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A Multivariate Analysis of Factors Influencing Green Space Provision in Residential Neighbourhood of Sub-Saharan African Cities

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Abstract
This research examines factors that influence the level of conformity to green space provision. Primary data was collected for three (3) types of residential neighbourhoods: Federal, State and Private. Reconnaissance survey revealed there are 8, 19 and 12 residential neighbourhoods respectively for Federal, State and Private. Ten (10%) of each were selected and thus, 1, 2, and 1 was selected for the Federal, State and Privately owned residential neighbourhoods. The total number of questionnaire that was administered on the household heads in the four (4) selected residential neighbourhoods was three hundred and thirty-two (332) but only three hundred and seven (307) was retrieved. Explanatory factor analysis was conducted on the perceived variables that could affect provision of green space.
Within the first component there exist similarities between all the three (3) variables that were highly loaded {residential density (0.832), nature of surrounding neighbourhood (0.825) and inadequate land (0.745)}. Each of them were related to the environment and thus the first factor affecting the provision of green space within residential neighbourhood could be regarded as physical and natural factors. On the other hand, the column for the second component had three (3) variables that were related to activities within the planning authorities (agency in charge of green space provision and compliance). These were, lack of working tools in planning authorities (0.856), lack of qualified staff in planning authorities (0.821) as well as inadequate number of staff in planning authorities (0.757). The third column represents factors relating to the government and it governmental, while the fourth and final component (factor) could be termed political factors. A near perfect structure of the variables emerged from the factor analysis and thus the reduction of the thirteen variables to four major factors. The study concluded that, better provision and care for green spaces within residential neighbourhood will require an effective policy framework, in which all decision-makers, can operate and work in collaboration.
Key Words: Cities, Green-space, Residential Neighbourhood and Sub-Saharan.

1. Introduction

Current trend in the built environment indicates that the need for more space to house urban residents is a global concern but more pronounced in the third world countries (United Nations, 2005). This is why cities in Africa are currently undergoing urban transition at an unprecedented scale and pace. For instance thirty years ago, only one West African city (Lagos) had a population of more than a million. On the contrary each of the major cities in Africa are now having populations above 1 million (UN-Habitat, 2003). The resultant effects of these are global destruction of flora resources, environmental pollution, climatic change, deforestation and depletion of the ozone layer, to mention but few (Vernon, 2002). These human actions rather than natural phenomena are the sources of most contemporary changes in the state and flow of the biosphere among other various issues threatening the environment today (Ifatimehin, Ishaya and Okafor, 2008). This is an indication that the sudden increase in urban population has led to expansion of physical development and invariably encroachment on or reduction of areas meant for green spaces. (Kessides, 2005 and Oluwafemi, 2010).
Urban green space adds many natural elements to the environment. It is provide for people's leisure in form of flowers and trees to beautify the landscape. In addition, the green space brings several important ecological service functions such as regulation of urban micro-climate, reduction of storm water runoff and conservation of carbon effect and energy. Furthermore, green spaces and greenery in other physical settings contribute to improved life spans of the elderly. Research findings suggested that green space development in areas where older members of the society live or work helps to promote uplifted spirits and more outdoor activities (Takano, Nakamura and Watanabe, 2002). Increase in residential area could also mean a reduction in areas left for green space within the metropolis. This is because, land is a fixed asset and its use can only change but cannot be

expanded. Even where reclamation is carried out, it is done with utmost difficulty, time consuming and capital intensive. This pressure on residential land use among other land uses has led to the development of lager percentage of residential areas for economic gain with little or no consideration for laws and regulations on open space, setback and green space within community centres, open areas and residential plots within the neighbourhoods. It is therefore imperative to study the extent of this scenario.

This research examines the provision of green space green space within the largest land use in urban area (residential use) in the most populated city in Sub-Saharan Africa. It aims at assessing the factors that influence the level of conformity to green space provision. This is with a view of understanding the physical planning implications of green space development on the residents. It posits that the relationships between green space and residential development should be empirically understood in research and academics. It foresees green space as an integral part of cities to attain comfort, convenience and healthy living. It is on this thrust that the study attempts to assess its provision within selected planned residential areas of Lagos metropolis.

