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Article · April 2017

DOI: 10.1016/j.ijsbe.2017.03.008

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International Journal of Sustainable Built Environment (2017) xxx, xxx–xxx

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Spatial analysis of housing quality in Nigeria

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Received 26 May 2016; accepted 31 March 2017

Abstract

The study examined the factors responsible for the spatial variation in housing quality across the 36 states and the Federal Capital Territory in Nigeria using 33 housing characteristics. The data used are the 2006 Housing Characteristics and Amenities tables which were sourced from Nigeria's National Population Commission (National Population Commission, 2006). Principal Component Analysis extracted three components. Component 1 accounting for 38% has electricity, water closet toilet, hygienic sources of water and high quality roofing, walling and flooring materials highly loaded on it. Component 2 (31%) comprised inferior walling, roofing and flooring materials, pit toilet, traditional and semi-detached house types, while component 3 (7%) had mainly zinc wall and public toilet highly loaded on it. Using these factor loadings as variables in discriminant analysis, three distinct regions of differing housing quality emerged corresponding to the western, eastern and northern geographical regions of the country with 97.3% of the states correctly classified and with the western (high) and northern (low) states at the opposite ends of the quality scale. It is recommended that non-conforming buildings, particularly, residential, and insanitary environment should be put in check through very strict and proactive enforcement of development control edicts and sanitary laws.

Keywords: Housing quality; Spatial variation; Regional differentiation

1. Introduction

Housing quality studies can be justified because it is an indispensable, social and physical infrastructure whose quality and quantity, serves as an instrument for measuring the standard of living, the level of technological advancement, culture and civilization (Mbina, 2007). The problem of deficiency in housing quality in Nigeria is common both in urban and rural areas. The situation is very severe in urban areas due to the fact that most people live in houses that are poor in terms of quality with unsatisfactory environments. The population growth resulting from rural–urban migration and rapid urbanization is the cause which leads to homelessness, the growth of slums and overcrowding (Mabogunje, 1975; Olotuah and Adesiji, 2005; Lawanson, 2006; Adeleye and Anofojie, 2011).

Quite a lot of studies have been conducted in Nigeria on housing condition and quality with only few undertaken at the national scale. Comprehensive surveys both at local

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Peer review under responsibility of The Gulf Organisation for Research and Development.

http://dx.doi.org/10.1016/j.ijsbe.2017.03.008
2212-6090/

and national scales have also not been attempted as what exist are purely sample surveys which, of course, are subject to sampling errors. Furthermore, the majority of these studies are centred on urban area where interests in identifying slum areas within the cities have taken the centre stage. Some of the recent studies include correlates of housing problems in slum areas (Ekop, 2012; Ogunleye, 2013; Uwadiegwu, 2013), spatial structure of housing quality (Aderamo and Ayobolu, 2010) and perception of housing quality (Adeleye et al., 2014).

The work of Abumere (1987) is an example of studies carried out at the national scale. He studied 40 cities cutting across various Nigerian city typologies – traditional, non-traditional and modern cities, cities serving as state capitals, industrial and non-industrial cities, metropolitan, large, medium and small cities reflecting ecological conditions. He noted that as a result of low building technology and absence of durable building materials, no more than nine percent of the houses surveyed were built of mud and bricks which had very short life spans. He further observed that the only cities with a reasonable percentage of buildings older than 80 years were the coastal towns located on sea and river ports and few other hinterland cities that formed contact points for colonial trade and administration. These cities include Sapele, Oshogbo, Kano, Owerri, Forcados, Bururtu, Calabar, Warri, Benin, Lagos, Ibadan, Onitsha and Asaba.

Another comprehensive survey with emphasis on rural areas across southern Nigeria was that of the Federal Ministry of Housing and Environment (1982) which observed a marked variation in the character and structure of rural settlement. The study noted that in some states like Imo, Anambra and Bendel (now Edo and Delta) states where it is often quite difficult to differentiate the rural areas from the urban centres the housing type, commercial structure and land use pattern in even the smallest rural settlements are quite similar to those of the urban centres. This is in contradistinction with the south western states of Ogun, Oyo, Ondo and Lagos, where rural settlements are in many respects different from urban centres. These differences are attributed by the report to the traditional social organization of the people in the two groups of states.

In terms of quality of total housing stock in the country, NISER (2005) estimated that as at 2000, the proportion of housing units with sound structure (44.5%) was less than half of the total stock in the country. These findings have been corroborated by a micro study at Yenagoa by Ede et al. (2007) who concluded that only 9% of the houses surveyed are older than 21 years yet only 14% are well maintained and need no repairs.

From these studies, certain factors begin to emerge which are germane to explaining the spatial variations of housing quality across Nigeria and these include age, quality of building materials, location, early contact with colonial administration, maintenance culture and socio-cultural factors.

