THE DEVELOPMENT OF THE NIGERIAN PORTS

1970 - 1982

by

ISAAC OLADIPO FALOWO

A Thesis presented for the Degree of Doctor of Philosophy
in the Department of Geography, Faculty of Social Sciences,
University of Glasgow.

Glasgow University

Glasgow

November 1986

ACKNOWLEDGEMENTS

The assistance of many individuals and organisations both in Nigeria and the United Kingdom who in one way or the other, have made the production of this thesis possible, is gratefully acknowledged. Although the list of these individuals and organisations is too long, the following deserve special mention and thanks:

Special thanks go to my two supervisors, Dr. Arthur Morris and Dr. John Briggs for their academic stimulation, inspiration and encouragement. My thanks also go to Dr. Ross Robinson of the University of Wollongong, Australia, for his valuable advice and support especially during the formative stages of the research. I am equally indebted to Dr.Alan Findlay for his willingness to help at all times.

In Nigeria, organisations and individuals that deserve thanks include the Nigerian Ports Authority, the various Shipping and Cargo Agents based in Lagos; the Department of Geography, University of Ife, Nigeria. Special mention is made of the assistance of Mr. Adedeji Adelabu of the University of Ife Central Library.

In the U.K., the assistance of Mr. K.C. Walls of the UKWAL Secretariat at Liverpool is much appreciated especially in his role as a liaison between myself and the member organisations of the UKWAL. The assistance of Mr. Amajo, the Lines Manager of the Nigerian National Shipping Line Based in Liverpool is kindly appreciated.

I would also like to acknowledge the unflinching support and cooperation which I received from my wife and my children.

Finally, I would like to thank the Directorate of Army Training, Nigerian Army for its three years of financial support.

CONTENTS

LIST OF TABLES

Page

Page

LIST OF FIGURES

SUMMARY

The decade, 1970 - 1980 witnessed rapid transformation in both political and economic terms, and the transmutations in spatial relationships which resulted from the transformations have revealed the inadequacies in Nigeria's seaport system. Because of the important role which seaports are thought to play in the development of the regions in which they are located, port development has been used as a planning tool, hence the link between port development programmes and National Development Plans, especially during the period 1962 - 1982. Although port development programmes during this period have been implemented on the basis of some official guide-lines or principles, it is doubtful whether one can speak of a definite comprehensive national policy on seaport development. Of the four National Development Plans that attempted to tackle the problem of seaport development, only the third and the fourth, made specific references to ports and these focused on solving the endemic port congestion problem that faced the major Nigerian ports.

The problems of congestion, from which Nigerian ports suffered during the 1970s, and the current problems of under-utilization of port facilities at almost all ports, derive, in part, from the failure of post-independence planning to predict the prospective shape of the country's economy. Forecasting the needs for port facilities across a range of national ports is, undoubtedly a difficult task because it involves not only changes in the national economy, but also in associated external economies. The improvement and development of the regional port system which results from such forecasts is a lengthy process which imposes heavy constraints on the relatively scarce financial and human resources. It involves

careful planning and analysis where the emphasis in development is not seen in 'one-off' project terms, but rather as a flexible, rolling development over many years.

One important problem of practical national significance that arises from the emerging structure of the Nigerian port system is that of evolving a coordinated and rational order of ports. Rationality in this context is interpreted in terms of a coordinated development that does not lead to wastage by duplication of facilities, and where the ports function at minimum total costs to the economy, the Ports Authority and the various port customers. Unfortunately, Nigerian ports have not met these criteria of rationality; and certainly not, with the deliberate policy of over-investment that was enunciated at the beginning of the port development plan, and the consequences of over-provision, duplication and under-utilization of facilities at almost all Nigerian Ports. Nor do the operational inefficiences manifested in long delays to vessels and land transport at the Lagos ports, meet these criteria of rationality.

The decision-making process in port development plays a significant role in shaping the pattern of port development in Nigeria. Three aspects of the decision-making process that appear to be in operation are: the nature of the decision itself, the organisations involved in the decision, and the scale of the decision. Because of the manpower and technological constraints in initiating and executing port projects in developing countries, most are dependent on foreign agencies and governments for aid. In such situations, port planning continues to be guided by foreign consulting bodies which in many cases recommend large-scale projects to be carried out by engineering companies based in the donor countries. It naturally follows that the acquisition of facilities through such foreign-aid packages, will tend to obscure the long-term economic dangers of over investment, duplication and consequently, under-utilization. The same consequences result from the increasing concentration of decision-making process in Port Authorities, especially where decisions to provide facilities at either old or new locations are influenced by political judgements rather than by sound economic principles.

Scale is a crucial factor in port development. Two planning scales that are usually considered in port planning are the static and the dynamic. In the static perspective, planning is essentially a rationalisation of port operations to ensure operational efficiency. An optimal use of facilities in the short-run is a necesary pre-condition for long-term efficiency. The performance of the Lagos ports does not show a rationalisation of operations to ensure this type of efficiency that would be a short-term substitute for the long-term expansion of facilities. In the dynamic perspective, port planning seeks to expand infrastructural capacity sequentially over time in an optimal fashion, so that some ports do not become bottle-necks to the detriment of the whole system. The study shows that Nigeria's port development has always consisted largely of facility planning whereby single facilities have been built at ports to meet some urgent needs.

Under situations of increasing concentration of decision-making (especially in the provision of port facilities) in Public Authorities, the crucial role of the primary users of the ports in port choice is given inadequate emphasis. This situation has resulted in port-owners providing expensive facilities at locations where they are not being adequately used. A knowledge of the business expectations of the shipping and cargo interests is vital to the estimation of the future pattern of port demand.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The role of transport facilities as stimuli to economic development especially in the developing countries has been recognised in the literature (Kraft et al, 1971). What is true of transport in general is also true of seaports in particular. It has been demonstrated that insufficient investment in port equipment and facilities can lead to direct and indirect losses in trade and investment (Ogundana, 1978; Taylor, 1984). This is certainly true of most African countries whose external trade is orientated overwhelmingly towards overseas countries, partly as a result of the long period of colonial dependence, and partly because of a marked similarity of resource endowment which makes many of them competitors for overseas markets rather than natural trading partners. Throughout Africa, therefore, the provision of port facilities has been a necessary precondition of modern economic growth; and the stage of economic development reached in a given part of Africa, is in considerable measure, a function of the capacity and degree of sophistication of the port facilities available (Hilling, 1970; Hoyle, 1970).

In the light of the above, it is clear that inadequate seaport capacity, which directly leads to the interruption of the flow of foreign trade could have drastic repercussions on the other sectors of the economy. The critical significance of port facilities for the overall performance of the Nigerian economy was demonstrated by the congestion in Nigerian ports during the mid 1970s. During 1975 alone, Nigeria lost well over N300 million in demurrage payments to ships, surcharges of freight rates, and the cost of delays to cargoes and inland transport (Ogundana, 1978).

Unfortunately, and in spite of the importance of seaports in the economy of the country, port development policy in general has not been well articulated in the country. Ports merited only a passing reference in the 1965 Statement on Transport Policy (Federation of Nigeria, 1965). The Second National Development Plan (1970) stressed the need for greater coordination among the various transport modes, but this was spelt out largely in terms of the traditional rail - road problem. The Third National Development Plan (1975), as it related to port development was aimed at creating excess port facilities at all Nigerian ports as a means of avoiding the expensive and frustrating delays experienced at the major Nigerian ports (Gowon, 1975). As a result of this policy of excess capacity, the size of the port component of the Third National Development Plan, initially estimated to cost about N418 million expanded to N1,043 million without any due regard to the amount of traffic that would be attracted to these ports. Such investment policy during the study period was unprecedented in the history of seaport development in Nigeria (1970-1982). Although the investment was by no means evenly distributed among the ports, nevertheless, every port had its own share of the huge investment.

Having regard to the huge investment involved and the resulting trade that was attracted to these ports, it is of great interest to the public and especially to the port planning authorities to know the success of the development (investment) policy and to question whether the policy has fulfilled its promises. The results of such policy monitoring and evaluation, it is hoped, may guide the future action of the planning authorities.

The rationale for the study stems from the above considerations, and more especially from the apparent contradictions which have resulted from the investment policy, notably that after the massive investments in the port system, some ports were not being used sufficiently and those that were being used, were still experiencing delays and congestion, inspite of the fact that they were operating under capacity. In the analysis of these apparent contradictions, the study attempts to investigate the performance of the port system in the light of the international trade that is attracted to and handled at these ports during the study period.

1.2 Conceptual Background

Port Studies in General

During the past three decades or so, many studies have been conducted in port geography in general (Bird, 1957; Morgan, 1958), and in the area of spatial relations of seaports in particular (Weigend, 1956; Elliot, 1969). However, the recent appearance of many studies dealing with specialised aspects of ports marks the continuation of a trend towards port analysis from an increasing number of viewpoints (Robinson, 1976; Chu, 1978; Bird, 1982).

Reviewing the derivative nature of the evolution of transport geography in general, Rimmer (1978) has identified four phases in the development of studies in transport geography, these being the 'descriptive'. the 'interaction, quantification and prediction', the 'behavioural' and the 'redirection' stages. Bird (1980, 1984) has gone on to categorize the corresponding seaport study approaches that have emerged in the literature in the context of the phases recognised by Rimmer. Important among these include:

(i) The historico-genetic approach which embraces studies with hinterland and foreland emphasis; for example Weigend (1956), Bird (1963), Elliot (1969), Hoyle (1968) and Hilling (1969).

(ii) the economic approach which emphasises the distinction between sea-ports as transport nodes and seaport terminals as locations for inductries often based on bulk imports. Included in this category of approach are studies relating to investment appraisal of port development; for example Goss (1967), Gilman (1977).

(iii) The ports and regional development approach which emphasises the links between seaport development and the development of the hinterland. The approach emphasises the crital role of the seaport as a permissive or restrictive factor in regional development of the hinterland. Examples are: Taaffe at al (1963), Hilling (1966), Hoyle and Pinder (1981).

(iv) The future orientation approach which is oriented to decision-making; it involves studies of characteristics and behaviour of the port which could aid development decisions at the port; examples are: Shaffer (1965), Portbury (1966), Bird and Pollock (1978) amd Chu (1978).

Whilst Bird's approaches may be said to represent a fair classification of the types of seaport studies that have appeared in the literature, it is worth noting that these divisions are not mutually exclusive. The earlier approaches, represented by the historico-genetic approach in seaport development studies have much in common with descriptive geography, with the emphasis being placed on the recording of facts about the site and situation of visible seaport features. Students of seaports who practised in this field of approach concentrated on genetic forms of explanation - a kind of past-to-present causality approach in which the present is seen as emanating from past decisions and previous functioning (Robinson, 1976).

It is not altogether surprising that this kind of 'informed inventory' approach was emphasised at this time. The study of port geography like its parent, transportation geography, has passed through two major phases of approach: the morphological and the systematic/functional approaches. The bulk of what was transportation geography before the 1950s was morphological in approach, which fell under the general rubric of description. Positivist research workers who practised along these lines restricted themselves to describing how things are, and how they will develop if they continue on the same track. To the positivist research workers, 'the ultimate aim in geographical studies of transportation is the description and explanation of the phenomenon as a feature of the earth's surface' (Eliot Hurst, 1974a, p.15) This conclusion thus implies that the functional aspects of transportation modes were completely neglected.

The positivist trend was extended to port studies where the major inadequacy with this trend is that relatively little attention is paid to the functional relationships between the various factors, natural or manmade, which condition the supply and demand of port facilities. Instead, interest is focused mainly on the description of harbours and on cartographic presentation of individual port's trading statistics to explain traffic largely in terms of the size and character of the hinterlands. Furthermore, these approaches have not attempted to establish a relationship between the morphology and the operational characteristics of the port, the complex linkages between the systems inputs and system elements operating within the port system. In other words, the problem of operational interdependencies, of the relationships between elements in the morphology, and the capacity and efficiency (which might be a logical focus of morphological studies) have been left virtually untouched (Robinson, 1976).

1.3 Modelling Approach

Because the traditional geographer's approach was inadequate in fully describing the spatial relations of a seaport, attention was focused on the issue of theoretical approaches especially as they related to port planning problems. Many studies, therefore, made attempts to model port development. Bird's 'Anyport' model was one of the first studies to appear in the literature. In his study of British sea and river ports, the pattern of port location was crystallised in a six stage model, starting with the primitive stage, through the stage of marginal quay extension etc. (Bird, 1963). This attempt constituted a good description of the process of evolution of the installations and physical layout of a port. However, a major limitation is that whilst the model focuses on the actual port area, insufficient attention was paid to the hinterland which the port serves, to the forelands served by ships, nor indeed to the development of shipping itself.

Another pioneering study in seaport modelling was Rimmer's attempt to investigate the differential size of ports within a model framework formulated on the basis of a search for regularities in the spatial patterns of port location (Rimmer, 1976a). This model was first developed and applied to New Zealand ports. In a later study, the model was refined to enable its use in the Australian context (Rimmer, 1967b). Six phases in the development of a regional port system were identified, starting with the first phase of scattered pattern of equidistant ports and ending with the fifth and sixth phases of the development of specialist and primitive ports respectively.

Rimmer's model has the advantage over that of Bird, of paying adequate attention to developments in both hinterland and the organisation of maritime space in the formulation of the model. However, there are a number of flaws in Rimmer's model. The most obvious being the attempt to explain the fifth phase of the development of a specialist port. His explanation tends to be related more to the capacity limitations of the existing ports than to the dynamic requirements of shipping. Whilst the model tries to strike a balance between interdependent landward and maritime factors, the role that is assigned to shipping in the model appears to be minimal. It is widely recognised that technological designs of shipping which have involved changes in size, shape and specialisation of ports, has always been the principal pacemaker in sea transport developments. Shipping, therefore, would be seen as the generator of changes in port concentration and consequently the initiator of changes in the hierarchical structuring of ports. In the words of Hoyle:

> 'the gateway (port) must be selected, designed and adapted to accomodate the ocean carrier, not vice-versa, and in this sense, it is the maritime perspective that is predominant' (Hoyle, 1983, p.5)

The modelling approaches described above could at best suggest a useful classification for studying and comparing the evolutionary pattern of different ports, or group of ports, without answering the critical question of how heavy the use of port facilities needs to be before a port evolves from one stage to another. On the question of the relationship between the port and the hinterland, the models may be able to give an intimation of the idea that a larger port would have a larger hinterland and vice-versa. However, when it comes to the problem of overlapping port hinterlands and the amount of traffic generated per unit area, these models may not be able to give an acceptable answer, because it will be difficult to calculate each port's share of the overlapping hinterland. Furthermore, the effect of containerisation with its associated concept of through transport, has further weakened the usefulness of the traditional concept of the hinterland, in the sense that hinterlands are no longer discrete. Within a regional port grouping, the hinterland of Port A may possibly be part of the foreland of Port B (Gilman, 1976; Mayer, 1973; and Hayuth, 1982). Indeed, mutually exclusive hinterlands are no longer true of most seaports in the developed countries of Europe and America, especially in areas of general cargo. The establishment of through-distribution networks and landbridges, set up by container haulage companies, has changed this concept. The models and forecasts of future traffic of a seaport made under the assumption of discrete hinterlands are no longer true for these developed countries, and indeed for some developing countries that have adopted container technology.

1.4 Use of Queuing Models

Queuing models are another body of models employed in the study of ports. Queuing models have been employed to deal with stochastic processes of queue or waiting line formations, and are applied to problems arising from the need to adjust capacity to changing patterns of demands. Queuing analysis in port studies has been concerned with questions of the optimum number of berths that should be provided at a port, the probability of congestion in the port given a certain number of berths, and the cost of delays in a port, given a certain number of berths (Fratar et al, 1960; Mettam, 1967; White, 1972; Gooneratne and Buckley, 1970). Some of these studies , such as Plumlee and Nicolaou (1966), attempt to trade off ship idle time and berth idle time to define the optimum number of berths. Eddison and Owen (1953) use a method based on the minimisation of the costs of total annual ship time in port against investment costs.

Queuing models are essentially partial equilibrium models and are restricted by assumptions which may in some cases adversely affect their applicability. For example, queuing models are restricted by assumptions about ship arrival distributions, service and queuing times distributions; some of these are approximated by mathematical distributions (e.g. Poisson and Erlang distributions) which in some cases may not accord to reality. Apart from this, there is the problem of determining the level of congestion; in most cases arbitrary levels are chosen. One other problem relates to the assumptions about interchangeability of berths. With increasing specialisation of shipping at berths which directly leads to a subset of berths within a port system functioning as an operational unit, this assumption appears inadequate. In the light of this, it would appear that queuing model is appropriate when a ship discharges once only at a berth (Robinson and Tognetts, 1973).

1.5 Systems Conception of the Port

Dissatisfaction with the morphological approach to transportation studies and the need for such studies to have some theoretical orientation led to an emphasis on systematic/functional approach. Hay (1973) describes the aim of this approach as a study which provides '... a systematic framework for the description, analysis and explanation of the spatial patterns in transport phenomena' (Hay, 1973, p.3). The systems approach which was first advocated by Colley (1894), looks at the generality of transport system as being functional and interrelated; functions connoting linkages, connections and interrelationships within transport structures.

When the systems conception is applied to port studies, a port may be conceptualised as an operational system within an interacting system of ports, transport axes and traffic-generating activities. The port provides services to both land and maritime organisations - land trucks and ocean vessels. Commodities of international trade move to and are drawn from hinterland origins along port-linked routes and networks to the exporting port, from where they are assembled for shipment and then move across maritime space to the importing port before ulitmately radiating individually through port-linked routes to the cargo destinations.

Once the port is conceptionalised as an operational system, scale obviously becomes an important factor in defining the system boundaries as well as the characteristics of the port system. For the spatial analysis of ports, Robinson (1976) has recognised five system scales:

(i) The intra-port single element system in which the physical limits of the port represent the system boundaries.

(ii) The port-hinterland system which is represented by the 'classical' hinterland study in geographical literature.

(iii) The two-element port system which comprises the shipping network which links two ports A and B together with the land-based linkages.

(iv) The regional port system which includes ports along a section of coastline, in which there are interport shipping linkages which may suggest interdependence within the port system.

(v) The much larger port system which comprises a total interactive port system in which all linkages land and sea exist.

Elliot (1969), still addressing the issue of system scale in the spatial analysis of ports, has suggested that port analysis should be within the dimension of the total interactive port system which should involve not only the study of port's transport hinterland, but also of their forelands. However, such foreland-hinterland conceptualisation may become inadequate in view of changing maritime technology. Hayuth (1982) has amply demonstrated that both forelands and hinterlands may be discontinuous, and this suggestion has led to the modification of this concept from that of the 'classical port triptych' (i.e. hinterland, port, maritime transport) to the 'extended triptych' (i.e. hinterland of port A, port A, maritime transport, port B, hinterland of port B) with the latter (hinterland of port B) possibly being part of the foreland of port A (Bird, 1983).

The whole process of international trade from the hinterland through the port to the foreland is concerned with the linkages and flows that comprise a transportation network, with centres or nodes connected by sea and by land linkages, and the entire system of hinterlands and forelands associated with the network. The focus within such studies is on the centres or nodes, especially their size, function and accesibility to the rest of the network (Robinson, 1968). The focus is also on studies of the structures of dominance and competition among the nodes within each network of linkages and flows. Linkages and nodes may be organised into systems of hinterlands and/or forelands in a variety of ways. There will be those linkages which are most clearly associated with a node. There will also be a system of hinterlands and/or forelands which will include a number of nodes each with its set of strongest linkages (Robinson, 1968).

Closely linked with the above are the concepts of the dynamics of port system and the dominant port. The former concept, although very recent in the literature, is fast gaining ground (Ogundana, 1970; Zalenski, 1972; and Robinson, 1976). Under this concept, ports are seen not to operate in discrete independence, but in webs of operational relationships whereby like water ripples, happenings in one are bound to affect the others, either on the local, regional, national or international scale. The concept of the dominant port implies the concentration and polarisation of port activities in selected ports (nodes), a phenomenon which is thought to be the result of interport competitive struggle within a system of ports.

The node (port) within the interactive system of ports is a focus of attention. Elliot (1969) has identified and described three significant factors which influence the operational character and status of this port node in its traditional role as a terminal point within the interactive port system. These are:

(i) The range and vigour of economic activities ocurring at tide water and inland location. This would include factors like the export base and the domestic market effects which determine the economic dynamism of the port's hinterland as a source of exports and as a market for imports. Port industrialisation is also significant in influencing port status.

(ii) The trade and traffic of the aggregate of domestic and overseas ports with which the port is interrelated. This factor is what Sun and Bunamo (1973) describe as the trading partner effect, and relates to the orientation of a particular port to its foreign trading blocs. If a port located within a regional system of ports is favourably located in relation to a growing external market, that port will have an advantage over other ports within the regional grouping.

(iii) The organisation of the maritime transport which provides the intervening link between port and foreland areas. This will be reflected in the quality and frequency of shipping services that link the port with the foreland areas.

Weigend (1958), on the other hand, has recognised six elements that influence the choice of a port from the hinterland point of view, namely the port, the carrier, the cargo, the hinterland, the foreland and the maritime space. Robinson (1976), has also recognised that operational capacity and efficiency of ports at the level of the total interactive port system are related to the individual port's maritime linkages, as well as the routing of inland flows and the attainment of optimal patterns of maritime shipping linkages in the system. The emphasis of Elliot (1969), Weigend (1968) and Robinson (1976) could be broadly classified into two levels: Elliot's 'range and vigour of economic activities', and Weigend's 'the port, the cargo and the carrier' are of intra-port significance; whilst Elliot's 'aggregate trade and traffic' and 'organisation of maritime transport', and Weigend's 'hinterland-maritime-space-foreland' factors, and Robinson's 'routeing of inland flows and shippage linkages' are of inter-port concerns.

The factors suggested by these writers have not included any decision-making elements. The issue of decision-making in port studies is relavant because it seeks to discover patterns, regularities or principles in the way people and organisations actually make decisions involving spatial effects, in given situations. The nature of the decision-maker, the decision itself, the goals or values, the state of knowledge and the aspirations of the decision-maker, are very important and could, in fact, sometimes be more important in determining the status and characteristics of the individual ports within a system of ports, than the physical elements of that port system.

Various studies have demonstrated the role which port users can play in the spatial structuring of port operations. Preston and Rees (1971) have discussed the role of consignees in structuring port costs, and Smith (1980) has drawn attention to the role of shipping companies in structuring container traffic at Nigerian ports. Both studies have demonstrated the importance of adaptiveness and entrepreneurship in the process of containerisation in the ports of Hongkong and Lagos, and have thus suggested the importance of the role of the decision-makers in the rapid and successful containerisation of break-bulk traffic at the two ports. Therefore, an effective analysis of port development should take into consideration the part played by the decision-making elements in the port system. In this regard, the principal decision-making elements in the port system include the Government and/or the Ports Authority and the primary port customers (i.e. the shipping companies, the transport agencies and the shippers and consignees). The Port Authority, the shipping lines and other transport agents are, theoretically, agents to execute their clients' orders. However, these organisations may affect the system by their decisions on whether or not to provide or offer particular services, or by providing and offering different types of services. Since it is the function of a port to serve port users, the facilities of the port must be capable of providing the users with services at a level and cost that the port user will accept or tolerate. If, however, the port users are not willing to pay for the services that they are offered, or the services provided are not at locations which are profitable to the port users, the system will stop functioning.

1.6 Port Studies in Nigeria

Not many studies have been done on seaport analysis in Nigeria. The earlier studies used the same concepts and methodologies as those studies carried out in Europe, Australia and New Zealand, and were mainly confined to studies relating to port location and the configuration and pattern of evolution of the Nigerian ports (Ogundana, 1970, 1971 and 1972). The emphasis in these studies was on testing of the descriptive models of Bird (1963) and Rimmer (1967). The inadequacies in terms of concept and methods, which characterised these models, were similarly exhibited in these Nigerian studies. Most of these studies focus on the harbour-hinterland descriptive framework. For example, Ogundana (1972) attempted to describe the evolution of Nigerian ports using Bird's

(1963) and Pounds (1947) descriptive models. He, however, concluded that neither of these two models satisfactorily explained the shifting location of Nigerian seaports from the interior to the coast. Equally, the same historical perspectives were used in a comparative study of the changes in the character and functions of the Nigerian ports (Ogundana, 1970). He examined two dimensions to the changes which may take place over time within the port system: changes in the relative significance of individual ports as well as changes in the composite structure of the ports taken as a whole. He noted the tendency towards port diffusion, port concentration and a mixture of diffusion and concentration (unstabilised structure).

Other Nigerian studies were even more partial in their approach. They were either studies which were devoted to the port aspect of the essential transport elements in the functioning of Nigeria's export nodes (Hodder, 1959; White, 1963; Ogundana, 1966; Osayimwese, 1974), or specifically to the landward connections of the ports as a means of optimising port operations (PPGS University of Ife, 1979).

A new element in port studies in Nigeria is that of port consultants (NEDECO, 1971; MIT, 1977). This category of studies focus on the problem of achieving an optimum allocation of investment resources in Nigerian ports. This involves questions of the amount, timing and impact of investments in the port system. NEDECO study was designed as an economic study to determine the volume and type of traffic expected to pass through the major Nigerian ports, taking into consideration the existing inland transport connections. The study also attempted to determine the ways in which the economic costs of transport can be reduced and the utilization of the major ports, optimized. The methodology included the technique of dynamic programming, using purely economic criteria for optimization.

Two major limitations are apparent in these studies. Firstly, they usually involve traffic projections which in almost all cases, have usually been overgeneralised and very often erroneous. Secondly, the models used usually include only economic criteria; non-market factors have no place in the models. For example, whilst Shn eerson's study (Shn eerson, 1981) recognised the importance of non-market cost factors, such as the frequency of shipping service and forwarding agents in the structuring of the port system, these were not included in the model because there had not been any published statistics on these aspects.

All the studies above have focused attention on the understanding of ports at two conceptual scales; a single port and a group of ports. There have been two main thrusts of port study at these two scales. The first relates to early seaport studies which tended to investigate port installations and constructions in order to determine and explain what is where and why. The second thrust relates to the development of ports over time and space. It is the latter thrust in seaport studies that has trends which are pertinent to the present study.

The conceptual framework and the technique of analysis which have been used in the study of the development of ports over time and space are sometimes related to the general theory of polarised development in urban studies which stipulates that development tends to have its origin in a few centres that give rise to a few large urban complexes. This concept of small numbers of centres constituting hearths of development was used in the study of West African ports (Taaffe et al, 1963), and in a study of Australian seaports (Rimmer, 1967a). In these studies the phenomenon of centrality (port traffic concentration) at favoured seaports, was treated as the outcome of interport competitive struggle which is mainly interpreted from the measurement of the land patterns of association. Thus, the substantive literature on port development studies is characterised not only by its emphasis on the many aspects of landward connections or associations, but by a conceptual framework which fails to see the ship as the crucial operational element in the structuring of port activities, either within a single port or within a series of ports.

The issue of the relationship between ports (port 'relatedness') is also a central focus of some of those studies (Rimmer, 1967). There are two sides to the issue of port relationships. The relationships between ports within the regional port system, and the relationship between a port and its hinterland area. The latter relationship was emphasised by Rimmer (1967b) and examined in terms of the landward extent of the port-linked transport network. The relationships between ports have received little attention, even where ports have existed in an adjacent physical space, much less across maritime space (Robinson, 1968). Such relationship, where it has received some attention, has not been measured using shipping linkages which are regarded as being critical in structuring port relationships (Hoyle and Hilling, 1984). The present study intends to attempt to fill this gap in the literature by using shipping linkages within the Nigerian port system as in index of association and in effect, a measure of the 'relatedness' of the ports. The need to look at port relationships from this point of view is very crucial to the development process. A whole range of regional ports are often served by the same shipping companies from the same or different forelands, resulting in most cases in forelands overlap. Where forelands overlap, development of facilities at ports should take into account the type of facilities provided and where they are provided.

The need for rationalisation of shipping movements as well as provision of facilities at the single port also calls for the understanding of the operational relationships between elements in the port morphology. Emphasis in earlier studies has been on patterns of layout and function of the morphological elements (Hoyle, 1968; Morgan, 1958). The present study intends to fill this gap in the literature by bringing into focus the operational interdependencies between the morphological elements within the port. The identification of the berths or groups of berths which function together as operational units is certainly crucial to the development of facilities at a port (Ogundana, 1978). The identification of such units can also help in refining the queuing model with its characteristic limiting assumption of interchangeability of berths.

The few studies on port development that have been undertaken in Nigeria have been approached solely from the point of view of the relationship between the ports and elements of the hinterland and maritime space. By implication these studies have tended to see the evolution of the centre-periphery relationship in spatial functioning of the ports as an outcome of interport competition for traffic of the hinterlands and the forelands (Ogundana, 1970, 1971, 1972). This is contrary to the present trend which recognises the fact that port development in general, and relationships between ports in particular, are the result of several factors, namely, ship design and shipping services (Hoyle and Hilling, 1984); the process of port selection by the ship operating companies who use the port facilities (Willingale, 1984), interport competition in terms of regional patterns of trade and the characteristics of foreland areas (Sun and Bunamo, 1973), and political factors (Taylor, 1984; Chiu and Chu, 1984). The present study seeks a wider framework from that used in the study of Nigerian ports, in an attempt to understand the present structure of the Nigerian port system. It calls for the evidence and opinion of the principal decision-makers in the port business. It is hoped that port plans based on the evidence of the port users will be more rational than those based only on the relationship between the ports and elements of the hinterland and maritime space.

1.7 Objectives of the Present Study

The main objective of the present study is to define and understand the present structure of port development in Nigeria. This objective will be achieved in two ways. First, the study is to investigate how Nigerian ports are organised into hierarchies and hinterlands. This is done by studying the structures of dominance and competition among ports within the network of linkages and flows created by the movement of international trade. Clearly, the focus is on the issue of functional relatedness among the ports, interpreted from the measure of both the land patterns of association and the shipping linkages between the ports. Secondly, the study proceeds to attempt to understand the structure that is defined. Understanding the structure takes one into the complex process of decision-making in port operations where the Port Authorities and the various port customers act as the actual decision-making units.

1.8 Research Questions

Three main research questions are asked, and they are as follows:

(1) To what extent do Nigerian general cargo ports function interdependently within the network of interport shipping and land transport linkages that service international trade in non-fuel commodities?

(2) To what extent is the nodal status of a Nigerian port determined by the degree of focusing on it of maritime and landward flows of commodities of international trade?

(3) Is the competitiveness of a Nigerian port, in terms of traffic attraction and operational efficiency, determined by the amount of infrastructural development at that port?

1.9 Organisation of the Study

The fundamental assumption of the study is that Nigeria operates an irrational port structure, and that decision-making elements outside the port are, to a large extent, responsible for structuring the port system. The thesis is divided into three parts: the first provides a reference framework, descriptive and empirical in character, against which the analysis that follows in other parts may be examined. The second part examines the research questions. Its concern is to explain the notions of port status and port efficiency in the functioning of the port system. Part three considers the role played by factors outside the port operations in structuring the ports and goes on to consider the planning implications of the substantive findings of the second part.

Chapter One establishes the scope and describes the methodology used in the study. Chapter Two considers the regional setting and underlies both the general characteristics of port activity as well as the changing patterns of port development during the period 1970-1982. Chapter Three establishes a conceptual framework for port development against which port development objectives during the period of study are judged. Chapters Four and Five examine functional structures within the Nigerian port system from both seaward and landward perspectives, with the understanding that the identification of these functional relationships among the ports is crucial to the development and planning of a rational order of ports in Nigeria.

Chapter Six examines in more detail the proposition that Lagos ports are not only the largest within the regional grouping, but are also the effective operational focus, before going on to measure port performance at these ports. Chapter Seven focuses on factors outside port operations that help to explain the present structure of the port system. It dwells on the roles of the Ports Authority and the principal port customers in the development process of the Nigerian ports. Chapter Eight considers the problems of practical national significance that arise as a result of the emerging structure of port development. Chapter Nine concludes the thesis with a summary of the findings and considers the possible effects of an enlarged port system on a possible common port policy within the political and econmic framework of the Economic Community of West African States (ECOWAS).

1.10 Methodology

The design and nature of the objectives of the study necessitate the use of several forms of data and data collection methods including the use of a combination of structured questionnaires, interviews and examination of public data. Both historical data and field survey approaches were combined. For Part One of the study the historical data compiled by the Nigerian Ports Authority (NPA) are well documented and reliable. The thirteen issues of the yearly annual reports of the NPA from 1970-1982 provide the chief source of data. This was further supplemented by other relevant publications.

For Part Two of the study, three main sources of data were available. The first was the University of Ife Port Survey data which was obtained in its raw form. A port-gate survey was conducted by the Department of Geography, University of Ife, in February 1979 at five Nigerian ports: Lagos, including Apapa and Tin Can Island ports; Koko, Warri, Calabar and Port Harcourt. The objective of that survey was to collect relevant data on port-linked flows so as to determine the structure and pattern of port-hinterland relationships with regards to the types, operations and frequencies of vehicles and commodities which they carry to and from the major Nigerian ports. The survey which was conducted simultaneously at the five ports for a period of seven days, used pre-coded questionnaires to extract the needed information. The sampling procedure used in the survey was the volume cluster sampling procedure, one out of every five vehicles was surveyed. The type of data obtained from the survey related to the origin of freight by weight, destination of freight by weight; origin and destination of freight by type; vehicle particulars, e.g. vehicles capacity, date and time of vehicle arrival and departure to and from the port.

The second source was mainly obtained from the records of the Ports Autority departments at the Lagos ports. The daily log books of the Harbour Master's department at both Apapa and Tin Can Island ports contain details of the movement of each non-fuel cargo vessel presenting itself for servicing at the two Lagos ports. In addition, the Pilot's department's log books include the time of arrival of each vessel at the Lagos Roadstead (where vessels first anchor on arrival at the ports), and at the entrance channel to the berths. For the purpose of the study, only ocean going vessels which occupied berths at the two ports were included. Vessels which loaded or discharged at buoys and anchorages, as well as tankers bound for petroleum wharves and naval vessels and vessels 'in ballast' were excluded.

For the period from January 1, 1984, until June 1984, the following data were abstracted from official records: name of vessel, net registered and gross registered tonnage of vessel; date and time of arrival at the Lagos Roadstead; date and time of berthing; berth occupied, including changes during the period in port; type and tonnage of commodity loaded and/or discharged; date and time of quitting the berth for the sea, and the next port of call within and outside the country. The raw data were edited and valid and complete data pertaining to 390 vessels and 228 vessels which occupied berths at Apapa and Tin Can Island ports respectively were obtained for the analysis. Data for the movement of ocean-going vessels within the Nigerian waters were similarly extracted from the Harbour Master's department.

The third source was the records of thirteen major Forwarding Agents recognised by the Nigerian Ports Authority. For the period of seven days from 4th June to 10th June 1984, the records of these major Forwarding Agents were examined to seek information about the inland destinations of import commodities. The Forwarding Agents' sources were presumed to be more accurate than the records shown in the Shed Delivery Records (SDR) which were official records of the NPA because in almost all cases, destination on the SDR showed the address of the Forwarding Agent in Lagos city, even though the consignment might actually travel further inland to the location of the ultimate consignee. To make comparability with the 1979 data possible, the volume cluster procedure was also adopted; one out of every five vehicles conveying import commodities from the three port locations at Apapa, Tin Can Island and Kiri Kiri Lighter Terminal were surveyed and information relating to berth origin, date and time of arrival and departure from port premises, vehicle capacity, type and tonnage of commodity carried and inland destination were obtained. The decision to limit this aspect of the survey to Lagos port is due mainly to time and finance constraints. To do the survey in five Nigerian ports would mean spreading the survey over large geographical parts of the country, since the ports are located in different parts, spreading from west to east. Lagos was chosen because it is the largest port in the country (in 1982 it handled more than 63 percent of all Nigerian ports' total traffic).

For Part Three of the study, the investigatory technique of structured questionnaires combined with interviews was used. Data were collected in two main ways: structured questionnaire survey and informal discussions. Informal discussions (which represent a most valuable method of collecting information both in individual and group situations) were held with representatives of the NPA in Lagos, port users in Lagos and in the United Kingdom. The questionnaire was divided into three sections, each section encompassing the roles of the major participants in the port business. The first section asked questions about the role of ports; the second, the role of ships, and the third, the role of shippers and consignees. All three sections were concerned with questions of perception of port problems. The questionnaire was made up of twenty constructs consisting of bi-polar opposites representing the roles of port-owners/operators (5), ship operators and their agents (11), and cargo interests as represented by consignees and consignors (4). These questionnaire forms were based on the format designed by Osgood (1957) in the first part of his 'Semantic differential' procedure and used by Bird (1982) in investigating decision-makers' role in seaport development in the European Economic Community (See Appendix 1 to Chapter One).

In this first questionnaire form, posted questionnaires were sent to five identified interest groups, viz.: portowners/operators based in Nigeria; shipowners/operators based in the United Kingdom; ship-owners/operators based in Nigeria; consignees based in Nigeria and consignors based in the United Kingdom. These questionnaires were sent to Nigeria in October 1985 and to interest groups based in the United Kingdom in Febrauay 1986. Distribution and responses are as shown in Table 1.1.

Table 1.1

Response to Questionnaire Survey Among Interest Groups

Interest Group	No. of Questionnaires sent	No. of Responses	% of Responses
1. Portowners/Operators	5	4	80
2. Shipowners/Operators (Nigeria)*	20	15	75
3. Shipowners/Operators (U.K.)	4	3	75
4. Consignees (Nigeria)	12	8	66.6
5. Consignees (U.K.)	10	5	50
TOTAL	51	35	68.6

* Shipowners/Operators in Nigeria include representatives of Shipping Companies.

One major shortcoming associated with this form of survey is the fact that the researcher imposes his own constructs on the respondent without actually allowing the respondent to choose those constructs which he feels are relevant to his own situation. However, in this study, positive efforts were made to reduce the effects of such lapses in the design of the questionnaires. For example, interest groups that were included in the survey in the United Kingdom were given the opportunity to talk around the constructs and had the option either to add their own constructs to those provided by the researcher if they so wished, or if they were of the opinion that a particular construct was irrelevant or that they would not have identified it themselves, they they could reject the construct completely. Another problem is that the design of the questions in the first questionnaire is such that they relate mainly to perception of elements in the port system and, therefore, they ask the question: 'how' rather than the more positive question: 'why'. In such situations, attitudes and views expressed by decision-makers may be given in a hypothetical situation, and there may be no guarantee that the way they see the problem is the way they are going to act when they are directly involved in that particular role.

This explains why the second stage of the survey in the United Kingdom was narrowed down to the role of the Shipping Lines. During the interviews conducted in London and Liverpool in April 1986, representatives of six Liner Conference members of the United Kingdom West Africa Lines (UKWAL) which operate to Nigerian ports were met. They were asked to identify those problems they associated with each of the Nigerian ports they used either now or in the past. With regard to decision factors, they were asked, firstly to identify the ports they used, and secondly to identify by themselves those factors which led to their choice of that particular port as the main port in preference to any other port they chose not to use at all. Such decision factors elicited from the respondents were compiled in the second questionnaire form which was later sent to the respondents for grading. The factors which represent seventeen decision factors were grouped under four headings: economic, infrastructural, superstructural and technical factors. (See Appendix 2 to Chapter One).

CHAPTER TWO

THE SPATIAL PATTERNS OF PORT DEVELOPMENT IN NIGERIA (1970 - 1982)

2.1 Introduction

This chapter summarises the development of seaports from the point of view of their performance in the share of international trade. The main concern is with showing the changes which occurred in the spatial patterns of port concentration of traffic during the period 1970-1982. It is hoped that this will lead to a better understanding of the patterns of development of the whole port system. In 1982, there were nine general cargo ports located within three hundred and ninety-four nautical miles sailing distance of Lagos ports. These ports are grouped into four port complexes, namely Apapa and Tin Can Island ports which constitute the Lagos port complex; Warri, Burrutu, Koko and Sapele ports which constitute the Delta port complex; Port Harcourt port and the Federal Lighter Terminal at Onne near Port Harcourt which constitute the Rivers port complex; and the Calabar port complex (See Table 2.1 and Figure 2.1 respectively).

Port status is measured, using the weight of cargo, given in measurement tonnes. Although the usefulness of other criteria for the measurement of port status is acknowledged, yet because of the methodological and conceptual problem which such application would pose in the Nigerian example (Carter, 1962; Rimmer, 1966) the weight of cargo is assumed to be the most satisfactory single measure of port status.

Figure 2.1

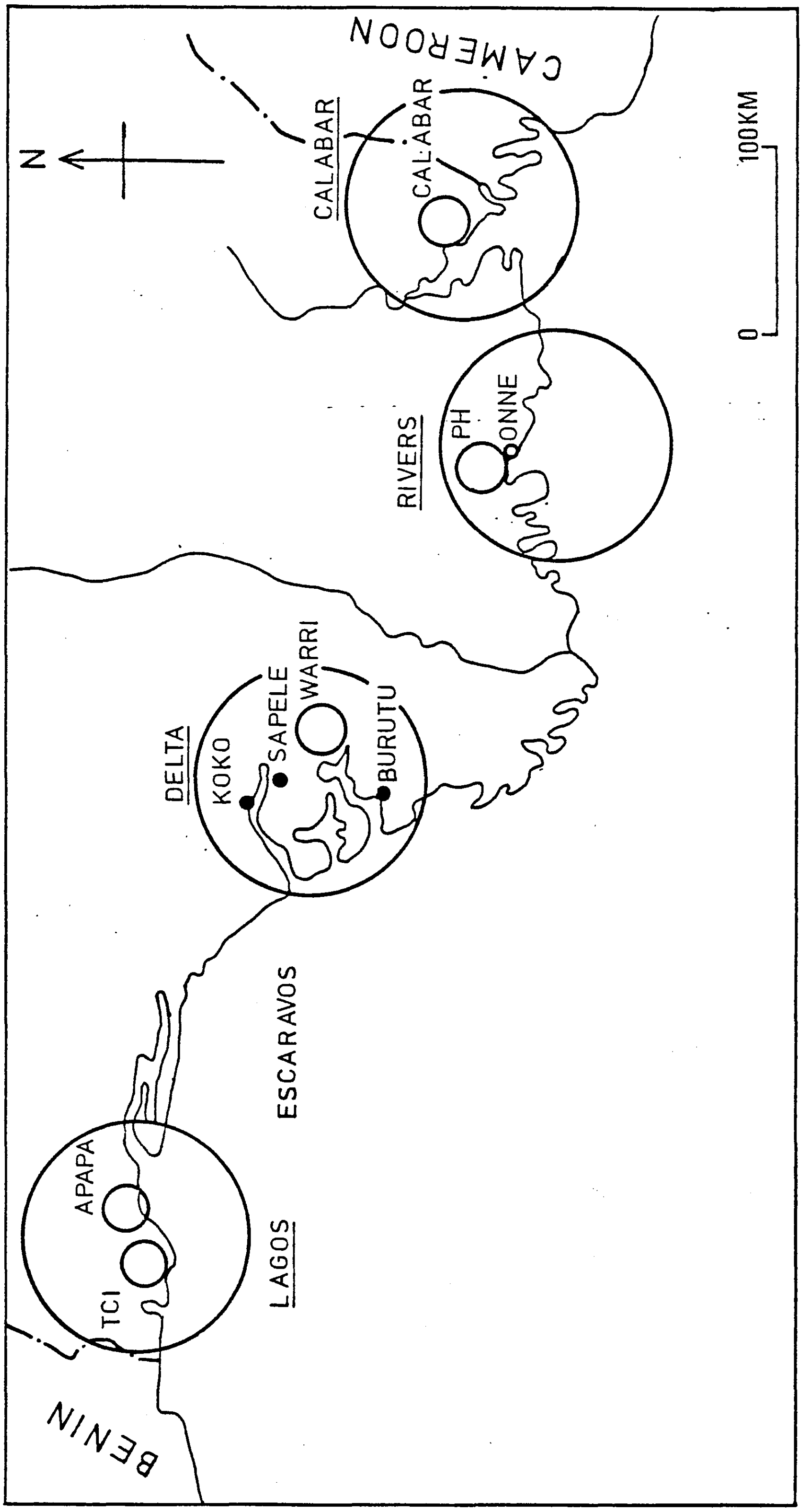


Figure 2.1 NIGERIAN PORTS.

2.2 Concentration of Traffic in Nigerian Ports

The period 1970-1982 was a period of rapid change in terms of the magnitude of foreign trade flows through Nigerian Ports. Table 2.2 shows that total non-fuel foreign traffic handled at all Nigerian ports had increased from 3.0 million metric tonnes in 1969-70 to an all time figure of 18.0 million metric tonnes in 1981 - an increase of 600 percent.

Table 2.1

Table of Distances Port to Port: Nigerian Port System

(Nautical Miles)

	Burutu	Warri	Koko	Sapele	Port Harcourt	Calabar
LAGOS	158	184	171	192	315	394
*Burutu		32	64	85	248	327
*Warri			86	107	269	348
*Koko				21	261	340
*Sapele					282	361
Port Harcourt						163
Calabar						

* Distances assume a crossing of Escaravos Bar when a seaward voyage is undertaken.

Source: Nigerian Ports Authority, 1984 Diary.

Table 2.2

Total Non-Fuel Foreign Traffic Handled by Nigerian Ports

1970 - 1982 (metric tonnes)

Year	Imports	Exports	Total	% Change
1970-71	3,247,154	1,515,282	4,762,436	0.0
1971-72	3,992,484	1,164,768	5,157,252	+8.3
1972-73	3,166,142	1,190,475	4,356,617	-15.5
1973-74	3,447,319	1,235,118	4,682,437	+7.5
1974-75	4,197,633	722,717	4,920,350	+5.1
1975-76	6,086,864	719,898	6,806,762	+38.3
1976-77	8,754,010	821,727	9,575,737	+40.7
1977-78	11,556,722	824,792	12,381,514	+29.3
1978-79	11,954,905	742,810	12,697,715	+2.6
1979-80	11,473,174	744,624	12,217,798	-3.8
*1980	11,570,159	721,270	12,291,429	+0.6
1981	17,159,806	866,676	18,026,482	+46.7
1982	15,605,281	617,374	16,222,655	-10.0

* Figures from April to December only.
Source: Compiled from Nigerian Ports Authority Annual Reports.

The mixture of plus and minus signs in the column showing percentage change in Table 2.2 does indicate periods of growth and decline in the total trade of all ports taken together. In all, two periods of rapid growth interspersed by periods of moderate growth and outright decline are recognisable. The periods 1975-76 and 1981 witnessed the highest growth in international trade. This high rate of growth, particularly in the import trade coincided with the period when oil revenues increased by between 108 percent and 207 percent (Nigerian

Trade Summary, 1980). Such increases meant that the government had at its disposal huge foreign exchange to finance the equally rising imports. This probably explained the increase in total foreign trade at a time when exports of non-fuel commodities were decreasing in tonnage and probably value terms.

The period of moderate growth and decline between 1970-71 and 1974-75 is probably equally explained by the oil price phenomenon, when oil prices were probably at their lowest during that decade. At this time the export sector of the non-fuel commodities was enhanced and, therefore, probably played a more positive role in financing imports than at an any other time during the period of study. Also the period from 1978 to 1982 (except for 1981) showed that international trade either stabilised or declined outright. This period coincided with the period of general world economic recession when the problem as far as Nigeria was concerned was finding customers for her oil. The apparent upward trend in 1981 probably correlated with high borrowings to finance imports.

The foregoing has shown that in general terms, international trade in Nigeria has grown by leaps and bounds. No doubt, specific changes have taken place at the composite level of the Nigerian port system as well as at individual port levels. These specific changes that have taken place are better interpreted and understood against the more general characteristics of the Nigerian port economy.

2.3 Characteristics of the Port Economy

Six general characteristics of foreign trade flows as well as those of the ports which handle such flows underlie the distinctive character of the Nigerian regional economy. These characteristics are:

(a) High Volume Commodity Flows

The high commodity flow characteristic of the port economy during the period under review, shows that significant changes have taken place in the import sector of the national economy. The trend shows an import-sector dominance in the country's economic growth, with the export-sector economy contributing very little. Indeed, more than 60 percent of the current exports in non-fuel traffic is made up of re-exports of wheat offal and empty containers.

Tables 2.3(a) and (b) which represent changes in selected commodities through Nigerian ports between 1970 and 1982 show the increasing strength of the import sector in the overall foreign trade traffic. Very large rises in tonnages of imported consumer items like rice, wheat grains, cement, sugar and salt can be seen, whilst the tonnages for traditional agricultural exports such as groundnuts, rubber, palm oil and palm kernels have declined significantly and some have completely disappeared from the foreign trade list, e.g. cotton, benni-seed, shea butter, groundnuts and hides and skins.

Table 2.3(a)

Changes in Selected Commodities (Imports) Through all Nigerian Ports

1970 and 1982

Commodity	1970 Tonnage	1970 % of Total Tonnage	1982 Tonnage	1982 % of Total Tonnage	% Increase 1970-82
Rice	185	0.1	880,273	11.3	476,723.0
Cement	561,620	48.0	2,307,947	29.3	310.9
Wheat grains	270,348	23.0	1,328,253	16.9	391.3
Fertilizer	30,640	2.6	600,730	7.6	1,860.6
Sugar	7,285	0.6	637,092	8.1	8,645.2
Salt	65,224	5.5	176,844	2.2	171.1
Machinery	26,800	2.3	334,050	4.2	1,146.4
Motor Vehicles	68,524	5.9	452,828	5.7	560.8
Iron and Steel	140,609	12.0	1,160,185	14.7	725.1
TOTAL	1,171,235	100.0	7,878,202	100.0	572.6

Table 2.3(b)

Changes in Selected Export Commodities Through Nigerian Ports

1970 - 1982

Commodity	1970 Tonnage	1970 % of Total Tonnage	1982 Tonnage	1982 % of Total Tonnage	% Increase 1970-82
Cocoa	215,000	28.5	112,288	45.7	-47.8
Palm produce	386,424	51.3	30,922	12.6	-92.0
Rubber	54,644	7.3	7,702	3.1	-85.9
Wheat offal	51,626	6.9	94,745	38.6	+83.5
Cotton	45,378	6.0	-	0.0	-100.0
TOTAL	753,072	100.0	245,657	100.0	-67.4

Source: NPA Annual Reports, 1970 and 1982.

A comparison of the two sectors of the trade shows that the largely demand-orientated import flows and the export flows are significantly different; imports increase at significant rates whilst exports decrease at equally significant rates. The characteristics of the port economy depicted in the Table has far reaching implications for the characteristics of the shipping economy that is involved in carrying the country's international trade. For example, the decreasing export tonnages would probably mean that the export ships would be characterised by low load factors on the return leg of the journey whilst increasing imports would probably mean good prospects for full loads for import vessels on the first leg of the journey. The highly unidirectional character of the trade that emerges from this would certainly have implications for freight costs. For example, the cost of operating an empty ship on the return leg of a sea journey by shipowners is usually included in the freight rate of the first leg of the journey. The result is that consignees must absorb higher transport costs than otherwise would be the case if there had been cargo available for the return journey.

The increasing concentration, in tonnage terms, of imports, implies other characteristics of the shipping economy; namely, the increasing utilisation of bigger ships and the need for ships to engage in multi-port itineraries along the Nigerian coast. Increasing utilisation of bigger ships was brought about by the need for shipping companies to achieve economy of scale on the one hand, whilst the use of specialised vessels such as unitised and containerised vessels was brought about by the need to cut down on the number of days ships spend in ports.

The use of bigger vessels for the inward journeys implies that very often ships would carry consignments which were destined for more than one port in Nigeria. Such has encouraged multi-port itineraries which suggests the logic for some degree of functional or operational integration among the ports.

Table 2.4 aptly depicts these characteristics. The average load per vessel for inward journeys during 1970 was 1837 tonnes, whilst the average for outward journeys was 1152. The much larger relative rise of total inward cargo by 1982 as well as the increase in the average Net Registered Tonnage (NRT) of ships between 1970 and 1982 shows the increasing utilization of larger ships on the Nigerian trade route. Just as the increasing load factor of import vessels suggests the logic for multi-port itineraries so also the decreasing load factor for export vessels suggests the logic for multi-port itineraries for ships to load or to top up their export loads.

Both the increasing volume of inward traffic and the increasing load factor of import vessels relative to the average vessel's Net Registered Tonnage (which is a measure of the size of the ship) which became evident as from 1976-77, imply the increasing importance of the Nigerian market in the Europe - West Africa shipping range. It will be noted that Nigerian ports, apart from the ports of Cameroon Republic, are the last ports of visit on the Europe - West Africa shipping route. The relatively high load factors, therefore, show the importance of the Nigerian market on this shipping range between West Africa and the Western world markets. For example, Nigeria accounts for more than half of the total general cargo and more than 60 percent of containerised cargo originating from the United Kingdom to West Africa (National Ports Council, 1977).

Table 2.4

Vessel Size and Vessel Load Factor at Nigerian Ports - 1970-1982

Year	No. of Vessels	Total NRT of Vessels	Imports (Tonnes)	Exports (Tonnes)	Average NRT	Load Factor Imports (tonnes)	Load Factor Exports (tonnes)
1970-71	2445	6,348,253	4,492,152	2,816,851	2596	1837	1152
1971-72	2630	8,089,008	5,281,466	2,831,638	3076	2008	1076
1972-73	2678	8,289,851	4,459,164	3,103,075	3095	1665	1202
1973-74	2562	8,244,039	5,256,724	3,218,698	3218	2052	1256
1974-75	2643	8,260,707	5,979,492	2,461,934	3126	2262	931
1975-76	3390	9,877,194	8,481,284	2,518,241	2914	2501	742
1976-77	3955	10,341,874	11,853,063	2,558,284	2615	2997	647
1977-78	4834	13,425,981	15,694,964	2,419,808	2777	3247	501
1978-79	5132	15,385,316	17,395,286	2,656,374	1999	3390	518
1979-80	4281	14,234,710	15,584,787	2,354,415	3325	3640	550
1980	3718	12,984,834	14,401,270	2,085,415	3492	3873	561
1981	5634	19,546,857	20,728,974	2,913,742	3469	3679	517
1982	4860	17,930,883	20,073,797	2,537,432	3689	4130	522

Note: Vessels include those that carried petroleun products.
NRT = Net Registered Tonnage: Ship measures of cubic capacity in tonnes of 100 cubic feet

Source: Complied from NPA Reports, 1970 - 1982.

(b) Resource/Demand Orientated Port Location

Two factors have influenced the relative significance of Nigerian ports especially during the 1970-82 period. They are: the location of the ports in relation to the potential demand for port services from the hinterland or the foreland, and the structure and quality of the connecting transport by land and sea. Any change in this balance is certainly bound to have implications for the changing pattern of port concentration in the country. For example, before oil became important in the country's economy, agricultural exports played a major role in the country's development. Port location during this time of agricultural export dominance took advantage of the core areas of agricultural production with Lagos port being located in the core area of cocoa production and Port Harcourt in the heartland of palm oil and rubber production. The central northern part of the country which is not located close to a seaport, but which produced the bulk of groundnut exports, took advantage of the relative proximity of the two ports of Lagos and Port Harcourt either by rail or road or even river transport.

It could thus be argued that the generation of transport network postulated by regional economic growth theory as a characteristic of regional economies in the initial phase of export-sector dominance (Rostow, 1964) was applicable to Nigeria as a 'maritime network' because production was geared mainly towards export. Port location, which took advantage of this production, could be described as resource-orientated port location.

The ports which gained the leadership as a result of their resource-orientated location have also grown to be the leading industrial centres which have been able to generate increasingly greater pulls than the relatively declining ports. The cumulative growth which invariably characterises these 'leader' ports might be due to external economies. For example, the concentration in them of institutional services for foreign trade, such as banking, commodity markets, forwarding agencies and so on, could afford such ports external economies. Such services are not easily developed at new points, and their perpetuation at larger ports has, no doubt, been a factor in port consolidation or concentration.

Lagos and Port Harcourt, for example, have had an increasingly competitive advantage over all other Nigerian ports. Lagos is not only the political capital, but has also become the financial hub and the leading Nigerian business centre.

Now that the resource-orientated nature of the ports has been modified as a result of dwindling agricultural exports, the ports through their industries and other external economies, have become sources of demand for foreign trade imports. The concentration of import-substitution industries coupled with the large urban populations at these ports have meant a greater demand for foreign trade goods. A combination of these factors has been responsible for the concentration of higher tonnage import volumes and a high degree of 'filter effect' of these imports at the ports.

