

RESPONSE OF SOYABEAN (*Glycine max* (L.) Merrill) VARIETIES TO WEED  
CONTROL TREATMENTS AND ROW ARRANGEMENT IN THE NIGERIAN  
SAVANNAH

BY

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## ABSTRACT

Field experiments were conducted during the 2012 rainy season at Samaru located  $11^{\circ} 11'N 07^{\circ} 38'E$ , 686 metres above sea level in the Northern Guinea Savannah and during the 2012/2013 dry season at Kadawa located  $11^{\circ} 39'N 08^{\circ} 02'E$ , 500 metres above sea level in the Sudan Savannah ecological zones of Nigeria, to study the effect of weed control treatments and row arrangement on soyabean varieties. The experiment consisted of five weed control treatments which included application of Butachlor and Pendimethalin each at  $2.5 \text{ kg a.i ha}^{-1}$ , one hoe weeding at 3 weeks after sowing, two hoe weeding at 3 and 6 weeks after sowing and a weedy check with two soyabean varieties; (TGx 1835-10E and TGx 1987-62F) and two row arrangement; (Single and double row). The treatments were laid out in a split plot design with factorial combination of weed control treatments and row arrangement on the main plot while varieties were assigned to the sub-plots. Results indicated that weed dry weight and weed cover score were significantly lower in the weed control treatments than the weedy check plots. Plots treated with Butachlor at  $2.5 \text{ kg a.i ha}^{-1}$  and those weeded twice at 3 and 6 WAS resulted to significantly higher values for crop vigour, plant height and canopy spread. At 6 and 9 WAS plots weeded once or twice had wider canopy spread at both locations. There was significant increase in the crude protein (0.5%) and oil content (0.8%) with the application of Pendimethalin at  $2.5 \text{ kg a.i ha}^{-1}$  compared to the other weed control measures and the weedy check. Yield parameters including number of pods per plant, seeds per pod, dry biomass, 100 seed weight and grain yield were also significantly increased in plots weeded twice. Double row arrangement of soyabean recorded the least weed dry weight, weed cover score and produced significantly more vigorous crops with wider canopy spread, heavier dry biomass and also improved the oil content of the crops compared to the single rows. Variety TGx 1987-62F recorded lower weed dry weight and produced significantly taller and more vigorous crops with wider canopy though delayed flowering and produced more number of pods with heavier dry biomass and higher grain yield at Samaru, however at Kadawa variety TGx 1835-10E produced significantly more seeds per pod, 100 seed weight and grain yield. There was positive and significant relationship between soyabean grain yield and parameters like plant height, crop vigour, canopy spread, dry biomass and number of pods per plant. There was however negative and highly significant association between grain yield with weed dry weight and weed cover score. In conclusion the results obtained from this study indicated that plots weeded twice at 3 and 6 WAS and double row arrangement of the two soyabean varieties resulted in effective long season weed control at both locations. Variety TGx 1987-62F performed better during the rainy season at Samaru while TGx 1835-10E performed better at Kadawa during the dry season.

# CHAPTER ONE

## INTRODUCTION

### 1.1. Background to the Study

A city is said to be monocentric in nature when it is characterized by a unicity centered Central Business District (CBD). The monocentric city model was formulated by Alonso in 1964 as an adaptation of Von Thunen's 1826 theory of agricultural land and land use to the urban case. This idea was immediately expanded to include production, transport and housing and has been generalized in many ways (Mills, 1967, 1972; Muth, 1969; Fujita, 1989).

Moreover, the basic design model for monocentric city is envisaged as circular residential area or district surrounding CBD in which all jobs are located. The model further distinguishes between an open city (with perfectly elastic population) and a closed city (with fixed population that is fairly inelastic) (Anas and Kim, 1996). This city model has been the dominant view of urban land use structure since the early 90s by the urban economists, as it allows for easy generation of rent gradient in transportation friction for commuting or commerce between a city center and periphery (Wheaton, 2004). However, when population and density of the city change, the gradient become steeper as travel distance to the CBD increases and speeds for accessing such facility deteriorate.

The monocentric urban spatial form has been the model most widely used to analyze the spatial organization of cities in the United State of America e.g. Chicago, New York and Los Angeles. However, as these cities grow in size the original

monocentric structure tend to dissolve with time progressively into polycentric structure (Bertaud, 2002).

Empirical findings on urban spatial structure ensures that density of activity declines with distance from the CBD, indicating positive relationships which virtually fall overtime so that population has become more disperse. Evidence of these are provided for Japan by Mills and Ohta (1976), for Latin America by Ingram and Carroll (1981) and for a number of developing nations by Mills and Tan (1980). Therefore, any theory of urban spatial structure should accord with these facts. It is of utmost importance, therefore, to study urban structure, because cities growth patterns are undergoing qualitative change that could come in many decades or even centuries (Garreau, 1992).

The existing urban and sub-urban development patterns and the subsequent automobile dependence that is associated with them are leading to increased traffic congestion and air pollution. In response to the growing ills caused by urban expansion, there has been an increased interest in creating more liveable communities. These ideas have been put into practice in most large metropolitan areas. For example the Guide for Transit-Oriented-Development, by Twin Cities Metropolitan Council (2006), where it prescribed the geometric dimension and catchment areas for local services on walking distance or time (to be  $\frac{1}{4}$  to  $\frac{1}{2}$  mile or 5 to 8 minutes, respectively).

Moreover, cities evolve over space and time with the specifics of development being intimately related to the geographical and environmental constraints, the socio-economic development and the geo-political condition of each country. All very large metropolises, whether in developing or developed countries,

sooner or later have to face the problem of spatial re-organization from a mono-centric structure to a dispersed or a multi-centric structure (Alpkokin, Black and Hayashi 2010).

Intra-urban movement in a city is somewhat related to the existing land use patterns especially as it relates to a real distribution of housing, employment opportunities and recreation facilities (Filani,1994). The movement of people to their places of work or business locations, markets, schools and worship centers create traffic in the city at various time of the day and at some particular routes. Indeed, land uses, by virtue of occupancy are taken to generate interaction need and these needs are directed to specific target by specific transportation facilities (Oduwaye, Alade and Adekunle, 2011).

Trip is seen as a single journey made by an individual between any two given points, using a specified mode of travel and for a defined purpose (ITE, 2010). Thus any one-way person movement by a mechanized mode of transport having an origin (the starting point) and a destination (the terminating point) is considered as a trip. A trip may take any of these form; home base and non-home base trips (HB and NHB), trip production and attraction and or trip purpose. When all these are critically examined, trip generation provides the relationship between urban activity and travel pattern (Oyedepo and Makinde, 2009).

Travel trip is derived demand in the sense that people do not travel for travel's sake but to facilitate community activities, both socially and economically. Each trip is therefore made for a particular purpose and is also dependent on many factors varying from income, automobile availability, age or distance (Oyedepo and Makinde, 2009). It was observed that, vehicles do not move about the road for

mysterious reasons of their own, rather they move only because people want them to move in connection with activities which they (the people) are engaged in (Buchanan, 1963).

Trips therefore do not occur by chance, rather it occur where there is need for it. That is why in urban space there are a lot of activities and or uses such as offices, schools, markets, hospitals, recreational areas, churches and mosques, and because of these activities people have to move (HMSO, 1964; Christopher, 2004).

Furthermore, as a result of different trips made by individuals in towns and cities, it was asserted that; everywhere in the world urban traffic problems are at alarming rate and that transport planners are convinced that the situation will become worse over time, if proper measures are not taken (Chiroma, 1992). Despite the universal similarity in the increase of transport ownership to facilitate trips and increase demand, there is spatial integration of settlements, towns and cities. This coupled with increase in population leads to failure in the provision of urban infrastructure to keep pace with the current change in land uses which produce severe transportation problems (Christopher, 2004).

Transportation therefore is known to be the movement of people, goods and services from one place to another under a desirable condition, while on the other hand transportation planning is concerned with the development of comprehensive plan with respect to the social, economic and environmental impacts of the populace to enhance positive goals (Dahiru, 2006). Thus, the fundamental goal of transportation planning and management is to accommodate the need for mobility in order to provide efficient access to various activities that satisfy human needs.

It is possible to explain why land use generate trips and cause problems. Land use potentials of an area depend on the transport system that provides access to it, and if the system is properly linked with other areas, it is possible that traffic will be generated or attracted to the area. So if land use capability changes, traffic generated will be affected, and in the same way, if transport system linking various land use change, trips generated or attracted will be affected (Litman, 2011)

Therefore, it is not surprising when traffic congestion occur in most transport corridors within the Federal Capital City leading to the CBD. This was based on the assertion that failure to identify the causes of trip making or vehicle movement, rest on the measurement of traffic volumes and the design of roads and intersections, for the purpose of promoting the efficient movement of vehicles, the problems would still remain unsolved (Buchanan, 1963).

## **1.2 Statement of the Research Problem**

An underlying factor with the problems of trip making in urban areas is not unrelated to its land use potentials and the condition of its transport system. For example, trips are made to the central area because it offers greater access to many parts of the urban center. The reason for the trip to the central area is that land uses are more concentrated there and inversely proportional to its (central area's) population. For this reason, large population of the urban area depends largely on the central area for jobs and other services while the central area looks up to its suburbs for raw materials and labour supply.

The movement and spatial interaction of urban residents are crucial to the effective functioning of the city. The rapid increase in urbanization in most developing countries has created mobility problems. This mobility crisis today has

posed a serious challenge to transport planners (Ipingbemi, 2010). The changing urban form due to high rate of urbanization in any given city, over the years must have impacted on the trip pattern of residents (Stephen, Ho and Ojo, 2012).

Adah (1995) studied journey to work in Abuja. The author observed that, the problem of long travelling time to work, result in man hour waste and make workers to spend a greater percentage of their lean income on commuting to and from work. Again, the problems of convenience and strain have also been identified as well as the problem of inadequate supply of public transport which are themselves unreliable. The conclusion of the author was that, the low pace of residential housing development which led to the separation between the work areas and the areas of residencies is the determinant factor. The major limitation of his work is that it examined only the Journey to work of civil servants. This cannot adequately explain the problem of trip making in Abuja, as civil servants account for only a small fraction of the total number of commuting public in the city.

Mu'azu (2010) carried out a study on Journey to work from Kubwa to Abuja city. The study observed that, lack of appropriate public transport system mostly affects the low income groups, as they spend much of their lean income on Journey to work. Greater loss of man hour on commuting was also identified by the author. However, the study simply examined the situation of trip making only from Kubwa to the FCC. This is just a single satellite town in the federal capital city, Abuja, and hence can not be used to generalize on the pattern of trip making in FCC, Abuja.

Momoh and Kaltho (2011) in a study on Urban form and sustainable transport: A study of seven districts in the federal capital territory, Abuja, claimed that marital status, car ownership, and personal income (Socio-economic variables) and distance



(spatial variable) are the factors that affect travel behavior or choice of mode to travel by individuals in FCC, Abuja. The author's conclusion was that, the manipulation of urban form will not lead to sustainable transport. This study therefore failed to address other transport problems and emphasized mainly transport externalities such as pollution.

On the basis of this therefore, this study tried to fill the gap in knowledge identified from the previous studies, as it analyzed the effects of city structure on all aspects of trips made by individuals in FCC, Abuja. It is against this background that this study attempts to answer the following research questions:

- i. What are the nature and type of trips made in the study area?
- ii. What are the characteristics and magnitudes of trips in the study area?
- iii. What are the discerned patterns of trips made in the study area?
- iv. What are the effects of monocentric trip pattern in the study area?

### **1.3 Aim and Objectives**

The aim of this study is to examine the effects of monocentric urban spatial form on trip generation pattern in Federal Capital City Abuja. This aim shall be achieved using the following set of specific objectives, which are to:

- i. identify the various types of trip to the Central Business District of FCC;
- ii. determine Trip characteristics in FCC;
- iii. determine trip pattern and identify factors influencing the choice of means to travel in FCC;
- iv. assess the effects and constraints of trip on commuters to the central business district of FCC Abuja.

#### **1.4 Scope of the Study**

The study covers only the automobile commuters (private and public) in FCC, who travel the central area. The study is restricted to inbound passengers only, where their areas of residence, trip pattern, trip origin and destination, trip purpose, time of trip, cost of trips, types of vehicles used and their trip challenges were considered. The spatial extent of the study will cover only the designated transport terminals serving the CBD of the federal capital city Abuja to serve as the traffic analysis zones (TAZ). The temporal scope of the study covers the time period between 6am to 7pm for working days alone.

#### **1.5. Justification of the Study.**

Many attempts have been made, or put in place by different transportation experts in the country, in order to reduce the chaotic and unpleasant state or condition of transport system regardless of the mode adopted. Yet all these measures have little impact towards reducing the problems in our cities today. Rather the scenarios are getting worse with time.

To the best knowledge of the researcher, only few studies have attempted to examine the cause-effect relationship of all the inherent transportation problems in our cities today (particularly the federal capital city, Abuja). When this (cause-effect relationship) become explicit, it would make us to clearly know and understand why traffic always faced a particular direction more than the other within the same city for the purpose of satisfying peoples' travel demand.

This research will demonstrate that a proper understanding of the causes of trips which resulted to vehicular movement as well as the reasons behind the choice of

a particular mode by individuals is required for effective transport needs for diverse trips. Improving the efficiency of urban travel demand can also lead to the reduction in system congestion, man hour waste, improve delivery time and lower costs of transport fares and at the same time ensure the restoration of urban environmental quality. Therefore, this research become imperative as it will strictly view trips as function of land use activities, for proper planning and management of the various modes of transport system in the country.

## **CHAPTER TWO**

### **CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW**

#### **2.1 Conceptual Framework.**

##### **2.1.1 Form Concepts and Issues**

Urban form can refers to the physical form of urban areas in three dimensions at a variety of scales. Marshall (2004) distinguishes urban form, from other urban and form related terms: these are set out below.

**Urban structure** is sometimes used to describe a variety of patterns and spatial distributions. Urban structure may best be equated with the two dimensional organizations of the ground plan of an urban area, such as the street pattern or the structure of land parcels. In this sense, it can be regarded as a specialized aspect of urban form; however, urban structure can also have socio-economic interpretations which have no direct associations with physical form. In its physical manifestation,

urban structure is perhaps best reserved for application to forms that are or relate to contiguous structures, such as transport networks, or the structure of public spaces plus private parcels of land. This interpretation would exclude non-contiguous scatters constellations of buildings or land parcels (Marshall, 2004).

**Settlement form** is more specific than urban form in implying the overall form of discrete units of settlement such as cities, towns and villages. In contrast, urban form could apply to any portion of urbanity, whether constituting part of a city, town or other urban accretion (Marshall, 2004).

**Development pattern** implies the layout of an urban area in deliberate formations, as opposed to emergent accretions. In other words, a development pattern is one that is consciously conceived e.g. a housing layout, or a linear extension to a city, whereas a settlement pattern might be a spontaneous aggregation of dwellings with no conception as an entity. The term development pattern might also connote the dynamic or chronological development of a settlement, as where an original core gains a gridded extension and then a suburban fringe (Marshall, 2004).

**Built form** typically implies urban form in three dimensions, at the scale of individual buildings. Like development pattern, built form has the connotation of the representation or construction of a preconceived artifact rather than an emergent accretion of independently assembled parts (Marshall, 2004).

**Urban fabric** has the connotation of being a continuous surface, often a pre-existing form that may be ‘torn’ by new interventions e.g. urban highways, or ‘repaired’ again e.g. by sensitive infill development. It is suggested that the urban fabric has a fractal dimension lying between two and three. Like a garment fabric, it is composed of surfaces, with a variety of tucks and folds, laying out a configuration of

adjacency and accessibility, without necessarily including the solid three-dimensional material of which it is made (Marshall, 2004).

**Urban geometry** is not a well established term but could be used in a specific way to differentiate geometric manifestations of urban patterns from urban topological ones. The Geometry aspect as derived from the ancient Greek meaning of ‘measurement of the Earth’ which relates to the mathematical study of lines, shapes and forms, such as the dimensions of a rectangle or cuboids. Therefore the term urban geometry may refer to the geometry of the urban surface of the Earth, which implies primarily the delineation and form of different areas (including surface areas used as routes, networks and parking spaces as well as land parcels) but in its widest sense could include all the wrinkles and indentations of the surface of the urban fabric, including the vertical surfaces of buildings and their interiors. Urban geometry could be seen, in effect, as a geometric interpretation of urban geography (Marshall, 2004).

**Urban topology** may be used in contrast to urban geometry. Topology in the most general sense is derived from the ancient Greek meaning of the ‘study of place’. More specifically it refers to the mathematical study of configurations or relations between entities, independently of their absolute (metric) dimensions, such as the placement of two rectangles in relation to each other e.g. adjacent or overlapping. We can therefore use the term urban topology to refer to the topology of urban places, implying the non-metric configurational relationships between urban entities, such as the concentric rings in a settlement (e.g. a central core surrounded by annular bands of inner and outer suburbs), or the structure of transportation networks (e.g. grid or radial) – independently of their absolute size and shape (Marshall, 2004).

**Urban form** is perhaps the most all-encompassing of these terms that can imply either design or emergence of form, in two or three dimensions, from the scale of courtyards to conurbations. Although urban form includes all three dimensions in principle, at the widest scale, an urban area approximates to a two-dimensional surface, akin to an image on a map. From this point of view, urban form may refer to the overall size or shape of the urban area (e.g., a linear or star-shaped form), or its degree of articulation into discrete settlement units called districts (Marshall, 2004).

