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Relationship between Road Distance Accessibility and Functional Index of Facility Occurrence in Lagos Island, Nigeria

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Abstract

The central aim of this paper is to find out the relationship between road distance accessibility and functional index of facility occurrence in Lagos Island, Nigeria. In particular it seeks to find out areas that have below or above average level of occurrence of facilities relative to the level of accessibility. Using both simple regression analysis and Pearson's Product

Moment Correlation Coefficient, it was found that no strong relationship between road distance accessibility and occurrence of facilities could be established (i.e. r = -0.14). Based on the findings, recommendations that would enhance equitable transport development in Lagos Island were proffered.

Keywords: Distance; road; accessibility; functional index; facility; Lagos Island

Introduction

It is essential to appreciate that the purpose of transport is to provide accessibility, or the ability to take a journey for a specific purpose. Transport is not consumed for its own sake, but it is merely a means to an end (a derived demand) (Hoyle and Knowles, 1992; Atubi and Onokala, 2004a, and 2004b).

However, studies of accessibility are more concerned with issues of efficiency and equity with respect to location of public facilities. An efficient location of public facilities is defined as that which gives the minimum total systems cost of operation and travel of a given level or volume of service. Equity in location of public facilities on the other hand is one which promotes greater equality of conditions (Rich, 1979; Chandra et al, 2000).

Thus in the U.S.A. accessibility studies in the late 1970's and 1980's seem to centre on or emphasis access to public facilities as observed in Lineberry (1977), couller (1980), Mclafferty and Gosh (1982) Rosenberg (1983) and Meyer (1995).

In Nigeria several studies on accessibility tend to be related to urban centres or urban based activities. Thus Weinnand (1973) in a study of development in Nigeria observed that spread effects of concentration of development are limited to the vicinity core areas while much of the periphery is virtually immuned to development impulses. This study is supported by other studies from other developing countries (Robinson and Salih, 1971; Gilbert, 1975; Atubi and Ali, 2006; Atubi, 2007a).

Other works on accessibility in Nigeria include Bardi (1982) and Abumere (1982). Both arrived at the conclusion that accessibility declined from the state capital of Benin-City to the peripheries of the state as well as accessibility of major centres to the bus transport services in Enugu (Ali,

1998) and accessibility and occurrence of public facilities in Lagos Island, Nigeria (Atubi, 2007a).

Study area

The study area is located within Lagos State. Lagos State is situated at the South-Western corner of Nigeria and is a coastal state. Lagos Island, which is the study area, is one of the 20 Local Government Areas in Lagos State (see Fig. 1). Lagos Island is the second largest urban complex in Nigeria after Kano and claims 2% of the nation's population on a less than 0.2% land area.

