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Changing pattern of landuse and intra-urban transport development in Akure, Ondo State, Nigeria

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CHANGING PATTERN OF LANDUSE AND INTRA-URBAN TRANSPORT DEVELOPMENT IN AKURE, ONDO STATE, NIGERIA

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I certify that the materials in this thesis have not been presented for any other degree or professional qualification in this or any other University.

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DEDICATED

To the Glory of God Almighty for His Guidance and protection throughout my search for knowledge;

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ABSTRACT

This study investigates the implications of change in the pattern of landuse on intra-city transport development in Akure (a medium-sized city). The specific objectives pursued include; identifying the pattern of landuse development in Akure over the past four decades and accounting for any observable changes; identifying and explaining the overall pattern of intra-city movement of passengers within the various landuse zones and accounting for the observed pattern; examining the efficiency and reliability of public transport services on one hand and transport infrastructures on the other hand in terms of their ability to cope with traffic generated and attracted by these landuses; and finally examining the implications of the study for a comprehensive urban transport planning.

The types of data required for the study include: Landuse types and pattern; Landuse characteristics; transport operations and management; infrastructural facilities and efficiency; socio-economic characteristics of commuters, travel behaviour and the characteristics of urban transport problems. The data were collected by direct field interview using appropriate sampling techniques and other secondary sources. The data so collected were subjected to two major analytical techniques viz: factor analytic method for pattern identification and the multivariate statistics (regression analysis and variance etc) for explanation and prediction. Graphs, tables and various types of cartographic tools were employed in the description and explanation of the results.

The result of the analyses reveals a remarkable and rapid development of the area extent of the city between 1976 and 1986. There is also a high increase in the intensity of use of commercial, recreational and public landuse types in the core of the city during the same period. However, each landuse depicts different patterns resulting from some governmental policies and other factors affecting the growth and evolution. In terms of urban morphology, the present structure in Akure can be said to be the result of three major processes which occurred during the pre-colonial, colonial and post colonial periods. However, the processes are interwoven in the sense that it continued from one stage to another to produce the present pattern. A study of the changing morphology of the city reveals that as at 1966, the pattern of the city was one of the concentric pattern while that of 1976 shows radial growth along the road arteries. By 1986, the sectoral growth of the city had intensified along the axial roads of Oba-Ile, Owo, Ilesa, Ondo, Ado-Ekiti and Idanre. The result of various developments in different directions of the city between 1976 and 1996 led to multinuclei pattern of the city as at 1996. The sprawl of the city could be noticed along the inter-city roads. The public landuse where Federal and State Secretariat are located, also witness rapid growth.

A number of factors can be said to be responsible for change in landuse and its emerging pattern in Akure Prominent among the factor is the state creation in 1976 when Akure as a provincial headquarter assumed the status of a state capital. This development brought about population increase and the expansion of secondary and tertiary activities for the city.

The spatial growth of Akure also influenced the spatial pattern of road developments in the city. The commuting distance of Akure increased from 5.2 km in 1966 to 6.4 km in 1976; 10.5km in 1986 and 13 km in 1996 for the major artery road. The increase in commuting distance has impact on trip attraction, distribution and fares paid by commuters. A number of factors had been found to influence trip generation. Such factors include change in socio-economic characteristics of commuters, reasons for trip making and change in landuse types. The change in pattern of landuses in the city also had its effects on public transport services and infrastructural facilities. The study observes in many areas, acute traffic congestion and parking problems which inhibit smooth traffic flow during the day. The result of the analysis of variance shows that public transport services in various landuse zones was not adequate and efficient. The city centre where the community's greatest needs are located experienced traffic chaotic situation partly because of lack of parking spaces. The different rates of trip in various landuse zones in the study area were investigated using non-routed cartographic technique. The result shows that the core area (i.e. CBD, Commercial landuse and High residential landuse zones) is concentrated with flows from all parts of the town. The pattern reveals low flow of people in the periphery of the town while the movement in the commercial and CBD were not easily discernible (blurred).

Using factor analysis, four trip sub-region patterns within which groups of traffic exhibit high degree of similarity were discerned. The most dominant zone (1st order) is the commercial landuse with central attracting pattern. The public/semi-public landuse emerged as dominant zone (2nd order) with NW-SE attracting pattern. The satelite zone (3rd order) include industrial, transport/communication, military/police, residential (medium), residential (low) and recreational landuse with NW-SW attracting pattern. Educational landuse however emerged as an independent zone with North West-South attracting pattern.

It was also revealed that vehicles owned in a house, population of household, distance to the nearest bus stop, income and waiting time at bus stop explain more of trip generation than the conventional socio-economic variables. On aggregate level, all trip purposes when regressed with other independent variables account for 44.65% of the trip generation in the city with income being the sole influence of trip generation.

The study ended with the implication of the research for planning. Specifically, it shows that landuses have grown tremendously over the years with intensification in the core area and outward expansion in the city. The emerging pattern of landuse growth over the years shows that there is need for conscious transport infrastructure and service development policy. The study recommends that Government should control proliferation of landuse development. It also recommends the construction of circular road to ensure immediate and future distribution of flow of traffic in the city. In addition to making provision for public parking spaces in the city.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Landuse and transport planning have occupied the attention of planners for a very long time because of their interplay and their spatial effects on the urban environment. Urbanisation, urban expansion and transportation are thus intricately interwoven (Ikya, 1994). This is why studies on land use pattern assist in unfolding the intricacies underlining the philosophy and development of the city and its transport (See for example Blunden and Black, 1984; Rhind and Hudson, 1980; Mabogunje, 1968; and Ayeni, 1979). The multivarious functions of the city make urban landuse dynamic, and accounts for the changes in urban morphology as depicted by the models of urban structure.

The industrial revolution of the 19th century and the development of the automobile in the 20th century accelerated the process of urbanisation throughout the world. Since then, population grew, landuse became dispersed, socio-political and economic scene changed, trip length increased and urban functions became complex. The effect of industrialization on urbanisation is therefore observable in the new role played by villages and small towns as they assume more administrative, industrial and commercial roles in addition to their primary roles as residential and cultural centres.

The recent trend in urbanisation in Nigerian cities has resulted in the continuous influx of people into the major cities. The rural-urban migration in Nigeria reduces the number of people in the rural areas while at the same time increasing that of the cities and consequently the spatial sizes of the cities

(Onokerhoraye and Omuta, 1978; Sada, 1973 and Mabogunje, 1968). The rapid growth of cities creates some urban transport problems which manifest in the form of delay, accidents, congestion and environmental pollutions. There is therefore the need to provide adequate transportation facilities for people to enable them accomplish their daily activities.

In some cities of Nigeria, such as Lagos, government provides public transport services to complement the efforts of private owners. In other cities, the provision of public transport services is virtually in the hands of private entrepreneurs. Thus, there is little or no organisation in most of the cities' public transport service system because each driver determines the time of operation, routes to be taken and fare to be collected. The result is that most commuters have to wait for hours in certain landuse type before they are accessible to one type of transport or the other.

The landuse types create nodes of desires and fulfilment. Transport assists to even out this spatial imbalance in needs. Often coincidence arises from individual commuter's journey during peak hour periods. Urban landuse planning and management is geared towards mitigating this mobility problem and ensuring a smooth flow of urban traffic as exemplified by the work of urban transport scholars. While some aim at identifying the causes and dimension of transport problems (see Adefolalu, 1977; Adeniyi, 1985; Emielu, 1978; Filani and Osayiwense, 1977 and Ogunsanya, 1984), others are pre-occupied with various options for solving transport problems (see Ayeni, 1975; Adeniji, 1987; Ogunsanya, 1987; Okpala, 1981; Oyefesobi, 1981 and Omiunu, 1988).

1.2 STATEMENT OF THE PROBLEM

The level of urbanization in the third world indicates that in 1920, only 6.9% of the population lived in cities with 20,000 people and above. This rose to 10.4% by 1940. By 1950, three cities in the developing world had more than 4 million population. Because of the rapid industrialization and improvement in transportation, the number of cities in this category had increased to twenty by 1980 and it is envisaged that it will be about sixty by the end of the century. On the other hand, cities with one million people each will, according to United Nations forecasts, increase to about 300 by the year 2000 in the developing world. The rapid growth in population and the multivarious functions performed by cities make them generators and attractors of traffic. The ultimate implication of these are mobility problems if adequate attention is not paid to transport in urban planning.

Nigerian cities are no exemptions in the situation described above. According to Ayeni (1978) Nigeria has a rate of urbanization that is one of the highest in the world. For instance, the number of cities of 20,000 people or more rose from 56 in 1952 to 180 in 1963 and the proportion of the country's population in such cities rose to 19.1%. This rapid growth has implication for landuse and spatial expansion. For example within the city of Lagos, the commuting distance increased from 20km in 1970 to 35km in 1995 while that of Kaduna increased from 6km to 10km during the same period (Ikya, 1993). Today, many urban centres of the country suffer from high rate incidence of inadequate attention to the provision for urban movement, lack of awareness of the impact of changing

landuse on transport development, increasing journey distance and travel time due to transport system deficiencies, environmental pollution, ineffectiveness of traffic and landuse regulation control where they exist, lack of provision for freight movement, traffic congestion, accidents and parking space problems.

Transportation problems as enumerated above have attracted several government commissioned studies as exemplified by the works of Max Lock on master plan for Bauchi, Gombe, Minna and Dar Al-Handasah for Gembu, Okene, Offa, Lokoja. These types of studies were intense in the country between 1974 and 1978 for the major urban centres in the country, but they were not essentially transport based as they were used to prepare a comprehensive master plan for cities under study. The studies in addition to being master plans for cities also highlighted congestion problems, their causes and management.

There are other transport based studies conducted on some urban centres. These studies focus mainly on Lagos metropolis because of the severity of her transportation problems in the country. According to Ogunsanya (1993) not less than twelve of such studies have been carried out in the last two decades. Important among the studies are Traffic Improvement Plan for Lagos Metropolitan Area by Lea Deleuw - Osot in 1974, Transportation systems and services in Greater Lagos by Sigmud Grava in 1974, Lagos Metropolitan Area Transportation study by Transponconsult in 1970 and Mass Transit and Transport Systems Management Programme for the metropolitan Area by Dar Al-Handash in 1992 among others. These studies were essentially aimed at providing short-term

traffic management solutions for Lagos transport problems in addition to recommending adequate parking facilities, enforcement of parking control and introduction of one-way traffic.

There are other non-commissioned studies on urban transportation emanating from researchers in the Universities, Research Centres and Polytechnics. The studies cut across various disciplines because of the complexity of urban transportation problems. Examples of such non-governmental works include those by Adefolalu (1977) on traffic congestion in the city of Lagos; Oyefesobi (1981) on accident reduction; Orioke (1981) on traffic education; Ogunsanya (1982) on human factors in urban traffic congestion and Omiunu (1981) on rapid growth and expansion of cities which have serious implications on existing urban transport facilities.

From the foregoing, it could be deduced that past studies on urban transportation, have been restricted to the big cities like Lagos, Ibadan, Kano, Kaduna and Port Harcourt. The major areas of focus of most of these studies include congestion, delays, infrastructures, public transport effectiveness and the likes. Hitherto the medium-size cities of Nigeria lack such specific transport based studies even though evidence of transport problems have started to emerge in these cities. Rapid urbanization of Nigerian cities resulting from state creation has been on since 1963 when the Mid-West region was created from the Western Region and it has continued till 1996 when the number of states in the Federation increased from the initial 12 of 1966 to thirty-six. Thus, there has been a

continuous change in the spatial structure of land uses in most cities with the attendant implications on intra-city transport development.

Akure is a medium-sized urban centre and was a provincial headquarter of Ondo Province in 1939. It became a state capital and Local Government headquarter in 1976. The city's morphology has changed over time to assume its present status with its attendant transportation problems, as experienced in some other medium-sized urban centres.

Part of the causes of transportation problems have been attributed to the fact that city structures predated the advent of the automobile. According to Bolade (1986) the problems of haphazard development is prevalent in all our growing urban centres. This problem according to him, can be attributed to unplanned growth resulting in scattered agglomeration of settlement patterns and the spatial expansion of the cities along the main transport routes. This situation is worsened by apparent lack of understanding of the relationship between city's changing landuse and its transport needs.

Sargent (1972) also recognised that the forces which influence urban morphology have been given little attention compared to studies of the nature of land occupance. He further explained that geographic analysis of an urban area is best carried out within a framework that is capable of providing insight into the landuse pattern and processes. If such a pattern can be studied over a period of time, and its influence on transport established, one can model the future scenerio. By so doing, a major gap would have been filled in urban transport

studies. The study reported here is therefore concerned with this neglected aspect of urban transport studies with a view to bridging this gap and providing planning policies that would ensure adequate and reliable transport services in the city.

1.3 AIMS AND OBJECTIVES OF THE STUDY

The main purpose of this study is to investigate the implications of change in the pattern of urban landuse on transport development. The study has the following specific objectives.

(i) To identify the pattern of landuse development in Akure over the past four decades and to account for observable changes.

(ii) To identify and explain the overall pattern of intra-city movement of passengers within the various landuse zones and account for the observed pattern.

(iii) To examine the efficiency and reliability of public transport services, on the one hand, and transport infrastructures, on the other hand, in terms of coping with traffic generated and attracted by these landuses.

(iv) To examine the implications of the study for a comprehensive urban transportation planning.

1.4 THE CONCEPTUAL FRAMEWORK

A lot of theoretical works had been done on urban public transportation (Ullman, 1956; Smith, 1964; Hay, 1981; Robbins, 1975; Ayeni, 1975; Adeniji, 1987 and Ogunsanya, 1993). Urban transport studies involve the movement of traffic

over space. Urban traffic patterns depend primarily on trips which start or end at home. Abler et al (1972) argues that the basis for trips rests on the locational structure of different but complementary activities, their type, location and intensity, the geographic pattern of various population units and their social and economic characteristics from one landuse zone to another. Landuse activities have impact on transport system, hence, the concept of spatial interaction is very important in studying their relationship. Hurst (1966) views spatial interaction as the movement of goods and people between two geographically separated points. Ayeni (1979) on the other hand views spatial interaction as a means for satisfying certain needs arising from the locational separation of producers and consumers.

(a) **Conditions for Spatial Interaction**

In the quest for the basis of spatial interaction, Ullman (1956) postulated three principles which are relevant to this study. These are complementarity, intervening opportunities and transferability. Complementarity implies areal differentiation and the existence of supply and demand which are specifically complementary in different areas and this can result in interaction. Intervening opportunity sets up a constraint as to the possibility of interaction taking place between two places even if the condition of complementarity is fulfilled. Transferability relates to the ease with which such demands could be met and it is measured in real terms of transfer and time costs.

Another concept worth examining in urban transport is the quality of transport services and infrastructural provision within the various landuses. Two terms help to explain the level of quality. These are efficiency and reliability.

(b) **Efficiency**

An attempt to formulate a concept of spatial efficiency must be related to the ease of movement within the urban system. According to Ayeni (1979) the ease of movement is a very broad term as it may relate not only to the movement of people but also to those of goods and services. An efficient spatial system may be described as one that minimizes the efforts of movement, subject to the constraints that obtain in the system. In this way, the concept of spatial efficiency is useful in establishing performance criteria for city system such as the patterns of spatial interaction and parking facilities in the Central Business District (CBD) where traffic problems is more pronounced.

In the extension of efficiency concept to movement in cities, there is need to outline the areas where public transit system is needed in order to be efficient. Such objectives include the identification of landuse zones which are not well served with public transport system, waiting time at bus stop, walking time to bus stop and journey time to other landuse activities. Thus, the following are used as measures of efficiency in respect of flow of movement of public transport system:-(i) walking time to bus stop (ii) waiting time at bus stop (iii) journey time to places of other landuse activities.

(c) **Reliability**

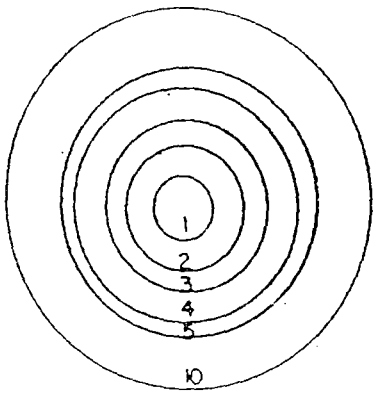
Robbins (1975) defines reliability as the ability of transport services to perform day-in day-out; adhering to the time-table that is published for it. Thus, reliability of public transport services cannot be measured in terms of the published time table only. It can be subjectively measured by the frequency of public transport services in various landuses.

(d) **The Structure of the City**

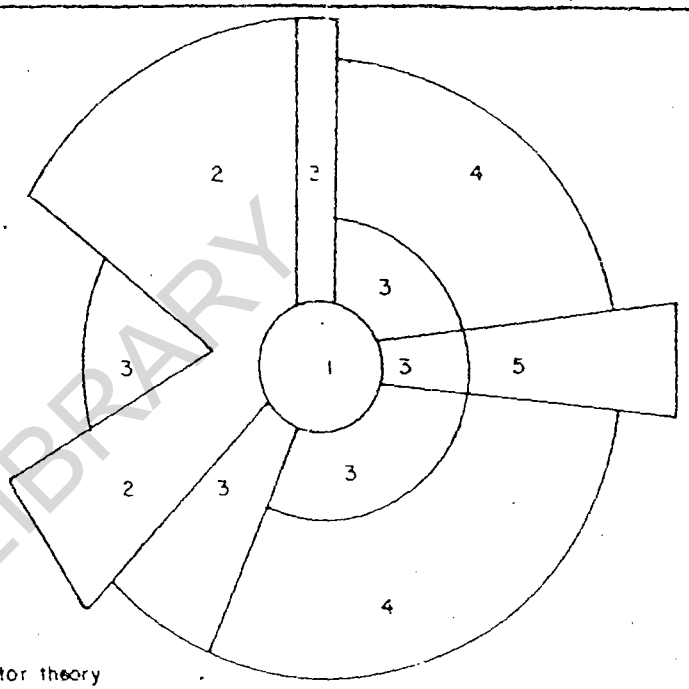
Three conceptual issues help to explain the structure of urban centres in relation to its transport system. They follow the three classical ecological theories of urban morphology as articulated by Burgess (1925), Hoyt (1939) and Harris and Ullman (1945). The earliest known of the classical models of urban growth is Burgess concentric zonation hypothesis (fig. 1.1a). The model states that as a city grows, it expands radially around the Central Business District (CBD) to form a series of concentric circles. Burgess identified five zones with each zone characterised by different landuse.

The first zone is the centre of the city, the second is the zone in transition comprising an area of residential deterioration as a result of encroachments from the CBD. The third zone is the independent working man's homes. Next to this is the zone of better residences. The 5th zone is the commuter's zone consisting of suburbs with men commuting to jobs in the CBD. The operating mechanism of the concentric circle model was the growth and radial expansion of the city with each zone having a tendency to expand outward.

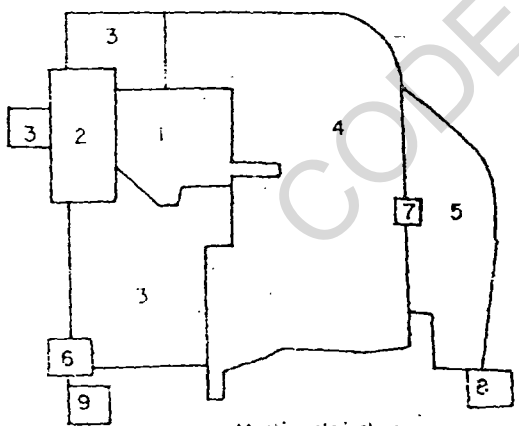
Hoyt's (1939) model of sectoral growth pattern (fig. 1.1b) is also an example from America. Hoyt analysed the distribution of residential neighbourhoods of various qualities as influenced by rent levels and found that they were neither distributed randomly nor in the form of concentric circles. According to Hoyt different types of residential areas usually grew outward along distinct radii and new growth on the area of a given sector tended to take on the character of the initial growth in that sector. A major influence of transport on sector theory is



(a) Concentric theory



(b) Sector theory



(c) Multinuclei theory

1. Central business district
2. Wholesale light manufacturing
3. Low class residential
4. Medium class residential
5. High class residential
6. Heavy manufacturing
7. Outlying business district
8. Residential suburb
9. Industrial suburb
10. Commuter's zone

Fig. 1.1 Models of the internal structure of cities. Source: Hudson, F. S. Geography of settlements (1980)

discernible on the pattern of its landscape. Hoyt's model can be seen as a direct response to Burgess work. According to Onokerhoraye and Omuta (1978), Hoyt's model is essentially complementary to that of Burgess. It is a distortion of the morphology of concentric landscape of Burgess because the structure that is produced is a wedge-like pattern of sectors that developed along roads.

The multinuclei theory was put forward by Harris and Ullman (1945) (see Fig. 1.1c). It is an amalgam of Burgess and Hoyt's models with the addition of multiple nucleus. There are many nuclei in the city. The presence of such nuclei reflects the internal differentiation of the city in the course of growth. Harris and Ullman therefore identified some variables as being responsible for multiple nuclei structure. Such variables include location of some activities in certain parts of the city and the fact that some activities cannot afford high rent of the most desirable sites. Based on these variables, the theory articulates that as city grows, it absorbs existing nuclei while new ones are created. Their numbers vary from city to city but the larger the city, the more numerous and specialised are the nuclei.

These classical models as developed in America and which emerge from the process of analysis and generalisation do not rigidly conform to the reality of any city. However, elements of each model are recognizable in the vast majority of urban centres. The models however, remain as valuable tools for analysing the modern city and providing the necessary basic tools for urban landuse/transport comparisons.

1.5 THE STUDY AREA

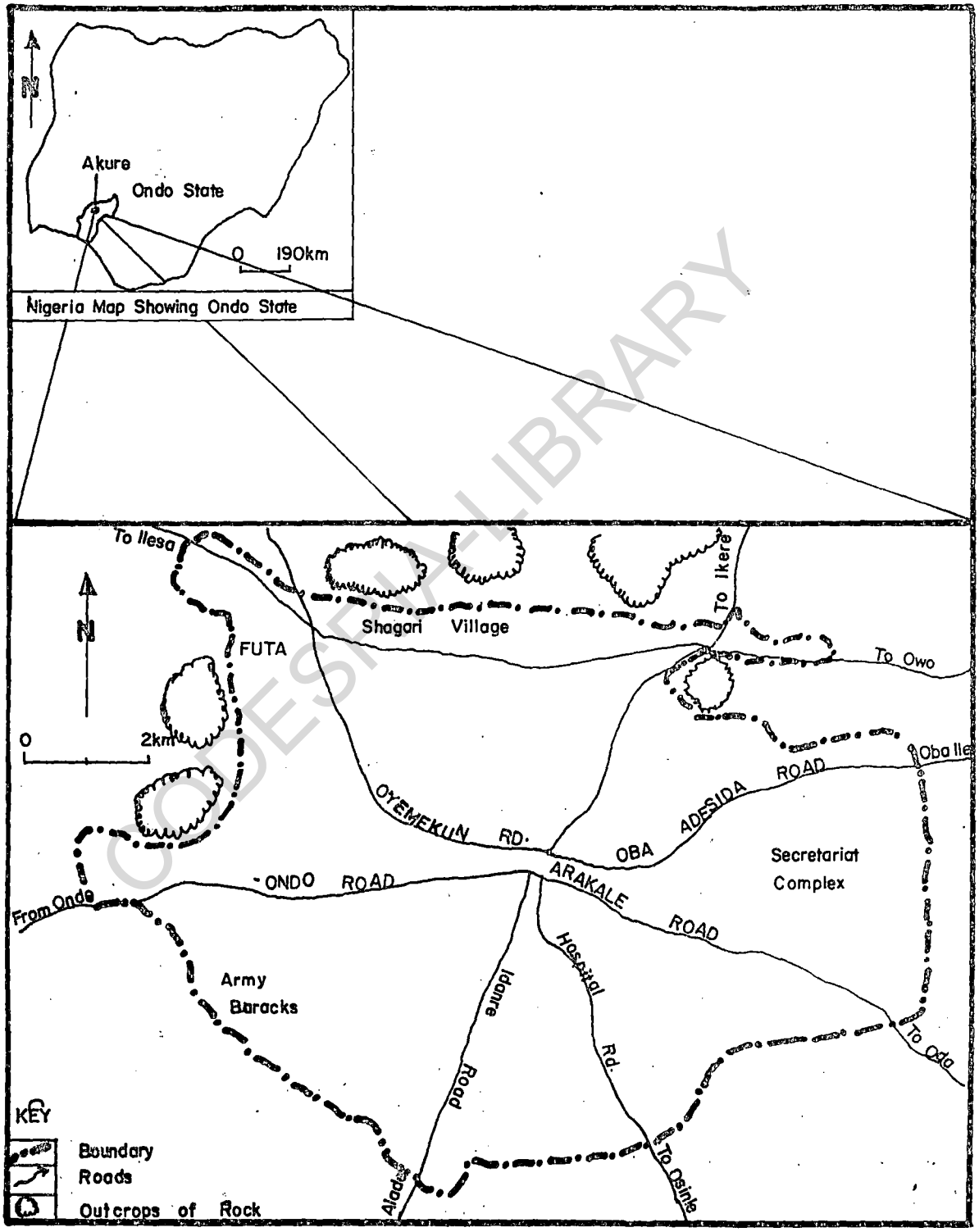
The study area is Akure, the capital of Ondo state. It is located on latitude 7° 15' north of Equator and longitude 5°5' East of Greenwich Meridian (Fig. 1.2).

Akure is a nodal town which is vintagely located in relation to all the big towns in Ondo and Ekiti states. It is surrounded within a 40 km radius by some important towns such as Ondo town to the South, Owo to the East and Ado-Ekiti to the North. Similarly, Ikare-Akoko, Ifon and Okitipupa are all located within another 96 kilometres radius to Akure.

The history of the origin of Akure like any other Yoruba town was traced to Oduduwa, the great ancestor of the Yoruba race. Akure has grown over time and had functioned as the headquarters of the former Ondo Province in the old Western State, the headquarter of Akure Local Government Area, the capital town of Ondo State as well as the seat of branches of all Federal Government departments in the state. These multivarious functions have contributed to the rapid growth and development of Akure with its emerging mobility problems.

Akure is generally about 250 metres above the mean sea level. The area towards Ado-Ekiti and Idanre are hilly and studded with large granite formation rising to 410 metres (1350ft) and 496 metres (1650ft) above sea level respectively. These granite formations are said to be of volcanic origin underlain by basement complex rocks which are mostly impermeable gneisses and granites. The rocks influence surface runoff during any slightest rainfall. Thus, many areas close to the rock outcrops are affected by erosion during rainy season.

FIG. 1.1 Map of Ondo State Showing the Study area.



(The Study area — Akure)

Akure is within the influence of South-West monsoon winds hence it comes under the rainy climate which is characterised by high temperature, high relative humidity and double maxima rainfall. Akure therefore enjoys abundant rainfall of over 1500 mm annually. This tropical rainy climate also influences and determines the vegetational setting of Akure. Rainforest consisting of thick and dense vegetation characterise the periphery of the city. The rapid rate of surface flow of rain from the adjacent rocks surrounding Akure influences problems of flood in the city. River Ala which drains the city outflows its banks during this period and some houses between Isolo and Oke-Ijebu in the North-West and Oke-Aro areas in the South-West are flooded rendering occupants homeless for days.

Apart from this, extensive alluvial deposits of clays, loams, silts and sands on the roads resulting partly from the depositional elements of the Ala river are common. Such roads are covered with heaps of erosive materials which impede smooth movement of vehicles. These heaps eventually scare transport operators from such routes because constitute impediments to smooth driving in such areas.

The population of Akure according to 1963 census was 71,106. In 1990, the population was estimated to be 157.947 (Ondo State of Nigeria, 1990). The projection was based on annual growth rate of 3% using the 1963 base year. The provisional population for Akure Local Government Area is 316,925 (1991 census). The increased relative political influence of Akure as a state capital since 1976 has been partly responsible for its rapid development. Thus, as the population of the town increases, its economic base also improves. Akure like any other town

in Ondo State, relies on farming as its primary occupation. However, secondary, tertiary and quartenary activities start to emerge as part of its main functions since migrants were attracted to the city to take advantage of the opportunities provided by the state capital. With its new administrative status, other complimentary services were attracted. The multivarious functions performed by Akure influenced the desire to construct new roads and rehabilitate old ones to take care of increased activities in the city.

Improvement in transport facilities was given prominence in Akure particularly since 1976 when the city became a capital town. New roads were constructed and extended to the newly built-up areas. Old roads were reconstructed and enlarged. Other important transport facilities developed include pedestrian walkways, overhead pedestrian bridges, zebra crossings, bus stops, street lights, traffic lights, parking facilities and tarring of earth roads.

1.6 JUSTIFICATION FOR THE CHOICE OF THE STUDY AREA

The choice of Akure as the study area is based on the fact that it has played just as it is still playing important administrative, educational, commercial, industrial and defence roles for over a million people within and outside the state. The fact that the city is adding more functions to its primary roles as enumerated above in addition to its being a centre for diffusion of innovations make its activities to continue to be complex. This study is carried out to serve as a useful guide in planning the transport needs of this growing city.

1.7 ORGANISATION OF THE THESIS

The thesis is divided into eight chapters. Chapter one is the introduction. It discusses the statement of the problem, the aims and objectives of the study, the basic conceptual framework, the study area and the justification for the choice of the study area. In chapter two the study examines existing literatures on the dynamics of landuse and transport development. In this chapter, theoretical, methodological and empirical issues in urban transport studies are reviewed. Chapter three discusses the methodology in which the type of the data required, their sources, the methods of data collection and the data analysis strategy and methodology were explained. Chapter four is an overview of the general pattern of landuse and their distribution in Akure as at 1966, 1976, 1986 and 1996. It examines the relative decline or increase in any particular landuse when comparison is made between what existed in 1976 and 1996. Also factors of change in landuse were identified and discussed. Chapter five highlights the overall pattern of intra-urban mobility in Akure. The concepts of trip generation through mode, purposes and other socio-economic characteristics were highlighted and discussed. Chapter six is devoted to the identification of the transport pattern of interaction in Akure. It applies factor analysis to the movement pattern of commuters in the city. Chapter seven estimates trip generation using regression model while chapter eight examines the management of transport system in Akure. Route infrastructural efficiency, road quality efficiency, road complementary efficiency and reliability efficiency were carried out on the major routes in the town. Chapter nine summarises the findings and identifies the relevance of the research for a comprehensive urban transportation planning.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents a review of the issues in transport and landuse. It is organised in three parts viz:

(a) Conceptual/theoretical issues

(b) Methodological issues in landuse and transport analysis

(c) The dynamics of landuse and transport development.

2.2 CONCEPTUAL/THEORETICAL ISSUES

Conceptually, models refer to sets of statements or frame of reference which have established relationship of how the systems work (Gould et al, 1972). A variety of models have been advanced to explain the urban spatial structure emanating from city movement and interaction. These are:

(a) Concentric model of Burgess (1923)

(b) Sector model of Hoyt (1939) and

(c) multi-nuclei model of Harris and Ullman (1945).

These have been examined earlier (See chapter one).

These models are however not mutually exclusive for both the Hoyt and the multi-nuclei models are modifications of the concentric circle theory. Recent theories of urban growth and structure have been developed to take care of traditional models of urban structure.

The size and morphology of any urban centre determine to a reasonable extent the type of public transport system used. As the city assumed new

status, it expanded and its transport system became more complex. Vuchic (1981) applied a theory of public transport mode to a transportation system in a model urban area. The theory is based on a hypothetical model settlement with changing population size. This model is divided into four growth periods which are small settlement, town, medium size city and a big city. The first stage of growth is characterised by small settlement comprising of a few houses and other buildings which are connected by network of paths. Commuting within the settlement is by walking. As the settlement grows in size the desire to timely satisfy the wants of the increased settlers become inevitable. Apart from this waiting time takes too long and made commuters uncomfortable. These inconveniences call for a means of mobility other than foot to replace trekking. This position influenced motorised system of transportation to replace trekking. The motorised cabin is a small coach with capacity for one to three persons with their luggage. It is used by the owner for travelling within the settlement to carry out all the socio-economic attributes of the geographical area. The short-comings of this stage leads to the beginning of public transport system. The motorised cabin has its limitation in terms of the number of people that it can carry. Hence, a further development, is the introduction of common carrier service. This becomes a necessity to cater for the mobility needs of those who could not afford private vehicles. These vehicles are operated by professional drivers who are ready to exchange their services for a fare. This marks the introduction of the public transport system.

Rhind and Hudson (1980:180) contending that sectorally structured processes may produce partial concentric zonal patterns, attempted a fusion of Burgess and Hoyt models. While adhering to a unicentred city, they attempted to modify the resultant models in a way which makes it more appropriate to the historical context of British Cities in the Post Second World War period rather than to American cities of the inter war years. As a small settlement grows into a town, specialised activities increased such that existing transport network becomes frequently congested. There is therefore the need to expand the capacity for the urban transport system. Large buses emerge to supply the necessary demand for commuters. In the final growth stage, the settlement assumes a large city status which requires higher performance transportation system. In addition to the introduction of large capacity carrying vehicles, intra-city rail systems are introduced to cater for the increase in demand in urban travels.

Daniels and Warnes (1983) also put forward a theory to explain the spatio temporal relationship that existed between transport and urban growth. This theory has five distinctive phases. The first phase is the Pedestrain City which represented the situation where the only means of transport was by foot. Commuters could only make trips to wherever they could conveniently walk to while the second phase shows the introduction of horse, bus and tram ways. The city under this stage remained compact and concentric because the two forms of transport system did not adequately solve the mobility requirement of the urban dwellers. The third phase witnessed the development of railways. This brings some changes in size and structure of the city. The fourth phase shows the

development of fast railway and bus which leads to the decentralization of the CBD and the creation of secondary CBD along sectoral structures. The arrival of cars and other forms of personal transport in the fifth phase confers different accessibility advantages on intra-urban locations while at the same time making possible the appearance of new landuses. Both the Vuchic (1981) and the Daniel and Warnes (1983) theories explain that the more complex the city, the more sophisticated its transport system becomes.

The emerging trend of new cities all over Nigeria shows that initially, there is rural-urban migration. This migration swells population of the city centre and its immediate concentric zones. As more people leave the country-side to the city centre, the rent for space in the city centre increased. This development leads to mass movement of city dwellers to the periphery as it becomes costly to live in the centre of the city. The spatial expansion of urban centres has in addition been explained using the concepts of centrifugal and centripetal waves. Blumenfold (1961) explained this by using a case study from his study of North America where the "country-to-city" movement of population continues and he called this centripetal wave. The centripetal wave according to Blumenfold is now being met by a second centrifugal wave which he referred to as "city-to-suburb force". The combined result of these two movements is "metropolis" which is emerging as the predominant form of human settlement in every section of the globe. This new settlement is endowed with high population, industries, commerce, education, service industries and residential zones which kept on expanding radially. The daily activities of these metropolitan areas spread out over a far wider territory

and this territory includes not only urban but also extensive open areas. These open areas could be park, golf-fields, air-fields, cemetary, recreational ground, near-by-farms and forests. This situation Blumenfold (1961) referred to as modern metropolis which is neither city nor country. However, this kind of settlement as described by Blumenfold is characterised by separation of residences from places of work which need efficient transportation system.

2.3 METHODOLOGICAL ISSUES IN LANDUSE AND TRANSPORT ANALYSIS

The use of graph theory in intra urban network flow had hitherto been largely focussed on regional network especially in developed countries. Ogunsanya (1986) however applied this graph theory to an urban network where the intersections or junctions were considered as nodes and the roads as links in the intra-urban network. This enabled him to abstract an urban road network as a graph and evaluated the technique in intra-urban transport network flow estimation of Barnsley. Other works on transportation network include that of Kansky (1963), Marble (1965), Gauthier (1968), Garrison (1960), Nystuen and Dacey (1961). These researchers have applied graph theory to the study of transportation network and came up with results that are of immense use in the area of planning.

Ayeni (1983) examined the development of an urban landuse transportation model for Lagos. In the paper, he provided a synthesis of the social characteristics of urban transportation system into rudiments of urban landuse and transport system modelling. His paper identified some of the links between

landuse and transportation models. The model constitutes an approach for identifying the nature, characteristics and magnitude of urban transportation problem, sorting these out into their various components in space, monitoring them as well as designing effective and efficient routes and network system for their solution. Ayeni's paper is no doubt a sound paper theoretically, but as usual, the issue of developing theories and models in the social sciences is faced with a lot of assumptions. The assumptions cannot but be relaxed in actual situation and this, may introduce distortion into the actual application of the model in real life situations. The model has some variables which had to do with human behaviour and decision making. Human beings are very complex and may decide to take some rational decisions which the model may not be able to explain. For example the problems of ranking paths by trip makers in any urban area may involve considering different variables, thus one cannot easily predict the path a potential trip maker would take.

In the analysis of vehicular concentration on roads, Omiunu (1988) applied the index of percentage of vehicular concentration on some selected roads (25 roads) in Benin City, using the formula $IVC = \frac{TVM}{TVY} \times \frac{100}{1}$

Where IVC = Index of Vehicular concentration.

TVM = Total Vehicular Traffic per month.

TVY = Total Vehicular Traffic for the year.

Both TVM and TVY were based on peak hours from 7.30-8.30 a.m., 12.30-2.30 p.m. and 5.30 - 7.30 p.m.

The formula according to Omiunu was adapted from Winifred Ashton's work on the theory of road traffic flow. However, the formula would have been very appropriately used if the researcher had considered other variables that can lead to concentration of vehicles on roads. To use the formula for one variable (flooding) amount to introducing bias into his research studies. Other variables that would have been considered include landuse, inter state roads (through roads) and any other type of roads.