2. Urbanisation and Environmental Changes

Urbanisation or Urban Drift is the physical growth of urban areas as a result of global change. Urbanization is also defined by the United Nations as movement of people from rural to urban areas with population growth equating to urban migration. The United Nations projected that half of the world's population would live in urban areas at the end of 2008, (The Associated Press, 2008). Urbanization is closely linked to modernization, industrialization, and the sociological process of rationalization. As more and more people leave villages and farms to live in cities, urban growth results. The rapid growth of cities like Chicago in the late 19th century and Mumbai a century later can be attributed largely to rural-urban migration. This kind of growth is especially commonplace in developing countries. The rapid urbanization of the world's population over the twentieth century is described in the 2005 Revision of the UN World Urbanization Prospects report. The global proportion of urban population rose dramatically from 13% (220 million) in 1900, to 29% (732 million) in 1950, to 49% (3.2 billion) in 2005.

In Nigeria the process of urbanisation predates the independent of the country. According to Mabogunje (1968), as of 1921, the country's population which was estimated at about 18.63 million, had about 1.35 million of the total population living in 29 cities. By 1991, over 40% of the about 100 million Nigerians live in urban areas (Odumosu, 1999). Urban development in Nigeria has been accompanied by inherent problems like; low level of liveability, poor municipal administrative system and lack of physical development plans to guide development among others.

The urban heat island has become a growing concern and is increasing over the years. The urban heat island is formed when industrial and urban areas are developed and heat becomes more abundant. In rural areas, a large part of the incoming solar energy is used to evaporate water from vegetation and soil. In cities, where less vegetation and exposed soil exists, the majority of the sun's energy is absorbed by urban structures and asphalt. Hence, during warm daylight hours, less evaporative cooling in cities allows surface temperature to rise higher than in rural areas. Additional city heat is given off by vehicles and factories, as well as by industrial and domestic heating and cooling units. (Simon, 2007). This effect causes the city to become 2 to 10^{o} F (1 to 6^{o} C) warmer than surrounding landscapes, impacts also include reducing soil moisture and intensification of carbon dioxide emissions (Simon, 2007).

3. The Garden City Concept

The Garden City idea originated from the works of Ebenezer Howard in the 19^{th} century. His theory was postulated to overcome the depressing ugliness, haphazard growth and unhealthy conditions of cities. Howard's proposal emphasized the integration of the town and the country side. Howard analysed in his book the reasons for people to move to the city or to the countryside. He found out that both have advantages and function as magnets. Therefore, his solution was to develop a city structure which contains the advantages of a city and those of the countryside. He used three magnets to explain is ideal. According to him, town (city) and country (village) are to be integrated to each other so that green nature with fresh air in the latter will suppress the depressing, ugly, haphazard growth and unhealthy conditions in the former. By implication, the green space would be provided in the city master plan for people to enjoy leisure and fresh air. In the contrary, what exists within towns and between rural areas and cities today is that natural resources including forests and water bodies are cleared or reclaimed respectively to create space for buildings and road system. That is why many millennium cities and towns still lack enough open spaces for leisure (Ward, 1992). In Howard's view, urban people need space and healthy environment to rest and spend leisure time after working for long hours.

Many of the Howard's idea were put in practice. For instance, Letchworth is located thirty-five miles from London with a total area of 3,822 acres[2]. A total of 1,300 acres of land has been reserved as a major component

of greenbelt for the uses of residents. It was designed for a maximum of 35,000 populations. In thirty years, the town had successfully developed into a garden city with the total of population of 15,000, with more than 150 shops and industries. The second garden city that successfully developed was Welwyn. The site is located 24 miles from London. The site have a land mass of 2,378 acres and it was designed for a population of 40,000. In fifteen years it had a population of 10,000 with fifty industries. Meanwhile, Howard's concept for the garden city was a means of controlling the growth of cities through the building of series of new towns physically separated from each other and from the parent city. The garden cities were to be self-contained for the needs of the people. The garden city has influenced many planners or the first group of new towns built in Britain after the Second World War.