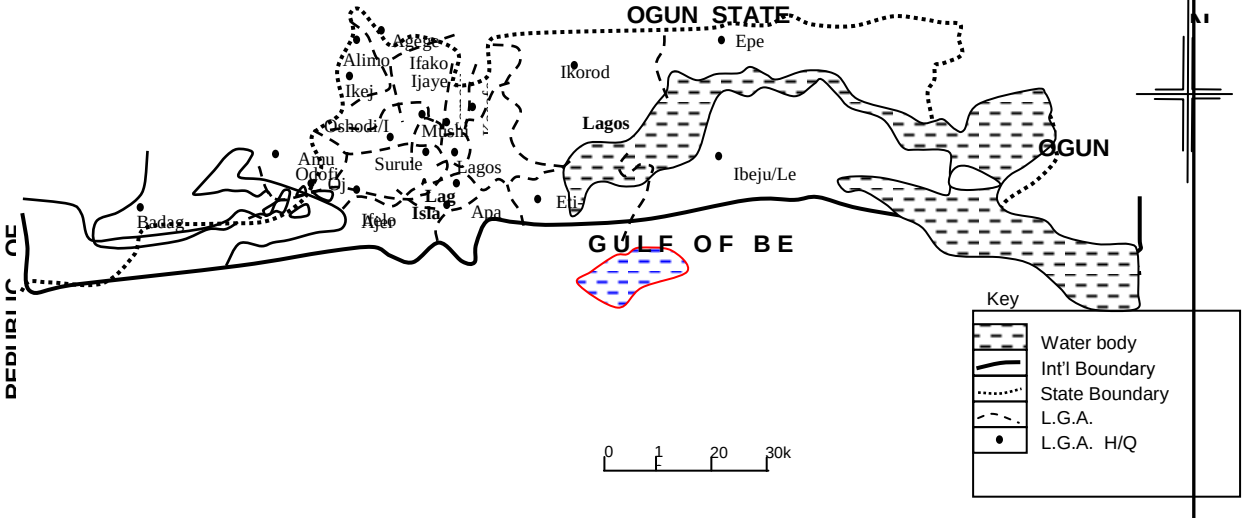

FIG. 1: Map of Lagos State Showing the 20 L.G.As and the Study Area
Source: Lagos State Ministry of Environment and Physical Planning (1999)

Methodology/materials collected

In developing the research design, areas that area accessible to the road network and with population of 1000 and above were taken as activity centres. The choice of nodes was therefore, based on population size. Based on the adopted operational definition of major centres, 30 major centres were identified (see Figure 3). In order to classify the major centres, data on six areas of central facility provision were collected namely: Medical, educational, market, postal services, banking and administrative headquarters. The choice of these facilities was based on the fact that they are capable of generating home-to-facility travels. Data on travel time and cost were collected both by personal observation and oral interviews.

To ascertain if a relationship exists between accessibility and functional indices of facility occurrence in the study area Pearson's Product Moment Correlation Coefficient Statistics (r) was employed.

Discussion of results/findings

Appendix 1 shows the calculation of the correlation between road distance accessibility and functional index. The correlation coefficient (r) is given as r = -0.14 which shows that it is negative and at 1% probability level is not significant (Appendix 2 and 3). The negative correlation coefficient shows that the greater the accessibility index value (hence the les accessible the centre is), the lower the level of facility occurrence. This is consistent with observations in the study area.

Although the coefficient of correlation proves insignificant at 1% level, it is important to approach the correlation with some caution as there is a tendency for large sample size to indicate high coefficient. We would rather say that the coefficient indicates that the association between accessibility and functional index is not strong. It was also observed that a good number of centres with low accessibility have high functional index and vice versa. Areas with the shortest road distance to all parts of the study area do not have more facilities. This is further discussed in analysis of residuals.

Meanwhile, the calculated regression equation is as shown in appendix 4. It is of the form:

$$\text{Log } (F_I) = 0.548 \text{ Log (RAI) } 1.897 \text{ - - - - - - (1)}$$

Where: F_1 = Functional index,

RAI = index of road distance accessibility

From the map of figure 2 it was observed that areas of positive residual, which mean areas that tend to have more facilities than the assumed level of distance accessibility, are widely distributed throughout Lagos Island: not all nodes with high level of accessibility have excess number or type of facilities. Rather it was observed that there are two areas of positive residuals. The first are those areas which have high accessibility indices and also correspondingly high functional indices. These are identified as II, III, IV and VI or Tinubu areas, Bamgbose, C.M.S. (New Marina) and Sand-Grouse areas respectively. the second are those areas with low accessibility indices but high functional indices relative to the surrounding centres. These are marked by I, V and VII. They are identified as Olowogbowo, Tafawa Balewa and Odulami areas respectively.