The country's oil-dependent economy has been able to benefit the relatively smaller ports, particularly those that are located in the oil producing areas through the multiplier effects of the oil economy. For example, since the mid-1970s the government of Nigeria has engaged in the process of economic diversification. This policy has favoured the hitherto neglected areas of the country, including the oil producing areas of Bendel and Rivers States. As a result, ports like Warri and Sapele, which are located in these areas, witnessed the location of industrial and other development projects which rely mainly on imports of raw materials for their functioning. This development trend has led to the increasing significance of the delta ports of Warri and Sapele for import traffic.

In summary, the changing relative significance of ports in Nigeria, in terms of tonnage volumes may be seen as a reflection of the duality in the economic potential of the country's resources. Dwindling agricultural exports have meant decreasing foreign trade in this sector, but increasing crude oil exports have meant the availability of foreign exchange earnings to support a growing import trade.

(c) Port Morphologies

The period of accelerated international trade growth during the 1970s was accompanied by technological changes in ocean transport. Both events initiated a process of port reconstruction and expansion, a combined process which led to the modification and in some instances, complete alteration of the physical morphologies of some Nigerian ports.

Table 2.5 shows some characteristics of the morphology of the ports in 1970 and 1982. With the exceptions of the Lagos and Port Harcourt ports, the Nigerian ports in 1970 showed rather simple characteristics of more or less contiguous on-side general cargo berths with back-up transit sheds and warehouses. The port of Koko which was, in

Table 2.5

Characteristics of Nigerian Port Morphologies - 1970 and 1982

	LAGOS PORTS		DELTA PORTS		RIVERS PORTS		CROSS RIVER PORT	
	1970	1982	1970	1982	1970	1982	1970	1982
Draught in Metres:								
Entrance Depth	9.2	11.5	6.3-7.6	10.0	8.9	11.2	6.0	7.0
Harbour Depth	5.2-8.3	8.2-10.5	3.9-7.6	3.9-11.5	6.3	7.9	5.8	7.0-8.0
Berths: No./Length (metres)								
Anchorage/Buoys	3/120	19/137-228	14/92-230	25/105-230	2/110	5/160-239	-	10/120
Container	1/212	5/250	-	-	-	-	-	-
General Cargo	11/172	31/161-183	5/49-265	24/91-265	6/176	24/137-178	3/60	6/150-286
Roll-on-roll-off	-	3/250	-	2/170	-	-	-	
Silo	1/198	1/198	-	1/187	-	1/178	-	1/188
Petroleum	1/178	5/35-180	-	1/200	-	1/183	-	-
Vegetable Oil	1/97	1/152	-	-	1/97	1/143	-	-
Coal/Gypsum	1/122	1/122	-	-	1/137	1/137	-	-
Fishery	1/86	1/115	-	2/69	-	-	-	-
Lighter/Jetties	1/116	2/1140-1560	-	-	-	4/64-143	1/36	-
Dry Bulk	1/97	2/157-180	-	2/58-185	1/68	1/105	-	-
Storage Capacity (sq.m. of floor space)								
Warehouses	58,055	78,055}	50,521}	123,301	15,791	32,586}		56,224
Transit Sheds	68,970	124,907}	}		25,544	46,737}	3,994	47,663
Silo Capacity(tonnes)	36,000	76,000	-	-	-	3,048	-	4,545
Vegetable Oil Tank (c.c.)	16,000	30,000	4,000	7,048	45,000	-	15,000	-

Source:Compiled from NPA Annual Reports - 1970 and 1982.

1970, the smallest Nigerian port had an entrance channel depth of 7.2 metres, and only one general cargo berth, 49 metres in length and a back-up warehouse with less than 5000 square metres of storage capacity.

By 1982, and as a result of massive development efforts at all ports, both infrastructural and superstructural facilities at these ports were upgraded in order to meet the demands of the growing international trade in the country, and the demands of technological changes in ocean transport. The major ports of Lagos and Port Harcourt benefitted most from these development efforts; but minor ports like Warri, Sapele and Calabar which suffered relative neglect during preceding development eras, made significant gains. New ports were built at Warri, Sapele and Calabar to replace the deteriorating old ones. A modern container terminal of four berths and one roll-on-roll-off berth were added to the Apapa port complex in Lagos; an ultra-modern port was built at Tin Can Island, some three kilometres west of Apapa port, with adequate facilities for general cargo, dry bulk cargo and roll-on-roll-off cargo. The development of lighterage systems at or near the major ports was embarked upon to boost further the government policy of providing necessary adequate capacity at the ports. Two big Lighter Terminals were built at Lagos and at Onne near Port Harcourt.

By the end of 1982, the Nigerian port system consisted of ports which have facilities that range from simple on-side general cargo berths to the complex port morphologies of on-shore berths made up of general cargo, container, roll-on-roll-off and bulk as well as off-shore berths. Thus, the traditional concept of a port implying a complex of berth arrangements, storage sheds, back-up transportation facilities apply to almost all the Nigerian ports. The development of these facilities was a direct response to the growing international trade as well as developments in the technology of ocean transport.

(d) Obsolescence and Instability in the Spatial Pattern of Port Concentration Over Time

A feature of the spatial pattern of port concentration in the Nigerian port system is its relative instability over time. This instability involves frequent changes in either the absolute or relative significance of the individual ports. The concepts of port concentration and diffusion have been used to describe the structure of a port system at any given point in time (Ogundana, 1970). Port concentration implies that a few of the many ports in a regional port system are of unequal significance; and this situation is brought about as a result of some of these ports increasing their relative significance, over a period of time, over other ports which either gain modestly or decline in absolute terms. Port concentration manifests itself in two complementary ways: first, initial relative decline of certain ports, and second, an absolute decrease in the number of operating ports. Port diffusion is the opposite of port concentration and occurs when hitherto higher-order ports decline in significance leading to the increasing significance of new or previously smaller ports. The end result of port diffusion may be an absolute or relative increase in the number of functioning ports (Ogundana, 1970).

A port structure may be characterised by alternating concentration and diffusion, leading to an unstable port structure. Developments in international trade as well as in land and sea transport may be responsible for setting in motion the process of concentration or diffusion. For example, a period of diffusion may be initiated by the construction of new ports to serve either new trades or an expanded part of an existing trade, thereby leading to an absolute increase in the number of ports. There may also be a diversion of trade to formerly less important ports.

In the same way, technological development in land and especially in maritime transport, and consequently the need to rationalise shipping services, may lead to the concentration of trade and shipping services to one or two major ports within the regional port system.

The process of port development in Nigeria, exemplifies some of the concepts described in the preceding paragraphs; evidence is provided showing the changing significance of individual ports and of groups of ports over periods of time. The composite structure of the port system has changed considerably from the era of concentration between 1910 and 1950 to that of diffusion from 1950 to the present time. The number of effectively functioning general cargo ports has fluctuated from fourteen in 1927 to seven in 1970, and from seven in 1970 to nine in 1982 (Table 2.6)

The general trend in the development of the ports has been that of competition among the ports, and this has led to the changing pattern of port concentration and diffusion. The leadership of Apapa port has been sustained, although some threat to this leadership has been offered by the newcomer Tin Can Island port. Other smaller ports which could not withstand the competition have either declined or have gone into obsolescence.

Table 2.6

Functioning General Cargo Ports and Terminals Under NPA Management

1970 and 1982

Port Complex	1970	1982
LAGOS	Apapa Port Complex	1. Apapa Port Complex 2. Tin Can Island Port 3. Kirikiri Lighter Terminal 4. Ikorodu Lighter Terminal
RIVERS	Port Harcourt	1. Port Harcourt 2. Federal Lighter Terminal 3. Federal Ocean Terminal*
DELTA	1. Warri 2. Koko 3. Burutu** 4. Sapele	1. Warri 2. Sapele 3. Koko
CROSS RIVER	1. Calabar	1. Calabar

* Completed in 1983
** Did not function in 1982

Source: NPA Development Department Statistics Division, Lagos.

(e) Oligopolistic Corporate Structures

The structure of the port industry in Nigeria (until the early 1970s) could be seen as an extreme case in which two development philosophies were side by side. Before this period, Apapa and Port Harcourt were owned and operated by the Federal Government, whilst the remaining ports were under private ownership and management. The two major ports, therefore, benefited from the advantages of direct governmental administration in terms of access to relatively large development investment funds and in terms of integrated management under the Nigerian Ports Authority. The smaller ports, on the other hand, were under different privately owned companies with limited funds for development. These private developers could obviously not match the pace of development at the two government owned and operated ports.

However, the acceleration of international trade between 1970 and 1977 spurred the expansion and reconstruction of Nigerian ports. New or expanded ports were needed as responses to the lack of capacity in existing ports which had continued to incur congestion costs as a result of rapid increases in port throughput. These ports also needed to adapt to changes in shipping technology involving the use of larger and more specialised vessels.

The investments required for this process of massive expansion exceeded the financial capabilities of individual ports, particularly those under the management of private operators. As a result, the smaller ports suffered relative decline compared to ports under the management of the Nigerian Ports Authority. Since 1974, however, the management of all Nigerian ports was transferred to the Nigerian Ports Authority. Planning for the different ports, therefore, became centralised, with the result that the development of individual ports was no longer influenced by external competitive factors, but by corporate policies for development.

(f) Foreland Orientation of International Trade

The foreland orientation of the international trade of any country will tend to have implications for the structure and hierarchical organisation of that nation's regional port system. Any port within a regional port system achieves a distinct advantage or disadvantage if its location provides the shortest route to a rapidly growing or declining foreign trade block (Sun and Bunamo, 1973). In the same way, a port that has traffic exchanges with large and diversified foreland areas is likely to be more prosperous than another port which has traffic exchanges with a limited number of foreland areas. The diversity and extent of foreland connections is an important factor in traffic aggregation at a port (Rimmer, 1967). For example, the major port with its diversified traffic and improved terminal facilities has a wide range of shiping services to different forelands. The minor port with a smaller variety and volume of trade has fewer direct overseas shipping connections. A port which has traffic exchange with a limited number of foreland areas has a restricted or concentrated foreland structure, whereas another port with a wider spread of traffic has a diffused foreland influence. Traffic to a dominant foreland is shared among port outlets, unlike traffic to a peripheral foreland which tends to be more concentrated in few ports within the system (Ogundana, 1972).

When these ideas are interpreted in terms of the foreland orientation of Nigeria's import trade in 1972 and 1979, it will not be difficult to understand the relationship between foreland structure and port growth. Table 2.7 shows the foreland structure of import trade in Nigeria in 1972 and 1979. Western Europe and the United States of America constituted the largest foreign trading block for Nigerian ports, both accounting for 71 percent and 67 percent of the total import trade in 1972 and 1979 respectively. The two trading blocks together, recorded increases of 545 percent between the two years. Lagos port provides the shortest route and is the first port of call from these dominant foreland areas.

Table 2.7

Foreland Structure of Nigeria's Import Trade (1972 and 1979)

Country	1972 Tonnage	1972 % of Total Trade	1979 Tonnage	1979 % of Total Trade	% Incr. 1972-79
U.K.	443,804	29.4	1,783,601	17.3	+300.0
W. Germany	204,850	13.6	1,667,158	16.2	+700.0
Netherlands	68,559	4.5	474,326	4.6	+590.0
Belgium	28,876	1.9	186,236	1.8	+545.0
France	88,756	5.9	880,385	8.6	+891.0
Italy	63,349	4.2	589,592	5.7	+830.0
Japan	149,350	9.9	1,113,330	10.8	+645.0
Spain	12,866	0.8	211,946	2.1	+1547.0
U.S.A	155,952	10.3	1,095,084	10.6	+602.0
Africa	14,539	0.9	72,398	0.7	+398.0
Others*	280,545	18.6	2,226,923	21.6	+694.0
TOTAL	1,511,445	100.0	10,300,979	100.0	+581.0

* Includes Eastern Europe, U.S.S.R and South America.

Source: Nigeria Trade Summary, 1972 and 1979.

Other peripheral forelands such as Japan, Eastern Europe and the Soviet Union also made significant gains in the import trade with Nigeria. As traffic from peripheral forelands is likely to be largely channelled through leading ports, just as trade with new areas is likely to be initiated through the major ports which possess superior terminal organisation (Ogundana, 1972), such trade increases that are evident in Table 2.7 are more likely to benefit first, the two major Nigerian ports of Lagos and Port Harcourt.

The relative spread of forelands of particular Nigerian ports is thus as much a factor as an element of port growth in the country.

2.4 The Changing Spatial Concentration in Total Trade

During the thirteen years covered by this study, two types of changes in the spatial pattern of international trade can be recognised. The first is the change in the composite structure of the port complex as a result of the relative spread of traffic among the ports. The general pattern that can be identified from Table 2.8 (See Appendix 1 to Chapter Two) is that of consistent decrease in the value of Hirschman's index of trade concentration, which suggests diffusion within the port complex (Britton, 1965). The decrease in the value of the index from 82.6 in 1970-71 to 53.6 in 1982 also suggests the high intensity of the diffusion that characterised the port system.

The second change is that which has occurred in the relative tonnages that have been focused on each port. Of the six functioning ports in 1970, Apapa showed an absolute dominance by accounting for 81.9 percent of the total Nigerian ports trade. Port Harcourt was a poor second with a share of only 8.3 percent. This could be attributed to the disruption to traffic caused by the Nigerian civil war between 1967 and 1970. (The relative market shares of Apapa and Port Harcourt during the 1966-67 pre-civil war years were 69.4 percent and 30.4 percent respectively). Warri port closely followed Port Harcourt as the third most important port in Nigeria in 1970 with a total market share of 6.6 percent.

It was observed previously that the period 1970-82 witnessed some rapid growth in Nigeria's international trade. The result was that the existing ports had an inadequte capacity to handle this increase. New ports had to be built and facilitise at old ports were expanded and modernised so that the ports could have sufficient capacity for the increasing trade. The period 1970-1982 was, therefore, an era of port diffusion leading not only to an absolute increase in the number of functioning ports, but also to increased handling capacity in the ports. In 1982, and as a result of these changes, the rank order of the ports was slightly modified, even though there was very little change in the ascendency of the minor ports to major ports. Apapa still retained its leadership but with a much reduced 46.1 percent share. In absolute gross tonnage, however, Apapa recorded a growth of 195 percent over the 1970 level, but in relative terms, there was a decline of 35 percent over its 1970 level. Port Harcourt retained its second place with a large increase in gross tonnage of over 660 percent and in relative terms as well with an increased share up to 18.0 percent of Nigeria's general cargo port trade. Warri port was displaced from third place by the new port of Tin Can Island with 17.2 percent of Nigeria's trade, although Warri increased its gross tonnage in both absolute and relative terms with 10.6 percent of market share in 1982.

On the whole, Apapa, Port Harcourt, Warri and the new port, TinCan Island retained their leadership role as major Nigerian ports, accounting for more than 90 percent of the total trade. Among the smaller ports, Sapele and Onne have taken the lead in the share of the market whilst Burutu no longer functions.

Changes in the absolute tonnages in each port as well as the percentage changes in these absolute tonnages may not reveal the full impact of the changes that have taken place in overall trade among the ports. A further measure of change is, therefore, obtained by calculating the difference between the actual tonnage of a port in 1982 and the hypothetical tonnage showing what the level of change would have been if the ports had grown at the national rate between 1970 and 1982.

Table 2.9 shows the pattern of deviations of actual from hypothetical gross tonnage shares of Nigeria's ports in 1970 and 1982. The magnitude of gains recorded by Port Harcourt showed a return to its pre-civil war status after a period of rehabilitation and port expansion that followed the civil war years. This gain could also be explained by the growing inefficiency at Apapa port brought about by the lack of adequate capacity which manifested itself in the congestion in that port between 1975 and 1977, during which period traffic had to be diverted from Apapa to other Nigerian ports. The relative decline of Apapa in 1982 could be explained by the building of the Tin Can Island port in close proximity to the Apapa port.

In Table 2.10, traffic to the ports is combined on the basis of the grouping of port complexes in order to see what effect the opening of new ports and the disuse of some old ports would have on the total pattern. The pattern of gains and losses remain the same with the Lagos port complex recording losses over the 1970 level, whilst the three other port complexes made net gains. The magnitude of loss sustained by the Lagos port complex was, however, reduced, which further confirms the loss of trade from Apapa to Tin can Island.

Table 2.9

Pattern of Deviation of Port Total Traffic - 1970 and 1982

PORT	1970 Tonnage	1982 Tonnage	Actual Growth	Hypothetical Growth	Difference Between Actual & Hypothetical Growth	% Difference (Deviation)
All Nigerian Ports	4,762,436	16,485,855	11,723,419	246.2		
Apapa	3,900,734	7,606,575	3,705,841	9,603,607	-5,897,766	-159.1
Port Harcourt	391,228	2,983,043	2,592,755	943,203	+1,628,552	+62.8
Warri	308,064	1,765,384	1,448,320	741,201	+707,119	+48.8
Calabar	102,186	388,279	286,093	251,581	+34,512	+12.1
Koko	19,117	64,253	45,136	47,066	-1,930	-4.4

Source: Compiled from NPA Reports: 1970 and 1982.

Table 2.10

Pattern Of Deviation of Port Total Traffic Grouped by Port Complexes - 1970 and 1982

PORT	1970 Tonnage	1982 Tonnage	Actual Growth	Hypothetical Growth	Difference Between Actual & Hypothetical Growth	% Difference (Deviation)
All Ports	4,762,436	16,484,855	11,723,419	246.2		
Lagos	3,900,734	10,438,766	6,538,032	9,603,607	-3,065,575	-46.8
Rivers	391,228	3,386,161	2,994,933	963,203	+2,031,730	+67.8
Delta	368,228	2,272,649	1,904,421	906,577	+997,844	+52.3
Calabar	102,186	388,279	286,093	251,581	+34,512	+12.1

Source: Compiled from NPA Reports: 1970 and 1982.

2.5 Concentration Changes in Import Trade

It is desirable to consider imports and exports separately because their characteristics vary markedly. During the period of study, the percentage of imports in the total foreign trade (less crude oil and petroleum products) increased from 68.2 percent in 1970 to 96.2 percent in 1982. Imports consist largely of finished manufactured goods, bulk cement, wheat grains, iron and steel products, machinery, industrial raw materials and fertilizer. The varying contributions which these import commodities made to the total import trade over the years were responsible for the changes that have occurred in the overseas import trade between 1970 and 1982.

The concentration changes in import trade (Table 2.11) bears some similarities to the pattern of concentration changes of total aggregate trade. This is not altogether surprising because imports have increasingly dominated the non-fuel international trade of the country especially since 1966.

When the ports are ranked in gross tonnage shares, in 1970 Apapa port once again dominates, with Port Harcourt and Warri ranking second and third respectively. In 1982, Apapa ranked first but with much reduced tonnage share, Port Harcourt was second, and newcomer Tin Can Island port once again dislodged Warri from the third place.

Table 2.11

Concentration Changes in Import Trade: Nigerian Ports: 1970 and 1982

PORT	1970		1982			
	1 Tonnage	2 Market Share	3 Tonnage	4 Market Share	5 Col. 3 as % of Col.1	6 % Change Cols4-2
Apapa	2,596,587	79.9	7,293,509	46.0	+280.8	-33.9
Port Harcourt	326,202	10.1	2,955,851	18.6	+906.1	+8.7
Tin Can Island	-	0.0	2,787,165	17.7	-	+17.7
Warri	252,926	7.7	1,693,258	10.6	+669.4	+2.8
Sapele	-	-	437,038	2.7	-	+2.7
Calabar	34,262	1.0	245,653	1.5	+716.9	+0.5
Koko	16,793	0.5	64,253	0.5	+382.6	-0.3
Burutu	20,384	0.7	-	-	-	-0.7
Onne	-	-	391,764	2.5	-	+2.5

Source: Computed from NPA Reports: 1970 and 1982.

2.6 Concentration Changes in Export Trade

Exports comprised 31.8 percent of total overseas trade in non-fuel cargo in 1970; but this share dropped to only 3.8 percent in 1982. This reversal of fortunes in the export trade, as compared to the import trade, is due to the dwindling emphasis placed on the internal production of agricultural crops which had constituted the bulk of the export trade. The exports consist mainly of agricultural products such as cocoa, rubber, palm produce and cotton, all of which have declined in both relative and absolute terms in Nigeria's international trade.

Table 2.12 shows the concentration changes in export volumes in 1970 and 1982. In share tonnage volumes, Apapa retains its prominent position with 86 percent of the total export trade in 1970. Calabar was second with Port Harcourt in the third place. In 1982 the first two ranks were taken by Apapa and Calabar, whilst Warri edged out Port Harcourt from the third rank. The changes that took place in export concentration are better understood by analysing the concentration changes that have taken place in the ports' handling of particular commodities.

Table 2.12

Concentration Changes in Export Volumes: Nigerian Ports: 1970 & 1982

PORT	1970 1 Tonnage	 2 Market Share	1982 3 Tonnage	 4 Market Share	5 Col. 3 as % of Col.1	6 % Change Cols4-2
Apapa	1,304,147	86.0	313,066	50.8	24.0	-35.2
Port Harcourt	65,086	4.2	27,192	4.4	41.7	+0.2
Tin Can Island	-	-	45,026	7.2	-	+7.2
Warri	55,138	3.6	63,126	10.3	114.4	+6.7
Sapele	-	-	14,974	2.4	-	+2.4
Calabar	67,924	4.4	142,626	23.1	209.9	+18.7
Koko	2,324	0.1	-	0.0	0.0	-0.1
Burutu	20,663	1.3	-	0.0	-	-1.3
Onne	-	0.0	11,364	1.8	-	+1.8

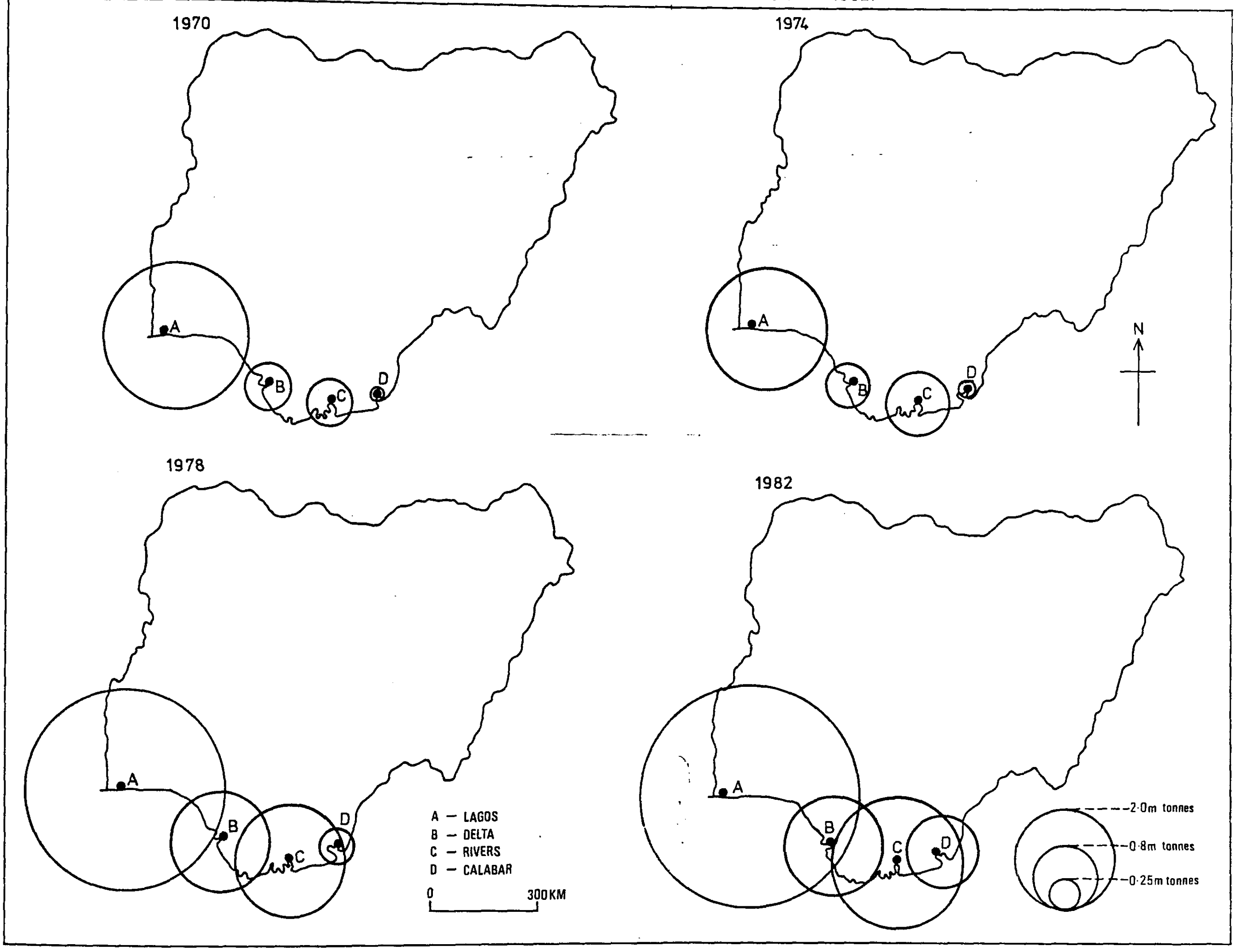
Source: Computed from NPA Reports: 1970 and 1982.

2.7 Concentration Changes in Specialisation

A notable characteristic of the traffic pattern of Nigerian ports is the fluctuating significance of the types of cargo which pass through the ports at specific periods. The aggregate trades passing through the ports have been identified and their pattern of concentration analysed (Figure 2.2). Clearly in 1970, in both absolute and relative terms, Apapa had a near monopoly of the port traffic of these commodities both in imports and exports. This was particularly true of container imports, both import and export of wheat grains and fish imports. In terms of these commodities, therefore, Apapa could be described as a specialist port. However, progressively from 1972, this pattern of concentration began to change. For example, the imported container traffic was shared among all functioning ports (except Koko) by 1982. Apapa which handled 100 percent import of container traffic in 1970, handled only 53 percent in 1982, with the new ports of Tin Can Island and Onne handling 15 percent and 14 percent respectively. Port Harcourt had a share of 13 percent, whilst Warri and Calabar shared 2 percent and 1.8 percent respectively. The monopoly of Apapa in wheat grains and fish traffic had also declined by 1982. The share of Apapa had reduced to 64.8 percent in wheat imports and 34.8 percent in fish imports. Dry bulk traffic followed the same pattern of deconcentration from Apapa to other Nigerian ports. Indeed, the only commodity that deviated from this general pattern is vegetable oil. The probable reason for this is the specialised handling requirement of this commodity and the fact that Lagos port had since the colonial times been a concentration centre for the export of the commodity.

Perhaps, a factor that has helped the deconcentration of container

Fig.2·2 CHANGING SPATIAL CONCENTRATION IN NIGERIA'S FOREIGN TRADE 1970-1982.



traffic from Apapa port is the response to changes in maritime transport technology which has resulted in the use of multi-purpose ships especially along the routes of developing countries. It is usually possible for such ships to carry a mixture of break-bulk cargo and containerised cargo.

Another factor that has also aided the process of deconcentration from Apapa is the development of the handling facilities for such cargo in other ports; for example, fish wharves at Koko and Sapele after 1970 (See Table 2.5 showing the characteristics of Nigerian port morphology). Equally, the building of flour mills at Sapele, Port Harcourt and Calabar during the third National Development Plan period was instrumental in deconcentrating wheat grains traffic from the Lagos port.

2.8 Summary and Conclusion

The above discussion has been concerned with showing the changes which have occurred in the spatial patterns of port concentration in Nigeria during the period 1970-1982. This period has been the most significant in terms of development of trade and facilities within the port system, and the changes which have taken place, during this period, have been interpreted as reflecting the characteristics of both the national and the port economies. The concentration changes in the import trade have been mainly due to a growing economy heavily dependent on booming oil exports, particularly during the latter half of the 1970s. This had a direct effect on the development of facilities and capacities at the different ports in the system. The Nigerian Government, in conjunction with the Nigerian Ports Authority, made extensive provisions to improve the capacity of the Nigerian ports through investment in new facilities. Port capacity was increased as a result.

The spatial patterns of port concentration have shown that all ports have fluctuated in significance in absolute and relative terms. Individual ports, most especially Apapa, Sapele, Burutu and Koko experienced periods of traffic concentration alternating with periods of traffic diffusion. Concentration at the level of the composite port system was manifested in terms of decrease in the number of functioning ports at any given period, whilst diffusion was manifested not only by the increase in the number of functioning ports, but also by the diversion of trade from existing ports to new ports or to new facilities built in existing ports.

The way commodities of trade shift from one port to another suggests some pattern of relationships among these ports. Port 'relatedness', a central aspect of this thesis, is linked up in the way the ports function in their competitive or complementary relationships. The pattern of international trade identified in this chapter certainly emphasises such relationships, the detailed knowledge of which may, among other things, suggest possible directions of policies and port development planning. The precise nature of such interport functional relationships is the focus of subsequent chapters (Chapter Four and Chapter Five). But before going to these chapters, it is essential that the reasoning and the policies behind the most massive development programme which Nigerian ports have witnessed to date be reviewed. The review which is done in the next chapter (Chapter Three) is done from the standpoint of theory and practice.

CHAPTER THREE

PORT DEVELOPMENT IN NIGERIA: A REVIEW OF POLICIES AND PROGRAMMES 1962 - 1985

3.1 Introduction

Since the beginning of this century, Nigeria has passed through various forms of colonial and post-colonial administrations, each with varying emphases on port development. During the post colonial period in particular, wide-ranging technological innovations in maritime transport and the growing awareness of the need for efficient seaports serving a buoyant and expanding foreign trade sector, have led to massive port development programmes. Although these port development programmes have been implemented on the basis of some official guidelines or principles, it is doubtful whether one can speak of a definite comprehensive national policy on seaport development in the country. For example, as indicated by Filani and Osayimwese (1974), port development policy has not been well articulated in Nigeria. Ports had only a brief mention in the 1965 Statement on Transport Policy (Federation of Nigeria, 1965). The Second National Development Plan made little reference to port development in general but rather stressed the need for greater coordination among the various transport modes; and this was spelt out largely in terms of the traditional rail-road problem (Federal Republic of Nigeria, 1970).

The third and fourth National Development Plans which made more specific and more detailed reference to ports, concentrated on solving the endemic port congestion problems that faced the major

Nigerian ports; but fall far short of enunciating a comprehensive policy for such development. The statements on policy left no one in doubt that improvement of port facilities and expectations of higher levels of operational efficiency in the use of these facilities were high in the government's policy.

This chapter examines the programme of port development within the context of the first four National Development Plans in Nigeria. This is viewed from the background of the theoretical framework for port development. The chapter attempts to identify those objectives which are relevant to the development of Nigerian ports, and from which performance of such ports may be evaluated.

3.2 Conceptual Framework for Port Development

The very beginning of an effective port development strategy is to state the aims and objectives for development. It is such policy objectives that provide the benchmark against which to design a programme and evaluate performance.

The development of ports could be guided by a number of objectives which can be grouped into three (Ogundana, 1978a), viz.:

(i) Objectives based on the port as a commercial enterprise.

(ii) Objectives based on the port as a service facility.

(iii) Objectives based on the port as a development node.

3.3 Objectives Based on the Port as a Commercial Enterprise

The goal of a port undertaking may be to maximise net profits; that is the difference between revenue and the total costs of financing, operating and administering the port, either in the short or long run. This is often the case where the port is private or where the government or local authorities who own the port regard it as a source of revenue.

Such a policy is particularly successful when the port is a regional monopoly and it is thus in a position to charge in excess of marginal costs without appreciably affecting the demand for port services, especially if the traffic is high valued like manufactures or strategic like industrial fuel. Policies for revenue maximisation or the maximisation of port reserves to allow the port undertaking as much working and investment capital as posible are related to the goal of maximum profit (Frankel, 1977)

This kind of policy objective is the one usually emphasised by some European and North American countries, e.g. the United Kingdom and some ports authorities in the United States of America.

The dilemma with such objectives is that they are based solely on the financial profitability of the port enterprise, and do not take social costs sufficiently into consideration.

3.4 Objectives Based on the Port as a Service Facility

Two main criteria are emphasised under this objective of service facility. They are: service sufficiency and service at least cost.

The service sufficiency policy is to ensure that a certain percentage of traffic within a given time can be serviced. This objective is essentially the same as ensuring that the average berth occupancy rate is within a specified level. The dilemma with this type of approach is how to balance ship waiting time against berth idle time. Because port planning, especially in a developing country suffers under the unpredictability of demand both by quantity and quality of cargo flow, an attempt is usually made, under these circumstances, to create port capacity that is equal to peak demand, a situation which leaves facilities unused at slack periods. As a result, ports are often over-designed and provided with excess capacity of facilities some of which may become obsolete before completion.

Such development philosophy is prevalent in most developing countries when many national ports which have suffered obvious neglect in the past, attempt to react to lack of available capacity in the existing ports which have incurred increasing congestion costs as a result of rapid increases in port throughput. The policy may also reflect the need by some of these countries to adapt to changes in shipping technology involving the accommodation of larger and more specialised vessels and in some cases a changeover from conventional cargo handling to unitisation and containerisation.

Secondly, a port may have as its policy to provide services for all or essential demand at least cost. Least cost in this context may be defined as user freight charges, or user incurred costs in port including cost of waiting time and lost opportunities, or total throughput costs, including both the costs of providing port services as well as port-incurred costs of the users of the system.

3.5 Objectives Based on the Port as a Development Node

It is common now to view ports not merely as terminals to service traffic but more as nodes which generate and attract development. It is thought that the port functions in such a way that it has some beneficial influence on the economy of the area within which it is located. The port thus possesses the characteristics of a propulsive industry and constitutes its metropolitan area into a 'growth pole' in the regional economy. Three factors induce the emergence of a port-dominated economy around the port. They are: the immediate employment potential of the port itself; that is the number of people dependent upon the port for their livelihood; what is termed the 'Perroux effect' of port functions, that is the high degree of economic linkages between the port and other industries; and the 'Keynes effects', that is the multiplier effects of port operations which mainly include services which are provided around the port to further the basic objectives of the ports, e.g. ship agency services, warehousing, storage, forwarding and clearing, packaging and repacking.

Because of the growth pole potential of the port, a port objective may be formulated to maximise economic impact on the hinterland by port investments and operations. This broad policy may be taken as involving:

(i) maximising the competitiveness of the hinterland economy by introducing effective port capacity and throughput charges.

(ii) maximising direct and indirect employment at the port, including multiplier effects.

(iii) maximising the generation of port-related industry by provision of land, access facilities and port capacity which induces such development.

(iv) minimising regional contrasts in port-induced development.

The planning philosophy of a port as a development node is now very common in developing countries where new ports or old port expansion are increasingly being used as instruments of industrialisation strategies, either by developing industrial export-processing or free trade zones adjacent to port facilities. In some of these countries, new ports have been established within a context of broader spatial development strategies at national or regional levels, usually involving political considerations..

Because of the nature of the dual economy of these countries (characterised by high degree of polaristion), a good deal of emphasis is given to decentralisation strategies to reduce the dominance of the primate city (which in most cases are port-cities), to achieve a more structured urban hierarchy, and to promote balanced regional growth (Hoyle, 1981; Robinson, 1981).

In practice, and especially in developing countries, port policy involves multiple objectives and could consist of a combination of some of those listed above.

3.6 Port Development in Nigeria: 1962-1982

At the time of independence in 1960, the Nigerian Government inherited two ports owned and managed by the colonial government; these being Apapa in Lagos and Port Harcourt. Four other ports were under private ownership and management, namely, Calabar, Warri Sapele and Burutu.

The period 1956-1961 coincided with the period of the first major wharf extensions at the two government-owned ports (there were an additional six berths at Lagos and four at Port Harcourt). Before this period, the Nigerian port system had suffered congestion since 1945. The Second World War had diverted all trade to Lagos and Port Harcourt which taxed the capacity of these two ports. Moreover, plans for port expansion at these two ports could not be implemented until after the war. Thus, extension work which was in progress in Lagos in 1954 and in Port Harcourt in 1957, was, in fact, necessitated by serious congestion.

The policy of port concentration at these two major ports was encouraged, and therefore, development of infrastructures were concentrated at these two ports. Clearly identifiable in this policy is the objective of service facility; the main interest being focused on the trade between Nigeria and Europe and North America.

The period 1962-1968 coincided with the first National Development Plan in the country, and was the first long range development programme of the Nigerian Ports Authority itself, created in 1954. The beginning of the programme saw the commencement of the second wharf extension at Apapa (Lagos) with five additional berths, and at Port Harcourt with one additional berth. The increased capacity created by earlier expansion was soon saturated. Apapa started to manifest congestion as from 1960/1961. Considerable delays to import ships continued until 1965/66 when the Apapa second wharf extension was completed.

The seemimg excess capacity during 1966/67 was soon absorbed in 1968, with the beginning of the Nigerian civil war and the consequent closure of other ports in the country. Lagos port became the country's sole outlet. Lagos port continued to be congested throughout the civil war, but the situation became serious on the conclusion of the war when shipment of relief materials and liberalisation of foreign trade resulted in unprecedented inflow of goods, e.g. cement. The worst period was from July 1975 to February 1976 when over two hundred ships were waiting daily off Lagos (Turkur, 1982).

All other Nigerian ports suffered from the glut because as ships tried to escape Lagos, they got into the net further east in Warri, Port Harcourt and Calabar. Neighbouring countries' ports, namely Benin Republic and Togo shared in this congestion.

Naturally, the civil war interrupted whatever development projects that were planned for the ports during the First National Development Plan period. After the cessation of hostilities the Nigerian Ports Authority first reaction to earlier congestion and to the damage done to facilities and equipment in other ports, was the acquisition of the privately owned ports of Warri, Burutu and Calabar. The acquisition marked the beginning of a port development programme which coincided with a four-year Second National Development Plan (1970-1974) which emphasised economic reconstruction and rehabilitation. During this period, a programme of reconstruction and rehabilitation of the six ports directly controlled by the Nigerian Ports Authority was commenced, namely, Lagos, Port Harcourt, Calabar, Warri, Burutu and Koko. The emphasis was mainly on rehabilitation and reconstruction of port structures and mechanical equipment that were damaged during the war.

As with the First National Development Plan, port planning during the Second National Development Plan was not tied to any specific objectives. Deductions can, however, be made that the plan of rehabilitation and reconstruction was ad hoc and was geared mainly to the objectives of service facility. The plan fell short of a well reasoned and comprehensive development plan which could bring about a rational port development in the country.

The period 1975-1980 which coincided with the Third National Development Plan period witnessed the next widespread development of the Nigerian port system. The development was either in the form of the building of new ports or the expansion of facilities at old ports. A new port, Tin Can Island port was built in Lagos with two roll-on-roll-off (Ro-ro) berths, one dry bulk berth and seven general cargo berths. The third Apapa wharf extensin (also in Lagos) was executed, consisting of four container berths, one roll-on-roll-off (Ro-ro) berth and two modern general cargo berths, four finger jetties and a deepened access channel and turning basin; two lighter terminals one at Kiri-Kiri and the other at Ikorodu near Lagos.

The development of Port Harcourt port was no less remarkable. There was the construction of a new Federal Ocean Terminal consisting of five general cargo berths, one container berth and one bulk berth. There was also one Federal Lighter Terminal at Onne near Port Harcourt with sixteen berths.

At Calabar, there was the construction of a new port with four modern general cargo berths. A multi-purpose Ocean Terminal, an industrial/commercial port complex was proposed to be built at

Ibeno, near Calabar. This project was expected to be completed during the Fourth National Development Plan

At Warri port, there was the rehabilitation of old berths, as well as the development of six new general cargo berths and a lighter terminal, while at Sapele port, there was the construction of five new general cargo berths and one roll-on-roll-off (Ro-ro) berth. At Koko port, in addition to the old facilities, there was the development of an ultra-modern fishing terminal as well as general cargo berth.

Whilst most of these developments were executed by 1980 which was the end of the Third National Development Plan, some of them spilled over to the Fourth National Development Plan, and unfortunately suffered from the adverse consequencies of the economic glut in the country. A notable example of such project is the proposed multi-purpose industrial/commercial port complex at Ibeno near Calabar which was estimated to cost N305.5 million.

In terms of stated objectives for port development the Third and Fourth National Development Plans were better than the First and Second. Whilst the First National Development plan made just a casual reference to port development, the second, it would be recalled, merely made a reference to the issue of greater coordination among the various modes of transport in the country; and this was spelt out largely in terms of the traditional rail-road problem.

The Third plan was specifically concerned about the problem of port congestion and, therefore, set out to emphasise considerable expansion of facilities in all five major ports in order to avert the continuing trend of port congestion.

The objective of the Fourth National Development plan recognised the dwindling revenues of the government and, therefore, sought higher levels of operational efficiency from the Nigerian Ports Authority, because of the inability of the government to grant further subsidies for development at the ports. The plan sought to tackle the problems of congestion in Lagos port on the one hand, and the problem of under utilization of the other Nigerian ports on the other.

While these objectives were not as comprehensive as one would expect, they no doubt indicated the pattern which port development would follow during the Third and Fourth Development Plans. For example, the 1975-80 Third National development plan clearly emphasised the goal of considerable expansion which was interpreted in terms of putting excess capacity at all Nigerian ports. The third Apapa wharf extension aptly demonstrated the deliberate policy of installing overcapacity at the ports. For example, the World Bank Group at the study and planning stages recommended two container berths, but the Nigerian Ports Authority at the execution stage constructed four container berths, justifying its action by what it described as the 'increasing trend of containerisation' and its experience during the congestion crisis. The planned development of lighter terminals at Onne near Port Harcourt was equally expanded at the stage of execution to include sixteen berths which could comfortably accommodate ocean going vessels.

Clearly, therefore, port development during the Third National Development Plan was geared towards the objective of the port as a service facility. It would appear, therefore, that the two main criteria of service efficiency and service at least cost were emphasised.

One very important objective, though not stated, but which can nevertheless be inferred, is the objective of port development based on the port as a development node. Right from the time of independence, Nigeria has used industrialisation as a strategy for regional development, with emphasis in industrial development being on import substitution industries. Because these industries are based mainly on imported raw materials, ports as transhipment or break-bulk locations represent minimum transport locations for such industries and, therefore, have inherent advantages for industrial location. However, these industries were concentrated at the two major ports of Lagos and Port Harcourt. Since the major objectives in the Third and Fourth National Development Plans were geared towards reducing inequalities in areas and promoting balanced development among the different geographical areas in the country, attempts were made to maximise the inherent advantage of ports to shape the spatial patterns of regional and national growth by decentralising industries form Lagos and Port Harcourt and spreading them to other ports like Warri, Calabar and Sapele. It was in furtherance of this objective that the projected port-industrial complex at Ibeno near Calabar was planned. Calabar it will be noted is one of the most economically depressed areas in the country.

The extent to which this particular objective is realised in some of the Nigerian examples given, is, in fact, a different matter altogether; but conceptually such objective is related to the notion of a 'growth pole', a set of sectorally interrelated high growth industries capable, through multiplier effects, of generating economic growth.

3.7 Summary and Conclusion

The review of port development policy attempted in this chapter shows that because of the importance of ports in the economic development of the country, port development planning during the period of the study was largely integrated with National Development Plans. The review also showed that the centralisation of decision-making in the Nigerian Ports Authority (which is a government parastatal agency) coupled with availability of development capital from oil resources, meant that the development of individual ports was no longer influenced by external competitive factors, but by deliberate government policies for development. The implications of these as far as the development of Nigerian ports was concerned was that the concept of the port at both intra-port and inter-port levels, being a system, appears not to have been taken into consideration.

It appears that for any port plan to be rational, not only must the changes in the significance of each port be taken into account, the degree of functional relationships at the two levels must also be taken into due consideration.

The following two chapters attempt to examine the issue of functional relationships, one from the point of view of maritime transport, and the other from the landward perspective.

CHAPTER FOUR

THE FUNCTIONAL STRUCTURE OF THE NIGERIAN PORT SYSTEM (1983-84)

4.1 Introduction

Ports within a regional port system, especially those that are served from common forelands, are interdependent. Such ports, by virtue of their common forelands, may have their fortunes intertwined with those of adjacent ports (Goss, 1967; Ogundana, 1970). As a result of these characteristics, the problems of capacity in planning a regional port system must, therefore, be related not only to each individual port and its maritime linkages, but also to the attainment of optimal patterns of maritime shipping linkages in the system. The approach to capacity problems, therefore, must begin with a consideration of the essential functional interdependence of ports within the regional port system (Robinson, 1970). This chapter sets out to examine the precise nature of the functional relationship by looking at the problem of functional interdependence among Nigerian ports in terms of movement of ships between the ports. Since the primary function of a port is to serve ships and their cargoes, the movement of ships between ports, therefore, creates linkages which effectively provide an index of functional or operational interdependence. The chapter also aims to show which ports within the grouping function together in competitive or complementary relationships. The analysis also aims to ascertain the largest port as well as bring into focus the port which serves as the effective operational focus within the regional port grouping.

In carrying out the analysis, three particular sets of spatial relationships are focussed upon, these being:

(a) The Nigerian ports as a focus of shipping flows.

(b) The Functional linkages that are sustained by shipping movement between the ports.

(c) The foreland orientation of shipping flows to the ports.

4.2 The Nigerian Ports as a Focus of Shipping Flows.

A common measure in the gauging of the status of a port is the combination of the Net Registered Tonnage (NRT) and the number of ships visiting that port over a given period of time (Rimmer, 1966). A combination of these two measures is used in the analysis in this chapter. Table 4.1 shows the pattern of ship visits to Nigerian Ports in 1983-84. In terms of the number of ship calls and the average Net Registered Tonnage of the ships, Apapa remains dominant with 34.8 percent of ship calls. When the two ports of Apapa and Tin Can Island are grouped together (because of their location in Lagos), their combined status within the regional port system is enhanced with 58.3 percent of the total number of ship calls. There appears to be a close relationship betwen the status of individual ports (based on the number of calls) and the average size of vessels (as represented by the average NRT) making the calls. With the exception of Calabar, the more dominant ports appear to have bigger vessels calling at them. The overall pattern of ship calls would tend to suggest the degree of usage to which individual ports within the port system are being put. The combined effects of higher number of ship calls and larger vessels would confer greater dominance on the dominant ports.

Table 4.1

Pattern of Ship Visits to Nigerian Ports (1983-84)

Port	No. of Ships	%	Average NRT
Apapa	794	34.8	4971
Tin Can Island	537	23.5	4764
Port Harcourt	443	19.4	4714
Warri	282	12.3	4696
Sapele	108	4.7	3024
Onne	63	2.7	2214
Calabar	38	1.7	3205
Koko	21	0.9	1144
TOTAL	2286	100.0	

Source: Compiled from NPA Records, 1984.

N.B. Number of ships include those that made more than one port call.

The pattern depicted in Table 4.1 only shows the number of calls at each port, while obscuring information about ships which leave the first port of call to visit other ports. The major ship movement sequences for the whole port system as well as for individual ports are shown in Tables 4.2 and 4.3 respectively.

Table 4.2

Major Shipping Movement Sequences: Nigerian Ports (1983-84)

No. of Ports in Sequence	No. of Ship Calls	%	Cumulative %
1 only	1346	58.90	58.90
2 only	934	40.86	99.76
3 only	5	0.20	99.96
4 only	1	0.04	100.0

Source: Compiled from NPA Records, 1984.

Table 4.2 shows that more than 99 percent of the ship calls are involved in one or two movement sequences, implying that 58 percent visited just one Nigerian port, whilst 40.8 percent called at two Nigerian ports before leaving the system. No ship visited more than four Nigerian ports during one voyage.

Table 4.3

Percentage of Ships in Movement Sequences at Individual Ports

PORT	1 1 Port Only	2 2 Only	3 3 Only	4 4 Only	5 Total
Apapa	63.3	36.1	0.4	0.2	100
Tin Can Island	65.0	34.6	0.4	0.0	100
Port Harcourt	31.6	68.4	0.0	0.0	100
Warri	55.7	44.3	0.0	0.0	100
Sapele	90.7	9.3	0.0	0.0	100
Onne	95.2	4.8	0.0	0.0	100
Calabar	55.3	44.7	0.0	0.0	100
Koko	85.7	14.3	0.0	0.0	100

Source: Computed from NPA Records, 1984.

Table 4.3 shows the number of ships in given sequence patterns disaggregated at the individual port level. Very low and zero percentages in columns 3 and 4 imply that vessels rarely visit more than two Nigerian ports during any voyage during the period of study. Indeed, it is in the Lagos ports that ships which made their first port call visit three and four ports; but such ships are indeed very few, representing 0.4 percent for three port visits at both Apapa and Tin Can Island, and 0.2 percent for four port visits at Apapa. The table also suggests that individual Nigerian ports are linked in at least two sequence movements with other ports in the system. In terms of relationship, and within the Nigerian port system, therefore, no single port is an isolated phenomenon. However, the degree of linkage within the two movement sequence structure varies with lower percentage values in column 2, suggesting minimal linkage. For example, Onne, Sapele, and Koko have more than 80 percent of the total number of ship calls limited to them, whilst Port Harcourt, Calabar and Warri have more than 40 percent of ships visiting them linked with one other Nigerian port. The importance of Port Harcourt in particular, is empahsised in this two sequence movement structure with 68.4 percent of ships calling at that port being linked with one other Nigerian port. Once again, as in the case of Table 4.1, the trend in Table 4.3 (with the exception of Calabar) suggests some kind of relationship between port status and the degree of port linkage as emphasised in this case by the number of ships involved in particular movement sequences. There appears to be a trend towards decreasing linkage with decreasing status of ports. Indeed, the higher percentage of one port call sequence visits in column 1 seems to confirm the hypothesis that smaller ports located in peripheral areas are not likely to be increasingly served by shipping services from ports in central areas, but have direct services of their own (Bird, 1982, p.15). Column 1 shows that 95.2 percent, 90.7 percent and 85.7 percent of total ship calls to Onne, Sapele and Koko respectively, represent direct shipping to these ports.

The linkage pattern within the Nigerian port system in 1984 probably underestimates the degree of linkage which normally characterises the port system. The explanation for the relative independence of some of the minor ports is probably related indirectly to the economic crisis in the country in 1984; and directly to the type of cargo handled by these ports in 1984. As a result of the rationalisation of shipping services brought about by the downturn in international trade to Nigerian ports, the operational ship schedule of some of the major U.K. liner shipping companies, surveyed during the study, has completely excluded ports like Sapele, Koko Onne and to some extent Calabar. The implications are that these ports are no longer linked by the regular liner services. However, because of the needs of industries like flour mills, and construction industries, located at these ports, raw materials are mainly imported through chartered non-liner ships.

The example of Sapele port emphasises this point clearly. Of the ninety-eight ships representing 90.7 percent of the total number of ship calls to Sapele in 1983-84, 54.1 percent carried frozen fish, 15 percent bitumen, 10.2 percent each carried construction cement and wheat flours, whilst 5.1 percent each carried salt and explosives (Field Data, 1984).

4.3 Foreland Orientation of Shipping Flows to Nigerian Ports

The relationship among ports in a regional port system rests on functional association and interdependence, measured from either the maritime or landward perspective (Ogundana, 1970). On the strength of this assertion, it is suggested that ports which are served by the same shiping services, and as a result, are linked to common forelands, are within those foreland areas related. The link by the shipping services would imply that the shipping needs at the regional ports of destination would be identical. Furthermore, the relationship between port structure and foreland spread would provide some insight into the status of ports in a regional port system.

Table 4.4 shows the grouping of the import forelands for each of the Nigerian ports into foreland areas. The importance of each foreland area is measured on the basis of the number of shipping movements received from each foreland area by each port. A port which has shipping exchanges with a limited number of foreland areas has a restricted or concentrated foreland structure, whereas, another port with a wider spread of shipping exchanges, has a diffused foreland influence (Ogundana, 1972).

Table 4.4

Foreland Origins of Shipping Movements to Nigerian Ports

Port Destination	Foreland Origin (% of Ships) 1	2	3	4	5	6	7	8	Total No. of Ships
Apapa	28.5	31.3	43.4	41.7	38.0	45.1	22.5	25.0	794
Tin Can Island	16.4	18.8	35.3	32.8	25.2	41.1	10.0	9.1	537
Port Harcourt	33.7	21.4	5.2	20.5	19.3	9.2	14.2	26.8	443
Warri	11.6	14.9	16.1	4.3	5.9	4.6	53.3	5.0	282
Sapele	4.0	3.4	0.0	0.0	7.1	0.0	0.0	24.1	108
Calabar	4.0	2.8	0.0	0.7	1.5	0.0	0.0	1.8	38
Koko	0.0	0.4	0.0	0.0	0.0	0.0	0.0	8.2	21
Onne	1.8	7.0	6.0	0.0	3.0	0.0	0.0	0.0	63
TOTAL	100	100	100	100	100	100	100	100	2286
Total No. of Ships	172	713	249	302	337	173	120	220	

Key:
1. United Kingdom and Ireland
2. Continental Europe
3. The Far East Countries
4. The Mediterranean Countries
5. United States of America and Canada
6. South America
7. Africa and Its Islands
8. High Seas

Source: Compiled from NPA Records, Lagos, 1984.

On the strength of these assertions, and drawing conclusions from Table 4.4, Continental Europe, the United States of America and Canada, and the United Kingdom and Ireland constitute the dominant foreland areas to Nigerian ports as a whole in 1983-84. Shipping services from these foreland areas are shared by both major and minor Nigerian ports. On the contrary, the Far East countries, South America and Africa have the least number of shipping exchanges, and by definition, constitute the peripheral foreland areas. Shipping services from the peripheral foreland areas are routed predominantly through the major ports.

The location of the two Lagos ports of Apapa and Tin Can Island in relation to the foreland areas of all Nigerian ports confers some advantages on these two ports. Table 4.5 shows information about the average length of sea voyage which ships make to each Nigerian port, from different foreland areas. Clearly, ships from five of the six foreland areas shown travel less distance to reach the Lagos port than other Nigerian ports. The two Lagos ports, therefore, constitute the shortest sea route and the first port of call for 1697 vessels, representing 74.2 percent of the total number of ship calls made to Nigerian ports from these foreland areas.

Table 4.5

Average Sea Voyage by Ships Visiting Nigerian Ports (Nautical Miles)

Foreland Ports*	Lagos	Port Harcourt	Delta	Calabar
Liverpool	4067	4382	4251	4461
Hamburg	4155	4470	4339	4549
Hongkong	9494	9179	9310	9100
Marseilles	3787	4102	3971	4181
New York	4960	5275	5144	5354
Buenos Aires	4300	4615	4484	4694

* Chosen as approximation of the locus of foreland areas.
Source: Compiled from NPA Magazine, 1981.

The foreland structure depicted in Table 4.4 has implications for port growth and development in the country. The extension of trade ties to new and peripheral foreland areas (as demonstrated by the example of trade to South America and the Far east) tends to benefit, first the existing major port, thereby leading to further traffic aggregation at the port. With further traffic growth at such ports, there will be further additions to the existing superior terminal facilities which are already installed at those ports. On the other hand, the sharing of the traffic from the dominant fore-lands among all Nigerian ports would mean that the port facilities that handle such traffic will be provided at all these ports.

4.4 Linkage Patterns in the Nigerian Port System - 1983-84

The first two parts of this chapter focused attention on the array of shipping flows and the pattern of ship visits to Nigerian ports. The focal point of the precise nature of relationships between the ports as created by these array of ships will now be examined.

Structural pattern implies a definable set of relationships which hold together a number of elements or objects in juxtaposition one with another. Thus, the relationships themselves, or in this particular case, the linkages between the elements, take on major importance in the definition of structure (Clark, 1973). Within the context of this study, the spatial or functional organisation that is present within the structure of the Nigerian port system is defined in terms of functionality as identified through an interaction matrix describing the shipping linkages existing between the ports within the Nigerian port system.

Interaction or flow matrices have often been used in investigating flows while searching for patterns of spatial or functional interaction (Nystuen and Dacey, 1961; Clarke, 1973; Holmes, 1978). Many different methods ranging from the primary linkage analysis (Nystuen and Dacey, 1961); factor analysis (Goddard, 1970); and Markov chain analysis (Marble, 1964; Robinson and Takacs, 1978) have been used. In such studies, usually mainly directed towards describing and interpreting interaction or flow systems, interactions are usually depicted in dyadic matrices, in which each score indicates a flow between an origin-destination dyad. Commonly, though not always, these matrices are square with each origin also acting as a destination.

Within the context of the study objective in this chapter, primary linkage analysis (graph theoretical analysis) is used. This method is useful when the objective is to identify the overall system structure. It is designed to provide measures of relative strength of interaction. It is an ideal method used when one powerful system-wide higher-order interaction pattern, focuses, for example, on a dominant node, and completely overshadows a series of lower-order interaction sub-systems, as in the case with the Nigerian port system (Holmes, 1978). Moreover, primary linkage analysis has the advantage of simplicity and robustness, as well as ease in application and interpretation.

