

Land Use and Traffic Pattern along Lagos – Badagry Corridor, Lagos, Nigeria

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1 ABSTRACT

Challenges of urban mobility are taking new dimension in many cities of developing countries as land uses along major traffic corridors become intense and change rapidly. Traffic delays are now the common experience due to difficulty in traffic management arising from the complex interaction between traffic and land use. This paper examines the traffic and land use pattern along Lagos-Badagry corridor, in Lagos metropolis. It serves as a baseline study as the corridor is currently undergoing an upgrade. The study showed that the dominant land uses along the corridor are residential (28.6%), institutional (22.2%) and industrial (18.8%). Also, twelve traffic conflict points which are dominantly commercial use were identified along the corridor. Internally generated traffic along the corridor was 77.0% and through traffic accounted for the remaining 23.0%. The maximum hourly volume of traffic was found to be 3860 passenger car units which is equivalent of 82.4% of the corridor's capacity. The study recommended the need to integrate land use with transportation. Further, there is need for proper land use management through development plans with a view to achieving healthy, investment friendly and sustainable urban planning and development. Spatial interaction between land use and transport should be regularly studied and strategies to improve this relationship be put in place to make the city work and livable. The study concludes that the current land use and traffic pattern along the corridor would change significantly once the upgrade is completed and that the findings in this study would provide a good basis for measuring the impact of the upgrade on both traffic and land use along the corridor.

2 INTRODUCTION

Different land use types are found in metropolitan cities and each of them is unique and has its own propensity to generate not only trips but also dictate the pattern of development. Thus, transportation can be regarded as a land use factor in planning and development of cities. The rapid urbanization coupled with economic growth and forces of globalization across the globe means not only that more people than ever before will be living and working in cities but also that more people and more goods will be making more trips in urban centres, often over long distances (Zegras, 1997). The increase in spatial interaction between various land uses arising from increasing economic growth and urbanization as currently being experienced in Lagos makes urban transport planning and management a great challenge. This is because the movements generated within and between the land uses produce conflicts along major traffic corridors and activity centres.

Although the relationship between transportation and land use patterns has long been recognized, it is only recently that transportation been seen as a tool of land use planning rather than simply concomitant to it. In adopting transportation as a land use planning tool, it is essential to appreciate the scale of the complexity of movement within the city. This should follow at least two approaches; the first approach involves an examination of some determinants of trips at the household, firm or individual levels while the second is focused on the capacity of the various land uses to generate and attract trips (Ayeni, 1979). The outcome of many of these studies has influenced to a great extent several transport and land use planning decisions and policy issues in many countries of the world (Fadare, 1989, Mokhtarian and Meenakshisundaram, 2002, Srinivasan, 2005).

Lagos-Badagry corridor is a major economic route that links Lagos and Nigeria to other West African countries and preliminary studies reveal that traffic congestion, poor traffic management, haphazard land use and poor control of human activities are major issues of concern. The economic significance of this corridor has led to its upgrade by the Lagos State Government from a four to ten-lane dual-carriage expressway as part of the ECOWAS Transit corridor. The upgrading project is a huge investment and the expected socio-economic impact by State Government can only be achieved if the current challenges are understood and lessons learnt to prevent future reoccurrence of the challenges. Consequently, this paper seeks to understand the land use and traffic pattern in the study area as a means of identifying the conflicts and making

recommendations for improved land use and transport development. The outcome of this study is expected to have implications for land use and transport planning along other major corridors in Lagos and other major cities in Nigeria.

3 LAND USE AND TRANSPORTATION INTERACTION

The land use and transportation interaction studies could be linked to the theories of urban growth. Several scholars have reviewed the urban growth theories with a view to providing explanations to their validity or otherwise in understanding patterns of urban growth and land use development. (Fadare, 1987, Oduwaye, 2002, Bawa-Allah, 2006, and Agunbiade, 2006). These theories (Concentric Zone, Sector and Multiple-Nuclei) were developed to generalize about the patterns of urban land use found in the early industrial cities of the United States, hence there had been criticisms on their ability to provide explanations for the understanding of land use patterns of non American cities particularly in relation to transport.

