 and 2). The fallow plots recorded slope angle of 2^0 and 4^0 (1 and 2) while farmlands have between 3^0 and 4^0 . In terms of porosity, orchards have higher pore spaces (P_r)

of between 4.2% and 4.6%, followed by fallow plots with porosity of between 3.1% and 3.3% while farmlands have the least pore spaces of between 1.2% and 2.7%. The soil moisture is higher in orchard (61% to 63%) but lowest in farmlands (56%). In the textural analysis, farmland has the lowest content of sand (S_a) of 86.88% and higher silt content (S_i) of 4.73% while orchards have the lowest silt content of between 2.28% and 2.62%. Although clay content (C_c) is highest in fallow plots, with fallow plots 1 having 8.85%, it also has the lowest clay content with fallow plots 2 having the lowest clay content of 7.12% in the study area.

Table 5: Summary Landuse Sites and Parameter

S/N	Land use Sites	Parameters									
		R_i (mm)	R_o (mm)	R_f (mm)	S_p (0^0)	C_l	P_r (%)	M_w (%)	S_a (%)	S_i (%)	C_c (%)
1	Orchard 1	190972.76	171.35	191144.12	3	0.23	4.6	63	89.68	2.28	8.04
2	Orchard 2	191168.47	219.76	191388.24	3	0.23	4.2	61	88.97	2.62	8.41
3	Fallow 1	191123.65	264.58	191388.24	2	0.23	3.1	60.5	88.04	3.11	8.85
4	Fallow 2	191087.58	300.65	191388.24	4	0.23	3.3	59	89.42	3.46	7.12
5	Farmland 1	190518.06	381.94	191388.24	3	0.25	2.7	56	88.85	3.58	7.57
6	Farmland 2	190976.36	411.88	191388.24	4	0.25	1.2	56	86.88	4.73	8.39

Source: Authors Field Work (July – September 2012).

3.4 Soil Infiltration Correlation Matrix

To analyze the association, correlation coefficients of +/- 0.8 (See table 6) were the only ones considered significant at 0.05 level of significance (2 tailed test) and thus used to interpret the relationships. There are also some variables that have direct relationship with infiltration amount on the different land use surfaces in the study area.

In the group of variables with positive correlation with infiltration amount are soil porosity (P_r) (0.90) and soil moisture (M_w) (0.98). This means that these variables operate in the same direction with soil infiltration, implying that the more the pore spaces in the soil the more the water that

infiltrates into the soil and also the more the water infiltrated in the soil the more the moisture available in the soil.

The other group was variables with negative correlation with the infiltration amount in the study area. This includes runoff (R_o) (-0.97), Silt (S_i) (-0.91) land use coefficient (C_l) (-0.82). This implies that runoff operates in an opposite direction with infiltration, as runoff increases, rain water infiltration decreases. High runoff on the soil surface results in low water infiltration in the soil. Meaning that as silt content of the soil and land use coefficient increases, infiltration amount decreases in the different land use surfaces.

Table 6: Infiltration Correlation Matrix

	R_I	R_o	R_f	S_p	C_l	P_r	M_w	S_a	S_i	C_c
R_I	1.00									
R_o	-0.97*	1.00								
R_f	-0.12	0.33	1.00							
S_p	-0.41	0.49	0.78	1.00						
C_l	-0.82*	0.83*	0.44	0.34	1.00					
P_r	0.90*	-0.96*	-0.45	-0.39	-0.79	1.00				
M_w	0.98*	-0.97*	-0.24	-0.45	-0.89*	0.88	1.00			
S_a	0.59	-0.72	-0.75	-0.10	-0.58	0.86*	0.59	1.00		
S_i	-0.91*	0.97*	0.40	0.55	0.77	-0.98**	-0.90*	-0.79	1.00	
C_c	0.27	-0.15	0.68	-0.59	-0.10	-0.07	0.26	-0.55	-0.10	1.00

Source: Correlation Matrix result

3.5 Modeling Infiltration Capacity

In modeling the relationship that exists between the variables that are significant to the soil moisture in the study area, multiple regression (linear regression equation) was used to determine the effect of the variables on soil moisture in the study area. The infiltration amount (X_1), was made the dependent variable, runoff amount (X_2), land use coefficient (X_5), soil porosity (X_6), soil moisture (X_7), and silt (X_9) are the independent variables. A linear equation results from the association.

$$R_I = a + b_{x1} + c_{x2} + d_{x5} + e_{x6} + f_{x9} + u \dots (8)$$

Where

R_I = Infiltration amount (dependent variable),
 a = constant (moisture intercept), b, c, d, e, f ,
are the beta values of variable X_2, X_5, X_6, X_7, X_9 , which are independent variables of runoff, land use coefficient, soil porosity, soil moisture and silt respectively.

X can subsequently be replaced with R_o, C_l, P_r, M_w and S_i which are the symbols (Table 7) of the variables used in the model. Thus the equation can be rewritten as:

$$\begin{aligned} R_I &= a + b_{RO} + c_{Cl} + d_{Pr} + e_{Mw} + f_{Si} + u \dots (9) \\ &= R_I = 2008642.62 + (-0.01R_o) + (-0.045C_l) + \\ &\quad (0.013P_r) + (0.001M_w) + (-0.011S_i) + u \end{aligned}$$

Infiltration capacity (R_I) is therefore a function of the variables R_I , R_o , C_I , P_r , S_i and so the equation can also be expressed as:

$$R_I = f(R_O + C_I + P_r + M_w + S_I) \dots \dots \dots (10)$$

Where

R_I is infiltration, and, R_o , C_I , P_r , M_w , S_I are runoff amount, land use coefficient, soil porosity, soil moisture, and soil silt respectively (Table 7).

To further aid the analysis, variable codes and symbols were derived for each parameter used. The variable codes were used when running the data through the multiple correlation and regression analysis while the symbols were used for the actual interpretation.

Table 7: Measured variables and symbols.

s/n	Parameters	Variable code	Symbol
1	Infiltration amount	X_1	R_I
2	Runoff amount of a plot	X_2	R_o
3	Rainfall	X_3	R_f
4	Slope of runoff plot	X_4	S_p
5	Land use coefficient	X_5	C_I
6	Measure of soil porosity	X_6	P_r
7	Soil moisture weight	X_7	M_w
8	Soil sand content	X_8	S_a
9	Soil silt content	X_9	S_I
10	Soil clay content	X_{10}	C_c

Equation 10 was subsequently used to predict infiltration capacity in the study area. The results are the expected values while the actual values are the infiltration capacity measured from the field and the residual amounts are the differences between the

actual and the expected predicted by the equation (Table 8)

The actual infiltration amount collected from the experimental plots is 12054548.5 mm while the expected infiltration amount was 12051572.8 mm with a residual infiltration amount of 2975.71mm.

Table 8: Infiltration Prediction

Land use sites	Actual (mm)	Expected (mm)	Residual (mm)
Orchard 1	2011496	2008621.82	2874.18
Orchard 2	2010981.1	2008608.42	2372.68
Fallow 1	2009465	2008600.65	864.35
Fallow 2	2007844.5	2008592.32	-747.82
Farmland 1	2007440.4	2008581.63	-1141.23
Farmland 2	2007321.5	2008567.96	-1246.46
Total	12054548.5	12051572.8	2975.71

Source: Regression results.

The model has a regression coefficient of 99.97% ($r = 0.99$) and a coefficient of determination of 99.94% ($r^2 = 0.99$) (table 9).

These results indicate that the model predicted the observed infiltration capacities reasonably well in the study area.

Table 9: Results of the Infiltration Model

Model	R	R ²	Residual
Infiltration	0.99	0.99	2975.71mm

Source: Regression Coefficient of the model

4. CONCLUSION

This paper made use of actual field measurements rather than simulated data and it is a combination of existing works in hydrology and soil science thereby contributing to the knowledge in the use of land and soil water management. The paper evaluated infiltration characteristics on different agricultural land use surfaces. The major parameters influencing infiltration in the study area are: runoff, land use coefficient, soil porosity, soil moisture content and silt. The significance levels of these parameters were tested with a linear regression equation in order to develop a model in predicting infiltration capacity in this study area. As such, the following equation or model was developed.

$$R_i = f(R_o + C_i + P_r + M_w + S_i) \dots \dots \dots (10)$$

The results revealed that porosity, texture (silt) and moisture highly correlate with infiltration capacity. This also agrees with Saxton, Rawls, Rosenberger and Papendick, (1986) assertion that the major soil and water characteristics that affect infiltration include initial moisture content, hydraulic conductivity of the soil, profile, texture, soil structure, porosity, degree of swelling of soil colloids, organic matter, vegetative cover, duration of irrigation or rainfall and viscosity of water of which these parameters are of a part.

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It can also be concluded that orchard land use has better infiltration capacities, compared to the other land uses. This could be because the leaves and trees slow down the rain before it hits the ground, giving plant roots time to absorb water and time for the water to soak into the earth (Taylor, Mulholland and Thornburrow, 2009). This is consistent with the findings of Nord (2008), that plant cover increases the infiltration capacity of soils.

5. RECOMMENDATION

Further studies should be carried out in different parts of the country and such studies should incorporate more parameters other than the ones considered in this paper, such as infiltration rates, evaporation, erosivity, rainfall duration and soil profile analysis to mention but a few. This will provide more comprehensive information for assessing infiltration not just for agricultural land use but also for urban land use surfaces.

Bush fallow systems should be encouraged for organic matter build-up which will in turn improve the infiltration rate and capacity of the soil but where not possible, the use of surface ameliorants such as conservation tillage, use of high residue crops, cover crops, compost manuring and mulching should be incorporated into farming systems to increase organic matter build-up and subsequently soil aeration and porosity.

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Competency Requirements for Real Estate Practice: The Nigerian Experience



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Abstract

With a focus on the real estate markets of Abuja and Lagos in Nigeria, this paper examined the perceptual stands of real estate professionals on the competency requirements for real estate practice in the country. The paper adopted questionnaire survey conducted on all Estate Surveying and Valuation (ESV) Firms in Lagos and Abuja. The questionnaire solicited information on practitioners' views on the knowledge, skills and attributes required for effective real estate practice in the country. The respondents were asked to rank 24 knowledge areas, 10 skills and 10 attributes as identified and conceptualized from literature. Mean rating, frequency distribution and standard deviation were used in data analysis. For effective real estate practice in Nigeria, property valuation, property management and real estate agency were rated the most important categories of knowledge required whereas communication and honesty were rated the most important skill and attribute respectively. It appears the ESV Firms ranking of the identified knowledge areas was based largely on their practices and experiences, because over 80% of the practitioners considered these areas as essential priorities. The least rated knowledge area was basic accounting, while second language and commercial awareness were the least rated skills and attributes respectively. The findings of this paper can be used as a guide for real estate continuing professional development plan and as a framework for curriculum development and redesign. This paper is one of the few that have identified the expectations of real estate practitioners with respect to graduates' competency in developing countries like Nigeria.

Keywords – Competency, Real Estate, Knowledge, Skills, Attributes, Nigeria

1. BACKGROUND TO THE STUDY

The Nigerian Real Estate Market has over the years, recorded steady and consistent growth thus becoming one of the greatest contributors to the Nation's GDP from the non-oil sector. Currently valued at approximately N6.3 Trillion and having contributed 8.03%, 11% and 13.05% in 2015, 2016 and 2017 respectively, the real estate market is estimated to grow at an average of 10% over the next few years (Nigerian Real Estate Group, 2016). There are growing concerns however that the steady growth recorded in the sector has resulted in the kind of sophistication and dynamism being experienced in the real estate business environment both in the public and private sectors (Oladokun, 2012; Dugeri,

2011), hence, the demand for higher level of expertise from real estate practitioners.

In the recent past, practitioners were considered to possess the requisite competencies to meet the requirement of the labour market (Nigerian Employers Consultative Association, 2005). However, the situation presently appears to be different, globalization has steered in the restructuring of the nation to a knowledge-based economy with resultant effects in virtually all sectors including real estate. As a result, there seems to be only a few employees and practitioners that are adequately prepared and possess the required competencies to reflect the changing dynamics in the industry. Real estate practitioners are considered competent, only

when they have attained the required knowledge, skills and attributes. This enables them to get along with the changing dynamics, make critical decisions, solve problems, develop respect and ultimately drive the market towards increased productivity.

Simply put, competency is something which a person or professional in a chosen career path should be able to do comfortably, or the representation of an action, behaviour or outcome which a person or group of persons should be able to demonstrate, or the ability to transfer skills and knowledge to new situations within the occupational area (Stewart and Hamlin, 1992; Holmes and Joyce, 1993). Competence is further viewed as an expression of the integration or combination of knowledge, skill and personal attributes and provides a common cultural thread, value orientation, a language for success, a framework for thinking excellence and communicating the future (Wisher, 1994; Meyer and Semark, 1996).

A justification for a study of the competencies required of Real Estate practitioners is that, the ability of the Real Estate professionals to meet with differing and changing client needs, market sophistication and growth and advanced technology hugely depends on the knowledge base of the profession. The Real Estate professional also must bear in mind that building and leveraging knowledge is the key to success in this age of globalisation (Prokesch, 1997). The Real Estate Surveying profession is arguably facing threats to its traditional roles and functions resulting from changing client needs in the construction industry, advances in technology and the particular needs of a developing economy. The profession's continuous growth and relevance therefore requires enhancing its knowledge domain so that it can adjust its area of service as new opportunities arise. Competent Estate Surveyors must have a range of skills, knowledge, and understanding which can be applied in a range of contexts and organisations (Hassall *et al.*, 1996). This paper, therefore,

presents a model of the important competencies required for Real Estate practice in Nigeria, and this is with a view to providing information that could enhance the competency rating of real estate practitioners and improved market productivity.

2. RELEVANT LITERATURE

In the developed economies, the study of competency expectations of real estate practitioners is a topical and popular area. Several studies (Gibler *et al.* 2002; Epley, 2004; Manning and Epley, 2006; Yu, 2001; Callanan and McCarthy, 2003; Galuppo and Worzala 2004; Weinstein and Worzala 2008 and Poon *et al.* 2011; Aliu and Aigbavboa, 2019) examined the key areas of knowledge and skills required for real estate practitioners in Australia, Hong Kong, New Zealand the UK and the USA. These researches identified several knowledge and skill areas considered important for real estate management practice, of these identified areas, valuation, effective oral communication, honesty, strategic planning, real estate portfolio management, business negotiation and deal-making skills are identified as the most important competencies. On the other hand, the ability to speak a foreign language, international finance/economics and tax management are identified as the least important.

