ISSN (Online) : 2455 - 3662
SJIF Impact Factor :3.967

EPRA International Journal of

Multidisciplinary Research

Monthly Peer Reviewed & Indexed International Online Journal

Volume: 3 Issue: 3 March 2017

Published By :
EPRA Journals

SJIF Impact Factor: 3.967 Volume: 3 | Issue: 3 | March 2017

EPRA International Journal of Multidisciplinary Research (IJMR) ISSN (Online): 2455-3662

LAND USE PATTERNS AND TRAFFIC GENERATION AND CONVERGENCE IN ONTSHA, ANAMBRA STATE, NIGERIA

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ABSTRACT

This paper investigated land use patterns and road vehicular traffic generation and convergence in the city of Ontsha, Anambra State, Nigeria. The parameters of study are the route ways, the rolling stocks and the various land uses. The methodology of study was direct field observation and measurement. The city was segregated into five traffic zones. Roads in the traffic zones were aggregated. Using stratified random sampling technique; eight arterial roads and one freeway were selected for study. Eleven hours of traffic count were undertaken, from 7a.m through 6p.m ff six days on each of the roads. The essence was to obtain traffic density as well as, the direction of traffic, trip origin and termini, travel time, etc. The null hypothesis that there is no significant relationship between land use and traffic generation and convergence was validated using Pearson's Product Moment correlation. The result obtained was tested for significance using student t-test. The results show positive correlation between traffic generation and convergence and land use areas of the city. Environmental problems arising from urban road transportation in Onitsha were evaluated and policy implications and recommendations were based.

KEYWORDS: *transportation systems, delay, dirt, dust, noise accidents, and pollution*

INTRODUCTION

The location, intensity and pattern of land use in an area to a reasonable extent influence the pattern of traffic it generates. Okpala (1981) stated that the city's activity systems determine the pattern of flow of the transportation systems, in terms of origins, destinations, routes, freight volume and passenger trafficked through the system. Voorhees, Barnes and Coleman (undated) had stated that transportation is influenced by the pattern of land use arrangement in the urban area. Rodrigue (2009) has argued that cities are land use and transportation are parts of a dynamic system subject to external influences, with each comment of the system constantly

evolving as reflected by changes in technology, economics, and demographics and changing values/culture.

Stable empirical relationship exists between patterns of land use location, transportation and the demands for transportation services; as these represent the outcome of many decisions made by residents, proximate and distal trip makers across the city's spheres of influence, governments and businesses at varied spatial scales. And therefore, retroactions arise from the deficiency in one component or its dysfunction reflected as negative externalities such as congestion, delay, dirt, dust, noise accidents, and pollution, generated in the course of meeting these demands.

Accessibility, mobility and flexibility conferred by road transportation services have instigated the streaming of pedestrians, and vehicles of all sorts into the city of Onitsha; to participate in businesses as varied as the trip makers themselves, and at different locations.

The growth of the city of Onitsha from a small fishing and farming settlement by the bank of the River Niger, to a flourishing commercial center; centre can be traced to its site and situation (Udo, 1978), extensive commercial activities, and early development of transportation facilities, especially the extensive ferry services

Early development of extensive motorized ferry services such as steam boats and steam engine in 1927, solved the problem of crossing the River. Development of overland transport infrastructure hooked Onitsha to the main axis of two international trade routes. One is the Trans-Saharan International trade route with the upper Niger-Benue Valley, from which spices, dried fish, and agricultural produce flowed. The other is the Trans-Atlantic trade route with the forest south beyond Aboh, Nembe and Kalabari (Okoye, 1996).

Following Christian Missionary and trade expeditions of 1857, led by Beikie and McGregor Laird, a number of European companies participated in the flourishing Inland Niger trade with trading posts at Idah and Onitsha. Four of these later amalgamated to form the United African Company, (UAC), (Okoye, 1996). These contacts made more processed foreign goods to be traded at Onitsha. The vastly increased trading activities led to increased population movement especially from liberated slaves (Bosah, 1974) into Onisha. Missionary and commercial activities led to other tribes in Nigeria moving into Onitsha either to take up civil service jobs or to participate in commerce or enroll in formal education offered by the missionaries.

