THE STRUCTURE AND DYNAMICS OF CENTRAL PLACE SYSTEMS: A CASE STUDY OF SOUTH-WEST NIGERIA CENTRAL PLACES.

BY

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ABSTRACT

This study analyses the spatial structure and the underlying processes of central places in South-West Nigeria. It adopts the systemic approach to the problem of spatial structure and spatial dynamics and then utilises concepts of "order by fluctuation and dissipative structure" developed in physics as alternative explanatory paradigm for examining the changing relationships between spatial structure and spatial dynamics.

The study operationalised conceptual issues such as, systems analysis and systems of central places human settlement as central places; and, spatial dynamics and spatial structure. It also discussed central place theory [CPT] and Dynamic central place theory [DCPT] as theoretical foundation for the research.

The study covered all central places in South-west Nigeria with population figures of 5,000 and above in 1952. However, local government headquarters [1976 local government reforms] that do not meet this criterion were included, being central places to their geo-political units. The spatial structure of the one hundred and thirty six central places so identified between 1900 and 1963 were analysed using

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population data. Since this variable is discontinuous after 1963, a total of fourty-five central functions were collected for each of the central places for three different periods - 1967, 1976 and 1991. These central functions which covered industrial, commercial and service activities were obtained mainly from secondary sources.

The changing distribution pattern of the central places since 1900, is first examined using high order Nearest Neighbour technique, while both qualitative and quantitative changes in the spatial structure are evaluated with certain indices of population growth and concentration. Processes of central place growth are discussed within three dominant historical phases, namely, pre-colonial, colonial and early independence epochs. The study then employed multivariate factor analytical technique to examine and analyse the structural features of the central places in the three time periods - 1967, 1976 and 1991 [important benchmarks in Nigeria's political and economic history]. It further employed the technique of hierarchical cluster analysis to define the functional hierarchy of the central places. Changes in the hierarchical structure of the central places within different classes or orders are analysed using the Markov chain model,

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which also provides a framework for generalising the spatial processes of the central places.

From a detailed analysis of the structure of central places, the study identifies pertinent spatial processes that govern spatial structure of development in the region. These spatial processes are related to the observed spatial structure of the central places by an explanatory/predictive canonical model. Changes in the relationships are also examined while processes that govern the spatial structure are quantified.

The results of the higher order nearest neigbour analysis shows no statistically significant changes in the location pattern of the central places. However, there is a marked deviation of the distribution pattern of the central places from theoretical postulation of regularity. Factors of socio-economic and political culture of the Yoruba race within prevailing physiographic context are noted to be fundamental to the observed distributional pattern of the central places. Furthermore, observed variations in the relative sizes and growth structure of the central places from earliest times to date are understandable within broad geographical cum historical context of regional central places. Essentially, it

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is the nature and changing role of the centers as historical settlements and traditional centers of trade, administration and cultural activities that are fundamental.

Furthermore, the factor analytical technique shows that the regional central places possess three basic structural features which are; Industrial development; Education and commerce; and, Social or basic services. Based on the identified dimensions, the hierarchical cluster analysis reveals that five classes or orders of centers are distinguishable in the three periods. It is observed that changes in the hierarchy of the central places can be described by Markov chain model. The results of the model show that higher order centres are more stable in the hierarchy, and that the probability of lower order centres moving into higher orders decreases with time. However an equilibrium distribution of centres in the hierarchy will be reached by the year 2026 A.D.

The results of the canonical correlation model of the relationship between spatial structure and spatial processes show that the observed variations in the spatial structure of the S.W. Nigeria central places are due mainly to changing but differing political functions of the central places and their

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accessibility seen in the strategic location of a center as either Port city, or along important road or railway network or air accessibility.

This study provides useful information on the trend and character of the regional space economy and, the types and relative strength of the underlying spatial processes. It is suggested that research into spatial dynamics of regional economic structure, should begin with an examination of the spatio-temporal structure of the system of interest, rather than invoking constant universal processes to be related to a spatial structure. The significant relationship between spatial structure and processes produced by the canonical correlation in this study shows that relevant spatial processes could emerge from a careful analyses of a spatial structure.

The study further shows that while systems analysis provides an adequate framework for conceptualizing the web of interrelationships in a spatio-temporal organisation of cities, the unraveling of these relationships remains a major challenge to the formulation of theories and development of models of temporal and spatial processes.

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DEDICATION

To my wife

Funke Christy Adeboyejo

She is a source of encouragement to me

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ACKNOWLEDGEMENT

Now unto the king Immortal, Invisible and the only wise God, be all the Glory, Honour and Praise. Whatever I am, it is by His Grace. Lord I appreciate you.

Indeed, I owe a lot to many people and institutions that have contributed in one way or the other towards the successful completion of this thesis.

I have great pleasure in expressing my profound gratitude to Professor Bola Ayeni under whose supervision this work was carried out. He consistently showed keen interest in the work, and painstakingly read the several drafts. His constructive criticisms were very invaluable, for which I will for ever remain grateful.

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I am grateful to my parents Mr. and Mrs. C.A. Adeboyejo for their moral support and prayers throughout my academic career. In particular, I thank them for their untiring endurance for the delay in reaping the benefits of their labour. I also thank all my brothers and sisters for their undiminishing support and constant prayers during this study.

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CERTIFICATION

I Certify that this work was carried out by Mr. Aina Thompson Adeboyejo in the Department of Geography, University of Ibadan.

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CHAPTER ONE

INTRODUCTION AND GOAL OF RESEARCH

1.1 INTRODUCTION

Various forms of human settlements [villages, towns and cities] develop spontaneously in many parts of the world. They are not planned. In a similar vein, within their national or regional context, they grow or decline at different rates. Growth centers have emerged in many locations for different reasons. Similarly, declining centers have sprung up and have come to dominate the development scenery. While complex changes involving demographic characteristics and wide range economic functions are taking place within settlements in a region, it is the simplification of these characteristics that we see in the declining centres. In most cases, however, the complex mechanisms of growth or decline are not well understood and, where known, they are not regulated.

The implications of unregulated mechanisms of growth or decline on the structure of national and regional economies is far reaching. These can be resolved in crisis of regional development, an ugly scenery in which majority live in largely undeveloped rural areas perhaps far below the poverty line. In both the developed and developing economies, spatial development inequality is not only seen in the breath-taking

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gap between "urban rich areas" and "rural poor" environment, but also among towns and cities of comparable sizes where variations in development is a major feature. However, the phenomenon is more pronounced in the developing countries where the issue has assumed political significance.

The structure of a regional or national space economy is indeed a reflection of its past. It also provides either a constraining or smoothening framework for future development. Consequently, it emphasizes the need to understand the structure of a regional system in relation to the various complex mechanisms summarised in the socio-political and economic history of such entities. Notwithstanding, Geography and scholars of urban studies have had difficulty dealing with process-pattern relationships [Coffey,1981]. This difficulty perhaps stems from the long standing belief that geography is essentially morphological [dealing only with structures] [Schaeffer,1953]. As such, reference need not be made to time and change.

The spatial organisation of a nation or its sub-regions, no doubt should be of primary concern. However, since the fundamental nature of the city systems is developmental, changes in them should also be explored. Equally important are

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the underlying processes or dynamics of the spatial structure. The analysis of the development of a spatial structure in relation to the underlying processes is of both scientific and practical importance. Structural dynamics is not an exclusive preserve of the natural sciences, but also that in the social sciences in general and urban geography in particular, social processes are knowable and are analytically tractable.An examination of the spatial structure in relation to processes will highlight what should be objects of positive policy in a regional development framework. Our primary interest in this research therefore is the structure of Central places and the underlying spatial dynamics or processes. The research seeks to investigate the spatio-temporal dimension of a regional structure and the associated processes within a systemic context. Our position here is that rather than invoking certain universally recognised processes and relating them to any regional structure, research into problems of spatial structure and spatial dynamics should begin with a careful examination of the systems of interest in search of relevant processes. The identified processes can then be related to the observed structure. Such approach it is believed is more meaningful within the context of regional planning.

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1.2 STATEMENT OF THE PROBLEM

Virtually all attempts to understand the nature of spatial structure or spatial systems in urban geography have operated within classical Central Place Theory [CPT]. It is therefore only natural, necessary and systematic to examine the problem within this context so that we can proceed from known to the unknown.

A close look at the existing literature on CPT shows that researchers have been pre-occupied with either a theoretical discussion and mathematical formulation aimed at establishing some general properties of central place structure. [Beavon,1977; Dacey,1966,1976; White,1974; Denike and Parr,1970;] or empirical studies designed to validate the geometric implications of the theory. [Morrill,1962;1963; Guzen-zade,1982; Yeates et al 1980;].

The structural defect in the classical CPT is reflected in the nature of conclusions derived from theoretical discussions. The point is, the discussions have been focussed on a perfect equilibrium state of Cities or systems of Cities, while neglecting the role of time and the complex nature of central places. Furthermore, the discussions are surprisingly silent on the processes that give rise to observed structure

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of central places.

One major implication of CPT which has received a great deal of attention is the concept of hierarchical arrangement of central places. [Taffee, 1962; Abiodun, 1967; 1968; Conzen, 1977; Bourne,1975]. The major focus has been on establishing the validity or otherwise of the existence of hierarchy of centers. [Berry,1956; Berry et al,1962; Isard,1956; Davies, 1967; Mabogunje, 1968; Preston, 1971; Berry and Garrison, 1958a].

However from the point of view of regional development, what is crucial is not whether there is hierarchy or not, but the nature of the hierarchy, particularly its spatial economic implication and the underlying spatial dynamics or processes. Regional systems hierarchy will reveal the spatial character of an economic system. Given this important observation what then is vital from the stand point of regional planning is the dynamics of regional hierarchical structure rather than its presence or otherwise.

Furthermore, given a system of Cities, one can identify three basic dimensions - the size distribution, spatial arrangement and the stage of development or time component. Researchers have however been preoccupied with the first two

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dimensions, thus deriving static equilibrium results. Central places are dynamic entities, thus their structure are constantly changing. Similarly the underlying spatial processes are changing, giving rise to different structures at different times. Thus processes operating in the central places need to be considered in dynamic terms with the aim of predicting future structures. Therefore, if development of central places take place through time, and conditions within each place is constantly changing, an investigation of the time and spatial dimensions of central place systems is necessary. This venture is beneficial at least for three reasons.

First, that time-space consideration will lead to an improvement of theory and call for a refinement of methods of investigation, particularly the multitude of existing static urban systems models. Secondly, the approach makes possible, the identification of the dominant processes that govern the spatial organisation of central places and of the structure of the national or regional space economy. Finally, an understanding of such processes is required for monitoring emerging regional and national urban systems, and planning the system with a view to meeting national development goals.

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1.3 AIM AND OBJECTIVES:

The primary concern of this study is the analysis of the structure of South Western Nigeria central place systems and their underlying spatial processes. The research seeks to examine the spatio-temporal distribution, the relative sizes, concentration and growth structure of the central places, and then evaluate the underlying spatial processes of location and growth of the central place systems. Furthermore, the study seeks to analyse the functional structure of the central place systems; the nature of and changes in the regional functional hierarchy; the spatial economic development implications of the hierarchical structure and the changing quantitative relationships between spatial structure and the underlying spatial processes.

In order to achieve the above, the study specifically seeks to:

1. analyse the distribution of central places in the region in three time periods [1900, 1952 and 1963],with a view to discovering the underlying dynamics of location.
2. evaluate in relation to the underlying processes, the qualitative and quantitative changes

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in the central places from about 1800 to date.

3. examine the nature, and spatial pattern of the hierarchical systems of the central places, and the structural relationships in the hierarchy.

4. analyse changes in the hierarchy of the central place systems.

5. evaluate the relationships between central place spatial structure and underlying spatial processes.

1.4 THE SCOPE OF THE RESEARCH

This research covers South-Western Nigeria. Comprising of the present states of Lagos, Ogun, Ondo, Oyo and Osun states, it occupies a total of 73,852 sq km, representing just about 7.92% of Nigeria's land area. The region had a total population of 4.6 million and 10.9 million in 1952 and 1963 respectively, representing about 15% and 19.6% of Nigeria's total population for these periods. A total of 135 or about 47.9% of the 329 urban centers in the country in 1952 were found in this area. Similarly out of the 181 cities that had population of 20,000 and above in 1963, 77 or 42.5% are found in the area. The region, no doubt has the densest clusters of urban centers in Nigeria.

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For a very long period, South-Western Nigeria remained a single political entity. First, it was part of the old Oyo empire that thrived sometimes between the 16th and early 19th century. It also existed as a single geopolitical and administrative unit of Western Region from 1945 to 1967 and mainly as Western state up to 1976, when it was broken into four geopolitical units of Lagos, Oyo, Ogun and Ondo states. The fifth state, Osun was carved out of former Oyo state in 1991. Figure 1.1 shows the administrative regions of South-Western Nigeria between 1955 and 1991. The distribution of central places in the region is also shown in figure 1.2. It should be of interest therefore to investigate the influence of the changing political and administrative environment on the elemental components of the political system.

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ADMINISTRATIVE REGIONS OF SOUTH-WEST NIGERIA (1955-1991)

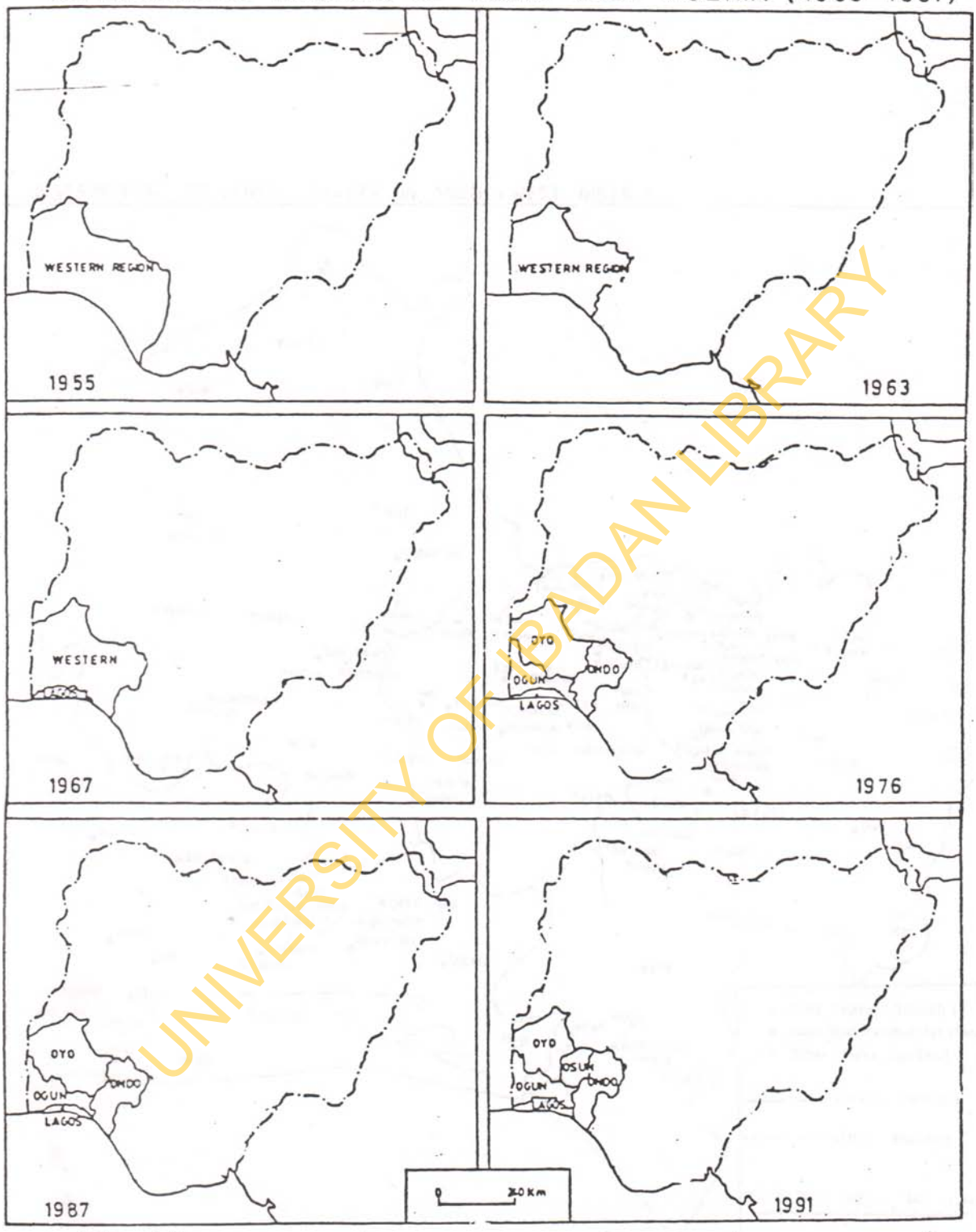

Fig. 1.1:

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DISTRIBUTION OF CENTAL PLACES IN SOUTH - WEST NIGERIA

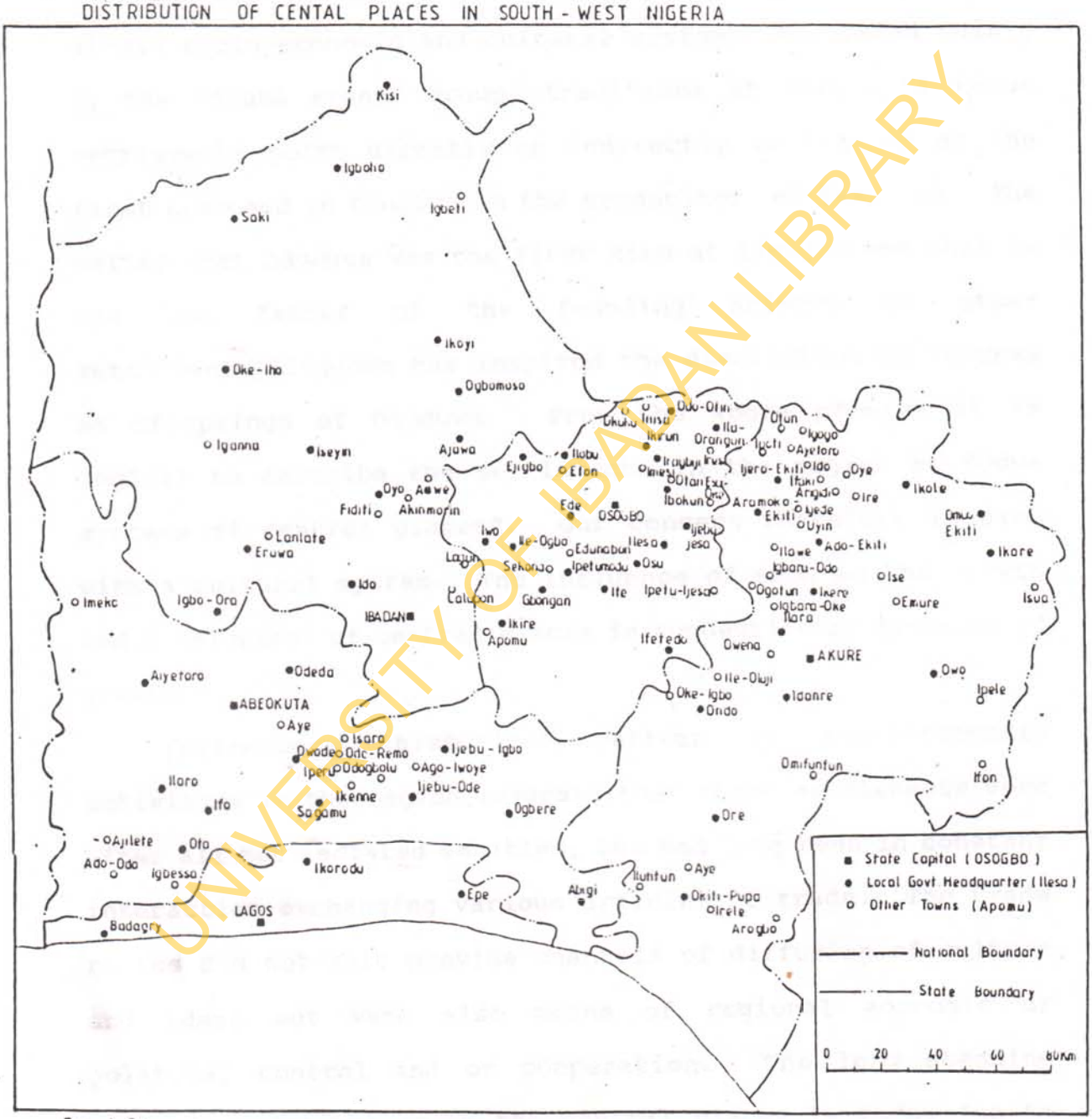

Fig. 1.2 :
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The settlements in the region constitute elements of a single socio-economic and cultural system. Populated mainly by the Yoruba ethnic group, traditions of origin of these settlements point directly or indirectly to Ile-Ife as the first home and to Oduduwa as the progenitor of the race. The belief that Oduduwa was the first king at Ile-Ife and that he was the father of the founding princes of other settlements/Kingdoms has inspired the description of Yorubas as offsprings of Oduduwa. From the above premise it is logical to describe the settlements in the region as "Odua systems of central places". Our concern therefore is also with a cultural system. The influence of such on the growth and development of central places is suggestive of dynamics of growth.

Furthermore, historical pattern of socio-economic activities in the region suggests that these settlements were after all not isolated entities, but had long been in constant interaction exchanging various articles of trade. The trade routes did not only provide channels of diffusion of culture and ideas but were also means of regional economic or political control and or cooperation. The long standing economic relations among the central places is today (up to

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1991) evident in the presence of such regional organisations as Odua group of companies, jointly owned by the states of Ogun, Oyo, Ondo and Osun. Again the voting patterns in this region in the 1983 and the annulled June 12 1993 elections are reminiscence of the existing historical political cooperation among the settlements in the area. Thus factors of regional economic cooperation, political integration and the presence of various sub-regional development associations are manifestations of the presence of long standing "spirit of communal existence" which have prevented the death of settlement, through various community development programmes. With the steady growth of settlements ensured, it is possible to investigate the complex forces of change in the settlements.

Besides, South Western Nigeria has a unique pattern of urban development. In the region, urbanization predates European colonisation of the country. Urbanism it is noted has always been a way of life of the people [Mabogunje 1968; 1972]. Colonial urban development represents one of the phases of urbanisation in the area. It is therefore possible to examine and analyse the ever changing dynamics of central place systems within changing socio-economic and political

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frameworks.

The Yoruba race generally is one of the best known peoples of Nigeria. With sizeable population; long urban tradition; sophisticated and large-scale political organisations and, outstanding cultural heritage, these and related themes have attracted several scholars from different disciplines. Thus for this research, it is possible to make reference to archival and numerous published sources for relevant data and necessary information.

1.5 ORGANISATION OF CHAPTERS

The First chapter of this research discusses the introduction to the study and formulates the research problem which follows on from a survey of the existing literature. The regional context of the research is also discussed. In chapter two, various conceptual and theoretical issues in central place systems, the methods of survey and analytical techniques are discussed. The discussions here provide a consistent notation for the series of analysis that begins in the next chapter.

In chapter three, the spatio-temporal distribution and underlying location processes of the central places are

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examined. While in chapter four, the concentration, relative size distribution, and growth structure of the regional central place populations are analysed, and the processes of central place population growth and concentration discussed within dominant historical epochs.

Chapter five examines the functional structure of the central place systems. It highlights the structural features of the systems, defines and analyses the hierarchy of the central places. An accounting model of change is then employed in chapter six to analyse the stability of the central places in the hierarchical structure and a generalisation of the processes of change in the hierarchy is made.

The quantitative relationships between the processes and observed spatial structure are presented in chapter Seven, while the summary of research findings, the theoretical and planning implications of the study as well as research agenda for the future are presented in chapter Eight.

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CHAPTER TWO

ISSUES IN CENTRAL PLACE SYSTEMS

2.1 INTRODUCTION

The structure [spatial arrangement] of central place systems can be described by any of a number of models. It can also be generated by several processes. In any empirical investigation of structure and processes of central place systems therefore certain issues directly related to concepts and theories come to the fore. In the discussion that follows in this chapter, pertinent conceptual and theoretical issues in central place studies are discussed in order to, put the research within an appropriate conceptual and theoretical path and thus provide the work with a consistent culture.

2.2 HUMAN SETTLEMENTS AS CENTRAL PLACES

Human settlements consist of such habitations as hamlets, villages, towns, and cities. In them, nature and the efforts of individuals, the ingenuity of human communities and the entire culture of the world fuse together. In them also exist the past and present in a unity that lay the foundation for the future [Doxiadis 1968]. Generally, world settlement patterns form a continuum that is more of a reflection of

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growth-path of settlements from the smallest hamlet to the largest metropolitan center, from the most elementary to the most complex in technology and from the most rural to the most urban in culture [Tisdale, 1942].

It is seen from the above that along a continuum of settlement patterns are hamlets, villages, towns and cities, and that those different classes reflect more of different degrees of human concentration and or the varying levels of technological and economic advancement. From the point of view of their economic functions, towns and cities are points in space where basically trading economy is articulated [Christaller, 1933]. Thus they are points where rural areas collect their surpluses for sale and buy certain other goods and services. The goods and services are those which require central locations for their efficient disposal, hence their definition as central goods, and the locations - towns, cities, as central places.

In a sense, villages and hamlets are central places, being centers of primary production and services. It is however, the human settlement types in the upper end of the settlement continuum [towns, cities, and metropolis] that are for the purpose of this research referred to as central

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places. This conceptualisation offers a greater precision of expression in terms of economically functional entities in a settlement system.

Towns, cities and metropolis [central places] are not only dwelling places and cultural museums, they are workshops for people. They are multifunctional units and as such, they attract people of different occupational background and skill. They are the most active members of settlement systems and, being leading members in the system, they have the potentials to generate flows of goods, services, information, people and idea. Thus as a form of human settlement, a central place is a social system located in geographic space. It occupies a precise position in a system of interconnected settlements, providing goods and services to dispersed population.

The structure of the central place system is the arrangement of the entire central places in terms of hierarchies or continuum of functions. [Coffey 1981]. National or regional development takes place within this network, but the occurrence is neither uniform nor simultaneous, for development impulses or activities originate from certain centers and are transmitted to other areas in a definite order. [Friedman 1978]. It follows therefore that the

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structure of central places in a region will create a pattern of development potentials that will govern the evolving character of the region or nation. The structure also suggests the presence of dependency relations, the nature of which may be a controlling one for national or regional development.

In this study therefore, we utilise the concept of central places as functional or economic expression of towns and cities, examine the structure of the regional central place systems, and the nature of the dependency relations within the systems. The presence of dependency relations within a set of central places informed our conceptualisation of these human settlements as systems and, investigation within systemic framework is therefore naturally appealing. The concepts of systems analysis and systems of central places is therefore operationalised next.

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2.3 SYSTEMS ANALYSIS AND SYSTEM OF CENTRAL PLACES.

The system approach is an organising framework that provides not only conceptual but also a methodological focus to central place study. Even though it is not a recent one, the formal application of the concept in many fields particularly urban geography is relatively new.

To the scientist, the term refers to a set of objects together with the relationships between the objects and between their attributes [Hall and Fagan, 1968]. For a system of central places, the objects are the locations, or the set of central places, while the attributes are defined to include the activities within the city. Such attributes or activities include, economic characteristics and population composition. The spatial interaction and the qualitative and quantitative aspects of the relation between the central places are identified as the observed relationships between the objects. In an holistic manner, the system concept stresses the dynamic interrelatedness of central places with emphasis placed on the relationships of their components, rather than on the specific characteristics of the elements [Coffey 1981].

In a regional or national context, system of central places refers to the set of settlement or aggregate of towns

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and cities. It includes the totality of activities in each settlement, and the observed relationship of settlements with their surrounding areas. Thus the presence of strong interactions among a set of settlements in a bounded area, the existence of feedback effects which regulate growth and change, all imply the existence of a system of central places. Such interactions can be seen in the pattern of historical dominance and, or, of economic interaction as in trade relations among central places. The feedback effects can be in form of either infrastructural provision to lower order centers or rural-urban migration and its wide implications at both ends. All these may regulate growth and change at the rural and urban centers respectively. The question however is, what type of systems are central place systems, and, how do they differ from natural systems.

Bourne [1978] observed that central place systems are not simple economic or political systems. Characteristically, they are inherently complex, highly unstable, often diffused and are continually evolving in response to external influences,. which are highly unpredictable. These external influences constitute what Emery and Trist,[1972] term "the turbulent environment of the social systems"

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Furthermore, central place systems are cumulative learning systems [Dunn, 1971]. Within the context of regional development this implies that a central place system has internal self-regulating mechanism that dictate their form and evolution and that they learn from experiences and can make adaptive changes to expected future situations. They can also adjust to different internal stress conditions and different external needs. However, unlike natural systems, it is rather difficult if not impossible to deduce the response conditioned by any given change in the operating parts of the system. This makes prediction of future systems path difficult.

Major attractions of the concept of central place system are that, it provides a framework for monitoring the aggregate development and behaviour of central places. It also provides a linkage for studies that focus on the relationships between the nation and its elemental spatial components. Such linkage makes possible an interdisciplinary methodological approach to the understanding of the processes operating in a system of central places. The concept also provides a framework for unravelling the web of interrelationships among central places in a region. In essence, systemic approach is a good if not appropriate method for scientific geography.

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2.4 SPATIAL DYNAMICS AND SPATIAL STRUCTURE

The general usage of the term dynamics suggests a continuous operations or series of operations taking place or carried on in a definite manner. Harvey [1969] provides a more scientific usage of the term when he writes. "It is a sequence of events overtime that are connected by some mechanisms." An explanatory context to the usage of the term is also provided in that any "sequence of events" may not be explaining anything in particular, whereas "a sequence of events connected by certain established mechanisms" is an explanatory inference [Coffey, 1981]. The argument is, if "event" in context is seen as geographical phenomena, sequence of events connected by mechanisms implies changes in the phenomenon of interest and the underlying process or forces of change. In geographical analysis, changes can be seen over time and over space. Similarly processes have spatio-temporal dimension. Thus we can talk of spatial dynamics or spatial processes. We can also talk of spatial structure or form.

It is important to make the distinction between spatial dynamics and structural changes at the onset because, in the geographic literature there is a tendency to interpret spatial dynamics only in terms of changes in geographical

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events, that is, equating structural changes with dynamics or processes. It is argued for instance that, space and time are inseparable entities, as such spatial structures in the real world are simply slow processes of long duration [Blaunt 1961]. Again according to Chisholm [1967], it is arbitrary dichotomising spatial structure and spatial process. To him, the distinction is a matter of the temporal scale adopted. Furthermore Abler, Adams and Gould [1971] pointed out that process and structure are in essence the same thing, arguing that in the study of spatial phenomenon, whether we see process or structure depends on the time perspective adopted and the rapidity that the process moves.

Spatial dynamics may be conceived narrowly as both changes and processes. This conceptualisation may partly be responsible for the observation that geography has always had difficulty dealing with process [Coffey, 1981]. We thus need a wider perception.

In his discussions of the geographic methodology and the general nature of the discipline, Schaeffer [1953] established a form-process dichotomy within the discipline. To him, geography is essentially morphological and that purely geographical laws contain no reference to time and change. He

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however quickly added that,

> ".. this is not to deny that the spatial structures that are explored are like all structures anywhere, the results of processes, but that the geographer deals with them as he finds them readily made."

Commenting on spatial dynamics, Harvey, [1969] identifies a dichotomy between indigenous [to geography] morphometric laws or postulates and derivatives [exogenous] process postulates. He argues that, synthesis in geography can be achieved when exogenous theories governing processes are linked to theories of spatial form. Thus such works as; Haggerstrand's [1968] diffusion theory and Losch's [1967] central place theory are models of interaction between processes and spatial form.

Bunge [1966] made a useful attempt to resolve form-process dichotomy, saying, the terms are not contradictory concept but dual expression. The dual can be designated as spatial process [dynamics] meaning, movement over earth's surface, and spatial structure, meaning, the resulting arrangement of phenomena on the earth's surface- the distribution. Again referring to spatial structure and spatial process, Warntz, William and Bunge [1968] say they are co-equal duals of form and movement. Even though equating process with movement seems rather a reductionist view of the term, it

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helps in establishing the basic distinction, and to carry analysis beyond changes in spatial structures. Spatial process can be seen as a feedback loop in which morphology [structure] is not only the result of changes, but to a large extent plays a causal role by setting the initial conditions or constraints for the processes.

The position adopted here is, " if the language we employ constraints not only the manner in which we think, but the things we think about"[Whorf, Benjamin, 1965], the dichotomy between spatial process and spatial structure is more than mere semantics. It is a fundamental one. Secondly the process structure dichotomy leads to analysis rather than synthesis. Analysis possibly beyond what has been reached already.

The search for an understanding of the structure of central place system and the underlying spatial process provides a very strong theoretical motivation to experiment with central place theory as an organising framework.

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2.5 CENTRAL PLACE THEORY [CPT]

Central place theory has for a long time remained the most versatile framework for the analysis of the factors of location, number, sizes and spacing of central places. [Berry,1967]. It has equally proved useful as a reference point for finding order and structure within economic landscapes and urban systems, and a valuable basis for public policy decisions relating to service provision and the spatial planning of investment. [Schultz,1970; Treuner,1970].

Though originally formulated by Walter Christaller[1933], several scholars have attempted to extend the usefulness of the theory [Losch,1954; Isard,1965; Parr,1973,1977; Berry,1967; Glasson,1978] among others. However common to all the formulations and reformulations are concepts of threshold, range of goods and services and hierarchy of central places.

The threshold of a good or service is defined as the minimum population or size of the market necessary to support the provision of a good or service, while the range is the maximum distance consumers are ready to travel to buy such goods and services. The goods and services are those that require central locations for their efficient distribution, hence they are referred to as central goods. Given the

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assumption of isotropic plain which include equal transportation in all directions and equal population distribution in the region, CPT postulates hexagonal market area of central Places. This arrangement stems from the fact that central places function mainly to provide central goods and services.

Furthermore, on the basis of their cost-value and the frequencies with which they are demanded [Fig.2.1], central goods and services are categorised into grades in an ascending order of importance, with each grade having its range or upper limit and threshold or lower limit. Because of the frequency of demand, lower order goods would need to be provided at numerous locations and hence to be available in central places of every size, while higher order goods, being less demanded need to be in much fewer centers. From the order systems among central goods and services emerged an order systems among central places - hierarchy of central places, with hexagonal trade area. [Fig. 2.1b and 2.1c]. The spatial arrangement of central places is such that higher order centers are further apart from smaller ones, but in such a way that there exists specific relationships between them.

The arrangement and ordering of centers in Christaller's

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CPT are offshoot of three principles described as the K - Values which defines the geometry of the schemes. In the first scheme, [K = 3 systems, or marketing principle, market area physical sizes increase from the smallest through to the largest by a constant of 3 such that K = 3,9, 27, 81, .. 243 etc. For those of transport or administrative principles, the market areas progress by a ratio of four and seven respectively.[Fig. 2.2]

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DEMAND AND TRADE AREA IN CENTRAL PLACE LANDSCAPE

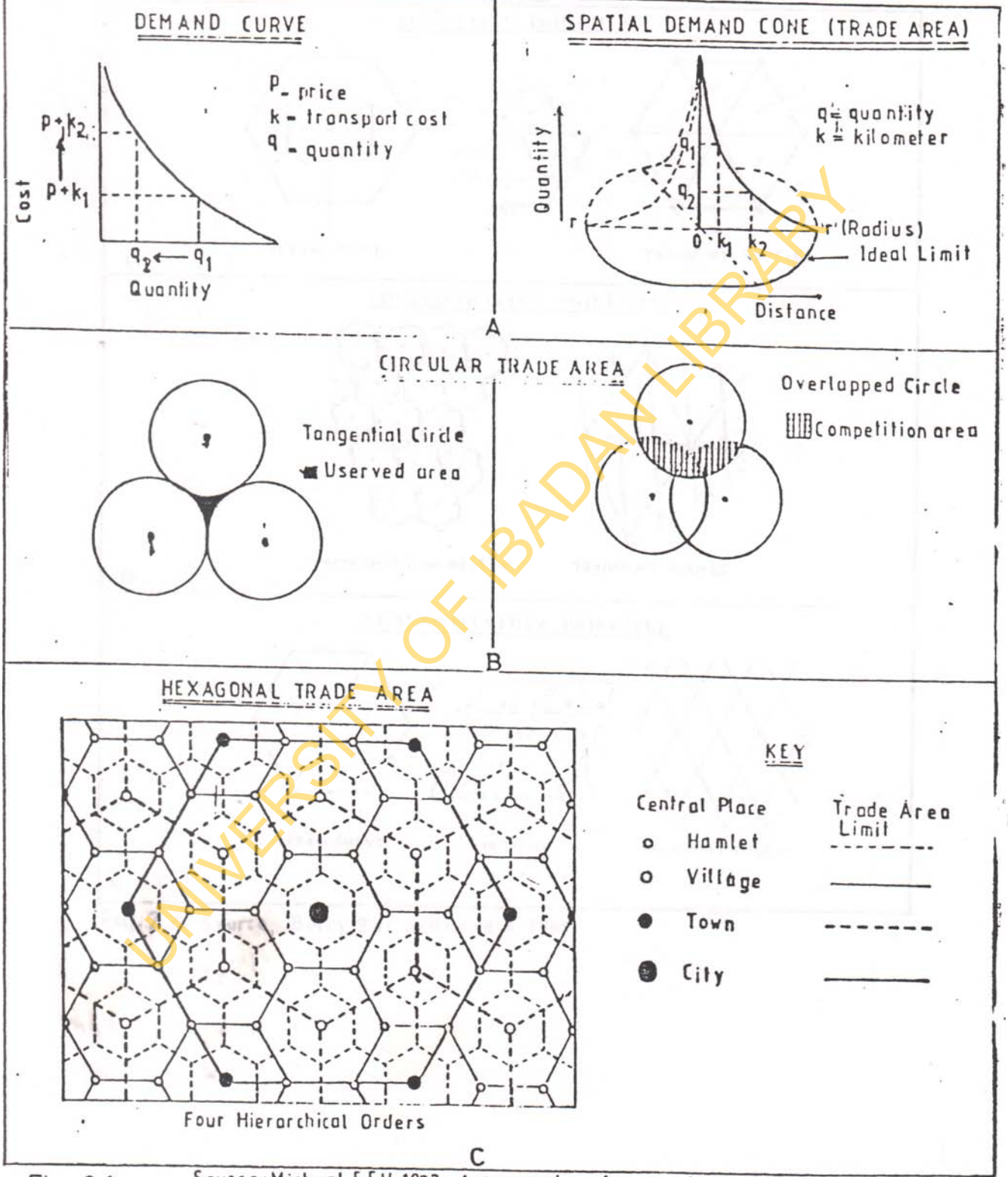

Fig: 2.1. Source: Micheal, E.E.H 1972 A geography of economic behaviour

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THE SYSTEM of CENTRAL PLACES

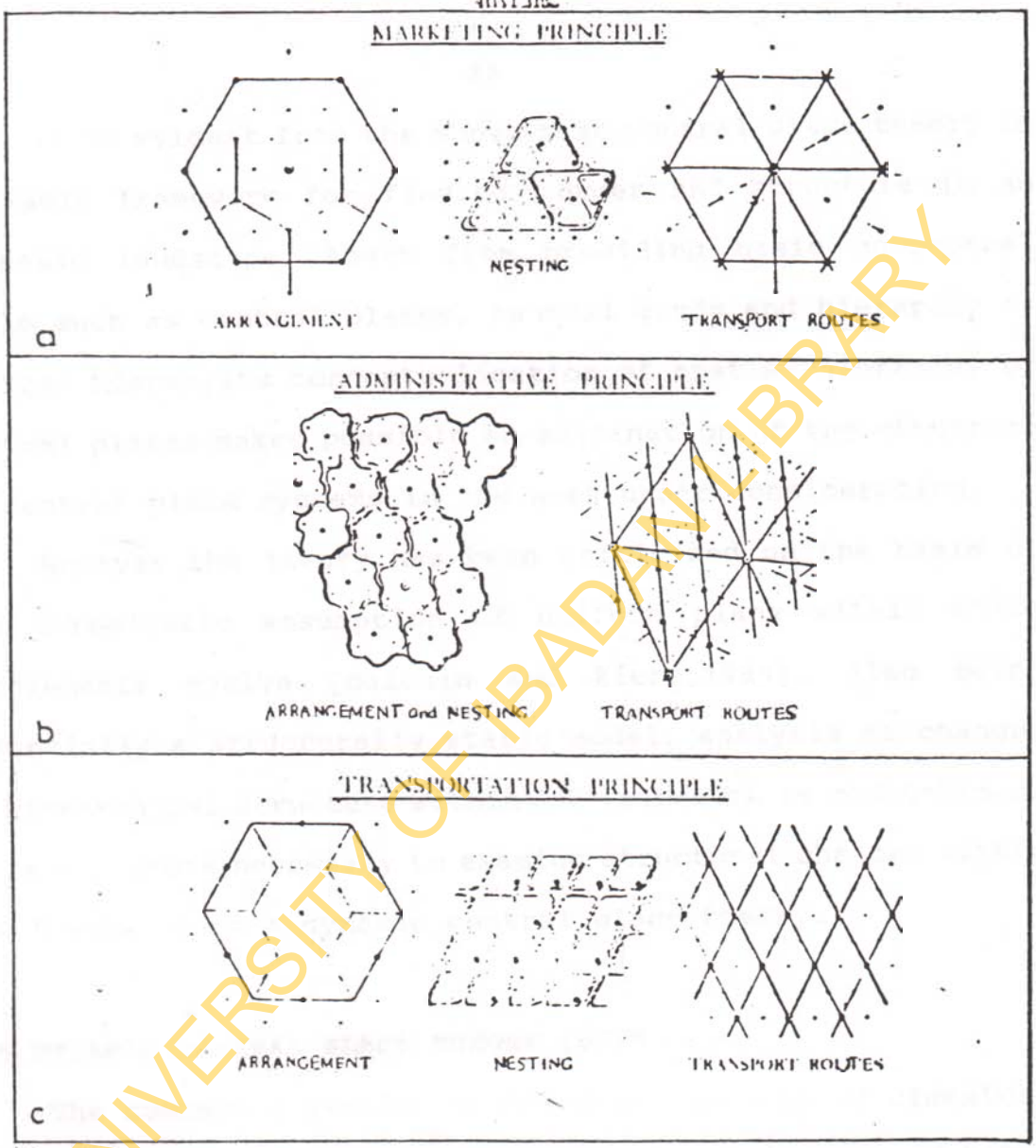

Fig. 2.2: Source, Berry, B.J.L. and Pred A. 1961

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It is evident from the above that central place theory is a viable framework for finding order and structure in an economic landscape. Apart from providing basic conceptual tools such as central places, central goods and hierarchy of central places,its conceptualisation of spatial hierarchy of central places makes possible an examination of the structure of central place systems in the area under consideration.

However the theory has been criticized on the basis of its unrealistic assumption of uniform plane within which settlements evolve [Balchin and kiere,1985]. Also being essentially a structurally static model, analysis of changes in hierarchical structure within CPT framework is constrained. It is therefore necessary to examine structural changes within the framework of a dynamic central place theory.

2.6 DYNAMIC CENTRAL PLACE THEORY [DCPT].

The conceptualisation of the basic problem of classical central place theory in temporal terms is the essence of DCPT. While the traditional models of Christaller and Losch regard towns as given entities for which an optimum pattern of location is to be derived, DCPT offers a new perspective in which concern is with the growth of each element in the

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system.

The DCPT as formulated by White, [1974], rejects many of the postulations of CPT, such as the uniform population distribution. It however adheres to the conservative general CPT position that, CPT problem is essentially one of examining the implications arising from the union of the micro-economic theory of the firm with the theory of the consumer spatial interaction. White [1974] views the problem of location in CPT differently. He adopts the stance that the locations of central places are given and fixed, and as such the problem is to describe the growth of each place in the system. The appearance of a particular locational pattern, viz -random, linear, clustered or hierarchical is seen as being consequential upon differential growth of centers. Emphasis therefore should be on growth processes, while the emergence of a particular pattern should be of secondary importance.

What the DCPT emphasizes as being of primary importance is the behaviour of the system. Here two major classes of problems are highlighted. The first class of problems relates to the aggregate development of the system which depends on the internal structural features, the initial conditions and particular trends in such fundamental conditions as population

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or transport technology. It is presumed that the developing system may be found to correspond to an existing typology such as the rank size rule or the log normal distribution.

The second class of problems concerns, the readjustment of the system following a shock to some part of it. That is, the system sensitivity to changes such as the introduction of new technology or innovation of some sort to some parts of the system.

The major attractions of DCPT as related to this research in particular are that, first, by adopting the position that the set of central places are given and fixed, it is possible to analyse the resulting locational pattern of central places and describe them within distinctive regional geographical setting. Again, since DCPT views emergence of hierarchical structure as being consequential upon differential growth of centers, it is possible to examine not only the changing spatial structure of central places but also the underlying processes of change. Furthermore by placing emphasis on what should be of primary significance in central place studies viz - processes of aggregate development and central place systems behaviour, DCPT redirects research focus in a more fruitful and relevant direction. This also makes possible a

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central place study within an explicit systemic framework.

Although DCPT facilitates analysis of structural changes in central place systems, our concern in this study goes beyond this to include structure -process relationship in a complex social system whose development is far from the equilibrium situation postulated by CPT. In this vein, we search for a framework for examining not only the complex relationship between structure and process but also the changing pattern of the relationship. There is therefore a strong motivation to explore the concepts of "order by fluctuation" and "dissipative structure".

2.7 CONCEPTS OF "ORDER BY FLUCTUATION" AND "DISSIPATIVE STRUCTURE"

The concept of order by fluctuation facilitates the study of the evolution of complex systems that are far from equilibrium. It is a combination of deterministic laws of economics and stochastic elements. It also reconciles the different meaning of the word evolution in the natural and human sciences and offers a new dimension in which the interrelationships and interdependencies of the different variables of a system of interest give rise to its self-

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organization.

In a system of central places which is characterised by interdependencies and interaction of the spatial distributions of population and of different variables of the system [such as economic activities], the positive feedback inherent in such interaction gives rise to a self-organization of the spatial structure of the system. This reflects the effects of chance events and the deterministic laws of economics. This evolutionary type is termed "order by fluctuation" and it is characteristic of the self-organization of many complex systems. [Nicholas and Prigogine 1977; Prigogine, Allen and Herman, 1977; Allen and Sanglier, 1978, 1979].

The occurrence of self-organization is based on the flows of energy and the existence of certain non-linear interaction mechanisms between macroscopic elements of the system. In central place systems these correspond to the behaviours of the actors of the system and the populations and economic activities. The structure that results from such evolution in the physical science has been called "dissipative structure", differing entirely from those characterising thermodynamic equilibrium. It stresses the dependence of the structure [ordered constitution] on the dissipative processes -flows and

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reactions which are taking place. [Nicholas and Prigogine, 1977].

The evolution of complex systems occurs through the movement along a stable trajectory involving;

[i] the determinism dictated by the equations of the variables in which simple and extrapolative predictions of population growth are possible.

[ii] moment of instability when fluctuations of density or innovations drive the system off to some new stable trajectory.

The fluctuations present in the system is vital. It shows that the evolution of the system with non-linear mechanism is not necessarily determined solely by the equations of the interacting variables, but also by stochastic elements. Fluctuations introduce the element of stability in the development of the system. The state of the system is stable if when fluctuation occurs which throw the system off its trajectory, it returns to its trajectory damping out the fluctuation. Fluctuation may however drive the system completely away from its path, giving it a new solution which may be qualitative change in its characteristics. The evolution of a system over time will depend on the particular

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fluctuation which occur, that is on the history of the system. [Allen and Sanglier, 1978, 1977, 1981; Nicholas and Prigogine 1977].

What is being stressed therefore is that, the spatial organization of a system does not result uniquely from the deterministic laws present in the equations of the system but also the memory or the history of the particular system.

A major attraction of the paradigm here is that it highlights the importance of both deterministic laws or events such as locational characteristics of centers and, fluctuations or stochastic events as the dominant processes in the development of spatial structure. By stressing the dependence of system structures on dissipative processes or flows of energy and parameters [which corresponds to the influence of the actors of the system] it is possible to identify such energy parameters [processes] in the system under consideration and relate it to the observed structure through an explanatory model.

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2.8 WORKING HYPOTHESES

From the discussion of problems of this research and consideration of various conceptual and theoretical issues in central place study, it is hypothesized that, the structure of central place systems is indicative of the underlying processes. Put differently, that a definite relationship exist between an observed spatial structure and underlying processes. However for operational purposes the working hypotheses are that,

1. The emergence and the distribution of central places in S.W. Nigeria closely approximates theoretical postulates. Put differently, the central places are regular point patterns generated by deterministic processes.
2. There is hierarchy of central places, and that a relationship exists between; order of central places and classes of central functions; and between population and functional sizes of central places.
3. Changes in the hierarchy of central places and the future distribution of centers in the hierarchy can be described and predicted by a stochastic

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process model.

4. The spatial structure of the central places is explained by the site and situation characteristics of different locations as well as their socio-political attributes.

2.9 RESEARCH METHODOLOGY

2.9.1 Types, Sources and Method of data collection

Two sets of data measuring sizes of central places were collected for each of the One hundred and thirty six central places covered by the study. They are, Population figures and the central functions performed by the centers. The size of the study area [see figure 1.2], and the temporal scope of the research demands that we utilise most if not all available secondary sources to obtain the relevant data.

The quantitative growth of the central places from about 1850 to early 1900 were analysed using population figures of the centers as contained in the accounts of the missionaries who visited these centers during the period. These figures were obtained from national published historical literature. Population figures for 1952, and 1963 were extracted from population reports for Western Nigeria for these periods.

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However, one major problem arising from the use of population figure for a dynamic study in the region and the country as a whole is discontinuity. With the 1963 Census as the most recent source of population figure [since the details of the 1991 census are yet to be released], it became obvious that if current picture of relative sizes and dynamics of central places must be known, resort must be made to the use of central functions performed.

A total of forty-five central functions [see appendix 1.1 and table 4.1] were collected for each of the central places. The central functions were chosen to measure the total commercial, industrial and service sizes of the central places. They were collected for three time periods - 1991, 1976 and 1967.

In collecting relevant data on central functions, two types of sources based on scale of data aggregation were identified. These are those published at the national and state levels. The former were found not to be comprehensive as they cover mainly the major towns in the region, while the latter were not only more comprehensive in terms of the number of settlements, but more detailed with respect to information content. Thus Ministries and establishments in all the State

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Capitals were visited.

Most of the variables on Commercial, Industrial and Service functions of the Central places were extracted from directory of business enterprises and yellow pages published usually by the different State Chambers of Commerce and Industry. For 1991 central functions, the 1991 or in some cases the 1990 edition of the directory were used. For 1976, back issues of the publications were available in all the States, though date of publication could be different. It is observed that, there could be up to about five years gap between the period of fieldwork and publication of some of these directories. For instance, the 1991 comprehensive business directory for Oyo/Osun States which was used for this study is still a 'confidential document' in one of the Director General's office at the Secretariat in Ibadan. Thus for 1976 Commercial and Industrial Sizes for Oyo/Osun States, the 1979 Business Directory was used. For Ondo State, the 1982 [maiden edition] of the Business Directory was used, and for Ogun State, it was the 1986/87 edition of the directory that was utilised. The data for Lagos for 1976 was obtained from Owen's Commerce, Travel and International Register, 1976, 23rd

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edition.

From each of the State's Ministries of education and health, current directory of Schools and health institutions were obtained or purchased. Since the date of establishment of Schools is usually indicated , it was possible to know the number and location of schools in the centers in the three periods covered. However,with the exception of Lagos State, date of establishment of health institutions were not stated. Thus for the periods before 1991, reliance was on Business directories for other States.

Although publications at the State level is largely used, other Publications at National level such as , the Nigeria Industrial Directory, Various editions of 'Who Makes What in Nigeria', 'Nigeria Yellow Pages' were used to crosscheck the available information for the towns covered by the States directories. A lot of inconsistencies were noted. There was hardly any two publications giving the same figure on the same variable in the same town. Having aggregated from different sources, we pick the higher figure, assuming the presence of underestimation or incomplete survey in the areas affected.

Information on social services such as Police formations

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were obtained directly from State's Police Headquarters. Getting this information for the current year was like getting honey from the rock, and no information for earlier periods was available. However from personal discussion with one of the States' Police Public Relations Officer, each local government has a police station, while the growth in number follows closely the creation of local government. Thus the history of Local government creation in the country was used to project backward the number of such services in 1976 and 1967, for towns where the service is available in 1991.

A comprehensive data on the length of Dual Carriage Way and the total number of overhead Bridges in Lagos State were obtained from the Highway division of the States Ministry of Transport. In Oyo/Osun and Ondo States this information was not readily available. However with the assistance of Road engineers in the Ministry of Transport, the dual carriage ways in these States were identified and the researcher took a ride through them to estimate their length. These services are mainly found in the State Capitals.

The data on marketing activities in each central place was extracted from Market Calendars, an annual publication of each State's Ministry of Commerce and Industry.

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2.9.2 Data Analysis

The spatial organization of a territory in terms of its locational pattern, population size distribution, relative growth structure and functional relationships is no doubt a complex one. Also the development of the structure of such regional central place systems involves complex processes of change within equally dynamic socio-political and economic environment. The need to understand the complex structure of central place systems and evaluate the underlying spatial processes call for the utilization of a number of techniques and models that deal with aspects of spatial structure and processes in geography. This is because there is currently no single technique that is capable of simultaneously unravelling the details of and changes in a spatial structure and the interrelationships between such structure and the underlying processes. Thus aspects of structure and underlying processes of South-Western Nigeria central places are investigated using a number of statistical techniques and models. The sketches of these techniques are presented here while details are given in the appropriate section.

In analyzing the locational pattern of the central places, the method of nearest neighbour analysis is employed,

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while certain indices of population concentration, such as measures of urban primacy, urban ratio etc are used to describe the size distribution and growth structure of the regional urban population. The methods of factor analysis and hierarchical cluster analysis are used to define and analyse the functional organization of the central place systems. Changes in the hierarchy are analysed using Markov chain model. The model is also used to generalise the underlying processes of change. The quantitative relationship between spatial structure and the underlying processes is analysed using Canonical model.

2.10 CONCLUSION

The discussion in this chapter has established both conceptual and theoretical paths for the analyses of the structure of central place systems that begins in the next chapter. An explanatory framework has also been sketched for examining the complex relationship between spatial structure and spatial dynamics. In a way therefore, the study seeks to utilise concepts of 'order by fluctuation and dissipative structure' to improve understanding of geographical phenomenon. The major hypotheses to be tested, methods of data collection and analyses are also discussed.

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CHAPTER THREE

SPATIO-TEMPORAL DISTRIBUTION OF CENTRAL PLACES IN S.W.NIGERIA

3.1 INTRODUCTION

The notion that the type and distribution of settlements provide insight into the processes which govern their location and spacing is a recurrent theme in settlement geography [Hudson J.C and Fowler P.M 1972; Rogers 1967; Guy C.M 1976; Faniran 1974; Smalley and Unwin 1968]. Interests of settlement geographers in the above direction has been aroused in recent times with the growing body of quantitative methods which tend to offer greater accuracy in distinguishing between different settlement patterns and the possibility of relating them to processes [Dacey 1968; Hudson 1969; Grossman 1981].

Thus within the conceptual and theoretical framework established in the preceding section, this chapter analyses the growth processes and spatio-temporal pattern of central places in the study area. The chapter examines the changing locational pattern of the central places and evaluates the underlying spatial dynamics. It tests the hypothesis that the spatial pattern of the central places closely approximates

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theoretical postulates of regularity with underlying deterministic processes. The major pursuit here therefore, is the analysis of the 'spatial foundation' upon which people and activities are formed in the region. The discussion here provides a backdrop for the subsequent analyses in this research

The data base for the analysis in this section is the population figures of the central places extracted from 1952 and 1963 census reports of Western Nigeria. Figures for period before 1952 are the quantitative description of these central places as contained in the accounts of the missionaries who visited the area at various times between 1820 and 1900. However a descriptive analysis of the location pattern of the central places in the region will set the stage for the quantitative analysis of the observed spatial pattern.