The development of European Reserved Area (now known as Government Reserved Area – GRA) before independence in Nigeria was based on the Garden City theory (Adedokun, 1999). The areas were developed as a cool fruit and flower fit garden where residents can sit on a shady veranda in the privacy of the home. Extensive public fields were also developed near offices and homes, reached by shady pathway (Oduwaye, 2002). Olomola (1999) observed that in pursuit of government policy on the European Reserved Area (now GRA), houses were built around Race Course along Onikan, which later extended to present day Ikoyi. This created racial segregation in the settlement pattern of Lagos.

4. The Study Area

Lagos is considered one of Africa's fastest growing cities and Nigeria's commercial nerve centre. The greatest concentration of manufacturing and service industries in Nigeria occurs in the Lagos area owing to the distinct advantages offered by a seaport and international airport - as well as to its former role as Nigeria's capital before the capital was moved to Abuja. Lagos is the most important city in the Federation of Nigeria. It is the main city of Lagos State, which is situated in the southwestern coast of Nigeria (Aluko, 2011). The Metropolitan area of Lagos takes up to 37 per cent of the land area of Lagos State and houses about 90 per cents of its population (United Nations 1999). According to the preliminary results of the 2006 census, there are 7,937,932 inhabitants in Metropolitan Lagos (Federal Republic of Nigeria, 2007). This figure is lower than what had been anticipated and has created a controversy in Nigeria. The area of Lagos constitutes of two major regions: the Island, which is the original city and the mainland, which is made up by rapidly growing settlements. The climate in Lagos is tropical, hot and wet. The environment is characteristic as coastal with wetlands, sandy barrier islands, beaches, low-lying tidal flats and estuaries. The average temperature in Lagos is 27 °C and the annual average rainfall 1532 mm (Aluko, 2011).

5. Research Methodology

Primary data was collected for this research. This was through the administration of questionnaire on household heads in selected neighbourhoods. Three (3) types of residential neighbourhood: Federal, State and Private were identified. Reconnaissance survey revealed there were 8, 19 and 12 residential neighbourhoods respectively for Federal, State and Private. Ten (10%) of each were selected and thus, 1, 2, and 1 was selected for the Federal, State and Privately owned residential neighbourhoods. Three percent (3%) of the household head was selected from the 2311 household in Lekki Phase I (state) and 1434 in Victoria Garden City (private). This brings the number of administered questionnaire in the two neighbourhoods to 112 (3%). In the case of Abesan Housing Estate and Festac Town, there are 3498 and 11207 households respectively, out of which 221 (1.5%) was selected. The total number of questionnaire that was administered on the household heads in the four (4) selected residential neighbourhoods was three hundred and thirty-two (332) but only three hundred and seven (307) was retrieved. Explanatory factor analysis was conducted on the perceived variables that could affect provision of green space.

6. Discussion of Findings

Factor analysis identifies unobserved variables that explain patterns of correlations within a set of observed variables. It is often used to identify a small number of factors that explain most of the variance embedded in a larger number of variables. Thus, factor analysis is about data structure and reduction. Although, there are three types of factor analyses, namely exploratory factor analysis, confirmatory factor analysis, and structural equation modeling. However this survey adopted the exploratory factor analysis.

6.1 Residents' Responses on Factors Affecting Green Space Provision

Presented in Table 1 is the correlation matrix of factor affecting the provision of green space. The top half of the Table contains the Pearson correlation coefficient between all pairs of questions while the bottom half contains the one-tailed significance of these coefficients. It is important to eliminate multicollinearity (variable that is highly correlated with so many other variables) and singularity (variables without correlation with so many other

variables) in the data. In a nutshell, all questions in the data correlated fairly well and only view among the correlation coefficients are relatively large, and these cannot create multicollinearity and singularity in the data. The determinant listed in Table 1 which is a good measure for determining the level of multicollinearity and singularity is 0.002. This value was far greater than the necessary value of 0.00001.