From 1905, Onitsha became the headquarters of the central division till 1917 when it acquired the status of second class township.

Rising urban population and increased motorization in the city led to upsurge of demand for urban transport needs/services. There is land use intensification in the vicinity of road space such that it is difficult to differentiate living space and space for commerce from moving /parking space for vehicle. The problem is exacerbated by the fact that the same road space provided for in 1966; and used by a fewer number of persons and vehicles is today still being used by close to one million people plus and near corresponding number of vehicles.

A number of works had been done on urban road transport in Onitsha (Monanu, 1975; Monanu and Ofomata, 1975; Muoghalu, 1988; Okoye, 1996, Ikegbunam, 2008).

The aim of this study is to investigate the congruence between urban land use patterns and Onitsha urban road vehicular traffic generation and convergence, with a view to articulating pro-active measures to deal with the problems of location mismatches and transportation difficulties in the City of Onitsha

THEORETICAL FRAMEWORK

The theoretical basis of this study is the theory of urban land market postulated by Alonso, (1960) and Wingo, (1961). The model states that land use patterns results from multiple decisions made by individuals about location, which are regulated in different ways by economic processes operating in the society. The model advances the idea that each activity derives utility from every site where it is located relative to others in consideration of site rent, which is a saving in transportation costs in over coming the friction of distance. This was the original idea embedded in Von Thunen (1826), agricultural land use model. In identifying with the above viewpoint, Ratcliff (1949) observed that the locational patterns of land use in urban areas result from basic economic forces. And their location on the principal transport arteries is a reflection of the operation of the economic mechanisms of the society.

THE STUDY AREA

The study area is the Onitsha legal city. The legal city of Onitsha is made up of Onitsha North and South Local Govt. Areas. Onitsha lies within the coordinates of latitude 6°78'N and 6°86'N and longitude 6°47'E and 6°49'E. Onitsha

has an area of 50 square kilometers with its neighbouring satellites towns (Anambra State Government, 2008). The Onitsha is bounded by four Local Government Areas namely; Idemili North to the east and Oyi Local Government to the North East, Anambra West to the North, and Ogbaru in the South and South West. The Western neighbour of Onitsha is the River Niger, which separates Anambra and Delta states.

Onitsha lies on the dip slope section of the east facing scarp slopes of the Awka-Orlu cuesta landscape. It is underlain by flood plain deposits, and coarse to fine grained Nanka sands of the Bende-Ameki formation of the Eocene era (Orajaka, 1975, p.7)

Onitsha grew out of spate of migrations of people from heterogeneous cultural backgrounds, which predated 1500A.D (Okoye, 1996). The growth of Onitsha were pivoted from three discrete settlements namely; the Waterside settlement, the Government station and the inland Town (inhabited mainly by the indigenes).

By 1905, Onitsha became the headquarters of the Central Division. The location f Government Station gave Onitsha the status of Second Class Township in 1917. However, in 1924, the tree discrete settlements merged to form one supreme curt area. Following the Local Government Reform of 1954, Onitsha came under an elected Urban District Council, which by 1959 became known as Urban County Council. Today, Onitsha is the Headquarters of Onitsha North and South Local Government Areas as well, as the Diocesan Headquarters of Catholic and Anglican Dioceses on the Niger as well as numerous Christian religious faiths. Onitsha hosts an High Court, Police Area Command and an Army barrack.

The above precedents led to a steady growth in the population of Onitsha. Ajayi Crowther, (1931), put the population at 13,000 in 1857, while Adolphe Burdo (undated) estimated the population to be around 15,000 before 1880. The 1931, 1953, 1963, 1991 and 2006 population censuses returned 18,084, 76, 921, 163,032, 256,941 and 261, 604 figures respectively. These figures are gross under estimates and extremely controversial as they were products of political manipulation and ethnic militia interferences. However, Onitsha has a day time population 1, 500, 000 (UN - HABITAT, 2009).