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3.2 THE LOCATIONAL PATTERN OF THE CENTRAL PLACES

3.2.1 Spatial and temporal distribution of central places.

The spatial pattern of central places or of any geographical phenomenon can be viewed from two perspectives - the exact point in space or site where each center is located and, the relative location of each place to other places and activities in the region. These two sides of central place location require that the pattern be examined within the prevailing geographical setting and then highlight both the distinguishing site characteristic and observed locational relationship of each center to the other.

Figure 3.1 shows the study area and the locational pattern of central places with population of 5,000 and above in 1900. The locations shown are probably not the only ones in this category this period, but are only those given qualitative description by the visiting missionaries at various times before 1900. The relatively few central places are found concentrated north of the region, in the area north of the present day Osun State and extending to the Western part of Oyo State. This region of central place concentration coincides with most part of the Western uplands in the rain forest environment [fig.3.4]. However the more open Guinea

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Savannah environment to the north-west [the present Oyo North] and the south-eastern part covering most of the present Ondo State are relatively devoid of any central place location. [This is perhaps as a result of absence of missionaries activities in this area whose qualitative account form the major source of information about the centers in the region]. Occasional clusters of points are found to the South around the present Ogun and Lagos State.

Although the 1900 locational pattern could not be said to be complete, [for reasons earlier on stated], the 1952 and 1963 census revealed progressively more comprehensive information about central places with population of 5,000 and above. These are shown in Figures 3.2 and 3.3, which reveals the tendency for the 1900 spatial pattern to persist in these periods. A review of the 1952 locational pattern for instance shows that central place locations are still concentrated in the northern part of the region, though spreading eastward and southward. Again, more locations seems to emerge between 1900 and 1952. What seems to be the most dramatic locational increase occurred north of the present Ondo State where number of central places increased from just two in 1900 to about fourty in 1952.

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Although more locations seem to emerge by 1963 in different parts of the region, the 1952 general location pattern is still visible. Apart from the fact that central place locations spread east and South-West within the region, there is no observed changes or relocation of centers. However, the increasing complexity of locations at each succeeding period is expected to have a significant effect on the distribution pattern of the Central places hence, the next section gives a quantitative expression of the spatial pattern of the central places in each period.

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SOUTH WEST NIGERIA: LOCATION PATTERN OF CENTRAL PLACES IN 1900

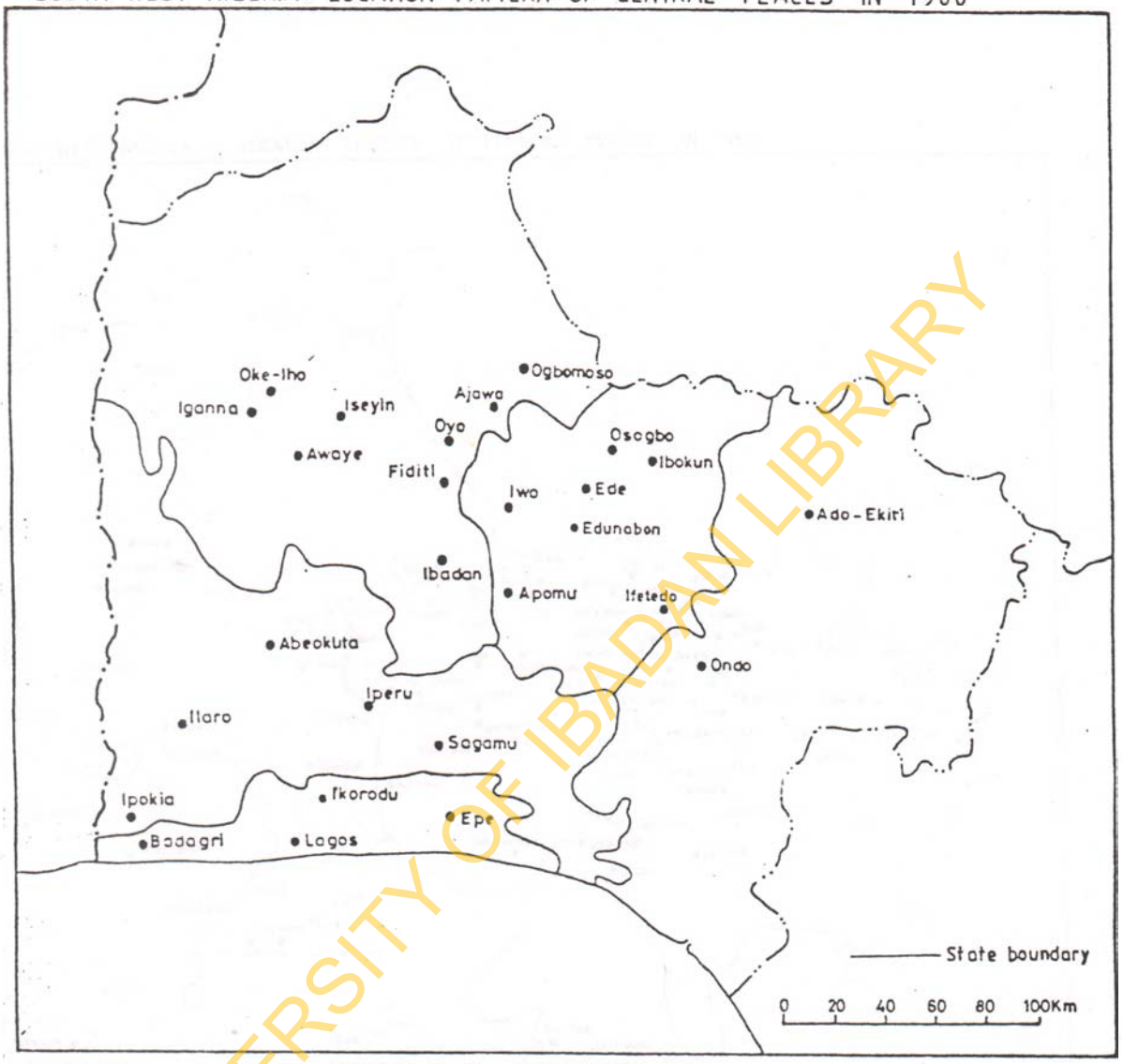

Fig. 3.1: Source:- Compiled by the author (1993)

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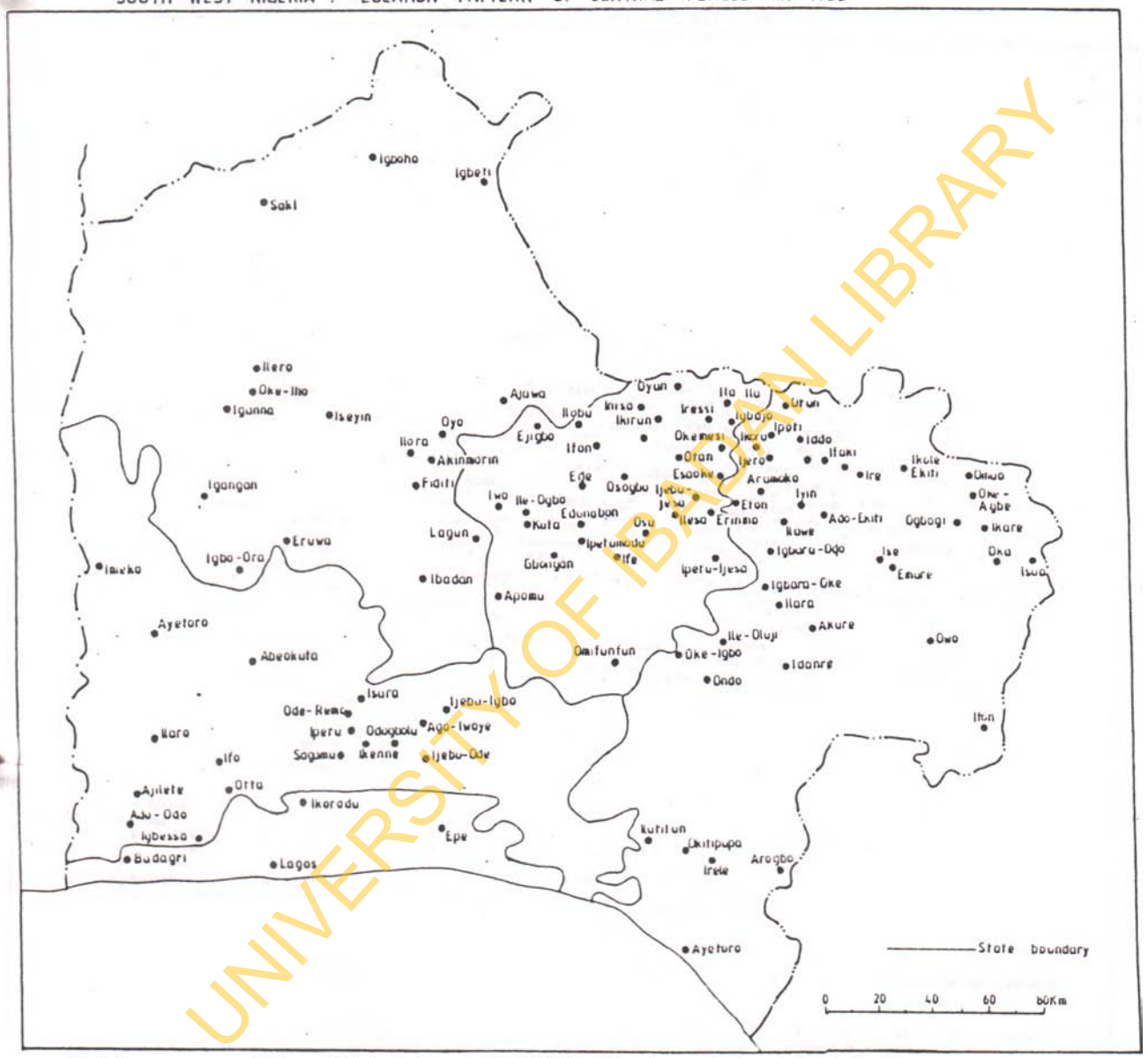
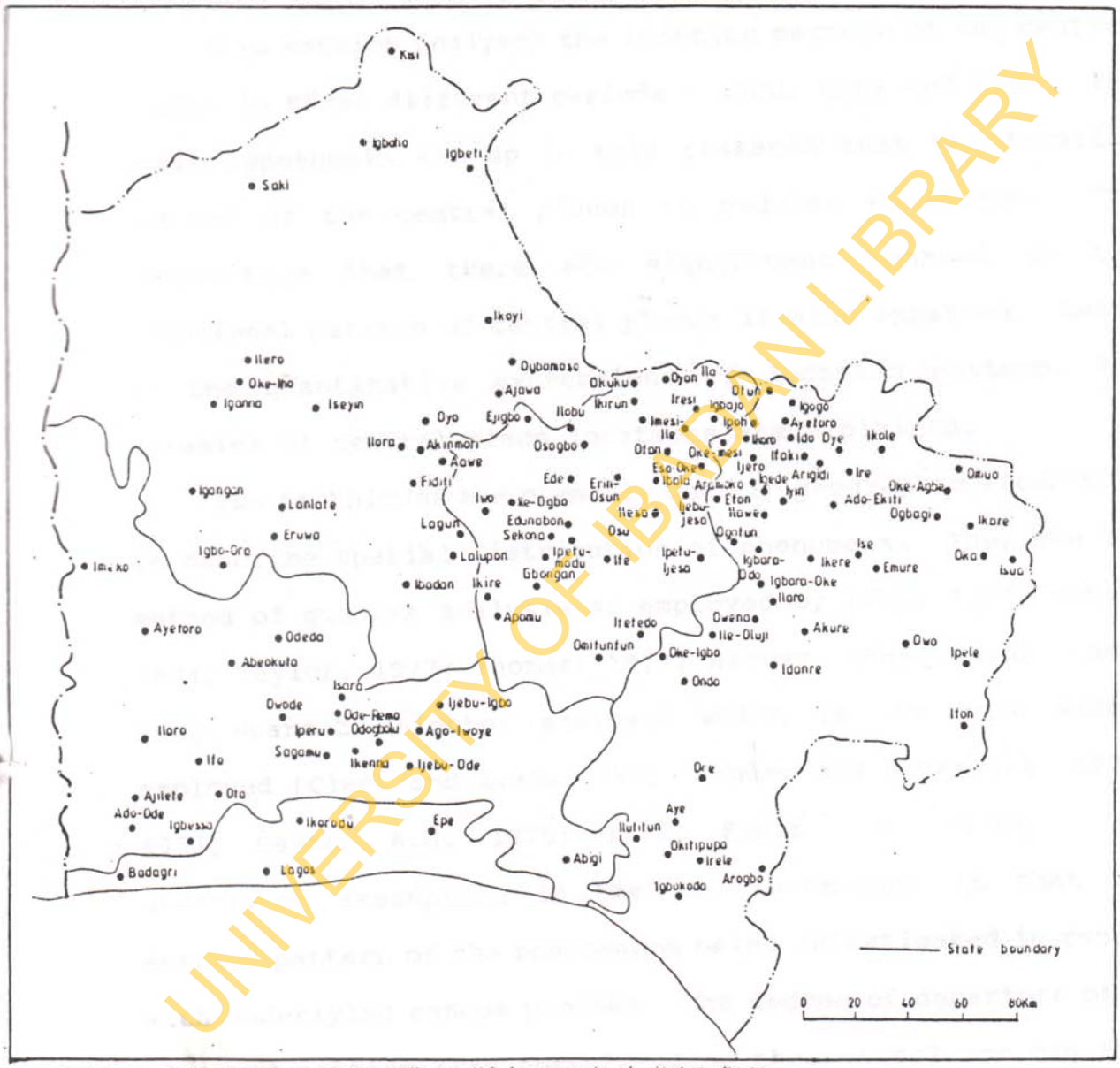
SOUTH-WEST NIGERIA : LOCATION PATTERN OF CENTRAL PLACES IN 1952


Igboho
Igbeti
Saki
Ilero
Oke-Iho
Igunna
Iseyin
Oyo
Ajawa
Ilobu
Inisa
Ikirun
Iresi
Iwo
Ilu
Ilua
Ijaye
Ipeti
Ido
Ofun
Ijero
Ikole Ekiti
Ondo
Oke-Agbe
Ife
Ibadan
Abeokuta
Ijebu-Ode
Ikorodu
Epe
Lagos
Ayetoro
Ota
Ijebu-Ife
Ilesa
Ede
Ogbomoso
Oshogbo
Ilorin
Offa
Ijebu-Igbo
Ijebu-Ode
Ikenne
Sagamu
Ijebu-Ife
Ijebu-Ife
Ijebu-Ife

SOUTH-WEST NIGERIA: LOCATION PATTERN OF CENTRAL PLACES IN 1963


Kaiama
Igbaho
Igbeti
Saki
Ikoyi
Ilero
Oke-Iho
Igonna
Iseyin
Ajawa
Oyo
Eyigbo
Ilobu
Ikirun
Iresi
Imesi-Ile
Ibokun
Igbajo
Ifetedo
Ayetoro
Igogo
Ikole
Oye
Ido
Ikaro
Ifaki
Ijero
Ekiti
Ise
Ire
Arigidi
Ayegbo
Ikede
Iyin
Ado-Ekiti
Oke-Agbe
Omuo
Ogbagi
Ikare
Oka
Iwaro
Emure
Ikere
Igbara-Oke
Ilaro
Owena
Ile-Oluji
Akure
Owo
Ipele
Idanre
Ondo
Ifon
Ore
Aye
Ilutitun
Okitipupa
Irele
Arogbo
Igbokoda
Abigi
Ode-Aye
Ogbese
Ikaram
Ajue
Ajilete
Ota
Ado-Ode
Igbessa
Ikorodu
Epe
Badagri
Lagos
Ijebu-Ode
Ikenne
Sagamu
Iperu
Ijebu-Igbo
Ago-Iwoye
Ilaro
Ife
Owode
Isara
Abeokuta
Ayetoro
Odeda
Ilaro
Igbo-Ora
Imeko
Eruwa
Lanlate
Igangan
Fiditi
Akinmorin
Osogbo
Oke-Ila
Ede
Ikirun
Ile-Ogbo
Iwo
Edunabon
Sekona
Lagun
Lalupon
Ibadan
Ikire
Gbongan
Apomu
Ife
Ipetu-Modu
Ipetu-Ijesa
Ijebu-Jesa
Ilesa
Esa-Oke
Ibala
Aramoko
Eton
Ilawe
Ogotun
Osu
Erin-Osun
Oke-Imesi
Ifon
Oke-Igbo
Gbelutun
Iretedo
Aporau
Ilaro
Igbara-Oke
Ikere
Ise
Emure
Oka
Isua
Omuo
Ikare
Ogbagi
Ado-Ekiti
Oke-Agbe
Iyin
Ire
Ikole
Oye
Ido
Ikaro
Ifaki
Ijero
Ekiti
Ayegbo
Arigidi
Ikede
Ife

3.2.2 Locational Analysis of Central place Point pattern

This section analyses the location pattern of the central places in three different periods - 1900, 1952 and 1963. The first hypothesis set up in this research that the location pattern of the central places is regular is tested. The proposition that there are significant changes in the locational pattern of central places is also examined. Based on the quantitative expressions of location pattern, the dynamics of central place locations are explained.

Two techniques are commonly used in geographic literature to describe spatial distribution of phenomena. They are the method of quadrat analysis as employed by [Guy, 1976; Getis, 1974; Taylor, 1977; Thomas, 1977; Harvey, 1966] among others and, Nearest neighbor analysis which is the more widely employed [Clark and Evans, 1954; Pinder and Witherick, 1972; 1973; Dawson A.H. 1975; 1976; Faniran A. 1974]. The underlying assumption in the two techniques is that the spatial pattern of the phenomenon being investigated is random with underlying random process. The degree of departure of an observed pattern from postulated or theoretical one can then be ascertained. Then it is possible to evaluate the underlying processes of a real world distribution. The

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particular method of comparing an observed pattern with a theoretical random distribution permits the construction of hypotheses about the specific processes which have generated the observed pattern and offer direction for further research [Roder 1975].

In this study, the method of nearest neighbor analysis is employed since it avoids many of the short comings of quadrat analysis. First, the technique makes use of distances measured in two-dimensional space, as such it is more geographic than quadrat analysis which involves arbitrary choice of quadrat size [Silk, 1979]. Nearest neighbour analysis as a measure of dispersion, indicates the configuration of points [Boots 1975]. It is denoted with the Index R, and symbolised as $R = \bar{d} / \delta$. The method compares observed mean $\bar{d}$ and expected mean δ of nearest neighbor distance.

$\bar{d}$ is given by $\bar{d} = \Sigma \text{MinDij}/n$ where MinDij is the minimum distance between places i and j or the minimum value in a row of distance measured between places i and all the other centers being considered.

n = total number places, where $i = 1, 2, \ldots n$.

On the other hand, δ is given by

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$\delta = 1/ [2\sqrt{\lambda}]$ where λ is the estimated density of points per unit area. It is given by $\lambda = \sqrt{n/A}$ where A is the size of the study area measured in the same scale with distance among all the centers being considered.

The expected mean δ is a theoretical value derived under the assumption that the point pattern was generated by a spatially independent random process. The expectations of the different values of $R = \bar{d} / \delta$ are summarised in Table 3.1 below

TABLE 3.1

THEORETICAL PATTERN AND UNDERLYING SPATIAL PROCESS OF R - RATIO

R-RATIO	SPATIAL PATTERN	SPATIAL PROCESS
0.0	Perfectly Clustered	Clustering
<1.0	Clustered	Clustering
1.0	Random	Stochastic
>1.0	Dispersed	Dispersion
2.149	Perfectly Regular	Deterministic

Source: Summarised from the literature

However, for more emphatic conclusion, a test of significance is carried out for the distribution pattern with the symbol

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$$Z = \frac{\bar{d} - \delta}{\sigma \bar{d}}$$

Where Z is the standardised value of R statistics derived under the assumption that the probability distribution of a point pattern approximates a normal curve, with a mean of zero and standard deviation of one.

σd is the standard error of the mean distance, which by convention is also the standard deviation of the expected mean distance. It is given by $0.26136 / [\sqrt{n\lambda}]$

It is expected that, if the pattern of central places is generated by a random process, the distribution of observed mean distance $\bar{d}$ is normal. This is tested against the null hypothesis that there is no statistically significant difference between the observed pattern and the theoretical random pattern. A significance level is set up at 95% and 99% confidence level. If the calculated value of Z is less than the tabulated, the null hypothesis is accepted and vice versa.

Most of the problems associated with the use of nearest neighbor statistics arise where the boundary of the study area is not properly defined. For instance, points can lie outside the boundary in which case to omit them is to decrease the already small number of points and including them might be

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meaningless [Roder 1975]. The effect of no clearly defined boundary is that the observed mean closely approximate the theoretical mean. The boundary problem does not arise in the study as seen in figures 3.1, 3.2 and 3.3. However, nearest neighbor technique has been observed to be insensitive to composite distributions [Getis, 1964; King, 1962]. For instance a repeated pattern of two or more closely spaced point, occurring far from one another would yield a low value of R [which shows a clustering even though the pattern may be dispersed]. Making measurements of distances to second [R2] third [R3] or even higher order [Rn] nearest neighbours to obtain new values of R has been suggested [Getis, 1964; Clark and Evans, 1954; Silk 1979]. It has been noted earlier on that there are occasional clusters of central places as such observed mean of first, second and third order nearest neighbours are obtained. These are compared with each other and their statistical significance determined.

Table 3.2 shows the result of three orders of nearest neihgbour analysis over three time periods [1900, 1952 and 1963]. The computation procedures are presented in appendix 2, 3 and 4.

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TABLE 3.2

RESULTS OF NEAREST NEIGHBOR ANALYSIS OF CENTRAL PLACES

YEAR N.N PARAMETERS	1900	1952	1963
R_1	0.958**	1.023**	1.05**
R_2	1.032**	1.310	1.41
R_3	1.255	1.870	2.03
σd	3.008	0.715	0.568
Z_1	-0.396	0.448	1.283
Z_2	0.296	5.987	10.853
Z_3	2.390	16.720	27.381

**** Not Significant at both 99% level where Z = 2.33 and at 95% level with Z = 1.64**

Source: Aurthur's computation

It is evident from table 3.2 that the value of R_1 increases overtime [from 1900 to 1952 and 1963] while successively higher values are obtained for R_2 and R_3 in the three periods, suggesting composite distributions. For instance, R_1 values increased from 0.96 in 1900 to 1.02 and 1.05 in 1952 and 1963 respectively. This tend to suggest that the initial pattern of central places was clustering and that over time, there was a tendency towards dispersion [R > 1.0]. However, the calculated Z_1 values which ranged from 0.396 in 1900 to 0.448 and 1.28 in 1952 and 1963 respectively, are all

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less than tabulated Z value at both 99% and 95% confidence level. This implies that the observed mean distance of first order nearest-neighbour over the period does not show a statistically significant difference from the expected if the points were random. Thus the value of R_1 in the three periods show the locational pattern of the central places to be more random than clustered. This from theory [see summary in table 3.1] tend to suggest underlying random or stochastic spatial process. Although Roder,[1975] cautioned that "unless we know the process [underlying a distribution] to be random we can not speak of the result as being random or stochastic". The several implications of a randomly distributed phenomenon are however highlighted by Clark and Evans, [1956]. Two of these are particularly relevant to the observation here. First, that each central place has equal chance of occurring in a subarea as any other center and, secondly any subarea has equal chance of receiving a center as any other subarea. Although randomly and not regularly distributed, the point is that the observed distribution is one realisation of possible spatial distributions and as such it is possible that processes other than randomness could have been in operation.

However the presence of composite distributions is

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suggested by R_2 and R_3 which are greater than R_1 in the three periods. The R_2 values of 1.032, 1.31 and 1.41 in 1900, 1952 and 1963 respectively show that the observed pattern is still close to unity. However, the corresponding Z_2 values of 0.296, 5.987 and 10.85 show that it is only the 1900 second order nearest neighbor pattern that is not significantly different from a random distribution. Again a more significant departure from randomness is shown by R_3 values of 1.255, 1.87 and 2.03 respectively in the three periods as their corresponding Z values of 2.39; 16.72 and 27.38 are all greater than the tabulated Z values. Thus R_2 values in 1952 and 1963, and R_3 values in the three periods also show the tendency for the patterns to be more dispersed than random.

The values of R_1, R_2 and R_3 in each time period suggest the fact that the pattern of the central places is a composite distribution of both randomness [R_1 R_2 and R_3 in 1900] and dispersion [R_1 R_2 in 1952 and 1963]. The above observation clearly shows the need to make measurements of point patterns to the second, third or higher - order nearest neighbours. Again, since R_1 values show no statistically significant difference from random pattern over time, and that the values of R_2 in the three periods are still close to unity, it is put

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forward that there are no significant changes in the distribution pattern of the central places over time. This is plausible given the locational inertia of settlements generally and the historical fact of the origin of these central places which date mainly to the late Nineteenth century.

The values of R_1 and R_2 in the three periods show there is a departure of the observed distribution of central places from classical central place theory postulation of regularity. The vulnerability of central place theory as a scheme for analysing the distribution of settlements has been noted [Morrill,1964; Preston 1974;] It was noted long ago, Ullman,[1941] that "central place theory probably is valid an interpretation of settlement distribution over land as the concentric-zone theory does for land use within cities". In industrial areas the central place scheme is generally observed to be distorted by; industrial concentration in response to resource location and transportation. Again in the developing areas, where regional planning is a recent practice, and where the settlements are mainly prehistoric in origin, the ideal may not be approached given the low level of technological development. Thus factors of the natural

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environment, the socio-political or cultural organisations of the society and the particular role of each center in the region would generally distort theoretical postulation.

It is however interesting to note that some scholars in Nigeria [Mabogunje, 1968; Ayeni, 1978; 1980] have provided argument that the central places of South-West Nigeria show amazing regularity in their spacing, since according to these writers,"they are mostly between 50-80 km apart". They pointed out for instance that the distance between Ibadan and its six neighbouring towns are 48km, 53km and 69km to each of Iwo, Oyo and Ijebu-Ode in that order. It is further pointed out that Ile-Ife and Oshogbo lie approximately 80 km away from Ibadan, while Oyo, Ogbomosho and Ilorin are 48km apart in that order [Ayeni 1978; 1980].

While the apparent regularity as observed by these authors is not disputed, the qualitative evidence given does not provide a strong basis for such important conclusion. No doubt these researchers have focussed on points without reference to the size of area, and have looked at some clustered points in search of regularity to support a theory. The quantitative expression of the general pattern of central place distribution in S.W. Nigeria as provided here does not

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support regularity.

Apart from the general distribution pattern of all central places in an area, CPT also postulates that the pattern of higher order [leading centers in a region] central places be regular, more widely spaced and are fewer in number. This group of issues is briefly considered in the next section.

3.2.3 Pattern of Higher order Central places

Higher order central places are so designated by virtue of the number, type or range of goods and services offered. They are more functionally complex with large trade area or commuting field [Christaller 1933]. It has been observed that higher order central places have larger population size than lower order centers [Berry et al, 1958. Yeates et. al. 1982].

From the point of view of their population the 1963 census report of Western Nigeria show that the leading or higher order central places in S. W. Nigeria are Lagos, Ibadan, Abeokuta, Akure and Ado-Ekiti. Since they are few in number, simple statistical measures of variability [range, mean and standard deviation] are used to describe their locational pattern. The relative distances among them are

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shown in table 3.3 below.

TABLE 3.3

RELATIVE DISTANCES AMONG HIGHER ORDER CENTRAL PLACES:

CENTERS	LAGOS	IBADAN	ABEOKUTA	AKURE	ADOEKITI
LAGOS	_	143	102	304	350
IBADAN	143	_	77	206	235
ABEOKUTA	102	77	_	283	312
AKURE	304	206	283	_	50
ADOEKITI	350	235	312	50	_

With a range of 300 kilometers, mean of 206 and standard deviation of 107.5, it is obvious that the locational pattern of the largest central places shows a great deal of disparity. That is, the relative spacing of the leading central places is far from being regular. Even the relative distances among the three closest centers is not regular. For instance, the distance between Lagos and two closest centers - Ibadan and Abeokuta are 143 and 102 respectively, while Abeokuta is 77km from Ibadan. However, in line with theoretical postulation, they are much more widely spaced, and are fewer in number than the lower order central places. That they are fewer in number and more widely spaced may be due in part to the fact that they are capitals of ancient kingdoms with broad territorial

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organisations, and not necessarily because they provide goods and services that are less frequently demanded.

The analysis of the locational pattern of central places in S.W.Nigeria does not support the regularity postulated by central place theory. Thus the first hypothesis set up in this research is rejected. The findings here as shown by the R indices is that the distribution pattern is indeed a composite one which incorporates randomness and dispersion. However since the observed distribution is one realisation of many possible outcomes, it is only tentative to infer an underlying stochastic or dispersion processes for the observed pattern. This is evident from the theoretical observation that, a variety of spatial patterns may be generated by the same process, while compound processes may lead to various degrees and types of patterns. [Coxeter,1961]. It is also observed that most real world spatial patterns appear as though they have been produced by a process which have both deterministic and stochastic components [Silk,1979]. The above theoretical observation highlight the need to evaluate in this region, the complex socio-economic and political/historical factors that distort observation from theoretical postulates. Thus the combined influence of regional geographical and historical

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setting on the location and spacing of the central places are evaluated in the next section.

3.2.4 Dynamics of Central place location

It is opined here that, the observed general distribution pattern of a regional central place system to a great extent is an outcome of an age-long "cold war" between man and nature in an attempt to gain supremacy over one another. At the earliest stages of human life, nature no doubt largely determined man's habitat, while land was almost exclusively the source of his food supply. If earliest settlements had any specific role to perform, this would be land related, location specific and as such nature determined. However with improvement in technology and advances in civilisation, man became more successful in his attempts to defy nature. The spatial distribution of central places in a region is therefore a realisation of man's continous interraction with himself [in the society] and nature. The distribution is the unfolding of events of triumvirate interactions Man-Society-Nature. These tripartite interactons are investigated in the region of South-West Nigeria.

Central places of South-West Nigeria are historic

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settlements. They are traditional centers of trade, administration and cultural activities. As such any attempt to understand the dynamics of their location and their relative spacing should be based on the particular nature and the long standing role of these central places within the prevailing historical-geographical context and the changing socio-economic and political culture of the Yoruba race. Fig. 3.4 shows the central places within their physiographic setting.

As shown in the figure, the variety of geological features and the contrasts of relief and drainage render difficult a simple extrapolation of the relationship between nature and the distribution of central places. A review of the locational processes of the central places within the regional settings should highlight the unfolding of events leading to the observed pattern. However the observed contrasts in the regional geographic environment is sufficiently complex as to distort postulated theoretical regularity.

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PHYSIOGRAPHIC SETTING OF THE CENTRAL PLACES

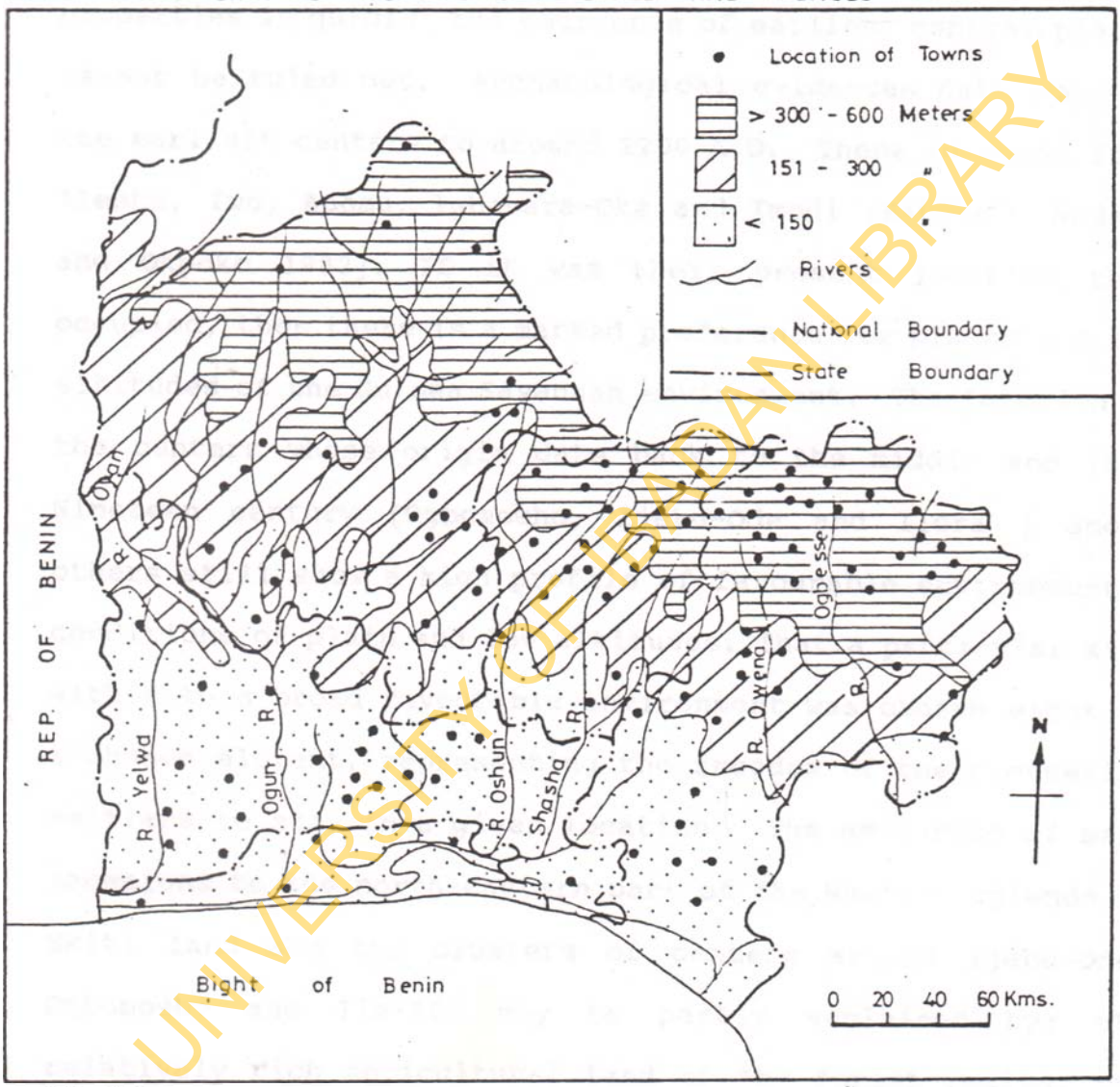

Fig. 3.4

Source : Compiled by the Author (1993)

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The initial influence of favourable environmental properties in guiding the emergence of earliest central places cannot be ruled out. Archaeological evidences date some of the earliest centers to around 1200 A.D. These include, Ife, Ilesha, Iwo, Apomu, lgbabara-Oke and Imodi [Babour, Andah, and Okpoko 1982]. If it was their present location they occupied, then there is a marked preference for plains and low altitudes of the Guinea Savannah environment. The location of the centers whose origin date back to the middle and late Nineteen century [Ogbomosho, Ijebu-Ode and Ilora] among others still show a high profile of favourable environmental conditions of plain and low altitudes. That a particular site within this broad favourable environment was chosen might be a chance element, representing the freedom of the pioneering settlers to stay in a given location. The emergence of many locations to the north-eastern part of the Western uplands in Ekiti land and the clusters of centers around Ijebu-Ode, Ogbomosho and Ile-Ife may be partly explained by; the relatively rich agricultural land of the forest region, the diversified composition of the vegetative cover and the presence of many swift flowing navigable rivers. The varied natural resources of the surrounding areas owes great

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potential to the development of commercial agriculture and perhaps the continuity of urban life from the pre-colonial times to the present.

Evidences of favourable environmental condition have also been provided for location of settlements in different parts of the world. These include the cities of Tlemcen in Algeria [Richard and Blake, 1986]; Chiang Mai in Thailand [Chakrit and Clarke, 1973] and Ranchi in India [Srivastaba 1977].

What then govern the choice of difficult terrains such as hilltops and the jungles of the coastal belt which witnessed the emergence of centers of population concentration between the 16th and early 18th century. The locational process in this period is a function of several interacting and interrelated forces. First was the inevitable changes in human society characterised by increase in population due to birth and or immigration, and its attendant pressure on land. Secondly was the improvement in technology as seen in the use of iron weapons either for farming and or more importantly for warfare. All these no doubt stimulated a new political culture characterised by militancy.

The militant political culture has as its distinguishing

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feature the presence of militant ruling class with insatiable desire to dominate neighbouring hamlets and villages. The militant political culture of the Yoruba settlements could be seen, in the historical foundation or the tradition of origin of the towns and cities. Traditions of origin link the founders of these central places with different revolutionary phases that transformed hitherto loosely organised hamlets and villages and set them on the path to becoming great cities. Such evidence of revolutionary transformations are provided in the narratives of warfare in the origin of Ilesha, Ijebu-Ijesha, Ado-Ekiti, Akure, Ijebu-Ode, Ijebu-Igbo, Ila-orangun Ondo, Owo among others.

The militant political culture is also seen in traditional kingship symbols, titles and staff of offices in these towns. For instance as kingship symbols we have the Sword and Axe for Ewi of Ado-Ekiti; Tiger for Deji of Akure; Sword for Ooni of Ile-Ife. Such tittle as Are-Ona Kakanfo had war intentions, meaning military commander or Chief of defence staff.

These early towns and cities became administrative headquarters of organised Kingdoms which varied in sizes and thrived at different times between 1300 to about 1900. The

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longest and most extensive of these however was Oyo empire which flourished between 10th or 14th century to about 1797. At its hey day, it subjugated and pacified all the other Yoruba Kingdoms till the end of 18th Century, when the empire collapsed partly as a result of internal ranglings and partly as a result of external aggressions.

With the exit of Oyo empire, the militant Yoruba culture became fuelled as the hitherto pacified kingdoms fought to occupy positions held by Oyo empire. The attendant civil strife in Yorubaland was a major process in the emergence of towns and cities in the early part of the 19th century. It also bears its imprints on the location pattern of the towns. Many of the hitherto less inviting hilltop fortresses and jungles offered vantage defensive positions and military bases. Within this context one can explain the emergence and subsequent growth of Ibadan [1829] on "seven Hills" as a military cum refugee camp, Abeokuta [1830] on Olumo rock as a defensive position and Idanre on Idanre hill as a refugee fortress. Similarly the emergence and growth of Ilaro, Sagamu and the regrouping of settlements around AdoEkiti became inevitable either for joint defence and, or as military camps.

The spatial organisation of the territory in terms of

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trade relations was a guiding principle in the emergence of coastal settlement of Epe, Badagry and the founding of Lagos with commanding river and ocean positions. These centers were coastal ports and played intermediary role between European traders at the coast and the distant traders from the hinterland.

Again, Under the prevailing low transport technology and the much more organised economic relations among the earliest central places, the need to minimise distance in a network of trade relations would no doubt guide the locations or relocations of many other central places. The distance between each of Oyo, Abeokuta, Ibadan, Ado-ekiti Owo and other neighbouring central places were such that would be covered on foot in two or three days. If we note that these traditional centers of trade were also headquarters of their respective kingdoms, distance minimisation within each kingdom would be fundamental in explaining the locational pattern and spacing of those central places at that level. Perhaps, the regularity noted by some scholars in the region would be more relevant at this micro levels.

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3.3 CONCLUSION

The preceding sections have been focused on the distribution pattern and location processes of the central places. The result of the Nearest Neighbour analysis shows a marked deviation of the general distribution of the central places from theoretical postulates of regularity. The observations of mean first, second and third order nearest neighbour distance reveal that the observed location pattern of central places is a composite one, which consists of random and dispersed distributions. The value of the first order nearest neighbour shows that there is no statisticaly significant changes in the distribution pattern of the central places overtime. This is as expected, given the locational inertia of settlements in general.

From the point of view of location processes it is suggested that the departure of central place pattern from theoretical postulate is understandable within the prevailing regional historical cum geographical context, and the changing socio- economic and political culture of the Yoruba race. Of particular importance are aspects of relief and drainage, militant political culture, and, the functions of the settlements as centers of trade and administration.

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The "spatial foundation" upon which people and activities are formed have been examined. The discussion thus provides basis for further analysis of the space-time pattern of the regional central place populations [the concentration, spatial distribution and relative growth of each central place within the region] and an evaluation of the underlying spatial processes of growth.

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CHAPTER FOUR

THE DEVELOPMENT OF CENTRAL PLACE SYSTEMS.

4.1 INTRODUCTION

While the preceding section analyses the spatial foundation upon which people and activities are formed in the region, this chapter examines the space-time development patterns of the central places and discusses the underlying processes within the framework of different historical and technological contexts to which the regional central place systems must adjust. The discussion here is motivated by the observation that; patterns and processes of central place development vary not only among nations but also among the various subregions of a country and, secondly that there may be a relationship between spatial concentration of people and economic activities on the one hand, and their underlying processes on the other.

While the analyses of these relationships are carried out later in this work, the specific issues examined in this chapter are the pace and level of central place population growth; the size distribution, spatial concentration and, the likely trends in the regional population development to the year 2000 A.D. The underlying processes of growth and patterns

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are also evaluated. The discussion here provides a backdrop for the analysis of functional composition of the central places and an examination of the relationships between population and functions which follows in the next chapter.

4.2 GROWTH STRUCTURE OF REGIONAL CENTRAL PLACE POPULATIONS.

Two different but closely related issues are examined here. These are the phenomena of "Urban population growth" and "Urbanisation". It is essential to make a distinction between them, for there is the tendency by some scholars in the literature to use the terms interchangeably.

The accepted practice in the geographic literature is to view urban population growth as a measure of absolute change which involves only the urban areas without reference to the rural population growth. Its manifestation in a region are seen either in a multiplication of points of concentration and or increase in the number of individuals at different points. Urbanisation on the other hand may be viewed as a structural phenomenon that connotes changing balance between rural and urban populations. It is a rise in the proportion of total population living in urban centers, relative to the rural areas.

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Though basically different, these two concepts are measures of spatial population concentration, size distribution and growth. They are also logical outcome of complex processes of growth and development. As such the pattern and trend of a regional population should provide great insight into the underlying processes of change.

4.2.1 Regional Urban Population: Trends and Patterns.

One can describe the urban component of a regional population defined as the threshold value Y^1 above which a central place is called urban and below which it is rural. Though Y^1 is arbitrary [United Nations 1955], it varies with nations [Carter 1972] probably because of different cultural and economic situations. This necessitates that national or regional data be presented according to a standard scale [UN 1958, 1969].

In Nigeria, the Federal office of statistics [FOS] sets Y^1 to be 20,000 in 1963. However, the value was 5,000 in 1952. For Y^1 = 20,000, we derive table 4.1 which shows the frequency of urban centers in the constituent state and the region as against the national distribution.

Table 4.1 reveals that the number of urban places

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increased from 13 in 1900 to 26 in 1952 and 72 in 1963. Given the rate of increase between 1952-1963, it took about 9 years for the number of urban centers to double in the region. The time of doubling during the same period was 11 years for the country as a whole. However for the different states that make up the region, the rates vary, ranging from just 2 years in Ondo and Oyo/Osun state to about 22 years for Ogun state.

TABLE 4.1

SPATIAL AND TEMPORAL CONCENTRATION OF URBAN CENTERS:

YEAR / STATE/REG.	1900	1952	1963	ANNUAL INCREASE 1952-1963 [%]
LAGOS	2	1	4	300
OGUN	3	4	6	50
OYO/OSUN	8	15	37	146
ONDO	*	6	26	333
S.W.NIG	13	26	72	177
NIGERIA	29	56	181	221

Source: Western Nigeria Census Report 1952 and 1963.

* Data not available

Further insight into the distribution of the centers can be obtained when we divide them into size classes. Given the wide variations in the data set, all the central places with

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urban population of more than 5,000 are ordered and divided into Seven size classes as shown in table 4.2. The table shows the growth structure of the urban centers in different size classes and their population over the three periods.

It is evident from the table that the rate of increase in number of centers differs with each size class, with central places in the 5000 - 19999 size class having the most dramatic increase in number. The rate however decreases with increasing size class, with the result that there are fewer high size class central places than lower size class centers. The above implies that forces of growth of low size-class centers are near universal, perhaps high fertility rate, while the transformation from medium sized centers to large metropolitan areas would require huge capital outlay and high infrastructural facilities that are usually available in few centers with initial growth advantage.

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TABLE 4.2

SIZE-CLASS DISTRIBUTION OF URBAN CENTERS IN S.W.NIGERIA [1900-1963]

YEAR / SIZE CLASS	1900 NO OF CENTERS	1900 CLASS POP	1952 NO OF CENTERS	1952 CLASS POP	1963 NO OF CENTERS	1963 C.POP '000
5-19999	10	98750	77	628000	110	1143
20-39999	9	246000	16	449279	34	926
40-79999	3	191000	4	238379	19	1063
80-99999	1	975000	1	84451	6	518
100-150000	-	-	3	333542	5	598
150000+	-	-	2	855404	8	2918
TOTAL	23		103	2289055	182	6025

Source: Computed from Western Nigeria Population Report 1952 & 1963

If we take the 1963 Census as the most recent data, it is interesting to note from table 4.2 that, of 6 million total urban population, about 3.5 million or 58% live in 13 cities of over 100,000 population, while 2.9 million or 48% live in 8 cities of over 150,000. Again, just about (15%) of the regional urban population are concentrated in as many as 34 urban centers in the 20-40,000 size class, and another 18% in 19 urban centers within the 40,000 - 80,000 size class. The above shows that most of the urban population actually reside

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in few large central places which include the present administrative state capitals.

In order to highlight the regional variations in the distribution of central places in different size classes, the pattern is rearranged within the present geopolitical units. Table 4.3 shows the regional variations. It is evident from the table that in each succeeding period, central places in different size classes become progressively more represented in Oyo/Osun and Ondo State. In 1963 for instance nine (82%) of the 11 centers with population of 100,000 and above in the region are found in Oyo/Osun state. These nine centers jointly account for about 60% of the total population in this class, while Lagos state with just one center share 25%. With about 59% of central places in the 5-20,000 class also located in Oyo/Osun state, the greatest concentration of central places in different size class is in this state. Furthermore about 55% of the total population in all the size classes are concentrated also in Oyo/Osun state, followed by Ondo, Lagos and Ogun with 23%, 14% and 8% in that order. If population is a major factor in the spliting of Oyo state into two in 1991, the effort is a laudable one. Perhaps it was long overdue.

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TABLE 4.3
REGIONAL VARIATIONS IN SIZE-CLASS DISTRIBUTIONS OF CENTRAL PLACES

STATE	LAGOS		OYO/OSUN		ONDO		OGUN	
1900 SIZE CLASS	NO OF CENT-ERS	CLAS POP. '000	N OF CENT -ERS	CLASS POP '000	N OF CENT -ERS	CLASS POP '000	N OF CENT -ERS	CLA -SS POP
5-19999	2	140	6	48	1	15	3	212
20-39999	2	50	5	139	-	-	2	57
40-79999	-	-	2	115	-	-	1	76
80-99999	-	-	1	98	-	-	-	-
100-150000	-	-	-	-	-	-	-	-
150000+	-	-	-	-	-	-	-	-
TOTAL	4	190	13	400	1	15	6	345
1952								
5-19999	2	14	30	252	31	236	14	126
20-39999	-	-	7	183	6	184	3	818
40-79999	-	-	4	238	-	-	-	845
80-99999	-	-	-	-	-	-	1	-
100-150000	-	-	3	333	-	-	-	-
150000+	1	396	1	459	-	-	-	-
TOTAL	3	410	45	1465	37	420	18	1789
1963								
5-19999	1	85	65	642	20	283	24	210
20-39999	-	-	17	486	15	398	2	41
40-79999	1	44	8	433	7	424	3	161
80-99999	1	81	3	276	2	161	-	-
100-150000	-	-	4	491	1	107	-	-
150000+	1	784	5	1388	1	158	1	187
TOTAL	4	917	94	3716	46	1531	29	599

Source: Computed from Western Nigeria Population Report 1952 & 1963

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4.2.2 Regional Urban Primacy.

One major characteristic feature of developing areas generally is the concentration of population in one or a few urban areas. This phenomenon is often referred to as urban primacy. Given the statistics in the previous section, it is possible for such tendency to exist in the region under consideration.

Three measures of urban primacy are commonly used in the literature. These include:

[a] the percentage of urban population in the largest city

[b] the percentage of urban population in cities of more than half a million people and,

[c] the ratio of the size of the largest city to the combined sizes of the next three largest cities i.e the four-city index of first-city primacy.

Using the population sizes of the central places in 1952 and 1963, the indicators of urban primacy for the region and areas of the present geopolitical units are summarised in table 4.4

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TABLE 4.4

INDICATORS OF REGIONAL URBAN PRIMACY

	PERCENT OF URBAN POPULATION IN					
	LARGEST CITY		CITY OVER 500000		FOUR-CITY INDEX OF FIRST-CITY PRIMACY	
AREA	1952	1963	1952	1963	1952	1963
S.W.NIG	23.9	18.4	0	17.7	0.729	2.446
LAGOS	100	87.9	0	87.9	1.00	7.322
OYO/ OSUN	37.3	17.0	0	20.2	1.377	1.054
ONDO	31.1	10.4	0	0	0.407	0.587
OGUN	50.6	85.3	0	0	1.032	1.163

Source:Computed from Western Nigeria Census Reports [1952 and 1963]

From table 4.4, the "largest city index" of urban primacy shows that between 1952 and 1963 [with the exception of areas of present Ogun state] there was a downward trend in urban primacy in the region. For instance, the regional urban primacy decreased from 23.9% in 1952 to 18.4% in 1963. Similarly for the areas of Lagos and Oyo/Osun states, the percentage decrease over the two periods are from 100% to 66% and, from 37% to 17% in that order. The above suggests that

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there is apparently, a tendency towards spatial deconcentration of population in the region. This may, however, be due to the increasing number of urban centers in various geopolitical units in the region as shown in table 4.1. That the observed tendency towards spatial deconcentration is more apparent than real is also evident from the values of "city over 0.5 million" and "four-city" indices which show a dramatic increase over these periods. The indices further show that the highest spatial concentration of population is in the area of Lagos state [with well over 7.3 o/oo of the 1963 urban population in the metropolis], followed by, Ogun state with 1.2 o/oo and, Oyo/Osun and Ondo states with 1.05 o/oo and 59% respectively.

The discussion in this section has so far been focussed on the increasing number and absolute change in the sizes [spatio-temporal concentration and size distribution] of individual urban centers in the region without reference to rural population growth. Thus it is the issue of the changing balance between urban and rural population, i.e the structural relationship in the regional central place populations that is examined in the next section.

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4.2.3 Regional Urban Ratio.

Compared with the historical experience of some parts of the country, a remarkable social phenomenon in the area of South-Western Nigeria is the increasing concentration of people in the urban centers relative to the rural areas. Although this phenomenon is near universal, its peculiarity in this region lies in the fact that the process is deeply rooted in the past and has continued in varying scale and magnitude to the present. Also the underlying forces of such spatial shift in population and the attendant socio-economic and political crisis are all parts of the great problem which is associated with most practical issues in the cities today. However it is the question of the level and pace of urbanisation in the region that is addressed here.

One common measure of urbanisation as a structural phenomenon is the index of urban ratio. It is defined as the quotient between the total regional population and the urban population component. [Theil,1967; Swanson,1975]. The index is a direct measure of level of urbanisation and an indirect measure of ruralness of national or regional population. Symbolically, it is expressed as

$$UR = UP/TP \qquad 4.1$$

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where UR is the urban ratio, UP is the regional urban population and TP the total regional population.

To the economic theorists, urban ratio represents the outcome of increased regional efficiency in capital-labour ratios. Though the economic view at best permits inferences about the rate of capital formation [Swanson,1975], the index has been used in the geographic literature as a correlative of level and pace of economic and technological development [Berry,1971; Pernia, E.M,1988; 1982; Tolley and Thomas,1987].

A change in urban ratio over a time period represents a change both in the level of 'urbaness' and 'ruralness' of the regional population. It also denotes a change in the level of economic and technological development. Urban ratio change is given by

$$UR_t = [UP_2 - UP_1] / TP_2 \qquad 4.2$$

To the extent that the measure provides an insight into the structure of a regional space economy, it can be used [if only as an introductory guide to a more rigorous analysis] to asses the regional variations in the distribution of economic activities. This in addition to a quantitative description of the level and pace of urbanisation.

From equation 4.1 and 4.2 above we derive table 4.5 which

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summarises the regional urban ratio indices as against the national figures over the time periods 1952-2000 A.D. Figures after 1963 are projections based on federal Office of Statistics recommended rates of 2.5% for periods between 1963 to 1980 and 3.4% there after. The regional urban ratio of 0.39 and 0.54 in 1952 and 1963 respectively show that the level of urban development in the region is well over the national average of 0.11 and 0.19 in these periods. The above implies that, while the country's total population was about 89% and 80% rural in 1952 and 1963, the corresponding figures for the south-west region were 61% and 46%. This shows that the region is one of or perhaps the most urbanised in the country.

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TABLE 4.5

REGIONAL URBAN RATIOS [1952 TO 2000 A.D]

POPULATION OF CENTERS IN '000						
YEAR	1952	1963	1952-63	1980	1990	2000
S.W NIG.						
URBAN POP	1914	6025	4030	6134	8569	11970
% GROWTH	-	19	210.5	2.5	3.4	3.4
U. RATIO	0.39	0.54	0.37	0.67	0.67	0.67
TOTAL POP	4887	10926	6039	9191	12840	17937
NIGERIA						
URBAN POP	3237	10627	7390	16186	22822	32179
% GROWTH	10.6	20.8	228.3	2.5	3.4	3.4
U. RATIO	0.11	0.19	0.13	0.19	0.19	0.19
TOTAL POP	30403	55670	25267	84796	118462	165847

Source: Computed from Western Nigeria Census reports 1952 and 1963 and projections based on 1963 figures

The table also shows that with annual growth rate of about 19%, the pace of urban development in the region is at par with the national rate, even though the total size of urban population is said to be a major determinant of the rate of urban development [Berry,1977]. Similar demographic surprise has been noted by Kelley and Williamson, [1981] in a study of urbanisation processes in some third world

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countries. Our observation here suggests that, contrary to popularly held opinion, the processes of urban development may not lie solely in the "core of the problem" - the size of urban population, but as Pernia, [1988] pointed out, it lies also in historical and geographical parameters, internal and international [interregional] market forces, and, macro economic and sectoral policies having spatial biases.

The low national urban ratio of below 20% [table 4.5] is suggestive of the developing nature of the economy, while the regional statistics point to the fact that a considerable level [above national average] of economic and technological development have been attained in the region.

For further insight into the spatial variations in urban development in the region, table 4.6 shows the urban ratio characteristics of the areas covered by the present geopolitical units in the region.

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TABLE 4.6

SPATIO-TEMPORAL VARIATIONS IN REGIONAL URBAN RATIO

	POPULATION OF CENTERS IN '000					
YEAR	1952	1963	1952-63	1980	1990	2000
OYO/OSUN						
URBAN POP	1230	3107	1877	4732	6672	9408
% GROWTH	-	13.9	152.6	2.5	3.4	3.4
U. RATIO	0.51	0.60	0.36	0.60	0.60	0.60
TOTAL POP	2432	5204	2772	7933	11106	15548
OGUN						
URB. POP	166	385	219	586	826	1165
% GROWTH	-	12	131.9	2.5	3.4	3.4
U. RATIO	0.17	0.25	0.14	0.25	0.25	0.25
TOTAL POP	977	1550	573	2362	3306	4630
ONDO						
URB. POP	122	1268	1146	1930	2721	3837
% GROWTH	-	85	939.3	2.5	3.4	3.4
U. RATIO	0.13	0.46	0.42	0.46	0.47	0.47
TOTAL POP	945	2729	1784	4157	5820	8148
LAGOS						
URB. POP	396	1238	842	1804	2526	3536
% GROWTH	-	18.1	212.6	2.5	3.4	3.4
U. RATIO	0.74	0.82	0.56	0.82	0.82	0.82
TOTAL POP	533	1497	964	2199	3078	4310

SOURCE: Computed from Western Nigeria Census Reports[1952 & 1963]

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The table shows a great deal of regional disparity in UR values and amount of changes. For instance, the 1952 urban ratio reveals Ondo State to be both the least urban, and least developed. With UR = 13% the area is obviously the most rural in the region. It is closely followed by Ogun state with UR = 17% [rural population component of 83%]. The most urbanised is Lagos state with UR 74% followed by Oyo/Osun state with 51%.

