



Assessing the Freight Transport and Modal Logistics Infrastructure Connectivity in Apapa Seaport

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Abstract

This study focuses on freight transport and modal logistics infrastructure connectivity in Apapa Seaport. The present system of freight movement and distribution from Nigerian seaports is not consistent with the best practices. The delay in cargo clearance from the port to the hinterland is a constraint to logistics schedule of road haulage. Primary data were obtained through the administration of structured questionnaires to clearing agents in Apapa Port and truck drivers that were systematically sampled at the Apapa exit gate. The data gathered were analyzed using descriptive and Anova analysis. The study revealed the availability of major modal logistics infrastructure connectivity that aids onward delivery however some of these logistics infrastructure are obsolete and in poor condition. Furthermore, result using Anova test revealed a statistically significant difference in the mean spatial distribution of cargo. It is therefore recommended that, there is need for a modal shift from road to rail or inland waterways for onward delivery of cargo to different inland container depots (ICDs) in the hinterland to promote sustainable transport system in Nigeria. And also an effective model for integrating different modes of transport in the Port for onward delivery.

Keywords: Freight, Logistics, Infrastructure, Connectivity, Port, Hinterland.

1. Introduction

The rapid growth of e-commerce demand fast response deliveries. Businesses have sought to sustain sophisticated short-cycle and manufacturing processes to meet customer requirements directly. Logistics infrastructure thereby conditions the effective performance of the logistics processes. The logistics infrastructure as a set of various facilities, equipment and technical devices facilitate the completion of the logistics processes in the logistics micro and macro-systems (Grzelakowski, 2014). Modal connectivity in seaport integrate or interconnect different modes of transportation; air, sea, land and pipeline for effective and efficient movement of cargoes through logistics facilities. Logistics facilities thereby tend to facilitate the movement of cargo as and when they are needed and desired



by the consignees. This helps in economic transactions, serving as a major enabler of growth of trade and commerce in an economy. The ports infrastructure connectivity which link an economy to the global markets contributes to economic development through decrease in shipping time, decrease in transport cost and employment creation (Ahmodu *et. al*, 2021). Due to economic transformation, cargoes need to be shipped from point of origin to point of destination at a minimal cost and time through modal connectivity for efficient and effective services. Economic transformation and development of any country are hardly possible without an efficient transport system (Salim, 2003; Lingaitiene, 2006).

Apapa Port is characterized with an intermodal connectivity that aid movement of cargo to different locations in Nigeria. The development of rail system and interconnection of it along some selected major cities of Nigeria to the major seaport is seen as a means to improve movement and delivery of goods across the Nation which can enhance the operational functionality of the Port through intermodal connectivity (Ndikom, 2004). The non-operation of the rail system in Nigeria seaports over several decades has result to the use of road network as the first leg journey for conveyance/evacuation of cargo from the Port to the hinterland through articulated trucks that has increased congestion and high rate of accidents on our roads. It is quite discouraging that the rail tracks laid at Apapa port linking cities are not effectively use which has compounded the problems of congestion along these route/corridors (Ndikom, 2011). The effective utilization of different mode of access in the Port will increase productivity, reduce congestion and promote modal shift. Modern transport and freight distribution system globally are adopting the best practices of multimodal transport that are reliable, timely, safe, and cost-effective.

The integration of sea, rail, road and pipeline transport is to control the entire chain of cargo distribution in an efficient, cost-effective and timely manner (Ubogu, 2011). Freight transportation has become a major element in an economy which need to adapt to the rapid change of economic trends. Modal logistics infrastructure thereby making all facilities of multimodal freight transportation process to be reliable in offering connectivity with other modes and have the flexibility to make adjustment to changes when alternative business opportunities are developed while the freight is still on transit. Intermodal transport and logistics are the key factors in the development of economic growth, spatial connectivity and market integration (Zecevic, 2012).

The modal logistics infrastructure connectivity in Apapa Port is not highly restructured which has led the present system of moving cargoes to be a major challenge. Integrating rail-road in the port for distribution of freight to the hinterland would impact positive efficient transport system/services, hence, encourage the incorporation of multimodal transport system (Ubogu, 2011). The delay in the time taken for onward delivery of cargo from Apapa Port to hinterlands has also been a constraint to logistics schedule. The weight of high volume of cargo evacuated by trucks plying the access road linking the Apapa-Ijora and Apapa-Mile2 via Ibadan road has led to deterioration of the road access creating potholes, ditches, which often causes truck accident/crash on the road resulting to some



cargo not reaching the consignees destinations. Many studies have been conducted on freight transport and modal logistics. A review of the studies of Daramola (2022), Etu (2017), Odeleye (2015), Adetunji and Atomode (2014), Somuyiwa (2010), Ubogu (2011), and Ojekunle (2004), revealed a focus on freight movement on specific corridors. This paper therefore analyze the spatial flow of cargo from Apapa Port to six geo-political zones in Nigeria by truck and also assess the logistics infrastructures in Apapa Port.

