MODELING THE EFFECT OF CHANGES IN THE PRICE OF CONSTRUCTION MATERIALS ON THE RATE OF DEV ELOPMENT IN ABUJA

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The ever increasing cost of building construction materials in Nigeria has been a major sour ce of concern to all the stakeholders in industry because of its overarching effects on infrast ructure development. Globally, persistent rise in the price of materials has been reported to have consequential effects on sustainable development. This study, therefore, determines to analyse the effects of an increase in the prices of construction materials on the rate of devel opment in Abuja. In order to achieve this, data were sourced qualitatively and quantitatively from Abuja using archival data, personal observations and Geospatial techniques which inv olve the use of Remote Sensing and Geographical Information System (GIS) to determine t he rate of development over the years. Some selected building materials were examined and compared with the rate of development. The growth rate for the period of study was based o n built-up area per square meter. The data were analysed using both descriptive and inferent ial statistical analysis, to determine the relationship between the increases in prices of select ed materials on the rate of development. The result of the research has shown that changes i n the prices of building materials have effect on the rate of development explaining an aver age 85% in the variation explained by the models. The changes in the built-up area and veg etation between 1990 and 2014 was found to be significantly high. The research has indicat ed that a reduction in the prices of building materials will lead to a significant reduction in t he cost of housing projects in order to improve housing affordability and sustainability. The study is expected to contribute largely to currently discuss and vision of Nigeria in achievin g sustainable urban development. It will also be of benefit to all the stakeholders in underst anding the essence of achieving sustainable growth through an effective price control mech anism.

Keywords: *Building materials, sustainable development and rate of development*

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47

INTRODUCTION

The Nigerian construction industry remains one of the major contributor to the nation's economy most especially in the provision of housing to the teeming population. This is because it involves housing construction which forms the fundamental requirement of a man due to its influence on his welfare, health and productivity (Agbola and Kassim. 2007; Akintunde, 2008). However, the ever increasing cost of housing construction in Nigeria has being a major source of concern to all the stakeholders in the industry because of its overarching effects on infrastructure development. The persistent increase in the cost of building construction is frequently traced to the upsurge in cost of building materials which are very vital in realising any housing project (Udegbe, 2007). For example, research (e.g. Arayela, 2005) has established that that the cost of building materials constitute about 65 percent of the construction cost. Ogunsemi (2010) and Adedeji (2010) resonate this assertion by positing that building materials constitute the major factors that limits the provision of housing and established that they account for between 50-60 percent of the cost of buildings.

As stated by Windapo, Ogunsanmi, and Iyagba (2004), the continuous and incessant increase in the cost of building materials may give rise to a serious shortage in housing provision with high number of both middle- and low-income earners being schemed out of the housing market for home ownership all over the country. Hence, one of the main problems, which this paper intends to examine, is basically how housing delivery and its sustainability is being affected by the changes in prices of building materials in the delivery of housing process. However, researchers such as Jagboro and Owoeye (2004) argued that persistent increase in the prices of building materials has magnifying impacts on the industry. Idoro and Jolaiya (2010) for example, established that quite a number of construction projects were often not completed on schedule due to the hike in prices of materials. Idoro and Jolaiya (2010) stressed further that many projects were not completed in time due to the cost of materials which has been on the increase perhaps on daily basis. The unfortunate trend in the building material supply situation is that demand has increased over the years while local production has diminished (Jinadu, 2004). For instance, production of cement requires a huge capital and considering high forex component coupled with the devaluation of Naira in the last two decades, it has not been possible to make significant investment in local manufacturing (Makoju, 1995). Therefore, material becomes an indispensable resource in the building construction sector as it account for a higher percentage total cost of building (Omange and Udegbe. 2000).

Although, the visible rate of development noticed in Abuja municipalities cannot be denied, but there is still a huge housing deficit considering the urban growth noticeable in the capital due to high cost of building materials and pervasiveness of unskilled or old labour (Okoruwa, 2014). Hence, the expected rate of development in terms of houses constructed cannot be achieved without a drastic reduction in the cost of building construction and its attendant costs which determines the cost of owning a house. In spite of the plethora number of studies that have examined the nexus between the cost of building materials as against the total cost of building in Nigeria, little or no research exist that explores whether there is a link between rate of development and prices of building material. Few studies that populated the literature

either identify causes of changes in the price of building materials or the consequences of the changes on project delivery (e.g. Jagboro&Owoeye, 2004; Mekson, 2008; Njoku, 2007; Oladipo& Oni, 2012). Hence, this study aims at examining the impact of changes in the prices of building materials on rate of development of urban centres- Abuja specifically.