Land use and transportation are mutually interconnected (Mitchell and Rapkin, 1952). The use of the term "land use" is based on the fact that through development, urban space accommodates a great variety of human activities. Land is a convenient measure of space, and land use provides a spatial accounting framework for urban development and activities. The location of activities and their need for interaction creates the demand for transportation, while the provision of transport facilities influences the location itself. Land uses, by virtue of their occupancy, are taken to generate interaction needs (trip generation), and these needs are directed to specific targets by specific transportation facilities (trip distribution and modal split). The use of the transportation system creates congestion, which leads to user adjustments (recognized in a capacity constrained assignment). Several works have been done on the relationship between land use and transportation majority of which are concentrated in developed countries of the world. The degree of this relationship has been studied by many authors who include Kuzmyak and Pratt (2003), TRL (2004), Bento, et al, (2004) and Turcotte (2008).

Transport is a land use in itself and has the uniqueness of relating intimately with all other land uses. This interaction is understood when the Town Planners and Engineers are able to predict the types and locations of future transportation and land uses and travel patterns. This interactive relationship serves as the basis for travel-demand forecasting, which uses the output of land use models as input, assuming that different land uses generate different levels of activity and travel. This interaction also produces diverse transportation problems which Black (1995) described as complex bundle of interrelated problems with traffic congestion as the most visible manifestation. Congestion results in longer travel time, which is one of the main areas of transport dysfunctions observed in many large cities of the world (Awake, 2001). "Travel time, cost and how difficult it is for people to get to and from work have often play a key role in whether a city is able to attract business" (Auclair, 1999).

Studies on land use and transportation in developing countries and Nigeria in particular reveal several factors for the conflicts observed in many cities. Asuquo (1981) noted that land use and transportation are mutually embedded and that the organization of land use activities in any city basically rests on the effective linkages of the transport network system. Adeniji (1993) observed that throughout the history of human settlements, transportation has always been closely related to the structure and density of settlement and the use of land and that transport route generates different land uses on its sides. The conflict between them obviously stems from the physical structure of towns as a result of structural conversion of buildings (Banjo 1984). Ayeni (1985) examined the traffic implication of the location of major economic activities in urban areas in Nigeria, using Agbowa Shopping Complex in Ogun State as a case study and contends that the location of such activities should be based on sound planning principles so as to eliminate the likely traffic problems that may develop when shopping complex becomes fully operational.

Asuquo (1981) further noted that inadequately planned transportation systems, increase in demand of land for development and changes in land use activities/ patterns produce more pressure, confusion and social cost to the city and the inhabitants. Olanrewaju et al (1995) argued that the growth pattern and uncoordinated land use structure have complicated transport demand situation in Lagos, Nigeria and this same reason was noted by Fadare (1997) as being responsible for the transport problem in Ibadan. Transportation problems arising from conflicts with land use in Nigeria have also received some emphasis in the works of other researchers such as Okpala (1980) in Enugu and Sule (1986) in Calabar. Most of these researchers



recognized that transportation problem should be seen as a system of a larger urban system and as such be analysed within the context of land use patterns (Anikamadu, 1987).

The conflicts between transport and land use in Lagos and Lagos-Badagry corridor in particular varies in magnitude and dimension from one location to another and deserves proper attention if the socio-economic and environmental costs of the conflicts must be reduced and make living and working sustainable and safe. Thus, the objective of this paper is to present insights into the land use and transport characteristics along the Lagos – Badagry corridor as well as identifying the conflict points. It also seeks to identify the land use factors that affect travel along the corridor.