The Principal Components Analysis (PCA) has been employed to construct environmental quality index, extract factors to explain housing quality and spatial distribution over space. In their study in Ilorin, Nigeria, Aderamo and Ayobolu (2010) identified five most important factors that can be used to describe housing quality in Ilorin. These are internal facilities; major materials for roofing and materials for external walls; the type of toilet and bathroom facilities available and if the centrally provided electricity by the Power Holding Company of Nigeria (PHCN) is available.

The type of variables included in housing quality analysis varies across studies and this depends on the focus of study. The literature contains various environmental quality studies. It is remarkable that researchers have been focussing on three main areas when examining environmental quality as it relates to housing and its environment. The first area is examining the relationship between environmental quality of housing areas and users' well-being, the second is by focusing on housing and its environment via user satisfaction and perception while the third is concerned with environmental quality as a factor in housing price structure (Alkay, 2009).

Studies that belong to these groups include housing and sales prices (Alkay, 2009), housing and inequality in socio-economic characteristics (Odoi et al., 2005; Owens, 2012), Environmental quality and malaria and diarrhoea mortality (Fobil et al., 2011), public housing and users' satisfaction (Ojo and Oloruntoba, 2012) and urban environmental quality and human well-being (Pacione, 2003), among others. Yet, there are other studies concerned with measuring housing quality or deterioration alone (Fiadzo, 1982; Bunch, 1996; Craig et al., 2001; Khatun, 2007).

Consequently, variables used range from flooring, walling and roofing materials to type of toilet facility, sources of water and lighting, drainage, street quality, proximity to other facilities and socio-economic variables like education, income, religion and race. This current study examines the physical quality of houses and their distribution across the states and regions in Nigeria in the light of comprehensive data provided by the 2006 housing and amenities survey by the National Population Commission as opposed to opinion surveys typified by Anofojie et al. (2014) study of Lagos. The aim is to identify the underlying characteristics of housing that account for the spatial housing quality distribution in Nigeria.

The objectives of this study are threefold. First, the attempt was to identify the various dimensions that account for the distribution of housing quality in Nigeria using the method of Principal Component Analysis. Second, the study examined how the housing quality varies across the states based on the extracted components and finally the regional clustering, pattern that emerged based on the housing quality analysis was identified.

Please cite this article in press as: Morenikeji, W. et al. Spatial analysis of housing quality in Nigeria. International Journal of Sustainable Built Environment (2017), http://dx.doi.org/10.1016/j.ijsbe.2017.03.008

2. Methodology

The study relied on the 2006 Housing Characteristics and Amenities tables released by the Nigeria's National Population Commission (National Population Commission, 2006). The table provided the statistics on housing characteristics on the State and Local Government Areas (LGA) basis. For the purpose of this study, the data on the 36 states and the Federal Capital Territory (FCT) in Nigeria were extracted. Data used included the housing characteristics with weighted scores shown in Table 1:

The 37 (states) by 33 (variables) data matrix was subjected to Principal Factor Analysis (PCA) with varimax rotation. The PCA is a data reduction technique which has been widely used in multivariate analyses. As observed by Alkay (2009), PCA lends itself, among other things, to abolishing the dependent structure between variables, to separately show the dimensions that affect changeability in a data set and provides opportunity to separate variables into components.

Factors extracted are then saved as scores in the matrix table and the loadings of each state on each factor is observed and mapped. It is hypothesized that states located in each broad geographical zone (northern, western and eastern Nigeria) will closely exhibit similar physical characteristics and will be distinctly different from states outside their geographical zone. Discriminant analysis was performed to achieve this.

3. Data analysis and interpretation

Tanagra statistical software (Rakotomalala, 2005) was used for the principal component and discriminant analyses while TinkerPlots software (Konold and Miller, 2005) was used for the graphics for its dynamic data exploration capabilities.

3.1. Extraction of the Principal components

Three components with Eigen factor of greater than or equal to 1.0 were extracted. Components 1, 2 and 3 account for 38%, 31% and 7%, respectively. Components 1 and 2 jointly account for 69% of the variances in the housing characteristics. The variables that load highly on

Table 1
Variables used in the analysis.