The main data used for the analysis is the ship visit data from port to port arranged into a port-to-port square matrix (Table 4.6). Digraphs derived from the port-to-port ship visit data are used as the basis for the description of interport functional relationship. Because of the irreflexive nature of digraphs, intra-port movement of ships were eliminated from the analysis; that is all entries on the principal diagonal of the matrix were set equal to zero. The result of this was an aggregated net flow matrix of ship movement within the Nigerian port system (Table 4.6)

Table 4.6

Port-to-port Interaction Matrix Showing Shipping Flows Among Nigerian Ports: 1983-84

	NO. OF SHIPS								
	Apapa	TCI	PH	Warri	Sap.	Cal.	Koko	Onne	Total
Apapa	-	7	161	67	5	17	3	2	262
Tin Can Island	10	-	105	40	5	0	0	1	161
Port Harcourt	15	14	-	5	0	0	0	0	34
Warri	4	6	3	-	0	0	0	0	13
Sapele	0	0	0	0	-	0	0	0	0
Calabar	0	0	0	0	0	-	0	0	0
Koko	0	0	0	0	0	0	-	0	0
Onne	0	0	0	0	0	0	0	-	0
TOTAL	29	27	269	112	10	17	3	3	470

Source: Complied from NPA Records, Lagos, 1984.

An adjacency matrix (Table 4.7) was constructed from the aggregated shipping net flows matrix in Table 4.6. This adjacency matrix constitutes the basic data for the remainder of the analysis.

The matrix includes one row and one column for each port, and the approach to the construction of the adjacency matrix is as follows: If there is a flow of ships from port x to port y, the entry at the intersection of row x and column y is '1'; if on the other hand, there is no flow from x to port y, the entry x,y is '0'. A digraph of the interport shipping linkages based on this recorded adjacency matrix is shown in Figure 4.1. The arcs of the digraph represent the movements of ships between ports with the arrow pointing from the originating port to the receiving port.

Table 4.7

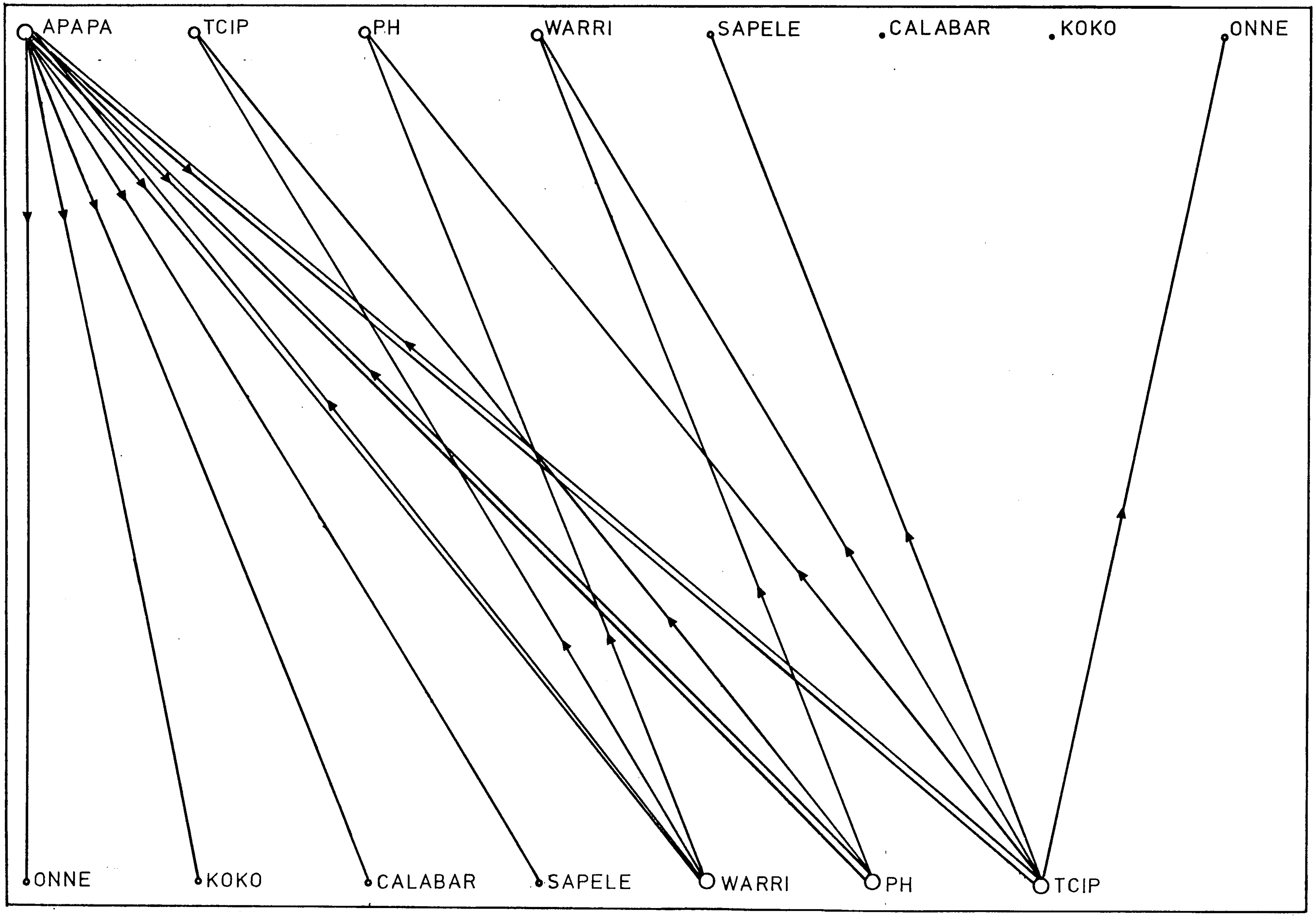
Adjacency Matrix Based on Aggregated Net Movement of Ships

	Apapa	TCI	PH	Warri	Sap.	Cal.	Koko	Onne	d^+
Apapa	0	1	1	1	1	1	1	1	7
Tin Can Island	1	0	1	1	1	0	0	1	5
Port Harcourt	1	1	0	1	0	0	0	0	3
Warri	1	1	1	0	0	0	0	0	3
Sapele	0	0	0	0	0	0	0	0	0
Calabar	0	0	0	0	0	0	0	0	0
Koko	0	0	0	0	0	0	0	0	0
Onne	0	0	0	0	0	0	0	0	0
d^-	3	3	3	3	2	1	1	2	

Source: Derived from Table 4.6.

From the digraph the percentage of connectivity (PC) of the Nigerian port system, based on interport ship movement can be calculated. The percentage of connectivity compares the total possible number of arcs in a dagraph containing v vertices, that is v(v-1) with the total observed number of arcs in the dagraph. The percentage of connectivity is given by the formula:

Figure 4·1 DIGRAPH OF INTERPORT SHIPPING LINKAGES



$$PC = \left[\frac{aobs}{v(v-1)}\right] 100$$

For the Nigerian port system, the measure is:

$$PC = \left[\frac{18}{8(7)}\right] 100$$

$$= 32.1$$

This measure indicates that 32.1 percent of the possible interport shipping flows are found within the Nigerian port system, Although the index is not significant, it nevertheless gives an idea of the degree of connectivity sustained by interport shipping linkages within Nigerian ports.

A comparison of this index of connectivity with connectivity of the port system in other developing or developed countries would be appropriate, at least as a means of gauging the connectivity of the Nigerian port system. However, it is noted that such statistics showing the port-to-port movement of foreign trade ships are not easily available in the developing countries. Also, comparison with ports of developed countries is very difficult to make because the trend in shipping in such countries is towards intensified containerisation. More than 70 percent of the trade between developed countries is carried in new purpose built cellular ships. For such trades, the need to decrease the number of ships calls in order to boost productivity has led to ships visiting fewer ports, in most cases, only one national port. In the early 1980s according to Containerisation International (1983), trade along the Mediterranean sea route, was focused mainly on Genoa which constituted a springboard of feeder connections with Malta, Libya and Tunisia.

Similarly, on the far East-U.K. and Continental Europe route, the U.K. is served by just one port, Southampton. The South African trade with the U.K. equally operates through Southampton only, whilst the Australian trade is served through Tilbury (Gilman and Williams, 1976). In these developed countries, the national ports are connected not by main-line shipping services, as the Nigerian example indicates, but by feeder-shipping services. However, if the 'links-no-links' measures involving main route ships were to be applied to the U.K. ports in respect of trade from the countries cited above, the percentage of connectivity of the major U.K. ports would be zero, because, as was explained earlier, it is only feeder services that link some of these ports.

The percentage of connectivity although it accurately measures the general linkage characteristics of the whole network in terms of 'links-no-links', does not, however, give due consideration to the importance of each node in the network in terms of this linkage. A measure which incorporates the significance of each node, and which is directly related to one of the objectives of this study is that of relative centrality within the system.

Following the suggestion of Campbell (1975), the first step in the calculation of the index of relative centrality is the derivation of a distance matrix. The distance matrix indicates by an appropriate entry in each cell aij, the number of steps along a sequence of arcs providing the shortest path i ... If each directed path exists j is reachable from i, if it does not exist, j is said to be unreachable from i, and the entry aij is infinity (∞). A distance matrix of the Nigerian port system, derived from the digraph shown in Figure 4.1 (See Table 4.8) indicates that only half of the vertices in the digraph are reachable within a maximum of two steps from all the other vertices. The lack of mutual reachability in the other half of the vertices indicates that the entire digraph is a weak one (Harary et at, 1965, p.64)

Table 4.8

Distance Matrix of Aggregated Net Movement of Ships

	Apapa	TCI	PH	Warri	Sap.	Cal.	Koko	Onne	ai	$\sum di^j/ai$
Apapa	0	1	1	1	1	1	1	1	7	5.4
Tin Can Island	1	0	1	1	1	2	2	1	9	4.2
Port Harcourt	1	1	0	1	2	2	2	2	11	3.5
Warri	1	1	1	0	2	2	2	2	11	3.5
Sapele	0	0	0	0	0	0	0	0	0	0.0
Calabar	0	0	0	0	0	0	0	0	0	0.0
Koko	0	0	0	0	0	0	0	0	0	0.0
Onne	0	0	0	0	0	0	0	0	0	0.0
$\sum$ dij = 38									38	

Source: Derived from Figure 4.1. $\sum$dij = 38

On further analysis, the rows of the distance matrix were totaled (ai), and the total distance in the matrix derived ($\sum$ dij). The index of the relative centrality ($\sum$ dij/ai) was computed for each vertex, and the result was entered in the last column of Table 4.8. From the analysis, the ports are ranked according to their position of centrality within the total port system (Table 4.9). From the table, Apapa and Tin Can Island come out top; followed by Port Harcourt and Warri. The ports of Sapele, Calabar, Koko and Onne recorded zero values which suggest that these ports are 'peripheral' within the Nigerian port system.

Table 4.9

Rank Order of Position of Centrality Within the Nigerian Port System

RANK	PORT	No. of Direct Connections to Other Ports
1	Apapa	7
2	Tin Can Island	5
3	Port Harcourt	3
5	Warri	3
5	Sapele	0
5	Calabar	0
5	Koko	0
5	Onne	0

Source: Compiled from Table 4.8

The relative centrality derived from the analysis reflects the general nature of the linkages of the ports, showing very little of the strength of the relationship in shipping inputs. It is, therefore, necessary to have a measure which indicates the closeness of each port's ties with other ports in the system, using such inputs and outputs. Accordingly, the linkage pattern is further examined along the lines suggested by Leontief (1965) who suggested two linkage measures which may be utilized as criteria for the simplification of an input-output structure. These are supply and demand linkages. Following this suggestion, the port-to-port matrix showing shipping movements are viewed as input-output matrix. In each row of the matrix, the cells which meet the definition for a demand link are identified. These cells represent the principal interport markets of the given port. Similarly, in each column of the matrix, the cells which meet the definition for a supply link are identified. These cells represent the principal sources of shipping inputs for a given port. Two ports may be considered to be linked if either the supply or the demand link definition is satisfied, following the interpretation of Ritchier (1965, p.25). The port linkages are defined on the basis of the sizes of the shipping input-output coefficients. If there are n ports in the matrix, two ports would be considered as linked if one sends $1/_{n}$th or more of its output to the other, or if one receives $1/_{n}$th or more of its input from the other. The former is a demand linkage, and the latter, a supply linkage. Since the port-to-port matrix has a total of eight ports, two ports are linked if one port sends at least 12.5 percent of its output to the other, or if one receives at least 12.5 percent of its input from the other.

Tables 4.10 and 4.11 show the demand and supply matrices for the Nigerian port system. and Table 4.12 is the adjacency matrix derived from them. For example, in Table 4.10 the cell value of 2.7 percent indicates that 2.7 percent of the total ship exchanges of Apapa with other Nigerian ports is sent to Tin Can Island port, whereas in Table 4.11, the cell value of 25.9 indicates that 25.9 percent of the total ship exchanges from all other Nigerian ports received by Tin Can Island port are sent from Apapa port.

Table 4.10

Demand Linkage Matrix for Nigerian Port System Shipping Flows

	Apapa	TCI	PH	Warri	Sap.	Cal.	Koko	Onne
Apapa	.	2.7	61.4	25.6	1.9	6.4	1.1	0.8
Tin Can Island	6.2	.	65.2	24.8	3.1	0.0	0.0	0.6
Port Harcourt	44.1	41.2	.	14.7	0.0	0.0	0.0	0.0
Warri	30.8	46.2	23.1	.	0.0	0.0	0.0	0.0
Sapele	0.0	0.0	0.0	0.0	.	0.0	0.0	0.0
Calabar	0.0	0.0	0.0	0.0	0.0	.	0.0	0.0
Koko	0.0	0.0	0.0	0.0	0.0	0.0	.	0.0
Onne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.

Table 4.11

Supply Linkage Matrix for Nigerian Port System Shipping Flows

	Apapa	TCI	PH	Warri	Sap.	Cal.	Koko	Onne
Apapa	.	25.9	59.8	59.8	50.0	100.0	100.0	66.7
Tin Can Island	34.5	.	39.1	35.7	50.0	0.0	0.0	33.3
Port Harcourt	51.7	51.9	.	4.5	0.0	0.0	0.0	0.0
Warri	13.8	22.2	1.1	.	0.0	0.0	0.0	0.0
Sapele	0.0	0.0	0.0	0.0	.	0.0	0.0	0.0
Calabar	0.0	0.0	0.0	0.0	0.0	.	0.0	0.0
Koko	0.0	0.0	0.0	0.0	0.0	0.0	.	0.0
Onne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.

Table 4.12

Adjancency Matrix Based on Demand and Supply Linkage Matrices

	Apapa	TCI	PH	Warri	Sap.	Cal.	Koko	Onne	
Apapa	0	1	1	1	1	1	1	1	7
Tin Can Island	1	0	1	1	1	0	0	1	5
Port Harcourt	1	1	0	1	0	0	0	0	3
Warri	1	1	1	0	0	0	0	0	3
Sapele	0	0	0	0	0	0	0	0	0
Calabar	0	0	0	0	0	0	0	0	0
Koko	0	0	0	0	0	0	0	0	0
Onne	0	0	0	0	0	0	0	0	0

Sources: Compiled from Table 4.6.

The percentage of connectivity (PC) of 32.1 shows that the inclusion of shipping inputs and outputs from and to the respective ports does not imprOve the value of the index of connectivity. The result, however, once again confirms the relative centrality of Apapa,Tin Can Island, Port Harcourt and Warri (Table 4.9).

The result of the various statistical analysis in the previous sections reveals the high degree of functional ties among the major Nigerian ports on the one hand, and the functional independence of the minor ports on the other. Further empirical evidence from the total interaction matrix for all ships visiting the Nigerian port system in 1983-84 confirms this pattern (Table 4.13). In Table 4.13, the foreland origin of all ships is included so that the matrix can include the number of ships that made just one port call and returned to the foreland. The entry vector (in the matrix) from foreland to all ports, therefore, indicates the number of ships that moved directly from their respective foreland origins to individual ports. This vector (row) not only indicates the importance of some ports within the system, but also emphasises the dominance of Apapa and Tin can Island within the pattern. The exit vector, from individual ports to foreland indicates the importance of these ports as the last port of call[1]. Thus, a larger number of ships leave directly from Port Harcourt, Warri and Sapele, relative to the number of ships that came directly from their respective forelands. The positions of Port Harcourt and Warri are particularly significant in the linkage pattern with more than 200 percent and 150 percent respectively of the number of ships received directly from the forelands sailing out from them. Many calls within the matrix have zero values which suggests a considerable degree of functional independence.

Table 4.13

Foreland to Port Interaction Matrix for Ships

	F'land	Apapa	TCI	PH	Warri	Sap.	Cal.	Koko	Onne	Total
Apapa	.	765	510	174	170	98	21	18	60	1816
Tin Can Island	532	.	7	161	67	5	17	3	2	794
Port Harcourt	409	15	14	.	5	0	0	0	0	443
Warri	269	4	6	3	.	0	0	0	0	282
Sapele	108	0	0	0	0	.	0	0	0	108
Calabar	38	0	0	0	0	0	..	0	0	38
Koko	21	0	0	0	0	0	0	.	0	21
Onne	63	0	0	0	0	0	0	0	.	63
TOTAL	1816	794	537	443	282	108	38	21	63	

Sources: Compiled from Tables 4.4 and 4.6

If the total interaction patterns are further disaggregated by vessel/cargo type, it is possible to clarify the role of the particular ship types within the overall interaction pattern. The matrices in Table 4.14 (A-F)(See Appendix 1 to Chapter 4) show the total interaction patterns for the seven major user types of ships. Although the classification is not mutually exclusive, the specific patterns are quite different as they are revealing.

Most of the matrices depict highly directional pattern of movement from the foreland origins to the respective port destinations. Onne and Apapa remain the focus of ships carrying containers and barges (A). Whilst Apapa is linked with Port Harcourt and Warri in this traffic, Onne demonstrates some form of independence. The movements of refrigerated cargo (B), combined roll-on-roll-off and container (D) and container traffic (E) similarly exhibit highly directional pattern from their foreland origins to their ports of destination. These vessel/cargo types show remarkably distinct spatial patterns which to a large extent suggest some relationship with specialised facilities present at these ports (See Table 2.5), but more specifically relate to the geographical characteristics of the hinterland division of these ports. For example, the container ships (E) depict a highly directional pattern of movement from the foreland to Apapa port. The absence of link movement with other Nigerian ports suggests that no other Nigerian port has full container terminal facilities for servicing such category of ships[2]. Similarly, the roll-on-roll-off/container vessels are greatly focused on Tin Can Island port from where Warri and port Harcourt are linked.

The matrices for dry bulk and refrigerated ships indicate the importance of these categories of ships in all Nigerian ports (with the exception of the port of Onne). Again, the matrices confirm very little linkage between the ports: the only linkages being those between the two Lagos ports and Port Harcourt, Warri and Calabar. The bulk of the dry bulk vessels involved in this linkage carry bulk cement and bulk wheat, whilst the ones visiting Warri and Sapele carry mainly iron-ore and construction cement. The apparent dominance of the Delta ports of Warri and Sapele in the dry bulk cargo is no doubt linked with the goegraphical characteristics of their hinterlands in terms of the spread of industries, to which reference has already been made in Chapter Two. The Delta ports are fast becoming a major commercial and industrial centre of the country, with a second petroleum oil refinery in Warri, and a steel reduction plant in Aladja near Warri. It also has the main integrated Ajaokuta Iron and Steel industry in its transport hinterland.[3]

The lack of linkage in the pattern of ship visit of refrigrated cargo, which includes mainly frozen fish and meat, is not difficult to understand. The perishable nature of this type of cargo makes shipping around unsuitable for the cargo. Apapa,Koko and Sapele have specialised fishery berths. Other ports use general cargo for discharging the fish and meat.

The matrices of the general/container ships (F) suggest the most extensive set of links. The foreland links focus on Apapa and Tin Can Island ports from where intra-system links are made with all the other Nigerian ports. Indeed, the linkage pattern is significantly different from the pattern of port independence which is depicted for all other vessel/cargo types. The reasons for this pattern are not dificult to understand. First unlike the other types of cargo which are specialised cargo, the cargo involved in this category of movement are probably a mixture of commercial, consumer and industrial cargo which are in high demand in all port hinterlands. As a result of the cargo type and mix, this category falls into that which fits into the regular pattern of ship operating schedules to the Nigerian ports. Furthermore, these vesels are usually loaded in the import foreland countries with consignments destined for more than one Nigerian port. In some cases, the amount of cargo destined to a partcular port location may not be up to a full load. In such cases consignments to one other Nigerian port are included. It would appear, therefore, that a very important factor in routing a particular ship/cargo type through a particular port or combination of Nigerian ports is the amount of cargo that is available at that particular foreland country. This linkage pattern created by this category of ship is probably a result of the policy of shipping companies attempting to attain a given level of service by taking advantage of economies of scale while retaining the service frequency to satisfy shippers or consignees.

4.5 Evaluation of Vessel Itineraries

One method of rationalising ship movements within the Nigerian port system is to have shipping services with different itineraries, but with the Lagos ports as the focus. Three types of such itineraries adopted by five major shipping companies sampled for the evaluation of ship itineraries emerge; they are: Lagos ports only; Lagos ports and Port Harcourt; Lagos ports and Warri. In the evaluation of the itineraries, the addition of one other Nigerian port to Lagos port during a particular voyage is assessed, using cost calculations relating to both marine and inland sector costs. Specifically, three categories of costs of shipping goods through Nigerian ports are used in the calculations; they are: ocean costs of using an additional port to Lagos ports; ship waiting times at the additional port, and landside transport costs to the port users. A number of assumptions are made in the calcualtion of these costs. For example, inland sector costs are calculated using the hinterland distribution and freight rate models of 1979[4] (Appendix 2 to Chapter Four). In lieu of steaming costs of ships from Lagos to either Warri or Port Harcourt, the number of days of travel time is used as the basis for the calculation of additional ocean costs for adding one port to the itinerary. The cost of maintaining a ship of the average size that is used to link these ports is assumed to be N5,000 per day[5].

Tables 4.15 and 4.16 show the tonnages and the number of containers handled by the five sampled shipping companies during May 1983 to May 1984. The statistics are in respect of ships involved in two-port itineraries during this period. These shipping companies, between them, handled more than 35 percent of all imports to Lagos ports during this period. The two tables constitute the source data for the calculations of costs in Appendix 2 to Chapter Four.

Table 4.15

Tonnages Discharged by Sampled Ships on Two-Port Itineraries

(1983-84)

Shipping Co.	Lagos-Port Harcourt			Lagos-Warri		
	Lagos	Port Harcourt	No. of Ships	Lagos	Warri	No. of Ships
Umarco	100,126	78,745	30	72,222	28,777	14
Alraine	25,001	30,128	8	26,134	21,033	8
Lansal	90,404	63,707	21	18,751	14,788	3
Wasa	52,262	28,463	13	32,867	24,946	10
Golden Eagle	43,966	27,368	13	18,347	6,888	3
TOTAL	311,759	228,411	85	168,321	96,432	38

Source: Compiled from Field Survey, 1984.

Table 4.16

Containers Discharged by Sampled Ships on Two-Port Itineraries

(1983-84)

Shipping Co.	No. of Containers Handled	
	Port Harcourt	Warri
Umarco	886	207
Alraine	707	154
Lansal	500	88
Wasa	323	61
Golden Eagle	593	46
TOTAL	3009	556

Source: Compiled from Field Survey, 1984.

The Appendix summarises results of cost calculations for the addition of another port to Lagos during any one voyage. In the analysis, the use of Lagos port alone is compared with the addition of either Port Harcourt or Warri with Lagos port. These ports, it will be remembered from the analysis in the previous sections, serve as the functional focus within the network of the Nigerian port system; and in almost all cases sampled, Lagos serves as the first port of call. The relatively high proportion of cargo that is discharged at Port Harcourt and Warri compared to the tonnage discharged at Lagos, tends to make the case for diversion of import cargo ships to a second port very strong. This argument is strengthened by the capacity constraints of inland transport sector in Lagos. Because of the heavy reliance on road transport, it may not be feasible distributing all import commodities through already congested Lagos roads. Secondly, total cost calculations show some modest savings of N6.2 per tonne and N10.9 per tonne with diversions to Port Harcourt and Warri respectively. The high differentials in inland sector costs between Lagos only and Lagos and Port Harcourt or Lagos and Warri tend to emphasise the greater importance of inland transport in the total costs calculations. The inland sector costs are obviously more important than ocean sector costs. This factor probably explains the desirability of discharging import cargo in ports that are closest to the ultimate hinterlands of the cargo. This, by implication, justifies a two-port model of itinerary for import ships using the ports of Lagos, Port Harcourt and Warri. However, owing to special local circumstances or some marketing reasons, some individual operators may find each itinerary uneconomic.

4.6 Summary and Conclusion

Concern in this chapter has been with the relational structure of ports and with the identification of the effective functional focus within Nigeria's regional port system. Shipping inputs and shipping movements have been used in the analysis because of the importance of shipping as generators of changes in port concentration and as the initiators of changes in the hierarchical structuring of ports. The ports of Lagos, Port Harcourt and Warri, remain the effective functional focus within the Nigerian port system. The conclusions that may be drawn from the analyses are that linkages betwen ports, in terms of the intensity of or volume of shipping movements on the linkages, do provide a basis for the interpretation of the functional structuring of ports within the Nigerian system of ports. The results show that a two-port model of shipping itinerary is economic for the system, with Lagos remaining the focus and the first port of call. The main justification for this two-port model of shipping itinerary appears to be the high cost of inland sector distribution, and the significant proportion of cargo destined for the second port in the itinerary. If, however, the cargo involved in the diversion to a second port is not significant, the advantage of distributing imports through two ports may be lost. This is probably why a diversion from Lagos to Sapele or Calabar on a regular scheduled basis may not be a paying proposition. One proposition which appears to be feasible, but which has not been considered in this analysis is the use of feeder services to link the second port from a 'Lagos only' itinerary. The use of feeder services will no doubt substantially reduce the ocean sector costs of distribution of import cargo.

The results of the analysis in this chapter have implications for the provision of facilities at ports which are linked together by the same shipping services. Since the same ships call at these ports, facilities at such ports must be provided to the same standard, which would mean, in some cases, the duplication of expensive port facilities. If the cost of providing these facilities were to be added to the overall costs, then a two port itinerary may be more costly than a one port itinerary. This again will strengthen the case for the use of feeder services. In conclusion, functional linkages that are identified in this chapter have been assessed from the point of view of shipping linkages. Another point of view through which functional linkages in the port system can be assessed is from the hinterland space. The next chapter focuses on this.

NOTES

1. Many of the vessels will invariably go back to the foreland through Lagos ports. Many of such vessels are either on 'orders' or they are 'in ballast'. Since such vessels are empty, they are excluded from vessels visiting Lagos ports.

2. Although container boxes are discharged at almost every Nigerian port, such containers are carried in all purpose semi-cellular vessels, as against the purpose built cellular vessels which discharge at the Container Terminal at Apapa port.

3. The Ogunnu Wharf near Warri handles exclusively cargo for the Ajaokuta Iron and Steel Industry. The industry itself is located in Kwara State.

4. In the absence of hinterland distribution statistics for Port Harcourt and Warri ports in 1983-84, the 1979 distribution model is used as an approximation of inland destination of imports. The 1982 published freight rates for inland haulage of import commodities are assumed for 1983-84 (See Chapter Five).

5. Information was given by the Nigerian National Shipping Line based in Liverpool.

CHAPTER FIVE

THE HINTERLAND STRUCTURE AND THE PATTERN OF FUNCTIONAL RELATIONSHIP IN THE NIGERIAN PORT SYSTEM (1979)

5.1 Introduction

In most port analysis and planning studies carried out in Nigeria (Economic Associates, London, 1967; NEDECO, 1970), the emphasis has been on the infrastructures at the single port, or a group of ports, as a basis of the port's ability to handle traffic. It has, therefore, often been assumed that the capacity, efficiency and ability of a port to handle traffic are a function of the port's stock of quays, berth space, warehouses, handling equipment and the methods of working the ship. While this view of a port is correct in a narrow sense, it is nevertheless necessary that the port be viewed as a part of a system in international trade. The ports are equipped with these facilities in order to serve not only the needs of the forelands, with which the ports are linked in maritime space, but also the needs of the landward hinterlands, with which the ports are linked by land transport.

The present chapter attempts to examine the functional linkages within the port system from a landward perspective. The main objective is to determine the precise nature of the interdependence between major Nigerian ports on the basis of the landward movement of the imports from and exports to these major ports. The aim is also the study of the structures of dominance and competition among the port and hinterland nodes within the network of linkages and flows that result from the movement of imports and exports. The study of the interrelationships between the ports in relation to the hinterland links, can provide important keys to an understanding of the present structure and possible future development of the port system. The fundamental assumption of the chapter is that on the land side, ports that can serve as alternative inlets or outlets to a part or all of a defined unit area of the country are, within that area, related. The relationship of ports on this basis may be competitive or complementary. When related in a competitive framework, the affected ports vie for traffic in their overlapping hinterlands, and developments at any one port affect the fortunes of the other ports in the system (Ogundana, 1970; Garnett, 1970).

5.2 Hinterland Patterns of the Nigerian Ports.

The four major port complexes of Lagos (including Apapa and Tin Can Island ports), Delta (including Warri and Sapele), Rivers and Calabar, are for the purpose of the analysis regarded as freight generating points, whilst the national spaces behind these ports (the hinterlands) are regarded as freight attracting zones and are styled 'import-demand-zones'. In terms of exports, the ports are regarded as freight attracting points, whilst the hinterland origins can be regarded as freight generating zones and are styled 'export-demand-zones'.

Data on road movement of imports and export traffic are used in the analysis. The data on road movement have been obtained from a 19 x 4 port to hinterland and hinterland to port flow matrix constructed from survey data of port-linked freight movements for one week period in February 1979 by the Public Project Study Group, University of Ife (See Chapter One). Although road, rail, river and air transportation link the major Nigerian ports to their hinterlands, data analysis is limited only to road movements. This is partly because no data were collected for these other modes in the 1979 Survey which is the source of the analysis in this chapter. Further, road transport accounts for more than 97 percent of the flow of import deliveries within the country during the 1978-79 financial year (Nigerian Ports Authority, 1979), and both past and present trends show that road transport will continue to gain in importance relative to other competing modes (Falowo,1979). Consequently, rail, water and air transportation are relatively insignificant in the movement of international freight to and from the major Nigerian ports. An analysis of road flow is, therefore, used to delineate the hinterlands of the ports, since no other means of transportation sufficiently affects the hinterland delineation (Dutt, 1971).

For imports and exports, different categories of hinterlands have been determined on the basis of weight and type of commodity originating or terminating at inland origins and destinations. To arrive at this distribution the country has been divided into nineteen subdivisions, the boundaries of which coincide with the nineteen states boundaries in Nigeria[1] (See Figure 5.1). These sub-divisions are styled 'standard regions', which as they stand, are very large geographical units. Consequently, distances from the ports vary between boundaries of each standard region, and so the state capital was selected to be the arbitrary centre of each region for measurement purposes. It is assumed that these state capitals are the destinations of import cargoes, from which imports are further distributed over the state territory; they are also assumed to be the origins of export cargoes, from where the Marketing Boards

Figure 5.1

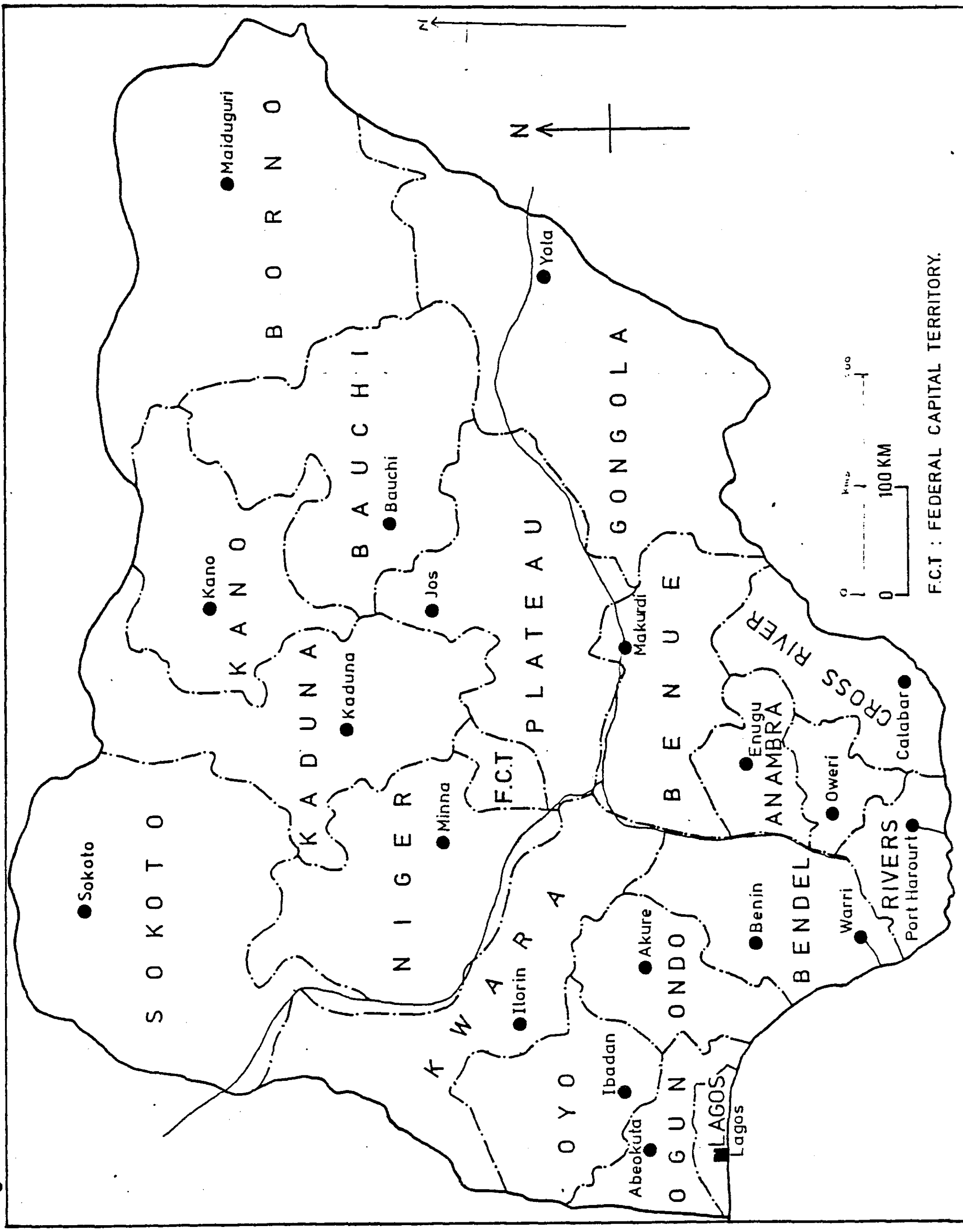


Fig.5.1 THE 19 STATES OF NIGERIA.

collect agricultural export produce prior to onward transport to the ports for export. Previous studies have suggested that for a port development study, it is of little interest to know precisely the final destination of imported goods or the precise origin of export goods (NEDECO, 1971; Ministry of Transport, 1966). If certain categories of import goods like wheat, for example, are destined for a flour mill plant at the port-city, that port-city is relevant for the selection process of the port of entry, inspite of the fact that the final product, wheat flour, is ultimately destined for another location. Similarly, for import and export goods that are distributed or assembled through inland depots, each inland depot is relevant for the selection process of the port of entry or exit.

The aggregate flow pattern shows that a total of 40,831 metric tonnes of imports and 2,593 metric tonnes of exports were handled at the major Nigerian ports during one week of the survey in February 1979. Of these totals 29,716 metric tonnes and 2,052 metric tonnes respectively representing 72.8 percent of imports and 79.1 percent of exports were handled by the Lagos ports, (Table 5.1). Port Harcourt and the Delta ports respectively were responsible for 17.7 percent and 8.1 percent of the total trade with the hinterlands.

Table 5.1

Import and Export Tonnages Handled at Nigerian Ports in February 1979 (Metric Tonnes)

Port	Import	%	Rank	Export	%	Rank
Lagos	29,716	72.8	1	2,052	79.0	1
Port Harcourt	7,235	17.7	2	439	16.9	2
Delta	3,327	8.1	3	22	0.9	4
Calabar	553	1.4	4	80	3.2	3

Source: University of Ife Field Survey, February 1979.

Table 5.2 summarises the aggregate trade from each of the five Nigerian ports to the different standard regions during the first week in February, 1979. The Lagos ports have the most widespread links, with trade links with fifteen out of the total import-export demand zones. Port Harcourt and Delta ports have trade links with nine and seven zones respectively, whilst Calabar's influence is restricted to just one zone. In these spread terms, the Lagos ports remain the main focus and the most truly national port, whilst Calabar port, and to some extent, the Delta ports have restricted influence, and therefore, remain mainly regional ports. In terms of dominance based on the intensity of trade links, the Lagos ports remain unique, handling more than 50 percent of the total hinterland trade in each of the 12 of the 15 hinterland zones with which the ports have links. Port Harcourt is dominant in three, whilst the Delta ports and Calabar are each dominant in just one hinterland zone. Lagos ports establish trade monopoly in five regions whilst Port Harcourt has monopoly in two regions. Except for these, the ports, in general are engaged, in various combinations, in compe-

Table 5.2

Port-Hinterland Trade Links within the Nigerian Port System

February 1979

Standard Regions	LAGOS Ton.	LAGOS % of Regs. Trade	PORT HARCOURT Ton.	PORT HARCOURT % of Regs. Trade	DELTA Ton.	DELTA % of Regs. Trade	CALABAR Ton.	CALABAR % of Regs. Trade	TOTAL Ton.	TOTAL %
Anambra	310	24.0	634	50.0	330	26.0	-	0.0	1274	100
Bauchi	100	100.0	-	0.0	-	0.0	-	0.0	100	100
Bendel	81	3.1	84	3.3	2432	93.9	-	0.0	2588	100
Benue	-	0.0	142	100.0	-	0.0	-	0.0	142	100
Borno	150	65.2	-	0.0	80	34.8	-	0.0	230	100
Cross River	-	0.0	261	29.2	-	0.0	633	70.8	894	100
Gongola	-	-	-	-	-	-	-	-	-	-
Imo	10	0.4	2601	90.9	250	8.7	-	0.0	2861	100
Kaduna	1448	80.5	350	19.5	-	0.0	-	0.0	1798	100
Kano	1165	75.4	380	24.6	-	0.0	-	0.0	1545	100
Kwara	446	91.8	-	0.0	40	8.2	-	0.0	486	100
Lagos	25303	100.0	-	0.0	-	0.0	-	0.0	25303	100
Niger	134	100.0	-	0.0	-	0.0	-	0.0	143	100
Ogun	633	100.0	-	0.0	-	0.0	-	0.0	633	100
Ondo	282	59.0	-	0.0	196	41.0	-	0.0	478	100
Oyo	959	97.0	-	0.0	30	3.0	-	0.0	989	100
Plateau	375	86.2	60	13.8	-	0.0	-	0.0	435	100
Rivers	-	0.0	3162	100.0	-	0.0	-	0.0	3162	100
Sokoto	200	100.0	-	0.0	-	0.0	-	0.0	200	100

Source: University of Ife, Field Survey, February 1979.

tition for trade links with different hinterland zones. This pattern is more vividly depicted when the ports' trade is disaggregated into inports and exports (See Figures 5.2, 5.3, 5.4, 5.5, and 5.6).

5.3 Linkage Patterns Within the Port-Hinterland System

A significant aspect of any hinterland analysis, especially as it is set out in this study, is the identification of the precise nature of the pattern of relationships between the ports and the hinterlands, and the correct mapping of these patterns of relationships. The cartographic methods of mapping these patterns from empirical data which have been used thus far in the analysis seem inadequate, not only because such methods have been criticised for their conceptual poverty (Smith, 1970), but also because such methods have not been able to show clearly which links or relationships are 'significant' and which are not 'significant', especially when linkage in this respect involves more than one link from each port to the hinterland and vice versa, or when flows are related to competition between alternative origins or destinations.

The problem is to identify and portray a port-hinterland system structure where the emphasis is on the specific nature of the relationship, not only between the port-hinterland origin/destination nodes, but also on possible relationship between the ports themselves in the handling of international trade. This task involves two different but related concepts: firstly, the identification and portrayal of the system structure; and secondly, the identification and portrayal of the spatial structure. The distinction between the two concepts is rather tenuous, but nevertheless significant. System structure can be analysed aspatially, by simply examining the scores in the interaction matrix, but spatial structure analysis, on the other hand, involves the examination of additional information on distance relationships between the pair of nodes (Holmes, 1978).

Because of the unclear pattern of relationships between ports and hinterlands described in the preceding sections, a better way of identifying the hinterland pattern may be to follow the lead of Holmes (1978) by modelling the total system interaction pattern and thereby identifying the 'network' which best represents flows from each port node to each hinterland node and vice versa. Holmes and Haggett (1977), have suggested the use of two criteria by which system structure may be identified. These are criteria based upon minimum volume or frequency of flow; and criteria based upon directionality or orientation of flows to each node. The latter criterion has been used in the identification of primary links (Nystuen and Dacey, 1961), of minimum directionality links (Leontief, 1965), of hierarchical links (Rouget, 1972), and of salient links in transaction flow analysis (Brams, 1966; Savage and Deutsch, 1960).

The existing directionality measures share one common characteristic in that the measure of significance used is established by pre-determined criteria based either on rank order (as with primary links identification), orientation incident to a single vertex (as with minimum directionality links), or orientation incident to both divergent and convergent flows (as with hierarchical and salient links). The common limitation with these approaches is that the pre-determined measure of significance based on rank order does not reflect the varying directionality characteristics of all arcs incident to each vertex.

The approach used in this study, presents a departure from the practice, in the sense that a variable threshold for significance is used, reflecting the directionality characteristics of all the arcs incident to each vertex (Holmes and Haggett, 1977). The method for link identification used assumes an initial k(k - n) matrix of flows between vertices (representing the pair of port-hinterland nodes). The problem is to partition the initial matrix into a binary (1.0) matrix in which significant flows are represented by the positive cells (1) and 'insignificant' flows by other cells (0). It is assumed that the number of positive cells will be much smaller than the k(k - n) original cells, and hence the essential structure of the flow matrix will be more readily identified.

Since the objective of the analysis is to reduce the confusion in multiple component mapping, data are reduced by a combination technique which provides an objective means of analysing the system pattern. The reduction method used is that suggested by Weaver (1954), and modified by Coppock (1964), in identifying multi-factor agricultural regions. It involves the comparison of a series of theoretical models with an observed situation to see which of the model situations or values, the actual observed values resemble. The data are converted into percentages which are ranked before comparing them to a series of model situations. In an ideal 'one-branch' area the expected distribution would be 100 per cent in one branch and zero percent in the others; in a 'two-branch area', 50 percent would be found in two branches and zero percent in the remainder; in the 'three-branch' situation, the expected figures would be 33.3 percent, 33.3 percent and 33.3 percent with zero percent in the remainder, and so on until the number of model cases is equal to the number of variables (See Appendix 1 to Chapter Five for the model form and the explanatory notes).

The measure of goodness of fit of the set of observed flows (W) and the sets of expected flows $(\hat{W}_1)$, $(\hat{W}_2)$ .... $(\hat{W}_k)$ is the method of least squares. That is, the deviations of each of the actual percentages from the model situation were calculated (f), were then squared (f^2), and were finally summed $(\sum f^2)$. This process is repeated for each of the theoretical distributions and the one which has the lowest deviation score is that which most clearly resembles the actual situation. This minimum least square value may be anywhere between 1 and k according to the distribution of flows in the observed flow vector. If the minimum occurred in the jth cycle, then all those links with higher-ranking flows, that is, flows (wi) to (wj) inclusive will be categorised as significant. Significant flows are represented as positive cells (1) in a binary matrix and mapped as a link or arc on a graph. All other flows that rank lower than j are represented by zero values in the binary matrix and are not mapped on to a graph.

5.4 Port-Hinterland Export Flows

The reduction model (combination model) is applied to the row vectors of the 19 x 4 matrix (converted to percentages) describing the outflow of exports from each of the nineteen standard regions of the country to each of the five major ports (Table 5.3). The binary matrix derived from Table 5.3 shows three significant links to Lagos, four to Port Harcourt and one each to Delta and Calabar ports (Table 5.4). The information derived from the binary matrix is mapped on a graph (Figure 5.2) which represents the map of significant arcs. Delta and Calabar ports are described by single links from parts of the Nigerian port hinterland. Port Harcourt has the highest number of significant links, four out of nine, but representing only 14.6 percent of the total export outflow stream.

Table 5.3

Inland Origin of Exports Through Major Nigerian Ports: February 1979

Regions of Origin	Ports of Destination (Percentage Share)			
	LAGOS	PORT HARCOURT	DELTA	CALABAR
Anambra	0.0	13.4	0.0	0.0
Bauchi	3.9	0.0	0.0	0.0
Bendel	0.0	16.9	100.0	0.0
Benue	0.0	0.0	0.0	0.0
Borno	0.0	0.0	0.0	0.0
Cross River	0.0	33.3	0.0	100.0
Gongola	0.0	0.0	0.0	0.0
Imo	0.0	8.9	0.0	0.0
Kaduna	2.1	4.6	0.0	0.0
Kano	16.5	0.0	0.0	0.0
Kwara	0.5	0.0	0.0	0.0
Lagos	41.4	0.0	0.0	0.0
Niger	3.1	0.0	0.0	0.0
Ogun	3.4	0.0	0.0	0.0
Ondo	5.6	0.0	0.0	0.0
Oyo	15.3	0.0	0.0	0.0
Plateau	3.8	0.0	0.0	0.0
Rivers	0.0	23.0	0.0	0.0
Sokoto	4.4	0.0	0.0	0.0
TOTAL	100.0	100.0	100.0	100.0

Source: Compiled from University of Ife, Field Survey, February 1979.

Table 5.4

Binary Matrix Showing Export Outflows Originating from Standard Regions

Standard Regions	LAGOS	PORT HARCOURT	DELTA	CALABAR	TOTAL
Anambra	0	1	0	0	1
Bauchi	0	0	0	0	0
Bendel	0	1	1	0	2
Benue	0	0	0	0	0
Borno	0	0	0	0	0
Cross River	0	1	0	1	2
Gongola	0	0	0	0	0
Imo	0	0	0	0	0
Kaduna	0	0	0	0	0
Kano	1	0	0	0	1
Kwara	0	0	0	0	0
Lagos	1	0	0	0	1
Niger	0	0	0	0	0
Ogun	0	0	0	0	0
Ondo	0	0	0	0	0
Oyo	1	0	0	0	1
Plateau	0	0	0	0	0
Rivers	0	1	0	0	1
Sokoto	0	0	0	0	0
TOTAL	3	4	1	1	9

Source: Derived from Table 5.3.

Figure 5.2

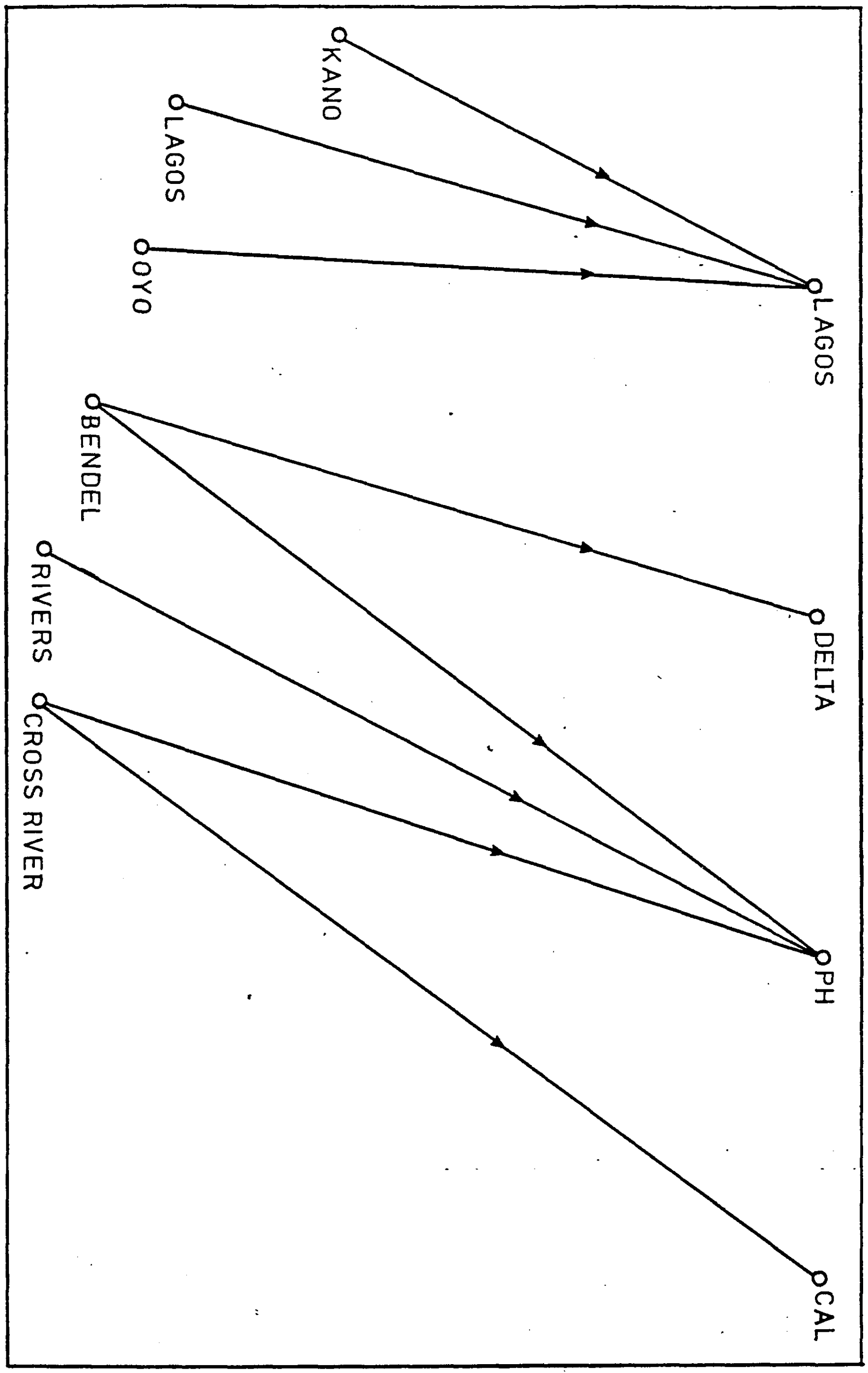


Figure 5.2 DIAGRAM OF SIGNIFICANT ARCS OF EXPORT OUTFLOWS TO PORTS

The Lagos ports have three significant links, three out of nine, but representing 57.9 percent of the total export outflow stream. The independence of Lagos ports is demonstrated in contrast to the linkage between Delta and Port Harcourt ports, a pattern which suggests that these latter ports are competitively linked and as a consequence do serve as alternative outlets for the export trade of Bendel State. Similarly, Port Harcourt and Calabar are linked up in their competition for exports from Cross River state.

A significant aspect of the pattern of links depicted by the graph is that ports which compete for exports do so in a spatially discrete part of the country. Outflows of exports from standard regions north of the Niger-Benue axis are not at all significant.[2] Lagos ports have a monopoly of exports from standard regions which are located in the south-western parts of the country. The competition that occurs between Port Harcourt and the Delta ports, on the one hand, and Port Harcourt and Calabar, on the other, is confined to the eastern half of Southern Nigeria, notably in Bendel and Cross River.

5.5 Port-hinterland Import Flows

The model is applied to the row vectors of the 4 x 19 matrix, (converted to percentages) describing the outflow of import traffic from each of the four port locations to each of the 19 designated standard regions (Table 5.5). The binary matrix derived from Table 5.5 shows a number of significant links with different hinterlands (Table 5.6). There are thirteen significant flows from the Lagos ports, five from Port Harcourt, four from the Delta ports, but only one from Calabar port, this being to its immediate hinterland of

Table 5.5

Inland Destination of Imports Through Major Nigerian Ports

February 1979

Standard Regions Destination	Originating Ports				
	LAGOS	PORT HARCOURT	DELTA	CALABAR	TOTAL
Anambra	25.6	47.3	27.1	0.0	100
Bauchi	100.0	0.0	0.0	0.0	100
Bendel	3.3	0.4	96.3	0.0	100
Benue	0.0	100.0	0.0	0.0	100
Borno	65.2	0.0	34.8	0.0	100
Cross River	0.0	17.2	0.0	82.8	100
Gongola	0.0	0.0	0.0	0.0	0
Imo	0.4	90.8	8.8	0.0	100
Kaduna	81.0	19.0	0.0	0.0	100
Kano	68.5	31.5	0.0	0.0	100
Kwara	91.5	0.0	8.5	0.0	100
Lagos	100.0	0.0	0.0	0.0	100
Niger	100.0	0.0	0.0	0.0	100
Ogun	100.0	0.0	0.0	0.0	100
Ondo	46.0	0.0	54.0	0.0	100
Oyo	95.6	0.0	4.4	0.0	100
Plateau	83.2	16.8	0.0	0.0	100
Rivers	0.0	100.0	0.0	0.0	100
Sokoto	0.0	100.0	0.0	0.0	100

Source: Compiled from University of Ife, Field Survey, February 1979.

Table 5.6

Binary Matrix Showing Import Outflows Originating from Major Ports

Standard Regions Destination	LAGOS	PORT HARCOURT	DELTA	CALABAR	TOTAL
Anambra	1	1	1	0	3
Bauchi	1	0	0	0	1
Bendel	0	0	1	0	1
Benue	0	1	0	0	1
Borno	1	0	1	0	2
Cross River	0	0	0	1	1
Gongola*	0	0	0	0	0
Imo	0	1	0	0	1
Kaduna	1	0	0	0	1
Kano	1	1	0	0	2
Kwara	1	0	0	0	1
Lagos	1	0	0	0	1
Niger	1	0	0	0	1
Ogun	1	0	0	0	1
Ondo	1	0	1	0	2
Oyo	1	0	0	0	1
Plateau	1	0	0	0	1
Rivers	0	1	0	0	1
Sokoto	1	0	0	0	1

Source: Derived from Table 5.3.
* Survey did not produce any link between Gongola and any port.

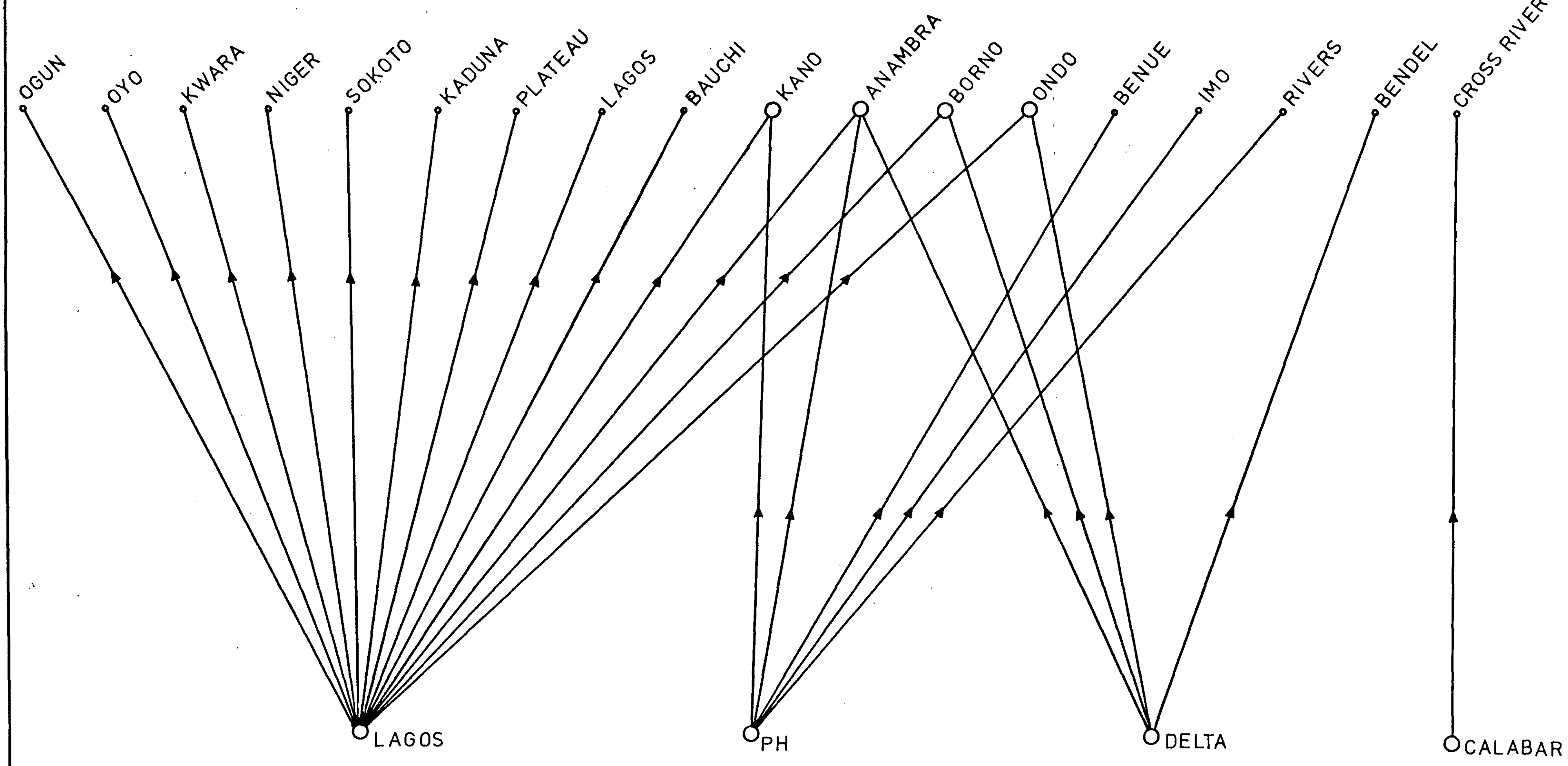
Cross River state. Lagos ports have the largest number of significant links with 56.5 percent of the total import outflow stream from all the major ports. Port Harcourt, Delta and Calabar ports rank next in descending order of magnitude with 21.7 percent, 17.4 percent and 4.4 percent respectively of the total outflow stream from all the major ports.