2. Literature Review

The Ullman's theory of Spatial Interaction was postulated by Ullman in 1956. This theory explains the reason for the basis of movement between places within a geographical space within the framework of distribution. The concept of complementarity under Ullman's theory explains the fact that for two spatially separated regions to interact there must be demand in one area and supply in the other area. This implies geographically that, there must be spatial interaction between regions. Therefore, there must be an exchange interaction between these regions thereby leading to what is called regional integration. This complementarity of supply and demand brings about movement and spatial interaction between one point of production and another point of consumption. Ullman's theory of spatial interaction explains that regions cannot be independent on their own, which is why there is need for interaction to exist. This model therefore helps to explain the movement of cargo from origin (i.e the seaport) to destination (i.e hinterland).

Recent studies on freight transport in Nigeria include Daramola (2022), Odeleye (2015), Adetunji and Atomode (2014), Ubogu (2011) and Ojekunle (2004). The study of Daramola (2022) in examining the implication of Nigeria's lopsided land transport structure for performance and efficiency in the freight transport sector, found that freight shippers will not explore modal comparative advantages such as capacity and lower freight rates except such advantages are complemented with competitiveness conferred by technology especially speed. The author recommends an upgrade in the existing rail tracks in a way that fast speed are assured. In the study of Odeleye (2015), it is revealed that a challenge exists with respect to integrated transport infrastructure in Nigeria, hence there are constraints to realizing seamless freight and passenger transport services. The author recommends public-private-partnerships (PPPs) to achieve a sustainable integrated transport infrastructure system. Adetunji and Atomode (2014) assess the urban freight movement for effective transport planning. It was revealed that the pattern of freight movement is dominated in such a way that the bulk of the freight (70.8%) originates from and (60%) terminates outside the metropolis. Hence, the need for appropriate measures to be incorporate into the urban transport planning for freight transport. The authors recommends that the revitalization and construction of light rail system are important to facilitate the movement of freight in the country at large. Ubogu (2011) in another study on the potentials of rail-road integration for port-hinterland freight transport. The purpose was to conduct an aerial coverage of truck haulage in Nigeria. Using descriptive analysis (percentage distribution) to analyze data obtained from 302 truck drivers at the seaport terminal. The main outcome showed 45.7% of their operations terminates within the port



cities and States close to the seaports that are mostly the industrialized areas of Nigeria. He further stated that populated industrial and commercial towns, excluding the port towns, are hinterland freight hubs that receives substantial quantity of maritime goods. The geographical location of industries and commercial centers across Nigeria influences the distribution of freight spatially. Similarly, Ojekunle (2004) carried out a study on urban freight transport. The purpose was to review urban freight flow in Nigeria. The study revealed that markets and industrial zones are the major freight generating and attracting points acting as the threshold of demand.

Freight transport is essential in most economic and social activity. Therefore, organizations rely on movement of goods ranging from large movement of bulk commodities to package delivery to maintain commerce (Somuyiwa, 2010). The demand for freight transportation results from the producers and consumers that are geographically apart. Considering the global trade, the unimodal road transport is no longer the feasible solution. This, thereby, necessitate other modes of transport (and their combinations) for the transportation of freight. The market share of freight transportation has witnessed several trends. In many countries including Nigeria, new markets are rising as the customer base is growing. In view of this, Ghiani, Laporte, and Musmanno, (2013) ascertained that effective and efficient transportation is necessarily required, as the share of transportation cost is significant in the supply chain. The goal of intermodal transport in movement of goods is to achieve economic efficiency. According to Somuyiwa and Dosunmu (2008), efficient logistics infrastructure is pertinent in reducing port congestion which will promote intermodality and optimize customer's service deliveries through effective supply chain. This allows customer to gain a competitive advantage over a competitor. Logistics management is customer driven, requires reduction in cycle time of parts and services and develops partnership with other companies that complement or supplement companies existing capabilities. Implementing logistics management requires suppliers and customers to work together in defining the strategic direction when dealing with certain markets. Customers expect consistent quality of products and services worldwide. Transport tends to be the main component of logistics service and its share in overall logistics cost has actually been increasing in recent years. The growth of containerized transport together with technological developments in improving the systems for transferring cargo between modes has considerably affected modern transport patterns and practices. In the recent practice, shippers and consignees often prefer to deal with one party who arranges for the transportation of cargoes from door to door and assumes responsibility throughout, irrespective of whether this is the party that actually carries out the different stages of the transport (Somuyiwa & Dosunmu, 2008).