Ogunsanya (1984:93) demonstrated the usefulness of isochrones in traffic congestions. He interpreted the spacing of the isochrones in a similar way as contours in a topographical map. Thus, the close isochrones indicated steep or highly congested area depending on the spacing of the isochrones. Areas where the space is even, indicated even travel time and thus, low or absence of traffic congestion. Ogunsanya (1985/86) also used the basic concepts of graph theory and Markov Chain model to build a link probability value on the basis of modal flow values obtained from a junction count. To do this, urban network is regarded as a circuit consisting of junctions which are nodes in the network and each road is joined by a link which is Uni-or/bi-directional. In the compilation, it was assumed that all links in the network are equal. In the real sense, all links cannot be equal because links have different capacities to carry traffic e.g. dual carriage way and single carriage way can of course not be the same. Hence, the model did not take care of different links that exist in the urban centres and this could be taken care of by using weighting method.

Existing Studies (Ullman, 1957; Hay and Smith, 1970; Goddard, 1970; and Ogunsanya, 1982) have shown on regional or macro scale that some pattern discerning techniques can be used in the identification of spatial pattern of flows between region. One of such method is the non-routed cartographic technique. Ogunsanya (1982:293) used the non-routed cartographic technique to depict the result of the overall pattern of intra-metropolitan freight flow between fourteen (14) sectors in the city of Lagos. The overall pattern appears rather blurred indicating the complexity of intra-metropolitan freight flow and the inefficiency of the non-routed flow map in describing the pattern.

In an attempt to overcome the defects of the cartographic technique in discerning flow pattern, Berry (1966) demonstrated how the factor analysis can be used. Similarly Goddard (1970) used it in explaining the pattern of taxi flow in Central London; and Kanno (1976) in showing the pattern of freight flows between U.S.A. metropolitan centres, while Ogunsanya (1982) applied it to freight movement in Nigeria. The result of the factor analysis was better than the non-routed cartographic technique. The solution helped in the identification of major "consuming" regions and their important "producing" sources.

2.4 DYNAMICS OF LANDUSE AND TRANSPORT DEVELOPMENT

The importance attached to landuse and transport system had attracted a lot of concern all over the world. There is the argument that landuse influences the development of transport system. However, what is clear is that most cities of the developing world are increasingly witnessing a rapid rate of urbanization. The rapid rate of urbanization has impact on both landuse and transport system.

This is because mobility and access are important factors influencing the success of most urban economic activities. People take decisions about where to locate their residence and business while giving consideration to maximum advantage from external economies associated with household agglomeration along economic, social and educational class. The net result of such decision is a pattern of activity which is reflected in the locational segregation of the major components of the Urban system of change (Asuquo, 1981). Such segregation has been observed to affect three types of linkages upon which a system of exchange is based. They are people to people, people to activities and activities to activities. It is a well established fact that the changing urban structure affects its transport system. The landuse pattern of the urban community is interrelated with the physical characteristics of the transportation network and this is why the uses of land define the location of activities. In an attempt to meet various socio-economic needs of the urbanites, there are tendencies for people and goods to travel between these locations which result in traffic demand upon the elements of the transportation modes. According to Asuquo (1981:188) the location and characteristics network affect the pattern of travel between locations, hence, in some situations it largely determines the value and use of land.

Landuse and transport systems have been studied in developed countries to show how much travel may be expected within any landuse type in the future and how it is likely to be concentrated. However, to discover the above some basic landuse questions must be answered. Such questions include, how many people will be in the settlement, what activities will they engage in both for work and

leisure, what will be the pattern of residential and other uses of land. According to Roberts (1982:374) the fundamental assumption is that movement demands are directly related to the distribution and intensity of landuses and that these can be accurately predicted. Thus, planning information forms a vital input to any landuse/transport study.

The relationship between transport and urban growth is a subject of considerable theoretical interest and of practical importance to transport geographers. While some agreed that transport is a precondition for economic growth, others do not share this view. For example Berry (1960) is of the opinion that transport networks are only part of development infrastructures which affect urban growth. He does not share the view that there would be no growth without transport. Olayemi (1977) in his own contribution asserted that "while some people regard transport improvement as indispensable to an acceleration of the development process, others look at transport development as a result of rather than as a cause of economic development". He made reference to Lord Lugard who in 1922 stated that "the material development of Africa may be summed up in one word - Transport". In essence this means that transport development is inevitable to accelerating economic development not only at the regional level but also within the City.

The growth pattern of any city is affected among other things by its location and nature of its interaction with other areas. This is because interaction is brought about by transport network linking one place to another. If an area is not well served by transport network, it may have negative consequence on the

growth of such centre. Gauthier (1970) in his contribution to transport and regional development noted that "certain areas or centres are advantaged and therefore have a changing pattern of accessibility which may lead to a change in incidence of growth. This assertion is true of Nigeria today because the creation of states has led to the development found in the urban centres selected as capital towns. For example Adejuyigbe (1966) asserted that "the creation of states will lead to the development of more growth poles and indeed more overall development in the country". He stressed further by explaining that in the process of developing a town to serve as capital town, government will be compelled to undertake some improvement on infrastructures because the demand for it will increase.

Various contributions have been made towards the relationship between transport and internal structure of urban centres. The continuous demand for land in the city has led to increase in the rent and commercial activities. This in turn has increased the traffic to the city centres which makes planning inevitable in the core region of most cities in Nigeria. In line with this argument, Losch (1954) is of the opinion that new routes will be built simultaneously to meet the demand generated by increasing population emerging from different areas of a region. The change in network structure therefore has an impact on economic development by changing the pattern of internal accessibility for urban centres. Sometimes changes in the accessibility pattern of an urban centre may disrupt the existing patterns of spatial competition with the region. In Nigeria, experience from the creation of new capital towns has led to expansion of the road network in the core region which also affect the structures of the internal growth.

Nelson (1969) opined that urban transport not only laces the urban structures together, but also profoundly affects the arrangements and function of elements in the structure of the city. He quoted some examples from America and cited Charles Colby who identified centrifugal and centripetal forces as the main waves behind the dynamic nature affecting the form and structure of cities. The centrifugal forces according to Colby impelled functions to migrate from the central areas of the city to the periphery and centripetal forces tend to hold certain function in the central zone and attract others to it. Centripetal forces are the result of a number of attractive qualities of the central portion of the city such as site attraction, functional convenience, functional magnetism and functional prestige. The central forces on the other hand are not only opposite forces but are made up of merging influences. Such influences include the desire to leave one part of the city and the need to go to another (spatial force) i.e. when congestion in the central zone uproots and the empty spaces of the other zones attract. Others include site force, situational force, force of social evolution and organisation of occupance. These factors affecting centrifugal forces have been found to affect the residential movement of many people from the central zones of cities to the periphery. Thus, traffic congestion, high land values, unsatisfactory functional spacing of activities and the unsatisfactory transportation facilities of the central zone stand as major factors why city dwellers move to the periphery.

Nigeria is no doubt undergoing a rapid rate of urbanization in most of its towns. This rapid growth has adverse effect on the provision of infrastructural

facilities such as the transport services. According to Adeniji (1987:339) until the turn of the century, the majority of Africans lived in villages and small towns where residents only needed to travel a few metres to obtain goods and services. However, with increasing urbanization and the resultant spatial differentiation and expansion, this practice no longer holds. The variety and number of real or assumed need and desires have multiplied dramatically and these have greatly increased the need to commute between and within settlements.

i. **Modal Split**:- Modal split is the share of the total number of person's trip by different means of travel. Research activities have shown that a single means of travel in any urban centre cannot serve adequately the intra-urban travel needs of the majority of city-dwellers. Adeniji (1987), examined the research activities in urban transportation and came up with the results to show that a single mode of public transport cannot serve all the inter and intra-settlement needs in Nigeria. This problem according to him arose because of the diversity of travel pattern, user preferences, ridership density, variety of landuses and the affordability and availability of private and public transport. Within these various means of transportation, a distinction is often made between private and public transport. For example, Adeniji (1983) in another paper differentiated between public transport and private transport. According to him, public transport means public carriers of persons for hire or reward locally within an urban area. it covers all forms of motorised transport for carrying passengers in urban areas excluding private transport which is personal transit means or owner operator.

There have been cases for the use of mass transit in urban centres because of their comparative advantage of reducing some traffic problems in cities which taxi-cabs and mini-buses do not possess. Okpala (1981) while making a case for giving priorities to development of mass transit in our urban transportation, reviewed the increasing trend in car ownership in Nigeria. Okpala predicted that congestion in cities will worsen if the present trend of car ownership continued. He discussed the various measures necessary to make it effective and successful in minimizing traffic snarls in cities and importantly to meet the tremendous shortfall in demands for urban travels on the part of majority who possess no private vehicles. Okpala (1983:343) referred to mass transit in his paper as "any transportation system which can transport large number of passenger (upwards of 40 passengers) at a time and for which operations are regulated by time-tables with fixed routes and bus stops". In this case a minibus conveying more than ten passengers at any time could qualify as mass transit as it reduces the number of taxi-cabs on our roads by at least two. This in effect takes into consideration that as the level of socio-economic characteristics and population rises in urban centres, larger type of mass transit could be introduced.

Adeniji (1987) also observed that paratransit operations have dominated the urban public transport scene in Nigeria. The most common form included the adapted vehicles such as molue and mini-buses. He compared the reasons for commuter's choice of various modes of intermediate public transport service in Lagos using surrogates such as availability of such modes at various times of the day, waiting time before journey, faster journey, cheap fare and ability to carry

luggage. With these yardsticks, he was able to come up with preferences for various modes judging from the comparative advantage of one mode over the other.

The increasing socio-economic activities of most urban cities call for mixtures of conventional transit and paratransit which provide services that fit market needs of particular portion of the community. According to Roos (1971) the Urban Mass Transportation Administration sponsored a paratransit conference in 1975 which brought together 100 experts with different backgrounds to examine paratransit. The Principal finding of the conference was that the ideal urban transportation system is a cooperative mix of a paratransit and conventional transit with highly coordinated services. Such a system would allow greater overall operating efficiency and increase transit patronage by allowing each to do what it does best.

The morphology of any landscape can influence the type of mode of transport used in any city. In some cases the terrain played prominent part as it did in Lagos where the riverine nature of the city made the use of ferries possible in addition to other modes of urban transport in use. In some other cities, the stage of development play important role in the choice of mass-transit used. Mrakpor (1986) revealed in his study of public passenger transport services in Benin-City that mini-buses and taxis are the major types of public transport in the city. The study also demonstrated that car ownership and level of income tend to affect the individual use of public transport. This means that a low level of income and few private vehicle ownership may result in a high demand for public transport services.

Adeniji (1986) in his paper on improved urban transportation system and the rapidly growing towns and cities in Nigeria revealed that there is over dependence on car in many urban areas. The argument he advanced for modal split include the fact that:

i. over dependence on car seriously restricts the mobility of a vast majority of urban inhabitants who do not have access to or own a car.

ii. That the Central Business District (CBD) and inner city residential areas of almost all large cities simply lack the space to accommodate all travels by car at an acceptable cost to the general public.

Adeniji's (1986:391) research favoured mass transit for urban use. According to him, absence of well-organised mass transportation facilities in most of the Nigerian Urban Centres gave rise to the proliferation of private public transport operators who use adapted vehicles, mini-buses and taxis for their operation. While Adeniji was making a strong case for the use of mass-transit, he suggested that everybody including the affluents in the society should be encouraged to use para-mass transit for meeting their mobility needs. It is a well established fact that arguments are in favour of mass transit, yet experience from Nigeria shows that it has been a giant flop in terms of adequacy and reliability. For example Ogeniyi and Uroh (1992:21) scanning through the success of mass-transit asserted that it has failed to modernise the urban transit services, improve traffic flow and reduce hardship suffered by commuters. The programme was also to lay the foundation for developing comprehensive and integrated mass transit in Nigeria.

The response from the interview carried out by Ogeniyi and Uroh (1992:21) revealed mismanagement and looting of the corporation's vehicles as the major problem facing Government mass transit. However, Filani a member of the Task Force on Urban Mass-Transit sees the problem from a multidimensional perspective. He admitted that escalating cost in vehicles and spare parts indeed constitutes a danger to the Federal Government Mass Transit Programme but contends that the real danger are those of inadequate planning, lack of proper coordinations, insufficient public transport to cope with rising demand, urban congestion, neglect of rural to rural and farm to village transport linkages.

ii. **Traffic Management**

Traffic management is a technique designed and used to promote the efficient vehicular and non-vehicular movement in any geographical space. The need for traffic management in most urban centres cannot be overemphasised judging from the varieties of urban transportation problems such as traffic congestions and accidents. Many writers focussed their research work on the causes of traffic problems and ways of reducing them. For example Ogunsanya (1983:125) examined the contributions of freight vehicles to urban traffic delays with special reference to Lagos. The results show that on the average, 1% of freight vehicle is responsible for about 2% of the delays while 1% of the non-freight vehicles accounted for less than 1% of the delay problems. Thus, it was clear that freight vehicle category caused more problems than non-freight vehicles in Lagos. Ogunsanya (1984) also examined the impact of the use of odd and even numbered vehicles on alternate days in reducing congestions on urban

roads. The result of the analysis indicated that the restraints technique worked only during the first few months of its introduction. Subsequent effect of the edict indicated a complete failure of the method in terms of curbing traffic problems.

Omiunu (1988) examined the effect of floods in the city of Benin. He inferred that environmental hazard such as floods have given rise to concentration of vehicular traffic on a few of the urban roads in the city of Benin and make traffic management hectic. In this empirical study, the road is said to be a locus of great conflicts between man and the natural environment. Omiunu's (1988) findings further revealed that flooding had been a major environmental problem in Benin City and that rapid massive deforestation of the region's plant cover had further compounded the problems of flooding and their impact on the city's transportation system. He suggested that there is need to understand environmental determinants of flood in the city region, if the traffic management of the city is to be effective. Omiunu also complained of the degree and rapid deterioration of tarred surface in Benin City which result in the creation of gullies and erosion of tarred surfaces. These render smooth vehicular and in most cases non-vehicular movements impossible during rainy season and contribute to the over-concentration of vehicular traffic along some of the few passable roads. Other by-products of these problems include traffic congestion, atmospheric pollution and noise.

Ogunsanya (1984:84) also examined the case of traffic congestion in city centres with special reference to Ilorin. He stated the problems of Urban traffic problems and attributed them to the rapid growth of the city which also

influence the increase in automobile ownership in an environment that was least prepared for such a sudden and rapid technological change. The author's study of Ilorin revealed that the city is the gateway between the North and south-Western Nigeria. This attribute made Ilorin to handle a lot of "through" traffic which, in the absence of planned provision of transport infrastructure, made the road facilities over-stretched beyond the volume of traffic they can cope with. With the aid of Cleveland (1964) formula, the author was able to discover congested roads in the City of Ilorin.

Similarly, Emielu (1978:212) writing on Ilorin revealed that some of the new State Capitals experience acute problems of transportation which are manifested in the rate at which traffic jams occur on major roads. According to him, the cities had new functions added to them with their emergence as State Capitals, but had an insufficient time to adjust adequately to meet the demands of their new status. Emielu analysed the traffic problems using some important Urban facilities that generate movement of people and their locations in the city. He suggested some solutions to the problems of traffic in the city among which are construction of bridges to divert some traffic from the CBD which will also provide alternative and faster route to the industrial area and other important establishments in the city.

iii. **Patterns of Intra-Urban Travels**

The patterns of intra-urban travels show that different landuses have different capacity to generate and attract traffic. Most researchers have revealed that there is strong correlation between transport and landuse. Trip patterns

mean regular person's travel from origin (e.g. home) towards a particular destination (e.g. work place). The purposes for which trips are made include the visits and trips to market, work place, recreation place, social places, schools etc.

Ayeni (1983) recognised urban transportation as affecting links between people and activities, activities and activities, and people and people. This system is characterised by a set of origins and destinations as well as trip types. Ayeni (1983) also noted that patterns of interaction in cities possess both spatial and temporal dimensions. The spatial component deals with variations in trips attracted and generated in different parts of the city, while the temporal dimensions examined the flow of traffic over a time period say a day, a week or a month.

Ogunjumo (1986) while discussing the trip generation in Ile-Ife observed that peak hour-urban transportation problem has its major cause in the landuse pattern that predated the location of the new work places and the motor vehicles. He stressed that peak hour problems can be attributed to the problem of landuse and the socio-economic characteristics of the people. Where there is concentration of some landuse that attract workers such as shoppers and students, there is bound to be trip attraction which may worsen during peak hour periods. This probably explained why Adeniji (1986) suggested dispersal of CBD in most cities. According to him, the CBD and inner city residential areas of almost all large cities lack the space to accommodate all travels by car at an acceptable cost to the general public and that this may lead to dispersal of the CBD. Similarly, Emielu (1978:213) traced the evolution of transportation problem in Ilorin to the

creation of States in 1967. He analysed the traffic problems using some important urban facilities that generate and attract movement of people and the area of their location in the city as the major cause.

Olayemi (1977) made a critical study of the characteristics of work trip in Lagos and identified six main urban trip patterns in the city which are journey to work places, school trips, business trips, social trips and job seekers trip. He analysed and discovered that trip to places of work and school dominated the trip characteristics in Lagos. This study revealed the lopsided nature between landuse and transport. According to Olayemi, location of work places and schools are not in harmony with the transport situation. He cited the case of Lagos Island where most work places are located while Lagos mainland is where most workers resided. This locational arrangement of residence and work places causes a lot of traffic jam between the mainland and Island during the working days in a week.

The foregoing review indicates related literature in the study of landuse and transport development. The facts that have emerged from this review are that urban landuse is dynamic. It also reveals that the direction of change can be linked to the provision of transport infrastructures. This review has shown that a better understanding of the complex relationship between various landuses can only be achieved through a close study of the city's transport system.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

In this chapter, we examine the strategy and methodology adopted in this study of landuse and intra-urban transport in Akure.

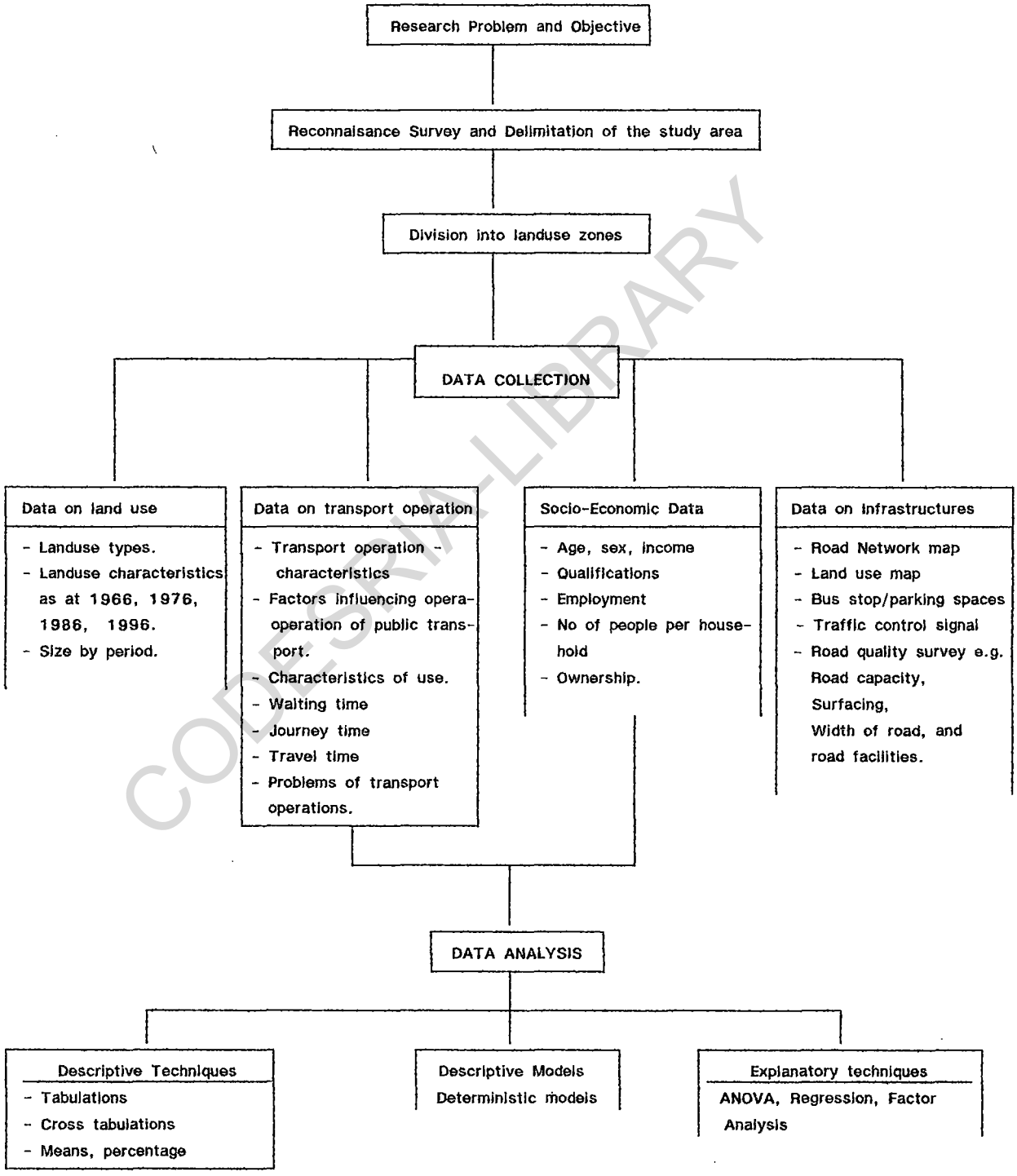
Figure 3.1 is an outline of the research design for the execution of the study. It is organised in three parts viz the Preliminary stage, the Data Collection stage and the Analysis stage.

3.2 THE PRELIMINARY STAGE

The preliminary stage is organised into two. The first involves a reconnaissance visit to the study area for an accurate determination of the extent of the city, and its basic landuse types and distribution. The researcher is aware of the fact that over time, a settlement grows spatially extending to areas beyond its built up areas. For a rapidly developing settlement, therefore, the determination of its areal extent is usually a problem. This is more so in the case of Akure which has almost engulfed other small settlements such as Oba-Ile, Oda, Ijare, Igoba and Isinigbo in the course of its areal expansion. It was therefore necessary to define the areal extent of Akure before proceeding to collect the required data.

In terms of definition, metropolis means an urban centre with a high population, high infrastructural investment, active community life and a very low percentage of agricultural employment if any (Berry and Horton, 1970). Apart from this definition, various terms have been used to describe the areal extent or influence of the metropolis. Such terms include Umland (Wise, 1966); Invasion

Fig. 3.1 **OUTLINE OF THE RESEARCH DESIGN**



of one type of landuse by another (Mabogunje, 1968); Urban field (Berry and Horton, 1970); Community of interest area (Northam, 1979) and city region (Dickson, 1930). In terms of criteria to be used, Berry and Horton (1970) are of the view that urban field consists of an enlargement of the space for urban living that extends far beyond the boundaries of existing metropolitan areas. Urban field is therefore defined primarily in terms of commuting to a central city. Thus, a metropolis can be measured using distance, fusion of metropolitan spaces and non-metropolitan peripheral spaces, population, secondary activities among others depending on the problem under investigation.

Gauthier (1968) explained further that the field of a city can be defined by the analysis of flow lines on the basis of overall transportation flows between the centre and its surrounding area. Bello (1990) used the extent of areas served by intra-city bus transport as an appropriate surrogate for determining the areal extent of Ilorin. As earlier noted, several methods have been adopted to define the areal extent of a city consequent on its changing structure over time. The United Nations (1971) put the areal extent of any city to include adjoining areas served by the city. However, the choice of surrogate for delimiting the areal extent of any city depends on the type of problems being investigated. This study which is on changing pattern of landuse and intra-city transport development therefore adopts the Areal Extent Approach which is concerned with areas where systematic daily movements oriented towards the city take place.

The choice of this surrogate is particularly relevant because the problem of this research relates to changing landuse pattern and transport development. The researcher therefore carried out a survey of all the intra-urban public transport service terminals in Akure with a view to delimiting the areal extent of the city. Figure 3.2 shows the city's public transport terminals. The routes to these transport terminals constitute the major public transport corridors for the collection of data on the demand, management and operation of public transport. The boundaries of the built-up areas at the out-skirts of the town served by the transport terminals were identified and regarded as the areal extent of Akure. The following public transport terminals were identified.

1. Federal University of Technology terminal

This location is the terminal for trips originating from Oyemekun-Oba Adesida road; Ilesa garage; Express road and Oja-Oba.

2. Ondo State Television terminals

For trips originating at Oja-Oba; Oyemekun-Oba Adesida road; Ondo road; Ilesa garage, Ijare and Express road.

3. Shagari Village terminals

For trips originating at Oja-Oba; Ijomu road; Isolo road; F.G.G.S. and Express road.

4. Ado-Motor Park and Federal Girls

For trips at Oja-Oba; Ijomu road; Oke-Eda; Esso; Oba-Ile; Fiwasaiye and Express road.

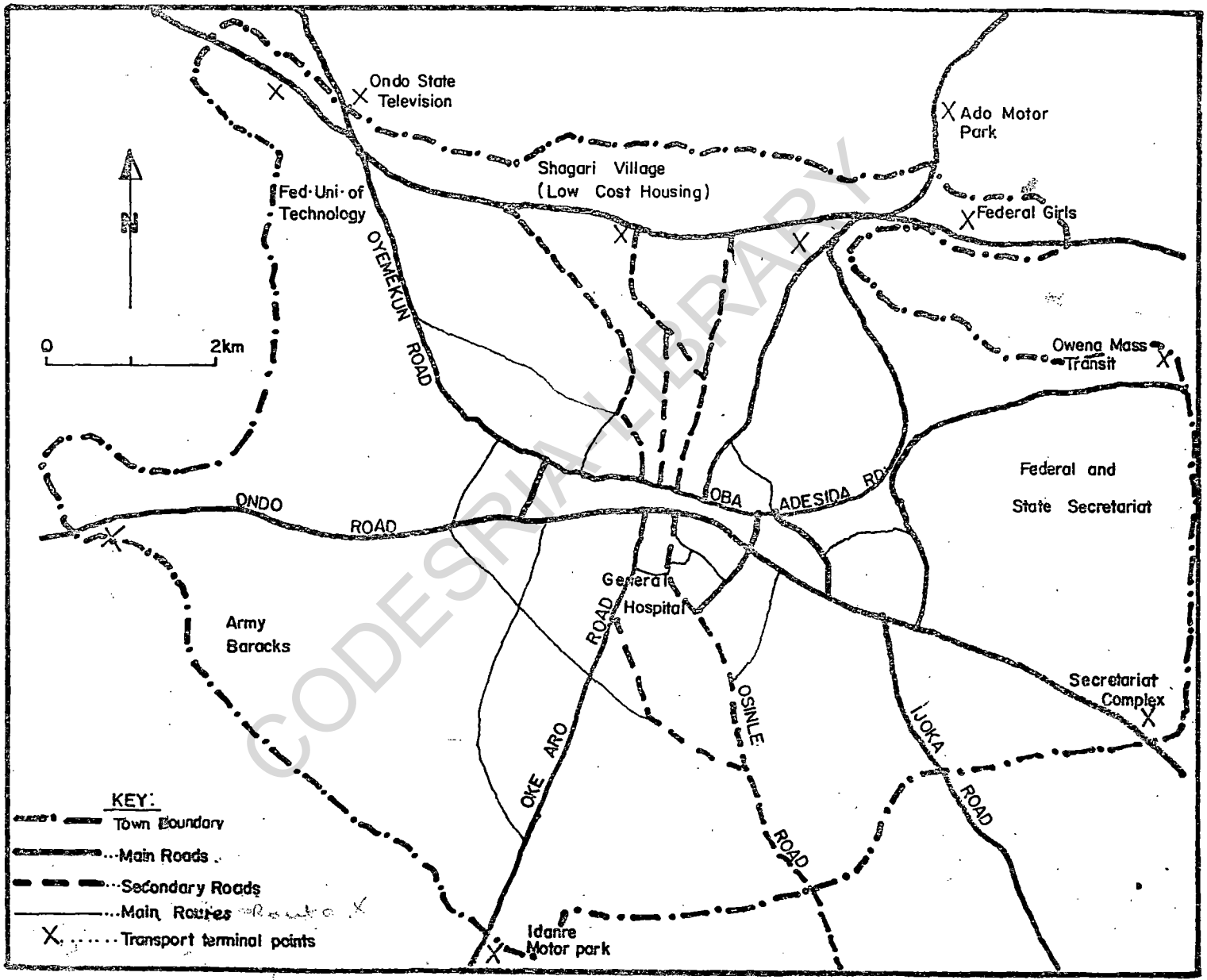


Fig. 3.2: A Map showing Intra-urban Transport Terminals in Akure.

5. Owena Mass Transit and Oba-Ile

For trips at Oja-Oba; Esso; Oke-Eda; Fiwasaiye; and Oba-Ile.

6. Secretariat Complex

For trips at Oja-Oba, NEPA; Old Secretriat; TISCO; Ala quarters and Hospital.

7. Ijoka Road

For trips at Oja-Oba, NEPA; Hospital; and Ala quarters.

8. Osinle Road

For trips at Oja-Oba; NEPA; Hospital and Oke Aro.

9. Idanre Motor Park

For trips at Old garage; Arakale; Hospital; Ondo Road; Oja Isinka and Atosin.

10. Army Barracks

For trips at old garage; Ilesa road; Oyemekun-Oba Adesida Road; Ondo road; Isinkan market and Ondo-bye pass.

The study area is bounded in the north by the Federal low cost Housing, Igoba Village, Federal Girls College and Ondo State Radio Corporation; to the West of the town by Federal University of Technology, Akure, Nigeria Prison Service, Military Acquisition zone and Army Comprehensive Secondary School; To the South by Idanre Motor Park, Ibi Paper Converter Company Limited, Green Park Hotel and Spring Sport Guest House; To the East by Federal Secretariat, Owena Motels, State Secretariat, Owena Mass Transportation Company, School of Agriculture and Ago Ireti (Leprosy rehabilitation centre).

After delimiting the areal extent of Akure, the major landuses of the city were mapped by updating the Ondo State Urban Development Project Report (1986). The map of the study area is classified into ten major landuses as shown in figure 4.4. The most dominant use to which land is put was used as the criterion for determining the landuse zones. This technique had earlier been used by Onokerhoraye and Omuta (1978) in delimiting the landuse zones in Benin City. In this study, the residential zone was taken as three distinct landuse zones based on the "intensity" of residential use. Thus, low, medium and high density residential zones were identified. On the whole ten major landuse zones were identified and used as the basis for collecting all the required information for this study.

3.3 DATA COLLECTION STAGE

The data collection stage can be categorised into three viz.

(a) Types of data required

(b) Methods of collection

(c) Techniques of analysis.

(a) Types of Data Required

Data for the study are required in respect of the following:

i. landuse pattern;

ii. transport operation and infrastructures;

iii. socio-economic characteristics and travel behaviour;

iv. urban transport problems.

Details of the data required for the study are as outlined in the Research Design (see figure 3.1).

(b) **Method of Collection**

There are two major sources of collecting the data required. These are:

i. Primary sources

ii. Secondary sources.

(a) Primary Sources

The primary source of data involves direct collection of data on the field using measurement, oral interview, questionnaire administration and field observations. The data collected from primary sources include:-

(i) Data on Landuse Pattern and other Landuse Characteristics

Data are required in terms of the landuse in the city for the period 1966, 1976, 1986, and 1996. For the first three periods, information required were extracted from maps. For the landuse types and pattern as at 1966, the researcher prepared Akure landuse from topographical maps of Akure sheet 264 N.W. and sheet 264 S.W. printed by Federal Surveys, Nigeria in the year 1966 using appropriate cartographic methods and town guide map collected from Town Planning Office, Akure. The two maps were joined together to produce the landuse map of Akure in the year 1966. The landuse map of Akure as at 1976 when the state was created was collected from the Town Planning Division, Akure. The landuse map of Akure as at 1986 was collected from Ondo State Urban

Development Project Preparation Study of Akure. The landuse map of Akure as at 1996 would have been better mapped from areal photograph but such photographs were not available. Apart from this, the primary concern of the researcher is not in the landuse measurement par se. Moreso, since a source existed for landuse pattern as at 1986 for the city, the researcher therefore updated this map using information gathered from Town Planning and field survey on new structures that emerged after 1986. The landuse maps of Akure as at 1966, 1976, 1986 and 1996 were outlined on a graph sheet and the areal extent of Akure at different periods calculated. The relative decline and expansion in specific landuse were deduced using the same technique.

For the landuse characteristics, a questionnaire was prepared to enable us get adequate information covering the period 1976 to 1996. The purposive sampling technique was used to administer the home based questionnaire to 200 respondents, out of the 1,000 respondents who answered questions on travel behaviour within the city. The two hundred respondents (200) were found during interview to have spent not less than 20 years in Akure, hence they were given another questionnaire to fill. It is the belief of the researcher that questions relating to the past 20 years will be easier to fill by these respondents judging from their long stay in the city. Thus information regarding landuse characteristics between 1976 and 1996 were supplied by this category of respondents. In each landuse zone, twenty respondents were made to respond to the questionnaire. Details of the data collected are as outlined in figure 3.1.

ii. Data on Transport Operation and Infrastructures

The data required for this has earlier been broadly outlined. Further details of data required include route terminals, type of vehicles used on route(s), turn around trip, number of fleet used on the route(s), trips per day (round trips), turn round time, cost of running a vehicle per day and daily income.

The instrument used here is the interview technique directed to the representatives of National Union of Road Transport Workers (NURTW) located on each route. A proforma which outlines the information required on transport operation was used to elicit information from the Union's representative. This method was adopted because most of the transport operators on each route are not ready to assist in granting audience to field assistants. Thus, the chairman of the driver's union situated on each major route was therefore purposively sampled to answer questions set on the proforma.

iii. Data on Socio-Economic Characteristics and Travel Behaviour

Data required here are factors which influence and determine the demand for public transport. Such information includes socio-economic characteristics of trip makers such as sex, age, educational qualification, occupation, trip to work characteristics, trip to market characteristics, trip to religious centre characteristics in all the ten landuse zones and people's perception about urban transport problems in Akure. Due to time and cost constraints, it was not possible to survey all the streets in the city, thus a sampling technique was adopted. The sampling involves dividing the land use zones into sampling units from where streets were selected using simple random sampling technique. In each sampled street, houses were selected by means of systematic sampling with a random

start. The sampling ratio adopted is 1:20. Thus, every 20th house in each sampled street was selected for the administration of the home based questionnaire. On the whole a total of 1,000 questionnaire was administered.

iv. Data on Intra-city Movement Pattern and Behaviour

The data required are Origin - Destination movement within the town, routes taken, purpose of trips, modes used and trip fares. The instrument used in collecting the data is the questionnaire approach. The administration of the questionnaire requires the respondent to complete a form on trip diary over a period of one week. The landuse zones in the study area were regarded as sampling units from where streets were selected using simple random sampling technique. In each sampled street, houses were selected by means of systematic sampling with a random start. Sampling ratio of 1:20 was adopted. Thus, on the average every 20th house was picked for questionnaire administration. On the whole, a total of 1,200 questionnaire was administered. The data are useful for the identification of demand characteristics for Public transport.

v. Historical Data

Historical processes of how Akure came into existence were gathered through personal contact with traditional chiefs like Ajana of Isolo and High Chief Obadua. Questions asked include areal extent of Akure during colonial and post colonial periods, values attached to land and level of transport development.

(b) Data from Secondary Sources

For the secondary data, the various establishments outlined earlier were visited. Information was collected in respect of the following:

i. Road network map.

ii. Data on vehicle stock.

i. Road Network

The data collected in this regard is the map guide showing the main roads and other structures in Akure. This map was collected from the Town Planning Office, Akure.

ii. Data on Vehicle Stock by Types

The Data collected in this regard include registration and renewal of vehicles from Ministry of Finance and Statistics Division, Akure. Thus, data on buses, taxi-cabs, motorcycles and other private vehicles were collected from their records. The data are useful in knowing the fleet size of different types of public transport registered and renewed in Akure.

3.4 DATA ANALYSIS STAGE

The data so generated were subjected to two major analytical techniques viz:-

(i) Descriptive techniques and

(ii) Multivariate techniques.

The descriptive analysis used include tabulations, cross tabulations, means and percentages. These techniques were used to summarise most of the data collected.

The non-routed cartographic technique was used to depict the pattern of origin-destination movement of respondents in the study area using the O-D matrix data. This technique is useful in discerning the overall spatial flow pattern of commuters in the city and thus used to identify areas where flows are concentrated.

Analysis of variance (ANOVA) is used to test whether there is any significant variation in the walking time to bus stop, journey time to places of work and waiting time at bus stops between and within the landuse zones. This technique is useful in identifying landuse zones where public transport can be said to be relatively reliable.

The multiple regression technique is used to analyse factors responsible for traffic generation in various landuse zones. This technique is useful in identifying and measuring the contribution of each explanatory variable considered as the factor influencing trip generation. The technique can be used to model demand for public transport and project for future needs in the city.

Factor analytical technique is used to depict the flow pattern of the city using data collected on O-D movement responses. This technique is applied on O-D data in order to overcome the defects usually associated with the non-routed carthographic technique in discerning flow pattern. Mean and standard deviation were used to order transport problems in terms of their severity as perceived by respondents in the town.

Details of the appropriate techniques were discussed where they have been used.

CHAPTER FOUR

LANDUSE TYPES AND PATTERN OF CHANGE IN AKURE

4.1 INTRODUCTION

This chapter identifies the evolution and spatial distribution of land use in Akure over a period of three decades (1966 - 1996). The chapter also examines the factors responsible for any observable change in landuse and the patterns which emerged thereafter. The composite growth pattern of various landuses in the city were identified and depicted by various figures in the chapter.