Figure 5.3 is the diagram of significant arcs derived from the data originating from the four major ports. Most of the hinterland standard regions are described by single links to the different ports; for example, Bauchi to Lagos ports, Bendel to Delta Ports, Benue to Port Harcourt and so on.

The pattern that emerges suggests that the ports are actively engaged in competition in few hinterland areas. Calabar port stands out distinctly as having no relationship at all with any port as far as the hinterland links are concerned. Port competition for hinterland trade links appears to be most intense in Anambra State where Lagos, Port Harcourt and Delta ports compete for the trade of this standard region. Similarly, Lagos and Delta ports serve as alternative inlets to the import trades of Borno and Ondo States, whilst Lagos and Port Harcourt are competitively related in Kano State. Indeed, two distinct spatial patterns of port relatedness emerge: firstly, there are those ports that compete for imports to the standard regions located south of the Niger-Benue axis; and secondly, there are those that vie for the import traffic of standard regions located north of the Niger-Benue axis.

When the export and import graphs are compared, the differences between the spatial patterns of the two types of trade are clearly brought out. The port-hinterland linkage in respect of import trade is more dense than that of export trade. The relative sparsity of the export trade linkage is not surprising, because as it was

Figure 5·3 DIAGRAM OF SIGNIFICANT ARCS OF IMPORT OUTFLOWS FROM PORTS



pointed out in Chapter Two, agricultural commodities constitute the bulk of the non-fuel export trade of the country, and in recent years, there has been a rapid down-turn in the production of these commodities. Both geographical sections of the country appear to have been affected by this down-turn; and this accounts for the absence of any significant links with twelve standard regions of the country, located north and south of the Niger-Benue axis (Figure 5.2).

5.6 Optimal Hinterland Pattern of Nigerian Ports Based on Total Costs

The preceding sections have shown two distinct hinterland patterns; hinterlands where the major ports are virtual monoplies, and hinterland areas where the ports compete for imports and exports (See Figures 5.4 - 5.8)

The question that can be posed is: Is this hinterland pattern optimal? To answer this question, an evaluation of the movement patterns of import and export commodities is carried out. The problem here, is that of distributing import and export commodities from and to the three ports of Lagos, Port Harcourt and the Delta ports, in such a way that the total costs (economic costs of inland transport and other related costs) are at a minimum. The optimization procedure that is followed is to allocate tonnages to hinterlands through their appropriate ports,based on inland transport and port costs.

Figure 5.4

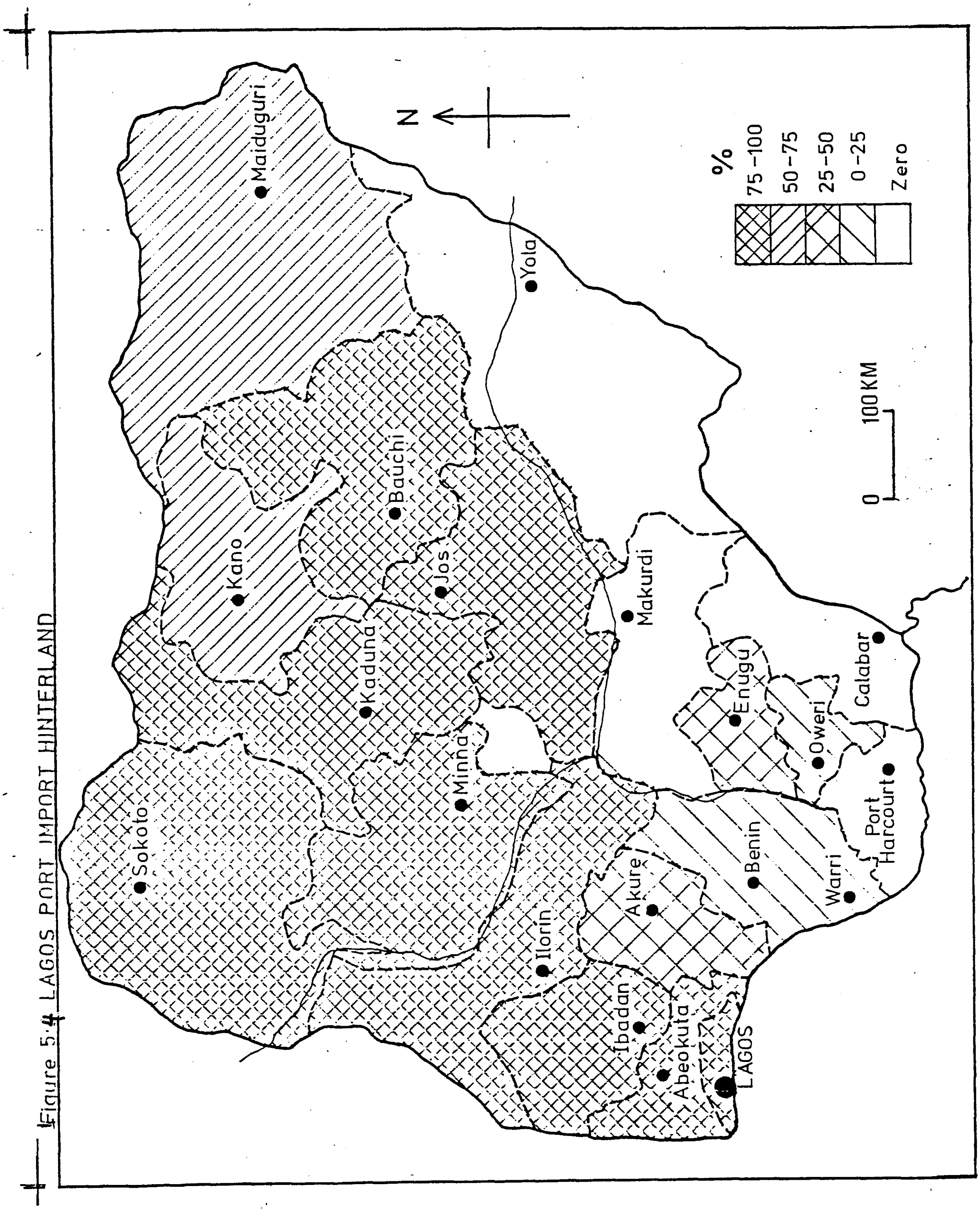


Figure 5.4 LAGOS PORT IMPORT HINTERLAND

Figure 5.5

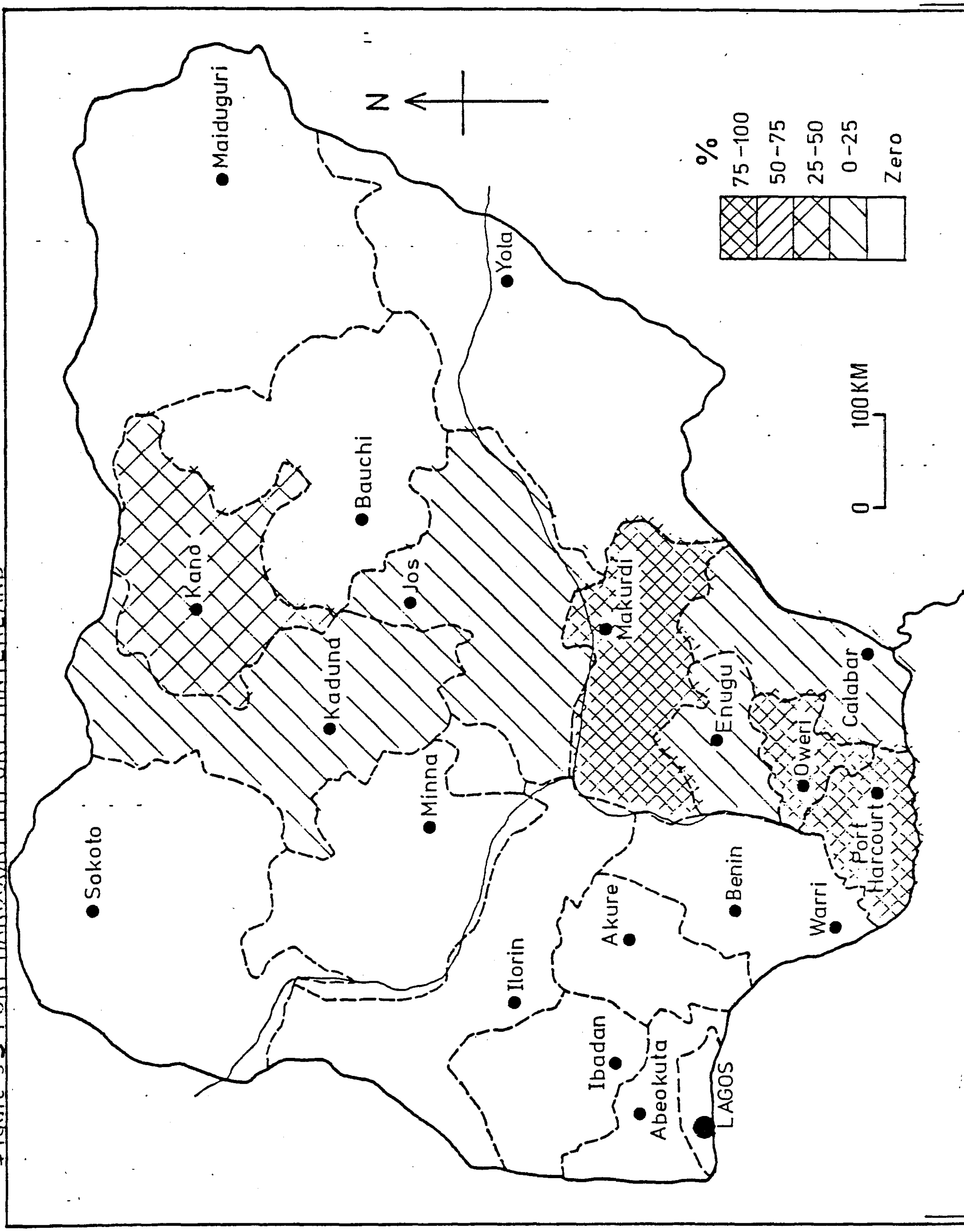


Figure 5.5 PORT HARCOURT IMPORT HINTERLAND

<u>Figure 5.6</u>

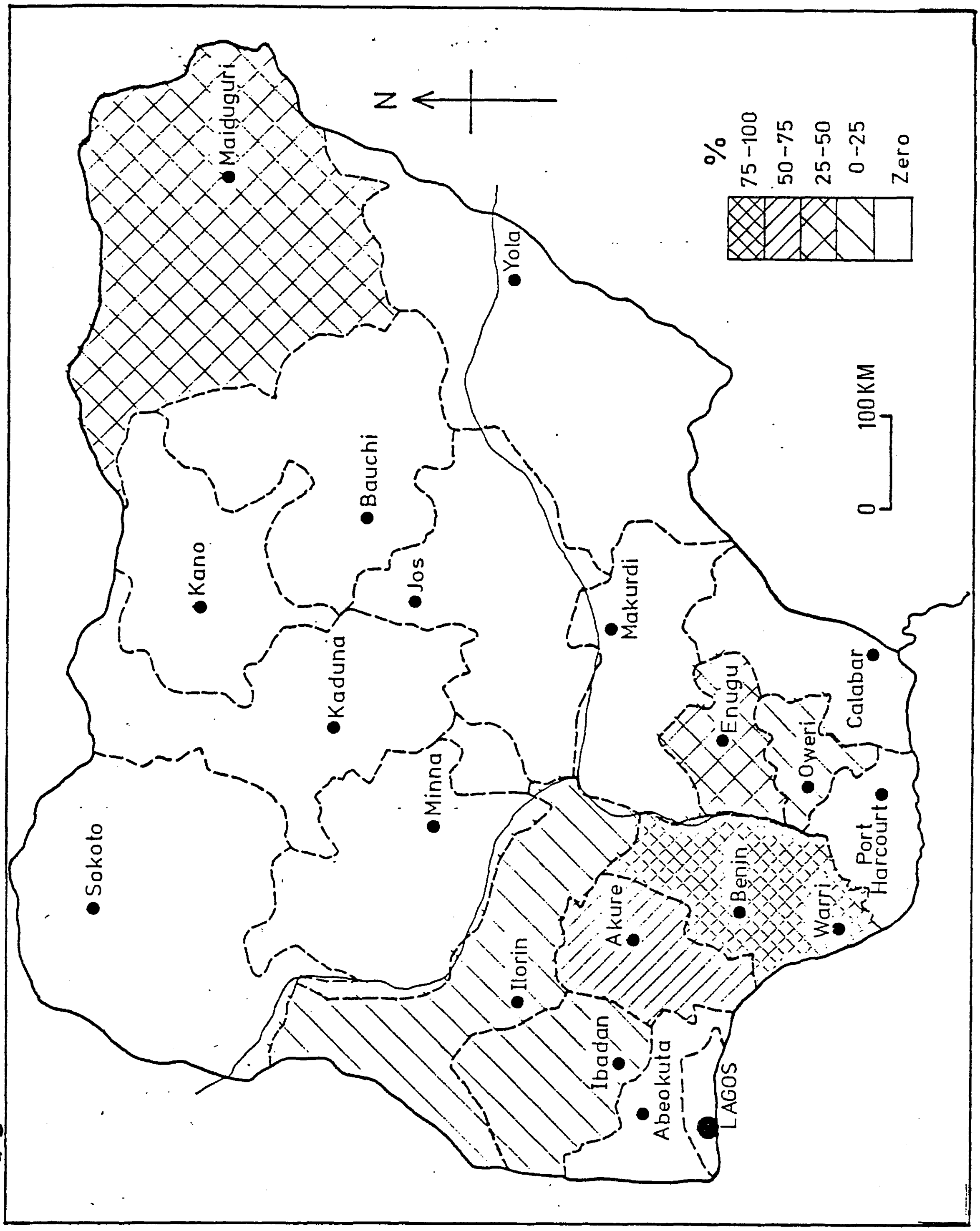


Figure 5·6 DELTA PORTS IMPORT HINTERLAND

Figure 5.7

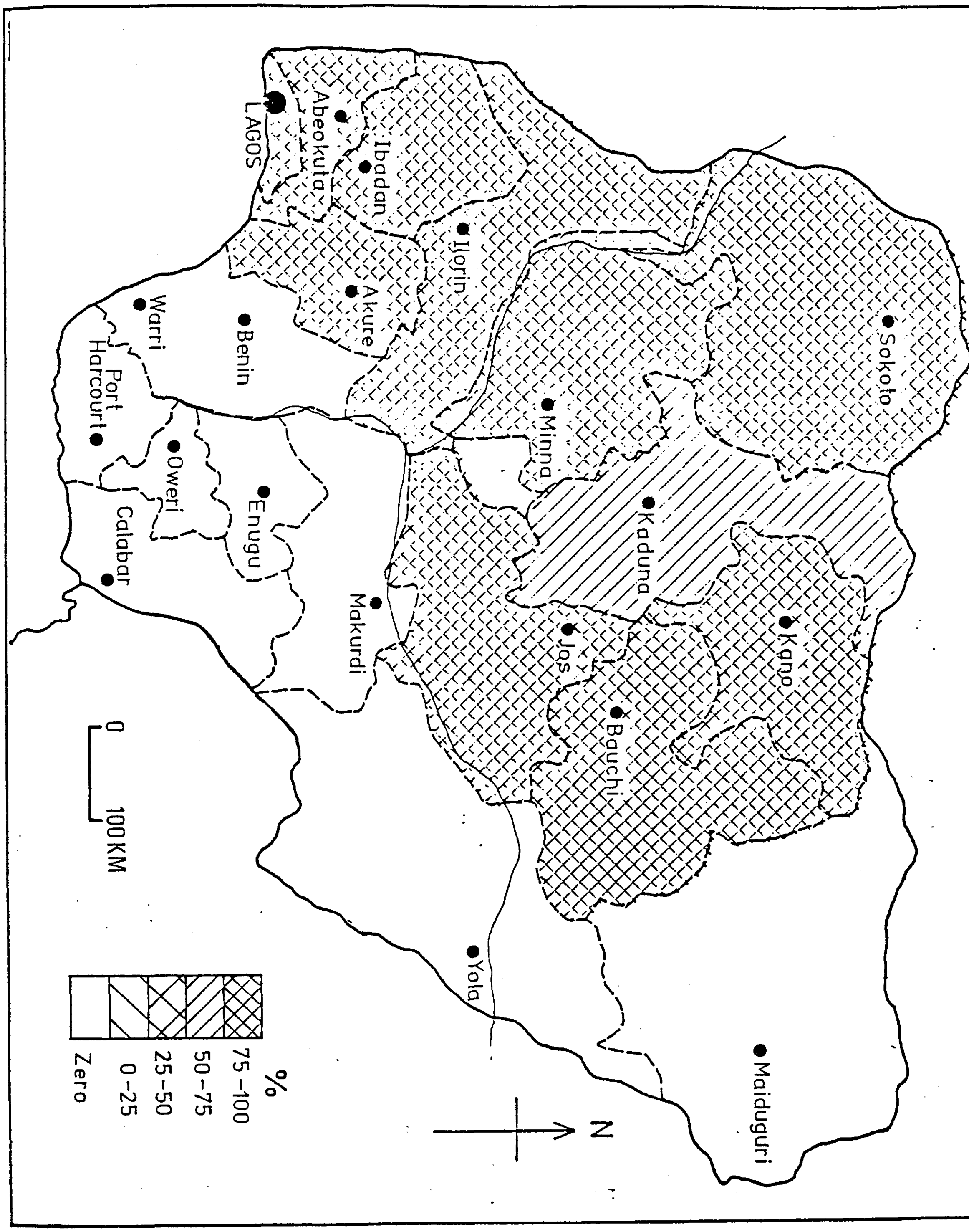


Figure 5.7 LAGOS EXPORT HINTERLAND

Figure 5.8

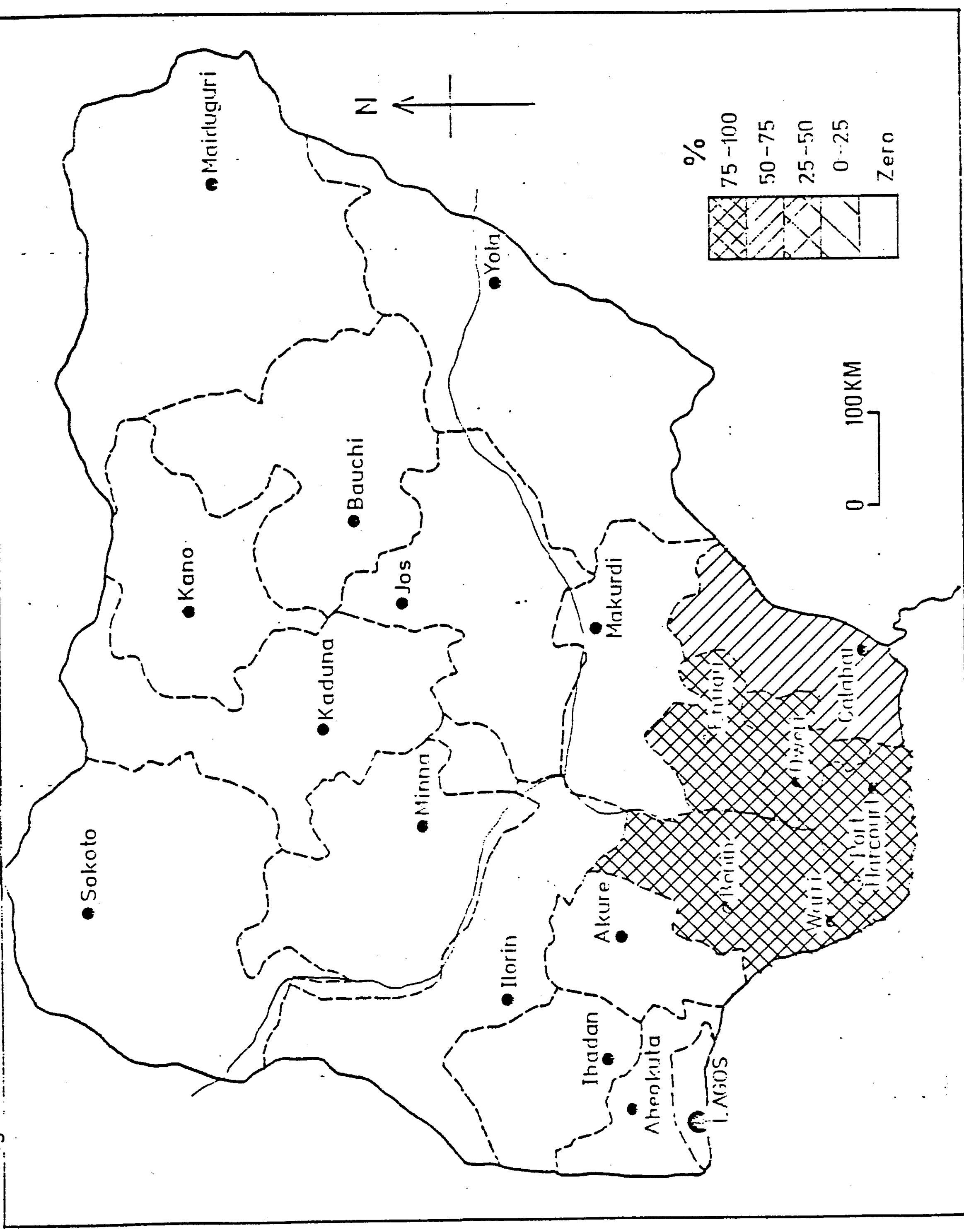


Figure 5.8 PORT HARCOURT EXPORT HINTERLAND

The variables that are used in the cost calculations include distance of origin of exports and destination of imports to and from the respective ports; the type and size of vehicles used for imports and exports, road costs and the vehicle utilization factor (load factor). The data on road costs are derived from the 1971 NEDECO study (NEDECO, 1971). These cost estimates are modified, giving due consideration to inflationary trends between 1970 and 1979. The data on vehicle size and vehicle utilization factor are computed from the 1979 University of Ife survey (Appendix 2 to Chapter 5,a,b,c and d).

In order to reflect the concept of total costs, port costs are considered along with inland transport costs. But since port costs are uniform throughout Nigerian ports (The Nigerian Ports Authority charges uniformly in all Nigerian ports), the quality of service factor at each port (interpreted in terms of delay costs to land transport) is substituted for port costs. The costs of delays to land transport at the ports are calculated using the Government Coastal Agency pre-loading demurrage rates in conjunction with data on land transport turnround times at the three ports.

The Government Coastal Agency (GCA) paid a demurrage of N140 per vehicle per day to vehicles of extra-metropolitan origin. It is assumed that all vehicles attracting pre-loading demurrage payments were from origins outside the port metropolis. It is also assumed that the GCA pre-loading demurrage rate applies to other forwarding agents operating in all Nigerian ports. The various cost calculations are shown in Appendices 2 to 11, to Chapter Five.

The optimum hinterland pattern for import commodities (based on total costs) is shown in Figure 5.9. The optimum solution calls for

Figure 5.9

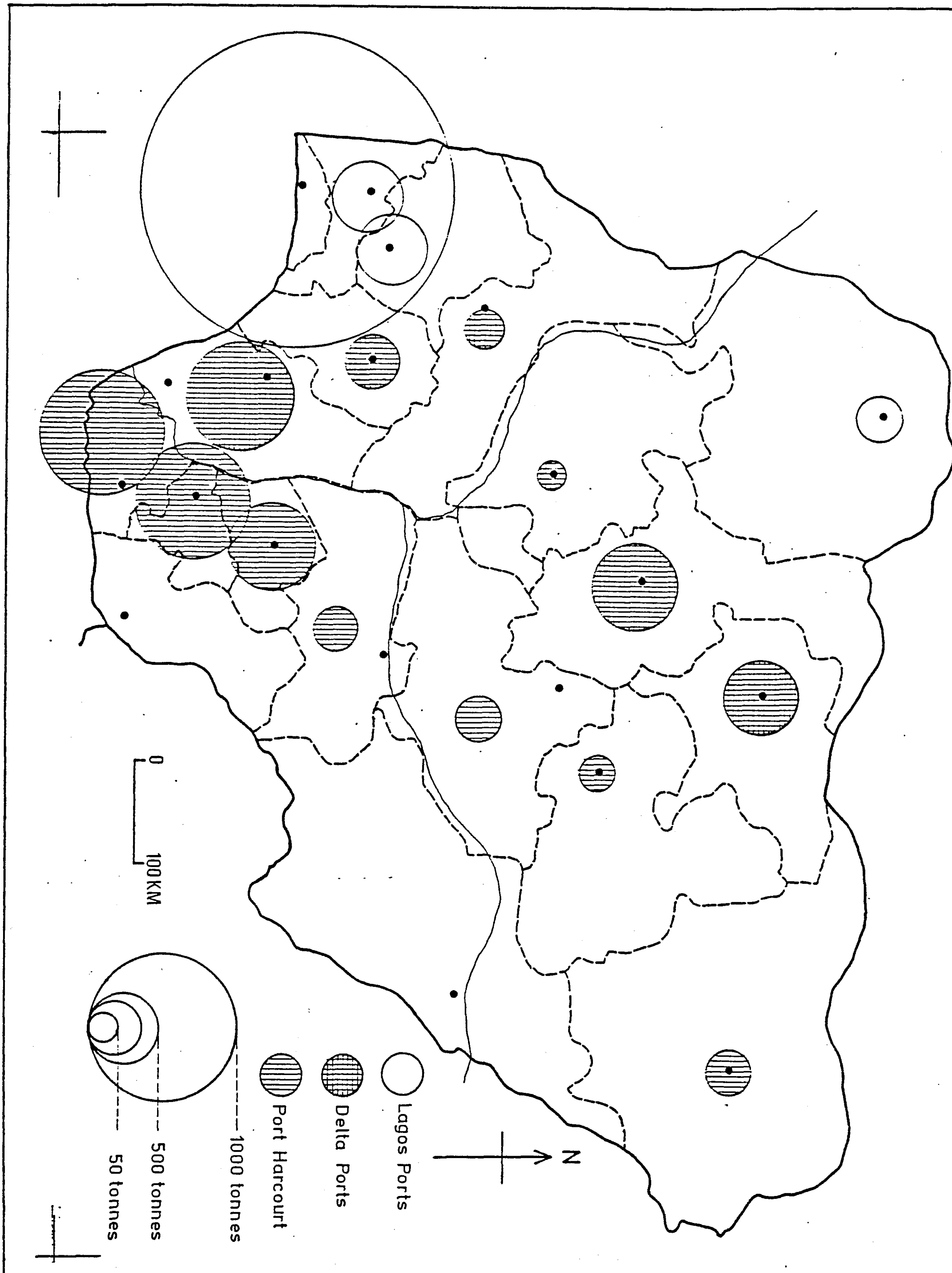


Fig.5.9 OPTIMUM IMPORT HINTERLAND OF NIGERIAN PORTS BASED ON TOTAL COSTS:1979

the routeing of all imports to Lagos, Ogun, Oyo and Sokoto States through Lagos ports. The solution also calls for the routeing of all imports to Anambra, Bauchi, Benue, Borno, Imo and Plateau through Port Harcourt. Similarly, all imports destined to the Delta ports are to be sent to Bendel, Kaduna, Kano, Kwara, Niger and Ondo States.

The actual tonnages sent to the respective inland destinations through each port, as against the model tonnages available at each port for inland destination are mapped and shown in Figure 5.10. Lagos ports were able to satisfy 99.9 percent of their model predicted hinterland import allocation. The breakdown of the percentages for individual hinterlands show that Lagos ports satisfied 100 percent in each of Lagos, Ogun and Sokoto States, whilst they were able to satisfy 95.5 percent in Oyo State. Port Harcourt was able to satisfy 81.5 percent of its model predicted hinterland import traffic allocation. The breakdown of the percentages are: 100 percent in each of Benue and River States, 90.8 percent in Imo; 47 percent in Anambra; zero percent in each of Bauchi and Borno States. However, Delta ports were able to satisfy only 41.6 percent of their model predicted hinterland import traffic with 96.3 percent in Bendel, 54 percent in Ondo, 8.4 percent in Kwara and zero percent in each of Kaduna, Kano and Niger States. Lagos ports extended their influence beyond their predicted hinterlands into ten other hinterlands. Port Harcourt and Delta ports similarly extended their influence into other states even though they were unable to satisfy their import demands of the states where they were supposed to be pre-eminent.

Table 5.7 shows the optimum solution to the export problem based on

Figure 5.10

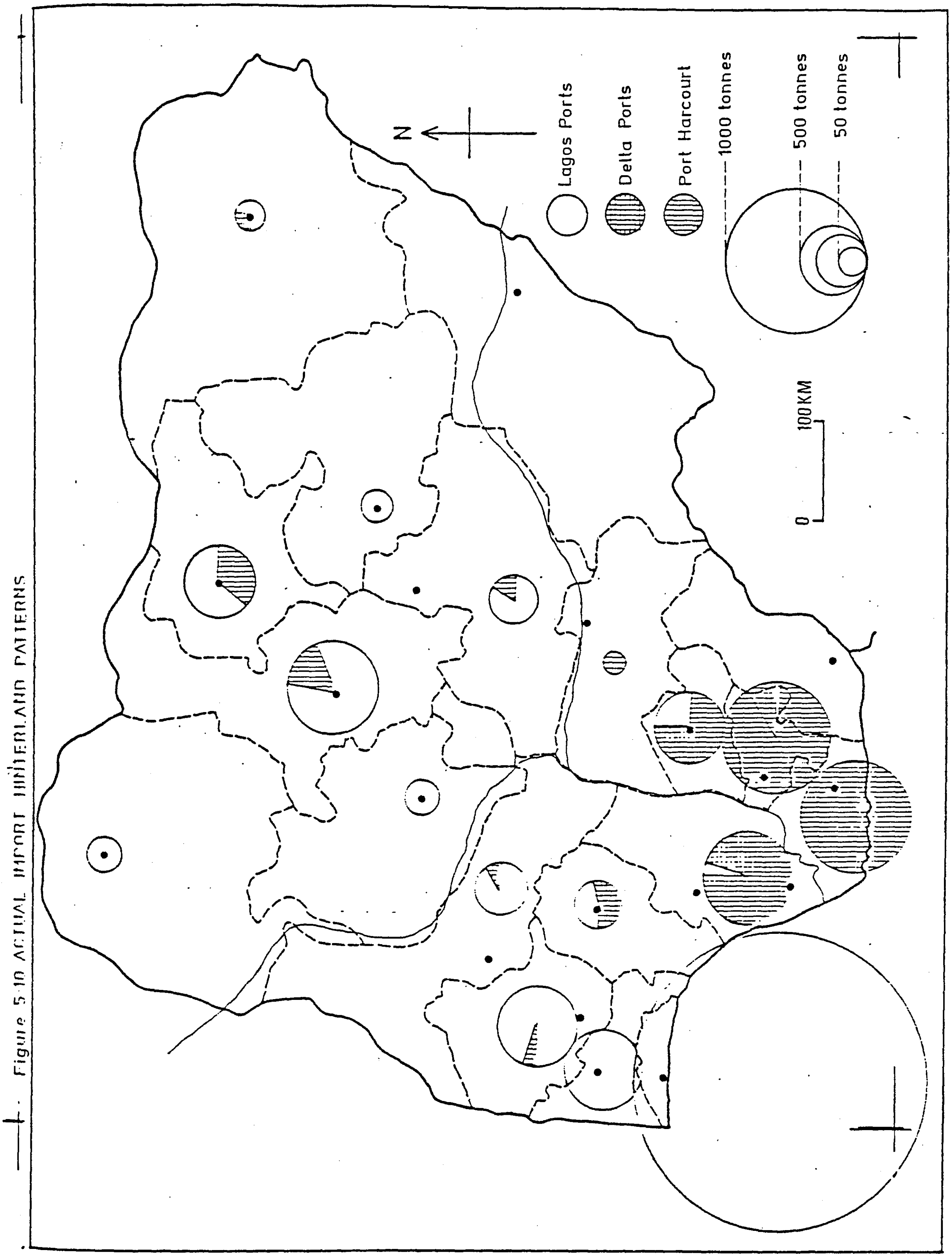


Figure 5.10 ACTUAL IMPORT HINTERLAND PATTERNS

the criteria of total costs. The solution calls for the routeing of all exports (except those of port metropolitan origins which have been explicitly assigned to local ports) through Port Harcourt. The numbers in parentheses show the actual export tonnages sent through the respective ports as against the model predicted tonnages available in each of the inland origins. This information is mapped and shown in Figure 5.11, and shows the dominance of Lagos[3]. Lagos extends its influence beyond its model predicted hinterland into ten states, whilst Port Harcourt is only able to satisfy the requirements of its import in four out of twelve hinterland zones, where it is expected to be pre-eminent.

In order to obtain an idea of the effects of imposing restrictions on both port and land transport (road) capacity at the different ports, estimates of the capacities were made. However, there arises the problem involved in the classification of the concept of port handling capacity. A practical approach to measuring the capacity of a port to handle imports and exports involves the classification of the main types of cargo passing through the ports into distinct groups such as general cargo, containerised cargo, dry bulk and liquid bulk. In this way, one can obtain some idea of physical handling capacity at the ports. But there is another dimension to the concept of capacity: capacity is also a function of efficiency with which physical facilities are utilized. Comparison of capacity of existing facilities at individual Nigerian ports with the actual throughput showed that all these ports had excess capacity in 1979. For example, Lagos used 83 percent of their general cargo facilities capacity, whilst the Delta and Port Harcourt ports used 62 percent and 69 percent respectively of their general cargo capacities.[4]

Figure 5.11

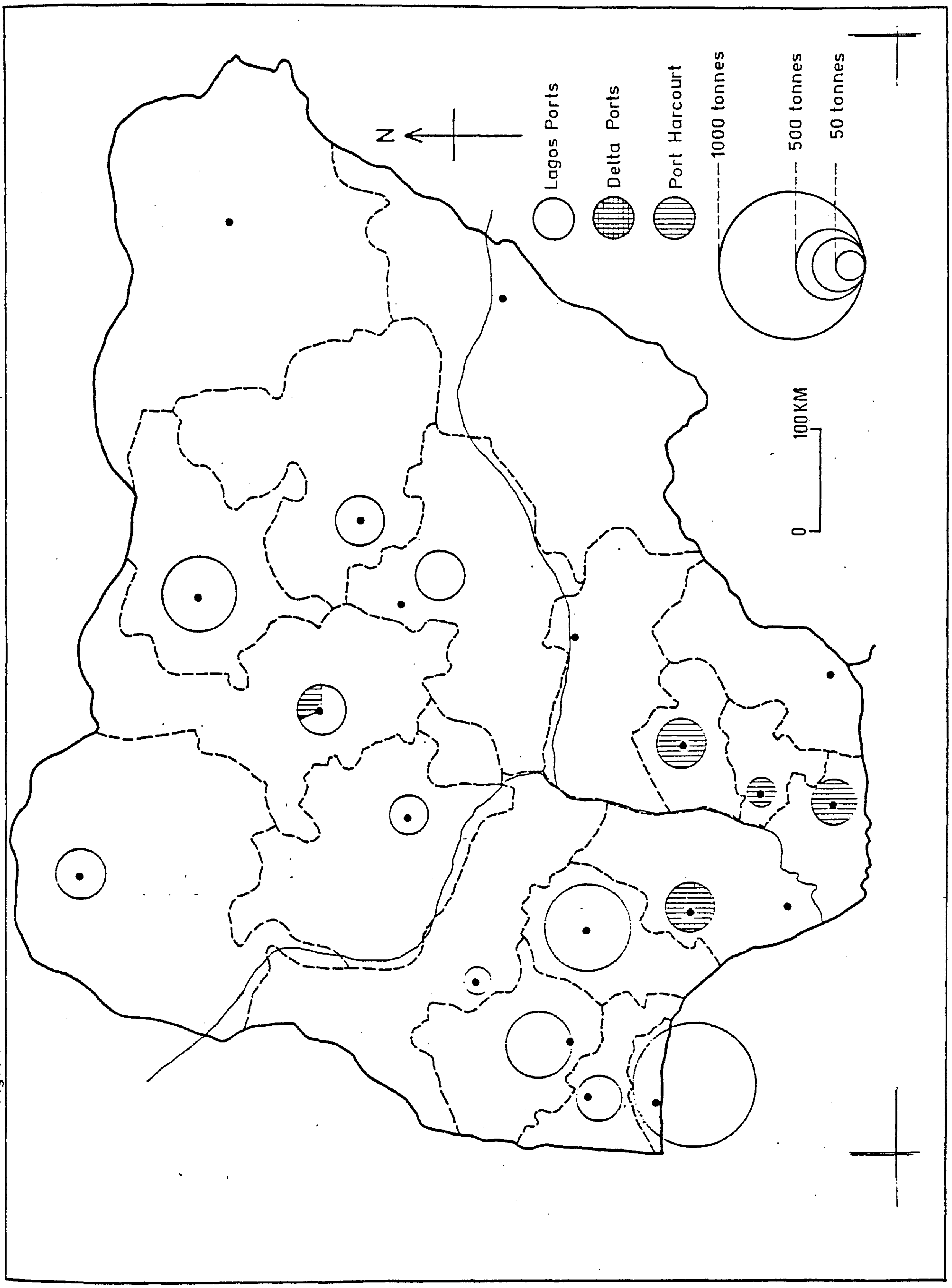


Figure 5.11 ACTUAL EXPORT HINTERLAND OF NIGERIAN PORTS (1979)

Table 5.7

Optimum Solution to the Export Problem Based on Economic Costs

Inland Origin	Port Destinations (Metric Tonnes) LAGOS PORTS	PORT HARCOURT
Anambra	0.0	59 (59)
Bauchi	0.0 (80)	80 (0.0)
Bendel	0.0	0.0 (74)
Benue	-	-
Borno	-	-
Cross River	0.0	0.0 (146)
Gongola	-	-
Imo	0.0	39 (39)
Kaduna	0.0 (43)	63 (20
Kano	0.0 (338)	338 (0.0)
Kwara	0.0 (10)	10 (0.0
Lagos	850 (850)	0.0 (0.0)
Niger	0.0 (64)	64 (0.0)
Ogun	0.0 (70)	70 (0.0
Ondo	0.0 (115)	115 (0.0)
Oyo	0.0 (314	314 (0.0
Plateau	0.0 (78)	78 (0.0)
Rivers	0.0	101 (101)
Sokoto	0.0 (90)	90 (0.0)
TOTAL	850 (2052)	1421 (439)

Source: Computed from Various Data (See Appendices to Chapter Five).

The question of calculating road capacities is a more difficult task because of the general dearth of road transport data in the country. In view of this problem, a simple method of estimating the practical capacity is to use maximum throughput by road at the ports based on the traffic of the preceding years (Osayinwese, 1974). The result of imposing such restrictions using maximum throughput capacity by road shows that there was excess capacity for both imports and exports at the three ports. Lagos ports used 93.2 percent of the road capacity, whilst Port Harcourt and Delta ports attained only 52 percent and 37 percent utilization respectively,[5] (See Appendix 12 to Chapter Five). The implications are that capacity constraints are not likely to make any significant difference to the model predicted hinterland pattern. The Delta ports as well as Port Harcourt are well able to handle the additional tonnages that are to be routed through them to the respective hinterland areas predicted by the total costs model.

The actual hinterland patterns for exports and imports show significant differences from patterns which are based on cost functions (compare Figures 5.9, 5.10 and 5.11). For the hinterland patterns, the general trend appears (with the exception of Kaduna and Kano States) to be that of decreasing port influence with increasing distance from the ports.[6] The intervening areas between the concentration of imports and exports in the southern and north-central parts of the country coincide in area with the relatively under-developed middle belt zone which lacks basic industrial base and which contributes very little in terms of export agricultural produce. The middle belt zone which comprises of Kwara, Niger, Benue and Gongola States together account for only 3.7 percent of the country's manufacturing employment in 1975, whilst they account for 15 percent of the population of the country (Onyemelukwe, 1984, p.137).

Generally, the ports tend to have much stronger influence in their respective immediate hinterlands. This trend is probably explained by the high proportion of imported commodities that remain within the port-city. This effect is referred to as the filter effect and is defined as the ability of the port metropolitan area to absorb effectively a high percentage of imports. A high degree of filtration is an indication of the high absorbtion capacity of the metropolitan areas while a low degree of filtration suggests that the import-demand-points for import commodities are concentrated outside the metropolitan area. Table 5.8 shows the filter effect of port cities on imports and exports in 1979.

Table 5.8

Filter Effect of Port Cities on Import and Export Flows (1979)

Port	Percentage of Imports	Percentage of Exports
Lagos	82.3	41.2
Port Harcourt	42.4	23.0
Delta	72.2	-

Source: Compiled from University of Ife Survey, 1979.

The high import filtration percentage of Lagos confirms the primate status of Lagos city which accounts for 40 percent of the country's manufacturing employment and 2.9 percent of its population. The high filter effect of Lagos city does not however suggest that Lagos is a less national port than for example Port Harcourt. As the commercial and industrial capital of the country, Lagos has trade links with virtually every state in the country, and quite a large proportion of the import commodities that are discharged in Lagos invariably find their way to other towns in the country. The smaller filter effect of Port Harcourt suggests the presence of large industrial and commercial cities in close proximity to Port Harcourt, notably Aba in Imo, and Onitsha in Anambra. Anambra State has 48 percent of the manufacturing employment in that region; whilst Rivers and Imo each has 33 percent and 19 percent respectively. The share of manufacturing employment within Lagos immediate hinterlands of Lagos, Ogun and Oyo is 91.8 percent for Lagos, 1.7 percent for Ogun and 6.5 percent for Oyo.

The proportion of exports that originate from the port states is much less than those of imports that remain in these states. This is due mainly to the fact that these port-states produce less of the agricultural export produce. The bulk of the exports from Lagos are in the form of semi-processed commodities, notably cocoa butter and cocoa beans.

A comparison of actual and optimum hinterland patterns for exports reveals that cost factors alone do not fully explain the hinterland patterns depicted. This probably explains why the solution to the export problem in 1979 is rather absurd. No doubt, cost factors do explain the choice of Port Harcourt, Delta and Calabar ports for exports from east of the river Niger because of the proximity of these hinterlands to these ports. It has been suggested that because of the low value of agricultural exports, such exports cannot withstand the higher cost of land transport like import commodities, and, therefore, such commodities tend to take advantage of the closest port to the collecting areas. This will probably explain rubber export from part of Cross River close to Port Harcourt or rubber export produced in Bendel State close to Port Harcourt being routed through Port Harcourt.

The choice of a port outlet for any interior location may also partly be a function of the relative efficiency of the ports themselves. Relative efficiency in this respect may be interpreted in terms of the number and quality of terminal facilities at each port, and in terms of the frequency and reliability of shipping services to each port. The relatively higher regularity of shipping services to Lagos (See Chapter Four) may cause exports from an interior location like Kano to route exports through Lagos port rather than Port Harcourt which has the same distance as with Lagos from Kano, both by rail and by road. The same factor may cause exports originating from Cross River to be sent through Port Harcourt, rather than through Calabar.

The port routeing of a particular export commodity may be motivated by political factors. The agricultural commodity Marketing Boards which are regionally based and are organised on regional political bases, control the export and dictate the port outlet of the export commodities.[7] Judging from the proximity factor, the export of cocoa originating from parts of Ondo and Oyo standard regions should have its outlet in the Delta ports (and some cocoa actually found outlet in these ports in the past, (Ogundana, 1971)). But the creation of the Mid-western State (now Bendel) from the former Western Region (now Lagos, Oyo, Ogun and Ondo States), altered the political map of the country. The Western Region Marketing Board directed that all cocoa collecting centres in the Western Region should use the Lagos port for exports, as against the Delta ports which were administratively no longer part of the Western Region. Although the equidistant locus between Lagos and Delta ports is just in the centre of the cocoa producing areas, the political boundary between the Western Region and the Mid-western Region became the hinterland divide of the two ports. The situation remains so until today.

Some useful deductions can be made from the pattern of linkages for import traffic. For example, there are a larger number of inter-linkages with a larger number of regions than for export traffic. This is probably explained by the fact that imports are mainly consumer items which are in demand in much larger number of centres than export items are available at such centres. Apart fromGongola which has no links with any port, all the other regions have one link or more with any of the four major port locations. Furthermore, competition for imports to the inland destinations is more established than competition for exports.

It would appear that the pattern of dominance and of competition by, and between, the ports is partly explained by the location factor; that is, the location of a particular port in relation to other competing ports. For ports competing for imports in the southern parts of the country, the location factor is crucial. This probably explains why the influence of Calabar port, and to some extent that of the Delta ports is reduced to the service of their immediate hinterlands. The same location advantage explains the dominance of Port Harcourt in Rivers, Imo, Anambra and Benue States, as well as the dominance of Lagos ports in the south-west of the country. The relative location factor as an explanatory factor cannot, however, be extended beyond the southern regions where there is evidence of penetration of big ports like Lagos and Port Harcourt into what is regarded as the 'enclaves of monopoly' of these smaller ports.

Lagos and Port Harcourt assert dominance over other ports in the traffic of the northern imports. The reason for this is not hard to explain. These ports have large metropolitan economies and function as sizeable consuming centres with competitive access to large consuming centres of the northern states. Indeed, each port is a major focus of land transport routes; each has the benefit of rail and road links with the large northern hinterland. The Lagos ports in particular, have managed to maintain their pre-eminence in port activity within the system; a pre-eminence which is brought about by the concentration in the ports of freight forwarders, shipping agents and goods handlers of many types. The long standing habit of shippers and agents with their headquarters in Lagos, and with promotional agencies to route import goods through the ports, undoubtedly plays a strong role in support of the Lagos ports.The Nigerian Ports Authority records show that of the total of 52 principal forwarding and clearing agents that are located in all the major ports, 31, representing 60 percent have their offices in the Lagos port. Similarly, 66 out of the total of 81 big consignees and shippers, representing 81.5 percent of the total, have their headquarters or warehouses in Lagos and Port Harcourt ports (NPA Report, 1982, pp.192 and 163). As the ports with easily the largest total number of sailings (Chapter Four) it is natural that Lagos ports offer service to the greatest number of overseas as well as inland points. Further, the strategic position of Lagos as the first port of call of the routes from Europe and North America which account for more than 75 percent of Nigeria's international shipping trade in non-fuel goods, means that it is the main discharging port, and thus tends to handle the bulk of the import cargo.

5.7 Summary and Conclusion

The result of the analysis in this chapter is that in terms of hinterland linkages and relationships, Nigerian ports are not as competitive as they are thought to be. The implication of this conclusion is that the major ports have discrete hinterlands, and that every standard region located in the south is sufficiently close to a specific major port from which it draws a very high proportion of its trade. However, notable exceptions to this general conclusion are the standard regions located in the northern parts of the country. Notable among these are Kaduna and Kano standard regions which lie roughly equidistant by road from the major ports. For these two standard regions the real competition is between Lagos and Port Harcourt ports. However, based on the criterion of distance and inland transport cost, these two northern hinterlands are within a competitive radius of the Delta ports.

The ports of Lagos and Port Harcourt remain dominant as regards trade with the hinterlands. This dominance is registered in the two facets of port functioning, notably monopoly and competition. The two facets sum up the degree of influence which a port has over part or the whole of the national landscape behind the port (hinterland). One question that remains to be answered is the extent and way in which the port-hinterland relations of a regional port system like Nigeria's, should (through the market forces or by intervention) influence infrastructural development at each port.

The relationship between ports, described as 'port relatedness' as set out and examined in this chapter has been adopted as the basis for port development policy in other parts of the world. In the

United Kingdom for example, the assumption behind the 1960s investment policy was that the more investment a port received relative to its competitors, the faster it grows; the more specialised berths that were completed, the more competitive would be the port operation, and the bigger the attraction of that port will be (Chu, 1978). Competition in this sense is based upon service to the hierarchy of hinterlands served by each port. Ports compete for facilities to achieve the product differentiation vis-a-vis other ports. In other words, port competition in real terms means competition for investment, or state approval of investment plans. This *a priori* assumption in the policy decision in new port locations or in existing port locations should not be considered in isolation. This was why the National Ports Council proposals for Portbury had to be related to facilities in alternative ports like London and Liverpool. The issue of competition in investment was linked up with the ability of a competing port to command a large immediate hinterland in terms of industry and population (Ministry of Transport, 1966).

One other major conclusion that is presented in this chapter relates to the evaluation of the distribution patterns of international trade in 1979, using total cost criteria. In this respect, the first major conclusion is that the movement of international trade commodities is suboptimal and, therefore, rather expensive to the ultimate consumer who bears the brunt of high import commodities. Secondly, the analysis in the chapter shows that cost factors do not fully explain the pattern of commodity movement from and to the ports. There is thus a gap between economic theory as it relates to costs and the actual practice.

The analyses in the last three chapters, would have, in general terms, put in a broad perspective the performance of each of the major Nigerian ports in the competition for service, whether in terms of more frequent sailings to a given port (Chapter Four) or in terms of the overall aggregate trade volume (Chapter Two), or even in terms of service to parts or the whole Nigerian national hinterland (Chapter Five). This type of appraisal is necessary in order to be able to audit geographically a regional port development process. Unfortunately, this type of appraisal which is a sine qua non in any port development plan, has not been evident in Nigerian port policy, at least during the past national development plan horizon. In view of this, the question that is to be asked is this: What is the planning implication of the present functional structure within the Nigerian port system? In other words, to what extent does the present functional structure within the port system influence development policy of the ports?

While general conclusions on the relationships can be presented on the basis of the foregoing analysis, much detailed study of each port on a macro regional basis is desirable to be able to establish the interrelationships between structure, function and policy. Detailed analyses at this scale, although desirable, is not what the present study can cope with. It may have to wait for future research. However, these interrelationships can be, and will be tested on a micro scale of a local port complex. All indications thus far point to the dominance of the Lagos ports in the network structure of the Nigerian regional port system.

NOTES

1. The nineteen states structure is the unit basis for regional economic planning in Nigeria.

2. The reason for this is fully explained later in the chapter.

3. Calabar and Delta ports have been excluded because as far as export commodities are concerned, they remain regional ports (local ports).

4. The capacity percentages are calculated from the data provided by Shneerson (1981, Table 2, p.206).

5. It is however recognised that flows of imports and export commodities through the ports are not regular and as such there would be periods when capacity is reduced, and other times when capacity is increased. Flows are likely to be uneven throughout the year.

6. Kaduna and Kano States are large centres of population and industries with 18.4% of Nigeria's population and 16.6% of the manufacturing employment in 1976.

7. All the commodity boards have been scrapped with effect from April 1986.

CHAPTER SIX

OPERATIONAL STRUCTURE AND EFFICIENCY AT THE LAGOS PORTS: 1984

6.1 Introduction

In the preceding two chapters, attention was focussed on the pattern of functional relationships that exist within the Nigerian port system from both the maritime and landward perspectives. Analyses in these chapters have shown that the Lagos ports have become the first ranking ports of Nigeria, both in terms of the magnitude of shipping focussed on them, and in terms of the distribution of international cargo into the Nigerian hinterland space. These Lagos ports, therefore, demand further detailed attention in the present chapter. The chapter sets out to measure the performance at the port complex, and in so doing, emphasis is placed on the question of port activity within the complex - the level of port usage in terms of commodities and shipping inputs; to determine whether these port activities are efficiently carried out, and by implication whether port activities are at present economic for the Ports Authority or the various shipping interests.

Data relating to ship movements and the load and unload pattern of ships, collected during the 1984 survey at the different port locations within the port complex, will be analysed especially from the standpoint of the queuing model. First, the data will be examined from the empirical standpoint in order to be able to specify the structural elements which must be expected to emerge from the queuing modelling approach. A comparison of the two results will then be made. Three problem areas in the spatial analysis of ports will be concentrated upon: that relating to the measurement of the level of congestion at the port, the problems of arrival, service and queuing times, and the problem of defining the operational structure within the port. The importance of structure is stressed in the chapter because it is believed that any approach to capacity and efficiency problems must begin with a consideration of the essential functional interdependence of separate physical sub-systems within the port system; the pattern of linkages among the infrastructural facilities (berths), which defines the operational sub-systems within the port system is pertinent to queuing analysis, and not only provides important keys to our understanding of the present structure, but also will point out the way to possible future development of the port.

6.2 Linkage Characteristics: Lagos Shipping, 1984

The Lagos port complex is located within metropolitan Lagos and is made up of Apapa and Tin Can Island ports, and the Kirikiri and Ikorodu Lighter Terminals. For the purpose of this study, the Lighter Terminals which cannot service ocean going vessels are explicitly excluded. Figure 6.1 and Table 6.1 respectively, show the locational and morphological characteristics of the two ports. They are both served by a common entrance channel which can take vessels up to 9.23 metres. Apapa port which is the larger has a total length of 4059 metres and 3385 metres of harbour anchorages and buoys, and is capable of handling up to twenty-nine loading and discharging vessels at a time. On the other hand, Tin can Island port has a total length of about 2500 metres and is capable of handling ten to fifteen vessels loading and discharging at a time.

Table 6.1

Characteristics of Lagos Ports' Morphologies: 1984

	Apapa	Tin Can Island
Entrance Depth (metres)*	11.5	11.5
Harbour Depths (main berths)	8.23 - 10.50	11.5
Berths: No./length (metres)		
Anchorages/Buoys*	27/91-182	4/110-180
Container	5/220-250	-
General Cargo	18/61-250	11/180-200
Roll-on-roll-off	1/250	3/120-170
Petroleum	6/35-177	-
Coal/Gypsum	1/122	-
Fishery	1/115	1/65
Lighter/Jetties	1/1560	1/1140
Dry Bulk	1/157	1/180
Bulk Vegetable Oil Wharf	1/152	-

* Common facilities to the two ports.
Source: Nigerian Ports Authority Diary, 1984.

The pattern of shipping linkages between the two ports is shown in Table 6.2. Only 15 vessels, representing 2.5 percent of foreign origin vessels visited the two ports during one voyage. Although this figure is small, it nevertheless is significant in terms of the interchangeability of facilities at the two different ports. The specific nature of these ship exchanges between the two ports is shown in Table 6.3. Significant aspects of the shipping exchanges are those between roll-on-roll-off facilities at Tin Can Island port and general cargo facilities at Apapa port on the one hand, and general cargo and container facilities on the other.

Table 6.2

Linkage Characteristics Between Apapa and Tin Can Island Ports

Proportion of Ships Using:	No.	%
Apapa only	375	62.2
Apapa and Tin Can Island	15	2.5
Tin Can Island	213	35.5
TOTAL	603	100

Source: Compiled from 1984 Field Survey.

