The Effects of Road Quality on Commercial Land Use Pattern in Makurdi Urban, Benue State, Nigeria

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Abstract

This study examines the effects of road quality on commercial landuse pattern in Makurdi, urban, Benue State. The study investigated the road condition and the spatial pattern of commercial landuse change in the study area. The study was carried out considering the year between 2008 and 2014, to determine the variation in landuse pattern across the neighbour in relations to the road quality in the study area. The study employed field observation and measurements. The study area road map, layout plans for the years 2008 and 2014 were used for the analysis. The data required for the study was obtained from primary and secondary sources that provided baseline and subsequent information needed for the research. The population for the research consists of one hundred and twenty seven majors in the study area from which a sample of forty-four roads was drawn for investigation representing 36.6% of the population of the area. Multi-stage simple random sampling was used in sampling. The research analysed variation in commercial land use pattern due to road quality across neighbourhoods in the study area. The result shows that interaction effects between neighbourhood and road quality was not statistically significant, $F_{(8, 28)} = .432$, $p = 0.892$. There was significant effect for neighbourhood, $F_{(8, 28)} = 4.279$, $p = 0.002$ and road quality, $F_{(1, 28)} = 20.419$, $p = 0.0001$. The study revealed that road quality influence commercial land use pattern across neighbourhoods in the study area. The study recommended that mix use development be encouraged, more roads to link the neighbourhoods in Makurdi urban should be develop and adequate attention should be given to planning of commercial landuses in the area.
Key Words: Road quality, Commercial landuse, Pattern, Makurdi urban, Neighbourhoods.

Introduction

In the history of cities, transportation and land use have a close link. People settled in areas that are accessible by different modes of transportation available at each period of time. As settlements grew into clusters, there is need for better transportation facilities. Based on the new modes of transportation that became available, cities in turn developed. SRPC (2003) defines the framework for land use and transportation cycle based on form, function, land use and transport. The form implies the nature and structure while the function implies the level of its efficiency and effectiveness relating to landuse and transportation. Land use and transport are interlinked; so whatever affects land use also affects the transport policy. To have an efficient and effective transport system implies getting the land use planning right, and planning urban development implies getting the transport access right. In other words, the different policy spheres and disciplines have to work together to deliver the best results for the functioning of towns or cities. The purpose is to reduce the need to travel, the length of journeys and make it easier for people to access jobs, shopping, leisure facilities and services by public transport, walking and cycling.

The rapid economic development of a country depends on her concern for transportation. However, urban road network is developed to link land uses in the town and facilitates the movement of people/services, thereby allowing for social interaction. High quality road network connects key urban centres and isolated local communities for which many public transport options are limited or not

available. The growth of towns necessitated for improved road network development to cater for increased pedestrian and vehicular movements. Umoren, Sule and Eni (2011) reported that a good quality road infrastructure attract socio-economic development than a bad road condition. Their study revealed that Akwa Ibom State has a total length of 6288km of roads. A total of 1272.6km (20 %) constituted paved or tarred roads while about 5015.4km (80 %) constituted unpaved roads. The study revealed that a greater percentage of the roads in the area were unpaved and could not be used in all seasons, maintenance costs are high and they reduce the economic life of vehicle. The study further reported that a greater number of the roads in the study area are single lane and narrow. Potholes, depressions and sagging surfaces are common features on the roads that impede free flow of traffic. The study recommended that efforts should be made to increase the length of paved roads in the area to attract socio-economic development.

It is a known fact that as the economic activities expands in the city centre, it spills over to adjoining areas and these changes seem to occur in nearly all cities in Nigeria (Egbenta, 2010). The trend was observed in most towns/cities including Uyo, Lagos, Enugu, Calabar and Jos. Residential plots situated along major roads were fast disappearing; while commercial land uses had invaded residential areas fronting the major roads within residential zones.