4.2 IDENTIFICATION OF LANDUSES

The term landuse originally belongs to the group of concepts in agricultural economy and used to imply economic use to which a piece of land is put e.g. landuse for pasture, cropland etc. (see Chapin, 1976). Over time the term has filtered into other areas of settlement study. The term when used in urban studies implies the spatial distribution of industrial, commercial, recreational, educational and public activities. Thus, the uses to which land is put define the location of activities.

The major problem with the use to which land is put in urban areas is its classification. The problem of classification arises because of the flexibility in the factors which produce this pattern and the relationship between the centre and the periphery (Onokerhoraye and Omuta, 1978). Other problems according to Falade (1996) is lack of effective control of urban growth despite the adoption of physical planning methods of control. Within the field of Urban transportation, landuse analysis is a convenient way to study the activities that provide the basis

for trip generation and attraction because travel patterns are dictated by network structure and landuse arrangements (Abler et al, 1972). In this identification of urban landuse, the classification as proposed by American Institute of Planners (1960) is adopted. Before the classification of landuse by American Institute of Planners (AIP, 1960), Batholomew (1955) used the criteria of privately developed area and publicly developed area to classify landuse. This criterion has been criticised on the basis of the fact that it attaches importance to the issue of land ownership and form of development rather than the way land is used. However, AIP (1960) in classifying land use attaches importance to the functional characteristics of land in terms of type of activity, product of the activity and facilities available for such activity. The AIP (1960) system is similar to a dichotomous classification in which an entity is divided into its component parts. For example a major landuse is "transportation" which can be sub-divided into vehicular and non-vehicular uses. Vehicular is further subdivided into routes and terminals. All these land-use designations are based primarily on the land-use characteristics of a specific parcel.

In Akure, there is a mixture of landuse on a specific parcel. The use of a part of a parcel may be classified as being prominent and less prominent. Zones with relatively homogeneous use are selected as being prominent in activity of a particular use, hence they are adopted as the criteria for classifying the landuse in Akure.

4.3 EVOLUTION OF URBAN MORPHOLOGY IN AKURE

The present morphology of Akure can be said to be the result of three major processes triggered off by the pre-colonial period, colonial and the post-colonial. However, the processes are interwoven in the sense that it continues from one stage to another to produce the present pattern. Thus, the situation of urban structures in Akure is largely the relics of the features of pre-colonial, colonial and post colonial days.

PRE-COLONIAL PERIODS

The actual date when Akure was founded is not known, however, history reveals that it dates back to the pre-colonial period. During this period, the main foci of the town was the central market and Oba's Palace with its extensive premises which were thickly walled. From the city's centre which is characterised by civic, social, commercial and administrative (King's Palace) activities are a number of wide roads which radiated to the outskirts of the town and some other neighbouring towns. Close to the city centre also are residential zones in form of quarters of irregular shapes and sizes surrounding the core. These residential zones are headed by traditional chiefs who interact on daily basis with the then administrative zone – city's centre. During this period, only four major prominent landuse types were identifiable and these are cultural, commercial, administrative and residential. The first three landuses were concentrated in the city centre while residential landuse surrounded them.

COLONIAL PERIODS

It is within the confines of the built up areas of Akure that the intensity of the use of land took place during the colonial period. In addition to cultural, commercial, residential and administrative landuses of the city centre, there is the religious landuse represented by the central mosque and traditional forest grove. Apart from this, intensification of landuse also centred on the use of the vacant land and expansion of commercial use of land along major road arteries. The open lands were further utilised for residential, commercial, public and semi public uses. Few roads were constructed to link up the built up areas with the major artery so as to facilitate mobility within the town by vehicular means. There was proliferation of residential buildings which result from the disintegration of the traditional compound dwellings system. Storey building and Government Reserved Areas (GRA) created for the colonial masters emerged at the peak of the development.

POST COLONIAL PERIOD

The period between 1960 and 1976 witnessed growth by outward expansion of the built up areas. The growth during this period centred on the core area and rapid development of the periphery into the immediate rural neighbourhoods. During this period, the city's structure is best described using the core/periphery surrogate. The core of the city centre encompasses the commercial, cultural, religious and residential zones. Other landuse zones such as education, recreation, public and semi-public located in the periphery depict the sectoral

pattern. In the core area, there is intensification of landuse with resultant modification to the urban spatial structure within the already built up parts of other areas in the city. In the periphery, there is the outward spread of the built-up parts of the urban centres into the urban fringes especially along the major traffic corridor in the town.

In the year 1976, Ondo State was created and Akure which had been the provincial headquarters subsequently became the state capital. Priority was given to raising the standard of the town to meet the challenges of new state capital dispensations. This led to the internal re-organisation of the town. Some of the structures located in the core area were demolished while some were moved to the periphery. Government housing estates such as Ala, Alagbaka, Oba-Ile, Federal Low Cost Housing and other private housing estates such as Ijapo, Okuta-Elerinla eventually emerged at the periphery of the town.

The city centre during this period became prominent in commercial activities such as banks, insurance, finance, industries, wholesale activities, retail activities, petroleum products etc. Some commercial activities secondary to what existed in the core area appeared along the major artery. Similarly, important junctions also witnessed agglomeration of activities which eventually became secondary foci points of commercial and social activities. The relative advantage enjoyed by these road junctions creates a pattern of city structure showing unequal growth of nodes thereby reflecting internal differentiation of the city in the course of its growth. Thus, the city morphology changed through time from what it used to be during the colonial period (concentric) to sectoral pattern shortly after 1976 when the state was created.

4.4 SPATIAL DISTRIBUTION OF CONTEMPORARY LANDUSES IN AKURE

Landuse in Akure has changed in terms of its size, characteristics and their spatial distribution over time. The dominant landuse types include commerce, residential, educational, public, transport and communication. In recent times, other landuses such as semi-public and recreational landuses have developed as a result of the socio-economic changes in this city.

Spatial Distribution and landuse change in Akure

Table 4.1 shows the hectarage and percentage of each of the landuse in Akure over the period between 1966 and 1996. The study observed a significant change over time in the landuse in Akure over the last three decades. Specifically, the areal extent of Akure was 1605 hectares in 1966 and 7995 hectares in 1996. Figure 4.1 shows the areal extent and pattern of Akure as at 1966. The landuse was more of concentric pattern with potential growth along the major routes of the town. Figure 4.2 shows the pattern of the city as at 1976. The landuse as at this time, was an extension of what existed in 1966. Figure 4.3. shows the pattern of landuse of the city as at 1986. there was a remarkable and rapid development of the areal extent of the city between 1976 and 1986. The percentage increase of the areal extent of the city in 1986 is 175.1% over what it was in 1976. Figure 4.4 shows the pattern and distribution of landuse as at 1996. The land increase as at 1996 over 1986 was 2665 hectares representing 50% increase.

This shows a declining rise in landuse shortly after the first few years when the town became a capital city. The landuse change in Akure since 1986 had been steady after the initial phenomenal growth of 1976. However, diminishing returns set into the demand for landed property after 1980 and that accounted for the decrease in the rate of areal expansion of the city after 1986 till 1996.

Table 4.1 **AREAS COVERED BY LANDUSE TYPES IN AKURE AS AT 1966, 1976, 1986 AND 1996. (VALUE IN HECTARES)**

Landuse Type	1996	%	1976	%	1986	%	1996	%
1. Educational	80	4.98	100	5.16	225	4.22	475	5.94
2. Industrial	15	0.94	50	2.58	200	3.75	400	5.00
3. Residential (High)	495	30.8	375	19.36	775	14.54	1100	13.76
4. Residential (Medium)	680	42.4	775	40	2100	39.40	2475	30.96
5. Residential (Low)	165	10.3	450	23.23	1100	20.64	1700	21.26
6. Commercial	20	1.25	25	1.29	300	5.63	425	5.32
7. Recreational	35	2.18	37.5	1.94	50	0.94	300	3.75
8. Transport and communication	20	1.25	25.0	1.29	150	2.81	195	2.44
9. Military/ Police	35	2.18	37.5	1.94	350	6.57	550	6.88
10. Public/ Semi-public	60	3.74	62.5	3.23	100	1.88	375	4.70
	1605	100	1937.5	100	5330	100	7995	100

Source: Fieldwork, 1996.

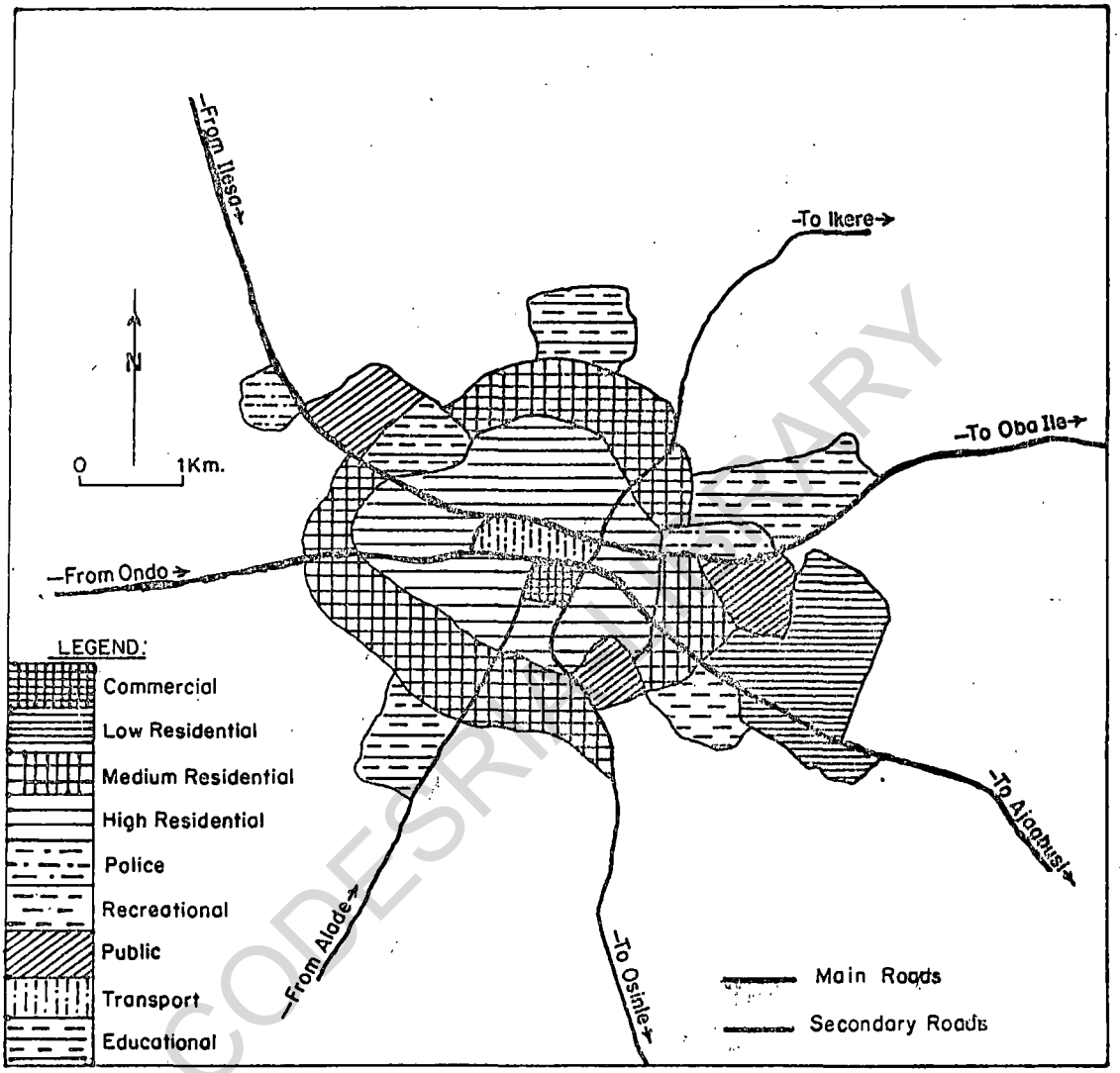


Fig. 4·1 : A Landuse Map of Akure as at 1966.

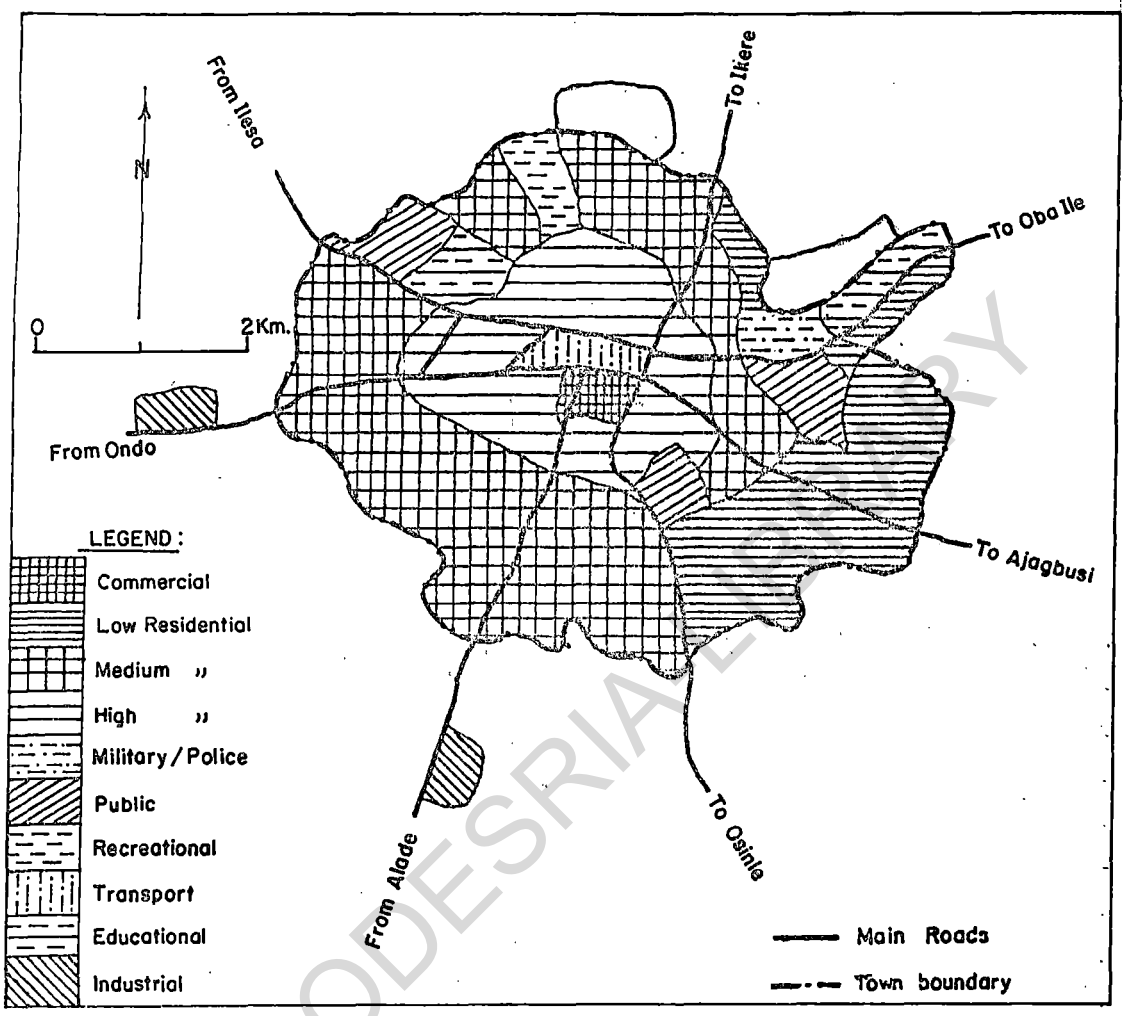
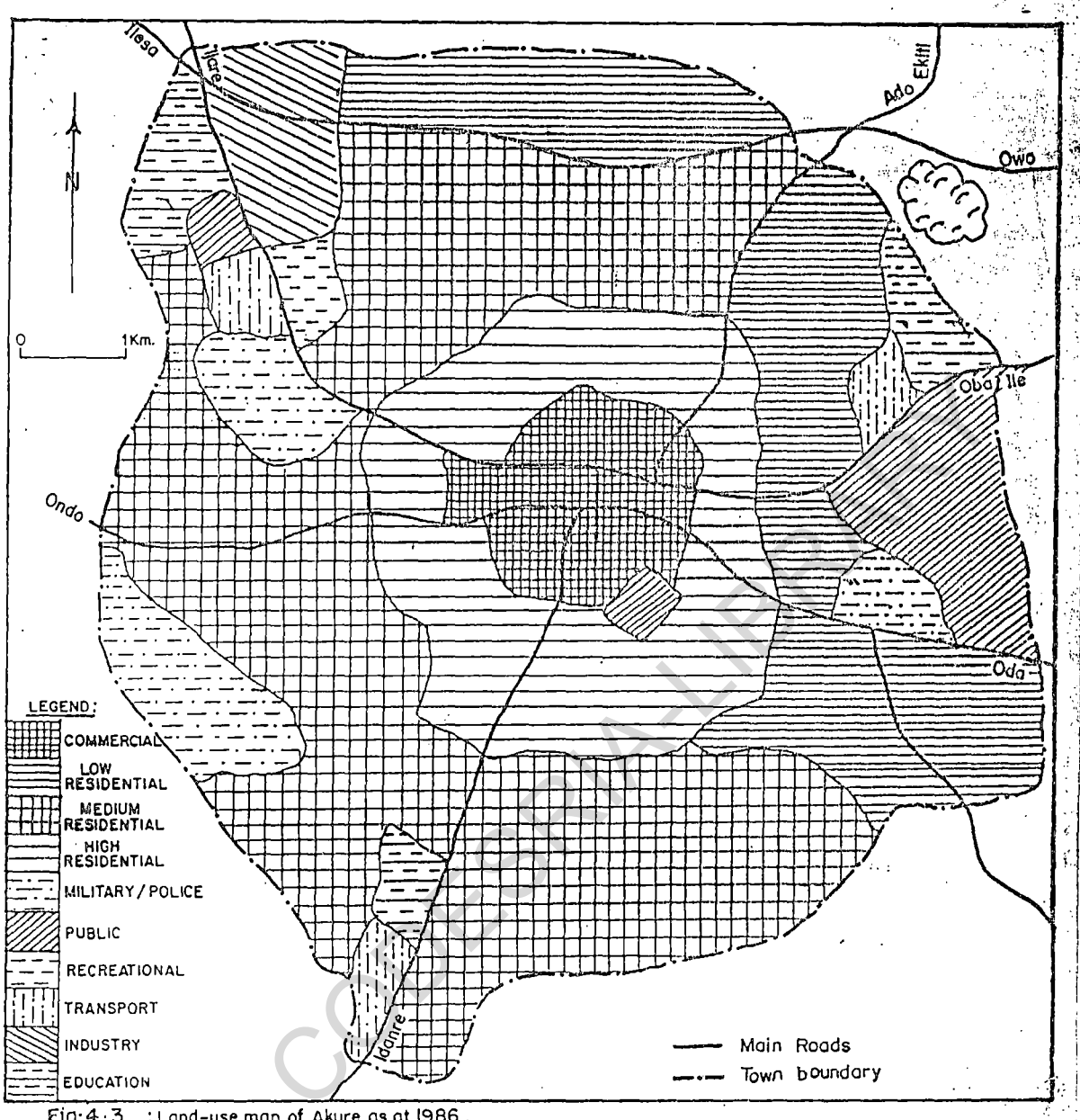


Fig. 4·2 : Land-Use map of Akure as at 1976.



Fig·4·3 : Land-use map of Akure as at 1986.

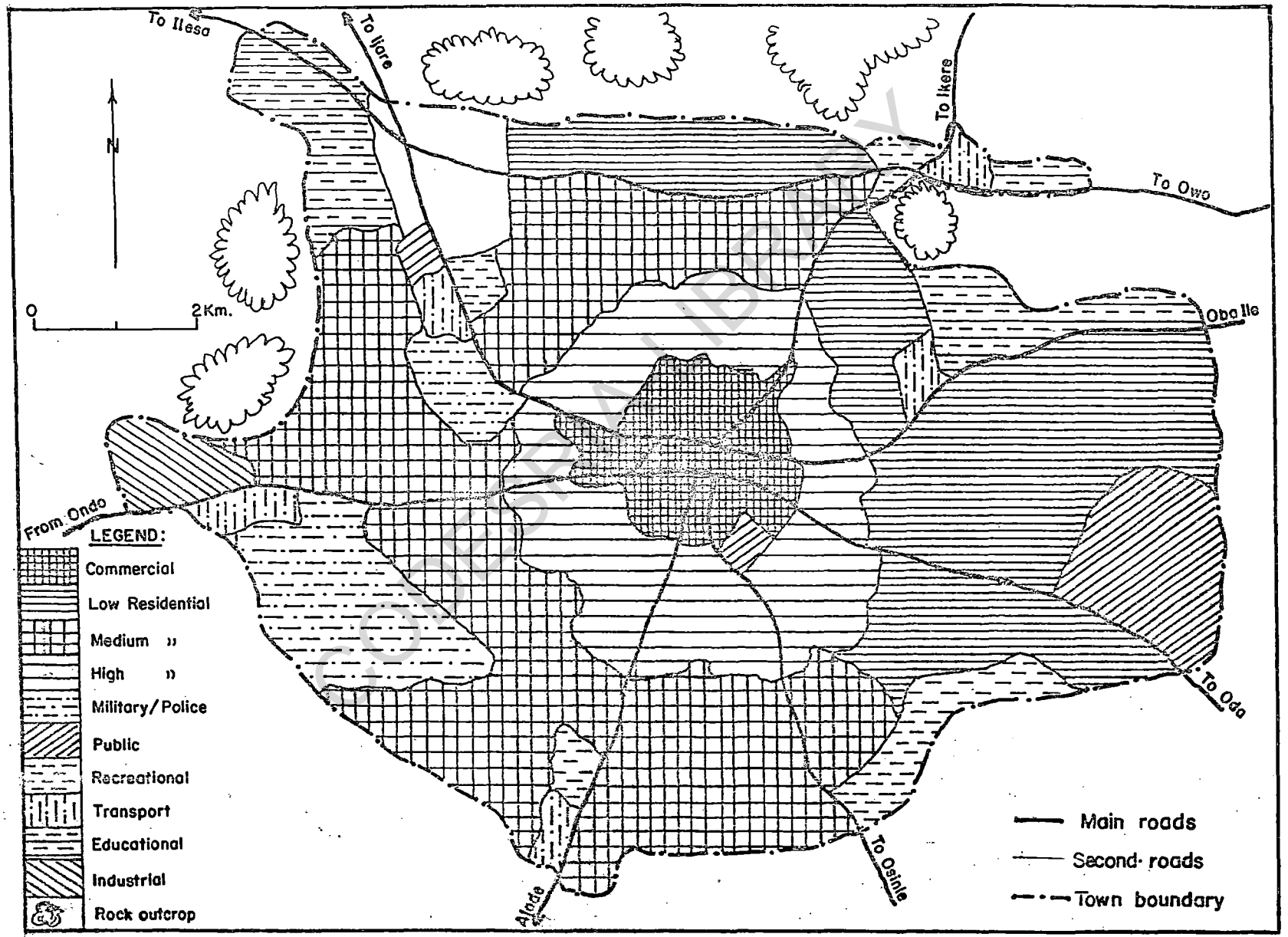


Fig. 4.4 : Major Land-Use Map of Akure as at 1986

(a) Residential Landuse:-

The residential landuse (High, medium and low) occupied about 5275 hectares representing 65.98% of the total landuse in Akure as at 1996. (See table 4.1).

The area covered by high residential landuse as at 1966 is 495 hectares. This value decreased to 375 hectares in 1976 as some of the land which had hitherto been used for residential purposes were used for commercial purposes. The fact however remains that land devoted for high residential purposes between 1966 and 1996 had been on the decrease in terms of the percentage of the total landuse it occupied from 30.8% of 1966 to 13.76% of 1996 (See Table 4.1).

The overall pattern of growth of high residential landuse between 1966 and 1996 is concentric (see Figure 4.5). The pattern is distinct except that landuse invasion has occurred in the core region. Commercial landuses have invaded part of the residential zone because of the high value attached to the lands in the city centre. In terms of composite growth pattern, Table 4.2 shows that the total area covered by high residential landuse as at 1966 was 495 hectares while that

Table 4.2 **Areas Covered by Residential landuse (High) types in Akure as at 1966, 1976, 1986 and 1996**

Year	Area in Hectares	Absolute Change	Percentage Increase/decrease	Rate of Change
1966	495	-	-	-
1976	375	120	24.2	2.4
1986	775	400	+ 106.67	10.7
1996	1110	335	43.2	4.3

Source:- Field work 1996.

of 1976 was 375 hectares that of 1986 was 775 hectares and that of 1996 was 1110 hectares. From this table, it could be deduced that the most remarkable growth took place between 1976 and 1986 when the percentage increase was 106.67and the annual rate of change was 10.7. This period coincided with the time when the state was created and demand for residential landuse increased.

Similarly the growth pattern of medium residential landuse (1966-1996) is sectoral in nature (see Figure 4.6). It expanded towards the south west, west, south and the north. Table 4.3 shows the total area covered by the landuse as at 1966 which was 680 hectares, 1976 was 775 hectares, 1986 was 2100 hectares and 1996 is 2475 hectares. From the pattern displayed by Figure 4.3, the growth was remarkable between 1976 and 1986. The percentage of growth during the period was 172.3 with 17.2 as the rate of change.

Table 4.3 **Areas Covered by Residential (Medium) landuse types as at 1966, 1976, 1986 and 1996**

Year	Area in Hectares	Absolute change	Percentage Increase/decrease	Rate of Change
1966	680	-	-	-
1976	775	95	14	1.4
1986	2110	1335	172.3	17.2
1996	2475	365	17.3	1.7

Source: Field work, 1996

The growth pattern of low residential landuse between 1966 and 1996 was wedge like (see Figure 4.7). It grows mainly in the Eastern and Northern parts of the town. The pattern of growth is remarkable between the year 1976 and 1986. The analysis of percentage growth is shown by Table 4.4. The growth pattern was highest between the period of 1976 and 1986 with 650 hectares accounting for absolute change. While the lowest growth of 285 hectares was recorded between 1966 and 1976.

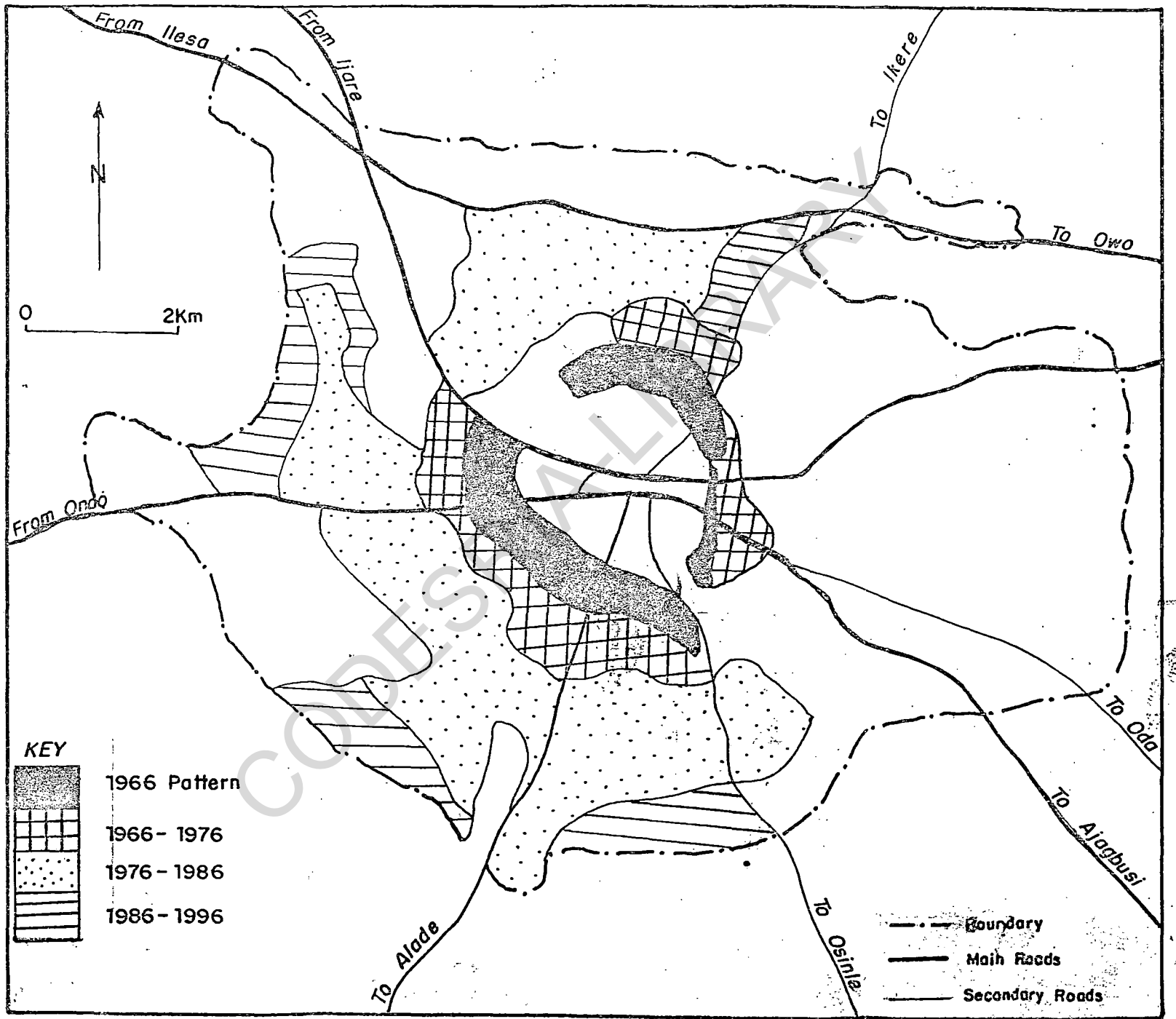


Fig. 4.6. Composite growth Pattern of Residential (medium) landuse in Akure (1966 1996)

Table 4.4 **Areas covered by Residential (Low) landuse types as at 1966 1976, 1986 and 1996**

Year	Area in Hectares	Absolute change	Percentage Increase/decrease	Rate of Change
1966	165	-	-	-
1976	450	285	172.7	17.3
1986	1100	650	144.4	14.4
1996	1700	600	54.6	5.5

Source:- Field work, 1996

Figures 4.1 and 4.2 show the major landuse map of Akure as at 1966 and 1976. In these maps, high residential landuse were prominent compared with other residential landuses. The morphology of the city at this time consisted of the old parts and are concentric in nature. However, the pattern changed in 1986 and 1996 (see Figures 4.3 and 4.4 respectively) when medium and low residential types became prominent. Thus, in 1996, the pattern shows the predominance of residential landuse over other uses in the city. Residential areas distributed all over the city included that of the old part of the town and the new areas occupied by GRA, Low Cost Housing, and Senior Civil Servant quarters while the others include affluent quarters such as Ijapo and Okuta-Elerinla.

The creation of states in 1976 and the choice of Akure as the capital calls for rapid urban renewal and expansion. There was a mass demolition of old structures and houses especially at the core of the city to give way to some

other structures which were located in the city centre and along Oba-Adesida road. Residents who were displaced by the exercise were re-settled at the periphery of the town and compensation paid to them. New structures emerged in some parts of the city while some residential buildings served dual purposes by providing both commercial and residential services.

The rapid rural-urban migration occasioned by the new status of Akure led to high demand in residential accommodation. This new land acquisition for residential buildings resulted into further expansion of the residential landuse in the city.

State owned housing estates for civil servants emerged along the eastern part of the town. These housing estates include Ala, Alagbaka, Oba-Ile and Ijapo while the Federal Housing Estate was located in the Northern part of the town along Ilesa-Owo Express road. As earlier enumerated three major types of residential landuse which existed in Akure during these periods are the high, medium and low densely populated zones. The highly populated residential zone was very close to the core of the city and forms a concentric pattern around the city centre. The houses were characterised by traditional compound type shared by indigenes, low income earners and traders (see Figure 4.5). However, there are houses which have experienced a process of selective urban renewal shortly after 1976. Unbuilt spaces in the city centre were built up to meet the demand for commercial purposes. This is due to the fact that these neighbourhoods have assumed a new importance due to their nearness to the core of the city. Important among such areas are old Isolo, Ijomu, Oba-nla, Ayetoro and Oritagun.

The medium residential zones are located shortly after the high residential zones. The middle income earners are found in this zone. Thus, the zone is dominated by junior officers in the civil service. The population of people living in this area are not as thickly populated as those in the high residential zones. The medium residential zone occupies the South-Eastern part of the town around Oluwatuyi quarter, Sijuade, Ijoka and Osinle. It also occupies part of the Northern part of the town around New Isolo and Oke-Ijebu. In the South-Western part of the town/residential (medium) types occupied New Oke-Aro quarters and Isinkan quarters (See Figure 4.6).

The low residential zones are located in the Eastern and Northern part of the town. This zone constitutes the area where the high income earners live. The Government Housing Estates such as Ala, Oba-Ile and Alagbaka include the areas where top civil servants in the state live. The Federal Housing Estate located in the Northern part of the town is where the top civil servants working in the Federal Ministry in the state reside. Other high income earners reside in Ijapo Housing Estate, Fanibi Layout and Okuta-Elerinla Estates. Others such as Federal University of Technology, Federal College of Agriculture and Federal Girls School are located at the periphery of the city.

(b) **Commercial Landuse:**

Commercial landuse occupies 425 hectares or 5.32% of urban landuse within the city as at 1996. (See Figure 4.8). During the colonial era, the country's economy was in the informal sector and the Oba market was a major foci point where agricultural products are sold. A small formal sector emerged with the

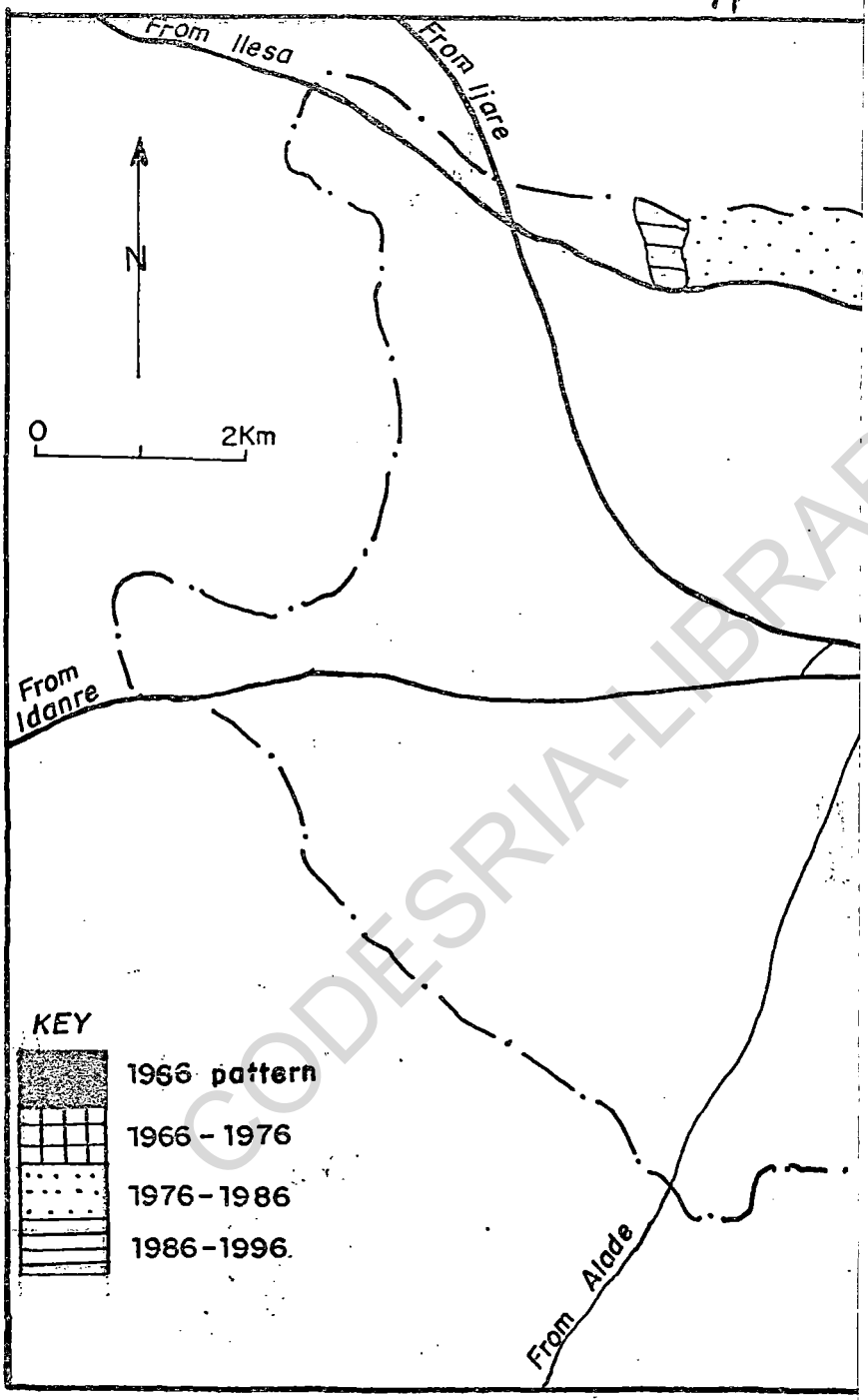


Fig. 4.7. Composite growth pattern of Residential (lo

growth of retail establishment by migrants after independence. The growth of wholesale became more pronounced when the State was created. The Ibos, Ijesas and few Ondo State indigenes dominated wholesale establishments in the town. The core became both traditional and modern in nature while retail trades expanded along major roads. Such roads include Ijomu, Isolo, Odo-Ikoyi, Arakale, Alakure, Oba Adesida and NEPA junction. The commercial activities along each route involve different types of goods. For example Arakale route is where most electronic shops and building materials are found. Alakure and Ondo bye-pass is where most spare parts are located; Oba-Adesida road is where most Bookshops are located while Odo-Ikoyi is where most plastic materials are found.