Literature

Construction is the broad process for realising human settlement and the creation of infrastructure that support development (Du Plessis, 2007). This include the extraction and beneficiations of raw materials, and components, the construction project cycle from feasibility to the construction, the management and operation of the built environment'' (Du Plessis, 2007).The construction industry is generally responsible for the physical transformation or the development of the which makes the built very vital to socio economic development of the nation. Considering the relationship between construction industry and the national economy, it becomes necessary that the cost of construction be within the reach of the average citizen. Akanni, Oke and Omotilewa (2014) contended that building materials significantly contribute to the quality and cost of housing, as it forms part of the used for building right from foundation to roofing and finishes. Thus, the building materials industry considered as a vital contributor to the national economy of any nation as its output governs both the rate and the quality of construction work (Akanni et al:, 2014).

Building materials and rate of development

Rate of development here depicts urban growth with respect the built up area. In other words, it is referred to the growth that make use of land for the construction of buildings. Urbanisation is mainly caused by urban growth, which could be due to material population growth, re-classification of urban and rural system and rural-urban migration (Agbola 2002). The existing data has shown that the Nigerian population has been growing at an alarming rate. The urban centres and towns are rapidly growing and this has resulted in overcrowding, below standard buildings as well as inadequacies in infrastructural development in the urban areas (Onibokun, 1985). Also, availability of building materials at affordable prices have become a key hindrance and making housing ownership an herculean task to be accomplished by most people that desire to own a house. Ihuah (2015) argued that the consequences of not addressing issues, such as the increasing costs of developments resulting from the high costs of building materials means that housing provision is inadequate. Adedeji (2002) asserted that building materials constitute the largest single input in housing construction and viewed that the cost of housing is one of the major obstacles to the realisation of housing delivery in Nigeria as indicated by the efforts of successive government in the country. However, Federal Ministry of Lands, Housing and Urban Development (FMLHUD, cited in Ihuah, 2015), reported that persistence upsurge in the costs of construction materials may be as a result national macro-economic causes which often lead to high cost of development and the reciprocal which outside the scope of this paper. Ihuah (n.d) identified among other things, overdependence on imported building materials as one of the most vital factor leading to high cost of building material which in his view contributed to the obstacles in sustainability urban development in the study area. Mainly, the rate at which building material prices changes in Nigeria is surprising and this

has negative impact on the construction industry which often lead to lack of development due to change in the total construction cost, redesigning and modification with consequential effects such as abandonment of project; poor workmanship resulting from the use of inferior materials, and restrained innovations in construction methods (Elinwa&Buba, 1993; Windapo*et al.*,2004; Idoro&Jolaiya, 2010; Oladipo& Oni, 2012). This paper hence, argued that the rate of development is restricted by the continuous increase in the cost of building materials and that materials are unarguably responsible for the cost of any housing construction project.

The use of sustainable building materials for housing construction has substantial influence on rate of development and attention of home builders has been directed towards sustainable housing as it help in reducing the environmental impacts in terms of the extraction, transportation, processing, fabrication or installation, reuse, recycling, and disposing of these structure based materials (Austin 2012; Roux and Alexander, 2007). In addition, Ihuah (2015) asserted that the use of sustainable building materials can offer a reduced cost of maintenance over the entire life-cycle of the building, through improved energy conservation, enhanced occupant good health and increased productivity, lowering of costs related to changing space or shapes, and greater design efficiency (Austin, 2012; Isaac et al., 2010). Therefore, the merits of sustainable building materials can summarised to enormous as it leads to overall superior performance of housing in terms of some specific criteria. These criteria include the benefit of sourcing the materials locally; reduced cost of transportation including the environmental impact as well as thermal efficiency in meeting the occupants' needs and health considerations. Other benefits that can improve rate of development through the use of sustainable materials according to Roux and Alexander (2007) and Spiegel and Meadows (1999) includes financial viability; ability to recycle the building materials and the use of renewable resources; toxic emissions generated by the product and maintenance costs.