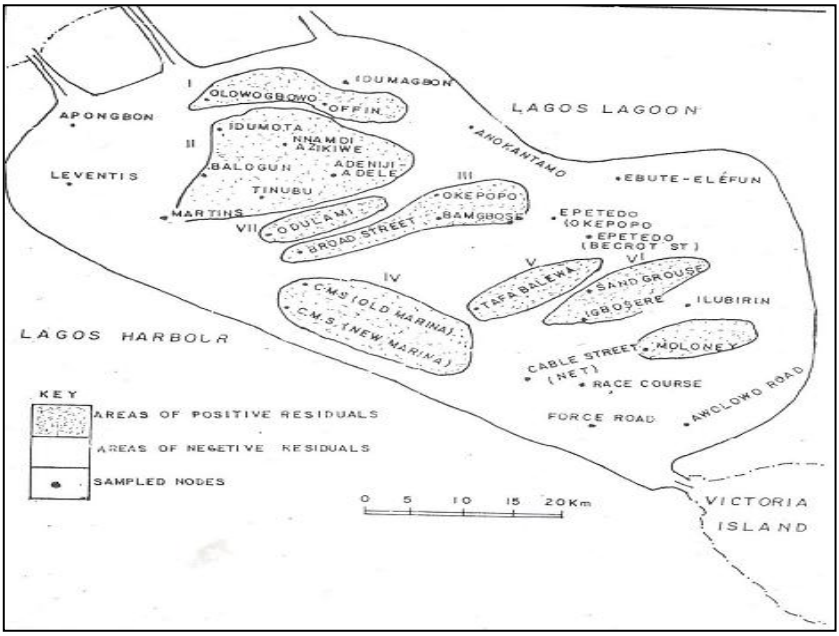

Fig. 2: Positive and Negative Residuals from the Regression of Functional Index on Accessibility

Within the first group it was observed that the network of roads is quite high and nodes are found at short distances from each other. Driving time within the centres in this group ranges from 3 minutes in Tinubu areas to about 15 minutes in Adele – Nnamdi Azikiwe axis. For these areas it may be plausible to say that high level of accessibility is a contributory factor in attracting the concentration of facilities. Thus, Broad Street with the sixth highest accessibility index also possesses a good number of first order facilities – specialist hospitals, a large daily market and commercial banks. The same may be said to some degree of C.M.S. (Old Marina) and Adeniji Adelel. For these centres, it may be said that accessibility indices establishment of facilities and establishment of facilities demands improvement of accessibility.

In the second group it was however noticed that there is a wide variation in levels of accessibility associated with positive residuals. This range from Offin (Ai = 313.7). Nonetheless we cannot say that road distance accessibility is an important factor in the establishment of facilities. This is especially true when we consider such centres in this area as Olowogbowo, Offin and Tafawa Balewa. Uniquely, Olowogbowo has the fourth greatest functional index both in number and type of facilities. Yet Olowogbowo is at the verge of the periphery of the study area. So its importance has not much to do with its accessibility to other parts of Lagos Island.

In the analysis of areas of negative residuals which indicate areas having less than expected level of facility occurrence, we also notice a wide distribution of centres throughout Lagos Island. In fact, the areas of negative residuals are around the areas of positive residuals. We have centres that are peripherally located marked by high accessibility indices such as Ilubiri (Ai = 258.7), Force Road (Ai = 293.4) and Race Course (Ai = 291.3) which have low indices of facility occurrence. This may look like neglect if we can consider distance accessibility alone. However, these centres have low population and this could account for the level of facility occurrence (See Figure 3 and Appendix 1).