Over time a process of landuse reconversion took place whereby some strategically located residential landuses were changed to commercial buildings. With increase in population, more markets notably NEPA, Isinkan, Oja-golu, Iloro, Mojere, Isolo, Oluwatuyi, Aralepo and Odo-Ikoyi were established to serve the inhabitants. All these markets were located to take advantage of the consequence of population and increase in demand for goods at various parts of the city. Intensive wholesaling and retailing activities could be noticed in markets mentioned above and along major junctions of the city's road network. There is also invasion of residential (high) landuse type by commercial landuse in the core of the city. Figure 4.8 shows the composite growth pattern of commercial landuse in the city between 1966 and 1996. The major growth was established between 1976 and 1986. The areal expansion of landuse recorded by commercial activities

during this period was 275 hectares representing 1110% of the percentage increase. The rate of change was also remarkable between 1976 and 1986. (See Table 4.5)

Table 4.5 **Areas Covered by Commercial landuse types as at 1966, 1976, 1986 and 1996**

Year	Hectares	Absolute change	Percentage Increase/decrease	Rate of Change
1966	20	-	-	-
1976	25	5	25	2.5
1986	300	275	1100	110
1996	425	125	41.7	4.2

Source:- Field work, 1996.

The pattern of commercial landuse as depicted by Fig. 4.8 is radial and grows towards the major routes from the core of the city. The commercial landuse had increased with the general expansion of the city. The new nucleus of commercial activities around the Post Office area, King's Palace and Old Motor Park had expanded along Oba-Adesida and Oyemekun roads housing most of the commercial banks, insurance companies, building materials, plastic materials and electronics shops.

(c) **Industrial Landuse:**

The industrial landuse occupies 400 hectares or 5.0% of Urban landuse within Akure as at 1996 (See Figure 4.9). The spatial development of manufacturing industries in Akure can be ordered into phases. Phase one occurred before

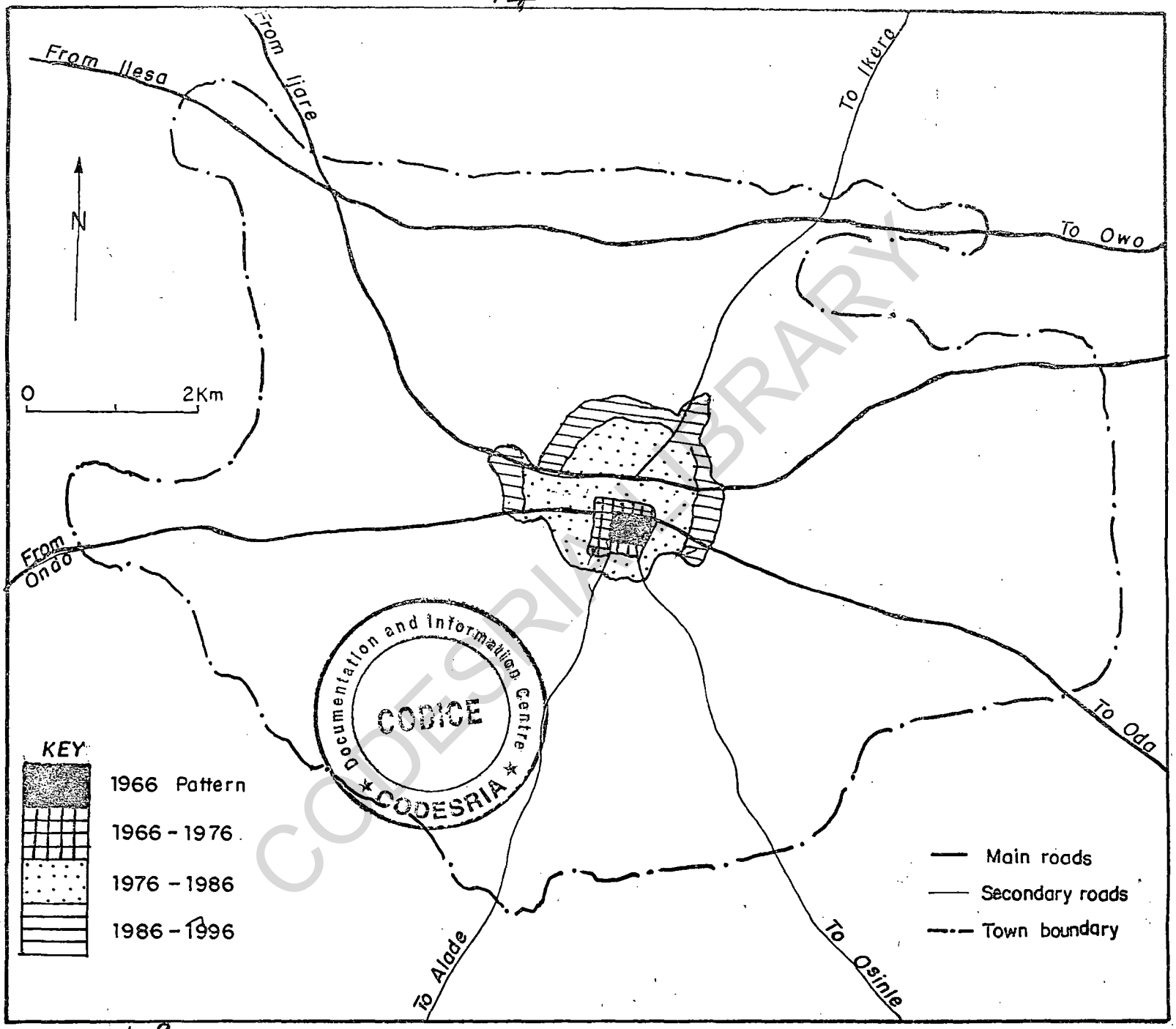


Fig. 4.8 Composite growth Pattern of Commercial landuse in Akure (1966-1996)

Nigeria's Independence. Traditional crafts and small scale industries notably Gold Smithing and Black Smithing dominated the industrial base of the town during this period. After independence, primary processing industries which use local raw materials were established in the town. Such primary industries include saw mills and gari processing industries. The saw mill industries were located at points close to the source of raw materials. Thus, most of the industries are found along the main routes leading into the town particularly Idanre, Ado, Owo, Ondo and Ilesa roads. These industries were located at the outskirts of the city where land is available. Gari industries were also located within the city especially in some houses in the high residential zones. These industries were so located because of their nearness to the Oba Market.

The phase II era started with the creation of Ondo State in 1976. Lands were specifically earmarked for industrial use (industrial estate) at the Northern and Western parts of the town. Modern large scale industries grew over time in the town. Most of these industries were consumer oriented and some of them use imported raw materials while others use local raw materials. These industries were located at the outskirts of the city. At the outskirt of the town, two types of industrial locations can be identified. These are isolated industries such as saw milling and areas of nucleated industrial development. Important industries include jute bag production, cork producing industry, packaging industry, rock quarrying, stone polishing, plastic industries, food and beverage industry, pharmaceutical and toiletries, furniture and paint industries. Other proposed industrial projects include brewery and soft drink plants. Figure 4.9 depicts the composite growth pattern of industrial landuse in the city between 1966 and 1996. As at 1966, the areal extent

of industrial landuse was restricted to the core of the city. The major growth in industrial expansion was experienced between 1976 and 1996. Table 4.6 shows the area covered by industrial landuse with 1986 as the major thrust for industrial take-off. This period recorded 300% increase in land devoted for industrial use over what existed in 1976. Others are as stated in Table 4.6.

Table 4.6 **Areas Covered by Industrial landuse types as at 1966, 1976, 1986 and 1996**

Year	Hectares	Absolute change	Percentage Increase/decrease	Rate of Change
1966	15	-	-	-
1976	50	35	233	23.3
1986	200	150	300	30
1996	400	200	100	10

Source:- Field work, 1996.

(d) **Public and Semi-Public Landuse**

Public and semi-public landuses occupied 375 hectares representing 4.69% of the land in use as at 1996 in Akure (See Figure 4.10).

Semi-public landuse are of various categories. The first is educational institution which has been facilitated by the colonial policy. Land was allocated to Christian Missionary for this purpose. Thus, Anglican, Catholic and to a limited extent Methodist dominated educational landuse before Government took over from

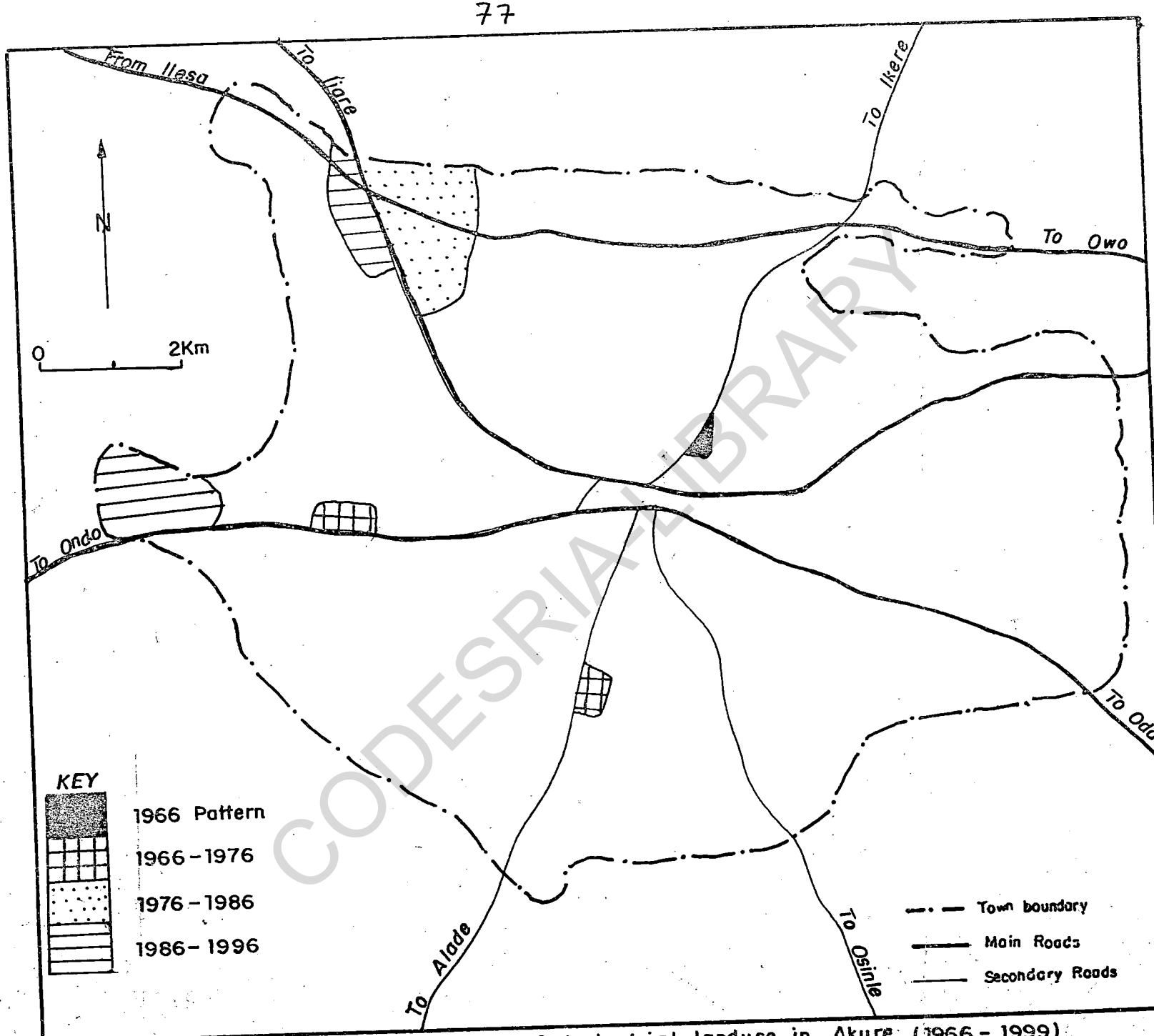


Fig. 4-9. Composite growth Pattern of Industrial landuse in Akure (1966 - 1999)

them. The second important semi-public landuse include Health Institutions such as Hospitals, Maternity Centres, Comprehensive Health Centres, Clinics, Mental Homes and Private Hospitals. The third is the land devoted to cemetaries. Most of these cemetaries are located on the grounds acquired by Christian Missionaries and are therefore close to the churches. The changes in the administrative status of Akure since 1976 also had a great impact on the public landuse. Before the creation of State, public and semi-public landuses in Akure were dispersed in terms of location. However after 1976, when Akure became the Capital of Ondo State majority of the ministries were concentrated in the Eastern part of Akure while some government offices remained where they were before 1976 e.g. Ministry of Works and Transport. Ondo State Secretariat, Federal Secretariat, Central Bank of Nigeria, Police Station, NEPA, Water Corporation, bank Headquarters, Insurance and Finance Headquarters were located in the Eastern part of Akure. Some public landuse such as Ondo State Ministry of Works and transport, Prisons, Welfare Homes, Scholarship Board were located in the Western part of the town (see Figure 4.10).

The composite growth pattern of public/semi-public landuse betweeen 1966 and 1996 as depicted by Figure 4.10 shows the concentration of public and semi-public landuse in the eastern part of the city. The growth of this landuse was well pronounced between 1976 and 1986. This is because of the new Secretariat built for both State and Federal use at the eastern part of the town. Similarly, NUT office, Farmer's House and National Library moved to their permanent buildings in the eastern zone of the city.

Table 4.7 **Areas Covered by Public/Semi-Public landuse as at 1966, 1976, 1986 and 1996**

Year	Hectares	Absolute change	Percentage increase/decrease	Rate of change
1966	60.0	-	-	-
1976	62.5	2.5	4.2	0.4
1986	100.0	37.5	60	6
1996	375.0	275	275	27.5

Source:- Field work, 1996.

As earlier noted, the percentage increase of Public/Semi public landuse in Akure has been gradual. This is probably due to the long term project of building offices on the permanent site. The percentage increase was highest in 1996 with 275% and rate of change of 27.5. Other percentage increases were as stated in Table 4.6.

(e) **Recreational landuse**

Recreational landuse occupies 300 hectares representing 3.75% of the total landuse in Akure as at 1996 (see Figure 4.11). The allocation of space for recreational landuse in Akure started during the colonial administration era. A section of the Rest House which is located at the Eastern part of the town was reserved for playing Lawn tennis by the colonial masters. Shortly before the creation of states, a stadium was built to serve the town and other towns in Ondo province. The standard of the stadium has been raised since 1976 when Ondo State was created.

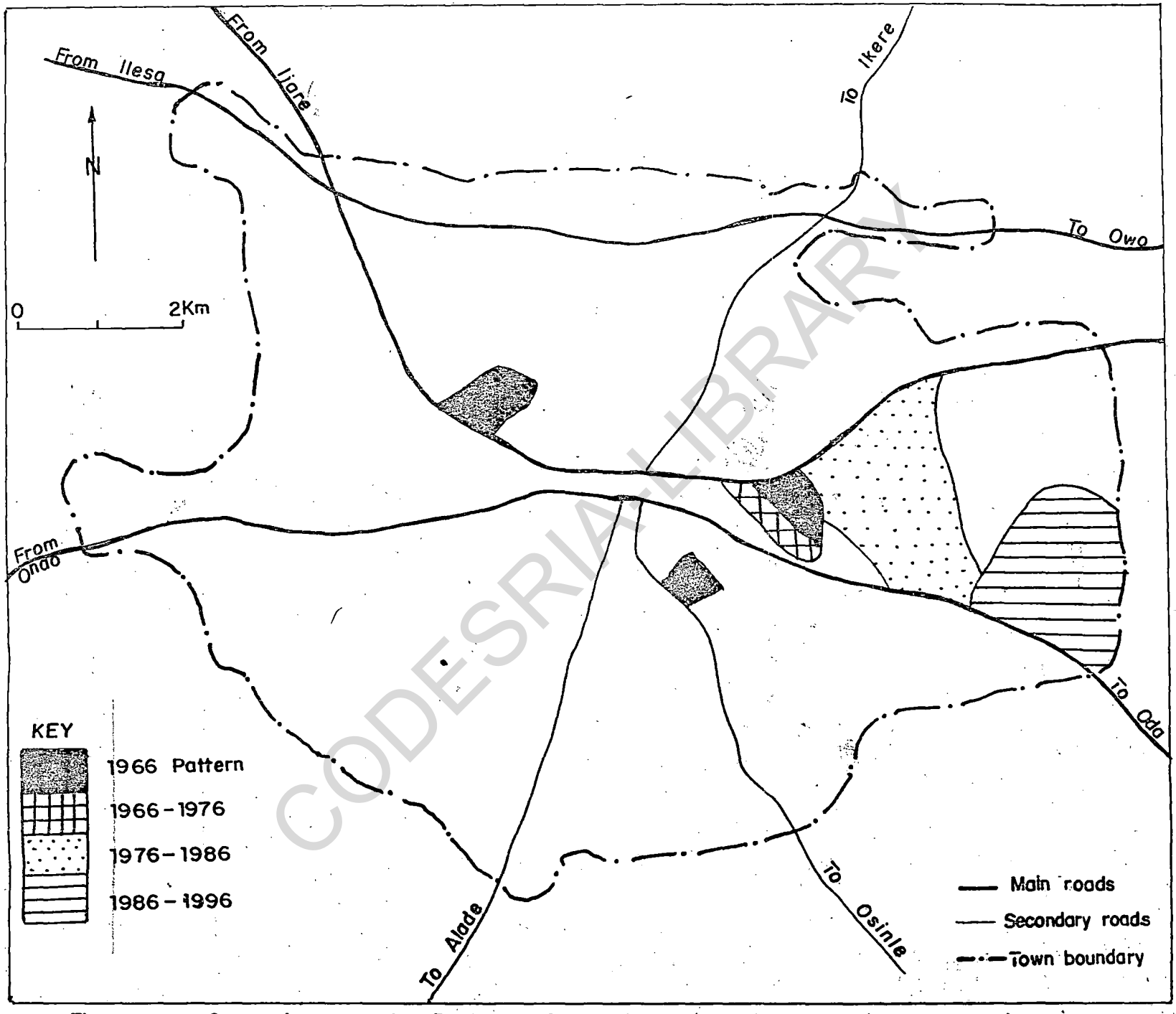


Fig. 4.6. Composite growth Pattern of Public landuse in Akure (1966 - 1996)

Other recreational facilities have also been established and developed within the town. These include cinema houses, cultural centres, Youth Centre, Town Hall, Hotels of various classes, private club houses, amusement parks and seasonal picnic centres. According to Ondo State 3rd National Development Plan (1975-1980), "The establishment of a modern hotel in the State capital was viewed as very important since there was no single hotel of international standard prior to 1976". The outcome of the proposal that followed is the building of Owena Motels and Government chalets in the eastern part of the city. To further supplement the efforts of the State Government and rising demand in the provision of recreational facilities, private hotels sprang up and mini relaxation points emerged in other parts of the town. Many recreational landuse also sprang up especially in the Housing Estates one of which was Ilunla Recreational Centre located in Ala Housing Estate and Central Town Hall in the core of the city (Figure 4.11). The figure depicts the composite growth pattern of recreational landuse between 1966 and 1996. During the period between 1966 and 1976, majority of the recreational landuses are located within the areal extent or built-up section of the city. However, shortly after the creation of the states recreational centres that grew up were located at the outskirts of the town. Examples of such recreational landuse include Owena Motels, Police and Army Officers' mess and some other private hotels.

Table 4.8 **Areas covered by recreational landuse as at 1966, 1976, 1986 and 1996**

Year	Hectare	Absolute Change	Percentage increase/decrease	Rate of Change
1966	35	-	-	-
1976	37.5	2.5	7.1	0.7
1986	50	12.5	33.3	3.3
1996	300	225	450	45

Source:- Field work, 1996

The major growth of recreational landuse as depicted by Figure 4.11 occurred between 1986 and 1996. This growth accounted for 450% increase over what existed in 1986. The rate of change was equally remarkable during this period.

(f) **Educational Landuse**

Educational landuse occupied 475 hectares representing 5.94% of the total landuse in Akure as at 1996 (Figure 4.12). The vantage location of Akure as the provincial headquarter since 1939 influenced the location of important institutions in the town within the State. Such schools include Federal Girls College, College of Agriculture, School of Nursing, Cooperative School, Minor Seminary, Vinning Theological College, Teacher's Training College and a host of important secondary schools. In addition to the above institutions, the Federal University of Technology was established in Akure after the creation of Ondo State in 1976. Other institutions that were created include Health technology, College of Information Technology, Cooperative College, Police Training College, School for the Deaf

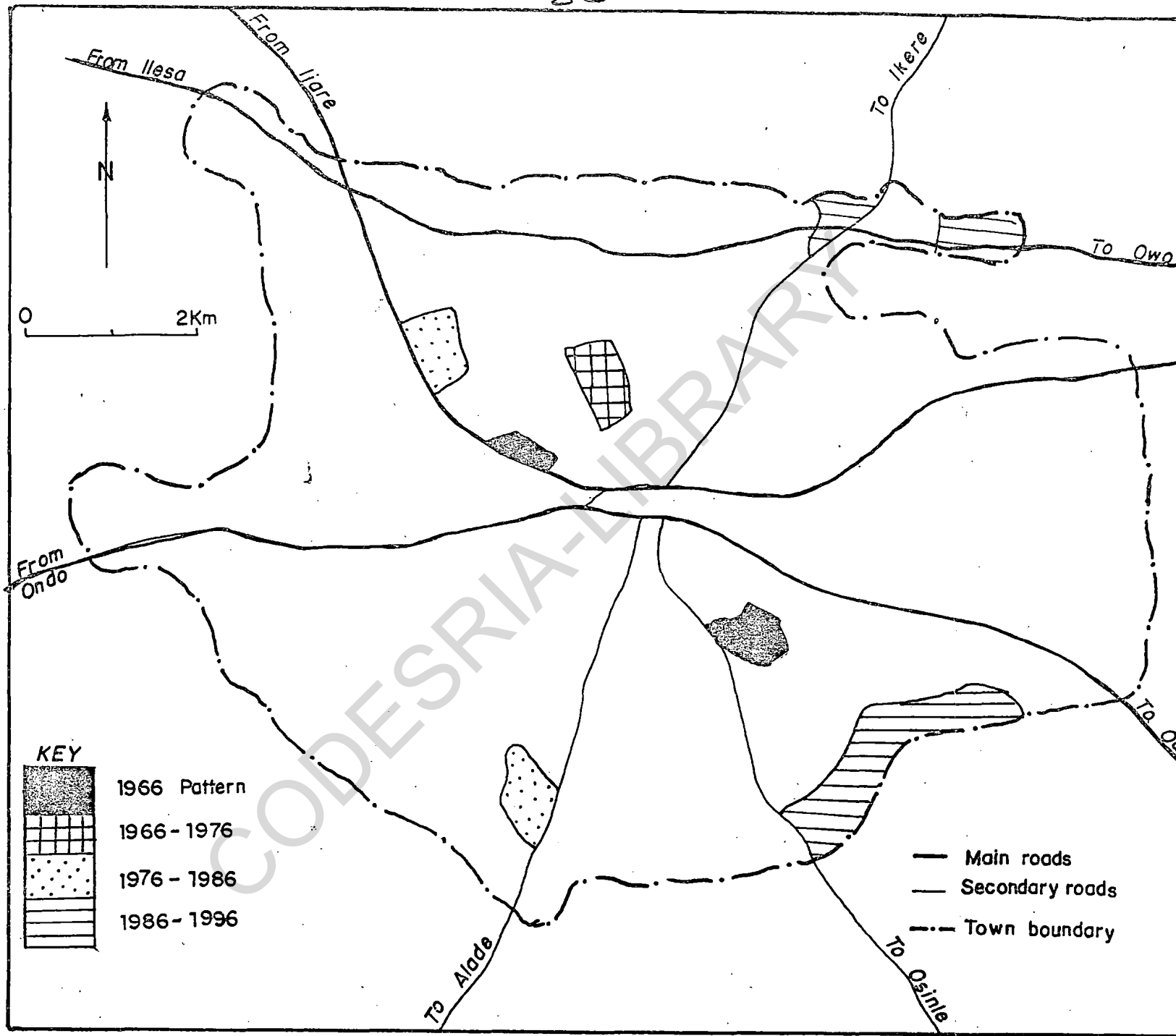


Fig. 4.11 Composite growth Pattern of Recreational landuse in Akure (1966 1996)

and Dumb and other private schools and Computer Training Centres aimed at meeting the rising demand for primary, secondary and tertiary education.

The educational landuse introduced physical expansion in the North-Eastern and North-Western part of the city. Figure 4.12 depicts the composite growth pattern of educational landuse between 1966 and 1996. These centripetal forces were evidenced by educational landuse development of the Federal University of Technology Akure, its staff school, host of Government and private schools in the North-Western part of the city on the one hand and College of Agriculture, Federal Girls College and a host of Government Secondary and private schools in the North-Eastern part of the city.

Table 4.9 **Areas covered by educational landuse as at 1966, 1976, 1986 and 1996**

Year	Hectare	Absolute Change	Percentage increase/decrease	Rate of Change
1966	80	-	-	-
1976	100	20	25	2.5
1986	225	125	125	12.5
1996	475	250	111	11.1

Source:- Field work, 1996.

The period between 1986 and 1996 accounted for the highest growth pattern in areal extent as far as educational landuse is concerned in the town. Thus, 250 hectares of growth in landuse was noted between 1986 and 1996. This

is probably due to the establishment of more public and private schools which were rampant between 1986 and 1996. Apart from this, the location of Police Training School, Staff Schools for Federal University of Technology and Federal Girls College in Akure also increased the landuse devoted to educational purposes.

(g) **Transport and Communication Landuse**

The transport and communication landuses occupied 195 hectares representing about 2.44% of the total landuse in Akure as at 1996 (see Figure 4.13). Shortly after Ondo State was created, it became necessary that the transport and traffic life of the State capital needed planning. This led to the construction of new roads and the re-construction of some old roads. Apart from improvement in road network, the only motor park which was located close to the C B D by 1976 was decentralized because of the traffic congestion experienced in the core area. Several motor parks now function as places where travellers could board and disembark from vehicles going out or coming into the town respectively. Thus, intra-urban Public transport services were further enhanced as there was increase in the demand for them.

Nigerian Telecommunication Services (NITEL) and The Nigerian Postal Services (NIPOST) handle the communication systems of the city. A host of Private Communication companies that handle communication contracts also exist. NITEL oversees the telephone services within Akure and between the city and other towns in the country and outside. The old Postal & Telecommunications (Now NITEL) site is located very close to the CBD while the new NITEL complex is

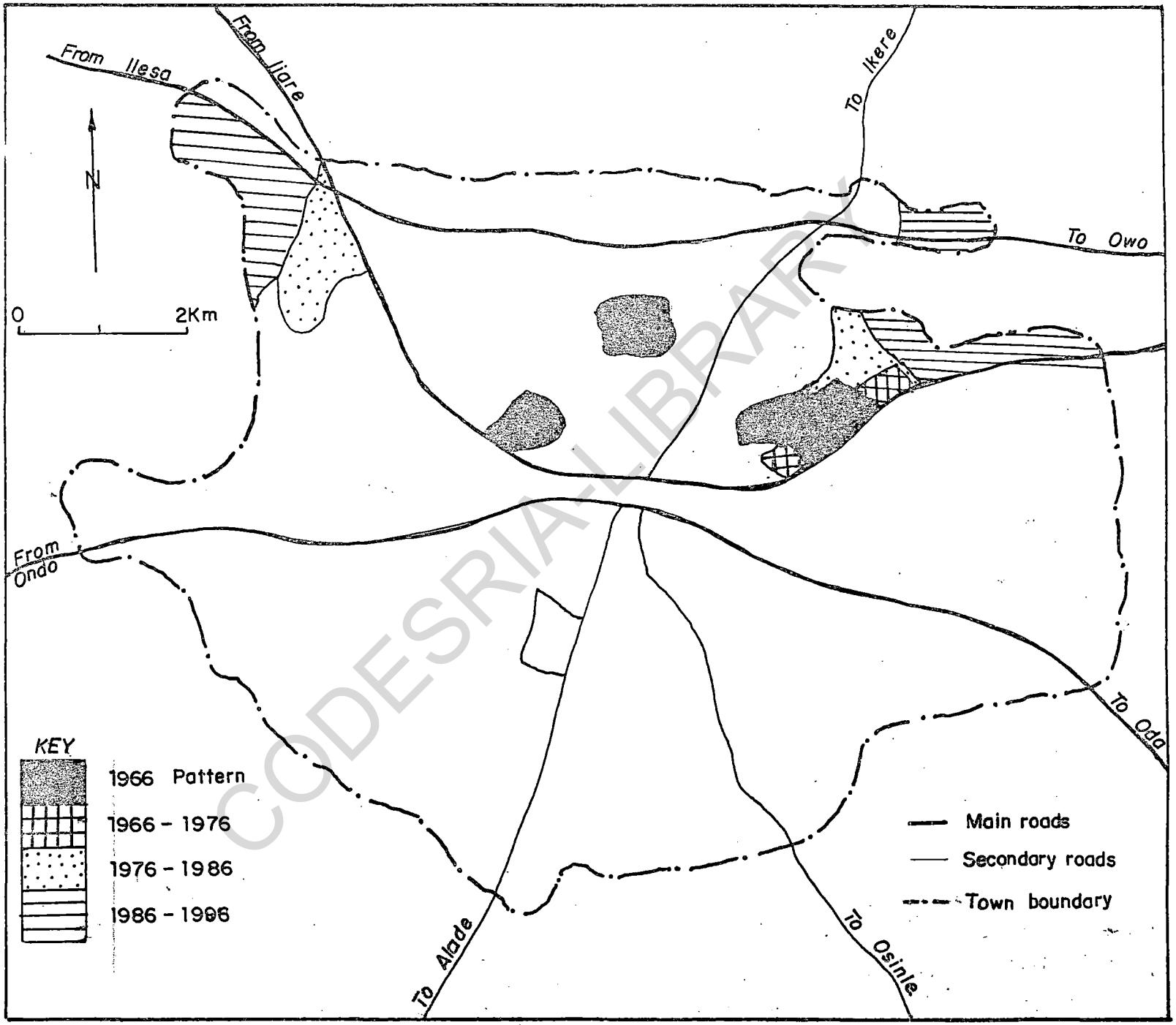


Fig. 4.12 Composite growth Pattern of Educational landuse in Akure (1966 - 1996).

located in the Eastern part of the town. Figure 4.13 depicts the composite growth pattern of transport landuse in the city between 1966 and 1996. These centripetal forces were evidenced by motor park development at the outskirts of the city to serve some particular routes. Thus, Owo-Benin-Onitsha motor park emerged at the North-Eastern part; Owo-Ikare-Okene-Ilorin-Abuja motor park emerged in the eastern part; Ilesa-Ife-Ibadan motor park emerged at the North western part and Ondo-Ore-Lagos motor park emerged at the Western part of the city.

Table 4.10 **Areas covered by Transport and Communication landuse as at 1966, 1976, 1986 and 1996**

Year	Hectare	Absolute Change	Percentage increase/decrease	Rate of Change
1966	20	-	-	-
1976	25	5	25	2.5
1986	150	125	500	50
1996	195	45	30	3

Source:- Field work, 1996.

Similarly, NITEL headquarter moved to the Eastern part of the city leaving skeletal activities in the core. The period between 1976 to 1986 accounted for 500% increase in the total growth in land devoted to transport/communication in the city. Others are as shown in Table 4.10.

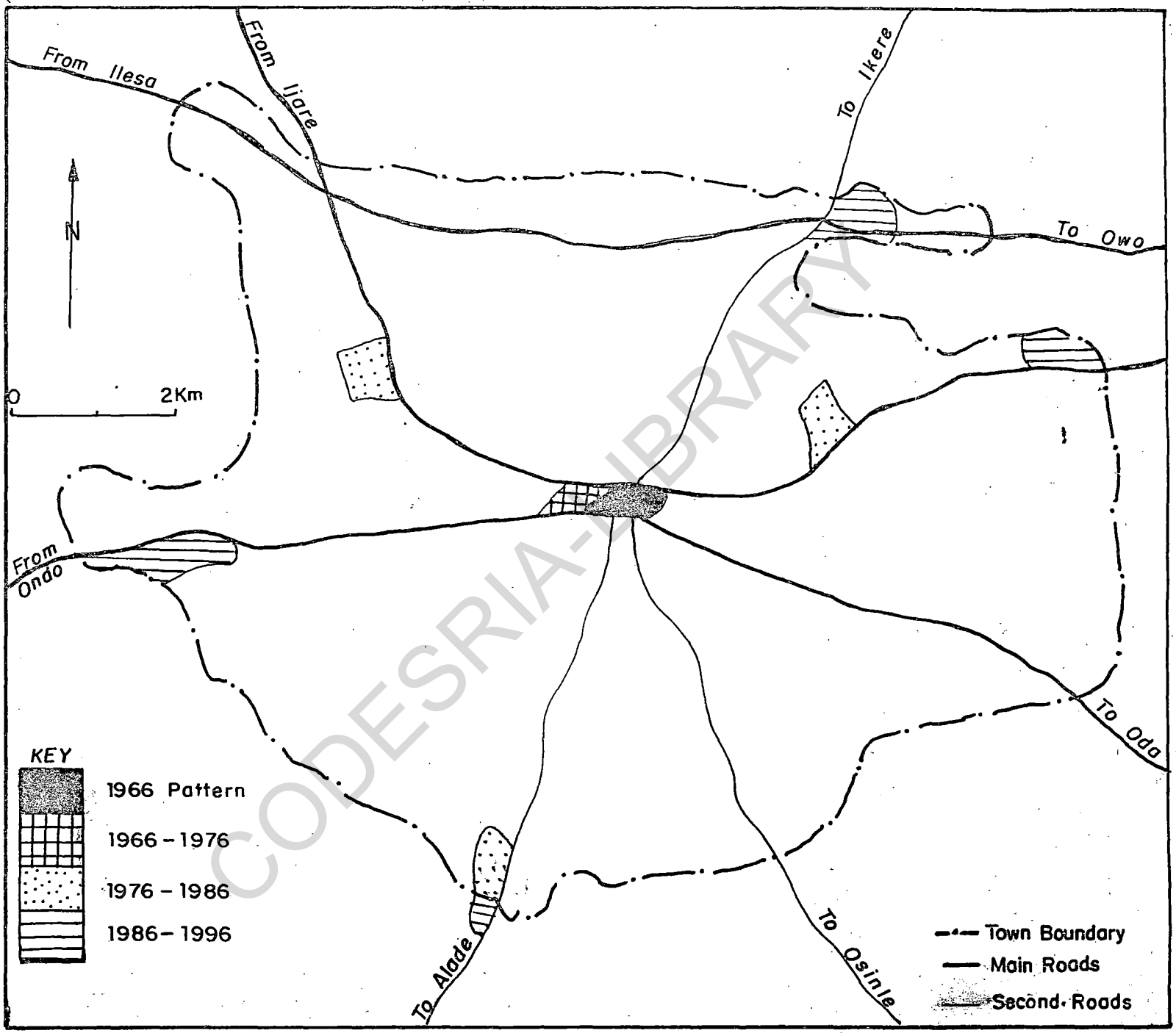


Fig. 4.13. Composite growth Pattern of Transport landuse in Akure (1966-1996)

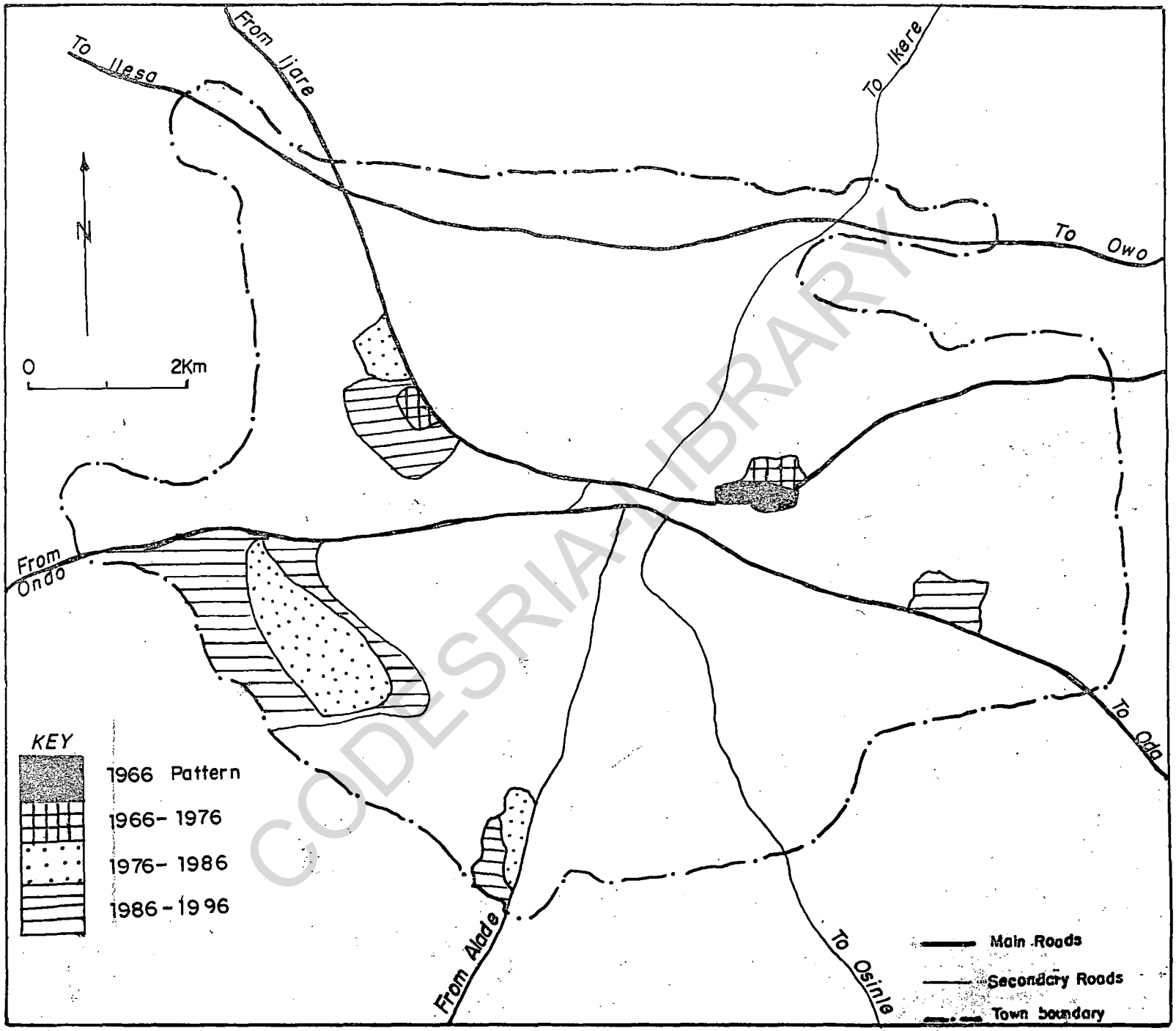


Fig. 4.14 Composite growth Pattern of Military/Police landuse in Akure (1966 - 1996).