In the Nigerian environment, several studies related, howbeit not directly to competency requirements and/or expectation for effective real estate practice. Oloyede and Adegoke (2007) investigated into compliance over the incompetence and quality of estate management graduates sent into the labour market on a yearly basis, the shortfalls of the existing curriculum and whether the current teaching technique is effective or not. The study targeted stakeholders comprising practicing estate surveyors, lecturers and final year students of estate management departments in three federal tertiary institutions using the combine tools of questionnaires and interview. The result indicated that graduates were deficient in valuation, agency, feasibility

and viability appraisal and property management. Although the study achieved its objective, it did not consider the skills and attributes required of estate management graduates in Nigeria.

Oladokun (2012) examined the skills requirements for the practice of corporate real estate management in Nigeria. This study found that the most important skills for corporate real estate managers are financial performance, investment in corporate strategy, productivity, space efficiency management, and customer and employee management. On the other hand, portfolio efficiency is rated as the least important skill for corporate real estate managers. Similarly, Oladokun and Ayodele (2015) evaluated the relevance of students' industrial work experience scheme (SIWES) to real estate education in Nigeria. The result demonstrates that SIWES is an integral part of real estate education and that it helps the students to acquire behavioural skills in addition to acquiring necessary experience required to set up private practice upon completion.

In conclusion, there are differences in competency expectations among different property sub-professionals and property professionals working in different countries. Real estate managers place more emphasis on strategic and management skills rather than technical and financial skills, including the ability to speak a foreign language. On the other hand, facility managers put a high value on business skills. Having technical knowledge on building construction and property development is important for valuation and property management professionals. The expectations for property professionals also vary according to the country in which they work.

RESEARCH METHODS

This study sets out to identify the required competencies in terms of knowledge, skills and attributes that a real estate practitioner must possess for effective real estate practice in

Nigeria and other similar developing countries. The study adopted a list of 24 knowledge areas, 10 skills and 10 attributes that were identified and conceptualized from literature as well as researcher's interaction with some key stakeholders in the Nigerian property market. The respondents targeted were members of the Nigerian Institution of Estate Surveyors and Valuers (NIESV), which is the umbrella body of all Real Estate Firms in Nigeria. It was expected that a survey of the views of members of NIESV would give an archetypal picture of the required competencies for real estate practice in the country. To access these Firms, the study made reference to the 2018 NIESV directory, an examination of which indicated that 357 and 105 registered Real Estate Firms had their head offices located in Lagos and Federal Capital Territory (FCT), Abuja respectively, representing 57% of the Real Estate Firms in Nigeria. The choice for Lagos and the FCT is premised on the fact that Lagos and the FCT are the commercial and administrative nerve centres of the country and thus account for a large percentage of its total real estate transaction and activities (Dugeri, 2011).

Table 1: Summary of Identified Knowledge areas, Skills and Attributes

24 Knowledge Areas	
Property Management	Property Rating and Taxation
Property Valuation	Risk Assessment & Management
Real Estate Agency	Portfolio management
Professional Practice and Ethics	Environmental Impact Assessment
Real Estate Investment	Building Technology
Real Estate Marketing	Health and Safety
Property Development	Research Methods
Property Finance	Urban and Regional Planning
Property Law	Basic Economics
Business Marketing	International Real Estate
Conflict Resolution /Arbitration	Architectural Designing
Project Management	Basic Accounting
10 Skills Sets	10 Attributes
Communication	Honesty
Leadership	Integrity
Teamwork	Reliability
Planning / Organizing	Discipline
Problem Solving and Creativity	Adaptability / Flexibility
Self-Awareness / Management	Personal / Professional Development
Numeracy	Innovation
ICT	Client Care / Services
Research and Analysis	Business Etiquette
Communication	Commercial Awareness

Source: Authors Field Survey, 2019

The instrument for data collection was a structured questionnaire. A total of 462 questionnaires were administered to all 462 registered and practicing real estate surveying firms in the study area. However, only 302 questionnaires were completed and returned, out of which 254 were considered fit for analysis and this is because they were properly filled, and all vital information provided. These 254 questionnaires represent a 55% response rate which is deemed adequate for the study (Moser and Kalton, 1999). The questionnaire consisted of two sections. Section One covered the demographic background of the respondents, specifically those aspects that were likely to influence their ratings of the competencies, such as experience (years) in practice, highest

qualification, professional status, size of firm and status in the firm. While Section Two asked respondents to rate on a Likert Scale 1 to 7, the level of importance of each of the identified competency to the practice of real estate, from “Not at all Important” (rated 1) to “Extremely Important” (rated 7). A list of forty four (44) competencies (24 knowledge areas, 10 skills and 10 attributes) was developed from wider research publications investigating professional competencies in built environment and real estate literature, as well as from interaction with stakeholders (academics and employers) in the real estate sector in Nigeria. Mean rating and frequency distribution was used to analyze and rank the respondents ratings on each of the 24 knowledge areas, 10 skills and 10 attributes. All

field work for this study was conducted in 2018, except otherwise stated.

3. RESEARCH FINDING AND DISCUSSIONS

4.1 Profile of Respondents

As shown on Table 2 below, all of the respondents across the locations are registered estate surveyors and valuers and licenced to practice real estate in the country. The majority of respondents (62.2%) are either managers or founding partners of real estate firms in the

country. 67.3% are within the upper echelon of their professional ladder as Associates and fellows of the Nigerian Institution of Estate Surveyors and Valuers (NIESV). Two-thirds of the respondents are either holding a first degree (B.Sc., B.Tech or HND) or a second degree (M.Sc., MBA) in Estate Management and have spent onwards of 10years and above in practice. These are indications that a greater percentage of the responses are reliable and as such they would be of relevance to this research.

Table 2: Respondents Profiles in the Study Area

	Level	Locations		Total
		Lagos	Abuja	
Respondents' Status in the Firm	Founding Partner	6(3.4%)	5 (6.3%)	11 (4.3%)
	Manager	97 (55.5%)	50 (63.3%)	147 (57.9%)
	Estate Surveyor	72 (41.3%)	24 (30.4%)	96 (37.8%)
	Total	175 (100%)	79 (100%)	254 (100.0%)
Highest Educational Qualification	M.Sc.(Est)	82 (46.9%)	15 (19.0%)	97 (38.1%)
	B.Sc. (Est)	77 (44.0%)	33 (41.7%)	110 (43.3%)
	HND (Est)	16 (9.1%)	31 (39.3%)	47 (18.5%)
	Total	175 (100%)	79 (100%)	254 (100.0%)
Highest Professional Qualification	Fellow	22 (12.6%)	2 (2.5%)	24 (9.4%)
	ANIVS	95 (54.3%)	52 (65.8%)	147 (57.9%)
	Graduate/Probationer	58 (33.2%)	25 (31.7%)	83 (32.7%)
	Total	175 (100%)	79 (100%)	254 (100.0%)
Years of Post-Qualification Experience	Below 5	39 (22.3%)	18 (22.8%)	57 (22.4%)
	5 – 15	98 (56%)	41 (51.9%)	139 (54.7%)
	16 – 30	28 (16%)	17 (21.5%)	45 (17.7%)
	Above 30	10 (5.7%)	3 (3.8%)	13 (5.1%)
	Total	175 (100%)	79 (100%)	254 (100.0%)

Source: Authors Field Survey, 2019

3.2 Knowledge Areas

Results of the analysis, as presented in Table 3, revealed that, in Lagos, property management, property valuations and real estate agency with mean and standard deviation of 6.77, 6.75, 6.71 and 0.477, 0.731, 0.694 were ranked 1st, 2nd and 3rd respectively. Although, judging from the values of their standard deviation, it appears there are more agreements amongst the respondents on their responses on real estate agency to that of property valuations. Professional practice and ethics, real estate investment, real estate

marketing and property development followed as 4th, 5th, 6th and 7th with mean and standard deviation of 6.56, 6.51, 6.46, 6.45 and 0.755, 0.642, 0.585, 0.603. Similarly, research methods, urban and regional planning, basic economics, international real estate, architectural designing and basic accounting were at the bottom of the table with mean and standard deviation of 6.00, 5.99, 5.98, 5.93, 5.90, 5.87 and 0.897, 1.259, 0.874, 0.944, 0.975, 0.877 were ranked 19th, 20th, 21st, 22nd, 23rd and 24th respectively. In general, it is clear from the table that property management,

property valuation and real estate agency were top ranked suggesting that the property market in Lagos places more emphasis on property management, real estate agency and appraisals (property valuations and feasibility studies). This is in agreement with Dugeri (2011) who opines that by virtue of Lagos being the economic epicentre of the country, agency, appraisal and management services appears to be more prominent in the property market. Furthermore, a closer look at the responses shows that none of the identified areas had a mean rating that is less than the benchmark of 3.5. In other words, there is a consensus amongst the respondents on the level of importance of the identified knowledge areas. It can therefore conclude that all the twenty four (24) identified Knowledge Areas are important for Estate Management Practice in the study area.

In the Federal Capital Territory (FCT), Abuja, property valuation has the highest mean rating and thus ranked 1st with a mean of 6.88 and standard deviation of 0.394. Property management, professional practice and ethics, real estate marketing and real estate agency with mean and standard deviation of 6.84, 6.77, 6.76, 6.71 and 0.373, 0.530, 0.512, 0.581 were ranked 2nd, 3rd, 4th, and 5th respectively. The respondents ranked real estate investment and property development as 7th and 8th respectively with a mean and standard deviation of 6.67, 6.60 and 0.593, 0.613. Correspondingly, international real estate, basic accounting, architectural designing, basic economics and urban and regional planning, were at the bottom of the table with mean and standard deviation of 6.37, 6.34, 6.33, 6.27, 6.20 and 0.936, 0.890, 0.858, 0.873, 1.055 were ranked 20th, 21st, 22nd, 23rd and 24th respectively. None of the identified areas had a mean rating less than the benchmark of 3.5. Generally, the result clearly showed that property valuation, property management, professional practice and ethics, real estate marketing and real estate agency amongst others had the highest rating, this may be because, as seat of government there might be ease in securing

credit facilities, stricter laws requiring valuation report for insurance, sales/purchases, mortgages etc. and on assets declaration, thereby placing more demand on the these areas. When compared to the Lagos study area the result was different such that real estate agency that was ranked third in Lagos had fifth ranking in Abuja. Real estate marketing that was ranked sixth in Lagos was ranked fourth in Abuja. However, the least mean rate was 5.87 implying that all the identified areas are very important. In other words, it is reasonable to conclude that the real estate practitioners in Abuja are of the opinion that the 24 identified Knowledge Areas are important for Estate Management Practice.

Overall, the result shows that, on the knowledge areas essential for real estate practice in Nigeria. Property valuation and property management jointly had the highest rating and thus ranked 1st with the same mean of 6.79 and standard deviation of 0.648 and 0.447 respectively. Real estate agency was rated and ranked 3rd with a mean of 6.71 and a 0.659 standard deviation. Professional practice and ethics ranked 4th while real estate marketing and real estate investment jointly shared the 5th position with a mean of 6.56 and standard deviation of 0.579 and 0.631 respectively. The respondents ranked property law and property development as 7th with the same mean rating of 6.50 and 0.646 and 0.609 standard deviation respectively. On the 9th position is property finance with a mean and standard deviation of 6.46 and 0.626. Correspondingly, international real estate, basic economics jointly shared the 20th position. Urban and regional planning, architectural designing and basic accounting were at the bottom of the table with mean and standard deviation of 6.06, 6.04, 6.02 and 1.201, 0.959, 0.907 ranked 22nd, 23rd and 24th respectively. Again, none of the identified areas had a mean rating that is less than the benchmark of 3.5 as showed on the table, implying that there is indeed a consensus amongst the respondents on the level of importance of the identified knowledge areas for effective real estate practice in Nigeria.

Table 3: Competency Requirements (Knowledge) of ESV Firms in the Study Areas

Knowledge Areas	Lagos			Abuja			Overall		
	Mean	Standard Deviation	Rank	Mean	Standard Deviation	Rank	Mean	Standard Deviation	Rank
Property Management	6.77	0.477	1 st	6.84	0.373	2 nd	6.79	0.447	1 st
Property Valuation	6.75	0.731	2 nd	6.88	0.394	1 st	6.79	0.648	2 nd
Real Estate Agency	6.71	0.694	3 rd	6.71	0.581	5 th	6.71	0.659	3 rd
Professional Practice and Ethics	6.56	0.755	4 th	6.77	0.53	3 rd	6.63	0.699	4 th
Real Estate Investment	6.51	0.642	5 th	6.67	0.593	7 th	6.56	0.631	6 th
Real Estate Marketing	6.46	0.585	6 th	6.76	0.512	4 th	6.56	0.579	5 th
Property Development	6.45	0.603	7 th	6.60	0.613	8 th	6.50	0.609	7 th
Property Finance	6.43	0.561	8 th	6.53	0.748	10 th	6.46	0.626	9 th
Property Law	6.41	0.654	9 th	6.68	0.589	6 th	6.50	0.646	8 th
Business Marketing	6.24	0.742	10 th	6.47	0.814	17 th	6.31	0.772	10 th
Conflict Resolution /Arbitration	6.22	0.989	11 th	6.48	0.814	13 th	6.30	0.944	13 th
Project Management	6.21	0.862	12 th	6.48	1.011	14 th	6.30	0.917	12 th
Property Rating and Taxation	6.20	0.884	13 th	6.55	0.75	9 th	6.31	0.859	11 th
Risk Assessment & Management	6.19	0.692	14 th	6.51	0.766	12 th	6.29	0.729	14 th
Portfolio management	6.19	0.842	15 th	6.51	0.732	11 th	6.29	0.821	15 th
Environmental Impact Assessment	6.11	1.106	16 th	6.43	0.996	19 th	6.21	1.082	16 th
Building Technology	6.04	0.88	17 th	6.47	0.731	15 th	6.17	0.858	17 th
Health and Safety	6.02	0.788	18 th	6.44	0.877	18 th	6.13	0.92	19 th
Research Methods	6.00	0.897	19 th	6.47	0.782	16 th	6.15	0.888	18 th
Urban and Regional Planning	5.99	1.259	20 th	6.20	1.055	24 th	6.06	1.201	22 nd
Basic Economics	5.98	0.874	21 st	6.27	0.873	23 rd	6.07	0.882	20 th
International Real Estate	5.93	0.944	22 nd	6.37	0.936	20 th	6.07	0.961	21 st
Architectural Designing	5.90	0.975	23 rd	6.33	0.858	22 nd	6.04	0.959	23 rd
Basic Accounting	5.87	0.877	24 th	6.34	0.89	21 st	6.02	0.907	24 th