4 THE CONTEXT OF LAGOS

Lagos Metropolis is located in Lagos State in the South-Western part of Nigeria (See Figure1). It is the largest city in Nigeria with approximately 16m people covering 37% of the land area of Lagos State and home to 85% of the state population (Lagos State, 2004a). The projected average population density of the built-up area of Lagos metropolis is about 20,000 people per square kilometer. By 2025, Lagos will become the third largest global city with an estimated population of 24 million people (Lagos State, 2004b). Lagos has the highest vehicular density in Nigeria (222 vehicles/km) as against the national average of 11vehicles/km. These scenarios have great implications for future travel demand in Lagos. The socio economic situation of Lagos has changed significantly over the years, while the use of motor cycle as a mode of intra city travel has also become significant in the last fifteen years with about 50% of intra city road accidents being attributed to use of motor bikes (Oyesiku, 2002). It is also very difficult at present to predict traffic situation in Lagos where average journey time to work is over one hour (Auclair, 1999).

4.1 Lagos-Badagry Corridor

The Lagos - Badagry corridor is a major transport axis consisting the four lane dual carriage expressway and adjoining land uses. It is approximately 60km with a shoulder of varying width and a median of between 2-6m. The expressway lies within Latitude 6° 24' to 6° 30' and within Longitude 20° 43' to 20° 22' East of the Greenwich Meridian. The corridor stretches from Eric Moore interchange in Surulere in the east to Badagry town in the west. The expressway is crossed by the North-South section of Apapa - Oworonosoki Expressway, which acts as a bypass or outer ring road linking northern Mainland Area with Apapa. The expressway also serves as a major international route linking Lagos with the Republic of Benin and other West African countries. At the moment the corridor is being upgraded from four to ten lane roadway as part of the ECOWAS Transit corridor. The road is expected to accommodate a light rail track which will be integrated with the road system to further improve intra-city travels. This development has implications for the immediate land uses adjoining the expressway as Lagos State Government has acquired properties within the right of way of this road. Thus the emerging land use along the corridor is expected to change from the current land use pattern. This therefore calls for another study as soon as the upgrading is completed to determine the impact of the upgrade.

5 METHODOLOGY

To achieve the objective of this study, two sets of primary data were collected and complemented with secondary data. These are land use and traffic data. A pilot survey was earlier conducted to identify the total number of neighbourhoods/residential areas, possible traffic survey points, and major traffic conflict points. The land use data include inventory of major land use categories and their physical characteristics using the existing land use map of the corridor as a guide. It also involves inventory of traffic conflict points and their dominant land uses. Based on the pilot survey, three traffic survey points (Mile 2, Iba and Ijanikin) were identified along the corridor. Mile 2 (east end) and Ijanikin (west end) were chosen as entry and exit points while Iba was chosen as a midpoint survey station. The traffic data (include traffic volume, traffic composition, origin and destination of travels) were collected by road side observation for thirteen hours (6am-7pm) on a weekday and a weekend. Roadside interview was conducted in both directions to obtain information on origin and destination of travels. Every tenth vehicle was systematically selected at points of traffic impedance and the drivers were interviewed with the aid of structured questionnaire. A total of 2374 drivers were interviewed during the survey. Secondary data from Lagos State government were used to complement the primary data.

6 DATA ANALYSIS AND FINDINGS

6.1 Land Use Pattern

Land uses within the study area are broadly classified in five categories. These are residential, commercial, institutional, industrial and religious/recreational. Residential use is the largest land use category in the area. It covers approximately 2,545.6 hectares (28.6%) of land. Notable residential development in the study area includes; Amuwo-Odofin residential scheme, Satellite Town, Festac Town, Agboju, Iworo/Ajido, Ojo town, Okokomaiko, Ajangbadi, and Ijanikin, Iba Housing Estate, Kirikiri, Navy Town and Millennium Mixed Housing Scheme. Institutional land uses account for the second largest land use category and covered approximately 1,966.9 hectares (22.2%) of the total land area. The major institutional land uses within the study area include Army Barracks Ojo, Lagos State University Ojo, National Postgraduate Medical College of Nigeria, Federal Government College Ijanikin, Lagos State Government College, Ojo, and Adeniran Ogunsanya College of Education. The industrial land use is dominated by Amuwo Industrial Estate, Volkswagen Assembly Factory and other small industrial establishments. Table 4.1 also indicates that this land use covers about 1,667.5 hectares of land (18.8%).