3. Methodology

This study adopts descriptive research methods. The primary data were collected through structured questionnaire administered to the 287 clearing agents met in Apapa Port using a census sampling technique. A condon survey was also conducted on truck drivers for in-



transit freight at exit gate of Apapa seaport. A systematic sampling technique of every 5th sample was used to track truck driver for onward delivery. A total of 171 truck drivers were sampled for three days. The data gathered were analysed using descriptive statistical analysis, a network flow map and anova.

4. Results

The following major modal logistics infrastructures available in Apapa Port include road (truck/trailers) access, rail (wagon) access, waterways (marine) access, terminal facility/quay, warehouses, gantry cranes, straddle carriers, forklifts, vessels, containers, communication facilities and reach stackers. The Port has potentiality of integrating connectivity of modal logistics infrastructures necessary to facilitate the loading/evacuation of cargo from Apapa Port.

Table 1: Effectiveness of mode of transport network linked to Apapa Port

Variables	Frequency	Percent (%)
Road		
<i>Very Effective</i>	118	41.11
<i>Effective</i>	129	44.95
<i>Moderate</i>	40	13.94
<i>Less Effective</i>	-	
<i>Not Effective</i>	-	
Rail		
<i>Very Effective</i>	-	
<i>Effective</i>	-	
<i>Moderate</i>	69	24.04
<i>Less Effective</i>	174	60.63
<i>Not Effective</i>	44	15.33
Inland waterways		
<i>Very Effective</i>	-	
<i>Effective</i>	-	
<i>Moderate</i>	-	
<i>Less Effective</i>	73	25.44
<i>Not Effective</i>	214	74.56
Total	287	100.0

Source: Authors' Field Survey, 2022.

Table 1 thereby revealed the effectiveness of modes of transportation linking Apapa Port. Majority of the respondents constituting 44.95% affirmed that the road network system is effective while 41.11% attested that it is very effective. The railway network system is attested by 60.63% of the respondent to be less effective while 24.04% affirmed to be moderately effective. 74.56% constituting majority of the respondent affirmed that the inland waterway is not effective for evacuation of cargo. This therefore revealed that the



road network system is the most effective mode in Apapa Port. Though, the rail network system is operational but not as effective as the road.

Table 2: Duration it takes to clear a particular cargo

Days	Frequency	Percent (%)
1-7	105	36.5
8-14	78	27.2
15-21	53	18.5
22-28	29	10.1
1 Month and Above	22	7.7
Total	287	100.0

Source: Authors' Field Survey, 2022.

Table 2 shows the analysis of the days it takes to clear a particular cargo. The result revealed that 36.5% of the respondents attested that it takes 1-7 days to clear a particular cargo from the port, 27.2% attested to take 8-14 days, 18.5% indicated that it takes 15-21 days, 10.1% 22-28 days while 7.7% 1 month and above. The result revealed the inefficiency of the Port in cargo clearance under the guidelines of UNCTAD for cargo to be cleared within 48 hours-72 hours as soon as cargo arrive port of call. The delay in clearing of cargo is the indication of the obsolete nature of some major cargo handling facilities and long documentation processes.

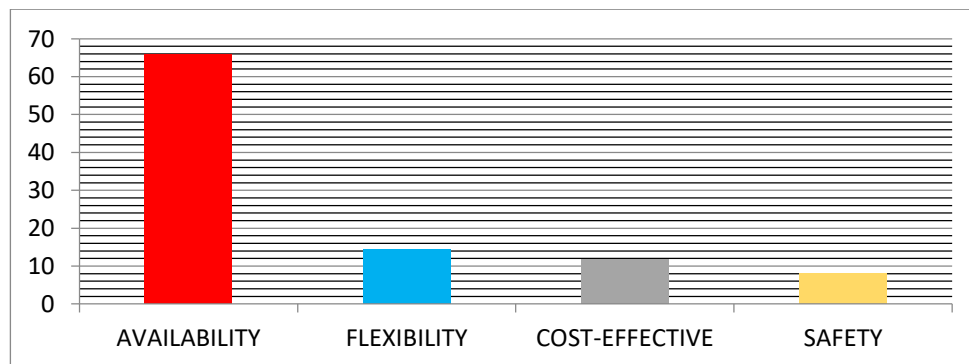


Fig. 1: Factors that determine choice of mode

Fig. 1 above shows the factors that determine choice of mode. 65.9% which represents the majority of the respondents, attested the availability of mode network influence their choice of mode, 14.3% is the flexibility, 11.8% cost effective and 8.0% safety. The result revealed the availability of road transport network system influences the choice of mode for onward delivery by the clearing agents.