Source: Authors Field Survey, 2019

3.2 Skills

Findings from Table 4, established that communication was ranked the most important skills in the Lagos study area with a mean and standard deviation of 6.85 and .357. Leadership and teamwork were rated and ranked 2nd and 3rd respectively with a mean and standard deviation of 6.68, 6.65 and 0.468, 0.525. In the same vein, second language and research and analysis were at the bottom of the table with mean rating and standard deviation of 6.19, 5.87 and 0.793, 1.246 ranking 9th and 10th respectively. Communication was also rated and ranked the most important skill in FCT, Abuja having a mean and standard deviation of 6.95 and 0.221 respectively. However, planning/organizing and teamwork came 2nd and 3rd respectively with a mean and standard deviation of 6.87, 6.84 and 0.336, 0.373. Leadership was ranked 5th, self-awareness/management and ICT took a joint position of 6th on the table with the same mean of 6.71 and standard deviation of 0.484 and 0.486 respectively. In the same vein, numeracy and research and analysis jointly shared the 8th position with a mean of 6.58 and standard deviation of 0.730 and 0.735 respectively. Second language was at the bottom of the table with mean rating and standard deviation of 6.38 and 0.978 ranked 10th. This result is expected because communication is the live wire of the real estate profession, and to effectively persuade his clients who are usually respectable persons in the society the estate surveyor and valuer should be able to exude good leadership quality and must be able to work with a team. A closer look at the Table further revealed a close spread in the mean of all the 10 identified skills which connotes the closeness in the consensus of practitioners' responses. It is therefore logical to conclude that all the identified skills are very important to the practice of Real Estate in the study area.

Looking at the larger picture, the result established that communication was ranked as the most important skill. Leadership and teamwork were ranked 2nd and 3rd respectively

with a mean and standard deviation of 6.71, 6.70 and 0.464, 0.490. Planning/Organizing was ranked 4th, problem solving and creativity 5th whereas self-awareness/management with a mean score of 6.49 and standard deviation of 0.539 was ranked 6th. In a similar manner, ICT, numeracy, research and analysis and second language had a mean score of 6.46, 6.43, 6.31, 6.03 and standard deviation of 0.669, 0.740, 0.793, 1.191 were ranked 7th, 8th, 9th and 10th respectively.

3.3 Attributes

Table 5 shows the analysis on the requisite attributes for Real Estate practice. Findings from the analysis revealed that honesty, integrity and reliability were ranked the most important attributes in the Lagos study area, with a mean and standard deviation of 6.79, 6.77, 6.75 and 0.409, 0.425, 0.432 they were rated and ranked 1st, 2nd and 3rd respectively. Discipline, adaptability/flexibility and personal/professional development were ranked 4th, 5th and 6th with a mean and standard deviation of 6.71, 6.67, 6.61 and 0.456, 0.520, 0.577 respectively. At the bottom of their rating and ranking were business etiquette and commercial awareness, with a mean and standard deviation of 6.46, 6.37 and 0.523, 0.532 to rank 9th and 10th.

Similarly, the table shows that integrity was ranked the most important attribute in the study area with a mean of 6.92 and standard deviation of 0.267. Honesty and reliability had a mean rating of 6.91 and 6.87 with standard deviation of 0.328 and 0.335 and were ranked 2nd and 3rd respectively. Client care/services was ranked 4th while personal/professional development and discipline were jointly ranked 5th. Business etiquette, commercial awareness, innovation and adaptability/flexibility appeared at the bottom of the table with a mean and standard deviation of 6.81, 6.77, 6.76, 6.38 and 0.397, 0.422, 0.430, 0.524 to rank 7th, 8th, 9th and 10th. Furthermore, on the attributes requisite for Real Estate practice in Nigeria. The table revealed that honesty, integrity and reliability had the highest mean

scores of 6.83, 6.82, 6.79 and standard deviation of 0.389, 0.388, and 0.407 were ranked 1st, 2nd and 3rd respectively. Discipline, personal/professional development and adaptability/flexibility were ranked 4th, 5th and 6th with a mean and standard deviation of 6.74, 6.68, 6.67 and 0.446, 0.532, 0.520 respectively. The 7th and 8th positions had innovation and client care/services, while business etiquette and commercial awareness appeared at the bottom of the table with a mean and standard deviation of 6.57, 6.50 and 0.512, 0.532 and were ranked 9th and 10th.

The results are not unexpected, the real estate profession carries the insignia “noble” this is so, because from inception, it has being a profession practiced mainly by the affluent. There exist regular exchange of financial resources which sometimes defines the entire livelihood of a client, these underscores the importance of honesty, integrity and reliability. A meticulous look at the table revealed a similar low spread in the mean of all the 10 identified attributes connoting that the respondents view around the mean was low. In other words, one can conclude that the practitioners in Lagos attached a high level of importance to all the identified attributes.

Table 4: Competency Requirements (Skills) of ESV Firms in the Study Areas

Skills	Lagos			Abuja			Nigeria		
	Mean	Standard Deviation	Rank	Mean	Standard Deviation	Rank	Mean	Standard Deviation	Rank
Communication	6.85	0.357	1 st	6.95	0.221	1 st	6.88	0.323	1 st
Leadership	6.68	0.468	2 nd	6.77	0.451	5 th	6.71	0.464	2 nd
Teamwork	6.65	0.525	3 rd	6.84	0.373	3 rd	6.70	0.49	3 rd
Planning / Organizing	6.58	0.540	4 th	6.87	0.336	2 nd	6.67	0.504	4 th
Problem Solving and Creativity	6.57	0.497	5 th	6.82	0.386	4 th	6.64	0.480	5 th
Self-Awareness / Management	6.39	0.535	6 th	6.71	0.484	6 th	6.49	0.539	6 th
Numeracy	6.37	0.735	7 th	6.58	0.735	9 th	6.43	0.740	8 th
ICT	6.35	0.710	8 th	6.71	0.486	7 th	6.46	0.669	7 th
Research and Analysis	6.19	0.793	9 th	6.58	0.730	8 th	6.31	0.793	9 th
Second Language	5.87	1.246	10 th	6.38	0.978	10 th	6.03	1.191	10 th

Source: Authors Field Survey, 2019

Table5: Competency Requirements (Attributes) of ESV Firms in the Study Areas

Attributes	Lagos			Abuja			Nigeria		
	Mean	Standard Deviation	Rank	Mean	Standard Deviation	Rank	Mean	Standard Deviation	Rank
Honesty	6.79	0.409	1 st	6.91	0.328	2 nd	6.83	0.389	1 st
Integrity	6.77	0.425	2 nd	6.92	0.267	1 st	6.82	0.388	2 nd
Reliability	6.75	0.432	3 rd	6.87	0.335	3 rd	6.79	0.407	3 rd
Discipline	6.71	0.456	4 th	6.82	0.416	5 th	6.74	0.446	4 th
Adaptability / Flexibility	6.67	0.520	5 th	6.67	0.524	10 th	6.67	0.520	6 th
Personal / Professional Development	6.61	0.577	6 th	6.82	0.384	6 th	6.68	0.532	5 th
Innovation	6.54	0.586	7 th	6.76	0.430	9 th	6.61	0.550	7 th
Client Care / Services	6.48	0.588	8 th	6.84	0.406	4 th	6.59	0.561	8 th
Business Etiquette	6.46	0.523	9 th	6.81	0.397	7 th	6.57	0.512	9 th
Commercial Awareness	6.37	0.532	10 th	6.77	0.422	8 th	6.50	0.532	10 th

Source: Authors Field Survey, 2019

Overall Discussion

The issue of unemployment has continued to reoccur in virtually every public discourse in Nigeria. Employment stakeholders believes that the graduates being churned out from Nigerian universities and across disciplines are not employable or better put, are not trained for the labour market and the industry. In the real estate sector, the Estate Surveying Firms which constitute the major employer of real estate graduates and other organizations tends to have the inclination that, the quality, focus and direction of training offered by the universities are not in tune with the present day realities and need of the labour market. In order to solve this problem several studies (globally and locally) have looked into areas related to labour market demands, competency expectations and employability of university graduates. Previous studies (Epley, 1996; Small and Karantonis, 2001; Yu, 2001; Harfoort *et al.*, 2003; Manning and Epley, 2006; Allen and Cater, 2007; Newell *et al.*, 2010; Poon *et al.*, 2011; Poon, 2012; and Boyd and Amidu, 2013) where based on developed economies. While (Oloyede and Adegoke, 2007; Oladokun, 2012; Oni *et al.*, 2014 and Oladokun and Ayodele, 2015), though having achieved their objectives, were not holistic enough and did not consider directly the need of the employers. It is therefore the paucity of local studies on the employability rating of estate management graduates of Nigerian universities that birthed this research work.

This study examined the competency requirements of Estate Surveying and Valuation firms in the study area, the results established that all the knowledge areas identified were considered very important for the practice of estate management in the study area. Although there were certain variations in the responses from the two locations, for instance property management was considered the most important knowledge area in the Lagos property market

whereas it was considered the second most important knowledge area in the Abuja market. In the same manner property valuation which was considered most important in the Abuja area was rated second most important by the respondents from the Lagos axis. The overall result however, revealed that property valuation and property management are the two most important knowledge areas for property professionals in Nigeria followed by real estate agency and professional practice and ethics. Although it appears the respondents ranking of the identified knowledge areas was based largely on their practice and experience. In general, the finding revealed a consensus in the respondents rating of all the identified knowledge areas as very important for estate management practice in Nigeria.

On the skills required, the study established that all the 10 identified skills were considered very important for the real estate profession, however of the identified skills, communication was adjudged the most important skill required by both the Lagos and FCT, Abuja areas respectively, this results agrees with the findings of Poon *et al* (2014), Callanan and McCarthy (2003), Galuppo and Worzala (2004) and Weinstein and Worzala (2008) that communication skills are important for property professionals. Leadership was considered the second most important skill in Lagos, but was ranked fifth in the Abuja property market. Teamwork, planning/organizing, problem solving and creativity and self-awareness followed in that order of importance. Second language was ranked 10th. This echoes Gibler *et al.* (2002), Poon *et al.* (2011) and Poon *et al.*'s (2014) research findings, which identified knowledge of a second language as the least important skill for property professionals in the USA, UK and in New Zealand.

Similarly, the respondents rated all the ten (10) identified attributes as also very important for the practice of estate management in the study area. Personal/professional development was ranked the first two most important attributes in the Lagos area whereas honesty and integrity got the highest rankings in the FCT, Abuja area. However, a broader picture showed personal/professional development and honesty were ranked the first two most important attributes required for the practice of estate management in Nigeria. Discipline, adaptability/flexibility, integrity and commercial awareness amongst others followed in that order of importance. This is however expected, because the real estate practitioners are seen as the custodian of client's wealth, in some cases, the client's life savings are tied to real estate investment(s) and subsequently kept in the care of real estate practitioners, hence the emphasis on honesty and personal/professional development amongst others.

4. CONCLUSION

The findings from this study, no doubt, confirms the earlier scepticism expressed by

authors and this researcher as to the fact that the competence possessed by graduates seem to be different from the requirement of employers and the realities of the market, and in a bid to creating harmony, and fill this vacuum, there is a need for the universities to produce graduates who fit into the demands of employers and the expectations of the labour market. The study therefore recommends that the real estate curriculum be reviewed to meet up with current realities. The review should incorporate and emphasize the 24 identified knowledge areas and should factor in the identified skills and attributes into the course learning outcomes. Skills and attributes assessment programs such as graduate skills assessment, work-study programs and supervised industrial work experience scheme was also suggested. It is important to understand that the real estate profession, no doubt has become an all comers, lawyers and engineers amongst other are infiltrating the profession. It is only the acquisition of requisite competence that can create the difference amongst the market players.

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ASSESSMENT OF ELECTRICAL HAZARD AWARENESS AND RISK MANAGEMENT IN BUILDINGS



(A Case Study of Kano Metropolitans)

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ABSTRACT:

This study assessed the level of electrical hazards and risk management awareness among electricity users in some selected buildings in Kano metropolis. A survey research method was used for the study while questionnaires were designed and distributed to respondents using random sampling techniques. Mean item score, percentage, frequency and ranking were used for data analysis. Results shows that; electricity users are aware of naked electrical parts/wires and intentional use of defective and unsafe tools as potential electrical hazard and they are not aware of failure to de-energised electrical equipment when it is being repaired and use of ungrounded circuit and equipment, as potential electrical hazards. On risk management, electricity users are aware of using non- conductive materials as a barrier to avoid risk, installing residual current devices or other alternative protection devices to prevent electrical shocks and using personal protective equipment (PPE) to safeguard electrical risk while working on building installation, as means of risk management and are not aware of tuning electrical tools and equipment off while on maintenance process, replacing the hazardous materials in building with less hazardous materials, and requires training for proper interaction with electrical system as a means of electrical risk management. In conclusion, the paper recommends that manufacturers of electrical equipment, appliances and machines should conspicuously print hazards and safety practices attributed to it on each one. This will remind the users hazards associated with them and electricity distribution companies should periodically organize workshops and seminars to train and educate building owners on the importance of electrical hazards and risk management as well as to equip them with the necessary skills in handling minor electrical problems in building.