Variable	S/N	Parameter	Score
Types of housing Units	1	Detached	6
	2	Traditional	2
	3	Flat	4
	4	Semi-detached	5
	5	Letin	3
	6	Improvised (informal + others)	1
Material used for Floor Finishing	7	Earth	1
	8	Wood	2
	9	Cement	3
	10	Tile (tile + marble + terrazzo)	4
Material used for Wall Finishing	11	Mud	2
	12	Wood	2
	13	Stone	3
	14	Cement	3
	15	Zinc	1
Material used for Roof Finishing	16	Palm (thatched/palm + leaves/raffia)	1
	17	Wood	2
	18	Earth	3
	19	Zinc	4
	20	Tile (tile + slate/asbestos/cement/concrete)	5
Water supply for domestic use	21	Pipe in	6
	22	Pipe out	5
	23	Vendor	2
	24	Well	3
	25	Borehole	4
	26	Pond (river/stream/spring + dugout/pond/pool)	1
Toilet facility for household use	27	Water Closet	3
	28	Pit	2
	29	Public	2
	30	Bush (bush + others)	1
Waste disposal method	31	Collected	4
		Buried	2
		Public site	3
Power source	32	Electricity	4
	33	Solar	3

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each component can be seen in bold fonts in Table 2. Thus, Component 1 is characterized by houses with electric light, water closet toilet, good sources of water supply and high quality roofing, flooring and walling materials. Consequently, Component 1 can be labelled "high quality housing". Component 2 can appropriately be labelled as "poor housing quality" owing to the fact that the variables that load highly on it reflect poor quality. These variables include wood, earth, palm and mud materials (for roof, floor and wall), pit toilet, traditional compound and semi-detached house types. The third component with zinc wall and public toilet variables loading highly on it can intuitively be labelled "slumming". This component accounts for merely 7% and was dropped from the analysis.

The components scores were saved as additional variables on the original 37 × 33 matrix table used for the analysis. This was to make it possible to see how the states in Nigeria load on each component. From Table 3, Lagos, Rivers, Kano, Oyo, Ogun, Kaduna and Anambra loaded relatively strongly on high housing quality (Component 1) with component score greater than 2.0. The extreme case of Lagos (17.3) is clear being a modern and the economic capital of Nigeria that is now being developed as a mega city. On the other hand, states like Kano, Katsina, Jigawa, Bauchi, Kaduna, Borno and Zamfara load highly on low housing quality (Component 2). The extreme case of Kano with a component score of 10.98 also can be observed. Furthermore, Kano simultaneously loads highly on Component 1 (4.06). This can be explained by the fact that Kano state of which Kano city is the capital (a strongly dual city – ancient and modern) has been one of the oldest and historical states in the country which featured prominently during the trans-Saharan trade era and is witnessing rapid modernization process.

The pattern exhibited by the states on the two components is such that some states are both positive, or both negative on the two components while some are positive on one and clearly negative on the other. The position of each state on the two axes is best presented with a scattergram with Component 1 on the Y-axis and Component 2 on the X-axis as shown in Fig. 1.

The pattern that emerged is one in which all the states that load positively on Component 2 are located in

Table 2
Variables loading on the principal components.

Attribute	Axis_1	Axis_2	Axis_3
Electric light	**0.9827**	−0.00461	−0.03802
WC	**0.97772**	−0.08717	0.05974
Water Pipe out	**0.96639**	−0.05094	0.09243
Letin	**0.95996**	−0.09401	−0.12017
Tile roof	**0.95762**	−0.05241	−0.13525
Tile floor	**0.94176**	0.15953	0.17454
Flat	**0.93704**	−0.18095	0.16104
Cement wall	**0.93449**	−0.20166	0.10259
Cement floor	**0.92414**	−0.15753	0.16309
Water Pipe in	**0.87094**	0.28674	0.0931
Water from Vendor	**0.86997**	0.09667	−0.08307
Borehole	**0.77558**	0.00158	0.25188
Zinc roof	0.56667	−0.16266	0.50295
Pit toilet	0.50384	**0.72658**	0.06496
Well water	0.50353	**0.68232**	0.06544
Wood roof	0.0202	**0.96651**	−0.05969
Earth floor	−0.1875	**0.95229**	0.03561
Wood floor	0.04072	**0.94775**	0.05449
Mud wall	−0.21358	**0.93671**	0.05076
Traditional compound	−0.24657	**0.92264**	0.03667
Earth roof	−0.09752	**0.91043**	−0.11807
Semi Detached	0.1243	**0.90462**	−0.04215
Wood wall	0.09313	**0.90329**	0.18088
Stone wall	0.07288	**0.76764**	0.02335
Palm roof	−0.28957	**0.70997**	0.26425
Public toilet	0.00872	−0.04527	**0.86708**
Zinc wall	0.21755	0.4495	**0.76036**
Detached	0.32398	0.28651	0.52236
bush	0.07615	−0.04603	0.00214
pond	−0.17228	0.02079	0.20553
Imprvsed	0.414	0.22066	0.03208
Var. Expl.	11.75744	9.61879	2.25693
% Expl.	38%	31%	7%
Cum.%	38%	69%	76%

The bold values are variables that loaded highly on each factor. They enabled us to name the factors.

