

ROAD TRANSPORT PROBLEMS IN KANO METROPOLIS, NIGERIA

BY

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**A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES,
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Declaration

I hereby declare that the work in this thesis titled “**Road transport problems in Kano Metropolis, Nigeria**” was performed by me in the Department of Geography under the supervision of Professor J.A. Ariyo and Dr. Ibrahim J. Musa. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this work has been presented for another degree or diploma at any institution.

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Certification

This thesis titled “**Road transport problems in Kano Metropolis, Nigeria**” meets the regulations governing the award of Master of Science Degree in Geography, Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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Dedication

This work is dedicated to my parents Ahmad Gwadabe and Khadija M. Dauda, my wife Khadija Muhammad and my children Khadija, Fatima, Ahmad, Abubakar, Abdullahi and Aisha.

Acknowledgments

I will start by expressing my thanks and gratitude to God, the Almighty for His mercy and for making it possible for me to complete this research.

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Abstract

Despite government efforts and huge investments in transport management in Kano Metropolis, the area still suffer from one form of transport problem or another. This study analyzed road transport problems in Kano Metropolis. The road maps of Kano metropolis for two different periods of 1990s and 2000s were used to produce topological maps of the area to detect the growth from 1990s to 2000s. And at selected traffic points on the road network of the study area information were collected on road designed capacity, available parking space and number of vehicles. In all, a sample of 542 commuters and 41 members of Kano State road transport authorities personnel were surveyed by means of a self-administered questionnaire. This study revealed that there has been some development in the road network of Kano metropolis, but the number of vehicles observed at the selected road junctions exceeded the designed capacity of the roads. The study further shows that trading activities along the roads and lack of effective planning are some of the factors obstructing efficient road transportation in urban Kano. The study recommends the relocation of Sabon Gari, Kwari, Singa, Kofar Wambai and Rimi markets from their present position. It was also suggested that more bus stops and parking space be provided to prevent indiscriminate parking and stopping at prohibited places.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Transport is the conveyance of people, goods, information and services from one geographical area to another for some purposes. It is of paramount importance in the life of any nation as it provides the means of interaction and integration of various regions and sectors of any country's economy (Arosanyin, 1998). The socio-economic development of any society depends to a large extent on the nature and structure of its transportation network since it provides the arteries through which the economic life stream of society flows (i.e. people, information, raw materials and finished products). Furthermore, transport plays a crucial role in the sustenance and expansion of ancient civilizations, in the circumnavigation of the globe, and in populating the "new world", (i.e. North and South America) and, in social, economic, political and military spheres of human life (Onakomaiya, 1998).

Transportation is inherently central to the development of nations, and is not only a necessity of life, but have a resultant effect on all aspects of our existence (Oyesiku, 2002). It provides access to goods, services and special activities to maintain a good quality of life. It is fundamental in breaking isolation and thus strengthening individual's capital base (World Bank, 2002 and Odufuwa, 2006).

Road transportation is a form of land transport which involves the movement of people and goods by motor cars, trucks, buses, motorcycles and bicycles (Areola *et al.*, 1999). In Nigeria, road transportation is the most popular and developed. In consequence, both the federal and state governments have

made enormous capital investment in the development of road transportation in the country, especially in the urban centres. In spite of the development of road transportation system in Nigeria as a whole and in urban centres in particular, the urban centres are still experiencing many transportation problems which, in Nigeria, include traffic congestion especially during working hours, decreasing travel speeds and deteriorating travel environment for pedestrians and non-motorized modes of transportation (Odeleye, 2001; Olayiwola *et al.*, 2005). This is because the provision of transport facilities is expanding at rates slower than the rates of growth of the urban population and expansion of urban area thus creating a wide margin between demand and supply of urban infrastructural facilities and services (Atubi and Onokala, 2003).

Urban transport is both an element and a catalyst in economic and social activities. It is the life wire of any urban environment and is central to the flow of knowledge, information and commercial goods. It provides the means by which people and goods are moved in space and time (Ladan, 2007). Improvement in urban transport will, therefore, facilitate economic growth, effectiveness of government activities and improved social interaction. The cities of Nigeria have become centres of problems of housing, unemployment, water supply and transportation, among others. These same urban centers are witnessing growth and development of different landuses, some compatible, some incompatible (Musa, 1994).

1.2 The Research Problem

In recent years, the growing volume of road traffic and its related problems in Nigeria have perhaps claimed more public attention than any other urban problems. The reason for this is quite clear. It is the most visible problem

that affects everybody in urban centers today. For instance, in metropolitan Kano, the fact that one owns a personal means of transport does not confer transportation comfort on such a person, because everyone experiences traffic delays and congestion problems on intra-urban roads.

Urban transportation has therefore received considerable attention in different parts of Nigeria. Its role in the development of Nigerian urban centers has been well articulated by Ogunsanya, (2002) where it is argued that it is both a “maker and breaker” of cities. Even though the provision of urban transport has enabled people to live further apart from their places of work, it has brought about an increase in the ownership and number of vehicles plying the roads and at the same time increased spatial distribution and diffusion of goods, services and ideas in the Nigerian urban space. On the other hand, urban transport has increased competition for urban space, traffic congestion problems, high transport cost, break in family ties, traffic accidents, environmental pollution and traffic noise (Aderamo, 2002).

The increase in the volume of vehicles plying intra-urban roads in recent years and the absence of urban mass transit which would have reduced the use of personal cars remained relatively undeveloped. These have accentuated transportation problems in most Nigerian urban centers. Urban Kano is growing at a very fast, both in population and in spatial terms, and the demand for public transport service is very high. Different studies on road transport problems in urban Kano have been undertaken, prominent among them is that by Haruna (1992), Zakari (1994) and Sani (1995). A review of these studies revealed that some of the roads are not motorable because they are untarred and are full of potholes resulting in congestions on the roads. Bad roads and indiscipline amongst the drivers are the root cause of traffic

congestion, as well as insufficient public transport to cope with rising demands. It was also revealed that traffic control officers undergo only crash training programmes so they could not cope with complex traffic problems. Also, at the time of their studies the population of urban Kano was put at 2,374,221 (NPC, 1991), with 1400 registered motor vehicles and about 18,000 registered motorcycle riders on the urban Kano roads (Kano state motor vehicle and motorcycle statistics unit, 1996).

Presently, the situation has changed, the number of people in urban Kano according to 2006 census was 2,836,323 (Official Gazette, 2009), with over 9800 registered motor vehicles and 6,500 registered tricycle riders, and about 1.9 registered motorcycle riders on the road on a daily basis (Kano State Societal Re-orientation 2009 census of motorcycles, tricycles and motor vehicles).

The main issue which this study seeks to address is the range of problems associated with the increase in the diversity and volume of vehicles on urban roads in Metropolitan Kano, despite all efforts by the state government in the area of road development. There is no doubt that the problems would not be the same in scope and magnitude as revealed in the studies carried out in the 1990s.

1.3 Study Aim and Objectives

The aim of this study is to assess road transport problems in urban Kano. This aim is to be achieved through the following specific objectives:

- i. To determine the changes that have taken place in the road network of Metropolitan Kano from the early 1990s to 2010

- ii. To determine the road capacity - volume ratio for a normal day at critical traffic congestion points in the metropolis
- iii. To assess the factors responsible for the identified transport problems in urban Kano
- iv. To profer solutions towards addressing the problems.

1.4 Scope of the Study

The spatial extent of this study is the Kano metropolitan area, which covers eight local government areas of Municipal, Gwale, Fagge, Dala, Nassarawa, Tarauni, Kumbotso and Ungogo. The focus is on problems associated with the use of road transport infrastructure by motor vehicles, motorcycles, tricycles, bicycles, carts and pedestrians.

1.5 Justification of the study

Kano city is the administrative centre of Kano State and the third largest city in Nigeria, after Ibadan and Lagos (The Web, 2007). In terms of population, it is the second most populous city in the country after Lagos (ibid, 2009). The reason why this study is necessary is that roads in metropolitan Kano require considerable attention because of the present growth in economic, commercial and socio-political activities that are taking place within urban Kano. The roads constitute the basic infrastructure for the daily movement of people, goods and services within the metropolis.

In addition transport services within Kano metropolis are mostly provided by motor vehicles, tricycles and motorcycles and the nature of operation of this transport modes involves conveyance of people and goods from one location to another for different purposes and sometimes result in the loss of lives and properties through accidents. It is hoped that the results

obtained from this study would go along way toward assisting policy makers and planners in the state in the provision and management of urban roads in order to ensure safety and comfort on the roads of the metropolis.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

Transportation is a major factor that encourages and facilitates urban agglomeration. If transportation were instantaneous and costless, we can interact from all corners of the globe (Heilbrum, 1981). In other words, there would be no cities if there was no need of transportation or friction of space. One of the primary aims of many transport planning efforts is to reduce spatial friction that separates people from the locations of various activities they perform (Ogbazi, 1992; Sohail, 2000). The city like human body is a series of connected parts and organs and as such, requires an efficient circulatory system in order to function as a living and vital organism.

Transportation is vital in the development of a city. It plays a pivotal role in facilitating and regulating the essential links between residence and employment, and between producers and users of goods and services, without which all meaningful interactions will be greatly reduced (Wang and Leh, 1993). For urban transport to achieve its primary role of efficiently moving passengers and goods from origin to destination it must have these features (i) a hierarchy of road network; (ii) officially designated stops spacing; (iii) route spacing; (iv) frequency of services and (v) adequate carrying capacity (Alan, 1995).

Transport has been likened to the human blood circulatory system whose healthy functioning is a necessary condition for the sustenance of human life (Adeniji, 2000). It provides a key to the understanding and operation of many other systems at many different scales. At one extreme, inter-continental transport provides essential communication between the advanced and

developing worlds, while local transport to rural markets in many parts of the Third World is a vital component in changing dynamic socio-economic structures (Barke and O'Hare, 1984).

Given the inevitability of transport as highlighted above, both government and international agencies (World Bank and DFID in some cases) have taken it upon themselves to support the provision of a befitting transport system at various levels of human endeavours so as to facilitate the movement of people, goods, information and services in and around the world. Arosanyin (1998) for examples, documented that for India to meet the supply of raw materials for improved industrialization, the government in her 5th Development Plan spent 20 percent of the development funds on transport. This was done through improvement of the railways and the ports and by increasing the shipping capacity of the nation while also increasing the number of the roads. In the same manner, the Nigerian government spent not less than 20 percent of total development plan budget on transport in the period (1962 - 1985) spanning two and half decades (FRN, 1981).

According to John *et al* (2005), developing countries have several factors in common that contribute to the severity of their transport problems. Overall, population growth and increasing urbanization have led to the rapid growth of large cities, which have been overwhelmed by the sudden increase in travel demand. The supply of transport infrastructure lagged far behind demand. Public sector finances in general are so limited that funding for transport improvements is grossly inadequate. Commenting on urban transport problems in Cameroon, Ambe (1997) opines that some of the most serious problems facing development planners and policy makers in the country reside in the transport sector and attributed the worrisome traffic congestion always

experienced in Duala and Younde (the two largest cities) to the colonial urban transport that was designed to serve colonial economic and administrative objectives and continually propagated by successive governments in the country. John *et al* (2005) conclude that although the nature and extent of transport problems vary from one country to another, virtually all developing countries suffer from the following:

- i. unplanned, haphazard development at the sub-urban fringe without adequate infrastructure, transport and other public services;
- ii. limited network of roads, often narrow, poorly maintained and unpaved;
- iii. extremely congested roads with an incompatible mix of both motorized and non-motorized vehicles traveling at widely different speeds;
- iv. rapidly increasing ownership and use of private cars and motorcycles;
- v. inadequate roadway accommodation for buses and non-motorized transport;
- vi. primitive or non-existent traffic control and management, often without the most basic street signage;
- vii. extremely high and rapidly rising traffic fatalities especially among pedestrians and motorcyclists;
- viii. overcrowded, uncomfortable, undependable, slow, transport; and
- ix. extremely high levels of transport related pollution, noise and other environmental impacts, especially in large cities.

2.2 The Concept of Network

Kansky (1963) defines network as the geometry of transport routes servicing an area. Whetham (1972) also defines it as a system of communication which man has created. He identifies three elements in a network, which are nodes or vertices, edge, route or links and the sub-graph or unconnected part. The nodes and linkages referred to the settlement and the road respectively. Much later Chapman (1979) improved on the definition and said a network may be either a static features at a point in time or a dynamic phenomenon, which is subjected to changes through time. He shows that a network grows with time.

In the process of making these elements (nodes and linkages) easily identifiable, a network is transformed into a graph called topological graph, which is a representation of the geometry of the network showing the relationships between nodes and linkages, without regards for scale and bends in the actual route.