Some urban form descriptors imply packages of features or associations. For example, ‘transit oriented development’ might imply a mixture of land uses in a fine-grained street grid arranged along a superstructure of transport nodes. While other packages related to urban form implied functional correspondences. Similarly, the distinctions between monocentric and multi-centric or polycentric cities, or between central cities, satellite cities and urban villages, are more than matters of physical arrangement, but imply functional relationships.

### **2.1.2 The Concept of Urban Spatial Structure**

Most studies of spatial structure and land uses of cities have been derived from decentralization about the patterns found in early industrial cities of the United States, due to changes in the shape and form of American cities overtime, new models of urban land use were developed to describe an urban landscape that was becoming increasingly complex and differentiated. Also none of the models accurately described the urban land use in all cities (Oluwosulu, 2007).

Marshall (2004) stated that no unified set of concepts or theories of urban form and structure has emerged over the years although several regional scientists and city planners have all presented their own theories, hypothesis and models with regard to this subject matter. Nonetheless each approach has some validity, but none of them have a universal acceptance.

Khisty and Lall (1998) viewed the city as a system made up of a number of related elements or components which together make up the city system. They defined the spatial system of the city as a "series of system components and their corresponding elements found within the fabric of the city". In their analysis they considered the nucleus of the city as the location of the initial settlement which develops over time as the Commercial and communications center of the city. This can be referred to as the central business district (CBD). As the city grows and spreads out, the influence of the CBD decline as prominent sub centers begin to develop (Bertaud, 2002). They ascertained that all cities are definable area, with identifiable boundaries at a certain point in time. Hence every city exhibits specific types of behaviour or pattern of movement. This behaviour takes the form of growth, changes and decay subject to a dominant set of mechanisms that underlie its form and determine the pattern of change that is likely to take place. They were of the view that since all cities have external environment which may be territorial hinterland they also have a historical sequence of development connected with it. This historical sequence which could be building cycles or rail system construction could be described as layers of which they termed as the personality of the city.

Ikya (1993) viewed city as essentially a complex living system made up of functioning and interacting parts. The author opined that the different urban land use

parts and transport provides the avenue for the interaction. The various land use types comprising of residential, commercial, open spaces, industrial, educational, administrative etc. are all spatially located within a city. These creates spatial imbalance as desires exists in one place and fulfillment in another. For example, an urban resident who is a worker must of necessity, has to move from his area of residence to his place of work. Also, for a student, he must move from his place of residence to his place of studies. Most cities are polycentric in character (i.e. having multiple city centers or central places) they therefore look through the complex interaction of their transport system.

Rodrigue (2005) defined cities as locations having a high level of accumulation concentration of economic activities and are composed of complex spatial structures that are supported by transport systems. The land use pattern of cities acts as the generators for movement of people and freight as they move from several origins and destinations. Thus the more complex the land use patterns, the more complex their associated movement will be.

The various concepts of urban spatial structure show that different authors view the city from different perspective. Essentially, the relationship between transportation and the land use activity in a city determines the pattern of movements which residents in the city observe, since movement is a function of accessibility, the more accessible an area is, the more developmental activities tend to be attracted by that area and this eventually leads to increase in traffic and its land value.

### **2.1.3 Urban Models Classification**



Urban models can be classified under different categories. These range from basic to mathematical in character, with a respective diversity of theoretical foundation purposes and functionality of uses.

- a. Basic models;** These rarely contain the capacity for prediction. They may be classified into scale, analogue, and conceptual. Examples of each include; wooden block models (scale), geographic map (analogue), arrows and boxes (conceptual).
- b. Mathematical Models;** These take the ideas encapsulated in a conceptual model and form them into mathematical symbols, enabling conceptual ideas to be tested and may be classified into predictive model (sub classes include probabilistic and example of mathematical models includes:
  - i.** Land-Use/Transportation Models: Land use/transportation models belong to the mathematical family of models. They composed of independent land use and travel models, with mechanisms for coupling either loosely or in a more integrated fashion. Land use models are used to predict demographic and economic measures of land-activities. These measures describe the population (usually in terms of income and movement) and built space environment (e.g., floor space) for a given urban area.
  - ii.** Travel-models (specifically, travel demand models) are used to predict travel patterns on transportation network. This class of models aims to simulate travel patterns as a function of human activities (commonly considered in terms of land uses) as well as the characteristics of the transport network (commonly considered in terms of accessibility) (Miller, Kager and Hunt, 1998).

**iii.** Descriptive or Analytical urban Models; The important differentiating factor between descriptive or analytical models and land use transportation models is that descriptive or analytical models offer explanations as to how various urban phenomena emerge, but they are generally abstract from questions of why those patterns materialize. Examples of descriptive or analytical models include: Concentric zone theory, Radial sector theory and multiple nuclei theory.

- **Concentric Zone/Ring Theory.**

This is considered to be a hypothetical pattern of land use development within an urban area in which different activities occur at different distance from the CBD resulting in a sequence of rings or zones. This theory was first suggested by an American Sociologist, E.W. Burgess in 1925, using Chicago as a case study. He said that towns expand outward and evenly from the original core area, so that each Zone grows by gradual colonization in to the next outer ring. In addition, the cost of land may decrease with increased distance from the CBD as demand for it falls drastically. This means that commercial uses that can afford high land values will be concentrated in the city center.

- **The Sector Theory.**

Homer Hoyt in 1939 criticized the idea already brought by Burgess when he developed a sector theory to explain land use development pattern in urban area. He argued that compatible land use could be grouped together while the non-conforming land uses would repel. This is a pattern of land use development in which uses such as industrial, high income residential or middle income resources are pushed out from the CBD into specific sectors or wedges.

- **The Multiple Nuclei Theory.**

This theory was postulated by Harris and Ullman in 1945. In the social sciences, it is seen as a model of urban land use in which a city grows from several independent points rather than from one single CBD. Each point act as a growth center for a particular kind of land use, such as industry, retail or high quality housing etc. As these centers expand they merge to form a single urban area. This theory is the most complicated of urban land use models and the only one that gives some insight into the growth of cities in developing countries.

In an urban setting CBD may not necessarily appeared to be the physical center, but rather a functional center of an urban area. Moreover the arrangement of land uses and or transportation routes within the urban area determines its form and pattern.

#### **2.1.4 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.

### **2.1.5 Von Thunen's Model of Rural and Agricultural Land Use System**

Early in the 19th century Von Thunen developed a theoretical model that describes how market processes determine local land-use patterns. Johann Heinrich von Thunen was a skilled farmer who was knowledgeable in economics. His model was created before the first large-scale industrialization and is simply explained in terms of agricultural land use around a central market city. Von Thunen's model was created before industrialization and is based on the following limiting assumptions:

- The central city is located centrally within an “Isolated state” which is self-sufficient and has no external influences.
- The isolated state is surrounded by an unoccupied wilderness.
- The land of the state is completely flat and has no rivers or mountains to interrupt the terrain.
- The soil quality and climate are consistent throughout the state.
- Farmers in the isolated state transport their own goods to market via oxcart, across land, directly to the central city.
- The selling price for the agricultural products is determined in the market by supply and demand.

- Farmers act to maximize profits.

However, in an isolated state with the foregoing statements being true, Von Thunen hypothesized that the following pattern would develop: Central City, Intensive Farming/Dairying, Forest, Extensive Field Crops, and Ranching/Animal Products.

There are four rings of agricultural activity surrounding the city. Dairying and intensive farming occur in the ring closest to the city. The related products (vegetables, fruit, milk and other dairy products) have the highest profits, but also the highest transportation costs because they are vulnerable and perishable. Timber and firewood will be produced for fuel and building materials in the second zone. Before industrialization (and coal power), wood was a very important fuel for heating and cooking. Wood is very heavy and therefore difficult and costly to transport. The third one consists of extensive field crops such as grain for bread. Since grain lasts longer than dairy products and is much lighter than wood, transport costs are considered to be lower, allowing a location further from the city. Ranching is located in the final ring surrounding the central city. Animals can be raised far from the city because they are self-transporting and thus have low transport costs. Beyond the fourth ring lies the unoccupied wilderness, which is too great a distance from the central city for any type of agricultural product.

The economic rationale behind the model is described in terms of profit and distance from the market. The profit consists of the (fixed) selling price minus the (fixed) production costs minus the (variable) transportation costs. The transportation costs increase linearly with distance. Originally, Von Thunen's model was only concerned with location. However, it is possible to derive the land rent from this

model. The farmers that grow a particular product prefer to locate closer to the city, as their profit will be higher. Thus for land closer to the city, they are willing to pay a rent, the land rent, which is at most the profit they make at that location. The conclusion is that land closer to the city will have a higher price than land that is located further from the city. In this simplified approach we state that land rent at a location will be equal to the local profit, being defined as:

$R = Y * (P - C_p) - Y * (C_t * d)$ , in which:

R = land rent (S/acre)

Y = yield (ton/acre)

P = market price (S/ton)

$C_p$  = production cost (S/ton)

$C_t$  = transportation cost (S/ton/miles)

d = distance from town (miles)

Even though the Von Thunen model was created at a time before factories, highways, and even railroads, it is still an important model in geography. The Von Thunen model is an excellent illustration of the Transport costs thus rises linearly with distance.

### **2.1.6 Ullman's Theory of Spatial Interaction**

This theory was postulated by Ullman in 1956. The theory explains the reason why movement takes place within a geographical space. The concept establishes the three principles necessary before spatial interaction can take

place. This theory has been used to explain the basis of movement between places in geographical space. According to Ullman the reason that people and goods moved from one place to another was as a result of three factors which are:

- Complementarily
- Transferability and
- Intervening opportunity.

### **2.1.7 Trip Generation in the Context of Urban Transportation Planning Process**

In order to effectively cope with the intricate derived demand nature of urban travel pattern, planners have responded accordingly by developing techniques required to meet such a complex task. This idea was backed up by a statement;

*“The urban travel forecasting demand model consists of a number of separate models used sequentially. The need for a number of distinct models which acting together predict travel demand undoubtedly reflects the complexity of urban travel, where consideration must be given to many possible destinations which might satisfy the same trip purpose and to the many routes available to travelers within each mode”* (Morlok, 1978), cited in Chiroma, (1992)

This statement not only highlights the intricacies involved in urban travel demand or the relationships between the origin and destination sites. But at the same time it also justifies the use of several models. To forecast an urban travel, there exist five main steps which are as follows.

- (i) Landuse forecasting: To predict the landuse growth/development for the future year, applicable to both the production and attraction sites.

- (ii) Trip generation: Estimating the number of trips originating and terminating in each area.
- (iii) Trip distribution: Assignment of trip origins to the various possible destinations yielding a spatial distribution of trips. This explains the direction of flow for the various trips originating and or produced by a given landuse.
- (iv) Model choice (model split): Allocating trips by different modes. It implies which transportation mode is used for urban trips and is the outcome of a modal choice. Modal choice depends on a number of factors such as technology, availability, preference, travel time and income.
- (v) Traffic/route assignment: The final selection of particular routes expected to be used by each mode. It involves the selection of prepared route(s) to be used for journeys within the city. For instance, a commuter driving a car has most of the time a fixed route. This route may be modified if there is congestion or if another activity (such as shopping) is linked with that trip. Several factors influence this, the two most important being transport costs and availability of transport facilities.

On the other hand, trip generation is appeared to be the first analytical stage of conventional transportation planning process. Also it is viewed as the determination of number of trips associated with a particular traffic zone, area of land, or any other unit of generation and at the same time consists of trips produced by and attracted to the generation unit (ITE, 2010). It is mainly concern with the prediction of persons or vehicular travel for a zone or combination of traffic zones.

### **2.1.8 Terms Associated with Trips**



- (i) Home-based trips: - This refers to those forms of trip having one end of the trip either the origin or the destination at home. This constitutes the majority of person journeys.
- (ii) Non-Home-based trips: - These refer to all categories of trips that are neither originating nor terminating at home.
- (iii) Trip production: - These are usually associated with residential areas where production points are either the home end of any home-based trip, or the origin of a non-home-based trip.
- (iv) Trip attraction: - These are identified as trips generated by work or other purposes (other than residential). They are the non-home end of a home-based trip or the destination of a non-home-based trip.
- (v) Trip purpose: - This has to do with the reasons for undertaken the trip. Trips are therefore classified by purpose in order to simplify the complex nature of urban travel demand. A typical classification includes work, school, business/shopping, sports, recreational and other trips.

## **2.2 Review of Relevant Literatures**

### **2.2.1 Transport, the Enabler for the Emergence and Growth 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 show how the colonialist used, the development of hybrid transport to penetrate the developing countries. The result of this was the restructuring of the pattern of city development and resource use.

Apart from Rimmer (1977), the works of Taffee, Morrill and Gould (1963) and Vance (1970) have similarly explained the inter-relationship 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 therefore are made up of different land uses. Transport helps to explain the vocational arrangement of these land uses. Prior to motorization, 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 road networks characterized by high cross junction and their complex traffic.

Daniels and Warners (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: pedestrian city; horse, bus and tramway city; early railway city; later rail and early bus city; and car and other private transport city. Hoyle and Knowles, (1998) argued that the outward expansion of cities was made possible first by the railways, then by electric trams while 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.

### **2.2.2 Landuse Pattern and Traffic Generation**

Kolade-Arikawe, (1982) observed that much concern were given on the aggregate patterns of movement generated by all land uses in the cities than their individual trip generating characteristics. The author argued that it is important to note

that land use decisions should not be made without the consideration of transportation needs and its impacts, because when land use capability changes, traffic generated will be affected, and in the same way if transport system linking various land uses change, traffic generated or attracted will also be affected

Johnson, (2003) opined that the precise effects of different land uses on transit are unclear, due to their degree of interconnectedness with density and socio economic influences. Though it is clear that the greater the intensity of land uses, the greater the demand for transportation. Hence transport operators choose to operate in areas where the demand for their services is high. Michael, Kevin and Ahmed (2008) noted that high intensity land uses which generate concentrated travel demands need to be in locations which can be well served by public transport.

### **2.2.3 Urban Form and Demand for Transportation**

Olowosulu, (2007) observed that the type of urban structure defines the most efficient mode of transport. The spatial structure which characterizes a city has a direct impact on trip length, the feasibility of transit system being the dominant mode of transport and environmental pollution. The work of Bento, Cropper, Mobarak and Vinha, (2004) revealed that the number of miles a household travels and the mode it chooses for different trips will depend on: the structure of the city in which the household resides; the distribution of population and employment within the city; the site of the city and its road or transit networks.

Study by Olowosulu (2008) showed that urban models as developed by Alonso, Mills and others proved that in a city with one central business district in which all employment are located, the number of trips per worker is fixed while the distance traveled is proportional to how far from the central business district it locates. In

essence the nearer to the central business district a given household locates the higher the rent, and less money is spent on transport, whereas the further the household locates from the central business district the cheaper the rent but the higher the transport cost incurred.

Bertaud, (2004) argued that for a given population, the higher the density, the smaller the built-up area, hence trips will be shorter in length in cities with high densities than in cities with low densities, in a dominantly monocentric city, trips usually are shorter as the majority of trips are from the periphery to the central business district. Most trips have multiple origins but have one group of clustered destinations (i.e. the city center). However, in a predominantly polycentric city, most trips have multiple origins and multiple destinations. Hence there is multiplicity of routes with few riders. As a result transit systems can operate efficiently in monocentric cities but are difficult to operate in polycentric cities.

Berry (1972), in explaining the three classic principles of urban location derived from the locational orientation of economic activities, stated that cities could be: sites of specialized functions; expressions of the layout and characteristics of its transport network as well as central places. The author opined that the skeleton of the city comprises the location of its basic activities plus the urban transport network. Studies carried out by Tanimowo, (2006) and Steaphen, Ho and Ojo, (2012) showed that the spatial relations between the four basic landuses i.e. residential areas, industrial districts, central area and open areas determine the needs of intra-urban transportation. Hence the location of transportation facilities in turn determines the pattern of spatial distribution.

With regards to the above underlying basis, studies by Berry, (1972); Ubogu, (2006); Litman, (2011) and Oduwaye, Alade and Adekunle, (2011) revealed that the immediate effects of interaction on the form of the city are most explicit in urban transportation system adopted by the city.

#### **2.2.4 Urban Spatial Form and Travel Patterns**

Bertaud, (2004) Essentially, travel patterns of urban dwellers deals with trip-making, reasons for the trip (i.e. work trip, recreational trip, shopping trips etc), and modal split (i.e. mode Choice). The impact of various urban spatial structures on their transportation pattern can be determined by using indicators to measure some of the most important spatial characteristic. Among the indicators stated by the author are: the pattern of daily trips, the average built-density, density profile and density gradient.

In his paper "The Spatial Organization of Cities, Deliberate Outcome or unforeseen Consequence?" Bertaud (2004) noted that traditionally, the monocentric city has been the model most widely used to analyze the spatial organization of cities since works of Alonso (1964) and others on density gradients in metropolitan areas are based on the hypothesis of a monocentric city. Steaphen, Ho and Ojo, (2012) observed that travel pattern of residence over the years indicated that the structure of many cities has departed from the monocentric model as many trip generating activities are spread in clusters over a wide area outside the traditional Central Business District (CBD).

