Evaluating the Impact of Barging Activity on Road Decongestion in Apapa Lagos (Nigeria): A Case Study of AP Moller Terminal Ltd

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Introduction

The transportation of goods to and from a seaport, known as hinterland transportation, has become a crucial factor in improving the competitiveness of the port. This type of transportation allows shippers to easily access the port, which has led to better performance in the container market. Inland waterway transportation has been significantly impacted by containerization, which has resulted in the creation of new liner services like the hub and spoke network. The hub ports' connectivity and performance, both domestically and at sea, have increased because to this network (De Langen and Chouly, 2004).

Hinterland transportation has become a crucial component of seaports due to the rise in the volume of containers they handle. This is because shippers are now concentrating on inland operations as a result of the dramatic drop in the cost of deep-sea container transit. The percentage of hinterland transportation has increased due to intermodal transportation, which has also made it more dynamic. By diverting freight from clogged roadways and emphasizing rail or waterway traffic, it has improved port accessibility.

Traffic congestion is a pervasive problem in urban areas, causing significant economic losses, environmental pollution, and reduced quality of life for residents. In the quest for sustainable and efficient transportation systems, various alternative modes of transport have been explored to alleviate road congestion. One such alternative is barging, which involves transporting goods via inland waterways, such as rivers and canals. The purpose of this dissertation is to analyze the potential of barging as a workable solution to urban transportation issues and to look at how it affects road decongestion.

Persistent traffic slowdowns in a port city are likely indications that the available transport infrastructure for port-hinterland communication is overstretched. However, instead of a holistic urban infrastructure renewal to meet the astronomical rise in road and land usage, the government’s remedial measures proved to be merely short-term palliatives, leaving the problem intrinsically unsolved. Using a combination of primary and secondary sources, the study traces the development, neglect and subsequent deterioration of the intermodal transport system for maritime trade in Nigeria, especially its failure to cope with the increased road traffic at Apapa bottlenecks since the new millennium (Chilaka, 2019)

Traditional road-based transportation systems have struggled to cope with the growing demand for freight movement, resulting in bottlenecks and traffic congestion. Inland waterways provide an underutilized mode of transport that offers an alternative route for the movement of goods. Barging, the process of transporting cargo via rivers, canals, and other water bodies, presents an opportunity to divert freight from congested roads, thereby relieving pressure on urban road networks and improving their efficiency in terms of traffic flow.

Over the years, traditional road-based transportation systems have struggled to keep up with the ever-increasing demand for goods movement, leading to congestion hotspots and a plethora of associated issues. In contrast, inland waterways offer a comparatively underutilized mode of transport that can provide an alternative route for freight transportation. By diverting cargo from congested roads to waterways, barging has the potential to relieve pressure on urban road networks, enhancing their capacity and reducing traffic congestion.

Barge planning is a complex process due to the uncertainty of container arrivals and changing dynamics. The barge operator has to make decisions about which terminals to call at and which containers to load/unload well in advance. However, new information such as new orders, cancellations, and delays becomes available during this time gap, which makes decision-making challenging. As a result, the operator has limited information at the moment of decision-making (Pillac et al., 2013).

Uncertainty in container arrivals and new transport orders can disrupt operational plans for barge transport. Even if the origin-destination terminals and estimated arrival-due times are known, plans can still be affected. The dynamism and uncertainty of the situation can lead to a decrease in operational efficiency, which in turn affects the competitiveness of barge transport.

Modernizing the Sector

Over the last few years, the Nigerian government has been working towards revitalizing and modernizing the water transport sector. The (NIWA)National Inland Waterways Authority has taken several initiatives to improve the infrastructure including dredging water channels, constructing terminals, and upgrading vessels. The government has encouraged public-private partnerships to attract investment and enhance the efficiency of barging operations. Even now, barging is still a crucial part of Nigeria's transportation infrastructure. Particularly in areas with poor access to roads, the nation's vast network of inland waterways facilitates the movement of people and products. Barging is particularly advantageous for transporting bulk commodities such as petroleum products, agricultural produce, and construction materials. However, challenges remain in fully harnessing the potential of barging in Nigeria. These challenges include inadequate infrastructure, such as dredging and maintenance of water channels, limited access to financing for vessel acquisition and modernization, and coordination issues between government agencies and stakeholders.