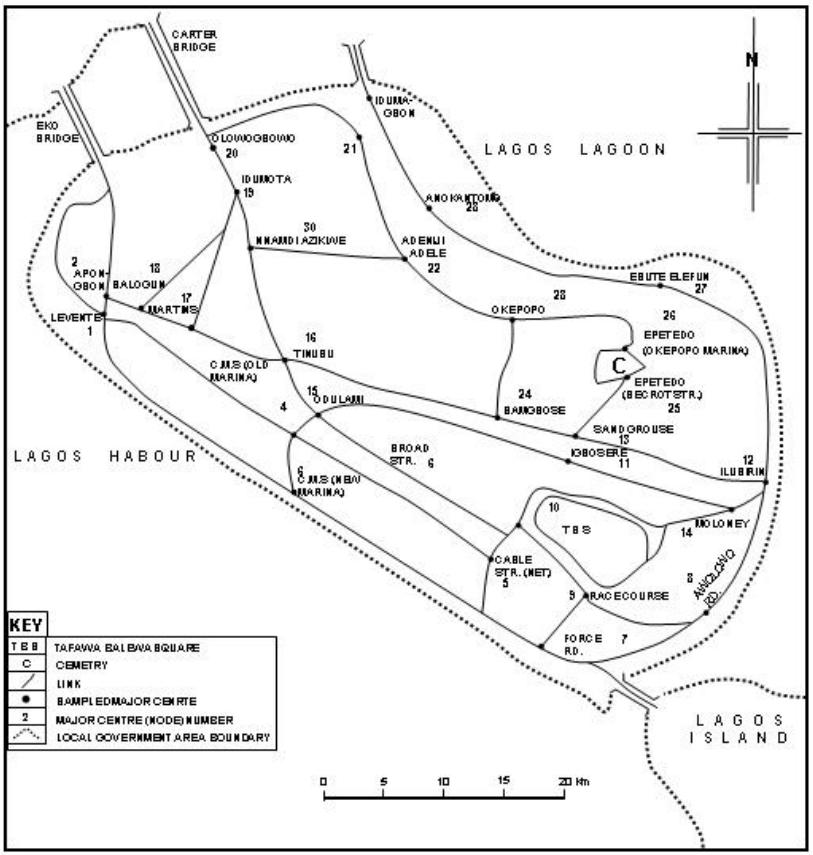

Fig. 3: Location of Sampled Major Centres in Lagos Island Local Government Area

Policy implications/recommendations

One strategy would be to provide those services which centres lack based on extensive surveys of what are available and what are needed. This centre based approach might prove more useful if the people are guided to choose out of their preferences.

To ease traffic flow along the routes, better road network characteristics must be ensured. For example, the roads have to be better connected to improve their accessibility, also roads have to be widened to more lanes to increase their carrying capacity and these are especially true for the routes headed to the Island. Better road network characteristics would not only lead to a faster flow of traffic along the routes, it would also make for a well structured road network system and also a faster pace at curbing congestion problem in the study area.

In a pilot survey it was found out in Idomota the major facility the centre desired was a commercial bank while at Nnamdi Azikiwe it was a hospital. In these centres the nearest commercial bank for Idumota is located at Martins street, and for Nnamdi Azikiwe the nearest hospital is located at Idumota providing them with these facilities would reduce the distance travelled to obtain these services. This suggestion can be achieved by purchasing structures on the ground. Moreover; landuse intensity here is quite high and this is marked by the great concentration of skyscrapers along these centres.

Conclusion

The strategy of constructing new links or expanding the width of the roads or increase the number of lanes to improve accessibility may involve heavier financial investment. Thus, a proper cost benefit analysis may be needed to determine the desirability of such investment as this would help to increase accessibility, reduce cost and time to other centres.

References

Abumere, S.I. (1982) "The Nodal Structure of Bendel State" *Nigerian Geographical Journal,* Vol. 25, Pp. 173-187.

Ali, A.N. (1988) *The Accessibility of Major Centres to the Transport Services in Enugu, Enugu State, Nigeria*. Unpublished M.Sc. Thesis, University of Nigeria, Nsukka.

Atubi, A.O. and Onokala, P.C. (2004a) The Road Network Characteristics on Traffic Flow in South Western Nigeria: A Case of Lagos Mainland. *Journal of Environmental Design and Management in the Tropics***,** Vol. 1, No. 1, pp. 39 – 51.