Table 3
Loading of States on the two major components.

S/N	State	Component 1	Component 2	Region
1	Lagos	17.260	−2.841	West
2	Rivers	4.462	−0.642	East
3	Kano	4.059	10.983	North
4	Oyo	3.241	−0.009	West
5	Ogun	2.209	−2.764	West
6	Kaduna	2.166	3.251	North
7	Anambra	2.053	−1.332	East
8	Delta	1.663	−0.764	West
9	Imo	1.223	−1.626	East
10	Edo	0.717	−2.767	West
11	Akwa Ibom	0.513	−0.489	East
12	Osun	0.283	−2.012	West
13	Enugu	0.235	−1.822	East
14	Katsina	0.181	6.889	North
15	Ondo	−0.114	−1.041	West
16	Abia	−0.289	−3.180	East
17	Borno	−0.329	3.164	North
18	Niger	−0.549	−0.012	North
19	Kogi	−0.706	−2.269	North
20	Jigawa	−1.139	4.921	North
21	Bauchi	−1.217	4.709	North
22	Cross River	−1.300	−1.463	East
23	Sokoto	−1.301	3.641	North
24	Ekiti	−1.393	−3.013	West
25	Kwara	−1.605	−2.744	North
26	Benue	−1.776	1.670	North
27	Fct Abuja	−1.911	−3.949	North
28	Plateau	−2.095	−0.854	North
29	Zamfara	−2.318	2.260	North
30	Adamawa	−2.356	0.216	North
31	Kebbi	−2.496	1.399	North
32	Bayelsa	−2.753	−2.469	East
33	Gombe	−2.790	−0.707	North
34	Nasarawa	−2.808	−2.436	North
35	Ebonyi	−2.813	−1.404	East
36	Yobe	−2.973	0.266	North
37	Taraba	−3.234	−0.756	North

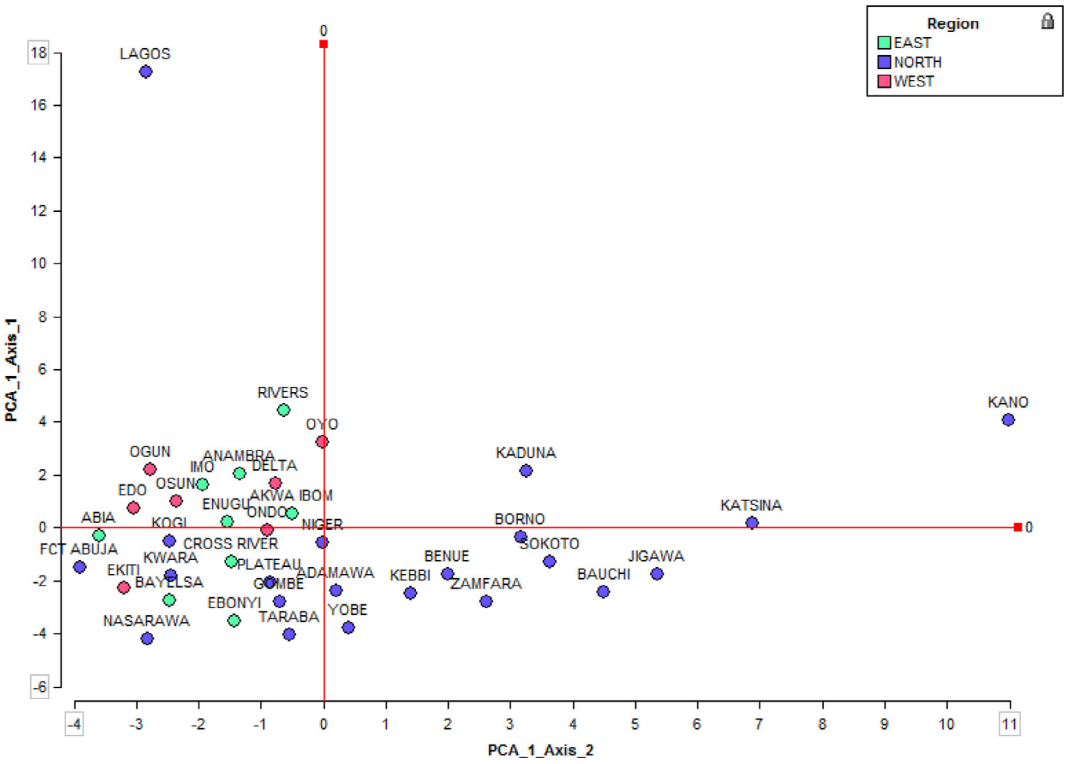

Fig. 1. Location of the States on the Principal Component axes.