Motivations of the Study

The topic "Evaluation of the Impact of Barging Activity on Road Decongestion" was motivated by the pressing issue of traffic congestion in urban areas, particularly in Apapa, Nigeria. Apapa is known for its heavy port-related traffic, leading to severe road congestion, prolonged travel times, and a host of economic and environmental challenges. As the situation worsens, finding effective solutions becomes crucial to ensure sustainable urban development and improve residents' overall quality of life. Apapa's traffic congestion issue is complex and has wide-ranging effects on both the local economy and the country. The goals of this investigation are intended to tackle many facets of the issue. Firstly, it will specifically assess the effectiveness of barging activities in reducing road congestion in Apapa. It will explore whether barging has lived up to its potential as an alternative transportation mode to ease the burden on the roads. Also, it will delve into the broader concept of intermodal transport and its contribution to decongestion in Apapa, with a focus on how barging fits into this integrated approach. It will provide insights into the holistic impact of intermodal solutions on the city's traffic situation.

The study attempts to add empirical data on the effect of barging and rail operations on road decongestion to the body of knowledge already in existence. The findings of this research will assist policymakers, transportation planners, importers, exporters and urban designers in making informed decisions regarding the integration of barging activities into the overall transportation framework. By highlighting the benefits and challenges associated with barging, the study seeks to facilitate the adoption of more sustainable and efficient freight transportation systems, ultimately leading to improved urban mobility and reduced environmental impact.

The Study Area

The study focused solely on AP Moller Terminal (APMT) in Apapa, Lagos State, Nigeria. The purpose was to evaluate the impact of barging activity on road decongestion in Apapa, Lagos, Nigeria, and to assess its effectiveness in contributing to the economy of the country. Other terminals within Apapa Port such as Apapa Bulk Terminal Limited (ABTL), Greenview Development Nigeria Ltd (GDNL), ENL Consortium (ENL), and Eko Support Services (ESS) were not captured in the study. It was difficult for the researcher to conduct this research because it was done with the knowledge that several factors seriously hindered the research, including the time frame, the unwillingness of important personnel to provide the information needed for successful research, and the need to strike a balance between the research and regular academic work.

Lagos is the most populated city in Africa, situated in southwest Nigeria. Its population is projected to reach 15.4 million in 2023. Before December 1991, the government of Nigeria planned to relocate the capital from Lagos to Abuja, which is situated in the middle of the country. The Lagos metropolitan region, home to about 11.5 million people as of 2018, is the biggest metropolitan area in Africa. Lagos functions as the economic core of the State and Nigeria in addition to being a significant financial hub in Africa.

The Nigerian Ports Authority (NPA) runs several ports and terminals, with the Lagos Port Complex (LPC) as one of the most significant. The terminals within the Apapa Port include ABTL, ENL, GDNL, and ESS. The area known as Apapa is situated close to the Lagos lagoon's outlet. It consists of homes, offices, and a closed railroad station in addition to ports and terminals that handle a variety of commodities, including bulk freight and containers. The NPA owned and operated the container terminal in the port until March 2005 when APMT (from the Danish firm A. P. Moller-Maersk Group) took over management of the facility (See Figure 1).

