IMPACT OF RESIDENTIAL LAND USE CHANGE ON INTRA URBAN ROAD NETWORK OF AKURE, NIGERIA

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ABSTRACT: *The utilization of different land uses in different locations generates the demand for transport, where system and supply of transport enable the distribution of different land uses in different locations. Therefore, one can simply argue that urban and spatial planners, transport planners, highway engineers, public transport and logistics operators, retailers and developers should all come together to create new strategies and policies on the logic of land use management, transport geography, accessibility, and implied division of labors. This study investigated the impact of residential land use change on intra urban road network of Akure, a medium size city with moderate population in southwestern Nigeria. Four major intra urban roads in the city center were considered in this research and a total of 150 houses and residents within 200m distance from the roads which amounted to 5% of the buildings within the study area were sampled. Information, relating to road network, condition of road, level of land use conversion among others, was gotten with Geographic Information System (GIS), questionnaire, personal observation and interview. It was found out that, most residential land use along intra urban roads in the city center had been converted to commercial land use either totally or partially. The study affirmed that, residential land use change has both physical and socio economic impacts on road network development and the environment. It was therefore recommended that, proper land use planning, establishment of a commercial center to cater for the city's commercial needs and the preparation and implementation of a transportation master plan will reduce the problems observed. This will ensure adequate intra urban road management as well as sustainable urban development in Nigeria.*

KEYWORDS: residential, land use change, road network, intra urban mobility

INTRODUCTION

The road network is the system of interconnected roads designed to accommodate wheeled road going vehicles and pedestrian traffic. The road network consists of a system of interconnected paved carriageways which are designed to carry buses, cars and goods vehicles; the road network generally forms the most basic level of transport infrastructure within urban areas, and will link with all other areas, both within and beyond the boundaries of the urban area **(**Wade & Sommer, 2011).

Globally, land is use for different purposes. These are not only limited to residential, but

commercial, religious, recreational, industrial, transport etc. The proportion of land allocated to various use in different parts of the world vary tremendously depending on the level of development, compliance with the planning regulations and the purpose to which the land is to be put (United Nations Environment Programme Annual Report, 2010). One of the major causes of residential land use change or change in the pattern of residential land use is urbanization. The rapid growth in population and the multi-various functions performed by cities make them generators and attractors of traffic. The ultimate implications of these are mobility problems if adequate attention is not paid to transport in urban planning (Ogunbodede, 1999).

The utilization of different land uses in different locations generates the demand for transport, where system and supply of transport enable the distribution of different land uses in different locations. Therefore, one can simply argue that urban and spatial planners, transport planners, highway engineers, public transport and logistics operators, retailers and developers should all come together to create new strategies and policies on the logic of land use management, transport geography, accessibility, and implied division of labors and other commuters involved (Marshall, Stephen & Banister, David, 2007). Transport directly influences urban development and spatial distribution of opportunities in different forms, such as services, households, employment, etc. Thus, the plan for the development of a new area should simultaneously be prepared with integrated kind of transport planning strategies; accessibility is one of the important concepts that allow the integration of land use with various transport networks. Owuputi (2016) indicated in his study on the impact of road development and expansion, that Akure has an extensive landscape with a lot of resources endowment spread over the city; this therefore requires the need for movement of goods and people between places. This has significantly shaped the existing road transport system as well as the development of transport itself. The development of intra city roads to cope with the demand of the city when it became a state capital has affected the spatial expansion of the city. Thus development has been in concentrated along the routes the growth has been in terms of physical expansion and growth of traffic (Owuputi, 2016).