Commercial land uses constitute the fourth in the hierarchy of land use size. This use covers about 1,197.5 hectares (13.4%). Major commercial land uses include Alaba International Market, Trade Fair Complex, Orile building material market, and other local markets. Religious and recreational land uses constitute the least in the hierarchy of human activities. These uses cover approximately 489.5 hectares (5.5%) of the total lands within the study areas. The major challenge of land use distribution pattern along the corridor is both in terms of planning standard and layout. The land use distribution as shown in table 1 indicates a clear departure from the land use zoning standard which suggests that the corridor was never planned as a unit. Apart from the institutional land uses, very few residential developments have development plans and exist in form of residential estates while many residential communities exist as slums. The Alaba international market which is a major commercial land use and traffic generator is also a slum development. This situation has implications for travel along the corridor.

LAND USE	SIZE (HECTARES)	PERCENTAGE
Residential	2,545.6	28.6
Industrial	1,667.5	18.8
Commercial	1,197.5	13.4
Institutional	1,966.9	22.2
Religious/Recreation	1,027.4	11.5
Forest/Creek	489.5	5.5
TOTAL	8,904.4	100.0

Table 1: Land Use Distribution along the Corridor.

Another clear indication of non-existence of land use plan for the corridor is the emergence of ribbon pattern commercial activities that overflow unto the right of way of the corridor. An examination of the existing land use map of the corridor reveals the haphazard distribution of land uses within the study area. The linkage between the land uses and the expressway is largely uncoordinated and as such create bottleneck at major entry and exit points. A good example of this is the Festac Town First gate. The most common and disturbing development phenomenon in the study area is the increasing number of residential conversions and extensions for commercial and industrial purposes along the major roads as observed along Lagos – Badagry. This aspect not only constitutes a problem to urban development in the area but also jeopardize the accomplishment of proper transportation planning. It is the challenge posed by these problems that necessitated this study.

6.2 Land Use and Traffic Conflict Points

The observed land use and traffic conflict points along Lagos-Badagry corridor are presented in Table 4. The dominant land use and the causes of the conflicts are also indicated in the table. The major conflict points along the corridor are Mile 2, Festac First Gate, Agboju, Alakija, Ado Sabo, Trade Fair Complex, Volkswagen, Iba Junction, Alaba Rago, Okokomaiko, Isashi Junction and Ijanikin. Majority of the dominant land uses at these conflict points are commercial in nature. The causes of conflicts along the corridor are more of the presence of markets, poor road condition, poor traffic management and on-street parking. The



effects of these conflict factors include encroachment on the road right-of-way, traffic congestion and difficulty in traffic management.

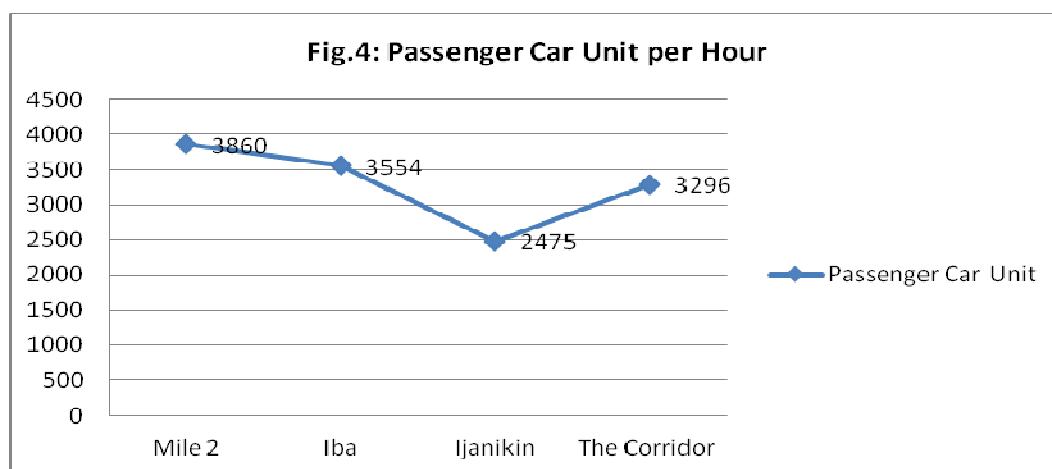
The major problems of Mile 2 are typical of major public transfer points in Lagos and these include traders and market activities encroaching on the roadway, bad driving habits of Bus drivers (picking passengers on the highway) and pedestrian movement along the edge of travelled roadway. Personal observation reveals that some parts of the road length need urgent attention and interventions. There are three pedestrian bridges over the entire length of the corridor. These are located at Mile 2, Ojo Cantonment and LASU gate. Pedestrian and vehicular conflict which increases accident rate is still very predominant. The perennial traffic congestion at Festac 1st Gate / Maza-maza does not allow for fast traffic movement. This is as a result of the bad condition of the road prevailing at Maza-maza bus stop. This has also led motorists to divert movement into the Navy town in Alakija and other routes leading to Kirikiri. During the peak periods (am and pm), heavy traffic queue usually build-up at Agboju, Festac 3rd gate, Volkswagen industry, Ojo, Iyana Iba junction and Okokomaiko town.