Columns 3-7 of table 4.6 show the urban ratio change and the projected change up to 2000 A.D. [The projection is based on assumed growth rate of 2.4% up to 1980 and 3.4% to 2000 A.D]. There is a sharp increase in UR values for all the states between 1952 and 1963, followed by constant rate for subsequent periods. Again if we take 1963 values as the most current, table 4.6 shows that Lagos state with UR = 82% is the most urbanised, and as such most developed economically and technologically. It is followed by Oyo/Osun and Ondo with UR = 60% and 46% respectively, while Ogun State is the least urbanised and the most rural of all the subregions in the area of South-West Nigeria.

The complex processes of growth of central place population are examined in the next section.

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4.3 REGIONAL CENTRAL PLACE POPULATION: HISTORICAL PERSPECTIVES OF GROWTH PROCESSES.

While the preceding section provides quantitative description of central place population distribution and relative growth structure, the complex processes of urban population growth and the resulting spatial pattern are evaluated here. The discussion is placed within Three main historical/economic epochs, not only because earlier scholars [Mabogunje,1978; Ayeni,1980] made similar distinction, but also for the fact that, each epoch has distinct socio-economic and political features which have significant impact on the relative growth and distribution pattern of human and economic activities in the region. First is the pre-colonial epoch which covers the millennia between 1200 and 1900 A.D. The six decades following it coincides with the colonial epoch, while the period since 1960 to date correspond broadly with the post colonial epoch.

Though a temporal continuum, each epoch is distinguishable by dominant technology guiding the development of the urban centers. An examination of the "post colonial era" earlier recognised as such by other workers [Mabogunje 1978; Ayeni; 1980] shows that two distinct epochs can be

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recognised within that broad division - the pre-recessionary epoch or early independence, which roughly covers the first twenty five years of independence (1960-85) and the recessionary epoch which is the current transitional stage. It is characterised by covert or overt anti- Urban policies. However, the effects of a depressing economy on the central place populations will be a major topic in the regional urban geography in the next decade or so, when the impacts of policy measures aimed at addressing the economic recessions are expected to be more visible particularly in the cities. As such discussions of the processes of population change are limited to the first three epochs

4.3.1 Pre-colonial epoch. [1200 -1900]

The processes of central place population change in the precolonial era can be understood within the prevailing socio political organisation of the different societies in the region. A chronological reckoning of these institutions starts with the existence of spatial units, variously referred to as hamlets, clans or village groups [Bradbury,1957 Nadel, 1942] or as mini states [Obayemi 1977]. This is because they are more or less well-defined communities with key

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institutions of government such as Osugbo and Ipampa [Lloyd, 1962], and were also ruled by a sovereign such as Oloja in Ondo Kingdom [Bekeley 1934] or the various Oba-prefixed or Olu-prefixed tittles in Yoruba towns. These spatial units provided the springboard for sustained growth of urban centers. Referring to the settlement units. Lloyd [1962] says

> "the transformation of these into urban units is comparable with the transformation of the multi-settlement mini-state into one having an urban center with sovereignty exercised by the ruler of one of the original settlements"

Kenyo [1948] identified fifteen of such polities in Ondo Kingdom. They include Oka, Ifore, Idoko; within the Ekiti kingdom. Ogunleye [1974] identified Oba, Ijare, Iju, Ita-Ogbolu, lgbara-Oke, while Ojo and Johnson, [1965] identified Iwo, Owu and Ikoyi in Oyo Kingdom.

Traditions of origin in various Towns or Kingdoms illustrate the domination or progressive absorption of smaller polities by larger ones, sometimes imperceptibly and without violence such as in Ekiti- Akoko area [Oguntuyi and Jegede 1973], or in revolutionary phases producing dynastic rulers such as in Ile-Ife, and Ijebu-Ode area [Obayemi, 1977] or military coercion followed by the working out of a

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constitution such as the growth of Ilesa among surrounding polities [Oni 1974].

Whether by absorption or revolutionary phases the presence of Spiritual focus provided by Cultic unity among the different polities no doubt hastened the growth of early urban centers which were headquarters of lager territorial unit or kingdoms. The Cultic or Spiritual unity assisted immigrants or dynastic founders in amalgamating the domains of small polity heads some of which are today more of ward heads in many urban centers e.g. Ijebuode, and Ibadan. The cultural unity of the polities are evident in the influence of Agemo cult in Ijebu-ode and the satellite towns; and the wielding influence of Obatala, Ogun, Ifa in Ekiti and Ijesha area or the dominating influence of Oshun in Osogbo area [Lloyd, 1962; Ogunba, 1965].

A major factor that also had profound influence on city sizes was extensive trading activities within broad but highly organised territorial units or kingdoms, The political organisation was such that hierarchy of towns defined by administrative functions existed. The hierarchical arrangements had implications for varying role of cities in the trading activities in the region.

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First in the hierarchical political structure were the headquarters of kingdoms. They served as terminals of numerous long distance trade routes from within and outside the region. These include Ibadan, Ijebu-Ode, Ado-Ekiti, Ondo and Owo. In addition to their functions as collectors and distributors of goods and services, they performed administrative functions for a wide area around them. They also provide spiritual focus for large areas being primarily cultic centers or ancestral homes of the pre-urban polities. Thus as terminals of trade routes, headquarters of administrative units, centers of religious attention and activities, these centers were foci of continuous interkingdom migration.

Next in the political hierarchy were provincial headquarters of larger kingdoms, such as Ijebu-Jesa, and Ibokun for Ilesa kingdom; [Abiola, Babafemi and Atayero, 1932]. They sometimes functioned as inter kingdom markets but served more localised areas on regular basis.

Thus the main engine that propelled the growth of urban centers in this era was a complex cultural and political processes involving the transformation of ancient polities or pre-urban territorial units into growth points. The

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transformation fostered as it were by Spiritual or Cultic unity among the polities, was engineered in many places by revolutionary coercion. In other areas, it was imperceptible domination process of the polities by the leading polity which was usually the ancestral home of other polities. Such ancestral homes/settlements became easily recognised as administrative headquarters of emerging kingdoms and terminals of long distance trade route, and were therefore the foci of internal and interkingdom migration. Figure 4.1, shows the spatial pattern of the dominant urban centers in 1900. It was however those for which quantitative description were made by visiting missionaries. Other contemporary centers of importance, for which data is not available include Ondo, Owo, Oka, Ikare among others.

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SPATIAL DISTRIBUTION OF CENTRAL PLACES IN 1900

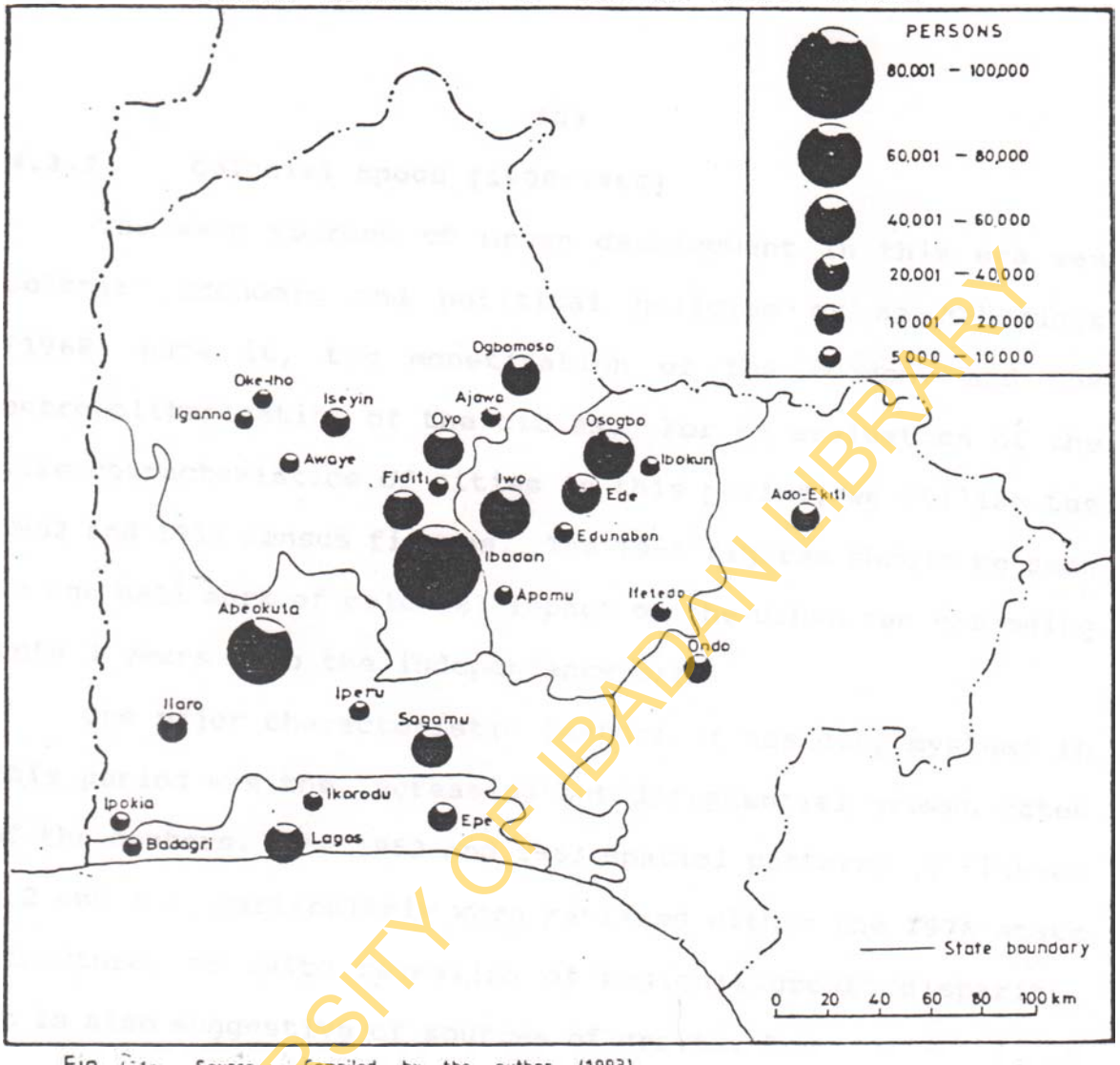

Fig. 4.1: Source:- Compiled by the author (1993)

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4.3.2 Colonial Epoch [1900-1960]

The main sources of urban development in this era was colonial economic and political policies or as Mabogunje [1968] puts it, the monetization of the economy and the metropolitanisation of the cities. For an evaluation of the size characteristics of cities in this period, we utilise the 1952 and 1963 census figures. The 1963 figures should be seen as the hall mark of colonial impact on the urban centers being only 3 years into the independence era.

One major characteristic feature of the city systems in this period was the increasing but differential growth rates of the centers. The 1952 and 1963 spatial patterns, [Figures 4.2 and 4.3] particularly when reviewed within the 1976 state structure, is quite revealing of regional growth disparity. It is also suggestive of sources of growth. From Table 4.6, it is evident that by 1952 only the total urban population for Oyo/Osun state had passed the million mark. However there was a sharp increase in total urban population between 1952-1963, when all the states except Ogun are well comfortable on the million mark scale. The rate of increase vary with Ondo state having the highest of 85%, compared to 18% for Lagos, 14% for Oyo and 12% for Ogun.

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SPATIAL DISTRIBUTION OF CENTRAL PLACES IN 1952

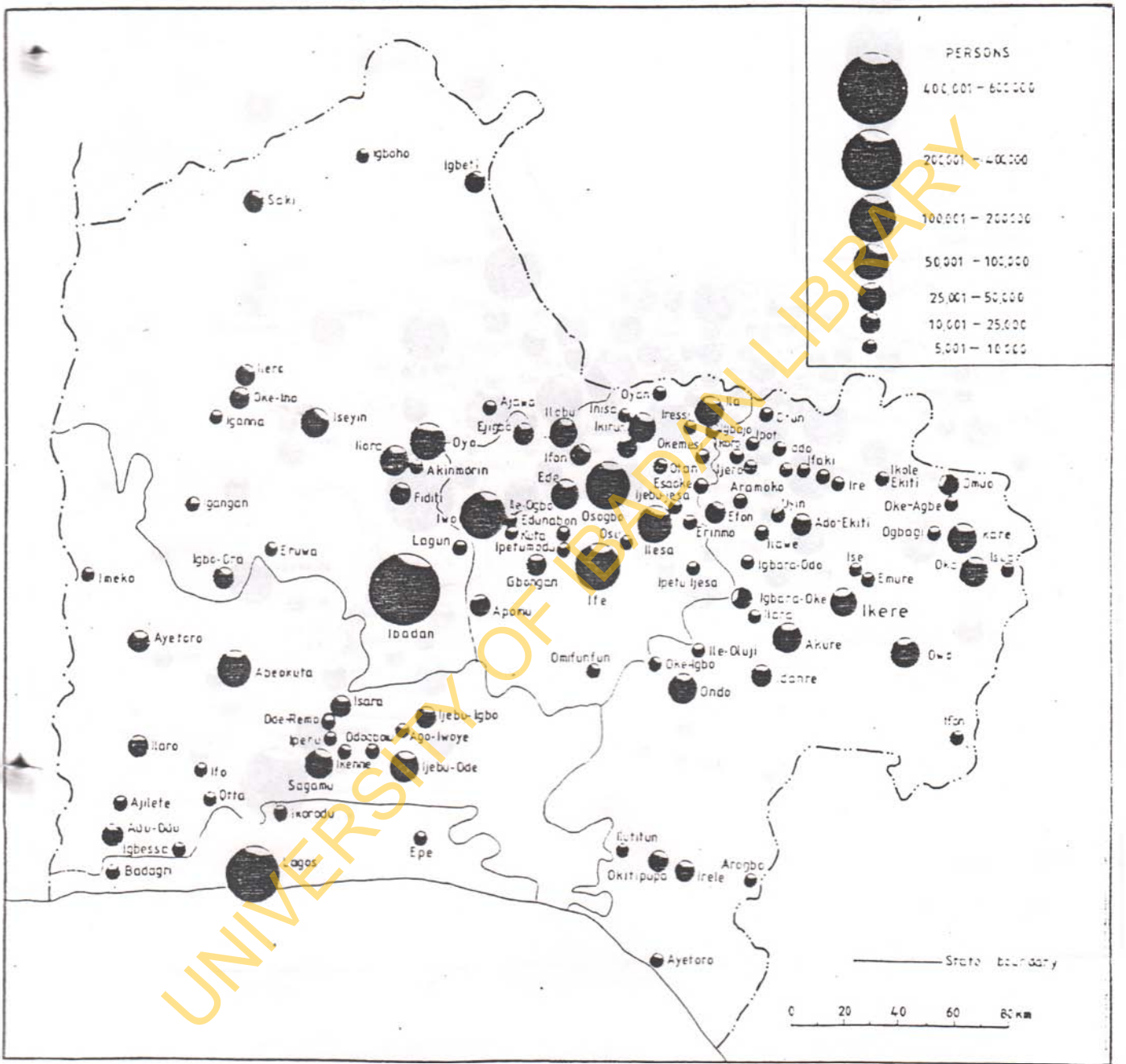

Fig. 4.2 Source : Compiled by the author (1993)

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SPATIAL DISTRIBUTION OF CENTRAL PLACES IN 1963

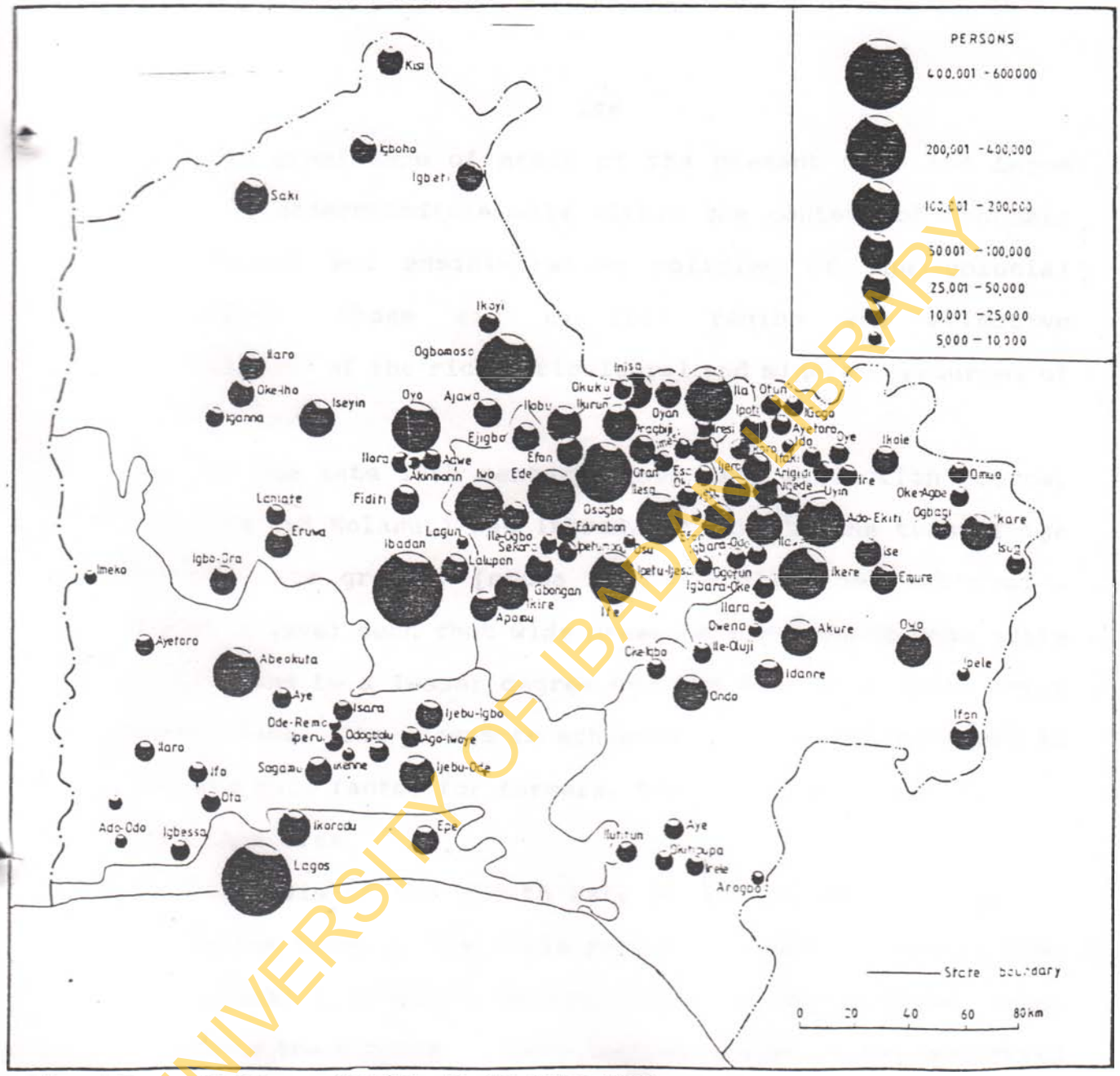

Fig. 4.3: Source: Compiled by the author (1993)

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The prominence of areas of the present Ondo and Lagos state is understandable only within the context of economic development and administrative policies of the colonial government, whose aim in this region was effective exploitation of the rich agricultural and mineral resources of the country.

By the late 19th century, cash crop production [cocoa, oil palm and Kolanut] was introduced, and by the turn of the century, its growth, [cocoa in particular] had achieved a dramatic level such that wide areas of the present Ondo state mainly, and to a lesser degree Oyo and Ogun were under cocoa plantations. The prospects achieved in its production was to act as a pull factor for farmers, traders, and migrant labours into this area.

Analysis of the growth rate of the largest One hundred and twelve towns in the whole region this period reveals that city annual growth rate varies, with Ondo agricultural towns recording the highest. These include Okemesi 7.9%; Ado-Ekiti 7.7% Effon Alaye 7.4% and Ijero 7.4%. Others are Ijare 7.1%, Aramoko 7.1% and Emure 7.0% among others. Virtually all the present state capitals in the system have relatively low growth rate. For instance, Abeokuta with 5.0%; Lagos

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metropolis 4.5%, Akure 4.1% and Ibadan 2.4%. Perhaps the coming into prominence and the subsequent change in sizes of the latter set of towns might not be unconnected with a shift in emphasis from agricultural based economy to industrial development policies of the last three decades.

Again the colonial administrative policy was such that favoured few centers. Lagos colony [the metropolis] became the seat of colonial government and later that of independent Nigeria [until 1991]. Ibadan was chosen as the headquarter, first of the Western region and later of the Western State Until 1976 when it became the capital of Oyo State. Some other towns were either provincial headquarters e.g. Abeokuta, Ijebu -Ode, Ondo, and Oyo or divisional headquarters such as Ilesha, Owo, Okitipupa and Ado-Ekiti. Their different but "Modern" administrative status was to attract to them different governmental attention as contained in such policies as township ordinance of 1917.

The British township ordinance of 1917 provided for the creation and administration of all towns in the country. It identifies three classes of towns in order of importance and degree of attention. Lagos was only the first class town, while the second class towns include, Ibadan, Abeokuta, Ondo,

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Ado-Ekiti. The township status provided the guideline for the distribution of governmental activities or facilities - roads, water supply, electricity, hospitals, education etc. The order of provision was to increase with order of towns. Thus there was "first class attention" in terms of concentration of amenities in Lagos. These were to act as baits for entrepreneurs in the location of early industrial and commercial entrepreneurs, particularly in Lagos which became a nucleus of industrial and commercial activities. It was to receive migrants-Labour and traders from all over the country and even beyond. It has been estimated that Lagos metropolis had between 1952-1963 a net migration of 244, 501 persons.

Again, the strategically located cities and regional or provincial headquarters were to be connected by either road or railway system [whose initial development was to facilitate evacuation of agricultural products]. They thus became important break points in the network of transportation, a factor that further enhanced their positions as centers of commercial and industrial activities. Such centers include, Oshogbo, Ibadan, Abeokuta, and Lagos. The not well favored locations such as Oyo, ogbomosho, Ede and Okitipupa lost their

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population to the fast growing commercial centers.[Mabogunje, 1968; Ayeni,1980]

4.3.3 Pre-recessionary [early independence epoch]

For the spatial expression of the regional central place populations of this era we may have to await a detailed Census report recently concluded in the Country. However, what legacy the preceding colonial epoch left for the region, is a pattern of spatial development inequalities; the creation of rapidly growing but very few large cities and a large number of rapidly depressing central places. All these were to be emphasized by both the economic and political processes of the independent Nigeria.

The driving force behind growth no doubt was economic engine, seen in industrialisation and apparently explicit spatial economic policies. But it soon became obvious that political or politicking process provided the pathway for the spatial allocation of the scarce economic resources. For instance, which state/city gets what federal/state activity is a function of effective representation of such a place in the decision making process at either federal or state level.

The industrialisation policy of this era no doubt had a

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cataclysmic effect on urbanisation in the area. The policy centered on import substitution with overwhelming reliance on imported inputs in the manufacturing sector. It was observed that "urban centers became the automatic locational choice for most of the assembly-type consumer goods industries in the country" {Onyemelukwe, 1978]. This is not only because they provided the demand threshold necessary for the industries viability, they possess the type of infrastructural bases for profitable manufacturing activity - electricity, transport, banking services etc. They also provide easy clearing house for labour.

The dramatic influence of this on Lagos is noteworthy. Its initial locational advantage with commanding river and ocean position at the coast greatly favoured it during the import substitutions industrial policies of this period. Not only were new ports built e.g. Kirikiri lighter terminal, old ones such as the third Apapa wharf were extended. As a result, many industries whose major raw-material component were import based [Bakeries, soap-making, Drugs and medicine, Basic industrial chemicals etc] sprang in Lagos. In perhaps more dramatic manner, financial institutions, Insurance and other commercial enterprises rose to either provide capital,

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services and or intermediate raw material demand of the industries.

The overall effect of the industrial policy could be summed up in the fact that there was unbalanced sectoral pattern of productivity advance. That is, there was a differential rate of total factor productivity growth between manufacturing and agriculture. The neglect of the rural based agric sector further impoverished the rural areas and forced out rural dwellers to the urban centers in search of better opportunities.

The presence of apparent or real better opportunities in the cities was reinforced by the upward wage and salary review in the modern sector. [Such as Udoji award of 1976]. This no doubt raised expectations of prospective rural emigrants and thus accentuated rural-urban migration in the country as a whole.

One dominant political process that had significant impact on the size structure of the urban centers was the state creation exercises, the most revolutionary of which was the 1976 state creation. The exercise saw the splitting of the former Western state into Ogun, Oyo and Ondo states, with Abeokuta, Ibadan and Ondo becoming state capitals, [see figure

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1.1] and many other cities in each state becoming local government headquarters. Within each state, the state capitals became the first order centers in the provision or allocation of resources while the local government headquarters were second order centers. This no doubt represent explicit spatial development policies, but the designation of a town as either state capital or local government headquarter had some politicking colouration.

All the above forces ensured a steady growth of the urban component of the central place system since independence. The urbanisation process could be said to reach its peak in the oil boom era and the years immediately following it - early 1980s. It is not an overstatement to say that some [if not all] the cities became too large, or to say that there was regional overurbanisation in S.W. Nigeria in the early 1980s. That the cities became too large is evident in the observation that

> "their growing failure to fulfill much of the expectations both of those who live in them and those who have to depend on them for services" [Mabogunje 1978.]

Overurbanisation became obvious when the economy could no longer finance such excesses as that of social costs of

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immigration. The problems arising from the overurbanisation of the cities were summarised by Mabogunje [1978] as "Unemployment, Liveability, Manageability and Serviceability". For instance, the scanty labour statistics shows that by 1984, urban unemployment was highest in Lagos state with 9.7% followed closely by Oyo/Osun states with 8.1%. For Ogun and Ondo states, Urban unemployment was 6.5% and 4.5% respectively. [Akinnifesi,1986]

Within the cities, the high incidence of overcrowding, growth of squatter settlements, poor environmental sanitation, worsening transportation problem, inadequate water and power supply all point to the fact that the cities of S.W. Nigeria and the country in general are overurbanised.

4.4 CONCLUSION

In the ongoing discussion, available population figures of central places for three periods [1900, 1952 and 1963] are employed to analyse the concentration, distribution and growth of the regional urban structure. The dynamics of the regional urbanisation are also examined within three historical - economic epochs. It is observed that both processes of central place location and the growth of central

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place population in the pre-colonial era are understandable within broad geographical and historical context of the regional central places and the nature and role of the central places, being historical settlements, and traditional centers of trade; administration and cultural activities. Since then growth processes reflect more of economic cum political activities of the colonial administration and later those of Independent government in Nigeria.

The discussion has so far utilised only population figures to highlight underlying spatial dynamics of central places. For more rigorous quantitative analysis, we proceed to employ socio-economic and political functions of the central places. The use of these variables becomes particularly necessary since population figure is first, one measure of central place size and relative growth. The variable again is very sensitive to rudimentary improvement in health condition and standard of living. More importantly perhaps is the paucity of this important data in the country since 1963. All these necessitate a search for and utilisation of more continuous and perhaps more reliable variables.

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CHAPTER FIVE

FUNCTIONAL HIERARCHY OF CENTRAL PLACES

5.1 INTRODUCTION

The most fundamental manifestation of complex organisations and one of the most common structures found in nature is hierarchical arrangement [Coffey, 1981; Simon, 1973]. The concept emphasizes the general inter-relationships of structure, and has as its distinguishing feature "the existence of discrete but interacting levels" [Pattee, 1969] or according to Simon [1973], the near decomposability of the system. However, different levels in the system are often related [functionally] to or may depend on [control by] the whole system [Koestler, 1967]. In fact the CPT developed by Christaller represents a spatial hierarchical model in which each central place is a member of a functional order of centers and each order of central places perform specific group of functions.

In the discussion that follows in this chapter, the functional organisation of S. W. Nigeria central places, the orderly functioning and periodic transformations in the hierarchical arrangement of the central place systems are analysed. The spatio-temporal pattern of and relationships in the hierarchical structure are examined. The hypothesis that

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there is hierarchy of central places in the region is tested.

The discussion here should highlight the spatial functional organisation of the central places and some of the underlying processes of the functional arrangement, which are to be related to the observed spatial economic structure of the central place systems later in this work.

5.2 CHOICE AND CLASSIFICATION OF CENTRAL FUNCTIONS

It is a well established fact in the geographic literature that any empirical investigation of the functional structure of central places must employ at least a wide range of functions, if not the total functions performed by the set of central places in the region. [Yeates M. Garner B. 1980; Abiodun 1967; 1968; Carter, 1972]. The above follows from the general observation that the use of single function such as number of telephone installed [Christaller, 1933] or some specialised functions such as Banking services or Daily Newspaper circulation; number of Air traffic passengers etc could only lead to an unrealistic conclusion about the relative importance and structural organisations of central places,[Berry B.J.L and Garrison W.L,1958; Abiodun,1967;1968; Davies, 1978]. This is particularly true of developing economies where the distribution of such functions is limited

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to few relatively large centers. Again for similar reason, many of the variables selected in the developed economies such as Population change, Employment characteristics; number of Rail and road connection etc. would be of little or no importance in our context where reliable figures are hard to come by, if they exist.

As such, an important influencing factor in the selection of central functions in the region is the prevailing condition in terms of the level of socio-political and economic development. Perhaps more fundamental is the exigency of a spatio-temporal comparism within a highly fragmented regional political framework, where each geo-political unit maintains individual stand in terms of method of data aggregation, storage and modus operandi governing retrieval of data for intending users.

However a total of forty-five central functions, measuring Commercial, Industrial and Service activities in the region are used. The functions, as listed in appendix 1, are those that can be obtained across the unit states of observation as distinct geo-political and data aggregating units.

Where many variables are involved, any discussion of the functional hierarchy of central places requires an elaboration

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of the classes or order of the central functions [Davies, 1978]. The need for classification of functions is in recognition of both the presence of orders of central functions, [Dacey, 1976; Alao, Dacey et. al. 1977], as well as the varying quantitative importance of central goods and services in an economic landscape. [Abiodun, 1968]. A classification scheme is though inherent in Christaller's delineation of low order and higher order goods which are based on strict economic principle of cost-value and frequency of demand of central functions [figure 2.1]. However, apart from the practical difficulty of determining the cost-value and demand frequency of central functions in the region, the spatial distribution of these functions may not be easily amenable to strict economic interpretation. For instance, certain services such as secondary school are known to be provided in many locations through communal efforts for non-economic reason of prestige. Similarly the distribution of many government owned establishments and services often defy rational economic interpretation or social equity consideration. Thus our knowledge of local conditions in terms of the level of socio-economic and political development and the relative importance of each of the functions in the region have been employed to derive four classes of central functions

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shown in table 5.1. Such level of disaggregation is deemed necessary in order to highlight any differences that might exist among the central places, and thus facilitate identification of the different orders of centers.

It would, however, be inappropriate to assume equal level of significance for the different grades of central function by awarding one or zero depending on the presence or absence of each function in a place. This is because of the varying quantitative importance of the functions in each class. For instance A class one function such as General hospital is more important than a private hospital, [class Two] since it is known in the region to have greater number of wards or hospital beds and more medical personnel. Again, a specialist hospital is in turn more important than a maternity [class three] and a primary health care or dispensary [class four].

Various measures aimed at assessing the relative importance of central functions have been suggested. These include the method of localisation coefficient introduced by Davies [1978] and refined by Bennison, [1980]. The underlying assumption that the degree of focality of each function would vary with the total number of that function in a region would be realistic if all the functions considered are in the same

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class. This is however not the case. The use of such technique would lead to data synthesis rather than analysis. The scalographic [weighting] technique introduced by Abiodun [1967, 1968] is more appealing here since it makes all the multivector parameters commensurable and simultaneously permits analysis of data using multivariate technique. As she suggested, any convenient weights or scores could be assigned to different classes of function, though very high scores would make data management difficult. For our purpose here a score of 7, 5, 3 and 1 have been assigned to classes one, two, three and four respectively [table 5.1].

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TABLE 5.1
CLASSES AND WEIGHTS OF CENTRAL FUNCTIONS

CLASSES	1	2	3	4
SCORES	7	5	3	1
University		Polytechnic/ College of Education	Secondary School	Primary/ Nursery School
State/General Hospital		Private Hospital	Maternity	Primary Health Care/Dispensary
High Court		Daily Markets	Police Stations	Periodic Markets
Police Divisional Headquarters		Magistrate Courts	Laundry/Dry Cleaning	Customary Court I and II
In-town Fly Overs		Insurance	Bookshop/Station-eries	Police Stations
In-town Double Carriage Ways		Legal Services	Chemists/ Medicine Stores	General Goods
Consultancies		Banking	Petrol Stations	Concrete Products
Travel Agencies		Motor Vehicle sales	Bakery/Bakery Products	Furniture/ Fixtures
Brewery		Hotel/ Restaurants		Woodmills
Textiles		Supermarkets		
Leather Industry		Printing/ Publishing		
Pulp/ Paper Products		Food Processing Industry		
Chemicals/ Chemical Products				
Fabricated Metal Products				
Machinery/Equipm-ents				
Non Metallic Industry				
Electrical/ Electronics				

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5.3 STRUCTURAL FEATURES OF THE CENTRAL PLACE SYSTEMS:

5.3.1 Identifying The Fundamental Structures of the Central Place Systems.

Any attempt to describe the functioning and periodic transformations in the structural arrangements of a central place system or quantify the processes giving rise to the structural organisation of central places, must begin with the determination of whether such a system has common basic dimensions of variation. The basic dimensions are here defined as, groups of closely interdependent variables whose interpretation may be tied to fundamental aspects of the central places. Furthermore consideration should also be given to the nature of the basic dimensions overtime, in order to carry analysis beyond morphology to a useful consideration of systems development. The hypotheses are, that the central places have common dimensions of variation which underlie the development of all the central places in the region, and also that the basic dimension or structural features of the central place systems have been consistent through time.

The use of multivariate technique for such analysis enjoys a wide support in the geographic literature [Yeates et al 1980; Carter, 1972; Abiodun 1967; 1968], because intuitive

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traditional approach which usually employs single variable or variable index would not only prove cumbersome but largely incapable when a large number of variables are to be used. Multivariate factor analytical technique is employed here because its basic hypothesis is that each of the original variables is a product of different combinations of common dimensions or factors and that, these basic factors are substantially fewer than the observed variables. The method identifies and separates clusters of closely interdependent variables. Complete output of factor analysis consists of many statistical information, such as the correlation matrix for all the variables; eigen values which describe the basic dimension of the data factor loadings; unrotated and rotated factor scores; the scores of each center on the factors etc. These can be used to describe the characteristics of the central places or as input into models of growth and change in the central place systems.

The technique is applied to the total of forty-five variables observed for the 136 central places that constitute the study area The analysis is carried out for three time periods, 1967, 1976, and 1991 in order to examine the structural changes in the central place system and also monitor underlying processes of such changes for quantifica-tion and

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predictive purposes. From the factor analytical procedure, a 45 X 45 matrix of correlation among the original variables was obtained for each period. These are shown in appendixes 5, 6 and 7 for 1967, 1976 and 1991 respectively. The correlation coefficients are positive and are generally very high throughout the periods. This implies that there is a high tendency for any pair of the original variables to occur together over space and, that this tendency holds overtime. For instance the coefficients between variable 1 [Banks] and variable 6 [supermarket] are 0.985, 0.959 and 0.977 in 1967, 1976 and 1991 respectively. The corresponding coefficient between variable 12 [Brewery] and variable 28 [travel agency] are 0.907, 0.935 and 0.796 respectively.

The implications of the above are that, all the forty-five original variables are not independent of each other, which signifies the presence of numerous redundancies in the pattern of variation of the central functions. As such the dimension of variation within the central places may not be distinguished with the spatially correlated variables. In order to ensure that each variable introduces different dimensions to the structural features of the central places, the output of factor loadings are extracted from the procedure factor analysis.

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The factor loadings are partitioned into different numbers/factors. The results as summarised in tables 5.2, 5.3 and 5.4 show that, a total of 12, 10 and 9 principal factors in 1967, 1976 and 1991 respectively, have eigen values greater or equals 0.1. The cumulative proportion of the Eigen values of factors in this category as shown in tables 5.2, 5.3 and 5.4 remain 99% in the three periods. However the relative contribution of each factor to the variance in the data set varies greatly as revealed by their Eigen values in each period. For instance, factor 1 with Eigen value of 36.4, 36.9, and 36.5 account for 81% 84.% and 83% of the variance in the data set in 1967, 1976 and 1991 respectively. The corresponding figures for factor two are 3.9 [8%] 3.6 [8%] and 3.8 [8%] while for factor three the figures are 1.4 [3%] 1.5 [3%] and 1.2[3%] respectively. The three factors jointly account for about 93%, 95% and 94% of the total variance in the data set in the three periods. They are therefore considered to have enough diagnostic power and are retained in this work for further interpretation.

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TABLE 5.2
EIGEN VALUES OF PRINCIPAL FACTORS IN 1967

PRINCIPAL FACTORS	EIGEN VALUES*	PROPORTION	CUMULATIVE PROPORTION
1	36.429	0.809	0.809
2	3.969	0.088	0.897
3	1.373	0.030	0.928
4	0.742	0.016	0.944
5	0.551	0.012	0.957
6	0.358	0.001	0.965
7	0.306	0.001	0.971
8	0.267	0.005	0.977
9	0.204	0.004	0.982
10	0.154	0.003	0.985
11	0.111	0.002	0.988
12	0.103	0.002	0.991
TOTAL	44.567	0.991	0.991

* Mineigen = 0.1; Communality Estimate = 45

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TABLE 5.3
EIGEN VALUES OF PRINCIPAL FACTORS IN 1976

PRINCIPAL FACTORS	EIGEN VALUES*	PROPORTION	CUMULATIVE PROPORTION
1	36.863	0.835	0.835
2	3.597	0.081	0.916
3	1.542	0.035	0.951
4	0.487	0.011	0.962
5	0.346	0.007	0.970
6	0.284	0.006	0.976
7	0.252	0.005	0.982
8	0.162	0.003	0.986
9	0.133	0.003	0.989
10	0.100	0.002	0.991
TOTAL	43.755	0.991	0.991

* MINEIGEN = 0.1; Communality Estimate = 44.16

TABLE 5.4
EIGEN VALUES OF PRINCIPAL FACTORS IN 1991

PRINCIPAL FACTORS	EIGEN VALUES*	PROPORTION	CUMULATIVE PROPORTION
1	36.544	0.830	0.830
2	3.797	0.086	0.916
3	1.224	0.027	0.944
4	0.585	0.013	0.957
5	0.482	0.011	0.968
6	0.451	0.010	0.979
7	0.240	0.005	0.984
8	0.182	0.004	0.988
9	0.108	0.002	0.991
TOTAL	43.613	0.991	0.991

* Mineigen = 0.1; Communality Estimate = 44.02

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TABLE 5.5

ROTATED FACTOR PATTERN IN 1967

VARIABLES	FACTOR1	FACTOR2	FACTOR3
1	0.985	-0.151	0.007
2	0.945	0.507	-0.047
3	0.923	0.625	-0.138
4	0.982	0.106	-0.067
5	0.978	0.555	-0.074
6	0.987	-0.095	-0.097
7	0.955	0.229	-0.098
8	0.975	0.167	-0.126
9	0.552	-0.017	0.667
10	0.934	0.242	-0.006
11	0.945	0.076	0.096
12	0.981	0.065	-0.157
13	0.937	-0.331	-0.067
14	0.952	-0.29	-0.07
15	0.927	0.336	-0.109
16	0.942	-0.279	0.001
17	0.893	0.412	-0.097
18	0.942	-0.317	-0.069
19	0.972	-0.118	-0.003
20	0.944	-0.316	-0.071
21	0.803	0.231	0.195
22	0.749	-0.282	0.311
23	0.781	-0.321	0.139
24	0.986	-0.122	-0.082
25	0.976	-0.174	-0.058
26	0.932	-0.349	-0.074
27	0.569	0.793	0.022
28	0.932	-0.346	-0.086
29	0.955	0.021	0.161
30	0.959	0.082	0.096
31	0.956	0.251	0.003
32	0.928	-0.361	-0.046
33	0.953	0.666	-0.219
34	0.604	0.508	-0.532
35	0.881	0.569	0.111
36	0.683	0.715	-0.083
37	0.986	-0.077	-0.018
38	0.541	0.095	0.281
39	0.976	-0.178	0.015
40	0.976	-0.164	-0.017
41	0.797	0.478	0.037
42	0.923	-0.368	-0.091
43	0.973	-0.18	-0.123
44	0.855	-0.218	0.326
45	0.958	0.164	-0.091

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TABLE 5.6

ROTATED FACTOR PATTERN IN 1976

VAR	FACTOR1	FACTOR2	FACTOR3
1	0.987	-0.125	0.014
2	0.951	0.581	-0.051
3	0.938	0.669	-0.171
4	0.961	0.228	-0.086
5	0.761	0.315	-0.078
6	0.983	0.072	-0.147
7	0.952	0.243	-0.147
8	0.971	0.177	-0.143
9	0.655	-0.024	0.567
10	0.951	-0.254	-0.006
11	0.958	-0.052	0.128
12	0.971	-0.018	-0.165
13	0.945	-0.304	-0.077
14	0.962	-0.244	-0.091
15	0.909	0.385	-0.011
16	0.931	-0.308	0.005
17	0.955	0.258	-0.077
18	0.938	-0.334	-0.076
19	0.957	-0.261	-0.067
20	0.936	-0.335	-0.093
21	0.866	0.201	0.171
22	0.786	-0.266	0.356
23	0.897	-0.351	0.054
24	0.973	-0.196	-0.106
25	0.988	-0.05	-0.061
26	0.936	-0.34	-0.068
27	0.595	0.269	0.015
28	0.938	-0.324	-0.111
29	0.932	0.047	0.109
30	0.981	-0.119	0.001
31	0.867	0.454	-0.112
32	0.927	-0.365	-0.051
33	0.754	0.577	-0.183
34	0.618	0.781	0.664
35	0.929	0.485	0.106
36	0.773	0.614	-0.028
37	0.987	-0.07	-0.043
38	0.539	0.063	0.212
39	0.851	0.089	0.418
40	0.988	-0.023	0.065
41	0.861	0.366	0.162
42	0.938	-0.323	-0.118
43	0.971	-0.201	-0.084
44	0.957	-0.071	0.165
45	0.982	0.017	-0.072

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TABLE 5.7

ROTATED FACTOR PATTERN IN 1991

VAR	FACTOR1	FACTOR2	FACTOR3
1	0.989	0.487	-0.001
2	0.991	0.578	-0.028
3	0.561	0.798	-0.073
4	0.966	0.314	-0.046
5	0.964	0.211	0.009
6	0.967	0.187	-0.129
7	0.985	0.128	-0.059
8	0.987	-0.006	-0.103
9	0.706	-0.191	0.363
10	0.945	0.178	-0.069
11	0.878	0.118	0.262
12	0.851	-0.011	0.128
13	0.897	-0.433	-0.048
14	0.941	-0.313	-0.088
15	0.985	0.041	-0.062
16	0.974	-0.201	-0.051
17	0.989	0.105	-0.062
18	0.915	-0.387	-0.043
19	0.917	-0.388	-0.055
20	0.977	0.079	-0.174
21	0.829	0.519	0.033
22	0.567	0.481	0.581
23	0.981	-0.064	-0.071
24	0.987	-0.092	-0.112
25	0.991	0.085	-0.042
26	0.985	-0.146	-0.038
27	0.965	-0.246	-0.052
28	0.981	-0.098	-0.146
29	0.623	0.733	-0.212
30	0.961	0.507	0.057
31	0.971	0.587	-0.109
32	0.893	-0.443	0.014
33	0.723	0.102	0.391
34	0.246	-0.025	0.637
35	0.982	-0.131	0.554
36	0.981	0.156	0.438
37	0.978	-0.141	-0.013
38	0.505	0.018	0.191
39	0.971	-0.157	0.121
40	0.981	0.118	0.072
41	0.895	0.281	0.125
42	0.907	-0.408	-0.071
43	0.931	-0.254	0.112
44	0.728	0.346	-0.152
45	0.948	-0.094	-0.029

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The weights or loadings of the variables on the original [unrotated] factor pattern in 1967; 1976 and 1991 are shown in appendixes 8, 9 and 10 respectively. It is evident from the appendices that, it is a difficult task naming the factors with the unrotated factor loadings. This is because virtually all the variables load positively high on the three factors. For instance, as many as 34 to 37, and 20 to 22 variables have coefficients greater than 0.50 on factors One and Two respectively in the three periods. This suggests the use of rotated factor loadings in naming the factors. The original factor pattern is rotated using widely employed varimax method. The rotated coefficients help in achieving much simpler structure in which each factor affects a few variables and each variable is correlated with a few factors. Again the number of high and low loadings are maximised thus reducing the number of intermediate scores. The rotated factor loadings help in identifying the structural features of the Central places. Tables 5.5, 5.6 and 5.7 show the rotated loadings on the three factors in 1967, 1976 and 1991 respectively.

Although most of the variables load positively high on factor One in the three periods, the scores of the centers on this dimension as shown in appendixes 11, 12 and 13 and the spatial pattern mapped in figures 5.1 5.2 and 5.3 suggest that

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the factor could be named Industrial development dimension. This is again borne out of the fact that virtually all the variables measuring Industrial functions [variables 9 to 23] have low negative loadings on factors Two and Three in the three periods.

The loadings of the variables on factor Two in the three periods are though generally low and mostly negative, there is, however, relatively higher positive loadings of variables measuring commerce [var. 1 to 8] and those measuring education [var. 33 to 36] on the factor. The scores of the central places on the dimension as shown in figures 5.4, 5.5 and 5.6 further suggest that factor Two in 1967 and 1976 is a measure of education and commerce, while in 1991, the factor measures commercial and basic health dimension.

Most of the variables either load positively or negatively low on factor three in the three periods. However, the scores of the centers on the factor as shown in figures 5.7, 5.8 and 5.9 suggest that factor three could be labelled, basic health services; basic health and judicial services and educational services respectively in 1967, 1976 and 1991 or for sake of temporal consistency, Basic services dimension.

The structural features of the central places as identified above are summarised below.

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YEAR	FACTORS	STRUCTURAL FEATURES
1967		
	[1]	Industrial development dimension
	[2]	Education and commerce
	[3]	Basic Health Services
1976		
	[1]	Industrial development dimension
	[2]	Education and commerce
	[3]	Basic health and Judicial services
1991		
	[1]	Industrial development dimension
	[2]	Commerce and Health
	[3]	Educational services.

It follows from the above that the structural features of the S.W. Nigeria central places described by forty-five original variables in 1967, 1976 and 1991 can be described by three new and independent factors. It is concluded that the central places of South-West Nigeria are spatial systems of three dimensions. This implies that the spatial organisations of the central place systems can be described by the pattern of the basic dimensions of variation identified while transformations in the spatial structure will reflect changes in these dimensions.

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Although three basic dimensions of variation or fundamental features of the central place systems are identified in each period, possible changes in each dimension could be detected over time. The discussion proceeds here to examine the temporal characteristics of structural features of the central place systems.

5.3.2 Changing Structural features of the Central Places

The processes of growth in a regional central place system are usually reflected in changes in the basic structural features of such systems overtime. This is because individual element in such spatial systems grows or declines in response to complex processes of change that originate either from within or outside the system. As such the structural features of a system of central places are expected to change progressively until a time when the system reaches a stable state. The properties of the structural features identified in the periods considered are examined and summarised in table 5.8.

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TABLE 5.8

CHARACTERISTICS OF THE STRUCTURAL FEATURES OF CENTRAL PLACES [1967, 1976 AND 1991]

YEAR / CHARACTERISTICS	1967	1976	1991
1. No. of Centers	136	136	136
2. Selection of Centers	Places Over 5000 Pop. in 1952	Same as in 1967	Same as in 1976
3.Type and Number of Functions			
3a. Commercial	8	8	8
3b. Industrial	14	14	14
3c. Services	22	22	22
4. Factor type and contribution			
4a. Factor 1	Industrial development	Industrial development	Industrial development
Contribution	81%	84%	83%
4b. Factor 2	Education and Commerce	Education and Commerce	Commerce and Health
Contribution	9%	8%	9%
4c. Factor 3	Basic health Services	Basic health and JudicialServices	Educational Services
Contribution	3%	4%	3%
Total Variance Explained	93%	96%	95%

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From table 5.8, the data set for the three periods is comparable, with the same number and set of central places [136 in all], and uniform type of central functions which cover Commercial, Industrial and Service activities. In each period three structural features are identified which are essentially variants of the same structure. The three dimensions jointly account for between 93 to 96% of the total variation in the original variables and, again the relative strength of each of the three dimensions is consistent overtime. There is therefore no strong reason to suggest changes in the structural features of the central places since 1967. That the fundamental dimensions of variation in central place systems might be consistent through time, had been suggested in the literature [King, 1966; Hodge, 1967; Berry, 1978; Ray and Mudie, 1972; Smith, 1973]. The reason for the observation here may however be due to the period of observation. The three periods, 1967, 1976 and 1991, fall mainly within the latter facet of one of the three easily recognisable political/economic epochs [the pre-recessionary epoch, and to some extent recessionary era] which the country as a whole and the region in particular had witnessed or is passing through. Perhaps fundamental changes would have been seen if structures of at least two historical epochs are compared. This has not been possible for practical

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reason of availability of relevant data. If there is no observed changes in the basic dimensions of variation in the central place systems overtime the same could not be said to be true of the spatial pattern of these factors. Any observable changes may be seen more in the scores of each center on each of the factors overtime. The spatial pattern of the three factors is therefore examined.

5.4 THE DISTRIBUTION OF CENTRAL PLACES ON THE DIMENSIONS

The pattern of loading of each of the forty-five original variables on the three independent factors shows a close but varying association of the primary variables with the factors. It follows that the forty-five by three matrix of factor loadings can be used to compute three weighted scores for each of the 136 central places. Each center receives a score based on its position along each of the three independent dimensions. The procedure is carried out for the three periods.

The Scores of the 136 central places on the three factors in 1967, 1976 and 1991 are shown in appendices 5.8, 5.9 and 5.10, while figures 5.1 to 5.9 show the spatial pattern of the three dimensions in these periods. If we use the three structural features as indices of level of functional provisions, or as surrogates of spatial economic development,

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the scoring coefficients of each central place on each factor will show the performances of the centers or the structure of the space economy in the three periods.

5.4.1 Industrial development dimension:

Figures 5.1, 5.2 and 5.3 show the distribution of the central places on the dimension of industrial development. Although the number of central places with positive score on the dimension increased from 46 in 1967 to 80 in 1976 and decreasing dramatically to 18 in 1991, it is only Lagos that load positively high, with a factor score of 11.0 in the three periods.