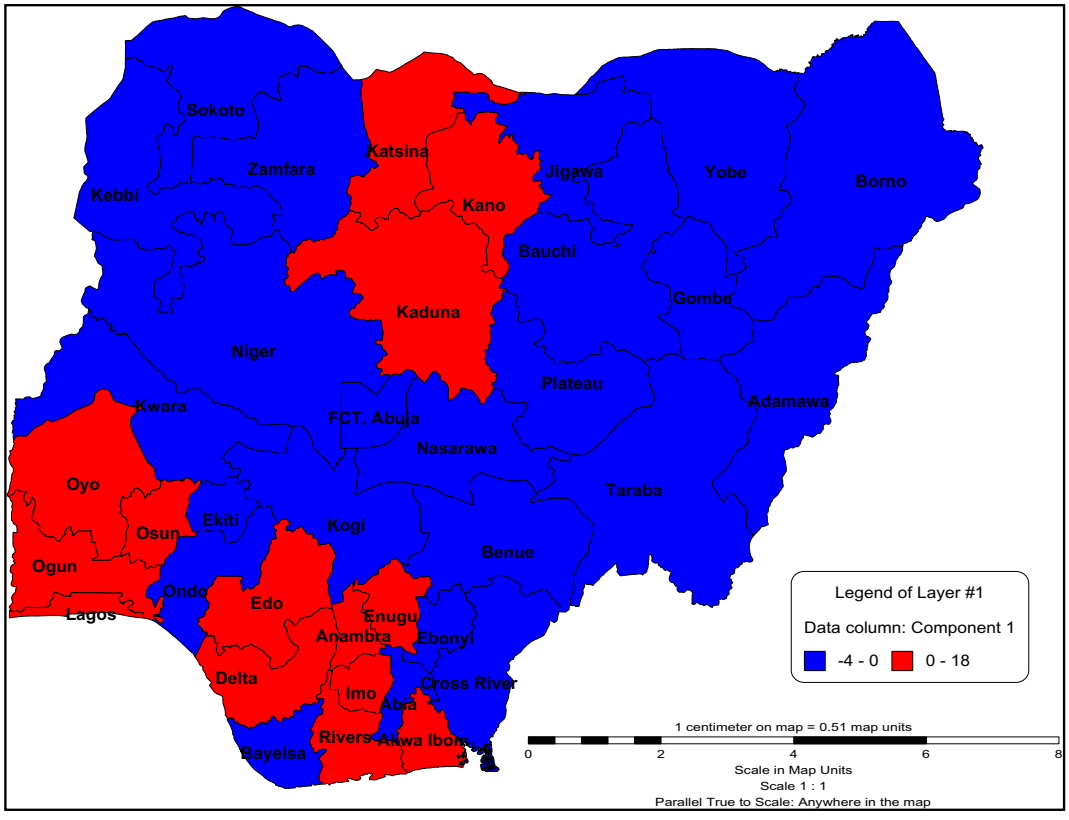

Fig. 2. Housing quality in Nigeria: Scores on component 1.

Table 4
Extraction of Canonical Discriminant Functions.

Function	Eigenvalue	% of Variance	Cumulative%	Canonical Correlation
1	6.992[a]	78.0	78.0	.935
2	1.978[a]	22.0	100.0	.815

[a] First 2 canonical discriminant functions were used in the analysis.

Table 5
Significance of functions extracted.

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.042	85.580	30	.000
2	.336	29.462	14	.009

Table 6
Functions at group centroids.

Code	Function	
	1	2
East	−2.802	1.853
North	2.337	.019
West	−2.690	−2.131

Unstandardized canonical discriminant functions evaluated at group means.

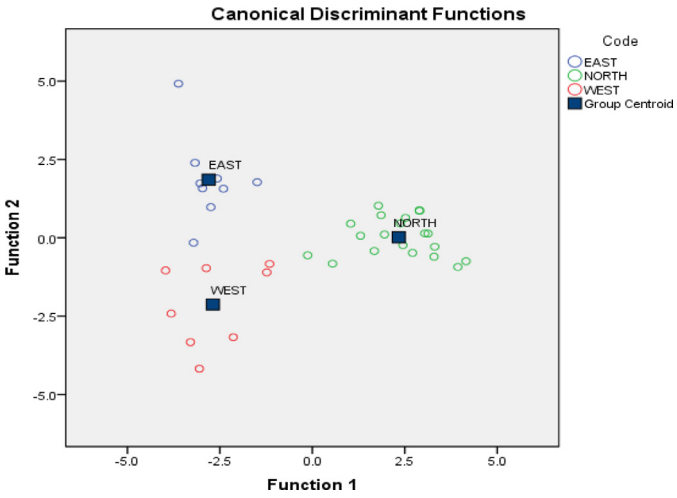

Fig. 3. Distribution of states around group centroids.

northern Nigeria. Indeed only three states from the North loaded on Component 1. Again, virtually all the states in South-West Nigeria, with the exception of Ondo and Ekiti states, load positively on Component 1 whereas all South-Eastern States are split almost equally between being positive or negative on component 1 only. The loading of each state on Component 1 is spatially displayed in Fig. 2.