Table 6.3

Matrix of Berth Visit Exchanges Between Apapa and Tin Can Island

Apapa Port Berth Destin.	Tin Can Island Port Berth Origin (No. of Ship Visits)										
	A1	A1a	A3	A4	A6	A7	A7a	A8	A8a	A9	FT
B5	0	1	0	1	1	0	0	0	0	1	0
B6	0	0	0	0	0	0	1	0	0	1	0
B/7A	0	0	0	0	0	0	0	0	0	0	1
B8	1	0	0	0	0	0	0	0	0	0	0
B9	0	0	0	0	0	0	0	0	0	2	0
B10A	0	0	0	0	0	0	0	0	1	0	0
B15	0	0	0	1	0	1	0	0	0	0	0
B17	0	0	1	0	0	0	0	0	0	0	0
B18	0	0	0	0	0	0	0	1	0	0	0

FT: Fish Terminal
A1-9: Berths 1-10 in Tin Can Island Port (A8-A9 - Roro facilities)
B5-B18: Berths 5-15 at Apapa Port (B15-B18 - Container Facilities)

Source: Compiled from 1984 Field Survey.

The characteristics of ships which call in at both ports are further examined in order to know the differences and similarities in the types and sizes of such ships. Table 6.4 shows the distribution of shipping tonnages at the two port locations between January and June 1984. The size profile of shipping tonnage in both ports is broadly similar, the modal class of size of ships in both ports being between 5,000-11,000 gross registered tonnage in Tin Can Island port and between 7,000-11,000 gross registered tonnage in Apapa port.

Table 6.4

Distribution of Shipping Tonnage: Apapa and Tin Can Island Ports 1984

Tonnage Class of Ships (000)GRT	Number of Ships in Each Tonnage Group			
	Apapa		Tin Can Island	
	No. of Ships	%	No. of Ships	%
Less than 1.0	10	1.9	6	2.5
1-2	18	3.5	8	3.4
2-3	24	4.7	15	6.4
3-5	58	11.4	34	14.4
5-7	96	18.8	46	19.5
7-9	106	20.7	37	15.7
9-11	106	20.7	42	17.8
11-13	21	4.1	15	6.4
13-15	25	4.9	12	5.1
15-20	21	4.1	21	8.8
> 20	26	5.2	0	0.0
TOTAL	511	100.0	236	100.0

N.B. The increase in the total number of ships in each port is due to the fact that some ships visit more than one berth.

Source: Compiled from berth occupancy data during 1984 Field Survey.

The average size of vessels which called at the two port locations are 8,500 GRT for Apapa and 8,000 GRT for Tin Can Island port. Similarly, there is very little difference in the percentage of vessels of the size category between 9,000-15,000 Gross Registered Tonnage that visited the two ports (29.7 percent of all vessels in Apapa,and 29.3 percent of all ships in Tin Can Island port). However, ship sizes of more than 20,000 GRT are confined to Apapa port only. This little difference is explained by the fact that the larger ships in this category discharge exclusively at the only grains berth located at Apapa. The difference does not, however, impose any restrictions on the interchangeability of facilities, a trend that was suggested in Table 6.3. The two ports have the same entrance channel, as well as identical alongside berth depths and length for most of their regular berths.

6.3 Intra-port Shipping Linkages and the Spatial Structure of Port Functions : Apapa and Tin Can Island Ports

During the visit of a ship to a port, it is likely that a ship discharges or loads at one berth, or visits more than one berth to load and/or discharge. Table 6.5 shows the distribution of the number of berths visited per ship at the two ports between January and June 1984. Less than 3 percent of the total number of visiting vessels made more than three berth calls at Apapa port. No ship visited more than two berths at Tin Can Island port. Although the percentage of more than one berth visit vessels at both ports is relatively small, it may well be that these small numbers of vessels cause operational problems especially within Apapa port. During the six months period of the survey of ship traffic at the two ports, it was revealed that a total of 390 foreign trade ships were involved in 511 different berth calls at Apapa making an average internal call per ship equal to 1.3. Similarly, a total of 228 vessels were involved in 236 different berth calls at Tin Can Island port, making an average berth call of 1.03

Table 6.5

Intra-port Shipping Linkages: Apapa and Tin Can Islands Ports - 1984

No. of Berths Visited	Apapa		Tin Can Island	
	No. of Vessels	%	No. of Vessels	%
1 Only	311	79.74	220	96.5
2 Only	52	13.33	8	3.5
3 Only	18	4.62	-	-
4 Only	5	1.28	-	-
5 Only	3	0.77	-	-
6 Only	-	0.0	-	-
7 Only	1	0.26	-	-
TOTAL	390	100.0	228	100.0

Source: Compiled from 1984 Field Survey.

The berth visit data are further disaggregated according to groups visited in order to identify those berths that were most intensively used. Tables 6.6 and 6.7 show the intensity of utilization of the groups of berths with the bulk berths at Apapa and the Ro-ro berths at Tin Can Island ports recording the highest utilization per berth respectively. The general cargo berths in both ports performed below each port's average number of calls. Two probable factors may be attributed to this trend. First is the general decline in the

Table 6.6

Berth Utilization At Apapa Port: Jan-June 1984

Berth Group	No. of Berths	No. of Calls	No. of Calls Per Berth	Rank
General Cargo	19	296	15.6	3
Container/Ro-ro	9	187	20.8	2
Bulk	1	28	28.0	1
TOTAL	29	511	17.6	-

Table 6.7

Berth Utilization At Tin Can Island: Jan-June 1984

Berth Group	No. of Berths	No. of Calls	No. of Calls Per Berth	Rank
General Cargo	10	122	12.2	3
Container/Ro-ro	3	77	25.7	1
Bulk	2	37	18.5	2
TOTAL	15	236	15.7	-

Source: Compiled from 1984 Field Survey.

volume of international import trade at these ports since 1981; and secondly, the fact that general cargo, in percentage terms, is decreasing relative to both unitised and bulk cargo. This pattern is confirmed by an examination of the trend in import trade at Tin Can Island port between 1978 and 1983 (Table 6.8). The general cargo component of the total import trade at the port decreased from 96.2 percent in 1978 to 71.3 percent in 1983, whilst unitised cargo increased from 1.1 percent in 1978 to 11.1 percent in 1983. Similarly, bulk cargo (excluding bulk cement) increased from 2.7 percent to 17.6 percent during the same period. This trend underlies the overall increase in the proportion of unitised cargo imports in the country in general.

Table 6.8

Import Throughput at Tin Can Island Port (1978-1983)

(000' tonnes)

Year	General Cargo	% of Total	Container	% of Total	Bulk Cargo	% of Total
1978	1921	96.2	21.8	1.1	53.3	2.7
1979	1454	90.4	67.8	4.2	85.4	5.4
1980	1533	81.8	174.7	9.3	166.0	8.9
1981	2248	82.4	351.1	12.9	128.4	4.7
1982	1978	76.1	262.7	10.1	357.6	13.8
1983	1174	71.3	182.2	11.1	289.2	17.6

Source: Compiled from Nigerian Ports Authority Annual Reports and Tin Can Island Port Annual Report 1983.

The preceding analysis for the two ports shows the number of ship visits to the group of berths, and on the basis of this, the intensity of usage is determined. However, the analysis does not show the actual interactive patterns of the individual berths within the groups and between the groups within each port system. It is crucial to the analysis that a definition of these berths in port which function as organisational or functional groups, or what is called in this study, the operational structure, should be carried out. Various estimation procedures have been used in defining functional or operational structure within a system. The most common of these methods is that based on the use of powering procedures for defining spatial structure. Nystuen and Dacey (1961) used telephone links as an index of functional association between cities in Washington State and as the basis for defining nodal regions and urban hierarchy. Intercity telephone calls were used as entries in the adjacency matrix and simple rules were established to define the 'dominate' centre or central city. By powering the matrix to the solution time and summing over the power series, the entries in the derived matrix accounted for the indirect pattern of calls and were used to derive dominant or nodal flows and nodal structure. The resultant pattern of urban hierarchy suggested the possibility of using direct and indirect linkages to define spatial structure.

Markov chain analysis is another methodology that has been used as a basis for defining 'functional distance' from interaction data, and for defining functional and nodal regions. In a series of related papers, Brown (1970), Brown and Horton (1971), Brown and Holmes (1971), the approach was used to identify nodal and hierarchical ordering among sets of cities. In an exploratory study, Robinson and Takacs (1976) used Markov chain analysis at the port of Port Kembla in Australia. They conceptualised the serial movement of ships from time of entry into the port to the time of exit with each berth stop as a state in the Markov process. All ships enter the port through an entry 'point' called the 'sea'. Movement after entry will be to an anchorage (if the berth system is saturated and queuing is necessary), or directly to a berth for servicing. Subsequent movements may be to another berth, to anchorage or the ship may in fact leave the port for the sea, which is in effect an Absorbing State.

This conceptualisation is analogous to that used in intra-urban person travel studies in which the home or residence is an Absorbing State (Hemmens, 1966, for example). If intra-port movement pattern is to be conceptualised as a Regular Chain, then the state 'sea' must be omitted and the interaction matrix is a berth-to-berth matrix.

The sea-to-berth conceptualisation is adopted in this study (i.e. the Absorbing Chains). However, as was observed by Hemmens (1966), if individual movement records are available, it would not be necessary to use estimation procedures of one sort or the other. For this study, individual movement records for each ship that used the two ports were, in fact, available and, therefore, a straightforward evaluation of the empirical data is carried out. In the following section of the chapter, therefore, an examination of the linkage patterns for these two Lagos ports is carried out from empirical data.

6.4 Observed Linkage Pattern in Apapa Port

Table 6.9 shows the total interaction matrix for all ships within Apapa port during the period of survey. The entry vector from 'sea' to all berths indicates the number of ships which were able to move directly to individual berths including both Roadstead and Anchorage as berths. In doing so, it not only indicates the importance of some berths in this direct, first-call pattern, but also emphasises the dominance of the roadstead in this pattern, and thus the problem of queuing for berths (339 vessels representing 86.9 percent of all vessels queued at the roadstead). The exit vector - from all berths to 'sea' - indicates the importance of berths in a last-call

Table 6.9

Matrix Showing Intra-port Shipping Linkages: Apapa Port

		Sea	Rstd	Anch	BB	General Cargo Berths													Container/Ro-ro Berths							General Cargo Berths						
					1	2	3	4	5	6	7	7A	8	9	10	10A	11	12	13	14	15	16	16A	17	18	18A	19	19a	20	BN1	BN2	BN3	IJORA
	Sea	.	339	0	3	1	0	0	0	2	1	4	2	1	1	1	2	0	1	0	13	6	2	3	0	1	0	0	2	1	0	2	2
	Rstd.	0	.	19	25	10	12	12	10	8	9	12	10	12	9	9	4	9	3	20	30	17	19	17	9	8	11	8	9	9	10	5	16
	Anch.	9	0	.	1	0	1	0	1	1	1	1	0	0	0	1	1	1	0	1	2	0	0	1	1	2	0	1	0	1	0	0	1
Bulk B.	1.	23	0	0	.	1	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
General Cargo Berths	2.	7	0	1	0	.	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3.	9	0	0	0	2	.	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4.	10	0	1	0	0	2	.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	5.	9	0	0	0	0	1	0	.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	6.	9	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7.	9	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	7A.	13	0	0	0	0	0	0	0	1	1	.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8.	11	0	0	0	0	4	0	0	0	1	0	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9.	10	0	0	0	0	0	2	0	0	0	0	5	.	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10.	5	0	0	0	0	0	0	0	0	0	0	1	3	.	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10A.	6	0	0	0	0	0	0	0	0	0	0	0	0	2	.	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	11.	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	12.	4	0	0	0	0	0	0	2	0	0	0	0	0	2	0	3	.	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	13.	2	0	0	0	0	0	0	1	0	0	0	0	0	0	2	2	1	.	0	0	0	0	0	0	0	1	0	0	0	0	0	0

(Contd)

Table 6.9 (Contd)

Matrix Showing Intra-port Shipping Linkages: Apapa Port

			Sea	Rstd	Anch	BB	General Cargo Berths													Container/Ro-ro Berths							General Cargo Berths						
						1	2	3	4	5	6	7	7A	8	9	10	10A	11	12	13	14	15	16	16A	17	18	18A	19	19a	20	BN1	BN2	BN3	IJ
C	R	14.	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	9	.	0	1	0	0	1	1	0	0	0	0	0	0	0
o	o	15.	43	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	.	0	0	0	0	0	0	0	0	0	0	0	0
n	r	16.	19	0	0	0	0	0	0	1	2	0	0	0	0	1	1	0	1	2	2	0	.	3	0	0	0	0	0	0	0	0	0	0
t	0	16A.	18	0	0	0	1	0	0	0	1	0	0	1	9	9	9	1	0	0	0	0	0	.	0	0	1	0	1	0	0	0	0	0
n		17.	14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	2	0	0	0	.	1	0	0	1	0	0	0	0	0
e	B	18.	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	.	0	0	1	0	0	0	0	0
r/	s	18A.	6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	.	2	0	0	0	0	0	0
G	C	19.	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	.	1	0	0	0	0	0
e	a	19A.	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	1	1	1	1	.	1	0	0	0	1
n	r	20.	8	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	2	0	0	0	1	1	1	1	0	4	.	1	0	0	1
e	g	BN1	9	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.	2	1	0
r	o	BN2	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	.	2	0
a		BN3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	.	2
l	B	IJORA	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	5	.

Source: Compiled from 1984 Field Survey.

pattern. It is worth noting the importance of the Roadstead and the Anchorage for vessels waiting for berths. The vector 'Roadstead' to Anchorage indicates that some vessels engaged in double queues at both the Roadstead and the Anchorage. As will be shown later, this is probably where the bulk of time spent by ships in the port is spent. In contrast, there are very few internally generated queues as indicated by the vector, all berths to Anchorage. Only two vessels used the Anchorage from alongside berths (that is, the berths to anchorage vector). It is also worth noting that these initial queuing times represented by queuing times at the Roadstead and the Anchorage are the ones usually taken into consideration in most queuing model applications.

Thus, a large number of ships make one berth call and return directly to the sea. 82.1 percent of all ships that loaded and/or unloaded at the bulk berth, 75 percent of those that loaded or discharged at the general cargo berths and 86.6 percent of ships that berthed at the container berths, made only one berth call and returned directly to the sea. These percentages are significant in terms of ship turnround time. They suggest the tendency among the general cargo berths to have longer ship 'dwell' time, because the ships visit more than one berth to load or discharge. Many cells within the matrix have either zero or very low values, indicating a relatively low connectivity with other berths, and by implication, a considerable degree of operational independence. However, it is apparent that some berths have some degree of interdependence within the port. The bulk berth, for example, is linked with some general cargo berths, whereas it (bulk berth) operates independent of the container berths. The general cargo berths have more internal links than external links with other groups of berths. This may be due to a combination of operational as well as morphological characteristics of the groups of berths. For example, the need to load and discharge cargo at port areas which share similar facilities will make such internal links mandatory. Similarly, the locational patterns of the berths which makes the group of berths more or less contiguous may explain the internal links (See Figure 6.1).

The pattern of internal linkages within the general cargo berths clearly demonstrates the influence of proximity. This probably explains why berths No. 2-13 have virtually no links with berths No. 19, 19A and 20. These latter berths are part of the new Apapa wharf extension and morphologically, are physically separated from the former berth groups by the container berths (See Figure 6.1). The degree of interdependence between container berths (berths 14-18A) and the general cargo berths is rather surprising, because by nature, container berths are expected to function as independent or quasi-independent units within the port system. That this is not so suggests the heterogeneous nature of ship loads which characterises shipping to Nigerian ports and which was identified in an earlier chapter. Most general cargo vessels top up their loads with boxes of containers whilst some container vessels also top up with general cargo. In the same way, dry bulk vessels top up with boxes of containers and some general cargo.

In general, it can be concluded that some links occur between the various units of berths within the Apapa port. The dry bulk berth is linked with the general cargo berths in a one-way direction; the general cargo berths are internally linked together, whilst container berths are linked in a 'symbiotic' relationship with general cargo berths. These results suggest the interchangeability of berths for the different vessel user types. This characteristic is assumed in most queuing model applications.

6.5 Observed Linkage Pattern at Tin Can Island Port

Table 6.10 depicts the pattern of relationships within the berths located at Tin Can Island port. The matrix shows fewer links between the berths than there are between the berths located at Apapa port. The bulk berths (Nos. 1 and 1A) function as independent berths with no links with either general cargo or the Ro-ro berths. There are two rather isolated links between the general cargo berths and the Ro-ro berths. In short, the relatively moderate degree of functional cohesion that is observable from Apapa port is altogether absent in Tin Can Island port. The berths function more or less independently of each other. The probable explanation for this difference is the different administrative as well as operational policies at the two ports. Whereas, at Apapa port, all berths are operated directly by the Nigerian Ports Authority, at Tin Can Island port, private operators operate side by side with the Nigerian Ports Authority. The general cargo berths are operated by NPA whilst the Ro-ro and dry bulk berths are operated by different private operators. However, this apparent degree of functional independence at the Tin CanIsland port does not impose any restrictions on the interchangeability of the berthing facilities within the port, since the maximum draught of the berths is the same for all the category of berths (Table 6.1).

Table 6.10

Matrix Showing Intra-port Shipping Linkages: Tin Can Island Port

		S e A	R d s	A n c	Bulk Berths 1	1A	General Cargo Berths 2	3	4	4A	5	6	7	7A	8	8A	Ro-Ro Berths 9	9A	10
	Sea	.	170	0	3	3	3	3	1	4	4	4	4	3	5	5	6	4	6
	Rds	0	.	12	17	14	3	9	9	6	12	10	10	4	8	6	35	17	10
	Anc	0	0	.	4	0	0	1	1	0	3	2	0	1	0	0	0	0	0
B	1.	20	0	0	.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	1A	17	0	0	0	.	0	0	0	0	0	0	0	0	0	0	0	0	0
G	2.	7	0	0	0	0	.	1	1	0	0	0	0	0	0	0	0	0	1
e	3.	14	0	0	0	0	1	.	1	0	0	0	0	0	0	0	0	0	0
n	4.	8	0	0	0	0	1	1	.	0	0	0	0	0	0	0	0	0	0
e	4A	10	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	0
r	5.	16	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0
a	6.	14	0	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0
l	7.	13	0	0	0	0	0	0	0	0	0	0	.	1	0	0	0	0	0
	7A	8	0	0	0	0	0	0	0	0	0	0	1	.	0	0	0	0	0
C	8.	15	0	0	0	0	0	0	0	0	0	0	0	0	.	2	0	0	0
B	8A	10	0	0	0	0	0	0	0	0	0	0	0	0	2	.	0	0	0
R o	9.	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.	0	0
r	9A	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	.	0
o	10	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.

Source: Compiled from 1984 Field Survey.

The general conclusions that may be drawn are that although infra-structural facilities at each port are expected to sort out the user vessels into clearly distinct operational groups, that is, general cargo, Ro-ro, container, and so on, there is, nevertheless, some discernible operational interdependence, both within each port and between the two ports. Thus, the condition of interchangeability of berths which the queuing model application prescribes, is satisfied at the two ports. The same conclusion can be reached as regards the interchangeability of facilities between the two port locations.

6.6 Pattern of Ship Arrivals at the Lagos Roadstead

The actual time of arrival of ships that used the two ports during the period of study is used in the analysis of the frequency of ships arrivals at the two ports. Tables 6.11 and 6.12 show the frequency distribution of the number of ships arriving at the two ports. The arrival data are sorted out and then tabulated and are shown as cumulative distribution. The average number of ships arriving daily was found to be 2.14 for Apapa and 1.25 for Tin Can island port. These means are used in the computation of the theoretical distribution on the basis of a negative exponential function. The theoretical distribution is given by the formula:

$$P(ns) = \frac{(\overline{ns})^{ns} \cdot e^{-\overline{ns}} \times T}{ns!}$$

and their values are given in percentages in Tables 6.11 and 6.12. A graphical presentation of the observed and theoretical distributions is made in Figure 6.2. There is an apparent lack of congruence between the observed and the theoretical distributions. However, to determine whether the observed frequency of ship arrivals fits the expected or theoretical frequency distribution, chi-square was computed using the formula:

$$X^2 = \sum \frac{[F(ns) - f(ns)]^2}{F(ns)}$$

Table 6.11

Ship Arrival Distribution at Apapa Port: Jan-June 1984

No. of ships Arriving ns	No. of days in which ships ns arrived Obs.	Exp.	Average No. of ships ns arriving daily	Value of X^2	No. of classes	Cumul. % distr. Obs.	Cumul. % distr. Exp.
0	32	21.4				100	100
1	33	45.8				82.4	87.8
2	41	49.0				64.3	62.6
3	45	35.0				41.7	36.1
4	18	18.7	2.14	21.7	8	17.0	16.9
5	6	8.0				7.1	6.6
6	3	2.8				3.8	2.2
7	3}	0.9}				2.2	0.6
8	1}	0.2}				0.5	0.2
9	-}	0.2}				0.0	0.1
TOTAL	182	182					

Source: Computed from 1984 Field Survey.

in which F(ns) is the expected frequency and f(ns) the observed frequency. The value of chi-square for arrival distribution is 21.7 for Apapa port, and 5.0 for Tin Can Island port. The critical values of X^2 at $p = 0.01$ is 20.09 for Apapa and 16.81 for Tin Can Island port. In the case of Apapa, the hypothesis of conformance between the two arrival distributions is rejected; that is there is a significant difference between expected and observed values at that port, whereas, in the case of Tin Can Island port, there is no significant difference between the observed and expected distributions.

Table 6.12

Ship Arrival Distribution at Tin Can Island Port: Jan-June 1984

No. of ships Arriving ns	No. of days in which ships ns arrived		Average No. of ships ns arriving daily	Value of X^2	No. of classes	Cumul. % distr.	Cumul. % distr.
	Obs.	Exp.				Obs.	Exp.
0	58	52.1				100	100
1	55	65.2				68.1	71.3
2	39	40.7				37.9	35.5
3	21	17.0	1.25	5.0	6	16.5	13.1
4	8	5.3				4.9	3.8
5	1	1.3}				0.6	0.9
6	-	0.3}				0.0	0.2
TOTAL	182	182					

Source: Computed from 1984 Field Survey.

A closer examination of the arrival distributions at the two ports shows that the observed number of arrivals is small relative to the capacity of the berthing facilities at each port. Apapa port has facilities to berth up to 29 vessels at a time, whilst Tin Can Island port also has facilities to berth up to 15 vessels at a time. The difference in the proportion of actual arrivals relative to the berthing capacity of each port may well have been responsible for the differences in the chi-square results. The rate of arrivals at each port is low, and that tends to suggest one important factor; that is the downward trend in the international trade at the two ports which had started during 1982 and which was apparent during the period of Field Survey.

Figure 6.2

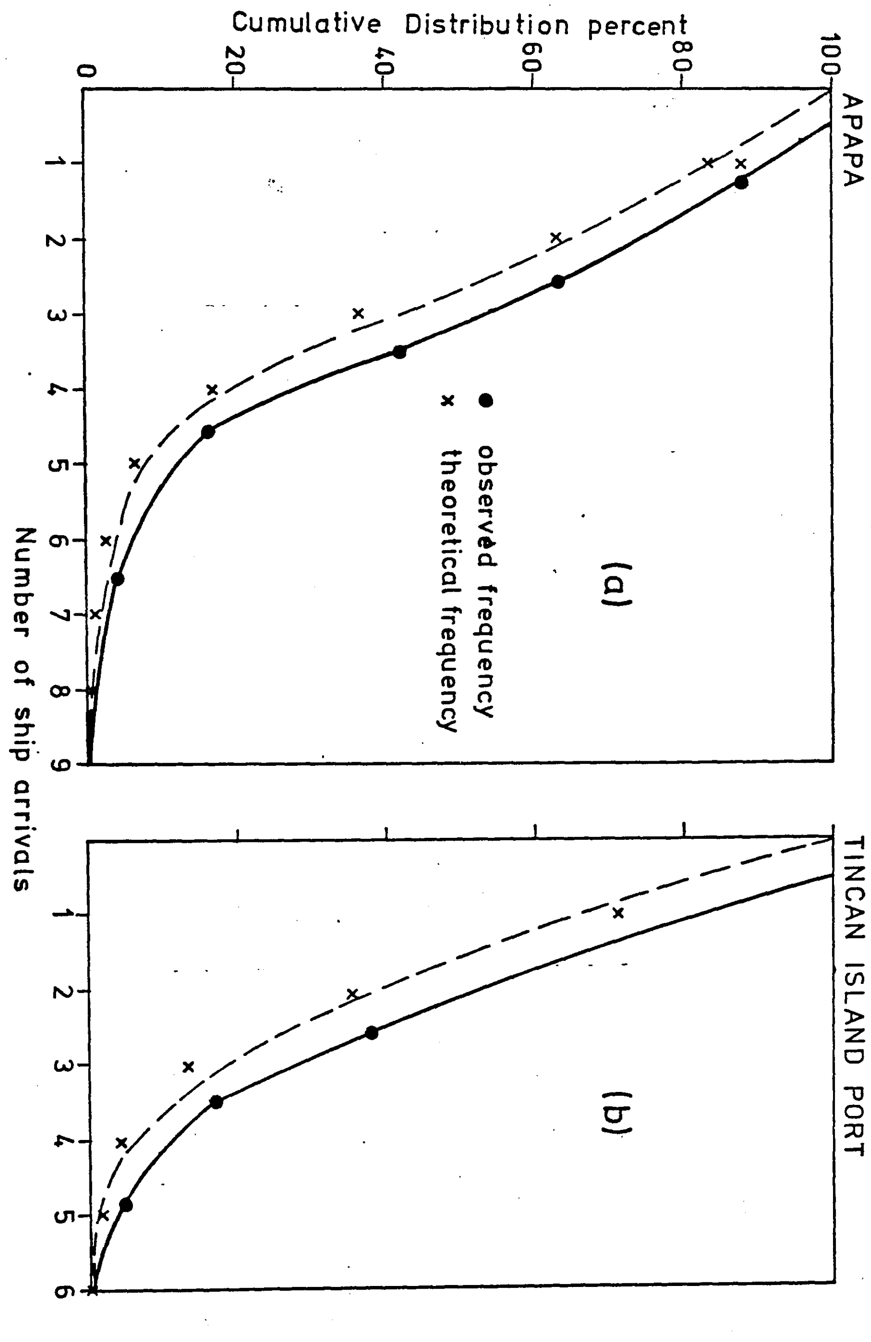


Fig.6.2 OBSERVED AND THEORETICAL DISTRIBUTIONS OF SHIP ARRIVALS AT LAGOS PORTS:1984.

However, the conclusion that can be drawn from the foregoing analysis of the pattern of ship arrivals at the two port locations is that inspite of the absence of an extremely good fit between the observed and the theoretical arrival distribution of vessels, especially at Apapa port, the distributions can still be approximated by the exponential function (Poisson's distribution). The slight difference in the range of values of 'goodness of fit' as shown in Tables 6.11 and 6.12, and in the graphical presentations in Figure 6.2 a and b merely indicate unusual results which do not contradict the underlying validity of the application of the Poisson distribution to ship traffic (Nicholaou, 1967; Mettam, 1967). Consequently, and in subsequent analysis, the arrival pattern of ships at the Lagos Roadstead is taken as a Poisson distribution.

6.7 Delay to Vessels in the Queue at the Lagos Roadstead

Usually, arriving vessels cannot proceed directly to berths due to a wide-ranging set of factors such as a lack of capacity at the Pilot's vessel; time of arrival (if at night, in ports without night operations; absence of a vacant berth, and so on). Such vessels, therefore, must have to stay in the queue at the roadstead. The data provided by the Pilot department at each port gave the date and time of arrival of each ship at the roadstead. Also provided were data and time at which each ship is presented to the Pilot's vessel for onward journey to berth, and the time the ship actually occupied the berths, as well as the time the ship finally vacates the berth either to change to another berth, or to sail out of the port.

A tabulation was made of the number of vessels arriving at the roadstead and the number of vessels departing from berth for each day during the six months period January to June 1984. The difference between arrivals and departures from the berths, is for each day, the number of vessels in the queue. The data are summarised in Table 6.13, and show the number of days in which a specified number of ships were in the queue at the roadstead anchorage prior to proceeding to berth. From these data given in Table 6.13, the mean value of the number of ships in the queue at the two port locations was computed and the results show that the mean length of the queue was 4.3 ships for Apapa and 7.5 ships for Tin Can Island Port.

Table 6.13

Number of Days in which a Queue of Ships Occurred at Lagos Roadstead

APAPA			TINCAN ISLAND		
x No. of ships in the queue	f No. of days of occurrence	fx	x No. of ships in the queue	f No. of days of occurrence	fx
0	13	0	0	1	0
1	19	19	1	0	0
2	24	48	2	1	2
3	29	87	3	0	0
4	13	52	4	1	4
5	25	125	5	24	120
6	20	120	6	26	156
7	13	91	7	51	357
8	11	88	8	24	192
9	8	72	9	21	189
10	3	30	10	18	180
11	2	22	11	8	88
12	1	12	12	7	84
13	1	13	13	0	0
TOTAL	182	779	TOTAL	182	1372

Source: Compiled from 1984 Field Survey.

From the ship traffic data, the duration of time spent by vessels at the roadstead before proceeding to berth was also calculated. Tables 6.14 and 6.15 show the distribution of delay times to arriving vessels at the two ports sorted out in a 2-day interval.

Table 6.14

Delay to Vessels in the Queue at the Lagos Roadstead: Apapa

Class Interval (days)	Bulk Berth %	Bulk Berth Cum.%	Convent. Berth %	Convent. Berth Cum.%	Contain. Berth %	Contain. Berth Cum.%	Port Total %	Port Total Cum.%
0-1	25.0	25.0	23.1	23.1	35.1	35.1	27.9	27.9
1-3	57.1	82.1	40.1	63.2	47.5	82.6	44.4	72.3
3-5	10.7	92.8	16.8	80.0	9.7	92.3	13.6	85.9
5-7	3.6	96.4	4.8	84.8	2.6	94.9	3.8	89.7
7-9	0.0	96.4	5.8	90.6	2.6	97.5	4.1	93.8
9-11	0.0	96.4	1.4	92.0	1.9	99.4	1.5	95.3
11-13	0.0	96.4	1.9	93.9	0.0	99.4	1.0	96.3
13-15	0.0	96.4	1.9	95.8	0.0	99.4	1.0	97.3
15-17	3.6	100.0	1.0	96.8	0.0	99.4	0.8	98.1
17-19	-	100.0	1.0	97.8	0.6	100.0	0.8	98.9
19-21	-	100.0	1.0	98.8	-	100.0	0.5	99.4
21-23	-	100.0	0.5	99.3	-	100.0	0.3	99.7
23-25	-	100.0	0.7	100.0	-	100.0	0.0	99.7
> 25	-	100.0	-	100.0	-	100.0	0.3	100.0

Source: Compiled from 1984 Field Survey.

Table 6.15

Delay to Vessels in the Queue at the Lagos Roadstead:

Tin Can Island Port

Class Interval (days)	Bulk Berth %	Bulk Berth Cum.%	Convent. Berth %	Convent. Berth Cum.%	Ro-ro Berth %	Ro-ro Berth Cum.%	Port Total %	Port Total Cum.%
0-1	48.7	48.7	27.9	27.9	32.9	32.9	32.9	32.9
1-3	32.4	81.1	47.0	74.9	50.0	82.9	45.6	78.5
3-5	5.4	86.5	14.8	89.7	15.8	98.7	13.6	92.1
5-7	8.1	94.6	4.3	94.0	1.3	100.0	3.9	96.0
7-9	5.4	100.0	1.7	95.7	-	-	1.8	97.8
9-11	-	-	1.7	97.4	-	-	0.9	98.7
11-13	-	-	1.7	99.1	-	-	0.9	99.6
13-15	-	-	0.9	100.0	-	-	0.4	100.0
> 15	-	100.0	-	100.0	-	100.0	-	100.0

Source: Compiled from 1984 Field Survey.

The mean value of delay was 2.9 days for vessels waiting to berth at Apapa and 2.2 days for vesels waiting to berth at Tin Can Island port. The results are more revealing when these data are disaggregated by berth groups. There is much similarity in the delay profile of ships waiting to berth at the bulk and container/Ro-ro berths at both ports. The mean delays for ships waiting to berth at these group of berths at Apapa are 2.48 days and 2.18 days respectively, whilst those for the same berth groups at Tin Can Island port are 2.02 days and 1.87 days respectively. The vessels waiting to berth at the conventional berths experience greater delays than other category of vessels. Their mean delay time is 3.5 days for Apapa and 2.57 days for Tin Can Island port. When the mean delay times for the two ports are compared, it is clear that while the general distribution pattern is similar, the spread of delay times involving vessels waiting to berth at Apapa port is greater than that of Tin Can Island port, and this feature affects the port total distribution patterns for Apapa and, therefore, causes delay times at that port to be much higher than those at Tin Can Island port.

6.8 Berth Service Time Distribution at the Lagos Ports

Data giving the date and time of arrival at a berth and the date and time of departure from the berth for the two port locations were analysed in order to find out what times each vessel spent in the port, loading or discharging cargo. For the purpose of the analysis, service time is taken as the sum of the berthing time, the loading and/or unloading time and the deberthing time. When a ship leaving a berth is immediately followed at berth by a ship that has been waiting there is a period between the departure from berth of one ship and the arrival at berth of the waiting ship. This time interval varies and during this interval, the berth is technically vacant, but cannot be used by a ship. Consequently, the time has been added to the time at berth of the departing ship to give an effective service time at berth. Because of the generally large service times that were observed, the time spent in service by vessels was calculated in days rather than hours; and a class interval of 2 days was used for a preliminary analysis for which the data are given in Tables 6.16 and 6.17.

Table 6.16 shows the frequency distribution of ship service time for Apapa port. The mean service time for all vessels using the port is 8.8 days, and the standard deviation of service time about the mean

Table 6.16

Ship Berth Service time: Apapa Port

Class Interval (days in port)	Convent Berth		Contain. Berth		Bulk Berth		Port Total	
	%	Cum.%	%	Cum.%	%	Cum.%	%	Cum.%
0-1	0.0	0.0	11.7	11.7	0.0	0.0	4.6	4.6
1-3	5.3	5.3	38.3	50.0	3.6	3.6	18.2	22.8
3-5	12.0	17.3	18.8	68.8	46.4	50.0	17.2	40.0
5-7	11.5	28.8	14.3	83.1	28.6	78.6	13.8	53.8
7-9	14.5	43.3	5.8	88.9	7.1	85.7	10.5	64.3
9-11	8.7	52.0	5.2	94.1	3.6	89.3	6.9	71.2
11-13	10.1	62.1	3.2	97.3	0.0	89.3	6.9	78.1
13-15	7.2	69.3	0.0	97.3	0.0	89.3	3.9	82.0
15-17	5.3	74.6	1.3	98.6	0.0	89.3	2.8	84.8
17-19	5.3	79.9	0.7	99.3	0.0	89.3	2.8	87.6
19-21	2.9	82.8	0.0	99.3	0.0	89.3	1.6	89.2
21-23	1.4	84.2	0.0	99.3	0.0	89.3	0.8	90.0
23-25	3.4	87.6	0.0	99.3	0.0	89.3	1.8	91.8
> 25	12.5	100.0	0.7	100.0	10.7	100.0	8.2	100.0
TOTAL	100		100		100		100	

Source: Computed from 1984 Field Survey.

is 7.3. In order to achieve a greater homogeneity within the data sets, attempts were made to disaggregate the data according to berth requirements. This analysis was made using data for all vessels using the port during the sample period, on the one hand, and on the other hand, analysis was made using all vessels but disaggregated by berthing pattern. This was done on the assumption that vessels using

Table 6.17

Ship Berth Service Time : Tin Can Island Port

Class Interval (days in port)	Convent Berth %	Convent Berth Cum.%	Ro-ro Berth %	Ro-ro Berth Cum.%	Bulk Berth %	Bulk Berth Cum.%	Port Total %	Port Total Cum.%
0-1	9.6	9.6	36.9	36.9	5.4	5.4	17.6	17.6
1-3	14.7	24.3	53.9	90.8	24.3	29.7	29.8	47.4
3-5	13.9	38.2	6.6	97.4	13.5	43.2	11.4	58.8
5-7	18.3	56.5	1.3	98.7	21.6	64.8	13.2	72.0
7-9	8.7	65.2	1.3	100.0	5.5	70.3	5.7	77.7
9-11	5.2	70.4	0.0	-	13.5	83.5	4.8	82.5
11-13	5.2	75.6	-	-	2.7	86.5	3.1	85.6
13-15	5.2	80.8	-	-	2.7	89.2	3.1	88.7
15-17	9.6	90.4	-	-	2.7	91.9	5.2	93.9
17-19	2.6	93.0	-	-	2.7	94.6	1.8	95.7
19-21	5.2	98.2	-	-	2.7	97.3	3.1	98.8
21-23	0.0	98.2	-	-	0.0	97.3	0.0	98.8
23-25	0.9	99.1	-	-	2.7	100.0	0.8	99.6
> 25	0.9	100.0	-	-	-	-	0.4	100.0
TOTAL	100		100		100		100	

Source: Computed from 1984 Field Survey.

similar berths would tend to be similar. This involved three sets of data referring to vessels using bulk berths, container berths and conventional berths. The mean service time for ships using conventional berths was calculated and found to be 12.26 days, compared with 7.35 days and 4.39 days respectively for ships using bulk and container berths. This means that ships using container berths have average berth times approximately one third of ships using conventional berths, and just a little more than half of the average berth time of ships using bulk berths. The relative spread of berth service times is slightly smaller for bulk and container ships for which the coefficient of variation (standard deviation divided by mean) is 0.89 for bulk berths and 0.96 for container berths, compared to 0.6 for ships using conventional berths.

The graphical presentation of berth service times shown in Figure 6.3 (a-d) confirms the differences in the spread of the berth service times for ships using the different berth group types. The distribution for the ships using the bulk berth and the container berths exhibit characteristic peaks at 3-5 days and 1-3 days respectively, whilst ships using conventional berths exhibit double peaks at 7-9 days and more than 25 days respectively. The distribution pattern for ships using conventional berths closely resembles that for all ships combined, with both exhibiting characteristic double peaks at the beginning and the end. This suggests that ships using conventional berths determine, to a large extent, the pattern of berth service times at the port in general.

When it seemed likely that some extreme values might have distorted the conclusions from the analysis,the original data was reduced by omitting the number of vessels that loaded and unloaded at more than one berth. This brought a great improvement to berth service time of all ships, with the mean service time being reduced from 8.8 days to 5.1 days. The standard deviation about the mean becomes 4.19. There are corresponding improvements in the berth service times of ships using conventional berths, from an average time of 12.26 days to 6.79 days. Berth service time improvements in respect of vessels

Figure 6.3

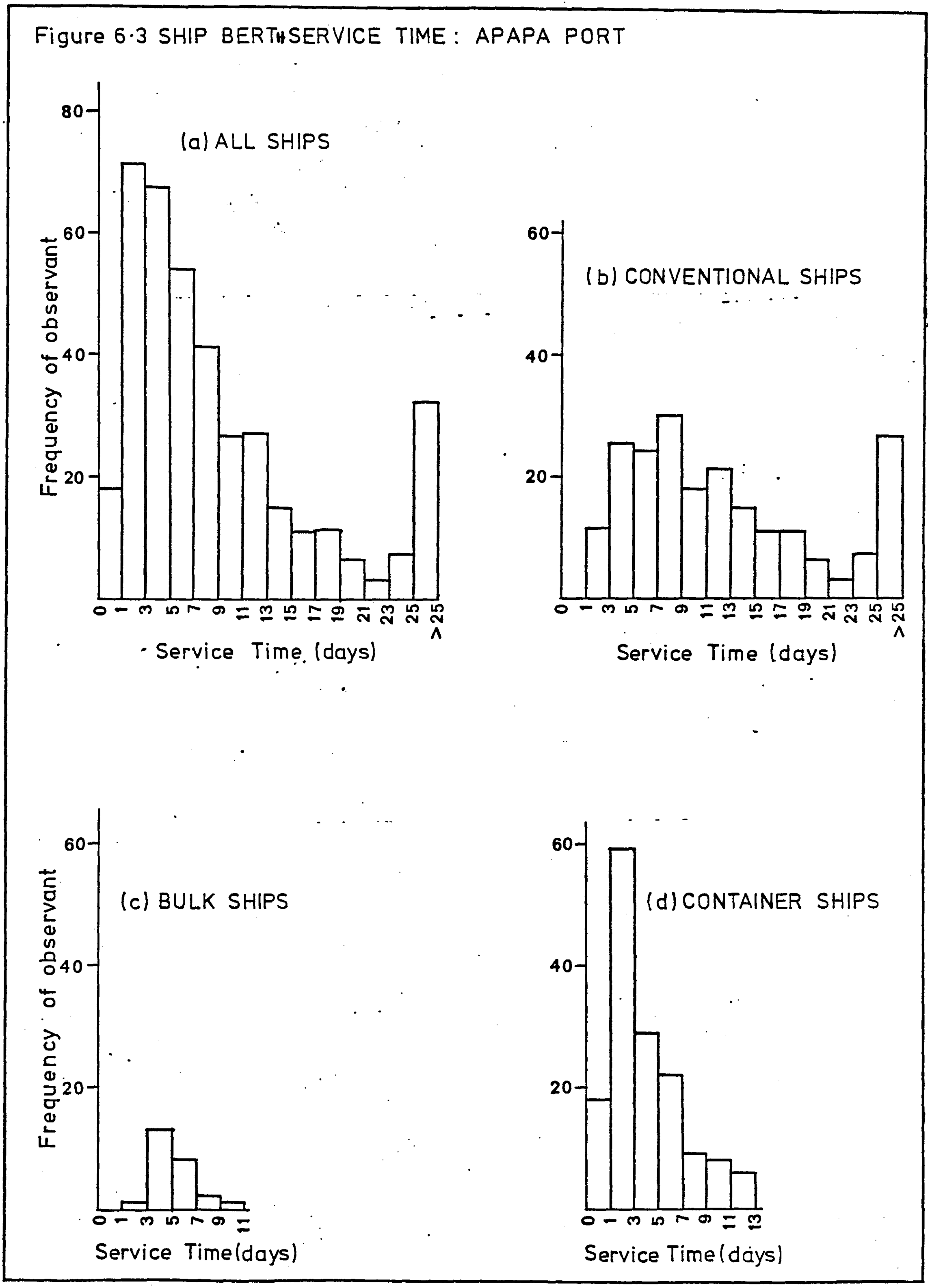


Figure 6·3 SHIP BERTH SERVICE TIME: APAPA PORT
(a) ALL SHIPS
(b) CONVENTIONAL SHIPS
(c) BULK SHIPS
(d) CONTAINER SHIPS
Frequency of observant
Service Time (days)
80
60
40
20
0
1
3
5
7
9
11
13
15
17
19
21
23
25
>25

Figure 6.4

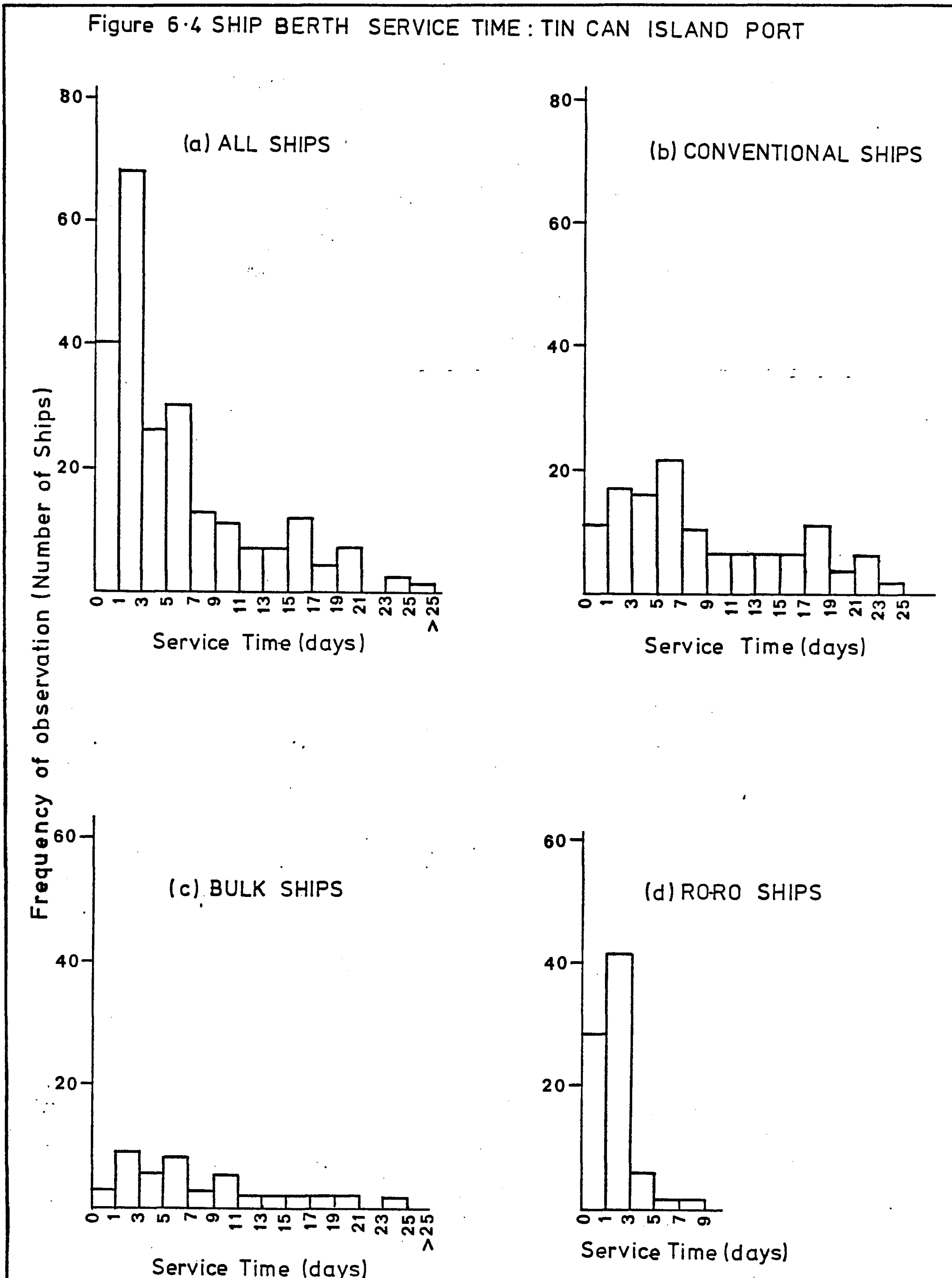


Figure 6·4 SHIP BERTH SERVICE TIME : TIN CAN ISLAND PORT
Frequency of observation (Number of Ships)
(a) ALL SHIPS
80
60
40
20
0 1 3 5 7 9 11 13 15 17 19 21 23 25 >25
Service Time (days)
(b) CONVENTIONAL SHIPS
80
60
40
20
0 1 3 5 7 9 11 13 15 17 19 21 23 25
Service Time (days)
(c) BULK SHIPS
60
40
20
0 1 3 5 7 9 11 13 15 17 19 21 23 25 >25
Service Time (days)
(d) RO-RO SHIPS
60
40
20
0 1 3 5 7 9
Service Time (days)

using container and bulk berths are not so significant because relatively fewer number of ships using these berths visited more than one berth (compare 9.2 percent and 10.7 percent respectively for container and bulk berths with 30.3 percent for ships using conventional berths). This conclusion tends to suggest that the number of berths visited, loading and unloading, has significant effect on berth service time of ships. Berth service times for the three categories of user types are similarly calculated for the Tin Can Island port (Table 6.17 and Figure 6.4 (a-d).

When the berth service times at the two ports are compared, it becomes obvious that average service times in general at Tin Can Island port are less than those of Apapa port (compare the average for all ships at Apapa of 8.8 days with 5.8 days at Tin Can Island port). Comparison of berth group times between the two port locations also show that service times at Tin Can Island port are generally smaller than those at Apapa port (compare average service time of 12.26 days for vesels using conventional berths at Apapa with 8.0 days for ships using the same type of berths at Tin Can Island port; also compare average service time of 6.9 days for vessels using bulk berths at Tin Can Island port with 7.35 days for vessels using the same type of berth facilities at Apapa port).

6.9 Size of Cargo Loads: Apapa and Tin Can Island Ports

The time spent at berth for service is a function of the amount of cargo that is unloaded and/or loaded. The analysis of the cargo load sizes of ships using the different berth group types at the two ports is necessary before any meaningful comparison can be made of the berth service times. Table 6.18 shows the pattern of the size

Table 6.18

Size of Cargo Loads at Apapa Port

Cargo Sizes (Tonnes)	Unloaded Bulk % of ships	Unloaded Conv. % of ships	Unloaded Cont. % of ships	Loaded Bulb % of ships	Loaded Conv. % of ships	Loaded Cont. % of ships	Total Handled Bulk % of ships	Total Handled Conv. % of ships	Total Handled Cont. % of ships
< 100	-	-	13.0	7.1	-	-	-	-	-
100-300	-	1.4	1.9	10.7	4.8	5.1	-	1.4	-
300-500	-	1.4	4.5	3.6	6.3	5.1	-	0.5	-
500-700	-	1.0	1.3	3.6	2.9	5.1	-	0.5	2.6
700-1000	-	3.8	1.9	3.6	3.4	9.7	-	1.0	-
1000-1500	-	6.3	9.7	-	5.3	5.1	-	6.7	2.6
1500-2000	-	6.7	9.7	-	3.8	1.3	-	6.3	3.9
2000-3000	-	13.0	14.5	7.1	2.4	3.2	-	10.6	9.1
3000-5000	-	25.5	20.5	3.6	2.9	-	-	24.0	27.9
5000-7000	-	20.7	11.8	-	1.9	-	-	25.0	26.6
7000-10000	-	12.0	7.8	-	-	-	-	14.4	19.5
10000-15000	3.6	4.8	3.4	-	-	-	-	5.8	7.8
15000-20000	21.4	2.0	-	-	-	-	21.4	2.4	-
> 20000	75.0	1.4	-	-	-	-	78.6	1.4	-
No. of Ships	28	208	154	11	70	92	28	208	154
Mean							23958	5048	3965

Source: Computed from 1984 Field Survey.

of cargo loads for ships that used Apapa port during the first six months of 1984.

Although the modal class of cargo load size for the conventional and container berths is the same, there is very little similarity between the load profile as far as the whole import traffic is concerned. Vessels using conventional berths have about 41 percent of ships discharging more than 5000 tonnes compared to 23 percent of ships using container berths. No vessels using container berths discharged more than 15,000 tonnes. The bulk berth is distinctive as far as the 'unloaded' load size is concerned. No ship using this berth discharged less than 10,000 tonnes; and, in fact, 75 percent of the ships discharged more than 20,000 tonnes. The lack of similarity in the discharged load suggests that these berths are not interchangeable as far as the size of cargo load is concerned.

If there is very little similarity between the ships using the different types of berths as regards discharged cargo, the same cannot be said of these ships as far as loaded cargo is concerned. There is broad similarity in the spread of cargo sizes between the conventional and container ships. Apart from the bulk berth, it would seem as if load sizes for vessels using Apapa port are generally small. This trend is not altogether surprising in view of the amount of shipping around that takes place among ports on the West African shipping range. This factor probably explains the low tonnages of ships within the range of less than 100 to 2000 tonnes for both conventional and container berths.

The load size profile of vessels using the Tin Can Island port is also examined (Table 6.19). The modal class for the unload cargo sizes at the bulk berths is the 5000-7000 tonnage group. The mean 'unload' size of ships is 6898. The load size profile is strikingly lower, 91 percent of all vessels using these berths recorded less than 100 tonnes. In fact, only four out of the 37 vesels which used these berths were engaged in loading. There is very little

Table 6.19

Size of Cargo Loads: Tin Can Island Port

Cargo Sizes (Tonnes)	Unloaded			Loaded			Total Handled		
	Bulk % of ships	Conv. % of ships	Ro-ro % of ships	Bulk % of ships	Conv. % of ships	Ro-ro % of ships	Bulk % of ships	Conv. % of ships	Ro-ro % of ships
< 100	-	1.7	6.6	75.0	72.2	63.1	-	-	2.6
100-300	-	1.7	1.3	-	5.2	7.9	-	2.6	9.2
300-500	-	4.3	2.6	-	7.0	13.2	-	2.6	6.6
500-700	2.7	0.9	-	25.0	4.3	6.6	2.1	2.6	6.6
700-1000	2.7	3.5	3.9	-	1.7	1.3	3.3	6.1	3.9
1000-1500	2.7	11.3	13.2	-	3.5	5.3	2.7	7.0	17.1
1500-2000	13.5	14.8	11.8	-	2.6	1.3	13.5	10.4	10.5
2000-3000	10.8	16.5	27.6	-	0.9	1.3	10.8	20.0	14.4
3000-5000	5.5	13.0	18.5	-	1.7	-	5.5	17.4	19.9
5000-7000	27.0	13.0	7.9	-	0.9	-	27.0	8.7	6.6
7000-10000	10.8	2.6	4.3	-	-	-	10.8	3.5	0.0
10000-15000	13.5	12.3	2.6	-	-	-	13.5	14.8	2.6
15000-20000	10.8	4.3	-	-	-	-	10.8	4.3	-
> 20000	-	-	-	-	-	-	-	-	-
No. of Ships	37	115	76	4	-	-	37	115	76
Mean							6935	5044	2653

Source: Computed from 1984 Field Survey.

similarity in the size of the 'unload' cargo loads between the vessels using conventional berths and those using the Roll-on-roll-off berths. Less than 70 percent of ships using conventional berths unload less than 5000 tonnes. The equivalent percentage for ships using Ro-ro berths is 85 percent. Loaded tonnage is relatively more important for Ro-ro berths than they are for either the conventional or the bulk berths. 15.8 percent of the total number of ships using the Ro-ro berths load between 500 and 3000 tonnes. The corresponding figures for conventional and the bulk berths are 8.8 percent and 5.7 percent respectively. The importance of the Ro-ro berths in the loaded tonnage load profile is probably enhanced by the loading of empty containers.

When the two ports are compared with regards to vessel load sizes, it becomes obvious that the bulk berth at Apapa has higher load factors than those located at Tin Can Island port (compare the mean tonnage of 23,958 per vessel at Apapa with the mean tonnage of 6935 at Tin Can Island port). The probable explanation for this difference is that the vessels using the bulk berth at Apapa are strictly dry bulk vessels discharging mainly bulk wheat, whereas the vessels using the bulk berths at Tin Can Island are a mixture of dry bulk and container and even general cargo vessels. There appears to be a great similarity in the cargo sizes (total cargo handled) of ships using conventional berths at the two ports (compare the mean tonnage of 5048 for Apapa and 5044 for Tin Can Island port). This characteristic once again emphasises the degree of interchangeability of these berths as far as load sizes are concerned. There appears to be very little similarity between the load sizes of vessels using container berths and Ro-ro berths at the two ports; only 9.2 percent of ships using the Ro-ro facilities at Tin Can Island carry more than 5000 tonnes, whilst the corresponding percentage for ships using container facilities at Apapa is 53.9. The mean total handled tonnage for container berths at Apapa is 3965; this does not compare favourably with the mean total handled tonnage of only 2653 at the

Roll-on-roll-off berths at Tin Can Island port.

The importance of container traffic in the total traffic pattern at both ports is demonstrated by Table 6.20. At Apapa both the conventional and bulk berths play a relatively minor role in the number of containers handled. But the fact that these berths handled containers at all tends to emphasise the practice of ships other than container ships of topping up with container boxes. 39 percent and 54.8 percent respectively of ships using the bulk berth and the conventional berths, handled no containers at all. 42.8 percent of ships using container berths handled less than 200 containers. This relatively small number of containers handled per ship is probably due to the same factor of considerable shipping around along the ports of West Africa. The number of containers handled at Tin Can Island port appears to be spread uniformly among the various berth user types. However, the Roll-on-roll-off berths appear to play a more prominent role in the container traffic with more than 80 percent of vessels handling some boxes of containers. The corresponding percentages for the bulk and conventional berths are 20.7 and 65.2 respectively.

When the two ports are compared, the load pattern of containers handled suggests that container traffic has a greater spread among the different berth groups in Tin Can Island than in Apapa. The conventional berths in Tin Can Island in particular handle a higher range of containers per ship than their counterparts in Apapa port. This may be due to the fact that conventional berths at Tin Can Island are more modern and better equipped with container handling equipment than the older Apapa berths.