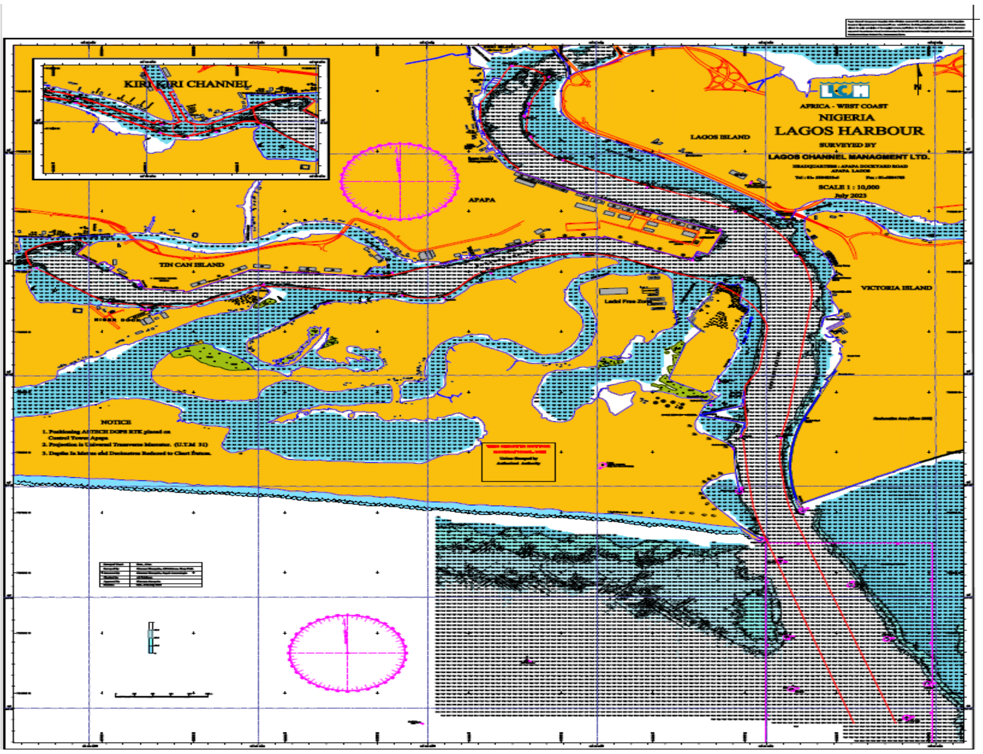


Figure 1: Showing the Lagos channel (Apapa and Tin Can Island Ports)

Plate 1. A barge

Literature Review

Inter-port competition has emerged because of recent developments in the rivalry between several transportation chains (Li et al. 2017). Ports need to strategically plan and optimize container barging handling to boost hinterland connectivity. This can enhance hinterland services and port performance, increasing their appeal to stakeholders and shippers who might desire to switch to inland transportation (Van der Horst and De Langen 2015; Konings et al. 2013; Song and Panayides 2012). To do this, though, more coordination and cooperation are needed from several parties, such as port authorities, maritime carriers, terminal operators, and barge operators. For example, the ports of Antwerp and Rotterdam are the largest consumers of barges in Western Europe, with container barging stretching between Hamburg and Le

Havre. Konings (2007) divides the container barging that occurs in these ports into three groups. The first category focuses on local trade and goods transit in the area. This kind of container trading entails making many trips to various seaport ports while only visiting one hinterland terminal, allowing the barges to make multiple calls at the terminals.

According to Konings (2007), the call size of the barges is typically less than 6 TEUs, and they frequently have to wait a long time at the port because of the wait times at each deep-sea terminal as well as the movement of the barges between the various terminals before ultimately departing the port. Furthermore, Konings (2007) found that an inland barge carrying 150 TEU could load and unload at various terminals for just one-third of its total port time, with the remaining two-thirds being used for waiting and sailing between the terminals. Three types of container trade flow between Antwerp and Rotterdam were recognized by Konings (2007). The movement of containers between the two ports by big ships makes up the second group. The ships transport containers in various regions and make calls at various terminals. Containers are moved around the ports to see various terminals. The movement from deep sea ports in Rotterdam and Antwerp to the Rhine regions, including Germany and Switzerland, is the subject of the third category. Containers in this category are transported by inland barges that hold more than 150 TEUs. Additionally, they make calls to various inland and maritime terminals. The three categories emphasize that different terminals must be called by inland barges transporting cargo.

The barges' weekly departures are reduced and their cost per TEU rises as a result of the length of time they spend waiting and sailing to various destinations. This is due to the fact that waiting and sailing take up more time than actually loading or unloading the containers. The loss of time at the port lowers economies of scale, raising the barges' overall transit costs. Shippers are then compelled to employ other means of transportation, making barge transportation less competitive. The tiny call size of the barges also has a negative impact on deep sea terminals. Due to their reduced operational efficiency and decreased productivity as a result of the tiny call size, they are forced to handle the barges with large cranes designed originally for sea boats. This is a really ineffective method of doing things (Visser et al. 2007).

Inadequate planning of marine vessel and cargo barge operations has resulted from terminal coordination problems. Concerns have been voiced by barge operators regarding the length of time spent visiting various port terminals and the treatment they have received there. Long wait times and ineffective operation planning have resulted in lost time and diminished economies of scale, raising overall transportation costs and making barge transportation less competitive.