Key words: *Electrical, Hazards, Risk, Management, Electricity Users*

INTRODUCTION

Electrical hazard and risk management is an important aspect to be observed in our buildings and work areas; therefore, Non-electrical workers require to receive electrical safety and risk management training. Electrical hazards and risks plays a great role to the socio-economic growth of any country, hence assessment hazards and risk management in public infrastructure is of paramount important. Electricity is key to modern technology and very vital to the human life, both at home, schools, offices and places of work. Electricity in daily basis plays significant roles in providing basic services

and meeting basic human needs, such as heating, cooking, sanitation, health services and lighting our buildings. For a society to grow electrical energy is highly needed because is the main source of economic and social development as well as mean of poverty reduction in local and urban areas as well as the country at large (Daniel, Patience, and Samuel, 2014). The extensive use of electricity in our buildings if not properly used, the end users of the energy might likely to expose to risk and hazard which might result to injuries, loss of life and properties. To handle electricity safely, it is necessary to understand how it works, how it can be directed, what hazards it offerings, and how

these hazards can be managed. Every year in Nigeria, electricity kills or seriously injures a significant number of individuals. Most of these injuries occur through lack of knowledge of electricity and its dangers (Daniel et al., 2014).

PROBLEM STATEMENT

The purpose of electrical risk management in building is to enable the building owners to carefully take the controls necessary for the protection of electrical appliances, building itself and health of building occupants. The controls include, prevention of occupational risk, provision of information to the workers, provision of training to the occupants on the means of implement the necessary measures to minimize risks (Guidance of risk assessment, 1996).

Electrical hazards in buildings results to serious injuries to significant number of people. The problem electrical hazards in cities of Nigeria has its roots partly from the lack of knowledge of electricity and its dangers (Daniel et al., 2014). Most of the electrical hazards resulted to accidents that happened due either to carelessness or to a lack of awareness of some basic guidelines of using electricity. The use of electricity is something taken for granted, but identifying hazard and observing risk management is very important. The extensive use of electricity in our buildings if not properly used, the end users of the energy might likely to expose to risk and hazard which might result to injuries, loss of life and properties. In view of the challenges of electrical hazards to buildings, effort should be made to train everyone on the use of electricity to meet human needs because electrical hazard poses a significant risk of death and injuries to individuals. The problem of electrical hazard has crippled so many sectors of the economy such as health care, commercial, industrial and educational facilities. Therefore, attention to electrical hazard and risk

management is the necessary initial step in any every building set up. It is in view of this, this study made to assess the electrical hazards awareness and risk management in buildings in Kano metropolis, Nigeria.

AIM AND OBJECTIVES

Aim

This study is aimed in assessing the level of electrical hazards awareness and risk management in buildings. with a view to enhancing the level of public electrical hazards awareness and risk management in Kano.

Objectives

1. To assess the level of electrical hazards awareness among the building occupants in Kano metropolis.
2. To determine the level of Electrical Risk Management awareness among the building occupants in Kano Metropolis.
3. To identify the optimum level of hazards and the risk associated with hazardous events in buildings.

LITERATURE REVIEW

The purpose of electrical risk management in building is to enable the building owners to carefully take the controls necessary for the protection of electrical appliances, building itself and health of building occupants. The controls include, prevention of occupational risk, provision of information to the workers, provision of training to the occupants on the means of implement the necessary measures to minimize risks (Guidance of risk assessment, 1996). It was recognised by (Safe work Australia, 2010) which guarantees that, using non- conductive materials such as wood, plastic or other alternative as a barrier to prevent any contact with risk, installing residual current devices or other alternative protection devices to prevent electrical shocks, using personal protective equipment (PPE) such as protective eyewear, insulated gloves etc. to

safeguard electrical risk while working on building installation, and using safe work practices such as exclusive zones, use of permits and warning signs to show the tendency of contacting with risk as a management of electrical risks in buildings. Occupational Safety and Health Administration (2009), recommends the means of managing fire as result electricity as, avoiding turning electrical tools and equipment off while the electrical work is carried out on the existing installation, replacing the hazardous materials in building with less hazardous materials, adherence to standard procedures and instructions that are required for an individual to safely interact with electrical system, and adequate training for proper interaction with electrical system in order to determine when and how hazardous situations can arise.

Hazards and risks are not the same thing. Generally, hazard is a basic property, condition of something that is likely to cause damage to people, environment, plant or equipment, which may result to an illness or injury (Susanne, 2012). Electrical hazard can be seen as a serious building hazard that exposes people to electrical injuries. Electrical hazard can sometime be identified as a measure of potential source of danger such as naked electrical wires, unprotected installation, electrical gadgets which are not switched off, over load socket outlet, unsafe acts and many others (Safe work Australia, 2012). A risk is the likelihood of a precise consequence occurring. Risks are usually stated in terms of likelihood and consequences, e.g. Technician may be electrocuted while maintaining a radio might be considered to be very low. In many cases the terms 'hazard' and 'risk' are used interchangeably, however, remember that hazard has a more general application and risk a specific application. Risk management is the systematic method of evaluating the risk for the condition of health and safety of

the workers while at work arising from conditions of the happening of hazard at workplace (Guidance of risk assessment, 1996). The purpose of risk assessment is to enable the householders to carefully take the controls necessary for the protection of safety and health of the building and its occupants. The controls include, prevention of occupational risk, provision of information to the building occupants, provision of training to the occupants on the means of implement the necessary measures to minimize risks (Devdatt, Siddiqu, Abhishek, and Bikirama, 2018).

Safe work Australia, (2010) which guarantees the use non- conductive materials such as wood, plastic or other alternative as a barrier to prevent contact with electrical risk and installing residual current devices or other alternative protection devices to prevent electrical shocks as a major management of electrical risks in buildings. OSHA. (2009), recommends the means of avoiding the fire accident as a result of electricity in a building. They stated that, the electricity user must avoid turning electrical tools and equipment off while the electrical work is carried out on the existing installation, replacing the less hazardous materials in building with hazardous materials, poor adherence to standard procedures and instructions that are required for an individual to safely interact with electrical system, and inadequate training required for proper interaction and foreseeable in appropriate interaction with electrical system in order to determine when and how hazardous situations can arise.

According to Saber et al., (2014) fires that ascend in the buildings, market, offices and other places as a result of electricity and are initiated due to inadequate and unsympathetic use of electrical tools and inadequate electrical hazard awareness and risk management. Ezennaya, Enmuoh, and

Agu, (2017) confirmed that electricity has long been recognized as a serious building hazard, exposing occupants to dangers such as electric shock, electrocution, burns, fires, and explosions. In 1992, for example, the Bureau of Labour Statistics reported that 6,210 work-related deaths occurred in private sector workplaces employing 11 workers or more. Six percent of the fatalities, or around 347 deaths, were the direct result of electrocutions at work. What makes these statistics more tragic is that, for the most part, these fatalities could have been easily avoided.

OSHA's electrical standards help minimize these potential hazards by specifying safety aspects in the design and use of electrical equipment and systems. The standards cover only those parts of any electrical system that building occupants would normally use or contact. For example, the exposed and/or operating elements of an electrical installation—lighting, equipment, motors, machines, appliances, switches, controls, and enclosures—must be constructed and installed so as to minimize electrical dangers.

RESEARCH METHODOLOGY

The study utilized electricity user's as the population. Survey method and interviews were adopted while a questionnaire was designed to raise queries about assessment of electrical hazard awareness and risk management in some selected buildings in Kano metropolitan. Two hundred and eighty-five buildings were surveyed. The target respondents only were residential building occupants. A total of 240 copies of questionnaires were administered and two hundred and four (204) were retrieved and found useful. This represent a return rate of 85. The data gathered were analysed using manual computation and statistical package for social sciences (SPSS) such as mean item score, percentage, frequency and ranking.

The questionnaire used consists of three sections: 'A', 'B' and 'C'. Section 'A' was designed to gather personal data about each respondent, while section 'B' consist of statements which were intended to assess the respondent's attitude towards electrical hazard. Section 'C' consists of close-ended statement which were intended to assess the respondent's attitude towards electrical risk management in buildings.

The Likert scale involving rating on interval scale of 5 and 1 developed for application in social sciences and management for quantification of qualitative variables was used. "Strongly Agree/Very high" were scored 5, "Agree/High" were scored 4, "Undecided/Moderate" were scored 3, "Disagree/Low" were scored 2 and "Strongly Disagree/Very low" were scored 1.

The five-point scale was used to calculate the mean score for each factor. The mean value of 3.50 was used as a decision point at five-point rating scale and any item that has it mean rating of 3.50 and above was considered aware or acceptable and any item that has the mean item below 3.50 was considered not aware and not acceptable. Mean score was then used to determine the relative ranking by sequential assigning high rank to the item with high mean scores and low rank to the item with low rank.

RESULTS AND DISCUSSION

This section deals with the results and discussion of the findings of the study.

From Table 1, which presents the respondents background, it was found out that 86.3% male responds to electrical hazard awareness and risk management in buildings which outnumbers their female counterpart with 13.7%, this shows most females do not participate in electrical installation maintenance activities and not aware of some electrical hazard and risk management in

most buildings around the study area. The age group of the respondents shows that, 0% of the respondents were between 10-20years older, 12.7% of the respondents were between 20-30years older, 47.1% of the respondents were between 30-40years older, and 40.1% of the respondents were between 40-50years older, indicating that the respondents were sensible enough and matured. Concerning with respondents' highest qualification, the study indicates that 10.8% of the respondents had a Primary School Leaving Certificate,

27.9% of the respondents had Senior Secondary School Leaving Certificate, 3.9% had City and Guild or certificate by the National Business and Technical Examination Board, 36.3% had Ordinary National Diploma, while 21.1% had a HND or Bachelor Degree. This indicate that the level education of the majority of the respondents is quite enough for them to have knowledge of electrical hazard and risk management awareness in buildings.

Table 1: Demographic characteristics of the respondents

VARIABLES	FREQUENCY	PERCENTAGE
Gender		
Male	176	86.3
Female	28	13.7
Age group of the respondents		
10 - 20	0	0
20 - 30	26	12.7
30 - 40	96	47.1
40 - 50	82	40.2
Highest qualification of the respondents		
Primary certificate	22	10.8
WASC/SSCE	57	27.9
C and G	8	3.9
OND/NCE	74	36.3
HND/BSC	43	21.1

Source: Surveyed work, 2019.

From Table 2, findings revealed that the types of building surveyed were 39.2% residential, 30.4% being commercial, 21.6% being public and 8.8% small-scale industrial buildings.

Table 2: Buildings surveyed

BUILDINGS	FREQUENCY	PERCENTAGE
Residential	80	39.2
Commercial	62	30.4
Public	44	21.6
Small scale industrial building	18	8.8

Source: Surveyed work, 2019.

Table 2 shows the percentage of buildings surveyed for this research work. From the 204 buildings surveyed, 80% are Residential buildings, 62% are Commercial buildings,

44% are Public buildings and 18% are Small scale industrial buildings. This shows that Residential and Commercial buildings were the buildings surveyed most for this study.

Table 3: Mean Responses of electricity users on the level of electrical hazards awareness in Kano metropolis.

HAZARDS	MEAN SCORES	REMARKS	RANKS
Poor and inadequate electrical installation	3.5490	Aware	2
Use of ungrounded circuit and equipment	3.4363	Not aware	6
Intentional use of defective and unsafe tools	3.5588	Aware	1
Exposed/naked electrical parts and wires	3.5196	Aware	5
Overloaded circuit	3.5196	Aware	11
Use of damage tools and equipment	3.5245	Aware	4
Use of coiled extension leads	3.3039	Not aware	9
High voltage bulb on lower lighting fitting	3.5441	Aware	3
Poor and loose electrical connections	3.5245	Aware	4
Use of tools or equipment to close to energised parts	3.5196	Aware	5
Failure to de-energised electrical equipment when it is being repaired	3.2941	Not aware	10
Fixing of wall socket or switches in the bath room	3.1863	Not Aware	12
Pulling the plug out of a socket out let by the cable	3.3137	Not aware	8
Covered ventilation holes in electrical equipment	3.3837	Not aware	7

Source: surveyed work, 2019.

Table 3 represents the results of the level of electrical hazards awareness in Kano State buildings. The Intentional use of defective and unsafe tools ranked 1st with mean score of 3.5490. Sixty-five (65) respondents strongly agreed that there is Poor and inadequate electrical protection of installation which represents the mean score of 3.5343 which was ranked 2nd. High voltage bulb on lower lighting fitting with mean score of 3.5294 was ranked 3rd. From table 3, about

Sixty (60) people responded to support that fixing of wall socket or switches in the bathroom with mean score of 3.1863, it was the least rank from the result. It can be said, that the intentional use of defective and unsafe tools, poor and inadequate electrical protection of installation and high voltage bulb on lower lighting fitting are the most electrical hazard prevalent in the buildings around at the study area.

Table 4: Mean Responses electricity users on the level of Electrical Risk Management awareness in Kano Metropolis

Risk Management	Mean Score	Remarks	Rank
Are all electrical tools and equipment turn off while the electrical work is carried out on the existing installation.	3.3480	Not aware	5
Are all hazardous materials in your building being replaces with one that is less hazardous.	3.2450	Not aware	8
Using non- conductive materials such as wood, plastic or other alternative as a barrier to avoid risk.	3.5490	Aware	1
Installing residual current devices or other alternative protection devices to prevent electrical shocks.	3.5392	Aware	2
Using safe work practices such as exclusive zones, use of permits and warning signs to show the tendency of contacting with risk.	3.5294	Aware	3
Using personal protective equipment (PPE) such as protective eyewear, insulated gloves etc. to safeguard electrical risk while working on building electrical installation.	3.5294	Aware	3
Adhere to standard procedures and instructions that are required for an individual to safely interact with electrical system.	3.3137	Not aware	6
Having required training of proper interaction and foreseeable in appropriate interaction with electrical system in order to determine when and how hazardous situations can arise.	3.3725	Not aware	4
Identifying who is going to provide assistance and summon help if needed.	3.2500	Not aware	7

Source: surveyed work, 2019.

Table 4 shows the level of electrical risk management awareness in Kano State Metropolis buildings. Using non-conductive materials such as wood, plastic or other alternative as a barrier to prevent any contact with risk ranked 1st with mean score of 3.5940. Sixty-four (64) respondents strongly agreed that installing residual current devices or other alternative protection devices to prevent electrical shocks with mean score of 3.5392 ranked 2nd. Using personal protective equipment (PPE) such as protective eyewear, insulated gloves etc. to safeguard electrical risk while working on building electrical installation, has a mean score of 3.2317 which ranked 3rd. Fifty-six (56) respondent strongly supported that replacement of hazardous materials in building with less hazardous materials has a mean score of 3.245 was ranked least on the table. This shows that using non- conductive materials such as wood, plastic or other alternative as a barrier to avoid risk, installing residual current devices or other alternative protection devices to prevent electrical shocks and using personal protective equipment (PPE) such as protective eyewear, insulated gloves etc. to safeguard electrical risk while working on building installation are the most common electrical risk management aware in Kano state buildings.