Table 6.20

Number of Containers Handled Per Ship: Apapa and Tin Can Island Ports

No. of Contain-ers	Bulk		Ro-ro/Container		Conventional	
	% ships Apapa	% ships Tin Can I.	% ships Apapa	% ships Tin Can I.	% ships Apapa	% ships Tin Can I.
0	39.3	70.3	-	19.8	54.8	34.8
0-10	10.7	-	-	5.3	14.9	8.7
10-20	3.6	5.4	-	5.3	16.4	13.0
20-50	14.3	2.7	4.5	32.9	13.9	7.0
50-100	17.8	8.1	19.5	13.2	-	13.9
100-150	14.3	8.1	14.3	6.6	-	9.6
150-200	-	-	4.5	3.9	-	4.3
200-300	-	2.7	15.6	5.2	-	2.6
300-400	-	-	28.0	6.6	-	5.2
400-500	-	2.7	9.2	1.2	-	0.9
500-600	-	-	4.0	-	-	-
600-700	-	-	0.8	-	-	-
700-800	-	-	-	-	-	-
No. of Ships	28	37	154	76	208	115
Mean No. of contrs. per ship	37.3	36.9	325.3	79.7	8.0	63.5

Source: Compiled from 1984 Field Survey.

6.10 Service Handling Rates for Ships: Apapa and Tin Can Island Ports

Service handling rate is defined here as the ratio of the total tonnage handled to the time (in days) the ship spends at berth. This is the ratio used by shipping management in estimating how long a

Figure 6.5

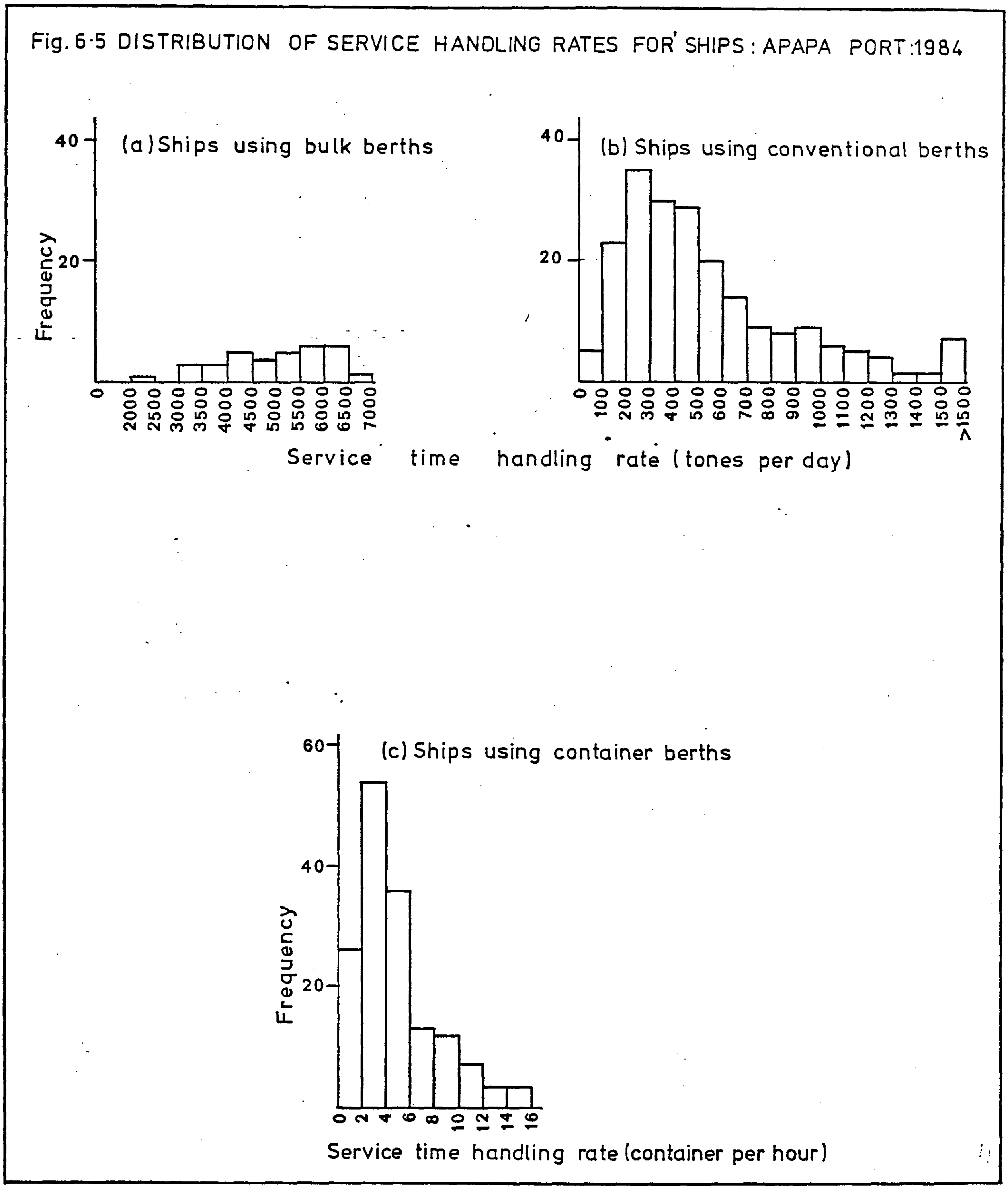


Fig. 6·5 DISTRIBUTION OF SERVICE HANDLING RATES FOR SHIPS : APAPA PORT :1984
(a) Ships using bulk berths
(b) Ships using conventional berths
Frequency
40
20
0
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
>1500
Service time handling rate (tones per day)
(c) Ships using container berths
60
40
20
0
2
4
6
8
10
12
14
16
Service time handling rate (container per hour)

Figure 6.6

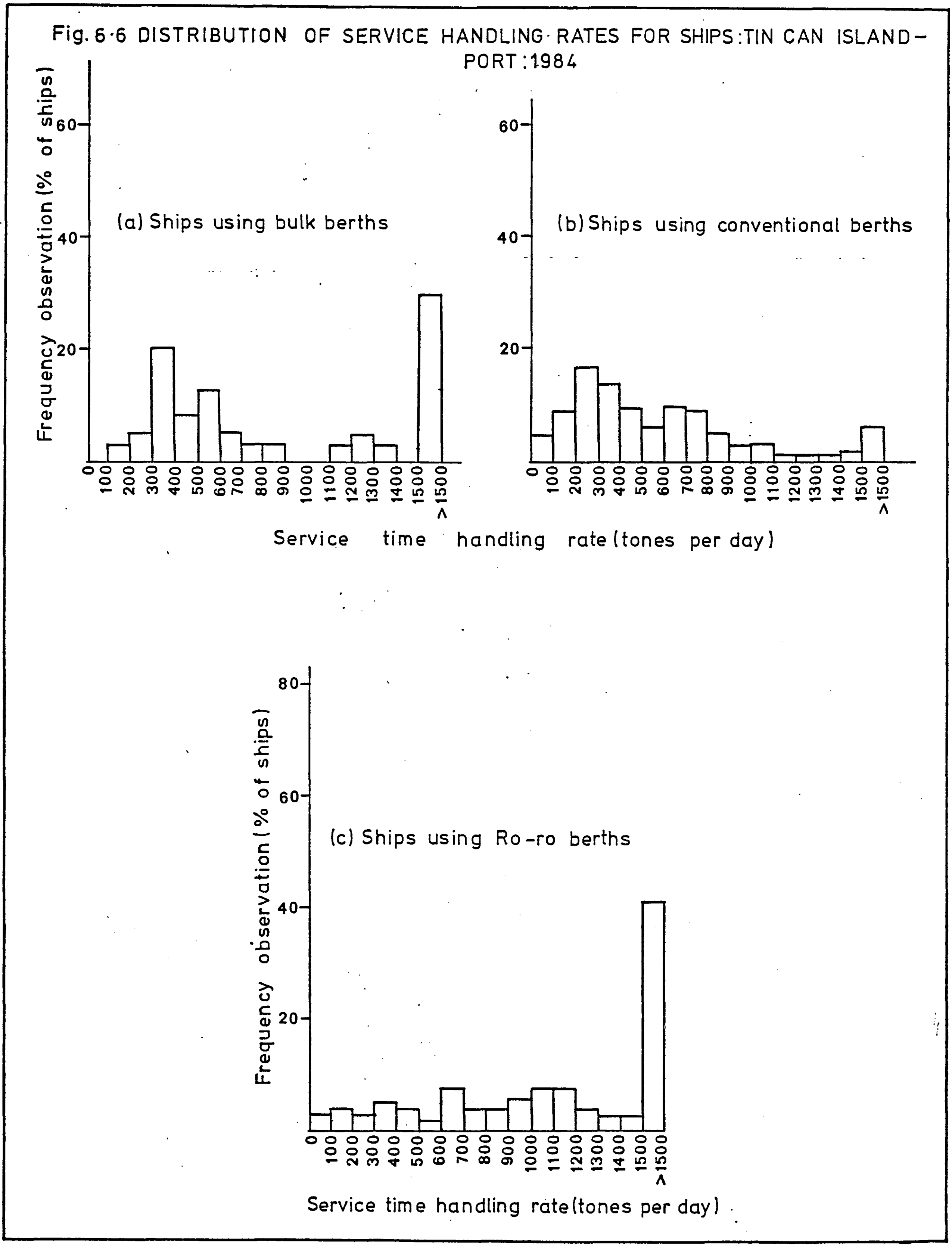


Fig. 6·6 DISTRIBUTION OF SERVICE HANDLING RATES FOR SHIPS: TIN CAN ISLAND-PORT: 1984
Frequency observation (% of ships)
(a) Ships using bulk berths
(b) Ships using conventional berths
60
40
20
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
>1500
Service time handling rate (tones per day)
(c) Ships using Ro-ro berths
80
Service time handling rate (tones per day)

ship will be in port (Edmond and Maggs, 1976). The handling rates distributions for the two ports are shown in Figures 6.5 and 6.6 for the three berth user ship types. The most striking feature of the distributions is the wide variation in the handling rates (as emphasised by the spread of the distributions) within and between berth user types. For the vessels which used the dry bulk berth at Apapa, the mode for the handling distribution is 6000-7000 tonnes per day, although the mean handling rate per day is 5634 tonnes. More than 50 percent of the vessels handled more than 5500 tonnes per day. The standard deviation of the handling rate about the mean is 1368; the coefficient of variation is 0.24 or 24 percent.

Handling rates at the conventional berths are more varied than they are at the bulk berth. The observed mean handling rate is 524 tonnes per day, with a standard deviation of 356 about the mean, and a coefficient of variation of 67 percent. The mean handling rate at the container berths is 4.7 container units per hour, or 723 tonnes per day.[1] The standard deviation is 3.2 and the coefficient of variation is 68 percent.

Handling rates distributions are even more varied in Tin Can Island port than in Apapa, even though the mean daily handling rates per ship are higher at the former port (except for bulk berths). The coefficient of variation for the different berths user types are: 75.2 percent for bulk berths, 69.5 percent for conventional berths and 38.4 percent for Ro-ro berths. On a priori grounds, it may be expected that Apapa, being the major port, with the larger average cargo loads per ship for all types of berth user vessels, and with relatively higher regularity of service, would have higher handling rates than the newer and smaller Tin Can Island port. However, in practice, the handling rates at the two comparable conventional berths show that these rates are higher at Tin Can Island (compare the average of 524 tonnes and 569 tonnes for Apapa and Tin Can Island).

One probable explanation for the better handling performance of Tin Can Island, particularly for ships using conventional berths, is the larger container component of the cargo vessels using these berths (compare the mean number of containers per ship of 63.5 for Tin Can Island and 8.0 for Apapa). This factor, together with the fact that the cargo composition at Tin Can Island is more homogeneous (Tin Can Island specialises in the discharge of fertilizers, whilst Apapa specialises in mixed industrial goods), makes handling performance higher at Tin Can Island port. Also, the differences in the delay factor at the two ports confer an advantage of higher handling rate on Tin Can Island. A simple delay factor which relates the number of days that vessels have to await a berth and the total number of vessels calling at the port shows that delay is less significant at Tin Can Island than at Apapa (compare a mean delay of 2.2 days and 2.9 days respectively for vessels waiting to berth at Tin Can Island and Apapa ports).

The bulk berth at Apapa has a higher productivity than the bulk berths at Tin Can Island port (compare the daily handling rate of 5636 tonnes at Apapa with only 691 tonnes for Tin Can Island port). The probable explanation for this lies in the fact that berths 1 and 1A at the latter port which are supposed to be used as dry bulk berths, are used to discharge a variety of conventional general cargo.[2] There appears, therefore, to be no basis for comparison of these berths with that at Apapa which is used to discharge mainly bulk wheat and bulk cement. In the same way, there appears to be no basis for the comparison of the container berths at Apapa with the Ro-ro berths at Tin Can Island port, on the basis of service handling rates because of the difference in the character and composition of the cargo discharged at these berths. The mean daily handling rate of 1100 tonnes is calculated for the Ro-ro berths at Tin Can Island port.

The question of measuring and assessing productivity as a means of demonstrating the degree of efficiency with which the capacity of the ports is being utilized has engaged the attention of researchers in seaport studies. The concensus is that questions of port capacity, efficiency and productivity are difficult to define precisely (Hoyle, 1978). Measures of productivity which are related to the volume of cargo handled at a port, or the average number of days required to work a ship may, in themselves be partial measures. Perhaps a more acceptable measure is to combine the volume handled with measures of variations in tonnage per ship working day.

The coefficient of variation of the handling distributions at the various berth groups at the two ports is, therefore, employed with the volumes handled per unit of time, to compare productivity at the berths. Higher volumes and lower coefficient of variations would indicate that the productive resources of labour, capital and technical equipment are being efficiently used, whilst lower tonnages and higher coefficient of variation would indicate otherwise.

Based on these, it would appear that handling service at the bulk berth at Tin Can Island port is inefficient with a relatively low handling rate of 691 tonnes and a high coefficient of service rate variation of 75.2 percent. The roll-on-roll-off facilities appear to be more efficiently utilized, relative to other berthing facilities at that port (compare a service rate of 1100 tonnes per day and a coefficient of variation of 38.4 percent for Ro-ro berths and 691 tonnes per day and a coefficient of variation of 75.2 percent for the bulk berth). The Ro-ro berths appear to combine the advantage of a relatively higher regularity of cargo flows with that of homogeneity of structure of cargo. The cargo mix of containers and vehicles and cars which is mainly discharged is probably more amenable to higher productive levels than conventionally handled cargo. The Ro-ro berths also have the advantage of higher productivity that characterises private enterprise compared to governmental enterprises. The Ro-ro berths, as already indicated, are exclusively managed by the Ro-ro Terminal Company (RTC), a private company with better serviced and equipped plants and equipment for handling operations.

Within Apapa port, the bulk berth appears to be more effectively utilized relative to other berth facilities (compare the coefficient of variation of 24 percent for the bulk berth with 66 percent for conventional berths and 68 percent for container berths). The reason for this better performance of the bulk berth relative to other berths is the fact that, by nature, the bulk berth is the least labour intensive, and, therefore, suffers least from the rigidities of established labour practices which adversely affect productivity in other berths. The bulk berth also has the relative advantage of higher regularity of cargo flow. The container berths appear to be efficiently operated, especiallly with the high coefficient of variation in the handling rate. The reasons are probably linked with the mix of cargo (mixture of containers and general cargo). A high proportion of the vessels that use the container facilities are semi-cellular vessels which cannot take full advantage of the handling equipment designed for full cellular container ships.[3] Another reason is probably related to the regularity of container flows and the multi-port itineraries of container carrying ships along the West African shipping range.

When the performance of the two Lagos ports is compared with other ports in developed and developing countries, it will appear that the Lagos ports are less efficiently utilized. Gilman (1977), gave evidence to the effect that where there is a cargo flow comprising mixed industrial goods, a variety of unit load methods, including a limited number of containers, the conventional cargo system can achieve up to about 1000 tonnes per two shift working day. Where big ships are involved, attempts have been made to double this figure. The mean daily handling rates of 569 tonnes for Tin Can Island and 524 tonnes for Apapa are not anywhere near the figure of 1000 tonnes. Also a comparison is made of handling rates at conventional berths at the Lagos ports and at the port of Hong Kong in 1973. The results shows that 33 percent of vessels using the conventional berths in Hong Kong in 1973 handled a mean daily tonnage of more than 1000 tonnes. The corresponding percentages for Apapa and Tin Can Island are 11.6 and 14.0 respectively (Table 6.21).

Table 6.21

Handling Performance at Conventional Berths

Lagos and Hong Kong Ports

Tonnage Class	APAPA* % of ships	TINCAN ISLAND* % of ships	HONG KONG** % of ships
0-400	45.7	44.3	12.0
500-1000	28.8	32.2	50.0
> 1000	11.6	14.0	33.0

Source: *1984: Field Survey at Lagos Ports, 1984.
**1973: Robinson and Chu, 1978. p.224

Comparison of container terminals with other similar terminals in developing countries also brings out clearly the poor perfomance of Apapa port. Maggs and Edmonds (1976) gave evidence from their studies of container terminal performance in developing countries that typical handling rates lie between 300 and 800 TEUs per day.[4] They recognised that where traffic flows are small and dispersed (like in the case of Nigeria especially since the economic recession in 1982), the performance is likely to be towards the bottom of the range, i.e. 300 TEUs. Even when these bottom lines are taken as the yardstick, handling rates at the container terminal still fall far below the bottom lines (compare 70.5 TEUs handling rate at Apapa with the 300 TEUs bottom of the range). Similarly, the performance of the Ro-ro facilities at Tin Can Island port compared with performance of similar facilities elsewhere in the developing countries, shows a poor handling performance. Whereas, on a multi-port itinerary, and where large tonnages are moved, Ro-ro facilities have demonstrated a capacity for about 7000 tonnes per day; the daily handling rate at Tin Can Island Roro terminal is only 1100 tonnes. Even when the bottom line range value of 3000 tonnes per day is taken (where smaller tonnages are involved) Tin Can Island port's performance is still not satisfactory.

The reasons for such poor performance are not hard to understand; the most important of these being the poor availability and unserviceability of working plant and equipment for cargo handling. Table 6.22 shows the situation of plant and equipment at Tin Can Island port in 1983 (the table also reflects the general situation of plant and equipment at Apapa port). In all cases more than 50 percent of all types of plant are not available for use mainly because they are not serviceable for lack of spare parts. These spare parts, in all cases, have to be ordered from foreign countries. The few available ones suffer from constant breakdowns as a result of misuse, and in many cases, as a result of power cuts and voltage fluctuations.

Table 6.22

Plant Availability Situation at Tin Can Island Port: 1983

Type of Plant	Total No. Plants	No. available for use	No. Not available for use	% Not Available for use
Mobile Cranes	11	3	8	72.7
Portal Cranes	10	3	7	70.0
Hyster Fork-lift	169	81	88	52.1
Freight Lifter	20	7	13	65.0
Trailer Trucks	16	6	10	62.5

Source: NPA, Tin Can Island Port, 7th Annual Report, 1983, p.15.

Another reason for low productivity is the attitude of the labour force to work. For example, during the one week period spent doing Field work at the two ports, it was discovered that in more than 80 percent of the period, shed operations started at 09.30 hours instead of 07.30 hours, and closed between 1700 hours and 1800 hours instead of 2200 hours - a daily loss of almost six hours.

Yet another reason for low productivity is linked with characteristics of shipping in the West African trade area. Far too many vessels originating from Europe engage in multi-port itineraries, and with too little cargo to be discharged at each port.[5] When small tonnages are related to the time spent in port (docking, preparing to work cargo, and changing from one berth to another within the port), low overall productivity of cargo handling operations often results. Under these operational conditions, port operations cannot be economic either to the shipper, the Ports Authority or the ship owner.

6.11 Summary and Conclusions

Analysis in this chapter confirms the operational interdependence of the various elements within the Lagos port system (Apapa and Tin Can Island ports). The implications of this conclusion is that groups of berths are interchangeable to the different category of ship user types. This ensures some degree of flexibility in port operations, especially in relation to the allocation of berthing facilities to arriving vessels. However, in terms of operational efficiency, the use of specialised facilities like container and Ro-ro by non-specialised vessels like conventional general cargo vessels, does not make for the desired efficiency because such non-specialised vessels cannot take advantage of the fast service that the specialised equipment is designed for. This, probably, is responsible for the long delays and the greater ship turnround times that are identified in the chapter. The chapter also shows that the load and unload pattern of the ships that use the Lagos ports is highly inefficient. Various factors, ranging from customs procedure, inavailability of plant and equipment and the attitude of the labour force, account for this.

NOTES

1. A 15 hour two shifts operation is assumed for this calculation. 70 percent of handled containers are assumed to be loaded with an assumed tonnage of 14 tonnes per loaded container, and 1.5 tonnes per empty container.

2. This is probably due to overcapacity of bulk berths at the two ports, and the fact that imports of dry bulk commodities have declined considerably at the ports. There is, furthermore, another berth at Tin Can Island port (Seament 1) which is devoted exclusively to the discharge of bulk cement. Even this, has suffered a great decline in throughput.

3. Shipping operators have not used the full cellular container vessels because of the low load factor of import container vessels, and the fact that containers return empty on the second leg of the journey.

4. Twenty Foot Equivalent Units (TEU) is the measure of standard containers of dimension 20' x 8' x 8'.

5. It is not unusual for vessels to call at between 5 to 7 ports during one journey.

CHAPTER SEVEN

THE ROLES OF PORT OWNERS AND PORT USERS IN THE DEVELOPMENT OF NIGERIAN SEAPORTS

7.1 Introduction

Analyses in the previous chapters have led to two major conclusions, viz.:

(i) That the history of port development in Nigeria has been characterised by the gradual concentration of traffic at fewer points culminating in the dominance of Lagos and Port Harcourt ports. This is in spite of positive efforts made by the autorities to deconcentrate port activities at these ports.

(ii) That the load and unload pattern of import and export trade at the Lagos port complex is inefficient, and that this has led to delays and decline in the rate of working the ships that are presented for service at the port complex. Two interrelated issues emerge from these conclusions and these can be posed in the form of questions, thus:

   (a) Why build prestige ports in peripheral areas such as Calabar and Sapele where ships would not use them sufficiently?

   (b) Why do port users demonstrate obvious preference for Lagos port inspite of the inefficiencies at that port, and when it is known that greater efficiency in terms of faster ship and land transport turnround times can be achieved at other Nigerian ports?[1]

The objective of this chapter is to attempt to answer these questions and to examine the importance of a number of factors which are believed to contribute to the explanation of the present structure of the Nigerian port System. The fundamental assumption in the chapter is that the answers to the questions raised can be found by investigating the roles of the various decision-making participants in the port business, especially their goals, values, their state of knowledge or their thinking habits and their prejudices.

Analysis in the chapter is in two parts. The first part seeks to concentrate on answering the 'how' question relating to the perception of elements in the port system, and thus seek to display and analyse the views of port owners and operators as well as port users of the Nigerian ports about the issues of port development in Nigeria in general.

The second part of the analysis seeks to concentrate on answering the more positive 'why' question in relation to direct involvement in port choice decision-making, and thus seek to analyse the decision factors which have motivated the primary users of the Nigerian ports based in the United Kingdom in their use of particular ports in Nigeria. (The selection of the U.K. port customers is justified on the grounds that U.K. is Nigeria's single biggest trade partner in Europe.)

Analysis in the two parts is achieved using the technique of point score analysis. The point score analysis technique, although it has been used mainly in the analysis of decision-making in agriculture (Ilbery, 1977), can, nevertheless, be adapted and used to analyse decision-making process in the choice of a port or ports. The approach adopted in the first part is the analysis of the constructs under the roles of the three major participants: the port owners/operators; the shipping lines and their representatives; and the cargo interests. Comparisons are made between the responses to the constructs and a priori expectations which are derived from the results of public data analysis in the previous chapters.

Analysis in the second part is narrowed down to the roles of the United Kingdom based shipping lines operating on the Nigerian route; and assesses the relative importance of decision factors which were elicited from the first set of questionnaires (See section on methodology in Chapter One).

As was discussed in Chapter One, twenty constructs made up of bi-polar opposites and administered to groups of port owners/ operators (5), shipowners and their agents (11), and cargo interests as represented by consignees and consignors (4), were included in the first questionnaire survey. Respondents in the five groups identified, totalling thirty-five were asked to grade these constructs on a 1-7 scale of agreement or disagreement between polarities or opposites. If their interpretation of the construct in question was very closely associated with one end of the scale, they should use the extreme categories (1 or 7); but if their interpretation was quite closely related they were to use 2 or 6; and if slightly related, 3 or 5. If respondents had no 'strong views' either way about the constructs they were to check the middle of the scale, that is 4.

7.2 Responses: Role of Port Owners/Operators

Table 7.1 shows scores from responses to questionnaires relating to the role of port owners/operators in the development of the Nigerian ports. Three groups of propositions are identifiable, viz.: those that relate to the provision of infrastructural facilities (P2,P4); those that relate to the mode of financing port development (Pl and P5); and the proposition relating to the issue of influencing competition between the ports (P3). Scores for propositions relating to the provision of infrastructural facilities are consistently high among all groups of respondents except United Kingdom based ship-owners whose low to medium scores probably suggest indifference. As for the propositions relating to the mode of financing port development (Pl and P5) all interest groups except U.K. based consignors seem to agree on the commercial approach to port development. Scores for the proposition relating to the issue of who has the right to influence competition between the ports (P3) suggest indifference among United Kingdom based shipping and cargo interests as well as Nigerian based cargo interests.

Table 7.1

Scores: Propositions Relating to the Roles of Port Owners/Operators

Decision-makers	SCORES P1	P2	P3	P4	P5
1. Port Owners/Operators	96.4	92.8	96.4	71.4	100.0
2. Shipowners/Operators (Nigeria)	59.0	83.8	82.8	72.3	96.1
3. Shipowners/Operators (U.K.)	71.4	42.8	47.6	57.1	47.6
4. Consignees (Nigeria)	69.6	82.1	50.0	53.5	96.4
5. Consignors (U.K.)	50.2	68.6	48.5	62.8	54.2

Notes:

(i) Notations indicating propositions:

P1 Nigerian ports should be run on commercial basis without subsidies.

P2 Ports should develop facilities in advance of known needs of port users.

P3 Ports should influence port ship routeing to correct imbalance in the use of certain ports.

P4 Ship congestion is a worse problem than over provision of berths.

P5 Shipowners should pay for the increased marginal costs of port improvement.

(ii) Scores represent percentage of maximum scores.

(iii) Number of respondents:

Port operators/owners = 4

Shipowners/operators (Nigeria) = 15

Shipowners/operators (U.K.) = 3

Consignees (Nigeria) = 8

Consignors (U.K.) = 5

(iv) Source: Compiled from Questionnaire Field Survey in Nigeria and U.K. in 1985.

When the port planning policy and the decision-making process that resulted in the present port structure in the country are put in perspective, it is not difficult to explain the scores which tend to emphasise the policy of provision of excess capacity at all ports. In spite of the fact that such policy suggests a wasteful use of scarce capital resources by the Ports Authority, the responses of the Nigerian Ports Authority (NPA) and those of Nigerian based shipping interests as well as the U.K. and Nigerian based cargo interests are positive. These responses might have been influenced by the experience of these parties during the Nigerian port congestion crisis during the mid 1970s when the government had to pay high demurrage to waiting ships and when cargo interests, especially commercial houses and industrialists, suffered financial losses in higher freight rates and lost opportunities.

The apparent indifference of shipowners and cargo interests based in the United Kingdom to (P4) may have been influenced by the fact that throughout the period of congestion, the U.K.-West Africa Line (UKWAL) conference members had priority berths allocated to them (Dickinson, 1984). For the others who did not enjoy such facilities, it was claimed that the demurrage claims more than compensated for the delays to their ships. Indeed, many incidents of sharp practices by some ship operators, hurrying their half loaded and in some cases empty ships to Nigerian ports to queue in order to qualify for demurrage payments, were reported by the local press.

On the issue of speculative development in advance of known needs of customers (P2), the high scores of port operators in Nigeria is probably justified. The implication of this proposition is the lack of consultation between the Ports Authority who are the providers of the facilities, and the users, in the port planning process. Prior to the mid 1970's big port investment policy in the country, the development of facilities at Nigerian ports has largely been the result of crisis planning, trying to solve avoidable problems only when they were manifested. Ogundana (1975) has demonstrated that quay development at Apapa in 1920, 1950, 1963 and 1965 has always been a consequence of apparent inadequate capacity; and the improvement of entrance channels at Lagos, Esc ravos (Delta) and Bonny (Port Harcourt) during these periods has been attended by indecision as to when the improvements should take place, and controversy as to the technology to be used in constructing the protective channel entrance breakwaters.

The low scores for U.K. ship operators are probably due to the fact that, true to the tradition of British shipping, the respondents believe that port developments should take place only when plans for customers' use are available and guaranteed. Such a view is in accord with the laisser-faire approach to port development adopted in the U.K. during the period 1964-1982 (Garratt, 1983).

All interest groups, excepting U.K. based cargo interests would want a commercial approach to seaport activity (P1 and P5). However, having regard to the port planning objectives in Nigeria, it is expected that port operators will opt in favour of a 'total benefits' approach. It is equally surprising that U.K. based shipping interests are in favour of the commercial approach when it is obvious that such may run counter to their interests. Laing (1977) has suggested that a subsidy for a port is an indirect subsidy for the shipowners and operators. However, that the U.K. shipping interests opt for the commercial approach to port activity may probably be due to the influence of their shipping environment. The tradition of free enterprise is very strong in shipping circles in the United Kingdom (Bird, 1982).

It is clear from this section that the major participant in providing facilities at the Nigerian ports is the Nigerian Ports Authority. Wide ranging views about the very important issue of provision of port facilities were expressed, and with the exception of one or two cases, each interest group appears to justify its role. For the Nigerian Ports Authority in particular, it would appear that the period of massive port development in the country coincided with the period of economic boom when huge revenues from oil provided money for infrastructural developments. This probably influenced the deliberate policy of provision of over capacity at all Nigerian ports (Gowon, 1975). However, the period of this present study coincided with the period of economic recession with dwindling oil revenues and a huge external debt burden. There is no doubt that this economic situation has changed the view of port development from the point of view of the Nigerian Ports Authority, from the 'total benefit' approach to that of a purely 'commercial' approach, as evidenced by their response.

The U.K. shipping and cargo interests recorded almost average scores which suggest indifference to most of the propositions. This trend brings into focus a sharp difference between the views of these groups and their Nigerian counterparts, especially shipping interests, who tend to go along with the views of port operators. The differing commercial environments of the interest groups may have accounted for these differences.

7.3 Responses: Role of Shipping Interests in Ship Routeing

The propositions in this section relate mainly to the role of shipping interests in routeing ships through Nigerian ports. Table 7.2 shows scores from responses by all interest groups to the propositions which are grouped under five headings: propositions relating to the importance of port location (P7, P9 and P14); those relating to the importance of infrastructural facilities at the ports (P12, P16); cargo availability (P6, P8); economic related propositions (P10, P11 and P13); and the freedom of choice proposition (15).

The 'location' propositions stress the importance of port location in relation to its hinterland and foreland. The highest scores for all interest groups for proposition 7 confirms the importance of the location of a port as a leading factor in the choice of a port. When the location of the port is interpreted in terms of the national hinterland and foreland it is clear that some ports will exhibit characteristics of 'central' and others 'peripheral' locations (e.g. Lagos and Calabar ports respectively). Opinions seem divided between port operators, shipowners and cargo interests based in Nigeria and the U.K. on the one hand, and U.K. based shipowners on the other, on the issue of the relationship that should exist between 'central' and 'peripheral' ports in terms of shipping services, and more especially growth and development (P9). The high scores of the first group show agreement with the proposition, whilst scores of U.K. based shipping interests suggest some indifference. Having regard to the reality of port development in general, and in Nigeria in particular, it would appear that the response of the first group is more realistic than that of the latter group, because the techno-

Table 7.2

Scores: Propositions Relating to the Role of Shipping Interests

Propositions	Port Ops.	Shipowners (Nigeria)	Shipowners (U.K)	Consignees (Nigeria)	Consignors (U.K.)
P6 Regular availability of cargo is the most important ship routeing factor.	78.5	82.8	95.2	92.8	67.1
P7 The decision to choose a particular port as a major terminal is due to its location.	89.2	90.4	80.9	85.7	94.2
P8 Frequency of service is a main distinguishing feature between Lagos and other Nigerian ports.	85.7	92.3	95.2	96.4	94.2
P9 Ports in peripheral areas are likely to be served by shipping services from ports in Central areas.	85.7	71.4	47.1	67.1	67.1
P10 Port charges on ships and cargo handling affect ship routeing.	37.1	34.2	23.8	33.9	35.7
P11 Port productivity affects ship routeing.	28.5	35.2	47.6	37.5	45.8
P12 Quality of port infrastructures affects ship routeing.	78.6	71.4	96.4	68.7	65.6
P13 Labour practices affect port routeing.	21.4	37.1	52.3	46.4	37.5
P14 Ultimate inland origin/destination of cargo determines ship routeing.	71.4	72.3	57.1	67.8	40.0
P15 Shipping interests should be free to choose ports which they wish to use.	96.4	76.1	57.1	66.1	88.5
P16 Availability of berths are powerful inducements for the choice of a port.	25.0	60.9	33.3	57.1	45.7

Notes: (i) Scores represent percentages of maximum scores.
(ii) Number of respondents
- Port operators/owners = 4
- Shipowners/operators (Nigeria) = 15
- Shipowners/operators (U.K.) = 3
- Consignees (Nigeria) = 8
- Consignors (U.K.) = 5

Total = 35

Source: Compiled from Questionnaire Field Survey in Nigeria and U.K. in 1985.

logical character of shipping development and the high cost of port infrastructure will certainly make for differential development in terms of the location of these infrastructures.[2]

For these reasons, therefore, it would appear that the proposition that central ports like Lagos would grow at the expense of peripheral ports like Calabar and Sapele should be borne out. The reason why U.K. based shipping interests are indifferent to the proposition is not hard to seek. Liner shipping which they represent tends to perpetuate a dispersed port pattern where they expect services to be provided evenly in a range of ports. The aim is to discourage competition (Ogundana, 1974).

All respondents, with the exception of the U.K. based cargo interests would agree that the ultimate inland origin or destination of cargo would influence the port routeing of that cargo (P14). The expectation from empirical evidence does indicate that several factors operate to decide this relationship. For example, the type of cargo will certainly influence the routeing, e.g. bulky agricultural exports which cannot bear the cost of long overland transport or high valued imports which can sustain long land transport costs; container traffic which is characterised by its 'through' concept which tends to widen the hinterland of big ships, and thus seek national markets rather than local or regional markets. To the extent that these influences are operative in determining the choice of particular Nigerian ports, the response of port operators and cargo interests in Nigeria and the United Kingdom are not borne out. The average scores of U.K. ship operators and consignors appear to be more realistic.

Regular availability of cargo (P6) and frequency of shipping services (P8) are related in the way the two factors influence ship routeing through the Nigerian ports. Availability of cargo will determine the frequency of shipping services; where import and export cargoes are regularly available, there will be more frequent shipping services. High scores by all groups excepting U.K. based cargo interests, suggest that these two factors are very important in the routeing of ships through Nigerian ports. This trend is not surprising because traffic sustains the life of any port, and the abundance and regularity of this would certainly mean vitality to the port.

As for infrastructural facilities (their availability and their quality), it is obvious from the respones that for some interest groups, the problem is not so much of availability, but that of quality. Consistently low scores by almost all respondents to proposition (P16) would indicate that berth availability is not a crucial factor. This response is borne out by the fact that the port operators embarked on a deliberate policy of overprovision of berthing facilities at all Nigerian ports. However, one would expect that some categories of infrastructures (for example, specialised facilities like container berths) would have attracted different responses altogether. That this is not the case is probably due to the fact that most container services to Nigerian ports are still undertaken in converted semi-cellular ships which can use the conventional facilities. As for quality of infrastructural facilities (P12), scores would indicate that all interest groups agree on their influence on ship routeing. However, there appears to be a stronger agreement by port operators and U.K. based shipping interests than by cargo interests. Although it is the responsibility of port operators to provide infrastructures (and there is evidence of self-justification in their response), shipping interests as users of such infrastructures are more sensitive to their use and obviously feel more concerned on this matter.

Three propositions 'port and cargo handling charges' (P10), 'port productivity' (P11), and 'labour practices' (P13) show very little variation in their scores. All respondents agree that port charges and cargo handling charges do not play a significant role in the choice of ports. The proposition is not true for the Nigerian port situation because the Nigerian Ports Authority (NPA) charges uniformly throughout Nigerian ports. Even if port charges and cargo handling charges are different, the response of ship operators would probably remain indifferent because such charges form a relatively small part of the total route charges. The same response is made to 'port productivity' (P11), and 'labour practices' (P13), except for U.K. based ship operators and consignors who probably are indifferent to these propositions. Indeed, empirical evidence suggests that 'port productivity' does not rank high among port choice factors. This probably explains why Lagos port with lower productivity and consequently longer ship and land transport turnround times has preference over other Nigerian ports where productivity is higher and where there are shorter ship and land transport turnround times. The same evidence suggests the relative insignificance of 'labour practices' as a differentiating factor in port choice. There appears to be very little difference in labour practices among the different ports.

The 'freedom of port choice' proposition elicits uniform responses except for the U.K. shipping operators who find it difficult to take a stand on this issue. Consistently high scores suggest agreement with the proposition that ship operators should be free to choose ports which they wish to use. However, there appears to be some contradictions in the views of some interest groups when responses to this proposition are compared with responses to proposition (P3) which guarantees the right of port operators to influence port ship routeing. For example, Nigerian port operators would like ship operators to have freedom of choice of ports, yet in proposition 3, they want to be able to influence the routeing of ships.

Quite apart from the self-justification displayed by port operators, the apparent contradiction probably stems from the fact that after the massive development in facilities at all ports, ships were not using some of the ports, e.g. Calabar, Sapele, Burutu etc. This led to the port operators/owners issuing a directive that all imports belonging to governments, both federal and state, and parastatals, should be directed to ports which are closest to their ultimate hinterland destinations (Daily Sketch, June 29, 1984). It is surprising that U.K. based ship operators find it difficult to take a stand on this issue. However, whether they express an opinion in favour or against freedom of choice, they already reserve the right to provide or refuse to provide services to particular ports probably on the grounds of the location of their customers (cargo interests) but probably more especially on the grounds of economy.

7.4 Responses: Role of Cargo Interests in Cargo Routeing

Table 7.3 shows the scores reflecting the views of all interest groups as regards the routeing of import cargoes through Nigerian ports.

Table 7.3

Scores: Propositions Relating to the Role of Cargo Interests

Propositions	Port Ops.	Shipowners (Nigeria)	Shipowners (U.K)	Consignees (Nigeria)	Consignors (U.K.)
P17 Size of port city market is the most important cargo routeing factor.	92.8	91.4	90.4	91.0	85.7
P18 Higher regularity of shipping services is the most important cargo routeing factor.	96.4	94.2	90.4	92.8	85.7
P19 Choice of road or rail at a port is an important factor in cargo routeing.	85.7	84.5	85.7	73.9	85.7
P20 Cargo security against loss or pilferage is an important factor in port cargo routeing.	85.7	94.2	85.7	96.4	85.7

N.B. Notes in Table 7.1 also apply.
Source: Compiled from Questionnaire Field Survey in Nigeria and U.K. in 1985.

Responses to propositions 'size of market' (P17), 'regularity of shipping services (P18), 'choice of mode of inland transport' (P19) and 'cargo security' (P20), generally tend to be similar with consistently high scores being recorded by all interest groups. For example, all groups agree that the size of the port-city market is an important factor that motivates a consignee to route cargo through a particular port. While this may be true to some extent, one would have expected a variety of views probably reflecting the commercial status of consignees. For example, if consignees were distributors, the market factor would obviously be very important. On the other hand, if consignees were industries, then the location of the industry would probably have been more relevant. However, the high degree of agreement by all respondents is supported by the dominance of the Lagos port in the international trade of the country. Lagos is not only the primate city, it is also the political and commercial capital of the country, and most commodity distributors have their warehouses located here. Most industries also have either their factories or their headquarters located here.

All respondents agree to the proposition relating to regularity of shipping services. Again, the a priori expectation is that opinions will be sorted according to the business interest among the consignees. Obviously consignments which are destined for markets as consumer items and those which are important for industries take advantage of a high regularity of shipping services. To that extent, therefore, regularity of shipping services would rank high among the factors of port choice among consignees. Empirical evidence from the study appears to confirm the proposition. The higher regularity of shipping services to Lagos and Port Harcourt ports partly explains the dominance of these two ports. The disproportionate hinterland shares of the two ports, especially Lagos (which in itself is an evidence that the port commands a national rather than a regional market) is testimony to the importance of this factor.

All respondents recorded high scores for the 'choice of mode of inland transport' proposition (P19). It is curious that port operators, U.K. based ship operators and consignors recorded higher scores than consignees based in Nigeria. The expectation is that hinterland links with the ports are an important factor in port routeing of commodities involved in international trade. This factor is even more crucial where there is a choice between different modes of transport, because better services are ensured under such competitive situations. However, the relatively lower scores recorded by Nigerian consignees who are in the frontline as cargo interests, probably reflects the varying importance attached to this factor. Empirical evidence suggests that because of inadequacies and inefficiences of other modes of transport other than road transport, most consignees do not use those modes for distributing import commodities from the ports. The rail, for example, is used mostly by government agencies and parastatals and not by major distributors and industries.[3]

On the proposition 'cargo security' (P20), responses are positively high. The a priori expectation is a higher agreement by cargo interests who are more directly involved than the other groups. The expectation is borne out if only by the expression of a wish or desire, because there is no direct empirical evidence to suggest that one Nigerian port is preferred to another on account of this factor.

The propositions which the five groups of interviewees responded to in the first part of the chapter represent assertions for agreement or disagreement. There is no doubt that some of the responses may have been mere wishes of respondents, especially where such respondents are not directly involved in a particular role. Even for those who are directly involved in particular roles, the responses merely show the degree of agreement or disagreement without necessarily eliciting how important such propositions are in influencing decision in that particular role.

Of the five groups of participants in the port development process, identified in this study, the role of the Ports Authority who are the providers of port facilities and that of the ship operating companies who are the primary decision-makers, are singled out as being crucial to the port development process. For example, if port facilities are not provided in certain locations, ship operators and cargo interests cannot use them. Furthermore, because of the nature of import trade to Nigeria (import transaction is usually on cost insurance freight terms - CIF), cargo interests may really have little influence on which ship and transport route, the cargo should be sent. In theoretical terms, shipping companies and the Ports Authority are agents who are supposed to execute their clients' orders, but in practical terms, they reserve the right to take decisions on whether or not to offer particular services, or to offer different kinds of services. This makes their roles more crucial in seaport development process. Therefore, the roles of the shipping companies are further examined in the remaining section of this chapter. These roles are examined from the background of the analysis of their responses to port routeing factors identified from the results of the previous analysis.

7.5 United Kingdom Based Shipping Lines and Port Choice Decisions Factors

In order to understand further the process of development of the Nigerian Port system, it was decided to ascertain the importance of decision factors in the choice of a Nigerian port, seen from the point of view of shipping companies based in the United Kingdom.

Whilst analysis in the preceding sections focused attention on general views of all participants, analysis in this section focuses on the specific role of the ship operators in their operation to what they considered as the most important Nigerian port. Altogether, six ship operators, all members of the U.K.-West Africa Conference Lines operating from the United Kingdom were sampled. All the six chose Lagos as the most important Nigerian port.

Decision factors which were elicited from the first questionnaire survey, were presented to the ship operators. They were asked to grade each of these seventeen decision factors in terms of their most important Nigerian port on a 5-point scale, with zero corresponding with 'very unimportant', 1 'unimportant, 2 'neutral', 3 'important', and 4 'very important' (Briggs, 1985).

Table 7.4 shows the relative scores and rankings obtained for each of the 17 decision factors in respect of conventional break-bulk traffic and container traffic. It is necessary to disaggregate the scores along these lines because of the different shipping and infrastructural demands of the two types of traffic (U.K. based port operators do not operate dry bulk services to Lagos port).

The scores are calculated by summing all the scores on each factor. As the maximum score on any factor is 4, it follows that with six respondents the maximum possible score is 24 points (6 multiplied by 4). The total scores are then calculated as a percentage of the maximum scores.

The dominance of the first six factors for conventional break-bulk traffic, i.e. 'availability of cargo' (1) 'port productivity' (2), 'berth availability' (3), 'location of service customers' (4) 'freedom of port-choice' (4), and 'nearness of inland origin-destination' (4), seems to emphasise the importance of these factors in the choice of ports by the shipping companies. This also tends to imply that the purely economic factors, i.e. 'total operating costs' and 'financial inducements' play relatively less importance in the choice of a Nigerian port. This emphasis on non-economic considerations implies that the ship operators put more emphasis on long term trade security and good will of customers rather than short term profit motive. However, care must be taken in reaching the conclusion that ship operators' considerations are dominated by non-economic factors in what would appear to be a purely commercial enterprise. There is no doubt that profit motivation is still very important, although that does not seem obvious in this study, particularly given the state of shipping and international trade in the world in general and the developing countries in particular.[4] Indeed the liner shipping operators have been identified as those whose ultimate returns are long term in nature and who depend on the commitment to and nurturing of a specific trade route (Evans and Davies, 1978). The fact that great emphasis is not placed on short term profitability is also probably the result of the downturn in international trade to Nigeria, and the fact that there is stiff

Table 7.4

Scores: Decision Factors Relating to Conventional Break-bulk and Container Traffic.

Decision Factor	Conventional Traffic Score as % of Max.	Conventional Traffic Rank	Container Traffic Score as % of Max.	Container Traffic Rank	Diff. in Score
1 Availability of Cargo	100.0	1	100.0	1	0.0
2 Port productivity	91.7	2	91.7	3	0.0
3 Berth availability	87.5	3	100.0	1	+12.5
4 Location of service customers	83.3	4	83.3	7	0.0
5 Freedom of port choice	83.3	4	91.7	3	+8.4
6 Nearness to inland destination	83.3	4	62.5	13	-20.8
7 Total operating costs	79.2	7	87.5	6	+8.3
8 Port seaward access	75.0	8	66.7	12	-8.3
9 Port landward access	75.0	8	83.3	7	+8.3
10 Imbalance of import/ export	75.0	8	79.2	10	+4.2
11 Port facilities	75.0	8	83.3	7	+8.3
12 Existing routeing pattern	66.7	12	75.0	11	+8.3
13 Port pricing	66.7	12	33.3	16	-33.3
14 Labour practices	58.3	14	91.7	3	+33.4
15 Location of port	50.0	15	58.3	14	+8.3
16 Size of port	50.0	15	58.3	14	+8.3
17 Financial inducements	33.3	17	33.3	17	0.0

Source: Compiled from Field Questionnaire Survey in U.K., 1986.

competition posed by the non-liner and non-conference members resulting from the present surplus of shipping capacity.

Other decision factors for conventional break-bulk traffic which are of equal significance in port choice are: 'port landward access' (8), 'port seaward access (8), and 'imbalance in import-export flows' (8). Other factors like 'port pricing' (12), 'labour practices' (14), size of port' (15), 'location of port' (15), and 'financial inducements' (17), are of least importance in descending order of importance.

For container traffic five factors appear dominant: the first two 'cargo availability' (1) and 'berth availability (1) tie for the first rank, whilst the next three, 'port productivity' (3), 'labour practices' (3), and 'freedom of port choice' (3), tie for the third rank. As in the case of conventional traffic cost considerations appear to be secondary to these factors: ('total operating costs' (16), 'port pricing' (16) and 'financial inducements' (16).

An analysis of the difference in scores between the two types of traffic brings out significant differences of the decision factors (Table 7.4). A negative sign in the final column of Table 7.4 indicates that the point score for that particular decision factor is higher for conventional break-bulk traffic, whilst a positive sign indicates that the points-score is higher for container traffic. The figure given is a measure of the difference between the two types of traffic.

Table 7.5 which is derived from Table 7.4, depicts the relative importance of the decision factors for both types of traffic and reveals that ten factors are relatively more inportant for container traffic and three factors are relatively more important for conventional break-bulk traffic. Of the ten decision factors that come out relatively more strongly for container traffic, the biggest difference, 33.4 percentage points, is registered by 'labour practices' with a score of 91.7 percent and a ranking of third for container traffic, compared with a score of 58.3 percent and a ranking of fourteenth for conventional break-bulk traffic.

The characteristics of labour practices at a port no doubt significantly affect a whole range of other operating factors within that port, that is, port productivity, turnround time for ships and, indeed, the total operating costs of ships in the port. The advantage of unitisation and indeed containerisation results in more efficient handling and faster ship turnround.

Table 7.5

Relatively Important Factors for Conventional Break-bulk and Container Traffic Respectively

(a) Factors relatively more important for conventional break-bulk traffic.		
1	Port pricing	(33.3)
2	Nearness to inland destination/origin	(20.8)
3	Port seaward access	(8.3)
(b) Factors relatively more important for container traffic.		
1	Labour Practices	(33.4)
2	Berth availability	(12.5)
3	Freedom of port choice	(8.4)
4	Total operating costs	(8.3)
5	Port landward access	(8.3)
6	Port facilities	(8.3)
7	Existing routeing pattern	(8.3)
8	Location of port	(8.3)
9	Size of port	(8.3)
10	Imbalance of import/export	(4.2)

Source: Derived from Table 7.4

However, although containerisation is expected to improve handling efficiency and speed up ship turnround time at a port, it would appear that the way the labour force is deployed will indicate if such advantages accrue to a container berth or not. Table 7.6 shows a comparison of labour components of cargo handling between a conventional berth and a container berth in a developing country environment. The table suggests that container handling can be more susceptible in terms of costs to an inefficient and an ineffective labour force than a conventional break-bulk berth. An inefficiently deployed labour force will not only lead to dwindling productivity, but also higher costs to both ship and cargo as well as to the labour force itself.

Table 7.6

Labour Inputs and Costs: Conventional and Container Berths

Labour Inputs	Conventional Berth	Container Berth
Number of shifts	2	2
Gang size	30	35
Average wage per shift	£1.7	£2
No. of staff per berth per day	60	120
Staff wages per annum	£830	£1000

Source: Extracted from Colin Hughes (1977, pp.301-2, Appendix)

The next biggest difference after 'labour practices' is 'berth availability'. This factor can be combined with other factors like 'port facilities', 'port landward access', to make up 'infrastructural' and 'superstructural' facilities. The importance of these infrastructural facilities is a more significant factor in the choice of port for container rather than for conventional break-bulk traffic. Indeed, the difference is not difficult to understand. Container traffic has a requirement for specialised berth facilities as well as port facilities. These conditions are not necessarily restrictive or limiting for conventional traffic where ships may be smaller and where there is no need for specialised equipment. For example, the comparative scale of both infrastructural and superstructural facilities for both conventional and container traffic are shown in Table 7.7. These characteristics clearly demonstrate the greater sensitivity of container traffic to these factors much more than conventional traffic does.

Table 7.7

Berth Characteristics and Costs: 1975 (US$1000)

	Conventional Berths (100,000 Tonnes p.a.) Cost (US $1000s)	Container (Ro-ro) Berth (840,000 Tonnes p.a.) Cost (US $1000s)
Berth	2100	3000
Surfacing	735	4200
Shed	960	-
Equipment:		
Shore cranes/gantry cranes	800	4000
Tractors/straddle carriers	68	2160
Trailers/tractors	66	296
Light fork lift/trailers	300	198
Mobile cranes /heavy forklift	62	280
Ramp	-	300
TOTAL	5091	14,434

Source: Extracted from David Hilling (1983, p.334, Table.1)

It is clear from Table 7.7 that the provision of infrastructural and superstructural facilities at a port that is expected to attract container traffic will entail a lot of capital as well as a high level of traffic flow. The much higher throughput that characterises a container terminal is obviously an advantage over the conventional facilities. However, this advantage rapidly disappears if the container berth is not used to its full capacity. For this reason, container facilities tend to be ideally located in areas where the optimum level of cargo flows is likely to be attained. There thus seems to be a close relationship between the group of decision factors of 'infrastructural' and 'superstructural' facilities and 'availability of cargo'.

'Port landward access' factor is more crucial to the operation of container traffic than it is to conventional break-bulk traffic. It is only a good network of roads and railways that can sustain the distribution of container traffic. Where there is no back-up of adequate and reliable inland transport, or where road and rail systems are ill-developed and inefficient, it is difficult to utilise the intermodal and 'through' transport advantages of containers; it also means that the higher productivity of container cargo handling imposes strains on the collection and distribution by conventional break-bulk methods which are usually adopted in such circumstances.

The way the factor of 'size of port' operates to serve as an influence in the choice of a port for container rather than for conventional break-bulk traffic is not quite clear. The only known relationship between port size and location of container terminal that can influence choice is probably the tendency for container terminals to concentrate. This is a characteristic which derives from the capital intensive nature which was described in the previous sections. The most probable choice for a container terminal is an existing port which has the advantage of location in terms of availability of cargo and existing hinterland infrastructures. More often than not, the obvious location is an existing large port.

'Imbalance of import-export cargo flow' factor has the least difference of 4.2 per cent points and ranking eighth for conventional traffic and tenth for container traffic. The reason for this slight difference probably has to do with the greater sensitivity of this factor to container trade than to conventional break-bulk trade. It would appear that because container shipping trade is more heavily capitalized than the break-bulk shipping trade, greater imbalance in container traffic would mean greater diseconomy than for conventional shipping.

The high cost of the container technology implies that high throughputs have to be attained if costs are to be recovered. The United Nations Conference on Trade and Development (UNCTAD, 1976), recommended that an annual traffic of 400,000-500,000 tonnes must be attained in order to justify a full container facility at a port. Any lower throughput would make the container more expensive than the conventional handling.[5]

The three decision factors which come out relatively more strongly for conventional break-bulk traffic are: 'port pricing', 'nearness to inland origin/destination', and 'port seaward access'. The way 'port pricing' factor works more in favour of conventional traffic than container traffic is not very clear, because all dues payable on ships using all Nigerian ports, ranging from light dues to berthage and pilotage dues show no discrimination between ports and between types of facilities. However, wharfinger dues (dues and rates paid on cargo) do show discrimination in favour of conventional goods. Wharfinger rates for general cargo is N2.24 per tonne, whereas, wharfinger rates for containerised cargo is N72.60 per loaded container of average weight of 12 tonnes, and N36.80 per empty container of average weight of 1-2 tonnes. As far as cargo dues are concerned, therefore, conventional facilities appear to be more competitive than container facilities, although this conclusion does not take into consideration other advantages that accrue from container handling.

The factor of 'nearness to inland destination/origin' has the next highest difference of 20.8 percent points, with a rank of four for conventional and thirteen for container traffic. Probably as a result of its characteristic of through and multi-modal transport, and the tendency towards port concentration, the hinterland for containers has actually become wider, even cutting across national boundaries. Also, because container ships tend to be much bigger than conventional ships, it is not economical for these ships to engage in multi-port itineraries. For such traffic, time factor on land is of lesser importance than time factor on the sea. On the other hand, conventional general cargo ships tend to be much smaller and can probably more profitably engage in multi-port itineraries. These factors combined probably make it possible for conventional vessels to operate closer to ultimate origins and destinations of cargoes.

In a developing country situation, container traffic involves mainly high valued industrial and commercial commodities which can bear the high cost of long land distances. On the other hand, agricultural exports are bulky and are of relative low values and can hardly bear the cost of long land distances. This characteristic probably explains why agricultural exports take advantage of proximity to a regional port.

The importance of the decision factors influencing port selection process for Lagos port in the context of the types of facilities can be extended to explain port selection process in the whole of the Nigerian port system. Five decision factors can be identified as favouring the Lagos port. These are: the popularity of Lagos as a port which derives from its status as Nigeria's primate city as well as the political and commercial capital of the country; the availability of port infrastructural as well as superstructural facilities (e.g. container and roll-on-roll-off facilities); the availability of cargo which directly results from the concentration of industrial and commercial organisations as well as shipping and forwarding agents; and, indeed, the location of Lagos port as the first port of call for ships from the most widespread and most important foreland areas of the United Kingdom, Western Europe and North and South America.

Some of these factors are interrelated. For example, the commercial status of Lagos means a large concentration of commercial and business organisations within its metropolis. The entrenched institutional framework for handling freight (including import freight) in the country means that these imports will be consigned to these commercial organisations who are mainly distributors, and who have their distribution networks throughout the country. Because of the advantages of the regularity of shipping services as well as other advantages described in the previous sections, these distributors prefer to import through one port (in this case, Lagos) and from there distribute to other parts of the country.