In recent decades, researchers have made substantial progress in empirically addressing the various forms of urban land use and its change over time. Ogunbodede (1999) pointed out that, as a consequence, the global dimension of urbanization-related land use change is now on the agenda of policymakers and researchers' worldwide. Transportation problems have also attracted several governments commissioned studies as exemplified by the works of Max Lock on master plan for Bauchi, Gombe, Minna and Dar AI-Handasah for Gembu, Okene, Offa, Lokoja. Ogunbodede (1999) also researched on the changing land use pattern and their effects on intra urban road network in Akure by identifying the landuse change pattern over 40 years, identifying and explaining the overall pattern of intra-city movement of passengers within the various landuse zones and accounting for the observed pattern. These types of studies were intense in the country between in the 1980s and 1990s for the major urban centers in the country, but they were not essentially transport based as they were used to prepare a comprehensive master plan for cities under study, the studies in addition to being master plans for cities also highlighted congestion problems, their causes and management. The ultimate implications of these are mobility problems if adequate attention is not paid to transport in urban planning. In this study, we aim to access the impact of Land use change on intra urban Road network pattern to study the in Akure, Nigeria with a view of making a
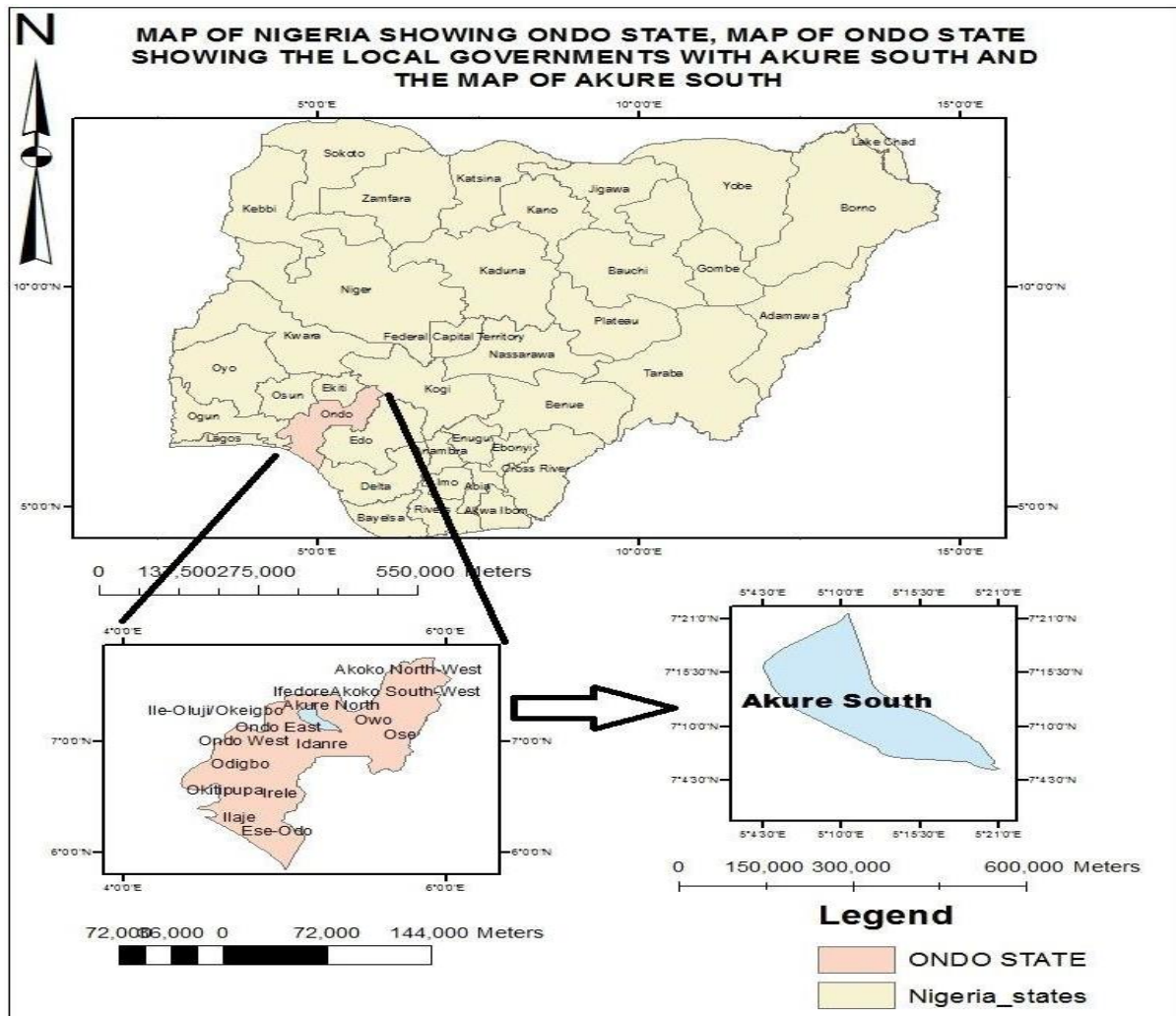
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recommendation for a sustainable urban center.

Figure 1: Location map of Akure, the study area
Source: Balogun (2011)

Study Area

The study area is Akure, the capital of Ondo state. It is located on latitude 7° 15' north of Equator and longitude 5°5' East of Greenwich Meridian. Akure is the capital city and administrative seat of Ondo State, it is located in south western Nigeria (Figure 1), and it is a nodal town which is vintagely located in relation to all the big towns in Ondo and Ekiti States. It is surrounded within a 40 km radius by some important towns such as Ondo town to the South, Owo to the East and Ado-Ekiti to the North. Similarly, lkare-Akoko, Ifon and Okitipupa are all located within another 96 kilometers radius to Akure. It covers an aerial extent of about 340 km^2. The population of Akure according to 2006 census was 484,798. In 1990, the population was estimated to be 157.947 (Ondo State of Nigeria, 1990). The projection was based on annual growth rate of 3% using the 1990 base year. The provisional population for Akure Local Government Area is 316,925 (1991 census). The multi-various functions performed by Akure

influenced the desire to construct new roads and rehabilitate old ones to take care of increased activities in the city. Improvement in transport facilities was given prominence in Akure particularly since 1976 when city became a capital town. New roads were constructed and extended to the newly built -up areas; old roads were reconstructed and enlarged.