Assessing electrical hazard and risk management awareness is very vital and of paramount importance in buildings. Electrical hazard possesses a significant risk to building, plant or equipment which may results to injuries, illness or death to individual, thus, attention to electrical hazard awareness and risk management is the essential in any building set up. The findings from Table 1 agreed with the work of Saber (2014) which said the electricity users are aware of improper electrical insulation, lighting fitting overheating and damage electrical appliance and equipment, as electrical Hazards in residential buildings. He also stated that, the electricity users are not

aware of ungrounded circuit and equipment, coiled extension leads, and covered ventilation holes in electrical equipment as electrical Hazards in residential buildings. In line of this Safe Work Australia, (2012) identified electrical hazard as a measure of potential source of danger such as naked electrical wires, unprotected installation, electrical gadgets which are not switched off, over load socket outlet, unsafe acts and many others. This may cause serious risk and accidents, such as setting the entire building ablaze, loss of property, injuries and many more. OSHA's electrical standards confirmed that electricity has long been recognized as a serious workplace hazard, exposing employees to dangers such as electric shock, electrocution, burns, fires, and explosions.

CONCLUSION

This work assesses electrical hazard and risk management awareness in buildings a case study of Kano metropolis. Findings of this work reveals that, electricity users are aware of poor and inadequate electrical protection of installation and Intentional use of defective and unsafe tools and as major electrical hazards. They are also, not aware of identifying who is going to provide assistance and summon help if needed and use of ungrounded circuit and equipment as potential electrical hazards.

Concerning electrical risk management in buildings, electricity users are aware of using non- conductive materials such as wood, plastic or other alternative as a barrier to avoid risk and installing residual current devices or other alternative protection devices to prevent electrical shocks as a major means of risk management in their buildings. And they are not aware of tuning electrical tools and equipment off while the electrical work is carried out on the existing installation and replacing the hazardous materials in building with less hazardous

materials as a major means of risk management in their buildings

From the work it has become clear that several consumers of electricity in buildings are not adequately aware about electrical hazards and risk management in buildings. No surprise the consequences of these is been realised in records of electrical accidents observes in many homes and buildings. To elude all sorts electrical hazards observes in Kano metropolis all hands must be on deck to see that electricity users have adequate awareness of electrical hazards and risk management.

RECOMMENDATIONS

In view of the results of this study “Assessment of Electrical Hazard Awareness and Risk Management in Buildings a Case Study of Kano State Metropolis”, the following recommendations are hereby made. First, the manufacturers of electrical equipment,

appliances and machines should be conspicuously printed hazards and safety practices attributed to it on each one. This will remind the users when using the appliances, equipment and machines. Secondly, Electrical distribution companies should periodically organize workshops and seminars to train and educate building owners on the importance of electrical hazards and risk management as well as to equip them with the necessary skills in handling minor electrical problems in building. Thirdly, building occupants should periodically maintain their electrical installation, as well as ensuring that electrical installations in use are in good working conditions to prevent electrical hazards. Building’s occupants also need to strictly adhere to all maintenance instructions given by the maintenance personal’s in charge of their buildings and report any electrical faults to them for appropriate action. This will minimize the occurrence of electrical hazards in buildings.

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**PREDICTING ACADEMIC SUCCESS OF ARCHITECTURE
UNDERGRADUATES AT KADUNA STATE UNIVERSITY USING
LOGISTIC REGRESSION ANALYSIS**



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Abstract

Predicting success aids decision and policy makers in planning and managing important desired outcomes in any organisation. Although this is a common practice in educational disciplines, it is rarely employed in architecture education. Logistic regression analysis was employed to predict the probability of undergraduate students studying architecture at Kaduna State University successfully graduating with a minimum second class degree that would qualify them for a Master of Science degree program in Architecture. This is a prerequisite for Professional Competence Examinations. Results from logistic regression analysis of 175 respondents established three variables significantly predict students' success. These are level/class ($p=0.005$, $\text{Exp}(\beta)=2.712$), quality of lecturers' experience and competence ($p=0.027$, $\text{Exp}(\beta)=2.393$) as well as cost of materials for assignments ($p=0.030$, $\text{Exp}(\beta)=1.73$). The implication is Kaduna State University Department of Architecture needs to carefully monitor student progress across levels/classes especially at 100L as results reveal students at this level are most susceptible to failure. In addition, students will greatly benefit from periodic evaluations of teaching staff to maintain academic standards within the program.

Keywords: *Academic success, Architecture undergraduates, Kaduna State University, Logistic Regression, Prediction*

INTRODUCTION

Academic success, also referred to as academic achievement or performance in literature connotes achievement of learning objectives, acquisition of desired skills and competencies as well as satisfaction of successfully completing academic activities (Maina & Ibrahim, 2019). Studies predicting academic success have gained research attention globally because of several related socio-economic factors notably decreasing quality of graduates as well as higher attrition rates owing to behavioural misconduct such as drug trafficking. The latter especially affects academic performance of students in Higher Educational Institutions (HEIs) in Nigeria (Akhiehiero, 2011). Many studies in literature focus on predicting factors which affect student success especially in courses where failure rates are high. These are

commonly Science, Technology, Engineering and Mathematics (STEM) courses (Alzen, Langdon & Otero, 2018; Mustapha, Usman & Yusuf, 2016) as well as for counselling, planning and policy implementation (Ayoola & Balogun, 2018). Alzen et al. (2018) investigated relationships between learning assistant (LA) program and probability of student success at the University of Boulder, Colorado in the United States. The authors conclude that exposure to LAs reduce failure rates in Introductory STEM courses (Mathematics, Chemistry and Physics) based on gender. Males were associated with 63% odds failure reduction rate as against 55% for females. For introductory mathematics courses in Nigerian universities, predictors of academic success largely depend on personal factors such as motivation, attitude and interest (Sule & Saporu, 2015), collaboration with peers

outside formal class time as well as lecturers' competence and regular attendance in class (Mustapha, Usman & Yusuf, 2016). In Ghana, Asampana, Nantomah and Tungosiamu (2017) found gender, age and mother's employment status significantly predict student's academic performance in Mathematics. Males, younger students and candidates with employed mothers were more likely to achieve higher grades. Mabula (2015) reports personal factors-absenteeism and misconduct significantly predict student performance in Mathematics in secondary schools in Tanzania.

Studies which focus on other discipline areas proffer a wide range of predictors for academic performance. Recommendations from such studies usually target planning and policy. Adejumo and Olatunji's 2013 study at the University of Ilorin predicted factors associated with graduating with a first class degree. Results revealed age and mode of entry predict very high academic performance. The younger the student, the better the odds for obtaining excellent results. Entrants through Direct Entry (DE) were also highly likely to graduate with a first class degree from the study. Gender was not a predictor of academic success as both males and females were likely to achieve high grades. For public secondary schools in Oyo State, Ayoola and Balogun (2018) found probability of academic success increased by schools achieving standard staff and student ratios as well as provision of well-equipped libraries and laboratories. In Ethiopia, Zewude and Ashina (2016) identified study time, peer influence, securing first choice at university, studying out of class time, amount of money received from family, prospects in life as well as father's education as major variables influencing academic performance.

For architecture undergraduates in Nigeria, multifaceted factors have been advanced to affect and predict academic performance from few studies as research predicting

academic factors are rare in architecture education. These include learning environment, parents' characteristics and level of study, ethnic group, mother's occupation, source of counselling, students' personal characteristics, parents' profession, gender as well as previous academic results (Opoko, Oluwatayo, Ezema & Ediae, 2015; Opoko, Oluwatayo & Ezema, 2016; Oluwatayo, Aderonmu & Aduwo, 2015; Aluko, Daniel, Oshodi, Aigbavboa & Abisuga, 2018). All the aforementioned studies were conducted at universities in southern parts of the country, with relatively little comparable cases in the north. Although Maina, Marafa and Daful (2018) conducted a similar study using a sample from the two oldest public universities offering architecture in northern Nigeria, recommendations predicting academic success are best implemented within specific institutions as illustrated in the foregoing review of literature. The current study partly bridges this gap using a cohort from Kaduna State University Department of Architecture. The study aims to establish factors which significantly predict academic success of architecture students as such studies are rare especially in northern Nigeria. This is important because the department is set to graduate its first cohort of undergraduate students. Consequently, this exercise serves as an essential feedback mechanism towards planning and monitoring in future.

METHODOLOGY/RESEARCH INSTRUMENTS

Research instruments and data collection

A quantitative approach was employed using questionnaires. Data was sourced from a population of 274 undergraduate students of KASU in the 2018/2019 academic session on variables related to demographic, socio-economic, school-based and personal attributes. These are presented in Table 1.

Table 1: Variables affecting academic performance from literature

Variables	Source(s)
<i>Parents' Educational attainment</i>	Amoo, Adeyinka & Aderibigbe (2018); Meritt & Buboltz (2015); Farooq, Chaudhry, Shafiq & Berhanu (2011)
<i>Age</i>	Ali, Haider, Munir, Khan & Ahmed (2013); Hanafi & Noor (2016)
<i>Counselling</i>	Opoko, Oluwatayo & Ezema (2016)
<i>Level/Class</i>	Sharker & Rahman (2015)
<i>Previous Academic results (O'Levels)</i>	Aluko, Daniel, Oshodi, Aigbavboa & Abisuga (2018)
<i>Gender</i>	Thiele, Singleton, Pope & Stanistreet (2016); Mersha, Bishaw & Tegegne (2013)
<i>Learning environment, School facilities (furniture, conveniences, cleanliness, indoorscaping, security, internet, water/electricity supply, worship facilities, shops)</i>	Ibem, Alagbe & Owoseni (2017); Opoko, Oluwatayo & Ezema (2016); Oluwatayo, Aderonmu & Aduwo (2015); Nchungo (2013); Akhihiro (2011)
<i>Lecturer competence/experience</i>	Obaje, Olufemi & Taiwo (2017); Olatunji, Aghimien, Oke & Olusola (2016); Alos, Caranto & David (2015); Dey, Choudhury, Mollah & Kim (2015); Mustafidah (2014); Muzenda (2013)
<i>Motivation</i>	Alshammari, Saguban, Pasay-an, Altheban & Al-Shammari (2018); Dixon, Keltner, Worell & Mello (2017)
<i>Relationship with peers/colleagues</i>	Maina & Ibrahim (2019)
<i>Location (urban/rural setting)</i>	Alam, Billah & Alam (2014)
<i>Accommodation/quality of hostels</i>	Adama, Aghimien & Fabunmi (2018); Owolabi (2015)
<i>IEQ (Lighting, Air, Acoustics)</i>	Davies & Lee (2007); Higgins, Hall, Wall, Woolner & McCaughey (2005)
<i>Time management</i>	Fernando (2017)
<i>Class attendance</i>	Piloff & Kling (2017)

Problems were encountered while collecting data on previous academic performance especially for O'Level subjects due to two principal reasons. First, many students were unable to provide O'Level results in a pilot survey using a similar cohort from another institution within the State. Few who did expressed uncertainty over accuracy of the results provided. This presented large amounts of missing data. Secondly, the questionnaire was anonymous as previous studies requesting for student identification with links to student records revealed large numbers of incomplete responses or students modified results to fit what they thought researchers wanted to know (Maina & Ibrahim, 2019). Importantly, linking questionnaires to student records negates anonymity. This is one limitation of the study. To ensure accuracy of data collected for the dependent variable (academic success measured with self-reported CGPA), questionnaires were distributed to the entire student population within two weeks of results being published. Self-reported

CGPAs are reliable when collected within this time frame (Ejeh & Maina, 2019).

Data Analysis

Logistic Regression (LR) falls within general linear models where a categorical dependent variable is predicted from independent variables which may take categorical or discrete values (Bahadir, 2016). Binary Logistic Regression (BLR) is usually employed to predict a dependent variable in two levels-0/1, pass/fail, cured/not cured, good/bad, successful/not successful etcetera. In this study, BLR was employed to investigate the probability of a student succeeding in the BSc program (graduating with a minimum 2.2 class of degree) to enable said candidate meet requirements of the Master of Science degree in Architecture towards registration for the Architects' Registration Council of Nigeria (ARCON) Professional Competence Examination. Thus students with CGPAs below 2.40 were coded not successful (0) in SPSS v21; students with CGPAs equal to and above 2.40 were coded successful (1). CGPA is the only dependent variable in the current study. All other

variables including demographic data and likert scaled items (Table 1) are independent variables.

The following steps were employed for the analyses:

1. All data were analysed for descriptive statistics-frequencies (N) and percentages (%) as well as for Means (M), Standard Deviations (SD). Demographic information of respondents are presented as frequencies and percentages (Table 2) while M and SD are employed to rank likert-measured items (Table 3). Mean values greater than or equal to 3 ($M \geq 3$) are considered important variables influencing academic performance in this study. SDs less than 1 denote clustering around the mean value of a variable.
2. To increase chances of achieving parsimony in the model, all variables were first subjected to individual binary logistic analyses against the dependent variable using a relaxed p value of 0.25 as suggested by Sperandei (2014). 15 variables met this criteria using results of Omnibus Tests of Model Coefficients (Table 4). This test measures strength of relationships between the dependent variable and each independent variable (Field, 2013).
3. A final logistic model was run using success as the dependent variable and the 15 variables from Step 2 as independent variables. This was set at $p=0.05$ or 95% confidence level. Model parameters were tested as follows:
 - a) Strength of relationship was measured using the *Omnibus Test of Model Coefficients* (Field, 2013). A significant value ($p \leq 0.05$) illustrates a strong relationship between the dependent variable and the model

(Asampana, Nantomah & Tungosiamu, 2017). Results are presented as the Chi-square (χ^2) statistic, degree of freedom (df) and p or significance value.