The high score of Lagos on factor one in the three periods, would suggest the fact that, the greatest concentration of the type of industrial establishment surveyed is in the center. That the town is highly industrialised is supported by available statistics and knowledge of Industrial development in the region. A survey of industrial establish-ments in Nigeria for instance shows that as early as 1965, out of the total of 288 Industrial establishments in South-Western Nigeria, about 216 or 75% were in Lagos, representing in that period about 33% of the Industrial establishments in the country as a whole. Mabogunje,[1974]. This trend perhaps remains until today as

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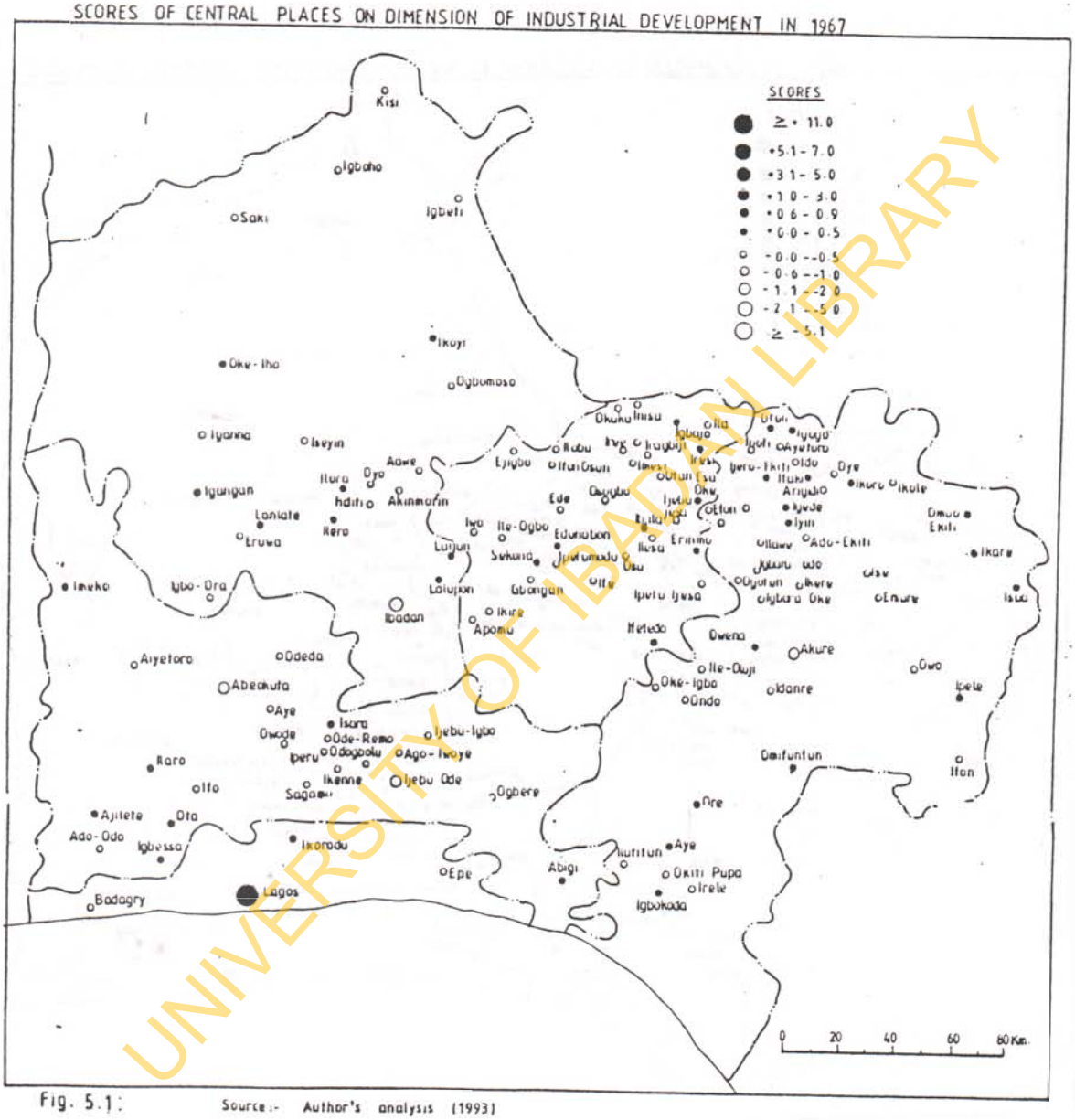
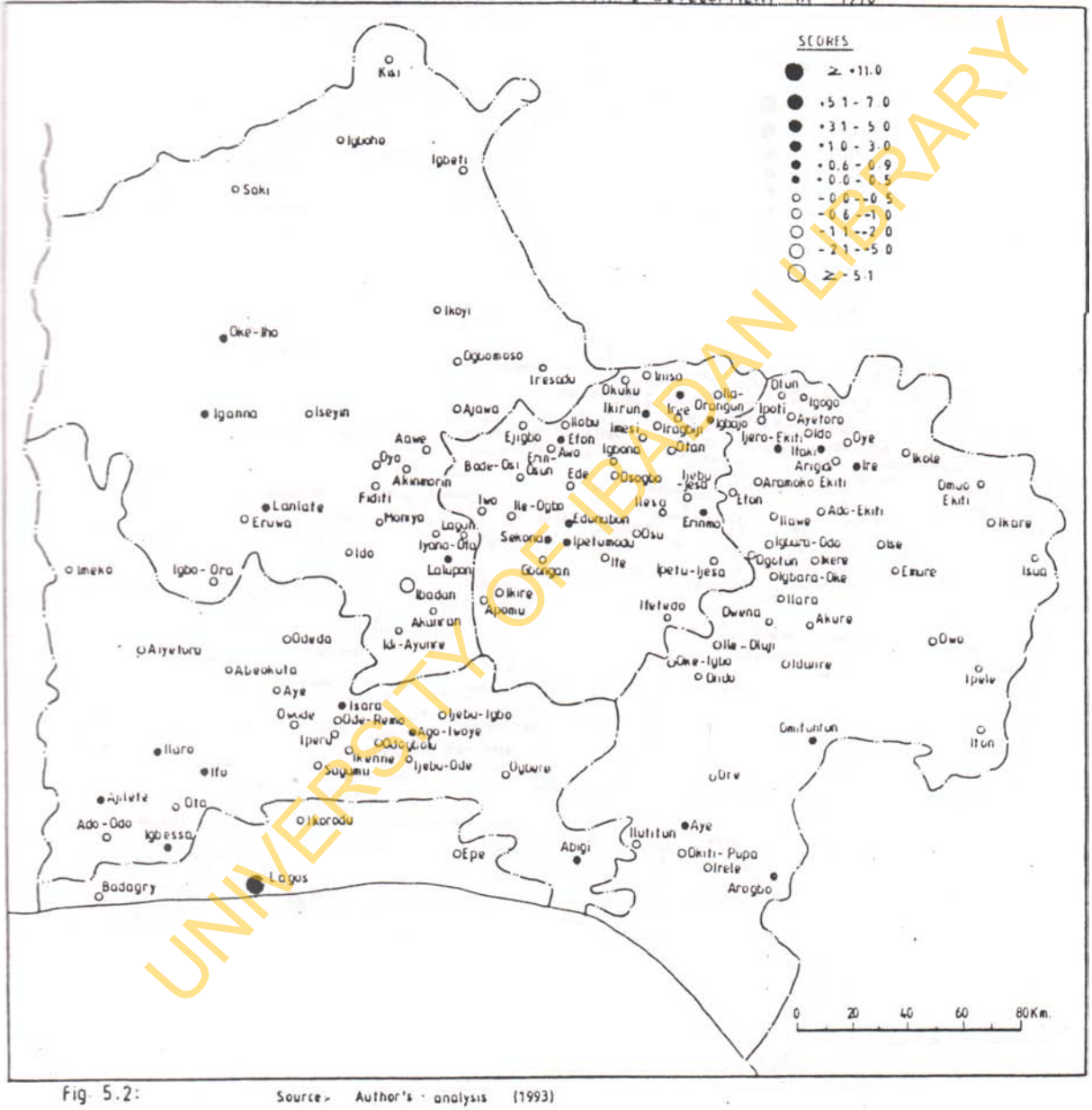
SCORES OF CENTRAL PLACES ON DIMENSION OF INDUSTRIAL DEVELOPMENT IN 1967


SCORES
≥ + 11.0
+5.1 - 7.0
+3.1 - 5.0
+1.0 - 3.0
+0.6 - 0.9
+0.0 - 0.5
-0.0 - -0.5
-0.6 - -1.0
-1.1 - -2.0
-2.1 - -5.0
≥ -5.1
Kisi
Igbaho
Saki
Igbeti
Ikoyi
Oke-Iho
Ogbomoso
Iseyin
Iwere
Aawe
Oyo
Iseyin
Igangan
Ibadan
Lanlate
Eruwa
Ikeko
Iyo-Ora
Ogbere
Ajilete
Ota
Ado-Odo
Igbessa
Ikorodu
Lagos
Badagry
Epe
Abigi
Aye
Ekiti Pupa
Irele
Igbokoda
Ore
Ondo
Owena
Akure
Ikare
Ijebu-Ode
Sagamu
Ilaro
Abeokuta
Aiyetoro
Ijebu-Iyebo
Ago-Iwoye
Ikenne
Ijebu Ode
Ogbere
Ife
Ilesa
Ede
Ilorin
Ikirun
Ilawe
Ado-Ekiti
Ikare
Iwaraja
Ijero-Ekiti
Ikere
Ikole
Omuo Ekiti
Ijero Ijesa
Ijero Ekiti
Ijero Ijesa
Ijero Ekiti
Ijero Ijesa
Ijero

SCORES OF CENTRAL PLACES ON DIMENSION OF INDUSTRIAL DEVELOPMENT IN 1976


SCORES
≥ +11.0
+5.1 - 7.0
+3.1 - 5.0
+1.0 - 3.0
+0.6 - 0.9
+0.0 - 0.5
-0.0 - -0.5
-0.6 - -1.0
-1.1 - -2.0
-2.1 - -5.0
≥ -5.1
Kaiama
Igboho
Igbeti
Saki
Oke-Iho
Ikoyi
Ogbomoso
Iresadu
Okuku
Ikirun
Ilobu
Imesi
Oriagbon
Ajawa
Iganna
Iseyin
Ejigbo
Efon
Awo
Igbona
Otan
Aawe
Oyo
Ona-
Osun
Ede
Osogbo
Ijebu
-Jesa
Bode-Osi
Akinmorin
Fiditi
Iwo
Ile-Ogbo
Ilesa
Lanlate
Eruwa
Monrya
Lagun
Iyana-Ofa
Sekona
Edunabon
Ipetumodu
Osu
Ido
Lalupon
Gbongan
Ite
Ipetu-Ijesa
Imeko
Igbo-Ora
Ibadan
Ikire
Apomu
Akanran
Ikl-Ayunre
Oluyole
Odeda
Abeokuta
Aye
Owode
Isara
Ijebu-Igbo
Ode-Remo
Ago-Iwoye
Iperu
Ikenne
Sagamu
Ijebu-Ode
Ogbere
Ilaro
Ifo
Ajilete
Ota
Ado-Odo
Ikorodu
Igbesa
Epe
Abigi
Lagos
Badagry
Ifetedo
Owena
Akure
Ile-Oluji
Oke-Igbo
Ondo
Oldwire
Owo
Ipele
Omuo
Ekiti
Ikare
Isua
Ifon
Ilawe
Ado-Ekiti
Igbara-Oke
Emure
Ikere
Ogotun
Aramoko Ekiti
Efon
Ijero-Ekiti
Ifaki
Ikole
Ire
Ariga
Oye
Oldo
Ipoti
Igogo
Ayetoro
Illa-
Orangun
Ire
Ikirun
Ijebu
Ife
Ilesa
Ibadan
Ife
Ijebu-Ife
Ilesa
Ife
Ibadan
Ife
Ijebu
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Ife

SCORES OF CENTRAL PLACES ON DIMENSION OF INDUSTRIAL DEVELOPMENT IN 1991

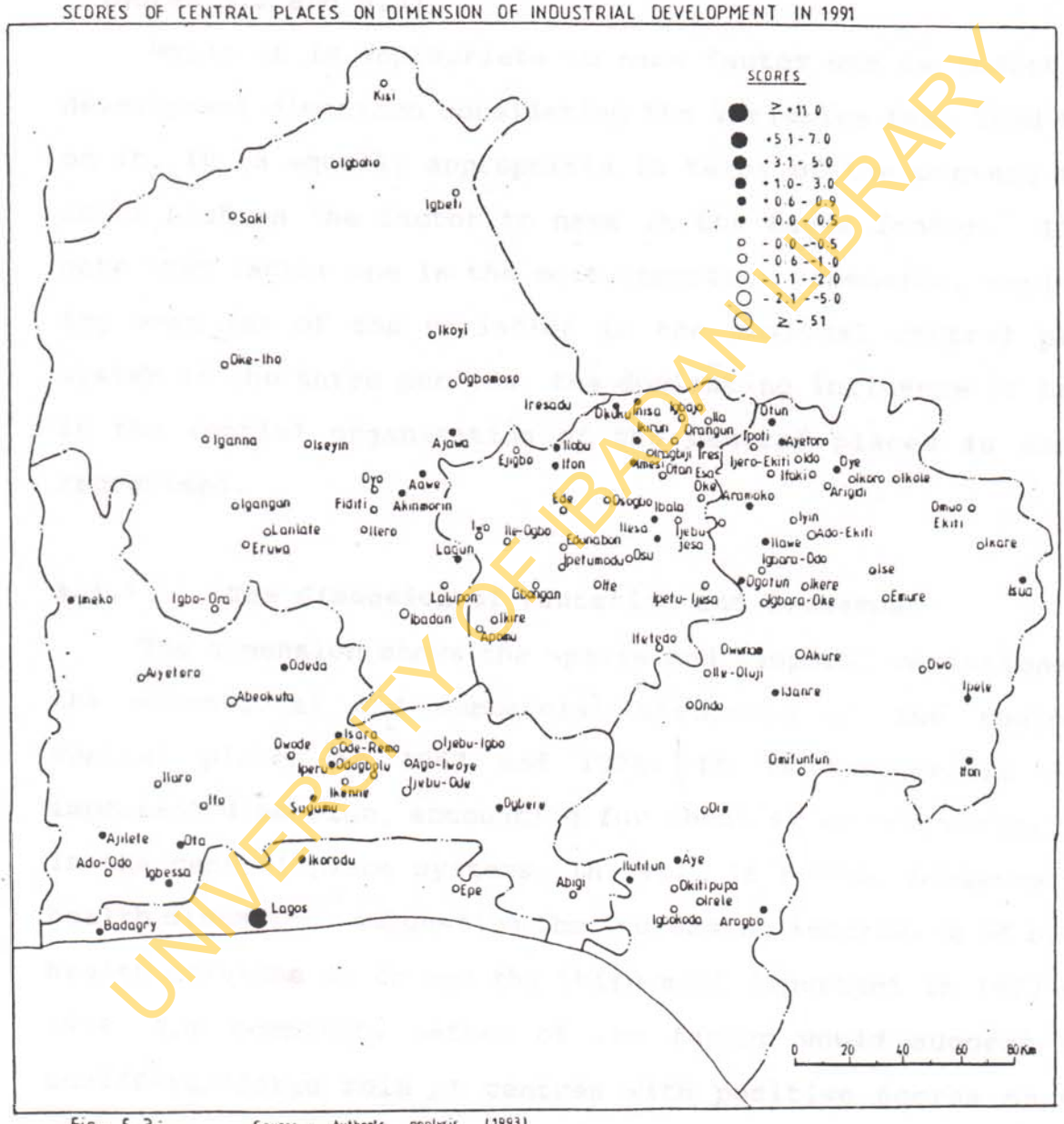

Fig. 5.3: Source :- Author's analysis (1993)

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revealed by the score of Lagos on this factor in 1976 and 1991. [figures 5.2 and 5.3].

While it is appropriate to name factor One as Industrial development dimension considering the variables that load high on it, it is equally appropriate in terms of the centers that score high on the factor to name it the Lagos factor. If we note that factor one is the most important dimension, explaining over 80% of the variation in the regional central place system in the three periods, the dominating influence of Lagos in the spatial organisation of the central places is easily recognised.

5.4.2 The dimension of Education and Commerce.

The dimension shows the spatia and temporal variations in the educational and commercial structure of the regional central places in 1967 and 1976. It is the second most important dimension, accounting for about 9% of the variations in the central place systems. In 1991, it became commerce and health dimension, suggesting the increasing importance of basic health services which was the third most important in 1967 and 1976. The composite nature of the factor would suggest the undifferentiated role of centres with positive scores on the dimension.

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SCORES OF CENTRAL PLACES ON DIMENSION OF EDUCATION AND COMMERCE IN 1967

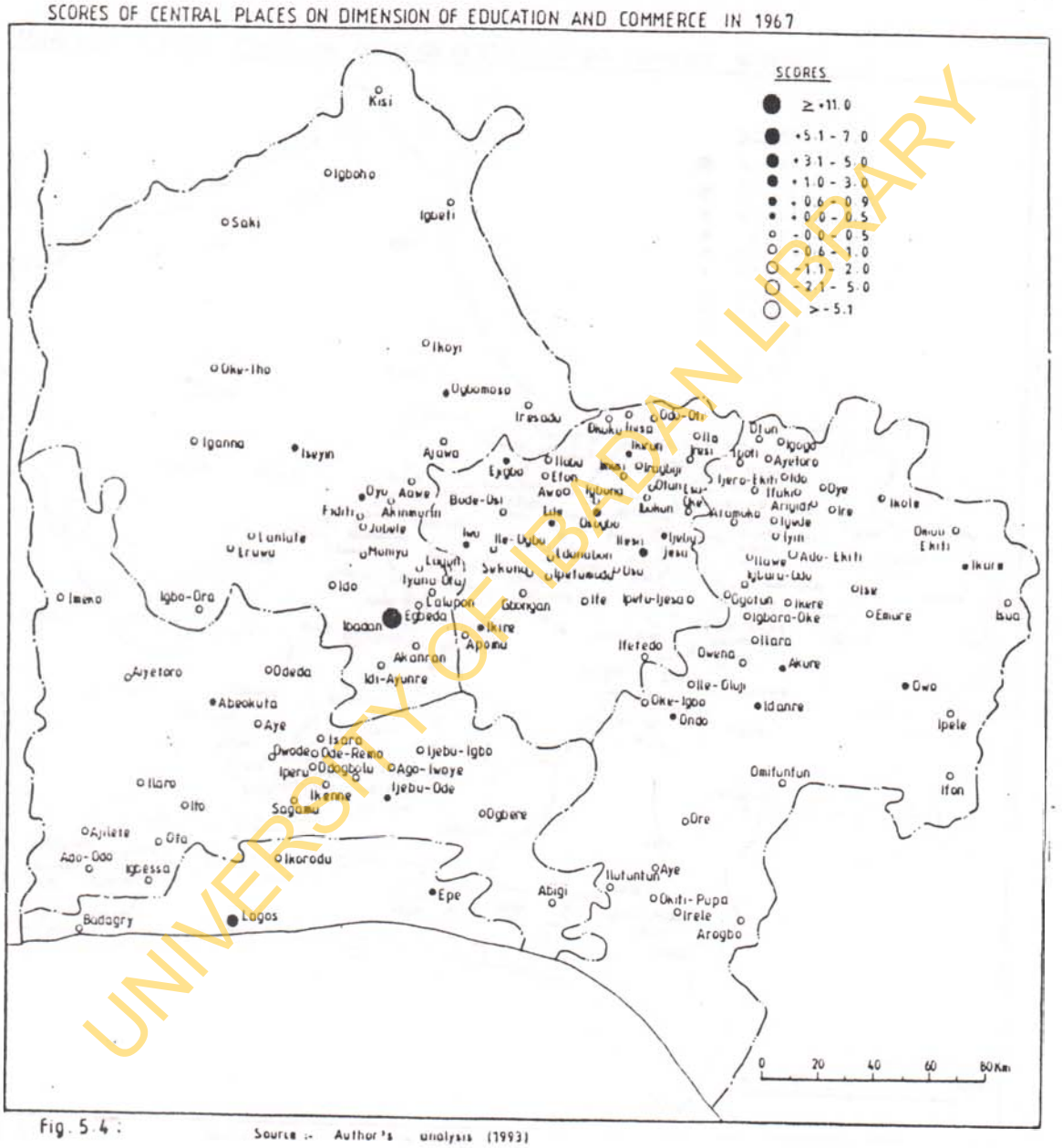

Fig. 5.4 : Source :- Author's analysis (1993)

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SCORES OF CENTRAL PLACES ON DIMENSION OF EDUCATION AND COMMERCE IN 1976

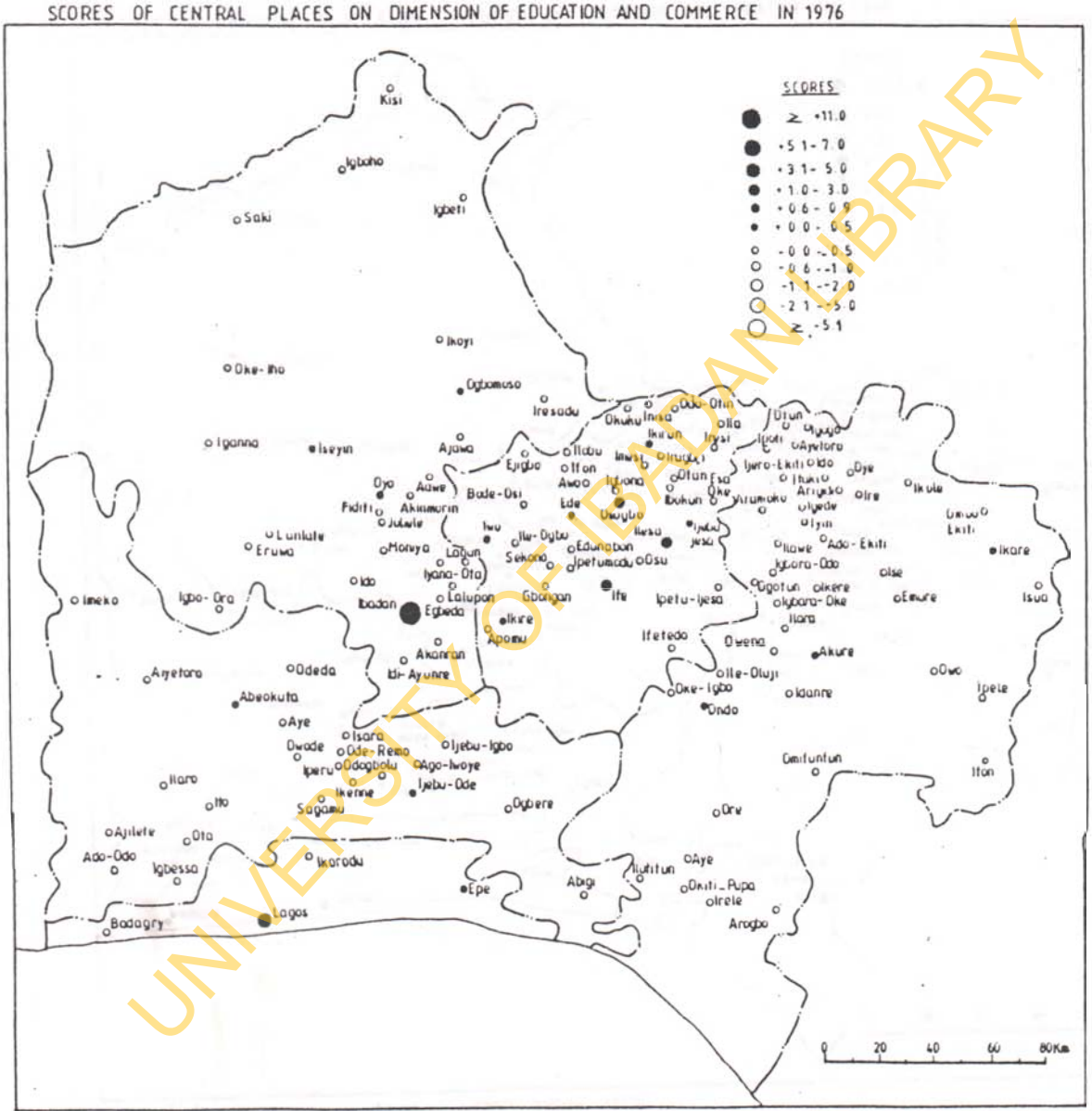

Fig. 5.5: Source :- Author's analysis (1993)

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SCORES OF CENTRAL PLACES ON DIMENSION OF EDUCATION AND HEALTH IN 1991

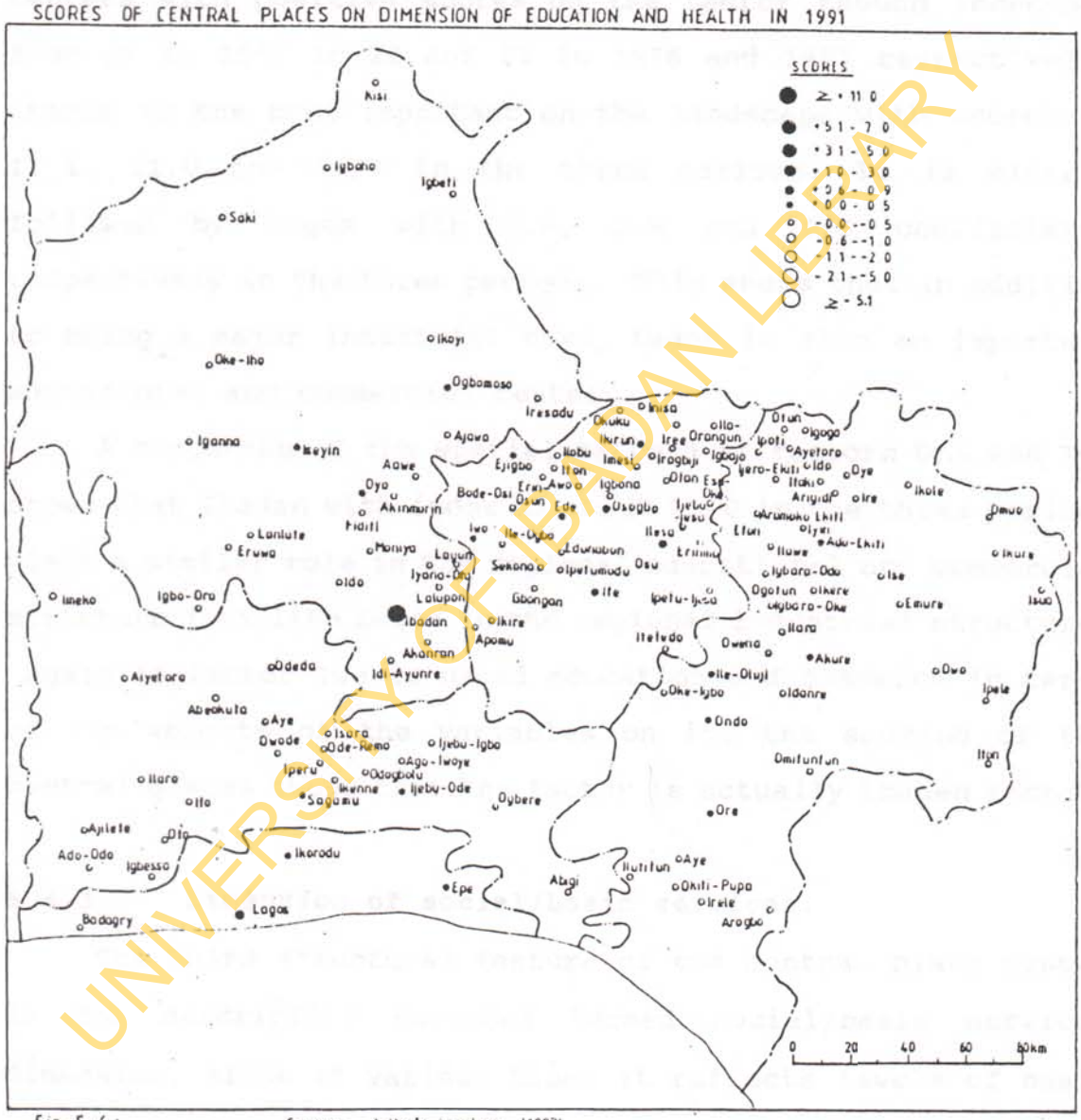

Fig. 5.6 : Source :- Author's analysis (1993)

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As shown in figures 5.4, 5.5 and 5.6, the number of centers with positive scores on the factor though increased from 17 in 1967 to 20 and 21 in 1976 and 1991 respectively, Ibadan is the most important on the landscape with scores of 11.1, 11.0 and 11.4 in the three periods. It is closely followed by Lagos with 2.6, 2.8 and 0.8 coefficients respectively in the three periods. This shows that in addition to being a major industrial town, Lagos is also an important educational and commercial center.

A comparism of the spatial pattern of factors One and Two shows that Ibadan with index of about 11.0 in the three periods plays a similar role in the regional educational and commercial structure just like Lagos in the regional industrial structure. Again if factor Two is named education and commerce in terms of the weights of the variables on it, the scoring of the central places shows that the factor is actually Ibadan factor.

5.4.3 Dimension of social/basic services.

The Third structural feature of the central place system is for descriptive purposes termed social/basic services dimension, since at various times it reflects levels of basic health, judicial and educational services provision. Although the dimension contributes just about 3% to variations in the

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original variables, this may be due more to the near universality of these services particularly education in the region. That factor three was for instance resolved into educational services suggest that this function which was associated with second most important dimension in 1967 and 1976 was by 1991 being provided in almost every center.

Figures 5.7, 5.8 and 5.9 show the scores of the central places on social/basic services dimension in 1967, 1976 and 1991 respectively. It is evident that unlike factors One and Two, no single center dominates the dimension. The centers with highest scores are; Oshogbo, with 6.9, 4.4 and 5.5 and Abeokuta with 3.3, 4.1 and 2.1 respectively in the three periods. Other centers with scores greater or equals 3.0 at various times include Ogbomosho, Oyo, Akure, Ondo, Ado-Ekiti, Owo and Ikare. The coefficients of these centers on the factor show that they perhaps provide basic services for their hinterlands.

By resolving the fourty-five original variables measuring the functions of central places into three new independent dimensions, we have in a way classified the space economy into three orthogonal factors or sectors. It is therefore the spatial and temporal patterns of the three sectors of regional economic development that have been considered. However, for

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SCORES OF CENTRAL PLACES ON DIMENSION OF BASIC HEALTH SERVICES IN 1967

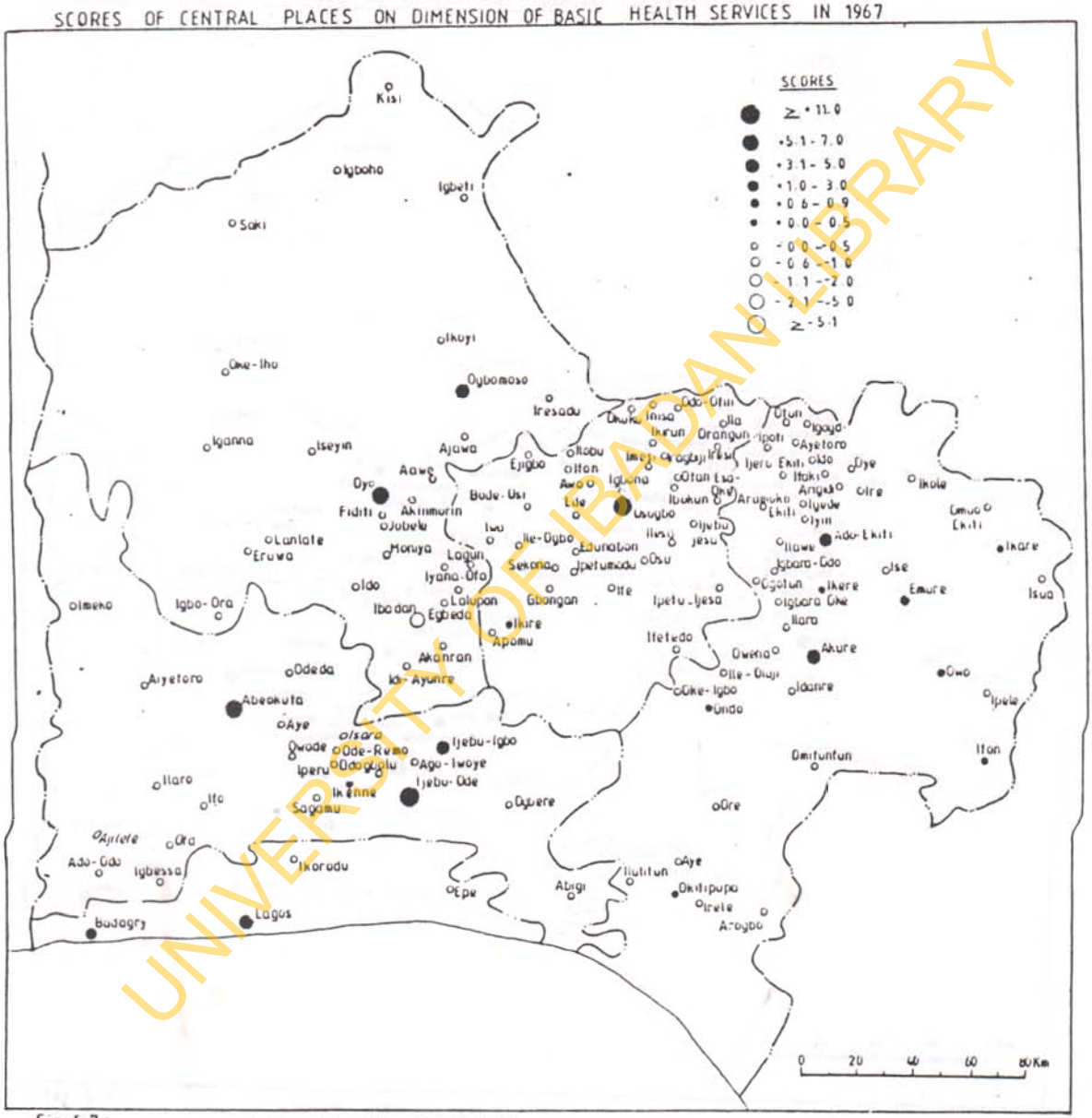

Fig. 5.7: Source :- Author's analysis (1993)

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SCORES OF CENTRAL PLACES ON HEALTH AND JUDICIAL SERVICES (1976)

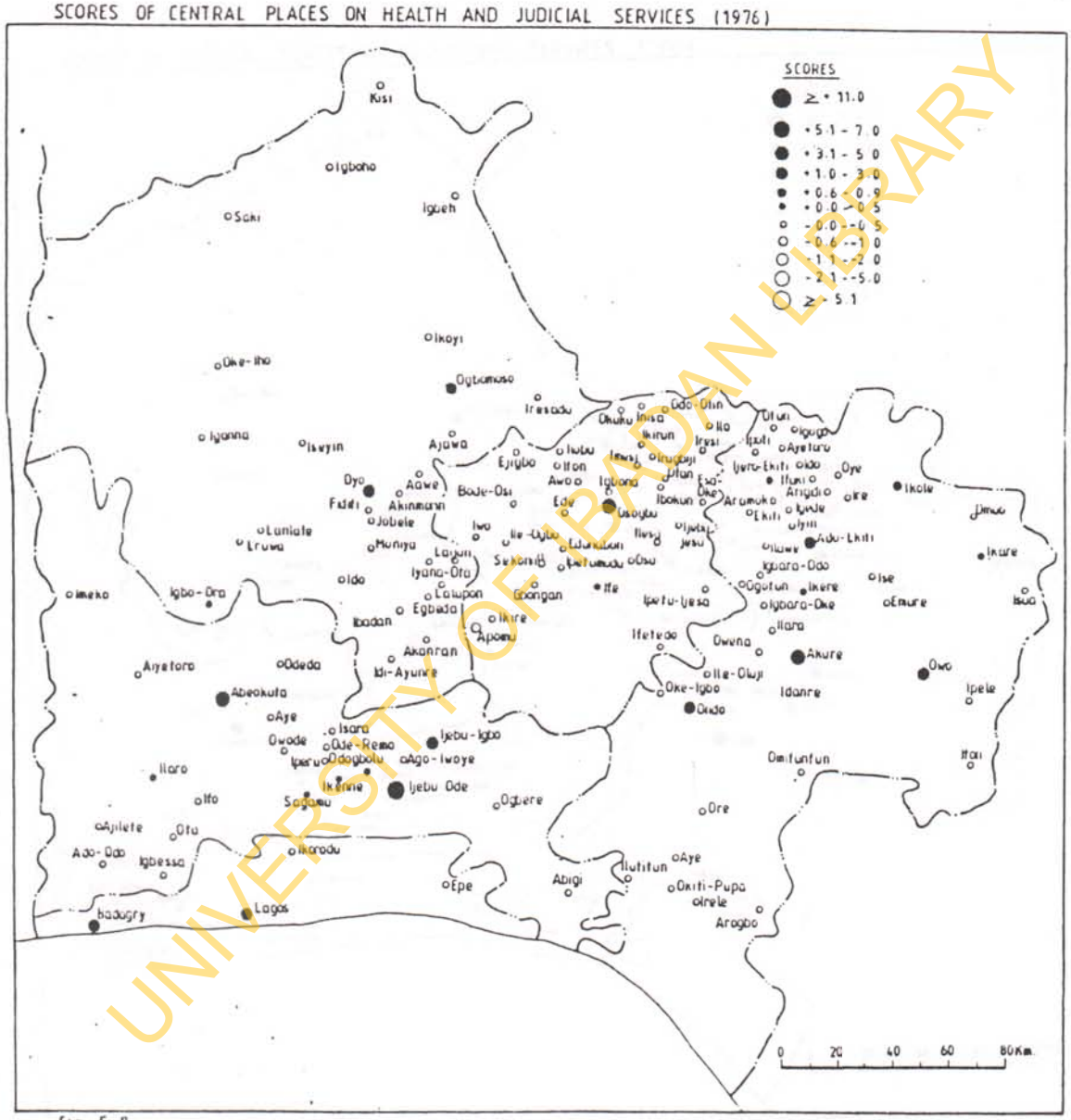

Fig. 5.8: Source :- Author's analysis (1993)

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SCORES OF CENTRAL PLACES ON EDUCATIONAL SERVICES (1991)

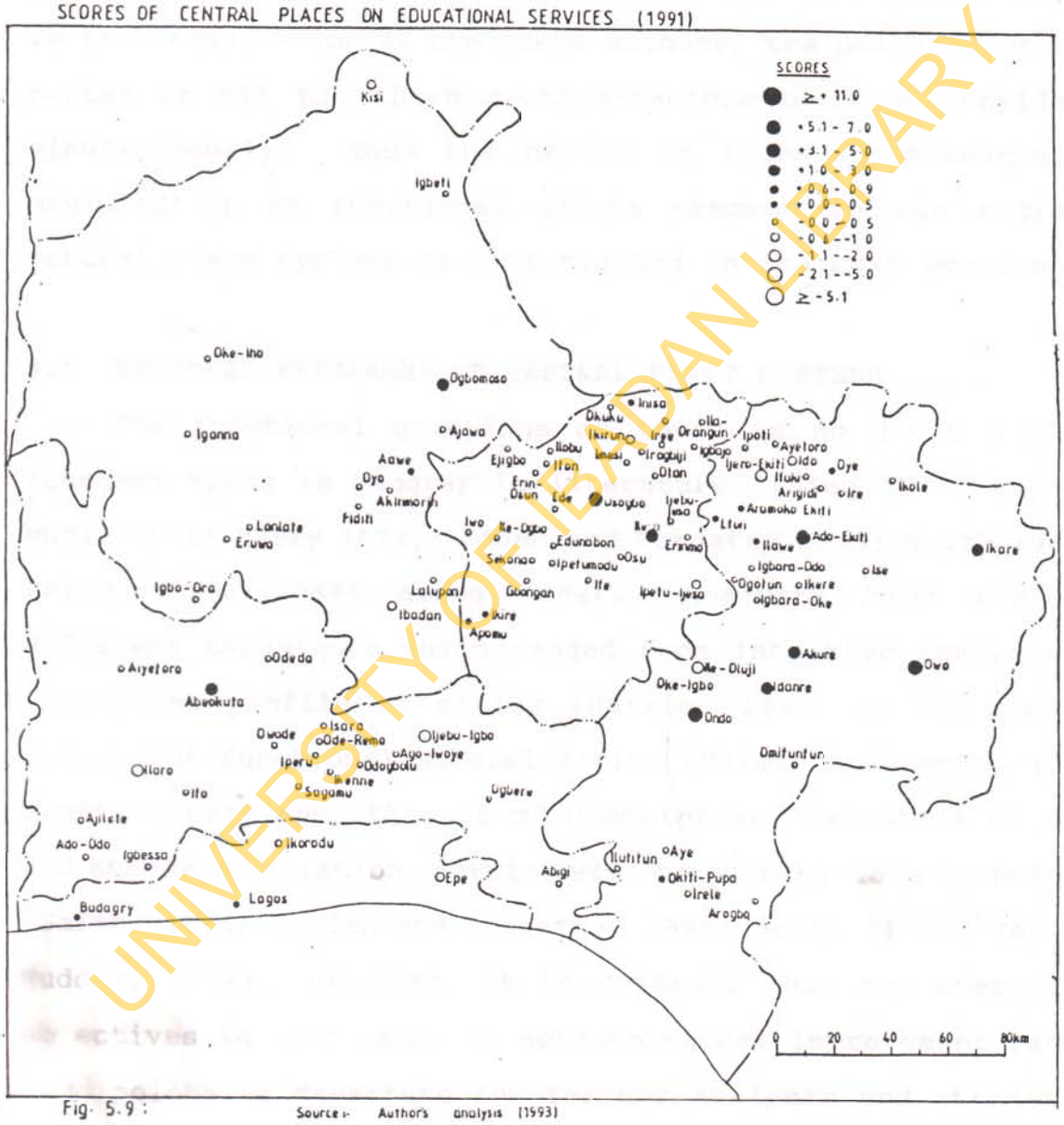

Fig. 5.9 : Source:- Author's analysis (1993)

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analysis of functional interdependence of the central place systems and modelling of changing fortune of the central places in the organisation of the space economy, the position of each center on all the three sectors/factors need be considered simultaneously. Thus the nature or types of hierarchical organisation or functional groups present in the regional central place systems is investigated in the next section.

5.5 REGIONAL HIERARCHY OF CENTRAL PLACE SYSTEMS

The functional groupings of towns is no doubt a major research theme in geographic literature. [King 1966; Ray and Mudie 1972; Berry 1972; Hadden and Borgatta 1965; Smith 1965a; Abiodun 1967,1968] among others. Analysts have employed different techniques which ranged from intuitive analysis of employment profile of cities [Harris, 1943] to the use of indices of functional specialization [Ullman and Dacey, 1962; Pratt, 1968;] and, the use of descriptive statistics of mean and standard deviation [Harris 1943] to multivariate techniques [Smith, 1965; Hadden and Borgatta, 1965; Berry, 1972; Ray and Muddie, 1972]. However, it is observed that the overriding objectives in most cases is methodological improvement rather than points of departure for further analysis and attempt to structure reality within a problem framework - the structure of

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space economy. The basic aim is to identify different orders or classes of central places, and analyse rigorously the changing distribution of central places in the hierarchical structure.

In his review of methods of grouping Towns, Carter [1972] concluded that, in the literature, "nothing like consensus exists as to the method for examining whether a hierarchical structure exists". We however employ the multivariate method of hierarchical cluster analysis. Apart from the wide support it enjoys in the literature, the particular appeal of hierarchical cluster analysis lies in the fact that by an inductive process, groups of central places are objectively derived. The technique further ensures maximum homogeneity within groups and maximises differences between them, thus making it possible to classify logically central places that are most similar in terms of service provisions. It is expected that in the regional network of central places, different orders or classes should be recognisable in each period of investigation. Thus spatio-temporal variation in the hierarchical order can be modelled, while future distribution of the central places in different orders can be predicted.

The hierarchical cluster analysis utilises as an input, the weighted scores of each central place on the new independent dimensions of variation in the original data set -

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that is, the three sectors to which the space economy is resolved. These dimensions jointly account for a total of 93%, 95% and 94% variability in the original data set. We begin the procedure by calculating the similarity between pairs of central places in terms of their scores on the independent structural dimensions. From this procedure a 136 x 136 distance similarity matrix is first derived. Beginning with the most similar pairs [the least distant], the central places are grouped systematically until a maximum generalisation is achieved, when an 1 x 1 matrix is obtained.

The m x n matrix where m [the central places under consideration] = 136 and n number of factors are three in the three periods, the data is analysed using software package - Genstat V Release 4.04B. From the starting point of 100% level, where 136 x 136 distance matrix are considered, a level of maximum generalisation was achieved variously at the 50th 40th and 45th levels in 1967, 1976 and 1991 respectively. In the three periods, while all the centers must have been grouped at very early stages [usually at the 85th and 90th levels], Ibadan and Lagos remained ungrouped until much later stages, while Lagos remained ungrouped throughout. The dendogram showing stages of grouping procedure, and the different groups or orders of central places that emerged in

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the three periods are shown in appendixes 14, 15 and 16.

It has however been observed that "there is no clearcut way of determining the optimal number of clusters in the hierarchical classification procedures [Andrew,1990]. He thus suggested a sharp change in the fusion level [of the dendogram]. Again according to Ward,[1963], changes in these distance values as the number of clusters is reduced, furnish useful clues to the appropriate number of groups [clusters] to be used for operational purposes". From appendices 14, 15 and 16, five distinct groups of centers are identifiable in each period. This observation confirms that, there is hierarchy of central places in the region.

The spatial distributions of the different order of central places in 1967, 1976 and 1991 as shown in figures 5.10, 5.11 and 5.12, reveal that in the three periods Lagos and Ibadan remained the only First and Second order centers respectively. This observation also confirms the spatial pattern of factors One and Two as discussed earlier on. Among the Third order centers in the periods are Abeokuta, Akure, Oshogbo, and Ado-Ekiti, while the Fourth order centers include, Oyo, Ogbomosho, Ilesha, Ijebu-ode, Ondo and Owo. Most of the centers cluster within the fifth order class throughout the periods of observation. They include Odeda, Aiyetoro and Abigi

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ORDER OF CENTRAL PLACES IN 1967

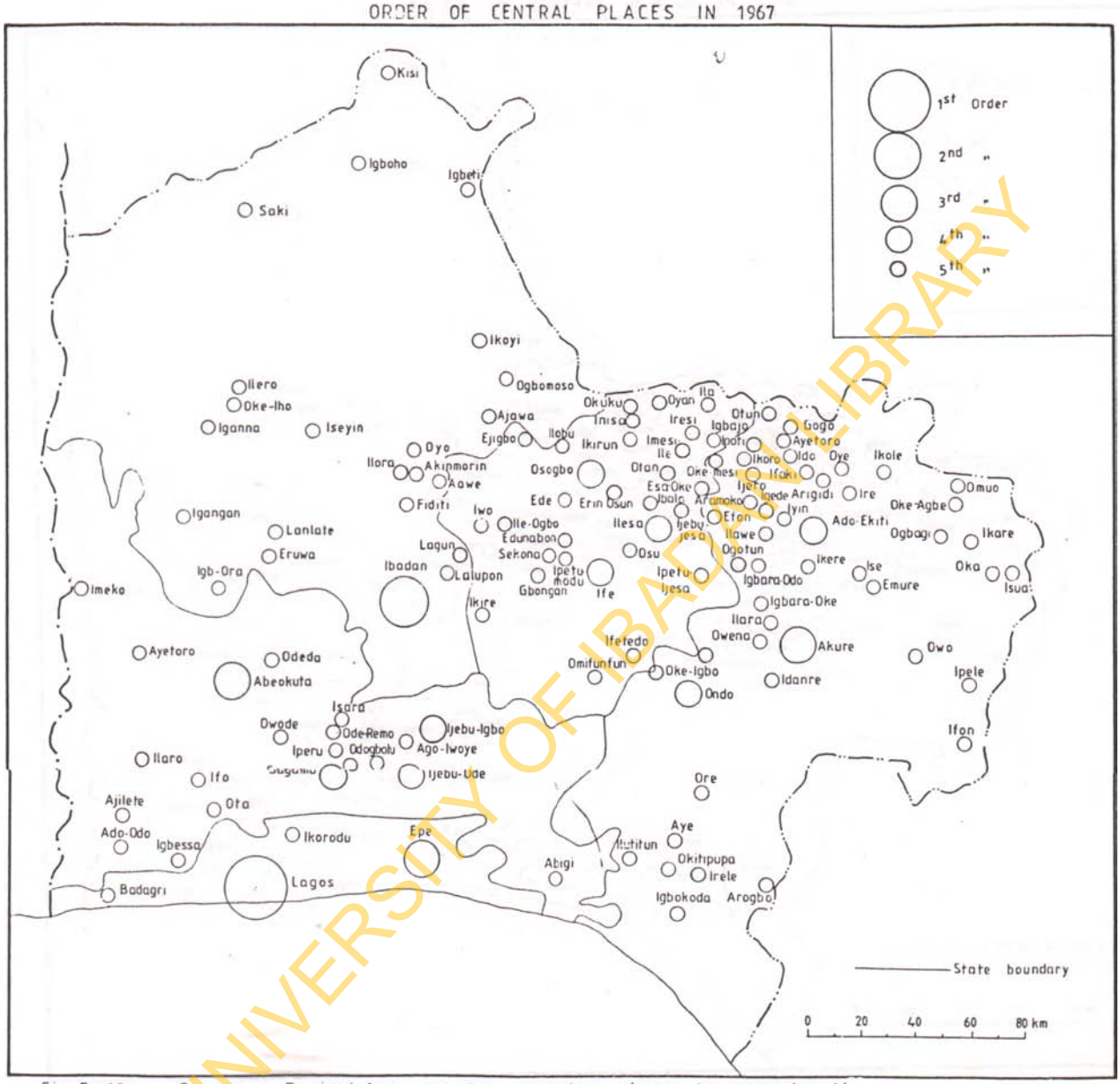

Fig. 5.10 Source : Derived from grouping procedure shown in appendix 14

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ORDER OF CENTRAL PLACES IN 1976

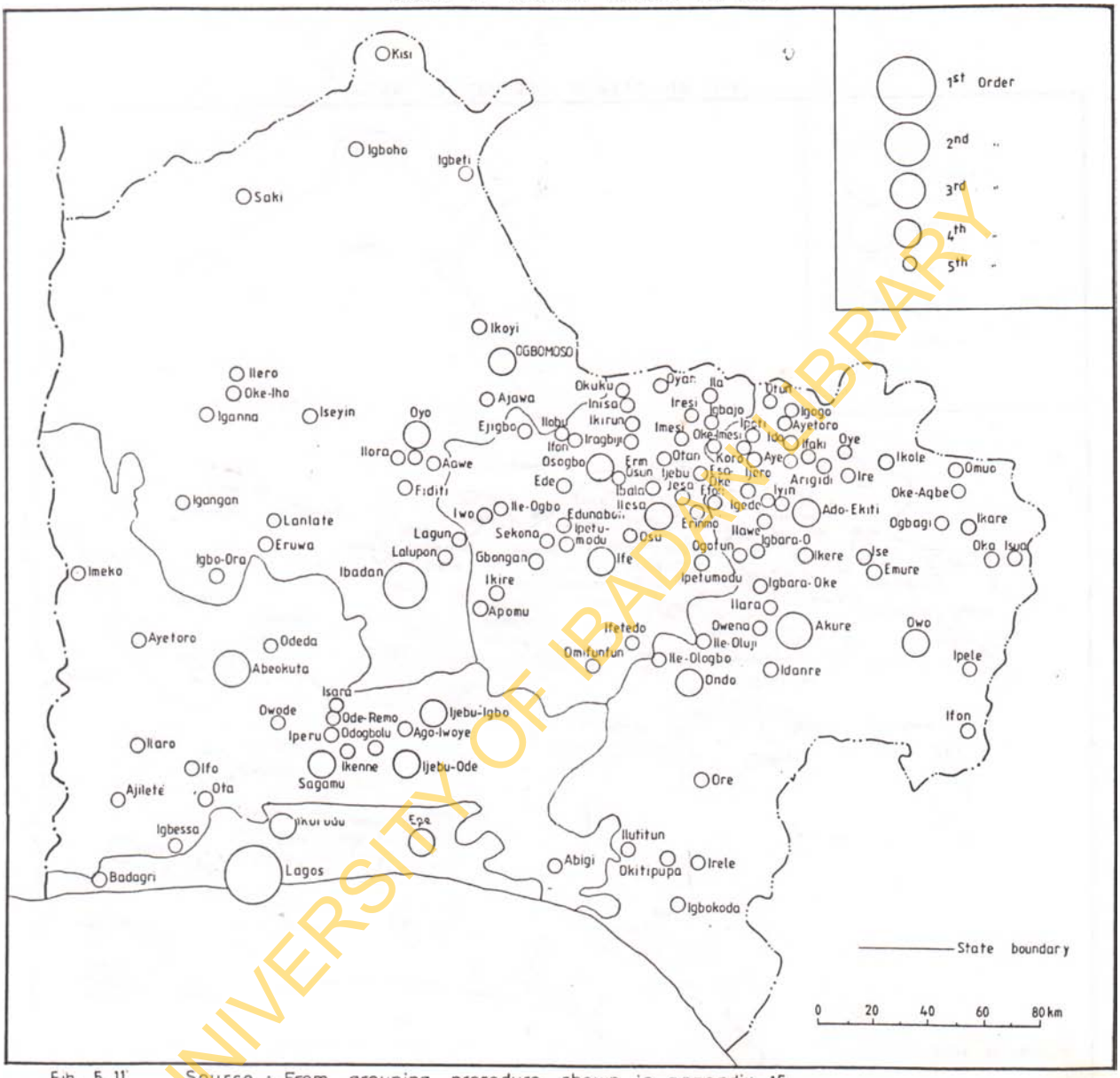

Fig. 5.11 Source : From grouping procedure shown in appendix 15

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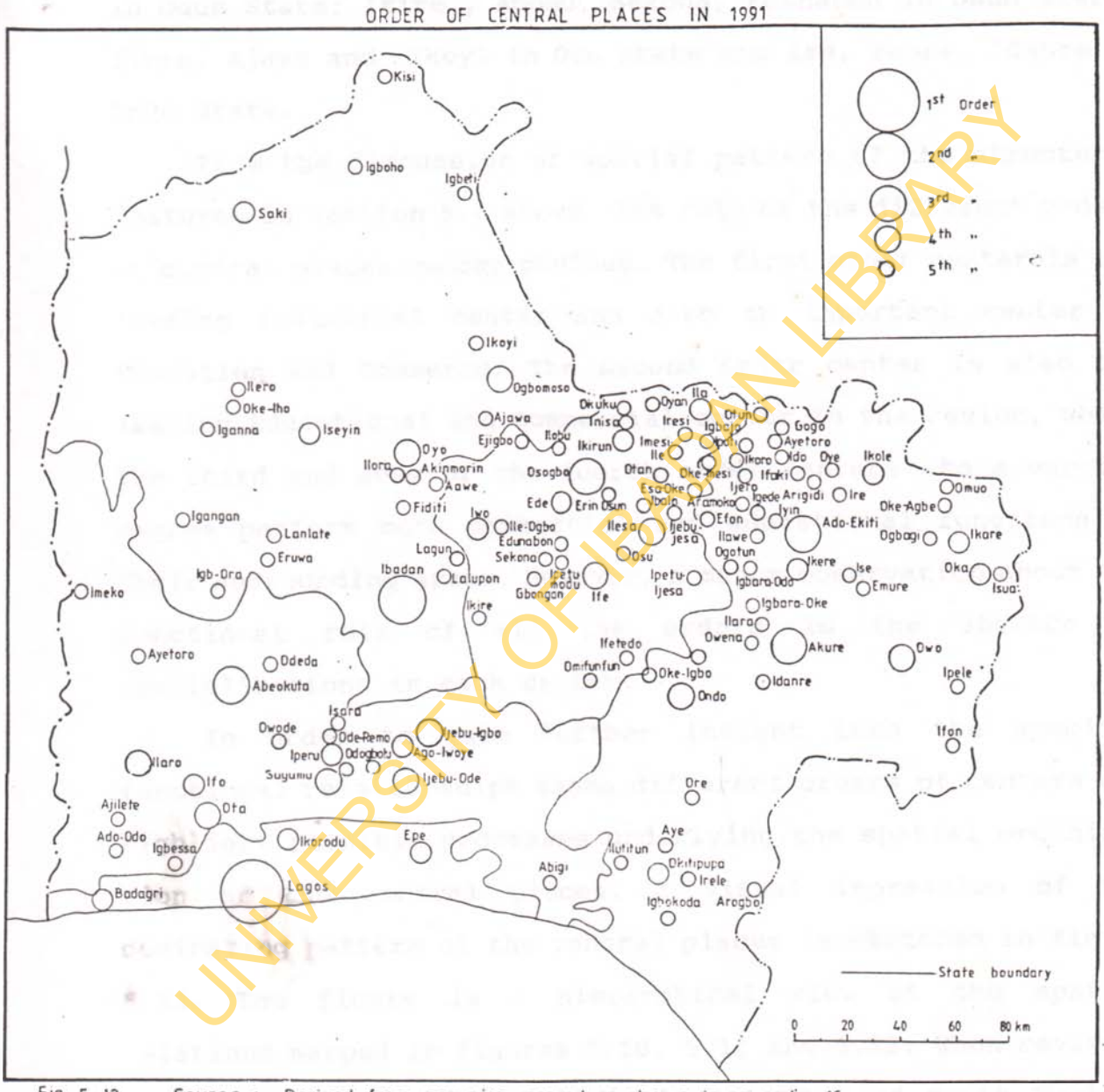

Fig. 5.12 Source : Derived from grouping procedure shown in appendix 16

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in Ogun State; Ikire,, Apomu, Sekona, Edunabon in Osun State; Ilora, Ajawa and Ikoyi in Oyo State and Ise, Emure, Idanre in Ondo State.

From the discussion of spatial pattern of the structural features in section 5.4 above, the role of the different orders of central places become obvious. The first order center is the leading Industrial center and also an important center of Education and Commerce. The second order center is also the leading Educational and Commercial center in the region, while the third and some of the fourth order centers to a varying degree perform both commercial and educational functions to their surrounding areas. However, a major observation about the functional role of all the orders is the absence of specialisations in each center.

In order to gain further insight into the specific functional relationships among different orders of centers and highlight possible processes underlying the spatial organisation of the central places, a visual impression of the dominating pattern of the central places is sketched in figure 5.13. The figure is a hierarchical view of the spatial relations mapped in figures 5.10, 5.11 and 5.12. When reviewed within the current geo-political structure of South Western Nigeria, the major observation is that the order of the central

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SPATIAL HIERARCHY OF THE CENTRAL PLACE SYSTEMS

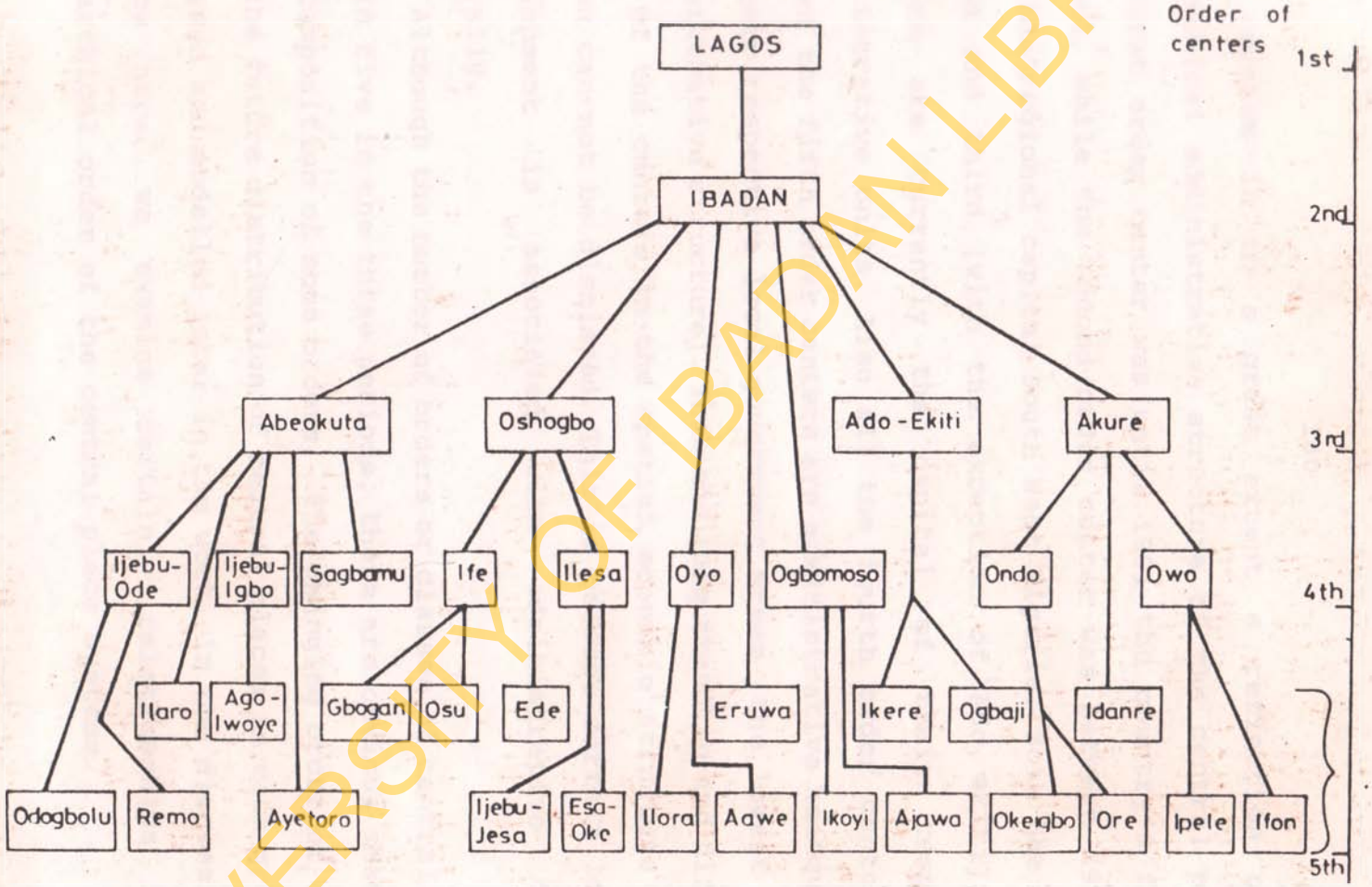

Fig. 5.13 Source Compiled by the author (1993)

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place system is to a great extent a reflection of the hierarchical administrative structure of the central places. The first order center was until 1991 the country's federal capital, while the second order center was between 1955 and 1976 the regional capital South West Nigeria. Both the first, second and third [with the exception of Ado ekiti] order centers are currently the capital of their respective administrative units. Also all the fourth order centers and some of the fifth order centers are administrative headquarters of their respective local government areas [the lowest in the administrative structure]. Thus the long standing and different role of the centers in the spatial economic structure of the region can not be dismissed. This is because certain level of development is associated with administrative centers generally.