Litman, (2013) and Marshall, (2004) argued that no city is ever 100% monocentric, or it is seldom 100% polycentric (i.e. with no discernable CBD). However, some cities are dominantly monocentric, others are dominantly polycentric

while many are in between. Some circumstances tend to accelerate the mutation toward polycentricity and others tend to retard it.

Accelerating factors are historical business center with low level of amenities, high private-car ownership and cheap land among others. While on the other hand, decelerating factors include a historical center with a high level of amenities, rail-based public transport, and difficult topography among others. In a polycentric city, jobs wherever they are, attract people from all over the city. The pattern of trips is different, since each sub center generates trips from all over the built-up area of the city. Therefore, trips tend to show a wide dispersion of origin and destination, appearing almost at random. Trip in polycentric city will tend to be longer than in a monocentric city. The work of Olowosulu (2007) pointed out that in a given city, the shorter the sum of trips to all potential destinations, the higher the value of land. Likewise a geometrically central location will provide trips of a shorter length to all other locations in the city.

### **2.2.5 Travel Behaviour of Urban Dwellers**

Travel behaviour consists of a movement through space using a particular mode of travel (Goledge and Garling, 2003). The dependency on automobile use differs from one country to another. For instance, in North America suburbs there tends to have high level of specialization of activities as most land uses are mono functional, hence the distances between various land use activities are significant. Therefore the spatial imprint of transportation is high, especially compared to the level of density. This implies a high level of automobile dependency in such cities.

On the other hand, the residential section of most European cities is fairly multifunctional with different economic functions sharing the same space. In most

cases, residential and locally oriented commercial functions are closely integrated. This is mixed with a good level of agglomeration, enabling a significant share of movements to occur locally either by walking or by public transit. This characteristic implies a lower spatial imprint of transportation as movement occurs on more spatially efficient urban transportation modes (Rodrigue, 1998). However, the problems of urban transportation in the developed world arises not only out of sheer size of modern cities but also out of organization of their land uses; the rhythm of their activities; the balancing of their public services with private rights of access and movement; taste and preferences of their citizens with respect to mode of travel, route, Comfort and cost (Dyekman, 1972).

In developing countries such as Kenya, Kwoba (1992) carried out a study in which he discovered that approximately 93.5 percent of trips in low income areas were on foot, 4 percent were by bicycle, 2 percent were by Para transit and 0.5 percent was by bus. One reason could be because most of the cities in the poorer regions in developing countries were densely populated and hence compact in nature.

Tama (1996) looked at work trip among civil servants in Yaounde-Cameroon and arrived at the conclusion that though work trip may be one of the most regular trips made from houses, it is definitely not the only contributor to the stream of traffic in the streets of towns and cities. The study was of the view that in order to fully appreciate urban travel patterns, it is essential to separate trips in to different purpose and to examine the modal splits for the identified trip types, because it is only after all these have been done that the data collected for transportation planning and effective transport policy can be properly focused.

In Nigeria the situation is not much different, as observed by Musa (1993) who did a study on journey to work pattern in Zaria urban area and conclude that varying distances separating the residents and workplace, location of employees have a functional relationship with income level, family size and education of the people. The study noted significant relationship between distance and income, whereas education and family size were inversely related. Teku (1999) also did a study on analysis of modal splits characteristics for efficient transport planning policy in Kaduna metropolis, one of the conclusion arrived at was that in making appropriate transportation planning policies factors which influence modal choice and change in travel behavior should be closely examined.

While other past studies have examine the trip behaviour and characteristics of urban residents, (Stephen, Ho, and Ojo, 2012; Ipingbemi, 2010; Oyedepo and Makinde, 2009; Asiyabola, 2007; Tanimowo, 2006) in the increasing number of urban neighbourhoods at the fringes due to population growth calls for further studies in to the trip pattern of residents.

Onokala, (1995) and Oyedepo and Makinde, (2009) observed that residential areas are the major traffic generating zones, while the public, semi-public, commercial and industrial landuses were the major traffic attracting zones in the city.

#### **2.2.6 Determinants of Urban Travel Pattern**

Oyedepo and Makinde, (2009) Ikyia, (1993) opined that urban land use, both residential and non-residential, constitutes the origin and destination of movements. This interaction between the origin and destination define the exact pattern of movement with their volume of traffic as well as their temporal and spatial dimensions.



A study by Muhammed (2013) showed that the production of home-based trip is based on the characteristics of the home end trip (origin), while the attraction for the non home based trip is determined by the characteristics of the destination.

### **2.2.7 Urban transportation and its induced problem in Nigeria**

According to Fox (1973) passenger transportation system exists to serve a community and is embedded in the community itself. Dyekman, (1972) argued that Urban transportation has to do not only with moving people and goods into, out of and through the city but also with the spatial organization of all human activities within it (i.e. the city). Also the work of Oduwaye, Alade and Adekunle, (2011) revealed that the initial relationship between transportation and land use was that transportation has been put in place to serve development. This process of building transport facilities to serve land development shaped the nature of development. Essentially, transportation availability increases aggregate accessibility to a given location and the attributes of the specific location determine whether people visit such location or otherwise.

Rodrigue (1998) argued that movement of people, freight and information has continuously been a fundamental of human's societies. Adefolalu, (1997a) opined that transport is significant to modern and rapidly developing urbanizing societies, for without it, no society can function effectively. The transport system in an urban area can be linked to a body's circulating system, without which the body cannot be nourished and made to function properly. Therefore, the functioning of urban economic activities depends to a large extent on the adequacy and efficiency of its transport system.

Galadima, (2012) observed that the problems militates against the effective performance of various agencies responsible for urban transport management are, duplication of responsibilities; lack of consultation/collaboration and information flow. All these according to the author consequently resulted to the ineffective enforcement of regulation, traffic congestion and irregular transport fares among others.

Hougenoord and Bevy (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. Ogunsanya, (2006) observed that urban transportation problems manifested in the form of environmental pollution, delay and accidents and landuse severance among others. Ayeni (1983) expressed the same view earlier observed that these problems are some of the most pressing and perhaps the most visible urban transportation problems in Nigeria.

Adefolalu (1997b) observing the city of Lagos, stated that traffic congestion is the most serious and intractable. Also a study by Oni (1992) has explains why the transport sector in the city of Lagos is described as 'organized chaos'. This developed the interest of geographers in urban transport issues such as Ayeni (1983) to assess the nature, severity and dimensions of the overall effects of these problems of transportation on urban residents and observed that it is highly irritating. However, with the recent introduction of Bus Rapid Transit (BRT) the scenario of the traffic problems has reduced drastically.

In examining the causes of urban traffic congestion Adefolalu (1997b) 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. With cities expanding tremendously, urban inhabitants now live further away from their places of work. Again, with this increased distance separating different activity areas, residents have to bear with the traffic congestion, delay, parking problems, accidents, traffic noise and environmental pollution.

However, Ogunsanya (2005) study road development and urban sprawl in Ilorin stated that traffic delays, congestion and parking problems are mere systems 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 traffic demand. The work of Ubogu (2006) has revealed that the concern over the growing volume of traffic and other related transportation problems in urban centers has elicited more public attention than other urban problems in Nigeria today.

Observing the effect of traffic congestion on the environment, Engwlich (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 effects on the health of people, community values and environmental ecology, to say the least, are deplorable. Ogunsanya, (1985) argued that automobiles are considered as the major source of more than 50 percent of pollution in Nigerian urban environment

A study by Ogunsanya (1983) on the human factor in urban traffic congestion in a developing environment: the case of Lagos, noted that illegal parking alone

accounts for 30% of the causes of delays in parts of Lagos. Also, Transpoconsult (1976) observed that 44.4% of the total parking space in Lagos obstructs free movement of traffic. Of this figure, 66.6% accounts for illegal parking. Moreover, the increase in the number of vehicles plying the urban roads in recent time, coupled with the fact that mass transit that would have reduced the use of personal cars remained relatively undeveloped. The result is the attendant problem of traffic congestion, traffic delays, traffic noise and environmental pollution of urban centers in Nigeria.

In a similar way a study by Ameyan (2002), reveals that transport that results in delay of 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. Osuji and Onyenechere, (2013) argued that traffic congestion nowadays has been established as the most serious transportation problems in Nigerian cities affecting work trips.

Ubogu, (2006) opined that the degree of urban transportation problems varies from one city to another depending on the functional characteristics of the city. These problems are common in Lagos, Kaduna, Kano, Ibadan, and Port Harcourt. Above all the aforementioned cities in Nigeria, Abuja is said to be not an exceptional city, despite its planning initiatives from the scratch. This is evident as it was stated that “the scourge of Nigeria’s former capital city, Lagos-appear to have suddenly become a constant feature in Abuja, the nation’s ultra-modern capital city. Tail-light cars stuck in traffic lining streets as far as the eye can see are now a common sight in the city. Tales of hours spent in traffic by commuters on their way to and from work are also

frequently exchange these days. A city famous for its 'from scratch' planning should have anticipated emerging traffic challenges" (Anonymous, 2013).

From the general view point Adetunji, (2013) revealed that acute shortage of transport services is evident in most Nigerian cities especially in the morning when commuting to the places of work and latter when returning from work. With regard to this issue, Olateru and Odufuwa (2009) opined that urban transportation problems in Nigerian cities such as the inefficiency of service, low quality and quantity, unaffordability, inaccessibility and unreliable means of public transport system were attributed to human factors. As the case of FCC the situation is severe as the work of Nwaogbe, Ukaegbu and Ibe, (2013) pointed out that the urban mass are totally inadequate in the city of Abuja which make passenger to wait for more than 15 minutes or get seat once in two trips. Every urban centre, worldwide has its peculiar transport problems. The level and types of transportation needs of a community are directly tied to its land use patterns and level of development.

Oduwaye, (2011) observed that distortion of master plan of Nigerian cities have led to negative outcomes including traffic congestion with attendant cost on energy and time spent on traffic. The work of Olowosulu, (2008) revealed that mobility is one of the most serious problems of urban centers in the developing world.

The work of Ikya (1993) pointed out nineteen basic problems of urban transportation in a developing country like Nigeria. Of these, seven main problems are of specific interest to the urban transport planners/managers. These are: Inadequate attention to and provision for movement needs in planned and unplanned settlements; Inadequate awareness of transport implications of land use developments; Absence of long term strategic perspective in transport actions resulting in reactive rather than

proactive planning measures; Inadequate and often inappropriately educated transport professionals incapable of putting their actions in a wider context; Inadequate institutional frameworks for plan formulation and implementation at different tiers of government; Ineffectiveness, (where they exist) of traffic and land use control and regulatory instrument; A seeming importance of planning actions which has a demoralizing effect on transport professionals.

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 and 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 solving 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 hold ups.

More recently, there has been the adoption of road pricing techniques and car pooling either through private initiative as in Singapore or Government as in the United States of America and Great Britain transport in the year 2000. 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 (Gwadabe, 2012). Other suggested solutions to traffic reduction are the intermodal coordination (Hoyle and Smith, 1998; Badejo, 2008), public enlightenment on traffic education (Ogunbodede, 2000), and the use of non-motorized transport (Hoyle and Smith, 1998; Ogunbodede, 2000).

## **CHAPTER THREE**

### **STUDY AREA AND METHODOLOGY.**

#### **3.1 The Study Area**

##### **3.1.1 The physical environment.**

###### **3.1.1.1 Location**

The FCC which is the study area occupies an area of about two hundred and fifty square kilometer (250km<sup>2</sup>). It is located at the northern quadrant of the federal capital territory (FCT) Abuja. The federal capital territory is located in the geographical center of Nigeria and it lies between latitude 8°25'N and 9°29'N and longitude 6°25'E and 7°39'E (figure 3.1). The federal capital territory occupies an area of eight thousand square kilometer (8000km<sup>2</sup>). It is bounded to the north by Kaduna state, to the east and south by Nasarawa state, to the southeast by Kogi state and to the south west by Niger state (FCDA, 1988).

###### **3.1.1.2 Geology**

There are two broad geological regions in the Federal Capital Territory (FCT), each with broadly similar structure and lithological characteristics. The first comprise the Basement Complex rock and account for more than 80 percent of the total area. The



second consists of sedimentary rock in the South and south-West, forming part of the Nupe sandstone (Oguchukwu, 2002).

The basement complex rocks are of three broad categories. The commonest are the granites and granite gneisses, many of which are banded. These kinds of rocks are found in Zuba dissected terrain. In some areas gneisses also form extensive hills but in this case the landscape tends to be low laying and almost flat or gently undulating. The second group of the basement complex rocks consists of the quartzite metamorphic rocks, notably, the quartz schist's and feldspartic quartz schist's pegmatites are associated with these rocks in many occurrences.

### **3.1.1.3 Climate**

Federal Capital City, being part of the Federal Capital Territory (FCT), falls under the tropical sub-humid climate with distinct dry and wet seasons with high temperature throughout the year. The climate is classified as the Aw according to Koppen's classification scheme. The sunshine duration ranges from 8 to 9 hours daily, but increase in cloud cover during the months of July, August and September drops the sunshine hours per day to the average of about four hours.

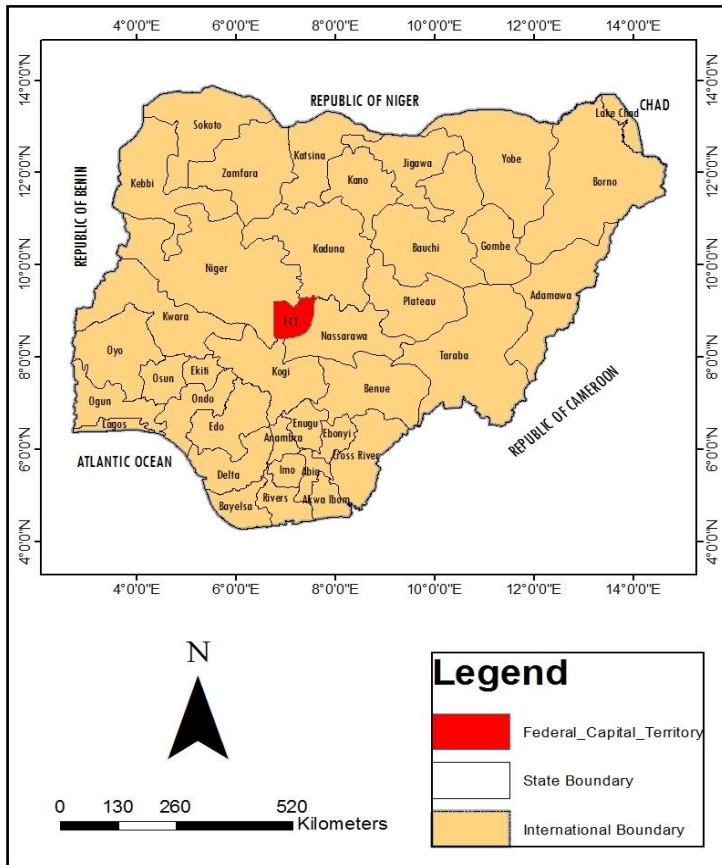
The climate is influenced by two distinct winds (South-easterlies and North-westerly). These winds influences the seasonal variation in the FCT, they are the Tropical Continental Air Mass (North-westerly) and Maritime air Mass (South-easterlies) that determines the seasonal variation in West Africa. Maritime Air Mass carries the moisture laden winds that brings about rainy season in West Africa while the Tropical Continental Air Mass is dry and dusty and brings about dry season in West Africa. The affect of Maritime Air Mass is felt in FCC somewhat between late February and early March to mid-October or early November when this air mass blow

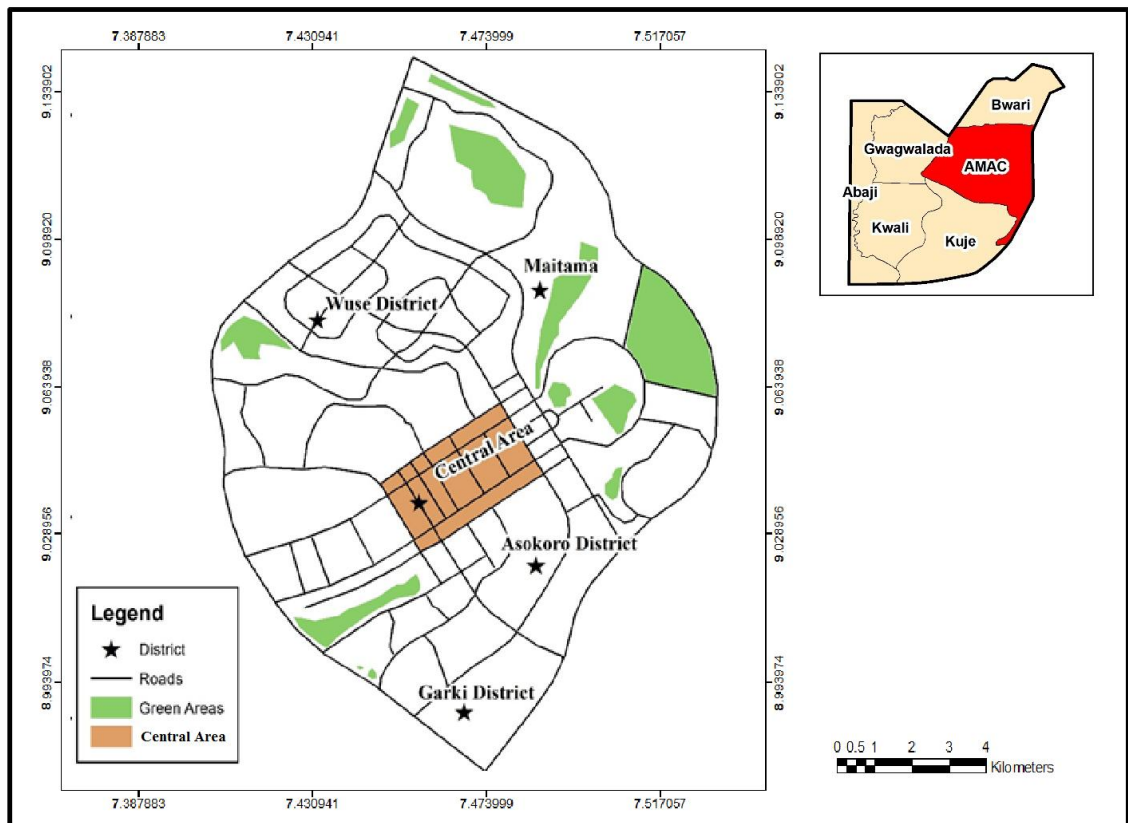
across West Africa hence, rainy season. While the effect of Tropical Continental Air Mass is felt in the area between mid- October or early November to late February or early March.