Conceptual Framework and Literature Review

Conceptual Framework
A variety of early concepts and models have been advanced to explain the urban spatial structure emanating from city movement and interaction. One of these models and concepts that explained the relationship between land use and transportation in terms of the impact of city growth on transportation was the sector model of HOYT. As an economist, he is of the opinion that the spatial development of any society or city depends to a large extent, on the nature and structure of the transportation networks inside it (Basorun, 2003). The model traced the historical growth of cities along travel routes in which different parts of sectors of the city take a star-like shape as defined by route ways from the center to the suburbs (Enisan & Aluko, 2015).

LITERATURE REVIEW

Urban Land Use and Transportation
In recent decades, researchers have made substantial progress in empirically addressing the various forms of urban land use and its change over time. As a consequence, the global dimension of urbanization-related land use change is now on the agenda of policymakers and researchers' worldwide. Transportation problems have also attracted several government commissioned studies as exemplified by the works of Max Lock on master plan for Bauchi, Gombe, Minna and Dar AI-Handasah for Gembu, Okene, Offa, Lokoja (Ogunbodede, 1999). These types of studies were intense in the country between in the 1980s and 1990s for the major urban centers in the country, but they were not essentially transport based as they were used to prepare a comprehensive master plan for cities under study. The studies in addition to being master plans for cities also highlighted congestion problems, their causes and management.

The importance attached to landuse and transport system had attracted a lot of concern all over the world. There is the argument that land use influences the development of transport system. However, what is clear is that most cities of the developing world are increasingly witnessing a rapid rate of urbanization. The rapid rate of urbanization has impact on both landuse and transport system. This is because mobility and access are important factors influencing the success of most urban economic activities. People take decisions about where to locate their residence and business, while giving considerations to maximum advantage from external economies associated with household agglomeration along economic, social and educational class. The net result of such decision is a pattern of activity which is reflected in the locational segregation of the major components of the urban system of change (Asuquo, 1981).

Various contributions have been made towards the relationship between transport and internal structure of urban centers. The continuous demand for land in the city has led to increase in the

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rent and commercial activities. This in turn has increased the traffic to the city centers which makes planning inevitable in the core region of most cities in Nigeria. In line with this argument Ogunbodede (1999) is of the opinion that new routes will be built simultaneously to meet the demand generated by increasing population emerging from different areas of a region. The change in network structure therefore has an impact on economic development by changing the pattern of internal accessibility for urban centers. Sometimes changes in the accessibility pattern of an urban center may disrupt the existing patterns of spatial competition with the region. In Nigeria, experience from the creation of new capital towns has led to expansion of the road network in the core region which also affects the structures of the internal growth.

Residential Land Use Change
The rapid pace of urbanization in the third world cities particularly in Nigeria has brought about arbitrary changes in land use which has become evident in most cities to the extent that a piece of land or a building serves many different purposes at the same time thus making it difficult to define a given area as either residential or commercial, Hence, one can find a land being used as residential and also commercial such as a shop or office, likewise the setbacks, roadsides and streets have not been left out but have been converted to commercial centres, thereby falling short of their intended purposes (Ogungbemi, 2012). This is as a result of some factors mostly economical in nature; however change of use is synonymous with increase in the intensity of use, triggered by increase in demand. Ogungbemi (2012) further stressed that if proper check is not put in place, a great threat is been posed to urban economy at large. Particularly, the characteristic feature of the cities such as the natural landscape, road network system and most importantly, housing stock is under great risk (Olajuyigbe, Adegboyega, Popoola & Olalekan, 2015).

Various works and studies have been carried out to study the dimension, and effects of residential land use change in different Nigerian cities, for example in Akure, Fawehinmi (2002) observed that shops and offices compete for space particularly along major transportation routes thereby converting existing residential structures to shops and office complex. Also Owoeye and Ogunleye (2015) in their analysis of structure and pattern of the changes and the causative factors of residential land use around the Ekiti State University (EKSU), Ado-Ekiti, it was discovered that there is one special characteristic of the changes where most of the actors are academicians of who majority are students tenants with few staffs of the institution living among the host community which seems to be a motivating factor that speeds up the rate of development and changing land use pattern around the university community. According to Olusina (2008) "the conversion of one use to another is due to non-proper enforcement of the existing planning regulations''. However, it could be said that this development is in realization of the principle of highest and best use thus, ascertaining the relevance of the theory (Marshall & Banister, 2007).

The existing planning laws have struggled to survive in the face of soaring demand for economic activities but because of the inevitable factor of obsolescence of existing buildings which have about the stagnation or depreciation in value, invading prospective economic activities with higher returns succeed existing use and the influence of planning laws thus resulting in property conversion (Ogungbemi, 2012). Finally, though property conversion is a

sound economic adjustment that seeks to allocate land to its highest and best use and which identifies issues of rents and property management as reasons for such conversion, it should be regarded as an illegal activity.

Road Network of Akure
Road transportation is the most predominant form of transport in Akure metropolis. It accounts for about 98 percent of all travel in the town. The city of Akure was not planned ab-initio and as a result of this, there is minimal functional relationship between the various land uses. Its poorly developed road network and inefficient traffic management techniques often create chaotic traffic pattern. The traffic composition in the city is mixed comprising of motorcycles, taxis, minibuses, Lorries and trucks (trailers). However, the traffic composition of Akure metropolis is dominated by taxis, motorcycles and buses (Owoputi, 2016).