The Calabar municipal land use had undergone a substantial level of change from residential use to commercial use with the latter becoming more prevalent. Eja, Nwachi, Sunday, Inah, and Ita (2011) examined the pattern of commercial land use pattern in Calabar, Nigeria. The study used questionnaire 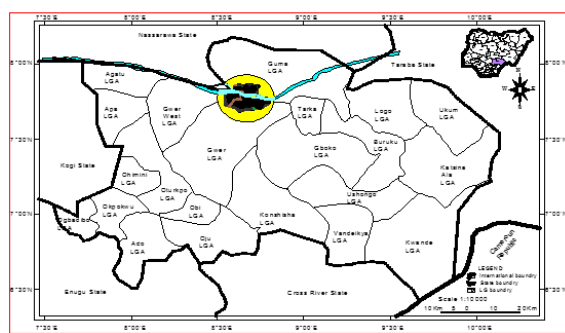to collect data on commercial land value and factors influencing the location of various land-use in the area. The study revealed that there is a positive relationship between commercial land use and rental value in the area.

The terms "invasion" and "succession," derived from plant and animal ecology is used to describe the processes of neighborhood population alteration. Weinstein (2007) explained the fundamental way one ethnic or racial group replaces another. A few people from one group invade a neighborhood inhabited largely by members of another group. The long-time residents begin to move out as the invading group move in, and in time the new group succeeds the old. According to Weinstein (1992), revealed long-time Coney residents who remained behind in the 1970s, unable or unwilling to move to a better neighborhood, needed no urban sociologist to quote Chicago School ecological theories to them. Competition for housing may result into conflict as the locals and the newcomers attempt to devise strategies to achieve their goal. If some accommodation between the locals and the newcomers is not conducive, one of the two groups will withdraw. If the newcomers withdraw, the invasion has been halted. If the established population withdraws, their departure coupled with the continued arrival of the new group will result in succession. Invasion and succession refer to change in land use or dominant activities in the neighborhood. The concepts of road network and commercial land use patterns, and invasion-succession theory are essential to guide the study towards attaining the stated objectives.

The study is aimed to assess the effects of road quality on commercial land use. The study will enlighten the policy makers of the need to formulate policies that will encourage maintenance of road network and re-zoning of some areas in Makurdi urban.

The Study Area
Makurdi, the capital of Benue state is delineated by sixteen kilometres radius with the centre of the town taken at a control near the post office. It lies between latitudes 7˚28' - 8˚00' North and longitudes 8˚28' - 8˚35' East (Shabu and Tyonum, 2013) as shown in Figure1. It is bounded by Guma local government in the north-east, Tarka local government in the east, Gwer local government in the south, Gwer-West local government in the west and Doma local government area of Nasarawa State in the north-west (Edan, Idowu, Abubakar and Aliyu, 2014).The town is traversed by trunk 'A' road that connects the southeastern parts of the country to the north. Makurdi has a total land area of about 820 square kilometres (Shabu and Tyonum, 2013). An assessment of the land use pattern in the study area indicated that the area comprises of residential, commercial, industrial, public space, public, recreational, transportation and urban agriculture landuses.

Figure 1: Makurdi on the Map of Benue state

The major roads also called primary or arterial roads are routes that carry long distance through traffic to specific areas in urban centers (Dauda and Lawali, 2014).

Arterial roads are the major road links in Makurdi urban. They handle large volumes of freight and passengers that traverse through the town.

Access roads are largely the neighbourhood street system. These roads are relatively free of through traffic and handle local traffic. These roads are required to provide a high level of safety and adequate access to neighbourhood services and facilities. Pathways are pedestrian ways and they are in the form of narrow accesses leading to individual premises. Vehicular traffic is restricted on the pathways. For the purpose of our investigation, major roads compose of arterials and collectors.

Methodology
The research design followed a multi stage framework covering survey analysis and interpretation of data. The data required for the study was obtained from primary and secondary sources that provided baseline and subsequent information needed for the research. The study employed field observations and measurements method in study area. The study area road map, layout plans for the years 2008 and 2014 was obtained from the Ministry of Lands and Survey, Makurdi and used for the analysis. The analogue Makurdi township map for the years 2008 and 2014 was obtained from Office of the Surveyor General of the Federation, Abuja. The purpose of selecting the above years for study was that the study area went through rapid road network development during the civilian administration that came to power in 1999. And therefore there was need to investigate how commercial landuse react to road network development in the study area. A Register of business premises was obtained from the Ministry of Commerce and Industries, Makurdi, for assessment of commercial landuse determined through

identification and measurement of commercial shop area cover in the study area. Other secondary data sources include available materials from scholarly sources such as textbooks, road transportation and other planning research journals, etc.