#### **3.1.1.4 Vegetation**

The main vegetation cover of Abuja is the Guinea savanna, characterized with scattered trees, shrubs and tall grasses. However, pocket of rain forest woodland, wood savanna, parkland and shrubs savanna are also found. This reflects the transitional nature of the area as between the southern forest zone and the northern grassland vegetation belt. Though, most of these species of vegetation have been depleted to give way for development.







Source: Modified from the Land use map of FCC, Abuja, from FCDA.

### 3.1.2 Human Setting

#### 3.1.2.1 Population.

Abuja is the capital city of Nigeria. It is located in the center of Nigeria within the federal capital territory (FCT). Abuja is a planned city and was built mainly in the 1980's. It officially became Nigeria's capital on 12 December 1991, replacing Lagos which is still the country's most populous city. At the 2006 census the FCC had a population of 776,298. This figure is projected to 778,014 and 778,567 for 2011 and 2012 respectively. This makes the FCC to be one of the top ten most populous cities in Nigeria. While the metropolitan area of Abuja recently had over three million

inhabitants. This makes it to be ranked the fourth largest urban area in Nigeria only surpassed by Lagos, Kano and Ibadan.

### **3.1.2.2 The Federal Capital City in the Master Plan Context.**

The Abuja master plan set some specific goals and objectives to be achieved as main aspirations stated in the organizational structure of the city as follows.

- i. National capital designed as a viable urban environment for the seat of national Government and the full range of supporting and complementary activities.
- ii. An overall land use pattern confined to a crescent shaped site defined by developable land above elevation 1,200 feet or 360 meters in the Gwagwa plains below the escarpment surrounding the outer arc of the site including the bold promontory of the Aso Hill.
- iii. A centrally-oriented city plan structure focusing on the location of Federal Government.
- iv. Sector centers straddling the bus way corridors to provide high accessibility to the city core and for inter and intra-sector travel.
- v. A city wide open space structure based on a longitudinal parking system internal to the city retention of the stream valley and water course network for both aesthetic and drainage purposes and preservation of the surrounding escarpment of hills and inselbergs which sprang up in the body of the Gwagwa plains and form the visual backdrop to the city and major focal points within the city.
- vi. A linear transportation system consisting of parallel transit corridors each forming the central spine of development and commercial spine.

## **3.2 Methodology.**

**3.2.1 Reconnaissance survey:** A reconnaissance survey was carried out in the study area to get the researcher acquainted and be more conversant with the area. This helped the researcher to acquire more knowledge about the various transport terminals serving the CBD of FCC, as well as other relevant areas. During the period of reconnaissance a volumetric count of vehicles was carried out at different terminals servicing the central area, where the total number of vehicles handled by such terminal was recorded.

### **3.2.1 Types of Data Required.**

- i. Types of trip.
- ii. Reason for trips.
- iii. Sources of trip.
- iv. Destination of trips.
- v. Cost of trips.
- vi. Intensity of vehicle flow.
- vii. Characteristics of trips pattern.
- viii. Determination of modal choice.
- ix. Types of vehicles.
- x. Time duration for trip.
- xi. Trip challenges.
- xii. Causes of trip challenges.
- xiii. Time to encounter trip challenges.
- xiv. Means of transport system.

### **3.2.2 Sources of Data.**

The primary sources of data for this study involved Questionnaires administration, and personal observations. All these data were obtained from the field survey. The data necessary for undertaking this research in its secondary form are Land use Maps/Development map, Government publications and other documents. All these were obtained from FCTA (Transport Unit), FCDA, FRSC and AMAC, others include Academic Materials, which were obtained from related text books, Journals, magazines and conference papers, as well as materials from related web site(s).

### **3.2.3 Sample Size and Sampling Technique.**

Within the central area, two designated transport terminals for private vehicles were identified. They are Secretariat and Wuse parking Areas. While Area 1 Junction, Area 11/ FCTA junction, Secretariat junction, N.N.P.C junction, National Hospital junction, NICON Junction and Barnes junction, have also been identified as terminals (Bus Tops) for public transit vehicles. All these areas stated as terminals form the sample frame for this study.

Also from the survey carried out during reconnaissance survey, it was found that, the above mentioned terminals operates (handled vehicles) at varying capacities per terminal per day. Nonetheless, the nine terminals had an aggregated average number of nineteen thousand, three hundred and forty five (19,345) vehicles per day. This aggregated number of vehicles (19,345) was therefore used as the population size for this study.

To determine the sample size for this study, Krejcie and Morgan (1970) method of determining the sample size was used, where population size of 15,000-



19,999 will be represented with a sample size of 375 at 5% margin error and 95% confidence level.

To arrived at the total number of respondents at each terminal. The technique adopted for the distribution of questionnaire is shown in Table 3.1.

**Table 3.1: Distribution of Questionnaire**

<b>S/No</b>	<b>Name of terminals.</b>	<b>Average number of vehicles handled per day.</b>	<b>Number of respondents.</b>
1	Secretariat parking area.	4,059 vehicles	79
2	Wuse parking area	2,938 vehicles	57
3	Area 1 Junction.	1,994 Vehicles	39
4	Area 11 Junction.	1,663 Vehicles	32
5	National Hospital Junction.	1,567 Vehicles	30
6	N.N.P.C. Junction.	1,935 Vehicles	37
7	Secretariat Junction.	2,199 Vehicles	43
8	NICON Junction.	1,596 vehicles	31
9	Barnes Junction.	1,394 Vehicles	27
<b>10</b>	<b>TOTAL.</b>	<b>19,345</b>	<b>375</b>

**Source: Field Survey, 2013.**

In selecting the respondents, a systematic random sampling method was employed in this study when administering questionnaires. This implies that part of

the questionnaire amounting to 225 (60% of 375) were administered in the morning hour. While 75 questionnaires each (20% of 375) were administered for mid-day and evening hours.

#### **3.2.4 Data Analysis.**

Descriptive statistics techniques were employed in the analysis of data obtained. The descriptive statistics, specifically the use of tables, bar charts and pie charts, were used in summarizing the analyzed data.

## **CHAPTER FOUR**

### **DATA PRESENTATION AND ANALYSIS**

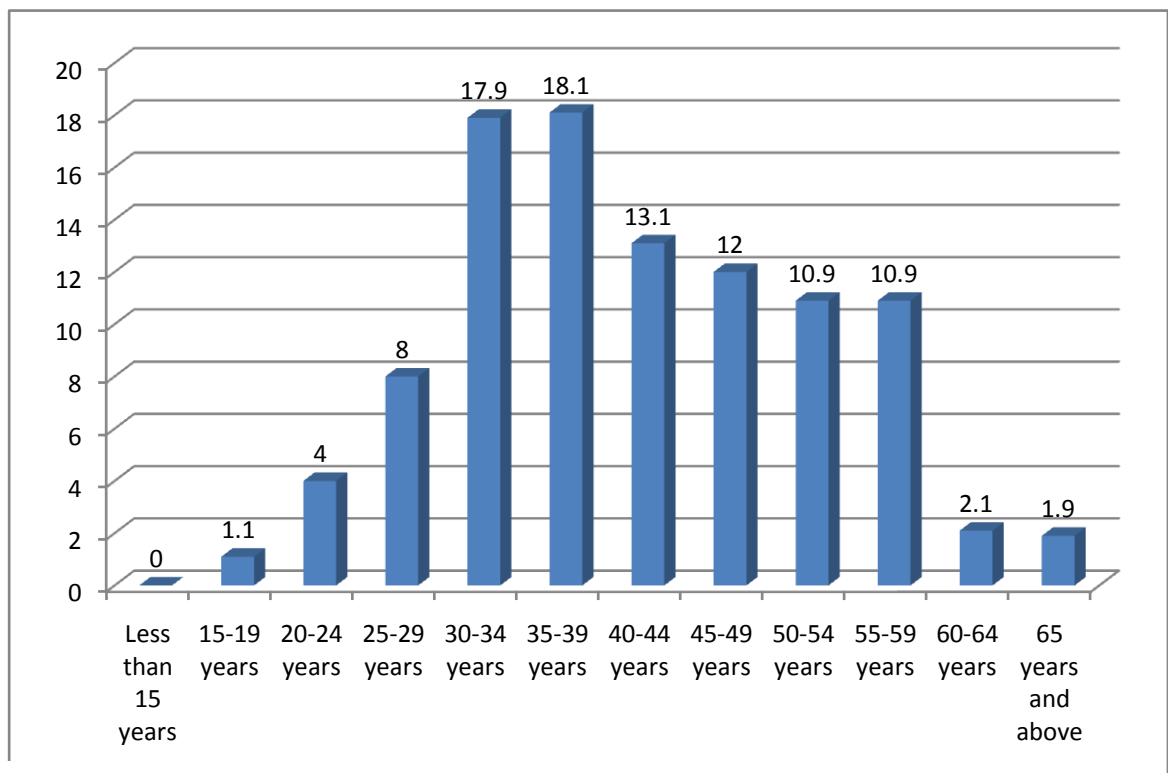
#### **4.1 Introduction**

This chapter contains the data collected from the field which were analyzed using descriptive statistics technique. The analyzed data were presented in the form of frequencies, percentage, pie charts, and bar charts. Also contain in this section are the analyzed data from automobile commuters around the Central Business District of FCC concerning the types, characteristics, and pattern of trips as well as the associated trip constraints.

## 4.2 Demographic and Socio-Economic Characteristics of Respondents

### 4.2.1 The Age Differences of Respondents.

From the survey conducted, the age distribution of respondents is shown in Figure 4.1. The figure shows that majority of respondents (18.1 percent) were between the age of 35-39 years, followed by those between the age of 30-34 years with proportionate share of (17.9 percent), then 40-44 years with a share of 13.1 percent. Those in the age of between 45-49 years represent 12 percent, while 50-54 years, 55-59 years constitute 10.9 percent each. For those between the age of 60-64 years and 65 years upward cover 2.1 percent and 1.9 percent respectively. It has also indicated from the figure that 8.0 percent, 4.0 percent and 1.1 percent represents 25-29 years, 20-24 years and 15-19 years respectively. Beside all these, as at the time of survey there was no respondent that fell within the age below 15 years.

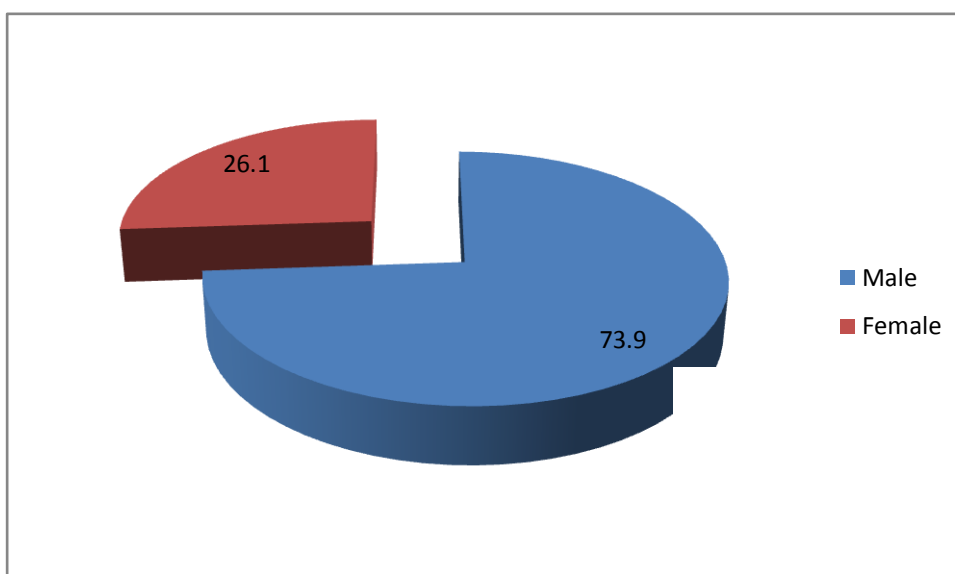


**Source: Author's field work, 2014.**

It can be inferred from Figure 4.1 that the higher number for the age bracket 35-39 and 30-34 years measuring 18.1 percent and 17.9 percent respectively, justifying those in their active working age, as most establishment now are more concern about the age limit of employees. The age range presented above indicate a gradual increase in the age range until it reaches peak before a subsequent decline in the age range as people grow older.

#### **4.2.2 The Gender Differences of Respondents**

Figure 4.2 shows the distribution of respondents by gender. The analysis of respondents by gender differences reveals that the male population was higher than that of the female as at the time of survey. The male constitute the frequency of 277 representing 73.9 percent, while the female has frequency rate of 98 representing 26.1 percent.



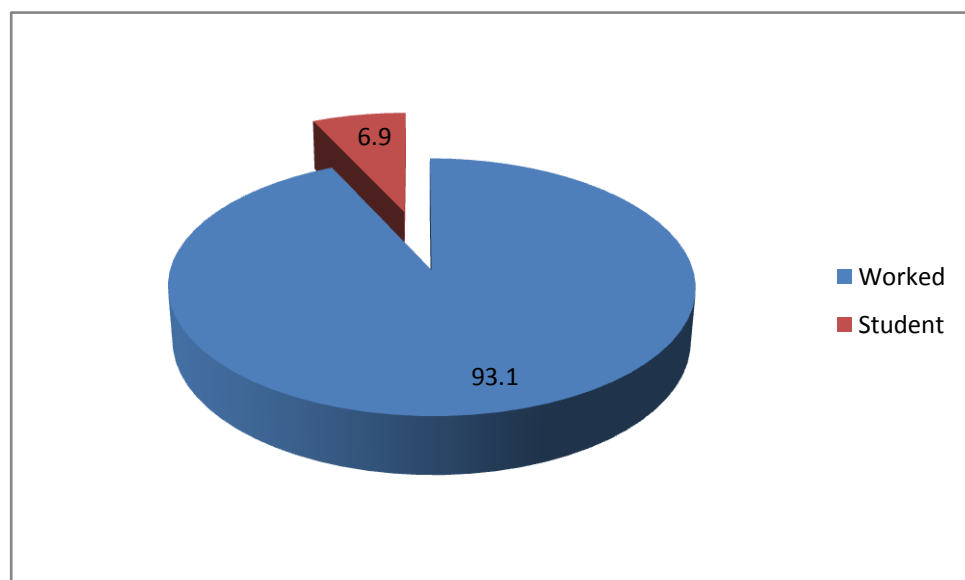
**FIGURE 4.2: Gender Differences of Respondents**

**Source: Author's field work, 2014.**

The higher percentage of male 73.9 percent in figure 4.2, may justify the fact that in most establishment the number of male workers supersede females. Therefore, more male are with the potentials of travelling to the CBD than their female counter part in FCC.

#### **4.2.3 Group of Respondents**

Figure 4.3 shows the distribution of respondents by their group as it was done during the survey. The figure shows that majority of respondents at the time of survey fall under the working group with frequency rate of 349 representing 93.1 percent against the other group which is student with frequency share of only 26 representing 6.9 percent.



**Fig. 4.3: Group of Respondents**

**Source: Author's field work, 2014.**

It can be deduce from figure 4.3 that the higher percentage (93.1%) for the working group justify the nature of the area as the zone of non residential land uses. This resulted to the influx of varying man power as their services are highly required by the Government and private individuals.

#### 4.2.4 Occupation of Respondents

Figure 4.4 presents the major occupation of respondents around the CBD of FCC as at the time of the survey. The figure indicates that the majority of respondents' were civil servants, with frequency of 188 which accounted for 50.1 percent. The table also shows that 75 are professionals (consultants, planners/architect, legal practitioners and pharmacist/medical doctors among others), representing 20.0 percent, then those in the category of other occupations take a frequency of 45 or 12.0 percent (this others include security personnel, task force, politicians and suppliers among others). While the remaining frequency of 41 or 10.0 percent are for the occupation of Business/Trading.