The factor of availability of infrastructural facilities also favours the choice of Lagos port. At the time of this study, it was the only Nigerian port that had a functioning full-container terminal facilities. As a result, the container import and export trades are concentrated at this port. Lagos, for example, accounts for 91 per cent of the national container traffic (Hilling, 1983). This infrastructural advantage would mean that most major shipping and forwarding organisations which handle container traffic would have their headquarters, as well as their consolidation centres, in Lagos, and this would mean a higher frequency of container shipping services and particularly the initiation of regular express container service to Lagos port. Some of these companies have invested heavily in back-up facilities to handle the container trade (Alraine and Panalpina shipping/forwarding companies have inland container depots in Lagos). The implications of all these are that these organisations seek to capture national markets in addition to regional markets. This means that the Lagos port will continue to attract more import traffic at the expense of other Nigerian ports.

The extent to which Lagos port continues to make inroads into the other ports' regional market is demonstrated by the expansion of import hinterland of Lagos port between 1979 and 1984 (Table 7.8). The Table shows that during this period, Lagos port made four hinterland region gains in Benue, Gongola, Imo and Rivers. Even more significant is the fact that some of these hinterland gains include the port cities of these areas, namely, Port Harcourt, Warri and Sapele.

One other important factor linked with the location of the shipping and cargo interests, but which respondents would not comment upon, is the 'relative ease' (ease not in terms of time, but in terms of the procedures for clearing cargo) with which these representatives are able to get their import consignments through the Lagos port compared with other Nigerian ports.

Perry (1985), has been able to establish a link between corruption and elements of the environment and location in both developed and developing countries. He came to the conclusion that a combination of circumstances make particular places more than usually corrupt. For example, capital cities, business and commercial centres and centres of governmental activity and decision taking are the most obvious examples. Abundant oil resources (environmental endowment) have made it possible for Nigerians to experience massive economic growth during the 1970s and early 1980s. This massive economic growth was acompanied by corruption on an unprecendented scale; and one area where this was manifested was in international import trade. It is not uncommon for importers with the active collaboration of shipping companies and their representatives to engage in a series of malpractices ranging from over invoicing of imports (in order to circumvent foreign exchange controls), to under-declaration of quantity of imports (in order to evade custom duties and port charges). It was frequently claimed (although there was no quantifiable evidence to substantiate this claim) that in such situations, it was much easier to engage in such malpractices and get away with them at the Lagos port because of the web of connection between some of the cargo interests located in the city, and the officials of both the Ports Authority and the Customs. Local newspapers reported the case of a whole cargo of rice being cleared without paying any customs duties in 1984. Many similar malpractices, allegedly involving stevedoring contractors, were mentioned during the present survey at the Lagos port. Furthermore, similar practices were tacitly confessed by one of the U.K.-based shipping lines during the

Table 7.8

Destination of Goods Originating by Road from Lagos Port Complex

(1979 and 1984)

Inland Destination	1979		1984	
	Tonnage	% Total	Tonnage	% Total
1. Anambra	310	1.0	78	0.16
2. Bauchi	20	0.1	1192	2.58
3. Bendel	81	0.3	855	1.85
4. Benue	-	0.0	345	0.75
5. Borno	150	0.5	1355	2.93
6. Cross River	-	0.0	-	0.0
7. Gongola	-	0.0	420	0.91
8. Imo	10	0.1	165	0.36
9. Kaduna	1405	4.7	3268	7.08
10. Kano	827	2.8	3320	7.19
11. Kwara	436	1.5	820	1.77
12. Lagos	24453	82.3	24420	52.88
13. Niger	70	0.2	610	1.32
14. Ogun	563	1.9	870	1.88
15. Ondo	167	0.5	1450	3.14
16. Oyo	645	2.2	5393	11.68
17. Plateau	297	1.0	383	0.83
18. Rivers	-	0.0	170	0.36
19. Sokoto	200	0.6	367	0.79
20. Others	104	0.4	692	1.50
TOTAL	29716	100.0	46176	99.96

Sources: University of Ife Survey, 1979, and Field Survey in Lagos, 1984.

interviews, when one cargo interest refused to allow a diversion of their vessel to another Nigerian port on the grounds that officials at that port would not 'understand their language', a Nigerian euphemism for corruption. For these reasons, therefore, some cargo interests prefer to discharge their cargo at Lagos rather than at any other Nigerian port, in spite of the disadvantages of doing so.

However, if this factor is truly an operative factor in the port selection process in Nigeria, the scale at which it operates is not known. Indeed, it follows reason to believe it does operate especially in the light of the other disadvantages of Lagos port in terms of high turnround times to both land and sea transport.

7.6 Conclusion

Analysis in this chapter has focused on the views of all parties responsible for the use and development of the Nigerian port system. One important trend is the divergence of views especially between port operators/owners in Nigeria and the U.K.-based ship operators/ owners on all the important port development problems of when, where and what amount of development should take place at the ports; how port development should be financed; and the issues of operational freedom in port choice. It would appear that such divergence of views on these important issues stem from self-justification and the protection of group interests, and it seems that what motivates these views is economic considerations.

Although it is the responsibility of the Nigerian Ports Authority to provide facilities at the ports, cost considerations limit the amount of facilities that can be provided at any given point in time. The high costs of the speculative provision of infrastructure, coupled with everchanging shipping technology, places a limit to the extent to which port facilities can be provided in advance of the known needs of shipowners, The problem of obtaining guarantees from users, especially ship operators, is another dimension to the problem of the port operators. This dilemma was clearly highlighted by the fact that after investing so much on the provision of these facilities at all Nigerian ports, customers were not using them. Naturally, and on the grounds of sound economics, Port Authorities would expect that facilities provided should be used so as to earn some return on investments. This probably is at the root of the divergence of views on issues like the freedom of port choice by shipping interests and the mode of financing port developments.

The profit motive (although this did not come to the forefront in the second section of the analysis) is arguably important in influencing the views of the shipping interests on issues such as the provision and use of infrastructural facilities at the ports. Whilst the ship operators acknowledge the obligation of Port Authorities to make speculative development, they in turn are not prepared to commit themselves to using these facilities, especially where such facilities are not economically rewarding.

A crucial factor in shaping the views of both Port Authorities and shipping interests is the downturn in trade which Nigerian ports have experienced during the past five to six years. For the U.K.-based shipping companies in particular, the deteriorating trading conditions have led to a situation whereby shipping capacity in the trade far exceeds the demand, and this has led to some measure of rationalisation of services among operators. This situation has led to the abandonment of certain ports like Calabar, Sapele and Koko by the ship operators, and the direct take over and absorption of rival operators like Palm Line, Elder Dempster Lines and Guinea Gulf Line by Ocean Transport and Trading Company. The Ports Authority also reacted to this situation by closing down its operations at Sapele port and handing it over to the Nigerian Navy.

The views and decision factors of respondents identified in this chapter, particularly the ways in which they favour the Lagos port, give cause for concern, especially in terms of planning objectives and strategies for port development in Nigeria. Indeed, all respondents in the study believe that the basic motive force for success in ports and shipping is regularity of cargo. This emphasises the point that these capital intensive transport service industries must be developed only where the service is needed. Furthermore, the trend in both port and shipping development is towards concentration - concentration of infrastructures in port development and of shipping in terms of the number of ports a ship will call at during a voyage.

The implication of this trend is that peripheral ports are more likely to be served from central ports with the result that central ports will grow in international traffic terms, at the expense of peripheral ports. This suggests that there is a limit to which ports can be used as a strategy for regional development. Indeed, the idea of using new port developments, or of putting expensive facilities at old ports to divert trade is ill-advised. There is certainly little to be gained by building prestige ports in certain locations if ships cannot and will not use them.

NOTES

1. For land transport turnround times, 20 percent of import vehicles at Lagos spent more than 16 hours in 1979. The corresponding percentages for Port Harcourt and Delta ports are 12 and 10 respectively. For export vehicles, the percentages are 30 for Lagos and 8 for Port Harcourt (See Appendix 2 to Chapter Five).

2. Specialised infrastructures such as container and Roll-on-roll-off facilities are capital intensive and as such, cannot be provided at every port. There is, therefore, the tendency for such facilities to be concentrated at the major national port (Hilling, 1983).

3. Analysis of import general cargo delivered at Lagos and Port Harcourt ports by mode of transport in 1980 showed that rail and road were responsible for 2.2 percent and 84.1 percent respectively, whilst at Port Harcourt the corresponding percentages were 0.9 and 98.6 respectively (NPA Annual Report, 1980).

4. Deteriorating international and especially third world trading conditions have resulted in the supply of excess shipping capacity along routes to developing countries. In such circumstances it would appear that the best way to remain in business is not to seek for quick profits.

5. At the peak of container traffic at Apapa in 1981, the average container berth throughput was 245,374 metric tonnes (NPA Annual Report, 1981).

CHAPTER EIGHT

IMPLICATIONS OF PRESENT PORT STRUCTURE FOR PORT POLICY

8.1 Introduction

One very important problem of practical national significance that arises from the emerging structure of the Nigerian port system is that of evolving a coordinated and rational order of ports both now and in the future. The fundamental assumption of this thesis is that Nigeria, at least during the period of study, does not operate a rational port system. The criteria for defining rationality as it applies in this study is necessarily based on the role which the Nigerian ports are thought to play in the national economy with particular emphasis on their transport terminal roles as links between land and maritime transport. Rationality in this context is interpreted as a coordinated development of ports within a regional port system that does not lead to wastage by the duplication of facilities; in fact, a coordinated development that ensures that regional port system as a whole is able to function at minimum total costs to the economy, such that the economic cost of providing these facilities, as well as the cost of time in ports of vessels, cargoes and trucks, and the cost of overland routeing of cargoes to and from the different ports, are at the minimum level possible.

Little in the analyses above has suggested that Nigerian ports have met these criteria. Indeed, the deliberate policy of overinvestment that was enunciated at the beginning of the development plan, and the consequences of overprovision, duplication and underutilization of facilities at almost all ports run counter to this concept of minimum cost to the economy as a whole. Nor do the operational inefficiences manifested in long delays to vessels and land transport witnessed at the Lagos ports, meet these criteria of 'rationality'.

This present chapter attempts to discuss some aspects of the problem facing port planners in the country and specifically focuses on the decision-making process which suggests why the planners have had to resort to an 'irrational' port policy. Later in the chapter, suggestions are made as to how some of these problems can be tackled.

8.2 Decision-making Process and Its Implications for Port Development

Several facts which have far-reaching implications for port development decision process emerge from the review of the development of the Nigerian ports in Chapter Two:

(i) The colonial government in Nigeria encouraged the public ownership of the major port facilities at Lagos and Port Harcourt ports, whilst private interests were allowed to develop facilities at other ports (e.g. Sapele, Warri, Burutu and Calabar). This mixed ownership and involvement in port operations resulted in port concentration of both infrastructures and traffic which created a dualistic structure in which the well equipped ports of Lagos and Port Harcourt sharply contrasted with the neglected and unimproved remainder. This dualism in the structure dis- regarded one very important fact in port planning, that ports in the country form a functional unit.[1]

(ii) During the post-colonial period, the government encouraged and insisted on public ownership of all port facilities. The Federal Government, through the Nigerian Ports Authority (NPA), became the sole investor in ports, not only creating investments funds, but also controlling their application and use. It is to be expected that this change in ownership policy should in terms of planning have an advantage over the previous policy, in the sense that the centralisation of decision-making process in public authorities should have enabled such authorities to plan the continuous functioning of the ports in a more rational way and to respond more sensitively to changing conditions of production.

(iii) The problem of the development of a rational and orderly system of ports is not limited to the centralisation of the decision-making process only, but rather extended to the development of an integrated planning policy which reduces interport rivalry. The degree of success in reconciling these two aspects is a function of the decision itself, of the duration of the decision-making process, of the organisations involved, and of the nature and content of the decision.

The duration of the decision-making process in port development is of considerable interest and probably plays a significant role in shaping the pattern of port development. The review of the development of the Nigerian port system has shown that the failure to initiate development projects and probably equally, the failure to execute projects already initiated in good time led to capacities during plan periods being saturated, before other projects are initiated. This problem was amply demonstrated by the four wharf extension projects at Apapa in Lagos in 1920, 1950, 1963 and 1975.

As was pointed out by Ogundana (1976), quay developments at Apapa during these periods were attended by indecision and controversy.

The delays caused as a result of indecision led in each period to congestion, and congestion in turn led to indirect losses in terms of higher freight rates and even the payment of demurrage rates to waiting ships. The same type of problem of indecision characterised the development of the entrance channel of the Port Harcourt port. As a result, there was no question of delays at Apapa benefiting the other government ports. Ogundana (1978) has calculated that during 1975 which was the peak of the Nigerian port congestion, Nigeria must have lost well over N300 million in demurrage payments to ships, surcharges of freight rates and the cost of delays on cargoes and inland transport.

In the same way, suspended or even abandoned projects led to substantial direct losses in terms of broken contracts, protection and maintenance costs of partially completed projects, and of course, huge increases in the cost of projects. Probably as a result of these factors, the size of investment in the Nigerian ports during the Third National Development Plan which was to cost about N418.54 million at the beginning of the plan, actually cost N1,043 million at the end of the plan period (Ogundana, 1978).[2]

Apart from the nature of the decision itself, the rationale and implications of the decision, and particularly the organisations involved in reaching the decision, are all crucial to port development. Because of the low level of technology and inadequate executive capacity to initiate and manage projects of this nature in developing countries, most countries are dependent on foreign governments and agencies for consultation and aid. In such situations port planning continues to be guided by foreign consulting bodies, which in many cases have a vested interest in recommending large scale projects to be carried out by engineering companies based in the donor country, making use of inputs purchased from that country. It naturally follows that the acquisition of facilities through such foreign-aid packages tends to obscure the long-term economic dangers of over-investment, duplication and consequently under-utilization.

The extension programmes of Lagos and Port Harcourt ports, and indeed development in other Nigerian ports, were based on reports of studies conducted by foreign agencies. To that extent it can be concluded that the complete lack, or the low level of information inputs that is usually experienced in a context of investment decision-making in developing countries, has certainly not characterised the development of ports in Nigeria.

A series of studies related to transport and port development in particular in Nigeria has been carried out by, among others, the Stanford Research Institute (1961), Economic Associates, London (1967), Netherlands Engineering Consultants (NEDECO, 1971), M.I.T. Centre of Transportation Studies (1977), and the World Bank Group (1972). Some of these studies, notably the ones undertaken by NEDECO were under tied-aid agreements between the Nigerian Government and the technical aid programme of the Netherlands government.

Despite the undoubtedly high quality of the various studies, there appeared to be little agreement in the findings. Moreover, most of the findings did not accord with reality. For example, Economic Associates of London which appraised the port investment programme for the period 1967-73 provided short and long-term forecasts of the volume of traffic through the ports, concluded that there was sufficient capacity for both imports and exports for at least another ten years from the date of the report, that is 1967. Thus, the report concluded that there would not be need for new investment, but rather need for replacement investment.

The NEDECO study on the other hand, was carried out within the framework of the development cooperation between the governments of Nigeria and the Netherlands. The main terms of reference of the study was to determine what additional port facilities would be required between 1967 and 1970. The study estimated that during 1967 - 1990 most of the new investments in Apapa would concentrate on facilities for coping with increased containerisation and liquid bulk cargoes. The NEDECO report further recommended a container terminal with one berth and a dry-bulk facility for Port Harcourt; a new port to be built at Warri and two new berths at Calabar.

Both studies underestimated the amount of traffic that would flow through the Nigerian ports, especially during the first ten years of the period covered by these studies. The phenomenal increase in imports during the mid 1970s oil boom and the consequent congestion which characterised Nigerian ports played havoc with the forecasts made by these studies. Moreover, where the reports made positive recommendations about the addition of new facilities and the replacement of old ones, the time-lag between planning and implementation was so long that the previous development would have become saturated before the completion of the project. For example, the NEDECO report recommended the improvement of Warri and Calabar port developments in 1971. These two projects were eventually completed in 1979 by which time these ports had suffered serious congestion problems, especially in 1975.

Perhaps much more important than the issues of the duration and organisations involved in policy decision process, are the nature and contents of the decision itself. If port policy is defined as a systematic approach which sets out to influence the location and the developemnt of port facilities according to certain specific targets, then one can argue that there is no port policy in Nigeria. However, it would appear from the review of the port planning procedure in Chapter Two that national planning for seaports in Nigeria is esentially based on the principle of service facility.[3] Statements of service sufficiency policy were made as a result of the country's serious port congestion during the mid-seventies. For example, the Head of State at that time, in formally launching the Third National Plan recorded that 'our aim is to create excess port facilities as a means of avoiding the expensive and frustrating delays currently being experienced at our major ports' (Gowon, 1975, p.85)

Moreover, economic efficiency based on cost minimisation has been the commonly stressed sector objective for transport development in general in Nigeria. It can be presumed that the policy of economic efficiency which was enunciated in the 1962-68 plan document as the guide for the transport sector, also applied to ports (Federation Of Nigeria, 1962).

Port policy decisions to develop modern facilities at all Nigerian ports, and to install excess capacity at these ports, itself a result of the policy of 'facility planning' at individual ports, would appear to negate the advantages which coordinated and centralised planning would have afforded. Indeed, in developing country situation, tied-aid programmes of port development has disadvantages. The first is that, where central planning authorities are involved in the plan formulation and implementation, such authorities may naturally not be disposed to considering the optimum port system. The second is that where decisions to develop ports have had to be taken under stress (as was the case during the port congestion crisis in Nigeria), the planning authorities may never give due consideration to the functional interdependent character of the port system both at planning and implementation stages. Under these circumstances, the planning authorities thought that the optimum port plan for development would emerge through a process of putting excess facilities at all ports.

There is no doubt that a deliberate policy of overcapacity, which was the guiding principle of port development during the period under review, is uneconomic as the wasted resources could be applied elsewhere in the economy. This is a situation when transport investment has a negative impact (Gauthier, 1970). Furthermore, economic efficiency based on cost minimisation which has been the commonly stressed sector objective for transport development in Nigeria, appears to be fraught with many dangers. The limitations of such policy based on such criterion are enforced by social and political considerations to serve less developed areas and maintain external services, especially by air and by sea.[4] The criterion of absolute economic efficiency for ports may also generate unbalanced induced development which may be politically undesirable.

However, from whatever way one looks at policy issues relating to the development of Nigerian ports, there appears to be problems in need of solution. Under-utilization, duplication of port capacities and the lack of operational efficiency at all Nigerian ports suggests that a change in policy is needed. The pattern of port usage by shipping companies and cargo interests that was identified in previous chapters suggests that if plans were to respond to purely economic criteria, facilities would continue to be located and developed at Lagos and Port Harcourt, and possibly Warri ports, where there are effective demands for such facilities. If, on the other hand, the authorities were to succumb to purely political rationalisation, as was identified in Chapter Two, then the resultant pattern of infrastructural development would mean that facilities would be idle at the smaller Nigerian ports like Calabar and Sapele because port users would not use them. The question then is what changes are necessary but at the same time acceptable within the current political framework?

8.3 Suggestions for Future Port Planning and Development

The first area where the 'searchlight' should be directed is in the area of the nature and content of the decision in port development, and this is tied up with the issue of what the objective for port development should be. A recent trend in developing countries has been the use of modern port developments as a mechanism for spreading development (Hilling, 1983). Frequently, such decisions are motivated by purely political considerations to the exclusion of a realistic economic assessment of the demand for port facilities and the most suitable location for such facilities.

The building of port infrastructures, at locations determined mainly by political considerations, as it would appear is the case at present, does not appear to be a sound policy. Post-colonial port diffusion in Nigeria has been inspired partly by the desire to use ports as instruments of regional development (Ogundana, 1970). New port construction at Onne, Calabar, Warri, Sapele and the proposed port industrial complex at Ibeno near Calabar (1980-85), are attempts to stimulate the relatively underdeveloped parts of the country (Hilling, 1983).

There is also the suggested need to understand the spatial and development impact of port functions before attempting to use ports as instruments for regional balance. The planning experience in Nigeria has shown that regional growth centres may have 'back wash' effects rather than the desired 'spread' effects. As the Second National Development Plan puts it: 'such state of affairs arises because development impulses generated in the fast growing industrial cities do not reach the areas far away' (Federation of Nigeria, 1970: 218). Moreover, where purely political factors are operative in port development, especially in the choice of a location, such ports may not prosper unless the economic base of the ports areas or the hinterland is buoyant. Therefore, care should be taken in using port development as a regional policy instrument. Apart from this, there is a limit to which expensive port infrastructures can be used as the basis for balancing regional economic contrasts. Their capital intensive nature makes it difficult to develop such infrastructures at every port. Thus, Ogundana asserts that 'increasing capital intensiveness of shipping technology emphasises the relative importance of centres of sustained dominance' (Ogundana, 1970, 180). Such centres of sustained dominance will be Lagos, Port Harcourt and possibly Warri.

A similar conclusion was reached by the Ministry of Transport in Britain when in the case of the study of the proposed investment policy of locating extra dock capacity at the port of Bristol at Portbury, it was concluded that there 'is the desirability of concentrating the future development of modern port facilities, whether by way of the construction of new berths or the modernisation of existing berths, at selected existing growths points in preference to the construction of very large numbers of new berths on virgin sites' (Ministry of Transport, 1966, 12).

Such a conclusion raises issues of spatial equity and social justice, especially within the context of the political framework in Nigeria, where emphasis is placed on the 'sharing of the national cake'. Within such a context, what is economically acceptable may not be socially or politically acceptable. However, because of the capital intensive nature of shipping technology, there is a limit to which port infrastructures can be used in a balancing 'political game'. The situation is aggravated, as it was revealed from the analysis in the preceding chapters, when such expensive infrastructures are located in areas where they will not be used. A possible solution is a national plan which would include compensatory benefits for the present ports whose existence can no longer be justified either as a result of rationalisation based on sound economic principles, or because port customers choose not to use them to any extent. For example, the economy of the declining port areas can be sustained if less expensive but viable lower order port functions are maintained, thereby introducing suitable shipping technology. The major port areas like Lagos and Port Harcourt can become central ports from where feeder services may be operated to the minor ports such as Calabar and Warri. A shipping technology that is suitable for this type of arrangement is the Barge Carrying Vessels (BCV) or LASH (lighter aboard ship technique). This a system whereby a mother ship is made to carry several component boats which can be separately loaded or discharged at feeder ports. These components can be loaded or discharged from the mothership while it is anchored in mid-stream. This technology has two advantages: the first is that multi-port itineraries within a regional port system will be eliminated, and secondly, the system eliminates the need to construct costly berths because it allows for the effective use of shallow existing berths or quays.

This system would allow port functions to be maintained in otherwise declining ports, and may thus allow the minor port areas to keep and possibly attract some port-associated services and industries. Furthermore, if as it may happen, the area of the minor port is served overland from a major port, a policy of inland freight equalisation may also be introduced so that the area of the minor port is not put at a disadvantage (Bird, 1971). This can be achieved by taking the major and minor ports as points of equal freight rates and rates are allowed to vary inland from the two points rather than make the major port the point with the lowest rate.

The technology suggested would involve the consent of the shipping companies which will be at the receiving end of such technological adaptation. This again emphasises the need for the decision-making process in port development to take into consideration the views of the different port customers, especially the Shipping Lines. Indeed, the channel of consultation betwen ports and their users should be kept open, not only in the preparation of port plans, but also on issues of operational importance. This suggestion is made in the belief that a knowledge of the business expectation of shipping and cargo interests is vital to the estimation of the future pattern of demand at the ports. It is not certain what the reaction of the shipping companies would be to this suggestion, especially now that these companies are operating under conditions of reduced international trade with Nigeria. They will, no doubt, see the suggestion as a gain to the Ports Authorities and a loss to themselves.[5] But given the good will which the shipping companies demonstrated in the analysis in the preceding chapter, it is to be hoped that the problem that the adaptation that is called for will create, is not insurmountable. At the present time Lighnes Centrafraines Shipping Line operates this type of service to the Lagos port on a regular basis from the Netherlands. The Nigerian National Shipping Line could be encouraged to start such operation with the hope that others would be persuaded to do the same.

Reference has already been made to the duration of decision-making process, that is, the time-lags between initiation and execution of decisions. The discussion from this suggests that rational planning within the context of this study should be a continuous exercise and not just an occasional four- or five-yearly affair when submissions are requested for inclusion in the National Development Plan. Port planning attempts should be aware of the three types of development time-lags which characterise all planning. These are the recognition time-lag (the awareness to take action), the planning time-lag and execution time-lag. The inescapable nature of these time-lags is not often recognised in port planning in Nigeria, with the result that the development of ports in Nigeria has largely been a product of crisis planning, trying to solve an avoidable problem only when it is manifested.

The problems of congestion, from which the Nigerian ports suffered during the 1970s, and the current problem of under-utilization of port facilities, derive in part from the failure of post-independence planning to predict the prospective shape of the country's economy. Forecasting the needs for port facilities is undoubtedly a difficult task, becasue it involves not only changes in the national economy but also in associated external economies (Weigend, 1956). A long-ranging analysis of possible economic and political policies, both internal and external, is needed to appreciate the changes that could occur in port traffic. The forecast on which the internal economy is based should be founded on continuous data collection and should not be based solely on aspects of government-sponsored pre-plan studies which are often conducted by uncommitted external bodies, usually under severe time constraints that often make it impossible to collect primary data necessary for effective planning. A dependable forecast of traffic for the port must rest on the input-output relations of the economy and not on mere projection of previous trends. It is also necessary to disaggregate the traffic forecast by traffic types and potential origins and destinations in the country. Such a refinement is necessary in order to analyse the allocation of such traffic to different modes of surface transport and to alternative port outlets. On the maritime side, a knowledge of the prospective forelands of traffic can be coordinated with an analysis of potential shipping inputs into the port.

In the light of changes in traffic volumes and in shipping technology, the port plan should be characterised by a high degree of flexibility, such that when terminal capacities are saturated, incremental additions can easily be made. It is not reasonable, in the light of fluctuations in the fortunes of the national economy to embark on rigid long-term plans. But where such long-term plans are called for on account of development time-lag periods, such plans must be elastic as to be able to adapt to possible changes in trade and sea transportation. No longer should the approach to port development in Nigeria be seen in 'one-off' project terms, rather than as a flexible, rolling development over many years. Such a step-by-step development strategy is justified by Walker (1930), when in laying the foundation of the development of the port of Belfast asserted that the policy of development is:

> 'To make the design so that the improvements be such as may be carried into effect by degrees, each step or measure being quite complete in itself, but at the same time a part of a great and connected whole which may be extended and the remaining parts executed as the trade of the port may require and the means of payment justify'.(Bird, 1984, 38)

Certainly, the dwindling trade of the Nigerian ports and the reduced means of payment for port investment in these ports will make this type of suggested approach mandatory.

One other very important area where attention should be focused is in the area of possible involvement of both public and private authorities in the production of port services. In this regard, privatisation as a means of either developing and operating port infrastructure or of achieving greater productivity than is possible under current arrangements or both, should be considered as a necessary and desirable alternative.

One of the problems relating to port operations that was identified in Chapter Eight was that port operations in some Nigerian ports were not productive. It is believed that port operations in such ports will tend to be more productive when spurred by the market mechanism and a profit orientation, and that it is privatisation which can lead to such a goal of greater efficiency and productivity. Privatisation within the context of this suggestion would involve large and highly integrated corporate structures, large firms or even transnationals. Such an extensive link would mean that port facilities would be developed with strong links with efficient shipping networks. This would bring to an end the era of port development without consultation with prospective users. The totality of all these measures would lead to the development of new and efficient terminals which could re-orientate and restructure existing ship movements. The Roll-on-roll-off terminal at the Tin Can Island port, managed by a private company, already shows evidence of such efficient management.

Because of the critical significance of Nigerian ports in the economy of the country, the question of private organisations developing and owning ports may not be contemplated. Privatisation that is suggested should, therefore, be limited to port operation and not port ownership. Under such arrangements, public authorities would still bear the responsibility of building new ports and of constructing new facilities at old ports; private enterprise will only be invited to operate these facilities, but under close supervision by the public authorities (the Nigerian Ports Authority).

The relatively lower berth handling rates at the Lagos ports compared to other similar ports in developing countries, e.g. Hong Kong, suggest some measure of inefficiency in port operations at these ports. Such inefficiency is, in part, linked with a lack of coordination and communication among the separate organisations responsible for loading, discharging and movement of cargo within and outside the ports. A rather disturbing fact that emerged during the field interviews at the Lagos ports in 1984 was the series of accusations and counter-accusations by different interest groups as far as causes of delays are concerned. For example, the Ports Authority put the blame of delays to ships squarely on the shipping interests who, they argue, attempt to circumvent regulations relating to ship entry requirements. Such lapses probably account for the mean value of delays to vessels arriving at Apapa and Tin Can Island ports to be 2.9 and 2.2 days respectively. Although these values are within the internationally accepted mean delay value of a maximum of ten days, it seems unacceptable in Nigerian ports, which operate under capacity, and where many berths remain idle for several days and even months at a time.

The cargo interests, as well as the shipping agents, blame both the Ports Authority and the Customs; the Ports Authority for ineffective use of labour, and plant and equipment; and customs for their cumbersome procedures of cargo examination. Some of these accusations are well founded. Customs seem overly pre-occupied with import and excise duties and prohibitions and restrictions on import cargo, making their procedures rather complex. Unfortunately, the current state of their bureaucratic practices has not adjusted to the rapid changes which faster movement of freight arising from increasing use of containers and Roll-on-roll-off (Ro-ro) traffic has brought about. The way the Customs handle the import and export cargo within the port, to a large extent, determines the time the cargo spends in the port premises. A random selection of cargo for examination, coupled with scrutiny of documents and the imposition and enforcement of existing stiff penalities for false declarations and other irregularities on the part of shipping and cargo interests would provide a more efficient and workable system of control for the Customs authorities. In addition, there should, as much as possible, be concentration of the many decision-making points for import cargo clearance.

The Ports Authority should use the statutory power of central control of all port operations to bring greater order and efficiency to port operations. Unfortunately, some of its officials are known to collude with shipping as well as cargo interests in perpetrating irregularities, in the form of false documents and false declarations, especially in the container operations. Effective control and supervision are not being exercised, particularly in the use of labour and plant and equipment. Enough control is not exercised in the way stevedoring contractors use NPA's labour force. A potentially more efficient system, which will benefit both ship and cargo interests and indeed the NPA itself, is to make port labour the responsibility of the stevedoring contractors. Since it is they who use the labour, they should have the power to 'hire' and 'fire'.

The late opening of sheds and the early closing of sheds cause delays in port operations. Late opening of sheds at 0930 hours instead of 0730 hours, as stipulated in port operation schedules, causes delays in the commencement of morning operations. Equally, early closing of sheds between 1700 and 1800 hours causes delays to vessels carrying shed cargo, and which have booked gangs until 2230 hours. Sheds should be left open till 2200 hours when the second shift finishes.

Plant and equipment shortages due to constant breakdown, constitute another source of delay. It is striking that such problems are at a minimum in port areas managed by private organisations, such as the Ro-ro Terminal Company at Tin Can Island port (RTC) and the Container Terminal Company (CTC) when it managed operations at Apapa Container Terminal. This suggests that the problem with the NPA-operated terminals is that of supervision and control. There should be greater control and flexibility, especially in the use of workable plants.

The problem of delays to ships caused by ships awaiting the arrival of land trucks for cargoes meant for direct discharge, or of land trucks waiting to be loaded either directly from the ship or from the cargo sheds, is in the main related not only to operational inefficiency of labour, plant and equipment, but also largely to the organisational structure of the delivery system, that is, the organisational structure of the forwarding and clearing agents.

With the introduction of unitisation and containerisation in particular, the physical distribution of cargo, for efficiency purposes, has been undergoing various changes in its structure and organisation. The distribution is being viewed increasingly as a total integrated system in which ocean carriers, land carriers, warehousing and customs inspection closely cooperate. A very good example of such cooperation is the U.K. shipping company, Ocean Transport and Trading Limited of Liverpool, together with some Nigerian trading and transport companies, which jointly own and operate the Kano Inland Container Depot (ICD). Other cooperative agreements for the physical distribution of import cargoes to their ultimate destinations within the country are those between shipping companies like Alraine, Panalpina, and Palm Line Agencies, and some truck transport companies based in Lagos. Freight consolidation under this system ensures a more efficient distribution system compared with the proliferation of small forwarding and clearing agents who, in most cases, have neither got the experience nor the necessary capital investment to organise themselves efficiently in the interests of their customers. Freight consolidation can be used to achieve a more efficient distribution of imports and exports from and to ports, for both land and sea carriers.

On the important question of a rational hinterland structure, suggestions have been made for a series of designated operational hinterland structures which would mean a system of hinterlands defined by regulations. This ensures that landward links in each port and hinterland system are fashioned for optimum connectivity (NEDECO, 1971). The objective of such a concept is to divide the Nigerian freight-generating and freight-receiving surface into operational hinterlands, each allocated to one or other of the major ports. This was attempted by the Nigerian government in its directive on port usage referred to in Chapter Seven. This appears to be a rather simplistic solution to the main problems of under-utilization of certain ports like Calabar and Sapele, and the apparent congestion at the Lagos ports.

Quite apart from the fact that such directives are binding only on government-consigned cargo (and this constitutes only about 11 percent of total imports (NPA Annual Report, 1982)), there is no evidence to suggest that the shipping interests would be willing to comply with such directives. Moreover, as was discussed in Chapter One, the concept of port hinterlands is constantly changing because of developments in both maritime and landside transportation such that port B may be the hinterland of Port A. This is particularly true of developments in unitised traffic. The ultimate goal of any port with regards to technological developments in maritime transport is to make containerisation a dominant technique in the general cargo trade; Nigerian ports are no exception. This development obviously makes the definition of port hinterlands rather difficult because of the spatial overlaps.

A further weakness of a defined hinterland structure is that the arrangement of foreland transport to Nigerian ports is structurally incompatible with a system of defined hinterlands. For example, a ship load from a particular foreland area may be made up of consignments to various parts of the country. The main reason for this is that usually ship loads may be insufficient to meet the frequency of shipping service needs of cargo interests in hinterlands of peripheral ports like Calabar. This is why the breaking of bulk of import cargoes in the hinterland rather than in the foreland, as suggested, is a more feasible suggestion. Reference was earlier made to the entrenched institutional framework for handling import trade in the country as well as the entrepreneur structure. Imports come mainly to sole distributors or a few distributors who have their distribution networks throughout the country. Since it is easier for such distributors to break bulk in the hinterland rather than in the foreland, they, therefore, prefer to import through one major port (e.g. Lagos), from where they distribute to other parts of the country. This is the main reason why Lagos ports account for a disproportionate share of the total imports into the country. The same reason accounts for the fact that as much as 80 percent of the import freight leaving Lagos ports have Lagos metropolitan area as its immediate destination (See Chapter Five).

In the light of these problems, one suggestion that can be offered is that whenever port users have identified a port of entry for imports, or an exit port for exports, efforts should be made to improve the inland transportation modes that are used with a view to ensuring their capacity and efficiency. Since roads have been increasingly used to distribute imports from the ports, emphasis should be on the improvement of road links with the port of choice. In addition to these, attention should be focused on the use of coastal waterways in distributing freight from the major ports. The development of an independent coastal water-borne transport service is essential for efficient distribution of imports and exports from and to major ports. Port operations will be greatly facilitated by a smooth flow of land-side traffic achieved through a coordinated management of the various modes and units of transportation.

All these suggestions, should be taken along with the suggestion made earlier for cost equalisation from such national ports that are used and the regional ports that should have been used. The establishment of efficient land and sea routes from the port should be sufficient to break down the inequality between the central and peripheral ports. In this respect, Lagos and Port Harcourt ports which have specialised container and Ro-ro facilities will continue to play an increasingly dominant role. These two ports are well linked into a network of roads and railways into different parts of the country. The road network currently appears to be adequate, but the railway is in need of improvements in terms of its linkages with many parts of Nigeria, as well as in terms of its speed and efficiency. The idea of a coastal water borne transport service which is already in use in the form of lighterage transport, should be pursued vigorously.

8.4 Summary and Conclusion

This chapter has attempted to highlight some of the problems which result from the conflict between theory, policy and practice as regards the production of port services (provision and utilization of port facilities) in Nigeria. The chapter has attempted to discuss aspects of these problems which have implications not only for the present but also for future port policy. Suggestions pertaining to the rational provision and effective utilization of these ports have been offered, using both landside and port infrastructures as levers. These suggestions, no doubt, open avenues to new management and operational procedures. Some of the procedures are complementary in the sense that they could be adopted together, while others are alternatives from which selections could be made on the basis of the peculiarities of the Nigerian transport system and the economic scene in general. For example, the economic problems facing the country at the present time exclusively rule out the provision of new port facilities, either at new locations or at old ports. There are also suggestions that do not fit into the present situation but which could be adopted in the future; for example, the improvement of railway links from the ports to other parts of the country may not be a feasible proposition at the moment, but it may be so in the future. Because of the state of the national economy, and the fact that almost all ports are operating under capacity, what appears to be desirable now are largely modifications in operational procedures.

NOTES

1. The dualism in ownership structure was reflected in the lack of integrated planning of all ports within the regional system, and in unequal access to development capital which in turn resulted in differential development of the ports.

2. Internal corruption could well have contributed to the huge increases. During the Second Republic, contracts were known to have been revised upwards mainly for monetary gains to political parties and to influential individuals in government.

3. See Chapter Three

4. These are enunciated in the Statement of Policy on Transport (Federation of Nigeria, 1965).

5. A gain to port owners because such technology will eliminate the need to construct expensive berthing facilities; and a loss to shipping companies because it (technology) will result in increased costs in procuring new ships.

CHAPTER NINE

CONCLUSIONS

9.1 Introduction

The main objective of this study is to define and understand the structure of port development in Nigeria. The objective has been achieved in two ways. Firstly, by investigating functional 'relatedness' among the ports using measures of land patterns of association and shipping linkages between the ports; and secondly, by attempting to understand the structure that is defined by bringing into focus the various natural and man-made factors which condition the supply and demand of port facilities. The major emphasis in the latter has been the process of decision-making in port operations where the Port Authorities and the various port customers are the actual decision-making units. This concluding chapter, therefore, presents a summary of the findings in this study.

9.2 Summary of Findings

(1) Functional Relatedness Among Nigerian Ports

The result of the analysis relating to the interdependence of Nigerian ports shows that the three ports of Lagos, Port Harcourt and Warri remain the effective functional focus within the Nigerian port system. From both the maritime and landward perspectives, these ports function as members of an interrelated group bound together in their competitive and complementary functional relationships, with an established case of hinterland and foreland overlap in the functioning of the major seaports. This conclusion has implications for the provision of facilities at these related ports. Given the advantages of central planning and control afforded by the Nigerian Ports Authority, the duplication and overprovision of port facilities should be prevented. However, the pattern of infrastructural developments at these ports clearly suggest that little account has been taken of the rationalisation of expensive facilities like Ro-ro and container facilities. There is, for example, duplication and apparent overprovision of the Ro-ro facilities at Apapa and Tin Can Island ports in Lagos; there is also duplication of Ro-ro facilities at Warri and Sapele ports in the Delta. In the same way, the rationale behind the facilities recently completed or under construction between 1980-1985, namely, the multi-purpose Ocean terminal near Calabar, the proposed Koko port development and the already constructed container terminal at Port Harcourt, may be seriously questioned, given the apparent overprovision of berths in all Nigerian ports, and the well established ability of the two major ports of Lagos and Port Harcourt to serve large regional as well as local markets.

(2) Decision-making Process and Development of the Ports

Two aspect of the decision-making process identified in the study relate to the supply of and the demand for port facilities. There are three aspects to the supply of port facilities, namely, the nature of the decision, the organisations involved in the decision and the time scale of the decision. The results of the study show that the way various facets of the decision-making process have interacted tend to suggest that Nigeria has, during the period covered by the study, operated an irrational port policy. It was shown in the study that the implications of the nature of the decision, and particularly the organisations involved in reaching the decision are all very crucial to port development. Port planning continues to be guided by foreign consulting bodies who in most cases have a vested interest in recommending large-scale projects to be carried out by engineering companies based in the aid-donor countries. The implication is that the acquisition of facilities through such foreign-aid packages, tends to obscure the long-term economic dangers of over-investment, duplication and under-utilization. Where such external assistance is given, as a result of lack of executive capacity to initiate and supervise port development projects, such assistance must be solicited for, and a choice made between possible firms, and the resulting reports and recommendations evaluated before appropriate decisions are taken.

(3) <u>The Scale of Port Development</u>

Scale is a crucial factor in port development. Two planning horizons that are usually considered in port planning are the static and the dynamic. In the static perspective, planning is essentially a rationalisation of port operations to ensure operational efficiency. An optimal use of facilities in the short-run is a necessary precondition for long-term efficiency. The performance of the Lagos ports investigated in this study does not show a rationalisation of operations to ensure the type of operational efficiency that would be a short-term substitute for the long-term expansion of facilities. Various factors, ranging from misuse and non-use of plant and equipment, attitudes of the labour force, lack of adequate training for the labour force, and the characteristics of shipping in the West Africa region, play prominent roles in operational efficiency at the Lagos ports.

In the dynamic perspective, port planning seeks to expand infrastructural capacity sequentially over time in an optimal fashion. Both in the single-port and multi-port situations, the capabilities of the system parts are altered consistently as the need arises so that some parts do not become bottlenecks to the detriment of the whole system. The study has shown that Nigeria's port development has always consisted largely of facility planning, whereby single facilities have been built to meet some urgent need. Planning activities in the static and dynamic time scale link up in a number of over-lapping assignments ranging from policy definition to traffic and technological forecasts and to implementation and audit. Unfortunately, the approach to the design of port plans during the period covered by the study does not show an awareness of these phases. More especially, the development exercises are not usually followed up by post-development evaluation that could have aided subsequent development efforts. It is commonly presumed that the planning phase ends as soon as the project is commissioned. It is valuable to follow-up on the operations of the project and learn of its unanticipated problems and impacts. Such analyses are invaluable for future planning exercises.

(4) Involvement of Public Authorities in the Supply of Port Facilities

One other planning dimension that the study identified is the degree of state or central authority and its agencies' involvement in the supply and operation of port facilities. State ownership of ports and facilities have meant maximum political control from the central government through its agencies, the Nigerian Ports Authority. Such controls have sometimes meant that port locations, or the location of facilities at existing ports, involve political decisions.

Unfortunately, ports thus located do not necessarily have a strong enough economic base to allow them to prosper. Examples are the Sapele, Burutu and Koko ports, all in the Delta area. The proposed multi-purpose port at Ibeno near Calabar is a further example.

State involvement in port operation similarly creates problems of operational inefficiency at the ports. There are limitations to the Ports Authority's autonomy during both civilian and military regimes, when clearance had to be sought from the Ministry of Transport for most of the Authority's decisions. The delay in getting responses sometimes increased the cost of projects as was the case with the dredging of the Bonny Bar. There has been an even greater erosion of the autonomy of the Authority in the military era as the government attempts to stem the rate of smuggling and falsification of entry documents. The emergency powers of a military port commandant during the military era conflicts with the regular powers of the general manager of the ports. Such conflicts result in operational inefficiencies at the ports.

(5) <u>The Role of Primary Users of the Ports</u>

The survey of primary users of port facilities in Nigeria has shown that an inadequate emphasis has been given to port users' choice. This situation has resulted in port owners providing expensive port facilities which are not being adequately used by port customers. To bridge this gap, it is considered useful to establish channels of consultation between the port and users of port facilities in the preparation of port plans. A knowledge of the business expectation of shipping and cargo interests is vital to the estimation of the future pattern of demand. Experience from this study has shown that although there is a need for the port owners to invest, to ensure that the ports are efficient (witness the congestion crisis in the mid 1970s), such investment should be in those ports which the users will be willing to use. Port investment during the period of study clearly suggests the belief on the part of the owners that investment will generate traffic, and will thus lead to greater efficiency at the ports.

One other conclusion which the study has highlighted is that for some category of hinterlands, especially those located in the northern parts of the country, neither distance, nor the cost of land transport from the ports play a critical role in the choice of a particular port for imports and exports. In fact, the study shows conclusively that the amount of cargo that is in demand or supply at a port is by far the most important port routeing factor. This factor, together with the fact that cargo and shipping interests take advantage of such favourite port locations, implies that shipping services will be better organised and more frequent to such ports. The implications are that shipping and cargo interests who concentrate here would seek and capture both regional and national markets. The clear implications in this conclusion is that in the development of port infrastructures port planners should give full thought to this kind of centre-periphery differentiating process which results from the choice of some favoured ports and the neglect of others.

(6) Operational Structure and Efficiency

The need for a rationalisation of shipping movements, within the regional port system as well as within the single port system, calls for the understanding of the operational relationships between elements in the port morphology at the two system scales. The conclusion in Chapter Five confirms that where the tonnage of imports destined for a second port, other than Lagos, is substantial, a two-port itinerary is rational. The large land distance from the Lagos port to large areas of the country and consequently the high land transport costs that will be involved, make such an itinerary necessary. However, the study of the operational relationships between elements in the port morphlogy of the Lagos port system in Chapter Six, does not indicate the rationalisation of shipping movements that is desired. Ships changing berths two or three times during one visit add to both increased berth service and turnround times, which increases shipping costs. Ship movement is even less rational when expensive facilities like container terminals, Ro-ro terminals and bulk berths are used as general cargo berths, as confirmed by the operational structure within the two Lagos ports. In such situations maximum advantage and efficient handling, that goes along with such specialised facilities, is not taken. Indeed, the reason that explains this structural pattern in the operation is the unwillingness of ship owners to invest in full-cellular container and Ro-ro vessels because of the fear that exports from the country cannot be carried in container ships. The implication of this for planners further strengthens the need for planners to understand the business expectations of shipping and cargo interests.

9.3 Contributions Made by the Study

The achievements claimed for this study are in two main areas which constitute the central focus of the study, that is, the question of the relationship between ports and that of understanding the pattern of the relationships. Firstly, as was discussed in Chapter One, the relationship between ports may be measured and quantified using shipping linkages between ports within a regional port system. Such relationship among ports, although it has been suggested in the literature (Robinson, 1976), has not actually been measured within the framework of a regional port system. If this assertion is true, then this study would have made a contribution, especially to seaport studies in Nigeria. Secondly, an achievement which may be claimed for this study relates to the behavioural approach that is adopted in an attempt to understand the complex natural and man-made factors that condition the demand and supply of port facilities at the Nigerian ports. A behavioural approach in port studies is relatively new (Bird, 1982; Willingale, 1981 and 1982); but what is even more important for this study is the emphasis given to individual decision-making units with respect to their overt behaviours, and a non-normative stance that emphasises the distinction between theory and practice.

This emphasis which represents a new orientation to behavioural studies in general, has posed philosophical as well as methodological questions which have not really been tackled seriously by port geographers. For example, one major methodological problem which arises and which was discussed in Chapter One relates to the issue of the researcher imposing his own constructs on the respondent without actually allowing the respondent to chose those constructs which are relevant to his own situation. The way this methodological problem was resolved by eliciting decisions factors from the respondents represents a departure from most perception studies in geography, and certainly, a new development in port studies.

However, one limitation in the study relates to the timing and the scope of the study. Both the 1979 and the 1984 field works were conducted when the country suffered recession as a result of the lack of adequate foreign exchange to finance imports. This is evident from the low level of utilization of facilities provided at the ports. Perhaps if the study had been conducted during the period of boom the results could have been different, especially as far as efficiency at the ports is concerned. Secondly, because of time and cost constraints the 1984 survey was limited to Lagos only. It would have been much better in terms of results if the other ports were also studied.

Whatever the achievements and limitations of the study, one fact remains unchallenged: it is that all Nigerian ports, as at the present time, have excess capacity. As most studies have concluded, facilities at all Nigerian ports in 1985 would be sufficient for predicted levels of port traffic until the end of the present century (Shneerson, 1981). However, one thing which such optimistic forecasts do not take into consideration are changes not only in economic terms, but also in terms of political and social goals due to new ideologies and new challenges. It is in the light of these possible challenges that the possible effects which a properly functioning Economic Community of West African States (ECOWAS) strategy of functional cooperation in seaport development policy will have on seaport development in Nigeria, becomes relevant.

Just as seaports within a national system do not function in isolation, so also, ports within the West African zone form an interdependent system. This necessitates an integrated port development policy in West Africa to be drawn up. Indeed, a realistic port development plan within the political and economic framework of ECOWAS cannot be conceived without reference to the status and prospects of other related ports within and outside each national boundary of the constituent states. West African ports form such an interdedendent system, especially as far as the traffic of the landlocked countries are concerned. For example, the ports of Lagos and Cotonou can serve as inlets or outlets for Niger and Chad; in the same way, Mali can be served through the ports of Guinea, Sierra Leone and Gambia. The case for such multi-national cooperation in port development and usage within the region on technological grounds is stronger in respect of capital-intensive than conventional technologies. In this respect, the apparent over capacity in container and Ro-ro facilities at the Lagos ports can be used up by extra-national traffic to Niger and Chad. Fortunately, the absence of integrated land transport system that may inhibit extra-national movement of goods in other parts of West Africa will constitute no problem in Nigeria because Nigeria is linked with Niger and Chad by Trunk 'A' roads. The development of a West African ports policy is certainly an area where attention should be focused.

One fact which the study highlighted and which has had significant effect on the size of the port investment in Nigeria during the period covered by the study is the attempt made by the Public Authorities to use ports as instruments of regional development. This brings into focus two issues relating to the relationship between seaport infrastructures and regional development. The first is the role which seaports play as economic enablers and sometimes as stimuli to regional development. The second which is a corrollary of the first is the effect which redundant or idle port infrastructures would have on the regional economy. These two areas require study in Nigeria. Indeed, there is the need to understand the spatial and developmental impact or lack of impact of port facilities on the economy of the region in which it is located. Subsequent port studies in Nigeria could perhaps focus profitably on these areas.

APPENDIX 1 to CHAPTER ONE

NIGERIAN PORTS QUESTIONNAIRE: I

Statements	Strong Disagreement 1	2	3	Neutral 4	5	6	Strong Agreement 7	
1 Nigerian ports should be run on commercial basis without subsidies.	:	:	:	:	:	:	:	1 Nigerian ports should receive govt. subsidies in return for stimulating regional development.
2 The Nigerian Ports Authority should develop facilities at the ports in advance of known needs of port users.	:	:	:	:	:	:	:	2 The Nigerian Ports Authority should respond to development initiatives of port users.
3 Port-owners in Nigeria should influence port ship routeing to correct imbalance in the use of certain ports.	:	:	:	:	:	:	:	3 Port-owners should not attempt to influence ship routeing.
4 Ship congestion in Nigerian ports is a worse problem than over-provision of berths.	:	:	:	:	:	:	:	4 Over-provision of berthing facilities is a worse problem than ship congestion at Nigerian ports
5 Shipowners using Nigerian ports should pay for the increased marginal costs of port improvement.	:	:	:	:	:	:	:	5 Shipowners using Nigerian ports should not be made to pay the increased marginal costs of port improvements.
6 Regular availability of cargo is the most important factor in port routeing in Nigerian Ports.	:	:	:	:	:	:	:	6 Regular availability of cargo is not the most important factor influencing ship routeing through Nigerian ports.
7 Decision to choose a Nigerian port as a major terminal is due to the location of that port.	:	:	:	:	:	:	:	7 The decision to choose a Nigerian port as a major terminal is rarely due to its location.
8 Frequency of shipping services is the main distinguishing feature between major and minor ports.	:	:	:	:	:	:	:	8 The importance of any Nigerian port is rarely determined by the frequency of shipping services to that port.

Statements	Strong Disagreement 1	2	3	Neutral 4	5	6	Strong Agreement 7	
9 Ports in 'peripheral' areas e.g. Calabar are likely to be increasingly served by shipping services from ports in 'central' areas.	:	:	:	:	:	:	:	9 Ports located in 'peripheral' areas of the country have direct shipping services from the forelands.
10 Port charges on ships and cargo significantly affect the routeing of ships through Nigerian ports.	:	:	:	:	:	:	:	10 Port charges on ships and cargo do not significantly affect the routeing of ships through Nigerian ports.
11 Port productivity significantly affects the routeing of ships through Nigerian ports.	:	:	:	:	:	:	:	11 Port productivity does not significantly affect the routeing of ships through Nigerian Ports.
12 The quality of port infrastructures affects the routeing of ships through Nigerian ports	:	:	:	:	:	:	:	12 Other factors other than the quality of port infrastructures determine the routeing of ships through Nigerian ports.
13 Labour practices at different Nigerian ports affect ship routeing.	:	:	:	:	:	:	:	13 Labour practices at Nigerian ports do not significantly affect ship routeing through the ports.
14 The ultimate inland origin/destination of cargo determines ship routeing through Nigerian ports.	:	:	:	:	:	:	:	14 The ultimate inland origin/destination of cargo does not affect ship routeing through Nigerian ports.
15 Shipping interests using Nigerian ports should be free to choose ports which they wish to use.	:	:	:	:	:	:	:	15 Shipping interests using Nigerian ports should not always be free to choose ports which they want to use.
16 Availability of berths are powerful inducements for the choice of certain Nigerian ports	:	:	:	:	:	:	:	16 Availability of berths at Nigerian ports have little influence on the choice of certain Nigerian ports.
17 The size of port-city market is the most important cargo routeing factor through Nigerian ports.	:	:	:	:	:	:	:	17 The size of port-city market is not the most important cargo routeing factor through Nigerian ports.
18 Higher regularity of shipping services is the most important cargo routeing factor through Nigerian ports	:	:	:	:	:	:	:	18 Higher regularity of shipping services is certainly not the most important cargo routeing factor through Nigerian ports.

Statements	Strong Disagreement 1	2	3	Neutral 4	5	6	Strong Agreement 7	
19 The choice of rail or road at a port is an important factor in cargo routeing through Nigerian ports.	:	:	:	:	:	:	:	19 The choice between alternative modes of inland transport plays little role in cargo routeing through Nigerian ports.
20 Security against damage, loss or pilferage at a Nigerian port is an important consideration in the routeing of cargo through the port.	:	:	:	:	:	:	:	20 Security of cargo does not play a significant role in cargo routeing through Nigerian ports.