The population for the research consists of One hundred and twenty seven major roads in Makurdi urban from which a sample of forty-four roads was drawn for investigation representing 36.6% of the population in the study area. The sample for the study was drawn using a multi stage simple random sampling technique. The geographic coordinates on Makurdi road map was converted to Universal Transverse Mercator (UTM) coordinates for ease of computation then gridded into four quadrants and labeled 1-4 as shown in figure 2.
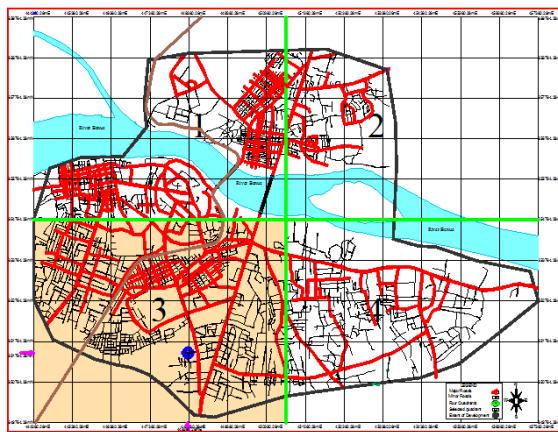

Figure 2: Makurdi Road Map Zoned into Quadrants

The Selection of the study location was based on quadrant sample location coordinate system using Excel spreadsheet approach. Random numbers for eastern and northern axes of the map were generated using Excel spreadsheet formula (Mathwave, 2015);

$$=RNAD() \qquad ... \text{Eqn. 1}$$

The generation of random numbers for east and north axes; =RAND() were 0.350763 and 0.172047 respectively. The sample location coordinates was derived using the formula (Wilson, 2007):

$$= RAND()*(high - low) + low \qquad \text{Eqn. 2}$$

To obtain quadrant sample location, the generated random numbers were used. Sample coordinate location for east axis was 0.305763(457380.28 − 444380.28) + 444380.28= 448355.20 mE. While for north axis; sample coordinate location was 0.172047(859764.18 − 849764.18) + 849764.14 = 851484.65 mN. The coordinates (448355.20 mE, 851484.65 mN) were plotted as shown in Figure 2 to determine sample location, and quadrant 3 was selected for study. The land use spatial pattern in Makurdi urban was assessed through the comparison derive by counting of tables on data generated in 2008 and 2014 approach. The total number of potholes, sagging and depressions on each road was used to assess the quality of each road, this was done by observation. The structural defects of each major road were counted and recorded. Road quality assessment was done using equation 3 as shown below.

$$Q = 1/n \qquad …\text{Eqn. 3}$$

Where; $\quad$ Q = road quality,

$\qquad$ n = number of structural defects (sagging, potholes and depressions),

$\qquad$ 1 = unity.

The scores were plotted on a model linear scale ranging from the minimum number (zero) to the maximum number (one). A benchmark was established at lower quartile. The road quality scores recorded below the benchmark of the model were classified as bad quality while road quality scores above the benchmark were regarded as good quality. The two-way ANOVA with the aid of SPSS software, which seeks to investigate the variation of commercial land use pattern due to road quality across the neighbourhoods in the study area was adopted in the analysis.

Results and Discussion

The selected forty-four roads were assessed to determine the road quality of the road network in the study area. The road quality assessment was based on the Road Quality Index (RQI) model derived by the researcher. The RQI has a benchmark that determines the road quality index for the roads in the study area. The benchmark is a point on the RQI model that determines whether the road was good or bad quality and expressed as follows:

Road Quality Range (RQR) = 0.50 – 0.03 = 0.47

Bench mark= 25% of RQR
= 0.12

If RQI < 0.12 = Bad Road Quality or
if RQI > 0.12 = Good Road Quality.