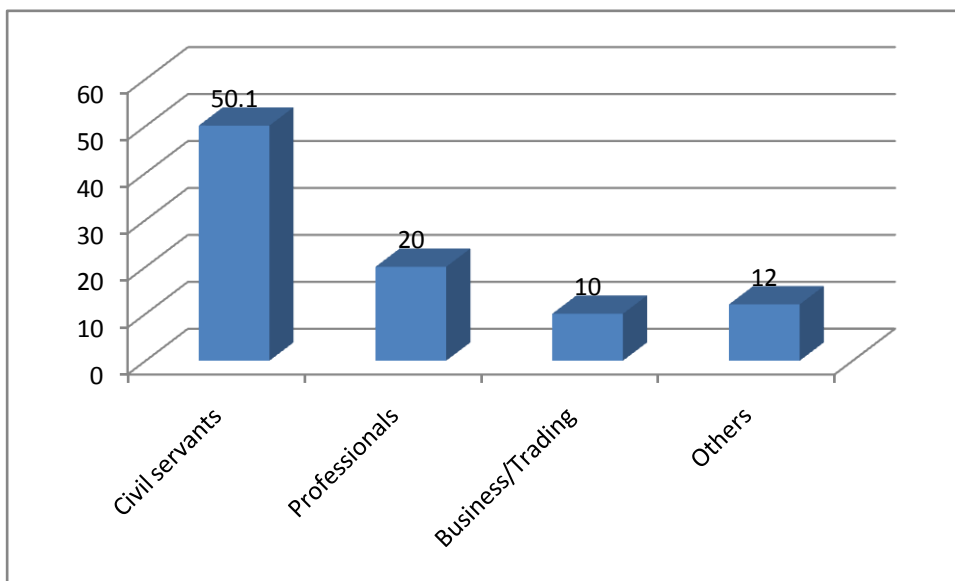


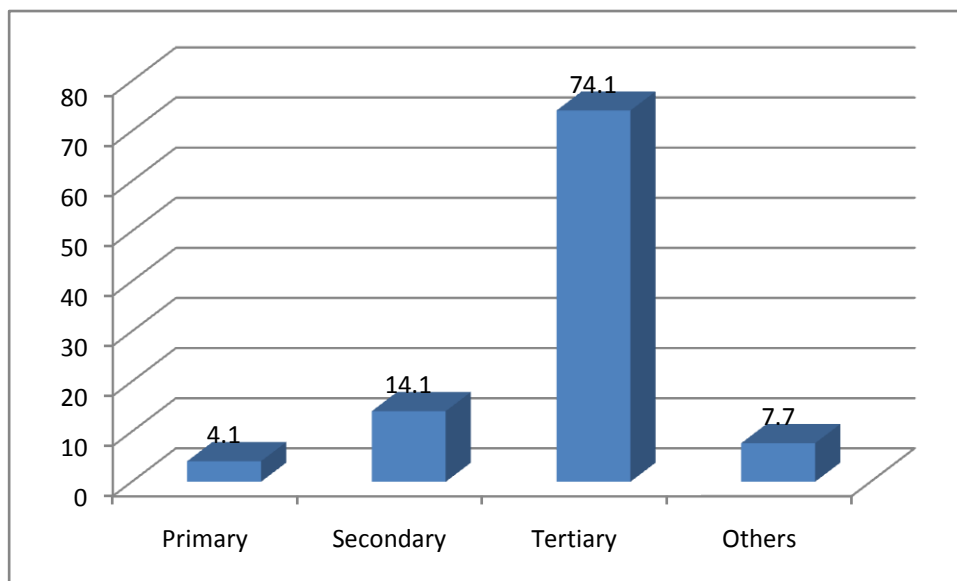
Figure 4.4 Major Occupation of Respondents

**Source: Author's field work, 2014.**

The higher proportion of 50.1 percent for the civil servants has justified the nature of FCC as the seat of Federal Government and is dominated by civil/public servants.

#### **4.2.5 Educational Background of Respondents**

Figure 4.5 shows the distribution of respondent by educational level. The figure reveals that majority of respondents (278) accounted for 74.1 percent as at the survey period had tertiary school qualification, then followed by those with secondary school as their highest qualification having frequency of 53 represented by 14.1 percent. More so, the frequencies of 15 which accounted for 4.0 percent and 29 represented by 7.7 percent were for primary schools and others respectively. This others comprised of no formal education, computer certificate and catering among others.



**FIGURE 4.5: EDUCATIONAL BACKGROUND OF RESPONDENTS**



**Source: Author's field work, 2014.**

The larger share for those with tertiary educational background (74.1%) justify FCT being the capital of Federal Republic of Nigeria, offers variety of job opportunities in many dimension, hence attracts skilled labour. Yet all are trooping to the CBD, because it is the major activity center, for both the city itself and the country at large. This result corroborate with the findings of Momoh and Kaltho, (2011) as well as Mu'azu (2010).

#### **4.2.6 Average Monthly Income of Respondents**

Table 4.1 contained the data for respondents' average monthly income. The table indicates that 129 respondents or 34.4 percent, which is the highest, is for respondents between the range of N50, 000-N100,000 as their monthly income, followed by N100,000-N150,000 with 104 respondents or 27.7 percent. It has also been indicated in the table that 61 or 16.3 percent is for respondents who earned less than N50, 000 as their average monthly income, 32 or 8.5 percent and 20 or 5.3 percent are for those receiving between N150,000-N200,000 and above N200,000 as their monthly income respectively. From the table, it has been indicated that 29 or 7.7 percent of respondents at the point of survey refused to disclose their income level for the researcher. This is probably because they viewed it as their private affair and for security reasons.

**Table 4.1 Distribution of Respondents by Monthly Income**

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<b>Average monthly income</b>	<b>Frequency</b>	<b>Percentage</b>
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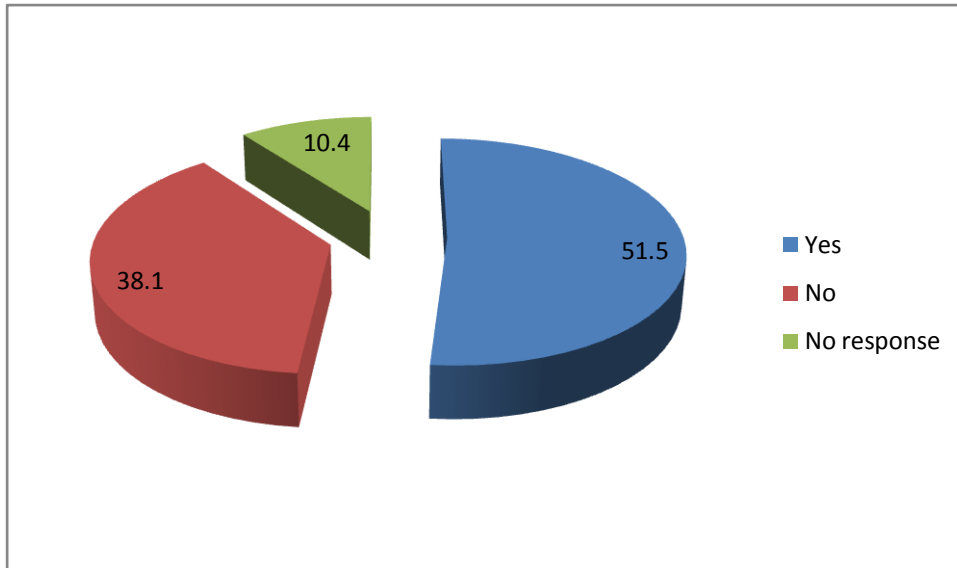
Less than N50,000	61	16.3
N50,000-N100,000.	129	34.4
N100,000-N150,000.	104	27.7
N150,000-N200,000.	32	8.5
N200,000 and above	20	5.3
No response	29	7.7
<b>Total.</b>	<b>375</b>	<b>100</b>

**Source: Author's field work, 2014.**

The higher proportion of respondents who earns between 50,000 to 150,000 Naira indicated that automobile commuters around the CBD of FCC were characterized mostly as medium income earners. This result finding much higher than the findings of Osuji and Onyenechere (2013).

#### **4.2.7 Vehicle Ownership of Respondents**

Figure 4.6 shows the responses on personal ownership of vehicle(s). The figure reveals that the highest share is for those that owned vehicle(s), having 193 or 51.5 percent, followed by 143 or 38.1 percent which represent respondents that had no vehicle as at the time of survey. But 39 or 10.4 percent of respondents could not respond to the question.



**Source: Author’s field work, 2014.**

As indicated in figure 4.6 the high proportion of respondents with private car ownership is expected due to poor and unreliable nature of public transportation system characterizes Abuja. Other reasons perhaps may be the separation between residential areas and places of work in the city and personal income as well.

### **4.3 The various types of trip at Central Business District of FCC**

#### **4.3.1 The purpose of trip to the central business district of FCC**

It is necessary for this research to classify the various trips flowing/trooping in to the CBD of FCC by their purpose. This will enable the researcher to have an indication of the reasons why people travel to the CBD and at which time of the day such category of trip is frequent. Table 4.2 entails information on the distribution of respondents by the purpose of their trip and the actual time for undertaken such category of trip as at the time of survey. The table shows that the work trips accounted

for the largest share of trips (56.2 percent) in the morning hours, then 2.1 percent for others trip. It is also indicated from the table that 0.5 percent and 1.0 percent are for shopping/business and school trips, respectively. During the survey period there was no response for sport trip as well as tourism/recreational trips around the CBD of FCC in the morning hours.

When it comes to mid-day, the analysis shows that the respondents with other reasons for coming to the CBD came first having 8.5 percent, followed by 7.4 percent for respondents' who's purpose of trips were shopping/business. The table further reveals that tourism/recreational trips accounted for 2.9 percent, while sport and work trips accounted for 0.2 percent and 0.5 percent, respectively. Also 0.2 percent of responses stand for the respondents who withheld information on their purpose of trip to the CBD and there was no response for school trip as at the time of survey in mid-day hours among trip makers around the CBD of FCC. On the other hand, 5.6 percent indicated the respondents' responses for others reasons for coming to CBD of FCC, followed by 5.0 percent for tourism/recreational trips in the evening hours. The table also shows the share of 1.0 percent, 4.0 percent, 2.6 percent and 1.3 percent stand for shopping/business, school, sport and work trips, respectively. It is indicated from the table a share of 0.2 percent of respondents who hide information for the researcher in the evening time as at the time for this survey.

Moreover, cumulatively the work trips accounted for the largest share of all trips (58.1 percent) in the CBD of FCC, followed by 16.3 percent for the reasons other than those stated in Table 4.9. The table also indicates that 2.9 percent and 8.0 percent represent sports and tourism/recreational trips, respectively. Those with shopping/business as their purpose of trip to the CBD had 4.1 percent, while 5.1

percent represents school trip. Also 0.5 percent withheld information to the researcher concerning their purpose of trips to the CBD of FCC, Abuja.

**Table 4.2 Distribution of Respondent by Trips Purpose**

Purpose of Trip	Time of trip						Total	
	Morning		Mid-day		Evening		Freq.	%
	Freq.	%	Freq.	%	Freq.	%		
Work	211	56.2	2	0.5	5	1.3	218	58.1
Sport	0	0.0	1	0.2	10	2.6	11	2.9
Tourism/Recreation	0	0.0	11	2.9	19	5.0	30	8.0
School	4	1.0	0	0.0	15	4.0	19	5.1
Shopping/business	2	0.5	28	7.4	4	1.0	34	9.1
Others	8	2.1	32	8.5	21	5.6	61	16.3
No response	0	0.0	1	0.2	1	0.2	2	0.5

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<b>Total</b>	<b>225</b>	<b>60</b>	<b>75</b>	<b>20</b>	<b>75</b>	<b>20</b>	<b>375</b>	<b>100</b>
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**Source: Author's field work, 2014.**

The higher proportion of work trip is expected because CBD's were the major principal zones for the city's economic activities. Moreover, this result is much higher than the findings of Christopher (2004), where work trip takes 36 percent, school trip 32 percent and others trip also 32 percent.

#### **4.3.2 Forms of trip To and From CBD of FCC**

It is very paramount, as required for this research to determine the various forms of trips on the basis of its form of classification as either the Home-based or non Home-based trips. This will give an indication for the proportion of one category or form of trip against the others in the CBD of FCC. This will be viewed for effective understanding from the two dimensional scales (i.e. incoming and outgoing trips). For the incoming trips it is indicated in Table 4.3 that in the morning hour Home-based trip accounted for the highest share of 53.7 percent against the relative share of 6.3 percent for the non Home-based trips. The proportion of all these in mid-day hours, it is 7.7 percent for non home-based trip against the 12.3 percent for home-based trips. While in the evening hours the relative share for home-based trip is 13.6 percent and 6.4 percent for the non home-based trips.

On the other hand, the outgoing trips from the CBD were found to be 33.9 percent for non-home-based trip against the 26.1 percent for home-based trip in the morning hours. The table also indicates that for mid-day trips to the CBD, it was determine that it is 11.7 percent for the home-based which is higher, against the 8.3

percent non home-based trips. By the evening hours, the table also shows that home-based trip accounted for the highest share of trips (15.2 percent), and then followed by the non home-based trip which represents a share of 4.8 percent.

Cumulatively, for the incoming trips the table indicates that majority of respondents' trip originates from their various areas of residence, accounting for 79.7 percent and hence are classified as home-based trips. While 20.3 percent of respondents' trips originate from areas other than their places of residence and hence are classified as non home-based trip. On the other hand, for the outgoing trips, 53.1 percent of respondents at CBD of FCC, terminated their trip at area other than their places of residence, hence are called non home-based trips. While for the respondents whose trips terminated at their areas of residence, hence often classified as home-based trips, and accounted for 46.9 percent.

**Table 4.3 Distribution of respondent by trips pattern**

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<b>TAZ</b>	<b>Direction of</b>	<b>Category</b>	<b>Time of trip</b>	<b>Total</b>
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	flow	of trips	Morning		Mid-day		Evening				
			Freq.	%	Freq.	%	Freq.	%	Freq.	%	
			<hr/>								
<b>CENTRAL BUSINESS DISTRICT (CBD)</b>	<b>Incoming trip</b>	Home-based	202	53.7	46	12.3	51	13.6	299	79.7	
		Non-home based	23	6.3	29	7.7	24	6.4	76	20.3	
	<hr/>										
		<b>Total</b>	<b>225</b>	<b>60</b>	<b>75</b>	<b>20</b>	<b>75</b>	<b>20</b>	<b>375</b>	<b>100</b>	
	<hr/>										
	<b>Outgoing trip</b>	Home-based	98	26.1	44	11.7	57	15.2	176	46.9	
		Non-home based	127	33.9	31	8.3	18	4.8	199	53.1	
<hr/>											
	<b>Total</b>	<b>225</b>	<b>60</b>	<b>75</b>	<b>20</b>	<b>75</b>	<b>20</b>	<b>375</b>	<b>100</b>		
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**Source: Author's field work, 2014.**

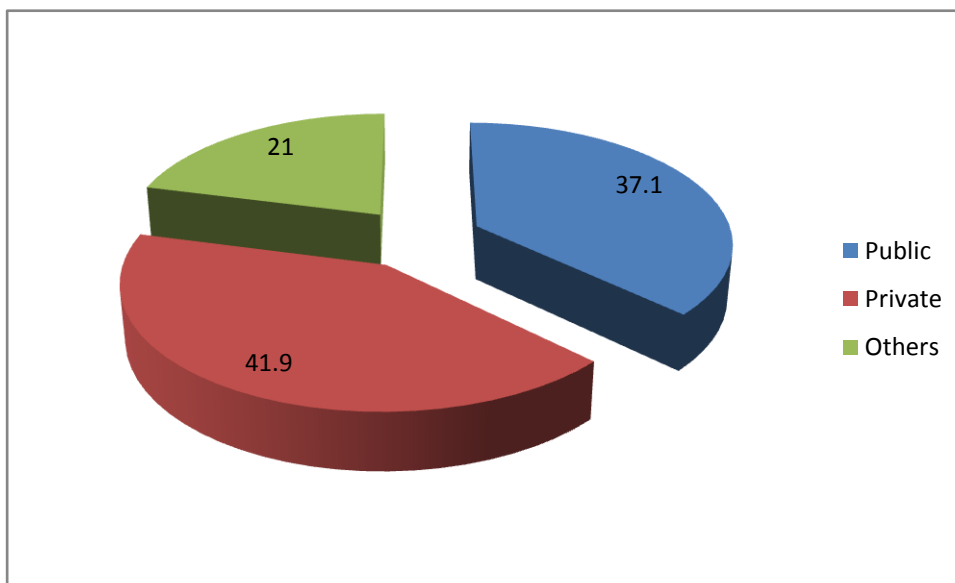
The higher rate for the attraction of Home-based trip by the CBD of FCC is perhaps due to the category of individual trip purpose which appear mainly classified as work trip. This is so because such category of trip is very important and conscious of time. The result of this study is contrary to the findings of Oyedepo and Makinde (2009), where Home-based work trip (17 percent), Non Home-based trip (31 percent) and Home-based others trip (52 percent).



#### 4.4 Trip Characteristics of Respondents around the CBD of FCC

##### 4.4.1 Means of travel to the Central Business District (CBD)

Figure 4.7 shows the distribution of respondents by their adopted means of travel (trip) to the Central area of the federal capital city, Abuja. It is indicated in the figure that majority of respondents 157 or 41.8 percent commute through the central area using their private vehicles. The figure also indicates the share of 139 or 37.1 percent for the users of public transport system, while 79 or 21.1 percent used other means when commuting to the CBD. This other means of transport includes official cars, staff bus, and lift among others.