(h) **Military/Police Landuse**

Military/Policy landuse occupied 550 hectares representing about 6.88% of the total landuse in Akure as at 1996 (see Figure 4.14). As at 1966, only one Police barrack was established in the town. The number of police barracks increased to two shortly before the state was created. Today, not less than eight areas within the city are devoted to police use. Similarly, the military took effective use of some parcels of land as barrack after the state was created. Intensive use of the land continued with creation of army barracks, officers mess and Army Comprehensive School in the Eastern part of the city. Similarly, the acquisition of a big parcel of land for Police Training Purposes also increased the use to which land is put by the Police Force in the State Capital. The composite growth pattern of Military/Police landuse as depicted by Figure 4.11 shows that major growth occured between 1976 and 1996. This growth according to Table 4.11 shows that the landuse devoted for this purpose increased from 35 hectares in 1966 to 37.5 hectares in 1976; to 350 hectares in 1986 and 550 hectares in 1996.

Table 4.11 **Areas covered by Military/Police landuse as at 1966, 1976, 1986 and 1996**

Year	Hectare	Absolute Change	Percentage increase/decrease	Rate of Change
1966	35	-	-	-
1976	37.5	2.5	7.1	0.7
1986	350	312.5	833.3	83.3
1996	550	200	57.1	5.7

Source:- Field work, 1996.

In summary, a lot of land use reconversion took place between 1966 and 1996. Prominent among landuses that were reconverted is the residential (High) landuses which was converted to commercial use in the city centre. Similarly, open landuse were reconverted for military/police and public/semi-public uses at the outskirts of the city. Within the core area, urban renewal in terms of new structures, road reconstruction and widening resulted in the demolition of many buildings. The overall change in landuse has implication for a change in travel demand, traffic generation, distribution and attraction which are treated in subsequent chapters.

4.5 FACTORS RESPONSIBLE FOR CHANGE IN LANDUSE IN AKURE

Landuse in Akure has changed through time in terms of size, structures, characteristics and spatial distribution as noted in the preceeding section. A number of factors can be said to be responsible for the change. Prominent among the factors are the effects of the state creation in 1976. Akure as a provincial Headquarter assumed the status of a State Capital in 1976. There was a sudden rise in the population of Akure shortly after the creation of the State. This rise in population was caused partly by the decentralization of the Western State Civil Service in 1976. This exercise led to the movement of not less than 4,000 civil servants and their dependants from Ibadan to Akure within a period of about six months (Ondo State Commemorative Hand book, 1978). Apart from this, people from the neighbouring towns moved to the new state capital in search of gainful employment. Thus, there was immediate increase in population and this resulted in greater demand for housing. 1976 marked the beginning of Urban development

in Akure as the expansion of the city extended into the nearby settlements from where people shuttled on daily basis to the city centre for other activities.

The roads in the town also faced reconstruction, extension in addition to the construction of new roads. Oba-Adesida and Oyemekun roads which run from West to the Eastern end of the city (See Figure 4.15) were the first to be reconstructed and expanded to dual carriage way. Similarly, Arakale road which runs parallel to Oba-Adesida and Oyemekun roads also was reconstructed and expanded but left as a single carriage-way. The aftermath change in land use as a result of the road reconstruction and expansion included the demolition of buildings, offices and petrol stations. It also affected the central market located in the CBD as part of its areal extent was reduced while the road passing by it was expanded. The demolition exercise also affected the commercial, residential, public and semi-public landuses as most of these landuses which were hitherto located in the city centre were re-located in the periphery.

Similarly, educational landuses were affected in the change. As at 1976, 5.16% of the total landuse was occupied by educational sector but in 1996 the landuse occupied 5.94%. The factor responsible for this included the policy of the Civilian Government in 1979. The Government approved Universal Free Primary Education (UPE) in the state and this led to increase in the number of primary schools and subsequently increase in the hectares of land occupied by educational landuse in 1996.

There was also change in industrial and manufacturing landuses in 1996 over what existed in 1976 as a result of Government and private individual's intention to develop the new state industrially. The aftermath of this intention was the establishment of Plastic, Cork, Toiletries, Packaging, plate, block, polish, candle, saw mills, furniture, glass, Pharmaceutical and drug factories in the state capital. The land devoted to industrial use has been on the increase since 1976. The percentage of land devoted to it increased from 2.58% in 1976 to 3.75% and 5.00% in 1986 and 1996 respectively.

More motor parks were created and located along the routes leading out of the town. In addition an airport was constructed at Oba-Ile in Akure. Since the town continues to expand, more roads were constructed to link places. The development of road networks in Akure also influenced the change from concentric pattern to sectoral and multinuclei structures at the periphery of the town. This is because some of the city functions which were formerly concentrated in a few centres started to develop along the main road arteries. Thus, the landuse devoted to transport increased from 25 hectares in 1976 to 195 hectares in 1996.

Government Housing Policy is also an important factor responsible for change in the pattern of landuse in Akure. The demand for accommodation in Akure rose astronomically and far in excess of available supply in 1976. This led some Government workers to live outside the State Capital. The problems created by inadequate accommodation for civil servants influenced Government Housing Corporation to build 4,500 housing units in the State to arrest the acute shortage of suitable accommodation in Akure and some important towns within the State.

The aftermath of this policy is the emergence of housing estates such as Ala, Alagbaka and Oba-Ile in the Eastern part of the town while the Federal Government Low Cost Housing (Shagari Village) occupied the Northern part of the town. Similarly, Ijapo, Fanibi and Okuta-Elerinla housing estates became prominent as wealthy people besieged the zone for a plot of land for residential purposes. Thus the residential landuse increased from 1600 hectares in 1976 to 3975 and 5275 hectares in 1986 and 1996 respectively.

There were also changes in the land devoted to commercial activities as at 1996 over what existed before 1976. The creation of Ondo state led to the upsurge in the population of Akure. This influenced many investors and businessmen to move to the new capital to establish their business. Shopping centres developed from the CBD towards the major roads emanating from the city centre. Similarly, important road junctions also became foci of business activities. Apart from this, there was expansion of commercial landuse into the High Residential zones in the city centre. Thus, most houses in the city centre were turned to commercial buildings as they fetched more income than when they were used for accommodation purposes alone. The landuse devoted to commercial purposes increased while that of high residential zone decreased in proportion overtime. This observation is equally true of Agwu's (1996) view that opportunity cost is attached to the consumption of land by various activities to which it is put. This is because land as a private good is such that its consumption by one activity necessarily precludes its consumption by other activities at least on a short term basis.

The status of Akure which changed from provincial headquarter to state capital is a factor which influenced the recreational activities of the town. Prior to 1976, there was no hotel of international standard in Akure. What existed were Hotels and Guest Houses. Other recreational landuse of prominence by 1976 included the stadium and Government Catering Rest House. Since the creation of the State, stadium, amusement parks and recreational centres in all the Housing estates have emerged as the crux of recreational development in the city.

There was no military base in Akure before the State creation. Shortly, after the state was created, a military base and its barrack were established and they occupied a portion of the landuse in the Western part of the town. Similarly, prior to 1976, there was only one police station and its barracks in the Eastern part of the town. Today, eight major police stations and barracks are spatially located within the city. Thus, the land devoted to military/police increased from 37.5 hectares in 1976 to 350 and 550 hectares in 1986 and 1996 respectively.

Another important factor that influenced change in landuse in Akure is land speculation. Land speculation according to Bello (1990) entails the with-holding of land for development in anticipation of future high land prices. Such expectations of future land prices and dates of maximum net gains resulted in the premature subdivision of land and uncoordinated development. According to Harvey and Clark (1965) the consequences of independent incremental additions to urban land is a growth process permitting a sprawl pattern. Thus, shortly after 1976, people started acquiring landed property in anticipation of a rise in house rent and this led to quick development of residential landuse at the expense of other landuse between 1976 and 1986.

The change in the trend for the provision of social amenities played important roles in influencing changes that occurred in landuse in Akure. According to Preston (1971) the extension of amenities to different parts of an urban area brings land within such areas closer to the point of actual development. This according to him is one of the forces stimulating urban development by attracting people to the urban areas because of the opportunities to enjoy amenities such as schools, water, electricity etc. Thus, people started acquiring land close to tertiary institution to build commercial and residential building believing that such projects would be demanded and at high prices always. Thus, commercial and residential landuse sprang up in areas where tertiary institutions are located.

4.6 CONCLUSION

There is no doubt that the way land is used in Akure has grown from residential, educational, commercial and public which it used to be prior 1966 to embrace military/police, transport/communication and recreational uses as at 1996. The areas covered by the various landuses as at 1976 increased from 1937.5 hectares in 1976 to 5330 and 7995 hectares in 1986 and 1996 respectively in the city. The phenomenal growth in landuse and subsequent change in its pattern occurred between 1976 and 1986. This period coincided with the time when Ondo State was created. It could therefore be inferred from this chapter that creation of state is a major factor in accelerating development of regions especially state capitals. There was thus many implications of this growth in landuse on the transport system. This is because transport and landuse are sub-systems of a city. The implications are however discussed in the subsequent chapters.

CHAPTER FIVE

CHARACTERISTICS OF INTRA-URBAN TRIPS IN AKURE

5.1 INTRODUCTION

This chapter highlights the types of trips generated by the identified landuse types in Akure. It does this by examining the volume of trips generated by various landuses by mode and purpose. The chapter also attempts an explanation of the volume of trips generated by different landuses using socio-economic variables of respondents in the city.

5.2 TYPES OF TRIPS GENERATED WITHIN AKURE METROPOLIS

There are four basic types of trips associated with an urban area. These are:

- trips originating from the city and destined for outside the state;
- trips originating from outside the state and destined for the city;
- through trips;
- intra-city trips.

Akure metropolis exhibits these different types of trips. In this study, our interest centres on the intra-urban trips. Intra-urban trip making is essentially concerned with movement between origins and destinations. Trips made by urban dwellers result in various spatial patterns depending upon the purpose of undertaking the journey. The spatial patterns resulting from inter zonal trips that occurred make it possible to measure the functional link between zones and the spatial differentiation of activities. The functional regions of an urban centre can therefore be identified through a study of the pattern of passenger movements. Intra-city movement is a function of demand. This is because differentiation in

resource endowment triggers off the demand for movement which in urban areas is explained by the amount of interaction that takes place in different landuses. On this premise therefore, it can be stated that the term demand is the desire of a commuter to obtain the advantages which can result from areal differentiation in terms of supplies of goods and services. According to Hanson (1965) demand for transport is a "derived demand". Transport is not demanded for its own sake but demanded to meet certain socio-economic, political and administrative activities which are not available at the user's origin. In transport studies, however, Roberts et al (1971) defined demand for travel as the desire of a specified commuter to obtain the advantages which can result from such travel and is essentially an abstract idea.

Roberts (1982) argued that the present day determinants of trip generation must be understood in order to assess future travel demand. There is the need to understand the characteristics of landuse, population and transport facilities that influence travel demand before the projection of trip generation can be made. This is because trip generation models are concerned with the estimation of the number of trips into and out of various traffic zones (O' Flaherty, 1979). They are based on the principles that landuse generates trips and that the number of "from home" trips are influenced by the following:

(a) Socio-economic variables such as car ownership or availability, household income and size, occupational status, household composition (e.g. number of workers per household).

(b) Location variables such as population or residential density, rateable values and distances of household from the town centre.

(c) Public transport accessibility variables (This last variable is of particular importance if the modal split is to be included as part of the trip generation model).

The physical growth of Akure in terms of spatial distribution of roads and landuses has great impact in the trip characteristics of its people. The trip generated within Akure metropolis was studied in eight major landuses. The study reveals that vast majority of movement within the city expresses the relationship between residences, work places, recreational centres, religious centres, commercial centres, industrial centres and educational centres. Responses to questionnaire administered to household heads in Akure reveals that the major types of trip generation in the city are for journey to and from places of work, market, recreation, religious centres etc. In this subsection we will examine the volume and pattern of trip generation from two angles - disaggregate and aggregate perspectives.

(a) Trips generated on disaggregate perspective

This relates to the volume of trip generated by landuse differentiated by mode of transport system and the purpose for which a journey is made.

(i) Volume of trips generated by landuse

The major landuses in Akure are Educational, Industrial, Residential, Commercial, Recreational, Transport, Military/Police and Public/Semi-public. The results of an examination of the trips generated by various Induses in Akure are shown in Table 5.1 The analysis of the data shows that the highest total trips of 2524 representing 22.7% of trips were generated by commercial landuse zone. This was however closely followed by 2170 trips and 1283 trips representing

11.54% respectively for low residential zone and high residential zone in the city. The lowest number of trips of (259) representing 2.33% was generated in recreational zones.

The main commercial landuse in Akure is located in the city centre and called Oja-Oba. This zone attracts a large number of trip makers daily in spite of decentralization of marketing activities to new market zones such as NEPA market, Isinkan market, Oja-golu, Osinle market, Mojere, Aralepo and Odokoyi markets. The reason for this persistent patronage of Oja-Oba appears to be due to its location as a centre for break-of-bulk of commodities in the town in particular and the state as a whole.

Table 5.1 **Volume of trips generated by various landuse**

Landuse	Volume of trips	Percentage
1. Educational	563	5.06
2. Industrial	1234	11.10
3. Residential (High)	1283	11.54
4. Residential (Medium)	1229	11.05
5. Residential (Low)	2170	19.52
6. Commercial	2524	22.70
7. Recreational	259	2.30
8. Transport/Communication	364	3.27
9. Military/Police	595	5.35
10. Public/Semi public	898	8.08
Total	11,119	100

Source:- Field work, 1997.

(ii) Volume of trips generated by mode

The modes used are trekking, motor cycle, taxi-cabs, bus, bicycle and private cars. An examination of the modes of intra-city trips in Akure reveals the dominant position of trips by taxi-cabs and private cars.

Table 5.2 **Percentage share of trips by mode**

Mode	Volume	Percentage
1. Trekking	1710	15.38
2. Motor cycle	888	7.99
3. Taxi Cabs	5139	46.22
4. Bus	438	3.94
5. Bicycle	305	2.74
6. Private Cars	2639	23.73
Total	11119	100

Source:- Field work, 1997.

Table 5.2 reveals that 18.12% of the city's trips used non-motorised mode (trekking and bicycle) in accomplishing movement in all the landuse zone. On the other hand as high as 81.88% of the city's trips were accomplished by mechanically powered mode of transport to move from one place to another. This means that the majority of the respondents relied very much on mechanically powered transport mode for movement. The Public transport system provides as much as 58.15% (motorcycle, taxi cabs and buses) of the means of movement in the city. This shows that almost 60% of the mode of movement in Akure lies in the hands of private transport owners. Invariably, this high proportion of residents

which depends on public transport services for their intra-urban travels in Akure are subjected to problems affecting public transport system. This trend is typical of most urban centres in Nigeria where there are no efficient mass transit system. Table 5.2 further shows that taxi-cabs are the most important means of transport used in accomplishing trips in all the landuses. The other mode of transport that ranked second in accomplishing trips in all the landuse was the private cars. However, in commercial landuse, trekking is ranked second to taxi-cabs as means of movement in the zone (see Table 5.3). Most of the landuse zones lacked the use of bicycle as mode of transport in accomplishing trips. The use of bus, as a means of transport is not well patronised in the city as its contribution to trip generation is low in commercial, military/police, public/semi public, industrial and residential landuse zones. Table 5.2 further reveals the rising importance of motorcycle as a means of accomplishing trips with 7.99% share in the total trips made by various modes. This mode (motorcycle) was however more extensively used in commercial and residential landuse zones than in any other zone.

The analysis by Table 5.2 shows that intra-urban trips in Akure were dominated by motor cars. Further, public transport modes such as taxi cabs and mini buses accounted for a total of 50.16% of the trips. This high percentage share of public transport is typical of most urban centres in Nigeria where there are no efficient mass transit systems.

In Nigeria, para-transit vehicles dominate the mode of urban travels. This trend however contrasts with what obtains in the advanced countries of the world where urban travels are by well organised public transport system (Adeniji, 1985).

Up till now, private owners still dominate intra-urban transport service in Akure. This situation has made well-organised public transport system impossible.

Table 5.3 **Volume of trip by mode in each landuse**

Landuse	Trips by Mode						
	Trekking	Motor cycle	Taxi Cabs	Bus	Bicycle	Private Cars	Total
1. Educational	46	25	340	20	25	107	563
2. Industrial	110	90	621	23	8	382	1234
3. Residential (High)	231	93	634	52	27	246	1283
4. Residential (Medium)	166	91	661	42	33	236	1229
5. Residential (Low)	176	117	1016	55	61	745	2170
6. Commercial	707	301	1027	101	25	363	2524
7. Recreational	32	32	121	29	20	25	259
8. Trans/Comm.	29	39	189	22	16	69	364
9. Military/Police	101	49	259	40	15	131	595
10. Pub/Semi Pub.	112	51	271	54	75	335	898

Source:- Field work, 1996.

(iii) Volume of trips generated by purpose

The purpose for which a trip is made includes journey to work place, to school, to shopping, to attend social activities, etc. Each of these types of trips is spatially distributed over the city between the residential areas and places of interest and activities.

Trip purposes also influence the volume of trip generation in various landuses in the city. This is because the volume of journeys made from origin to destination is functionally related to the ability of the respective areas to generate or attract movement. In Table 5.4, the analysis of the data on trips generated by purpose reveals that trips to work accounted for 4497 representing 40.44%. This is followed by commercial/shopping which accounted for 2505 trips representing 22.53% while social purpose accounted for 18.95% of the trips generated. Education and religion generated 8.84% and 8.66% of total trips respectively by purpose in the study area. The analysis shows that work trips dominate intra-urban travels in Akure. These are trips to Federal and State Secretariat located in the Eastern part of the town. Others are various Educational establishments in the city, Local Government Secretariat, NITEL, NIPOST, and a host of private establishments in the city.

The recreational trips are to major recreational areas such as Hotels, Stadium, educational sports grounds and social trips to relations and friends in various parts of the city. Trips to religious centres are specifically made by majority of people to churches and mosques which are located within the

Table 5.4 **Volume of trips generated by purpose**

	Purpose	Volume	Percentage
1.	Work	4497	40.44
2.	Business/ Commercial	2505	22.53
3.	Educational	983	8.84
4.	Social/ Recreational	2107	18.95
5.	Religious	963	8.66
6.	Medical	64	0.58
	Total	11119	100

Source:- Field work, 1996.

residential areas in various parts of the city on Sundays and Fridays on weekly.

Trips to markets and shopping centres are largely carried in Oja-Oba (Central market), NEPA junction, Oja golu, Mojere market, Isinkan market and Iloro market. The central market has continued to attract a large number of trip makers inspite of the traffic hold-up which characterise the zone. There is commodity specilization by all the markets mentioned above. For example, Iloro market specialises in tomatoes, onions and pepper; Mojere market specialises in spare parts; Isinkan market specialises in yam selling while NEPA sells already made clothes. Commodity specialization as stated above does not mean that the markets don't sell other goods apart from the ones mentioned.

(b) **Trips generated In aggregate terms**

This is the total volume of trips generated by landuses irrespective of mode and purpose for which a journey is made. The highest volume of trips was generated in commercial landuse with a volume of 2524 trips representing 22.7% of the total trips generated by all landuse. This figure is closely followed by Residential (low) with 2170 trips representing 19.52% of the total trips generated. Residential (medium) Residential (high) and industrial landuse generated 11.05%, 11.54% and 11.1% of the total trips respectively. Transport and Recreational landuse are found to contribute the least trips to the total volume of trips generated by all landuses (see Table 5.1). Table 5.1 reveals that some landuses are minor generators of travel. Such landuses include military/police, transport/communication, recreational and educational landuse. In Military/Police

landuse, people hardly go to the barracks except the relations of soldiers and policemen or people with cases in police stations who may frequent such zones once in a while.

Past studies have revealed recognizable, regular and predictable temporal patterns of movement in towns and cities (Daniels and Warnes, 1980; Adeniji, 1985; Mrakpor, 1986; Aribigbola, 1990; Ogunbodede, 1990 and Bello, 1994). The timing and duration of the peaks and lulls of movement vary with the size of towns, their occupational and industrial characteristics. According to Daniels and Warnes (1980) the principal rhythms of travel are diurnal, weekly and seasonal. This observed pattern is applicable to the study area. On diurnal pattern, Daniel and Warnes (1980) discovered that 70% of the movement made during the whole 24 hours occurred during triple-peak periods which are between 7.00 - 9.00 hours (morning peak) when 19.5% of all movements occurred; an extended midday peak between 11.30 and 14.30 hours during which 32.1% of all movements took place and an evening peak between 16.00 and 18.30 hours containing 21.1% of all movements. On weekly pattern, urban movement in Akure may be divided into working and leisure days. On working days, the patterns of activities and movement of both people and goods are very similar on each of the five working days. The evening journey from work tended to occur earlier on Fridays partly because of those who attended Jumat Services (Muslims) and never returned to work. Most of the travels on Saturdays are for shopping, social and recreation while Sundays are devoted to religious purposes and club meetings.

5.3 FACTORS INFLUENCING TRIP GENERATION IN AKURE

Conventionally the volume of trips generated is a function of some factors. notable amongst these are:- socio-economic characteristics, transport facilities etc. The characteristics and volume of trips generated based on these factors are discussed in this subsection.

(a) Socio-economic characteristics

The socio-economic characteristics of commuters that influence trip generation include age, educational qualification, income, occupation and sex. Daniel and Warnes (1980) have observed that people with higher occupational status make more motorised trips than non-motorised trips. O'Flaherty (1979) also observed that working age groups are more involved in trip generating activities than the aged and young ones. Table 5.5 shows the age groups and the percentages of the respondents involved in trip generation. Those in the age groups of 21-50 years dominate the category of age group making trips in the city since they constitute about 88.18% of the total trips made in Akure during the year of study.

Table 5.5 **Age of Respondents by Landuse**

Landuse / Age	Educa-tional	Indust-rial	Residential			Commer-cial	Recrea-tional	Trans./ Comm.	Mil./ Pol.	Pub./ Semi-pub.	Total	%
			High	Medium	Low							
20	0	-	7	2	2	9	1	-	4	-	25	2.66
21 - 30	12	23	26	38	20	58	18	19	13	16	243	25.58
31 - 40	29	35	36	33	55	51	26	22	27	37	351	37.38
41 - 50	28	24	23	8	44	33	26	8	25	20	239	25.45
50	5	6	9	4	17	14	9	2	4	11	81	8.63
Total	74	88	101	85	138	165	80	51	73	84	939	100

Source:- Field work, 1996

Similarly Table 5.6 shows the sex ratio of people by landuse in the city. 53.14% of the respondents were male while 46.86% were female. This implies that more of the males are involved in intra-urban movement than females.

Table 5.6 **Sex of Respondents by Landuse**

Land use / Sex	Educa-tional	Indust-rial	Residential			Commer-cial	Recrea-tional	Trans./ Comm.	Mil./ Pol.	Pub./ S. P.	Total	%
			High	Medium	Low							
Male	21	18	52	56	65	84	38	27	42	50	499	53.14
Female	33	70	49	29	73	81	42	24	31	34	440	46.86
Total	74	88	101	85	138	165	80	51	73	84	939	100

Source:- Field work, 1996.

In terms of educational qualification, Table 5.7 shows five major categories into which people living in Akure are classified. The table shows that trip generation is highly influenced by commuters whose level of educational attainment is secondary and above. About 68.64% of the total trip makers from the respondents have more than school certificate educational qualification. the pattern of educational level of respondents shows the people's acceptance of western education. Other reasons include the universal primary education (UPE) of past administrations and the fact that a minimum of school certificate now seems to be required in all works of life as the basis for employment and apprenticeship.

Table 5.7 **Educational Qualification of Respondents by Land Use**

Landuse Qua.	Educa-tional	Indust-rial	Residential			Commer-cial	Recrea-tional	Trans./ Comm.	Mil./ Pol.	Pub./ S. P.	Total	%
			High	Medium	Low							
No formal Education	6	11	26	20	31	16	20	6	12	5	153	16.30
Primary	5	21	14	19	14	31	10	5	10	13	142	15.12
Secondary	31	13	17	19	14	43	19	5	28	32	221	23.54
Tertiary (below University)	23	21	18	17	41	50	12	23	12	14	231	24.60
University	9	22	26	10	38	25	19	12	11	20	192	20.50
Total	74	88	101	85	138	165	80	51	73	84	939	100

Source:- Field work, 1996.

Table 5.8 shows the occupational pattern of the trip makers. The analysis of the data shows that 32.48% of the commuters who are civil servants have higher demand for public transport than any other occupational grouping. Those that are involved in shopping and business ranked second amongst the occupational groupings that demand transport services in the city. The result is expected because a lot of people in the city are in government work while others are also engaged in various business activities as shown in Table 5.8. Further analysis shows that those engaged in Business and Civil service jobs accounted for 62.19%.

Table 5.8 **Occupational Groupings of Respondents by Landuse**

Landuse/ Occupation	Educa- tional	Indust- rial	Residential			Commer- cial	Recrea- tional	Trans./ Comm.	Mil./ Pol.	Pub./ S.P.	Total	%
			High	Medium	Low							
Students/ apprentice	6	9	26	20	10	17	10	4	9	8	119	12.67
Business	30	28	25	19	30	66	13	20	26	22	279	29.71
Civil Servant	23	26	23	24	58	42	27	20	26	36	305	32.48
Vocational trade	6	11	19	12	24	23	17	3	9	5	129	13.74
Others (e.g farming)	9	14	8	10	16	17	13	4	3	13	107	11.40
Total	74	88	101	85	138	165	80	51	73	84	939	100

Source:- Field work, 1996.

Table 5.9 shows the pattern of the monthly income of the trip makers sampled during the study. Commuters with less than N20,000 per annum record the highest set of people who demanded for transport services. This is followed by those within N21,000 and N30,000, and N31,000 - N40,000 respectively. The analysis shows that the more income the commuters earn the less their demand for public transport. This result is equally expected since those in the high income groups are likely to possess their own private vehicles. Sometimes too, those in the high income group make use of official cars or staff buses. Similarly, the ability to pay for a journey affects the number of trips generated by a household. As observed by Maunder (1982), the higher the income, the higher the number of trips made.

The discussion so far gives the socio-economic background of people interviewed during the survey. The socio-economic characteristics of commuters such as age, sex, education, occupation and income affect trip making in a city and significantly affect the trip patterns. Schuldiner (1962) in his study of trip generation and the home has shown that trip generation analysis based on socio-economic characteristics could lead to better understanding of trip length and trip interchange for work and social trips.

Table 5.9 **Gross Income Per Annum by Landuse**

Landuse/ Gross Income per annum (In thousands)	Educa-tional	Indust-rial	Residential			Commer-cial	Recrea-tional	Trans./ Comm.	Mil./ Pol.	Pub./ S.P.	Tota	%
			High	Medium	Low							
20	41	51	33	41	35	33	40	9	16	30	329	35.04
21 - 30	10	14	21	25	42	36	20	26	28	20	242	25.77
31 - 40	6	8	21	11	24	20	10	12	15	19	156	16.61
41 - 50	13	11	12	5	18	32	6	3	8	10	118	12.57
50	4	4	14	3	19	34	4	1	6	5	94	10.01
Total	74	88	101	85	138	165	80	51	73	84	939	100

Source:- Field work, 1996

(b) **Transport Facilities**

Road is the major mode in Akure. Two kinds of vehicles are used for the movement of people in Akure. The two kinds of vehicles are the private vehicles and the public transport system. The public vehicles commonly used include taxi-cabs, mini-buses and recently motorcycles. The private vehicles in use include

Table 5.10 **Transport Facilities on Studied Routes**

Name of Routes	Petrol Stations	Pedestrian Crossing	Lay bys	Overhead bridge	Street lights	Traffic lights	Parking facilities	Bus Stops	Traffic wardens	Road Signs
1. Erekesan mkt/ Oke-Aro/ Idanre road	X	-	-	-	X	-	-	-	X	-
2. Erekesan mkt/ Ondo road/ Army barracks	X	X	X	X	X	-	-	-	X	-
3. Erekesan mkt/ Oyemekun/ FUTA	X	X	X	X	X	-	-	X	X	-
4. Erekesan mkt/ Oke-Ijebu/ Shagari Vill.	X	-	X	-	X	-	-	-	-	-
5. Erekesan mkt/ New Isolo Rd/	-	-	-	-	-	-	-	X	-	-
6. Erekesan mkt/ Hospital Rd/ Osinle Rd.	X	-	X	X	X	X	-	X	X	X
7. NEPA/Secre-tariat Rd/ Igbatoro Rd.	-	-	X	-	X	X	-	-	X	X
8. Hospital Rd/ Ijoka Rd/ Obodulu	X	-	X	-	-	-	-	X	-	-
9. Hospital Rd/ Sijuade/ Ala Rd.	X	-	X	-	-	-	-	X	-	-
10. Esso/ College of Agric./ Oba-Ile	X	X	X	-	X	-	-	-	X	-

Source:- Field work, 1996

cars of different types, staff buses of different make, motorcycles and bicycles. In some zones, private vehicles are intensively used than public transport system while in some the reverse is the case. For example, the majority of residents in the low residential zones possess their private vehicles hence public transport was not often patronised in such zones. This accounts for why transport operators are not interested in running routes to places like Ijapo and Ala quarters. It also accounted for why waiting time at bus stops in such landuse zones was longer than other landuse zones. Since most people living in government residential quarters possess their own private cars, distance to the few bus stops established in such zones are longer. Thus, it takes an appreciable longer time to move from residences to such bus stop.

The transport facilities studied on the selected routes include pedestrian crossing, lay bys, overhead bridge, street lights, parking facilities, bus stops, traffic lights, road signs, petrol stations and provision of traffic warden. Table 5.10 shows the analysis of facilities on these routes. None of the routes studied in Akure had parking facilities. Two of the routes representing 20% had road signs, three representing 30% had pedestrian crossings, four representing 40% had bus stops, while three had overhead bridges. Other routes where more than 50% of transport facilities can be found are as stated in Table 5.10. The analysis shows a low level of provision of transport facilities on all the studied routes except petrol stations which are privately owned. Lack of parking facilities in the town encouraged on-street parking and subsequently reduction in road width. The reduction in road width caused traffic hold-ups on major routes of the city. Low

provision of pedestrian crossing contributed to pedestrian-vehicular conflicts which often resulted in accident. Road signs are virtually non-existent in the town thus misleading motorists while inadequate provision of traffic lights affected free flow of vehicles since major nodes became points of traffic conflicts.

The implication of the transport facilities on the volume of trip generated was that some routes such as Erekesan market/Oyemekun/FUTA; Erekesan Market/Ondo road/Army barracks and Erekesan market/Hospital road/Osinle, possessing more than six transport facilities attracted more traffic. The remaining routes with less than six transport facilities are not as busy as those mentioned above. This means that transport facilities are an important factor in attracting traffic on routes.

5.4 CONCLUSION

This chapter reveals that for a meaningful analysis of intra-urban trips in any city, the socio-economic indices of residents could assist to a greater extent in unfolding trip length and trip interchange of commuters. This is because indices such as age, sex, education and income affect trip making of any commuter. The factors are also important in dictating the pattern of trips of commuters in the city.

CHAPTER SIX

SPATIAL PATTERN OF TRIPS IN AKURE METROPOLIS

6.1 Introduction

This chapter examines the pattern of movement of commuters in Akure as revealed by household data collected during the field survey. A non-routed but proportional cartographic technique is applied on the O-D trip matrix. An inspection of the matrix reveals that no recognizable order can be detected. Some pattern discerning techniques such as factor analysis is applied to group the trip volume.

6.2 NATURE OF INTERACTION PATTERNS IN AKURE

A household survey to collect Origin - Destination information was carried out on commuters in the sampled household in the various landuse zones earlier identified. The procedure for selecting each household has been discussed in chapter three. For those who responded to the questionnaire, the O-D matrix table was collated. A ten by ten matrix is prepared from the field. (see Table 6.1). The figures in Table 6.1 were used as the basis for mapping out the flow pattern of people within the landuse zones in Akure. For each of the flow, one millimetre was used to represent 30 trips (1mm to represent 30 trips). Using this scale, Table 6.1 was used to depict and describe the overall pattern of commuters movement in Akure between the ten different landuse zones. This interzonal flows can be depicted cartographically as indicated by Figure 6.1. An examination of the figure indicates that flows concentrate more on the city centres especially in the CBD, commercial zone and high residential zone. The effect on commercial zone is not easily discernable. Thus, the pattern of movement within the city

centre appears blurred indicating the complex nature of commuter's movement within the core area and the inefficiency of the non-routed flow map in describing the pattern.

Table 6.1 **Origin-Destination Matrix of Intracity Movement of Commuters in Akure**

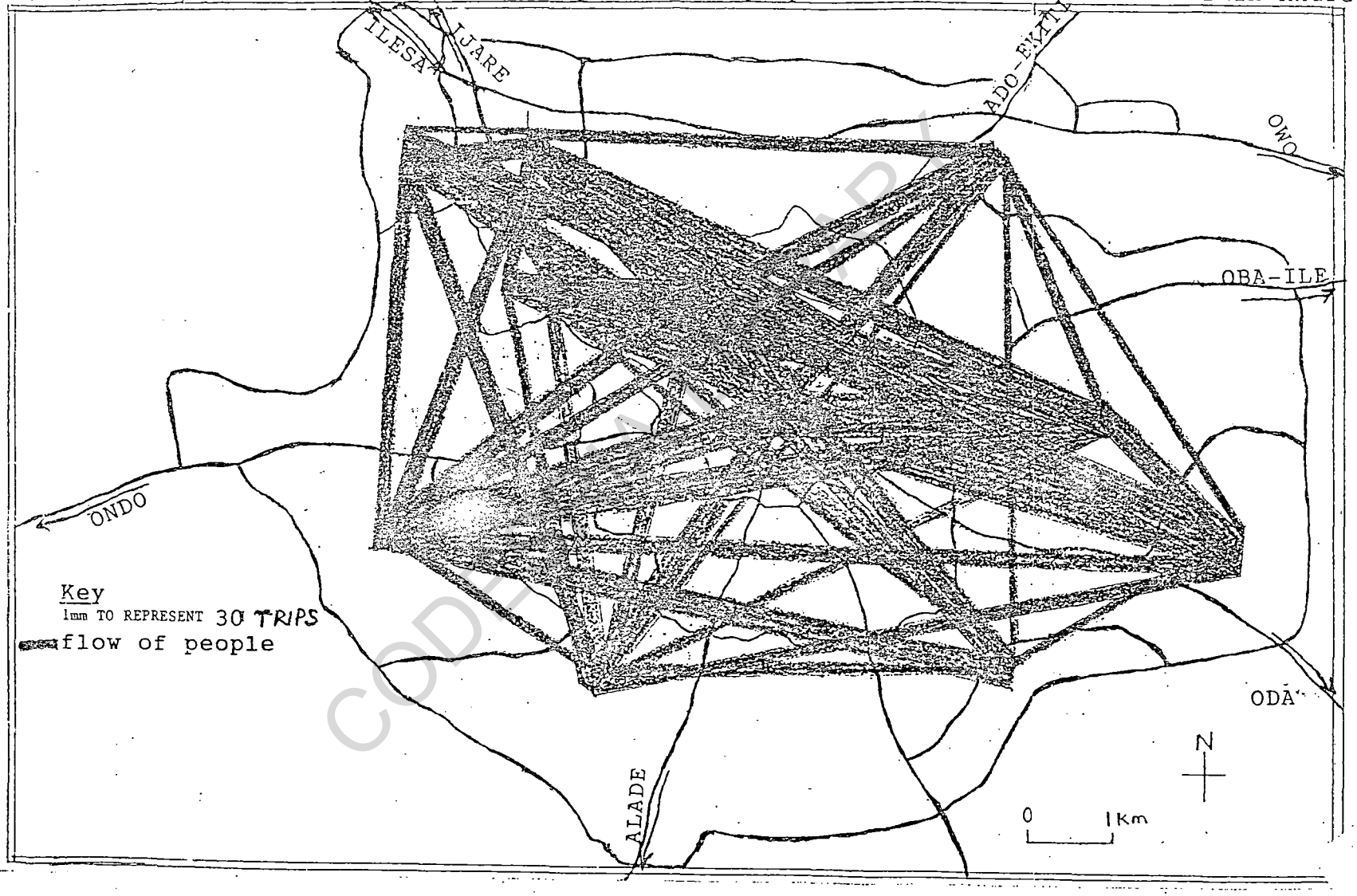
O-D	1	2	3	4	5	6	7	8	9	10
1	229	89	91	159	146	82	89	95	131	115
2	83	195	173	119	121	197	86	103	89	93
3	119	87	194	95	101	255	91	157	195	163
4	171	81	94	99	97	151	129	139	111	187
5	161	90	101	81	104	134	154	94	97	210
6	89	95	121	209	98	138	88	128	110	80
7	87	81	86	90	89	78	88	87	106	109
8	78	86	124	95	66	88	58	58	78	67
9	88	86	108	78	67	138	99	76	116	76
10	155	61	63	65	81	119	112	90	85	68

Source:- Field work, 1996.