Like Akure many Nigerian cities are faced with multiple environmental problems and They are characterized by non- functioning road infrastructural facilities and road furniture, most poorly governed, intensively dotted with illegal structures, while physical growth and development of the roads in the cities had not been properly managed or controlled. Aribigbola (2008) posits that in Akure a major instrument for planning in the city is the use of roads layout plan. Investigation revealed that to date a total of 5 major city roads were in Akure with numerous street roads. These are Oyemekun-Oba Adesida road which links Ijare- Ilesha road through the town to Owo / Ado Benin express way, the second road is the road that link Ondo road to Arakale to Igbatoro, Oda road, Third is the Oke-Ijebu road to Oja Oba, while the road to Oke-Aro lead to Oja-Oba from Idanre. The Ilesha – Akure -Owo expressway is a one way motor road. In 2008, when little expansion of road were designed. These roads were micro- manage by local government and private land lords / residents There is palpable lack of information on the procedure for the provision of roads and drainages, extension of street lights, determination of road furniture, location of electric street poles and bus-stop use for transport services among others. The socio- economic characteristics of the transportation system was low and a one way traffic movement toward Oja-Oba and Alagbaka area. There are two main categories of roads in the study area, namely track C and D which are the two that run through Akure town from Owo/Ado to First bank junction to Oba Adesida street, Oja Oba area to Oyemekun street to FUTA / Road Block junction to link Ijare- Ilesha road. The other one runs from Ondo road to Arakale to NEPA junction to Oda / Igbatoro road, The Idanre-Akure road run through Oke-Aro to Arakale, Oja Oba area. It is the statutory responsibility of government to ensure proper management of roads and road infrastructures and easy transportation services by vehicles (Owoputi, 2016).

MATERIALS AND METHOD

The research design type employed in this study is a survey research. This was done through the use off-field observations, personal interviews, socio-economic characterization, and the application of remote Sensing and Geographic Information System (GIS). The use of Geographic Information System (GIS) was adopted for this study in the analysis of the intra road urban network where residential land use changes had occurred and in the identification of the major urban roads, which were areas where systematic daily movements oriented towards

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the city center take place. The data employed in the study were obtained via primary and secondary sources, the primary data includes data that were collected via reconnaissance survey of the study area, Questionnaire, Oral interview, field observation etc., The secondary source of data employed, include information obtained from documented works from journals, textbooks, articles, Road network maps etc.

Due to the homogeneity of the sample population, out of the 3000 houses in the sample frame, 150 houses were chosen to form the sample size which represented 5% of the total houses in the sampling frame which means the questionnaires were administered to only 150 houses from 19 streets along the identified major urban roads of the city center from the sample frame, the roads were Oyemekun Road, Oba Adesida Road, Arakale Road and Oba Osupa (Hospital) Road (figure 2). Houses within 200m radius from the roads were sampled to collect data relating to land use conversion from residential to other uses over time and other data relevant to the study travel behavior was directed to the daily commuters of the road through oral interview.