RESEARCH METHOD

This study focused on the rate of development of the Federal Capital Territory, Abuja, Nigeria and the total population of the study comprised of all the local area councils. Purposive sampling method was used in the selection of the study area. This is because non-probability technique according to Aje (2008) gives every subject in the study population a non-zero probability of being included in the sample and also gives a range of alternative techniques to select samples based on researcher's subjective judgment. Therefore, research approach for this study involves archival research method which is a type of primary research that involve seeking out and extracting evidence from original archival records. Archival research methods entail a wide range of activities applied to make possible the investigation of documents and textual materials produced by and about organizations (Ventresca and Mohr, 2001). The methods according to Ventresca and Mohr (2001), involve the study of historic documents produced at some point in the relatively distant past, giving us access and opportunity which researcher may not likely have to the organizations, individuals, and events of that earlier time.

Archival or secondary data comprises of a wide collection of empirical data compiled by some individuals for their own use were collected. The secondary data consist of building material prices over the period of 24 years and maps of the Area Councils. Cost of building materials were sourced from the National Bureau of Statistics and Builders' magazine while the maps of the area councils were sought from Federal Capital Development Authority. The building materials considered in this paper includes cement; sand, aggregate, reinforcement, blocks, aluminium and timber. The Geographic Information System (GIS) was used in obtaining primary data, which is the satellite imagery. The GIS was employed to obtain the rate of development (the built area) of all the six area councils in Abuja since 1990 to 2014. The collected data were analysed using descriptive statistics and regression analysis, conclusions and recommendations were drawn based on the finding thereafter. The software packages employed for the analysis of the imageries is Land Water Information System. The package was employed in the classification and processing of the image. The study used a classification which was supervised for all the imageries by adopting five parameters which includes: Built-up Area; Bareland/Surface; Vegetation; Cultivated and Water Body. The use of Geospatial methods were adopted in establishing the rate of spatial growth of all the six area councils in Abuja between 1990 and 2014, three imageries of 1990, 2000 and 2014 were obtained and processed using Thematic Mapper 30M resolution.

FINDINGS AND DISCUSSION OF RESULTS

This section presents the results, interpretations and discussion of results based on the analysis carried out. The descriptive measures were used to describe the characteristics of the sample based on the method used in gathering the data, to check if the research variables violate any of the underlying statistical assumptions required to address research questions and create a systematic understanding of the type of data and give a synopsis of the variables used as sample. From Table 1, it was shown that Bwari area council has the least mean growth rate ($237810432m^2$) followed by Abaji ($317496814m^2$) while AMAC has the highest growth rate of $790393388 \ m^2$. This increase in growth may be as a result of the university located in the neighbourhood which often drives housing developers in providing housing for the students.

Table 2 shows the results of the correlational statistics employed to show the pattern and nature of associations among the variables included in the analysis. The statistical tool was used to assists in determining the strength of the relationship between the variables which can exhibit either positive, negative or no relationship (Hair *et al.*, 2010). Statistical correlation was employed in this paper as an important step for further analysis such as the development of regression model(s) which will follow (Hair *et al.*, 2010). From Table 2, the correlation matrix showed that the coefficient (r) ranges from 0.012 to 0.907. Changes in the price of cement has a high correlation with the rate of development in Kwali (r = 0.846; p = 0.001), follow by Kuje (r = 838; p = 0.001). Kuje (r = 0.414; p = 0.001) and Gwagwalada (r = 0.403; p = 0.01) has moderate correlational relationship with sand according to Dancey and Reidy's (2011) who categorised a correlational relationship with a coefficient of 1 to be a perfect correlation; 0.7 - 0.9 as a strong correlation; between 0.4 - 0.6 to be is moderate; 0.1 - 0.3 is weak; and that a coefficient 0 means that no relationship exists at all. Similar

51

relationship exist between changes in prices of blocks, Kwali and Abaji. This may be as a result that those two local government are outskirt of Abuja where local income people resides and this invariable dictate the pace of development unlike the central area councils.