Presented in Table 2 is the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity (Gorsuch, 1983). The KMO statistic varies between 0 and 1. A value of 0 indicates that the sum of partial correlation is large relative to the sum of correlations, indicating diffusion in the pattern of correlation (hence, factor analysis is likely to be inappropriate). A value closer to 1 indicates that patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors. The KMO for the data was 0.801. The Bartlett's measure tests the null hypothesis that the original correlation matrix is an identity matrix. For factor analysis to be adequate there is the need for relationships between variables. If *R*-matrix were an identity matrix then all correlation coefficients would be zero. Using a significant level of 0.05, the significant test confirms that the *R*-matrix is not an identical matrix; therefore, there were some relationships between the variables. For this data, Bartlett's test is highly significant ($p < 0.002$). See Table 2

In Table 3, the initial communalities which were the estimate of variance in each variable are one (1) in all components or factors. This is because principal component analysis works on the initial assumption that all variance is common. The communalities after extraction reflect the common variance in the data structure. Another way to look at these communalities is in terms of the proportion of variance explained by the underlying factors. The lowest in this regard was variable 22b (corruption within planning authority) where only 35.0% of the variance associated with this variable was common or shared across the selected residential neighbourhoods. Similarly, the highest level of common or shared communalities is on variable 22i (lack of qualified staff in planning authorities) with a record of 83.3% after extraction. For a reasonable representation of the variables it is expected that the communalities after exaction must be high. The average communalities as calculated from Table 3 is 0.676 (67.6%).

One important decision is the number of factors to extract. By Kaiser's criterion four factors are to be extracted (Gorsuch, 1983). However it is important to note that this criterion is accurate when there are less than 30 variables and the communalities after extraction are greater than 0.7 or when the sample size exceeds 250 and the average communality is greater than 0.6. (Field, 2005). This study satisfied the second conditions with an average of 0.676 communality after extraction and 307 sample size, thus four factor were extracted indicated as in Table 4

Presented in Table 4 were the lists of the eigenvalues associated with linear component (factor) before extraction, after extraction and after rotation. Before extraction there were 13 linear components (same number as the available variables). The eigenvalue associated with each factor represented the variance explained by that particular linear component and it is also represented in form of a percentage of variance explained. From Table 4, factor 1, 2, 3 and 4 explained 38.65%, 12.02%, 8.98% and 7.97% of the total variance respectively. All factors with eigenvalue above 1 were extracted and represented under the column ***extraction sums of squared loadings***. The values in this part of the Table 4 were the same as the values before extraction, except that the values for the discarded factors were ignored. The last column of Table 4 (***rotation sums of squared loadings)***, represented the eigenvalues of the factors after rotation. The rotation had the effect of optimizing the factors structure and one consequence for these data was that the relative importance of the four extracted factors was equivalent.

Before rotation factor 1 accounted for considerably more variance than the remaining three (38.65% compared to 12.02%, 8.98% and 7.97%). However after rotation, it accounted for only 20.326% of the total variance (compared to 18.499%, 17.407% and 11.375%). Together they accounted for almost 68% (two-third) of the variability in the original variables. Which suggested that four latent influenced were associated with provision of green space within the selected planned residential areas, but there were room for a lot of unexplained variations.

Often times in factor analysis it is possible to obtain factors that explained a large proportion of variance. This means that with factor analysis some variable load high on one factor and low on the other factor(s) and thus the need for rotation of the matrix. The rotated component matrix of the factors affecting provision of green space within the selected neighbourhoods is presented in Table 5. This Table explains the structure of the variables that has been studied and helps in the reductions of the variable into four factors. It is important to note that factors loading less than 0.4 have been suppressed and the output was sort by size as specified before running the analysis. Under the column for the first factor, there were four (4) variables, three (3) of which were highly loaded. Which were: residential density (0.832), nature of surrounding neighbourhood (0.825), inadequate land for green space development (0.745) and corruption within planning authority (0.480). Within the first component there exist similarities between all the three (3) components that were highly loaded, each of them were related to the environment and thus the first factor affecting the provision of green space within residential

neighbourhood as identified by household heads could be regarded as physical and natural factors within residential neighbourhood.