The questionnaire was prepared to enable us get adequate information relating to land use change and road development of the area and Geographic Information System (GIS) was used to map out the study area to know houses that fell within 200m radius from both side of the road [13]. The purposive sampling technique was used to administer the home based questionnaire to houses within 200m radius from both sides of the roads. Thus information regarding land use change was supplied by this category of respondents. Questionnaires analyzed using statistical packages and statistical tests (SPSS) were used to deduce the correlation between the indices of Land Use Change and the road network development. The analyzed data were further represented using simple descriptive statistics such as bar chart, pie chart, histogram to mention a few in order to elucidate information.
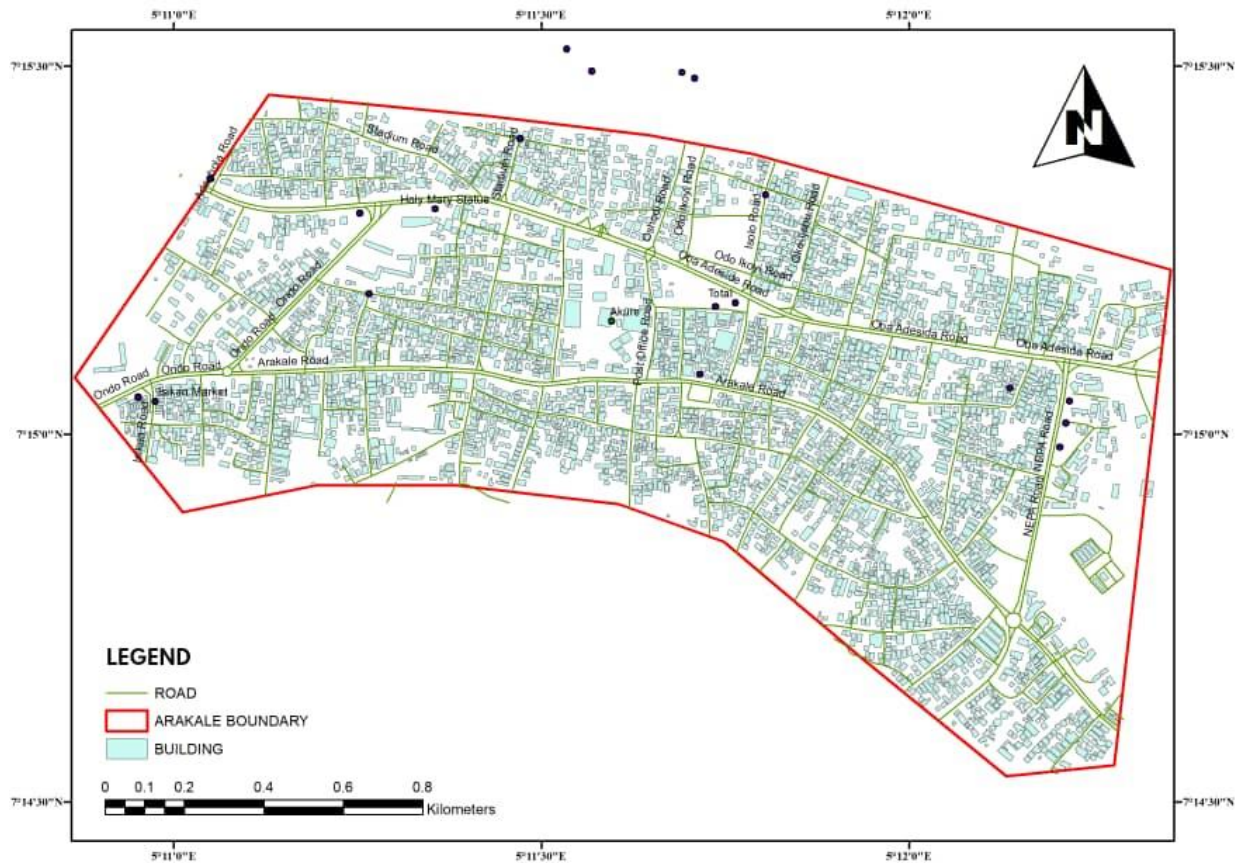
Figure: The study area
Source: Author's GIS digitization (2021)

DISCUSSION OF FINDINGS

The use of statistical package for social science (SPSS) was adopted as instrument for data analysis; findings were presented in tables and charts.

Major Intra Urban Roads in the Study Area

As presented in figure 3, those living along Oba Adesida Road represents 46.7% of the total respondents, 31.3% respondent's houses or shops fell along the Arakale Road, 20% of the respondents were along Oyemekun Road, while 2% were respondents who lived along Oba Osupa (hospital) Road.
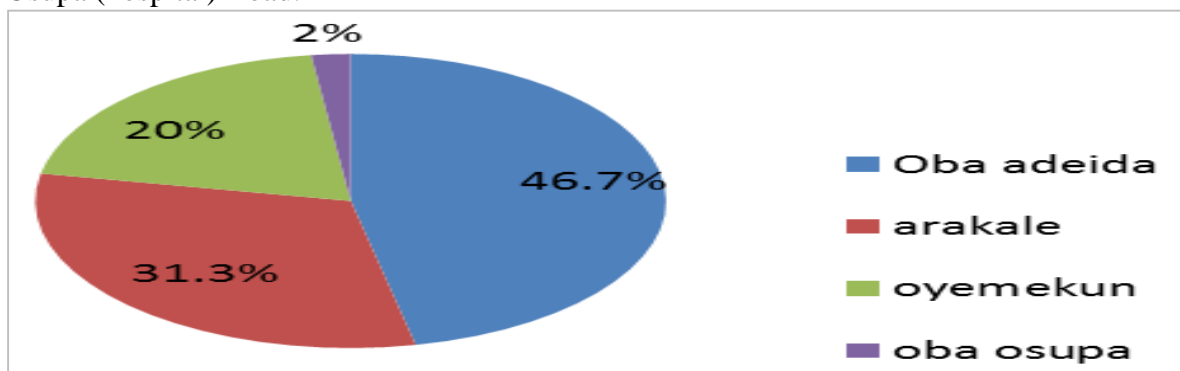