Key

1. Education
2. Industrial landuse
3. Residential (High) landuse
4. Residential (Medium) landuse
5. Residential (medium) landuse
6. Commercial landuse
7. Recreational landuse
8. Transport/Communication landuse
9. Military/Police landuse
10. Public/Semi public landuse

Figure 6.1 NOn-routed flow pattern of people within the landuse zones in Akure



6.3 (a) Application of factor analysis to movement patterns in Akure

In order to overcome the defects of the cartographic technique in discerning the flow pattern, Berry (1966), Goddard (1970), Kanno (1976), Smith (1970), and Ogunsanya (1982) demonstrated in their various studies how the technique of Factor Analysis can be used. In this study, factor analytic technique was used to identify the underlying pattern of commuters in the various landuse zones in the city. Thus, the technique was used to determine from the large number of variables, the smallest number of factors which account for all the observed relationships. The few factors identified suggest the basic underlying organisation and pattern inherent in the matrix. Apart from this, factor analysis can reduce any number of variables to new hybrid variables that represent geographical associations of the original variables (Johnson, 1978). Also Gould (1976) pointed out that factor analysis is used to "attain scientific parsimony or economy of description". Based on the above, in addition to its inherent attributes of clarity with which interelationships can be identified factor analysis has been adopted for the identification of the pattern of trips in Akure metropolis.

To determine the pattern of commuter's movement within Akure therefore, a factor analysis of the flow matrix is performed. The R-mode factor analysis which involves an analysis of the column vector and varimax rotation helps in the identification of major attracting and important generating zones of commuter's trips in Akure.

The application of the R-mode factor analysis with varimax rotation results in the extraction of four relevant factors which account for 89.9% of total explained variance. The factor loadings and factor scores of these factors are shown in Table 6.2. These four factors represent the four dimensions by which movement data in Akure may be classified. The factor loadings show groups of attraction or destination zones while the derived factor scores indicate the most prominent source of movement to each group. The pattern indicated by each of these dimensions is best indicated by a non-routed and non-proportional cartographic flow map. Each dimension of the factor solution can be interpreted as a commuter traffic sub-region wherein a group of intra-urban traffic zones exhibit a high degree of similarities in the way they assemble commuting behaviour.

(i) The First Dimension

The first dimension accounts for 34.5% of total explained variance and it is characterised by high factor loadings on the following landuse; Residential High (3), Residential Low (5), Commercial (6), Transport/Communication (8), Military/Police (9) and Public/Semi public (10). Spatially, these are concentrated in the central part of the city and can be labelled the central urban "attracting" region. An examination of the factor scores indicates that these traffic sectors have comparatively strong functional relationship with four sectors in the city as prominent originator to the former sectors. These are Residential (High), commercial, transport/communication and military/police. This is depicted by Figure 6.2.

Table 6.2:- THE FACTOR LOADINGS AND FACTOR SCORES OF THE O-D MATRIX

	LANDUSE ZONES	FACTOR 1		FACTOR 2		FACTOR 3		FACTOR 4	
		FACTOR LOADING	FACTOR SCORES	FACTOR LOADING	FACTOR SCORES	FACTOR LOADING	FACTOR SCORES	FACTOR LOADING	FACTOR SCORES
1.	Educational	0.25113	0.7145	0.78429	0.22171	0.40405	0.29661	-0.05598	-0.12853
2.	Industrial	0.36584	-0.12820	-0.48901	0.04969	0.32550	0.07259	0.71607	0.60747
3.	Residential (High)	0.67860	0.23173	-0.62980	-0.08019	-0.23710	-0.12003	0.12846	0.23716
4.	Residential (Medium)	0.28732	0.03553	-0.16329	-0.21382	0.75928	0.44787	-0.31437	-0.08618
5.	Residential (Low)	0.53629	-0.08256	0.14060	0.07903	0.73511	0.41003	0.22645	0.22301
6.	Commercial	0.84203	0.28810	-0.33035	0.03334	-0.38176	-0.14852	0.06413	0.14207
7.	Recreational	0.22996	-0.07391	0.79864	0.42660	-0.25104	-0.09538	0.35176	0.07587
8.	Transport/Communication	0.88629	0.27082	0.10879	0.05572	-0.01869	0.11178	-0.21800	0.08789
9.	Military/Police	0.73288	0.37579	0.0089	-0.10157	-0.12608	0.08590	-0.61082	-0.34119
10.	Public/Semi Public	0.57818	0.06935	0.65672	0.38530	-0.31961	-0.09269	0.23803	0.05281
	Eigen Value	3.44657		2.48739		1.76947		1.28763	
	PCT of variance	34.5		24.9		17.7		12.9	
	Cumulative PCT	34.5		59.3		77.0		89.9	

Source:- Computer output, 1996.

This sub-region constitutes the densely populated region of the city and is the important region for work place, residence and commercial activities.

(ii) The Second Dimension

The second dimension accounts for 24.9% of the total explained variance and has high loadings on the following landuse; Educational (1), Recreational (7) and Public/Semi Public (10). Factor scores are equally high on these stated landuse zones. The functional inter-relationship defines a subsystem which can be labelled North West - South-East attracting region (Figure 6.3). The pattern depicts a triangular structure with little inter-zonal connections. The commuter flow arrangements in this dimension are independent of those which underlie the central "attracting" region and have fewer connections. The three regions identified are both generating and attracting zones. The Public/Semi Public and Recreational landuse zones are sandwiched in two prominent residential landuse zone (low and medium). The educational landuse zone is where the Federal University of Technology Akure is located. All these zones attract workers on daily basis while on weekends the recreational landuse attracts more people from the major residential zones.

(iii) The Third Dimension

The third factor is responsible for 17.7% of the total explained variance. It indicates a rectangular pattern concentrating in the city centre with North West - South West attracting regions (See Figure 6.4). The pattern indicated a very high loading on residential (medium) (4) and residential (low) (5). Factor scores are high on educational (1) and Transport/communication (8). Thus, Residential

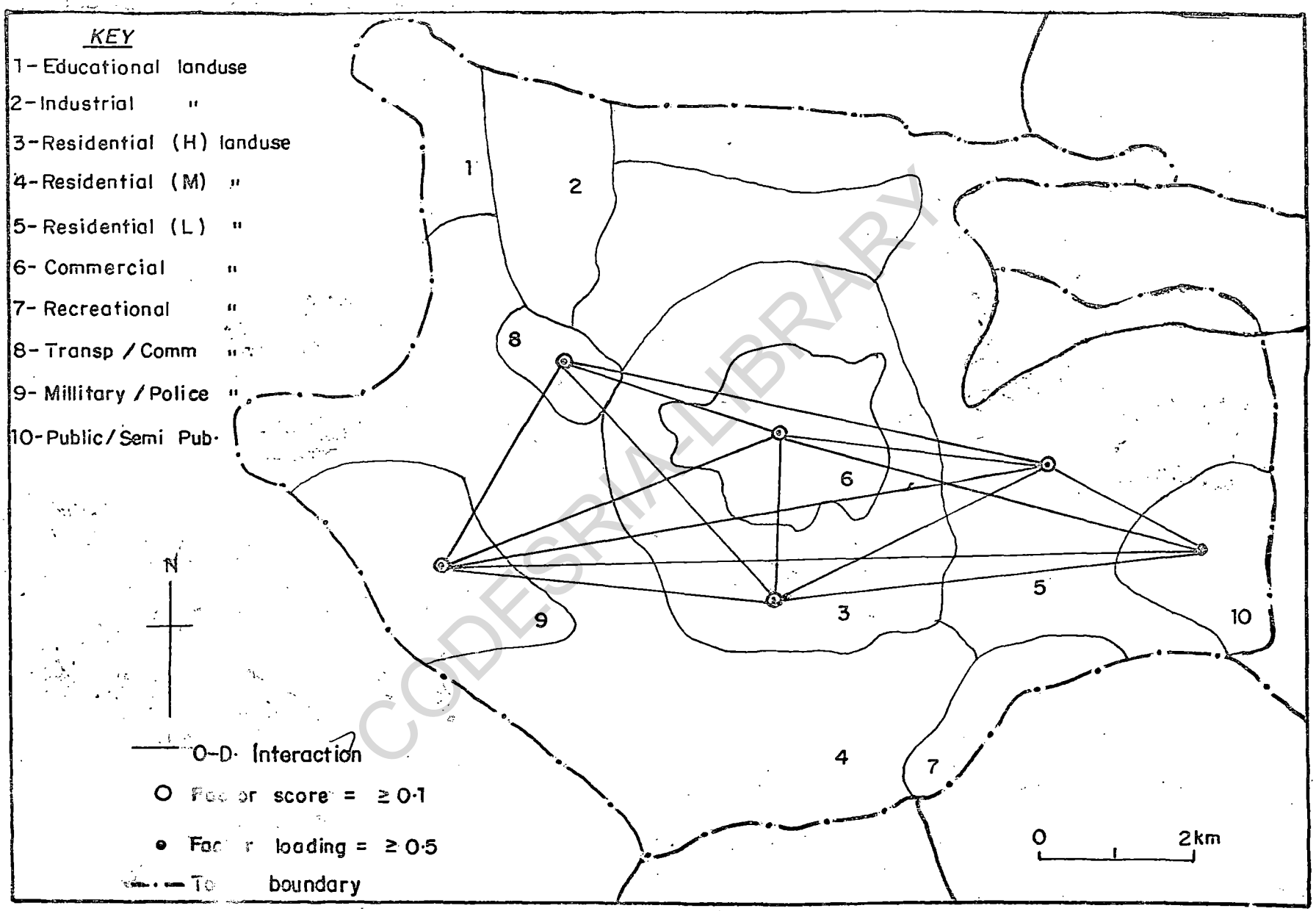


Fig. 6.2. Pattern of dominant flow of the central attracting region in Akure

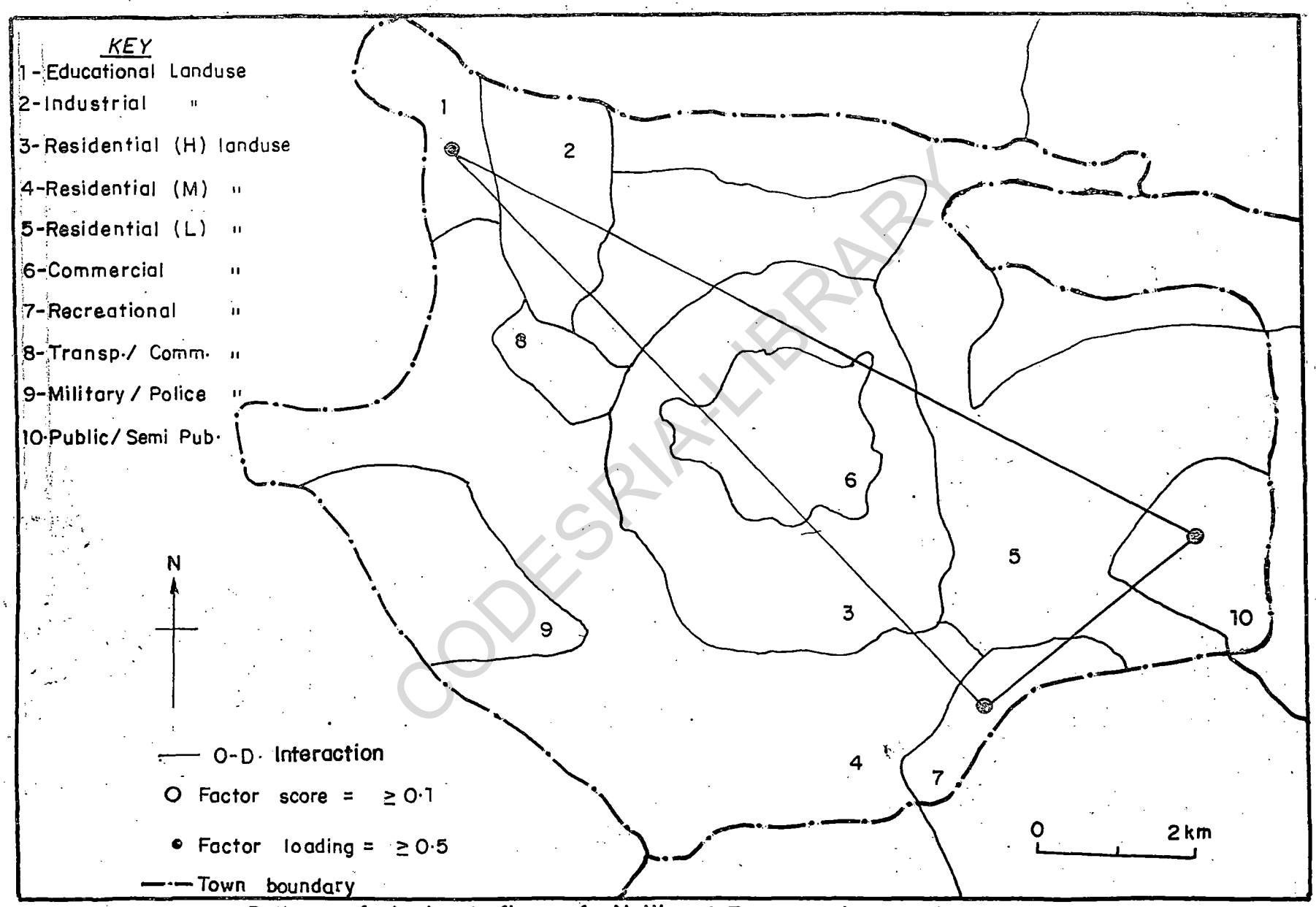


Fig. 6·3 Pattern of dominant flow of N·W – S·E attracting Region in Akure

(Medium and Low) are two prominent landuse zones of movement attraction and destination while Educational and Transport/Communication landuse zones are two movement generating regions within the city.

(iv) The Fourth Dimension

The fourth dimension accounts for only 12.9% of the total variance explained. Only one zone has high factor loading in this dimension. This zone is the industrial landuse (2). It indicates that this zone is a prominent attracting landuse region. Factor scores are high on commercial (6), Residential (high) (3) and Residential (medium) (4). Thus commercial, residential (high) and residential (low) are three prominent landuse zones of movement generating. The emerging dominant pattern as revealed by a non-proportional and non-routed cartographic technique in the fourth dimension is a North West-South attracting region. This region has very little inter-zonal connections and defines another rectangular pattern within the city centre (see Figure 6.5).

(b) **Application of the Landuse Hierarchy to Intra-Urban Movement in Akure**

An attempt has been made to group movement within various landuse zones on the basis of similarities in the way trips are generated and attracted in the city. The nodality of each functional region is examined on the basis of the intensity of interactions between one landuse and another. From these interactions, specific flow may be identified as dominating others. This is done in order to identify the overall structure of commuter's movement within the city of Akure.

Several methods have been proposed for determining the basic structure underlying flows. Of importance is the graph theorectic approach adopted by

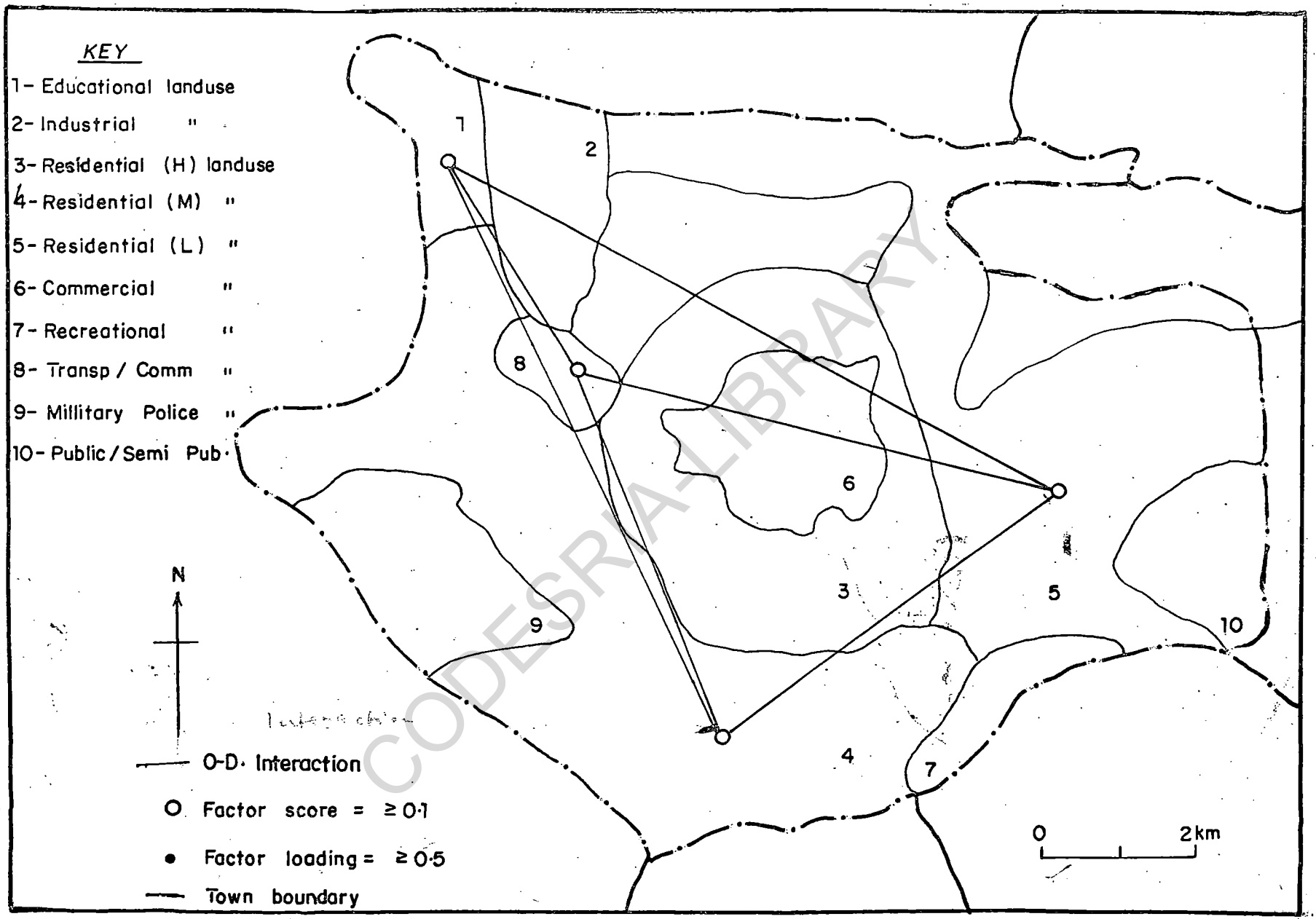


Fig. 6·4 Pattern of dominant flow of N·E – S·W attracting region in Akure

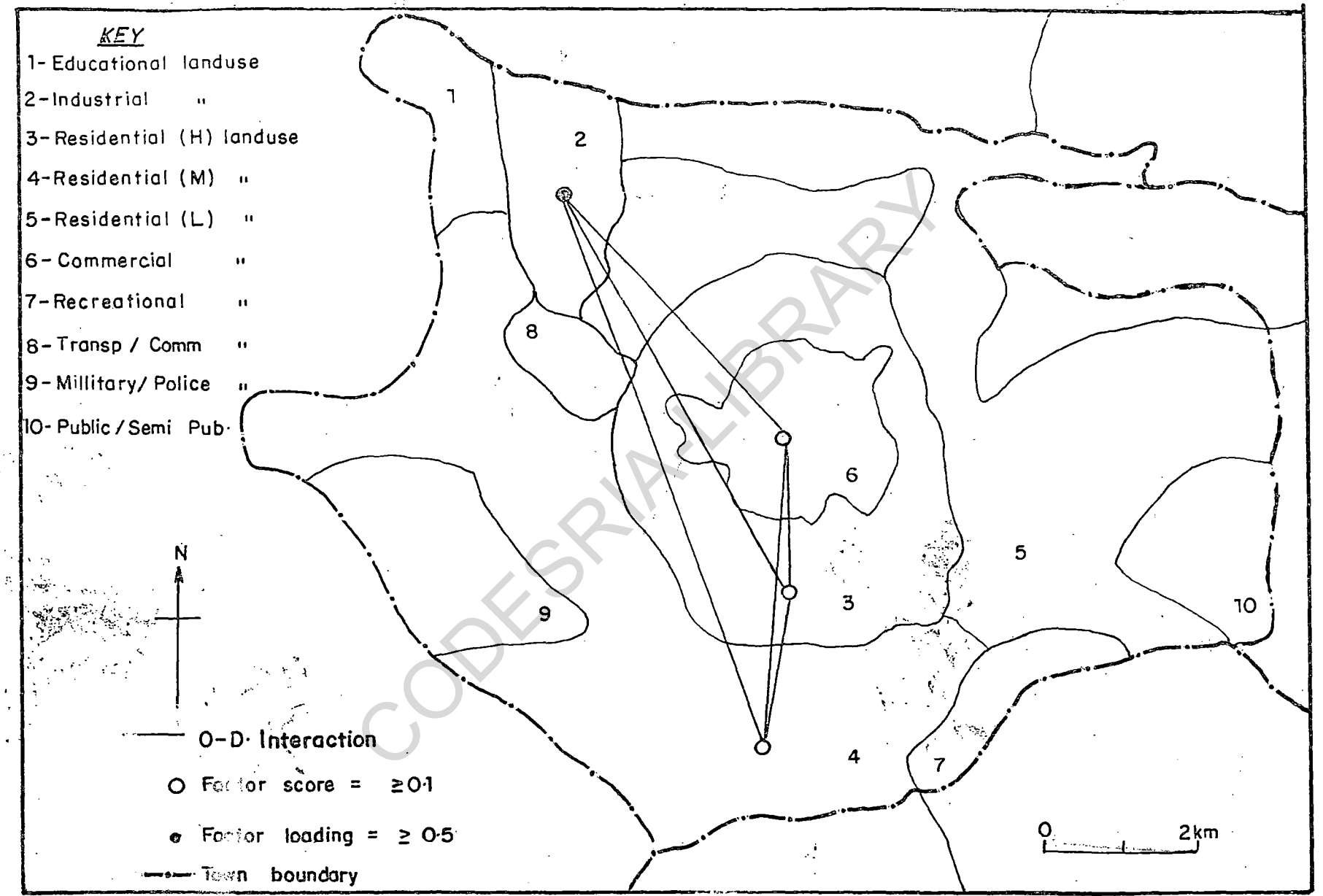


Fig 6·5· Pattern of dominant flow of NW-S attracting region in Akure

Nystuen and Dacey (1961) and Ogunsanya (1982). This is done by reducing flow matrices to series of graphs and considering flows as link. The principle of dominant association is applied to the O-D matrix of Akure to identify the underlying structure.

Nystuen and Dacey (1961) using the example of principle of dominant association, reveals the number of telephone messages between each pair of forty cities selected in Washington and its adjacent states. In the matrix, the maximum element in its row is determined. The functional size and rank of each city is measured by the number of messages it receives i.e. the column total. A city is termed "independent" or "central" if its largest flow is to a smaller city whereas a "subordinate" or "satellite" city sends its largest flow of outgoing telephone messages to a larger city. The relationship between the central city or nodal point and the subordinate is transitive. For example, if city A is subordinate to city B which is a satellite of city C, then A is subordinate to C. The graph showing this pattern of relationship therefore contains a hierarchy of cities with nested hierarchy of urban centres and nodal regions.

The nodal regions comprise "central places" or "dominant centres" and surrounding cities which are subordinate to them. Each city dominates an area around it and in turn the small cities are assigned to those larger urban places with which they have the greatest number of functional linkages. The city's functional relationship as revealed by network of flows defines the skeleton of nodal organisation of the entire region.

The principle of "dominant association" is adapted to movement of commuters in the city of Akure. It is used to order magnitude and direction of the flow of commuter's movement between the various landuse zones. The intra-urban movement of commuters are arranged in a ten by ten Origin-Destination matrix. The column totals of the matrix are calculated to determine the zones' functional sizes and ranks. This is shown by the last two rows in the matrix (Table 6.3). By simple examination the maximum element in each row zone is determined. As defined earlier, this is the "nodal flow" and it is underlined in the matrix. Using the property of "independent and sorbordinate". It is found that the two landuse zones asteriked (see Table 6.3) in the matrix, send their largest flows to smaller zones where size is determined by column total, while others send their largest flows to larger zones. By definition, the former are "independent" and the latter are "sorbodinates". in this way, the structure of association among the landuse zones is formulated by assigning each zone to one of several nodal centres. The resultant zonal structure is depicted by Figure 6.6

From the result, commercial landuse zone emerges as the most dominant centre with other subodinate landuse zones. Thus, commercial and educational landuse zones can be regarded as "indepedent"zones, while the rest landuse zones are subordinate to commercial landuse. The subordinate flows to the commercial landuse are concentrated in Western part and Southern part of its location. Public/semi public landuse dominates three traffic landuse zones to the South-West and North-West of its location. Educational landuse sends its largest flow within its zone while residential (low), residential (medium) and recreational

Table 6.3 O-D Matrix of Intra-Urban Commuter Movement

O-D	1	2	3	4	5	6	7	8	9	10
1 *	229	89	91	159	146	82	89	95	131	115
2	83	195	173	119	121	197	86	103	89	93
3	119	87	194	95	101	255	91	157	195	163
4	177	81	94	99	97	151	129	139	111	187
5	161	90	101	81	104	134	154	94	97	210
6*	89	95	121	209	98	138	88	128	110	80
7	87	81	86	90	89	78	88	87	106	109
8	78	86	124	95	66	88	58	58	78	67
9	88	86	108	78	67	138	99	76	116	76
10	155	61	63	65	81	119	112	90	90	68
Total	1266	951	1155	1090	970	1380	994	1027	1118	1168
Rank	2	10	4	6	9	1	8	7	5	3

Source:- Fieldwork data analysis, 1996.

* Largest flow from these landuse is to a "smaller" landuse where size is determined by column total.

- Largest flow under lined. Largest flow is determined by the volume of out-going movement flow.

1. Educational Landuse
2. Industrial Landuse
3. Residential (High) Landuse
4. Residential (Medium) Landuse
5. Residential (Low) Landuse
6. Commercial Landuse
7. Recreational Landuse
8. Transport/Communication Landuse
9. Military/Police Landuse
10. Public/Semi Public

landuses are subordinate to Public/Semi public landuse. By the transitivity concept, the properties of the principles of dominant association, this flow pattern contains hierarchies. In the flow pattern. commercial landuse is ranked as the most Dominant landuse zone, public/semi public landuse zone as second order landuse zones while others except educational landuse zone are third order landuse zones. The educational landuse zone remains as the independent landuse zone. It is however, noted that connections in the flow pattern may not always be direct. Thus, movement from one dominant centre to another subordinate may involve direct or indirect connections. The indirect connection may arise as a result of long distance to be covered between origin and destination. Thus, the movement may involve a stop over in a landuse zone before moving to the final destination. This study however, is interested in the pattern made by direct connections of movement and as such all linkages are analysed as direct.

The pattern of flow as enumerated above has some transport implications. The dominant zones are areas of diffusion of trips to other parts of the city. Thus, the commercial landuse where the central market, king's palace, central mosque, petrol stations, banks, town hall, post office, NITEL etc. are located constitutes a major traffic generation and attraction zone in the city because it belongs to the 1st order in the hierarchy. Such high order zones in the hierarchy constitute major growth points in physical area and traffic. The commercial landuse has grown in terms of intensity. Most of the downstair buildings have paved way for upstairs and taller buildings thus indicating high demand for the land in the zone. Similarly, major arteries in the town link up the city centre

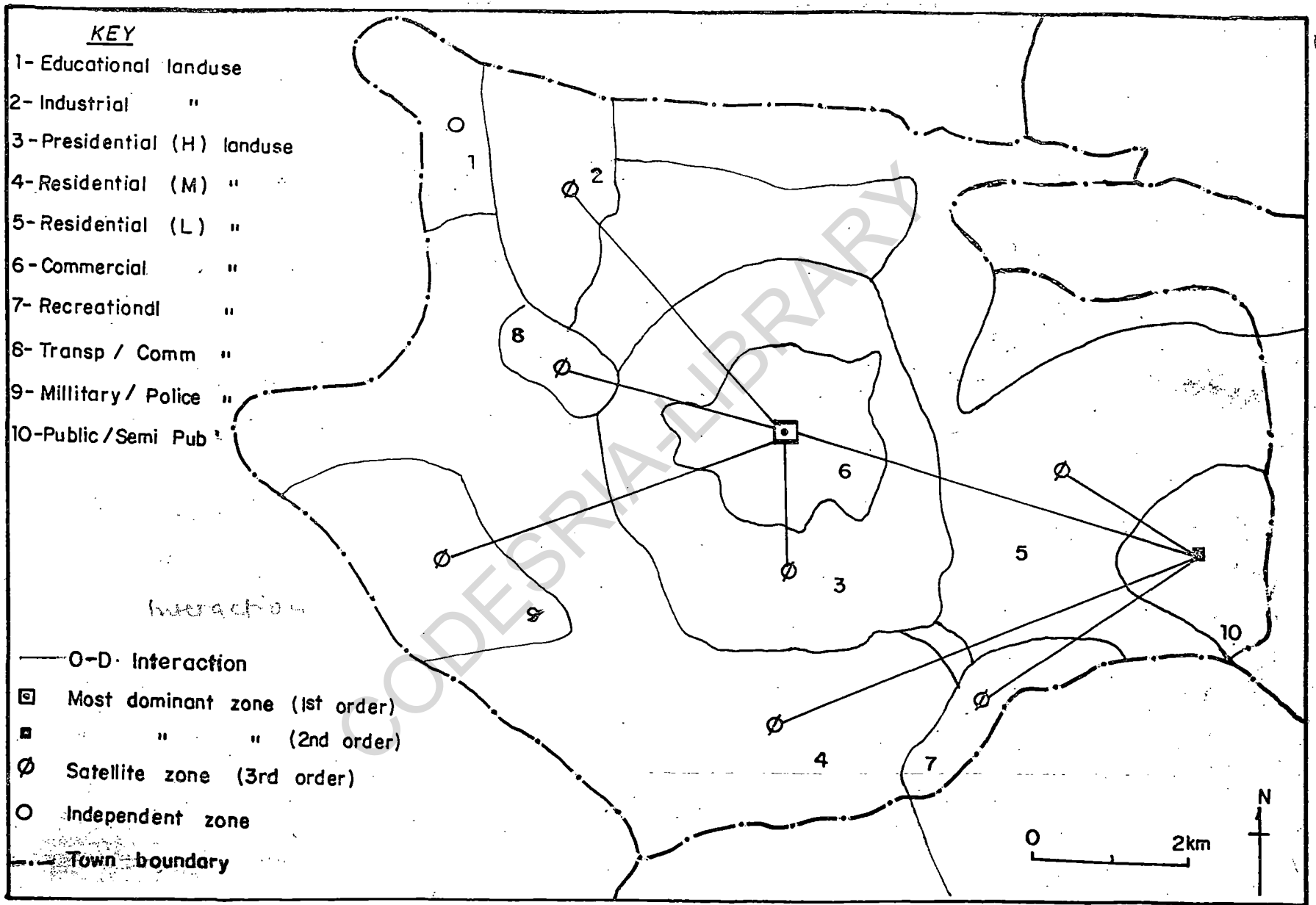


Fig. 6.6 Hierarchy of traffic flow in various landuse zone in Akure

where commercial landuse is located. This zone also played major role in traffic inter change within the city. Most traffic towards the periphery use the city centre as thorough-fare. The role played by this city centre in terms of traffic distribution contributes to the traffic chaotic situation often experienced in the central market.

The public/semi public landuse emerged as Dominant zone (2nd order). This zone though recently developed has been able to attract traffic due to the location of the Federal and State Secretariat in the zone. Similarly other traffic attracting factors include the location of the State Hotel, Ala and Alagbaka housing estates. NITEL headquarters, Bank headquarters, Insurance headquarters, State Government House and Office. The Secretariat in particular had been highly contributory to the traffic attraction to this zone.

The Satelite zone (3rd order) also contribute their impact to traffic attraction but not as much as the 1st and 2nd order. Educational landuse however emerged as an independent zone probably due to the presence of the Federal University in the zone. It also serves as a zone where concentration of private schools and few public schools are located.

CONCLUSION

This study shows that there exists, spatial pattern of trips in Akure metropolis. Using data collected on Origin-destination basis, the study further proves that a pattern of dominant flows on the basis of which the zones can be structured is possible. As pointed out in this chapter, four dimensions of flow patterns were discernible within the city.

The identification of these patterns is not without their planning implications. For example the hierarchical structuring can be used as a basis for planning for urban transportation infrastructures and services. Thus, the first order or dominant zones require substantial transport infrastructures such as four-lane roads, parking spaces, pedestrian overbridge, loading and unloading facilities. Similarly, mass transit should be encouraged in this zone since it will assist to reduce traffic congetion within the traffic dominant zone.

CHAPTER SEVEN

ESTIMATING TRIP GENERATION IN AKURE BY LANDUSE

7.1 INTRODUCTION:-

This chapter examines factors influencing trip generation in Akure. The approach adopted here is to identify the salient variables to use out of the independent variables hypothesised to be factors of trip generation by purpose. Six independent variables influencing trip generation by purpose were identified. An inspection of the regression analysis reveals that all the independent variables were significant at 0.15 level while only two are significant at 0.05 level. This means that only two out of the independent variables are significant (at 0.05) for estimating trip generation in the city.

7.2 FACTORS OF TRIP GENERATION

Table 7.1 shows the variables used and the method of their measurement. The variables are in two parts - those that are dependent (i.e y_1 - y_7) and those that are explanatory variables (X_1 - X_6). Previous studies especially in the more developed environment have shown different strength and direction of relationship between these dependent and independent variables. The extent to which this is true of Akure, in a developing environment is hereby being sought.

Table 7.1 - Definition of Independent (X_1 to X_6 and Dependent variables (Y_1 to Y_7)

Notation	Variables	Surrogate Measure
X_1	walking time	Average walking time from residence to the nearest bus stop
X_2	Waiting time	Average waiting time to get bus at bus stops.
X_3	Vehicle ownership	Average number of vehicles owned in a house.
X_4	Motorcycle	Average number of motocycle owned in a house.
X_5	Household size	Average number of people living in a house.
X_6	Income	Income earned by household head
Y_1	Work trips	Average trips generated by going to places of work.
Y_2	Business trips	Average trips generated by going to Business/Shopping centres.
Y_3	Educational trips	Average trips generated by going to educational centres.
Y_4	Social trips	Average trips generated by going to social/visit areas.
Y_5	Religious trips	Average trips generated by going to religious/worship/fellowship centres.
Y_6	Medical trips	Average trips generated by going to medical/miscellaneous centres.
Y_7	Total trips	Average trips generated by all purposes of movement (i.e. Y_1 to Y_6).

The regression procedure selected for this analysis is the stepwise type. The stepwise multiple regression is essentially a search procedure with a prime focus on identifying the independent variable(s) that actually possess strong relationship with the dependent. The stepwise multiple regression involves, among other procedures adding one variable at a time to the regression equation (see Draper and Smith; 1966). The outline of the steps involved in stepwise procedure as reported in Ogunsanya (1984) are as shown below;

Step 1:- Compute the simple correlation coefficient between the dependent and independent variables and select the variables with the highest coefficients, say X_4 for the regression equation.

Step 2:- Compute the partial correlation coefficients and select the variables with the highest partial coeffient as the next variable X_1.

Step 3:- Compute regression equation $z = (X_4, X_1)$ and using criteria F_1 to exclude and F_2 to include, decision is made whether to retain X_4 in the light of including X_1. The partial correlation coefficient for the remaining variables are computed and the next variable X_2 computed and the next variable X2, say is selected as in step 2.

Step 4:- The regression equation z + f (X_4, X_1, X_2) is then computed and $X_4$and X_2 are examined as to their significance. The decision is then made as to whether they should be retained before an additional variable to be included is determined as in step 3. This continues until all the variables are exhausted and the final best equation selected.

The computation for this analysis was done at the University of Ilorin using SAS subprogram regression.

7.3 THE REGRESSION MODEL

The application of regression analysis and its usefulness in research works have been noted and found to be common among geographical scholars. Among such scholars are Ayeni (1975), Drapper and Smith (1966), Ogunsanya (1984), Bello (1994), Aderanmo (1990), Ebisemiju (1967), Oyegun (1980) and Nie et al (1975) among others. In this research, the stepwise multiple regression analysis has equally been found useful especially in establishing relationship between independent variables that influence dependent variables.