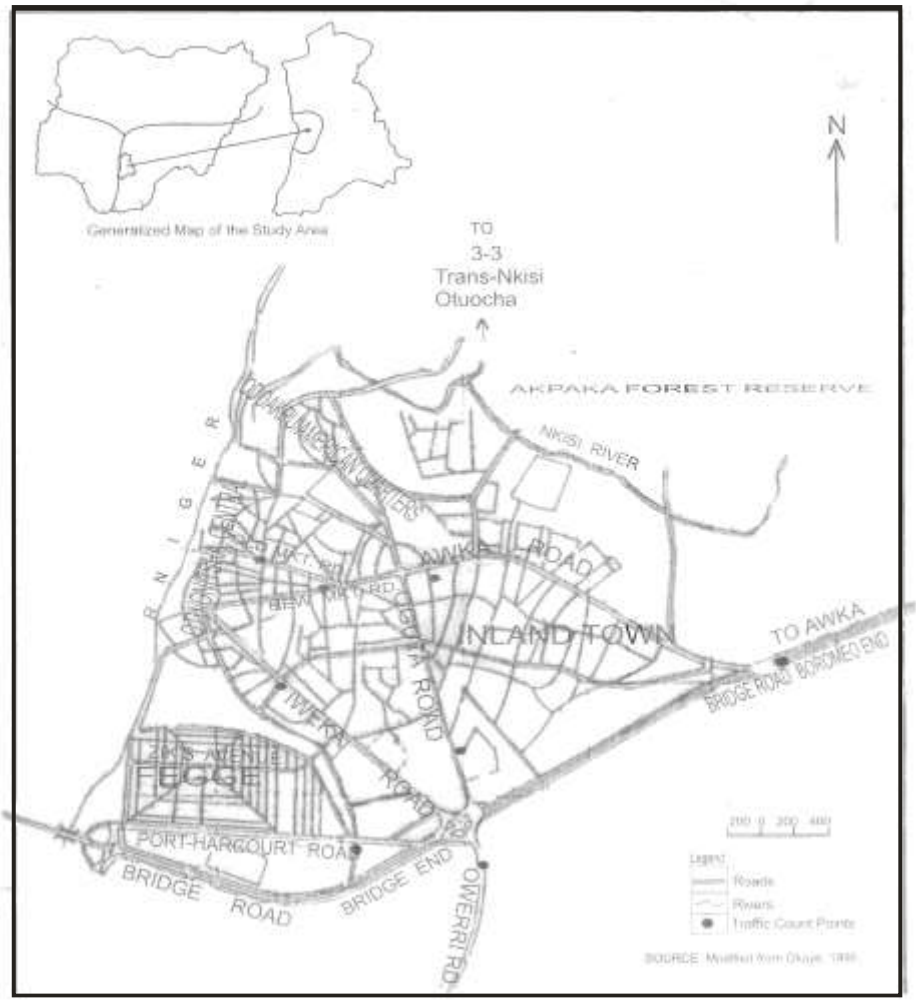
There was simultaneous growth in commercial activities. By 1916, the Main Market was relocated to a more spacious site where it developed fast to incorporate any available space, as shops sprang up on the streets that led out to the market such as Old and New market Roads, Iweka and Bright Street. The growth in residential areas led to the development of new residential lay outs, which in consequence shortened the distance from the main Market and rise of new market places (Okoye, 1996). Similarly, in the Federal Government Industrial Survey of 1967, Onitsha had 75 industries 2 of which employed over 200 persons each (Okoye, 1975, p.89). Data available from the Onitsha Chamber of Commerce, Mines, Industry and Agriculture (ONCCMIA), show that there are over 330 registered medium scale enterprises, cottage and micro industrial and commercial concerns (ONCCMIA, 2014). Onitsha has seven planned markets in addition to clusters of business thoroughfares. Every nook and corner of the city seethes with one commercial activity or the other.