Source: Author's field work, 2014.

The higher proportion for the use of private vehicles among respondent around the CBD of FCC may perhaps arises due to individual level of income (social status) and potential value of their trips, or the unreliable and adequate supply of public

transport facilities in FCT, Abuja as pointed out by Adah (1995). This result is in line with the findings of Mu'azu (2010).

#### 4.4.2 Categories of Public Means of Transport Facilities in FCC

Figure 4.8 represents the distribution of various categories of public transport used by respondents at CBD of FCC. The figure reveals that majority of respondents (48 or 12.8 percent) used Taxis, followed by 39 or 10.4 percent for those that used Buses. Also in the figure, 21 or 5.6 percent, 6 or 1.6 percent and 12 or 3.2 percent are for those that used midi-bus, single deck and Para transit vehicles, respectively. While a frequency rate of 13 or 3.5 percent used other means of public transport system.

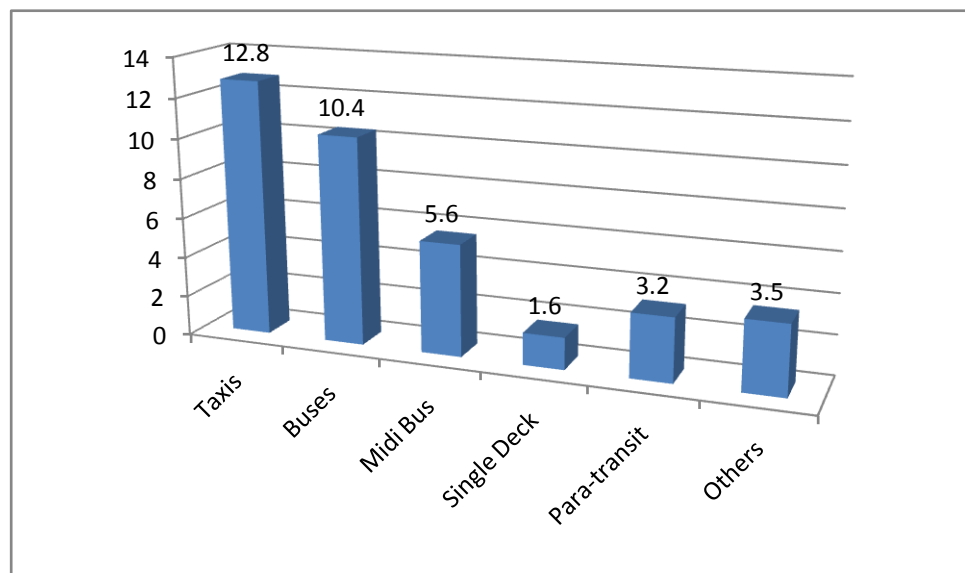


FIGURE 4.8: Categories of Public Means of Transport Facilities in FCC

Source: Author's field work, 2014.

#### 4.4.4 Commuting Time in FCC

Figure 4.9 shows the distribution of respondents by average commuting time to access the CBD of FCC. The figure indicates that majority of respondents, having

frequency of 121 or 32.3 percent, normally spent more than an hour before reaching the CBD and vice-versa. The figure further revealed that another substantive share of respondents 61 or 16.3 percent spent between 30-39 minutes, while those who spent between 40-49 minutes accounted for 54 or 14.4 percent.

The figure also indicated 32 or 8.5 percent, 42 or 11.2 percent and 38 or 10.1 percent, for those that normally spent between 50-59 minutes, 20-29 minutes and 10-19 minutes, respectively. Lastly the figure shows the frequency of 27 or 7.2 percent for those that can commute through the CBD in less than 10 minutes.

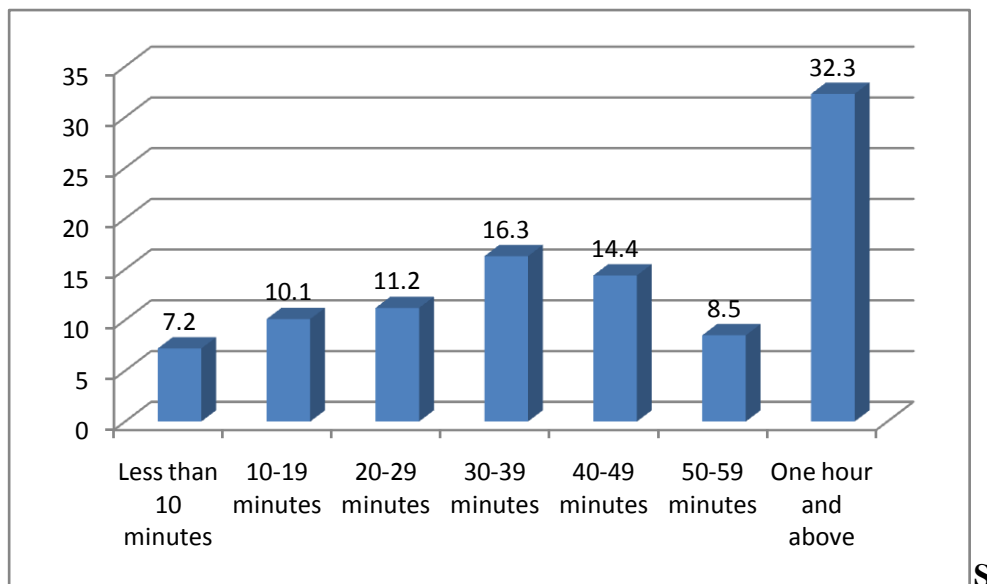


Figure 1.1: Frequency of Respondents for Different Commuting Time to CBD

**Source: Author’s field work, 2014.**

The lesser share of commuting time to reach CBD may justify the fact that accessibility is not always directly proportional to distance, whereas the higher share of commuting time indicates that workers in FCC lived in distant areas from their places of work. The result of this study is in line with the findings of Osuji and Onyenechere (2013), however, lower than the results of Mu’azu (2010).

#### 4.4.5 The fares of commuting cost To and From the CBD of FCC

Table 4.4 shows the distribution of respondents by their commuting cost in monetary term around the CBD. The Table shows that the largest share of respondents 85 or 22.7 percent, normally spent between N400-N500 as commuting cost, followed by 71 or 18.9 percent, for those that spent N500-N600, while those who spent above N600 as their commuting cost 64 or 17.6 percent. The Table also indicated that 66 or 17.1 percent, 28 or 7.5 percent and 10 or 2.7 percent, were for those that spent N300-N400, N200-N300 and N100-N200 as cost of trip respectively. Still on the Table there is share of 51 or 13.6 percent who refused to disclose information to the researcher on the actual money spent on commuting through the CBD.

**Table 4.4 Distribution of respondents by commuting cost.**

<b>Cost of Trip</b>	<b>Frequency.</b>	<b>Percentage.</b>
N100-N200	10	2.7
N200-N300	28	7.5
N300-N400	64	17.1
N400-N500	85	22.7
N500-N600	71	18.9

N600 and above.	66	17.6
No response.	51	13.6
<b>Total.</b>	<b>375</b>	<b>100</b>

**Source: Author's field work, 2014.**

The higher proportion of respondents (22.7 percent) in table 4.4 spending N400-N500 as commuting cost, justify the prevalence of high cost of transportation in FCC, Abuja, and the fact that there exist a longer distance separation between the individual home of residences and their places of work. This result is very much higher than the results of Osuji and Onyenechere (2013), but lesser than the findings of Mu'azu (2010).

#### **4.4.6 Nature of Trip to the CBD of FCC**

Figure 4.10 represent the distribution of the nature of trip undertook by the various respondents from origin to destination. The figure indicates that single/direct form of trip became the largest with frequency of 292 or 77.9 percent, while 83 or 22.1 percent, used to interchange vehicle at a point(s) on a single journey before accessing the CBD.

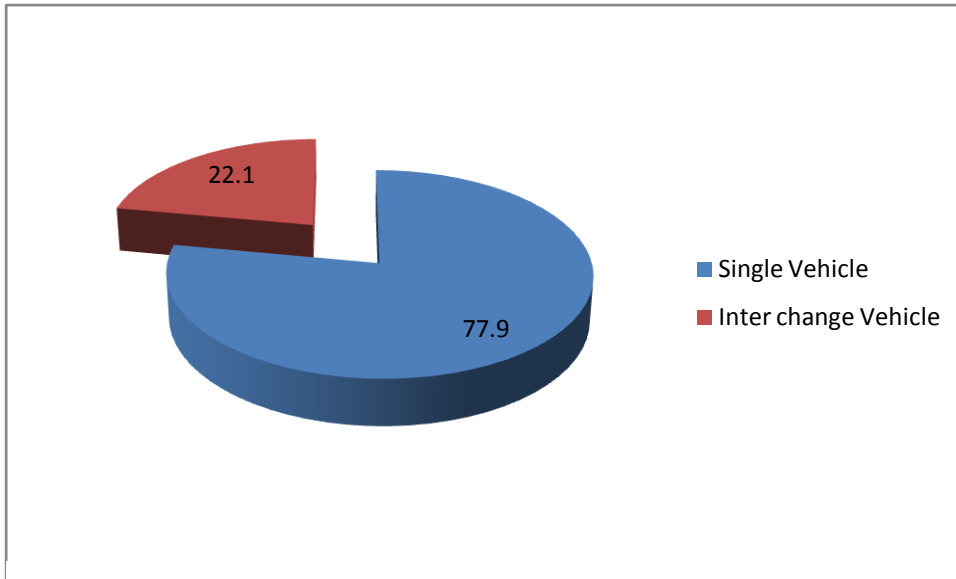


Figure 4.10: Single and Inter change Vehicle used for trip to CBD of FCC

**Source: Author's field work, 2014.**

The higher intensity of 77.9 percent for those involve on direct trip to the CBD is related to the fact that travelers gives priority to the use of private vehicles. More so, the CBD is properly linked with other areas and as well indicates possible signs of good transportation network envisage by the city.

#### **4.4.7 Frequency of Travel to the CBD of FCC**

Figure 4.11 presents the magnitude or frequency of making trip obtained from respondents at the time of survey. The figure has a cumulative share of respondents' trip to CBD, the result of the analysis reveals that daily trips, became the largest among all trips made to the CBD having 221 or 58.9 percent. Also the frequency of 90 or 24.0 percent is for those who made their trip to the CBD at random basis (i.e. without definite time). The figure further reveals that the respondents who made their trips more than once a week had 45 or 12.0 percent, while those with weekly trips had 19 or 5.1 percent.

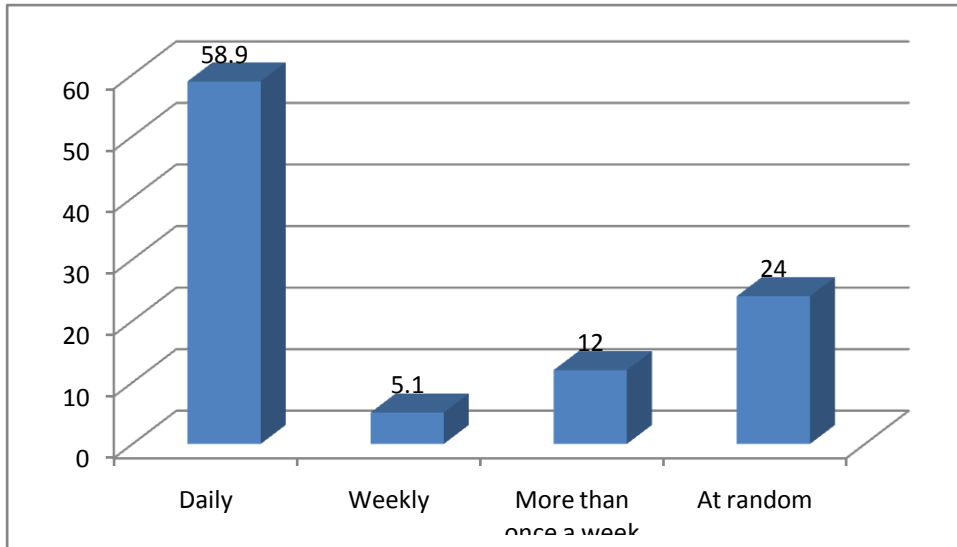


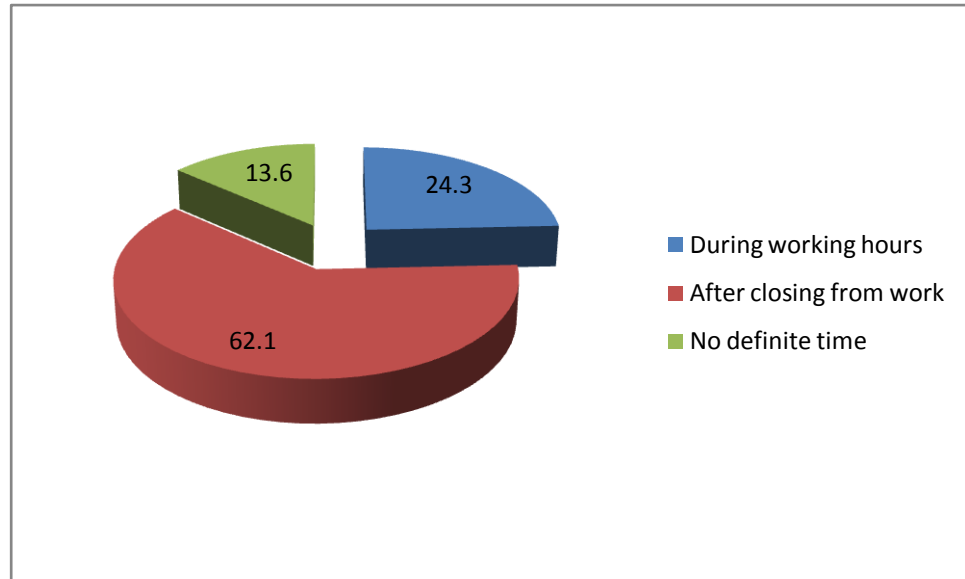
Figure 4.11: Frequency of trips to CBD of FCC

**Source: Author's field work, 2014.**

The higher proportion for daily trip justify the fact that CBD of FCC, Abuja is considered as a zone for non residential land uses, but serve as a center for the fulfilments of various individual travel demand for the entire metropolitan region.

#### 4.4.8 Time for Leaving CBD of FCC

Figure 4.12 shows the distribution of respondents by time to leave the CBD. The figure indicates that majority of the respondents, 233 or 62.1 percent used to leave CBD of FCC after closing hours from work, while 91 or 24.3 percent leaves CBD during the working hours. More so, the figure shows 51 or 13.6 percent for those who had no definite time to leave CBD, (i.e. leaves CBD as soon as their travel demands are satisfied).



**FIGURE 4.13: TRIP TIME RELATIVE TO WORKING HOURS OF RESPONDENTS ORIGINATED FROM CBD OF FCC**

**Source: Author’s field work, 2014.**

The higher proportion for those who leaved the CBD after the closing hours may perhaps justified the fact that works trip shares relatively some similar characteristics, which may appear contrary or different from other travel behaviour of a given commuter in the city, irrespective of the purpose attached to such category of trip.

#### **4.4.9 Other Trips Originated From CBD of FCC**

Figure 4.13 shows the involvement of other trips embarks by respondents which is different from their main purpose of trip to the CBD. The Figure reveals that majority of respondent 151 or 40.3 percent do not involved in any other category of trip, while 129 or 34.4 percent involved in other trip. Furthermore, the analysis in the figure indicated that 95 or 25.3 percent are not sure on their involvement of other trip and hence their responses were as the case may be.



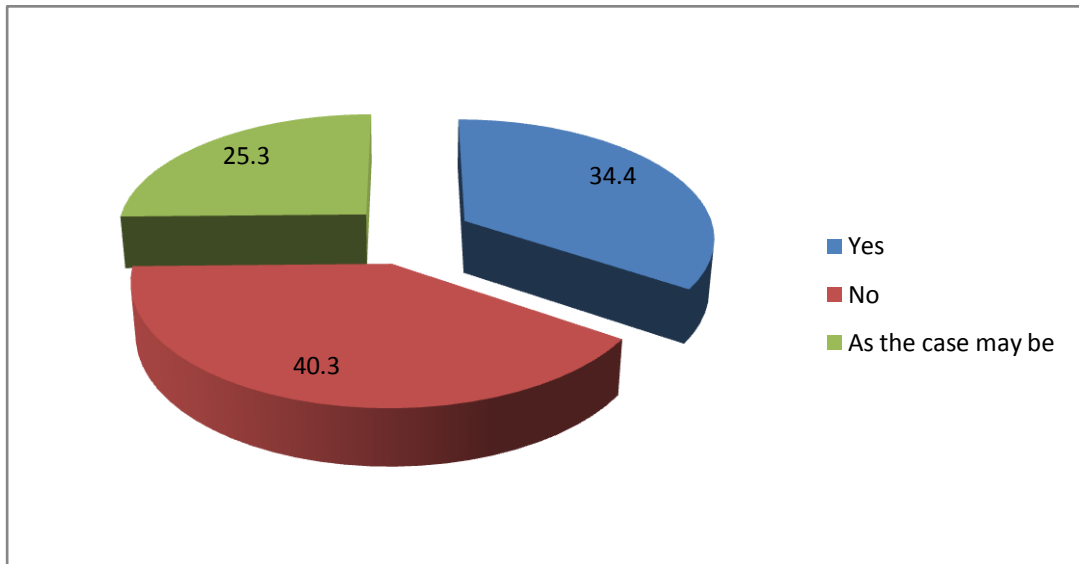


FIG. 4.14 Frequency of other trips originated from CBD of FCC

Source: Author's field work, 2014.