Twenty-six roads out of forty-four roads representing 59.10% were in good condition therefore are of good quality. Eighteen roads representing 40.9% of the roads in the study area were of bad quality.The study revealed that new bridge road, Iyorchia Ayu road, David Mark bypass, Abdullahi Shelleng road and Ishaya Bakut road in the study area have the highest RQI of 0.50 as shown on Table 1 below.The 2008 and 2014 land use in the study area was assess through a-screen digitisation of township maps as shown on Table 1.

The null hypothesis which states that "There is no significant variation in commercial landuse pattern due to road quality development across neighbourhoods in the study area" was tested. A two-way Analysis of Variance (ANOVA) was employed to investigate using SPSS Version 17. The application of the two-way ANOVA in this research was to compare the means of a single variable (commercial landuse pattern) at different levels of two conditions (road quality and neighbourhood) in the study area. The Levene's Test for a P-value significance of the analysis was 0.72. This value was more than 0.50, therefore, null hypothesis was rejected and the alternate hypothesis, which states, "there is significant variation in commercial land use pattern due to road quality development across the neighbourhoods in the study area" was accepted.The acceptance of alternate hypothesis provides adequate grounds for further investigation. The study area was divided into nine landuse categories: Wurukum, Ahule, High level. Old GRA, Ankpa quarters, Idye, Nyiman, Ankpa ward and Modern market. The interaction effects between neighbourhood and road quality was not statistically significant, $F_{(8, 28)}$ = .432, p = 0.892; therefore the main effect can be interpreted.There was significant effect for neighbourhood $F_{(8.28)}$ = 4.279, p = 0.002. From the (Neave, 1978) table of F-distribution, the table value for degree of freedom (28 under 8 at 5% level) is 2.27, therefore null hypotheses was rejected while alternate hypothesis was accepted. There was significant effect for road quality, $F_{(1, 28)}$ = 20.419, p = 0.0001.) From the table of F-distribution, the table value for degree of freedom (28 under 1 at 5% level) was 4.17, therefore null hypotheses was rejected while alternate hypothesis was accepted. This means that the good and bad nature of the road quality influence the commercial landuse pattern in the study area. Similarly, differences occur in commercial landuse pattern in the study area on the basis of neighbourhood.

The effect for neighbourhood and road quality provided in the Partial Eta Squired column are 0.550 and 0.442 respectively. Using Cohen's (1988) criterion, these effects are classified as large.This implies that the effects reach is statistical significance. The post-hoc comparisons indicated that the mean score for the Ankpa quarters, Ankpa ward, High level, Nyiman, and Wurukum differs significantly from one another as shown in Table 2 below.