Figure 3: Identified roads in the study area

Figure 4: Oba Adesida Road at the city center
Source: Field work 2021

Land Use Type

The city center is characterized with various land uses, therefore it is very important to take note of the predominant land use types along the major roads. The findings in figure 5 revealed that 46.7% of the land uses were commercial land use, 26.7% of the land uses were of mixed use (residential and commercial, residential and public, commercial and public), residential land use took 20% of the total land uses while 6.6% represents religious land.The higher percentage represent commercials and mixed land use due to the nature of the areas and presence of the major roads in the areas, also as a result of the development of the these roads the residential areas that used to dominate the area were been changed to commercial land.
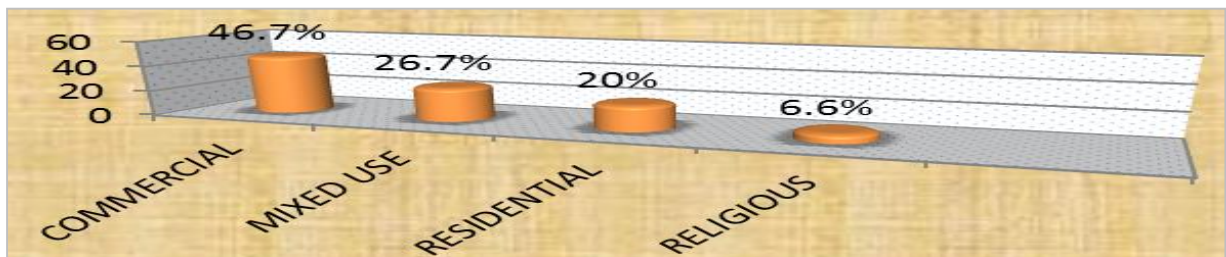

Figure 5: Land use type
Source: Field work 2021

Type of Land Use Change

From the analysis of the data shown in figure 6, it was discovered that buildings/lands that were converted from residential to commercial land use had a percentage of 78.9%, open space/ agricultural land use to commercial land use had a percentage of 10%, while others which includes land use change from residential to industrial land use, commercial land use to industrial, residential to religious use etc had a percentage of 11.1%. Apart from the fact that most residential land use had changed to commercial use because of high demand for commercial space as pictured in figure 6, there was evidence that development had expanded to use more of the agricultural and vacant land.
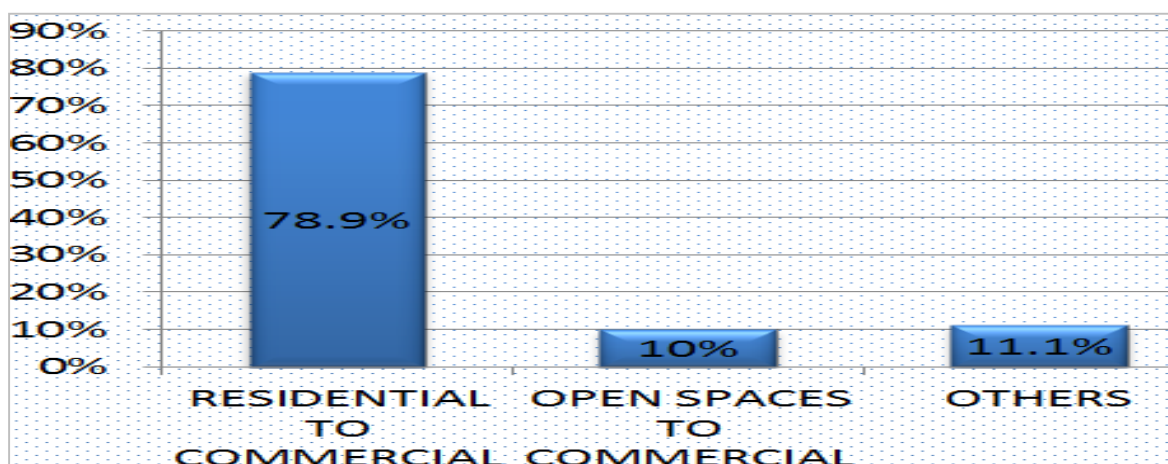
Figure 6: Type of Land use Change.

Figure 7: A building that had been changed from residential to commercial along Oba Adesida Road in the study area.
Source: Field work, 2021

Effect land Use Change on the Road Setback within the Study Area

Illustration in figure 8 below shows that in the process of changing the use of land to another, 50% of the respondents said the change in use of land had reduce the setback of their property from the main road that is they moved their properties more closer to the road, 20% indicated that there had been an increase in the setback of the road from the road, this might be a deliberate action by the respondents or stipulated planning standard to maintain a certain minimum distance from the road. 30% of the respondents indicated that there was no effect on the setback of their property from the road as a result of residential land use change.
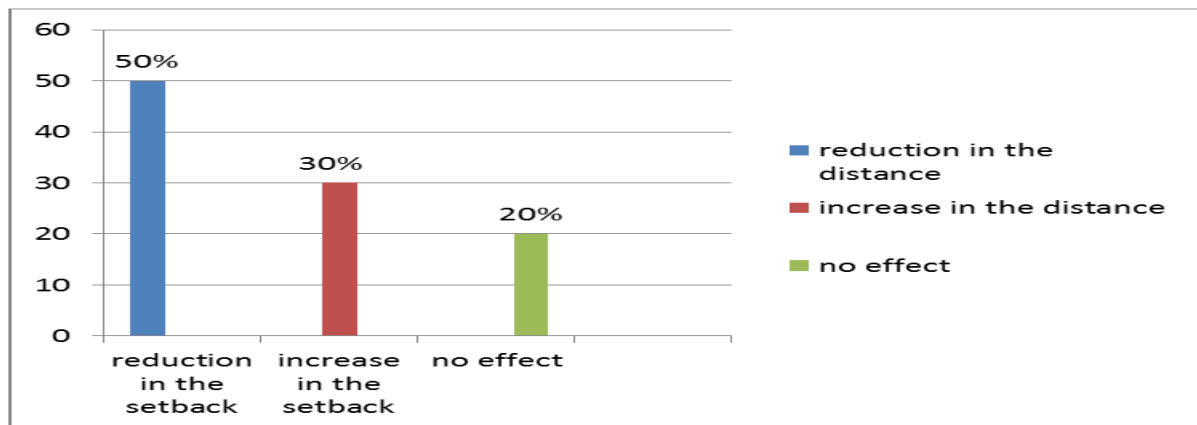
Figure 8: Effect of residential land use change on road setback in the study area
Source: Field work, 2021.