Although the number of orders or classes of central places remain five in the three periods, there are obvious changes in the composition of some orders. The changing order of centers and the future distribution of central places in each grade are analysed and modelled later in the work. In the discussions to follow here, we examine certain relationships in the hierarchical order of the central place systems.

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5.6 STRUCTURAL RELATIONSHIPS IN THE HIERARCHY OF CENTRAL PLACES

Generalisations about the fundamental features of hierarchy of central places have been made from the standpoint of abstractions on the geometric properties of central place systems [Parr 1978; Dacey and Huff 1971; Dacey 1966; Alao; Dacey et al. 1977]. Such theoretical statement include the fact that, higher level centers have more central functions, larger populations and that a specific relationship exists between the population of central places and their total functional size.

It is however more instructive to test the logical expectations that result from a less geometric view of a spatial organisation in a region where the relevance of some of the assumptions of central place theory is yet to be established. In the discussion that follows, the relationship between order of centers and type or order of central functions performed is examined. The hypothesis that higher order centers are more functionally complex than lower order centers is tested. Again the relationship between population and functions of central places is analysed and the conjecture that larger central places have more central functions is tested.

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5.6.1 Central functions and Order of Central Places.

The theoretical postulation of the relationship between central functions and order of central places is that; centers of each higher order in a hierarchy of central places perform all the functions of lower orders as well as carrying on a set of central functions which differentiate them from the lowest order centers . In order to examine the above relationship, the classes of functions performed by the central places in 1991 is used. This is because it is the most recent and most comprehensive. Moreover, emphasis here is on one time relationship. Since there is only one center in each of the first and second order class, the inventory of the type of central functions in different classes is taken. However all the centers in each of third through fifth order classes are ranked based on variety of functions, while the average number of functions performed by the centers in these classes are taken. The functional characteristics of the different orders of central places are summarised in table 5.9 below.

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TABLE 5.9
FUNCTIONAL CHARACTERISTICS OF ORDER OF CENTRAL PLACES

ORDER OF CENTERS	NO OF CENTERS	LEVELS/ NO OF CENTRAL FUNCTIONS				TYPES OR VARIETY OF FUNCTIONS
		1	2	3	4	
1	1	16	12	8	9	45
2	1	16	12	8	9	45
3	4	9	11	9	12	41
4	10	5	9	8	9	30
5	120	2	3	4	5	14

As seen from the table there is the tendency for the variety of central functions to increase with the order of central places, but the evidence provided is not strong enough for such important conclusion. The following observations and conclusions are derived from the table.

[a] that there is no difference between the first and second order centers in terms of the variety of functions performed. All the central functions surveyed are available in the two centers. This implies that the fundamental differences between the first and second order central places in the study area is not as such in the variety or complexity of function, but the total number of different classes of goods and services. For instance while all the forty-five central function surveyed are available in the two centers, the total number of first and second class functions in the first order center in 1991 are

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1475 and 1865, while the corresponding figures for the second order center are 484 and 1289 respectively.

[b] There is the tendency for a decrease in variety of functions with decreasing order of central places in the lowest order centers. That is, there is general tendency for successively higher order centers [within the lowest three orders] to possess all the functions provided by the next lower order central places. As seen from the table, while the third order centers perform about 41 of the central functions, the average number of functions performed by the fourth and fifth order centers are 30 and 14 respectively.

[c] It is observed that central functions that are characteristics of highest order centers [such as University or secondary school] are often provided at the lowest order centers. This is rather unexpected from theoretical postulations. It is believed that higher order functions have higher threshold value such that their presence cannot be supported by any center in the lowest grade. That is, there is not enough people in the hinterland of the center to support the provision of the goods or services. The underlying principle here is rational economic decision in the spatial allocation of resources or in the case of an entrepreneur, profit maximisation consideration. In this region, however, distribution of

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goods and services does not necessarily follow such strict economic principle, for higher order goods or services are known to have been provided particularly through communal efforts, for reasons other than rational economic decision.

The expected relationship between order of central places and variety of functions performed is not strongly supported. This implies that the underlying economic principles in the distribution of goods and services as postulated by theory may not fully answer the spatial distribution of goods and services and hence, the development of central place hierarchy in this region. Extraneous factors/processes such as human behaviour, the influence of the actors of the system will as well be important.

5.6.2 Central place size relationships

The theoretical expectations that central places larger in terms of population size will have more central functions is examined here, It is hypothesized that there is no relationship between population and functional size of central places. In testing the hypothesis, all the one hundred and thirty six central places are ranked, using their 1963 census figures. This is at present in the country the most detailed population figures, since the full report of the most recent census [1991

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census] is yet to be released. The scaled inventory of forty-five central functions observed for the 136 centers are summed up to obtain the functional size for each center in three different periods, 1967; 1976 and 1991. Based on their functional sizes the centres are also ranked in a descending order [see appendix 17].

While the functional size of the central places change overtime in the three periods, we do not use any projected figures of the 1963 census in the periods considered since such projections are based on constant rate and as such any observed relationship will not be different from that of the base period. Again, apart from the non-availability of acceptable figures after 1963, allowing population figures to remain constant helps in evaluating the status of this variable as either a process which governs the location of economic activities and hence the development of central place hierarchy or a spatial pattern which is a product of other processes. We first seek a visual support for the hypothesized relationships.

The 1963 populations of each center is plotted against its functional size in 1967, 1976 and 1991. A double logarithmic paper is used given the wide variations in the populations and functional sizes of the central places. Figures 5.14, 5.15 and 5.16 show the scatter diagram of the central place size

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relationships in 1967, 1976 and 1991. The figures show that there is a general tendency for the number of central functions performed to increase with the population of the central places. However, as seen from the figures, the hypothesized relationship is more evident among central places with population greater than 100,000. Deviations from the expected is more marked among centers that fall between 10,000 and 100,000 population, as many centers have less or more number of functions than expected of their population. For centers with population below 10,000, the hypothesized relationship is rather weak.

The above suggests that for central places with population greater than 100,000, population could be a process of development, i.e an important factor in the location or provision of socio-economic activities. For centers with population between 10,000 to 100,000 the pronounced deviations from the expected as shown by the rather "rough" line drawn through the scatter plot reveals that population may be a process and or a pattern, meaning, location of economic activities among centers in this group will be a function of many processes, among which is population factor.

However it is more instructive to provide quantitative support for the visual impression given above. The analysis

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CENTRAL PLACE SIZE RELATIONSHIP [1967]

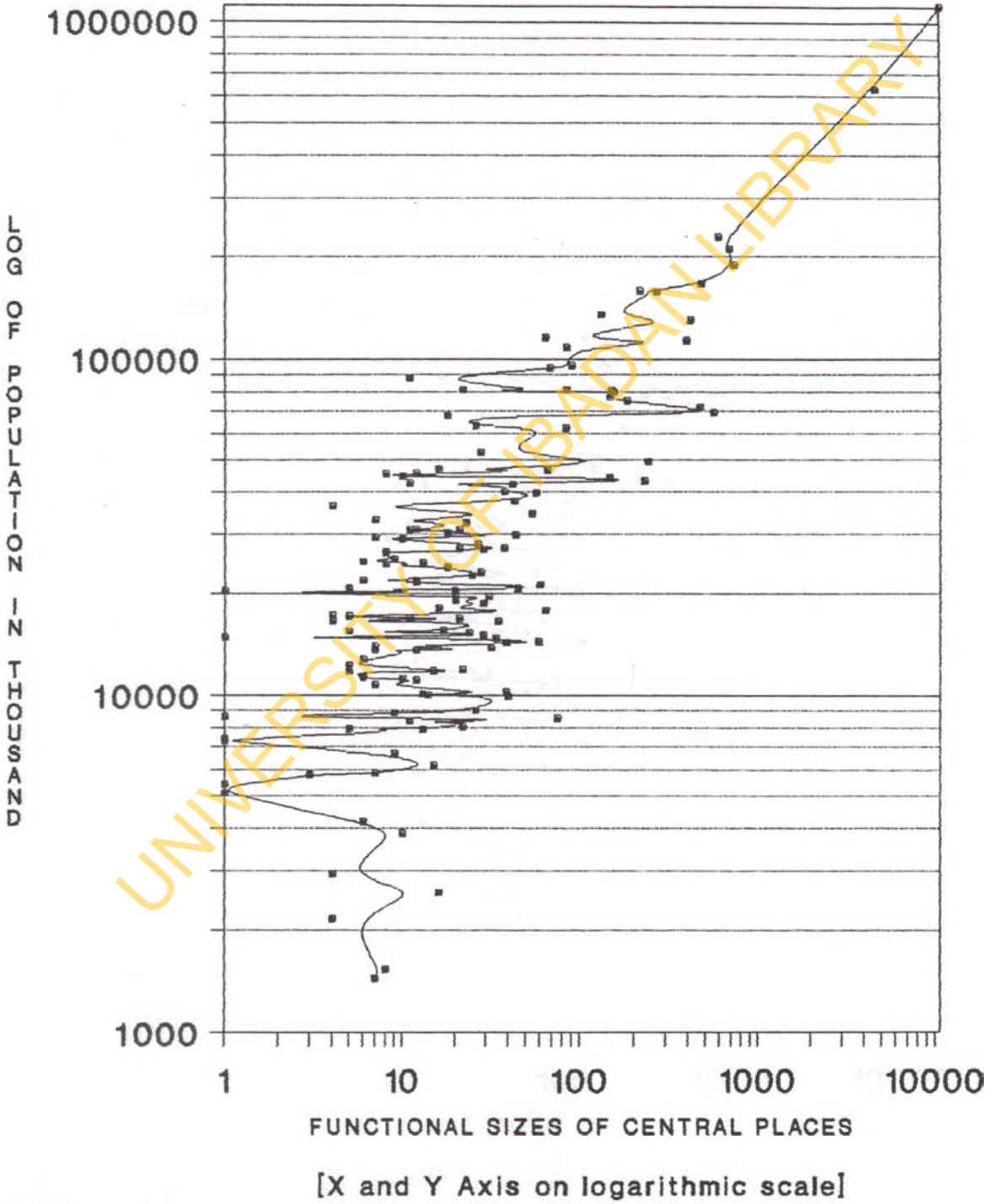

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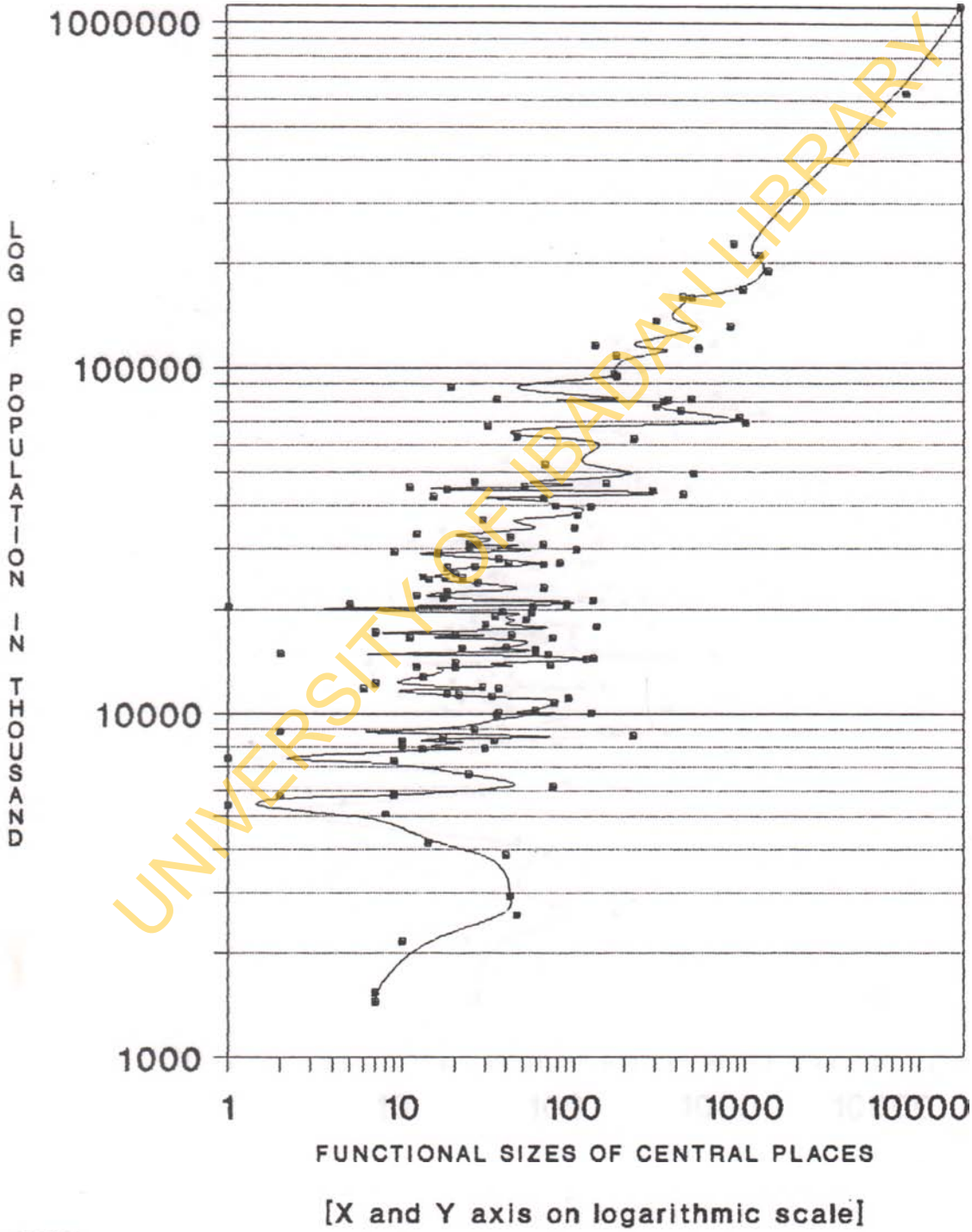
Fig 5.14

CENTRAL PLACE SIZE RELATIONSHIP [1976]



[X and Y axis on logarithmic scale]

Fig. 5.15

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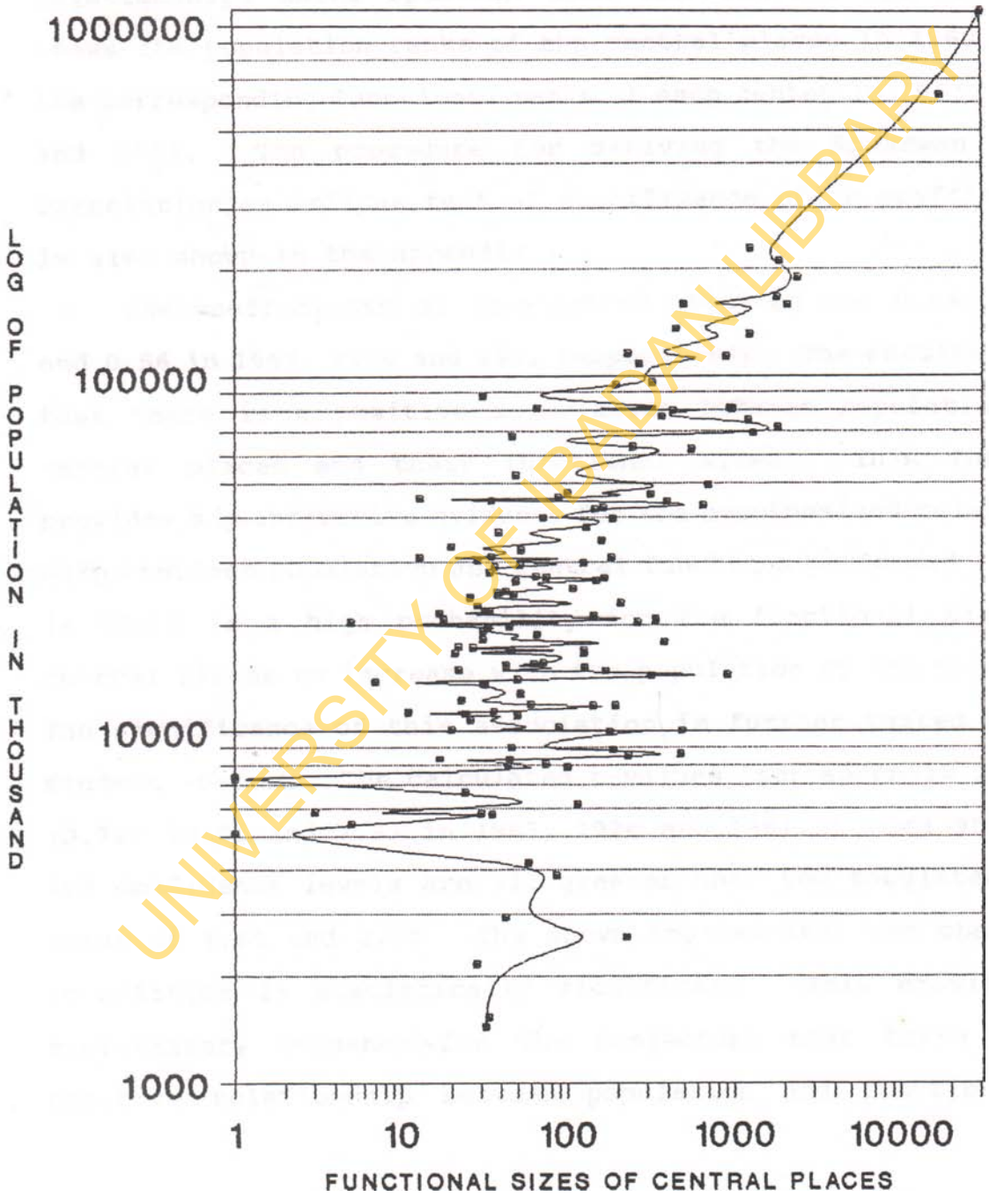
CENTRAL PLACE SIZE RELATIONSHIP [1991]



[X and Y axis on logarithmic scale]

Fig.5.16

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further investigates the nature of the central place size relationships using Spearman Rank correlation. Appendix 17 shows the population ranks of the central places in 1963, and the corresponding functional ranks of each center in 1967, 1976 and 1991. The procedure for deriving the Spearman rank correlation as well as test of significance of r coefficient is also shown in the appendix.

The coefficients of association obtained are 0.68; 0.67 and 0.56 in 1967, 1976 and 1991 respectively. The results show that there is a positive association between population of central places and their functional sizes. This further provides a quantitative evidence for the hypothesized relationships between population and central functions performed. That is there is a high probability for the functional size of central places to increase with the population of the centers. The significance of this association is further tested using student t-test. The calculated t-values [see appendix 17] of 10.74; 10.61 and 7.83 in 1967, 1976 and 1991 at both 95% and 99% confidence levels are all greater than the tabulated t - value of 1.65 and 2.33. The above implies that the observed correlation is statistically significant. This provides a confirmatory evidence for the conjecture that there is a positive relationship between population and functions of

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central places.

Although a positive relationship is observed between population and number of central functions performed by centers, the coefficient of association decreases overtime from 68% in 1967 to 67% and 56% in 1976 and 1991 respectively. The implications of these are that, the amount of spatial variation in the functional sizes of central places that is not accounted for by population factor increases from 32% in 1967 to 33% and 44% in 1976 and 1991. This suggests that the locational factors of economic activities are increasingly becoming a stochastic event, the pattern of which cannot be easily predicted using certain deterministic parameters of the central places such as the population or viability of a center.

5.7 CONCLUSION

This section analysed the structural organisations of the central places in 1967, 1976 and 1991, using a wide range of central functions performed by the central places and the technique of multivariate factor analysis and hierarchical cluster analysis. The results show that the South-West Nigeria central places are spatial systems of three dimensions, namely, Industrial development, Education and commerce; Basic/Social services. This implies that the spatial variations in the

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central places are products of these three independent dimensions. Thus the conjecture that the central places have common fundamental structural features is confirmed. Again the result of the hierarchical cluster analysis shows further that there indeed exists hierarchy of central places, confirming the second hypothesis set up in this research. Five orders of centers emerged in the three periods considered. From a consideration of certain geometric properties of the structural organisations of the central places, it is observed that, there is no strong evidence to confirm the hypothesis that there is a relationship between order of central places and the number or variety of central functions performed. However, a strong positive relationship is observed to exist between population and functional sizes of the central places, even though the strength of the relationship declines overtime. From the point of view of process, the implication of the observations is that the role of population as a process of development tend to decrease overtime, while stochastic processes such as the influence of actors of the system, may becoming more pronounced. Next in this discussion, changes in the hierarchy of the central places is analysed using a descriptive and predictive Stochastic process model- Markov chain model.

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CHAPTER SIX

CHANGES IN HIERARCHY OF CENTRAL PLACE SYSTEMS

6.1 INTRODUCTION

The analyses in the preceding chapter highlights the variations in the spatial structure of the central places by classifying them into five different functional orders or grades in three time periods. What is however concealed is the fact that as processes of development progress, the number of functions in different size classes changes such that centers move up or down the hierarchical structure. This chapter analyses changes in the hierarchical structure of the central place systems by employing an accounting model of change, The Markov chain. The primary concern is to describe quantitatively the observed changes in the hierarchy of central place systems, model the observed changes and generate the future distribution of centers in different hierarchical order. The hypothesis that changes in the hierarchy of central places can be modelled by Markov chain is tested. Furthermore the conjecture that higher order centers are more stable than lower order centers in the hierarchy is also examined. The underlying processes of change are then generalised for quantification in relation to the observed structure later in

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this work.

6.2 A MODEL OF CHANGE IN HIERARCHY OF CENTRAL PLACES

Markov chain model was originally developed by the Russian mathematician, A. Markov in 1907 for studying processes of classical mechanics. The justification for the adoption of the technique to geographical analyses in general has been provided by collins [1976]. Referring to the pioneering works of Gibrat, [1931] in his analysis of Industrial size distribution, Collins argues that Gibrat's law of proportional growth in its strongest form proposes that temporal changes in firm sizes [or that of any geographical event] are governed by a simple Markov process in which the probability of specified percentage increases are independent of a firms absolute size.

The chain is a stochastic model that is concerned with events that change in a random way over time. According to kemeny and Snell, [1973], it is a mathematical model for describing types of processes that proceed in a sequence of steps through a set of states. The set of states of the process are possible positions which a process may assume in its movements. It can be finite or countably infinite. A finite Markov chain is a stochastic process characterised by

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finite number of states denoted by S_1, $S_2 \ldots S_r$ and for which the probability $[P_{ij}]$ of entering a certain state depends on the last state occupied. In sum, Markov Chain is a scheme for determining the probability $[P_{ij}]$ of objects or event being in a specific state at a specific time. If the object for instance is in state S_i, there is the probability $[P_{ij}]$ that the next position will be state S_j. If the probabilities of all pairs of states are known, they can be arranged in a square matrix called the transition matrix $P = [P_{ij}]$.

$$P = \begin{bmatrix} P_{11} & P_{12} & P_{13} & \ldots & P_{1n} \\ P_{21} & P_{22} & P_{23} & \ldots & P_{2n} \\ \ldots & \ldots & \ldots & \ldots & \ldots \\ P_{m1} & P_{m2} & P_{m3} & \ldots & P_{mn} \end{bmatrix}$$

Matrix P is a stochastic matrix whose elements are probabilities

$$0 \leq P_{ij} \leq 1$$

Again the sum of all probabilities in any given row is unity

$$\sum_{j=1}^{n} P_{ij} = 1 \quad \text{for every } i$$

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Since its introduction into the geographic literature in early 1960s [Brown 1963], the model has been applied in studies directly related to changes in; housing stock [Clark,1965; Wolfe,1967, White,1971 and Gilbert,1972]; intra-urban travel behaviour [Marble,1964; Hemmens,1966]; industrial and, social mobility [Adelman,1958; Denton,1973; Mcginnis,1968; Mcfarland,1970; Iwunoh,1988]. It has also been widely applied in studies related to population distribution and urbanisation. [Bourne and Maher,1970; Fisher and Lawson,1972; Fuguitt,1965; Richardson, 1973; Harvey, 1976; Collins, 1976; Wills 1971, Lever, 1973; Mackinnon, 1975; Marayanaswami, 1980]. However most of these studies used the model for descriptive purposes only, while few have used it as a model of geographic process [Collins, 1976]. Again virtually all these studies face a similar problem which is classification of a system of spatial states. In many instances, classes or different Markov states were arbitrarily derived.

In this study the Markov chain is used as a descriptive and predictive model of change in hierarchy of central place systems, and as a stochastic technique to generalise underlying processes in the hierarchy of central places. By

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using variables such as central functions that are directly related to the economic sizes of cities, issues bordering on regional economic development and their underlying processes are discussed. Again, the problem of classification of spatial series did not arise here since this analysis utilises as input, the spatial systems or orders of central places which are objectively derived with multivariate factor analytical technique and hierarchical cluster analysis.

In the analysis to follow, the five orders of the hierarchical structure identified in the preceding section constitute the spatial states of a Markov process. Then we are dealing with a finite Markov chain in which $S = [S_1, S_2, \ldots S_5]$ are the classes of central places in 1967, 1976 and 1991.

The major attraction of Markov model lies in the fact that its basic structure matrix avoids the necessity of replicating analyses over as many spatial units as comprise the study area so that in generalising the processes involved, the technique provides insight which may not be readily attainable by conventional methods of analysis. [Rogers 1968].

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6.3 CHANGE PROCESS AND TRANSITION OF CENTRAL PLACES IN THE HIERARCHICAL STRUCTURE.

Changes in the hierarchy of central place systems occur as centers move up or down the hierarchy at different points in time. This familiar phenomenon of central place growth or decline is a spatial expression of numerous fundamental processes such as the location and development of transport routes; geographical position [absolute or relative] of a central place, the governmental spatial economic development policies and, the initial distribution and changing spatial pattern of governmental power. All these will influence the location decisions of entrepreneurs, particularly at the early stages of industrialisation and then further channel the subsequent location decisions of individuals and households.

The operation of these forces will produce transitions from one hierarchical class to another. In a regional planning context, where these processes are not guided or where their control has assumed political significance, there will emerge economic enclaves or favoured locations in a matrix of depressed economy. This will produce transition matrix that is characterised by near stability, with long passage times particularly for the low order centers. However

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where these forces are completely absent, transition from one hierarchical order to the next order would be attributed to influences of deterministic parameters present in the central places. Such parameters are mainly the spatial distribution of human and material resources. The transition matrix would be characterised with frequent crossing of orders, particularly increase in number of high order centres at the expense of lower order centres.

The structure matrix of Markov chain is used here as summary measure to describe movements of central places within the regional hierarchical structure. We however first show in table 6.1 the number and percentage of central places in different hierarchical order in the three periods. Since the total number of centers remain 136 throughout, the states being described here corresponds to a closed markov model in which there is no "birth" or "death" of centers [as a result of migration or relocation of economic activities]. As such changes in hierarchical structure will be as a result of internal processes of location of new economic activities.

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TABLE 6.1

NUMBER AND PERCENTAGES OF CENTERS IN DIFFERENT ORDERS

ORDER OF CENTER	NO OF CENTERS IN					
	1967	%	1976	%	1991	%
1	1	0.7	1	0.7	1	0.7
2	1	0.7	1	0.7	1	0.7
3	3	2.2	2	1.5	4	2.9
4	8	6	12	8.8	10	7.4
5	123	90	120	88.2	120	88.2
TOTAL	136	100	136	100	136	100

Source: Author's fieldwork

It is evident from table 6.1 that there are movement of central places within the hierarchical structure. For instance the table shows that between 1967 to 1976. the number of centers in the fifth order decreased from 123 in 1967 to 120 in 1976, while the centers in the fourth order increased from 8 to 12 over the same period. Again the number of fourth order centers decreased from 12 in 1976 to 10 in 1991 while those in the third order increased from two to four in the same period. The transition Matrixes for the central places between 1967-1976; 1976-1991 and 1967-1991 are shown in table 6.2a, 6.2b and 6.2c. The table shows that, out of the total number of twenty-one moves [up and down] within the

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hierarchical structure at different times between 1967 to 1991, fifteen were to higher order while six were to lower order. In the table each element P_{ij} represents the number of centers in hierarchical order or spatial state i at the initial period but which are in order j at the second period.

TABLE 6.2a
TRANSITION MATRIX OF CENTRAL PLACES 1967-1991.

ORDER OF CENTER	5	4	3	2	1	TOTAL IN 1967
5	118	5	0	0	0	123
4	1	5	2	0	0	8
3	1	0	2	0	0	3
2	0	0	0	1	0	1
1	0	0	0	0	1	1
TOTAL 1991	120	10	4	1	1	136

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TABLE 6.2b
TRANSITION MATRIX OF CENTRAL PLACES 1967-1976.

ORDER OF CENTER	5	4	3	2	1	TOTAL IN 1967
5	120	3	0	0	0	123
4	0	8	0	0	0	8
3	0	1	2	0	0	3
2	0	0	0	1	0	1
1	0	0	0	0	1	1
TOTAL 1976	120	12	2	1	1	136

TABLE 6.2c
TRANSITION MATRIX OF CENTRAL PLACES 1976-1991.

ORDER OF CENTER	5	4	3	2	1	TOTAL IN 1976
5	117	3	0	0	0	120
4	3	7	2	0	0	12
3	0	0	2	0	0	2
2	0	0	0	1	0	1
1	0	0	0	0	1	1
TOTAL 1991	120	10	4	1	1	136

Source: Author's Fieldwork

The most obvious features of the table is the preponderance of central places in the lowest order. This is also evident in figure 5.10, 5.11 and 5.12. The diagonal elements of the transition matrix show that the tendency is for the central places to remain in their hierarchical class

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throughout the period. The table further shows that between 1967 and 1991 three centers in the lowest order [5th] moved to the fourth order. Of the eight centers in the fourth order in 1967, two moved to the third order in 1991, while one declined to the fifth order. Again, out of the three third order centers in 1967, one declined to the fifth order in 1991 while the remaining two show no movement.

Analysis of the short term transition of the centers [1967-1976 and 1976-1991 tables 6.2b and 6.2c] shows that all the eight fourth order centers in 1967 remain in this state by 1976. Thus it is between 1976 and 1991 that the transitions out of the fourth order class [two centers to 3rd order, one to fifth order] actually took place.

It is observed that in the periods of observation, the first and second order centers show a considerable stability in the Chain. Being the only centers in their states, without movement in or out of the states, the first and second order states constitute the absorbing states of the transition matrix. That is, all the centers in the region will aspire to grow into any of these spatial states. Next the elements of the transition matrix are estimated.

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6.4 MODEL APPLICATION

6.4.1 An estimation of the transition pattern of central places

Let the transition probability matrix of the Markov chain described above be represented by P. Elements of $P = P_{ij}$ can be estimated using maximum likelihood technique [Bhat U.N. 1972; Collins, 1976], with the symbol [EQ.6.2]

$$P_{ij} = \frac{n_{ij}}{n_i}$$

P_{ij} = is the probability of a center in state i being in state j, where n_{ij} is the element of the ith row and j^{th} column, and n_i the sum of the elements of the ith row

$$ni = \sum_{j=1}^{5} nij$$

from equation 6.2 above and the entries in table 6.2, we derive table 6.3, the transition probability or structural matrix for the central places between 1967-1991; 1967-1976; and 1976-1991

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TABLE 6.3
TRANSITION PROBABILITY MATRIX FOR CENTRAL PLACES

ORDER OF CENTER	5	4	3	2	1
1967 TO 1991					
5	0.959	0.041	0	0	0
4	0.125	0.625	0.250	0	0
3	0.333	0.000	0.667	0	0
2	0	0	0	1.000	0
1	0	0	0	0	1.000
1967 TO 1976					
5	0.976	0.024	0	0	0
4	0	1.000	0	0	0
3	0	0.333	0.667	0	0
2	0	0	0	1.000	0
1	0	0	0	0	1.000
1976 TO 1991					
5	0.975	0.025	0	0	0
4	0.250	0.583	0.167	0	0
3	0	0	1.000	0	0
2	0	0	0	1.000	0
1	0	0	0	0	1.000

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The table above shows that the hierarchy of the central places is an egordic chain in that, the central places can move from any state to any other, while the system cannot be left. As an egordic chain, the total value of every horizontal line is unity. Also evident from the table is the fact that the chain is an absorbing one in that it has states whose diagonal values equal unity. [the first and second order states].

From table 6.3, it is further shown that between 1967 to 1991, the fifth order centers have just 0.041 probability of moving to the next higher order and 0.959 chance of continuing in that state. Also the fourth order class has a 0.625 probability of remaining in that class; 0.250 probability of moving to the third order class and 0.125 chance of declining to the fifth order. Again the third order centers have 0.667 chance of continuing in the class and 0.333 chance of declining to the fifth order.

The transition probabilities of the central places between 1967-1976 and 1976-1991 and for the period 1967-1991 show that the fourth order centers are the most unstable in the chain. This is most evident in the period between 1976 and 1991 when the probability of the fourth order center to

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continue in that class decreased to 0.583 from its 1967-1976 value of 1.00. Apart from the first and second order centers which do not show any change in their probability throughout, the chances of the third order centers to continue in that class increased from 0.667 in 1976 to 1.000 in 1991, creating the third absorbing state for the system.

The presence of three absorbing states in the chain is of interest from the point of view of regional politico-economic development. It shows that between 1967 and 1976, the goal of the fifth order states was perhaps to grow into the status of the fourth order centers, which were mainly the district headquarters, while the third order centers which were then mainly the divisional headquarters aspired to the status of regional headquarters [second order] or federal capital [first order]. However, with the political restructuring exercise of 1976, the probability of the fourth order centers staying in that class declined by 1991. More centers moved to the third order, which also became another absorbing state in that year.

If it is noted that the centers in the third, second and first orders in 1991 are mainly administrative state capitals [with the exception of Ado-Ekiti in Ondo state], and centers of great commercial activities, then the ultimate goal of

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central places in the hierarchical structure is to grow into any of these states, no matter how long the waiting period might be. However, whether this goal will be realised will depend on the institutional control or deliberate manipulation of processes that permit formation of new economic activities in favour of more of the fifth order centers. It is suggested here that in the region, the importance and changing role of a center as an administrative central place will influence location decisions of entrepreneurs. That is, the spatial pattern of governmental power will be a controlling one for regional economic development. Again, certain measures of space adjusting techniques such as transportation development will channel flows of human and material resources to desirable or favoured locations. The relationship between these processes and the spatial economic structure of the central places are examined later in this work.

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6.4.2 Validation of the transition pattern of central places

6.4.2.1 Markovity of the transition patterns

It is appropriate to establish whether or not the structural matrix posses Markov property. Here a test of first order Markov process is carried out. It is postulated that for each time period, the probability of being in any state j vary depending on the state previously occupied against the alternative hypothesis that the observations are statistically independent.

Ho: $P = P^{o}$

H1: $P \neq P^{o}$

Two asymptomatically equivalent test statistics have been developed to measure deviations of observed frequencies from expected structures under null hypothesis. These are the chi-square contigency table test and the maximum likelihood ratio criterion. As to which is more powerful, there is no agreement in the literature. The maximum likelihood criterion is used here for reasons of convenience and wide support it enjoys in the literature.

The test statistics is formally known as Minimum information discrimination statistics which is equivalent to $-2 \log \lambda$ [Sheppard,1974], where λ is the maximum likelihood

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ratio given by

$$\lambda = f[P_{ij}]/f[P'_{ij}] \qquad 6.3$$

where P_{ij} is the observed frequency of transition, P'_{ij} is the maximised value of the likelihood function or the probability of being in j for all i. From Kullback et al, [1962]

$$-2 \log \lambda = 2 [L [P'_{ij}] - L [P_{ij}]] \qquad 6.4$$

equation 6.4 can also be expressed thus [equation box 6.5]

$$=2\sum^{k}_{i=1}\sum^{k}_{j=1} nij \ln \frac{nij}{n_i P_{ij}}$$

in equation 6.5 above, k equals number of categories or states and ni total sum of all nij. From statistical theory when Ho is true, -2 Log λ has a X^2 distribution with [K-1].[K-1] degrees of freedom.

From equation 6.5 and information on tables 6.2a [the transition count matrix] and the probability matrix [table 6.3], the maximum likelihood criterion provides that,

$$2\sum^{5}_{i=1}\sum^{5}_{j=1} nij \ln \frac{n_{ij}}{n_i P^0_{ij}} = 2.91$$

With 95% confidence level and 16 degrees of freedom, -2 log λ [2.91] is less than X^2 table value of 3.35. The null

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hypothesis is therefore accepted. We therefore consider the structural matrices as realisation of a markov chain.

6.4.2.2 Stationarity of the transition patterns

Since Markov model is required here not only as a descriptive but also as a predictive tool, it is necessary to determine whether the transition probability matrices are stationary. This implies two things; that the generated or predicted distribution of central places is valid if and only if the values in the transition matrix P remain unchanged with each successive time period. That is, the conditions specifying the behaviour of the system at any one time period are the same for all other time periods. Secondly, that Markov chain is a useful technique in describing and predicting changes in central place size distribution.

Although it has been argued that in Markov chain model of town size change, stationarity is not contravened [Fuguitt,1965; Fano,1969], Bourne and Maher, [1970] used chi-square test and mean discrimination information statistics to demonstrate that for towns of Ontario-Quebec urban systems, stationarity is a valid assumption.

Following after Collins, [1976] and Lever,[1973] a way of

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ascertaining stationarity of the transition matrix and of determining the reliability of any predicted distribution of central places and hence, validity of Markov model, is to require the model to first generate some observed distributions of central places [in 1976 and 1991]. With an initial probability distribution vectors P[o] [the vector of central place distribution in 1967 and 1976] and the transition probability matrix p [1967-1976], the expected distribution of central places in the hierarchy in 1976 and 1991 are generated. The observed and expected states of the system in these periods can then be compared with chi-square statistics.

The logic of the approach is simple. Since Markov model like all mathematical models is not tied to any empirical theory, it's application according to Shepperd,[1974] depends on the validity of the mathematical process as an analogue of the observed distribution.

We multiply the vector of distribution of central places in 1967 with the 1976 transition matrix to obtain the expected distribution for that period. For the fifteen years between 1976 and 1991, temporal states of the system is generated by multiplying the 1976 vector of central place distribution with

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the successive powers of the 1976 transition probability matrix. The vector of observed and expected distributions of the central places in 1976 and 1991 are shown in table 6.4, where

TABLE 6.4
OBSERVED AND EXPECTED DISTRIBUTION OF CENTRAL PLACES IN 1976 AND 1991

STATES / YEAR		5	4	3	2	1
1976	OBS	120	12	2	1	1
	EXP	120.048	11.951	2.001	1	1
χ^2 0.00						
1991	OBS	120	10	4	1	1
	EXP	117.662	11.17	5.168	1	1
χ^2 0.433						

Source: Author's computation.

they are compared with the observed frequencies in these periods. The configurations of the predicted and the observed distributions in different states or orders of central places are shown in figures 6.1 and 6.2. The figures and table 6.4 reveal that the differences between observed and predicted distributions are small enough to be attributed to chance fluctuation.

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PREDICTED AND OBSERVED DISTRIBUTION
OF CENTRAL PLACES [1967 TO 1976]

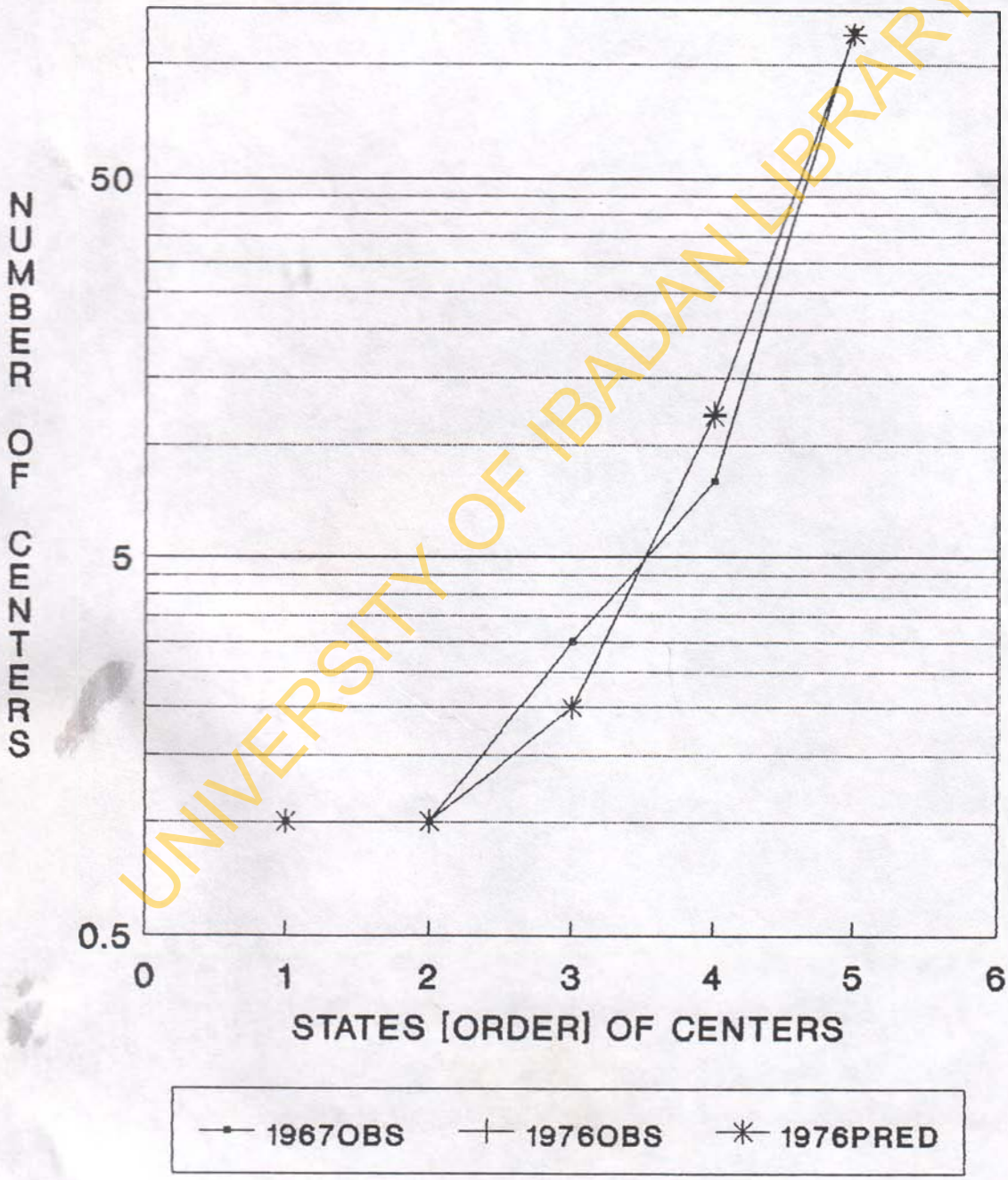

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FIG 6.1

PREDICTED AND OBSERVED DISTRIBUTION
OF CENTRAL PLACES [1967 TO 1991]

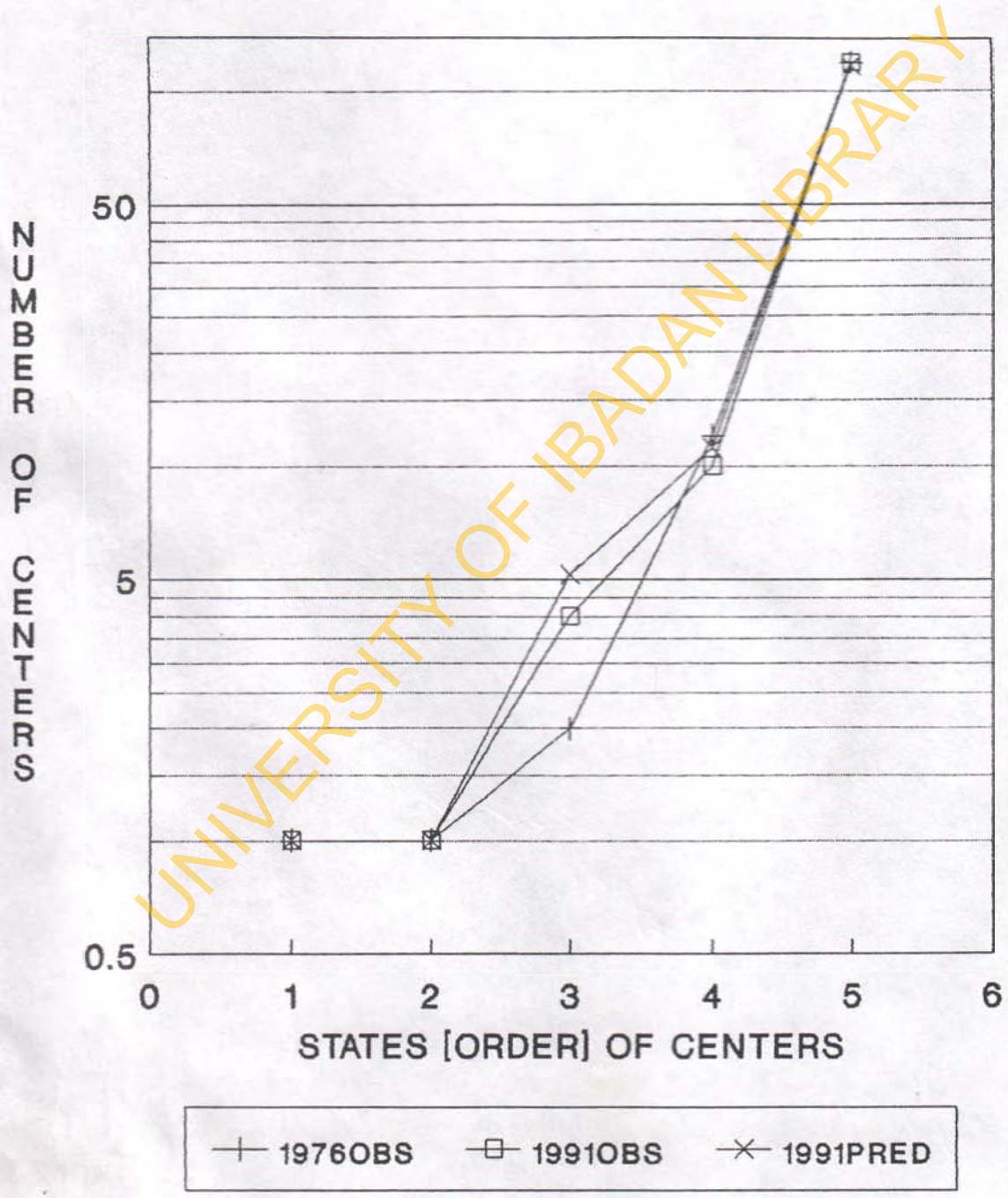

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FIG 6.2

With χ^2_4 = 0.0 and 0.43 in 1976 and 1991 less than 95% probability of 3.35, it is concluded that the differences between the observed and the predicted distribution of central places in each hierarchical class are not statistically significant. The result as shown in table 6.4 and figures 6.1 and 6.2 reveal that the transition probabilities can be used to describe future transition patterns of the central places. Again, the computed chi-square statistics reveal that Markov model is a useful predictive tool of the distribution of central places in different hierarchical grades.

6.5 ANALYSIS OF FUTURE TRANSITION PATTERNS OF CENTRAL PLACES

The tests of Markovity and stationarity in the preceding sections show that it is statistically safe to estimate the future transition probabilities and distribution of the central places in different hierarchical orders. This is achieved by powering the 1991 transition matrix. After thirty-five iterations, it is observed that a steady state transition is reached, in which there is no change in the probabilities of the centers moving from one state to the other. This shows that a state of equilibrium distribution of centers is attained by the year 2026 A.D, when the number of

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centers moving in and out of the different orders or states cancel out. The results of the iterations are summarised in table 6.5.

It is observed from the table that, with the exception of the first and second order centers which constitute the absorbing states of the chain, the probabilities of centers remaining in their states decrease with time. Again, the tendencies exist for centers to move up or down the hierarchy. This is expected of an economic landscape with capitalist tendencies, where forces of growth are not uniform.

The probability of the fifth order centers remaining in that class decreased from 0.959 in 1991 to 0.8393 in 2009 A.D and thereafter shows a slight increase until 2026 A.D when there is no visible change in the transition probabilities for all the states. However the tendency that the fifth order centers will move to fourth order initially increased from 0.041 in 1991 to 0.0925 in 1999, and thereafter decreased to 0.0917 in 2010 A.D

The fourth order centers have greater tendencies to decline than moving to higher orders. For instance its probability of moving to third order slightly increased from 0.25 in 1991 to 0.31 in 1999 after which this tendency

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TABLE 6.5

PROJECTED TRANSITION OF CENTRAL PLACES 1992 TO 2026 A.D

P =1992

0.924806	0.064944	0.01025	0	0
0.28125	0.39575	0.323	0	0
0.541458	0.013653	0.444889	0	0
0	0	0	1	0
0	0	0	0	1

P = 1993

0.898420	0.078507	0.023072	0	0
0.426746	0.258875	0.314378	0	0
0.669112	0.030732	0.300154	0	0
0	0	0	1	0
0	0	0	0	1

P = 1994

0.879081	0.085902	0.035016	0	0
0.546297	0.179293	0.274409	0	0
0.745472	0.046641	0.207886	0	0
0	0	0	1	0
0	0	0	0	1

P =1995

0.865437	0.089731	0.044831	0	0
0.637689	0.134456	0.227854	0	0
0.789964	0.059715	0.150320	0	0
0	0	0	1	0
0	0	0	0	1

P =1996

0.856099	0.091564	0.052335	0	0
0.704226	0.110100	0.185592	0	0
0.815096	0.069710	0.115192	0	0
0	0	0	1	0
0	0	0	0	1

P =1997

0.849872	0.092328	0.057798	0	0
0.750928	0.097736	0.151335	0	0
0.828750	0.076908	0.094261	0	0
0	0	0	1	0
0	0	0	0	1

P = 1998

0.845816	0.092549	0.061633	0	0
0.782751	0.091873	0.125374	0	0
0.835784	0.082096	0.082119	0	0
0	0	0	1	0
0	0	0	0	1

P = 1999

0.843230	0.092522	0.064247	0	0
0.803893	0.089513	0.106593	0	0
0.839125	0.085577	0.075297	0	0
0	0	0	1	0
0	0	0	0	1

P = 2008

0.839327	0.091797	0.068875	0	0
0.839271	0.091512	0.069215	0	0
0.839555	0.091741	0.068703	0	0
0	0	0	1	0
0	0	0	0	1

P = 2009

0.839324	0.091785	0.068889	0	0
0.839349	0.091605	0.069045	0	0
0.839479	0.091760	0.068760	0	0
0	0	0	1	0
0	0	0	0	1

P = 2010

0.839325	0.091778	0.068895	0	0
0.839378	0.091666	0.068954	0	0
0.839427	0.091768	0.068803	0	0
0	0	0	1	0
0	0	0	0	1

p =2011

0.839328	0.091773	0.068897	0	0
0.839384	0.091706	0.068909	0	0
0.839393	0.091772	0.068834	0	0
0	0	0	1	0
0	0	0	0	1

P = 2012

0.839330	0.091771	0.068898	0	0
0.839379	0.091731	0.068889	0	0
0.839371	0.091772	0.068855	0	0
0	0	0	1	0
0	0	0	0	1

P = 2013

0.839332	0.091769	0.068898	0	0
0.839371	0.091746	0.068881	0	0
0.839358	0.091772	0.068869	0	0
0	0	0	1	0
0	0	0	0	1

P = 2014

0.839334	0.091768	0.068897	0	0
0.839363	0.091755	0.068880	0	0
0.839349	0.091771	0.068879	0	0
0	0	0	1	0
0	0	0	0	1

P = 2015

0.839335	0.091768	0.068896	0	0
0.839356	0.091761	0.068882	0	0
0.839344	0.091770	0.068885	0	0
0	0	0	1	0
0	0	0	0	1

P = 2000

0.841617	0.092398	0.065983	0	0
0.817618	0.088905	0.093476	0	0
0.840492	0.087889	0.071617	0	0
0	0	0	1	0
0	0	0	0	1

P = 2001

0.840633	0.092255	0.067110	0	0
0.826336	0.089088	0.084575	0	0
0.840666	0.089391	0.069741	0	0
0	0	0	1	0
0	0	0	0	1

P = 2002

0.840047	0.092125	0.067826	0	0
0.831756	0.089560	0.078683	0	0
0.840789	0.090345	0.068865	0	0
0	0	0	1	0
0	0	0	0	1

P = 2003

0.839707	0.092020	0.068271	0	0
0.835051	0.090077	0.074871	0	0
0.840542	0.090938	0.068519	0	0
0	0	0	1	0
0	0	0	0	1

P = 2004

0.839516	0.091940	0.068542	0	0
0.837005	0.090535	0.072458	0	0
0.840264	0.091298	0.068437	0	0
0	0	0	1	0
0	0	0	0	1

P = 2005

0.839413	0.091803	0.068703	0	0
0.838134	0.090901	0.070963	0	0
0.840015	0.091512	0.068472	0	0
0	0	0	1	0
0	0	0	0	1

P = 2006

0.839361	0.091842	0.068795	0	0
0.838764	0.091177	0.070058	0	0
0.839815	0.091635	0.068549	0	0
0	0	0	1	0
0	0	0	0	1

P = 2007

0.839336	0.091815	0.068847	0	0
0.839101	0.091375	0.069523	0	0
0.839663	0.091704	0.068631	0	0
0	0	0	1	0
0	0	0	0	1

P =2016

0.839336	0.091767	0.068896
0.839350	0.091764	0.068884
0.839341	0.091769	0.068889

P =2017

0.839336	0.091767	0.068895
0.839346	0.091766	0.068887
0.839339	0.091769	0.068891

P = 2018

0.839337	0.091767	0.068895
0.839343	0.091767	0.068889
0.839338	0.091768	0.068892

P = 2019

0.839337	0.091767	0.068895
0.839341	0.091767	0.068890
0.839338	0.091768	0.068893

P =2020

0.839337	0.091767	0.068894
0.839340	0.091767	0.068892
0.839337	0.091768	0.068894

P = 2021

0.839337	0.091767	0.068894
0.839339	0.091767	0.068892
0.839337	0.091767	0.068894

P = 2022

0.839337	0.091767	0.068894
0.839338	0.091767	0.068893
0.839337	0.091767	0.068894

P = 2023

0.839337	0.091767	0.068894
0.839338	0.091767	0.068893
0.839337	0.091767	0.068894

P = 2024

0.839337	0.091767	0.068894
0.839338	0.091767	0.068894
0.839337	0.091767	0.068894

P = 2025

0.839337	0.091767	0.068894
0.839337	0.091767	0.068894
0.839337	0.091767	0.068894

P = 2026

0.839337	0.091767	0.068894
0.839337	0.091767	0.068894
0.839337	0.091767	0.068894

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decreased to 0.0688 in 2020 A.D. However, its probability of declining to fifth order increased from 0.125 in 1991 to 0.8393 in 2015 A.D

While the probability of third order centers remaining in that class decreased overtime, there seems to be an increasing tendency for these centers to move into fourth and even fifth order. This might be due to the fact that the second and first orders are absorbing states, without any movement in or out of them. Secondly, it is noted that throughout the period of observation, the only movement out of the third order was a decline of a center first to the fourth and then the fifth order in 1976 and 1991 respectively.