Table 1: Descriptive Statistics of material and rate of development

S/No		Mean	Std. Deviation	N
1	Cement	82954.16	73519.03	25
2	Sand	171847.64	190107.39	25
3	Aggregate	660754.60	787186.46	25
4	Reinforcement	399923.88	879556.96	25
5	Block	6103.80	5889.98	25
6	Aluminium	251398.20	252699.75	25
7	Timber	28606.00	20964.90	25
8	Kuje	596684702.00	128138296.53	25
9	Bwari	237810432.00	74412722.66	25
10	AMAC	790393388.40	254039772.28	25
11	Abaji	317496814.80	68585176.05	25
12	Kwali	366811060.00	153284830.63	25
13	Gwagwalada	346022146.80	122634405.15	25

Source: Author's Fieldwork (2015)

The summary of the results of regression analysis between the rate of development of the area councils and changes are presented in Tables 5. The models summary is shown in Table 5. Models 1, 2, 3, 4, 5 and 6 show considerably very high R square value of 90%, 90%, 88%, 89%, 89% and 89% respectively and these were significant at 0.01 level of confidence. The regression coefficient that is the values, one for each explanatory variable included in the equation, which indicate the strength and nature of relationship the explanatory variable has in relation to dependent variable ranged between 2 to 598 in absolute values. Changes in the prices of some selected building materials (cement, aggregate, blockwork and timber) exhibited positive and strong relationship with the rate of development in the study area. Changes in the prices of reinforcements also show the same positive effect except in Kwali area council. However, sand and aluminium show negative relationship to rate of development in some local councils (such as Kuje, Kwali etc.).

From the equations Table 3, the coefficient of correlation (R) which, according to Xiano and Proverbs (2005), measures the strength of a linear association is 0.95. This indicates that there is between 94-95% relationship between the dependent variable and the independent variables in all the models. The coefficient of determination (R^2) ranges 89 to 90% while the adjusted R^2 is 84-86% showing a high degree of fitness of the multiple regression model.

Table 2: Coefficients of the rate of development Models

Variables in the equation	Kuje Model 1	Bwari Model 2	AMAC Model 3	Abaji Model 4	Kwali Model 5	Gwags Model 6
(Constant)	438969122.11**	11706382.54**	458612472.37**	232864114.97**	207052317.71**	197556590.07**
Cement	334.796	246.126	570.202	179.015	598.405	197.195
Sand	-147.651	44.415	-177.090	-78.779	-232.491*	-136.143
Agg	46.295*	9.331**	94.705*	24.800*	34.637	54.567**
Rfmt	1.333	7.131	8.439	.921	-4.504	1.399
Block	16958.02**	2722.38**	29990.66**	9043.71**	20233.19**	17204.76**
Alum	-10.230	30.208	52.450	-4.969	-2.717	15.634
Timber	813.023	359.289	1842.919	440.955	215.681	347.610
R	.946	.948	.936	.945	.944	.942
R Square	.895	.898	.876	.893	.892	.887
Adjusted R Square	.851	.856	.825	.849	.848	.841
F Change	20.596**	21.334**	17.143**	20.208**	20.055	19.135

Source: Author's Fieldwork (2015)

The result of the GIS tools used is showing in Figures 1, 2 and 3 below indicate classified image representation of Land Use of Abuja between 1990, 2000 and 2014. The greenish area coverage is more compared to the pink colour areas. The state of land use coverage of Federal Capital Territory in 1990, 2000 and 2014 was generated from the supervised image classification of Land SAT Thematic Mapper 30M resolution. This indicates an increased in the pink mostly in Municipal area coverage as against the greenish colour area. The figures (1, 2, 3 and Table 1) showed that there was a considerable increase in the built-up area of the entire local councils with AMAC showing the highest increase. Urbanisation of Abuja accounts the increase in growth while human activities in the study area could explain the drastic reduction in the vegetation, bare area etc.
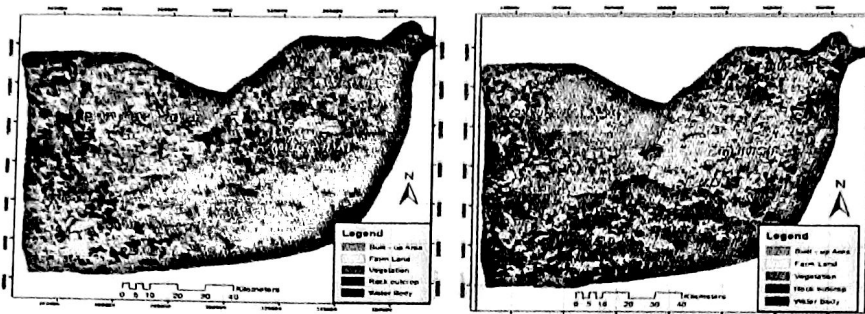
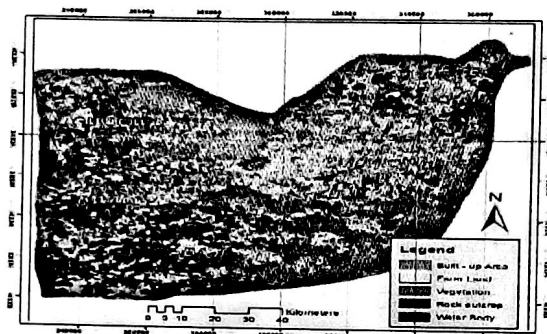Figure 1: Abuja Land use 1990Figure 2: Abuja Land Use 2000