S/No	Conflict Point	Dominant Land Use	Causes of Conflicts
1	Mile 2	Residential/Commercial	Road terminal
2	1 ST Gate	Institutional	Poor traffic management
3	Agboju	Commercial	Street trading
4	Alakija	Commercial	Filling station
5	Ado Sabo	Residential/Commercial	Filling station
6	Trade Fair Complex	Commercial	Poor road condition
7	Volkswagen	Industrial/Commercial	Limited access to Alaba market
8	Iba Junction	Commercial/Institutional	On-street parking and street trading
9	Alaba Rago	Commercial	On-street parking and market
10	Okokomaiko	Commercial/Residential	Market, poor road condition
11	Ishashi Junction	Commercial	Poor road condition and market
12	Ijanikin	Commercial/Institutional	Market

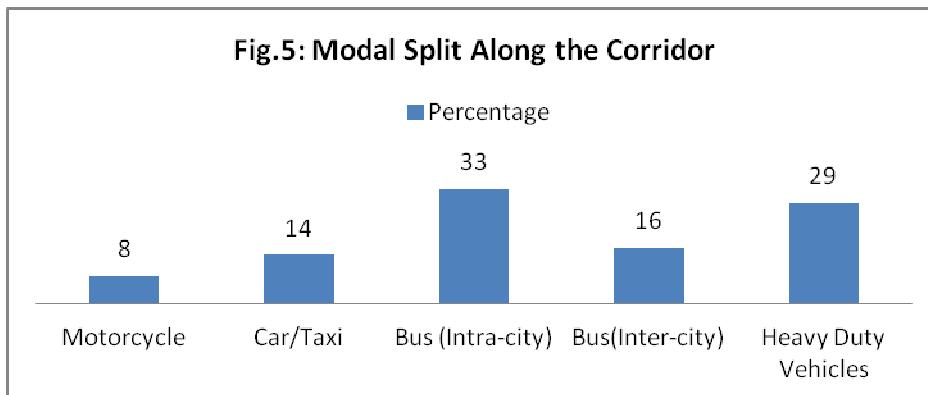
Table 2: Traffic Conflict Points along Lagos - Badagry Corridor. Source: Author's Field Survey, 2008.

6.3 Traffic Patterns

The traffic surveys conducted establish the total volume and composition of traffic along the corridor in the two directions as well as the land use of trip origin and destination. As shown in Appendix 1, the average number of vehicles per day was 28,204 or 50,184 pcu at Mile 2. This translates to an average of 2170 vehicles or 3860 pcu per hour. At Iba junction, the total number of vehicles per day was 25529 or 46,198 pcu per day. The average number of vehicles per hour at this station was 1963 or 3554 pcu per hour. Similarly, the average daily volume at Ijanikin is 17636 vehicles or 32,181 pcu while the average hourly volume was 1356 vehicles or 2475 pcu. On the average, the total number of vehicles per day was estimated at 23790 or 42854 pcu per day. Consequently, the average hourly volume along the corridor was estimated at 1830 vehicles or 3296 pcu (See fig.3). This figure represents 82.4% of the capacity of the corridor (4000 pcu per hour). This indicates that the design capacity of the corridor has not been exceeded. Consequently, the heavy congestion noticed during the survey cannot be attributed to overstretching of the road capacity by excess traffic but by other factors.