On the other hand, the column for the second component had three (3) variables that were related to activities within the planning authorities (agency in charge of green space provision and compliance). The variables were: lack of working tools in planning authorities (0.856), lack of qualified staff in planning authorities (0.821) as well as inadequate number of staff in planning authorities (0.757). In the column for the third factor, there are three variables among which two were much related. These are the first two variables in the column namely; cost of monitoring green space (0.809) and constant change in government policies (0.776). The column could be considered as governmental policies because; both variables were either directly or indirectly link to the government that is the financing body and regulator of the planning agency.

The fourth and final component (factor) could be termed political factor. This was because political influence by government (0.764) and activities of influential people in the society (0.588) were the top ranked variables under this factor. The score of the third variable under the fourth factors was approximately the same with the second variable (0.585 and 0.588 respectively). It could however be grouped alongside the third factor (governmental policies). A near perfect structure of the variables emerged from the factor analysis and thus the reduction of the thirteen variables to four important or major ones as already discussed.

7. Recommendations and Conclusion

From the findings of this research, some of the identified factors responsible for the non-provision of green space were inadequate facilities to aid work in planning authorities, lack of fund, non-availability of information on green space and lack of proper training for staffs of planning authorities. Furthermore, the laws on green space provision are weak and out dated. This has caused developers and residents to disregard the provision of green space and compliance with same even when they understand the importance of this land use. Another identified problem is the nature of land use in metropolitan Lagos. Land is very limited in Lagos therefore, land are often used for activities that will generate high income at short time. In the lighting of these mentioned identified problems, the research therefore recommends the following.

Practical application of planning laws that relate to green space has been difficult and challenging in metropolitan Lagos. It is therefore recommended that laws and regulations regarding compliance should be reconsidered (updated) to meet up with current day reality. For instance it is ridiculous to fine an offender N500, N1000 or even N5000 for breaching laws and regulations on provision of green space. The full weight of the law must be allowed to take its course on offenders without fear or favour. To improve the quality of knowledge on green space development in planning authorities, refresher courses for staff should be encourage. This will help town planners keep up with current trend on green space development in this century. It is equally recommended that planning authorities should be employ to make better provision for graduate entry from profession such as urban and regional planning, landscape planning and management, and landscape architecture in the planning authorities. This will help to place greater emphasis on provision of green space, managing recreational parks and urban agriculture (horticulture and vegetable garden) for public benefit.

In conclusion, better provision and care for green spaces within residential neighbourhood will require an effective policy framework, in which all decision-makers, can operate and work in collaboration. A more strategic approach is needed at the national level for improving co-ordination of national priorities and guiding local strategies for delivering networks of green spaces that benefit the whole communities and the nation at large.

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Table 1: Correlation Matrix of Residents' Responses

		a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**
Correlation	a	1.00												
	b	.287	1.00											
	c	.276	.468	1.00										
	d	.153	.360	.786	1.00									
	e	.157	.261	.482	.515	1.00								
	f	.298	.209	.260	.214	.437	1.00							
	g	.194	.290	.343	.390	.317	.503	1.00						
	h	.255	.336	.259	.269	.208	.286	.573	1.00					
	i	.208	.294	.280	.303	.133	.276	.607	.747	1.00				
	j	.296	.126	.115	.076	.119	.185	.225	.265	.381	1.00			
	k	.332	.283	.408	.430	.212	.188	.440	.430	.443	.339	1.00		
	l	.262	.323	.385	.376	.342	.233	.385	.384	.346	.240	.599	1.00	
	m	.210	.260	.271	.278	.229	.257	.344	.368	.367	.255	.474	.744	1.00
Sig.	a													
(1-tailed)	b	.000												
	c	.000	.000											
	d	.004	.000	.000										
	e	.003	.000	.000	.000									
	f	.000	.000	.000	.000	.000								
	g	.000	.000	.000	.000	.000	.000							
	h	.000	.000	.000	.000	.000	.000	.000						
	i	.000	.000	.000	.000	.010	.000	.000	.000					
	j	.000	.014	.022	.092	.019	.001	.000	.000	.000				
	k	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000			
	l	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		
	m	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	