3.2. Regional clusters

How homogeneous the states are within their three broad geographical regions of the country and how different each region is from the other regions in terms of these housing characteristics are the issues explored next. Each state was assigned to the geographical region to which it belongs and the regional location was used as the initial grouping variable for discriminant analysis.

The first function in Table 5 explains 78% of the between-class variations among the three regions and the second function 22%. Table 4 shows that with Chi-square value of 85.6 ($p = 0.000$) both functions are statistically significant. The centroids for the clusters of states in the Northern, Western and Eastern Regions are as presented in Table 6 and plotted in Fig. 3.

Fig. 3 shows the clustering of the states around their group centroid. The northern and eastern states exhibit a close knit clustering whereas the western states show a loose clustering indicating a wide variation in housing quality in the West.

The analysis correctly allocated 97.3% that is, 36 of the 37 geographical units into the three geographical initial regional grouping (Table 7) the only exception being

Table 7
Group membership prediction.

Code	Predicted Group Membership			Total
	East	North	West	
East	8 (88.9%)	0 (.0%)	1 (11.1%)	9
North	0 (.0%)	20 (100%)	0 (.0%)	20
West	0 (.0%)	0 (.0%)	8 (100%)	8

a. 97.3% of original grouped cases correctly classified.

Akwa-Ibom state that naturally belongs to the East but was found to be characteristically closer to the West in terms of housing characteristics.

While the closeness of Kwara and Kogi (North) with Edo and Ekiti (West) as graphically presented in Fig. 4 could be explained by their geographical proximity and law of spatial autocorrelation that of Akwa-Ibom (East) and Osun (West) is not easily explainable. While Akwa-Ibom is a coastal state, Osun is located in the hinterland and yet they are characteristically similar in terms of housing quality. It may be that the socio-economic development patterns in both states are similar in spite of spatial distance separating them.

4. Conclusion

This study has helped to identify the various dimensions that account for the spatial distribution of and differences in housing quality using Principal Component Analysis (PCA) method. They include types of housing units, material used for floor finishing, materials used for wall

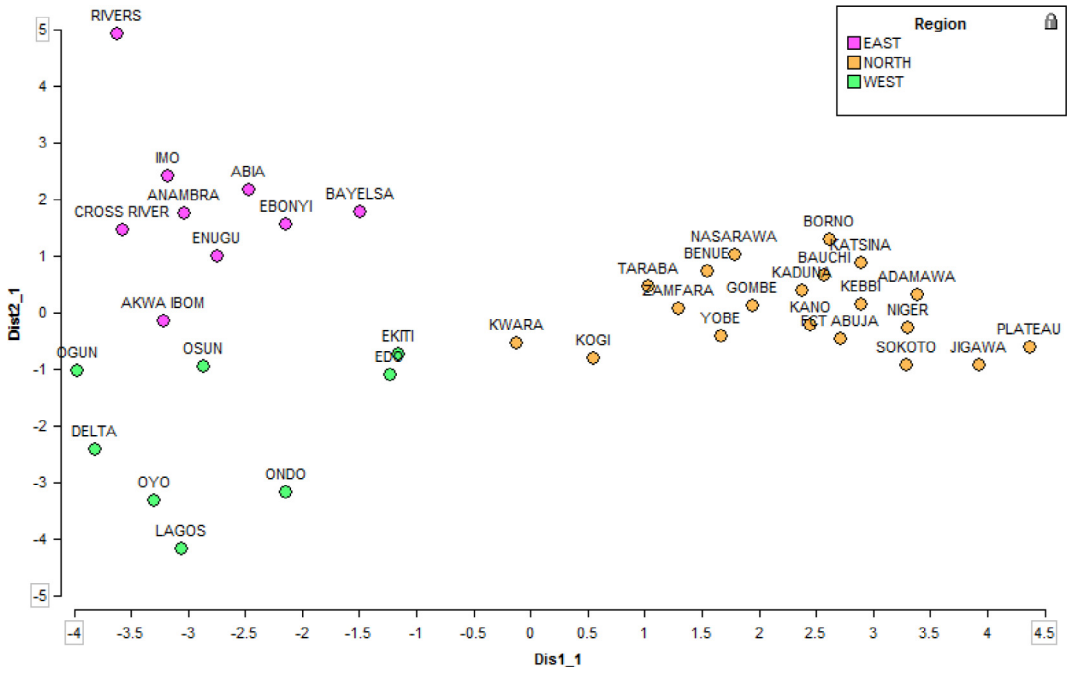

Fig. 4. Loadings of states on discriminant functions 1 and 2.

finishing, materials used for roof finishing, water supply for domestic use, and toilet facility for household use.