APPENDIX 2 to CHAPTER ONE

NIGERIAN PORTS QUESTIONNAIRE: II

Decision Factors	Very Unimportant 0	1	2	3	Very Important 4
Berth Availability	0	1	2	3	4
Location of Service Customers	0	1	2	3	4
Port Seaward Access	0	1	2	3	4
Port Landward Access	0	1	2	3	4
Port Facilities	0	1	2	3	4
Size of Port	0	1	2	3	4
Port Pricing	0	1	2	3	4
Port Productivity	0	1	2	3	4
Availability of Cargo	0	1	2	3	4
Imbalance of import/export Cargo Flows	0	1	2	3	4
Existing Routeing of Shipping Services	0	1	2	3	4
Financial Inducements by NPA	0	1	2	3	4
Location of Port in Relation to Other Nigerian Ports	0	1	2	3	4
Labour Practices	0	1	2	3	4
Freedom to Choose Ports which Shipowners Wish to Use	0	1	2	3	4
Nearness to Ultimate Inland Destination/Origin	0	1	2	3	4

APPENDIX 1 to CHAPTER TWO

(a)

Table 2.8

CHANGING SPATIAL CONCENTRATION: IMPORTS (1970 - 1982)

(Figures in Percentages)

	Apapa	TCI	PH	Warri	Calabar	Sapele	Onne	Koko	Burutu
1970	81.9	-	8.3	6.5	2.1	-	-	0.4	0.7
1971	76.0	-	14.5	6.8	1.7	-	-	0.8	0.2
1972	77.2	-	16.0	4.8	1.4	-	-	0.2	0.4
1973	75.9	-	16.8	5.8	1.3	-	-	0.1	0.1
1974	71.0	-	18.9	7.5	1.9	-	-	0.6	0.1
1975	68.2	-	20.1	7.3	2.2	-	-	2.1	0.1
1976	72.3	-	17.0	7.0	2.2	-	-	1.4	0.1
1977	65.4	5.0	13.9	8.5	2.3	4.8	-	1.0	0.1
1978	48.7	14.6	18.6	10.2	2.1	5.2	-	0.5	0.1
1979	53.5	13.3	18.0	9.4	1.8	3.3	-	0.6	0.1
1980	49.4	15.2	22.1	9.0	1.3	2.8	-	0.2	-
1981	43.0	15.5	24.5	10.8	2.1	3.7	0.1	0.3	-
1982	46.1	17.2	18.0	10.6	2.3	2.8	2.5	0.4	-

(b) HIRSCHMAN's INDEX OF TRADE CONCENTRATION

1970 $I = \sqrt{[(81.9)^2 + (8.3)^2 + (6.5)^2 + (2.1)^2 + (0.4)^2 + (0.7)^2]}$

$\sqrt{6707.6 + 68.99 + 43.56 + 4.41 + 0.16 + 0.49}$

$= 82.6$

1971 $I = \sqrt{[(76.0)^2 + (14.5)^2 + (6.8)^2 + (1.7)^2 + (0.8)^2 + (0.2)^2]}$

$= \sqrt{5776 + 210.25 + 46.24 + 2.89 + 0.64 + 0.04}$

$= 77.7$

1972 $I = \sqrt{[(77.2)^2 + (16.0)^2 + (4.8)^2 + (1.4)^2 + (0.2)^2 + (0.4)^2]}$

$= \sqrt{5959.84 + 256 + 23.04 + 1.96 + 0.04 + 0.16}$

$= 79.0$

1973 $I = \sqrt{[(75.9)^2 + (16.8)^2 + (5.8)^2 + (1.3)^2 + (0.1)^2 + (0.1)^2]}$

$= \sqrt{[5760.81 + 282.24 + 33.64 + 1.69 + 0.01 + 0.01]}$

$= \sqrt{6078.4}$

$= 77.9$

1974 $I = \sqrt{[(71.0)^2 + (18.9)^2 + (7.5)^2 + (1.9)^2 + (0.6)^2 + (0.1)^2]}$

$= \sqrt{[5041 + 357.21 + 56.25 + 3.61 + 0.36 + 0.01]}$

$= \sqrt{5458.44}$

$= 73.8$

1975 $I = \sqrt{[(68.2)^2 + (20.1)^2 + (7.3)^2 + (2.2)^2 + (2.1)^2 + (0.1)^2]}$

$= \sqrt{[4651.24 + 404.01 + 53.29 + 4.84 + 4.41 + 0.01]}$

$= \sqrt{5117.8}$

$= 71.5$

1976 $I = \sqrt{[(72.3)^2 + (17.0)^2 + (7.0)^2 + (2.2)^2 + (1.4)^2 + (0.1)^2]}$

$= \sqrt{[5227.29 + 289 + 49 + 4.84 + 1.96 + 0.01]}$

$= \sqrt{5572.1}$

$= 74.6$

$$1977 \quad I = \sqrt{[(65.4)^2 + (5.0)^2 + (13.9)^2 + (8.5)^2 + (2.3)^2 + 4.8)^2 + (1.0)^2 + (0.1)^2]}$$

$$= \sqrt{[4277.16 + 25 + 193.21 + 72.25 + 5.29 + 23.04 + 1.0 + 0.01]}$$

$$= \sqrt{4596.96}$$

$$= 67.8$$

$$1978 \quad I = \sqrt{[(48.7)^2 + (14.6)^2 + (18.6)^2 + (10.2)^2 + (2.1)^2 + (5.2)^2 + (0.5)^2 + (0.1)^2]}$$

$$= \sqrt{[2371.69 + 213.6 + 345.96 + 104.04 + 4.41 + 27.04 + 0.25 + 0.01]}$$

$$= \sqrt{3067}$$

$$= 55.4$$

$$1979 \quad I = \sqrt{[(53.5)^2 + (13.3)^2 + (18.0)^2 + (9.4)^2 + (1.8)^2 + (3.3)^2 + (0.6)^2 + (0.1)^2]}$$

$$= \sqrt{[2862.25 + 176.89 + 324 + 88.36 + 3.24 + 10.89 + 0.36 + 0.01]}$$

$$= \sqrt{3466}$$

$$= 58.8$$

$$1980 \quad I = \sqrt{[(49.4)^2 + (15.2)^2 + (22.1)^2 + (9.0)^2 + (1.3)2 + (2.8)^2 + (0.2)^2]}$$

$$= \sqrt{[2440.36 + 231.04 + 488.41 + 81.0 + 1.69 + 7.84 + 0.04]}$$

$$= \sqrt{3250.38]}$$

$$= 57.0$$

$$1981 \quad I = \sqrt{[(43.0)^2 + (15.5)^2 + (24.5)^2 + (10.8)^2 + 2.1)^2 + (3.7)^2 + (0.1)^2 + (0.3)^2]}$$

$$= \sqrt{[1849 + 240.25 + 600.25 + 116.64 + 4.41 + 13.69 + 0.01 + 0.09]}$$

$$= \sqrt{2824.37}$$

$$= 53.1$$

$$1982 \quad I = \sqrt{[(46.1)^2 + (17.2)^2 + (18.0)^2 + (10.6)^2 + (2.3)^2 + (2.8)^2 + (2.5)^2 + (0.5)^2]}$$

$$= \sqrt{[2125.21 + 295.84 + 324 + 112.36 + 5.29 + 7.84 + 6.25 + 0.25]}$$

$$= \sqrt{2877.04}$$

$$= 53.5$$

APPENDIX 1 to CHAPTER FOUR

AGGREGATE SHIP MOVEMENT LINKAGES FOR SPECIFIC VESSEL/CARGO TYPES

A. Container/ Barges	F/ld	Apapa	TCI	PH	Warri	Sapele	Cala.	Koko	Onne	Total
Foreland	.	21	0	0	0	0	0	0	58	79
Apapa	14	.	0	3	4	0	0	0	0	21
Tin Can Is.	0	0	.	0	0	0	0	0	0	0
Port Harcourt	3	0	0	.	0	0	0	0	0	3
Warri	4	0	0	0	.	0	0	0	0	4
Sapele	0	0	0	0	0	.	0	0	0	0
Calabar	0	0	0	0	0	0	.	0	0	0
Koko	0	0	0	0	0	0	0	.	0	0
Onne	58	0	0	0	0	0	0	0	.	58
TOTAL	79	21	0	3	4	0	0	0	58	

B. Refrigerated	F/ld	Apapa	TCI	PH	Warri	Sapele	Cala.	Koko	Onne	Total
Foreland	.	96	19	72	16	53	4	16	2	278
Apapa	96	.	0	0	0	0	0	0	0	96
Tin Can Is.	19	0	.	0	0	0	0	0	0	19
Port Har.	72	0	0	.	0	0	0	0	0	72
Warri	16	0	0	0	.	0	0	0	0	16
Sapele	53	0	0	0	0	.	0	0	0	53
Calabar	4	0	0	0	0	0	.	0	0	4
Koko	16	0	0	0	0	0	0	.	0	16
Onne	2	0	0	0	0	0	0	0	.	2
TOTAL	278	96	19	72	16	53	4	16	2	

C. Dry Bulk	F/ld	Apapa	TCI	PH	Warri	Sapele	Cala.	Koko	Onne	Total
Foreland	.	85	28	68	154	45	17	2	0	399
Apapa	67	.	0	3	7	0	8	0	0	85
Tin Can Is.	8	0	.	12	8	0	0	0	0	28
Port Har.	83	0	0	.	0	0	0	0	0	83
Warri	169	0	0	0	.	0	0	0	0	169
Sapele	45	0	0	0	0	.	0	0	0	45
Calabar	25	0	0	0	0	0	.	0	0	25
Koko	2	0	0	0	0	0	0	.	0	2
Onne	0	0	0	0	0	0	0	0	.	0
TOTAL	399	85	28	83	169	45	25	2	0	

D. Roro/Contain	F/ld	Apapa	TCI	PH	Warri	Sapele	Cala.	Koko	Onne	Total
Foreland	.	0	144	0	0	0	0	0	0	144
Apapa	0	.	0	0	0	0	0	0	0	0
Tin Can Is.	128	0	.	8	8	0	0	0	0	144
Port Har.	8	0	0	.	0	0	0	0	0	8
Warri	8	0	0	0	.	0	0	0	0	8
Sapele	0	0	0	0	0	.	0	0	0	0
Calabar	0	0	0	0	0	0	.	0	0	0
Koko	0	0	0	0	0	0	0	.	0	0
Onne	0	0	0	0	0	0	0	0	.	0
TOTAL	144	0	144	8	8	0	0	0	0	

E. Container	F/ld	Apapa	TCI	PH	Warri	Sapele	Cala.	Koko	Onne	Total
Foreland	.	146	0	0	0	0	0	0	0	146
Apapa	146	.	0	0	0	0	8	0	0	146
Tin Can Is.	0	0	.	0	0	0	0	0	0	0
Port Har.	0	0	0	.	0	0	0	0	0	0
Warri	0	0	0	0	.	0	0	0	0	0
Sapele	0	0	0	0	0	.	0	0	0	0
Calabar	0	0	0	0	0	0	.	0	0	0
Koko	0	0	0	0	0	0	0	.	0	0
Onne	0	0	0	0	0	0	0	0	.	0
TOTAL	146	146	0	0	0	0	0	0	0	

F. Gen./Contain	F/ld	Apapa	TCI	PH	Warri	Sapele	Cala.	Koko	Onne	Total
Foreland	.	417	312	34	65	0	0	0	0	828
Apapa	199	.	7	155	58	5	17	3	2	446
Tin Can Is.	214	10	.	85	24	5	0	0	1	339
Port Har.	243	15	14	.	5	0	0	0	0	277
Warri	139	4	6	3	.	0	0	0	0	152
Sapele	10	0	0	0	0	.	0	0	0	10
Calabar	17	0	0	0	0	0	.	0	0	17
Koko	3	0	0	0	0	0	0	.	0	3
Onne	3	0	0	0	0	0	0	0	.	3
TOTAL	828	446	339	277	152	10	17	3	3	

APPENDIX 2 to CHAPTER FOUR

OCEAN AND INLAND SECTOR COSTS. LAGOS ONLY

AND AN ADDITION OF A SECOND NIGERIAN PORT

(N000's in 1983-84)

Port Harcourt	85 Ships:	3009 Container Boxes Tonnage 228,411
Extra Ocean Sector Costs	2932.5	
Pilotage Dues etc.	537.5	
(a) Total Ocean Sector Costs	3470.0	
(b) Inland Costs from Port Harcourt	4811.3	
Total Costs from Port Harcourt (a+b)	8281.3	
Inland Costs from Lagos	9692.7	
Savings Using Lagos and Port Harcourt	1411.4	
	= N6.2 per Tonne of Cargo	

Warri	38 Ships:	556 Container Boxes Tonnage 96,432
Extra Ocean Sector Costs	646.0	
Pilotage Dues etc.	257.5	
(a) Total Ocean Sector Costs	903.5	
(b) Inland Costs from Warri	1566.5	
Total Costs from Warri (a+b)	2470.0	
Inland Costs from Lagos	3527.5	
Savings Using Lagos and Warri	1057.5	
	= N10.9 per Tonne of Cargo	

Assumptions for Inland Transport Sector Results

1979 Hinterland distribution model for Port Harcourt

1979 Hinterland distribution model for Warri

1982 Government published freight rates (roads) for general cargo and containers.

Assumptions for Ocean Sector Costs Results

Ship time at N5000 per day

Sailing time from Lagos to Warri = 1 day

Sailing time from Lagos to Port Harcourt = 1 day

Ship waiting time at Warri = 1.4 days

Ship waiting at Port Harcourt = 4.9 days

For Tug and Pilotage requirements:

Warri: 6.66m draught and 120m length

Port Harcourt: 6.68m draught and 140m length.

APPENDIX 3 to CHAPTER FOUR

HINTERLAND DISTRIBUTION OF IMPORTS USING 1979 MODEL

Inland Destination	PORT HARCOURT General Cargo (Tonnes)	PORT HARCOURT Cont. (Tonnes)	WARRI General Cargo (Tonnes)	WARRI Cont. (Tonnes)
Anambra	15,239	1,053	8,897	-
Bendel	193	-	64,706	556
Benue	3,858	-	-	-
Cross River	3,086	-	-	-
Imo	68,287	-	6,740	-
Kaduna	8,873	-	-	-
Kano	10,224	-	-	-
Borno	-	-	2,157	-
Kwara	-	-	1,078	-
Ondo	-	-	5,302	-
Oyo	-	-	809	-
Plateau	1,543	-	-	-
Rivers	81,597	1,956	-	-

APPENDIX 1 to CHAPTER FIVE

STRUCTURE OF FLOW MATRIX BETWEEN PORT-HINTERLAND NODES

The model is of the form:

Take all k outflows incident to a given vertex arrayed as a row vector of the initial flows matrix and rank these according to their percentages (Wi) from the largest (W1) to the smallest (Wk).

Estimate a set of expected flows ($\hat{W}j$) for each of a series of cycles 1,2,3 .... k, so that

1st Cycle

$$\hat{W}_1 = \sum_{i=1}^{k} Wi,$$

$$\hat{W}_2 = \hat{W}_3 = \ldots\ldots = \hat{W}_k = 0$$

2nd Cycle

$$\hat{W}_1 = \hat{W}_2 = 1/2 \sum_{i=1}^{k} Wi,$$

$$\hat{W}_3 = \hat{W}_4 = \ldots\ldots = \hat{W}_k = 0$$

jth Cycle

$$\hat{W}_1 = \hat{W}_2 = \ldots\ldots = W_j = 1/j \sum_{i=1} Wi$$

$$\hat{W}_j + 1 = \hat{W}_j + 2 = \ldots\ldots = \hat{W}_k = 0$$

and so on.

APPENDIX 2 to CHAPTER FIVE

(a) LAND TRANSPORT TURNROUND TIME FOR IMPORT VEHICLES: NIGERIAN PORTS, 1979

Hours in Port	LAGOS			PORT HARCOURT			DELTA		
	No.	%	Cum.%	No.	%	Cum.%	No.	%	Cum.%
0-4	146	5.8	5.8	78	15.6	15.6	125	44.5	44.5
4-8	724	28.6	34.4	256	52.3	66.9	100	35.6	80.1
8-12	765	30.2	64.6	70	14.1	81.0	15	5.3	85.4
12-16	390	15.4	80.0	35	7.0	88.0	14	5.0	90.4
16-20	169	6.7	86.7	25	5.0	93.0	13	4.6	95.0
20-24	82	3.3	90.0	21	4.2	97.2	5	1.9	96.9
24-28	70	2.7	92.7	11	2.2	99.4	4	1.4	98.3
28-32	52	2.1	94.8	3	0.6	100.0	3	1.1	99.4
32-36	42	1.7	96.5	-	0.0	100.0	1	0.3	99.7
36-40	31	1.2	97.7	-	0.0	100.0	1	0.3	100.0
40-44	25	1.0	98.7	-	0.0	100.0	-	0.0	100.0
44-48	22	0.8	99.5	-	0.0	100.0	-	0.0	100.0
> 48	12	0.5	100.0	-	0.0	100.0	-	0.0	100.0
TOTAL	2530	100	-	499	100	-	281	100	-

(b) LAND TRANSPORT TURNROUND TIME FOR EXPORT VEHICLES: LAGOS AND PORT HARCOURT, 1979

Hours in port	LAGOS			PORT HARCOURT		
	No.	%	Cum.%	No.	%	Cum.%
0-8	97	64.2	64.2	14	40.0	40.0
8-16	7	4.6	68.8	3	8.6	48.6
16-24	2	1.3	70.1	15	42.9	91.5
24-32	6	3.9	74.0	2	5.7	97.2
32-48	-	0.0	74.0	-	0.0	97.2
48-72	18	12.0	86.0	1	2.8	100.0
72-96	15	10.0	96.0	-	0.0	100.0
96-120	3	2.0	98.0	-	0.0	100.0
120-144	3	2.0	100.0	-	0.0	100.0
TOTAL	151	100	-	35	100	-

(c) VEHICLE SIZES USED FOR IMPORTS TO EXTRA-METROPOLITAN HINTERLANDS

Vehicle Size	LAGOS			PORT HARCOURT			DELTA		
	No Ex Met.	%	Cum.%	No Ex Met.	%	Cum.%	No Ex Met.	%	Cum.%
Less than 5 tons	10	3.2	3.2	-	0.0	0.0	-	0.0	0.0
5 Tons	14	4.5	7.7	2	0.7	0.7	-	0.0	0.0
10 Tons	38	12.2	19.9	3	1.1	1.8	19	27.9	27.9
15 Tons	84	26.9	46.8	208	73.0	74.8	20	29.4	57.3
20 Tons	24	7.7	54.5	1	0.4	75.2	13	19.2	76.5
25 Tons	52	16.6	71.1	7	2.4	77.6	8	11.8	88.3
30 Tons	28	9.0	80.1	16	5.6	83.2	5	7.3	95.6
35 Tons	62	19.9	100.0	48	16.8	100.0	3	4.4	100.0
TOTAL	312	100	-	285	100	-	68	100	-

(d) VEHICLES SIZES USED FOR EXPORTS FROM EXRTRA-METROPOLITAN ORIGINS TO PORTS, 1979

Vehicle Size	LAGOS			PORT HARCOURT		
	No Ex Met.	%	Cum.%	No Ex Met.	%	Cum.%
5 Tons	-	0.0	0.0	1	3.8	3.8
10 Tons	8	11.6	11.6	13	50.0	53.8
15 Tons	14	20.3	31.9	6	23.1	76.9
20 Tons	12	17.4	49.3	-	0.0	76.9
25 Tons	18	26.0	75.3	4	15.5	92.4
30 Tons	14	20.3	95.6	1	3.8	96.2
>30 Tons	3	4.4	100.0	1	3.8	100.0
TOTAL	69	100	-	26	100	-

APPENDIX 3 to CHAPTER FIVE

TRUCK OPERATING COSTS ON IDEAL NIGERIAN ROADS, 1970

	5 Ton Truck	10 Ton Truck	15 Ton Truck	22 Ton Trailer
Fixed Costs/Kilometre (Kobo)	9.3	14.5	13.6	18.1
Running Cost/Kilometre (Kobo)	14.5	21.2	27.6	37.6
Total Cost/Km (Kobo)	23.8	35.7	41.2	55.7
Maintenance Costs/Km (Kobo)	0.29	0.97	1.3	3.3
Cost/Vehicle/Km (Kobo)	24.1	36.7	42.5	59.0
Load/Vehicle (Tonnes)	3.75	7.5	11.25	16.6
Cost/Tonne/Km (Kobo)	6.4	4.9	3.77	3.57
Plus 30 percent	8.3	6.4	4.9	4.6

Source: NEDECO: The Development of the Nigerian Ports.

N.B. The cost has been adjusted by 30 percent upwards to take care of inflationary trends in costs in general in the country.

APPENDIX 4 to CHAPTER FIVE

COST CALCULATIONS: EXTRA-METROPOLITAN IMPORT TRAFFIC FROM PORTS

1 LAGOS PORTS

14, 5 tonne trucks at 8.3k per vehicle	= 116.2k
38, 10 tonne trucks at 6.4k per vehicle	= 243.2k
84, 15 tonne trucks at 4.9k per vehicle	= 411.6k
166, 22 tonne trucks at 4.6k per vehicle	= 763.6k
TOTAL	= 1534.6k
Average per tonne km per vehicle	= 1543.6/302
	= 5.08k per tonne km

2. PORT HARCOURT

2, 5 tonne trucks at 8.3k per vehicle	= 16k
3, 10 tonne trucks at 6.4k per vehicle	= 19.2k
208, 15 tonne trucks at 4.9k per vehicle	= 1019.2k
72, 22 tonne trucks at 4.6k per vehicle	= 331.2k
TOTAL	= 1386.2k
Average per tonne km per vehicle	= 1386.2/285
	= 4.86k per tonne km

3 DELTA PORTS

19, 10 tonne trucks at 6.4k per vehicle	= 121.6k
20, 25 tonne trucks at 4.9k per vehicle	= 98k
29, 22 tonne trucks at 4.6k per vehicle	= 133k
TOTAL	= 353k
Average per tonne km per vehicle	= 353/68
	= 5.19k

APPENDIX 5 to CHAPTER FIVE

DISTANCE AND TOTAL TRANSPORT COSTS: IMPORT TRAFFIC

Inland Region	Dist. from Lagos (kms)	Transport Cost from Lagos (5.08k) N.p.t.v.	Dist. from P.H. (kms)	Transport Cost from P.H. (4.86k) N.p.t.v.	Dist. from D.P. (kms)	Transport Cost from D.P. (5.19k) N.p.t.v.
1 Anambra	577	29.30	251	12.19	304	15.77
2 Bauchi	1208	61.36	977	47.78	1093	56.72
3 Bendel	320	16.25	356	17.30	0	0.0
4 Benue	887	45.05	507	24.64	735	38.14
5 Borno	1680	85.34	1440	69.98	1456	75.56
6 Cross River	784	39.82	198	9.62	491	25.48
7 Gongola	1422	72.23	1107	53.80	1136	58.95
8 Imo	555	28.19	113	5.49	270	14.01
9 Kaduna	893	45.36	1009	49.03	896	46.50
10 Kano	1151	58.47	1271	61.77	1158	60.10
11 Kwara	303	15.39	846	41.11	479	24.86
12 Lagos	0	0.0	689	33.48	435	22.57
13 Niger	736	37.38	833	40.48	702	36.43
14 Ogun	101	5.13	673	32.70	418	21.69
15 Ondo	346	17.57	526	25.56	272	14.11
16 Oyo	141	7.16	658	31.97	404	20.96
17 Plateau	1083	55.01	845	41.06	861	44.68
18 Rivers	689	35.00	0	0.0	383	19.87
19 Sokoto	1020	51.81	1509	73.33	1212	62.90

Note: N.p.t.v. = Naira per tonne vehicle
D.P. = Delta Ports
P.H. = Port Harcourt

APPENDIX 6 to CHAPTER FIVE

DELAY COSTS CALCULATIONS: IMPORT TRAFFIC

1 LAGOS PORTS

242 vehicles at N140 per vehicle	= N33,880
12 vehicles at N280 per vehicle	= N 3,360
TOTAL	= N37,240
Average for all import vehicles	= N37,240/2530
	= N14.71

2 PORT HARCOURT

14 vehicles at N140 per vehicle	= N1960
Average for all import vehicles	= N1960/499
	= N3.92

3 DELTA PORTS

9 vehicles at N140 per vehicle	= N1260
Average for all import vehicles	= N1260/9
	= N4.48

APPENDIX 7 to CHAPTER FIVE

TOTAL COSTS: TRANSPORT COSTS PLUS DELAY COSTS: IMPORTS

Inland Region	Total Costs from Lagos Ports N.p.t.v.	Total Costs from P.H. Port N.p.t.v	Total Costs From Delta Ports N.p.t.v
1 Anambra	44.01	16.11	20.25
2 Bauchi	76.07	51.40	61.20
3 Bendel	30.96	21.22	4.48
4 Benue	59.76	28.56	42.62
5 Borno	100.05	73.90	80.04
6 Cross River	54.53	13.54	29.96
7 Gongola	86.94	57.72	63.43
8 Imo	42.90	9.41	18.49
9 Kaduna	60.07	52.95	50.98
10 Kano	73.18	65.69	64.58
11 Kwara	30.10	45.03	29.34
12 Lagos	14.71	37.40	27.05
13 Niger	52.09	44.40	40.91
14 Ogun	19.84	36.62	26.17
15 Ondo	30.28	29.48	18.59
16 Oyo	21.87	35.89	25.44
17 Plateau	69.72	44.98	49.16
18 Rivers	49.71	3.92	24.35
19 Sokoto	66.52	77.25	67.38

Note: N.p.t.v = Naira per tonne vehicle
P.H. = Port Harcourt

APPENDIX 8 to CHAPTER FIVE

COST CALCULATIONS: EXTRA-METROPOLITAN EXPORT TRAFFIC TO PORTS

1 LAGOS PORTS

8, 10 tonne trucks at 6.4k per vehicle	= 51.2k
14, 15 tonne trucks at 4.9k per vehicle	= 68.6k
47, 22 tonne trucks at 4.6k per vehicle	= 216.2K
TOTAL	= 336.0k
Average per tonne km per vehicle	= 336.0/69
	= 4.87k per tonne km

2 PORT HARCOURT

1, 5 tonne truck at 8.3k per vehicle	= 8.3k
13, 10 tonne trucks at 6.4k per vehicle	= 83.2k
6, 15 tonne trucks at 4.9k per vehicle	= 29.4k
6, 22 tonne trucks at 4,6k per vehicle	= 27.6k
TOTAL	= 148.5k
Average per tonne km per vehicle	= 148.5/26
	= 5.71k per tonne km

APPENDIX 9 to CHAPTER FIVE

DISTANCE AND TOTAL TRANSPORT COSTS: EXPORT TRAFFIC

Inland Region Origin	Dist. from Lagos (kms)	Transport Cost from Lagos (4.87k) N.p.t.v.	Dist. from P.H. (kms)	Transport Cost from P.H. (5.71k) N.p.t.v.
1 Anambra	577	28.09	251	14.33
2 Bauchi	1208	58.82	977	55.78
3 Benue	887	43.19	507	28.94
4 Borno	1680	81.81	1440	82.22
5 Gongola	1422	69.25	1107	63.20
6 Imo	555	27.02	113	6.45
7 Kaduna	893	43.48	1009	57.61
8 Kano	1151	56.05	1271	72.57
9 Kwara	303	14.75	846	48.30
10 Niger	736	35.84	833	47.56
11 Ogun	101	4.91	673	38.42
12 Ondo	346	16.85	526	30.03
13 Oyo	141	6.86	658	37.57
14 Plateau	1083	52.74	845	48.24
15 Sokoto	1020	49.67	1509	86.16

Note: N.p.t.v. = Naira per tonne vehicle
P.H. = Port Harcourt

APPENDIX 10 to CHAPTER FIVE

DELAY COSTS CALCULATIONS: EXPORT TRAFFIC

1 LAGOS PORTS

6 vehicles at N140 per vehicle	=	N 840
16 vehicles at N280 per vehicle	=	N 5050
15 vehicles at N420 per vehicle	=	N 6300
3 vehicles at N560 per vehicle	=	N 1680
3 vehicles at N700 per vehicle	=	N 2100
TOTAL	=	N15960

Average for all export vehicles = N15,960/152

= N105.69

2 PORT HARCOURT

2 vehicles at N140 per vehicle	=	N280
1 vehicle at N280 per vehicle	=	N280
TOTAL	=	N560

Average for all export vehicles = N560/34

= N16.17

APPENDIX 11 to CHAPTER FIVE

TOTAL COSTS: TRANSPORT COSTS PLUS DELAY COSTS: EXPORTS

Inland Region Origin	Total cost from Lagos (N per tonne vehicle)	Total cost from Port Harcourt (N per tonne vehicle)
1 Anambra	133.09	30.33
2 Bauchi	163.82	71.78
3 Benue	148.19	44.94
4 Borno	186.81	98.22
5 Gongola	174.25	79.20
6 Imo	132.02	22.45
7 Kaduna	148.48	73.61
8 Kano	161.05	88.57
9 Kwara	119.75	64.30
10 Niger	140.84	63.56
11 Ogun	109.91	54.42
12 Ondo	121.85	46.03
13 Oyo	111.86	53.57
14 Plateau	157.74	64.24
15 Sokoto	154.67	102.16

APPENDIX 12 to CHAPTER FIVE

(a) ESTIMATED CAPACITY OF NIGERIAN PORTS BY TYPE OF FACILITY*

(000 Tonnes)

Type of Packing	Lagos	Port Harcourt	Delta
Break-bulk	4086	1197	2664
Cement	2400	-	-
Ro-ro	984	-	492
Container	2460	-	-
Lighters	750	270	450
Total Capacity	10680	2667	3606
Actual Throughput (1979)	6848	2444	1967

* More than 90 percent of the facilities have been installed by 1979.

Source: Shneerson, 1981, p.206.

(b) ROAD CAPACITY FOR IMPORTS 1979 and 1981*

(Metric Tonnes)

Deliveries by Road	Port Harcourt		Delta Ports	
	Feb. 1979	Dec. 1981	Feb. 1979	Dec. 1981
Direct Delivery by Road }		247,899		158,963
Indirect Delivery by Road }		32,476		4,203
Stacking Areas }		47,361		2,141
TOTAL	170,670	327,736	61,091	165,307
1979 as percentage of 1981	52		37	

* 1981 recorded the highest imports throughput.

Source: Nigerian Ports Authority Annual Reports, 1979 and 1981.

REFERENCES

1. AGERSCHOU, H. and KORSGAAR, J. (1969): 'Systems Analysis for Port Planning', Dock and Harbour Authority, March, 411-415.
2. BARBOUR, K.M. (1967): 'A Survey of the Bornu Railway Extension in Nigeria - a Geographical Audit', Nigerian Geographical Journal, 10, 11-28.
3. BEAVER, S.H. (1967): 'Ships and Shipping: the Geographical Consequences of Technological Change', Geography, 52, 133-156.
4. BENNATHAN, E. and WALTERS, A.A. (1979): Port Pricing and Investment Policy in Developing Countries, Oxford University Press.
5. BIGOSINSKI, J. (1979): Nigerian Ports Study: Traffic Studies and Projections, M.I.T. Centre for Transportation Studies, Report 79-1.
6. BIRD, J.H. (1963): The Major Seaports of the United Kingdom, Hutchinson and Company, London.
7. BIRD, J.H. (1969): 'Traffic Flows To and From British Seaports', Geography, 54, 248-302.
8. BIRD, J,H, (1971): Seaport and Seaport Terminals, Hutchinson University Library, London.
9. BIRD, J.H. (1980): 'Seaports as a Subset of Gateways for Regions: A Research Survey', Progress in Human Goegraphy, 4, 360-370.
10. BIRD, J.H. (1982): 'Transport Decision-makers Speak: The Seaport Development in the European Communities Research Project, Part I', Maritime Policy and Management, 9 (1), 1-22.

11. BIRD, J.H. (1982): 'Transport Decision-makers Speak: The Seaport Development in the European Communities Research Project, Part II', Maritime Policy and Management, 9 (2), 83-102.

12. BIRD, J.H. (1983): 'Gateways: Slow Recognition but Irresistible Rise', Tijdschrift voor Economische en Sociale Geografie, 74, 196-202.

13. BIRD, J.H. (1984): 'Seaport Development: Some Questions of Scale', in B.S HOYLE AND D. HILLING (eds): Seaport Systems and Spatial Change: Technology, Industry and Development Strategies, John Wiley and Sons, Chichester, 21-41.

14. BIRD, J.H. and POLLOCK, E.E. (1977): 'The Future of Seaports in the European Communities', Geographical Journal, 144, 23-48.

15. BIRD, J.H. and WILLINGALE, M.C. (1983): 'Methods of Investigating Decisions Involving Spatial Effects Including Content Analysis of Interviews', Transactions, Institute of British Geographers, 8, 143-156.

16. BOBROVITCH, D. (1982): 'Decentralised Planning and Competition in a National Multi-port System', Journal of Transport Economics and Policy, 31-42.

17. BRAMS, S.J. (1966): 'Transactions Flows in the International System', The American Political Science Review, 60, 880-898.

18. BRIGGS, J. (1984): Peasant Farmers and Crop Choice: A Study of Agricultural Decision-making in Central Sudan, Occasional Paper Series 13, Geography Department, Glasgow University, 19-21.

19. BRITTON, J.N.H. (1965): 'The External Relations of Seaports: Some New Considerations', Tijdschrift voor Economische en Sociale Geografie, May-June 1965, 109-112.

20. BROWN, L.A. (1970): 'On the Use of Markov Chains in Movement Research', Economic Geography, 46, 393-403.

21. BROWN, L.A. and HORTON, F.E. (1970): 'Functional Distance: An Operational Approach', Geographical Analysis, 2, 76-83.

22. BUCKLEY, D.J. and GOONERATNE, S.G. (1974): 'Optimal Scheduling of Certain Transport Facility Improvements to Cater for Growing Traffic Congestion', Journal of Transport Economics and Policy, 8, 122-135.

23. CARTER, R.E. (1962): 'A Comparative Analysis of U.S. Ports and Their Traffic Characteristics', Economic Geography, 38, 162-175.

24. CAMPBELL, J. (1975): 'Application of Graph Theoretical Analysis to Inter-industry Relationships', Regional Science and Urban Economics, 5, 91-106.

25. CHARLIER, J.J. (1981): 'Bruges to Zeebrugge: The Emergence of a Belgian Superport', in HOYLE, B.S. and PINDER, D.A. (eds), City Port Industrialisation and Regional Development: Spatial Analysis and Planning Strategies, Pergamon Press, London.

26. CHU, K.Y. (1978): 'The Growth and Decline of Major British Seaports: An Analysis of the Pattern of Non-fuel Cargo Traffic', Unpublished PhD Thesis, University of London.

27. CHIU, T.N. and CHU, K.Y. (1984): 'Port Development in the People's Republic of China: Readjustment Under Programmes of Accelerated Economic Growth', in B.S. HOYLE and D. HILLING (eds) Seaport Systems and Spatial Change, John Wiley and Sons, Chichester, 199-215.

28. CLARK, D. (1973): 'The Formal and Functional Structure of Wales', Annals of the Association of American Geographers, 63, 29-42.

29. COOLEY, C.H. (1894): 'The Theory of Transportation', Proceedings of the American Economic Association, 9, 225-370.

30. COPPOCK, J.T. (1964): 'Crop, Livestock and Enterprise Combinations in England and Wales', Economic Geography, 40, 65-81.

31. COUPER, A.D. (1972): The Geography of Sea Transport, Hutchinson University Library, London.

32. DESBARATS, J.M. (1972): 'Some Geographical Aspects of Port Modernisation: The case of Clydeport', Scottish Geographical Magazine, 88 (3), 182-195.

33. DICKINSON, B. (1984): 'The Development of the Nigerian Port System: Crisis Management in Response to Rapid Economic Change', in B.S. HOYLE and D. HILLING (eds), Seaport Systems and Spatial Change: Technology, Industry and Development Strategies, John Wiley and Sons, Chichester.

34. DUTT, A.K. (1971): 'Delineation of the Hinterland of Calcutta Port', The Professional Geographer, 23 (1), 22-27.

35. ECONOMIC ASSOCIATES (1967): Nigerian Ports: Traffic and Development, Vols. 1 and 2, London.

36. EDDISON, R.T. and OWEN, D.G (1953): 'Discharging Iron-ore', Operational Research Quarterly, 4, 39-50.

37. EDMOND, E.D. and MAGGS, R.P. (1976): 'Container Ship Turnround Times in U.K. Ports', Maritime Policy and Management, 4, 3-19.

38. ELIOT HURST, M.E. (1974a): Transportation Geography: Comments and Readings, New York, McGraw-Hill.

39. ELLIOT, N.R. (1966): 'The Functional Approach in Port Studies', in J.W. HOUSE (ed) Northern Geographical Essays in Honour of G.H.J. Daysh, Department of Geography, University of Newcastle-Upon-Tyne.

40. ELLIOT, N.R. (1969): 'Hinterland and Foreland as Illustrated by the Port of Tyne', Transactions, Institute of British Geographers, 47, 153-170.

41. EVANS, J. and DAVIES, J. (1978): 'The Liner Conference System: Its Origin, Achievements and Current Difficulties', Maritime Policy and Management, 5, 155-174.

42. FALOWO, I.O. (1979): 'Road and Rail Freight Movement in Nigeria: An Example in Inter-modal Competition', Unpublished MSc Dissertation, University of Ife, Nigeria.

43. FEDERAL GOVERNMENT OF NIGERIA (1984): 'Directive on Ports', Daily Sketch, June 29, 1984, 12.

44. FEDERAL REPUBLIC OF NIGERIA (1970): Second National Development Plan, 1970 - 1974, Lagos.

45. FEDERAL REPUBLIC OF NIGERIA (1975): Third National Development Plan, 1975 - 1980, Lagos.

46. FEDERATION OF NIGERIA (1962): Federal Government Development Programme, 1962 - 1968, Sessional Paper No. 1, Lagos.

47. FEDERATION OF NIGERIA (1965): Statement of Policy on Transport, Sessional Paper No. 1, Lagos.

48. FILANI, M.D. and OSAYIMWESE, Iz. (1974): 'The Organisation of Transport Planning in Nigeria', Nigerian Journal of Economic and Social Studies, 16, 387-402.

49. FRANKEL, E.G. (1977): Port Planning, Mimeo, Cambridge.

50. FRATRAR, T.J. et al. (1960): 'Prediction of Maximum Berth Occupancy', Journal of the Waterways and Harbours Division, Proceedings of the American Society of Civil Engineers, 86, 69-78.

51. GARNETT, H.C. (1970): 'Competition Between Ports and Investment Planning', Scottish Journal of Political Economy, 17, 411-424.

52. GARRATT, M.G. (1983): 'Port Choice and Its Regional Impact', in K.J. BUTTON and D. GILLINGWATER (eds) Transport, Location and Spatial Policy, Gower, Aldershot.

53. GAUTHIER, H.L. (1970): 'Geography, Transportation and Regional Development', Economic Geography, 46, 612-619.

54. GILLINGWATER, D. and BUTTON, K.J. (1983): 'Transport, Location and Spatial Policy: The Context', in K.J. BUTTON and D. GILLINGWATER (eds) Transport, Location and Spatial Policy, Gower, Aldershot.

55. GILMAN, S. and WILLIAMS, G.F. (1976): 'The Economics of Multi-port Itineraries for Large Container Ships', Journal of Transport Economics and Policy, May 1976, 137-149.

56. GILMAN, S. (1977): 'The Economics of Port Location in Through Transport Systems', International Journal of Transport Economics, 4, 257-270.

57. GILMAN S. (1977): 'Optimal Shipping Technologies for Routes to Developing Countries', Journal of Transport Economics and Policy, January 1977, 24-44.

58. GODDARD, J.B. (1970): 'Functional Regions Within the City Centre: A Study by Factor Analysis for Taxi Flows in Central London', Transactions, Institute of British Geographers, 49, 161-182.

59. GOONERATNE, S.G. and BUCKLEY, D.J. (1970): Operations Research Models for Bulk Handling Systems at Sea Transport Terminals with Particular Reference to Port Kembla, Technical Report No.1, School of Traffic Engineering, The University of New South Wales.

60. GOSS, R.O. (1967): 'The Turnround of Cargo Liners and Its Effect on Sea Transport Costs', Journal of Transport Economics and Policy, 1, 75-89.

61. GOSS, R.O. (1967): 'Towards an Economic Appraisal of Port Investments', Journal of Transport Economics and Policy, 1, 249-272.

62. GOSS, R.O. (1979): The Economic Efficiency of Seaports, Proceedings of the Conference on Ports' Policy and Practice, The Nautical Institute, London.

63. GOWON, Y. (1975): 'Address on Formal Launching of the Third National Development Plan 1975 - 1980', Lagos.

64. GROTEWOLD, A. (1961): 'Some Aspects of the Geography of International Trade', Economic Geography, 37, 310-319.

65. HAGENHAAR, J.M.C. (1973): 'Port Development in the European Economic Community', Water Spectrum, 5, 27-35.

66. HARARY, et al. (1965): Structural Models: An Introduction to the Theory of Directed Graphs, John Wiley and Sons, New York.

67. HAY, A.M. (1973): Transport for the Space Economy, Macmillan.

68. HAYUTH, Y. (1980): 'Inland Container Terminals: Function and Rationale;, Maritime Policy and Management, 7, 283-289.

69. HAYUTH, Y. (1982): 'Inter-modal Transportation and the Hinterland Concept', Tijdschrift voor Economische en Sociale Geografie, 73, 13-21.

70. HEMMENS, G.C. (1966): The Structure of Urban Activity Linkages, University of North Carolina, Chapel Hill.

71. HILLING, D. (1966): 'Tema, the Geography of a New Port', Geography, 51, 111-125.

72. HILLING, D. (1969): 'The Evolution of the Major Ports of West Africa', Geographical Journal, 135, 365-378.

73. HILLING, D. (1969b): 'Container Potential of West African Ports', Dock and Harbour Authority, 50, 9-13.

74. HILLING, D. (1970): 'Port Development and Economic Growth: The Case of Ghana', in B.S. HOYLE and D. HILLING (eds) Seaport and Development in Tropical Africa, Macmillan, 127-145.

75. HILLING, D. (1975): 'Port Specialisation and Efficiency: The Case of Ghana', Maritime Studies and Management, 3, 13-20.

76. HILLING, D. (1977a): 'The Evolution of a Port System: The Case of Ghana', Geography, 62, 97-105.

77. HILLING, D. (1978): Barge Carrier Systems: Inventory and Prospects, Benn, London.

78. HILLING, D (1983): 'Ships, Ports and Developing Countries', Geoforum, 14 (3), 333-339.

79. HILLING, D. and HOYLE, B.S. (1984): 'Spatial Approaches to Port Development', in B.S. HOYLE and D. HILLING (eds) Seaport Systems and Spatial Change, John Wiley and Sons, Chichester.

80. HODDER, B.W. (1959): 'The Growth of Trade at Lagos, Nigeria', Tijdschrift voor Economische en Sociale Geografie, October 1959, 197-202.

81. HOLMES, J.H. (1978): 'Dyadic Interaction Matrices: A Review of Transformation Purposes and Procedures', Progress in Human Geography, 2, 467-492.

82. HOLMES, J.H. and HAGGETT, P. (1977): 'Graph Theory Interpretation of Flow Matrices: A Note on Maximization Procedures for Identifying Significant Links', Geographical Analysis, 9, 388-399.

83. HOYLE, B.S. (1967): 'Early Port Development in East Africa: An Illustration of the Concept of Changing Port Hierarchies', Tijdschrift voor Economische en Sociale Goegrafie, April 1967, 94-102.

84. HOYLE, B.S. (1970): 'Transport and Economic Growth in Developing Countries: The Case of East Africa', in R.H. OSBORNE et al (eds) Geographical Essays in Honour of K.C. Edwards, University of Nottingham, 187-196.

85. HOYLE, B.S. (1978): 'African Politics and Port Expansion at Dar Es Salaam', Geographical Review, 69, 31-50.

86. HOYLE, B.S. (1981): 'Cityport Industralisation and Regional Development in Less-Developed Countries: The Tropical African Experience', in B.S HOYLE and D.A. PINDER (eds) Cityport Industrialisation and Regional Development, Pergamon, Oxford.

87. HOYLE, B.S. (1986): 'Transport and Economic Development in the Less-developed Countries: Some Reflections on the Seaports of Kenya and Tanzania', Geo Journal, 12 (3), 233-242.

88. HUGHES, C. (1977): 'Containerisation in an LDC Environment', Maritime Policy and Management, 4, 293-302.

89. HUSSAIN, M,S. (1981): 'Influences on Development Policy in the Port of Hamburg', in B.S. HOYLE and D.A. PINDER (eds) Port-city Industrialisation and Regional Development: Spatial Analysis and Planning Strategies, Pergamon Press, London, New York.

90. IKPORUKPO, C.O. (1986): 'Politics and Regional Policies: The Issue of State Creation in Nigeria', Political Geography Quarterly, 5 (2), 127-139.

91. ILBERY, B.W. (1977): 'Point Score Analysis: A Methodological Framework for Analysing the Decision-making Process in Agriculture', Tijdschrift voor Economische en Sociale Geografie, 68 (2), 66-71.

92. JOHNSON, K.M. and GARNETT, H.C. (1971): The Economics of Containerisation, George Allen and Unwin Ltd., London.

93. JONES, J.H. and BLUNDEN, W.R (1968): 'Ship Turn-around Time at the Port of Bangkok', Journal of the Waterways and Harbours Division, May 1968, 135-148.

94. JONES, P.N. and NORTH, J. (1982): 'Unit Loads Through British Ports: A Further Revolution', Geography, 67 (294) 29-40.

95. KENYON, J.B. (1970): 'Elements in Interport Competition in the U.S.', Economic Geography, 46, 1-24.

96. KRAFT, G. et al (1971): The Role of Transportation in Regional Economic Development, Heath Lexington Books, London.

97. LAING, E.T. (1977): 'The Distribution of Benefits from Port Investment', Maritime Policy and Management, 4, 142-154.

98. LE GOY, R.E.M. (1974): 'Development of Community Transport Policy', Chartered Institute of Transport Journal, 36, 57-63.

99. LEONTIEF, W.W. (1965): 'The Structure of the U.S. Economy', Scientific American, 212, 25-35.

100. MARBLE, D.F. (1964): 'A Simple Markov Model of Trip Structures in a Metropolitan Region', Papers and Proceedings, Regional Science Association, 1, 150-156.

101. MARSDEN, H.J. (1971): 'Regional Approach to Port Development Planning', Journal of the Waterways, Harbours and Coastal Engineering Division, Proceedings of the American Society of Civil Engineers, 33-44.

102. MASSACHUSSETS INSTITUTE OF TECHNOLOGY (1977): 'Nigerian Ports Study: Traffic Studies and Projections'.

103. MAYER, M.M (1973): 'Some Geographic Aspects of Technological Change in Maritime Transportation', Economic Geography, 49, 145-155.

104. METTAM, J.D. (1967): 'Berth Planning by Evaluation of Congestion and Cost', Journal of Waterways and Harbours Division, Proceedings of the American Society of Civil Engineers, 107-131.

105. METTAM, J.D. (1967): 'Forecasting Delays to Ships in Port', The Dock and Harbour Authority, April 1967, 380-382.

106. MINISTRY OF TRANSPORT (1966): Portbury: Reasons for the Minister's Decision Not to Authorise the Construction of a New Dock at Bristol, HMSO, London.

107. MITCHELL, K. and SHNEERSON, D. (1977): 'The Economics of Conventional Liner Break-bulk Cargo-handling Efficiency', Maritime Policy and Management, 4, 191-201.

108. MORGAN, F.W. (1951): 'Observations on the Study of Hinterlands in Europe', Tijdschrift voor Economische en Sociale Geografie, 42, 366-373.

109. NATIONAL PORTS COUNCIL (1977): Forecast of Area and Routes: 1975 - 1985, HMSO, London.

110. NATIONAL PORTS COUNCIL (1978): A Survey of the Inland Origins and Destinations of U.K. International Trade, HMSO, London.

113. NESTERENTS, D. and TYNER, W.R. (1967): 'Nigeria Plans Port of Koko Expansions', Dock and Harbour Authority, 48, 232-234.

112. NETHERLANDS ENGINEERING CONSULTANTS (1971): The Development of the Ports of Nigeria (1970 - 1990), The Hague.

113. NICOLAOU, S.N. (1967): 'Berth Planning by Evaluation of Congestion and Cost', Journal of the Waterways and Harbours Division, op cit, 107-131.

114. NYSTUEN, J.D and DACEY, M.F. (1961): 'A Graph Theory Interpretation of Nodal Regions', Papers, Regional Science Association, 7, 29-42.

115. OGUNDANA, B. (1966): 'Changing Port Outlets of Nigeria's Export Commodities', Nigerian Geographical Journal, 9, 25-43.

116. OGUNDANA, B. (1970): 'Patterns and Problems of Seaport Evolution in Nigeria', in HOYLE, B.S. and HILLING, D. (eds) Seaports and Development in Tropical Africa, Macmillan, London.

117. OGUNDANA, B. (1971): 'Transport Policy on Controlled Exports in Nigeria', Nigerian Journal of Economic and Social Studies, 13, 365-382.

118. OGUNDANA, B. (1971): 'The Location Factor in Changing Seaport Significance in Nigeria', Nigerian Geographical Journal, 14, 71-88.

119. OGUNDANA, B. (1972): 'Oscillating Seaport Location in Nigeria', Annals of the Association of American Geographers, 62, 110-121.

120. OGUNDANA, B. (1972): 'Seaport Hierarchy and Foreland Structure', in ADAMS and HELLEINDER (eds) International Geography, Toronto.

121. OGUNDANA,B. (1974): 'Seaport Development - Multi-national Cooperation in West Africa', Journal of Modern African Studies, 12 (3), 395-407.

122. OGUNDANA, B. (1975): 'Infrastructural Problems of Development in Nigeria: Ports Congestion', in O. OYEDIRAN (ed) Survey of Nigerian Affairs, Ibadan.

123. OGUNDANA,B. (1976): 'Changing the Capacity of Nigeria's Seaport Entrances', ODU, 14, 69-88.

124. OGUNDANA, B. (1978a): 'Planning Strategies for Seaport Development in Nigeria', Unpublished Paper presented at the National Workshop on Planning Strategy for the 1980s. University of Ibadan.

125. OGUNDANA, B. (1978b): 'Ports and External Trade', in J.S. OGUNTOYINBO et al (eds) Geography of Nigerian Development, Heinemann, Ibadan.

126. OSAYIMWESE, I. (1974): 'An Application of Linear Programming to the Evacuation of Groundnuts in Nigeria', Journal of Transport and Economic Policy, 8, 58-69.

127. OSGOOD, C.E. et al. (1957): 'The Measurement of Meaning', in F.N. KERLINGER (ed) The Foundations of Behavioural Research, Holt, Rinehart and Winston, Inc., New York.

128. PATTON, D.T. (1958): 'General Cargo Hinterlands of New York, Philadelphia, Baltimore and New Orleans', Annals of the Association of American Geographers, 48, 436-455.

129. PERRY, P. (1985): 'Towards a Political Geography of Corruption', New Zealand Geographer, April 1985, 2-7.

130. PLUMLEE, C.H. (1966): 'Optimum Size Seaport', Journal of Waterways and Harbours Division, Proceedings of the American Society of Civil Engineers, 92, 1-24.

131. POUNDS, N.G.J. (1947): 'Ports and Outports in North West Europe', Geographical Journal, 109, 219-228.

132. PRICE, E.H.M. (1966): 'Port Economics', The Dock and Harbour Authority, 46, 367-368.

133 PUBLIC PROJECTS STUDY GROUP (1979): Landward Connections and the Development of Nigerian Ports, Faculty of Social Sciences, University of Ife, Ife-Ife, Nigeria.

134. RAPOPORT, A. (1967): 'International Relations and Games Theory', in W. EDWARDS and A. TVERSKY (eds) quoted in B.W. ILBERY in Decision-making in Agriculture: A Case Study of North-East Oxfordshire, Regional Studies, 13, 199-210

135. RIMMER, P.J. (1966): 'The Problem of Comparing and Classifying Seaports', The Professional Geographer, 18 (2), 83-91.

136. RIMMER, P.J. (1967a): 'The Search for Spatial Regularities in the Development of Australian Seaports, Geografiska Annaler, 49b, 42-54.

137. RIMMER, P.J. (1967b): 'The Changing Status of New Zealand Seaports: 1853 - 1960', Annals of the Association of American Geographers, 57, 88-100.

138. RIMMER, P.J. (1967): 'Inferred Hinterlands: The Example of New Zealand Seaports', Geography, 52 (40, 384-392.

139. RIMMER, P.J. (1978): 'Redirections in Transport Geography', Progress in Human Geography, 2, 76-100.

140. RICHTER, C.E. (1969): 'Industrial Linkages and Geographic Association', Journal of Regional Science, 9, 19-28.

141. ROBINSON, R. (1968): 'Spatial Structuring of Port-linked Flows: The Port of Vancouver, Canada, 1965', Unpublished PhD Dissertation, University of British Columbia.

142. ROBINSON, R. (1976): 'Modelling the Port as an Operational System: A Perspective for Research', Economic Geography, 52, 71-86.

143. ROBINSON, R. (1981): 'Industrialisation, Newports and Spatial Development Strategies in Less-developed Countries: The Case of Thailand', in B.S. HOYLE and D.A. PINDER (eds) Cityport Industrialisation and Regional Development, Pergamon, London.

144. ROBINSON, R. (1985): 'Industrial Strategies and Port Development in Developing Countries; The Asian Case', Tijdschrift voor Economische en Sociale Geografie, 76 (2) 133-143.

145. ROBINSON, R and CHU, D. (1978): 'Containerisation and the Port of Hong Kong in the 1970s', Australian Geographer, 14, 98-111.

146. ROBINSON, R. and TAKACS, E. (1976): 'Defining Operational Structure in a Port: The Port of Kembla', Unpublished Paper, University of Wollongong.

147. ROBINSON, R. and TOGNETTI, K. (1973): Modelling and Port Policy Decisions: The Interface of Simulation and Practice, Proceedings of the International Conference on Transportation Research, Bruges, Belgium.

148. RODGERS, A.L. (1958): 'The Port of Genoa: External and Internal Relations', Annals of the Association of American Geographers, 48 (4), 319-351.

149. ROSTOW, W.W. (1960): The Stages of Economic Growth, Cambridge University Press, London.

150. ROUGET, B. (1972): 'Graph Theory and Hierarchisation Models', Regional and Urban Economics, 2 (3), 263-296.

151. SAVAGE, J.R. and DEUTSCH, K. (1960): 'A Statistical Model of Gross Analysis of Transaction Flows', Econometrica, 28, 551-572.

152. SHAFFER, N.M. (1965): The Competitive Position of the Port of Durban, North-Western University Studies in Geography, No. 8, Evanston.

153. SHAW, G. and WHEELER, D. (1985): Statistical Techniques in Geographical Analysis, John Wiley and Sons.

154. SHNEERSON, D. (1981): 'Investment in Port Systems: A Case Study of the Nigerian Ports', Journal of Transport Economics and Policy, 201-216.

155. SLACK, B. (1980): 'Technology and Seaports in the 1980s', Tijdschrift voor Economische en Sociale Geografie, 71, 108-113.

156. SMITH, R.H.T. (1970): 'Concepts and Methods in Commodity Flow Analysis', Economic Geography, 46 (2), 404-416.

157. SMITH, A.M. (1980): 'Bert: Alraine's New Nigerian ICD', Containerisation International, 14, 73.

158. SOLOMON, R.J. (1963): 'Four Stages in Port Evolution: The Case of Hobart', Tijdschrift voor Economische en Sociale Geografie, 54, 159-169.

159. STANFORD RESEARCH INSTITUTE (1961): The Economic Coordination of Transport Development In Nigeria, Stanford.

160. SUN, N. and BUNAMO, M. (1973): 'Competition for Handling U.S. Foreign Trade Cargoes: The Port of New York's Experience', Economic Geography, 49, 156-162.

161. TAAFFE, E.J. et al (1963): 'Transport Expansion in Under-developed Countries: A Comparative Analysis', Geographical Review, 53, 503-529.

162. TAKEL, R.E (1976): 'Principles of Port Planning', in Manual on Port Management, Part Two: Port Planning, Geneva.

163. TANNER, M.F. and WILLIAMS, A.F. (1967): 'Port Development and National Planning Strategy: The Implications of the Portbury Decision', Journal of Transport Economic and Policy, 315-324

164. TAYLOR, Z. (1984): 'Seaport Development and the Role of the State: The Case of Poland', in B.S HOYLE and D. HILLING (eds) Seaport Systems and Spatial Change, John Wiley and Sons, Chichester.

165. UNCTAD (1969): Improvement of Port Operations and Connected Facilities. Preliminary Report by the UNCTAD Secretariat, Part I, TD/B/C.4/42, Geneva.

166. UNCTAD (1976): Technological Change in Shipping and Its Effect on Ports, TB/C/C.4/129, Geneva.

167. VERHOEFF, J.M. (1981): 'Seaport Competition: Some Fundamental and Political Aspects', Maritime Policy and Management, 8 (1), 49-60.

168. VLEUGELS, R.L.M. (1973): 'Port Economy in the European Economic Community', Chartered Institute of Transport Journal, March 1973, 108-115.

169. WARD, M.W. (1966): 'Major Port Hinterlands in Malaya' Tijdschrift voor Economicshe en Sociale Geografie, 57, 242-250.

170. WEAVER, J.C. (1954): 'Crop-combination Regions in the Middle West', Geographical Review, 44, 175-200.

171. WEIGEND, G.G. (1956): 'The Problem of Hinterland and Foreland as Illustrated by the Port of Hamburg', Economic Geography, 32, 1-16.

172. WEIGEND, G.G (1958): 'Some Elements in the Study of Port Geography', Geographical Review, 48, 192-193.

173. de WEILLE, J. and RAY, A. (1974): 'The Optimum Port Capacity', Journal of Transport Economics and Policy, 8, 244-259.

174. WHITE, H.P. (1963): 'The Movement of Export Crops in Nigeria', Tijdschrift voor Economische en Sociale Geografie. November 1963, 248-253.

175. WHITE, H.P. and SENIOR, M.L. (1983): Transport Geography, Longman, London and New York.

176. WHITE, I.R.P. (1972): 'The Use of Waiting Line Theory in Planning Expansion of Port Facilities', The Dock and Harbour Authority, 50, 423-427.

177. WILLINGALE, M.C. (1981): 'The Port-routeing Behaviour of Short-sea Ship Operators; Theory and Practice', Maritime Policy and Management, 8 (2), 109-120.

178. WILLINGALE, M.C. (1984): 'Ship-operator Port-routeing Behaviour and the Development Process', in B.S. HOYLE and D. HILLING (eds) Seaport Systems and Spatial Change, John Wiley and Sons, Chichester.

179. WILLIS, H.D. and WHITE, I.R.P. (1969): 'The Application of Statistical Methods of Port Planning at Port Kembla', The Journal of the Institute of Engineers, Australia, Oct-Nov 1969, 175-180.

180. WILMES, P. and FRANKEL, E. (1973): 'Port Analysis and Planning', Proceedings of the International Conference on Transportation Research, 186-196.