Trend in road development showed that an increase in the number of roads from 4 arterials in 1925, to 7 arterials in 1966 (Okoye, 1996). By 2008, Onitsha has 239 accesses, 14 arterials, 34 collectors and 2 main freeways (Ikegbunam, 2008).

Traffic growth showed that by 1967, Onitsha had an internal traffic flow of 3,000 vehicles per day; and the two axis of the greatest volume of heavy traffic in the then East Central State were centred around Onitsha (Monanu and Ofomata, 1975, p.131). By 2008, Onitsha has total internal traffic flow of 88,668 vehicles per day (Ikegbunam, 2008).

It should be noted that unplanned and uncoordinated patterns of physical development which gave impetus to massive urban sprawl in all directions met these roads unprepared. As a consequence, there is ubiquitous incidence of traffic congestions and associated negative externalities on major arterials, especially, Awka Road, Old and New Market Roads, Oguta and Sokoto Roads, Venn Road North and South as well as Iweka and Port Harcourt Roads. Encroachments on them by various land uses have further aggravated their accessibility challenges.

Figure 1: Map of Onitsha showing the Traffic Zones



Map of Onitsha showing the Traffic Zones

METHODOLOGY

Direct field observation and measurement was used in data collection.

Sampling Design and Procedure:

The city was segregated into four traffic zones following enumeration area demarcation by the Independent National Electoral Commission (INEC), which corresponds with residential area delimitation by Okoye, (1996). The traffic zones are Inland Town, Odoakpu/American Quarters, Otu/ Onitsha Central and Fegge. Four classes of roads (accesses, local collector roads, arterials and the freeways) were identified in the study area. The accesses feed traffic into the local collectors which furnish into the arterial and finally into the freeways. The arterials and the freeways were chosen because of the weight of traffic they carry. Most of the urban road induced transport problems in the city occur on the arterials and the freeways. In addition, they traverse the major land use areas of the city. Using stratified random sampling technique two arterials were selected from each of the traffic zones, plus two freeways. Nine roads were all together selected for study. The roads are Awka road, Old and New Market Roads, Iweka, Oguta, Owerri, Port Harcourt, and Bridge Road and Zik's Avenue. Data on the major land use areas of the city, their population, as well as, the percentage of the total land area of the city they occupied were generated.

DATA COLLECTION

Eleven hours of traffic counts were undertaken from 7a.m to 6p.m from Monday via Saturday on each of the 10 roads; to obtain the weight of traffic, trip origin-destination, and traffic pattern/direction. Route interviews were conducted on trip makers and automobile owners on a check lists of questions such as trip origin - destination, modal choice, length of time spent on the traffic stream between origin and termini, length of time usually spent in a congested traffic; likely causes of traffic hiccups, etc. Recording instruments, stopwatches, notebooks and pens were used for data collection.

DATA PRESENTATION AND DISCUSSION OF FINDINGS

The results of the eleven hours of traffic counts on selected arterials are presented on Table1.

Table 1: Traffic Flow on The Ten Arterial Roads.

Arterial Roads	Working Day Flow	Mean Hourly Flow	Peak Hourly Flow	Peak Hour (am)	Peak Hour (pm)
Awka Road	14,571	1,325	3,418	10a.m-11a.m	4pm-5pm
Bridge Road	35,428	3,220	7,985	8am- 9am	3pm-4pm
New Mkt Rd	5,148	468	1,418	9am- 10am	4pm-5pm
Old Mkt Rd	4,326	393	1,274	9am- 10am	5pm-6pm
Oguta Road	4,977	452	1,392	8am- 9am	4pm-5pm
Iweka Road	8,888	808	2,215	8am- 9am	4pm-5pm
Port-Harcourt Rd	4,857	442	988	9am-10am	4pm-5pm
Owerri Road	10,109	919	2,447	10am-11am	5pm-6p
Zik's Avenue	1,452	132	318	8am-9am	5pm-6pm

Source: Authors Field Work,

Table.1 shows generalized traffic counts on 10 arterial roads under study. The table shows relative importance of each road in the overall daily transport demand in Onitsha, from 7a.m to 6p.m.