The regression analysis is used in this study to enable the researcher find the best linear prediction equation for trip generation purpose in the study area in addition to identifying the explanatory ability of independent variables.

Conceptually, it can be explained that trip generation is a function of a set of independent variables.

$Y = f(X_1\ X_2\ X_3\ ---\ X_7)$

This relationship can be made operational using a multiple regression equation of the firm:

$Y = a + b_1 X_1 + b2 X_2 + \ldots\ldots\ldots\ldots b_n Xn + e$ (equ. 1)

Where

Y-represents trip generation which is dependent on some variables.

a-represents the intercept of the regression plane.

f-represents the functional relationship between Y and X

b_1 ..... b_n represents the weights determined by empirical evidence (partial regression coefficients)

X_1 ..... X_n represents the explanatory variables (predictors) which are independent.

In this study, trip generation by purpose such as work, business /shopping, educational, Social/recreational, religious/worshipping and medical were regarded as dependent variables (i.e. predicted). Independent variables represents the explanatory variables [i.e. preditors X_1 - X_6 in Table 7.1].

Table 7.2:- **CORRELATION MATRIX OF THE DEPENDENT AND INDEPENDENT VARIABLES**

	X_1	X_2	X_3	X_4	X_5	X_6	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	Y_7
X_1	1.0000												
X_2	0.6561	1.0000											
X_3	0.1381	0.0136	1.0000										
X_4	-0.5827	-0.3473	-0.0586	1.0000									
X_5	-0.3136	-0.5230	0.0781	-0.0470	1.0000								
X_6	-0.3898	0.1855	0.0071	0.2689	-0.4537	1.0000							
Y_1	-0.2210	-0.2137	0.1197	0.0395	0.4090	0.0003	1.0000						
Y_2	-0.4193	-0.5028	-0.1714	-0.3231	0.4861	-0.0818	-0.1027	1.0000					
Y_3	0.1845	0.2501	0.1972	-0.3808	0.0675	0.3235	0.2660	-0.0590	1.0000				
Y_4	-0.2549	0.0873	0.1386	0.5351	0.1007	0.3883	-0.1798	-0.3051	0.3157	1.0000			
Y_5	0.1842	-0.2567	-0.1892	-0.1552	0.4528	-0.2721	0.0344	0.0747	0.4688	0.2832	1.0000		
Y_6	0.0833	0.0854	-0.2040	-0.3643	0.6605	-0.2381	0.5563	0.1075	0.4521	0.0647	0.5145	1.0000	
Y_7	-0.2172	-0.2628	-0.0734	-0.3062	0.6682	0.0486	0.2590	0.5268	0.6746	0.2657	0.6728	0.6849	1.0000

7.4 RESULTS OF THE REGRESSION MODEL

Before further discussing the model output explaining the relationship between the dependent variable Y_1 (1, 2 ... 7) and independent variables X_1 (1, 2 ... 6), it is pertinent to consider the coefficients of correlation variables listed by Table 7.2. The coefficient of correlation quantifies the relationship between two observed geographic factors and shows the direction and strength of relationship between the variables.

a, Correlation result

Table 7.2 shows the coefficient of correlation which indicates the strength and direction of variables examined. The results of the dependent variable (Yl = i = 1, 2 ... 6) for work trips shows that there is low correlation coefficient of $r_{x1\ y_1}$ = 0.22; $r_{x2\ y1}$ = -0.21; $r_{x3\ y_1}$ = 0.12; $r_{x4\ y1}$ = 0.04; $rx_{5\ y_1}$ = 0.41 and $r_{x6\ y1}$= 0.00.

Business trip (Y_2) has negative and low correlation coefficient of $r_{x1\ y2}$ = o.42; $r_{x2\ y2}$ = 0.50; $r_{x3\ y2}$ = 0.17; $r_{x4\ y2}$ = 0.32; $r_{x5\ y2}$ = 0.49 and $r_{x6\ y2}$ = 0.08.

Education trips (Y_3) has low correlation coefficient of $R_{x1\ y3}$ = 0.19; $r_{x2\ y3}$ = 0.25; $r_{x3\ y3}$ 0.20; $r_{x4\ y3}$ = 0.38; $r_{x5\ y3}$ = 0.07; r_{x6y3} = 0.32. However, motorcycle (X_4) has negative correlation with educational trips.

Social trips (Y_4) has a generally low correlation coefficient of $r_{x1\ y4}$ = 0.26; $r_{x2\ y4}$ = 0.09; $r_{x3\ y4}$ = 0.14; rx_4y_4 = 0.54 r_{x5y4} = 0.10 and $r_{x6\ y4}$ = 0.39.

Religious trips (y_5) has the following correlation coefficient $r_{x1\ y5}$ = 0.18; $r_{x2\ y5}$ = 0.26; $r_{x3\ y5}$ = 0.19; $r_{x4\ y5}$ = 0.16; $r_{x5\ y5}$ = 0.45 and $r_{x6\ y5}$ = 0.27.

Medical trips (y_6) shows that half of the coefficient of correlation is positive while the other half is negative. The dependent variable (y_6) has the following correlation coefficient of $r_{x1\ y6} = 0.08$; $r_{x2\ y6} = 0.09$; $r_{x3\ y6} = 0.20$; $r_{x4\ y6} = 0.36$; $r_{x5\ y6} = 0.66$ and $r_{x6\ y6} = 0.24$. (See Table 7.2).

Table 7.2 further reveals that many of the independent variables (X_i = i = 2 .... 6) have low inter correlation coefficient. In this study, however, $r_{x2\ x1}$ has a high correlation coefficient of 0.66. In like manner the intercorrelations between the independent and dependent variables were generally low.

b, **Regression result**

In this section, we examine the explanatory power of the dependent and that of independent variables from two perspectives.

i. at the level of purpose of trips

ii at the aggregate of all the trips.

Two levels of significance were used. The first is the conventional 0.05 and because this turned out to be rather stringent admitting only two variables, a less stringent level of 0.15 was adopted.

i, **Regression result at the level of purpose of trips**

Attempt was made to use multiple regression to regress dependent variable with the independent variable at the conventional 0.05 level of significance. The analysis reveals that only two of the independent variables x_2 (waiting time) and x_5 (population) were significant at 0.05 level for medical trips (y_6).

Medical trips

A number of trips are made on health basis such as going to chemists to purchase drugs or going to public/private hospitals for medical attention. Trips recorded under these categories were regarded as medical trips.

Table 7.3:- **Regression Summary for Dependent Varible (medical trips and Independent Variable**

Dependent Varibale	Independent Variable	Regression Coefficient	Standard Error	T- Value
y_6	x_2 (waiting time)	36.6195	15.2022	5.8024
	x_5 (population)	41.9765	10.6466	6.1914

F - Value = 7.86 R^2 = 0.6918

*Regression constant -234.27

*Significant at 0.05 level.

Multiple regression equation is

$y_6 = -234.27 + 36.62X_2 + 41.98X_5$

Source:- Computer Output

The stepwise regression selects only two of the independent variables. These variables namely X_2 (waiting time) and X_5 (population) account for 69.18% of the total variation in the dependent variable (medical trips, y_6). This indicates that the two factors combined together explained reasonably the spatial variation in medical trips in Akure. Table 7.3 shows the summary for the stepwise regression analysis. It is usual to seek for additional elements of the environment

responsible for the remaining unexplained 30.82%. Other elements that may probably account for the unexplained variance are distance to nearest hospital and chemist.

Table 7.4 shows the summary for medical trips. This summary explains the deviation of the expected from the observed values. The distribution shows that five of the observations record positive while the rest five recorded negative residuals. The distribution shows that the residuals -58.5 to 74.2 are high ranging.

Table 7.4:- **Summary of Residuals**

Observation	Observed	Computed	Residuals
1	402.0	418.6	-16.48
2	402.0	373.7	28.33
3	680.0	616.3	63.73
4	667.0	613.7	53.27
5	600.0	647.7	-47.72
6	450.0	533.6	-83.62
7	520.0	518.9	1.06
8	280.0	338.6	-58. 46
9	350.0	364.3	-14 .33
10	402.0	327.8	74 .21

Source:- Computer output

Test of the explanatory ability of the

Regression model at 0.05 significant level·

The predictive ability of a model can be assessed in terms of its explanatory

accuracy. In evaluating the explanatory accuracy of the model, Theil's (1966) inequality coefficient can be used. The formula for this test technique is given by the equation

$$U = \frac{\sqrt{\frac{\sum (P_1 - A_1)^2}{n}}}{\sqrt{\frac{\sum (Ai)^2}{n}}}$$

Where U is the inequality coefficient

Pi is the computed value.

Al is the actual observed value.

n is the number of observations.

This inequality model yields a coefficient which is a measure of the extent of error between actual and predicted values. The U coefficient is confined to the interval between 0 (zero) indicating perfect prediction and a value of i (unity) indicating poor prediction. The nearer the value is to zero, the better is the predictive ability of the model. The 'U' coefficient for this model is 0.10, which indicates a 90% predictive accuracy and measures the degree of success of the model for prediction (See Appendix "VIII" for details of the calculation). The usefulness of this model to trip generation is thus confirmed. Thus, this model provides not less than 90% ingredient for future trip prediction at 0.05 significant level.

However 0.15 siginificance level was considered and it was discovered that all the independent variables were significant for all the dependent variables at different level of coefficient of determination. The results are as stated below:

Work trips

Urban trips are made for a number of reasons, the major one is to travel to places of employment from a place to residence. All trips under this category are regarded as work trips.

Table 7.5 **Regression Summary for Dependent (y1) and Independent Variables**

Dependent Variable	Independent Variable	R^2 Change	Regression Coefficient	Standard Error	T-Value
Y_1	X_1 (walking time)	0.0488	4.61	67.89	0.48
	X_2 (waiting time)	0.0452	-0.83	32.38	0.07
	X_3 (vehicle)	0.0143	0.22	1.78	-0.03
	X_4 (motorcycle)	0.0016	0.29	5.49	0.12
	X_5 (population)	0.1673	13.81	20.03	0.05
	X_6 (income)	0.0000	2.07	6.89	0.68

F-value computed 0.140 R^2 = 0.2183

Regression constant = 447.7048807

*Significnt at 0.1500 level.

Multiple regression equation is

$$y_1 = 44.71 + 4.61\ X_1 - 0.83\ X_2 + 0.22\ X_3 + 0.29\ X_4 + 13.81\ X_5 + 2.07\ X_6$$

Source:- Computer output.

From the regression summary shown by Table 7.5, the coefficient of determination (R^2) is 0.2183 implying that only 21.83% of the total variance is explained by the combined influence of the six independent variables. An examination of the contribution of each independent variable reveals the order of

importance explained by each of the independent variable. For example X_5 (population contributes as much as 16.73% out of the 21.83% explained by all the independent variables. This shows that X_5 (population) with 0.1673 is the most significant variable of work trips in the study area. The analysis further substantiates and confirms early observation of the importance of population in the generation (See Ayeni, 1979).

Business Trip (y_2)

These are trips made to commercial zone for the purpose of shopping or selling of goods.

Table 7.6:- **Regression Summary for Dependent (Y_2) and Independent Variables**

Dependent Variable	Independent Variable	R^2 Change	Regression Coefficient	Standard Error	T-Value
Y_2	X_1 (walking time)	0.1758	-164.56	168.78	-0.97
	X_2 (waiting time)	0.2528	-48.20	80.50	-0.60
	X_3 (vehicle)	0.0294	-1.88	4.43	-0.42
	X_4 (motorcycle)	0.0067	-29.13	13.65	-2.13
	X_5 (population)	0.2363	9.02	49.79	0.18
	X_6 (income)	0.1044	-0.99	17.12	

F-value computed = 1.53 R_2 = 0.7537

Regression constant 4063.311980

*Significant at 0.1500 level.

Multiple regression equation is

$Y_2 = 4063.31 - 164.56X_1 - 48.20X_2 - 1.88X_3 - 29.13X_4 - 9.02X_5 - 0.99S_6$

Source:- Computer Output.

From the regression summary shown in Table 7.6, the coefficient of determination (R_2) is 0.7537 implying that 75.37% of the total variance is explained by the combined influence of the six independent variables. An examination of the contribution of each independent variable reveals the order of importance explained by each of the independent variables. For example X_2 (waiting time) with 25.3%. X_5 (population) with 23.6% and X_1 (walking time) with 17.7% contribute the total of 66.5% out of the 77.37% explained by all the independent variable (see Table 7.6 for others).

This shows that X_2, X_5, X_1, and X_6 are important independent variable influencing trip generation to market centres. This result also substantiates and confirms early observation of Mrakpor (1986) that waiting time and walking time are important determinants of trip generation in Benin City.

Educational trips (y_3)

These are trips made to educational institutions either by pupils or their parents. It also includes trips made to such institution for admission, contracts and visit purposes.

Table 7.7:- **Regression Summary for Dependent (Y_3) and Independent Variables**

Dependent Variable	Independent Variable	R^2 change	Regression Coefficient	Standard Error	T-Value
	X_1 (walking time)	0.0340	0.52	11.27	-0.26
	X_2 (waiting time)	0.0626	-17.02	64.71	0.05
	X_3 (vehicle)	0.0389	0.19	3.56	-0.47
	X_4 motorcycle)	0.1450	-0.20	10.97	1.13
	X_5 (population)	0.0046	45.33	40.03	1.15
	X_6 (income)	0.1047	20.77	13.76	0.71

F - value = 0.653 R^2 = 0.5664

Regression Constant = -1339.246872

*Significant at 0.1500 level.

Multiple regression equation is

$$y_3 = -1339.25 + 0.52X_1 - 17.02X_2 + 0.19X_3 - 0.20X_4 + 45.33X_5 + 20.77X_6$$

Source:- Computer output

From the regression summary shown by Table 7.7, the coefficient of determination (R^2) is 0.5664 implying that only 56.64% of the total variance is explained by the combined influence of the six independent variables. An examination of the contribution of each independent variable reveals the order of importance explained by each of the independent variables. For example, X_4 (motorcycle) with 14.5%, X_6 (income) with 10.47% and X_2 (waiting time) with 6.26% contribute all together 56.64% explained by all the independent variables (see table 7.7 for others)

The result also confirms ealier studies by Ayeni (1979) and Mrakpor (1986) that income (X_6) is important as a factor influencing trip generation. It shows that the higher the income of people, the tendency for one to increase his trip generating ability for educational purposes. Apart from this, it shows the increasing importance of motorcycle as a means of movement for education purpose in Akure city.

Social trips (Y4)

These are the trips made after the days work to friends and relations either to greet or congratulate the host. It also extends to trips made for the purpose of recreating oneself in beer parlours, hotels, guest houses or club houses.

Table 7.8:- **Regression Summary for Dependent (y_4) and Independent Variables**

Dependent Varible	Independent Variable	R^2 change	Regression Coefficient	Standard Error	T-Value
	X_1 (walking time)	0.0649	49.42	90.10	0.55
	X_2 (waiting time)	0.0076	24.04	42.98	0.56
Y_4	X_3 (vehicle)	0.00192	0.38	2.37	0.16
	X_4 (motorcycle)	0.02863	12.63	7.29	1.73
	X_5 (population)	0.0101	36.80	26.58	1.38
	X_6 (income)	0.1507	9.37	9.14	1.03

F - value = 0.946 R^2 = 0.6543

Regression constant = -1358.09

*Significant at 0.1500 level.

Multiple regression equation is

$$y_4 = -1358.09 + 49.42X_1 + 24.04X_2 + 0.38X_3 + 12.63X_4 + 36.80X_5 + 9.37X_6$$

Source: computer output.

From the regression summary shown by Table 7.8, the coefficient of determination R^2 is 0.6543 implying that only 65.43% of the total variance is explained by the combined influence of the six independent variable. An examination of the contribution of each independent variable reveals the order of importance explained by each of the independent variables. For example X_4(motorcycle) with 2.86%, X_6 (income) with 15.1% contribute all together 43.7% out of the 65.43% explained by all the independent variables (see Table 7.8 for others). This shows that motorcycle and income influence trip generation to social centres. The result also substantiates and confirms early studies of Aribigbola (1990) and Ogunbodede (1990) that income and rising influence of motorcycle play prominent role in trip generation to social places in Akure.

RELIGIOUS TRIPS(Y5)

These are trips made to churches and mosques in the city of Akure. Such trips are common on Sundays and Fridays for Christians and Muslims respectively.

Table 7.9 **Regression Summary for Dependent (Y_5) and Independent Variables**

Dependent Variable	Independent Variable	R^2 Change	Regression Coefficient	Standard Error	T-Value
	X_1(walking time)	0.0339	176.62	69.16	2.55
	X_2(waiting time)	0.0659	-63.03	32.99	-1.91
Y_5	X_3 (vehicle)	0.0358	-2.94	1.82	-1.62
	X_4(motorcycle)	0.0241	4.12	5.59	0.74
	X_5(population)	0.2051	46.18	20.40	2.26
	X_6(income)	0.0741			

F-value = 1.717 R^2 = 0.7745

Regression constant = -1372.55

*Significant at 0.1500 level.

Multiple regression equation is

$$y_5 = -1372.55 + 176.62X_1 - 63.03X_2 - 2.94X_3 + 4.12X_4 + 46.18X_5 + 13.13X_6$$

From the regression summary shown by Table 7.9, the coefficient of determination R^2 is 0.7745 implying that 77.45% of the total variance is explained by the combined influence of the six independent variables. An examination of the contribution of each independent variable reveals the order of importance explained by each of the independent variables.

For example X_5 (population) with 20.51%, X_6 (income) with 7.41 and X_2 (waiting time) with 6.59% contribute all together 34.51% to the R^2 i.e. coefficient of determination for religious trips.

Medical trips (y_6)

Table 7.10:- **Regression Summary for Dependent (y_6) and Independent Variable**

Dependent Variable	Independent Variable	R^2 change	Regression Coefficient	Standard Error	T-value
	X_1 (walking time)	0.0069	33.36	54.94	9.64
	X_2 (waiting time)	0.0073	21.93	24.77	0.89
y_6	X_3 (vehicles)	0.0416	-1.99	1.36	-1.46
	X_4 (motorcycle)	0.1327	-1.49	4.2	-0.36
	X_5 (population)	0.4363	49.93	15.32	3.26
	X_6 (income)	0.0567	5.01	5.27	

F - value = 2.66 R^2 = 0.8419

*Regression constant -468.65

*Significant at 0.1500 level.

Multiple regression equation is

$$y_6 = -468.65 + 33.36X_1 + 21.93X_2 - 1.99X_3 - 1.49X_4 + 49.93X_5 + 5.01X_6$$

Source:- Computer output

From the regression summary shown by Table 7.10, the coefficient of determination (R^2) is 0.8419. This implies that 84.19% of the total variance is explained by the combined influence of the six independent variables reveal the order of importance explained by each of the independent variables (X1.....X6). An examination of the contribution of each independent variable reveals the order of importance explained by each of the independent variable. For example X_5 (population) with 43.6% contributes the highest out of the six independent variables which explain 84.19 of the variance (see Table 7.10 for others).

It shows that population (X_5) and motorcycle (X_4) are important determinant of medical trips. It also shows the relative importance of the growth of motorcycle in mobility processes among other means of movement within the city.

ii. <u>Regression results at the level of aggregate of all trips</u>

In this subsection, attempt was made to regress dependent variable of all purpose of trips with the independent variables at 0.15 and 0.05 levels of significance. The analysis shows that all independent variables were significant at 0.15 for the total trips. When 0.05 was used, only one independent variable (income, X_6) was significant for prediction. The results are as presented below:

Total trips (y_7) at 0.15 significant level

Table 7.11:- **Regression Summary for Dependent (y_7) and Independent Variable**

Dependent Varibale	Independent Variable	R^2 change	Regression Coefficient	Standard Error	T-value
	X_1 (walking time)	0.0472	214.20	224.54	0.64
	X_2 (waiting time)	0.0691	-83.16	107.10	0.89
y_7	X_3 (vehicles)	0.0054	- 6.03	5.90	-1.46
	X_4 (motorcycle)	0.0938	-18.77	18.16	-0.36
	X_5 (population)	0.4464	201.09	86.24	3.26
	X_6 (income)	0.0024	49.35	22.78	0.95

F - value = 2.68 R^2 = 0.8428

*regression constant -27.16

*Significant at 0.1500 level.

Multiple regression equation is

$$y_7 = -27.16 + 214.20X_1 - 83.16X_2 - 6.03X_3 - 18.77X_4 + 201.09X_5 + 49.35X_6$$

Source:- computer output

From the regression summary shown by table 7.11, the coefficient of determination (R^2) is 0.8428. This implies that 84.28% of the total variance is explained by the combined influence of the six independent variables. Further examination shows that some independent variables are more important than others in terms of their contribution to R^2. For example population (X_5) play the most significant role in total trip generation in Akure. Other important variables that contribute meaningfully to trip generation in Akure include

motorcycle (X_4), waiting time (X_2) and walking time (X_1) (see Table 7.11)

The first shows that population (X_5) with 44.64%, motorcycle (X_4) with 9.4% and waiting time (X_2) with 6.91% are important factors influencing trip generation in Akure. It further lends credence to other results as shown before that motorcycle, waiting time and number of people living in a house are important in total trip generation in Akure.

In summary, when all the Dependednt variables (y_1 = i = 1, 2 ... 7) are regressed with the independent variable (X_1 = i = 1, 2 ... 6), at the 0.15 significant level, the result shows that all Independent variables are significant. However, when all the dependent variables are regressed with independent variables at 0.05 significant level, only two of the dependent variable y_6 (medical trips) and y_7 (total trips) are found to be significant. The result however shows that total trips (y_7) with R^2 of 84.28% is high enough for prediction purpose at 0.15 significant level. In social science 0.05 significant level for prediction is accepted hence efforts were made to examine the dependent variables at this level, the result is presented below:

Total trips (y_7) at 0.05 significant level

This is the total trips accruing from all trip purposes as defined under dependent variables y_1 to y_6. Thus, total trips is the aggregate of all trips to work, commercial, recreational, educational, religious and medical landuses.

Table 7.12:- **Regression Summary for Dependent (y_7 total trips) Independent Variable**

Dependent Variable	Independent Variable	Regression Coefficient	Standard Error	F-value
y_7	X_6 (income)	125.27	49.3184	6.45

R^2 = 0.4465 *Regression constant 2575.25

*Significant at 0.05 level.

Source:- Computer output.

Multiple regression equation is

$$y_7 = 2575.25 + 125.27X_6$$

y_7 = total trips

X_6 = income

From the regression summary, the coefficient of determination (R^2) is 0.4465 implying that 44.65% of the total variance is explained by the sole influence of the independent variable (X_6 - income). The result shows that whatever purpose a trip is undertaken, the issue of finance is prominent in determining movement. This result further confirms early study of Ayeni (1979) and Mrakpor (1986) on the importance of income among other socio-economic variables in trip generation. Although, the percentage accounted for by income in total trip is low (44.65%), some other relevant variable that may be considered include occupation, distance and activities in the city.

Table 7.13 shows the summary of residuals. This summary explains the deviation of the expected from the observed values. The distribution shows that five of the observation record positive while the rest five record negative residuals. The distribution of the residuals show a high range i.e -262.1 and 385.5.

Table 7.13:- Summary of Residuals

Observation	Observed	Computed	Residuals
1	3429.0	3286.0	143.0
2	2919.0	3181.1	-262.1
3	4397.0	4563.0	-166.0
4	4386.0	4265.5	120.5
5	4445.0	4433.8	11.2
6	4350.0	4050.8	299.2
7	3589.0	3844.1	-255.1
8	3710.0	3948.9	-238.9
9	2949.0	2986.3	-37.28
10	3968	3582.5	385.5

Source:- Computer output.

Test of the explanatory ability of the regression model at 0.15 significant level

Using Theil's (1966) inequality coefficient (see page 144) the regression model was tested at 0.15 significant level. The result revealed that 'U' coefficient for this model is 0.057, which indicates a 94.3% of success of the model for prediction (See Appendix "IX" for details of the calculation). The usefulness of this model to

trip generation is thus confirmed. Thus, this model provides not less than 94.3% ingredient for future trip prediction at 0.15 significant level.

When trips are considered at aggregate level, the regression equation in the form of:

$$y = 2575 + 125.27X_6$$

can be used for predicting trip generation in Akure at 0.05 level of significance. However, the prediction should be interpreted with caution because it can only account for 44.65% of trip generation at that level. When 0.1500 level is chosen, trips generated at aggregate level will explain 84.28% of total variance using regression equation in the form of :

$$y_7 = -22.16 + 214.20X_1 - 83.16X_2 - 6.03X_3 - 18.77X_4 + 201.09X_5 + 49.35X_6$$

7.5 Conclusion

This chapter examines the factors influencing trip generation in Akure and explores ways of estimating future trips in the city. Here factors responsible for trip generation in the city were identified. Two perspectives were adopted in estimating trip generation and they are:

i. at the level of purpose of trips

ii. at the aggregate of all the trips

Two levels of significance adopted were 0.05 and 0.15. The results show that all independent variables were significant for all the purpose of trips examined at 0.15 significant level. However, only medical trips and total trips have two and one of their independent variables respectively significant at 0.05 levels. Since

0.05 significant level is acceptable in social sciences, it follows that only medical trips and total trips can be used for prediction purposes.

CHAPTER EIGHT

EFFICIENCY OF TRANSPORT SYSTEM IN AKURE

8.1 INTRODUCTION

In this chapter, efficiency of transport system is considered from the point of infrastructures and services within the city. The major ten routes identified in the city earlier were subjected to standard roadway quality assessment index. The services of public transport services in various landuse zones were analysed using route performance screening procedure. The Likert scale was applied to responses on transport problems so as to enable the researcher rank the way people perceive transport problems affecting the city.

8.2 EFFICIENCY OF TRANSPORT INFRASTRUCTURES

Road is the major mode of transport system in Akure. The infrastructural needs of a good road include the material for its surfacing, its width, its complementary facilities and the nature of its surface. In assessing road qualities (see Bello, 1994; Aderamo, 1990; Arosanyin, 1998 and Aloba, 1975) a number of weighting scores are alloted to each road in order of importance. A roadway is termed efficient when it is capable of handling the designed volume of vehicles with the minimum possible friction (Bello, 1994). The efficiency of roadway may be measured using some indices of road quality such as - (a) road surface quality (b) road width and (c) road complementary facilities.

In a similar study carried out by Aloba (1975), three types of surfaces were identified. They are bituminous, gravel and earth. He awarded a score of 10 to bituminous surface, 5 to gravel surface and 1 to earth road. In this study, it has

been discovered that two major categories of surface exist and they are the paved and unpaved surfaces. Three major sub-types exist under paved surface and they are surface dressing (bituminous), asphalt and concrete. Concrete is the strongest and often used in a water logged environment and areas serviced by trucks or heavy-load duty vehicles. Asphalt is next and currently used on Nigerian highways and cities. Bituminous is the least in this category and not as durable as asphalt. Similarly, there are two types of unpaved surfaces and they are Earth and Gravel surfaces. The gravel surfaced roads are better than the earth road because they are more durable and not easily susceptible to erosion. Asphalt, gravel and earth surfaced roads were considered in this study for measurement because they are more in use in cities. Therefore, in the assessment of type of surface, asphalt surface was considered best and awarded a score of 10, gravel surface was awarded 5 while earth surface was awarded 1. In terms of condition of road surface, smooth surface was considered best and awarded 10, fairly smooth with 5 point and rough surface was awarded 1 point. Table 8.1 shows the weighting employed for the analysis of the route quality in Akure.

Table 8.1 **Weighting for road quality assessment**

	Index	Weighting 10	Weighting 5	Weighting 1
i.	Type of surface	Asphalt	Gravel	Earth
ii.	Condition of road surface	Smooth	Fairly smooth	Rough
iii.	Width of road in metres	1.4 metre or more	7.11 metres	3.4 metres
iv.	Road vehicular capacity	Four lane	Two lane	One lane
v.	Period of motorability	All year round	Partially seasonal	Strictly sasonal
vi.	Liable to flooding	Not applicable	Not liable to flooding	Liable to flooding
vii.	Road complementary facilities	Point of interchange, Bus Stops, terminals, parking, Lay by pedestrial walkways, pedestrian crossing, traffic light, traffic warden, road signs, petrol station, vulcaniser, zebra crossing. (Any six of the above)	Any 5 of the factors stated	Any 2 of the factors stated

Source:- Researcher's data analysis 1996.

Using the method Table 8.2 depicts the route quality in Akure. Route "1" made up of Erekesan market/Oyemekun road and FUTA road ranked first in terms of overall road quality scoring 13.3%. Route 10 (Esso/College of Agriculture/Oba-Ile route) ranked second scoring 12.14%. Route 2 (Erekesan market/Ondo road/Army barracks) ranked third scoring 11.04% while route 1 (Erekesan market/Oke Aro/Idanre route), Route 4 (Erekesan market/Oke-Ijebu/Shagari Village), Route 7 (NEPA/Secretariat/Igbatoro road) and route 9 'Hospital road/Sijuade quarters) ranked fourth scoring 9.93% each. Others are as stated in Table 8.2.

The characteristics of the selected routes as calculated from the weighted indices are as shown in the Table 8.3. The table shows that 70% of routes in Akure are asphalt surfaced. This is not unconnected with the efforts of the military administrator's concern to make all nooks and corners of the capital city accessible. Apart from this, the efforts of the Petroleum Trust Fund in road rehabilitation and reconstruction also influenced and increased the paved surfaces of roads in the town.

Majority of the roads which are asphalt surfaced are not liable to flooding. 50% of the routes have larger proportion of their roads in a smooth condition while 50% do not. A larger proportion of the roads in the town are of two lanes while few are of four lanes. Table 8.3 shows that 20% of the routes selected are of four lanes while 80% constitute two lanes. However, the width of routes vary from routes to routes. For two lanes routes, the width range from 8.00 to 11.00 metres while that of four lanes maintain 26 metres width throughout the city with street lights adorning them.

In terms of land use concentration and road quality, the best route in the city bifurcates the city into two. This route is made up of Oyemekun - Oba-Adesida roads and accumulate the functions of major thorough fare. It acts as the main artery for local traffic. This route also acts as point of interchange for traffic originating from the periphery of the town. It starts from the road which enters the city from Ilesa and link institutional, medium residential zone, commercial and public/semi-public areas of the city. This route is exemplified by its width which is four lanes, surfacing which is bituminous, all season motorability, high complementary facilities and with modern street lights.

Table 8.2: **SELECTED ROUTES AND THEIR ATTRIBUTES**

Route	Name of Route	Seasonal condition	Surface condition	Period of motorability	Width of road	Capacity of road	Type of surface	Road complementary facilities	Total quality measure	% of maximum obtainable
1	Erekesan mkt./ Oke Aro/Idanre Rd.	All season 10	Fairly smooth 5	All season 10	11 metres 5	Two lanes 5	Asphalt 10	Six 10	55	70 78.57
2	Erekesan mkt./ Ondo road/ Army barracks	All season 10	Smooth 10	All season 10	11 metres 5	Two lanes 5	Bituminous 10	Six 10	60	85.7
3	Erekesan mkt./ Oyemekun raod/ FUTA	All season 10	Smooth 10	All season 10	26 metres 10	Four lanes 10	Asphalt 10	Eight 10	70	100.0
4	Erekesan Mkt./ Oke-Ijebu/Shagari Village	All season 10	Smooth 10	All season 10	8.6 metres 5	Two lanes 5	Asphalt 10	Two 1	51	72.86
5	Erekesan Mkt./ New Isolo Rd./ Shagari Village	All season 10	Fairly Smooth 5	All season 10	11 metres 5	Two lanes 5	Gravel 5	Two 1	41	58.57
6	Erekesan Mkt./ Hospital/Osinle Rd.	All season 10	Fairly Smooth 5	All season 10	11 metres 5	Two lanes 5	Asphalt 10	Five 5	50	71.43
7	NEPA/Secretaria Igbatoro Rd.	All season 10	Smooth 10	All season 10	11 metres 5	Two lanes 5	Asphalt	Five 5	55	78.57
8	Hospital Rd/Ijoka/ Obadulu	All season 10	Fairly Smooth 5	All season 10	10.5 metres 5	Two lanes 5	Gravel 5	Two 1	41	58.57
9	Hospital Rd./ Sijuade/Ala quarters	All season 10	Smooth 10	All season 10	11 metres 5	Two lanes 5	Asphalt 10	Two 1	51	72.86
10	Esso/College of Agric./Oba Ile	All season 10	Fairly Smooth 5	All season 10	26 metres 10	Four lanes 10	Asphalt 10	Six 10	65	92.86

Source:- Fieldwork, 1996

Table 8.3 - **Characteristics of selected routes**

	Attributes	% of total
1.	Asphalt surface	70
	Gravel surface	20
	Earth surface	10
2.	Smooth surface	50.00
	Fairly smooth surface	50.00
	Rough surface	0.00
3.	Width of 14m and above	20.00
	Between 7 - 11 metres	80.00
	Between 3 - 4 metres	0.00
4.	Four lane routes	20.00
	Two lane routes	80.00
	One lane route	0.00
5.	All year round motorability/all season road	100.00
	Partially seasonal	0.00
6.	Roads not liable to flooding	100.00
	Road liable to flooding	0.00
7.	Road complementary facilities	
	- six or more facilities	40.00
	- five facilities	30.00
	- below five facilities	30.00

Source:- Field Work, 1996

It is equally observed that most of the routes in the city lack public parking spaces when route complementary facilities were examined. Most vehicles park on the road side because of lack of parking spaces. This reduces areas left on the road for free flow of vehicles on each route. Thus, the lack of these facilities on

most of the routes has been responsible for traffic hold-up experienced in the city.

8.3 EFFICIENCY OF TRANSPORT SERVICE

Since majority of the residents in Akure rely on public transport services in the town, attempt was made to examine the viability of these routes. Table 8.4 is the summary of the response to the questions asked from each NURTW representative located in each route. The analysis of route viability shows that not all routes make use of buses for movement within the city. The major routes such as route 3, 6 and 9 are plied by taxi-cabs only while other routes as shown by Table 8.4 are plied by the combination of buses and taxi cabs. Taxi-cabs are frequently used on routes that terminate at the periphery. For example route 1 ended up at the outskirt of the Idanre road, route 2 at the Army Barracks at the outskirt of the city on Ondo road, route 4 and 5 in the Low Cost Housing (Shagari village) and route 10 in a Satelite Village (Oba-Ile) about 8 kms from the city centre (see figure 8.1). In terms of average number of round trips per route, route 3 rank first with 38; route 2, 4, 6 and 9 rank second with 30 round trips each per day similarly, the average waiting time for bus/taxi cabs at each loading point range from 5 minutes to 14 minutes. The analysis also reveals that routes 3, 5, 7 and 10 have high waiting time at loading point. In terms of load capacity, almost all the routes have high loading except route 7 and 10. All the routes which originated from Erekesan market (a landuse situated in a commercial zone) have high capacity with low waiting time for routes 1, 3 and 4. The implication of this is that more public transport will still be viable for these

Table 8.4:- **Vehicle availability and trip characteristics per route in Akure**

Route Number	Route Name	Average No. of vehicles per route		Average No. of round trips per route		Average waiting time at loading point (minutes)	Load capacity (high or low)
		Bus	Taxi	Bus	Taxi		
1.	Erekesan Mkt/ Oke Aro Idanre Road	8	18	12	22	6	High
2.	Erekesan Mkt/ Ondo Road/ Army Barracks	7	22	15	30	14	High
3.	Erekesan Mkt/ Oke-Ijebu Rd/ FUTA	-	32	-	38	6	High
4.	Erekesan Mkt/ Oke-Ijebu Rd/ Shagari Village	6	20	14	30	5	High
5.	Erekesan Mkt/ Hospital Road/ Osinle Rd.	8	12	18	25	10	High
6.	Erekesan Mkt/ Hospital Road/ Osinle Rd.	-	28	-	30	5	Low
7.	NEPA/Secretariat/ Igbatoro Rd.	9	16	15	24	10	Low
8.	Hospital Rd/ Ijoka Rd/ Obodule Rd.	6	14	12	25	5	High
9.	Hospital Rd/ Sijuade Rd.	-	25	-	30	5	High
10.	Esso/College of Agriculture	12	14	14	25	10	Low

Source:- Field Work, 1996

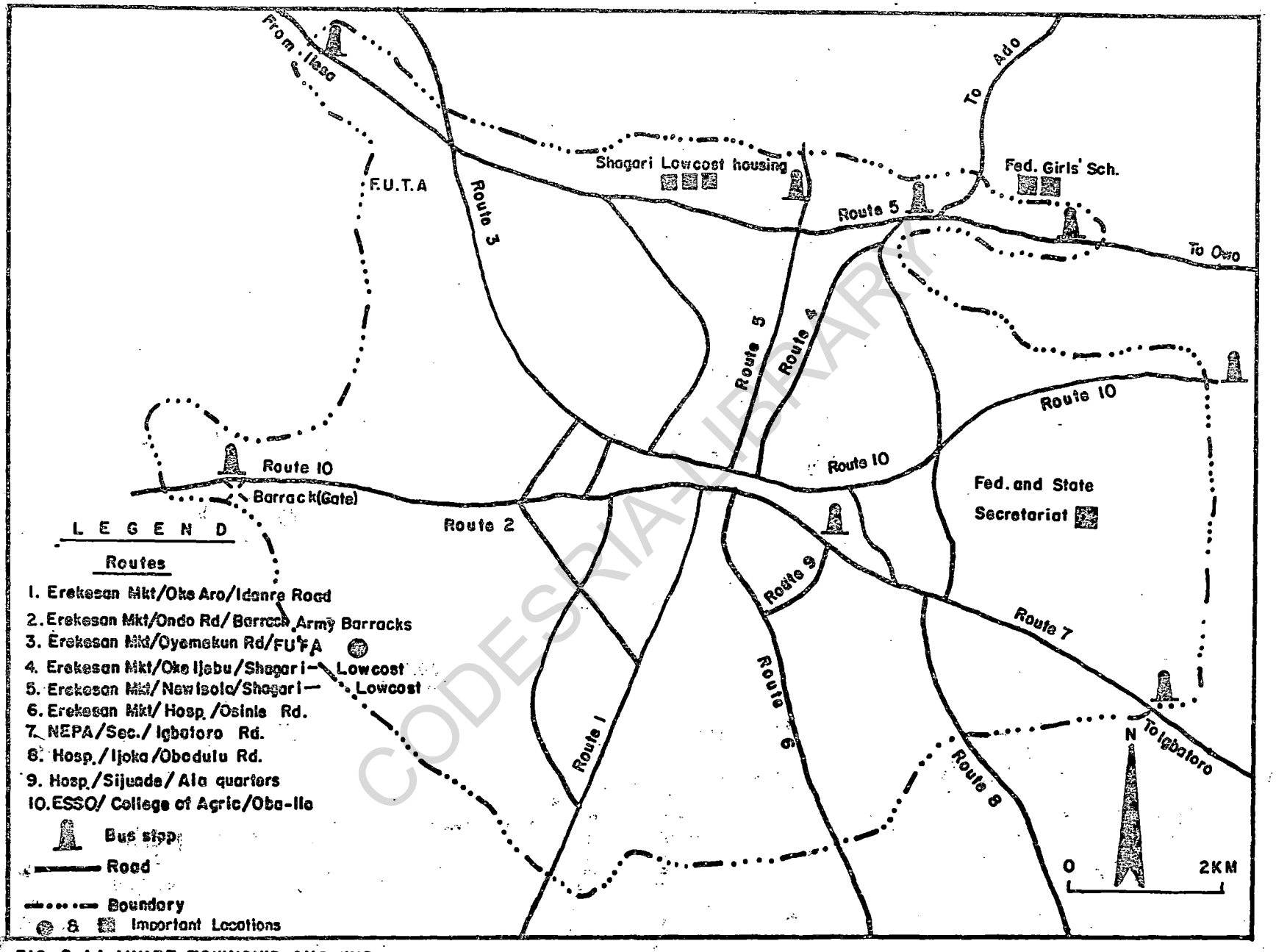


FIG. 8.1: AKURE TOWNSHIP SHOWING MAJOR ROAD TRANSPORT ROUTES.

routes. On the other hand, some of the routes which originated from Erekesan market have high load capacity with high waiting time for routes 2 and 4. The planning implication of this include the use of smaller vehicles for these routes.