- b) *Hosmer-Lemeshow goodness-of-fit* statistic was employed to assess how well the model fits data. Non-significant results translates to a good fit (Zewude & Ashine, 2016; Tanis, 2014)
- c) *Cox and Snell's measure* as well as *Nagelkerke's adjusted value* present pseudo effect size measures for the model (Field, 2013). Both measures gauge variance (in %) in a logistic regression model (Zewude & Ashine, 2016; Tanis, 2014).
- d) *Classification tables* display percentage prediction capabilities of the model. The closer to 100% overall percentage is, the better the model predicts success.
- e) *Beta values (β)*, *Wald statistic (z^2)* and *Exp(β)* present information about model parameters for each predictor (Ayoola & Balogun, 2018; Tanis, 2014). β values are parameters for each independent variable, as obtains in multiple regression. Positive values denote increase of each predictor alongside increase in the dependent variable, while negative values imply decrease in the predictor variable per unit increase of the dependent variable. The study employed *Exp(β)* values as measures of odds ratio (Field, 2013). This represents the odds of a student succeeding based on *Exp(β)* values of each predictor over a student who fails. Field (2013) explains that *Exp(β)* values greater than 1 indicate that as the

predictor increases, the odds of the outcome occurring increases and vice versa.

- f) Checking residuals for cases of outliers which may influence results (Field, 2013). Standardised z scores with absolute values of 3.29 or 1% of z scores with values >2.58 or more than 5% of cases with values >1.96 present poor model fit (ibid). Results from these analyses follow in the succeeding section.

RESULTS AND DISCUSSION

Results

Results from the first section of the questionnaire regarding demographic data are presented in Table 2. Out of a total student population of 274 in the 2018/2019 academic session, 175 questionnaires (64%) were retrieved, largely due to low retrieval rates from 300L who were away on mandatory Student Industrial Work Experience Scheme (SIWES). This posed the second limitation of

the study. Females account for 15% of the sample, while 76% of respondents are aged between 18-25 years. An overwhelming 91% secured admission to study architecture through UTME. Put together, the foregoing statistics fit normal student profiles of architecture undergraduates within the region reported by recent studies (Adedire, 2015). Results reveal 151 students (86%) have a minimum second class lower (2.2) CGPA and are thus classified successful for analyses. This is against 24 (14%) classified not successful. Fathers on average, are more educated from the sample as 66% have a minimum HND/BSc qualification as against mothers, who based on the same criterion, record 45% HND/BSc qualification. 80% of respondents reside in Kaduna, the Kaduna State capital, revealing a marked skew in admissions favouring location, indigenisation or a combination of both. More than half the sample received no counselling prior to admission; nonetheless, 67% note they were self-motivated to pursue a degree in architecture.

Table 2: Demographic profile of respondents

Variable	N	%	Variable	N	%	Variable	N	%
Level/Class			Father's highest education			Mother's highest education		
100L	60	34%	Primary School	7	4%	Primary School	10	6%
200L	57	32%	Secondary School	28	16%	Secondary School	44	25%
300L	12	7%	Diploma	20	11%	Diploma	39	22%
400L	46	27%	HND	29	17%	HND	26	15%
Gender			BSc	37	21%	BSc	37	21%
Male	153	87%	MSc	33	19%	MSc	10	6%
Female	15	9%	PhD	16	9%	PhD	5	3%
Missing	7	4%	Missing	5	3%	Missing	4	2%
Age on admission			Entry qualifications			Received counselling		
Below 18	25	14%	UTME	160	91%	Yes (1)	70	40%
18-25	132	76%	Remedials	6	4%	No (0)	100	57%
26-35	9	5%	DE	5	3%	Missing	5	3%
Missing	9	5%	Others	2	1%	Residency		
Motivation to study architecture			Missing	2	1%	Kaduna	140	80%
Self	118	67%	Academic success			State capital/urban area	26	15%
Others	47	27%	No (0)	24	14%	Non-urban areas	6	3%
Missing	10	6%	Yes (1)	151	86%	Missing	3	2%

Descriptive statistics of ordinal data employed for the analyses is presented in Table 3. Reliability for likert scaled items on the questionnaire was computed using Cronbach's alpha at 0.885. This value is

higher than the acceptable value of 0.7 (Field, 2013).

13 variables record mean values above 3. The first, attending lectures (M 4.09) is the only variable with a mean value above 4. Closely

related is quality of lectures received, measured by lecturers' experience/competence, which records the lowest SD, ranked fourth. Relationship with other students as well as collaboration with colleagues are ranked second and third respectively. This supports findings by Maina and Ibrahim (2019) regarding effect of interaction and socialisation as support mechanisms in learning environments for architecture students. Cost of materials, also ranked fourth along with quality of lecturer's experience, supports findings from a similar sample at Ahmadu Bello University as well

as University of Jos where it was ranked first (Maina, Marafa & Daful, 2018). Quality of facilities, specifically natural light and air within classrooms, studios and libraries were ranked seventh to tenth after interactive sessions in class, ranked sixth. The latter is closely related to attending lectures, relationship with other students as well as lecturer experiences. The last three variables with mean values above 3 are personal time management, quality of studios and general state of cleanliness ranked eleventh and twelfth respectively (Table 3).

Table 3: Descriptive statistics of ordinal independent variables ranked on mean values

Variables	N	M	SD	Rank
Attending lectures	175	4.09	.921	1
Relationship with other students	175	3.97	.912	2
Collaboration with colleagues	174	3.88	.882	3
Lecturers' experience/competence	174	3.60	.721	4
Cost of materials for assignments	174	3.60	1.197	4
Interactive sessions in class	175	3.34	.938	6
Quality of natural light in classrooms	174	3.25	.987	7
Quality of natural light in studios	174	3.17	1.155	8
Quality of air in classrooms	174	3.16	.970	9
Quality of library facilities	174	3.11	.961	10
Personal time management	175	3.07	.913	11
Quality of air in studios	173	3.02	1.045	12
General state of cleanliness	175	3.02	.897	12
Water supply	174	2.99	1.081	14
External lighting	174	2.94	.923	15
Power supply	175	2.67	1.013	16
Info about architecture program at registration/induction	175	2.66	.951	17
Relationship with academic Staff	175	2.63	.925	18
Security	174	2.59	1.054	19
Acoustic quality in classrooms	172	2.58	.911	20
Campus environment	175	2.57	.991	21
Overall quality of classrooms	175	2.55	.957	22
Departmental environs/landscaping	174	2.47	1.001	23
Quality of furniture	175	2.33	1.002	24
Availability/quality of cafeterias	175	2.33	.930	24
Overall quality of studios	175	2.33	1.024	24
Indoorscaping	173	2.32	.926	27
Relationship with non-academic staff	175	2.23	1.021	28
Availability/quality of shopping facilities	175	2.10	.971	29
Availability of worship facilities	174	1.97	.988	30
Quality of workshops	175	1.96	1.008	31
Quality of toilet/sanitary facilities	175	1.77	.920	32
Availability/quality of hostels/accommodation	175	1.75	.942	33
Internet Connectivity	175	1.45	.969	34

Results from step 2 of the analyses reveal 15 of 34 variables achieved significance lower than 0.25. Presented in Table 4, these include

Level/class, Mother's educational qualification, Lecturer's experience /competence, Collaboration with colleagues, General state of cleanliness, Information

about Architecture program at registration/induction, Availability/quality of cafeterias, Overall quality of Studios, Quality of air and natural light in studios, Overall

quality of classrooms, Cost of materials, Personal time management, Attending lectures and Quality of furniture.

Table 4: Initial screening of variables for logistic regression using omnibus coefficients $p \leq 0.25$

SNo	Variable	Omnibus Tests of Model Coefficients			
		N	χ^2	df	Sig
1	Level/class	175	5.453	1	0.02
2	Mother's Educational Qualification	171	3.54	1	0.06
3	Lecturer's experience/competence	174	7.699	1	0.006
4	Collaboration with colleagues	174	2.377	1	0.123
5	General state of cleanliness	175	1.85	1	0.174
6	Info about Architecture program at registration/induction	175	5.125	1	0.024
7	Availability/quality of cafeterias	175	1.951	1	0.162
8	Overall quality of studios	175	1.567	1	0.211
9	Quality of air in studios	173	2.619	1	0.106
10	Quality of natural light in studios	174	4.52	1	0.034
11	Overall quality of classrooms	175	3.749	1	0.053
12	Cost of materials for assignments	174	2.314	1	0.128
13	Personal time management	175	1.257	1	0.013
14	Attending lectures	175	1.374	1	0.241
15	Quality of furniture	175	5.106	1	0.024

Results from Step 3 revealed a significant value for Omnibus Test of Model Coefficients ($\chi^2=32.234$, $df=15$, $p=0.006$), illustrating a significant relationship between the dependent variable and model. Model summary in terms of effect size is presented

in Table 5. These figures represent a small to medium sized effect (Field, 2013) and explain approximately 17.6% and 31.9% variance of the dependent variable. This result means there are other factors explaining academic success currently not included in the model.

Table 5: Model summary

-2 LL	Cox & Snell's R^2	Nagelkerke's R^2
101.339	0.176	0.319

Table 6 presents the degree to which the model predicts academic success, which is 87.3%. The model correctly classifies five non-successful candidates against 18 candidates it misclassifies. The model shows

a tendency to accurately classify successful students (97.9%) compared to non-successful ones (21.7%). This trend is common from literature reviewed.

Table 6: Classification table

		Predicted	
		Academic success	% Correct
Observed	0	5	21.7%
	1	3	97.9%
Total			87.3%

Predictors of academic success for undergraduates studying Architecture at KASU are presented in Table 7. Three variables significantly predict success notably Level/class ($p=0.005$), Lecturers' experience/competence ($p=0.027$) and Cost of materials ($p=0.030$). Two other variables, Information about Architecture program at registration ($p=0.53$) as well as Mother's educational qualification ($p=0.59$) approach but fail to achieve significance. Five

variables record negative β values (Table 7 below horizontal line), implying that decreasing values of quality of natural light in studios, quality of furniture and studios, mother's educational qualification and collaboration with colleagues increase the probability of students successfully graduating. Checks of standardized z-scores for all predictors did not reveal extreme values, confirming model fitness.

Table 7: Variables predicting success for Architecture undergraduates at KASU (sig. in bold)

	β	S.E.	Wald	df	Sig.	Exp(β)	Lower 95% CI for Exp(β)	Upper
Level/Class	.998	.356	7.873	1	.005	2.712	1.351	5.443
Lecturer's experience/competence	.873	.396	4.860	1	.027	2.393	1.102	5.199
Info about Architecture program at registration/induction	.674	.348	3.743	1	.053	1.962	.991	3.885
Cost of materials for assignments	.548	.253	4.696	1	.030	1.730	1.054	2.839
Overall quality of classrooms	.486	.393	1.532	1	.216	1.626	.753	3.510
Availability/quality of cafeterias	.204	.343	.352	1	.553	1.226	.626	2.402
Personal time management	.195	.323	.363	1	.547	1.215	.645	2.289
Quality of air in studios	.180	.342	.279	1	.597	1.198	.613	2.339
Attending lectures	.113	.311	.132	1	.716	1.120	.609	2.061
General state of cleanliness	.067	.334	.040	1	.842	1.069	.556	2.055
Quality of natural light in studios	-.161	.298	.291	1	.589	.852	.475	1.526
Quality of furniture	-.187	.359	.272	1	.602	.829	.410	1.676
Overall quality of studios	-.282	.386	.532	1	.466	.755	.354	1.608
Mother's Educational Qualification	-.328	.174	3.564	1	.059	.720	.513	1.013
Collaboration with colleagues	-.354	.358	.975	1	.323	.702	.348	1.417
Constant	-5.949	2.343	6.450	1	.011	.003		

Discussion

Results indicate level/class of students significantly predicts academic success. In essence, the higher the level or class of a student, the odds candidate will graduate with a minimum 2.2 class of degree increases by 2.712. A re-examination of our success variable by level/class indicates the lowest occurrence of not succeeding is in 400L with a single case. 100L records the highest occurrence of failure with 13 candidates. 200L and 300L record 5 candidates each. These figures support Oluwatayo et al. (2015) as well as Maina and Ibrahim (2019) that architecture students require more attention and supervision at lower levels/classes compared to higher levels. The implication is that students who manage to

reach 400L have higher chances of successfully graduating with a minimum 2.2 class of degree. This assertion may seem intuitive, but worth reiterating as it is now confirmed by systematically analysed data.

The finding on Lecturer experience/competency being a significant predictor of academic performance is likewise supported by several studies across different academic disciplines worldwide (Table 1). In fact, Alos et al. (2015) maintain this variable is the most important predictor of academic performance. In this study, the odds of success increases by 2.393 based on lecturer experience/competency.

Cost of equipment for assignments emerged as the third significant predictor of academic performance from our sample, with the odds

of success increasing by 1.73 based on this variable. This variable was ranked first by a similar cohort from Ahmadu Bello University and the University of Jos (Maina, Marafa & Daful, 2018), confirming its pervading influence on architecture education in public universities, at least in northern parts of the country. Students of architecture studying at private universities are less likely to face economic related challenges because due to “the high fees charged in private universities, it rare for students from poor families to study there” (Opoko, Oluwatayo, & Ezema, 2016 p. 1233). This is a fundamental constraint to institutions and students as architecture is generally noted as an expensive course.

The five variables with negative beta values as well as odds ratios less than 1 in Table 7 present interesting contrasts. The first three regarding Indoor Environmental Quality (IEQ) in studios as well as the last-collaboration with colleagues imply that higher odds of success are likely with lower values of these variables. In essence, this finding points to the low importance attached to studio related issues from this sample, supporting findings in private universities (ibid). This may not be unrelated to the gradual loss of studio and reading culture observed over time in Nigerian architecture schools. Students no longer consistently employ studios and classrooms to design and read books, but have become dependent on mobile technology which can be put to use anywhere and not necessarily only within functional spaces designed for academic related activities. In addition, where facilities are not always available or conducive for learning, students are likely to adapt other means of getting their work done independent of school facilities. Thus, IEQ conditions of functional spaces may no longer be deemed critical nor important for academic success especially for *e-generation* students.

Negative values for collaboration with peers at first contradict findings in Table 3 where

relationship with other students and collaboration with colleagues were highly ranked by simple descriptive statistics. However, results from BLR exposes what was not evident using descriptive statistics-that as candidates move into higher classes, the need for independence (not collaboration) increases for architecture students in both public (Maina & Ibrahim, 2019) and private universities (Oluwatayo, Aderonmu & Aduwo, 2015). This finding also buttresses the case for employing inferential statistics which are likely to unearth deeper findings and expose hidden trends within a dataset. The finding on mothers’ educational qualification does not come as a surprise at it has been linked to success in architecture students (Opoko, Oluwatayo & Ezema, 2016). In this study, the lower the educational qualification of mothers, the higher the odds for success of students. This implies that although 67% of the sample claim to have been self-motivated (Table 2), mothers with lower educational qualification present another source of possible motivation. In the present economic climate of Nigeria with high unemployment rates, mothers who arguably spend more time at home with children are likely to encourage them to study hard in order to avoid problems associated with low income earning power and low educational qualifications.