There is spatial and temporal variability not only in working day flow, mean hour flow, morning and evening peak hour and off peak hour flows, but also on the time of the day when peak traffic occurred, in the 10 arterials under survey.

Available from the table is that 41% of the total traffic in Onitsha was accounted for by the Bridge Roads. Awka Road accounts for 17%, Owerri Road is responsible for 12%, while Iweka Road and New Market Road accounts for 10% and 6% respectively. Oguta Road, Old Market Road and Port-Harcourt Road carry 5% of the total traffic each. Field investigation showed that the Bridge road carry the greatest traffic at 20,863 vehicles per day, followed by Awka and Owerri roads with 14,571 and 10,109 vehicles respectively. Others are: Iweka, New Market, Oguta, Port Harcourt and Old Market Roads, in that order with their figures as presented on table 1.

The Owerri Road and the Bridge Road usher in traffic into and out of Onitsha. About 5% of the total traffic from the Niger Bridge is through traffic. The rest are intra-city and inter-city route ways.

In terms of internal traffic flow within the city, Awka Road is the most heavily trafficked at 14, 571 vehicles per day on average, followed by Iweka road with 8,888 vehicles. The New Market and Oguta Roads has 5,148 and 4,976 vehicles per day respectively. Port-Harcourt Road and Old Market Road have 4,404 and 4,326 vehicles respectively. Onitsha has total internal traffic flow of 88,668 vehicles per day. The Bridge Road and Owerri Road are 4-lane dual carriageways, while the rest are single carriageways.

Table: 2 Land use Characterization of Onitsha

Land Use Type	Percentage (%)
Commercial/Industrial	55%
Educational	03%
Administrative	01%
Residential	30%
Cultural	1.2%
Transportation	9.8%
	100%

Onitsha has five (5) main residential areas located at America Quarters/Odoakpu, Fegge, Inland Town, Otu/Onitsha Central and Woliwo Layout. It is within these traditional residential areas that other land use types are found, except Otu/Onitsha Central, which evolved ab initio as a commercial zone.

Table 3:Trip Demands By Traffic Zones in Onitsha

Traffic Zone	Average Persons Trip Per Day	Trip Making Pop of the Zone	Trip Demand By the Zone	Percentage %
Odoakpu/American Quarters	2.6	328,719.65	854,671	28.18
Fegge	3.0	326,873.45	980,620	32.33
Inland Town	3.0	136,370	381,836	12.36
Out/Onitsha Central	2.8	271,869	815,607	26.89
		1,063,832.2	3,032,734	100

Source: Field Computation, 2007

Available from field investigation (refer to Table 3) is that variability exists in average persons trip per day of between 2.6 and 3.0 trips. The table shows that a total of 3,032,734 trips were made daily by 1,063832.2 of the estimated Onitsha population of 1,588,031 for 2007. Evident from the Table 3 is that 28.18% of trips in Onitsha originated from Odoakpu/American Quarters Traffic zone; 32.73% were accounted for by Fegge Traffic Zone.

PATTERNS OF TRAFFIC GENERATION AND CONVERGENCE

Patterns of traffic generation and convergence show that three major land use types instigate and dominate trip generation and convergences in Onitsha. These are the commercial/industrial, educational and administrative land uses. Buchanan (1998) had related the volume and density of traffic demand to socio-economic and other factors, which generate traffic to an area. Most intra-city and inter-city movements are induced by commerce, which generates the greatest traffic by attraction due to highest intensity of use (Fortham, 1977). Onokala (1981) had stated that the pattern of work, shop and school trips contribute to problems of urban road transportation. The various educational and administrative landuses located along Awka and Oguta roads are responsible for traffic hiccups on them during the morning and afternoon rush hours. These were identified in the Inland Town traffic zone through Odoakpu/American Quarters to G.R.A., and was seen on such roads as Awka, Old and New Market Roads, Bridge Road, Iweka, Oguta Roads and Zik's Avenue.