#### 4.4.10 Categories of Other Trips Originated From CBD of FCC

Figure 4.14 shows the respondents' category of other trips involved during their period of stay at CBD of FCC. The figure revealed that majority of respondents having frequency of 79 or 21.1 percent used to carry out trips classified as others during their period of stay at CBD of FCC, (this others, include official meetings, Seminar, workshops and symposium). While on the other hand, 39 or 10.4 percent and 11 or 2.9 percent were for shopping and recreational trips respectively.

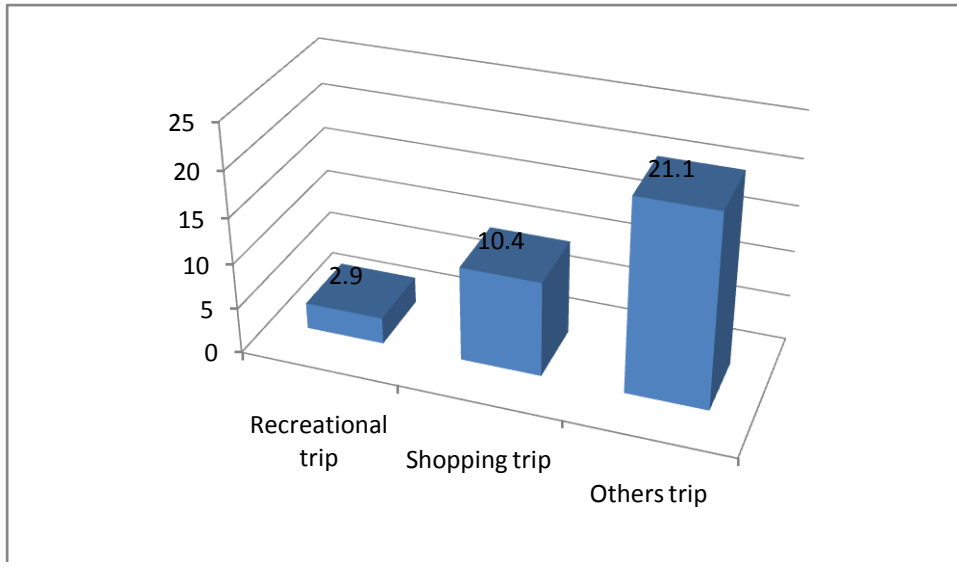


FIGURE 4.14: PROPORTION OF RESPONDENTS FOR DIFFERENT TRIP TYPES

**Source: Author’s field work, 2014.**

The higher proportion for other trips (seminars, conferences and workshops) justified the nature or degree of inter connectivity among the various land uses found to be located around the CBD of FCC Abuja.

#### 4.4.11 Time for Trip Making at CBD of FCC

Figure 4.15 presents the time frame for which respondents embarked upon other trip, while at CBD before their final departure time. The Figure indicates that most of the respondents 55 or 14.7 percent used the afternoon hours, followed by 49 or 13.1 percent for the morning hours. Moreover, the Figure had frequency of 25 or 6.7 percent, for the respondents who were not certain with their travel time.

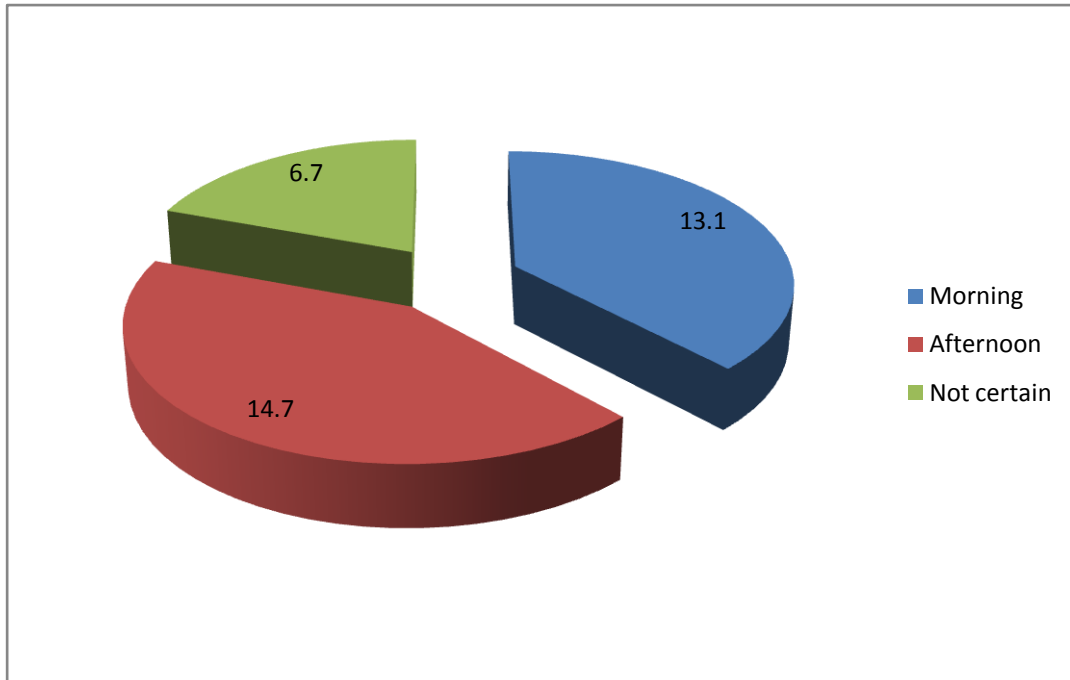


FIGURE 4.15: THE PERCENTAGE OF RESPONDENTS BY TRIP TIME ORIGINATED FROM CBD OF FCC

**Source: Author’s field work, 2014.**

The higher proportion of respondent without a certain time to embark on other category of trip apart from their main purpose which is to work, Such categories of trip were considered officials, hence tends to occur when ever the need arises.

#### 4.4.12 Destination of Other Trip Originated From CBD of FCC

Figure 4.16 present the result of the analysis of respondents by their destination of other trips while at CBD. The Figure shows that majority of respondents (33 or 8.8 percent) had their other trip terminated within the CBD, followed by 25 or 6.7 percent, for Garki. Also revealed in the Figure are the frequencies of 23 or 6.1 percent, 21 or 5.6 percent and 11 or 2.9 percent, had their trip destined at Asokoro, Wuse and Maitima, respectively. The result of the analysis further revealed that 16 or 4.3 percent had their other trips terminated around the areas of phase II of FCC.

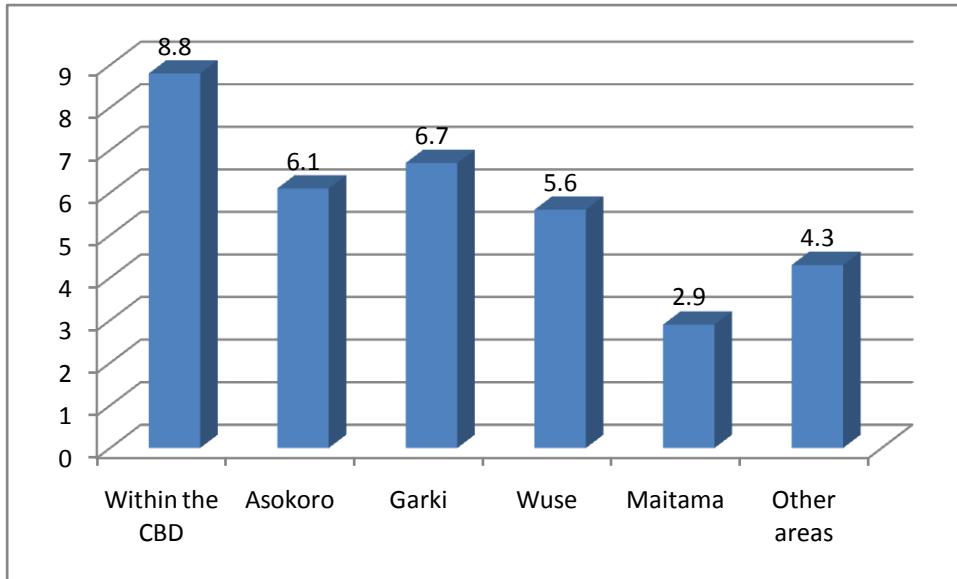


FIGURE 4.5: ORIGIN OF TRIP TO THE CBD OF FCC ABUJA

Source: Author's field work, 2014.

#### 4.5 Trip pattern and factors influencing the choice of means to travel in FCC

##### 4.5.1 The origin of trip at CBD

Of necessity to this research is the need to determine the origin of various trips flowing/trooping into the CBD of FCC Abuja from their areas of residence both within and beyond the city. This in return will give an indication for the proportion of the influence of the destination point (CBD) on the source regions (i.e. where people reside). The distribution of the origin (source) of trip to the CBD as at the time of survey is provided in Table 4.5. From the Table it is indicated that in the morning hours the major source of trip to the CBD, were found to be other areas outside FCC, with share of 65 or 17.3 percent, (the areas classified as others include, the satellite towns, other area councils of FCT, as well as areas beyond the limit of FCT, Abuja). This is followed by phase II of FCC with 63 or 16.8 percent, 56 or 14.9 percent for

Phase I, while 41 or 10.9 percent was considered as the trips originated from phase III of FCC.

The analysis of trip origin around CBD varies significantly during mid-day hours as at the time of survey as against the morning hour's findings. Here the Table indicates that majority of respondents around CBD, 43 or 11.4 percent, traced their origin of trip from other areas, while phase II had 13 or 3.4 percent. Yet 11 or 2.9 percent and 8 or 2.1 percent were for phase I and phase III, respectively. On the other hand, the table also reveals that, by the evening majority of respondents traced their origin of trip from phase I with a share of 6.4 percent, phase II and other areas accounted for 5.1 percent each. The area with the least percent during this period is phase III with a proportionate share of only 3.4 percent.

Generally it was indicated from Table 4.6; cumulatively the CBD attracted the largest share of its trip (127 or 33.9 percent), from other areas within and beyond the FCT on daily basis, followed by phase II with proportion of 95 or 25.3 percent. While 91 or 24.3 percent and 62 or 16.5 percent, originated from phase I and phase III, respectively.

**Table 4.5 Distribution of respondent at CBD of FCC by their trips origin**

Origin of Trip	Time of trip						Total	
	Morning		Mid-day		Evening		Freq.	%
	Freq.	%	Freq.	%	Freq.	%		
Phase I	56	14.9	11	2.9	24	6.4	91	24.3

Phase II	63	16.8	13	3.4	19	5.1	95	25.3
Phase III	41	10.9	8	2.1	13	3.4	62	16.5
Others	65	17.3	43	11.4	19	5.1	127	33.9
<b>Total</b>	<b>225</b>	<b>60</b>	<b>75</b>	<b>20</b>	<b>75</b>	<b>20</b>	<b>375</b>	<b>100</b>

**Source: Author's field work, 2014.**

The higher proportion of 33.9 percent trips attracted by the CBD of FCC from other areas may perhaps arises because the areas in close proximity are very much expensive to afford and at the same time could not cater for the housing requirements of all personalities whose services were required around the CBD of FCC, Abuja.

#### **4.5.2 Trip Destination at CBD of FCC**

The distribution of the various forms of trips from CBD as at the time of survey is provided in Table 4.6. The table revealed that majority of respondents (69 or 18.4 percent) who travel in the morning hours have their trip destination at phase I, followed by 61 or 16.2 percent, for other areas. It is also indicated in the Table that 51 or 13.5 percent had their trip destination at phase II, while phase III had 44 or 11.7 percent.

Furthermore, the result for the analysis of trip destination differs during the mid-day hours as most of the respondents (31 or 8.2 percent) had their trip destination at other areas (both within and beyond FCT). More so, the share of 18 or 4.8 percent, 14 or 3.7 percent and 12 or 3.2 percents are for phase I, phase II and phase III

respectively. For the evening hours as indicated in the table the largest share of respondents (36 or 9.6 percent) had their trip destination at phase I, followed by 17 or 4.5 percent for other areas. Also the Table featured the shares of 12 or 3.2 percent for trip destination at phase II, while phase III had 10 or 2.6 percent.

Cumulatively, the result of the analysis indicated the largest share of commuters around the CBD of FCC (123, or 32.8 percent) had their trips terminated at phase I, followed by 109 or 29.1 percent for other areas. It is also indicated from the research findings that the trip destination of respondents at phase II had frequency of 77, or 20.5 percent, while phase III was found to be 66 or 17.6 percent.

**Table 4.6 Distribution of respondent at CBD of FCC by their trips destination**

Destination of Trip	Time of trip						Total	
	Morning		Mid-day		Evening		Freq.	%
	Freq.	%	Freq.	%	Freq.	%		
Phase I	69	18.4	18	4.8	36	9.6	123	32.8

Phase II	51	13.5	14	3.7	12	3.2	77	20.5
Phase III	44	11.7	12	3.2	10	2.6	66	17.6
Others	61	16.2	31	8.2	17	4.5	109	29.1
<b>Total</b>	<b>225</b>	<b>60</b>	<b>75</b>	<b>20</b>	<b>75</b>	<b>20</b>	<b>375</b>	<b>100</b>

**Source: Author's field work, 2014.**

The higher proportion of 32.8 percent of trips distributed by the CBD of FCC Abuja terminated around the areas of phase I, may perhaps arises because commuters in FCC developed the habit of attending other activities which consider important to their daily life routine, before they finally reach their various destinations.

#### **4.5.3 Factors influencing the choice for means to travel in CBD**

Table 4.7 present some significant factors that affects individual choice of means to travel in CBD of FCC Abuja. The Table shows that majority of respondents (112 or 29.9 percent) used convenience/privacy as the main factor which determine their choice of means of travel to the CBD, followed by income and cost of travel 98 or 26.1 percent and 75 or 20.0 percent, respectively. The Table also indicated that 45 or 12.0 percent considered distance from the origin as a factor, while 15 or 4.0 percent of respondents considered age of the trip maker as the determinant factor. The proportionate share of respondents having other determinants factors accounted for 30 or 8.0 percent.



**Table 4.7 Distribution of respondents by factors determine their choice of means to travel in CBD**

<b>Responsive factors.</b>	<b>Frequency.</b>	<b>Percentage.</b>
Distance from the origin	45	12.0
Income of respondent	98	26.1
Convenience/Privacy	112	29.9
Cost of travel	75	20.0
Age of respondent	15	4.0
Others	30	8.0
<b>Total.</b>	<b>375</b>	<b>100</b>

**Source: Author's field work, 2014.**

As it is clearly indicated above the higher proportion of convenience/privacy among respondents as major determinant factor for the choice of means to travel, may as well justify the incompetency of public transport in FCC, and higher income earnings among respondents. More so this result is contrary to the findings of Momoh and Kaltho (2011), where family size and number of vehicles owned by an individual determine the choice of means to travel, while the educational level of individual is

negatively associated with the travel motive of individual in FCT Abuja. Furthermore, this result contrasts with the findings of Mu'azu (2010).

#### **4.6 Commuter's Trip Constraints in FCC**

##### **4.6.1 Forms of Trip Constraints to and From CBD of FCC**

Table 4.8 presents the various forms of trip constraints or challenges facing commuters around the CBD of FCC as obtained from the field at the time of survey. The Table reveals that the most striking constraint or challenges encountered by trip makers as identified by respondents is traffic congestion with share of 57 or 12.2 percent. This is followed by 46 or 12.3 percent, for the lost of man hour, 44 or 11.7 percent for the high cost of transport fares and 43 or 11.5 percent for the lengthy time spent on-board.

Also contained in the Table are the proportions of road traffic accident having 33 or 8.8 percent, while 41 which or 10.9 percent considered delay in accessing destinations. More so, it is also indicated in the Figure that the frequency of 32 or 8.5 percent, 39 or 10.4 percent and 40 or 11.7 percents were considered as the shares of prolong waiting time to board commercial vehicles, lack of safety in travel and environmental pollution, respectively.

**Table 4.8 Distribution of Respondents by Trip Constraints**

<b>Trip Constraints</b>	<b>Frequency</b>	<b>Percentage</b>
Road traffic accident	33	8.8
Lost of man hour	46	12.3

Delay in accessing destination	41	10.9
Lengthy time spent on-board	43	11.5
Traffic congestion	57	15.2
Prolong waiting time to board commercial vehicle	32	8.5
Lack of safety in travel	39	10.4
Environmental pollution	40	10.7
High cost of transport fares	44	11.7
<b>Total</b>	<b>375</b>	<b>100</b>

**Source: Author's field work, 2014.**

The higher rate of traffic congestion is related to the high usage of private vehicles among commuters in FCC Abuja. However, Fadairo (2013) observed that traffic congestions emanates due to the increasing growth in motor vehicles without corresponding improvement in the provision of transport facilities. This result is slightly higher with the result findings of Osuji and Onyenechere (2013).