A transport network provides a defined channel or channels for the flow of people, goods and services between places. These channels are in the form of physical structures like roads, railway lines or in the form of organized arranged air flight paths. Networks differ in their degree of connectivity and accessibility because settlements differ in their magnitude of socio-economic activities.

2.3 Transport and the City

Various principles have been advanced to explain the origin and existence of cities. The earliest submissions indicate the object of cities as military, political, cultural, religious and economic. More recent arguments by Carter (1977; 1983) also advanced the environmental, economic, military and

religious factors for the existence of cities were outlined. These conditions are no doubt crucial for the existence and growth of cities, but they do not explain the object of their existence. Aristotle in one of his works on politics had explained that "men came together in cities in order to live; they remain together in order to live the good life." This "good life" may be interpreted as the enjoyment of social surplus. Harvey (1973) argues that, "cities are formed through the geographic concentration of social surplus products". These submissions, however, are silent about the important role of transport. As far back as 1894, Cooley (cited in Chikolo, *et al.*, 2004: 3) had explained:

....two influences chiefly determine the location of cities: local facilities for production and location relative to transportation. The former of these acts mostly through the coarser and primary manufacturing industries. The finer manufactures seek the most convenient centres of distribution, that is, of transportation (page 7).

Ratzel 1903 (opcit, 2004: 3), a renowned German geographer emphasized this role of transport in the evolution of cities that "cities arise at the end of a route of transportation, or at a junction, where, for instance, a land transportation route ends and a waterway begins". But the process of city growth and development is complex. It involves several factors, none of which is capable of singularly effecting a change in the process of a city growth and development. In spite of this, transport stands out clearly as a catalyst in this process. The modern city is a centre of industry and commerce, a point for collecting, producing and distributing commodities of all kinds. Its location and the location of the various landuse within it must therefore be as accessible as possible. Cities do not produce all they require for their existence. They depend on the rural areas for food and raw materials. Goods manufactured in the cities must be distributed to spatially dispersed consumers. To pay for these goods, urban residents must go to work. To maintain city facilities, there must be an

efficient transport to move the municipal workers. Cities as we know them today are, therefore, not possible without transport which allows the movement of people and goods that make the city function. Modern cities in all their ramifications are, therefore, a product of transport (Orski, 1980).

2.4 Transport as Maker of Cities

Several attempts have been made to generalize the growth inducing influence of transport on cities. At the regional level, it has been found that the existing urban hierarchies owe their spatial pattern to transport. A good example is that demonstrated by the work of Rimmer (1977) to shows how the colonialists used the development of hybrid transport to penetrate the developing countries. The result is the restructuring of the pattern of city development and resource use. The first stage of this evolutionary process shows a developing country and a more developed country separated by a long and unconnected distance. The developing country is characterized by scattered small settlements linked with tracks, while the more developed country has relatively well built roads.

The second stage depicts contact by sea between the two countries and the development of foothold settlements in the form of trading ports and garrisons. The third stage involves some fundamental change in the transport system of both countries. The introduction of railways, roads and port facilities leads to diversification in the economy, especially in industrialization, and commercial agriculture. The fourth stage involves a further diversification of the economy. Modern transport system evolves and this leads to specialization, adaptation and selective investment in response to changing demand. The overall result is the restructuring of the pattern of city development and resource utilization, rapid urbanization with the initial and major urban centres

located along the coasts where maritime transport provides interaction linkage with the hinterland.

Apart from Rimmer (1977), the works of Taffee, Morrill and Gould (1963) and Vance (1970) have similarly explained the interrelationship between transport and the growth of cities. The Taffee, Morrill and Gould Model is particularly significant as it represents the parallel evolution of economic, political and city development in Ghana and Nigeria. A similar effect of transport also exists at the intra-city level. Cities are made up of different land uses. Transport helps to explain the locational arrangement of these land uses. In the pre-motorised period, when the means of movement was by foot, cities were essentially concentric with land use arranged in a circular form around the city centre. The use of horses, cars and trains led to a ribbon city form. The advent of the automobile in the cities results in complex city form with criss-crossing road networks and their complex traffic.

Daniels and Warnes (1983) put forward a theory to explain the spatio-temporal relationships that exist between transport and urban growth. This theory has five distinctive phases made of the:

- i. the pedestrian city;
- ii. the horse, bus and tramway city;
- iii. the early railway city;
- iv. the later rail and early bus city; and
- v. the car and other private transport city.

The pedestrian city represents the situation where the only means of transport in the urban area was by foot. Cities in this category were often

described as foot cities. The distinct morphology of the city was concentric where streets were usually narrow and the buildings were clustered in such a way that accessibility was possible only by foot. In some settlements, there were some wide routes which served as major streets leading to the palace and the city center. A dominant feature of the city at that time was an intermixture of land use a form of functional integration where the same building served as residence as well as manufacturing, industrial, commercial and storage center. The objective was to minimize the distance traversed in the daily movement between spatially separated urban land uses (Daniels and Warnes, 1983).

The horse-bus city is manifested in the construction of crude roads built to take wheeled chariots. A common means of movement in the city of ancient Rome were the horse drawn carts which competed with pedestrians going to work, to shop or for recreating in the use of the narrow street routes. The horse bus city was still concentric, as not much distance could still be traversed. Movement was dependent on the vagaries of the weather and the health of the beast of burden, which were prone to viral infection. Restricted by the friction of distance, cities then did not greatly expand geographically (opcit, 1983).

The development of the railway brought improved mobility as large number of people could reach distant places within a relatively short period. The introduction of this improved mode of transport led to city sprawl and a greater separation of the work place from residence. The concentric morphology of the city changed and growth occurred along the railway corridors leading to a sector pattern of urban form. Land use development along the railway corridors implied greater interaction and the need for improved mobility. The building of railways made this outward expansion possible (ibid, 1983).

This development of fast railways and the subsequent introduction of commuter bus system accentuated the expansion of the city along sector pattern. A notable development at this stage was that of special nuclei along the hedges, which is the result of the decentralization of the functions of the Central Business District (CBD) and the creation of minor ones. A significant feature of the railway age is that faster, more reliable and cheaper means of transportation became available and affordable. Thus, long distances could be traversed within a relatively short period. In the early days of the railway, the transport corridors in and out of the cities were, in effect, linear cities in their own right. They radiated from the centre like spokes of a wheel. Each spoke had the centre of the metropolis at one end, the country at the other end with a series of small centres in between. The outward expansion of cities was made possible first by the railways, then by electric trams (Hoyle and Knowles, 1998). The arrival of the motorcar and other forms of personal transport conferred different accessibility advantages on intra-city locations and encouraged further functional segregation and the development of specialized landuse (ibid, 1983). This theory, therefore, explains and shows that the more complex a city becomes the more sophisticated and complex the transport system which it requires.

The emerging trend of cities in Nigeria shows that initially, there was rural-urban migration. This migration swelled population of the city centre and its immediate concentric zones. As more people leave the country side to the city centre, the rent for space in the city centre increased. This development led to mass movement of city dwellers to the periphery as it become costly to live in the centre of the city (ibid, 1983).

2.5 Historical Development of Road Transportation in Nigeria

The first roads in Nigeria were built by the British colonialists for much the same reasons as the railway were, but more specifically: (i) feed and therefore complement the railway system, (ii) also carry goods directly to and from the ports, and (iii) serve administrative officers and missionaries in their opening up and administering the interior (Usman, 2005). Road development in Nigeria started later than railways, and proceeded in three phases as follows:

(i) The first road in Nigeria was the Ibadan - Oyo road built in 1905. This and other early twentieth century roads were inferior dirt roads, but they served the light traffic of those days. (ii) By 1930 when rail construction had virtually ceased, attention was turned, up till the civil war, to the extension of roads of all classes. Existing roads were widened and surfaced, new ones were built and bridges constructed over river obstacles. (iii) The post 1970 period, however, saw a road construction phase initiated by the military and directed towards: (a) widening and re-surfacing existing inter-urban roads, (b) construction of dual carriage ways and (c) building of ring roads and flyovers in dominant cities to ease traffic congestion (opcit, 2005: 153).

The 109-kilometre Lagos - Ibadan expressway which was opened in 1975, was the first of such roads to be built. It has a branch to Benin city, now already dualised up to Asaba in Delta State (Ileoje, 2004). From the mid-1980s emphasis on road development shifted to rural roads with the creation of the Directorate of Food, Roads and Rural Infrastructure (DFRRI). There was also the construction of dual carriage ways such as Abuja - Kaduna - Zaria-Kano expressway, the first in the north.

From May 1999, the significance of roads to economic growth and socio-political development was clearly recognized and underscored through a

number of policy initiatives to improve the hitherto deplorable roads and expand the national network. According to Ojabo (2007: 153):

...between June 1999 and December 2006, the Obasanjo administration completed 108 road and bridge projects covering 4,307.71 kilometers of roads. The sum of N99,011,325,212.31 was spent on the completed projects within the period under review. The administration embarked on the dualization of more highways than all other previous administrations. The setting up of the Federal Roads Maintenance Agency (FERMA) ensured continuous all years round maintenance/repairs of federal roads.

2.6 Intra-urban Traffic Problems in Nigeria

Movement of people, freight and information has continuously been a fundamental of human's societies (Rodrigue, 1998). Transport is significant to modern and rapidly developing urbanizing societies, for without it, no society can function well. The transport system in an urban area can be likened to a body's circulating system without which the body cannot be nourished and made to function properly (Adefolalu, 1993). Therefore, the functioning of urban economic activities depends to a large extent on the adequacy and efficiency of its transport system. Despite the significant role of transport in the life of any individual or society, there are problems that affect this sector and have made its operations sluggish and disappointing.

Hougendoorn and Bovy (2001) and North County Times (2004) observe that traffic flow, traffic growth and congestion are some of the main economic and societal problems related to transportation in industrialized countries. These problems manifest in the form of environmental pollution, delay, and accidents, landuse severance amongst others (Ogunsanya, 2006). Ayeni (1983) expressed the same view earlier observed that these problems are some of the

most pressing and perhaps most visible urban problems in Nigeria. Mabogunje (1974 in Ayeni, 1992) observes that one of the most serious problems in the cities is 'liveability' which manifest itself in form of environmental deteriorations, overloading and congestion.

Adefolalu (1977) observing the city of Lagos, stated that traffic congestion is the most serious and intractable. This explains why the transport sector in the city of Lagos is described as 'organized chaos' (Oni, 1992). But, the interest of geographers in urban transport issues as observed by Ayeni (1983) is to assess the nature, severity and dimensions of overall effect of these problems of transportation on urban residents. In examining the causes of urban traffic congestion Adefolalu (opcit) attributed the causes to inadequate road infrastructure to accommodate the increasing number of vehicles and poor driving habits. Roadside and on-road parking, roadside trading and total disregard for traffic regulations by road users are significant human contributions to urban traffic congestion.

However, Ogunsanya (2004) study in Ilorin stated that traffic delays, congestion and parking problems are mere symptoms of malfunctioning urban traffic system. Some of the basic reasons advanced for urban traffic problems are route inadequacy, human misuse of available road infrastructure, poor traffic management, absence of effective traffic and transportation planning and the unprecedented surge in urban travel demand.

Observing the effect of traffic congestion on the environment, Engwirth (1992) argued that automobiles emit pollutants into the urban environment and in the same vein, Filani (2000) stated that transport is believed to be one of the worst defilers of the environment. Its effect on the health of people, community values and environs ecology, to say the least, are deplorable. Automobiles

therefore are considered as the major source of more than 50 percent of pollution in Nigerian environment (Ogunsanya, 1985). In a similar way Ameyan (2002), reveals that transport that results in day long traffic congestion in the urban environment is road traffic accident. According to Aderamo (2002), urban environment are the most prone to motor traffic accidents because 75% of traffic accidents take place in built up areas of the cities. Odedokun (1991) looking beyond traffic buildup in Lagos as a result urban traffic accidents, stated that loss of present and future manpower resources, inability to fulfill social obligations, creation of widows, orphans among others are equally germane.

Consequently, varied suggestions have been made by various scholars on how to reduce the effects of traffic congestions. Some of these suggestions include improved traffic management and staggering of working hours (Adedimila, 1981), improvement in public mass transportation (Oduala, 1981), expansion of the road network (Okpala, 1981; Ogunsanya, 1985; 1989; Rahman, 2004), Contrary to the suggestion on the expansion of urban road networks, experience obtained in the US, UK, Japan and China have demonstrated that the solution to urban traffic congestion is not in the widening of existing road network or construction of more roads. Rather than solve the problems, expansion of road network or construction of more roads only offer temporary relief to motorist but in the long run induces more traffic. This paradox was noticed by Robert (1974) and North County Times (2004) when they observed that time and time again, new road space create extra traffic rather than reducing it. Since road way expansion is not a 'wonder drug to cure traffic jams'.