6.6 PROJECTED DISTRIBUTION OF CENTRAL PLACES

The distribution of central places in different states is estimated by multiplying the 1991 distribution vector with the successive powers of the 1991 transition matrix. The results for selected periods are summarised in table 6.6. The trend of the expected distributions are shown in figures 6.3 to 6.6.

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TABLE 6.6
PREDICTED DISTRIBUTION OF CENTRAL PLACES

ORDER / YEAR	5	4	3	2	1
1993	114.754	12.133	7.113	1	1
1995	113.389	12.351	8.259	1	1
2000	112.532	12.328	9.139	1	1
2005	112.471	12.301	9.227	1	1
2010	112.470	12.297	9.232	1	1
2020	112.471	12.296	9.231	1	1

Source: Author's computation

From table 6.6 and the figures, it is shown that out of the total of 120 centers in the fifth order in 1991, 8 are expected to move to higher orders by the year 2020 A.D, while the number of 4th order centers will increase from 10 to 12 within the same period. Again the number of centers in the third order will increase from 4 in 1991 to 7 in 1993 and from 8 in 1999 to 9 at the end of 2020 A.D.

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PREDICTED DISTRIBUTION OF CENTRAL PLACES [1991 AND 1995 AD]

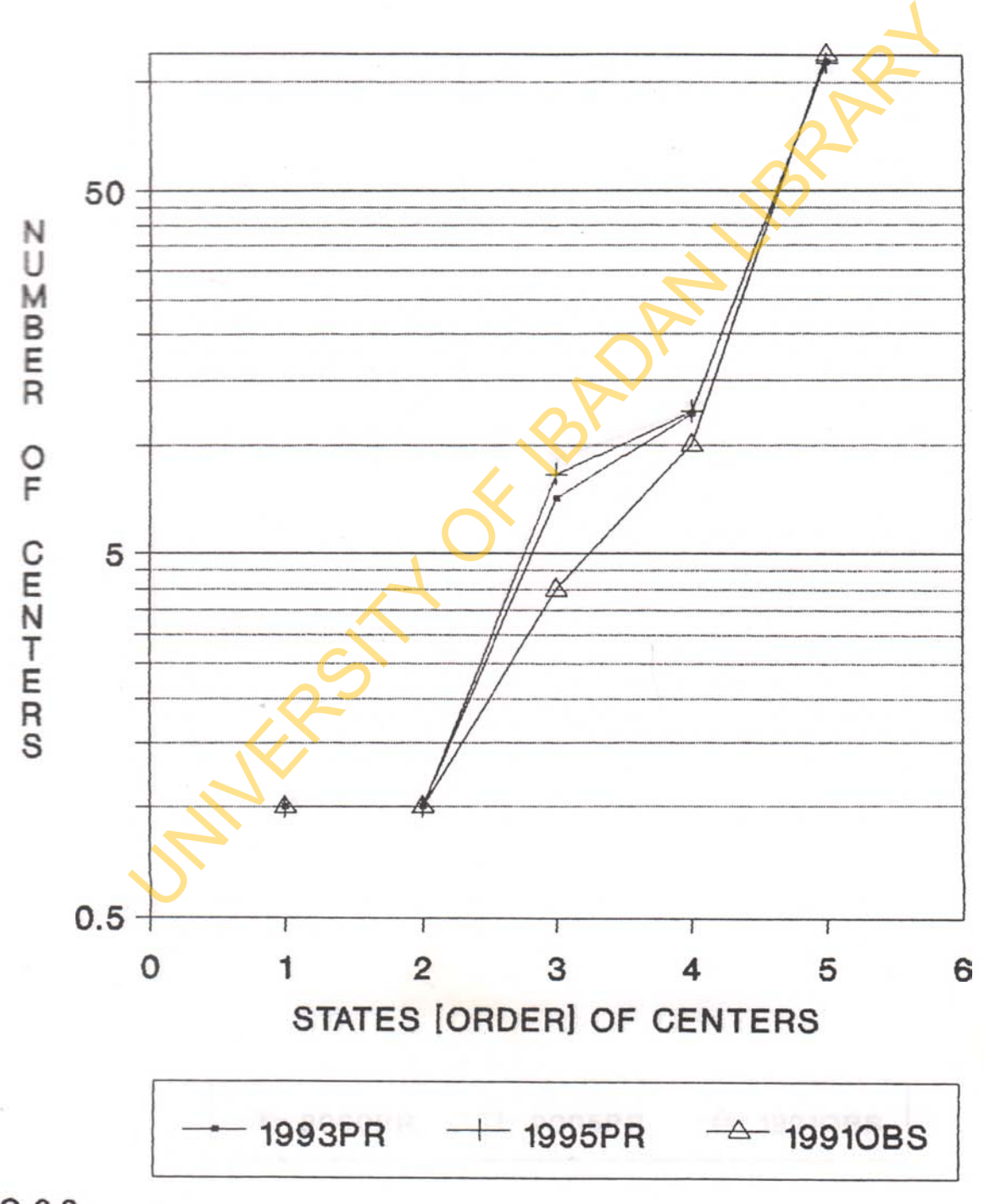

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FIG 6.3

PREDICTED DISTRIBUTION OF CENTRAL PLACES [2000 AND 2005AD]

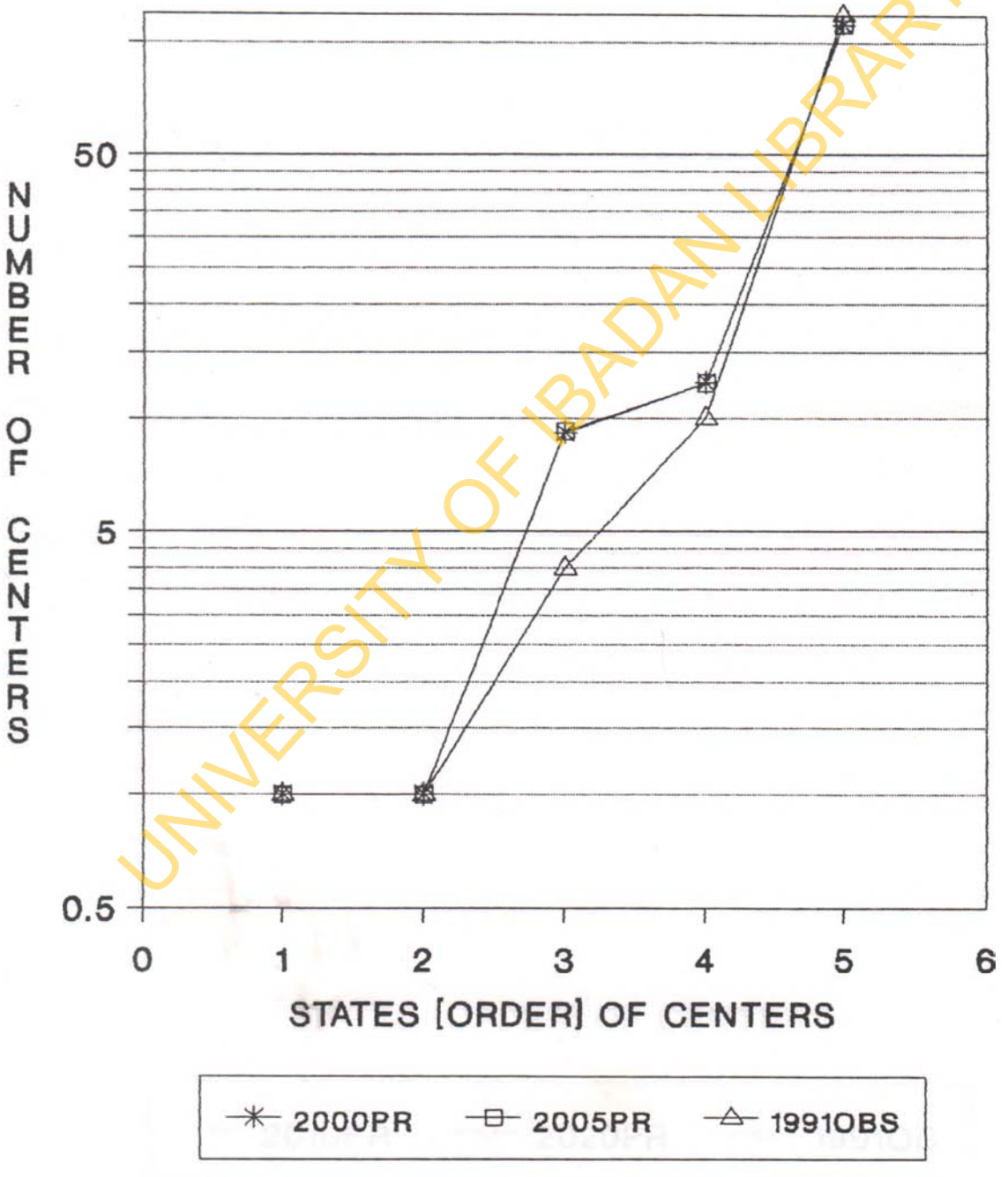

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FIG 6.4

PREDICTED DISTRIBUTION OF CENTRAL PLACES [2010 AND 2020AD]

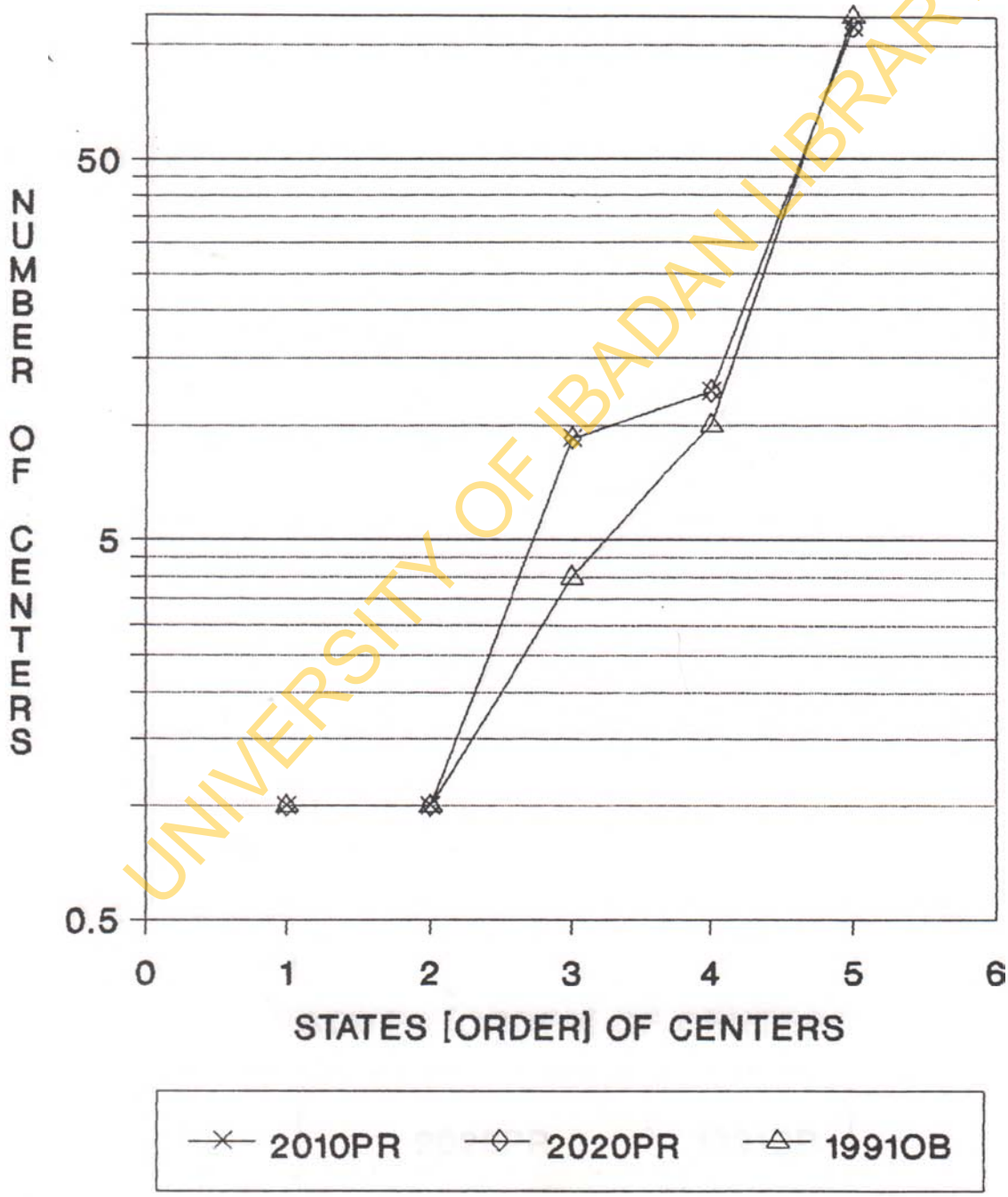

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FIG 6.5

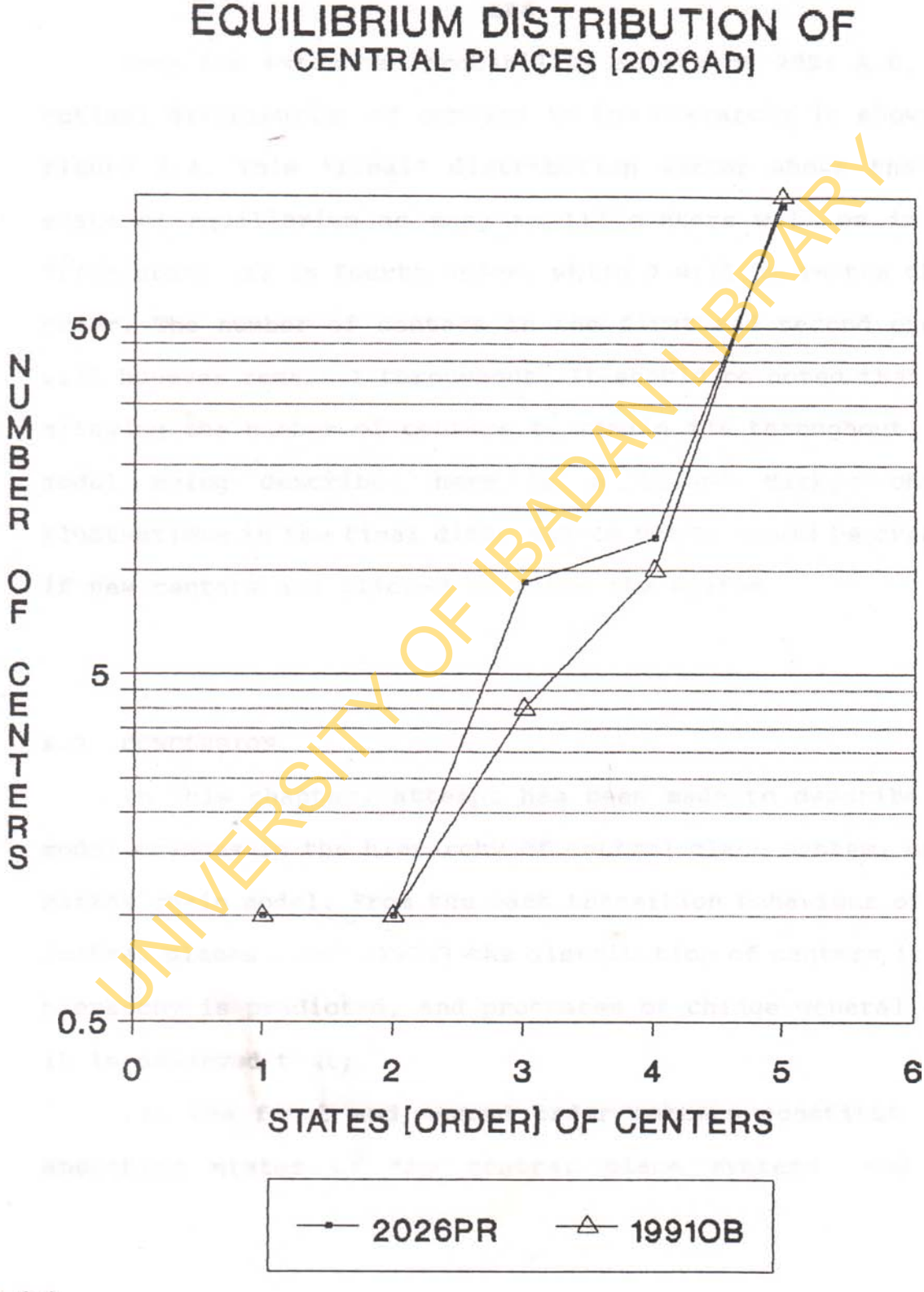

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FIG 6.6

From the estimated probability matrix of 2026 A.D, the optimal distribution of centers in the hierarchy is shown in figure 6.6. This 'final' distribution vector shows that in state of equilibrium as many as 112 centers will be in the fifth order; 12 in fourth order, while 9 will be in the third order. The number of centers in the first and second orders will however remain 1 throughout. It should be noted that, by allowing the number of centers to remain 136 throughout, the model being described here is a closed Markov chain. Fluctuations in the final distribution vector could be created if new centers are allowed to enter the system.

6.7 CONCLUSION

In this chapter, attempt has been made to describe and model changes in the hierarchy of central place system, using Markov chain model. From the past transition behaviour of the central places [1967 -1991] the distribution of centers in the hierarchy is predicted, and processes of change generalised. It is observed that;

[a] the first and second order centers constitute the absorbing states of the central place systems, and are

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therefore more stable than the lower order states. A great deal of instability is observed within the fifth to third order group, which constitute the transient states of the system.

[b] analysis of the short term transition matrices of the central places [1967-1976; 1976-1991] reveal that there is no statistically significant difference between observed and predicted distribution of the central places. It follows from this observation that, Markov chain as a rational accounting model of change, is a valid tool for describing the transition pattern [present and future], and distribution of central places in the region. This lends weight to the hypothesis that changes in the hierarchy of central places can be described and predicted by Markov model.

[c] the predicted distribution of central places show that only very few centers in the fifth order [less than 2%] will move to the fourth and third order centers between 1991 and the year 2020 A.D. However an equilibrium distribution of centers in the hierarchy is expected to be reached in the year 2026 A.D. This implies that given the ongoing processes of development in the region an optimal grouping of centers will be attained in 2026 A.D. At this steady state, the current

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[1993] distribution pattern of central places, in which well over 80% of the centers are in the lowest order will be emphasized. Next in this discussion, the quantitative relationships between the structure and identified processes of the central place systems are examined.

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CHAPTER SEVEN

INTERRELATIONSHIPS BETWEEN SPATIAL PROCESSES AND STRUCTURE OF CENTRAL PLACE SYTEMS

7.1 INTRODUCTION

This chapter examines the nature, strength and temporal dimension of the relationship between spatial structure of the central places and the underlying processes. The identified spatial processes in the preceding chapters are related to the observed spatial structure of the central places. The issues as addressed here are of two folds. The first centers on the hypothesis that there is no relationship between identified spatial processes and observed spatial structure of the central places. Related to this is the question of, the exact nature and significance of the interrelationship that might exist between the structure [pattern of economic development] and the spatial processes. We however first examine the theoretical relationship between spatial pattern or spatial form and spatial processes or function.

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7.2 THEORETICAL RELATIONSHIP BETWEEN SPATIAL PROCESS AND SPATIAL STRUCTURE

It is an established fact that spatial form [pattern] and spatial function [process] have both interdependent and causal interrelationships in space [Webber, 1964; Philbrick, 1957; Rummel, 1965; 1970; and Schwind, 1975]. This idea is anchored in the concept of the "field" as elaborated by Lewin [1951] in the social sciences, while the justification for exploring this relationship in spatial analysis was provided by Berry,[1966] when he writes, somewhat categorically that:

> "Spatial process must involve simultaneous congruent changes in spatial structure and behaviour and neither structure nor behaviour can be asserted to be the sole source through which external influences freed the process and compel change ... Behavioural changes may call forth structural changes as well as the converse"

Again Gould,[1966] said, spatial pattern and spatial process are circularly causal. Thus beyond the presence of association is the suggestion of causality which has a circular nature as obvious from Gould's statement. It follows from the above that it is possible to recognise the mutual relationships between spatial pattern and the underlying processes. Since spatial pattern and spatial processes have multivector parameters, it

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is almost certain that a suitable method for identifying and quantifying the relationship is the canonical model.

An important issue which has not been investigated but implicit in Berry's statement as quoted above, is the fact that spatial form compels change in spatial function or vice versa. If there is symbiotic relationship between the two, then the observed relationship must change overtime, because spatial patterns take place within a changing socio-economic and political setting. Similarly the underlying processes change within a geo-political framework. It is therefore hypothesized that, the nature and strength of mutual relationship between spatial form and spatial function changes over time. An explanatory framework for the analysis of the changing relationship between spatial form and function is provided by concepts of "order by fluctuation" and "dissipative structure" [Allen and Sanglier 1978, 1979 Prigogine, 1977] which as discussed in chapter two highlights the relevance of deterministic equations and stochastic events or memory of the system in explaining observed spatial structure. Again, since the changing relationships also involves multivariate parameters between two sets of variables, it is certain that the method of canonical

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correlation is a suitable technique in evaluating the changing nature of the relationships between spatial form and function.

7.3 MEASUREMENT OF THE RELATIONSHIP BETWEEN SPATIAL STRUCTURE AND SPATIAL PROCESSES

Canonical Correlation Model is a method of analysing the relationship between two sets of variables. The focus of the method is the identification of the structure of the multivariate complex under study, and the generation of maximum amount of correlation between linear functions of two groups of variables Kendall et al,[1976]. Put differently, the technique seeks to find the relationships between linear combinations of variables of one set and linear combinations of the second set. It is in essence, a generalisation of multivariate statistics which are special cases of canonical correlation. [Kendall et al, 1976; Maxwell 1979, Ayeni 1980].

The usefulness of the technique in geographic research has been rather explosive. These include the identification and isolation of the interrelationships between; social and physical space in Toronto, Bourne and Mudie, [1972]; formal and functional regionalisation such as, Berry, [1966] in India; and Ayeni, [1975] in Jos; the interrelationship between

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economic and cultural differences in Canada, Ray [1972] and, the formal and structural component of Wales. Clark, [1973] among others. In addition to an explicit systemic analysis, our approach also explores one potentiality of the technique which has not been noticed in the literature - the employment of the technique to measure trend in the relationship between spatial pattern and spatial processes. By employing this technique in a spatial system context within a dynamic framework, an important gap in the literature is bridged. Our approach here also enhances the predictive ability of the model. For the basic structural equations of the model see Kendall and Stuat, 1976; Maxwell,1979; Bourne and Mudie,1972]

7.4 CHOICE OF CANONICAL VARIABLES:

There are two sets of canonical variables, one measuring spatial process and the other set measuring spatial structure. There are a total of fifteen variables, with ten on the first set, measuring spatial processes and five variables on the second set, measuring spatial structure. All these are observed for one hundred and thirty six central places. Table 7.1 shows the list of the variables.

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TABLE 7.1
DEFINITION OF CANONICAL VARIABLES.

VAR NO	CODE	DESCRIPTION
PROCESSES		
X1	POTCIT	PORT CITY
X2	FEDCAP	FEDERAL CAPITAL
X3	STACAP	STATE CAPITAL
X4	LGHQ	LOCAL GOVERNMENT HEADQUARTER
X5	URTRAD	URBAN TRADITION
X6	METSTA	METROPOLITAN STATUS
X7	DISTSEA	DISTANCE FROM THE SEA
X8	ROACC	ROAD ACCESSIBILITY
X9	RALACC	RAIL ACCESSIBILITY
X10	AIRACC	AIR ACCESSIBILITY
PATTERN		
Y1	COMSIZE	COMMERCIAL SIZE
Y2	INDSIZE	INDUSTRIAL SIZE
Y3	SERVSIZE	SERVICE SIZE
Y4	HQORG	HEADQUARTERS OF ORGANISATIONS
Y5	POPSIZE	POPULATION SIZE

Variable Xi - Port facility. The value of one or zero is assigned to a central place that has port facility or otherwise. A central place is termed a port City, when its port has a minimum Quaylength of 2,000 meters; at least a modern warehouse; mechanised cargo-handling technique and, floating dock with minimum of 1,000 tonne lifting capacity.

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The presence of these port qualities have inherently high capacity to create employment opportunities, stimulate commercial and service related activities and other export oriented or import dependent manufacturing industries. All these in turn will generate further growth in the area where located as some of the firms have agglomerative tendencies.

The inclusions of X2 - Federal Capital Status, X3 - State capital and X4 - local government headquarter are to suggest how relations of governmental and economic power in a subregional system may contribute to an understanding of the evolution of spatial structure. While diffusionists school of thought would see the introduction of innovation in a regional system of central places as following the hierarchical pattern of settlements, locational theorists argue that the decision of firms to locate in an area reflects the spatial variation in the distribution of power i.e, entrepreneurs would want to locate as close as possible to the nucleus of power. It is then to be expected that where power is concentrated more generative activities will be located. The presence or absence of any of these variables attract one or zero to a particular center.

Variable X5 is denoted as urban tradition. Central

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places whose urban history predates colonialism are traditional centers of commercial activities, with enormous human resources that will be a pull factor to labour intensive industrial activities. It would also attract to itself services - both infrastructural and related activities. Such centers would wield enormous influence as to attract political functions or intervene in the politicking process to attract infrastructural services to itself.

Variable X6 is denoted as metropolitan status. In our context, a metropolitan area is defined as a city or an urban center with more than one town linked to it through the uncontrolled or unguarded process of urban development. They are "multiple urban centers". Usually their populations are well above one hundred thousand, and, in order to distinguish them from those centers still approaching metropolitan status, the 100,000 population mark is used as the minimum. They include; Ogbomosho, Ila-Orangun, Iwo, Ilesha among others.

Variable X7 - distance from the sea is a locational attribute that could influence the size of a given settlement. Since one broad pattern of settlement location at the global scale is that large cities have coastal concentration, we expect sizes of cities to decrease with increasing distance

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from the sea. We measure the distance in kilometers of each of the One hundred and thirty six cities from the sea.

We limit variables X8 - road accessibility to cities that are connected by federal trunk A road. All things being equal, all such places are important nodes in the regional road transport network. However, variables X8 [Road], X9 [Rail], and X10 [Air] accessibilities all measure the degree of communications within the system or the degree of inter-urban contact networks. These various measures will influence the pattern of spatial concentration of business organisations or of economic activities by channeling flows of people and goods to areas with comparative accessibility advantage. In fact, the importance of communications as a location factor for offices and businesses is widely acknowledged. [Tornquist, 1970; Thorngren, 1970; Goddard, 1971; Pred, 1966, 1973].

A total of Eight variables are aggregated to measure the overall commercial size [Y1] of a city. These variables as listed in appendix 1 include, Banks, Bookshops/Stationery stores, Drugs/Medicine stores and, Hotels and restaurants. Others are Petrol and Service stations; supermarkets, general goods and motor sales. The inventory of the fourtyfive central

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functions observed for each central place was classified, and weighted differently as discussed in chapter four. The sum of the commercial components of the central functions are obtained for each center to derive the total commercial size of the central places.

Variable Y2 - Industrial size is also an aggregate of fourteen variables of different industrial establishments in the system. The variables are chosen to cover a wide range of manufacturing activities, both small, medium and large scale industrial establishments. They are derived using the same procedure for the commercial sizes of the centers.

Services size of settlements, variable Y3, is also an aggregate of twenty-three service types both private and public service enterprises and infrastructural services. The concentration of these services in a town will highlight the level of service provision or availability in such a town, while the spatial pattern of the concentration will provide an interesting insight into the spatial structure of service provisions in the region. It is also obtained using the same procedure for commercial and industrial sizes of the central places.

Variable Y4 measures the size of headquarters of major

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job providing organisations in a given settlement, and is an important measure of size of a city. It refers to the number of multifunctional, multilocational business organisations whose headquarters are located within a central place. Such organisations have been observed to dominate advanced economies, and by way of neocolonialism, the developing economies. Either as private or joint venture, they are responsible for the lionshare of important growth - inducing or employment generating innovations that are fundamental to spatial economic development. Their concentration and spatial locational pattern in a system of central places will no doubt influence intermetropolitan circulation of specialised information and further concentrations of economic activities.

Population size [Y5] is one important measure of city size. It is the concentration of human resources in a given city, and no doubt an important consideration in the decision making involving location of market oriented products or services and or labour intensive manufacturing activities. The population size of a town will normally be a determining factor in provision of infrastructural facilities that will act as baits to entrepreneurs. While the 1963 Census figures for the 136 central places are used as measures of their 1967

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population sizes, the 1976 and 1991 figures are projections based on the 1963 census.

7.5 INTERPRETATION OF RESULTS

Table 7.2 shows the test of significance for the canonical correlations in 1967, 1976 and 1991. As seen in table 7.1, five canonical correlations are produced in each period. This implies that five meaningful patterns of interrelationship can be observed between spatial form and spatial functions of the regional central place systems for the periods.

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TABLE 7.2

TESTS OF SIGNIFICANCE OF CANONICAL CORRELATION
[1967, 1976 AND 1991]

VARIATES	CANONICAL CORRELATION. [λ]	EIGEN VALUE [λ^2]	WILK'S LAMBDA	DEG. OF FRED.	SIGNIFICANCE LEVEL	
1967						
1.	0.99996	0.99992	0.00000	40	0.0000	*
2.	0.98124	0.96283	0.005883	28	0.0001	*
3.	0.84620	0.71605	0.158331	18	0.0001	*
4.	0.57135	0.32644	0.557628	10	0.0001	*
5.	0.41486	0.17211	0.827883	4	0.0001	*
1976						
1.	0.99790	0.99580	0.000302	45	0.0001	*
2.	0.89547	0.80187	0.072261	32	0.0001	*
3.	0.70779	0.50097	0.364723	21	0.0001	*
4.	0.45800	0.20976	0.730870	12	0.0001	*
5.	0.27408	0.07512	0.924878	5	0.0765	**
1991						
1.	0.99957	0.99914	0.000054	45	0.0001	*
2.	0.88224	0.77834	0.064301	32	0.0001	*
3.	0.73116	0.53459	0.290106	21	0.0001	*
4.	0.59752	0.35703	0.623358	12	0.0001	*
5.	0.17464	0.03050	0.969499	5	0.0765	**

* Significant ** Not Significant

While all the five canonical correlations are very high in 1967 with the coefficients of 0.999, 0.981, 0.846, 0.571 and 0.414 respectively, only the first four are high in 1976

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and 1991. The canonical correlation coefficients of these four variates in 1976 are 0.997, 0.835, 0.708 and 0.458. Their corresponding coefficients in 1991 are 0.999, 0.882, 0.731 and 0.597. It is also shown that while all the five variates are significant in 1967, it is only the first four that are significant in 1976 and 1991. The Wilk's lambda of all the significant pairs in the three periods remain 0.0001. The above further implies that in 1967, all the observed pattern of interrelationships between spatial process and spatial pattern are significant, while four significant patterns emerged in 1976 and 1991. A prima facie case is provided for the conjecture that there is relationship between spatial processes and spatial structure of central places.

The Eigen values for the significant pairs of variates show the amount of variance in one variate that is accounted for by the other canonical variates. As shown in table 7.2, it is only the first three variates that have eigen values greater than 0.5. For 1967, the eigen values of the first three variates are 0.999, 0.962, and 0.716. Their corresponding values in 1976 are 0.995, 0.802 and 0.501. While in 1991, these figures are 0.999, 0.778 and 0.535 respectively. This suggests that the loading of variables on

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the first three variates in the three periods would reflect the essential pattern of relationships between spatial form and function.

The standardised canonical weights of the fifteen variables for the three periods, are shown in tables 7.3, 7.4 and 7.5. The canonical weights or coefficients show the importance of the original variables in each set in forming the variates. Warmick, [1973]. The canonical weights represent the direct contribution of the original variables to the variates. They are comparable to the standardised beta coefficients in a multiple regression model. Levine, [1977]. Since they do not represent the correlation between the original variables and the canonical variates they are not interpretable, Ayeni, [1986] noted. The coefficients are then transformed into canonical loadings or structure thereby allowing the interpretation of the variates in terms of correlation coefficients between the original variables and the variates.

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TABLE 7.3

STANDARDISED CANONICAL WEIGHTS OF THE FIFTEEN VARIABLES IN 1967

VARIA-BLES	CAN.VAR. 1	CAN.VAR. 2	CAN.VAR. 3	CAN.VAR. 4	CAN.VAR. 5
Y1.	-0.0027	1.6283	-3.5550	1.1949	-0.0486
Y2.	0.0007	0.0206	-0.1165	-0.6647	1.7298
Y3.	-0.0001	-0.0710	4.4502	-5.5353	-2.6701
Y4.	1.0064	-0.9188	-2.9389	2.3205	-0.2374
Y5.	-0.0060	-0.2376	1.8337	2.9374	1.5598
X1.	0.9698	-1.0138	0.1055	0.0313	0.0267
X2.	0.0000	0.0000	0.0000	0.0000	0.0000
X3.	0.0425	1.3245	0.6741	0.1550	0.0008
X4.	0.0008	0.0122	0.2393	0.3102	0.0548
X5.	-0.0016	0.0751	0.1820	0.7561	0.3674
X6.	0.0021	0.0107	0.7284	-0.8921	-0.5208
X7.	-0.0030	-0.0038	0.1122	0.2184	0.3296
X8.	-0.0004	0.0068	0.0052	-0.3758	0.9876
X9.	-0.0019	0.0894	0.3166	-0.0510	-0.0126
X10.	0.0000	0.0000	0.0000	0.0000	0.0000

Source: Derived from table 7.2

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TABLE 7.4

STANDARDISED CANONICAL WEIGHTS OF THE FIFTEEN VARIABLES IN 1976

VARIA-BLES	CAN.VAR. 1	CAN.VAR. 2	CAN.VAR. 3	CAN.VAR. 4	CAN.VAR. 5
Y1.	0.6558	-6.3557	1.5770	0.6168	-0.3010
Y2.	-0.3858	3.1683	3.3931	-9.0468	-5.7059
Y3.	0.9924	3.8963	-8.8500	5.5527	4.2055
Y4.	-0.2445	-3.2999	2.3790	2.5317	0.0186
Y5.	-0.1345	1.2094	2.7804	1.5427	1.5868
X1.	0.3180	0.9493	-0.4098	0.5159	-0.2324
X2.	0.0000	0.0000	0.0000	0.0000	0.0000
X3.	0.0650	0.5361	-0.7707	-0.4641	-0.2176
X4.	0.0170	0.1288	0.1759	0.3119	-0.0870
X5.	0.0073	0.0745	0.5517	0.4520	-0.8983
X6.	0.0571	0.3521	0.4460	-0.6991	0.8745
X7.	-0.0098	0.0424	0.2708	0.3557	0.2961
X8.	0.0319	0.0477	-0.1148	-0.5497	0.0345
X9.	-0.0012	0.0019	-0.0423	0.7624	0.7752
X10.	0.6659	-1.4444	0.6393	-0.2406	-0.1223

Source: Derived from table 7.2

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TABLE 7.5

STANDARDISED CANONICAL WEIGHTS OF THE FIFTEEN VARIABLES IN 1991

VARIA-BLES	CAN.VAR. 1	CAN.VAR. 2	CAN.VAR. 3	CAN.VAR. 4	CAN.VAR. 5
Y1.	-0.1890	-3.2040	-2.7796	6.0980	6.4582
Y2.	0.0436	2.7152	0.9558	4.3150	-9.0132
Y3.	-0.0161	3.4987	-2.6738	-15.5877	-0.1139
Y4.	1.1220	-3.5533	0.1514	5.7599	1.1770
Y5.	0.0151	0.6836	3.3724	-0.0335	1.8212
X1.	0.9934	-0.5781	0.4485	-0.1512	-0.1041
X2.	0.0000	0.0000	0.0000	0.0000	0.0000
X3.	0.0129	0.2818	-0.0718	-2.0886	-0.4369
X4.	-0.0042	0.0387	0.2268	-0.0683	0.4201
X5.	-0.0024	0.2150	0.5198	-0.0540	0.4685
X6.	0.0061	0.2849	0.3023	0.4308	-1.2042
X7.	-0.0038	0.1115	0.3704	0.0810	0.1709
X8.	0.0014	0.0495	-0.3037	-0.0872	0.3207
X9.	0.0007	0.2948	0.1165	0.2735	0.4342
X10.	-0.0027	0.4010	-0.9013	1.8082	0.5086

Source: Derived from table 7.2

The canonical structure matrix for the three periods are presented in tables 7.6, 7.7 and 7.8. The tables show the relationships between the spatial processes identified and the

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observed hierarchical spatial structure. Also from the table, the relative temporal contribution of each variable measuring spatial process can be seen. Since it is our aim to identify the processes that have been, that are still and likely still to be governing the spatial structure, we seek to discuss the relationships as summarised in each variate for the periods.

Table 7.6 shows that in 1967, variate 1 has all measures of spatial structure commercial size [Y1], Industrial size [Y2] service size [Y3], number of headquarters of job providing organisations [Y4] and population [Y5] with coefficients greater than 0.71 respectively associated with variables of Port city 0.99, Federal Capital 0.99, State capital 0.73 and Air accessibility 0.73. The high loading of these variables on variate 1 suggests that centers of great commercial, industrial and service activities, and those where population and headquarters of job providing organisations are concentrated are more of either Port city and, or federal capital or state capitals which have air accessibility. This implies that the higher the position of any city in the system hierarchy the more the concentration of these measures of spatial processes or vice-versa. If, as we do here, associate high ranking central places with most developed centers, this

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TABLE 7.6
CANONICAL STRUCTURE MATRIX OF THE FIFTEEN VARIABLES AND THEIR VARIATES IN 1967

VARIA-BLES	CAN.VAR. 1	CAN.VAR. 2	CAN.VAR. 3	CAN.VAR. 4	CAN.VAR. 5
Y1.	0.7140	0.6981	0.0467	0.0263	0.0047
Y2.	0.8218	0.1836	-0.0032	-0.2383	0.4838
Y3.	0.9124	0.3753	-0.1530	-0.0550	-0.0156
Y4.	0.9935	0.0045	0.0017	0.0012	0.0001
Y5.	0.8249	0.4613	0.2672	0.1712	0.0780
X1.	0.9995	-0.0296	0.0029	0.0031	0.0018
X2.	0.9995	-0.0296	0.0029	0.0031	0.0018
X3.	0.7254	0.6828	-0.0706	-0.0164	-0.0141
X4.	0.1199	0.1747	0.6264	0.4151	0.1186
X5.	0.1776	0.2659	0.7237	0.3694	0.1870
X6.	0.2862	0.3291	0.7838	-0.3255	-0.1272
X7.	-0.0573	-0.0513	0.0744	0.5226	0.1098
X8.	0.0746	0.0879	0.0881	-0.5064	0.8327
X9.	0.3793	0.4384	0.2869	0.0101	0.0123
X10.	0.7254	0.6828	-0.0706	-0.0164	-0.0141

Source: Derived from table 7.3

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TABLE 7.7
CANONICAL STRUCTURE MATRIX OF THE FIFTEEN VARIABLES AND THEIR VARIATES IN 1976

VARIA-BLES	CAN.VAR. 1	CAN.VAR. 2	CAN.VAR. 3	CAN.VAR. 4	CAN.VAR. 5
Y1.	0.9958	-0.0377	0.0788	-0.0271	0.0014
Y2.	0.8764	0.1524	0.0970	0.1951	-0.4016
Y3.	0.9012	0.1417	0.0406	0.2360	-0.3323
Y4.	0.3349	0.1434	0.0829	0.5419	-0.7529
Y5.	0.9477	0.1638	0.2551	0.0648	0.0759
X1.	0.8426	0.3110	-0.1975	0.2171	-0.1181
X2.	0.8426	0.3110	-0.1975	0.2171	-0.1181
X3.	0.7316	0.2273	-0.1521	-0.1989	0.1057
X4.	0.2139	0.3339	0.4233	0.0198	-0.0306
X5.	0.3135	0.3832	0.6740	-0.0594	-0.2887
X6.	0.4222	0.4724	0.5636	-0.3680	0.3269
X7.	-0.1924	-0.0177	0.3557	0.3840	0.1843
X8.	0.2753	0.1875	0.1690	-0.4429	-0.0510
X9.	0.5827	0.0672	-0.0464	0.2269	0.5138
X10.	0.9678	-0.2331	0.0396	-0.0252	0.0281

Source: Derived from table 7.4

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TABLE 7.8
CANONICAL STRUCTURE MATRIX OF THE FIFTEEN VARIABLES AND THEIR VARIATES IN 1991

VARIA-BLES	CAN.VAR. 1	CAN.VAR. 2	CAN.VAR. 3	CAN.VAR. 4	CAN.VAR. 5
Y1.	0.8137	0.4284	-0.1511	0.0850	0.0343
Y2.	0.8668	0.4026	-0.0995	0.0743	0.0132
Y3.	0.9248	0.2983	-0.0955	0.0194	0.0189
Y4.	0.9965	0.0547	-0.0237	0.0109	0.0050
Y5.	0.8180	0.4568	0.0528	0.0606	0.0377
X1.	0.9995	-0.0083	0.0037	0.0025	0.0010
X2.	0.9995	-0.0083	0.0037	0.0025	0.0010
X3.	0.5037	0.6255	-0.2285	-0.1924	-0.0100
X4.	0.1000	0.3699	0.2266	0.0039	0.0546
X5.	0.1756	0.5644	0.3739	0.0143	0.0252
X6.	0.2277	0.6256	0.2227	0.0934	-0.0808
X7.	-0.1896	0.0168	0.2975	0.0586	0.0315
X8.	0.1526	0.3221	-0.0108	-0.0432	0.0434
X9.	0.3753	0.5188	0.0254	-0.0490	0.0372
X10.	0.5793	0.5399	-0.3146	0.0895	0.0056

Source: Derived from table 7.5

relationship also holds for the spatial processes. That is, the pattern of the processes closely approximates the pattern of level of development in the region. This is true as observations in the preceding chapter shows that, Lagos,

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Ibadan, Abeokuta and Akure whose locations reflect the spatial pattern of most of these processes are indeed great centers of economic concentration. Again in 1976 and 1991,all measures of spatial structure remain positively correlated with processes of Port location X1, Federal capital status X2, State capital X3, Air accessibility and Road accessibility. However there are changes in the strength of the association [Tables 7.7 and 7.8] with the tendency for the canonical coefficients to decrease generally in 1976 only to rise again in 1991.

The observed changes in the strength of association between spatial process and pattern as seen in the pattern of loading of the variables on variate 1 in the three periods suggests that:

[a] there seems to be a major fluctuation in the system in 1976 and

[b] that by 1991 the system has almost dampened out the effects of the fluctuation.

[c] this fluctuation is perhaps occasioned by the political restructuring exercise of 1976, particularly, state creation.

The effects of the fluctuation in the system is such that, the degree of relationship between X3 - state capital

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and various measures of spatial structure appreciated from 0.72 in 1967 to 0.73 in 1976 when the status of administrative headquarters were given centers already renowned for commercial and service activities with high population concentration. The fluctuation decreased slightly the relative strength of Port location [X1] and Federal capital status [X2] from 0.99 in 1967 to 0.84 in 1976. This is perhaps due to the fact that the newly created state capitals either got increasing share of regional Commercial [Y1] Industrial [Y2] and Service activities [Y3] and population concentration [Y5] al of which at this period became more strongly associated with state capital [X3] or that these regional centers with great Industrial, Commercial and Service functions and also with population concentration were "active enough" in the regional political process to acquire the important status of administrative state capitals.

Again the fluctuation enhanced the importance of metropolitan status [X6] which appreciated from 0.28 in 1967 [table 7.6] to 0.42 in 1976 [table 7.7], and, railway accessibility [X9] from 0.37 in 1967 to 058 in 1976. All these imply that the central places located on railways and some of those of metropolitan status became strongly

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associated with centers of great commercial, industrial and service activities, with high population concentration or rather that since these processes had been in existence in these centers, they constitute important factors that led to their choice as state capitals.

However, the system seems to dampen the fluctuation as the 1967 pattern of association became re-emphasized in 1991. Virtually all variables that load high on variate 1 have near their 1967 coefficients of association. While the above seems to suggest the stability of the system, it shows the ineffectiveness of policy measures in redressing spatial development inequality. The unsuccessful attempt at reducing increasing concentration of economic activities in already few large centers.

It is however observed that variable X7 - distance from the sea with low coefficients of -0.05, -0.19 and 0.19 in the three periods shows no clear cut relationship with various measures of spatial structure. This may be due either to the distribution pattern of the central places in the region, which as shown in Figures 3.1 to 3.3 have tendency to be concentrated in the interior with fewer locations near the coast or that the scale of investigation is at the low level,

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for world pattern of settlement distribution show the tendency for large cities [or developed] to be concentrated near the coast. The observation here suggest that developed central places could be found located near the coast or in the interior.

The basic pattern of linkages identified by Variate 2 in the three periods still show that centers of great commercial activities [Y1] and population concentration [Y5] are very accessible either by air [X10] and or by rail [X9] and are likely to be state capitals [X3]. This is true of Lagos, Ibadan, Abeokuta and to some extent Akure. Whatever fluctuations that de-emphasized the relevance of these processes in 1976 were again dampened out, as their loading on variate 2 in 1991 still show that they are strongly related to various measures of city sizes particularly commercial, and industrial sizes and, population concentration.

Variate 3 in 1976 show that X4 - local government, X5 urban tradition and X6 metropolitan status, though have high loading of 0.62, 0.72 and 0.78 respectively, but the corresponding low loadings of measures of spatial structures show that these process are afterall weakly related to it. Meaning for instance that, local government headquarters [X4]

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or centers with long urban tradition [X5] are not necessarily centers of industrial concentration Y2 [-0.003], that they have virtually no headquarters of organisation located within them [Y4 = 0.001] and have little or no commercial activities [Y3 = 0.04], even though there is tendency for them to have significant population concentration [Y5 = 0.27]. This may be true of many local government headquarters such as Ogbere, and Odeda in Ogun state, Okitipupa, lgbokoda in Ondo state, Saki, Ilora, Ikirun, and Iwo in Oyo State among others. Some of these are metropolitan cities, but without corresponding significant economic development.

The weak relationship between these processes - local government headquarter, long urban tradition and metropolitan status is maintained in 1976 and re-emphasized in 1991 as shown by their loadings on variate 3 in these periods.

None of the variables measuring spatial structure load up to 0.5 on variate 4 throughout the three periods. However only two of the spatial process variables X7 - distance from the sea with 0.52 and X8 - presence of federal trunk A road with -0.50 load highly on it. The first observation regarding distance show that whether a city is high or low in the hierarchy does not depend so much on its location. That is,

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developed cities are close to the sea just as they can be found in the interior. The second observation is unexpected, that the presence of federal trunk A road is inversely related to spatial pattern of development. This might however be due to the relatively low density of trunk A road in the region since, all things being equal, such facility is expected to enhance development, especially in important nodes along the network.

In 1976, the coefficients of association between Y4-number of headquarters of organisations with 0.54 and distance from the sea with 0.38 implies that there is tendency for organisations to locate their headquarters near the coast. This may however be due to the location of Federal capital and most state capitals [X3], already associated with Y4 by variate 1, which are close to the sea. Variate 4 does not show any clear cut relationship between spatial pattern and processes in 1991 as all of the variables load very low on it, the highest value being 0.09 between air accessibility [X10] and commercial size [Y1].

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7.6. REDUNDANCY ANALYSIS OF STRUCTURE AND PROCESSES RELATIONSHIPS

7.6.1 Validity measures of Canonical model and Tests of Hypotheses

Canonical model was originally formulated to measure the strength of the interrelationship between two sets of variables. In the preceding section we made attempt to widen the usefulness of this technique by requiring it to monitor changes in the strength of these interrelationships, by applying the techniques in the same spatial field of observations at three different periods. [1967, 1976, 1991]. In this section, we seek to.

[i] evaluate the validity of the canonical model in reflecting the basic interrelationships between the regional process and spatial pattern.

[ii] validate the models ability to capture changing interrelationship as we have described, between the process and pattern.

The results of the above two issues will confirm the hypothesis that spatial processes are analytically tractable, and that the processes as identified and quantified in the

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subregion capture the underlying processes of the regional pattern of development.

[iii] validate the hypothesis that the processes that have been operating are still operating in the system and predict the relative strength of these processes, on the regional spatial structure.

[iv] Finally provide insight into the stability or otherwise of the system.

In seeking to address the above issues, four tests as suggested by Briggs and Leonard [1977] are carried out on the canonical model for the periods 1967, 1976 and 1991. These are:

1. Variance explained by each canonical variate. It shows whether or not the canonical correlation between any pair of variates can be attributed to a few or most of the highly correlated variables. In essence, it reveals the extent to which a canonical variate is representative of the data set of which it is a linear combination. The variance extracted is therefore expected to test the relevance of the various linkage identified by the variates.

2.Factor redundancy. This is a measure of the proportion of the total variance of the dependent variables that can be

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predicted by one canonical variate of the independent variable set. It is therefore a measure of the relative importance of a given canonical variate in explaining the variance in the dependent variable set. It is also expected here to show the relevance of the purported association between the spatial processes and pattern. i.e how meaningful does spatial process identified relates to the observed spatial structure.

3.Total redundancy. It is a measure of the proportion of total variance explained in one variable set by the other. In the independent variable total redundancy measures the predictive ability of the independent variables. In the dependent variable it is the amount of variance in the independent variable that is accounted for by the dependent variable. The values will therefore show the degree of relationship between spatial process and pattern. That is, at a certain degree of specification we should be able to comment on the relevance of the relationship between processes identified and the observed spatial structure.

4.Variable redundancy. Within the dependent variable set, variable redundancy measures the proportion of the variables variance that is explained by the canonical model. For the independent set, variable redundancy is a measure of the

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relative importance of each variable in contributing to the explanation of the dependent data set. Variable redundancy therefore shows the extent to which variables are involved in the predictive model. It points to both the variables making important contribution to the model as well as those that can be dropped without loss of significant information.
These measures are part of the output from the procedure canonical analysis

7.6.2 Interpretation of Results

Tables 7.9, 7.10 and 7.11 show the components of redundancies for the five canonical variates in 1967, 1976 and 1991.

It is evident from the tables that the first five canonical variates [of the independent set] with the total variance of 0.803, 0.689 and 0.687 in the three periods are highly representative of the data set of which they are linear combinations. This implies that the canonical correlation between each pair of variate can be attributed to most of the highly correlated variables. However given the total variances of 0.631, 0.570 and 0.623 for the first three variates in these periods respectively, the pattern of

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relationship between the first three variates could as well highlight the essential nature of the relationship between processes and patterns and the changing strength of these relationships. Within the dependent variables, the total variance remained at over 0.9 in the three periods. This means that the various measures of spatial structure are highly representative of the regional central place structure and that since they explain over 90% of the variance in the independent set,

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TABLE 7.9

STANDARDISED REDUNDANCIES FOR THE FIVE CANONICAL VARIATES IN 1967

VARIATES	CANONICAL CORRELATION [λ]	EIGEN VALUE [λ^2]	STANDARDISED VARIANCE	FACTOR REDUNDANCIES
PROCESS				
1	0.99999	0.99992	0.3331	0.3331
2	0.98124	0.96283	0.1346	0.1296
3	0.84620	0.71605	0.1636	0.1171
4	0.57135	0.32644	0.0945	0.0308
5	0.41486	0.17211	0.0771	0.0133
PATTERN				
1	0.99960	0.99992	0.7396	0.7396
2	0.98124	0.96283	0.1749	0.1684
3	0.84620	0.71605	0.0154	0.0139
4	0.57135	0.32644	0.0160	0.0059
5	0.41486	0.17211	0.0481	0.0083

Total Redundancy from the first set, given the second = 0.6240

Total Redundancy from the second set, given the first = 0.9360

Total Variance from the first set, given the second = 0.8030

Total Variance from the second set, given the first = 0.9940

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TABLE 7.10

STANDARDISED REDUNDANCIES FOR THE FIVE CANONICAL VARIATES IN 1976

VARIATES	CANONICAL CORRELATION [λ]	EIGEN VALUE [λ^2]	STANDARDISED VARIANCE	FACTOR REDUNDANCIES
PROCESS				
1	0.99790	0.99580	0.3667	0.3651
2	0.89547	0.80187	0.0821	0.0658
3	0.70779	0.50097	0.1211	0.0607
4	0.45800	0.20976	0.0669	0.0140
5	0.27408	0.07512	0.0532	0.0040
PATTERN				
1	0.99790	0.99580	0.7164	0.7134
2	0.89547	0.80187	0.0184	0.0148
3	0.70779	0.50097	0.0178	0.0089
4	0.45802	0.20976	0.0785	0.0165
5	0.27408	0.07512	0.1089	0.0127

Total Redundancy from the first set, given the second = 0.5096

Total Redundancy from the second set, given the first = 0.7663

Total Variance from the first set, given the second = 0.6899

Total Variance from the second set, given the first = 0.9400

Source: Author's computation

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TABLE 7.11

STANDARDISED REDUNDANCIES FOR THE FIVE CANONICAL VARIATES IN 1991

VARIATES	CANONICAL CORRELATION [λ]	EIGEN VALUE [λ^2]	STANDARDISED VARIANCE	FACTOR REDUNDANCIES
PROCESS				
1	0.99957	0.99914	0.2882	0.2880
2	0.88224	0.77835	0.2445	0.1903
3	0.73116	0.53459	0.0900	0.0481
4	0.59752	0.35703	0.0173	0.0062
5	0.17464	0.03051	0.0477	0.0015
PATTERN				
1	0.99957	0.99914	0.7869	0.7862
2	0.88224	0.77835	0.1621	0.1293
3	0.73116	0.53459	0.0169	0.0090
4	0.59752	0.35703	0.0095	0.0034
5	0.17464	0.03051	0.0207	0.0006

Total Redundancy from the first set, given the second = 0.5340

Total Redundancy from the second set, given the first = 0.9285

Total Variance from the first set, given the second = 0.6877

Total Variance from the second set, given the first = 0.9961

Source: Author's computation

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there is a very strong and objective basis for confirming or rejecting any hypothesized relationship about the structure and process of the central place systems.

Also from tables 7.9, 7.10 and 7.11, the total factor redundancy of the measures of spatial processes for the three periods [1967, 1976 and 1991] are 0.624, 0.510 and 0.534 respectively. While for the measures of spatial pattern, the corresponding total factor redundancies are 0.936, 0.766 and 0.929. The above implies that the measures of spatial processes predict about 62%, 51% and 53% of the variance of spatial structure while about 94%, 77% and 93% of the variability in spatial processes are predicted by spatial structure. These high degrees of predictability show that the spatial processes identified are highly related to the spatial structure. Thus we conclude the validity of canonical model in reflecting the basic interrelationships between spatial form and spatial function in the regional central place system. The hypothesis that there is a relationship between spatial pattern and spatial process is also confirmed.

Again, the varying degrees of predictability of the model, as seen in the different values for the three periods show that,there are changes in the basic pattern of

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interrelationships between spatial processes and spatial pattern. Within the independent spatial processes for instance, redundancies for the variates fluctuated from 0.624 in 1967 to 0.510 and 0.534 in 1976 and 1991 respectively. The depression of 1976 shows that some extraneous factors operated within the system and deemphasized the predictability of the processes in this period. The instability created is being gradually overcome within the system as evident from the rising strength of the spatial processes and their increasing relationship with the spatial structure.

Also within the spatial structure, the values of 0.936, 0.766 and 0.929 for the three periods reflect the fluctuating association between spatial processes and spatial structure. However, the quick recovery of the spatial structure in 1991 to near its 1967 path or form suggests the stability of the spatial structure in dampening out fluctuation. A comparism between the rate of adjustment of spatial structure and spatial processes will show that the form is more stable than the function. i.e spatial structures are more stable than the processes operating within them.

The above confirms the statement that there are changes in the relationship between spatial process and spatial

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pattern and also the model's ability to capture changing interrelationship between them. We also establish a strong case for the statement that the systems spatial structure is a stable one.

Table 7.12 shows the components of redundancies for the fifteen variables in 1967, 1976 and 1991. Each column of the dependent set shows the proportion of each variables variance that is predicted by the canonical model. The three columns show changes in the above directions over the period. Similarly within the independent variable set, the quantitative contribution of each measure of spatial processes to the explanation of the dependent variables is shown. The three columns therefore show changes in the relative contribution of each variable to the explanation.