Table 3: Origin-Destination survey of truck drivers

Seaport location	Lagos port complex Apapa
Estimated number of trucks exiting the gate per day	1140
5% of the total truck existing the gate per day	57
5% of the three days survey	171

Source: Authors' Field Survey, 2022.

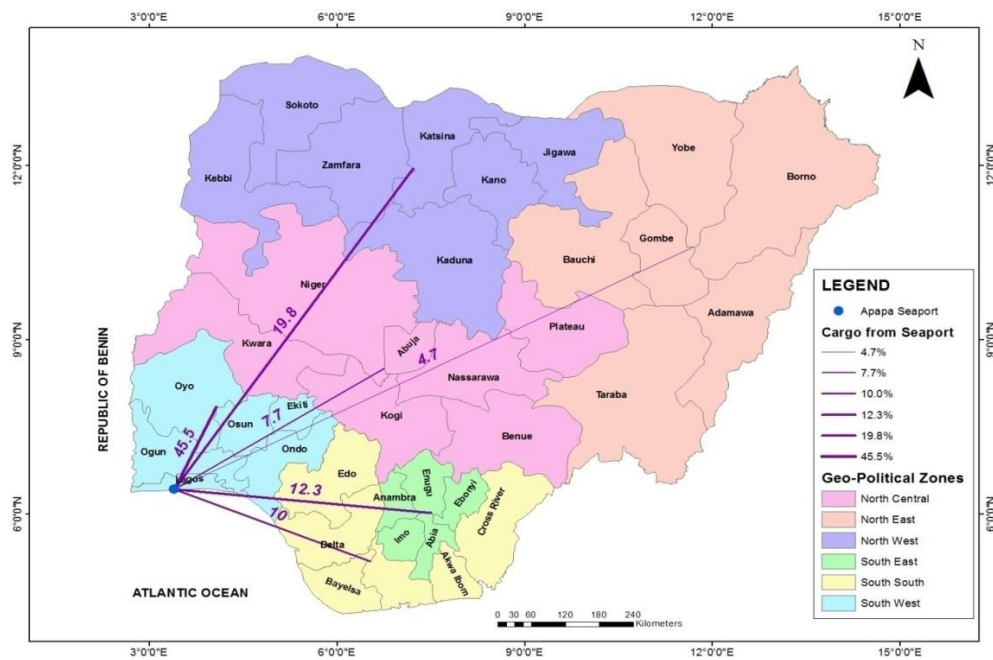


Fig. 2: Flow map showing aerial coverage of spatial distribution of cargo from seaport to hinterland by truck drivers.

Fig. 2 presents the aerial coverage of spatial flow of cargo by the truck drivers from Apapa seaport to the hinterlands. 45.5% of the cargo shipped emerge to be distributed to the South-West, 19.8% shipped to the North-West, 12.3% to the South-East, 10% to the South-South, 7.7% shipped to the North-Central, and 4.7% to the North-East.

Testing of Hypothesis

H₀: There is no significant difference in spatial flow of cargo to different locations (six geo-political zones in Nigeria) from Apapa port.



Table 3: Descriptive Statistics of Spatial Flow of Cargo by Truck Drivers to the Six Geo-Political Zones of Nigeria from Apapa Port

Geo-Political Zones	Number of States per zone	Mean	Standard Dev.
North-Central	6	2.167	1.169
North-East	3	2.667	2.082
North-West	4	8.500	3.873
South-East	4	5.250	4.349
South-South	5	3.400	2.510
South-West	5	15.600	13.221

Source: Authors' Field Survey, 2022.

Tables 3 showed the descriptive statistics of mean spatial flow of cargoes by truck drivers to six geo-political zones of Nigeria from Apapa Port. The result revealed a significant difference in the mean spatial flow of cargo to six geo-political zones in Nigeria with South-West having the highest mean compared to other zones.

Table 4: ANOVA Comparison of Mean Spatial Flow of Cargo from Apapa Port to Six Geo-Political Zones in Nigeria by Truck Drivers

Source of variation	Sum of Squares	Df	Mean Square	F _{cal}	F _{crit}	Significant level (p)
Between Groups	640.35	5	128.07	3.195*	2.68	0.027
Within Groups	841.65	21	40.08			
Total	1482.00	26				

*-Significant at 0.05 level of significance

Source: Authors' Field Survey, 2022.