Table 1: Road quality index and land use change by neighbourhoods

S/No.	Name of Road	RQI	2008	2014	Change	Neighbourhood
1	New bridge road	0.50	5.46	20.10	14.42	Wurukum
2	Abu King Shuluwa road	0.33	3.42	13.44	10.02	Ahule
3	Wurukum Market road	0.14	4.10	11.55	8.42	Wurukum
4	Gboko road	0.17	4.92	14.17	9.38	Wurukum
5	Onitsha street	0.08	3.53	9.50	7.28	Wurukum
6	Awe street	0.04	2.19	7.84	6.94	Wurukum
7	Iyorchia Ayu road	0.50	7.24	17.09	12.37	Wurukum
8	Amokachi lane	0.05	3.58	7.62	6.41	Wurukum
9	Konshisha street	0.14	5.39	18.37	12.92	High Level
10	Katsina Ala street	0.17	6.15	21.52	14.37	High Level
11	Abbatoir street	0.03	1.80	8.23	5.03	Wurukum
12	Conrad Welgba street	0.04	5.28	8.49	3.21	Idye
13	Ishaya Bakut road	0.50	3.86	8.21	4.35	Idye
14	Vandeikya street	0.14	5.13	17.09	11.96	High Level
15	Calabar street	0.04	5.84	12.92	7.08	High Level
16	Boniface Okoli street	0.06	2.34	3.35	1.01	Ankpa ward
17	Esther Acka street	0.25	4.36	8.57	4.21	High Level
18	Abdullahi Shelleng road	0.50	6.59	22.63	16.04	High Level
19	Balewa crescent	0.33	2.88	13.92	11.04	High Level
20	Kashim Ibrahim way	0.25	3.89	9.51	5.62	Old GRA
21	J S Tarka way	0.17	4.12	10.13	6.01	Old GRA
22	Ogiri Oko road	0.11	0.35	1.52	1.17	Old GRA
23	Joe Akaahan way	0.33	6.97	18.01	11.04	High Level
24	College crescent	0.05	0.85	3.21	2.36	Ankpa ward
25	Lawrence Onoja street	0.03	1.57	4.96	3.39	Ankpa ward
26	David Mark bypass	0.50	3.39	6.84	3.45	Ankpa ward
27	Edward Ujege street	0.20	6.80	10.69	3.89	High Level
28	Regina Agbese street	0.05	2.81	8.08	5.27	High Level
29	Iorkyar Ako street	0.20	3.62	13.06	9.44	High Level
30	Major Wende street	0.08	3.22	11.63	8.41	High Level
31	Ugbokolo street	0.17	3.62	8.89	4.91	High Level
32	Inikpi street	0.07	5.16	14.59	9.43	High Level
33	Jonah Jang crescent	0.14	4.98	10.15	5.17	Nyiman
34	Old Oturkpo road	0.10	6.15	15.58	9.43	High Level
35	Atom Kpera road	0.33	3.98	5.35	1.27	Ankpa ward
36	Jerry Agber street	0.14	6.77	13.46	6.69	Ankpa quarters
37	Jerome Hwande street	0.07	2.75	6.23	3.48	Ankpa ward
38	Simon Songo street	0.05	3.25	5.23	1.98	Ankpa quarters
39	Naka road	0.25	13.01	22.83	9.82	Ankpa ward
40	Simon Aondona street	0.07	2.15	8.60	6.45	Modern Market
41	Augustine Ezekwisili street	0.07	2.56	5.01	2.45	Modern Market
42	Ahmadu Comassie road	0.04	4.57	10.90	6.33	Modern Market
43	Dominic Oneya road	0.33	4.16	13.24	9.08	Modern Market
44	Sefanu Tor Sabo street	0.03	3.87	6.55	2.68	Modern Market

Source: Author's Fieldwork (2015)

Table 2: Post Hoc Tests Multiple Comparisons of Neighbourhoods.

Neighbourhood (I-J)	Mean Difference (I-J)	Std.Error	Sig. level (LSD)	Sig. level (HSD)
Ahule-High level	± 4.2860	1.97860	.039	NS
Ankpa quarters-High level	±6.9210	1.97860	.002	.036
Ankpa quarters-Wurukum	± 6.4063	2.07795	.005	NS
Ankpa ward- High level	±5.1960	1.20313	.000	.005
Ankpa ward- Wurukum	±4.6812	1.36034	.002	.041
High level- Idye	±5.5160	1.97860	.009	NS
High level-Modern market	±3.8980	1.35731	.008	NS
High level-Nyiman	±6.7110	1.97860	.002	.046
High level-Old GRA	±5.0293	1.66236	.005	NS
Idye-Wurukum	±5.0013	2.07795	.023	NS
Modern market-Wurukum	±3.3832	1.49843	.032	NS
Nyiman-Wurukum	±6.1963	2.07795	.006	NS
Old GRA-Wurukum	±4.5146	1.77945	.017	NS

Source: Author's Fieldwork (2015)

Table 3: Post Hoc Two-Way ANOVA Table

Tests of Between-Subjects Effects[b]

Dependent Variable: Commercial

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	544.248[a]	17	32.015	4.634	.000
Intercept	691.142	1	691.142	100.041	.000
Neighbourhood	236.498	8	29.562	4.279	.002
Road Quality	141.065	1	141.065	20.419	.000
Neighbourhood * Road Quality	23.883	8	2.985	.432	.892
Error	193.440	28	6.909		
Total	2768.998	46			
Corrected Total	737.688	45			

. r squared = .738
 (adjusted r squared = .579)
Source: Author's Data Analysis

The Post hoc test shows the neighbourhoods where significant variation in land use pattern occurs.