States like Lagos, Rivers, Kano, Oyo, Ogun, Kaduna and Anambra have a high housing quality with Lagos having the highest among them. The explanation to this is because these are the states that are more populous, economic and administrative activities are higher in those states unlike the remaining states that have a low housing quality. To a very large extent, because of the level of urbanization going on in the states, the planning authorities have taken measures to control the housing development which in turn have affected the housing quality. More so, the socioeconomic level of the inhabitants of these states is higher than that of the other states. The study has further helped to distinguished three clusters of marked differences in housing quality in Nigeria namely the northern, western and eastern states with the western (high) and northern (low) states at the opposite ends of the quality scale. As high as 97.3% of the states were correctly allocated to the three regions. Nevertheless, few of the underlying factors responsible for the low quality of houses in these regions are poverty level, high cost of building materials due to high inflation rate and poor enforcement of buildings byelaws and regulations.

5. Recommendations

The underlying factor responsible for people living in substandard houses with non-durable materials is poverty. Measures aimed at reducing poverty will have serendipity effect on housing quality hence the need for the Nigerian government to scale up poverty alleviation programmes implicit in the Sustainable Development Programme. Also, the government should consider subsidizing, just as it is being done in the case fertilizer, the cost of building materials, especially, cement, which price has increased from N1,600 in 2015 to N2,300 (43.75% change) in 2017.

Furthermore, the preponderances of non-conforming buildings, particularly, residential, and insanitary environment should be put in check through very strict and proactive enforcement of development control edicts and sanitary laws. Above all, slum upgrading and redevelopment as urban renewal strategies should be pursued to improve living conditions in the slum areas while at the same time, access to mortgage loans should be enhance by removing unnecessary and stringent conditions which have excluded the urban poor.

Individual author's contribution

Wole Morenikeji – Conceptualized the research, carried out the multivariate analysis.

Umaru Emmanuel – Extracted the data from the pdf to MSExcel and prepared the data in the right format for analysis. Contributed in writing the conclusion of the study.

Pai Halilu – a retired Director at the National Population Commission and contract lecturer facilitated access to the data and offered expert idea on the interpretation of Principal Component Analysis (PCA).

Jiya Solomon – carried out literature review and summarized the study that resulted in the abstract.

Idowu Owoeye – worked on the derivation of housing quality index and prepared the data for Discriminant Analysis.

Please cite this article in press as: Morenikeji, W. et al. Spatial analysis of housing quality in Nigeria. International Journal of Sustainable Built Environment (2017), http://dx.doi.org/10.1016/j.ijsbe.2017.03.008

Adeleye B.M. – Applied his knowledge of Geographic Information System to produce the map of spatial distribution of housing quality in Nigeria. He compiled the references.

References

Abumere, S.I., 1987. Urbanization and urban decay in Nigeria in urban renewal in Nigeria. In: Onibokun, Adepoju, Olokesusi, Femi, Egunjobi, Layi (Eds.), NISER/CURP Urban and Regional Planning Series, Vol IV.

Adeleye, O.A., Anofojie, A.E., 2011. Housing in Festac Town, Lagos State, Nigeria. Ife Research Publication in Geography 10 (1), 154–163.

Adeleye, O.A., Azeez, T.O., Yusuff, I.O., 2014. Perception of housing quality by residents and non residents of Ibara housing estate, Abeokuta, Ogun State, Nigeria. American Journal of Human Ecology 3 (3), 35–42. http://dx.doi.org/10.11634/216796221403586.

Aderamo, A.J., Ayobolu, D.F., 2010. Spatial structure of housing quality in Ilorin, Nigeria. Research Journal of Social Sciences 1 (5), 12–21, INSI net Publication.

Alkay E. (2009). The relationship between environmental quality level and housing sale.

Anofojie, A.E., Adeleye, O.A., Kadiri, M.A., 2014. Housing quality assessment in selected public residential estates in Amuwo-Odofin L.G.A. Lagos, Nigeria. Int. J. Res. Earth Environ. Sci. 2 (6).

Bunch, J.M., 1996. The physical ecology of slums in Madras: A GIS analysis of the 1986 survey of slums. Indian Geogr. J. 71 (1), 12–32.

Craig, A.M., Patricia, C.B., Fernando, R.B., Mauricio, L.B., 2001. Evaluating sanitary quality and classifying urban sectors according to environmental conditions. Environ. Urbanization 13 (1).