Atubi, A.O. and Onokala, P.C. (2004b) The Accessibility of Centres to the Road Networks: The Case of Lagos Island, Nigeria. *Journal of Ecology and Environmental Dynamics*, Vol. 2, pp. 140 – 151

Atubi, A.O. and Ali, A.N. (2006) The Development of Road Network and Accessibility of Centres in the Niger Delta Region of Nigeria. A Case of Warri Metropolis. *International Journal of Economics and Development Issues*, Vol. 6, No. 2.pp. 166-181

Atubi, A.O. (2007a) Network Accessibility and Occurrence of Public Facilities in Lagos Island, Nigeria. Journal of Geography and Planning Sciences, Vol. 1, No. 1, pp. 1 – 17.

Bardi, E.C. (1982) *Development of Road Network and Accessibility of Urban Centres within Bendel State of Nigeria 1967-1981: A Graph Though Approach*. Unpublished B.Sc. Essay. Department of Geography, University of Nigeria, Nsukka.

Chandra, B; susan, H; Kara, K; Hani, M; Quinglin, C and Lisa, W. (2000) Development of an Urban Accessibility Index: Literature Review. *Research Report Number*, 2-4938-1. Centre for Transportation Research: The University of Texas.

Coulter, P. (1980): "Measuring in Equality of Urban Public Services: A Methodological Discussion with Applications" *Policy Studies Journal*. Vol. 8, Pp. 692-706.

Gilbert, A. (1975) "A Note on the Incidence of Development in the Vicinity of a Growth Centre". *Regional Studies*, Vol. 9, Pp. 325-333.

Hoyle, B.S. and Knowles, R.D. (1992). "Rural Areas: The Accessibility Problem" In *Modern Transport Geography*, Longman House, Burntmill, Harlow England, Pp. 125-137.

Lineberry, R. (1977) *Equality and Urban Policy*. Sage, Berveley Hills.

Mclafferty, S. (1979) "Urban Structure and Geographical Access to Public Services "*Annals of the Association of American Geographers*, Vol. 72, No. 3, Pp. 347-354.

Mclafferty, S. (1982) "Reply to Kirby's Comment on Urban Structure and Geographical Access to Public Services" *Annals of the Association of American Geographers*, Vol. 73, Pp. 296-297.

Mclafferty, S. and Gosh, A. (1982) "Issues in Measuring Differential Access to Public Services". *Urban Studies*, Vol. 19, Pp. 383-398.

Meyer, M.D. (1995) *Alternative Performance Measures for Transportation Planning: Evaluation Toward Multimodal Planning.* Georgia Institute of Technology, Prepared for the US Department of Transportation, Report No. FTA-GA-26-7000.

Rich, R. (1979) "Neglected Issues in the Study of Urban Services Distribution: A Research Agenda" *Urban Studies*, Vo. 16, Pp. 121-136.

Robinson, G. and Salih, K.B. (1971): "The Spread of Development Around Kuala Lumper: A Methdology for an Exploratory Test of some Assumptions of a Growth- Pole Model". *Regional Studies*. Vol. 5, Pp. 303-314.

Rosenberg, M.W. (1983) "Accessibility to Health Case: A North American Perspective" *Progress in Human Geography*. Vol. 7 (1), Pp. 78-87.

Weinand, H.C. (1973) "Some Spatial Aspects of Economic Development in Nigeria" *Journal of Developing Areas*. Vol. 7, Pp. 247-263.