#### **4.6.2 Causes of Trip Constraints in FCC**

Figure 4.17 presents the major causes of trip challenge identified by respondents around the CBD of FCC. The Figure shows that majority of respondents (70 or 18.7 percent) had identified the directional flow of traffic as the major causes of trip constraints in FCC, followed by 67 or 17.9 percent and 59 or 15.7 percent for

personal income. The figure further indicated that 51 or 13.6 percent considered separation of residential areas from places of work, while unwillingness to use public transport had 46 or 12.3 percent. The figure also shows 43 or 11.5 percent and 39 or 10.4 percent considered lack of transit system and unreliable public transport system, respectively.

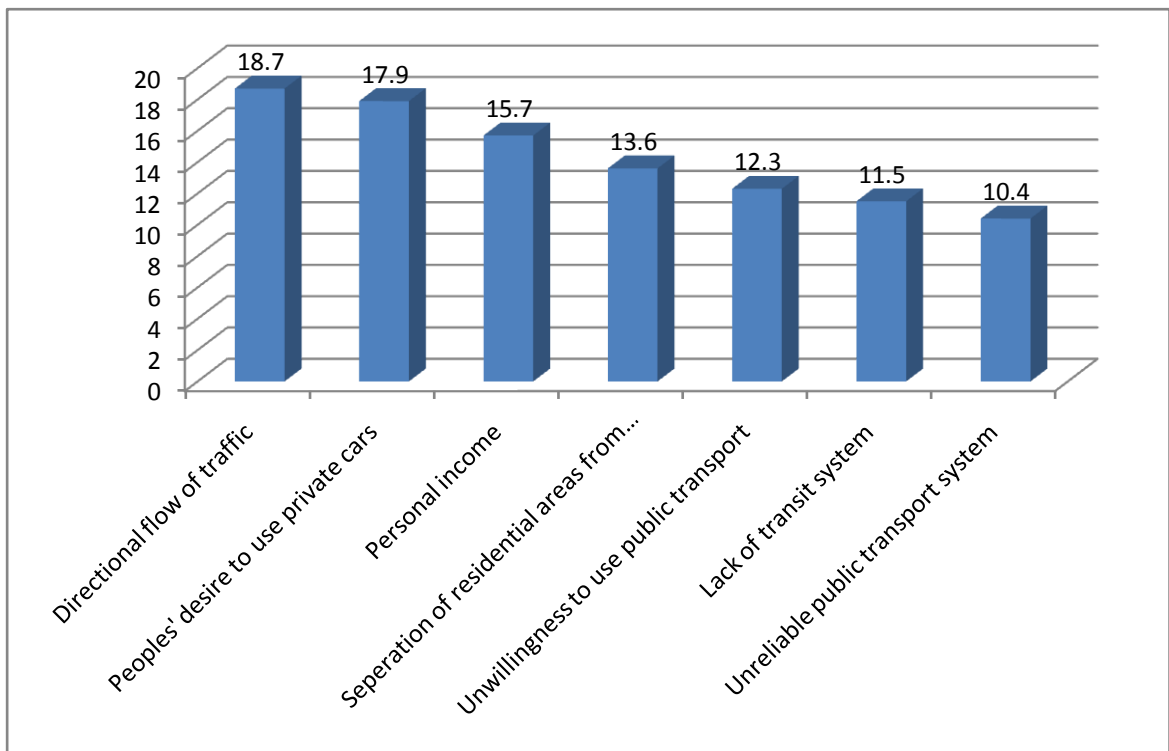


FIG. 4.17 Causes of Urban Transportation Problems in CBD, ABCO

**Source: Author's field work, 2014.**

The higher proportion of 18.7 percent for directional flow of traffic to be the major cause identified by respondents is perhaps due to lack of professional knowledge concerning the contribution of urban transit system in providing solutions to urban transportation problems, as well as their failure to consider the rate of personal car usage which is common in the city. However, Ogunsanya (2004) asserts

that urban transportation problems such as traffic delay and parking problems are merely the symptoms of the malfunctioning of the urban traffic regulatory systems

#### 4.6.3 Temporal Variation of Trip Constraints in FCC

Figure 4.18 contained the available information obtained from respondents on the field concerning the temporal variation of trip challenges as mostly encountered during their travel. The analysis presented in the Figure revealed that majority of respondents (161 or 42.9 percent) were worried about the scenario of trip constraints at both their way in to and out of the CBD. The figure also indicated 121 or 32.3 percent were more worried about the trip challenges only on their way to the CBD. While another share with the proportion of 93 or 24.8 percent get worried much about the challenges on their way back to their various destination areas.

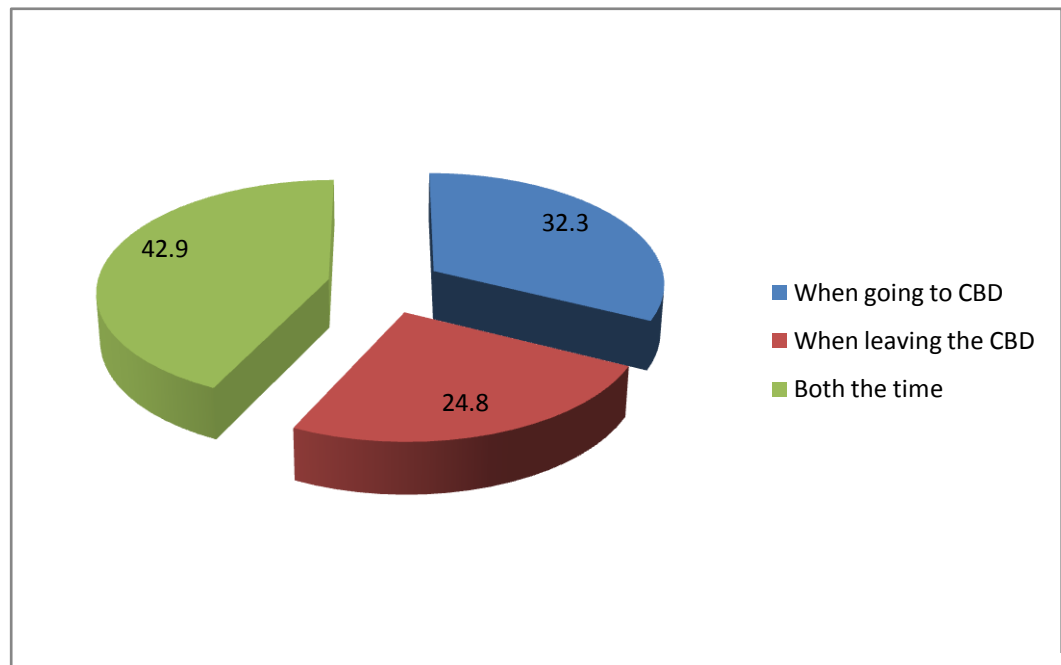


FIGURE 4.18: Temporal Variation of Trip Constraints in FCC

Source: Author's field work, 2014.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Summary of Major Findings**

The analysis indicated that most trips around the CBD were originated outside the FCC, which majorly classified as work trip. Hence, the frequency of commuting to the area seems to be on daily basis, characterized with a flow pattern of traffic which appeared to be one directional for both morning and evening. On the same point of view the data of the study has indicated that convenience was the major factor of consideration among trip makers, which has greater influence on the present individual choice of means to travel around the central area of the city, irrespective of the individual trip purpose.

Moreover, the available data for the study shows that trips attracted by the CBD of FCC were characterized majorly to be classified as home-based trips and distributed mainly the non home-based trips which terminated around the areas in phase I of the FCC. Traffic congestion was appeared to be the major transportation problem striking the minds of travelers around the city. Commuters spent much time before accessing the Central Area from their trips origin.

Above all, the study reveals that most travelers around the CBD of FCC suffered from one transportation problems or the other when commuting through the city to a given destination. That is to say, most trip makers around the city experienced transportation problem(s) peculiar to their individual locality, prepared individual means to travel, the time to undergo such trip and the area intended to visit.

## **5.2 Conclusion**

Accessibility is one of the key factors for ensuring effective growth and development of settlements. However, the recent phenomenon of urban transportation system in FCC showed a drastic reduction in quality of accessibility. It's a known fact that CBD's are the major trips attracting zones in urban areas, whether in

developed or developing countries. In a city with single CBD (like FCC, Abuja), it is the only major trip attracting zone for the entire city region (metropolitan area), and used to be the clustered destinations for multiple trip origins.

It is also clear that urban transportation problems are evident in the city, among which traffic congestion was the major challenging factor confronting commuters, as travelers spent much time before accessing destinations. The commuters attributed the circumstance to the urban design characteristics which forced traffic to move towards particular direction within a specific period of time aimed at satisfying peoples' travel demand. However, the situation is rather attributed to the peoples' desire to use private vehicles as well as inadequate and unreliable means of public transport system associated with the city.

Therefore, it can be concluded that, the city of Abuja itself is not the causes of its urban transportation problems, there are other socio-economic aspect accompany it. Rather, the city could be served as a workable framework in providing possible solutions to urban transportation problems.

### **5.3 Recommendations**

On the basis of the major findings indicated from the study, the following recommendations are suggested to further improve the present condition of transportation system in FCC, Abuja.

- i. To developed a policy frame work for public-private partnership in the provision of quality and reliable higher capacity public transportations systems to serve the inner city.
- ii. Provisions for higher capacity staff buses of the existing government ministries and parastatals within the Central Area. This will drastically



reduced the continuous arbitrary increase in the usage of private vehicles, and hence the volume of traffic along the major transport corridors of the city.

- iii. The FCTA should provide a frame work focusing on urban transit operation system in the context of urban transportation planning exercise for the FCT. The design characteristics as envisage by the city (FCC) make it feasible. This will ease mobility constraints to the city center.
- iv. The government should provide a dedicated lane reserved only for the public transit vehicles to fly. This will increase its quality of services e.g. the Bus Rapid Transit (BRT) in Lagos. This will reduced to the barest minimum the time spent on-board between locations. This will increase the level of usage in public transport system and at the same time discourage the use of private vehicles.
- v. To reduced the high rate of private cars usage in the city. By doing such the number of PCUs on the existing routes leading to the CBD will be reduced. This will facilitate the free flow of traffics around the city core.
- vi. Establishment of task force who should be responsible for the maintenance of stable and low rate transportation fares charged by public transport operators within the city.
- vii. Provide policy on traffic limitation around the central area, especially for single occupancy vehicle(s). This will discourage the high rate in the use of private cars around the city.
- viii. Parked and ride urban transportation management strategy should be developed and implemented fully in FCC. This will add to the commuting quality of passenger's movement to and from the CBD of FCC.

- ix. To review the Blue print of the FCC, Abuja and ensure proper implementation for the provision of such plan.

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**DEPARTMENT OF GEOGRAPHY, AHMADU BELLO  
UNIVERSITY, ZARIA.**

Dear respondents.

I am carrying out a study to investigate the **EFFECTS OF MONOCENTRIC URBAN SPATIAL FORM ON TRIP GENERATION PATTERN IN FEDERAL CAPITAL CITY (FCC) ABUJA**. This study is an academic research leading to the award of *Master of Science Degree in Transport Management* in the above named institution. The exercise is purely for academic purposes and all your responses or information given, will be treated in that regards with utmost confidentiality and anonymity.

**PERSONAL DATA OF RESPONDENTS**

1. Gender.  
(a) Male [  ]                      (b) Female. [  ]



2. Age group.
- (a) Less than 15 years [ ] (b) 15-19 years. [ ] (c). 20-24 years. [ ]  
 (d). 25-29 years. [ ] (e). 30-34 years. [ ] (f) 35-39 years [ ]  
 (g) 40-44 years [ ] (h) 45-49 years [ ] (i) 50-54 year [ ]  
 (j) 55-59 years [ ] (k) 60-64 years [ ] (l) Above 65 years[ ]
3. Please select one from the following as your group.
- (a) Worked [ ] (b) Student [ ]
4. If your answer is (a) in (3) above which one is your occupation?
- (a). Civil Servant. [ ] (b) professional [ ] (c) Trader [ ]  
 (d). Others specify.....
5. What is your average monthly income?
- (a). Less than #50,000 [ ] (b).#50,000- #100,000. [ ]  
 (c). #100,000- #150,000. [ ] (d).#150,000- #200,000. [ ]  
 (e). Above #200,000. [ ]
6. What is your level of education?
- (a) Primary [ ] (b) Secondary. [ ]  
 (c) Tertiary [ ] (d) Others specify.....
7. Do you own vehicle(s)
- (a). YES. [ ] (b). NO. [ ]

### TRIP CHARACTERITICS OF RESPONDENTS

1. Where did you begin your trip (Journey)?
- (a). Asokoro. [ ] (b). Garki. [ ]  
 (c). Maitama. [ ] (d). Utako. [ ]  
 (e). Wuse. [ ] (f). Others specify.....

2. Which name would you assign to the origin of trip you mention in one (1) above

(a). Place of residence [ ]

(b). Others specify.....

3. What is the average time do you normally take to reach the Central Area?

(a) Less than 10 minutes [ ]

(b) 10-19 minutes [ ]

(c) 20-29 minutes [ ]

(d) 30-39 minutes [ ]

(e) 40-49 minutes [ ]

(f) 50-59 minutes [ ]

(g) 1 hour and above [ ]

3. Identify the main constraint (trip challenge) ever encountered, as you traveled to the central area.

(a) Road traffic Accidents [ ]

(b) Lost of man hour [ ]

(c) Delay in accessing destination [ ]

(d) Lengthy time spent on-board [ ]

(e) Traffic congestion [ ]

(f) Prolong waiting time to board vehicles [ ]

(g) Lack of safety in travel [ ]

(h) Environmental pollution [ ]

(i) High cost of transport fares [ ]

4. What do you think are the possible causes that lead to the occurrence of those challenges you stated in (3) above.

- (a) One directional flow of traffics [ ]
- (b) Peoples desire to use private vehicles [ ]
- (c) Personal income [ ]
- (d) Separation of residential areas from places of work [ ]
- (e) Unwillingness to patronized public transport [ ]
- (f) Inadequate public transit system [ ]
- (g) Unreliable public transport system [ ]

5. Please at which time do you worry much about these challenges you stated (3)

above

- (a). When going to the CBD [ ]
- (b). When leaving the CBD [ ]
- (c). Boths time [ ]

6. What is the purpose of your trip to the central area?

- (a). Work [ ] (b). Sports. [ ]
- (c). Tourism/Recreation. [ ] (d). School. [ ]
- (e). Shopping. [ ] (f). Visiting. [ ]
- (g). Others Specify.....

7. Which means of travel do you normally used to commute to the central area.

- (a) Public transport. [ ] (b) Private car. [ ]
- (b) Others specify.....

8. If your answer is (a) in (7) above which one among the following?

- (a) Taxis. [ ] (b) Buses. [ ]
- (c) Midi Bus. [ ] (d) Single Deck. [ ]

- (e) Para transit. [    ]
- (f) Mass Transit [    ]

9. What is your frequency of trip to the central area?

- (a) Daily. [    ]
- (b) Weekly. [    ]
- (c) More than once a week. [    ]
- (d) At random. [    ]

10. What is the nature of trip you normally undergo, when commuting to the central area?

- (a) Single vehicle. [    ]
- (b) Inter change vehicle [    ]

11. If your answer is (b) in (10) above, please tell us your point(s) of interchange.

- (a) .....
- (b) .....
- (c) .....

12. What motivated you to choose this means of travel as your favorite mode?

- (a). Distance. [    ]
- (b). Income. [    ]
- (c). Convenience/Privacy. [    ]
- (d). Cost. [    ]
- (e). Age. [    ]
- (f). Others specify.....

13. Please kindly tell us the time you are anticipating to leave the central area.

- (a) During working hours [    ]
- (b) After closing hours [    ]
- (c) No definite time [    ]

14. Please quantify in monetary term, the average cost spend on transport, as your commuting cost to the central area.

- (a) Less than N100 [    ]
- (b) N100-N199 [    ]
- (c) N200-N299 [    ]
- (d) N300-N399 [    ]
- (e) N400-N499 [    ]
- (f) N500-N599 [    ]
- (g) N600 and above [    ]

15. How does it affect your living standard?

- (a) .....
- .....

16. Before your anticipated time for leaving the central area, do you normally embark on a particular trip?

- (a). YES. [    ]
- (b). NO. [    ]
- (c). Not sure [    ]

17. If your answer is (a) in (16) above, please which one among the following.

- (a). Recreational trip. [ ]
- (b). Shopping trip. [ ]
- (c). Others Specify.....

18. Please tell us the time you normally embark on such type of trip you mention in (17) above.

- (a) Morning [ ]
- (b) Afternoon [ ]
- (c) Not certain [ ]

19. Please tell us the destination of such type of trip you mention in (17) above.

- (a) Within the CBD [ ]
- (b) Asokoro [ ]
- (c) Garki [ ]
- (d) Wuse [ ]
- (e) Maitama [ ]
- (f) Other areas [ ]

20. After you have finished from the central area, please where do you intend to go?

- (a). Asokoro. [ ]
- (b). Garki. [ ]
- (c). Maitama. [ ]
- (d). Utako. [ ]
- (e). Wuse. [ ]
- (f). Others specify.....

21. Which name would you assign to such destination of trip you mention in (20) above

- (a). Place of residence [ ]

(b). Others specify.....