CONCLUSIONS AND RECOMMENDATIONS

This study investigated predictors of academic success among architecture undergraduates at KASU, with success equated to attaining a 2.2 class of degree to qualify candidates to register for ARCON Professional Competence Examination following a minimum 2 year internship under a registered architect. Results reveal level/class, experience/competence of lecturers as well as cost of equipment for assignments significantly predict success. Recommendations proffered target the institution as well as students.

First, it is imperative for the institution to recruit excellent lecturers with relevant academic and professional qualifications who will provide quality teaching as well as adequately and closely monitor students from inception to final year. This point cannot be overemphasised in light of the pervading culture of nepotism and 'godfatherism' especially for recruitment purposes at both Federal and State Civil Service levels in Nigeria. Results from the current study illustrate this single action addresses multiple variables directly predicting academic performance in the institution.

Secondly, the institution needs to liaise with students and possibly alumni regarding ways to supplement cost of materials for assignments. This is a problem faced by

many undergraduates in public schools of architecture especially under current harsh economic conditions in the country. Care must be taken to ensure quality training is maintained while balancing practical economic perspectives in the form of bursaries, scholarships or recycling of materials employed in models and drawings, for instance.

Thirdly, similar studies ought to be conducted preferably using larger samples, expanded variables as well as other data mining techniques to improve predictability of models. Additionally, a follow up study employing qualitative approaches notably interviews or open ended questionnaires in the same school would be beneficial towards triangulating results presented in this study.

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CHILD DEPRIVATION AND LABOUR IN CORE AREA OF AKURE, NIGERIA



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Abstract

This paper investigates child deprivation and labour in the core area of Akure, Nigeria. The research investigated child discrimination on different grounds, the dignity of the child, education, rest and leisure, health, hygiene, child's protection, abuse or neglect and maltreatment in the study area. Purposive sampling technique was employed where 60 questionnaires were administered within the study area. Findings revealed that there were more males than females among the deprived children and age cohort 10-14 years had the highest proportion of 53.3 percent. The respondents without formal education accounted for 56.7 percent (these were the children deprived of education) and 58.3 percent discriminated based on sex. Those whose dignities were not protected had 18.3 percent and 86.7% of the children were deprived of leisure and rest among others. Consequently, the study recommends improvement on the educational system, access to health facilities, child protection, good hygiene, protection of child's dignity, proper treatment, wholehearted efforts to eliminate all forms of child discrimination, economic exploitation and urban renewal among others.

Keywords: *Child labour, Deprivation, Discrimination, Education and Neglect.*

Introduction

Discrimination by age affects child labourers. Employers choose to employ children precisely because their young age makes them more vulnerable, more obedient and nimble, produce more within a short time for little or no pay. Children are cheaper, faster, work in conditions that are not safe, work for longer hours and less aware of their rights among others (Fasakin, Gabriel and Akande, 2019). The term child labour has many definitions from different scholars. International Labour Organization argues that child labour is difficult to define. It depends on the type of the job and if the age is under eighteen and if the job intervenes the children's education and development (International Labour Organization, 2004).

Child labour is a serious problem and a challenge for many developing countries. Many countries have enacted various laws and have taken serious initiatives to eradicate child labour, but still, the problem is very

widespread throughout the world. It has been observed over decades that, poverty forces poor families to send their children to work, which results in a serious problem the world is facing nowadays. Child labour can leave many severe consequences on children and their families. When children work, it does not mean as a standard, they support their families economically, neither all of them get paid for their work since many of them work as bonded labour or as slaves. In addition to that, they face many problems which may cause permanent damage to their childhood (Lana, 2014).

According to the International Labour Organization (ILO, 2013), the largest numbers of child labourers are engaged in hazardous work and the total number of child workers is increasing, even though it is forbidden by law. These children are vulnerable to diseases and they struggle with long-term physical and psychological pain. The main cause that induces children to work is poverty. These children work for their survival and their families. The incidence of child labour is most

prevalent in Sub-Saharan Africa followed by Asia and the Pacific. The prevalence of child labour is very high in Sub-Saharan Africa, especially in Nigeria. About 48 million child labourers across Sub-Saharan Africa, including 15 million in Nigeria that are engaged in child labour (Ajakaye, 2013).

Child labour is prevalent in urban centres in Nigeria. This is because a large number of people move from rural areas to the urban areas. Over the years there has been a rapid growth in Nigeria's urban population because of massive rural-urban migration. This pushes families to force their children to work in order to supplement family incomes (Okafor, 2010; Nseabasi & Abiodun 2010). The number of child labour is increasing in Nigeria, in 1995, the number of child labour was twelve million while by 2006 the number of child labour under the age fourteen has risen to fifteen million (Adegun, 2013). Awosusi and Adebo (2012) assert that many child labourers in Nigeria are abused physically, mentally, sexually and psychologically. They work long hours under dangerous and hazardous conditions with little or no pay benefits.

The deprived children under consideration in this study are those on the streets and some house-helpers exposed to hazards within the core area of Akure. Therefore, the study examines child deprivation and labour among residents living in the study area. The research investigates child discrimination on different grounds, the dignity of the child, education, rest and leisure, health, hygiene, child's protection, abuse or neglect and maltreatment among others of the respondents in the study area. However, suggestions were proffered to improve the condition of deprived children in the study area.

II. Materials and Methods

2.1 The Study Area

The study area is Akure, a Nigerian City, which like other traditional Yoruba towns in the country, has been in existence long before the advent of British colonial rule

and modern planning standards and practices. The City is located within Ondo State in the South Western part of Nigeria, one of the 36 states of Nigeria. It lies approximately between latitudes $7^{\circ} 51'$ and $8^{\circ} 00'$ North of the Equator and longitude $5^{\circ} 45'$ East and longitude $6^{\circ} 00'$ East of the Greenwich Meridian at an altitude of 370m above sea level. Akure is a medium-sized urban centre that became the provincial headquarters of old Ondo province in 1939. It also became the capital city of Ondo State and a Local Government Headquarters in 1979. These dual political roles of Akure have since acted as an impetus to the influx of people into the city (Olujimi and Olamiju, 2011; Gabriel, 2017; Gabriel and Fasakin, 2017).

Akure is located approximately 700 kilometres South West of Abuja, the Federal Capital of Nigeria and about 350 kilometres to Lagos, the former capital of Nigeria. It is located within the tropical rain forest region of Nigeria where rainfall is high throughout the year. The increased relative political influence of Akure as state capital since 1976 has greatly promoted its rapid growth and socio-economic activities resulting in its spatial expansion from an area of about 16 square kilometres in 1980 to about 30 square kilometres in 2000. The 1991 national population census, however, puts the population of Akure at 239,124 and its population in 2006 was 353,211 (NPC, 2006). Using a growth rate of 3.18 percent to project the population for 2019, the city was estimated to have 530,626 people using a formula for projection, $P_t = P_o (1+r)^n$.

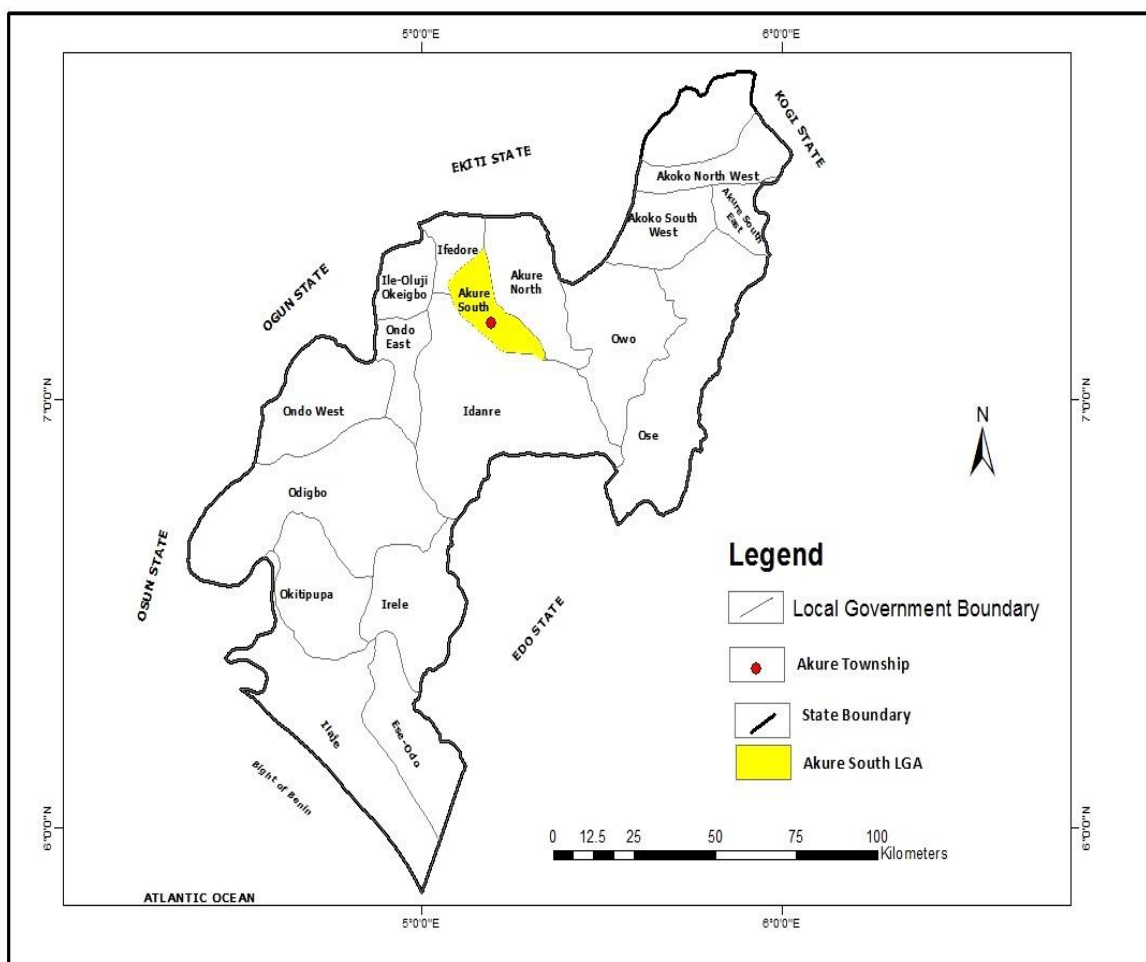


Fig. 1: The study area in its regional setting
Source: Digital Globe Satellite Imagery by Author, (2019)

Primary data for the study were generated from the administration of a structured questionnaire and interviews. The questionnaire focused on children within the age bracket 5 to less than 18 years living in the study area. It investigated among other things; discrimination on different grounds, the dignity of the child, education, rest and leisure, health, hygiene, child's protection, abuse or neglect and maltreatment. Secondary data were obtained from the Ministry of Lands and Housing and Ministry of Physical Planning, the Ministry of Women Affairs and Youth Development Akure, Ondo State. Since the deprived children are seen moving on the streets and some as house

helps, it was very difficult to prepare any sampling frame to select the desired sampling size. Therefore, a purposeful sampling technique was employed where 60 copies of questionnaire were administered at the city core. However, Fasakin, Gabriel and Akande (2019) in a similar study which includes the core area of Akure, used the following proportion for questionnaire administration: 60 questionnaires at the core; 48 questionnaires at the transitional zone; and 8 questionnaires at the peripheral zone and got good results.

Furthermore, the 60 copies of the questionnaire were randomly administered at the core, within Ijomu Street, Isolo, Odo

Ikoyi, Imuagun, Ajegunle Odopetu, Eyinke, Awo Street and Eruoba. Furthermore, the questionnaire was randomly administered on the streets and homes within the study area. The questionnaire was administered to one child at a time, that is, each question was read and explained in English and Yoruba, the languages that are mostly understood by these children, without influencing their choice. This was done to increase the accuracy of the responses. The questionnaire was structured in a simple way to be understood by the children. Twelve field assistants were employed to administer the questionnaire within one week. In addition, tables were used to present, interpret and discuss research findings.

III. Results and Discussion

3.1 Sex of Respondents

At the core, 61.7 percent of the respondents were males against 38.3 percent females. In addition, investigation revealed that there were more males than females within this zone who were deprived juveniles. This is not unconnected with street begging and hawking. However, some of the many immediate consequences that may

affect the children in life based on sex ratio imbalances are the poor level of education, low income and future partner among others. For instance, marriage is universal in Nigeria and men typically marry younger women with the reasonable age gap and other considerations based on individual interests. Therefore, it can be inferred that it may be difficult for the deprived females to marry when they get to marriageable status because of their predicament.

Kalpana, Suprakash, Bhat, and Prajakta, (2017) opined that education system reflects the inequality found outside the classroom. Girls the world over are less likely than their brothers to be attending primary school. In some cases, where a decision has to be made about which children to send to school, parents decide to invest in their sons' education rather than their daughters'. This may reflect the fact that upon marriage, daughters in some cultures may no longer contribute to family income and are therefore not seen as worth investing in. However, by contrast, there may also be pressure on boys but not girls to leave school and contribute to the family income.

Table 1: Sex of Respondents

Zone Variable	Core	
	Freq.	(%)
Sex		
Male	37	61.7
Female	23	38.3
Total	60	100.0

Source: Author's Fieldwork, 2019.

3.2 Age of Respondents

Findings revealed that the age cohort 10-14 years had the highest proportion of 53.3 percent. This was followed by respondents within the age bracket 15 to less than 18 years with 35.8 percent. The age cohort with the least proportion is 5-9 years which accounted for 11.7 percent of the total

respondents. Less than 5 years age cohort was excluded because none of the deprived children were found to be within this category. Further investigation revealed that age discrimination also affects child labourers. Employers choose to employ children precisely because their young age makes them more vulnerable, more obedient and nimble,

produce more within a short time for little or not pay, children are cheaper, faster, work in conditions that are not safe, work for longer

hours, and less aware of their rights among others.