More recently, there has been the adoption of road pricing and car-pooling either through private initiative as in Singapore or through government

initiative as in the United States of America and Great Britain transport in 2000s. In the case of Tokyo, double deck freeways are being constructed in the middle of major surface streets. However, major cities including Amsterdam, Boston, Madrid, Melbourne and Paris are considering a more dramatic move by putting a significant portion of expressway travel underground in high technological tunnels in order to reduce the number of vehicles stuck in congestion, reduce noise and emission at street levels, and also permit traffic to bypass congested areas. Other suggested solutions to traffic reduction are the intermodal coordination (Hoyle and Smith, 1998; Badejo, 2006), traffic education (Ogunbodede, 2000), and the use of non-motorized transport (Hoyle and Smith, 1998; Ogunbodede, 2000).

2.7 The State of Road Transportation in Nigeria

According to Wikipedia (2006) Nigeria has a total of 194,394 km of roads, out of which 60,068 km (including 1,194km of expressways) are paved and 134,326km are unpaved. The running of the nation's road network was vested in the federal and state ministries of works. At the federal level, the ministry of works was not only recognized to make it wholly road-focused, but also a number of new institutions and legal regimes were introduced to achieve government's objectives in the sector.

Although there are some modern, well-maintained road arteries in Nigeria, roads are generally in poor condition, causing damage to vehicles and contributing to hazardous traffic conditions (ibid, 2007). This assertion was made by Ileoje (2004: 135) who states that “Nigerian roads are generally in bad shape even the expressways tend to develop bumps and pot holes which

impede traffic. The Benin-Lagos and Enugu - Port-Harcourt expressways are often in bad condition”.

In May 2006, only one side of the Kaduna-Kano dual carriage way was used from Likoro to Daka Tsalle, a distance of about 10kms. The side not been used was closed due to its bad condition. Traffic congestion continued to affect township roads in urban centres such as Kano, Lagos, Kaduna, Ibadan, Enugu, Port Harcourt etc. according to Ileoje (2004:135) “driving on congested roads, as is almost always the case in Lagos, can be a night mare- what, with the extremely slow traffic, careless and impatient road users, and the environmental pollution caused by car hooting and exhaust smoke emission”.

2.8 Emergence of Urban Roads in Nigeria

Before the advent of colonialism, Nigeria had already evolved its own system of cities. Sokoto before the end of the 19th century had emerged the most populous city in the northern part of the country. Cities like Kano, Kukawa, Gumel and Zaria, each with a population of about 60,000 inhabitants already existed and served as administrative and commercial nodes in the international trade activities across the Sahara. Along the caravan routes, donkeys, bullocks, camels and mules provided the means of transport that facilitated the growth of urban settlements. In the south, similar urban centres existed, such as Saki, Iseyin, Ogbomoso, Ede, Iwo, which were important administrative centres. Calabar, Port Harcourt and Lagos were coastal trading points and cities of the hinterland gained their importance through linkage with them. City growth and development were therefore along transportation routes, transport intersections, or at points where land transport route ends and water ways begins, confirming Ratzel's observation, and Rimmer's theory. The structure of traditional urban centres in Nigeria before the advent of the automobile was

concentric. Two or more roads sometimes radiated from the centre running to other outskirts of the town and a number of narrower roads led away from these main roads. According to Mabogunje (1968) these main roads were wide and impressive and served as major thoroughfares for pedestrians on market days and recreational areas for dancing and for processions.

The streets also served as the locale for the dispensation of justice and dissemination of knowledge. It was in the town square that the council of elders often met to adjudicate and settle disputes, discussed and debated thorny issues and dispersed wisdom. Besides, the palace of the Oba, Obi, or Emir was always situated at the city centre. This is apart from its being the commercial, administrative and recreational centre. People settled around this centre in a concentric form to minimize the distance travelled in the absence of mechanical transport. Mabogunje (*ibid*) noted a similar situation for Ibadan, Schwerdtfeger (1972) in reference to Zaria and Ogunsanya and Aderamo (1992) in the case of Ilorin. But these ancient cities of Nigeria were very small in size compared with modern cities. For example, Bowen 1856 (cited in Chikolo, *et al.*, 2004) reported that Ibadan then had a population of 70,000; Lagos 20,000; Ogbomoso 25,000; Abeokuta 60,000; and Oyo 25,000. The cities were well planned with footpaths linking major activity areas. In Ibadan, Mabogunje (*ibid*) reported how much concentric structure was broken by transport. Gbagi was the central area and two roads ran through it. The first ran north to south by Mapo and the second ran west to east of Gbagi. These roads formed the axis along which development occurred in a sector form. On Lagos Island the construction of Marina road in 1861 by MC Cosky, a merchant, and of Broad Street shortly after, marked the beginning of sector development. A similar situation has been reported for Jos, Ile-Ife, Ilesha, Kano and Zaria (Oyeleye, 2001). As

transportation developed breaking the walls of the traditional cities, so also did cities began to develop, sprawling far out from the nucleus of the city.

2.9 The Case of Kano

The role of transport in our daily activities cannot be overemphasized and without it, the necessities of life would be difficult to achieve. As wonderful as the role of transport may be in our daily activities, it has been noted to possess a myriad of negative effects. This is why Clark (1958) described transport as the maker and breaker of cities. Ogunsanya (2002) also reiterated what Clark observed and confirmed how transport had built cities over the years in some urban areas in Nigeria and how it has gradually destroyed them in other areas.

The basis for trip generation rests on the locational structure of different, but complementary activities which are variedly located in space. Landuse activities, therefore, have impacts on transport hence, the concept of spatial interaction is very important in the study of the relationship of phenomena in space. In the quest for the basis of spatial interaction, Ullman (1956) postulated three concepts, which are relevant to this study. These are complementarity, intervening opportunity and transferability.

- i. Complementarity - This implies areal differentiation in natural resources and the existence of supply and demand in different areas, which can result in interaction between two distance places. However, factors influencing interaction go beyond areal differentiation. Ullman (1973: 376) opined that "for interaction to take place, there must be a demand in one place and a supply at another, and the demand and supply must be specifically complementary."

For instance, Metropolitan Kano being a commercial and an industrial centre constitutes both a supply and a demand area for various goods and services for people in other parts of the state, country as a whole and even the neighbouring countries.

Industrial products are highly produced in urban Kano whereas in places like Gombe, Bauchi, Yobe, Jigawa, Katsina, Zamfara for example, there is a high demand for such products. Urban Kano therefore serves as a centre for such products. Little wonder therefore that Kano serves as a conveying zone for buyers and sellers of the commodities to be transported to these areas of high demand regardless of the distance that has to be covered.

Narrowing down to within Kano Metropolitan area, one finds that the major markets and most shops are located at areas called Sabon-Gari Market, Singa, Kurmi, Kwari, Kofar Wambai, Rimi Markets, though there are other markets and shops located all over the urban Kano. But those above are the major centres for all business activities which attract people from all over Nigeria and our neighbouring countries like Niger, Tchad and Cameroon.

Consumers from other parts of urban Kano such as Hotoro, Gyadi-Gyadi, Yakasai, Gwagwarwa, Gwale, Kundila, Mariri, Tudun Wada Naibawa, e.t.c. normally travel to those markets to meet their daily needs. This is because there exist a complementary relationship between their needs and what is available at those markets mentioned above. Also, workers living at the centre of the city need to move to their places of work located at the outskirts of the city to meet their supply of labour and demand for income.

ii. Intervening opportunities - This has to do with the presence of an alternative supply of any commodity. In a sense, intervening opportunities are spatial sponges soaking up potential interaction between

complementary places. For instance, people from Mariri may consider it unnecessary to go to Sabon Gari market to buy foodstuffs if they could get such foodstuffs at Tarauni market. Also, a meat seller from Bachirawa would prefer to sell his meat at RijiyarLemo market rather than carrying such meat to Sabon-Gari market where demand is comparatively higher. In these two examples, Tarauni and Rijiyar Lemo markets serves as intervening opportunities.

- iii. Transferability- Besides complementarity and intervening opportunity, the third condition under which spatial interaction occurs is transferability, the means to overcome the friction of distance. Transferability is measured in real time and money costs. If the time and money of transversing a distance are too large, the movement will not take place despite perfect complementarity and the absence of intervening opportunities. Instead of reaping the benefits of interaction people will stay where they are and continue unchanged the life that they know. For example, a student living at Bayero University, Kano old site, may consider it uneconomical and time wasting to travel to Sabon-Gari Market if he has no money to pay the taxi fares even if supply at Sabon-Gari Market complements his demand and also even if there is an absence of intervening opportunity. In this example, transferability is affected by two factors, namely, availability of transport and ability to pay for the transport (in money and time terms).

Urban Kano has grown and is still growing very fast; many areas have seen the concentration of diverse economic activities necessitating the movement of people from one part of the metropolis to another. Previous studies have highlighted some problems of road transport in the city. Unlike previous studies, the present one takes a holistic approach to examining the problems by considering their physical, operational and institutional dimensions.

CHAPTER THREE

THE STUDY AREA AND METHODOLOGY

3.1 Location and History

Kano Metropolis (Fig. 3.1) is located on latitude 12⁰⁰' N and longitude 8⁰³¹'E. Kano has been an ancient city of Hausa people, long before the 10th century A.D. The man whom the city was named after, was a blacksmith as well as a hunter by name Kano. He lived in the village of Gaya (now headquarters of Gaya local Government Area) before his migration to Dutsen Dala (Dala hills) as well as Gwauron Dutse hill where he used to collect iron for his work, then hunt animals and return to his station at Gaya.

It was later he decided to leave Gaya and come to the present site Kano city and settled at Gwauron Dutse with his family. Kano was a Bamaguje by tribe, which formed the present Hausa race. He was an idol worshipper and had his temple where he worshiped his idol named "Tsimbirbira". Kano was a great warrior, blacksmith and spiritualist. He established an iron industry which attracted people from all walks of life to buy and sell there. It was after his death that the settlement was named after him. Where he lived is still part of the ancient Kano city known as Dala and Gwuron Dutse hills (Haruna, 1992: 7).

3.2 The Physical Setting

3.2.1 Geology

The geological composition of Kano is similar to those of other states located in the same geographical belt. It is underlain mainly by quartzite meta-sediments and the Basement Complex rocks of the Pre-Cambrian age. Action of prolonged denudation resulted in deep clay soil and laterite compositions. Regolithic hills are outcrops of the upland plains (Okeagu, *et al.*, 2004: 18).

3.2.2 Relief

Relief ranges from lower plains of about 500metres to the highlands of over 1000metres above sea level. Scenery is characterized by picturesque grouped hills, sandy plains alluvial channels and some stand-alone rock formations (op.cit, 2004: 18).

3.2.3 Drainage

Metropolitan Kano is drained by a network of rivers and rivelets including Challawa River, Kano River, Jakara River (Op.cit, 2004: 18).

3.2.4 Soils

Soils of urban Kano are mostly Ferruginous tropical soils and aerosols derived from the Basement complex rocks. Most of the soils have undergone prolonged weathering to produce fairly deep profiles, which have been subjected to lateralization in some cases (Okeagu, *et al.*, 2004: 19).

3.2.5 Climate

Climate of Kano metropolis is classified as tropical wet and dry (Koppen, 1923). It is characterized by four distinct seasons, namely; the dry and cool season, which lasts from mid-November to February and marked by occasional dusty harmattan haze; a dry and hot transitional period between the harmattan season and the wet season which lasts from March till May; the wet and warm season follows the hot season and lasts till September; and lastly the dry and warm-takes over till mid-November (Essiet and Tudun Wada, 1999: 56).

3.2.5.1 Rainfall

Rainfall is a very critical weather element in metropolitan Kano. This is because of its deficiency during the dry season. The rainfall occur during

summer months which starts mostly from May and ends in October with rain days ranging between 150-200, and an annual rainfall of over 1000mm. Amount, duration, and frequency of rainfall vary widely from one year to another. Highest amount of rainfall is received usually from July ending and through August every year. Rainfall is characterized by strong wind, thunder and lightening. Showers are intense and last for short periods (IAR, 2012). Over the years the rainy season is characterised by late annuals, early ceasations and long spells of drought of upto 21 days (NIMET, 2012).