Within the context of relative contribution to the explanation of the variables in the dependent set, all the variables of the independent set with the exception of X7 - distance from the sea and X8 - accessibility to federal trunk A road are very important. In terms of identification and quantification, the most important spatial processes that have been governing the spatial structure of

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TABLE 7.12

COMPONENTS OF REDUNDANCIES FOR THE FIFTEEN VARIABLES IN 1967, 1976 AND 1991

VARIABLES	REDUNDANCY 1967	REDUNDANCY 1976	1991
PROCESSES			
X1	0.9999	0.8151	0.9991
X2	0.9999	0.8151	0.93991
X3	0.9788	0.5952	0.7343
X4	0.3834	0.2249	0.2012
X5	0.5252	0.4501	0.4901
X6	0.6634	0.5521	0.5081
X7	0.1010	0.1340	0.1292
X8	0.2216	0.1593	0.1309
X8	0.3879	0.3735	0.4142
X10	0.9788	0.9772	0.7341
PATTERN			
Y1	0.9807	0.9919	0.8769
Y2	0.7667	0.8082	0.9291
Y3	0.9858	0.8457	0.9540
Y4	0.9999	0.2358	0.9968
Y5	0.9470	0.9498	0.8857

Author's Computation 1993

S.W. Nigeria central places are factors of Port location [X1] and Federal capital status [X2], which share equal strength of 0.999, 0.815, and 0.999 in the three periods; Air accessibility [X10] 0.979, 0.977 and 0.734; and, State capital factor [X3] with 0.979, 0.60 and 0.73 in the three periods.

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Others include long urban tradition [X5], metropolitan status [X6], and Railway accessibility. Thus we conclude that these factors have been and are still governing the spatial pattern of concentration of economic activities in the region.

A look at the spatial pattern of these processes show that the dominant ones are concentrated in Lagos, Ibadan, Abeokuta and Akure. These towns from all indications will continue to dominate the regional economic landscape. The removal of one of the most important factor - Federal Capital status from Lagos may not have any lasting negative effect on the city, given the presence of other processes, particularly Port location which has equal variance with Federal Capital status. It is being suggested here that at best, the exercise will introduce another fluctuation in the system, whose effect may cause some initial instability. But as noted earlier on, and as seen in the ability of the system to return to 'normal' in 1991 after the 1976 fluctuation, the system will soon dampen the fluctuation as Lagos continue to maintain its dominance of the regional economic space. Again all the variables of the dependent set have high redundancy values for the three periods. This shows that the canonical model gave a good explanation of their variances.

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CHAPTER EIGHT

SUMMARY AND CONCLUSION

8.1 INTRODUCTION

Attempt has been made in this study to analyse the spatial structure and underlying processes of South-West Nigeria Central places. This has been done within a dynamic [inter-temporal] framework and an explicit systemic thinking. Among other things, the study has analysed the changing location pattern of the central places and examined both the processes and pattern of their size distribution and relative growth. It also analysed the functional structure of the central places; examined aspects of relationships in the structure of central place systems, and modelled the changing distribution of centers in the hierarchical groups. Processes of central place systems growth and development are examined. The quantitative relationships between the spatial processes and observed spatial structure of the central places are examined. The study has therefore provided useful insight into the structure of the central place systems and the type and strength of the underlying spatial processes.

In the discussion that follows the summary of research findings is presented. Also both the planning and theoretical

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implications of the results are highlighted. Based on research findings and implications of study, a research agenda for the future is provided.

8.2 SUMMARY

1. The analysis of the locational pattern of the central places shows that their distribution does not conform with theoretical postulates of regularity. The observed mean distance of first order nearest neighbour analysis in 1900, 1952 and 1963 show that there is no statistically significant difference from the expected if the points were random. It is further observed that there is no statistically significant changes in the location pattern of the central places overtime. This is to be expected, given the locational inertia of settlements generally, and the fact of traditions of origins of these settlements. Once established, settlements are not known to relocate but each center may adjust its location towards a newly constructed road or grow along major transport routes. At least in the region, the fact of settlement relocation is weakly supported by history. The traditions of origin of virtually all the centers considered

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point out the fact that by 1900 the 1963 spatial location pattern of the central places had been established.

From the point of view of location processes, it can be concluded that forces of unification and diversification have operated to produce the current location pattern of the central places. At the earliest times, forces of unification could be seen in the prevailing geography of the region, and the relatively simple socio-economic and political culture of pioneering settlers. On the other hand, forces of diversification would be seen in the dynamic nature of the Yoruba race, mainly in improvement in technology initially seen in development of new tools and later in transportation, and the emergence of new political culture characterised by militancy.

2. The analysis of the concentration and growth structure of the regional central place populations show that the number of urban places in the region increased from 14 in 1900 to 26 in 1952 and 72 in 1963. Thus between 1952-1963 it took just 9 years for the number of urban places in the region to double, while the doubling time for the country as a whole in the same period was 11 years.

It is revealed in this study that well over 3 million or

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55% of the total 5.5 million urban population in the region live in 11 cities of over 100,000 population. Again just about 17% of the total regional urban population are found in as many as 34 cities. This point to the fact that most of the urban population actually reside in few large central places. These centers are mainly administrative state capitals and some of the traditional urban places which are also local government headquarters. There are however spatio-temporal variations in the relative sizes, distribution pattern and growth structure of the central place populations [figures 4.4; 4.5 and 4.6]. The processes of regional population growth are discussed within three dominant historical epochs - pre-colonial, colonial and pre-recessionary periods. The main engine that propelled the growth of central place populations in the pre-colonial era was a complex cultural and political processes. These are evidence first, in the transformation of ancient spatial units. The transformation is noted to be fostered by Spiritual or Cultic unity among the existing polities. Second, was the nature and role of the centers as traditional centers of trade and administration, a factor that ensured steady influx of migrants from the rural hinterland to the more important centers. In the colonial

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period, it was the British administrative policy seen in the "Monetization of the economy and Metropolitanization of the cities". In the pre-recessionary period (first two decades after independence) it was a mixture of economic and political or politicking processes of independent government of Nigeria in the region.

3. It is observed that the South-West Nigeria central places are spatial systems of three dimensions. The result of the multivariate factor analysis shows that the spatial variations among the central places, originally described by forty-five variables can be described by three new independent dimensions. These are; Industrial development; commerce and education; and, Basic or social services. These dimensions or structural features are substantially the same in 1967, 1976 and 1991. Based on the structural features, the central places were grouped. The result of the hierarchical cluster analysis shows that in the three periods considered, five orders of central places are distinguishable. The hypothesis that there is hierarchy of central places in the region is confirmed. The spatial patterns of the hierarchical structure [figures 5.10, 5.11 and 5.12] show that most of the central places considered fall within the lowest order class, while

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one center is found in each of first and second order.

An examination of the structural relationship in the hierarchy of central places show that the expected theoretical relationships between order of central places and variety of functions performed is only observed for the third through the fifth orders, while in the first and second orders, the essential difference is not as such in the variety of functions performed but the total number of such functions. Furthermore the analysis of size relationships in the hierarchy of central places show that there is positive relationship between population and functions of the central places. However, the coefficient of association decreases overtime, an observation that suggests that the amount of spatial variation in the functional sizes of the central places not accounted for by population factor decreases over time. This further implies that population factor may be becoming less important in explaining the distribution of socio-economic activities in the region.

4. Although the number of orders of central places remain five in the three periods, it is observed that there are movements of centres within the hierarchical structure. The dynamics of these movements and transition pattern are

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investigated using Markov chain model. The analysis of the short-term transition pattern of the central places 1967-1976 and 1976-1991 show that, there is no significant difference between the observed and the expected distribution of central places in the different hierarchical order. This implies that, Markov chain as a rational accounting model of change can be used to describe changes in the hierarchy of central places, and also to predict both the future transition pattern and distribution of central places in each hierarchical order. The movement pattern of the central places shows that, higher order centers are more stable than lower order centers in the hierarchy. The probability of the first and second order centers to continue in their class between 1967 and 1991 remain unity. Again for the third order this tendency increased from 0.667 in 1976 to unity in 1991, while frequent crossing of hierarchical classes is a major feature of the fourth and fifth orders. Analysis of the future transition pattern of the central places reveal that an equilibrium distribution of central places will be reached in the year 2026 A.D, and that at the steady state, the predicted distribution pattern of the central places will not be different from that observed at the base period [1991].

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The processes of change in the hierarchical structure are generalised to be the location and development of transport routes; initial location and changing spatial pattern of governmental power in the region. All these it is argued would influence location decisions of entrepreneurs and the decisions of individuals and households. It would also channel economic activities to centers that are most accessible to the populace and those close to or are the seat of government [actors of the system].

5. From the detailed analysis of the structure of the central place systems which was considered from the pre-historic period to date, pertinent processes governing the emergence, growth and variations of the systems spatial structure are identified. The quantitative relationship between the processes and observed spatial structure are examined by employing an explanatory/predictive canonical model. The technique highlights the degree of association between the identified spatial processes and observed spatial pattern and, the relative strength and contributions of the spatial processes to the variations in observed structure of central places. Observations made are that,

(a) the relationship between spatial processes and spatial

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structure of the regional central place systems is not a steady but a fluctuating one. This is clearly borne out by the canonical correlation coefficients of the variables measuring spatial structure and pattern in 1967, 1976 and 1991 [table 7.6; 7.7 and 7.8]. This is as expected since observations in the preceding chapters indicate that the regional spatial structure of central places has dynamic characteristics. There are changes within each central place. New activities are being added just as some are possibly dying out. All these are taking place at different times and places. The processes that induce growth also have both spatial and temporal dimensions. Thus changes in human societies and in the underlying spatial processes would result in fluctuation in the relationship between structure and spatial processes.

(b) It is noted that all the spatial processes identified are relevant and strongly predict variations in spatial structure of the central places. This is a testimony of the fact that, social processes are knowable and are analytically tractable. It further shows that canonical correlation model is a good technique for examining the dynamic relationship between spatial process and spatial structure.

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6. Within the explanatory framework of "concepts of order by fluctuation and dissipative structure". It is observed that the spatial structure of South-West Nigeria central place system is a stable one. The canonical structure matrix for the three periods shows that a fluctuation occurred in 1976 which drive the system off its 1967 path. The fluctuation is however dampened by 1991 as the system returns to its near 1967 path. The fluctuation reflects the influence of the actors of the system, seen in the process of state creation and local government reforms aimed at redressing spatial development inequality. The return of the system to its 1967 path suggest that the dominant pattern of spatial development inequality is re-emphasized no sooner than spatial development policy measures were introduced. It is concluded that the observed system stability is the stability of spatial development inequality. It is the irresponsiveness of the spatial structure to spatial development policies or the ineffectiveness of the policies in redressing what looks like a chronic regional development problem.

7. From the point of view of their relevance, the processes that have been and are still governing the spatial structure of the regional central place systems are, in order of

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importance. Port location factor, administrative importance of Federal capital, Air accessibility and State capital factor. Others are factors of Metropolitan status, Urban tradition and Railway accessibility. With reference to spatial structure, all the five variables used in measuring size of central places are important. They are the Population size, total Commercial; Industrial and Service sizes and the size or number of headquarters of multifunctional organisations. Thus within the South-Western Nigeria region, or in similar settings, these measures are very important and should be taken into consideration in subsequent studies.

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8.3 PLANNING IMPLICATIONS

The employment of systemic framework in the analysis of central place systems raises pertinent questions directly related to planning. For instance, given the fact that politically different entities are actually related in space and that interaction among cities cut across political boundaries, the basic question then is, what is the appropriate unit of planning in any region? the whole region, state or city level? Systems analysis highlights the fact that decisions, policies and planning activities in one city or state have implications for cities in another state. These and other related issues will be addressed if further studies employ explicit systemic framework. While we do not conclude, we wish to suggest at this level, that a general framework of planning should be formulated at the national level, while these guidelines are pursued at state level. [in line with the national plan]. At city .level, planning activities are pursued in line with the directives from the state. That is, any physical planning at the city level that does not take into consideration the relationship of that city with the neighbouring cities may be counter productive.

This study provides quantitative evidence for the fact

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that any center with Port facility and or any administrative function such as federal or state capital would constitute focal point of economic development activities. Particularly for import dependent economies, such centers would naturally act as baits for imported raw-material dependent industries, and other related commercial and service functions. The ability of such centers to generate employment-real or unreal is high. Such centers would therefore attract population. In terms of physical planning, the needs of such industries or establishments;- good access roads, and that of the people-housing should be considered.

Again, since these processes have great potentiality to generate growth, [population growth in particular] the concentration of all these functions in a single location will frustrate any attempt at reducing urban problems - liveability, manageability, pollution, crime rate etc. While there is obvious symbiotic relationship between port location and air accessibility, administrative function of federal and state capital should not be concentrated in a center with port facility and air accessibility. We wish to applaud the federal governments effort in shifting the federal capital from Lagos. We suggest that the Lagos state capital should

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also be moved to a more convenient location in the state. This it is hoped will reduce the apparently insurmountable urban problems in Lagos to a more manageable level.

It is observed that the factor of local government headquarter has a relatively low capability to attract growth induced functions such as employment generating industries to any center designated as such. Perhaps this is due to the low ability or failure of the local authorities in many places to provide basic infrastructural needs for such activities. It is noted here that local government headquarters are, potentially valuable reference points for population redistribution, If only their infrastructural and industrial bases would be strengthened. This implies that there should be an explicit spatial development policies that recognise and treat the local government headquarters as important development nuclei. Most of them are presently concentrated in the fifth order class.

This study has shown that the national development objectives:- satisfaction of human needs and, the achievement of a just and egalitarian society is far from being met at least in this region - that is development is concentrated in few areas mainly large urban centers. This pattern of

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regional economic development is still dominant till present. The implications of the above becomes more obvious when we note that a significant proportion of the regional population still lives in the rural areas.

8.4 THEORETICAL IMPLICATIONS AND A RESEARCH AGENDA FOR THE FUTURE.

Within a general framework of system analysis, this study has shown that cities are interrelated and interdependent entities. As such it is being stressed that changes in one center will induce changes in another. It is therefore expedient to examine in greater details how changes in one city induces changes in another, and the influence of such changes in the system as a whole. Again, the nature of functional interdependency and the pattern of dominance - subdominance relationships in the system is another area that will provide useful information on the spatial organisation and orderly functioning of regional central place systems. The point is, systemic framework is a good if not appropriate method of scientific geography.

This study has shown the inadequacy of many of the models in urban geography to capture changes in geographical

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phenomena. The employment of such structurally static models in geographical analysis brings about the achievement of static results. Being static models, with ability to produce only static results, the explanations inferred for spatial processes are largely inadequate. This is more obvious when explicit systemic framework is employed. For instance in the study of evolution of complex systems such as central place systems, an equilibrium spatial organisation is postulated by existing geographical models such as CPT. However such paradigms as " Concepts of order by fluctuation and dissipative structure" combines deterministic laws of economics and stochastic elements. It shows that the evolution of complex social systems is far from a static equilibrium. By emphasizing the feedback mechanisms present in a system which reflects the effects of chance events and deterministic laws of economics, the paradigm suggests what should be areas of emphasis.

The question is, how does the interaction of spatial distributions, [of populations and different variables of the system], and the positive feedback inherent in such interaction give rise to a self-organisation of the systems spatial structure?. There is therefore the need to require

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existing models in urban geography to operate in dynamic or at least inter temporal empirical analyses. Our aim is not to put them "on trial" but to seek to enhance their practical utility. This also implies that further studies should include temporal dimensions.

Although this study identifies the processes that have been and that are still governing the spatial structure of S.W. Nigeria system of central places, there is the need to study closely the exact role of these processes in the regional system. What amount of development that is associated with each process. Their increased dominance in molding the geography of the state through the locations they occupy, the number of employment they generate, the principles governing their operation and in particular the resources they allocate to different parts of the system. All these deserve close attention.

This study has shown that, in explaining the dynamics of central place systems in a given region, we cannot rely on certain universally identified processes and relate such to an observed structures. Rather a detailed analysis of the state of the system of interest in search of particular relevant processes will prove fruitful and valid/relevant results will

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be obtained when we relate such processes to observed structure. One important aspect of the systems structures that has not been given much attention is the shapes of central places. It is hypothesised here that the form or shape of central places is indicative of the processes governing spatial pattern. If examined within a dynamic framework changes in the shapes of cities would further suggest additional processes. It would also have practical implications for planning particularly within each city.

Although this study provides useful insight into the structure and dynamics of central place systems in south-West Nigeria, there is the need to have such studies for other areas and at much more localised level, so that a detailed national picture emerges. The identification and quantification of spatial dynamics should be seen as a prelude to the real thing - formulation of models and techniques that deal with spatial dynamics of the central place systems.

The systemic properties of Nigerian central places need greater attention. In particular, more attention is needed on the specific nature or structure of interactions among the cities. While attempt is made here to define systems of central places at the regional level, closer attention is

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needed to identify properties that define subsystems in the various regions that make up the country. The structure of such subsystems in terms of their systemic properties, the role of each subsystem, their aggregate behaviour, objective functions and pattern of information flow within them should lead to greater understanding of growth processes at much more localised scale.

In order to come to full grasp with the spatial dynamics of a regional or national central place structure, there is the need to re-examine existing conceptual and theoretical frameworks, tools and methodology in geography. These as they currently stand are largely inadequate in cooping with the intricacies and subtleties of the problem.

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APPENDIXES

APPENDIX 1

LIST OF CENTRAL FUNCTIONS

CODE NO	COMMERCE
1	BANKING
2	BOOKSHOPS AND STATIONARIES
3	CHEMISTS AND MEDICINE STORES
4	HOTELS AND RESTAURANT
5	PETROL SERVICE STATION
6	SUPERMAKETS
7	GENERAL GOODS
8	MOTOR VEHICLE SALES
	MANUFACTURING INDUSTRIES
9	ELECTRICAL AND ELECTRONICS
10	FOOD PROCESSING
11	BAKARY AND CONFECTIONARY
12	BREWERY
13	TESTILE/KINITTING MILLS
14	LEATHER INDUSTRIES [FOOTWEAR CARPET AND RUG]
15	FURNITURE/FIXTURES
16	PULP/PAPER PRODUCTS
17	PRINTING AND PUBLISHING
18	CHEMICALS/CHEMICAL PRODUCTS
19	NON-METALIC MINERAL PRODUCTS [CERAMIC, GLASS, ASBESTORS. CHALK AND STRUCTURAL CLAY]
20	FABRICATED METAL PRODUCT
21	CONCRETE PRODUCT
22	WOODMILLS [PLAYWWOD AND PARTIDE BOARD
23	MACHINARY AND EQUIPMENT

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SERVICES

24	CONSULTANCY [MANAGEMENT & ENGINEERING]
25	INSURANCE
26	LAUNDARY/DRY CLEANING
27	LEGAL SERVICES
28	TRAVEL AGENCY
29	STATE/GENERAL HOSPITAL
30	MATERNITY HOSPITAL
31	PRIVATE/SPECIALIST HOSPITAL
32	PRY HEALTHCARE/DISPENSARY
33	UNIVERSITY
34	POLYTECHNIC/COLLEGE OF EDUCATION/TC
35	SECONDARY SCHOOLS [JSS/SSS]
36	PRIMARY SCHOOL/NURSARY SCHOOL
37	DAILY MARKETS
38	PERIODIC MARKETS
39	HIGH COURT
40	MAGISTRATE COURT
41	CUSTOMARY COURT I AND II
42	STATE CAPITAL
43	LOCAL GOVERNMENT
44	IN-TOWN FLYOVER
45	IN-TOWN DOUBLE CARRIAGE WAYS

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APPENDIX 2

NEAREST NEIGHBOUR ANALYSIS OF CENTRAL PLACE LOCATION PATTERN IN 1900

The nearest neighbour statistics is derived with the symbol

$$R = \bar{d}/\delta$$

$\bar{d} = \Sigma$ MinDij/N where MinDij is the minimum distance between places i and j, N = total number of places

$$\delta = \frac{1}{2\sqrt{\lambda}}$$

where λ = is the estimated density of points per unit area. It is given by $\lambda = N/A$, where A is the size of the study area. Substituting for R parameters in the above,

N = 24 A = 76287km²

Density of central places per unit area

λ = 0.0003146

1. Theoretical mean distance of central place

$$\delta = [2\sqrt{\lambda}] = 28.19$$

$$= \frac{1}{2\times\sqrt{0.0003146}}$$

$$= \frac{1}{0.0354738} = 28.19$$

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2. Observed first order Mean distance, where

$\Sigma_1 \min D_{ij}$ = 647,

$\bar{d}_1$ = 27.0. and Standard error = 15.43

R_1 = 27.00/28.19= 0.958

3.Observed second order Mean distance, where

$\Sigma_2 \min D_{ij}$ = 698,

$\bar{d}_2$ = 29.08. and Standard error = 17.08

R_2 = 29.08/28.19= 1.032

4.Observed third order Mean distance, where

$\Sigma_3 \min D_{ij}$ = 849

$\bar{d}_3$ = 35.38. and Standard error = 16.89

R_3 = 35.38/28.19= 1.255

5. TEST FOR SIGNIFICANCE

$$Z = \frac{\bar{d}_1 - \delta}{\sigma \bar{d}}$$

$$\sigma \bar{d} = \frac{\sigma}{\sqrt{n\lambda}}$$

$$= \frac{0.26136}{\sqrt{24 \times 0.0003146}}$$

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$= 0.26136/0.08689 \qquad = 3.008$

$Z_1 = (27.00 - 28.19)/3.008$

$= -1.19/3.008 \qquad = -0.396$

$z_2 = (29.08 - 28.19)/ 196.570$

$= 0.89/3.008 \qquad = 0.296$

$Z_3 = (35.38 - 28.19)/ 194.383$

$= 7.19/3.008 \qquad = 2.390$

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Appendix 3
Nearest Neighbour Analysis of Central Place Location Pattern in 1952

The nearest neighbour statistics is derived with the symbol

$$R = d/\delta$$

$\bar{d} = \Sigma$ MinDij/N where MinDij is the minimum distance between places i and j, N = total number of places

$$\delta = \frac{1}{2\sqrt{\lambda}}$$

where λ = is the estimated density of points per unit area. It is given by $\lambda = N/A$, where A is the size of the study area. Substituting for R parameters in the above,

N = 101 A = 76287km²

Density of central places per unit area

λ = 0.0013239

1. Theoretical mean distance of central place

$$\delta = \frac{1}{2\sqrt{\lambda}} = \frac{1}{2 \times 0.36386}$$

$$\delta = \frac{1}{0.0727722} = 13.742$$

2.Observed first order Mean distance, where

$\Sigma_1$minDij =1420,

d_1 = 14.06 and s_1 = 9.29

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R_1 = 14.06/13.74 = 1.023

3.Observed second order Mean distance, where

$\Sigma_2 \min D_{ij}$ = 1821

$\bar{d}_2$ = 18.02 and s_2 = 11.80

R_2 = 18.02/13.74 = 1.31

4. Observed third order Mean distance, Where

$\Sigma_3 \min D_{ij}$ = 2595

$\bar{d}_3^2$ = 25.69 and s_3 = 13.71

R_3 = 25.69/13.742 = 1.87

TEST OF SIGNIFICANCE

$$= z_1 \frac{\bar{d} - \delta}{\sigma \bar{d}}$$

$$FORR_1 = \sqrt{n\lambda} = \sqrt{101 \times 0.0013239}$$

$$\sigma \bar{d}_1 = \frac{0.26136}{0.3656} = 0.7149$$

z_1 = (14.06 - 13.74)/0.7149 = 0.448

z_2 = [(18.02 -13.74)/0.714879] = 5.987

z_3 = [(25.69-13.74)/0.714879] = 16.72

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APPENDIX 4

NEAREST NEIGHBOUR ANALYSIS OF CENTRAL PLACE LOCATION PATTERN IN 1963

The nearest neighbour statistics is derived with the symbol

$$R = d/\delta$$

$\bar{d} = \Sigma$ MinDij/N where MinDij is the minimum distance between places i and j, N = total number of places

$$\delta = \frac{1}{2\sqrt{\lambda}}$$

where λ = is the estimated density of points per unit area. It is given by $\lambda = N/A$, where A is the size of the study area. Substituting for R parameters in the above,

N = 127 A = 76287km²

1.Density of central places per unit area

$\lambda = 0.00166$

2.Theoretical mean distance of central places

$$\delta = \frac{1}{2\sqrt{\lambda}}$$

$$= \frac{1}{2\sqrt{0.00166}}$$

$$= \frac{1}{0.0816} = \delta = 12.25$$

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3. Observed first order Mean distance, where,

$\Sigma_1 \min D_{ij}$ =1631

$\bar{d}_1$ = 12.84

s_1 = 8.09 standard error of the mean distances.

R_1 = 12.84/12.25 = 1.05

4. Observed second order Mean distance.

$\Sigma_2 \min D_{ij}$ = 2190

d_2 = 17.24

s_2 = 10.71

R_2 = 17.24/12.25 = 1.41

5.Observed third order Mean distance, where,

$\Sigma_3 \min D_{ij}$ = 3155

d_3 = 24.84

s_3 = 14.64

R_3 = 24.84/12.25 = 2.03

TEST OF SIGNIFICANCE

$$Z_1 = \frac{\bar{d} - \delta}{\sigma \bar{d}}$$

$$\sigma \bar{d} = 0.26136 \times \sqrt{n\lambda}$$

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= 0.26136/0.4598 = 0.5684

Z_1 = [(12.84 -12.25)/ 0.4598] = 1.283

Z_2 = [(17.24 - 12.25) / 0.4598] = 10.853

Z_3 = [24.84 - 12.25) / 0.4598] = 27.38

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APPENDIX 5

1967 CORRELATION MATRIX:

	V1	V2	V3	V4	V5	V6	V7
V1	1.00000						
V2	.88289	1.00000					
V3	.85553	.98487	1.00000				
V4	.94608	.97226	.96152	1.00000			
V5	.94092	.97332	.96843	.98122	1.00000		
V6	.98515	.91271	.90007	.97079	.96112	1.00000	
V7	.90329	.98856	.97835	.97523	.97840	.94065	1.00000
V8	.93641	.98138	.97367	.98379	.99051	.96068	.98616
V9	.53598	.50896	.43478	.51891	.49636	.50753	.51423
V10	.95312	.80409	.78234	.89033	.88778	.94352	.83028
V11	.93036	.90555	.88035	.92216	.94326	.91681	.90608
V12	.95681	.95820	.95242	.98308	.97837	.97926	.97093
V13	.97471	.78779	.76803	.89203	.87135	.96537	.82556
V14	.98108	.81641	.79195	.90908	.88935	.97632	.85371
V15	.86059	.98786	.98078	.95733	.97265	.89694	.97903

	V1	V2	V3	V4	V5	V6	V7
V16	.96825	.80790	.77516	.89422	.87390	.95803	.84310
V17	.81264	.97862	.97334	.93405	.94949	.85420	.96292
V18	.97692	.79815	.77500	.89620	.87452	.96783	.83403
V19	.97633	.88644	.85327	.94105	.92181	.96612	.89570
V20	.97974	.79894	.77773	.89679	.87812	.96988	.83594
V21	.75250	.82559	.77697	.81303	.78742	.75198	.80142
V22	.77999	.60514	.55424	.68131	.66536	.72921	.61573
V23	.83020	.62842	.60274	.70394	.71344	.78364	.65086
V24	.99040	.90191	.88229	.96278	.94756	.99386	.92347
V25	.98799	.87061	.85335	.94168	.93893	.99018	.90408
V26	.97257	.77823	.75809	.88389	.86306	.96320	.81899
V27	.45008	.78750	.78887	.64051	.67976	.48581	.72986
V28	.97090	.77981	.75967	.88437	.86289	.96327	.82061
V29	.93625	.90049	.86251	.92880	.92616	.92671	.90086
V30	.93791	.92721	.88898	.93791	.94073	.92305	.91625
V31	.90452	.98788	.96302	.97054	.96681	.91734	.97009
V32	.96916	.76978	.74348	.87681	.85243	.95612	.80829
V33	.68471	.81353	.83270	.77523	.82261	.72244	.80843
V34	.57343	.61900	.57396	.56565	.61121	.50687	.56245

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1967 CORRELATION MATRIX:

	V1	V2	V3	V4	V5	V6	V7
V35	.81120	.94226	.92190	.89778	.91460	.82965	.92317
V36	.56559	.87353	.88141	.75593	.78800	.61655	.82926
V37	.98055	.91242	.88555	.96551	.95303	.98458	.92732
V38	.51907	.51659	.46595	.50255	.49716	.47856	.48179
V39	.98884	.86518	.84116	.93671	.92896	.98058	.89006
V40	.98636	.87041	.84615	.94042	.93307	.98060	.89385
V41	.70758	.89158	.86928	.82472	.83772	.72664	.84960
V42	.96553	.76476	.74547	.87379	.85199	.95765	.80816
V43	.98671	.87295	.85932	.94643	.93185	.99247	.90349
V44	.87289	.72759	.69246	.81780	.78270	.83359	.72478
V45	.91748	.95945	.95323	.96527	.97103	.93977	.96126

	V8	V9	V10	V11	V12	V13	V14
V8	1.00000						
V9	.45336	1.00000					
V10	.86741	.51184	1.00000				
V11	.92537	.56820	.85166	1.00000			

	V8	V9	V10	V11	V12	V13	V14
V12	.98927	.42672	.89431	.91102	1.00000		
V13	.86718	.47260	.94829	.86072	.90952	1.00000	
V14	.88835	.49182	.96108	.86302	.92698	.99344	1.00000
V15	.97709	.44968	.80156	.89558	.94593	.76365	.79350
V16	.86972	.52807	.94819	.85805	.90547	.97925	.98386
V17	.95239	.44596	.75995	.86299	.91451	.70356	.73885
V18	.87514	.47435	.95837	.84662	.91683	.99372	.99704
V19	.92880	.51379	.94339	.87478	.94798	.94812	.96389
V20	.87766	.47278	.95630	.85742	.91896	.99591	.99708
V21	.79209	.61843	.67460	.75978	.77205	.66205	.69012
V22	.64508	.55710	.75287	.71157	.67365	.76349	.76530
V23	.70132	.46319	.76995	.80743	.72611	.82921	.80874
V24	.95299	.48699	.94816	.90295	.97703	.97092	.98236
V25	.93117	.52405	.95398	.92181	.94976	.97810	.98306
V26	.86114	.47105	.95147	.84684	.90604	.99668	.99564
V27	.69406	.29609	.32855	.62012	.61853	.27153	.30761
V28	.86245	.46116	.95408	.83799	.90782	.99534	.99638
V29	.91369	.65175	.88666	.91345	.90857	.87621	.89130
V30	.93842	.56663	.88900	.91961	.92593	.86211	.88377

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1967 CORRELATION MATRIX:

	V8	V9	V10	V11	V12	V13	V14
V31	.97387	.52340	.83357	.90664	.95962	.81148	.84065
V32	.85008	.48988	.95478	.83295	.89554	.99312	.99516
V33	.82095	.27394	.59999	.73379	.77113	.59566	.61861
V34	.57962	.52775	.50239	.66210	.53908	.43451	.44475
V35	.90427	.57847	.73335	.87787	.87094	.69769	.72566
V36	.79862	.30186	.46119	.69066	.73738	.41062	.44863
V37	.94798	.54149	.94325	.91963	.96186	.95106	.96517
V38	.50020	.31036	.47866	.50226	.49329	.46290	.47324
V39	.91892	.55732	.95786	.92196	.94055	.97342	.97966
V40	.92491	.52456	.95743	.91622	.94480	.96971	.97874
V41	.84111	.41789	.63215	.77247	.79478	.58715	.62184
V42	.85081	.45529	.95075	.82957	.89846	.99496	.99462
V43	.93616	.45412	.94977	.88835	.96821	.98190	.98967
V44	.75021	.71292	.85928	.83080	.76887	.86139	.85120
V45	.97183	.46288	.85461	.91459	.96673	.85002	.86977

	V15	V16	V17	V18	V19	V20	V21
V15	1.00000						
V16	.77614	1.00000					
V17	.99294	.72510	1.00000				
V18	.77212	.97964	.71413	1.00000			
V19	.85624	.95516	.81386	.96714	1.00000		
V20	.77430	.97819	.71545	.99912	.96195	1.00000	
V21	.80869	.68398	.80429	.66830	.73604	.66781	1.00000
V22	.56837	.75204	.51674	.76935	.75708	.77036	.61169
V23	.60676	.79105	.54412	.81199	.76596	.82529	.52151
V24	.87961	.96602	.83487	.97890	.98419	.97882	.74939
V25	.85886	.96603	.80969	.97569	.95587	.97961	.72640
V26	.75382	.97509	.69305	.99724	.94865	.99882	.65677
V27	.79351	.30718	.83045	.28273	.46249	.28816	.60318
V28	.75537	.97699	.69518	.99878	.95373	.99898	.65323
V29	.87206	.89279	.83891	.88569	.93249	.88466	.77768
V30	.90736	.88214	.88121	.87660	.94650	.87547	.78858
V31	.96833	.83708	.95813	.82551	.91537	.82443	.83744
V32	.74188	.97828	.68206	.99792	.95451	.99714	.66068
V33	.83930	.60142	.83423	.60446	.67481	.60687	.64331

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1967 CORRELATION MATRIX:

	V15	V16	V17	V18	V19	V20	V21
V34	.59381	.48477	.59059	.44660	.56867	.44981	.54611
V35	.92555	.72389	.92192	.70562	.80550	.70730	.79597
V36	.88279	.44102	.91134	.42271	.57874	.42505	.68962
V37	.89254	.95537	.85578	.95580	.96940	.95577	.78347
V38	.48649	.51285	.48196	.47495	.55600	.46798	.48546
V39	.84578	.96828	.79896	.97237	.95910	.97514	.74752
V40	.85321	.96640	.80705	.97162	.96265	.97302	.75024
V41	.88478	.64064	.89852	.60176	.73628	.59778	.77776
V42	.74068	.97456	.67901	.99714	.94525	.99771	.64160
V43	.85363	.96843	.80416	.98648	.97112	.98778	.71784
V44	.68234	.88473	.65245	.84733	.84710	.84871	.69858
V45	.95047	.85730	.92693	.85518	.90389	.85757	.79132

	V22	V23	V24	V25	V26	V27	V28
V22	1.00000						
V23	.76882	1.00000					
V24	.74458	.78635	1.00000				

	V22	V23	V24	V25	V26	V27	V28
V25	.75509	.82420	.98320	1.00000			
V26	.76901	.82649	.97048	.97590	1.00000		
V27	.22327	.24853	.46714	.41411	.25371	1.00000	
V28	.76433	.81465	.97222	.97377	.99925	.25320	1.00000
V29	.75206	.73405	.92606	.91986	.87181	.55797	.87114
V30	.70578	.73153	.93140	.91098	.85662	.62088	.85791
V31	.64890	.64831	.91875	.87758	.80362	.75143	.80573
V32	.77731	.81339	.96735	.96891	.99767	.23611	.99836
V33	.41664	.46020	.70063	.70560	.58922	.66618	.59145
V34	.51427	.48611	.52223	.49957	.42390	.62767	.42019
V35	.60362	.57850	.81376	.79028	.68566	.79576	.68540
V36	.30866	.30642	.59593	.54309	.39413	.96795	.39695
V37	.74466	.77031	.98313	.97666	.94720	.49133	.94768
V38	.42406	.38581	.50663	.47795	.44912	.36060	.45485
V39	.77845	.83591	.97900	.98812	.97078	.41248	.96879
V40	.77234	.81128	.98090	.98537	.96747	.41730	.96726
V41	.48793	.44701	.72464	.68510	.57001	.80136	.57537
V42	.76226	.81539	.96605	.97030	.99922	.23023	.99962
V43	.74169	.79590	.99623	.98621	.98274	.41341	.98378

	V22	V23	V24	V25	V26	V27	V28
V44	.73483	.75947	.83998	.85174	.84710	.31342	.83982
V45	.63857	.68856	.93127	.90955	.84248	.67266	.84362

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1967 CORRELATION MATRIX:

	V29	V30	V31	V32	V33	V34	V35
V29	1.00000						
V30	.92933	1.00000					
V31	.91827	.94691	1.00000				
V32	.87498	.85922	.80084	1.00000			
V33	.73171	.70995	.79061	.57695	1.00000		
V34	.68167	.67515	.64404	.42970	.45530	1.00000	
V35	.86945	.87015	.92905	.68025	.74893	.69959	1.00000
V36	.65205	.69976	.83728	.37865	.77101	.59459	.86303
V37	.93206	.94195	.92534	.94594	.70509	.54619	.84024
V38	.53964	.57231	.55279	.46318	.42067	.47642	.48210
V39	.93350	.92001	.88335	.96764	.67770	.54300	.79947
V40	.93008	.92516	.88756	.96572	.69019	.53285	.80313
V41	.77117	.82939	.88676	.57187	.77960	.62776	.87679

	V29	V30	V31	V32	V33	V34	V35
V42	.86127	.84557	.79070	.99798	.57913	.40487	.66972
V43	.90530	.90427	.88838	.97724	.68183	.47666	.77898
V44	.85596	.82982	.77578	.85439	.50082	.60230	.68994
V45	.89927	.92546	.95625	.83344	.77874	.58744	.89976

	V36	V37	V38	V39	V40	V41	V42
V36	1.00000						
V37	.61681	1.00000					
V38	.40191	.53639	1.00000				
V39	.53736	.97190	.50170	1.00000			
V40	.54906	.97743	.50858	.99461	1.00000		
V41	.86952	.76045	.54124	.69021	.70575	1.00000	
V42	.37567	.94076	.44419	.96480	.96280	.55666	1.00000
V43	.55051	.97490	.47817	.97888	.97968	.67982	.97973
V44	.39298	.85689	.50008	.88192	.86130	.60246	.83592
V45	.78336	.93449	.49369	.90796	.91398	.84005	.83260

	V43	V44	V45
V43	1.00000		
V44	.82711	1.00000	
V45	.91550	.75555	1.00000

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APPENDIX 6

1976 CORRELATION MATRIX:

	V1	V2	V3	V4	V5	V6	V7
V1	1.00000						
V2	.89998	1.00000					
V3	.88885	.97951	1.00000				
V4	.91517	.99132	.98434	1.00000			
V5	.70898	.79779	.79174	.79094	1.00000		
V6	.95964	.96384	.97089	.97404	.76970	1.00000	
V7	.90580	.98554	.99020	.98858	.79239	.98164	1.00000
V8	.93590	.97938	.98356	.98165	.80553	.98943	.98911
V9	.64462	.60002	.52904	.59398	.45746	.57348	.56362
V10	.96699	.84215	.81805	.85452	.64567	.91680	.84028
V11	.96310	.88373	.86642	.89298	.72443	.91949	.87434
V12	.95678	.93171	.93122	.94555	.73077	.97932	.94594
V13	.97297	.81501	.81862	.84333	.62839	.91930	.83586
V14	.97904	.85044	.85128	.87685	.66447	.94281	.87125
V15	.84704	.98678	.97666	.97281	.80280	.94005	.97807

	V1	V2	V3	V4	V5	V6	V7
V16	.94924	.80290	.78768	.82934	.60362	.89136	.81396
V17	.90388	.99482	.97976	.98936	.79636	.97128	.98858
V18	.96863	.80161	.80373	.83003	.61126	.90977	.82325
V19	.97768	.84256	.83927	.86641	.64366	.93028	.85798
V20	.96645	.79999	.80462	.82975	.61668	.91090	.82408
V21	.82751	.87549	.82840	.87939	.67820	.84604	.85558
V22	.82806	.64273	.60615	.65682	.49733	.70156	.62642
V23	.93936	.75058	.73617	.77762	.57070	.84514	.76102
V24	.98447	.87594	.87946	.90068	.68157	.95966	.89671
V25	.98087	.92734	.92738	.93992	.73859	.98120	.94064
V26	.96694	.79628	.79943	.82733	.60763	.90677	.81854
V27	.50149	.78595	.77031	.74438	.67778	.64381	.76025
V28	.96607	.80578	.81267	.83653	.61656	.91705	.83188
V29	.91175	.89374	.86942	.89942	.75005	.90045	.87798
V30	.98357	.90341	.88482	.91217	.72714	.95451	.90241
V31	.79853	.95996	.96086	.95380	.78868	.90517	.95926
V32	.95995	.78200	.77864	.81292	.59873	.89231	.80153
V33	.69618	.80407	.82799	.80417	.68193	.78748	.81740
V34	.61048	.57443	.47825	.54518	.44250	.50822	.49606

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1976 CORRELATION MATRIX:

	V1	V2	V3	V4	V5	V6	V7
V35	.88371	.96219	.92221	.94735	.79417	.91403	.93243
V36	.68766	.90871	.90259	.88653	.76991	.81083	.89103
V37	.98037	.92712	.91367	.94304	.73152	.97207	.92952
V38	.52637	.51985	.47498	.51892	.35230	.49062	.48723
V39	.84604	.80298	.75836	.78351	.64323	.78802	.76991
V40	.97715	.92882	.91215	.93906	.74273	.96229	.92671
V41	.80330	.91355	.87065	.90063	.74074	.84425	.88014
V42	.96543	.80545	.81391	.83633	.61727	.91783	.83263
V43	.98378	.87318	.87217	.89528	.67297	.95150	.88902
V44	.94904	.88739	.85954	.90152	.68239	.90664	.86841
V45	.96727	.94038	.94084	.95609	.75859	.97903	.95081

	V8	V9	V10	V11	V12	V13	V14
V8	1.00000						
V9	.54858	1.00000					
V10	.87595	.61561	1.00000				
V11	.90732	.69586	.91611	1.00000			

	V8	V9	V10	V11	V12	V13	V14
V12	.96311	.53223	.93642	.90579	1.00000		
V13	.87491	.57836	.97705	.92223	.93640	1.00000	
V14	.90290	.58191	.97640	.91987	.95354	.99205	1.00000
V15	.96899	.52349	.77787	.83714	.89997	.75198	.78984
V16	.84357	.63641	.96127	.90622	.90350	.97275	.97798
V17	.98212	.59485	.85569	.88429	.94063	.82976	.86393
V18	.86361	.57656	.97599	.90481	.92882	.99437	.99231
V19	.89293	.58909	.97520	.90891	.94364	.98634	.99291
V20	.86383	.56780	.97516	.90112	.93022	.99488	.99329
V21	.84497	.69725	.76328	.82828	.83458	.74217	.77247
V22	.67025	.67883	.81114	.83690	.70646	.79620	.78402
V23	.80460	.60090	.93386	.89020	.86343	.94870	.94022
V24	.92552	.58621	.97280	.92538	.96659	.98765	.99619
V25	.96155	.63951	.95410	.95755	.96818	.95848	.96703
V26	.85879	.58856	.97355	.91307	.92492	.99547	.99017
V27	.71929	.37535	.36506	.54196	.56376	.33177	.38183
V28	.86938	.56311	.97484	.90061	.93533	.99498	.99388
V29	.89569	.70318	.87536	.90558	.86918	.84867	.87024
V30	.93203	.62944	.96742	.94146	.95791	.96372	.97585

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1976 CORRELATION MATRIX:

	V8	V9	V10	V11	V12	V13	V14
V31	.93838	.48184	.70240	.78425	.85244	.68898	.73768
V32	.84147	.59359	.97476	.89428	.91392	.99024	.98839
V33	.83428	.33920	.61079	.68509	.73228	.61273	.64621
V34	.51896	.67467	.58014	.64455	.49959	.50894	.52061
V35	.93575	.65038	.82243	.88896	.87653	.78177	.81495
V36	.86243	.46935	.57967	.70373	.74339	.54743	.59772
V37	.94780	.63009	.95924	.93936	.96706	.95618	.97276
V38	.49958	.34145	.49197	.50962	.48166	.46844	.49154
V39	.79515	.77013	.77731	.90883	.75633	.75541	.75495
V40	.94654	.68672	.94508	.96502	.95153	.93707	.95215
V41	.86791	.63944	.72072	.81581	.79735	.68677	.72932
V42	.87026	.55736	.97419	.90007	.93617	.99511	.99371
V43	.91960	.58612	.97259	.91741	.95937	.98258	.99313
V44	.88795	.73153	.92255	.93442	.89521	.91209	.92419
V45	.96438	.60049	.92738	.92844	.96527	.92821	.94900

	V15	V16	V17	V18	V19	V20	V21
V15	1.00000						
V16	.72846	1.00000					
V17	.98558	.81868	1.00000				
V18	.73253	.97325	.81423	1.00000			
V19	.77623	.97090	.85115	.99440	1.00000		
V20	.73223	.97240	.81391	.99958	.99304	1.00000	
V21	.85325	.74726	.87182	.72999	.75771	.72709	1.00000
V22	.56807	.78553	.63605	.80001	.79529	.79238	.66338
V23	.67243	.93230	.75328	.95821	.95343	.95356	.69419
V24	.81991	.96543	.88621	.98865	.99353	.98889	.79111
V25	.88990	.93581	.93876	.94805	.95576	.94798	.83303
V26	.72695	.97281	.80952	.99773	.98780	.99768	.73772
V27	.83827	.30648	.76441	.30392	.37267	.29938	.65207
V28	.74029	.97116	.82056	.99860	.99170	.99943	.73280
V29	.85224	.84466	.89141	.84726	.86916	.84501	.82665
V30	.84807	.95169	.90675	.96310	.97581	.96134	.82027
V31	.97280	.66756	.95280	.67200	.72504	.67177	.82738
V32	.70699	.97683	.79520	.99744	.99037	.99730	.72643
V33	.84625	.57751	.81268	.60027	.63447	.60171	.67887

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1976 CORRELATION MATRIX:

	V15	V16	V17	V18	V19	V20	V21
V34	.52232	.55355	.55892	.50621	.53672	.49413	.65701
V35	.94691	.78309	.95648	.76800	.80934	.76412	.85571
V36	.94111	.52610	.89758	.52451	.58444	.52270	.77563
V37	.87583	.94773	.93315	.95241	.96770	.95162	.84334
V38	.48456	.50471	.51234	.47252	.50783	.46399	.49377
V39	.76341	.74902	.79626	.73906	.75337	.72916	.78696
V40	.88343	.92794	.93475	.92785	.94228	.92644	.85602
V41	.89746	.70687	.90188	.67463	.72511	.66922	.86431
V42	.74105	.97008	.82073	.99821	.99088	.99921	.73018
V43	.81385	.96382	.88107	.98813	.99767	.98711	.78076
V44	.82034	.92923	.88763	.91025	.93207	.90453	.83158
V45	.90477	.90390	.94475	.92077	.94008	.92135	.84802

	V22	V23	V24	V25	V26	V27	V28
V22	1.00000						
V23	.83269	1.00000					
V24	.77953	.93662	1.00000				

	V22	V23	V24	V25	V26	V27	V28
V25	.76364	.89783	.97582	1.00000			
V26	.80300	.95716	.98591	.94985	1.00000		
V27	.28576	.28512	.43038	.54611	.29609	1.00000	
V28	.78565	.94806	.99045	.95134	.99752	.30689	1.00000
V29	.77111	.82218	.88137	.91509	.84679	.56377	.84597
V30	.78633	.92844	.97948	.97333	.95845	.49272	.95978
V31	.52884	.61105	.77269	.82849	.66431	.87949	.68049
V32	.80393	.95654	.98157	.93577	.99575	.26559	.99588
V33	.43228	.53847	.67360	.75689	.59445	.67312	.61003
V34	.67807	.55972	.51557	.55086	.50038	.41752	.48176
V35	.69973	.74327	.83246	.89940	.76150	.75984	.76584
V36	.44962	.48057	.63615	.73441	.51687	.94148	.53108
V37	.76567	.90429	.97914	.98004	.94982	.52776	.95345
V38	.49185	.49905	.49304	.48879	.45597	.37155	.45851
V39	.81927	.77130	.76407	.83047	.74472	.61829	.72337
V40	.81498	.89035	.95810	.97773	.92805	.56809	.92764
V41	.62192	.64574	.75085	.81336	.66747	.78330	.67149
V42	.78328	.94671	.99030	.95172	.99719	.30764	.99993
V43	.78700	.94264	.99705	.96717	.98144	.42952	.98698

	V22	V23	V24	V25	V26	V27	V28
V44	.80422	.89486	.93123	.92872	.90843	.52096	.90194
V45	.75227	.86318	.96146	.96995	.91813	.59446	.92545

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1976 CORRELATION MATRIX:

	V29	V30	V31	V32	V33	V34	V35
V29	1.00000						
V30	.90173	1.00000					
V31	.80194	.79398	1.00000				
V32	.84364	.95625	.64538	1.00000			
V33	.74356	.68198	.81356	.57793	1.00000		
V34	.64154	.62243	.50447	.51562	.43045	1.00000	
V35	.90517	.88109	.90921	.75342	.81918	.68041	1.00000
V36	.73856	.68478	.95668	.49476	.81088	.50538	.89344
V37	.92126	.98068	.82823	.94496	.70987	.57366	.89877
V38	.49048	.52589	.49376	.46863	.42067	.53091	.55267
V39	.82452	.82385	.72329	.72555	.60466	.79251	.85052
V40	.93455	.96984	.83871	.91955	.72085	.64887	.91956
V41	.83563	.81001	.89819	.66302	.75848	.66985	.93214

	V29	V30	V31	V32	V33	V34	V35
V42	.84416	.95896	.68101	.99498	.61144	.47695	.76468
V43	.88155	.98089	.76832	.98141	.66721	.53745	.83579
V44	.89595	.94710	.79474	.90815	.64539	.69834	.87467
V45	.91519	.96054	.87575	.90971	.74603	.56243	.90656

	V36	V37	V38	V39	V40	V41	V42
V36	1.00000						
V37	.71996	1.00000					
V38	.45483	.53881	1.00000				
V39	.70612	.79953	.50512	1.00000			
V40	.74850	.97179	.52535	.88157	1.00000		
V41	.89264	.82721	.56089	.80272	.84318	1.00000	
V42	.53177	.95268	.45594	.72187	.92713	.66930	1.00000
V43	.63429	.97716	.51367	.76524	.95423	.75557	.98643
V44	.69222	.94615	.56500	.86326	.95084	.83657	.89937
V45	.77793	.97206	.50599	.79916	.96930	.84762	.92552

	V43	V44	V45
V43	1.00000		
V44	.93726	1.00000	
V45	.95705	.92282	1.00000

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APPENDIX 7

1991 CORRELATION MATRIX:

	V1	V2	V3	V4	V5	V6	V7
V1	1.00000						
V2	.98833	1.00000					
V3	.62574	.62948	1.00000				
V4	.97165	.97755	.71083	1.00000			
V5	.97649	.97422	.72210	.97405	1.00000		
V6	.97710	.97675	.70173	.97616	.96795	1.00000	
V7	.98740	.99093	.65911	.99008	.98009	.98236	1.00000
V8	.97468	.98387	.56794	.95561	.95171	.97003	.97734
V9	.67558	.69258	.20657	.62781	.65542	.60330	.65815
V10	.94344	.94524	.67261	.96744	.94207	.94753	.95826
V11	.89428	.86402	.55356	.86644	.86107	.83703	.85798
V12	.84113	.83693	.49656	.78654	.82865	.81405	.81402
V13	.85058	.85856	.16451	.77990	.77405	.79336	.83340
V14	.90370	.90872	.28914	.84760	.84181	.86034	.89213
V15	.97708	.98184	.60068	.96097	.95853	.97340	.97724

	V1	V2	V3	V4	V5	V6	V7
V16	.94789	.95083	.39170	.89955	.89655	.91281	.93580
V17	.98622	.99025	.64652	.97903	.97505	.98622	.99010
V18	.86983	.87464	.21010	.80564	.79903	.81475	.85259
V19	.87361	.88057	.21018	.80827	.80115	.82091	.85739
V20	.97459	.97752	.62187	.97016	.95320	.98274	.98337
V21	.85956	.86342	.86938	.91937	.90160	.89070	.88796
V22	.59584	.58137	.66302	.63149	.65937	.56007	.58589
V23	.96310	.96737	.49719	.94300	.92931	.94272	.96129
V24	.96936	.97392	.48354	.94157	.92648	.95343	.96802
V25	.98846	.99145	.63339	.97493	.97499	.98235	.98886
V26	.96641	.96728	.44268	.91988	.92090	.93381	.95363
V27	.93665	.93935	.34856	.88314	.87819	.89690	.92293
V28	.96325	.96917	.47770	.93624	.91933	.95161	.96369
V29	.68031	.68020	.94013	.76768	.74772	.76950	.72066
V30	.93117	.93589	.37927	.87889	.88911	.88384	.91973
V31	.97452	.97794	.69224	.98596	.96917	.98665	.98675
V32	.84424	.85249	.14549	.77304	.76936	.77611	.82638
V33	.73695	.70909	.46505	.70614	.71049	.66273	.70847
V34	.24479	.23121	.08777	.22271	.23026	.19690	.22347

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1991 CORRELATION MATRIX:

	V1	V2	V3	V4	V5	V6	V7
V35	.96377	.96394	.44723	.91531	.92479	.91989	.94654
V36	.98689	.98575	.67989	.98025	.98047	.98523	.98733
V37	.94878	.96300	.44099	.91401	.91725	.92001	.94635
V38	.49470	.50205	.25453	.47675	.47922	.45940	.47945
V39	.95417	.94200	.41021	.88853	.90184	.89819	.92365
V40	.96345	.96083	.45378	.91659	.92382	.92145	.94573
V41	.90450	.90514	.71175	.91217	.93236	.89872	.90700
V42	.86309	.87064	.18851	.79604	.78680	.81196	.84712
V43	.89638	.90296	.30401	.84064	.84135	.83061	.87921
V44	.77951	.77452	.92303	.84754	.82915	.84695	.80807
V45	.93038	.93211	.45525	.90155	.89349	.90437	.92375

	V8	V9	V10	V11	V12	V13	V14
V8	1.00000						
V9	.65388	1.00000					
V10	.92672	.60071	1.00000				
V11	.82159	.60700	.85420	1.00000			

	V8	V9	V10	V11	V12	V13	V14
V12	.85172	.64714	.79400	.78047	1.00000		
V13	.89517	.70027	.77518	.72844	.76452	1.00000	
V14	.93782	.69701	.85622	.76834	.80368	.98573	1.00000
V15	.98965	.64743	.93982	.85882	.87902	.87269	.91914
V16	.97064	.70690	.88897	.82306	.83464	.96610	.98575
V17	.98966	.65270	.95255	.85968	.85013	.84540	.90177
V18	.90831	.70989	.81995	.75256	.78632	.99113	.99352
V19	.91475	.70938	.80576	.74585	.76942	.99519	.99176
V20	.98076	.62527	.95892	.81171	.80145	.84913	.91382
V21	.80509	.52135	.88692	.80226	.70094	.52064	.61660
V22	.50539	.53084	.58613	.71518	.60006	.27945	.33802
V23	.97368	.69688	.92748	.83513	.80127	.90887	.95151
V24	.98708	.68502	.92110	.82189	.80746	.93135	.96586
V25	.99207	.66270	.94592	.85814	.85406	.85477	.90789
V26	.98210	.71046	.89873	.83694	.84850	.95124	.97485
V27	.96251	.70994	.86868	.80953	.81810	.97800	.99026
V28	.98542	.66898	.91497	.80521	.79636	.93061	.96469
V29	.62994	.25946	.72871	.55108	.46566	.24501	.37175
V30	.94660	.74196	.86588	.81727	.84239	.94837	.96404

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1991 CORRELATION MATRIX:

	V8	V9	V10	V11	V12	V13	V14
V31	.96574	.63182	.95738	.83286	.78179	.79140	.86104
V32	.88313	.74296	.76464	.72830	.75430	.99399	.97754
V33	.67929	.52612	.66913	.78480	.61560	.59152	.61306
V34	.21095	.24665	.19745	.26672	.19876	.21206	.20785
V35	.96622	.75883	.89084	.85331	.83565	.93679	.95939
V36	.97347	.65698	.94946	.86426	.81619	.81370	.87507
V37	.97147	.74120	.89991	.81856	.83345	.93869	.96157
V38	.46927	.40181	.47524	.48186	.38289	.42119	.43344
V39	.94496	.74215	.87634	.88733	.85962	.93168	.95167
V40	.96436	.73770	.89926	.87793	.85740	.92982	.95512
V41	.86503	.68736	.87449	.81446	.74608	.66557	.73180
V42	.90771	.69596	.78765	.73332	.75910	.99786	.98741
V43	.90726	.79938	.81290	.79105	.77823	.93087	.93555
V44	.72531	.36008	.80694	.66639	.55305	.37480	.49153
V45	.93603	.69754	.88163	.82637	.77409	.89232	.92158