Ede, P.N., Andrew, E.E., Eleoke, C.C., 2007. Determinants of housing and neighbourhood quality for Yenagoa, Balyesa State of Nigeria. Journal of the Nigerian Institute of Town Planners XX (1).

Ekop, G., 2012. An assessment of the interrelationships among housing quality variable sets in calabar metropolis. Journal of Geography and Regional Planning 5 (14), 375–380.

Fiadzo, E., 1982. On the estimation of determinants of housing quality: the case of Ghana. Joint Centre for Housing Studies, Harvard University.

FMHE, 1982. Rural Housing in Southern States of Nigeria. Final Report jointly prepared by the Physical Planning & Dev Division of NISER and Faculty of Environmental Design and Management, University of Ife. jchs.harvard.edu/sites/jchs.harvard.edu/files/w04-6.pdf. Accessed 16th November 2015.

Fobil, J.N., Kraema, Alexander, Meyer, Christian G., May, Juergan, 2011. Neighbourhood Urban Environmental Quality Conditions are likely to Drive Malaria and Diarrhea Mortality in Accra, Ghana. J. Environ. Public Health.

Khatun, T., 2007. Measuring environmental degradation by using principal component analysis. Environment Development Sustainability 11 (2), 439–457.

Konold, Clifford, Miller, Craig D., 2005. TinkerPlots: dynamic data exploration. Key Curriculum Press; University of Massachusetts, Emeryville, Calif. [MA].

Lawanson, T.O., 2006. Challenges of Sustainability and Urban Development in Nigeria: Reviewing the Millennium Development Goals. Africa Insight (submitted for publication). http://scholar.google.com/scholar_url?url=http://www.academia.edu/download/22902400/print_-_2.doc&hl=en&sa=X&scisig=AAGBfm1oEDbjVCMXkRc4jnHPkXx-Gr5OhUg&nossl=1&oi=scholarr. Accessed on 8th February, 2016.

Mabogunje, A.L., 1975. Prolegomenon to urban poverty in Nigeria, in Poverty in Nigeria. In: Proceedings of the 1975 Annual Conference of the Nigerian Economic Society, 1975, pp. 69–91.

Mbina, A.A., 2007. Assessing the housing delivery services in Nigeria. In: Ekop, O.B. et al. (Eds.), Physical development of urban settlements in Nigeria. Development Universal Consortia, Ikot Ekpene, Nigeria, pp. 1–2.

National Population Commission, 2006. Housing Characteristics and Amenities Tables: 2006 Census Census Priority Tables (Vol. 2). Abuja, Nigeria.

NISER, 2005. Review of Nigerian Development (2003/2004): Public – Private Partnership in Nigerian Development. NISER, Ibadan.

Odoi, Agricola, Wray, Ron, Emo, Marion, Birch, Stephen, Hutchinson, Brian, Eyles, John, Abernathy, Tom, 2005. Inequalities in neighbourhood socio-economic characteristics: potential evidence-base for neighbourhood health planning. Int. J. Health Geogr. 4, 20, http://www.ij-healthgeographics.com/content/4/1/20.

Ogunleye, M.B., 2013. Analysis of the socio-economic Characteristics and Housing Condition in the Core Neighbourhood of Akure, Nigeria. J. Geogr. Reg. Plan. 6 (6), 229–236.

Ojo, I.C., Oloruntoba, K., 2012. Public housing provision and user satisfaction in Ondo State, Nigeria. British Journal of Arts and Social Sciences, 2046-9578 8 (1).

Olotuah, A.O., Adesiji, O.S., 2005. Housing poverty, slum formation, and deviant behaviour. Online Proceedings of the Housing Studies Association Conference, University of Lincoln, Lincoln, UK. 8–9 September 2005.

Owens, A., 2012. Neighbourhoods on the rise: a typology of neighbourhoods experiencing socioeconomic. Ascent City Community 11 (4), 345–369.

Pacione, M., 2003. Urban environmental quality and human wellbeing—a social geographical perspective. Landsc. Urban Plan. 65 (2003), 19–30.

Rakotomalala, R., 2005. TANAGRA: a free software for research and academic purposes. In: Proceedings of EGC', RNTI-E-3, vol. 2, pp. 697–702, 2005Tanagra Data Mining Software v. 1.4.50.

Uwadiegwu, B.O., 2013. The structural profile of the socio economic and housing problems of the slum areas in Enugu City, Nigeria: An Insider's Perception. Int. J. Eng. Sci. 2 (3), 08–14.

Please cite this article in press as: Morenikeji, W. et al. Spatial analysis of housing quality in Nigeria. International Journal of Sustainable Built Environment (2017), http://dx.doi.org/10.1016/j.ijsbe.2017.03.008