a. Determinant = 0.002

Source: Author's fieldwork, 2012

KEY

a	Political influence by government	b	Corruption within planning authority
c	Residential density	d	Nature of surrounding neighbourhood
e	Inadequate land	f	Weak policy on green space
g	Inadequate number of staff in planning authorities	h	Lack of working tools planning authorities
i	Lack of qualified staff in planning authorities	j	Influential people in the society
k	Lack of cooperation by town planner/developer	l	Cost of monitoring green space
m	Constant change in government policies		

Table 2: KMO and Bartlett's test of residents' responses

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.801
Bartlett's Test of Sphericity	Approx. Chi-Square	1.804E3
	df	78
	Sig.	.0002

Source: Author's fieldwork, 2012

Table 3: Communalities of Residents' Responses

Factors Affecting Green Space Provision	**Initial**	**Extraction**
Political influence by government (22a)	1.000	.661
Corruption within planning Authority (22b)	1.000	.350
Residential density (22c)	1.000	.772
Nature of surrounding neighbourhood (22d)	1.000	.793
Inadequate land (22e)	1.000	.616
Weak policy on green space (22f)	1.000	.659
In adequate number of staff in planning authorities (22g)	1.000	.723
Lack of working tools planning authorities (22h)	1.000	.766
lack of qualified staff in planning authorities (22i)	1.000	.823
Influential people in the society (22j)	1.000	.521
lack of cooperation by town planner/developer (22k)	1.000	.643
Cost of monitoring green space (22l)	1.000	.780
Constant change in government policies (22m)	1.000	.682

Extraction Method: Principal Component Analysis
Source: Author's fieldwork,2012

Table 4: Total Variance Explained of Residents' Responses

Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
	Total	**Variance (%)**	**Cumulative (%)**	**Total**	**Variance (%)**	**Cumulative (%)**	**Total**	**Variance (%)**	**Cumulative (%)**
1	5.024	38.648	38.648	5.024	38.648	38.648	2.642	20.326	20.326
2	1.562	12.014	50.662	1.562	12.014	50.662	2.405	18.499	38.825
3	1.167	8.977	59.638	1.167	8.977	59.638	2.263	17.407	56.231
4	1.036	7.967	67.606	1.036	7.967	67.606	1.479	11.375	67.606
5	.959	7.378	74.984						
6	.779	5.989	80.973						
7	.631	4.854	85.828						
8	.488	3.751	89.579						
9	.422	3.246	92.824						
10	.316	2.434	95.259						
11	.225	1.733	96.992						
12	.211	1.626	98.617						
13	.180	1.383	100.000						

Extraction Method: Principal Component Analysis.
Source: Author's fieldwork, 2012

Table 5: Rotated Component Matrix[a] of Residents' Responses

Variable	Component			
	1	2	3	4
Residential density (c)	.832			
Nature of surrounding neighbourhood (d)	.825			
Inadequate land (e)	.745			
Corruption within planning Authority (b)	.480			
Lack of working tools planning authorities (h)		.856		
lack of qualified staff in planning authorities (i)		.821		
Inadequate number of staff in planning authorities (g)		.757		
Cost of monitoring green space (l)			.809	
Constant change in government policies (m)			.776	
lack of cooperation by town planner/developer (k)			.686	
Political influence by government (a)				.764
Influential people in the society (j)				.588
Weak policy on green space (f)				.585

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Source: Author's fieldwork, 2012.