3.2.5.2 Temperature

Temperatures of Kano Metropolis range between 26^oC and 34^oC. Unlike the rainfall, there is little variation in temperature from one year to another, but the mean temperature value could be as low as 20^oC during the harmattan period especially at night and upto 40^oC + in April – May. (IAR, 2012).

3.3 The Human Setting

3.3.1 Population

Kano metropolis is the second most populous urban centre in the country after Lagos with nearly three million people. The population density at the city centres and its environs rises to about 10,000 persons per square kilometer (ibid, 2009).

Population of metropolitan Kano is predominantly Hausa – Fulani. Nupe and Kanuri tribesmen occupy a distinct part of the old city. Yorubas and Igbos are also found in large numbers. Koreans, Lebanese and Shuwa Arabs communities have been assimilated into the culture of the Kanawa (the people of Kano) as a result of trade, Islam and marriages. Urban Kano, like Lagos in the south is the melting point of Nigeria ethnic diversity (op-cit, 2004: 19).

3.3.2 Settlement

Metropolitan Kano has two distinct types of settlement pattern. These two are the traditional nucleated pattern, which is prevalent within the walled city of Kano. Houses are irregular in shape because some are round, while others are either rectangular or square in shape. Some of these houses are roofed with mud. Streets are inter-connected but very narrow and this causes problem of space for parking vehicles within the old city.

Second type of settlement patterns found within Kano metropolis is the modern type of nucleated settlement. Sabon Gari is one of such area with this type of settlement pattern is Sabon Gari. Sabon gari is a high density modern settlement, although the streets are wide. Another area of modern settlement pattern with low housing density is found in Nassarawa, Kundila, Sharada e.t.c. where the streets are well lined and the houses are attached to each other. Streets are wider and tarred and also interconnected. Houses here are rectangular or square in shape and are roofed with corrugated iron sheets (ibid, 1992: 10).

3.3.3 Economy

Kano Metropolis is the commercial nerve centre of Kano State and is noted for its famous markets and it is the most leading industrial centre in the north. Trading articles in Metropolitan Kano include leather goods, local crafts as well as dyed textile materials (ibid, 2004: 20).

3.3.4 Transport and Communication

Urban Kano is one of the renowned centers of the trans-Sahara trade with North Africa employing camel caravans across the Sahara Desert. The British occupation of Kano in 1904 changed the direction of trade. The means of communication improved as Kano became accessible by road in 1906, by rail

1911 and by air in the late 1940s. There are direct road transport services to several states capitals and Abuja and to all the local government, headquarters in the state. Kano is a major railway terminus extending to Nguru. It is also the gateway to Nigeria by air from Europe and the Middle East (ibid, 2004: 20).

3.4 Changes in the road network of Kano Metropolis

The type of data used here were extracted largely from road maps showing the road network of the metropolis for two different periods of 1990s and 2000s (Appendix 1 & 2). These maps were sourced from Kano State Ministry of Land and Physical Planning. The alpha, beta and shimbil indices were calculated from the road network maps to determine changes that have taken place in the connectivity of the road network of Kano Metropolis.

3.5 Determination of road capacity-volume ratio in Kano Metropolis

At selected traffic points on the road network of the study areas information were collected on:

- i. road designed capacity (number of vehicles to be carried);
- ii. available parking space along the road;
- iii. number of motor vehicles observed (buses, cars, taxis and trucks);
- iv. number of tricycles observed; and
- v. number of motorcycles and bicycles observed.

The information collected about the items shown above were entered into a table similar to Table 3.1 from which the capacity-volume ratio at each point were determined.

Table 3.1: An example of daily traffic count at Makwarari and Gwawzo Road Junction

Road designed capacity (No. of vehicles to be carried)	Available parking space along the road	Number of motor vehicles observed (buses, cars, taxis and trucks)	Number of tricycles observed	Number of motorcycles and bicycles observed

3.6 Administration of Questionnaire

A sample of 600 commuters and 50 Kano State road transport authority personnel were targeted to be surveyed by means of a self administered questionnaire. Out of these, 542 commuters and 41 members of the Kano State road transport authority personnel returned the completed questionnaire respectively.

Table 3.2 provides information on the areas covered, number of commuters that were interviewed directly or indirectly in each of the Metropolitan local government areas.

Table 3.2: Number of Commuters Interviewed and Areas Covered

Local govt. Area	No of Questions Issued	Method	No of Questions Returned	%	Areas Covered for Interview
Dala	75	Indirect	69	12.7	Dala primary school and Mumbayya house
Nassarawa	75	Indirect	68	12.5	Day Science College K/Nassarawa and Audu Bako Secretariat.
Gwale	75	Indirect	67	12.4	Aminu Kano School of legal studies
Fagge	75	Indirect	65	11.9	Fagge A & B and Fagge A Primary School
Uugogo	75	Indirect	67	12.4	GTC Ungogo and R/Lemo Qtrs
Kumbotso	75	Direct	70	12.9	Saadatu Rimi Col. of Educ.
Tarauni	75	Indirect	68	12.5	G.S.S Tarauni and Hoforo Dan Marke Qtrs
Municipal	75	Indirect	68	12.5	Rumfa College and Municipal Zonal Educ. Office
Total	600		542	99.8	

Source: Author's Fieldwork, 2011

3.6.1 Assessing the factors responsible for road traffic problems

The physical inspection of the municipal roads was carried out to determine the condition of:

- i. parking facilities;
- ii. quality of pavement;
- iii. traffic control devices;
- iv. pedestrian walkways;
- v. drainage;
- vi. indiscriminate parking;
- vii. trading activities by the road side; and
- viii. untarred roads.

The structured questionnaire which was used to survey road transport authorities in Kano State solicited the following information:

- i. transport development policy;
- ii. financing of road development;
- iii. effectiveness of transport planning;
- iv. existence of overlaps and conflicts among agencies responsible for planning and implementing transport solutions; and
- v. adequacy of skilled personnel to manage road transport in Kano State.

For this purpose the transport management institutions whose officials were interviewed are Kano State Ministry of Land and Physical Planning, Kano State Ministry of Transport, Works and Housing and Kano State Urban Planning and Development Authority.

Table 3.3: Members of Kano State Road Transport Authorities Personnel Interviewed and Areas Covered.

Ministry/Parastatals	No of Questions Issued	Method	No of Questions Returned	%	Areas Covered for Interview
Kano State Ministry of Land and Physical Planning	15	Direct	13	31.2	Department of physical planning
Kano State Ministry of Transport Works and Housing	20	Direct	17	41.5	Department of transport
Kano State Urban Planning and Development Authority (KNUPDA)	15	Direct	11	26.8	Department of urban Planning and Engineering Department
Total	50		41	100	

Source: Author's Fieldwork, 2011

Table 3.3 provides information on the number of ministries/parastatals covered, and the personnel of road transport authorities that were interviewed directly or indirectly.

3.7 Method of Data Analysis

To achieve objective one, the alpha, beta and shimbel indices were used to determine the changes that have taken place in the road network of Kano Metropolis in the 1990s and 2000s. The indices are defined thus:

Alpha index (α): This is the ratio of actual number of circuits to the number of maximum circuits in the network (Chou, 1999), where a circuit is a loop in the network and is composed of nodes and links.

This quantity is useful to evaluative network structure in terms of the number of the ways that proceed from one node to another and can be used in comparing and differentiating the connectivity levels of different networks or a network over several time periods. The alpha is given by the formula

$$\alpha = \frac{e-v+1}{2v-5}$$

Where

e = number of link (or edge)
v = node or (vertex) in a circuit

The values of the alpha range from 0 to 1.

Beta index (β): This is the ratio between the number of links and the number of nodes. It indicates the average number of links (edges) or roads leading into or out of each node (vertices). Connectivity increases as beta increases. Beta index is given by the formula $\beta = e/v$ it forms some useful common yardsticks for comparison between networks, given by the formula:

Shimbel index: This is a summation of all the shortest path distance among all points (vertex or node) in a defined zone or circuit. This is useful in evaluating concentrated levels of transportation networks in urban transportation analysis.

To achieve objectives two, three and four, descriptive statistics, using frequency distribution tables, charts, ratios and percentages were used to summarize the data.

3.8 Challenges Encountered During the Field Survey

A number of problems were encountered during the field survey, notable among them are financial constraints, time limitation, unwillingness of some identified respondents to cooperate in the research endeavour. This category of people felt it was dangerous disclosing one's private life to a stranger. In general however, there was a high level of cooperation of the targeted population in the research endeavour.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

This chapter presents the results obtained from the field investigations. In so doing, some indices commonly employed in transport network analysis i.e. alpha, beta and shimbel indices and descriptive statistics were used to analyzed and discussed the results obtained.

4.1 Change in the road network of Kano Metropolis

This involves the use of topological maps to calculate the level of accessibility and connectively of the roads using beta, alpha and shimbel indices. Appendix I and II shows the road network in 1990s and 2000s.

4.1.1 Topological Maps

One of the most important concepts used in geography is accessibility (Nagle, 2000). Accessibility refers to the ease of getting to a place measured in terms of distance, cost or time. Topological maps are simplified maps which show the relative position of a place and its accessibility to other places. This study chose to use this concept because it possesses the following strength

- i. it allows for comparison;
- ii. the statistics involved are simple;
- iii. it provide simple theory; and
- iv. it simplifies complex patterns.

For Metropolitan Kano, the following codes were used, as shown in Table 4.1, Figure 4.1 shows the topological map of road network in 1990s and Table 4.2 gives the measured values.

Table 4.1: Codes used in the study of 1990s

1. Gidan Radio - GR
2. Civic Centre Junction - CC
3. Filin Fakin - FF
4. Bello Road Junction - BR
5. Kwari Junction - KW
6. Fagge Mosque Round About - FM
7. Galadima Road Junction - GL
8. Yankura Junction - YKR
9. Bata Round about - BT
10. Igbo Road Junction - IGB
11. Beirut Road Junction - BRT
12. Railway Junction - RW
13. Murtala Muhammad Junction (CFAO) - MM
14. Triumph Junction - TR
15. Kofar Mazugal Junction - KM
16. Hajj Camp Junction - HC
17. Federal Secretariat Round About - FS
18. Kofar Rulwa Junction - KR
19. Mumbayya House Junction - MBY
20. Taludu Round About - TUD
21. Gidan Murtala Round About -GM
22. Kofar Danagundi Junction - KD
23. Kwanar Hauren Wanki - KHW
24. Kofar Gadon Kaya - KK
25. Kofar Famfo - KF
26. KofarKabuga - KKB
27. Madobi Raid Round about - MDB

28. Matan Fada Junction - MFD
29. School of Technology Junction - SOT
30. Land and Survey Junction - LAS
31. Magwan Junction - MG
32. Government House - GH
33. Sokoto Road Junction - SKT
34. Gidan Bello Maitama - GBM
35. Wudil Road Junction - WDL
36. Kwanar Maggi - KMG
37. Kwanar Sabo - KWS
38. Kofar Mata - KMT
39. Dangi Round about- DG
40. Zoo Road by Court Road Junction - ZRC
41. Gidan Buhari - GB
42. Total - TT
43. Gyadi - Gyadi - GG
44. AKTH by Court Road Junction - ACR
45. Unguwa Uku Junction - UKU

Source: Author's Fieldwork, 2011

Table 4.2: Matrix to show connectivity of nodes in Kano Metropolis in 1990s

	GR	C C	FF	BR	K W	F M	G L	YK R	B T	IGB O	B R	R W	M M	T R	K M	H C	FS	K R	MB Y	TU D	G M	K D
GR	-	1	2	3	4	5	4	5	6	7	2	3	4	3	4	5	6	7	8	9	1	2
CC	1	-	1	2	3	4	5	6	7	8	1	2	3	5	6	7	5	6	7	8	2	3
FF	2	1	-	1	2	3	4	5	6	7	2	3	4	5	6	7	8	9	10	11	3	4
BR	3	2	1	-	1	2	3	4	5	6	3	4	5	6	7	8	9	10	11	12	4	5
KW	4	3	2	1	-	1	2	3	4	5	4	5	6	7	8	9	10	11	12	13	5	6
FM	5	4	3	2	1	-	1	2	3	4	5	6	4	1	2	3	4	5	6	7	5	6
GL	6	5	4	3	2	1	-	1	2	3	2	5	3	2	3	4	5	6	7	8	7	8
YKR	7	6	5	4	3	2	1	-	1	2	3	4	2	2	3	4	3	4	5	6	4	3
BT	8	7	6	5	4	3	2	1	-	1	5	6	1	3	4	5	6	7	8	9	7	8
IGB	9	8	7	6	5	4	3	2	1	-	7	8	2	4	5	6	7	8	9	10	8	9
VR	1	2	3	7	6	5	4	5	6	7	-	1	3	6	7	8	9	10	11	12	3	4
RW	10	9	8	7	6	5	4	3	2	3	1	-	1	5	6	7	8	9	10	11	4	5
MM	9	8	7	6	5	4	3	2	1	2	2	1	-	4	5	6	7	8	9	10	5	6
TR	9	8	7	6	5	4	3	2	1	2	2	1	5	-	1	2	3	4	5	6	6	7
KM	7	6	5	4	3	2	3	4	5	6	8	7	6	1	-	1	2	3	4	5	7	8
HC	9	10	11	12	4	3	4	5	9	5	13	12	11	2	1	-	1	2	7	6	11	10
FS	10	7	6	6	5	3	4	5	6	7	10	9	8	3	2	1	-	1	2	3	9	10
KR	10	9	8	7	6	5	6	7	8	9	11	10	9	4	3	2	1	-	1	2	7	6
MBY	11	10	9	8	7	6	7	8	9	10	12	11	10	5	4	3	2	1	-	1	8	7
TUD	12	11	10	9	8	7	11	9	10	11	13	12	11	10	5	4	3	2	1	-	6	5
GM	1	2	3	4	5	5	4	3	6	5	4	3	2	4	8	10	9	8	7	6	-	1
KD	3	4	5	4	5	3	6	7	8	9	5	4	5	6	7	8	7	6	5	3	1	-