Development of Barge Transportation in Nigeria

The use of barge in Nigeria started with movement of crude oil in the oil-rich Niger Delta region of Nigeria by cash-strapped domestic oil companies. It was a new and riskier way to move crude oil extracted from their onshore fields, after militant attacks over the past years rendered crucial Forcados pipeline and export terminal unusable. These barges were used to move tens of thousands of barrels at a time directly from wellheads to alternative terminals such as Chevron owned Escravos. Though volumes that can be transported by barge are low, and loading is twice as long. It is also more costly but it kept the players running by ensuring that they meet their commitment to their buyers abroad. Most barges carry heavy or bulky items that would be hard to move any other way. Some items you may find on barges include coal, grain, oil, chemicals, and trash. They also haul recyclable materials, sand, gravel, timber, iron ore, and other minerals. A river barge can carry about 10,000 to 30,000 barrels of crude oil.

Economic Viability and Environmental Implication

It is crucial to evaluate the economic feasibility of barging activities. Numerous studies have examined the cost-effectiveness of barging in comparison to other transportation modes, considering factors such as fuel consumption, labour expenses, infrastructure investments, and externalities. While initial investments in waterway infrastructure may be necessary, long-term cost savings and economic advantages can be achieved through enhanced efficiency and reduced road maintenance expenses. Studies have shown that barging can have a positive impact on the environment. This is due to the fact that barges have lower carbon emissions and consume less energy, which supports sustainable transportation practices. Furthermore, by reducing the need for road transport, barging can help alleviate the environmental effects of congested roads, such as air and noise pollution.

Methodology

The AP Moller Terminal, its customers, and any parties with an interest in any of the Apapa ports make up the research population. The study focused on containers that were moved by barge between 2020 and 2022 to different locations in Lagos, as well as containers moved by rail. These containers include those from all shipping lines that utilize the APM Terminal, such as import direct delivery (customs cleared and ready for customer delivery), import boxes for stemming, export containers, as well as dry or reefer containers that are either empty or loaded.

The samples size for the research was strictly AP Moller terminals, as other terminals within the Apapa port complex (GDNL, ABTL, ESS, ENL) were not considered. Data for the research was gathered with the help of assistants from the AP Moller Terminals, for research purposes and the data set includes information from 2020 through 2022 for barge, and 2021 to August 2023. Both descriptive and inferential statistical approaches were used in the research project. For data analysis in this study, multiple regressions and simple percentages were the most appropriate tools. These were employed to ascertain the percentage of containers that were conveyed via barge.

Findings

Import-laden Containers moved by Barge

According to the data received from APMT for the period under review (2020-2022), the total number of import containers moved by barge is shown below.

Table 1: Volume of import containers moved by barge 2020-2022, APM Terminals

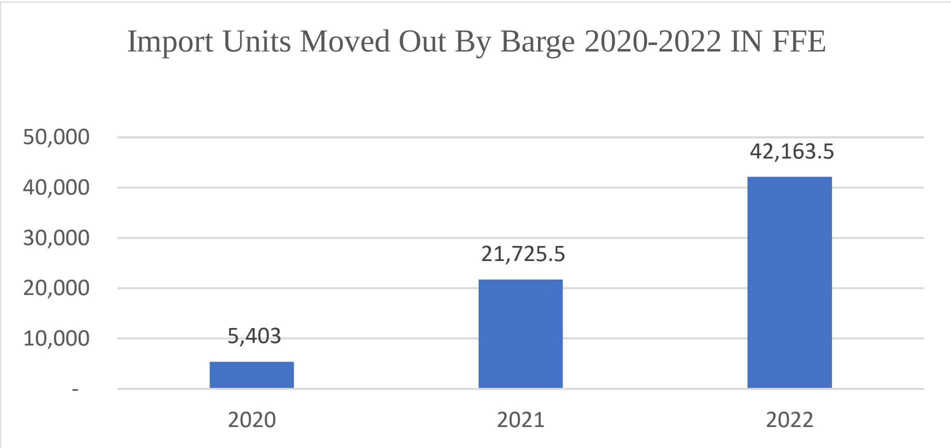
Imported Full Containers Out - Barge				
Year	20ft	40ft	TEU	FFE
2020	2,228	4,289	10,806	5,403
2021	8,635	17,410	43,455	21,725.5
2022	14,637	34,845	84,327	42,163.5
		Total	138,588.0	69,292