Analysis of modal split as shown in Figure 5 indicates that travel within the study area is distributed among the following modes as follows: Motorcycle (Okada, 8%), Car and Taxi (14%), Pick-up, Mini-bus (Danfo, 21%), Midi bus (Molue, 12%), Conventional (Luxury) Bus (16%), Truck and Tipper (20%) and Trailer and Tanker (9%). The mini and midi bus (Danfo and Molue) are the common mode of public transport and the combination of the two accounts for 32% of the total number of vehicles observed during the study. The luxury bus is used for inter-city travels within the area. The prominence of this mode along the corridor is primarily due to the location of their terminals at Mazamaza and Festac first gate. Truck, tipper, trailer and tanker are heavy duty vehicles that account for 29% of all modes. The origin and destination survey was used to determine the traffic generating capacity of the land uses. The distribution of the trips into various land uses is as presented in Table 3.



The table indicates that 77.0% of the total trips have their origin within the study area while 23.0% are externally generated. It is further revealed that residential land use generated the largest number of trips (665) or 28.0% of the total trips generated. Institutional land use generated the second largest number of trips (489 trips or 21.6%) while commercial land use generated 18.3% (434 trips). Industrial and religious/recreation land use generated 5.8% and 4.3% of the total trips respectively. The magnitude of the residential, institutional and commercial land uses within the study area could be responsible for the large proportion of trips generated.

Land use	No of trips	Percentage
Residential	665	28.0
Commercial	434	18..3
Institutional	489	20.6
Industrial	137	5.8
Religious/Recreation	102	4.3
External Traffic	545	23.0
TOTAL	2374	100.0

Table 3: Distribution of Trips Generated By Land Use. Source: Author's field survey, 2008.

7 IMPLICATION OF FINDINGS AND CONCLUSION

This study examines the land use and traffic patterns along Lagos-Badagry corridor. It also identifies the major traffic conflict points and the nature of dominant land use of the conflict points. The work reveals haphazard distribution of land uses along the corridor where residential (28.6%), institutional (22.2%) and industrial (18.8%) are the three largest land uses. The average hourly volume along the corridor is estimated at 1830 vehicles or 3296 pcu which represents 82.4% of the design capacity of the corridor. This suggests that the design capacity has not been exceeded. The bus mode (Danfo and Molue) and heavy duty vehicles account for 33% and 29% of all modes. This has implications for road safety along the corridor. This work further reveals that 77% trips observed along the corridor are generated within the study area while 23% are external. Residential, institutional and commercial land uses in that order generates 28.0%, 20.6% and 18.3% respectively of the traffic observed along the corridor. The haphazard distribution of land uses suggests possibility of conflicts among the traffic they generate. Twelve traffic conflicts points with commercial activities as dominant land use were identified along the corridor. This is partly responsible for the traffic congestion observed along the corridor.



To ameliorate the current situation in the study area and Lagos in general, the general land use pattern of the city should be understood. There is the need to respond to its sprawling land use pattern by adopting transport and land use integration concept. This could be achieved by adopting concepts which encourages the development of high density mixed land use of housing and employment along major arteries of metropolitan areas. It has the potential of minimizing urban trip length and time. The concept of transport and land use integration was adopted in Curitiba in Brazil and later replicated in the New-York city with outstanding success. Apart from integrating land use with transportation, there is need for proper land use management through development plans with a view to achieving healthy, investment friendly and sustainable urban planning and development. Spatial interaction between land uses should be regularly studied. As a result of many conflict points observed on the corridor, this paper recommends the need for improved traffic management system and of the road condition along the corridor and the city in general. Indeed, the current upgrade would change the current land use and traffic patterns along the corridor when it is completed, thus the findings in this study would provide a good basis for measuring the impact of the upgrade. However, the ongoing upgrade can only help to ameliorate the traffic problem if proper land use along the corridor is done.

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