Table 4.2 Continued

	KHW	KK	KF	KBG	MDB	MF	SOT	LAS	MGW	GH	SKT	GBM	WDL	KM	KS	Total Shimbel Index
GR	3	4	5	6	3	4	5	6	5	6	7	8	9	10	11	183
CC	4	5	6	7	2	3	4	5	5	6	7	8	9	11	12	186
FF	5	6	7	8	9	1	2	3	4	5	6	7	8	9	10	193
BR	6	7	8	9	10	2	3	4	5	6	7	8	9	10	11	216
KW	7	8	9	10	11	3	4	5	6	7	8	9	10	11	12	241
FM	8	9	11	11	12	4	5	6	7	8	9	10	11	7	13	214
GL	9	10	9	12	13	5	6	7	8	9	10	11	12	10	9	229
YKR	7	8	8	10	11	6	7	8	9	6	7	8	9	11	10	234
BT	6	7	7	9	10	7	8	9	10	11	10	9	8	12	13	243
IGBO	5	6	6	8	9	8	9	10	11	9	10	11	12	13	12	268
VR	4	5	7	7	8	9	10	11	12	13	7	8	9	8	11	250
RW	5	6	8	8	9	3	4	5	6	7	8	9	10	6	7	224
MM	6	7	9	9	10	4	5	6	7	8	9	10	11	12	13	235
TR	7	8	10	10	11	5	6	7	8	9	10	11	12	6	5	213
KM	12	9	14	11	12	6	7	8	9	11	10	9	8	7	6	228
HC	3	13	5	15	16	2	3	4	6	7	7	19	18	17	16	318
FS	4	4	6	6	7	3	4	8	9	10	11	12	13	14	15	239
KR	5	5	7	7	8	4	5	6	7	8	9	10	11	6	9	236
MBY	6	6	8	8	9	5	6	7	8	9	10	11	12	7	5	229
TUD	4	7	6	9	10	8	11	8	9	10	11	12	13	14	5	319
GM	5	3	4	5	6	7	6	5	4	6	5	4	3	4	5	180
KD	4	5	4	5	6	5	6	7	3	4	5	2	6	4	4	175

Table 4.2 Continued

	GR	CC	FF	BR	KW	FM	GL	YKR	BT	IGBO	BR	RW	MM	TR	KM	HC	FS	KR	MBY	TUD	GM	KD
KHW	3	4	5	6	7	8	9	10	8	9	5	12	9	8	7	6	5	4	3	2	2	1
KK	4	5	6	7	8	9	11	12	13	14	13	12	11	9	8	7	6	5	4	3	3	2
KF	4	5	6	7	8	9	10	11	12	13	11	13	12	8	7	6	5	4	3	2	4	3
KB	8	9	10	11	13	14	15	16	17	12	14	13	12	7	6	5	4	3	2	1	5	4
MDB	8	9	10	11	12	13	14	15	16	12	14	5	12	7	6	5	4	3	3	2	5	4
MFD	3	4	5	6	7	8	9	10	11	12	13	6	6	12	11	10	9	8	7	6	5	4
SOT	5	6	4	5	6	7	8	9	8	7	6	6	7	8	9	11	10	9	8	7	6	5
LAS	6	7	8	9	10	11	12	7	8	9	10	7	8	7	6	12	11	10	9	8	7	6
MGW	6	7	8	9	10	11	12	13	12	12	13	2	9	13	12	12	11	10	9	8	7	6
GH	7	8	9	9	8	7	6	5	4	5	3	3	3	15	14	13	12	11	10	9	6	7
SKT	8	9	4	10	9	8	7	6	5	6	4	4	4	16	15	14	13	12	7	10	7	8
GBM	9	10	11	11	10	9	8	7	6	7	5	5	5	5	6	7	8	9	10	6	8	9
WDL	10	11	12	12	11	10	9	8	7	8	6	6	6	6	7	8	9	10	11	7	9	10
KM	11	12	13	13	12	11	10	9	8	9	7	5	7	7	8	9	10	11	12	8	10	11
KS	6	7	6	9	10	7	6	7	8	9	6	7	4	8	9	10	11	12	13	9	11	12

Table 4.2 Continued

	KHW	KK	KF	KBG	MDB	MF	SOT	LAS	MGW	GH	SKT	GBM	WDL	KM	KS	Total Shimbel Index
KHW	-	1	2	3	4	4	5	5	7	8	9	10	11	12	13	222
KK	1	-	1	2	2	5	6	7	8	9	10	11	12	13	14	273
KF	2	1	-	1	1	6	7	8	9	10	11	12	13	14	15	272
KBG	3	2	1	-	2	7	8	9	10	11	12	13	14	15	16	324
MDB	3	2	1	2	-	7	8	9	10	11	12	13	14	15	15	321
MFD	3	2	1	2	7	-	1	2	3	4	5	6	7	8	9	231
SOT	3	4	5	6	8	1	-	1	2	3	4	5	6	7	8	220
LAS	4	5	4	5	6	2	1	-	1	2	3	4	5	6	7	189
MGW	5	6	7	8	10	3	2	1	-	1	2	3	4	5	6	280
GH	6	7	8	9	11	4	3	2	1	-	1	2	3	4	5	239
SKT	7	8	8	10	12	5	4	3	2	1	-	1	2	3	4	266
GBM	8	9	10	11	13	6	5	4	3	2	1	-	1	2	3	248
WDL	9	10	11	12	14	7	6	5	4	3	2	1	-	1	2	279
KM	8	7	6	5	4	8	7	6	5	4	3	2	1	-	1	283
KS	7	8	9	10	11	9	8	7	6	5	4	3	2	1	-	271

Table 4.2 Continued

	GR	CC	FF	BR	KW	FM	GL	YKR	BT	IGBO	BR	RW	MM	TR	KM	HC	FS	KR	MBY	TUD	GM	KD
KMT	7	6	5	4	3	5	7	8	11	12	13	14	8	9	6	7	8	7	6	5	12	11
DG	8	7	6	5	4	3	2	6	7	8	9	10	7	8	5	4	3	2	7	8	9	10
ZRC	5	4	3	4	5	6	7	8	9	10	11	12	5	4	3	7	6	8	9	10	11	12
GB	6	5	4	3	2	5	6	7	8	9	10	13	6	7	8	9	10	11	12	4	5	6
TT	7	4	5	6	7	8	9	10	11	12	13	12	5	6	7	8	9	10	11	3	4	5
GG	8	3	4	5	6	7	8	9	10	11	12	11	4	5	6	7	8	9	10	2	3	4
ACR	9	8	3	4	5	6	9	8	9	10	11	10	3	4	5	6	7	8	9	3	5	6
UKU	11	10	9	8	7	4	5	6	7	8	9	9	10	11	12	13	14	15	6	7	8	9

Table 4.2 Continued

KHW	KK	KF	KBG	MDB	MF	SOT	LAS	MGW	GH	SKT	GBM	WDL	KM	KS	Total Index	Shimbel
10	9	8	7	6	5	4	-	7	6	7	10	4	5	6	231	
11	12	13	5	4	6	5	8	-	7	8	11	5	6	7	227	
13	14	15	5	6	7	6	7	11	-	7	10	6	10	8	229	
7	8	9	10	11	8	7	6	12	9	-	7	7	11	10	240	
6	7	8	9	10	9	8	5	10	11	13	-	8	7	11	233	
5	6	7	8	9	10	9	4	9	12	12	5	-	8	12	238	
7	8	9	10	11	7	6	5	4	7	10	4	11	-	7	243	
3	4	5	6	7	6	9	3	5	9	9	8	12	10	-	221	

Source: Author's Field Work, 2011

The data presented in Table 4.2 shows that the most accessible place in 1990s in Kano Metropolis with the lowest Shimbel index are Gidan Radio, Civic Centre, Kwanar Danagundi and Land and Survey with 183, 186,175 and 189 points each, while the least accessible with the highest Shimbel index are Madobi Road Round About, Kabuga Junction, Taludu Round About, and Hajj Camp with 321, 324, 315 and 318 points on Shimbel index respectively.

Beta index = $e/n = 45/44 = 1.022$. The Beta index is a measure of connectivity, which is a measure of the efficiency of a network; it is measured in terms of linkages. The beta index (1.022) reveals that the connectivity of Kano Metropolis in 1990s is a fairly developed one because $(e/n) > 1.0$.

The alpha index compares the actual number of circuits with the maximum possible for that network:

$$\begin{aligned} \text{Alpha index} &= \frac{e-n+1}{2n-5} \times 100\% \\ &= \frac{45-44+1}{2 \times 44-5} \times 100\% \\ &= \frac{2}{88-5} \times 100\% \\ &= \frac{2}{83} \times 100\% = 2.41\% \end{aligned}$$

The alpha index (2.41%) indicates low road network connectivity in Metropolitan Kano in 1990s.

For Kano Metropolis, the following codes were also used as shown in Table 4.3, Figure 4.2 shows the Topological map of road network in 2000s and Table 4.4 gives the measured values.

Table 4.3: Codes used in the study of 2000s

1. Silver Jubilee - SJ
2. Gidan Mintala Road-about - GM
3. Kwanar JSB - KTSB
4. Kofar Damagundi - KD
5. Kwanar Hauran Wanki - KHW
6. Kwanar Sharada - KS
7. AIG Office Jn - AIG
8. Kofar Gadon Kaya - KGK
9. Kofar Farfo - KF
10. Kofar Kabuga - KBG
11. KAP Junction - KAP
12. Kwanar Bagauda - KWB
13. Sharada Rd - SH
14. Kwanar Freedom - KWF
15. Kwanar Sharada Pol. Station
16. Kwanar Ganduje - KGD
17. Madobi Junction - MDB
18. Matanfada Junciton - MFD
19. School of Technology Junction - SOT
20. Land and Survey Junciton - LAS
21. Magwar Junction - MGW

22. Government House Road about - GH
23. Sokoto Road Junction - SKT
24. Taranni Market Junction - TRN
25. Gidan Bello Maitama Junciton - GBM
26. UDP Junciton - UDP
27. Wudil Road Junction - WDL
28. Kwanar Maggi - KMG
29. NIDC Junction - NDC
30. CBN Junction - CBN
31. Tashar Tsamiya Junciton - TMS
32. Danmarke - DM
33. Col. Daudu Suleiman Junction DS
34. NNPC Round-about - NNPC
35. Obasanjo Round-about - OBJ
36. Gidan Radio - GR
37. Civic Centre Junciton - CC
38. Filin Fakin - FF
39. Bello Road - BL
40. Kwari Junciton - KW
41. Fagge Mosque Round - aboutu FGM
42. Galadima Road Junciton - GL
43. Yankura Junciton - YKR
44. Bata Round-about -BT
45. Igbo Road Junction - IG
46. Beimt Road Junction - BRT