Table 8.5 shows the average cost for running a kilometre herein referred to as Cost Per Kilometre (CPK) and average earning on running a kilometre per day also referred to as Earning Per Kilometre (EPK). The difference between Earning per km (EPK) and cost of running a km (CPK) is the profit also referred to in this work as profit per km (PPK).

Table 8.5:- **Assessment of cost and earning per km in the study area**

Route No.	Routes Names	Earning per Km N K	Cost per Km N K	Profit per Km N K
1.	Erekesan Market/Oke Aro Rd/Idanre Rd.	180.00	50.00	130.00
2.	Erekesan Market/Ondo Rd/Army Barracks	205.00	60.00	145.00
3.	Erekesan Market/Oyemekun Rd/FUTA	195.00	60.00	135.00
4.	Erekesan Market/Oke-Ijebu/Shagari Village	210.00	85.00	145.00
5.	Erekesan Market/New Isolo/Shagari Village	165.00	45.00	120.00
6.	Erekesan Market/Hospital Rd/Sijuade Rd.	175.00	45.00	130.00
7.	NEPA/Secretariat/Igbatoro Rd.	175.00	40.00	135.00
8.	Hospital Rd/Ijoka Rd/Oboduiu	170.00	40.00	130.00
9.	Hospital Rd/SijuadeRd/Ala quarters	160.00	40.00	120.00
10.	Esso/College of Agric./Oba-Ile	180.00	50.00	130.00

Source:- Field Work, 1996

The cost per km takes into consideration the current expenditure on daily basis. Such daily recurrent expenditures include cost of buying petrol, engine oil and tolls paid daily to NURTW representatives on each route. The CPK however excludes repairs, servicing of vehicles, hackney permit, and other vehicles licences. The summary that can be deduced from Table 8.5 is that all the routes are viable i.e. the EPK is greater than CPK. However, some routes are more viable than others. The cost of registering a vehicle and other conditions attached to it for a particular route however varies and it is used to scare away transport operators from some routes.

To examine the viability of transport services on each route based on standardized Route Performance Screening Procedure, the indices used by Ogunsanya (1989) and Bello (1994) was adopted. The route screening procedure has eight different case studies where the earning and cost per road is compared; similarly, average waiting time and load factors are considered before planning implications profered (See Table 8.6 for details).

Table 8.7 is deduced from Tables 8.4 and Table 8.5. Using all the attributes as stated in Table 8.6. The major selected routes in Akure were subjected to the standardized Route Performance Screening Procedure. The results are as presented in Table 8.7 and discussion thereafter discussed.

Table 8.6:- **Route Performance Screening Procedure**

Case 1			Case 2		
	High	Low		High	Low
EPK:CPK	*		EPK:CPK	*	
Average waiting time	*		Average waiting time	*	
Load factor	*		Load factor	*	
Remarks			Remarks		
Need for extra buses on the route or route shortening			Route probably operating well, though reduction in buses or route extension should not be ruled out.		
Case 3			**Case 4**		
	High	Low		High	Low
EPK:CPK	*		EPK:CPK	*	
Average waiting time		*	Average waiting time	*	
Load factor	*		Load factor		*
Remarks			Remarks		
Route operating well, although load factor should be reduced possibly by route alterations			Possibly a low frequency route operating quite well, more smaller buses might be considered		
Case 5			**Case 6**		
	High	Low		High	Low
EPK:CPK		*	EPK:CPK		*
Average waiting time		*	Average waiting time	*	
Load factor		*	Load factor		*
Remarks			Remarks		
Too many buses on the route or possible case for route extension			Route layout may be wrong		
Case 7			**Case 8**		
	High	Low		High	Low
EPK:CPK		*	EPK:CPK		*
Average waiting time	*		Average waiting time		*
Load factor	*		Load factor	*	
Remarks			Remarks		
If low frequency route There may be a case for reduction in buses. Also a case for more smaller buses or route restructuring			Route layout probably at fault. Possibly a case for fewer, large buses.		

EPK = Earning Per Km.(EPK) in a day
CPK = Cost Per Km. (CPK) in a day.

Source:- Fourace 1987

Table 8.7:- **Summary of Route Performance in Akure**

	Route	a	b	c	Implication	Remarks
1.	Erekesan Market/Oke-Aro/Idanre Rd.	High	Low	High	Low frequency route need for bus reduction or route shortening	Efficient
2.	Erekesan Market/Ondo Road/Army Barracks	High	High	High	There is need for extra buses on the route	Fairly Efficient
3.	Erekesan Market/Oyemekun Road/ FUTA	High	Low	High	Low frequency route. Need for bus reduction	Efficient
4.	Erekesan Market/Oke-Ijebu Road/ Shagari Village	High	Low	High	Low frequency route Need for bus reduction	Efficient
5.	Erekesan Market/Hospital/Osinle Rd.	High	High	High	There is need for extra buses on the route	Fairly Efficient
6.	Erekesan Market/Hospital Road/ Osinle Road	High	Low	Low	Route extension should be considered	Not Efficient
7.	NEPA/Secretariat/Igbatoro Road	High	High	High	Need for extra buses on the route	Fairly Efficient
8.	Hospital Road/Ijoka Road/ Obodulu Road	High	Low	High	There is need for route shortening or reduction in buses	Efficient
9.	Hospital Road/Sijuade Road/Ala Quarters	High	Low	High	There is need for route shortening or reduction in buses	Efficient
10.	Esso/College of Agric./Oba-Ile	High	High	Low	A low frequency route. More smaller buses might be considered.	Not Efficient

Where a = EPK:CPK (i.e. when EPK is compared with CPK)

b = Average Waiting time at loading point.

c = Load factor.

Source:- Field Work, 1996.

Routes 1, 3, 4, 8 and 9 though operating well can still maximise profit, if the routes are shortened or the vehicles are reduced. Table 8.4 indicates that routes 1, 4 and 8 make use of both buses and taxi cabs. On these routes, reduction in the number of buses will stimulate further demand and make the routes more viable than it is now. Similarly, the number of taxi-cabs that ply routes 3 and 9 are too many. A reduction in their number will further increase earning per the routes concerned. For route 6 to be move viable, route extension should be considered. By so doing, the transport operator will be able to make profit since there will be increase in the demand for their services resulting from the additional areas to be covered. For route 10, the load factor is low high EPK:CPK and waiting time at loading point. This means that the route is a low frequency route which is operating quite well. Since the route make use of bus (see Table 8.4), a reduction in the use of bus will assist to stimulate more demand for taxi-cabs and increase load factor for the route.

8.4 ACCESSIBILITY AND RELIABILITY OF PUBLIC TRANSPORT SERVICES IN VARIOUS LANDUSE ZONES IN AKURE

Accessibility in this study refers to the ease of boarding public transport services by commuters in various landuse zones. The accessibility index is measured in terms of time used to cover distance between house and nearest bus stop where public transport could be got. It is also measured in terms of convenience to boarding vehicles by passengers in different bus stops.

In most landuse zones people have to trek from their various places of activities to bus stops where they can get public transport services. Time is therefore used as a surrogate for measuring distance covered to walk from individual houses or other places of activities to the point where people could get a bus or taxi. Table 8.8 shows the average journey time from residences located in various zones to the nearest bus stops where they can be accessible to public transport services. The table shows that transport/communication landuse has the highest means of 15.38 minutes for people trekking from residences to places.

Table 8.8:- **Journey Time In Various Landuse Zone in Akure**

Journey Time / Landuse Zone	Mean Walking time from residence to bus stops (minutes)	Mean waiting time at bus stops (minutes)	Mean journey time to place of work (minutes)
1. Educational	9.87	8.81	20.35
2. Industrial	7.07	8.21	25.80
3. Residential (High)	10.2	10.88	20.43
4. Residential (Med.)	6.59	5.75	4.96
5. Residential (low)	7.81	8.82	10.9
6. Commercial	9.87	9.23	17.56
7. Recreational	8.61	8.95	1.47
8. Transport/Comm	15.38	11.84	24.76
9. Military/Police	7.07	10.153	19.79
10. Public/Semi Public	8.02	7.5	10.20

Source:- Field Work, 1996.

where they can get public transport. The lowest mean walking time of 6.59 minutes is experienced in medium residential landuse zone. Similarly, the mean waiting time at bus stops is also collected to know how reliable the public transport services that frequent each zone is now. The study reveals that none of the commuters emanating from various landuse zones spend less than 5 minutes for waiting for public transport services, while commuters in seven different landuse zones have to spend between 5 and 10 minutes for waiting for public transport services. The mean journey time to place of work also vary considerably in various landuse zones. Workers in about six landuse zones spend more than 15 minutes to get to their various places of work while workers in about four landuse zones spend less than 15 minutes.

The reliability of public transport service is measured in terms of walking time to bus stop, waiting time at bus stop and journey time to place of work. It has been noted earlier that differences occur in spatial distribution of landuse in the city. Thus, the differences which occur in mean walking time from residence to bus stop, mean journey time to places of work and mean waiting time at bus stop were subjected to Analysis of Variance (ANOVA) test (see Dinham 1976). The null hypothesis was set thus.

H_0 Test:- There are no significant variations in the mean walking time to bus stop, mean journey time to places of work and mean waiting time at bus stop between and within the ten landuse zones in Akure.

Table 8.9 **ANOVA Test for Reliability of Public Transport Services**

Source of Variation	Sum of Square	df	Ms	F
between	287.9	2	143.95	5.50
Within	706.18	27	26.15	
Total	994.08	29		

The statistical table F distribution values at

= 0.05 is 3.35

= 0.01 is 5.49

The result shows that calculated F is greater than the table F at both 0.05 and 0.01 levels. The null hypothesis is therefore rejected at both levels of significance. This means that H_1 hypothesis holds i.e. there is significanct variation in the walking time to bus stop, waiting time at bus stop and journey time to places of work between and within the ten landuse zones in Akure.

The variation in walking time is explained due to differences which occur in distance from residence to feeder routes in various landuse zones. Journey time to place of work also varies in different landuse zone because some people live close to their place of work while others live far. The waiting time at bus stop also vary significantly in different zones. This affects the degree to which public transport is adequate in the city.

Table 8.5 **PROBLEMS OF TRANSPORT SYSTEM IN AKURE**

Transport problems were identified and respondents were asked to rank the problems the way they perceive each one of them in order of importance. The Likert scale was applied to analyse the response. On a 5 - point scale of response, the options of the respondents were summed up. The mean and standard deviation of responses on each problem item was calculated. A mean cut-off point of 3.50 was set for rejecting or accepting an item (See Nwoke 1988 : 160 and Ugonabo, 1988 : 221). The summary of the transport problems in Akure as perceived by residents are as stated in Table 8.10. Of all the transport problems in Akure, bad roads account for the dominant problems with a mean cut-off point of 3.79. Others are as stated in Table 8.10. Although some transport problems were rejected based on their mean and standard deviation score, yet their scores represented their importance as an acceptable problem the nearer the scores are to 3.50 (accepted mean) (see Okoye, 1995). Thus poor road network is next to bad roads closely followed by long periods of waiting for public transport and inadequate fleet of public vehicles on some roads.

Table 8.10 **Trasnport Problems In Akure as Perceived by Residents**

S/N	Transport Problems	Scores								Remarks
		5	4	3	2	1	N	$\bar{X}$	SD	
1.	Congestion on roads	306	413	128	282	217	1346	3.23	1.24	Reject
2.	Overcrowded vehicle	242	400	164	339	202	1347	3.11	1.36	Reject
3.	Inadequate fleet of public vehicles	283	455	263	200	69	1270	3.54	1.16	Accept
4.	Long periods of waiting for transport at bus stop	321	497	194	259	79	1347	3.55	1.20	Accept
5.	Accident	186	256	429	315	164	1350	2.99	1.21	Reject
6.	parking problems	186	391	312	149		1348	3.12	1.28	Reject
7.	Flood problems	309	345	277	296	119	1346	3.32	1.28	Reject
8.	Inadequate drainage system	326	442	190	274	114	1346	3.44	1.65	Reject
9.	Traffic hold-ups/go slow	228	358	217	297	134	1234	3.20	1.29	Reject
10.	Poor road network	452	341	93	230	118	1234	3.63	1.38	Accept
11.	Bad roads	570	257	92	155	141	1215	3.79	1.44	Accept

Source:- Field Work

8.6 CONCLUSION

This chapter examines the levels of efficiency of transport system which are considered from the point of infrastructures and services. The application of indices such as road quality assessment, trip characteristics and route performance screening procedure index revealed the lapses inherent in some of the selected routes. The study shows that public transport system enjoys good patronage in the city and as such it needs to be adequately and efficiently provided for. On adequacy; some landuse zones were not adequately provided with public transport services especially High residential zones where taxi-cabs believed that those who lived there possess their private vehicles. On efficiency, services on some routes should be shortened while there is need to increase vehicles on others to make transport operators reap maximum benefits.

Transport problems as perceived by residents in Akure show that poor road network is next to bad roads while long periods of waiting for public transport is closely followed by inadequate public vehicles on some roads.

CHAPTER NINE

SUMMARY AND CONCLUSION

9.1 INTRODUCTION

The main objective of this study is the detailed investigation of the implication of changing pattern of landuse on urban transport development. The specific objectives pursued include; identifying the pattern of landuse development in Akure over the past four decades and accounting for any observable changes; Identifying and explaining the overall pattern of intra-urban movement of passengers within the various landuse zones and accounting for the observed pattern; examining the efficiency and reliability of public transport services on one hand and transport infrastructures on the other hand in terms of their ability to cope with traffic generated and attracted by these landuses and finally, examining the implications of the study for a comprehensive urban transport planning. The study made use of data collected from both primary and secondary sources to achieve the stated objectives.

9.2 SUMMARY OF FINDINGS

The study observed a significant change over time, in the landuse in Akure over the last three decades. Specifically, the areal extent of Akure was 1605 hectares as at 1966, 1937.5 hectares in 1976, 5330 hectares in 1986 and 7995 hectares in 1996. There was a remarkable and rapid expansion or growth of the areal extent of the city between 1976 and 1986. The percentage increase of the

areal extent of the city in 1986 was 175.1% over what it was in 1976. While the land increase as at 1996 over 1986 was 2665 hectares representing 50% increase. This shows a declining rise in landuse shortly after the first few years when the town became a capital city. The absolute areal growth in landuse as at 1996 over 1976 was 60.57 hectares representing 312.65% increase in landuse over a period of twenty years (20 years) whereas the total area covered by landuse as at 1980 was 4706 hectares (Akure Master Plan 1980 - 2000 Years). Thus the percentage increase in landuse between 1976 and 1980 (a period of 4 years) is 242.89%. This percentage increase is greater than what it was between 1980 and 1996 (a period of 16 years) which was 69.89% increase. The rapid development of the city and the rush to acquire landed property in the few years (4 years) of attaining capital status can be said to account for the rapid and absolute increase in landuse (242.89%) as at 1980. Diminishing returns however set into the demand for landed property after 1980 and that accounted for the decrease in the rate of areal expansion of the city after 1980 till 1996 (69.89%).

The study further reveals that there was a relative increase in almost all the type of land use in the study area in 1986 over what existed in 1976 except Educational and public landuse. In 1996, the study also reveals that residential landuses (High, medium and low) have been declining in relative terms since 1976 from 82.58% in 1976 to 74.58% in 1989 and 65.98% in 1996. On the other

hand, there were remarkable increases in the intensity of landuse especially commercial, recreational, police/military and public/semi public landuses in the town. The emerging pattern of housing estates, industrial estates, public and military landuses at the periphery are noted as they also affect the transport and facilities of the town.

The overall landuse pattern in Akure as at 1966 and 1976 exhibits the characteristics of the pattern which Burgess (1925) explained and called concentric zones. As at 1976, the pattern of growth in land use in Akure can best be explained as concentric round the city centre. However, the pattern changed from concentric to multinuclei in 1986 and 1996. The latter pattern of landuse as noted above is influenced by initial advantage provided by transport during the concentric period. The pattern of landuse however has its implications in the development of transport system and facilities.

The study further reveals that the commuting distance of Akure increased from 5.2km in 1966 to 6.4km in 1976; 10.5km in 1986 and 13km in 1996 for the major artery road. The differential rates of trips flow in ten different landuse Zones were investigated by using non-routed cartographic technique of analysis. A ten by ten O-D movement matrix was carried out on trip generated and attracted by commuters resident in different landuses. The result shows that the core area (i.e. CBD, Commercial landuse and high residential landuse Zones) are concentrated

with flows from all parts of the town. This makes the city centre a chaotic zone for both vehicular and non-vehicular traffic means. The study also reveals low flow of people in the periphery of the town while the flow in the commercial and CBD are not easily discernible (blurred). Factor analytic technique was applied to the ten by ten O.D movement matrix to enable us discern the pattern of trip generated and attracted. The application of the R-mode factor analysis with varimax rotation results in the extraction of four relevant factors which account for 89.9% of total explained variance. The factors loadings show group of attraction or destination while the derived factors scores indicate the most prominent generating landuse regions. The patterns indicated by each of the dimensions have been shown in chapter six. The first dimension shows the pattern of dominant flow of the central attracting region, the second shows the pattern of dominant flow of NW-SE attracting region, the third shows the pattern of dominant flow of NE-SW attracting region and the fourth shows the pattern of dominant flow of North-West attracting region. The first dimension accounts for 34.5% of the total variance and with high factor loadings on residential (High), residential (low), commercial transport/communication, military/police and public/semi public landuses. The second dimension accounts for 24.9% of the total variance and has high factor loading on Educational, Recreational and Publi/Semi public landuses. The third dimension accounts for 17.7% of the total variance and with high factor loadings on Educational, medium residential and low residential landuses.

The fourth dimension accounts for 12.9% of the total variance and with high loadings on industrial and high residential landuses. The patterns of flow were ordered in hierarchical form. The emerging pattern when the principle of dominant association was applied to the O-D matrix shows four hierachy of zones. The most dominant zone (1st order) is the commercial landuse. The public/semi public landuse emerged as dominant zone (2nd order). The satelite zone (3rd order) include industrial, transport/communication, military/police, medium residential, low residential and recreational landuses. Educational landuses however emerged as an independent zone.

Attempt was made to model trip generation in the city. Six major purposes of movement were identified and used as dependent variables. They are work trips (Y_1); Business trips (Y_2) Educational trips (Y_3); Social trips (Y_4); Religious trips (Y_5) and Medical trips (Y_6). The six trip generating types were regressed using independent variables X_1 to X_6 where X_1 represents walking time, X_2 for waiting time, X_3 for vehicles, X_4 for motorcycle, X_5 for population and X_6 for income. Generally, the correlation matrix shows a low coefficient of correlation. When the dependent variables were regressed against the independent variables using the stepwise procedure, all the six dependent variables were significant at 0.1500 level. However, when 0.05 significant level was adopted only two dependent variables (medical trips (Y_6) and total trips (Y_7) were significant. Waiting time (X_6) and population (X_5) help to explain 69.18% of total variance in the medical trips (dependent variable) while income (X_6) helps to explain

44.65% of total variance in the total trips (dependent variable). The result shows that whatever purpose a trip is undertaken, the issue of income, population and waiting time at bus stops are important determinants of trip generation.

The efficiency of public transport was examined by using the following efficiency parameters: road efficiency, fleet efficiency and management/operational efficiency. The indicators used to assess the route way include road surface quality, road surface condition, road width and road complementary facilities. Similarly, the vehicle round trip which was examined in conjunction with the load factor showed that most routes have satisfactory round trips. The assessment of the management was carried out through an examination of both revenue and cost measured in terms of EPK and CPK, waiting time and load factor. The assessment carried out on each route was used to profer management policies.

9.3 CONTRIBUTION OF STUDY

Several studies have been carried out on urban transport problems with the major aim of finding solutions to traffic congestion. Most of these studies use traffic census on major routes to assess the severity of urban transport problems and use same to profer solutions (See Bello 1994; Aderamo 1990 and Aribigbola, 1990). Studies which evaluated the involvement of changing pattern of landuse to solve urban transport problems particularly in Nigeria are scanty in the literature.

In this study landuse and transport are viewed as important components of an urban system. Any slight change in landuse affects the transport system (infrastructure and services) and vice versa. Thus, the dynamics of urban landuse arising from rapid change in socio-economic, political, cultural and administrative activities that take place within the various landuses have been noted and analysed.

A major contribution of this study to knowledge is the identification of landuse zones where the community's greatest needs are located. These zones are commercial, residential and public/semi public. With these zones identified as areas where the community's greatest needs are located, other sub-components of transport system such as roadway quality, parking space, fleet size, management, adequate and reliable public transport system can be concentrated.

The analysis and assessment of the non-routed cartographic technique and factor analysis which are used to generate flow patterns of commuters provide the framework guiding areas where urban transport infrastructures can assist in ameliorating traffic congestion in the city. The factor analytic technique helps us to further identify hierarchy of destination and important origins of trips. Areas that are within the 1st hierarchy should be accorded priority in terms of transport infrastructures and services while others should follow accordingly. This is an important aspect of the study and other contributions centre on it. It is a complete departure from the conventional approach which concerns itself with identification of routes with dense traffic in determining the transport planning needs of an urban area. Another major contribution to knowledge is the identification of factors which influence trip generation apart from the conventional socio-economic variables. Purpose of trip generation was used as dependent variables while waiting time, walking time, vehicle, motorcycle, population and income were used as independent variables. The stepwise multiple regression applied reveals the contribution of each independent variable to the trip generation. Apart from this, trip purpose at disaggregate level can be used to identify the contribution of trips resulting from embarking on any journey. On overall trips in a city (aggregate level) the multiple regression also provide a model for forecasting trips. Thus a number of trip forecasting models at 0.15 and 0.05 significant levels have been evolved as the crux of the contribution of landuse to trip generation.

9.4 PLANNING IMPLICATIONS

The findings of this study have a lot of transport planning implications. The study reveals that various landuses have different potential to generate and attract traffic. The potential of landuse to generate or attract traffic depends on location, characteristics and areal extent. The trend since the last four decades shows a continual growth of importance in the way commercial and public landuses are put to, while some also decline in importance (e.g. cultural uses). It also reveals that the stage of development of a city plays important role in the choice of transport system and infrastructures adopted. This is a concern to city planners because of the transport implication of such growth. The identification of the volume of traffic generated or attracted by these landuses suggest the need for para transit on the routes that link up commercial and public landuses to residential zones of the city. This kind of measure will go a long way to reduce congestion in some routes and also reduce waiting time at bus stops to such zones.

Commissioned work on the town showed that as much as 80.27% of the commuter's in the city depend on public transport for their commuting activities as at 1980 (Akure Master Plan 1980-2000). This study however reveals that as much as 60.06% depend on public transport for their daily activities as at 1996. In either cases, more than 50% of the commuters resident in the town still rely on public transport. These studies show that public transport system enjoys good patronage in the city and as such need to be adequately and efficiently provided for. On adequacy, some landuse zones are not adequately provided with

public transport services especially high residential zone, transport/communication and military/police landuse zones. On efficiency, some routes should be shortened while there is need to increase vehicles on others to make transport operator reap maximum benefits. The bituminous layers of some routes have started to wear. This, if not checked by constant maintenance, may lead to delays and prolong journey time. The efforts of the Petroleum Trust fund (PTF) in the reconstruction of some routes are praise worthy. It is however, the duty of urban transport planners to ensure maintenance culture on these routes so that they could last longer.

The existing road network and the quality of individual street sections reveal that lot of improvement strategy need to be undertaken, if the future traffic is to be properly managed.

The core area of the city is dominated by Arakale, Ondo road, Oyemekun road, Oba-Adesida road etc. Of importance however is Oyemekun and Oba-Adesida road (4 lane way) which accumulate the function of major thorough fare and main distribution artery for local traffic. According to Ondo State Urban Development Project preparation study (1986). "the Ilesa-Benin Federal Highway bypasses the built-up area, it does not prevent through-going traffic from taking the "main street"; traffic going from Ondo to Ado-Ekiti and to Owo still prefers the shorter and seemingly more natural traject through the core area". This finding further lend credence to the result of this work that the core area is a loci of traffic convergence. This work therefore suggest a ring road around the core-area of the city. The ring road will assist to disperse traffic from any point of the

city which is not destined for the city centre to the right direction. The boundary of the core area as at 1996 as shown by Figure 4.4 is suggested for the construction of a circular road. This boundary is chosen because not much money would be spent on compensation for demolition of houses. Apart from this, the construction of the circular road will serve both immediate and future free flow as well as the efficient distribution of traffic in the city.

Erekesan market has been and will continue to be an attractive zone for commercial activities in the city. Public parking space is suggested in this zone. This will reduce drastically the parking of vehicles on roads. It is also hoped that this will check incessant traffic hold-ups in the core of the city. The periphery of the city on the other hand needs gradual planning in the area of transport infrastructures and services before the emergence of other structures which can pose problems to its achievement.

Similarly, public parking spaces are conspicuously absent in almost all the landuse zones except public/semi public landuse zone. The commercial landuse zone in particular as noted above deserves special attention. The town planners should make necessary provision for a public parking space in the core area of the city even if tolls are collected from motorist. It is therefore the duty of urban transport planners to ensure the provision of road space with appropriate road complementary facilities to ensure free flow of traffic especially in the core region which predates planning policies.

9.5 FUTURE RESEARCH AREA

The main focus of this thesis is the investigation into the changing pattern of landuse and intra urban transport development with reference to the city of Akure. The study reveals the trend of change in landuse over four decades and how it could be used to plan its transport system (Infrastructure and services). A study of change in landuse and how it affects freight movement is an important area where future work could be concentrated. It is therefore suggested that a research into this area will complement this work and make comprehensive planning in the area of urban transportation possible in Akure.

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APPENDIX IV

DEPARTMENT OF GEOGRAPHY,

UNIVERSITY OF ILORIN, ILORIN

An investigation into the route quality and performance of major routes in Akure.

Interview proforma, for Chairman or Representative of NURTW on each route.

A. Road quality survey:

1. Name of route:
2. State the conditions of the route surface (major part)

(tick as appropriate)

a

Tarred	Quality	Asphalt	Gravel
i	Smooth		
ii	Fairly smooth		
iii	Rough		

b

Untarred	Quality	Earth Road
i	Smooth	
ii	Fairly smooth	
iii	Rough	

3. Type of lane

   (a) One single lane ☐

   (b) two lanes ☐

   (c) more than dual carriage way ☐

4. Seasonality of route

   (a) All season ☐

   (b) Seasonal ☐

5. Complementary facilities available on this route (tick as applicable)

	Availability	V. Good	Good	Fair	Poor
i. Kerbs					
ii. Laybys					
iii. Parking facilities					
iv. Zebbra Crossing					
v. Road/terminals					
vi. Bus stop/terminals					
vii. Petrol Stations					
viii. Vulcanizers					
ix. Traffic light					
x. Traffic warden					

B. Transport Services

1. Type of vehicle plying this route

(a) Taxi Cabs ☐ (b) motor cycle ☐

(c) bus ☐ (d) others (specify) ☐

2. What is the average number of trips per day in this route? .....

3. What is the average cost (fuel, receipts etc) of running trips per day?

.....

4. What is the average income for running trips for a day? .....

APPENDIX V

To examine the viability of transport services on each route, the Route Performance screening procedure is applied.

Case 1	high	low
EPK:CPK	*	
Average waiting time	*	
Load factor	*	
Need for extra buses on the route or route shortening		

Case 2	high	low
EPK:CPK	*	
Average waiting time		*
Load factor		*
Route probably operating well, through reduction in buses or route extension should not be ruled out.		

Case 3	high	low
EPK:CPK	*	
Average waiting time		*
Load factor	*	
Route operating well, although load factor should be reduced possibly by route alterations		

Case 4	high	low
EPK:CPK	*	
Average waiting time	*	
Load factor		*
Possibly a low frequency route operating quite well, more smaller buses might be considered.		

Case 5	high	low
EPK:CPK		*
Average waiting time		*
Load factor		*
Too many buses on the route or possible case for route extension		

Case 6	high	low
EPK:CPK		*
Average waiting time	*	
Load factor		*
Route layout may be wrong		

Case 7	high	low
EPK:CPK		*
Average waiting time	*	
Load factor	*	
If low frequency route There may be a case for reduction in buses. Also a case for more smaller buses or route restructuring		

Case 8	high	low
EPK:CPK		*
Average waiting time		*
Load factor	*	
Route layout probably at fault. Possibly a case for fewer, large buses.		

EPK = Earning Per Km.(EPK) in a day
CPK = Cost Per Km. (CPK) in a day.

Source:- Fourace, 1987.

APPENDIX VI

Standard Roadway Quality Assessment

(Weighting Scores)

Index	Weighting 10	Weighting 5	Weighting 1
1. Types of surface	Asphalt	Gravel	Earth
2. Condition of the road surface	Smooth	Rough	Rough and full of pot holes
3. Road width	4 or more lanes vehicular capacity	2 lanes vehicular capacity	1 lane vehicular capacity
4. Road Complementary	-Point of interchange -Bus stops -Terminals -Parking facilities -Pedestrian walkways -Pedestrian crossing -Traffic light/traffic warden -road signs -petrol station -Road side Vulcanizer -Zebbra crossing -bridge/ overhead bridge. Above 6 facilities attract 10 points	where up to 6 facilities are present record 5 points where less than 6 facilities are available score 2	No Complementary facilities at all = 1

APPENDIX VII - ANOVA

Test 1

The null statistical hypothesis states thus H_0 - There are no significant variation in the mean walking time to bus stop, mean journey time to places of work and mean waiting time at bus stop between and within the ten (10) different landuse zones in Akure.

H_1 - The alternate hypothesis i.e. there is significant variation in the above means.

Analysis of variance (ANOVA)as used by Dinham (1976:225) was used, to get the following:

i. Total sum of squares = SS_T = $\sum X^2_{ij}$ (All Scores) $-$ $\frac{(\sum Xi)}{N}$ (All scores)

ii. Between sum of squares = SS_B $\frac{\sum (Xi)^2}{n}$ (groups) (each group) $-$ $\frac{(\sum Xij)^2}{N}$ (All scores)

iii. Within sum of squares = SS_W $\sum X^2ij$ (All scores) $-$ $\frac{\sum (Xi)^2}{n}$ (Groups) (Each group)

Zone	Mean Walking time to bus stop		Mean journey time to place of work		Mean waiting time at bus stop	
	X_1	X_1^2	X_2	X_2^2	X_3	X_3^2
1	9.87	97.42	20.35	414.12	8.81	77.62
2	7.07	49.99	25.80	665.64	8.21	67.40
3a	10.2	104.04	20.43	417.30	10.88	118.37
b	6.59	43.43	4.96	24.60	5.75	33.06
c	7.81	61.00	10.9	118.81	8.82	77.79
4	9.87	97.42	17.56	308.35	9.23	85.19
5	8.61	74.13	1.47	2.16	8.95	80.10
6	15.38	236.54	24.76	613.06	11.84	140.19
7	7.07	49.99	19.79	391.64	10.53	110.88
8	8.02	64.32	10.20	104.04	7.50	56.25

$\sum X_1$	90.49	156.22	90.52	$\sum Xij = 337.23$
$\bar{X}$	9.05	15.62	9.05	
n	10	10	10	N = 30
$\frac{\sum (X_1)^2}{n}$	818.84	2440.47	819.39	$\frac{\sum (Xi)^2}{n} = 4078.7$
$\sum X^2ij$	878.22	3059.81	846.85	$\sum X^2ij = 4784.88$

i. $SS_T = \sum X^2ij - \frac{(\sum Xij)^2}{N}$

$= 4784.88 - 3790.80$

$= 994.08$

ii. $SS_B = \frac{\sum(\quad Xi)^2}{n} - \frac{(\sum Xij)^2}{N}$

$= 4078.7 - 3790.80$

$= 287.9$

iii. $SS_W = \sum X^2ij - \frac{\sum(\sum Xi)^2}{n}$

$= 4784.88 - 4078.7$

$= 706.18$

Source of Variation	Sum of squares	df	MS	F
Between	287.9	2	143.95	5.50
Within	706.18	27	26.15	
Total	994.08	29		

The table F distribution values

at α = 0.05 is 3.35

at α = 0.01 is 5.49

The null hypothesis (H_0) is therefore rejected at both 0.01 and 0.05, levels of significance. This means that the H_1 hypothesis holds, i.e. there is statistically significant variation in the walking time to bus stop, journey time to places of work and waiting time at bus stop between and within the ten (10) residential zones in Akure. The rejection of H_0 at both alfa levels erases the possibility of committing both type I and II errors.

APPENDIX VIII

Explanatory ability of the Regression Model at 0.05 significant level.

	Computed (P_1)	Observed (A_1)	$P_1 - A_1$ Residual	$(P_1 - A_1)^2$	$(A_1)^2$
1	418.6	402	-16.48	271.59	161604
2	373.7	402	28.33	802.59	161604
3	616.3	680	63.73	4061.51	462400
4	613.7	667	53.27	2837.69	444889
5	647.7	600	47.72	2277.2	360000
6	533.6	450	83.62	6992.3	202500
7	518.9	520	1.06	1.12	270400
8	338.6	280	-58.46	3417.57	78400
9	364.3	350	-14.33	205.35	122500
10	327.8	402	74.21	5507.12	161604
				Σ = 26374.04	Σ = 2425901

Using Theil's model (1966)

$$U = \frac{\sqrt{\frac{(P_1 - A_1)^2}{n}}}{\sqrt{\frac{(Ai)^2}{n}}}$$

$$U = \frac{\sqrt{2637.4}}{\sqrt{242590.1}}$$

$$U = \frac{51.36}{492.5}$$

$$U = 0.10$$

This indicates a 90% predictive accuracy at 0.05 significant level.

APPENDIX IX

Explanatory ability of the Regression Model at 0.15 significant level.

	Computed	Observed (A_1)	$P_1 - A_1$ Residual	$(P_1 - A_1)^2$	$(A_1)^2$
1	3286	3429	143	20449	11758041
2	3181.1	2919	-262.1	68696.41	8520561
3	4563.0	4397	-166	27556	19333609
4	5265.5	4386	120.5	14520.25	19236996
5	4433.8	4445	11.2	125.44	19758025
6	4050.8	4350	299.2	89520.64	18922500
7	3844.1	3589	-255.1	65076.01	12880921
8	3948.9	3710	-238.9	57073.21	13764100
9	2986.3	2949	-39.28	1389.80	8696601
10	3582.5	3968	385.5	148610.25	15745024
				Σ = 493017.01	Σ = 1486163.78

$$U = \frac{\sqrt{49301.7}}{\sqrt{14862637.8}}$$

$$U = \frac{222.04}{3855.08}$$

$$U = 0.057$$

This model therefore indicates a 94.3% predictive accuracy at 0.15 significant level.

APPENDIX X

UNIVERSITY OF ILORIN, ILORIN, NIGERIA

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Our ref:

your ref:

Date: 8th April, 1993

To Whom It May Concern,

This is to introduce Mr. E.F. OGUNBODEDE a student in the Department of Geography of this University. He is preparing his thesis based on original research and fieldwork, as part of the requirements for his P.hD. degree. It would be most appreciated if you could offer him all necessary assistance and information to carry out the research on Urban Landuse and Intra-City Transport Development in Akure.

Thank you.

Dr. J.F. Olorunfemi
Ag. Head of Department