	V15	V16	V17	V18	V19	V20	V21
V15	1.00000						
V16	.95726	1.00000					
V17	.99145	.94752	1.00000				
V18	.88842	.97349	.86716	1.00000			
V19	.89096	.97590	.87122	.99560	1.00000		
V20	.97286	.94505	.98507	.87568	.87740	1.00000	
V21	.83680	.69592	.86901	.55515	.55417	.84132	1.00000
V22	.56222	.42603	.58355	.31556	.30491	.48618	.74815
V23	.96350	.96945	.96879	.93068	.93350	.97261	.76918
V24	.97370	.98672	.97432	.94305	.94980	.97951	.76434
V25	.98921	.95181	.99712	.87399	.87867	.98175	.85777
V26	.97153	.99300	.96275	.95749	.96188	.95601	.73446
V27	.94823	.99539	.93471	.98125	.98642	.93308	.66865
V28	.96981	.98433	.97011	.94072	.94878	.97941	.75322
V29	.64633	.46819	.70426	.29276	.29867	.71301	.87978
V30	.93736	.97500	.92569	.95611	.95822	.91275	.68294
V31	.96255	.91360	.98510	.81890	.82446	.98653	.88965
V32	.85794	.95883	.83558	.98819	.99253	.83538	.51186
V33	.67759	.67937	.69744	.60638	.60777	.64464	.65113

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1991 CORRELATION MATRIX:

	V15	V16	V17	V18	V19	V20	V21
V34	.21656	.21955	.21481	.21393	.21485	.19165	.19117
V35	.95862	.97926	.95248	.94519	.94989	.93826	.74295
V36	.97576	.92631	.98958	.83708	.84281	.97766	.88558
V37	.95882	.98236	.95483	.94604	.95158	.94266	.73459
V38	.45789	.47439	.48255	.43840	.44085	.46004	.40270
V39	.94294	.97570	.93615	.94355	.94349	.91470	.71800
V40	.96096	.97831	.95442	.93948	.94102	.93672	.75182
V41	.87289	.80600	.90451	.69774	.70224	.87175	.87642
V42	.88425	.97201	.86064	.99086	.99720	.86608	.53881
V43	.88514	.94753	.88687	.94101	.94882	.87305	.62614
V44	.74018	.58929	.79539	.41984	.42652	.79609	.92303
V45	.92778	.94095	.92709	.90285	.90885	.92368	.73621

	V22	V23	V24	V25	V26	V27	V28
V22	1.00000						
V23	.49755	1.00000					
V24	.44854	.98568	1.00000				

	V22	V23	V24	V25	V26	V27	V28
V25	.58566	.96844	.97545	1.00000			
V26	.47219	.97624	.98986	.96953	1.00000		
V27	.40726	.96728	.98415	.94030	.99170	1.00000	
V28	.41992	.98296	.99914	.97082	.98658	.98204	1.00000
V29	.55329	.58709	.57625	.68673	.51120	.42889	.57686
V30	.46338	.94935	.95771	.93187	.97535	.97337	.95193
V31	.56407	.95561	.95651	.97989	.92911	.89516	.95456
V32	.30550	.90463	.92244	.84628	.94296	.97174	.91991
V33	.63745	.65791	.66670	.71801	.68887	.65737	.64703
V34	.29670	.22467	.21357	.22267	.22758	.22193	.20503
V35	.53689	.96989	.97589	.96020	.98859	.98022	.96905
V36	.60794	.95689	.96016	.98813	.94692	.91269	.95500
V37	.47837	.96507	.97745	.96017	.98334	.97774	.97378
V38	.34996	.48161	.47423	.49199	.47737	.46335	.46783
V39	.53038	.94846	.95755	.94269	.97699	.97057	.94831
V40	.53925	.96598	.97042	.96048	.98413	.97366	.96363
V41	.69447	.85230	.84072	.90089	.83077	.78159	.82977
V42	.28423	.92179	.94440	.86880	.95772	.98430	.94458
V43	.45777	.93013	.93247	.89428	.94345	.95226	.92577

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1991 CORRELATION MATRIX:

	V22	V23	V24	V25	V26	V27	V28
V44	.60971	.68871	.68248	.77944	.62465	.55106	.68005
V45	.47168	.94184	.94897	.92948	.94428	.93905	.94590

	V29	V30	V31	V32	V33	V34	V35
V29	1.00000						
V30	.43565	1.00000					
V31	.77912	.88718	1.00000				
V32	.22897	.95110	.78420	1.00000			
V33	.42356	.69286	.66917	.60627	1.00000		
V34	.10175	.28699	.22192	.23718	.22919	1.00000	
V35	.50056	.97194	.91794	.93609	.70963	.25315	1.00000
V36	.73542	.90949	.98548	.80615	.71171	.22288	.94853
V37	.51003	.97561	.92388	.93760	.67789	.22206	.97855
V38	.30878	.50574	.48728	.44245	.48993	.14132	.50490
V39	.46292	.97476	.89684	.93261	.74340	.30246	.97832
V40	.51052	.96940	.92055	.92662	.71126	.30088	.98562
V41	.74934	.82530	.91578	.67910	.69889	.23764	.85389

	V29	V30	V31	V32	V33	V34	V35
V42	.27841	.94880	.81145	.99234	.59411	.20963	.94286
V43	.38643	.96159	.85483	.95322	.68873	.26985	.94871
V44	.98097	.55745	.85806	.36279	.53062	.12934	.61900
V45	.53528	.92220	.90701	.88941	.65568	.23298	.94284

	V36	V37	V38	V39	V40	V41	V42
V36	1.00000						
V37	.93786	1.00000					
V38	.49566	.52495	1.00000				
V39	.92320	.96409	.50713	1.00000			
V40	.94187	.97364	.49682	.98734	1.00000		
V41	.92554	.84812	.53669	.83817	.84623	1.00000	
V42	.83071	.94485	.42748	.93429	.93446	.68076	1.00000
V43	.87037	.95254	.53278	.95166	.93625	.80672	.93580
V44	.82402	.62252	.37122	.59373	.62498	.82912	.40641
V45	.91811	.93852	.46654	.92840	.95168	.82170	.90224

	V43	V44	V45
V43	1.00000		
V44	.51735	1.00000	
V45	.90164	.63424	1.00000

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APPENDIX 8

UNROTATED FACTOR LOADINGS IN 1967

VAR	FACTOR1	FACTOR2	FACTOR3
1	0.589	0.431	0.146
2	0.568	0.793	0.151
3	0.555	0.811	0.081
4	0.717	0.656	0.145
5	0.686	0.688	0.117
6	0.847	0.499	0.128
7	0.631	0.748	0.159
8	0.687	0.705	0.071
9	0.316	0.213	0.104
10	0.878	0.332	0.147
11	0.671	0.58	0.202
12	0.761	0.634	0.034
13	0.941	0.273	0.103
14	0.931	0.315	0.121
15	0.545	0.813	0.091
16	0.906	0.303	0.166
17	0.471	0.853	0.107
18	0.941	0.285	0.101
19	0.838	0.448	0.128
20	0.941	0.287	0.098
21	0.442	0.597	0.325
22	0.668	0.166	0.242
23	0.752	0.175	0.138
24	0.862	0.471	0.097
25	0.873	0.419	0.151
26	0.951	0.256	0.103
27	-0.021	0.966	0.068
28	0.951	0.259	0.093
29	0.707	0.521	0.295
30	0.691	0.586	0.191
31	0.601	0.743	0.153
32	0.951	0.237	0.126
33	0.389	0.714	-0.012
34	0.224	0.471	0.241
35	0.455	0.783	0.248
36	0.13	0.978	0.03
37	0.82	0.495	0.162
38	0.301	0.282	0.081
39	0.864	0.403	0.18
40	0.861	0.417	0.142
41	0.332	0.813	0.105
42	0.958	0.238	0.091
43	0.893	0.425	0.067
44	0.739	0.254	0.411
45	0.669	0.687	0.086

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APPENDIX 9

UNROTATED FACTOR LOADINGS IN 1976

VAR	FACTOR1	FACTOR2	FACTOR3
1	0.822	0.468	0.253
2	0.559	0.785	0.208
3	0.583	0.791	0.113
4	0.605	0.754	0.184
5	0.391	0.669	0.146
6	0.732	0.655	0.14
7	0.604	0.774	0.144
8	0.657	0.725	0.128
9	0.383	0.262	0.857
10	0.877	0.349	0.227
11	0.728	0.485	0.358
12	0.783	0.579	0.096
13	0.919	0.319	0.171
14	0.898	0.378	0.162
15	0.477	0.851	0.141
16	0.889	0.289	0.249
17	0.581	0.771	0.195
18	0.932	0.292	0.171
19	0.901	0.359	0.175
20	0.935	0.292	0.157
21	0.491	0.622	0.396
22	0.677	0.181	0.466
23	0.883	0.231	0.246
24	0.881	0.427	0.159
25	0.791	0.539	0.231
26	0.932	0.284	0.186
27	-0.015	0.964	0.161
28	0.933	0.306	0.147
29	0.643	0.542	0.371
30	0.818	0.469	0.233
31	0.405	0.886	0.111
32	0.936	0.254	0.196
33	0.364	0.726	0.031
34	0.273	0.281	0.635
35	0.502	0.734	0.321
36	0.217	0.941	0.169
37	0.797	0.519	0.214
38	0.312	0.302	0.163
39	0.503	0.489	0.572
40	0.746	0.539	0.315
41	0.389	0.751	0.343
42	0.934	0.307	0.141
43	0.877	0.419	0.164
44	0.732	0.466	0.387
45	0.748	0.595	0.187

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APPENDIX 10

UNROTATED FACTOR LOADING IN 1991

VAR	FACTOR1	FACTOR2	FACTOR3
1	0.759	0.577	0.127
2	0.769	0.579	0.113
3	0.041	0.963	0.129
4	0.682	0.681	0.145
5	0.671	0.665	0.166
6	0.709	0.676	0.066
7	0.744	0.624	0.107
8	0.829	0.518	0.084
9	0.593	0.162	0.196
10	0.685	0.643	0.121
11	0.613	0.474	0.351
12	0.684	0.383	0.286
13	0.978	0.108	0.052
14	0.954	0.239	0.045
15	0.798	0.545	0.149
16	0.913	0.341	0.069
17	0.762	0.603	0.124
18	0.965	0.155	0.061
19	0.971	0.159	0.044
20	0.782	0.605	0.019
21	0.389	0.849	0.213
22	0.122	0.551	0.701
23	0.849	0.464	0.109
24	0.874	0.453	0.044
25	0.771	0.583	0.128
26	0.891	0.388	0.102
27	0.933	0.298	0.086
28	0.879	0.452	0.018
29	0.137	0.981	-0.032
30	0.881	0.311	0.091
31	0.703	0.679	0.051
32	0.966	0.088	0.072
33	0.459	0.353	0.204
34	0.146	0.061	0.068
35	0.864	0.381	0.168
36	0.721	0.639	0.121
37	0.871	0.385	0.094
38	0.331	0.216	0.069
39	0.852	0.341	0.143
40	0.853	0.389	0.151
41	0.539	0.671	0.159
42	0.977	0.139	0.043
43	0.867	0.248	0.108
44	0.261	0.949	0.018
45	0.828	0.415	0.088

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NOTES ON APPENDIXES 11 TO 13: LIST [CODES] OF CENTRAL PLACES.

1. ABEOKUTA	31. AKINMORIN	61. ILESHA	91. AYE
2. ADO-ODO	32. EDUNABON	62. IMESI-ILE	92.AIYETORO-EKITI
3. AIYETORO	33. EDE	63. IJEBUJESHA	93. ARIGIDI
4. AJILETE	34. ERUWA	64. IGBOHO	94. EFFON
5. AGO-IWOYE	35. ESA-OKE	65. IGBETI	95. EMURE
6. IJEBU-ODE	36. EJIGBO	66. ISEHIN	96.IDDOEKITI
7. IJEBU-IGBO	37. ERINOSUN	67. IGANNA	97. IFAKI
8. IKENNE	38. FIDITI	68. ILERO	98.IGBARA-ODO
9. IPERU	39. GBOGAN	69. ILORA	99.IGBARA-OKE
10. ISHARA	40. IBADAN	70. IBALA	100. IJERO
11. IFO	41. IGANGAN	71. LAGUN	101. IKORO
12. IGBESSA	42. IGBOORA	72. LANLATE	102. IPOTI
13. ILARO	43. IFETEDO	73. OTAN-ILE	103. IKOLE
14 IMEKO	44. IKOYI	74. OYAN	104.ISEEKITI
15. OTTA	45. IREE	75. OKEAGBO	105. IRE
16. SAGAMU	46. IRESSI	76. OGBOMOSHO	106.IJAWAROGBO
17. ODOGBOLU	47. IGBAJO	77. OSHOGBO	107. ILUTITUN
18. ODEREMO	48. IKIRUN	78. OMIFUNFUN	108. IRELE
19.OWODE-EGBADO	49. IRAGBIJI	79.OSHU	109.IJARE
20. OGBERE	50. ILEOGBO	80. OYO	110.LARAMOKIN
21. OWODE-EGBA	51. IWO	81. LALUPON	111. IDANRE
22. ODEDA	52. INISHA	82. OKUKU	112.ILELUJI
23. ABIGI	53. IFON	83. SAKI	113. IPELE
24. LAGOS	54. ILOBU	84. KISI	114. IFON
25. EPE	55. ERINMO	85. OKEOLA	115. IKARE
26. IKORODU	56. OKEHO	86. IKIRE	116. ISHUA
27. BADAGRY	57. SEKONA	87. IPETU-IJESHA	117. OGOTUN
28. APOMU	58. ILE-IFE	88. AKURE	118. OKEMESI
29. AWE	59. IPETUMODU	89. ADO-EKITI	119. OTUN
30. AJAWA	60. ILLA	90. ARAMOKO	120.O'PUPA

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122. OKEIGBO	127. OMUO	132. IKERE	
123. OWO	128. GOGO	133. IGBOKODA	
124. OKEAGBE	129. UYIN	134. IGEDE	
125. OGBAGI	130. ORE	135. OYE	

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APPENDIX 11

SCORES OF THE CENTRAL PLACES ON THE THREE DIMENSIONS IN 1967

CENTER CODE	FACTOR1	FACTOR2	FACTOR3
1	-0.845	0.283	3.256
2	-0.007	-0.126	-0.243
3	-0.061	-0.152	-0.304
4	0.019	-0.185	-0.238
5	-0.091	-0.131	-0.251
6	-0.974	0.083	6.372
7	-0.477	-0.073	1.051
8	-0.058	-0.122	0.445
9	-0.023	-0.198	-0.305
10	0.023	-0.202	-0.248
11	-0.014	-0.111	-0.249
12	0.023	-0.202	-0.248
13	0.028	-0.104	-0.267
14	0.011	-0.167	-0.239
15	0.081	-0.135	-0.274
16	-0.119	-0.114	-0.375
17	-0.038	-0.127	-0.301
18	-0.067	-0.343	-0.249
19	-0.008	-0.29	-0.246
20	-0.017	-0.119	-0.244
21	-0.01	-0.136	-0.242
22	-0.021	-0.118	-0.243
23	0.008	-0.166	-0.239
24	11.119	2.641	1.063
25	-0.101	0.044	-0.441
26	0.071	-0.008	-0.267
27	-0.052	-0.063	0.733
28	-0.006	-0.157	-0.305
29	-0.019	-0.111	-0.248
30	-0.025	-0.106	-0.244
31	-0.015	-0.136	-0.246
32	0.055	-0.071	-0.242
33	-0.065	0.058	-0.272
34	-0.096	-0.089	-0.252
35	0.006	-0.192	-0.253
36	-0.019	0.004	-0.297
37	-0.043	-0.071	-0.237
38	-0.018	-0.117	-0.344
39	-0.035	-0.056	-0.249
40	-2.609	11.085	-1.229
41	0.016	-0.155	-0.238
42	-0.064	-0.061	-0.298
43	0.057	-0.075	-0.244
44	0.064	-0.088	-0.246
45	-0.024	-0.103	-0.247

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APPENDIX 11 CONTD.

CODE	FACTOR1	FACTOR2	FACTOR3
46	0.015	-0.181	-0.242
47	0.001	-0.122	-0.247
48	-0.082	0.172	-0.364
49	-0.129	-0.086	-0.249
50	-0.052	-0.159	-0.296
51	-0.231	0.118	-0.275
52	-0.024	-0.128	-0.249
53	0.049	-0.261	-0.247
54	-0.027	-0.108	-0.247
55	0.019	-0.185	-0.238
56	0.001	-0.093	-0.251
57	0.014	-0.185	-0.241
58	-0.076	0.496	-0.091
59	-0.018	-0.093	-0.248
60	-0.011	-0.079	-0.249
61	-0.031	0.654	-0.421
62	-0.011	-0.125	-0.244
63	-0.028	-0.103	-0.248
64	-0.018	-0.121	-0.248
65	-0.015	-0.136	-0.246
66	-0.019	0.223	-0.251
67	-0.198	-0.294	-0.248
68	0.059	-0.089	-0.242
69	0.055	-0.099	-0.245
70	0.054	-0.261	-0.243
71	0.054	-0.261	-0.243
72	0.052	-0.076	-0.246
73	-0.014	-0.147	-0.245
74	-0.031	-0.145	0.241
75	0.054	-0.261	-0.243
76	-0.214	0.377	2.594
77	-0.423	0.833	6.918
78	0.049	-0.261	-0.247
79	-0.031	-0.101	-0.247
80	-0.192	0.277	3.134
81	0.046	-0.239	-0.247
82	-0.032	-0.101	-0.247
83	-0.049	-0.117	-0.271
84	-0.023	-0.119	-0.247
85	0.117	-0.201	-0.242
86	-0.063	-0.056	0.225
87	-0.293	-0.106	-0.044
88	-0.655	-0.114	1.853
89	-0.292	-0.604	1.734
90	-0.022	-0.108	-0.244

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APPENDIX 11 CONTD.

CODE	FACTOR1	FACTOR2	FACTOR3
91	0.117	-0.201	-0.242
92	-0.069	-0.123	-0.414
93	-0.104	-0.302	-0.251
94	-0.158	-0.126	-0.421
95	-0.446	-0.409	0.011
96	-0.008	-0.058	-0.296
97	0.012	-0.155	-0.249
98	-0.012	-0.116	-0.243
99	-0.011	-0.126	-0.243
100	0.023	-0.102	-0.257
101	0.023	-0.202	-0.248
102	-0.011	-0.126	-0.243
103	-0.381	-0.215	-0.072
104	-0.081	-0.332	-0.247
105	0.087	-0.151	-0.246
106	0.117	-0.201	-0.242
107	-0.011	-0.136	-0.242
108	-0.018	-0.197	-0.288
109	0.077	-0.151	-0.248
110	0.053	-0.076	-0.241
111	-0.133	0.033	-0.425
112	-0.195	-0.203	-0.299
113	0.017	-0.176	-0.249
114	-0.163	-0.269	0.241
115	-0.125	-0.008	0.162
116	0.015	-0.171	-0.239
117	-0.013	-0.111	-0.243
118	-0.017	-0.109	-0.243
119	0.026	-0.043	-0.244
120	-0.003	-0.099	0.244
121	-0.481	-0.167	0.043
122	-0.031	-0.086	-0.245
123	-0.242	0.112	0.441
124	0.023	-0.202	0.248
125	0.042	-0.068	-0.242
126	-0.161	-0.197	-0.254
127	0.016	-0.016	-0.251
128	0.117	-0.201	-0.242
129	0.036	-0.094	-0.236
130	0.057	-0.107	-0.244
131	0.046	-0.069	-0.242
132	-0.193	-0.139	0.162
133	0.066	-0.111	0.241
134	0.003	-0.156	0.251
135	-0.021	-0.118	0.243
136	-0.088	-0.124	0.248

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APPENDIX 12
SCORES OF THE CENTRAL PLACES ON THE THREE DIMENSIONS IN 1976

CENTER CODE	FACTOR1	FACTOR2	FACTOR3
1	-0.955	0.196	4.108
2	0.042	-0.157	-0.294
3	-0.063	-0.195	-0.198
4	0.026	-0.181	-0.382
5	0.087	-0.091	-0.171
6	-0.911	0.068	5.271
7	-0.504	-0.041	1.508
8	-0.039	-0.079	0.457
9	0.028	-0.168	0.003
10	0.031	-0.184	-0.267
11	0.041	-0.167	-0.393
12	0.031	-0.183	-0.266
13	-0.131	-0.239	-0.293
14	0.029	-0.156	-0.311
15	-0.065	-0.271	0.062
16	-0.366	-0.237	0.115
17	-0.071	-0.151	0.165
18	0.004	-0.231	-0.393
19	0.055	-0.214	-0.392
20	0.027	-0.176	-0.302
21	0.052	-0.156	-0.298
22	0.031	-0.147	-0.316
23	0.034	-0.166	-0.417
24	11.021	2.812	1.721
25	0.053	0.043	-0.254
26	-0.031	-0.211	-0.128
27	-0.153	-0.087	1.001
28	0.017	-0.103	-0.681
29	-0.011	-0.244	-0.337
30	0.038	-0.113	-0.405
31	0.047	-0.144	-0.313
32	0.082	-0.033	-0.592
33	-0.031	0.074	-0.382
34	-0.015	-0.081	-0.434
35	-0.006	-0.102	0.022
36	-0.121	-0.098	-0.308
37	0.069	-0.116	-0.345
38	-0.045	-0.134	-0.238
39	0.089	0.029	-0.526
40	-2.674	11.011	-1.383
41	0.054	-0.159	-0.406
42	-0.256	-0.215	0.319
43	0.031	-0.131	-0.441
44	-0.027	-0.136	-0.506
45	0.089	-0.026	-0.577

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APPENDIX 12 CONTD.

CODE	FACTOR1	FACTOR2	FACTOR3
46	0.057	-0.145	-0.386
47	0.024	-0.134	-0.506
48	0.016	0.312	-0.451
49	-0.088	-0.088	-0.213
50	0.017	-0.123	-0.162
51	-0.226	-0.071	-0.482
52	0.057	-0.117	-0.571
53	0.026	-0.178	-0.395
54	0.021	-0.131	-0.334
55	0.037	-0.158	-0.446
56	-0.096	-0.168	-0.323
57	0.047	-0.15	-0.427
58	-1.085	0.631	0.265
59	0.063	-0.001	-0.442
60	-0.085	-0.148	0.079
61	-0.311	0.857	-0.091
62	0.053	-0.142	-0.211
63	0.034	0.007	-0.446
64	0.021	-0.153	-0.271
65	0.085	-0.123	-0.181
66	-0.011	0.131	-0.127
67	0.026	-0.163	-0.438
68	-0.001	-0.168	-0.361
69	-0.009	-0.138	-0.275
70	-0.034	-0.202	-0.369
71	-0.034	-0.202	-0.369
72	0.084	-0.126	-0.496
73	0.039	-0.119	-0.341
74	0.013	-0.182	-0.351
75	0.034	-0.202	-0.369
76	-0.213	0.506	2.057
77	-0.562	0.873	4.411
78	0.031	-0.191	-0.382
79	0.001	-0.139	-0.272
80	-0.454	0.173	3.045
81	0.065	-0.173	-0.35
82	0.065	-0.112	-0.473
83	-0.164	-0.084	-0.311
84	0.024	-0.153	-0.318
85	0.027	-0.197	-0.341
86	-0.101	0.179	-0.189
87	-0.011	-0.024	-0.233
88	-0.828	0.039	4.358
89	-0.678	-0.315	2.784
90	-0.063	-0.217	-0.297

UNIVERSITY OF IBADAN LIBRARY

APPENDIX 12 CONTD.

CODE	FACTOR1	FACTOR2	FACTOR3
91	0.027	-0.197	-0.341
92	0.049	-0.169	-0.371
93	-0.009	-0.243	-0.361
94	0.006	-0.189	-0.362
95	-0.144	-0.296	-0.185
96	-0.053	-0.164	-0.184
97	0.041	-0.128	-0.121
98	0.008	-0.157	-0.311
99	0.008	-0.157	-0.309
100	-0.078	-0.187	0.344
101	0.031	-0.183	-0.266
102	0.052	-0.155	-0.298
103	-0.231	-0.251	0.736
104	-0.041	-0.347	-0.567
105	0.021	-0.161	-0.135
106	0.027	-0.197	-0.341
107	0.022	-0.163	-0.281
108	0.008	-0.193	-0.306
109	-0.025	-0.162	-0.151
110	0.041	-0.132	-0.168
111	-0.032	-0.146	-0.187
112	-0.004	-0.148	-0.332
113	0.032	-0.182	-0.264
114	0.046	-0.191	-0.411
115	-0.136	0.076	0.123
116	0.056	-0.174	-0.401
117	0.052	-0.151	-0.304
118	0.078	-0.124	-0.405
119	-0.021	-0.144	-0.299
120	-0.114	-0.126	0.718
121	-0.601	0.256	2.023
122	0.043	-0.155	-0.343
123	-0.408	-0.077	1.216
124	0.031	-0.183	-0.266
125	-0.007	-0.149	-0.268
126	-0.051	-0.159	-0.381
127	0.036	-0.063	0.026
128	0.027	-0.198	-0.341
129	0.057	-0.149	-0.106
130	0.027	-0.124	-0.469
131	0.021	-0.152	-0.283
132	-0.381	-0.342	0.541
133	0.062	-0.126	-0.322
134	0.031	-0.132	-0.469
135	0.053	-0.118	-0.444
136	-0.007	-0.158	-0.371

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APPENDIX 13

SCORES OF CENTRAL PLACES ON THE THREE DIMENSIONS IN 1991

CENTER CODE	FACTOR1	FACTOR2	FACTOR3
1	-0.921	-0.008	2.097
2	-0.001	-0.111	-0.335
3	-0.061	-0.142	-0.204
4	0.001	-0.153	-0.251
5	-0.292	-0.326	-0.269
6	-0.749	0.365	-0.183
7	-0.732	-0.111	-1.767
8	-0.072	-0.147	-0.343
9	0.041	-0.113	-0.441
10	0.019	-0.158	-0.121
11	-0.156	-0.178	-0.268
12	0.035	-0.153	-0.036
13	-0.355	-0.157	-1.137
14	0.013	-0.099	-0.444
15	0.251	-0.037	-0.593
16	0.345	0.057	-0.243
17	-0.161	-0.284	-0.519
18	-0.006	-0.211	-0.056
19	-0.123	-0.148	-0.441
20	0.047	-0.151	-0.127
21	-0.101	-0.227	0.186
22	0.013	-0.141	-0.297
23	-0.011	-0.136	-0.286
24	11.391	0.833	0.557
25	-0.146	0.086	-0.771
26	0.171	0.461	0.037
27	0.179	-0.008	0.511
28	-0.031	-0.157	0.113
29	0.002	-0.156	0.241
30	0.028	-0.165	-0.025
31	0.002	-0.149	-0.188
32	-0.037	-0.132	-0.426
33	-0.175	0.102	-0.587
34	-0.126	-0.043	-0.694
35	-0.024	-0.167	-0.245
36	-0.036	0.008	-0.311
37	0.044	-0.164	0.107
38	-0.041	-0.117	-0.118
39	-0.089	-0.095	-0.481
40	-0.806	11.403	-0.837
41	-0.005	-0.128	-0.343
42	-0.002	-0.073	-0.094
43	-0.039	-0.143	-0.288
44	-0.145	-0.155	-0.864
45	-0.049	-0.175	-0.355

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APPENDIX 13 CONTD.

CODE	FACTOR1	FACTOR2	FACTOR3
46	0.015	-0.161	-0.263
47	-0.041	-0.155	-0.233
48	0.001	0.264	-0.641
49	-0.054	-0.142	-0.257
50	-0.054	-0.158	-0.405
51	-0.233	0.076	-0.077
52	0.046	-0.131	0.558
53	-0.028	-0.179	-0.351
54	0.021	-0.152	-0.124
55	0.001	-0.177	-0.168
56	-0.079	-0.125	-0.565
57	0.019	-0.165	-0.167
58	-0.481	0.046	-0.401
59	-0.001	-0.126	-0.143
60	-0.028	-0.006	-0.322
61	0.067	0.418	2.118
62	0.051	-0.151	0.162
63	-0.001	-0.086	-0.055
64	-0.181	-0.181	-0.727
65	-0.129	-0.136	-0.175
66	-0.141	0.143	-0.885
67	-0.001	-0.206	-0.027
68	-0.004	-0.137	-0.208
69	-0.042	-0.151	-0.167
70	0.025	-0.171	-0.085
71	0.025	-0.171	-0.085
72	-0.019	-0.148	-0.336
73	-0.086	-0.153	-0.531
74	-0.059	-0.146	-0.414
75	0.025	-0.171	-0.085
76	-0.267	0.493	2.206
77	-0.172	0.318	5.465
78	-0.001	-0.174	-0.218
79	-0.064	-0.101	-0.395
80	-0.157	0.493	-0.264
81	-0.046	-0.161	-0.481
82	0.011	-0.096	-0.283
83	-0.292	-0.208	-0.247
84	-0.141	-0.084	-0.812
85	0.031	-0.143	-0.077
86	-0.048	-0.175	0.043
87	-0.034	-0.103	-0.323
88	-0.658	0.171	1.339
89	-0.713	0.462	4.511
90	0.019	-0.101	0.099

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APPENDIX 13 CONTD.

CODE	FACTOR1	FACTOR2	FACTOR3
91	0.001	-0.163	-0.147
92	0.007	-0.149	-0.206
93	-0.009	-0.188	-0.032
94	-0.081	-0.181	0.002
95	-0.024	-0.215	0.116
96	-0.081	-0.101	-0.675
97	-0.075	-0.166	-0.435
98	-0.041	-0.132	-0.333
99	-0.008	-0.134	-0.225
100	-0.264	-0.213	-1.169
101	-0.049	-0.162	-0.431
102	-0.012	-0.142	-0.186
103	-0.036	-0.098	-0.191
104	-0.156	-0.167	-0.405
105	-0.017	-0.159	-0.083
106	0.001	-0.163	-0.147
107	0.029	-0.103	-0.043
108	-0.021	-0.141	0.001
109	-0.037	-0.151	-0.234
110	-0.027	-0.137	-0.299
111	0.029	-0.172	1.135
112	-0.392	0.041	-1.167
113	0.001	-0.171	-0.071
114	0.013	-0.196	0.062
115	-0.112	-0.084	2.689
116	0.047	-0.149	0.133
117	0.031	-0.121	-0.149
118	-0.001	-0.145	-0.059
119	0.011	-0.153	0.022
120	-0.185	-0.047	0.854
121	-0.431	0.226	4.979
122	-0.049	-0.143	-0.209
123	-0.121	-0.076	4.252
124	-0.001	-0.171	-0.077
125	0.007	-0.144	-0.181
126	-0.173	-0.088	-0.535
127	-0.082	-0.076	-0.457
128	-0.006	-0.159	-0.247
129	-0.039	-0.174	-0.189
130	-0.031	0.014	-0.031
131	0.074	-0.137	0.016
132	-0.251	-0.147	-0.511
133	-0.268	-0.019	-0.776
134	0.012	-0.197	0.327
135	-0.011	-0.182	0.069
136	0.112	-0.179	0.848

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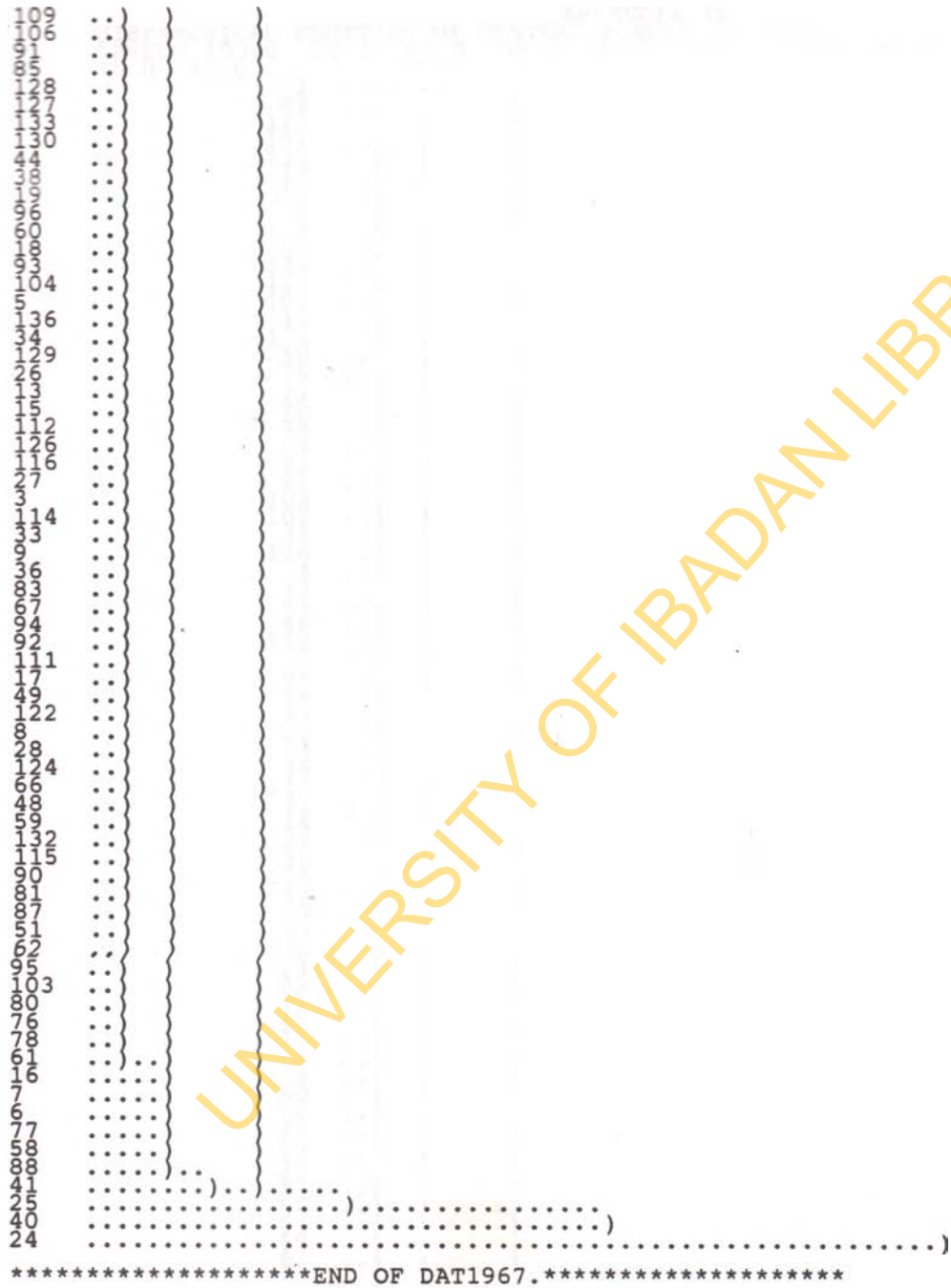
APPENDIX 14

HIERARCHICAL CLUSTERS OF CENTRAL PLACES IN 1967.

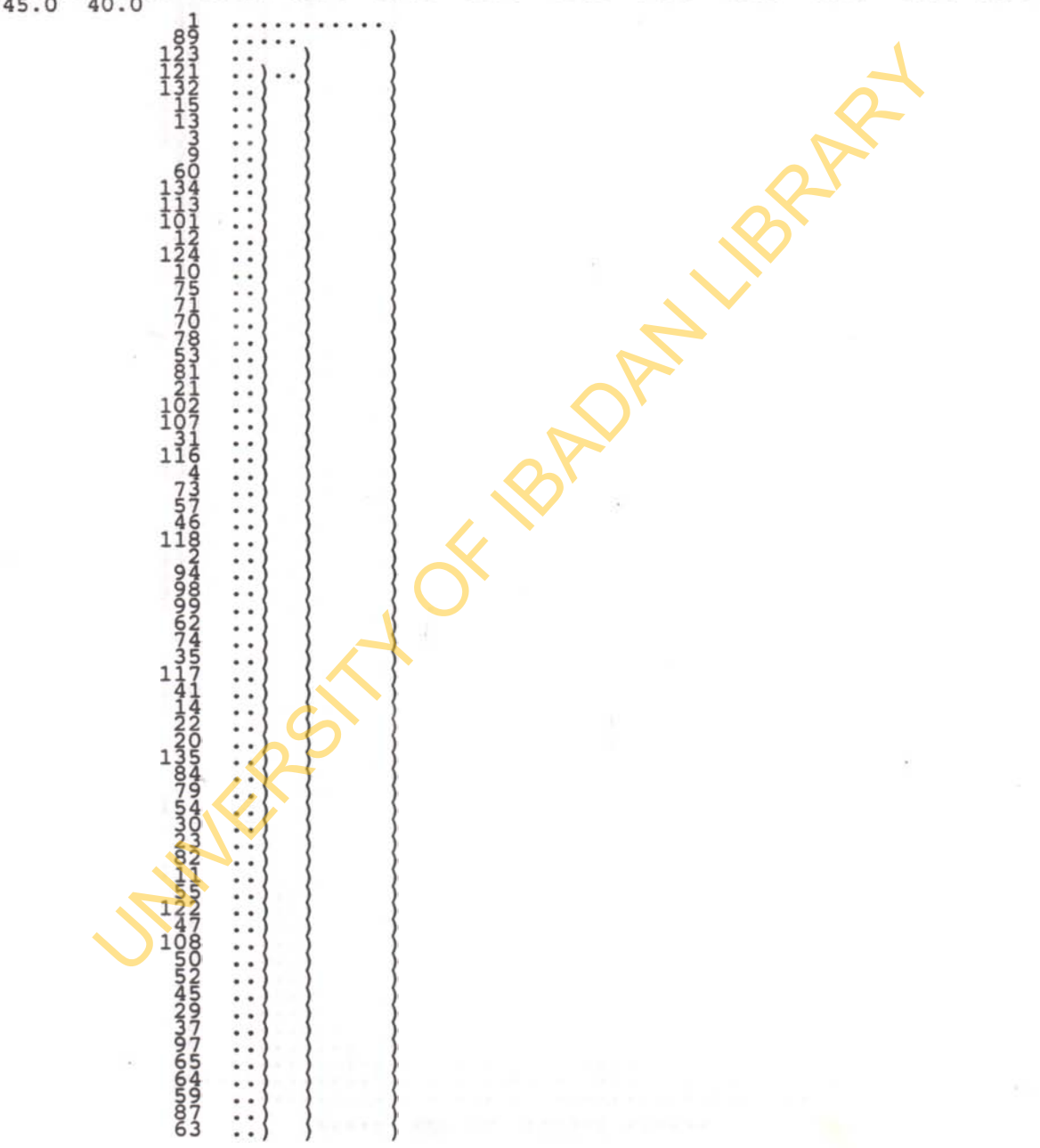
UNIVERSITY OF IBADAN LIBRARY



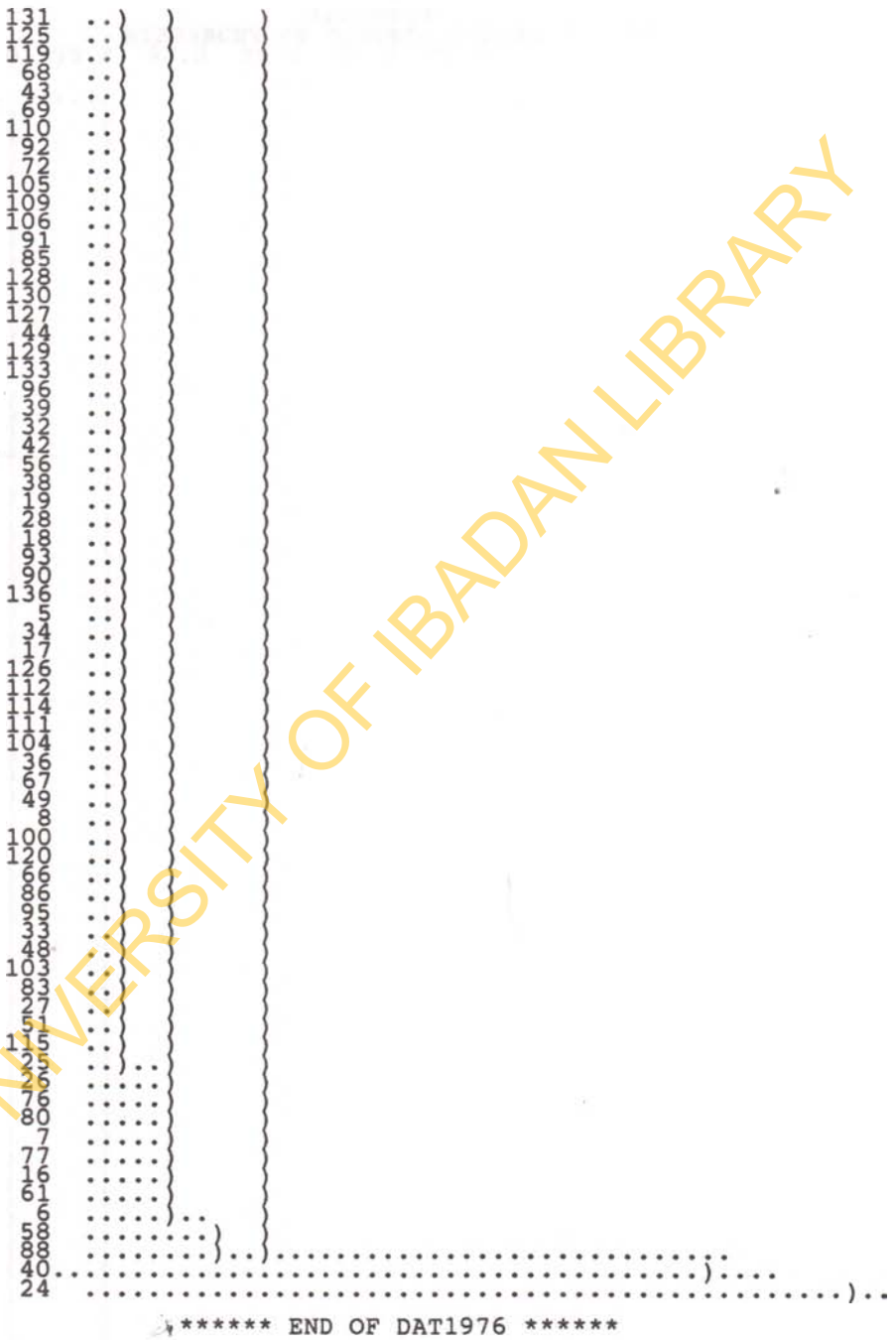
UNIVERSITY OF IBADAN LIBRARY

APPENDIX 15

HIERARCHICAL CLUSTERS OF CENTRAL PLACES IN 1976

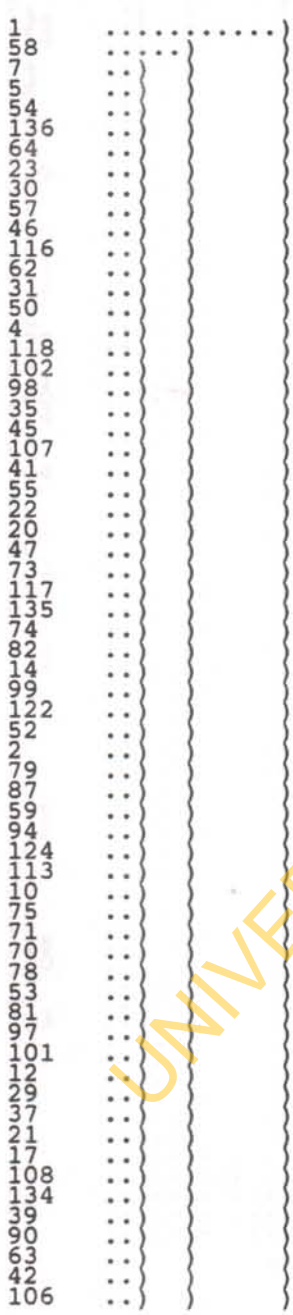


UNIVERSITY OF IBADAN LIBRARY

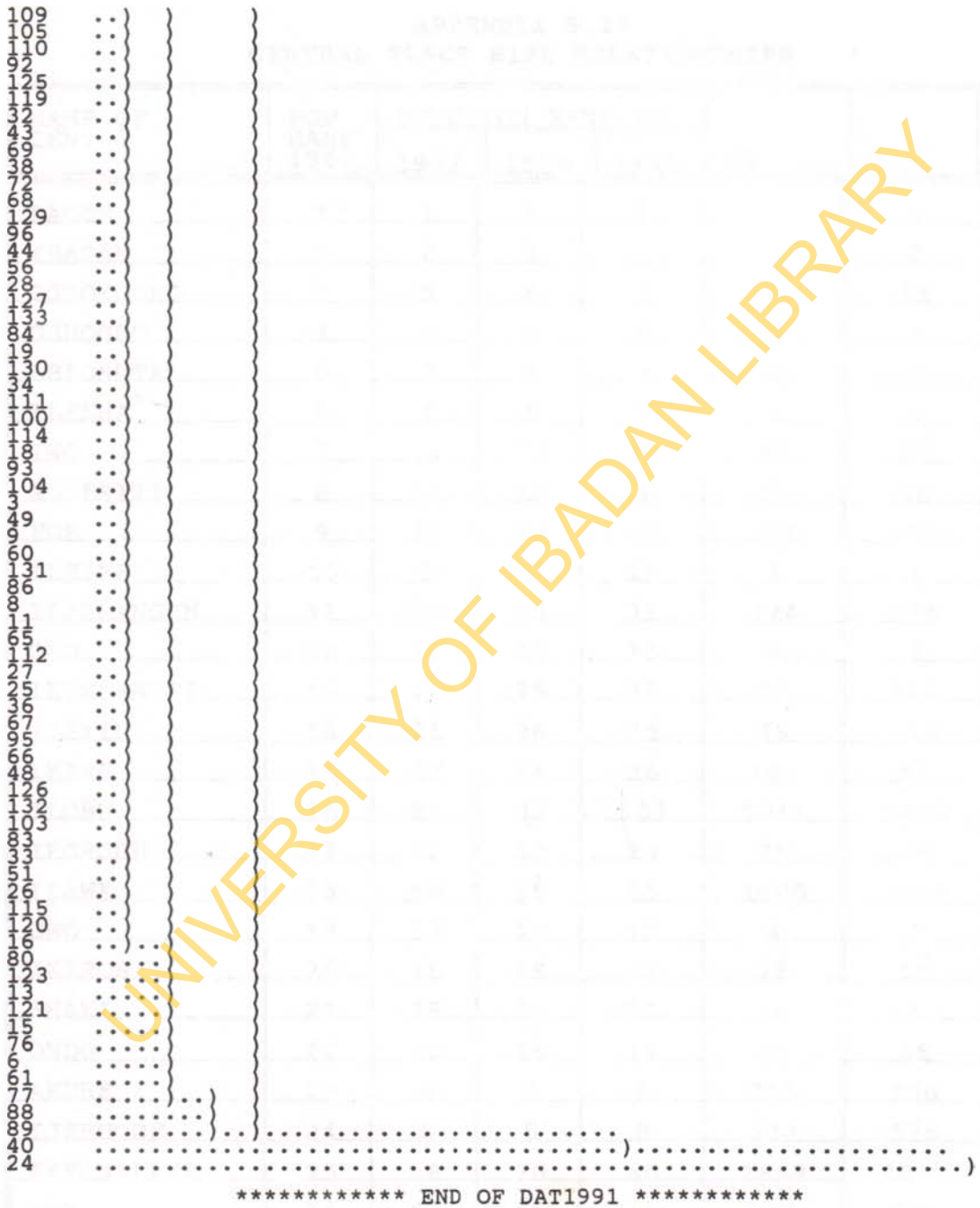


UNIVERSITY OF IBADAN LIBRARY

APPENDIX 16
HIERARCHY OF CENTRAL PLACES IN 1991



UNIVERSITY OF IBADAN LIBRARY



********** END OF DAT1991 **********

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APPENDIX 5.14
CENTRAL PLACE SIZE RELATIONSHIPS

NAME OF CENTER	POP RANK 1963	FUNCTION RANK IN			$D67^2$	$D76^2$	$D91^2$
		1967	1976	1991			
LAGOS	1	1	1	1	0	0	0
IBADAN	2	2	2	2	0	0	0
OGBOMOSHO	3	5	8	9	4	25	36
OSHOGBO	4	4	4	5	0	0	1
ABEOKUTA	5	3	3	3	4	4	4
ILESHA	6	7	6	7	1	0	1
IWO	7	14	15	20	49	64	169
ADOEKITI	8	11	12	4	9	16	16
EDE	9	20	19	19	121	100	100
ILEIFE	10	9	9	10	1	1	0
ILAORANGUN	11	29	29	32	324	324	441
OYO	12	10	10	15	4	4	9
IKEREEKITI	13	22	25	29	81	144	256
ISEYIN	14	21	26	26	49	144	144
IKIRE	15	27	24	36	144	81	441
ILOBU	16	87	90	103	5041	5474	7569
IKORODU	17	22	13	13	25	16	16
ILAWE	18	58	65	65	1600	2209	2209
OWO	19	17	17	12	4	4	49
IKIRUN	20	16	18	21	16	14	1
SHAKI	21	18	20	24	9	1	9
ONDO	22	15	16	11	49	36	121
AKURE	23	8	7	6	225	256	289
IJEBUODE	24	6	5	8	324	576	256
EFFONALAYE	25	68	70	80	1849	2025	3025
OKA	26	53	55	31	721	841	25

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IKARE	27	24	22	18	9	25	81
INISHA	28	50	44	76	484	256	2304
SHAGAMU	29	12	11	16	289	324	169
IGBOHO	30	72	77	57	1764	2209	729
EJIGBO	31	28	27	27	9	16	16
ISEEKITI	32	81	54	58	2401	484	676
AJAWA	33	99	107	125	4356	5476	8464
ILEOGBO	34	92	91	93	3364	3249	3481
EPE	35	19	21	22	256	196	169
IJEBUIGBO	36	13	14	17	529	484	361
KISI	37	87	99	44	2500	3844	49
IJERO	38	37	45	47	1	49	81
IRAGBIJI	39	41	40	63	4	1	576
IKOLE	40	32	33	38	64	49	4
IGBOORA	41	36	35	49	25	36	64
IFON[OYO]	42	45	73	89	9	961	2209
OKEHO	43	33	37	45	100	36	4
ERINOSHUN	44	105	104	119	3721	3844	5625
EMURE	45	57	57	72	144	144	729
IGEDE	46	81	80	93	1225	1296	2209
LALUPON	47	87	75	125	1600	784	6084
IDANRE	48	61	48	40	169	0	64
OKEMESI	49	68	80	108	361	961	3481
GBOGAN	50	35	36	51	225	196	1
IPOTI	51	104	113	72	2809	3844	441
ILERO	52	92	98	91	1600	2116	1521
OYAN	53	52	62	96	1	81	1849
APOMU	54	41	39	68	169	225	196
FIDITI	55	61	59	62	36	16	49
ERUWA	56	47	45	43	81	121	169

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ARAMOKO	57	99	77	46	1764	400	121
IGBARAODO	58	99	91	76	1681	1089	324
IGBETI	59	96	86	55	1369	729	16
ILUTITUN	60	111	102	87	2601	1764	729
UYIN EKITI	61	78	83	90	289	484	841
OTAN ILE	62	99	100	78	1369	1444	256
OKUKU	63	68	75	112	25	144	2401
OMUO	64	50	45	35	196	361	841
OTUN EKITI	65	55	91	108	100	676	1849
ILARAMOKIN	66	111	104	102	2025	1444	1296
ILORA	67	81	91	96	196	576	841
IJARE	68	81	96	122	169	784	2916
IPETU-IJESHA	69	30	31	48	1521	1600	441
ILARO	70	34	38	25	1296	1024	2925
ISHARA	71	117	126	121	2126	3025	2500
ILEOLUJI	72	65	51	30	49	441	1764
GOGO	73	130	133	129	3249	3600	3136
IREE	74	65	61	84	81	169	100
AAWE	75	46	52	98	841	529	529
IFAKI	76	65	67	103	121	169	729
IGBAJO	77	47	53	66	900	576	121
IGANNA	78	72	71	103	36	49	625
OKITIPUPA	79	26	28	23	2809	2601	3136
AIYETORO ONDO	80	123	119	117	1849	1521	1369
IKORO	81	117	119	101	1296	1444	400
IPERU	82	61	56	51	441	676	961
OGOTUN	83	87	86	82	16	9	1
IREEKITI	84	123	107	118	1521	529	1156
IPETUMODU	85	43	42	51	1764	1849	1156
IKOYI	86	71	60	64	225	676	900

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IRELE	87	117	83	69	900	16	324
LANLATE	88	56	49	87	1024	1521	1
AIYETORO	89	47	49	50	1764	1936	1521
AYEEKITI	90	130	130	117	1600	1600	729
AGOIWOYE	91	44	43	42	2209	2304	2401
OTA	92	31	30	14	3721	3844	6084
IJEBUIJESHA	93	39	34	28	2916	3481	4225
IGBARAOKE	94	104	86	74	100	64	400
IFONEKITI	95	123	119	128	784	576	1089
OYE	96	104	104	103	64	64	81
ESAOKE	97	81	86	101	256	441	16
OGBAGI	98	111	103	72	169	25	256
IGBESSA	99	117	119	116	324	400	289
OKEIGBO	100	58	73	70	1764	729	600
IFO	101	75	62	37	676	1521	3969
OKEAGBE	102	117	125	124	225	529	484
IGANGAN	103	111	91	92	64	144	169
SEKONA	104	111	109	57	49	25	2209
IRESSI	105	92	85	114	169	400	81
EDUNABON	106	81	69	74	625	1369	1024
ARIGIDI	107	104	113	112	9	36	25
ODOGBOLU	108	39	41	59	4761	4489	2401
ISHUA	109	78	126	119	961	289	100
IMESIILE	110	77	62	78	1089	2304	1024
IKENNE	111	38	32	41	5329	6241	4900
IFETEDO	112	53	65	82	3481	2209	900
IGBOKODA	113	96	77	38	289	1296	5625
OKEOLA	114	130	130	80	256	256	1156
BADAGRY	115	25	23	32	8100	8464	6889
ODEREMO	116	87	96	84	841	400	1024

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IPELE	117	61	109	122	3136	64	25
IDOEKITI	118	58	67	63	3600	2601	3025
IMEKO	119	117	109	86	4	100	1089
ADOODO	120	78	71	58	1764	2401	3844
LAGUN	121	130	133	134	81	144	169
IBALA	122	130	133	134	64	121	144
AKINMORIN	123	96	113	114	729	100	121
OSU	124	75	80	54	2401	1936	4900
OWENA	125	104	119	133	441	36	64
AJILETE	126	128	113	107	4	169	361
ERINMO	127	128	113	55	1	196	5184
AROGBO	128	130	130	129	4	4	1
OKEAGBO	129	130	123	134	1	16	25
OWODEEGBA	130	111	118	71	361	361	3481
OWODEEGBADO	131	92	100	61	1521	961	4900
OMIFUNFUN	132	123	128	132	81	16	0
ORE	133	72	57	34	3721	5776	9801
ABIGI	134	123	128	110	121	36	576
OGBERE	135	99	109	98	1296	676	1369
ODEDA	136	104	119	100	1024	289	1296

1. $\sum D67^2 = 135,756$
2. $\sum D76^2 = 137,030$
3. $\sum D91^2 = 182,742$

$$rs = 1 - \frac{6\sum d_i^2}{n^3 - n}$$

In 1967,
rs = 1- 0.3238
rs = 0.68

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$$rs = 1 - \frac{814536}{2515320}$$

2. In 1976,

$$rs = 1 - \frac{822180}{2515320}$$

rs = 1 - 0.3268
rs = 0.67

3. In 1991

$$rs = 1 - \frac{1096452}{2515320}$$

rs = 1 - 0.4359
rs = 0.56

SIGNIFICANCE TEST

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

In 1967,

$$t = \frac{0.68\sqrt{136-2}}{\sqrt{1-0.682}}$$

$$t = \frac{7.872}{0.733}$$

t in 1967 = 10.739

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In 1976

$$t=\frac{0.67\sqrt{136.2}}{\sqrt{1-0.67^2}}$$

$$t=\frac{7.872}{0.742}$$

t = 10.61

In 1991

$$t=\frac{0.56\sqrt{136-2}}{\sqrt{1-0.56^2}}$$

$$t=\frac{6.482}{0.828}$$

t = 7.83

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