47. Kwanar Waika - KJWA
48. Railway Junciton - RW
49. Post Office - PO
50. MTD Junction - MTD
51. Muntala Muhammed Junction - MM
52. ABN Junction - ABN
53. Alumaje Junciton - AM
54. Triumph Junciton - TR
55. Kofar Mata - KMT
56. Kofar Mazugal Junciton - KM
57. Hajj Cmap Junciton - HC
58. Federal Sec. Round-about - FS
59. Bakin Zuro Junciton - BZ
60. Kofar Ruwa Junction - KR
61. Mumbayya Junction - IRH
62. Isyaka Rabi H. Junciton - KFW
63. Kofar Waika Junciton - GD
64. Goron Duitse Junction - TUD
65. Taludu Junction - KPS
66. Kwanar Police Station - KSA
67. Kwanar SAS
68. Kwanar Prison - KP
69. Kwanar Hausawa - KH
70. Kwanar WRECA - KWC
71. Kofar Mata - KMT
72. Zoo Road by Count Road Juncitoin - DG
73. Gidan Buhari Junction - ZRC

- 74. Total Junciton - TT
- 75. Gyadi Gyadi Round-about - GG
- 76. Unguwa Uku Junciton - UKU
- 77. Aminu Kano Teaching - AKTH

Source: Author's Field Work, 2011

Table 4.4: Matrix to show connectivity of nodes in Kano Metropolis in 2000s

	SJ	GM	KTSB	KD	KHW	KS	AIG	KGK	KF	KK	KAP	KBG	SH	KWF	KSP	KG	MDB	MFD	SOT	LAS	MG	GH
SJ	-	1	2	3	4	5	6	7	8	9	4	5	6	7	8	9	10	1	2	3	4	5
GM	1	-	1	2	3	4	5	6	7	8	3	4	5	6	7	8	9	2	3	3	4	5
KTSB	3	2	-	3	1	2	3	4	5	6	1	2	3	4	2	4	3	4	5	3	4	5
KD	2	1	1	-	4	5	6	7	8	9	2	3	4	5	6	7	8	3	4	5	6	7
KHW	4	3	2	1	-	1	2	3	4	5	2	3	4	5	6	7	8	4	5	6	7	8
KS	5	4	3	2	1	-	1	2	3	4	3	4	5	6	7	8	9	6	7	8	9	10
AIG	6	5	4	3	2	1	-	1	2	3	4	5	6	7	8	9	10	7	8	9	10	11
KGK	7	6	5	4	3	2	1	-	1	2	5	6	7	8	9	10	11	8	9	10	11	12
KF	8	7	6	5	4	3	2	1	-	1	6	7	8	9	10	11	12	9	10	11	12	13
KK	9	8	7	6	5	4	3	2	1	-	7	8	9	10	11	12	13	10	11	12	13	14
KAP	4	3	2	1	2	3	4	5	6	7	-	1	2	3	4	5	6	5	6	7	8	9
KBG	5	4	3	2	1	4	5	6	7	8	9	-	1	2	3	4	5	6	7	8	9	10
SH	6	5	4	3	2	5	6	7	8	9	10	11	-	1	2	3	8	9	10	11	12	13
KWF	7	6	5	4	3	2	1	8	9	10	11	12	13	-	1	2	3	10	11	12	13	14
KSP	8	7	6	5	4	3	2	1	10	11	12	13	14	15	-	1	2	11	12	13	14	15
KG	9	8	7	6	5	4	3	2	3	5	6	4	3	2	1	-	1	12	13	14	15	16
MDB	9	8	7	6	5	4	3	2	1	2	5	4	4	3	2	1	-	8	9	10	11	12
KFD	1	2	3	4	5	6	7	8	9	10	5	6	7	8	9	10	11	-	1	2	3	4
SOT	2	3	4	5	6	7	8	9	10	11	6	7	8	9	10	11	12	1	-	1	2	3
LAS	3	4	5	6	7	8	9	10	11	12	7	8	9	10	11	12	13	2	1	-	1	2
MG	4	5	6	7	8	9	10	11	12	13	8	9	10	11	12	13	14	3	2	1	-	1
GH	5	6	7	8	9	10	11	12	13	14	9	10	11	12	13	14	15	4	3	2	1	-

Table 4.4 Continued

SKT	TRN	GBM	UDP	WDL	KMG	NIDC	CBN	TMS	DM	CDS	NNPC	Total Shimbel Index
6	7	8	9	10	11	9	10	11	12	13	14	213
6	7	6	7	8	9	10	11	12	13	14	15	214
6	7	11	12	13	10	15	12	13	14	15	16	216
8	9	10	11	12	13	14	15	16	17	18	19	267
9	10	11	12	13	14	15	16	17	18	19	14	258
11	12	13	14	15	16	17	18	19	20	21	22	305
12	13	14	15	16	17	18	19	16	17	18	15	333
13	14	15	16	17	18	19	16	11	12	13	14	315
14	15	16	17	18	19	17	11	16	17	18	19	352
15	16	17	18	19	11	12	13	14	15	16	17	401
10	11	12	13	14	15	16	17	16	17	18	19	289
11	12	13	14	15	16	17	18	19	14	15	16	307
14	18	16	17	16	17	18	14	13	12	11	10	318
15	16	17	11	12	13	14	15	16	17	18	19	340
16	17	11	12	13	14	15	16	17	18	19	13	360
17	18	6	7	8	9	10	11	12	13	14	15	369
13	14	15	16	17	9	10	11	12	13	14	15	398
5	6	7	8	9	10	7	12	13	14	15	16	247
4	5	6	7	8	9	10	11	12	13	14	15	249
3	4	5	6	7	8	9	10	11	12	13	14	253
2	3	4	5	6	7	8	9	10	11	12	13	259

Table 4.4Continued

	SJ	GM	KTSB	KA	KH	KS	AI	KG	KF	KB	KA	KB	SH	KF	KS	KG	MD	MFD	SOT	LAS	MG	GH
SKT	7	8	9	9	10	11	12	13	14	15	10	11	12	13	14	15	16	6	4	3	2	1
TRN	7	8	9	10	11	12	13	14	15	16	11	12	13	14	15	16	17	6	5	4	3	2
GBM	8	9	10	11	12	13	14	15	16	17	12	13	14	15	16	17	18	7	6	5	4	3
UDP	9	10	11	12	13	14	15	16	17	18	13	14	15	16	17	18	19	8	7	6	5	4
WDL	10	11	12	13	14	15	16	17	18	19	14	15	16	17	18	19	17	9	8	7	6	5
KMG	11	12	13	14	15	16	17	18	19	20	15	16	17	18	19	20	21	10	9	8	7	6
NIDC	12	13	14	15	16	17	18	19	20	21	16	17	18	19	20	21	22	11	10	9	8	7
CBN	13	14	15	16	17	18	19	20	21	22	17	18	19	20	21	22	23	12	11	10	9	8
TMS	14	15	16	6	7	8	9	10	11	12	13	14	15	11	17	18	19	13	12	11	10	9
DM	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	10	11	12	13	12	11	10
DS	16	17	18	19	20	21	22	23	24	25	20	21	22	23	24	25	26	15	14	13	12	11
NNPC	17	18	19	20	21	22	23	24	25	26	12	13	14	15	16	17	18	16	15	14	13	12

Table 4.4Continued

SKT	TRN	GBM	UDP	WDL	KMG	NIDC	CBN	TMS	DM	CDS	NNPC	Total Shimbel Index
-	1	3	4	5	6	7	8	9	10	11	12	267
1	-	2	3	4	5	6	11	12	13	14	15	301
2	1	-	2	3	4	5	6	7	8	9	10	289
3	2	1	-	2	3	4	5	6	7	8	9	303
4	3	2	1	-	2	3	4	5	6	7	8	319
5	4	3	2	1	-	2	3	4	5	6	7	334
6	5	4	3	2	1	-	2	3	4	5	6	357
7	6	5	4	3	2	1	-	2	3	4	5	379
8	7	6	5	4	3	2	1	-	2	3	4	288
9	8	7	6	5	4	3	2	1	-	2	3	317
10	9	8	7	6	5	4	3	2	1	-	2	307
11	10	13	14	15	16	17	18	7	8	9	-	417

Table 4.4Continued

	OBJ	GR	CC	FF	BL	KW	FGM	GL	YKR	BT	IG	BRT	KWA	RW	PO	MTD	MM	ABN	AM	TR
OBJ	-	1	2	3	4	5	6	7	8	9	10	3	4	5	6	7	8	10	11	6
GR	1	-	1	2	3	4	5	6	7	8	9	2	3	4	5	6	7	9	10	7
CC	2	1	-	1	2	3	4	5	6	7	8	1	2	3	4	5	6	8	9	5
FF	3	2	1	-	1	2	3	4	5	6	7	2	3	4	5	6	7	9	10	4
BL	4	3	2	1	-	1	2	3	4	5	6	3	4	5	6	7	8	10	11	3
KW	5	4	3	2	1	-	1	2	3	4	5	4	5	6	7	8	9	11	12	2
FGM	6	5	4	3	2	1	-	1	2	3	4	5	6	7	8	9	10	12	13	1
GL	7	6	5	4	3	2	1	-	1	2	3	6	7	8	9	10	11	13	14	2
YKR	8	7	6	5	4	3	2	1	-	1	2	7	8	9	10	11	12	14	15	3
BT	9	8	7	6	5	4	3	2	1	-	1	7	8	9	10	12	13	17	15	4
IG	10	9	8	7	6	5	4	3	2	1	-	9	10	11	12	13	14	16	17	5
BRT	11	10	9	8	7	6	5	4	3	2	1	-	11	12	13	14	15	17	18	5
KJWA	12	11	10	9	8	7	6	5	4	3	2	1	-	1	2	3	4	6	7	8
RW	5	13	12	11	10	9	8	7	6	4	6	2	1	-	1	2	3	5	6	7
PO	6	5	4	5	6	7	6	5	4	5	4	3	2	1	-	1	2	4	5	8
MTD	7	6	5	6	7	6	5	4	3	3	3	4	3	2	1	-	1	3	4	6
MM	10	9	8	7	6	5	4	3	2	2	2	5	4	3	2	1	-	2	3	5
ABN	12	11	10	9	8	7	6	5	4	1	4	7	6	5	4	2	2	1	2	7
AM	13	12	11	10	9	8	7	6	5	3	5	8	7	6	5	4	3	-	1	8
TR	7	6	5	4	3	2	1	2	3	4	6	5	9	8	7	6	5	1	-	1

Table 4.4 Continued

KM	HC	FS	BZ	KRW	MBY	IR	KW	GD	TUD	GM	KP	SAS	KPS	KHS	KWR	Total Shimbel Index
7	8	9	10	11	12	13	14	15	16	18	19	20	21	22	23	217
8	9	10	11	12	13	14	15	16	17	1	2	3	4	5	6	225
6	7	8	9	10	11	12	13	14	15	2	3	4	5	6	7	206
5	6	7	8	9	10	11	12	13	14	3	4	5	6	7	8	204
4	5	6	7	17	16	15	14	13	12	7	8	6	7	8	10	227
3	4	5	6	7	8	9	10	11	12	5	6	7	8	9	10	229
2	3	4	5	6	7	8	9	10	11	12	7	14	15	16	17	244
3	4	5	6	7	8	9	10	11	12	7	8	9	10	11	12	234
4	5	6	7	8	9	10	11	12	13	8	9	10	11	12	13	262
5	6	7	8	9	10	11	12	13	14	11	12	13	14	15	16	300
6	7	8	9	10	11	12	13	14	15	9	10	11	12	13	14	318
6	8	9	10	11	12	13	14	15	16	4	5	6	7	8	9	304
9	10	11	12	13	14	15	16	17	18	11	12	13	14	15	16	315
8	9	10	11	12	13	14	16	16	17	8	9	10	11	12	13	311
9	8	9	10	11	12	13	14	15	16	7	8	9	10	11	12	251
7	8	10	11	12	13	14	15	16	17	7	8	9	10	11	12	224
6	5	6	7	8	9	10	11	12	13	8	9	10	11	12	13	273
8	9	10	11	12	13	14	15	16	17	11	12	13	14	15	16	238
9	10	11	12	13	14	15	16	16	18	12	13	14	15	16	17	225
1	2	3	4	5	6	7	8	9	10	7	8	9	10	11	12	220