Table 4 illustrates the ANOVA comparison of mean spatial flow of cargoes by truck drivers to six geo-political zones of Nigeria from Apapa Port. The result revealed a significant difference in the mean spatial flow of cargoes by truck drivers to the six geo-political zones of Nigeria from Apapa Port at 0.05 level of significance. Since the ($F_{cal} = 3.195 > F_{crit} = 2.68$; $df = 5, 21$; $p < 0.05$), the H_0 is rejected. Hence there was significant difference in the spatial distribution of cargoes to the six geo-political zones in Nigeria from Apapa port.

Since, the ANOVA statistics indicates there was significant difference in the mean spatial flow of cargo by truck drivers to the six geo-political zones of Nigeria from Apapa port, there is need to identify where the difference are, hence the need to carry out Duncan Post Hoc tests.

Table 5 showed a statistically significant difference in the mean spatial flow of cargoes between South-West (15.600) and North-Central (2.167), North-East (2.667), South-South (3.400) & South-East (5.250). However, there is no statistically significant difference in the mean spatial flow of the cargoes between South-West (15.600) and North-West (8.500).



Table 5: Presents the result of the Dungan Post Hoc tests.

Geo-Political Zone	Number of States	Significant level = 0.05	
		A	B
North-Central	6	2.167	
North-East	3	2.667	
South-South	5	3.400	
South-East	4	5.250	
North-West	4	8.500	8.500
South-West	5		15.600
Sig.		0.202	0.116

Source: Authors' Field Survey, 2022.

Discussion

The origin-destination survey showed the aerial coverage of spatial flow of cargo by the truck drivers from Apapa seaport to the hinterlands. The result revealed 45.5% of the maritime cargo shipped emerge to be distributed and terminated at the seaport state (Lagos State) and the surrounding states (Ogun, Ondo, Osun, and Oyo) located in the South-West zone, 19.8% shipped to the North-West zone, 12.3% to the South-East zone, 10% to the South-South zone, 7.7% shipped to the North-Central zone, and 4.7% to the North-East zone. It was further observed that states dominated with industrial and commercial centers are the most locations (hinterland freight hubs) maritime goods are substantially freight to from Apapa Port. The flow of cargo to industrial and commercial centers has geographically increase the reach of Apapa port. This is akin to the studies of Ojekunle, 2004; and Ubogu, 2011 that freight flow terminates in industrial and commercial zones in Nigeria which are known to be the generating and attracting nodes acting as a threshold of demand. The ANOVA test result showed descriptive statistics comparison of mean spatial flow of cargoes by truck drivers to six geo-political zones of Nigeria from Apapa Port. The result revealed a significant difference in the mean spatial flow of cargoes by truck drivers to the six geo-political zones of Nigeria from Apapa Port at 0.05 level of significance as ($F_{cal} = 3.195 > F_{crit} = 2.68$; $df = 5, 21$; $p < 0.05$). The Duncan Post Hoc tests result further identified where the difference are. There is statistically significant difference in the mean spatial flow of cargoes between South-West (15.600) and North-Central (2.167), North-East (2.667), South-South (3.400) & South-East (5.250) in favour of South-West zone. However, no statistically significant difference in the mean spatial flow of the cargoes between South-West (15.600) and North-West (8.500).

5. Conclusion and Recommendations

Modal logistics infrastructures needed in a Port to facilitates the loading/evacuation of cargo from Apapa Port. The logistics infrastructures aids in facilitating the loading and evacuation of cargo in the Port. However, the road network system is the most effective modes of transportation linking Apapa Port. It availability majorly influence the choice of mode for onward delivery by the clearing agents. Zones dominated with industrial and commercial centers tends to influence freight demand. From the findings, the South-West



and North-West zones receives more of the spatially flow of maritime goods. These zones therefore are dominated with industrial and commercial centers where economic activities take place thereby generating and attracting substantial quantity of maritime goods shipped from Apapa seaport. The geographical demand in one area and supply in another leads to a greater exchange of regional interaction.

Modern logistics infrastructures should be adequately provided for each terminal of the Port to meet the demand of high volume of cargo handled at the Port in other to reduce the time for cargo clearance. Documentation processes should be more automated or computerize at each terminal in Apapa Port to reduce waiting time for onward delivery. There is need for a modal shift from road to rail or inland waterways for onward delivery of cargo to different inland container depots (ICDs) in the hinterland to promote sustainable transport system in Nigeria. Hence, this will reduce the volume of trucks plying the road network. Furthermore, the railway transport system should be improved adequately and highly encouraged for onward delivery in order to reduce port congestion, cost and accidents on the road.

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