Effect of Residential Land Use Change on Road Network
Figure 9, indicates that 77.8% of the respondents agreed that as a result of residential land use change there was an increase in the traffic volume on the road, due to the commercial activities of the area, more trips generated were being generated from other parts of the city to the city center,. 22.2% of the respondents believed that the effect of residential land use change on the road network was in the expansion of the road. As the population of the city center increases which partly results in the change in the use of land, there was the need to expand the road to accommodate more commuters on the road.
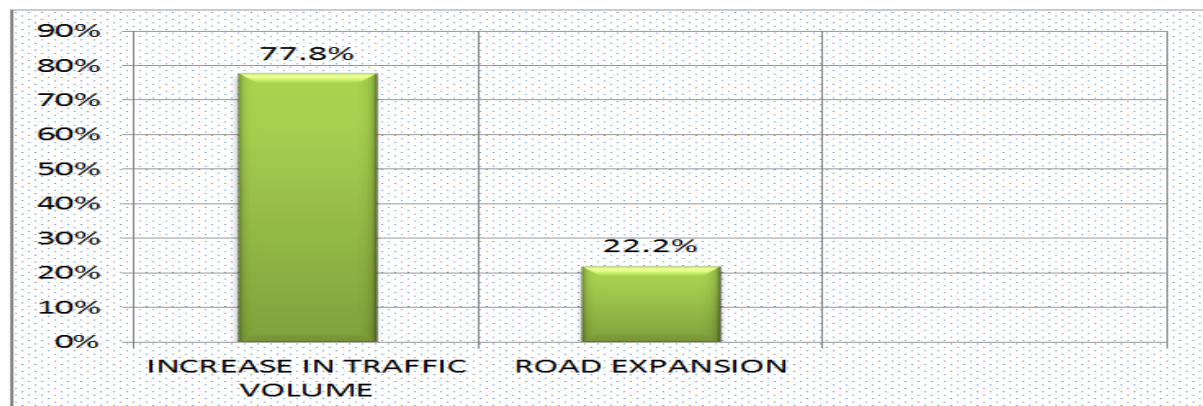

Figure 9: Effect of residential land use change on road network
Source: Field work, 2021

Effect of Change in Land Use on the Urban Sphere
Figure 10 indicates that 35.7% of the respondents indicated there had been new developments in the area as a result of change in land use (figure 11), 28.6% indicated that there was an increase in the commercial activities as a result of residential land use change, the urban sphere had been reshaped in terms of the pattern of development, type of building that were been developed etc. About 7.1% of the respondents affirmed that residential land use change had reshaped the urban sphere as it had led to more conversion of land, 7.1% of the respondents

indicated that population increase was the effect of residential land use change on the urban sphere, this was due to the fact that land use change itself was as a result of population increase, because as the population of the area increased there was more demand for land for various purposes, 21.4% of the respondents said the residential land use change had brought about the expansion and construction of new roads, apart from new developments and increase in the commercial activities that had been the most ways the urban sphere had been reshaped expansion of roads was still another way and residential land use change was indirectly responsible.
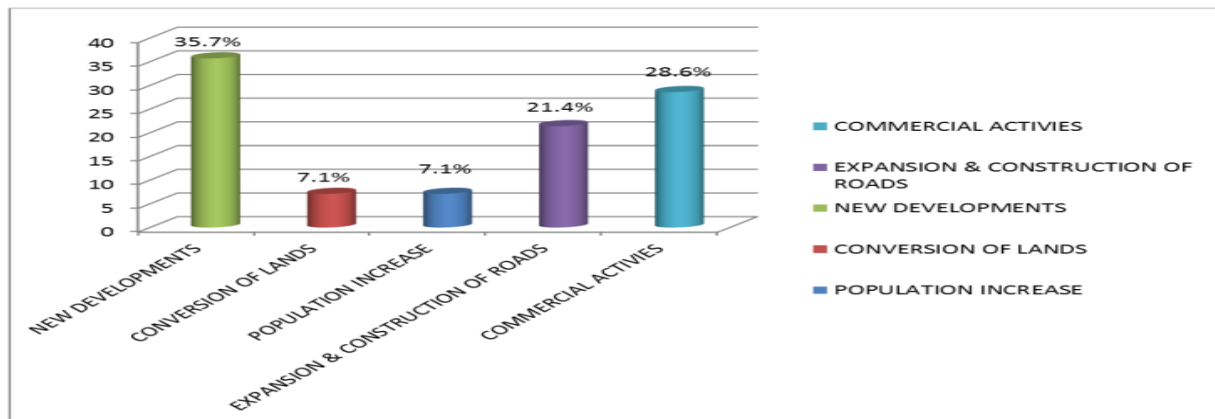