Table 4.4 Continued

	OBJ	GR	CC	FF	BL	KW	FGM	GL	YKR	BT	IG	BRT	KWA	RW	PO	MTD	MM	ABN	AM	TR
KM	8	7	6	5	4	3	2	3	4	8	7	15	14	13	9	8	11	9	10	1
HC	9	8	7	6	5	4	2	6	7	10	11	16	15	14	10	13	12	8	9	2
FS	7	6	5	4	3	4	3	4	5	6	14	13	12	11	11	12	13	7	8	3
BZ	8	9	10	11	2	3	4	3	4	5	6	7	8	9	10	11	12	6	7	4
KR	6	7	8	9	6	4	7	8	9	6	5	6	7	8	9	10	11	5	6	5
MBY	9	8	7	6	5	3	4	5	6	7	8	9	7	5	6	10	9	10	7	6
IRH	10	9	8	7	6	4	5	6	7	8	9	8	5	6	7	8	9	9	8	7
KFW	11	10	9	8	7	5	6	7	8	9	8	7	6	7	8	9	10	10	9	8
GD	12	11	10	10	11	6	12	13	14	15	16	17	18	19	9	14	15	11	10	9
TUD	13	12	11	10	9	7	8	9	10	11	13	14	15	16	10	11	13	12	11	10
KPS	2	3	4	5	6	7	5	6	9	8	2	12	11	10	9	18	8	9	10	9
KSA	3	4	5	6	7	6	5	4	7	4	5	6	7	8	9	7	6	8	9	11
KP	4	5	6	7	8	9	10	8	3	6	5	4	5	6	7	10	6	4	6	10
KH	5	6	7	8	9	10	11	10	7	12	13	14	15	16	8	8	18	12	10	7
KWC	6	5	4	3	5	6	7	11	11	13	14	15	16	17	7	17	19	10	11	14
KMT	5	6	7	8	9	10	11	12	12	14	3	4	5	6	7	18	9	6	9	12
DG	6	7	8	9	10	11	12	13	13	15	4	5	6	7	8	8	10	7	8	6
ZRC	7	8	9	11	12	13	14	15	14	11	6	7	8	9	6	9	8	8	6	8
GB	2	3	4	5	6	7	8	9	10	11	11	6	7	8	9	7	11	9	7	9
TT	5	6	7	8	9	10	11	12	13	14	12	3	4	5	6	10	8	5	5	7
GG	4	5	6	7	8	9	10	11	12	13	13	6	7	8	9	7	11	3	3	5
UKU	3	4	5	6	7	8	9	10	11	12	14	5	6	7	8	10	10	4	6	4
AKTH	2	3	4	5	6	7	8	9	10	11	3	4	5	6	7	8	9	3	5	5

Table 4.4 Continued

KM	HC	FS	BZ	KRW	MBY	IR	KW	GD	TUD	GM	KP	SAS	KPS	KHS	KWR	Total Shimbel Index
-	1	2	3	4	5	6	7	8	9	8	9	10	11	11	12	220
1	-	1	2	3	4	5	6	7	8	9	19	11	12	12	13	239
2	1	-	1	2	3	4	5	11	12	13	14	15	16	13	14	231
3	2	1	-	1	2	3	4	5	8	9	7	8	12	17	11	235
10	11	12	1	-	1	2	16	17	18	19	6	7	13	14	15	407
5	4	3	2	1	-	1	2	3	4	5	5	6	8	9	9	233
6	5	4	3	2	1	-	1	2	3	4	4	5	7	8	9	228
7	6	5	4	3	2	1	-	1	2	3	3	4	6	7	8	232
8	7	6	5	4	3	2	1	-	1	2	2	3	5	6	7	309
9	8	7	6	5	4	3	2	1	-	1	1	1	4	5	6	201
13	10	9	8	7	6	5	3	3	2	-	2	1	2	3	5	237
11	11	10	9	8	7	6	5	4	3	1	-	2	1	4	4	214
8	12	11	10	9	8	7	6	5	4	2	1	-	2	4	3	325
15	13	12	11	10	9	8	7	6	5	3	2	3	-	3	2	325
13	14	13	12	11	10	9	8	7	6	4	3	4	5	-	1	306
5	6	4	3	12	9	10	9	6	3	5	4	7	4	3	-	312
4	5	6	7	8	8	6	7	5	7	7	4	6	3	8	5	282
3	4	5	6	7	7	9	5	6	6	6	6	5	2	9	6	244
2	3	12	11	10	10	8	6	4	11	7	5	3	3	7	7	245
6	7	9	10	9	11	5	7	4	9	8	9	2	7	4	5	239
7	8	6	7	5	8	7	13	12	10	11	8	11	6	5	8	241
4	5	7	6	4	7	4	11	11	7	12	11	12	5	6	4	246
3	4	5	5	6	3	6	10	7	8	9	7	4	4	5	3	248

Source: Author's Field Work, 2011

Figure 4.2 displays the topological map of road network Kano Metropolis in 2000s and Table 4.4 reveals the measured values.

The data in Table 4.4 indicate that the most accessible places in Metropolitan Kano in 2000s have low Shimbel index of 212, 216, 213, 214, 206. The places are Gidan Murtala, Kwanar TSB, Silver Jubilee, Kwanar Police Station and Civic Centre receptively. On the other hand, the least accessible in the area with very high shimbel index of (417, 407, 401 and 398) are NNPC round about, Kabuga, Madobi Junction, and Kafar Ruwa respectively.

$$\text{Beta index} = e/n = 77/70 = 1.1$$

The beta index (1.1) in 2000s in Metropolitan Kano reveals that the network of Kano Metropolis is an integrated and developed one because the result (e/n) is > 1 .

$$\begin{aligned} \text{Alpha index} &= \frac{e-v+1}{2v-5} \times 100\% \\ &= \frac{77-70+1}{2 \times 70-5} \times 100\% \\ &= \frac{7+1}{140-5} \times 100\% \\ &= 5.93\% \end{aligned}$$

The high alpha index (5.93%) in Metropolitan Kano in the 2000s indicates a higher degree of connectivity as compared to the period of 1990s.

4.2 Road Capacity-Volume Ratio in Metropolitan Kano

4.2.1 Daily traffic count at Dangi round-about

Figure 4.3 indicates the selected traffic point on the road network of the study area while Table 4.5 shows the daily traffic count at the round-about. Dangi round about road is a major out-let of vehicles moving in and out from

urban Kano to the periphery of the close settled zone. The traffic here is always very heavy. The road that links this round-about was designed to carry two motor vehicles at a time (see Plate I). But the study and the Plate 1 reveal that the number of vehicles observed on the lanes at the junction or during stoppage time have exceeded the capacity of designed lanes (see Plate II). The main problems of motorists are that the width of the lane was not designed to carry the present volume of vehicles. This is further complicated by the refusal of vehicle owners to observe traffic rules.

Table 4.5: Daily traffic count at Dangi round-about

Road designed capacity (No. of vehicles to be carried)	Available parking space along the road	Number of motor vehicles observed (buses, cars, taxes and trucks)	Number of tricycles observed	Number of motorcycles and bicycles observed
2	1	4	2	16

Source: Author's Field Work, 2011

4.2.2 Daily Traffic Count at Igbo and France Road Junction

Figure 4.4 shows the selected traffic spots on the Igbo and France road junction while Table 4.6 displays the daily traffic count at the junction. The road that links this junction has three designed lanes and lacks any available parking space (see Plate III). However, the traffic count results indicated that the number of motorcycles, tricycles and motor vehicles that are moving on the roads and converging at this junction exceeded the capacity of available lanes designed for them (see Plate IV). This is because the junction is located at the core of Central Business District that have Sabon Gari market, Coca-cola Company, Bata round-about and other multi-national companies that attract to and fro movements of people within the area, hence people preferred to use motorcyclists because of its flexibility within the traffic holdup.

Table 4.6: Daily traffic count at Igbo and France road junction

Road designed capacity (No. of vehicles to be carried)	Available parking space along the road	Number of motor vehicles observed (buses, cars, taxis and trucks)	Number of tricycles observed	Number of motorcycles and bicycles observed
3	Nil	2	1	37

Source: Author's Field Work, 2011

4.3 Road Transport Problems and their Perceived Causes in Metropolitan Kano

This section tries to assess the factors responsible for road traffic problems in Kano Metropolis.

Distribution of commuters by perceived causes of road transport problems in Kano metropolis.

It appears from Table 4.7 that commuters indicate more than one cause of road traffic problems. Over 70% of commuters considered trading activities which is mostly conspicuous in areas like Sabon Gari, Singa, Kwari, Rimi, Kofar Wambai and Kurmi as a major cause of traffic problems. This is because the trading activities are located by the road side. Nearly 70% also identified indiscriminate parking by motor vehicles, motorcycles and tricycles, shop owners and market people along major roads as a major traffic problems, which have existed because of lack of regulated parking systems. All these combine to produce traffic congestions which lead to delay in traveling and result in the consumption of more fuel and emission of smoke.

Table 4.7: Distribution of commuters by perceived causes of road transport problems in Kano Metropolis

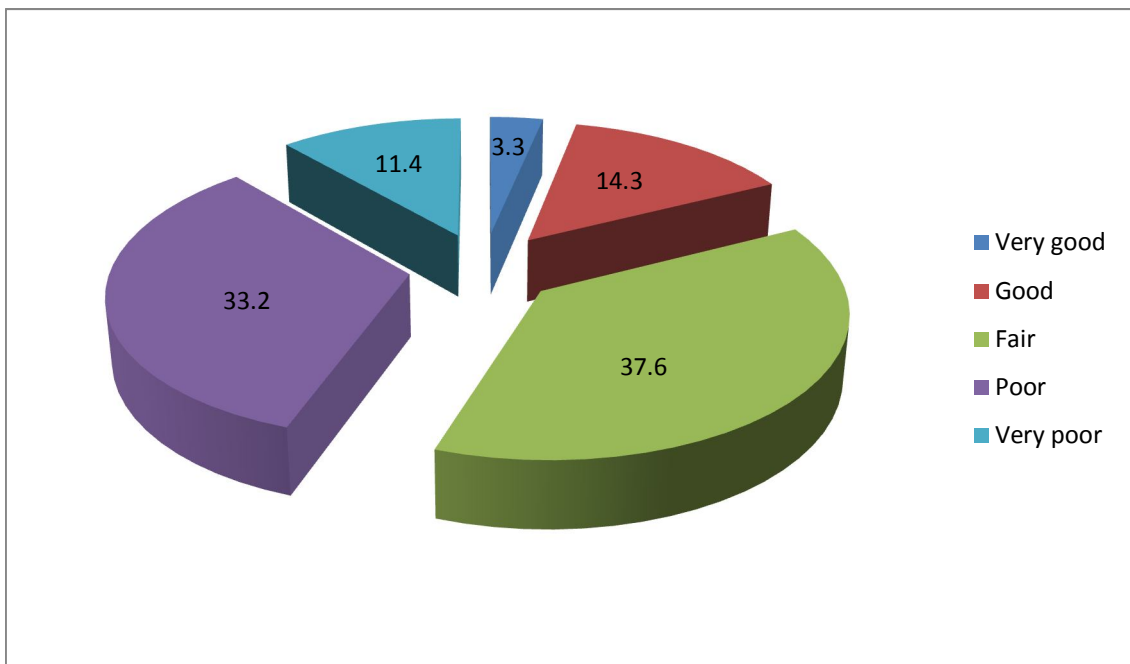
Causes of traffic problems	No. of respondents	Percentage
Absence of quality pavement	143	26.4
Lack of parking facilities	186	34.3
Poor drainage system and lack of culverts	161	29.7
Absence of pedestrian walkways	143	26.4
Indiscriminate parking by motor vehicle, tricycle and motorcycle drivers and riders	377	69.6
Too many motor vehicles, tricycles, motorcycles, bicycles and pedestrians on the road at any time.	322	59.4
Trading activities by the roadside	381	70.3
Poor roads that are untarred	107	19.7
Absence of traffic control devices	166	30.6

Source: Author's Field Work, 2011

These findings corroborate what Adefolalu's (1977) study of urban traffic problems in the city of Lagos noted where it was observed that indiscriminate and uncontrolled parking are part of the causes of vehicular traffic flow problem in the city. Adedimila (1981) also indicated similar findings that road factors were causes of traffic problems in Lagos. The study noted that most of the feeder roads are impassable, lack sidewalks or where present are narrow and badly surfaced, which normally force pedestrians to use vehicular traffic lanes thereby restricting traffic flow.

Assessment of the Quality of Transport Infrastructure and Services in Kano Metropolis by the Commuters

The result in Figure 4.5 shows that 55.3% of commuters opined that the quality of transport infrastructure and services in urban Kano is fair to very good (37.6%, 14.4% and 3.3% fair, good and very good respectively). This indicates that government is making frantic effort in metropolitan roads development.