Table 2: Age of Respondents

Zone Variable Age	Core	
	Freq.	(%)
5-9	7	11.7
10-14	32	53.3
15 to less than 18	21	35.0
Total	60	100.0

Source: Author's Fieldwork, 2019.

3.3 Level of Education

The educational attainment of these children is important. This is because the surest way out of abject poverty is education. The educational level of the deprived children in the study area is shown in table 3. The table revealed that respondents without formal education accounted for 56.7 percent (these are the children deprived of education) in the study area. This is because deprivation in education is measured by attendance and completion of primary school (United Nations Children's Fund, 2014). The negative impact on the physiological and psychological levels of children includes specific concerns about child labour and its consequences on mental health. It is worth noting that one-third of children in the developing world are failing to complete even 4 years of education (ILO, 2003). Schooling problems also contribute to child labour, whether it is the inaccessibility of schools or the lack of quality education which spurs parents to send their children into more profitable pursuits.

However, this study revealed that many of these children endure lives of pure deprivation. There are problems with the intuitive solution of immediately abolishing juvenile deprivation to prevent such abuse. First, there seems to be no international agreement defining child labour, making it hard to isolate cases of abuse, let alone abolish them. Second, many children may have to work in order to attend school so abolishing child labour may only hinder their education. Any plan for abolishment depends on schooling. The State (Ondo State and by extension the Federal Government) could help by making it worthwhile for a child to attend school, whether it be by providing students with nutritional supplements or increasing the quality and usefulness of obtaining an education. Kalpana (2011) suggested that there must be an economic change in the condition of a struggling family to free a child from the responsibility of working. Family subsidies can help provide this support.

Table 3: Level of Education of Respondents

Zone Variable	Core	
	Freq.	(%)
Level of Education		
No formal education	34	56.7
Primary education	20	33.3
Secondary education	6	10.0
Total	60	100.0

Source: Author's Fieldwork, 2019.

3.4 Discrimination of Respondents

Table 4 reveals the category of discrimination among deprived children in the study area. It shows that 58.3 percent of the children investigated were discriminated based on their sex. Those that attributed their discrimination to religion were found to be 21.7%. Therefore, it can be deduced that the 58.3 percent discrimination based on sex means that there is a need for more advocacy on child's rights and education in the study area. In addition, the study revealed that certain types of work are gender biased. House-helps in the study area were mostly females. Street hawking and begging comprise of both genders. It means that boys and girls are faced with different forms of harm and exploitation.

Findings revealed that the boys tend to work more in environments away from parental control, or in jobs that are associated with men's work, such as work outdoors or physical labour. Examples include farming, wholesale and retail trade, transport, construction, and restaurants and hotels. Girls, on the other hand, tend to work in the domestic sphere, in what are perceived to be protected environments in or near the home, or in jobs that are associated with women's roles, such as work demanding patience or attention to detail. These include domestic service, home-based manufacturing, tailoring and catering among others. Discrimination in the workplace may mean that girls have fewer options available to them. For

example, girls in slums in Isolo, now excluded from tailoring or garment work, may be forced to choose between the few options available – restaurant stewardess, street begging, child domestic work or sexual exploitation. Boys may have more varied opportunities and therefore the option to choose less hazardous work. Girls are also less likely to get equal pay for equal work.

Further investigation revealed that there are several gender discrimination-related consequences of child labour. One of the most obvious is the problem faced by girls who have been sexually exploited. On return to their families and communities, if their situation is common knowledge they may face ostracisation and even physical harm. While those who experience discrimination on the basis of ethnicity include: non indigenes, asylum seekers and migrants. Religious traditions may also play a role in the exploitation of children, such as the Almajiri system in Nigeria, where children are handed over to religious leaders. These children are found on the street begging for food, clothing, money and other forms of arms. It has been reported that the leaders of some Koranic schools (*madrasas*) in some countries, for example in West Africa, have forced their pupils to beg. The working conditions of many children prevent them from practising their religion – those who are never allowed time off cannot frequent places of worship (Gabriel, 2013).

Table 4: Discrimination of Respondents

Zone Variable Discrimination	Core	
	Freq.	(%)
Religion	13	21.7
Ethnicity	12	20.0
Sex	35	58.3
Total	60	100.0

Source: Author's Fieldwork, 2019.

3.5 Dignity of Respondents

The results in table 5 show juvenile dignity in the core area of Akure. Findings revealed that the dignity of the children that were strongly protected as 15.0 percent. While those whose dignities were not protected had 18.3 percent, however by inference, this suggests that these were the children found to be in child poverty. Because investigation revealed that the

dignity of the respondents was not protected in terms of health, privacy, nutrition, education and sanitation among others. UNICEF (2014) defined child poverty as a child who is deprived in two or more of the following basic child rights: nutrition, health, water, education, shelter, sanitation, information and protection. In addition, 53.4 percent of the respondents could not say that their dignity was protected or not.

Table 5: Dignity of Respondents

Zone Variable Dignity	Core	
	Freq.	(%)
Strongly agree	9	15.0
Agree	8	13.3
Cannot say	32	53.4
Disagree	11	18.3
Total	60	100.0

Source: Author's Fieldwork, 2019.

3.6 Leisure and Rest

Table 6 shows rest and leisure as one of the rights of the child. The ordinal scale used to examine this was interpreted as follows: "Always" means having time for leisure and rest often; "Rarely" connotes having time for leisure and rest occasionally; "Not at all" means not having time for leisure and rest. In the study area, children deprived

access to leisure and rest revealed 86.7 percent and those who had opportunity occasionally 13.3 percent. Furthermore, the study showed that some children did not have time for leisure and rest. This implies that 86.7% of the children were deprived of leisure and rest. This has negative effects on the child's total development. That is, the development of the child's personality,

talents and mental and physical abilities to their fullest potential. Note that a child has the right to play.

United Nations (2013) states that all children have a right to play. This universal right is enshrined in article 31 of the UN Convention on the Rights of the Child

(CRC). Article 12 of African Charter on the Rights and Welfare of the Child states that, “state parties shall recognize the right of the child to rest and leisure, to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts”.

Table 6: Rest and Leisure of Respondents

Table 3: Rest and Leisure of Respondents		
Zone	Core	
Variable	Freq.	(%)
Rest & Leisure		
Always	0	0
Rarely	8	13.3
Not at all	52	86.7
Total	60	100

Source: Author’s Fieldwork, 2019.

3.7 Access to Health Facilities

Findings revealed the proportions of the respondents who had access to health facilities in the study area. Children without access to any health facility revealed 70.0 percent and those that had access to health facilities 30.0 percent. Furthermore, children in hazardous work face risks to their health on a daily basis. If children are disabled through work, they have very, little chance of gaining any form of compensation, though their chances of a normal adult working life may have been ruined through the loss of a limb or permanent damage to their lungs. This, in turn, increases the risk of poverty and the discrimination associated with it. Sexually exploited children, as well as those in armed conflict and domestic work are particularly at risk in this dimension. They may be discriminated against and stigmatized on the basis of the exploitation they underwent.

House helps are often denied medical treatment when required since they are child domestics, and do not share the same status as the other children in the household. Children who suffer an accident at work may also feel that this is their own fault for being careless or bad at their job. In addition, work that is particularly traumatic may also cause mental problems for children, ranging from depression and low self-esteem to severe psychological disorders. Federal Government of Nigeria/UNICEF, 2001 in Lachman, (2002) opined that ignorance begets poverty and poverty begets ignorance in a vicious cycle that results in and is reinforced by ill health, vulnerability and voicelessness. Social exclusion and political marginalization compound the synergistic inter-relationship between poverty, ignorance, poor health, malnutrition, and mortality.

Table 7: Access to Health Facility

Variable	Zone	Core	
		Freq.	(%)
Access			
Yes		18	30.0
No		42	70.0
Total		60	100.0

Source: Author's Fieldwork, 2019.

3

3.8 Child Protection

Children not only have rights to health, nutrition and education, but they also have rights to protection, freedom from violence and exploitation, to “a safe and supportive environment”. Result in table 8 revealed the extents of child protection in the study area. Children being protected from any form of hazards revealed 25.0 percent and those that were not being protected 75.0 percent. Therefore, it can be deduced that these children are vulnerable to hazards.

Information gathered revealed that some of these children were not living with their biological parents. Note that a child's first line of protection is the family, for a full and harmonious development of their personality. Children are supposed to grow up in a family environment, in an atmosphere of happiness, love and understanding. Consequently, all institutions of society should respect and support the efforts of parents and other care-givers to nurture and care for children in a family environment.

Table 8: Protection of Respondents

Variable	Zone	Core	
		Freq.	(%)
Protection			
Yes		15	25.0
No		45	75.0
Total		60	100.0

Source: Author's Fieldwork, 2019.

3.9 Hygiene of Respondents

The study showed that hygiene in the study area is mostly fair, that is, 75.0 percent. The condition of hygiene that was examined to be bad had 15 percent. This is because of the environmental condition of the core. This zone exhibits characteristics such as poor

drainage system, poor waste management system and poor toilet facilities as revealed during the field survey. It can be deduced that the poor level of hygiene among deprived children could lead to diarrhea and related diseases that cause poor infant and child growth in the study area.

Table 9: Hygiene of Respondents

Variable	Zone	Core	
		Freq.	(%)
Hygiene			
Very good		0	0
Good		6	10.0
Fair		45	75.0
Bad		9	15.0
Total		60	100.0

Source: Author's Fieldwork, 2019.

3.10 Neglect of Respondents

Neglect is the most common type of child abuse. Not providing a child with adequate food, clothing or shelter to survive and to grow has important effects on the child's future and puts a child at greater risk of disease, infection, retardation or even death. Neglect also includes not providing access to health and educational services. Emotional neglect is also common and can have negative long-term effects on brain development and future mental health. Verbally, the deprived children affirmed that they were victims of some of these attributes of neglect.

However, table 10 shows the results of the neglect of children in the study area. Findings revealed that the children who agreed that they were strongly neglected as 38.3 percent, while those that could not say they were neglected or not accounted for 23.4 percent. It was observed that none of the respondents ascribed to the fact that they were not neglected. This suggests that the deprived children were not provided with adequate food, clothing, education, information, shelter and health care among others.

Table 10: Neglect of Respondents

Variable	Zone	Core	
		Freq.	(%)
Neglect			
Strongly agree		23	38.3
Agree		23	38.3
Cannot say		14	23.4
Disagree		0	0
Total		60	100.0

Source: Author's Fieldwork, 2019.

3.12 Maltreatment of Respondents

Results in table 11 show levels of maltreatment of the children. The ordinal scale used to examine this was interpreted as follows: "Always" means being maltreated often; "Rarely" connotes being maltreated occasionally; "Not at all" means not being maltreated. Children being maltreated rarely

revealed 63.3 percent and while those who were not maltreated accounted for 36.7 percent. The maltreatment as revealed by the respondents includes whipping, hunger, starvation, verbal abuse, farming, hawking and other forms of suffering untold. According to Kalpana, Suprakash, Bhat, and Prajakta (2017), child abuse is unfortunately

prevalent worldwide. It includes a plethora of physical, sexual, psychological, developmental, and economic violation or maltreatment targeted at an individual less

than 18 years of age. Therefore, this study concurs with the findings of Kalpana et al (2017).

Table 11: Maltreatment of Respondents

Variable Maltreatment	Core	
	Freq.	(%)
Rarely	38	63.3
Not at all	22	36.7
Total	60	100.0

Source: Author's Fieldwork, 2019.

3.12 Monthly Income of Respondents

The findings in table 12 showed the monthly income of the respondents in the core area of Akure. It revealed that 11.7 percent of the children earned less than ₦5,000 per month and 88.3 percent ₦5,000 to ₦9,000. In addition, the findings showed that poorer children are more in the high density area. One of the implications of this is that there will be more concentration of the destitute children at the city core.

Further investigation revealed that child labour is fundamentally a reflection of poverty and weak economic and social institutions. There is a strong negative association between poverty and the incidence of child labour. It showed that

children work for a variety of reasons, the most important being poverty and the induced pressure upon them to escape from this plight. Though the children are not well paid, they still serve as major contributors to family income in developing countries. Traditional factors such as rigid cultural and social roles in the study area further limit the educational attainment of the deprived children. These children are the objects of extreme exploitation in terms of toiling for long hours for minimal pay. Their work conditions are bad, often not providing the stimulation for proper physical and mental development. However, the monthly income of these deprived children is far below expectation and nothing to write home about.

Table 12: Monthly Income of Respondents

Zone Variable Monthly Income (₦)	Core	
	Freq.	(%)
Nothing	0	0
Less than 5,000	7	11.7
5,000-9,000	53	88.3
9,100-14,000	0	0
Total	60	100.0

Source: Author's Fieldwork, 2019.

IV. Conclusion and Recommendation

The study revealed the predicament of deprived children in child labour in the core area of Akure. The findings showed that there were more males than females among the deprived children and age cohort 10-14 years had the highest proportion of 53.3 percent. The respondents without formal education accounted for 56.7 percent (these are the children deprived of education) and 58.3 percent discriminated based on sex. Those whose dignities were not protected had 18.3 percent and 86.7% of the children were deprived of leisure and rest. However, many were deprived of health facilities, protection, good hygiene, neglected and maltreated. Therefore, the state of some of these children in the core area of Akure is far from the ideal. Findings of this study and indeed other studies have corroborated this. The problem exceeds the families involved to the government, town planners and decision makers. Beyond that, however, the condition of the majority of these children is problematic.

Since children are tender, fragile and just learning about the world, their living condition will profoundly influence almost all aspects of their lives. This puts a great deal of responsibility on the shoulders of planners, who need to balance a number of different issues in urban design to make this study area and other related areas more conducive for children. Some of the major issues that are critical to the creation and maintenance of a child-friendly environment within the core are accessibility, safety, green space and integration among others. The benefits of child-friendly environment design range from the promotion of healthier lifestyles to improving the quality of socio-economic interactions to the long-term sustainability of the environment.

In line with the findings of this study, the following measures are suggested as means of resolving the problems of child

deprivation and labour in Akure. There should be an improvement in the education system, wholehearted efforts to eliminate all forms of child discrimination and economic exploitation, access to health facilities, child protection, good hygiene, protection of child dignity, proper treatment and urban renewal among others.

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