Table 3 shows the post hoc two-way ANOVA test, it can be inferred that commercial landuse pattern varies with neighbourhood and road quality (p = 0.002 and p = 0.0001) respectively. It can be concluded that commercial landuse pattern varies with the neighbourhood and road quality in the study area. The improvements of road network in the study area influenced positively on commercial activities. Businesses cluster where they can take economic advantage and maximize profits. The areas designed for resident has changed to commercial area. However, the impact is associated with environmental and traffic consequences.

Makurdi urban is expanding very fast. The Makurdi CBD has grown beyond its limits and exerts pressure on the zones that surrounds it. Commercial land use extends to other neighbourhoods outside the CBD leading to gradual disappearance of residential land use and commercial land use increased by 19.07% annually. This agrees with Barau and Bashayi's (2013)

study, which reported that the emerging of Lafia CBD witnessed the gradual change in land use from residential use to commercial use. It also agrees with Egbenta (2010) who stressed that residential neighbourhoods in Enugu bordering business district were overwhelmed by the expansion of the Enugu business district. Commercial land use pattern varies in neighbourhoods due to the road quality in the study area. The variation in commercial land use occurs in all neighbourhoods at varying intensities.

The increase in commercial activities in Makurdi urban per year is tremendous as residential land use is fast disappearing. This is an indication that adequate consideration was not given for commercial places in the planning of the Makurdi urban when the layouts were prepared. The implication of the inadequate provision for commercial spaces in Makurdi urban is that the wind of invasion-succession will compel residents to move to urban fringe. This would likely create housing problems. The rents will soar, residents would pair up with their neighbours thereby increasing the occupancy ratio and altering the residential densities. There is need to plan the Makurdi urban fringe to accommodate these people so as to avoid haphazard development and promotion of squatter settlements.

The emerging commercial land use pattern in the study area has changed the zoning plan of the area. There is need to rezone these areas so as to avert incompatible uses. This would boost the internally generated revenue hence property owners will pay appropriate ground rents on their commercial property. The emerging commercial land use pattern would be associated with environmental problems hence the anticipation of increase waste generation, strain of water and electricity in those areas, indiscriminate constructions would likely cause drainage problems. The

study identified concentration of road network development in some neighbourhoods leaving others without adequate road network. This implies that commercial activities would concentrate on the existing major roads, that would likely cause traffic congestion.

Conclusion

The study revealed that 59.10% of the road networks in the study area are of good quality while 40.10% were rated as bad quality. Most of the good quality roads are found in High level, and Wurukum neighbourhoods. Good road network enhance free flow of vehicle thereby influencing distribution of goods and services and motivates the shop owners to locate their business along good quality roads in anticipation of maximum profits.

The study revealed that "there is significant variation in commercial landuse pattern due to road quality and neighbourhoods across the study area. The interaction effect between road quality and neighbourhood was not statistically significant, $F_{(8, 46)} = .432$, $p = 0.892$ at 5% level. However, the effect for road quality, $F_{(1, 46)} = 20.419$, $p = 0.0001$ and neighbourhood, $F_{(8, 46)} = 4.279$, $p = 0.002$, were statistically significant. This implies that the road quality and neighbourhood influence the variations in commercial landuse pattern in the study area. The effects of road network on commercial land use pattern in Makurdi urban was studied in relation with the neighbourhood. The road quality and neighbourhoods influence the pattern of commercial landuse activities in the study area.

Recommendations

The following recommendations were made based on the findings, to point the way

forward on the part of the policy makers. The study recommends the following:

i.   The Government should encourage subdivision design that will maximise connectivity and develop major roads in Ahule, Nyiman, Idye and Ankpa quarters neighbourhoods to connect more areas.

ii.   Houses fronting Abdullahi Shellang road, Iyorchia Ayu road, Konshisha street, Katsina Ala street, New Bridge road, Naka road, Joe Akaahan Way and Atom Kpera road should be redesigned to at least four storey. The upper, middle and lower storey should be used for residential, offices and retail business respectively.

iii.   As the planning of the study \area continue to evolve the government should give adequate attention on planning of commercial areas, since commercial investment contribute to the economy of the area.

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