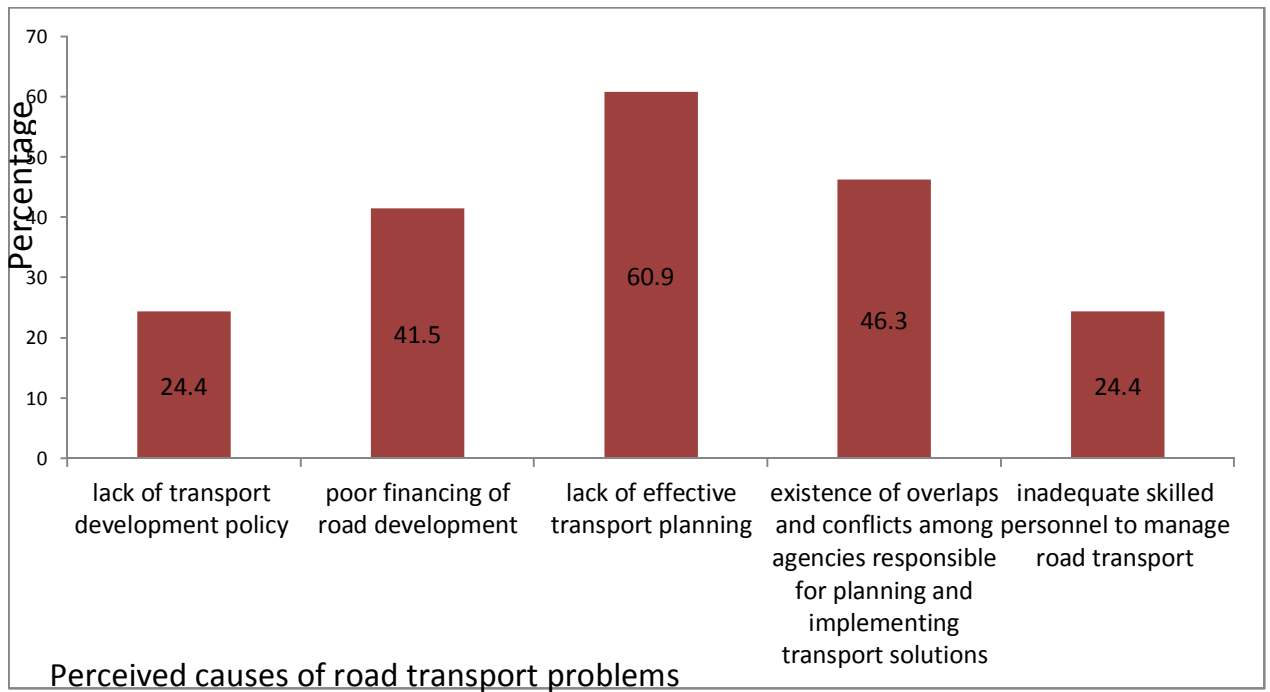


Source: Author's Field Work, 2011

Figure 4.5: Assessment of the quality of transport infrastructure and services in Kano metropolis by commuters.

Distribution of Personnel of Road Transport Authorities by Perceived Causes of Road Transport Problems in Metropolitan Kano

As shown in Figure 4.6 lack of effective transport planning was perceived by the majority of the personnel of road transport authorities as the main cause of road transport problems in urban Kano. This is because there has been a continuous change in the leadership of transport management institutions in the state, which leads to lack of policy continuity. The two other causes of road transport perceived to be important by 46.3% and 41.5% respectively of the personnel are overlaps in the mandate of planning authorities and poor financing of road development.



Source: Author's Field Work, 2011

Figure 4.6: Distribution of personnel of road transport authorities by perceived causes of road transport problems in metropolitan Kano

Ranking of Causes of Road Transport Problems in Urban Kano by Personnel of Road Transport Authorities

Table 4.8 indicates that the personnel of road transport authorities in urban Kano identified more than one cause of road transport problems and it reveals that illegal bus stops and indiscriminate parking were ranked as very significant causes of road transport problems in metropolitan Kano by 97.6% and 95.1% respectively. This is because of weak traffic law enforcement. Also, increasing urbanization (95.1%) contributes significantly to road traffic problems. This is because Kano city serves as the capital of Kano State as well as a commercial nerve centre and indeed the whole of northern Nigeria. These functions have encouraged movement of people from mainly rural settlements to this mega city as well as from neighbouring states and countries like the Republic of Niger.

Table 4.8: Ranking of Causes of Road Transport Problems in Urban Kano by Personnel of Road Transport Authorities

Categories of causes	A Very significantly		B Significantly		C Less significantly		D Not at all	
	No. of respondents	%	No. of respondents	%	No. of respondents	%	No. of respondents	%
Absence of traffic lights on most of the road junctions	Nil	Nil	25	60.9	Nil	Nil	8	19.5
Insufficient public transport to cope with rising demand	15	36.6	8	19.5	Nil	Nil	15	36.6
Lack of intermodal coordination	Nil	Nil	8	19.5	8	19.5	8	19.5
Trading activities by the roadside	30	73.2	Nil	Nil	Nil	Nil	Nil	Nil
Indiscriminate parking by motor vehicle, tricycle and motorcycles drivers and riders	39	95.1	Nil	Nil	8	19.5	Nil	Nil
Insufficient road width (narrow roads)	Nil	Nil	25	60.9	8	19.5	8	19.5
Increasing urbanization	8	19.5	39	95.1	Nil	Nil	Nil	Nil
Illegal bus stops	40	97.6	Nil	Nil	Nil	Nil	Nil	Nil
Rising ownership of transport vehicles	25	60.9	Nil	Nil	15	36.6	Nil	Nil

Table 4.8 Continued

Lack of drainage along transportation corridors	Nil	Nil	8	19.5	15	36.6	15	36.6
Absence of quality pavement	Nil	Nil	8	19.5	8	19.5	15	36.6
Violation of traffic control light by road users	25	60.9	8	19.5	8	19.5	Nil	Nil
Disregard for road regulations by road users	25	60.9	8	19.5	8	19.5	Nil	Nil
Lack of regulated parking space	15	36.6	15	36.6	0	19.5	Nil	Nil

Source: Author's Field Work, 2011

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Major Findings

This study analyzed the road transport problems in metropolitan Kano. The results obtained revealed that there is the development in the road network of Kano metropolis studied over two time periods of 1990s and 2000s. And the traffic count results indicated that the number of motorcycles, tricycles and motor vehicles that are moving on the roads and converging at most of the road junctions exceeded the capacity of available lanes meant for them. The reasons for this is that the width of the lanes were not designed to carry the present volume of vehicles. In addition, trading activities, indiscriminate parking and ineffective transport planning were perceived by the majority of commuters and the personnel of road transport authorities in Kano Metropolis as part of the problems. Also illegal bus stops and violation of traffic control light by road users were ranked as very significant causes of road transport problems in metropolitan Kano.

5.2 Conclusion

In spite of the growth which has been recorded in the road network of metropolitan Kano, there are still many problems which impede the smooth flow of traffic in the city. These problems are related to infrastructural facilities, human factors and management problems. The findings show that absence of traffic light on most of the road junctions, insufficient road width are some of the major factors contributing to traffic problems in metropolitan Kano. In addition, increasing urbanization, violation of traffic control light by road users and overlaps and conflicts among agencies responsible for implementing transport solutions are some of the human factors as well as management problems obstructing traffic problems in the study area.

5.3 Recommendations

For effective traffic flow and perfect road transportation system in Kano metropolis, the following measures are recommended.

1. There is the need for relocating of Sabon Gari, Singa and Kwari markets from the present position. This will reduce travel volume generated by trading around the urban core.
2. The road transport authorities in the state should intensify traffic education and awareness campaign for private and commercial drivers and motorcycle and tricycle riders.
3. It is suggested that more bus stops and parking spaces be provided to prevent indiscriminate parking and stopping at prohibited places, thereby causing unnecessary congestions on the narrow roads.
4. Flyovers should be built in the metropolis without none to ease traffic congestions.

5. There is need for the installation of more traffic light signals and roads signs in the metropolis.
6. There is need for strong law enforcement agency in the metropolis by the appropriate authorities against illegal parkings and illegal bus stops.

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Appendix I

**Department of Geography,
Faculty of Science,
Ahmadu Bello University, Zaria.**

Dear Sir /Alhaji/Madam,

QUESTIONNAIRE ONROAD TRANSPORT PROBLEMS IN METROPOLITAN KANO FOR COMMUTERS

I am a student of Ahmadu Bello University, Zaria, carrying out a research for the award of Master of Science degree in Geography. This questionnaire is meant to collect information pertaining to ROAD TRANSPORT PROBLEMS IN METROPOLITAN KANO. The information required is purely for academic purposes. However, all information provided will be treated confidentially and for the purpose of this study only. I would be most grateful if you could spare some minutes to respond or complete this questionnaire for me.

Thank you.

Salisu GWADABE

Please for each question, tick (x) against the option that adequately represents your view or opinion

1. Sex: Male Female
2. Rank-----
3. How old are you?
4. What is your occupation?
[a] Civil Servant [b] Trader
[c] Driver [d] Others (specify)
5. Name your place of work-----

6. What kind of transport problem(s) do you encountered while getting to your working place/activity?
[a] Competition by other modes of transport sharing the roadways
[b] Traffic hold up by excessive growth of vehicular traffic on the roads
[c] Wrongful overtaking
[d] Indiscriminate parking and dropping of passenger on the road
[e] Disobedience to traffic control by wardens
7. What mode of transport do *you* use in getting to the place of work/activity?
[a] Private car [b] Public transport
[c] Motorcycle [d] Tricycle
[e] Bicycle [f] Trecking

8. What do you think are the causes of road transport problems in Kano Metropolis?
- [a] Absence of quality pavement []
 - [b] Lack of parking facilities []
 - [c] Poor drainage system and lack of culverts []
 - [d] Absence of pedestrian walkways []
 - [e] Indiscriminate parking by motor vehicles tricycle and motorcycle riders []
 - [f] Too many motor vehicles, tricycle, motorcycle, bicycles and pedestrians on the road at any time []
 - [g] Trading activities by the roadside []
 - [h] Poor roads that are untarred []
 - [i] Absence of traffic control devices []
9. Why are some roads in urban Kano not motorable?
- [a] Because of the existence of potholes []
 - [b] Because of the existence of refuse dumpsites on the roads []
 - [c] Using motorcycles and tricycles to convey bulky good on the roads []
 - [d] Because of the refusal of vehicle owners to obey parking rules []
10. How will you rate the characteristics of transport movement in metropolitan Kano?
- [a] Very good []
 - [b] Good []
 - [c] Fair []
 - [d] Poor []
 - [e] Very poor []

11. What is your view about transport quality infrastructure and services in Kano metropolis?

[a] Very good []

[b] Good []

[c] Fair []

[d] Poor []

[e] Very poor []

Appendix II

**Department of Geography,
Faculty of Science,
Ahmadu Bello University, Zaria.**

Dear Sir/Alhaji/Madam,

QUESTIONNAIRE ON ROAD TRANSPORT PROBLEMS IN KANO METROPOLIS FOR PERSONNEL OF ROAD TRANSPORT AUTHORITIES IN KANO STATE

I am a student of Ahmadu Bello University, Zaria, carrying out a research for the award of Master of Science degree in Geography. This questionnaires meant to collect information pertaining to ROAD TRANSPORT PROBLEMS IN METROPOLITAN KANO. The information required is purely for academic purposes. However, all information provided will be treated confidentially and for the purpose of this study only. I would be most grateful if you could spare some minutes to respond or complete this questionnaire for me,

Thank you.

Salisu GWADABE

Please for each question, tick (x) against the option that adequately represents your view or opinion

1. Sex: Male Female
2. Position in your Organization -----
3. How old are you?
4. What is your specific duty in this Organization?-----
5. Name your place-----
6. What are the perceived causes of road transport problems in Kano Metropolis?
 - [a] Lack of transport development policy
 - [b] Poor financing of road development
 - [c] Lack of effective transport planning
 - [d] Existence of overlaps and conflicts among agencies responsible for planning and implementing transport solutions
 - [e] Inadequate skilled personnel to manage road transport in Kano State
7. What are the causes of road transport problems in metropolitan Kano?
 A = Very significantly = Significantly
 C = Less significantly = Not at all

		A	B	C	D
a.	Absence of traffic lights on most of the road junctions				
b.	Insufficient public transport to cope with rising demand				
c.	Lack of intermodal coordination				
d.	Trading activities by the roadside				
e.	Indiscriminate parking by motor vehicles, tricycle and motorcycle drivers and riders				
f.	Insufficient road width (narrow roads)				

g.	Increasing urbanization				
h.	Illegal bus stops				
i.	Rising ownership of transport vehicles				
j-	Lack of drainage along transportation corridors				
k.	Poor public transport				
l.	Absence of quality pavement				
m.	Violation of traffic control light by road users				
n.	Disregard for road regulations by road users				
o.	Lack of regulated parking space				

8. What efforts has your organization been making in solving the transportation problems in urban Kano?-----
9. Have you any idea what plans the appropriate authority is making to improve transportation within Kano Metropolis? -----