Figure 10: Effect change in land use on the urban sphere
Source: Field work, 2021

Figure 11: New commercial development along Arakale Road
Source: Field work, 2021

Effect of Re-development and Expansion of Major Intra Urban Road within the Study Area

There were several physical and socio economic effects of the redevelopment and expansion of the major intra urban roads that were sampled, these effects and their percentages are shown in table 1, 36.6% of the respondents believed that there had been increase in the commercial activities in the area, the development of any road in the city center would definitely lead to easy accessibility to commercial areas and would enhance trading commercial activities. 22% of the respondents said there had been change in the land use due to influx of people to the area

as a result of re-development of the road. Almost 14% of the respondents indicated that part of the effect of the redevelopment of the road had been increase in the traffic volume as more cars and taxis now commute the area, 7.3% of the respondents said that the recent reconstruction of the road had increased the use of the pedestrian bridge due to the recent construction of the road median (Table 1) to reduce road crossing, 6.7% of the respondents answered that there was road side trading as a result of the expansion in the size of road example was the road side trading that predominant around Olukayode-Texaco bus stop area along Oba Adesida road.

Redevelopment of the road had also led to increase in the population of the area in some ways according to 6.7% of the respondents that answered the questionnaires, the remaining 6.7% of the respondents said that there had been reduction in the congestion of cars along the roads as a result of the expansion of the roads, expansion of the Oba Ade Osupa road from a single carriage way to double carriage had reduce the congestion of cars in the area.

Table 1: Effect of re-development and expansion of major intra urban road within the study area

Effect of redevelopment of roads	Percentage	Frequency
Increase in Commercial activities	36.6	55
Increase in the population	6.7	10
Reduction in the congestion of cars	6.7	10
Road side trading	6.7	10
Change in the land use	22	33
Increase in the traffic volume	14	21
Use of the pedestrian bridge	7.3	11
Total	100	150

Source: Field work, 2021.

CONCLUSION AND RECOMMENDATION

Conclusion
The study investigated the impact of residential land use change on the intra urban road network of Akure which consisted the four major road of the city's center namely; Oyemekun road, Oba Adesida Road, Arakale Road, Oba Osupa (Hospital) road and had led to the conclusion that residential land use change was at the base of a series of interrelated activity taking place at the city center or can be said to be the basis of the level of development and other activities taking place at the city center. As the city grows, there is the influx of people into the city center from different parts of the city, mostly cause of the commercial value attached to the city which had led to more conversion of most residential land use along the roads of the city center. Another reason for the increase in commercial activities of this area was the good condition of the road and the simplicity in the network of the four roads that was studied.

Findings from the study also led to the conclusion that, the pattern of development at the city center was along the major intra urban roads, as more developments comes to the city center there was a tremendous impact on the network of the roads in terms of the volume of traffic on road and expansion and reconstruction of the roads to accommodate the effects that comes with

these developments for example the expansion of the Oba Osupa Road to double carriage road was in response to new developments that was starting to concentrate along the road, this pattern of development shows similarities with the sectorial model of Hoyt. However there were socio-economic and physical implications that residential land use change had on the environment as it was found out congestion, degradation of the environment, insecurity and increase in population were all negative effects of residential land use change. So there was need to develop strategies to make the city center sustainable.

Recommendation

Having found out the complications associated with residential land use change and its impact on road network and the environment, there was a need to suggest following solutions that would serve as strategies in ensuring a sustainable urban center.

Ensuring Proper Land Use Planning

It was evident that there isn't enough land use planning to ensure that there is harmony between different land uses in the area, although there is a control department at the state's physical planning ministry but the establishment of a Land use planning agency that would focus only the proper use of land and monitor land use changes will go a long way in enhancing land use planning, part of the responsibilities of this agency can also be in ensuring that residential land use change occurring along the major intra urban road.

Establishment of a Modern Commercial Center

Another solution to the problems of residential land use change is the establishment of a modern commercial center to replace the old shops and stores at the city center, this can be in form of shopping centers, malls, office complex with adequate space that can serve different commercial purpose. This would reduce residential land use change among people that are desperate to locate their businesses in the city center.

Preparation and Implementation of Transportation Master Plans

In order to solve the problems of effects of residential land use change on roads, the government might embark on the preparation of transportation master plans although the government did a great job in the provision of the pedestrian bridge and road median on OBA ADESIDA road, but this transportation master plan would also provide infrastructures necessary for the easy movement of people within the city center and also determine the roads that needed to be developed in terms of expansion or reconstruction

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