Figure 2: Abuja Land Use 2000

The results of the analysis affirmed the position of previous researcher who agreed that the cost of building materials have significant impact not only to the construction industry but also to people aspiring to own houses (Anosike, 2009; Mekson, 2008; Mohammed, 2008; Njoku, 2007). Anosike (2009) illustrated that if a bag of cement valued at N1, 350.00 in 2006, goes as high as N1, 850.00 in 2009 means that 37% increment; and the price still soar up as high as N2, 000.00 in 2015 during peak season but now around N 1, 400. The position of these researchers corroborated the view of Jagboro and Owoeye (2004) who had earlier posited that increase in the prices of building materials has resonating effects on housing development.   Idoro and Jolaiya (2010) contended that many housing or construction projects were completed beyond and above cost of materials, which have been on the increase almost on daily basis. The findings on the rate of development is analogous to the findings reported by Adeleye (2015), who examined the consequences of urban growth in Suleja, a suburb of Abuja.

Table 2: Correlations between changes in the prices of materials and the rate of development (built up area)

	Cement	Sand	Agg	Rfmt	Block	Alum	Timber	Kuje	Bwari	Amac	Abaji	Kwali	Gwags
Cement	1												
Sand	.644**	1											
Agg	.169	.311	1										
Rfmt	-.109	-.011	-.199	1									
Block	.907**	.484*	.000	-.114	1								
Alum	.519**	.234	.131	-.314	.510**	1							
Timber	.324	.368	.430*	-.093	.328	.411*	1						
Kuje	.838**	.414*	.302	-.161	.880**	.515**	.484*	1					
Bwari	.822**	.444*	.353	-.184	.865**	.495*	.518**	.993**	1				
AMAC	.833**	.469*	.347	-.156	.854**	.553**	.530**	.983**	.977**	1			
Abaji	.837**	.415*	.303	-.159	.879**	.515**	.485*	1.000**	.992**	.984**	1		
Kwali	.846**	.338	.154	-.179	.909**	.517**	.349	.973**	.961**	.935**	.972**	1	
Gwags	.826**	.403*	.333	-.180	.866**	.533**	.454*	.990**	.989**	.978**	.989**	.972**	1

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Agg- Aggregate; Alum- Aluminium; Rfmt- Reinforcement;

Source: Author's Fieldwork (2015)

CONCLUSION

This study acknowledged that few studies have examined the causes of changes in the prices of building materials as well as their effect on the construction industry most especially in the developing nation's context. Most of the scholars have unanimous views concerning the influence of changes in the prices of building materials on housing construction. As a result, this study explored the impact of changes in the prices of building materials on the rate of development (built up areas) in Abuja area councils. The study covered the entire 6 local area councils in Abuja, Nigeria. The results of the analysis showed that there insignificant differences rate of development in all the area councils examined except Kwali with the incessant changes on prices of materials. These differences were noted on the changes in the prices of blocks and aggregate used as building materials in the area council. The result of the research has shown that changes in the prices of building materials impact on the rate of development explaining an average 85% in the variation explained by the models. The research has indicated that a reduction in the prices of building materials will lead to a significant reduction in cost of housing projects in order improve housing affordability and sustainability.

On a final note, the study is not without its limitations. The research only investigated the impact of building materials on the rate of development of 6 area councils in Abuja. The study did not considered the actual number of houses constructed within the period nor vertical sprawl but focused only on the built areas produced by the GIS. Therefore to generalise the result, further research is required into the factors that often lead to changes in the prices of materials and the effects of labour on the rate of development. Further research is also required to investigate the impact of the combine effects of labour, materials and macroeconomic variable on the rate of development in the local area councils studied.

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