TRAVEL TIME

Analysis of length of time spent on the traffic stream show variability in travel time among trip makers between trip origin and termini in the traffic zones. The reason for the variability obviously is traffic congestion, intensification of land uses near the road space; large pedestrian traffic in conflict with vehicle traffic.

The question then is whether a direct relationship exists between traffic congestion and hourly flow of traffic. This hypothesis was validated using Pearson's product Moment Correlation. The results obtained were tested for significance by student 't' test of statistics. There is positive correlation between traffic congestion, and hourly flow of traffic for Awka Road, Bridge Road (Bridge end), Oguta Road, Old Market Road, Iweka Road, Zik's Avenue and Port Harcourt Road and a negative correlations for the New Market Road, Owerri Road and Boromeo end of the Bridge Road. Therefore, the hourly flow of traffic does not contribute significantly to traffic congestion instead, other factors and circumstances do. The results of co-efficient of determination show variability in the magnitude of traffic congestion explained by hourly traffic. For example, in Awka Road, 44.65% of traffic congestion is attributed to hourly flow of traffic while, 55.35% is explained by some other factors. But for Port-Harcourt and Oguta Roads, the hourly flow of traffic is a causative factor of traffic congestion.

CONCLUSIONS AND POLICY IMPLICATIONS

Attempts had been made to analyze the Onitsha urban road transport system from the point of view of geography and environmental management. The discoveries made were quite revealing. Variability exists in travel mode, trip pattern, modal composition and peak and off peak hour traffic, among others.

A number of approaches/options used for containing the environmental impacts of urban road transportation include road engineering, economic instrument, and planning and sound environmental management options.

As existing roads get busier, as is the case with Onitsha traffic environment, provision of various control mechanisms such as different light pigmentation should be installed at various intersections such as Boromeo junction, Savoy junction, D.M.G.S., Ogbommanu, Modebe..

Route segregation by function, space and time, and construction of by-passes and ring roads helps segregate external and internal traffic into the city. Motorways can be constructed through the suburbs. There is need for pedestrian precincts and traffic free areas to be created in the inner city, especially in Ose, Main Market, Iweka and Venn Roads and the Bridge Road (from flyover down to Uga junction). Awka Road and Oguta Road have many educational land uses on them. There is need to assign alternative routes for school runs as most of the difficulties on Awka Road occur during the morning and afternoon school runs. From DMGS down to the Main Market should be segregated as a restricted area for cars, trucks, lorries, trailers and bikes in the daytime. Alternative routes can also be segregated for inter-city buses especially mini buses that ply the Bridge Road especially, from the Lagos Park (fly over) to the Niger Street junction. Road pricing involving taxing motorists contributing to traffic congestion in a transport stream during rush hours is another approach. This is also called congestion tax. Road pricing is the most equitable method of sharing the road space. Some of the weaknesses of road pricing include subjectivity in fixing the prices. For the city of Onitsha, it is suggested that road pricing involving varied license fees be applied across time and zones depending on the severity of congestion in such areas.

Parking charges may be imposed. These include on-street parking, public off-street parking, private off-street parking and residential parking. Using parking as a restrictive mechanism could deter people from putting many cars in the transport stream. This is more applied with on-street parking. The private sector could be encouraged to provide off-street parking as is already going on around Odoakpu/ American Quarters and Otu/Onitsha Central Traffic zones. This will help rid the streets of vehicles whose drivers are not leaving the environment within a couple of hours. Private cars and slow moving vehicles should be banned from busy roads in the daytime. This approach has been used with measured success in the city of Rome (Roth, 1999). Also roadside trading and sidewalk parking should be banned.

A corollary to parking charges, is the introduction of Park and Ride facilities for Old and New Market Roads, Awka and Iweka Roads, for intra city transport; and Bridge Road and Owerri Road, for inter city transports. Park and Ride have been used with success in the cities of Bogota, Belo Horizonte and Baton Rouge (Nwokolo, 2000).

Another approach is staggering of working hours. There is also advocacy for redistribution of land use within the city. In this way, heavy pedestrian traffic in conflict with vehicle flows on the roads in the study area could be curbed.

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