APPENDIX I

LOGARITHMIC TRANSFORMATION OF ACCESSIBILITY AND FUNCTIONAL INDICES DATA

Node No.	Accessibility Index (RAI)	Log (RAI) = X	Functional Index (FI)	Log (FI) = Y
1	336.8	2.52737	0	0
2	320.4	2.5056925	0	0
3	268.5	2.4289443	20	1.30102999
4	242.9	2.38542752	90	1.95424251
5	324.0	2.5117497	5	0.6989700
6	247.8	2.3941013	177	2.27797327
7	293.4	2.467460	0	0
8	300.5	2.4778445	24	1.38021124
9	291.3	2.46434049	16	1.20411998
10	275.7	2.44043677	50	1.6989700
11	262	2.41830129	20	1.30102999
12	258.7	2.41279645	5	0.6989700
13	252.8	2.4027771	42	1.6232493
14	256	2.40823997	17	1.2304489
15	212.4	2.3271545	10	1.0000000
16	214.1	2.33061667	27	1.43136376
17	246.4	2.3916407	34	1.53147892
18	263.3	2.42045086	15	1.17609126
19	268.7	2.42926767	40	1.60205999
20	291.4	2.46448955	61	1.78532984
21	313.7	2.49651452	31	1.49136169
22	266.2	2.42520805	70	1.845098
23	268.8	2.4294293	19	1.2787536
24	233.2	2.36772855	53	1.7242759
25	306	2.48572143	5	0.6989700
26	379.3	2.57898284	5	0.6989700
27	430.8	2.63427569	33	1.5185139
28	508.8	2.7065471	33	1.5185139
29	631.5	2.80037336	35	1.5440680
30	228	2.35793485	20	1.3010299

Σx	=	73,891818	Σy	=	37.4850939
Σx^2	=	182.316441	Σy^2	=	56.0592696
$\bar{x}$	=	2.4630606	$\bar{y}$	=	1.24950313
σx	=	0.1044547	σy	=	0.3955683
Σxy	=	92.08256785			

APPENDIX 2

Correlation between road distance accessibility index (rai) and functional index (FI)

Correlation Coefficient (rxy) is given as

Rxy =

$$rxy = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 . (\sum x)^2} \times \sqrt{n\sum y^2 - (\sum y)^2}}$$

$$= \frac{30 \times 92.0825679 - (73.8912)(37.435094}{\sqrt{30 \times 182.316441 - (73.89182)^2} \times \sqrt{30 \times 56.0592696 - (37.485004)^2}}$$

$$= \frac{-7.3648}{51.24410196}$$

= -0.1437 (Approximately -0.144)

Hence the correlation coefficient (rxy) between road distance accessibility and functional index is -0.144.

Test of significance for the correlation coefficient between rai and FI

The student's test is given by

$$t = \frac{r\sqrt{n-2}}{\sqrt{(1-r^2)}}$$

Where r = 0.14

n = 30

Hence $t = \frac{0.14\sqrt{28}}{\sqrt{(1-(0.14)^2}}$

$$t = \frac{0.741}{0.990}$$

= 0.75

Ho: There is no relationship between accessibility and functional index.

Hi: There is relationship between the two.

Table value n-2 degree of freedom

30 – 2 = 28

0.01 = 1 – 0.01 = 0.99

= 2.47

But t 0.01 < t calculated

Hence at 0.01 probability level we cannot reject Ho but state that there is no significant relationship between accessibility and functional index of facility occurrence.

APPENDIX 3

Calculation of single regression equation of functional index (FI) and road distance accessibility (RAI)

The regression of Y (Log FI) on x (Log RAI) is given by

$$y - \bar{y} = ryx \frac{(6y)}{(6x)}(x - \bar{x})$$ (Theakstone and Harrison, 1970, p. 90)

Where

Y	=	1.249
X	=	2.463
Oy	=	0.396
Ox	=	0.104
ryx	=	-0.144

Hence y – 1.249 = - 0.144 $y - \bar{y} = ryx \frac{(0.396)}{(0.104)}(x - 2.463)$

i.e Y – 1.249 = - 0.548 (x – 2.463)

y – 1.249 = 0.548 + 1.349

y = - 0.548x + 1.897

Hence regression equation becomes

Log FI = -0.548 Log RAI + 1.897.

APPENDIX 4

Calculation of standard error and confidence limits of the FI – RAI

Standard error of y on x (S.EY on x) is given as:

S.EY on $x = y\sqrt{(r - r^2)}$ for estimate of y.

S.E = 0.396 $\sqrt{1-(0.144)^2}$

S.E = 0.396 x 0.989

= 0.392

Hence at 68% coefficient limits or 1 (S.E) the regression equation would be:

Log FI = 0.548 Log RAI + 1.897 ± 0.39