Source: APMT

A total of 2,228 twenty-foot import containers and 4289 forty-foot containers were moved by barge out of APMT in 2020. This gives a 5,403 FFE for the period, equivalent to the number of trucks taken out of the road. In 2021, 8,635 twenty-foot import containers were moved out of the terminal by barge, while 17,410 forty-foot containers were moved in in the same period, with an FFE value of 21,725.5. This indicates that a total of 21,725 40ft trucks that could have moved import boxes out of the terminal were taken off the road as a result of barging. This represents a 402% jump in the volume of import containers barged out of APMT in YoY.

Also, 14,637 twenty-foot import containers and 34,845 forty-foot import laden units were transported out of the terminal by barge in 2022. These numbers translate to 42,163.5 FFE, which means the number of trucks taken off the road for 2022. Year-on-year volume in 2022 vs 2021 increased by 197%. Overall, 69,292 forty-foot trucks were taken off Apapa road between 2020-2023 due to barging activity of import containers only.

Figure 2. Export Units moved by Barge 2020-2022, APM Terminals



Source: APMT

EXPORT CONTAINERS MOVED BY BARGE

The table below shows the number of export containers gated into the terminal via barge between 2020 and 2023.

Table 2: Volume of export containers moved into the terminal by barge 2020-2022

Export Containers In – By Barge				
Year	20ft	40ft	TEU	FFE
2020	2,763	853	4,469	2,234.5
2021	6,146	4,363	14,872	7,436
2022	6591	4,154	14,899	7,449.5
		Total	34,240	17,120

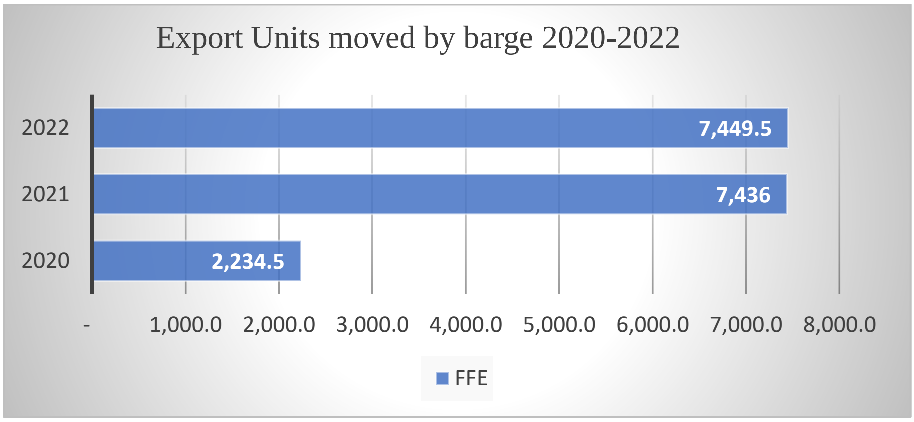
Source: APMT

A total of 2,763 twenty-foot export containers and 853 forty-foot containers were moved by barge into APMT in 2020. This gives a 2,234.5 FFE for the period, equivalent to the number of trucks taken out of the road.

In 2021, a total of 6146 twenty-foot export containers were moved into the terminal by barge, while 4,363 forty-foot containers were moved in the same period, with an FFE value of 7436. This indicates that a total of 7,436 40ft trucks that could have brought export boxes to the terminal were taken off the road as a result of barging. This represents a 233% jump in the volume of export containers barged into APMT in 2020 compared to 2021.

Also, 6591 twenty-foot export containers were transported into the terminal by barge in 2022 compared to 4154 forty-foot in the same year. These numbers translate to 7449.5 FFE, which means the number of export trucks taken off the road for 2022. Year-on-year volume 2022 vs 2021 increased by 0.2%.

Figure 3: Export unit moved by Barge 2020-2022



Source: APMT

Empty Container Inbound – By Barge

The table below shows the volume of empty containers moved into APMT by barge for the period under review.

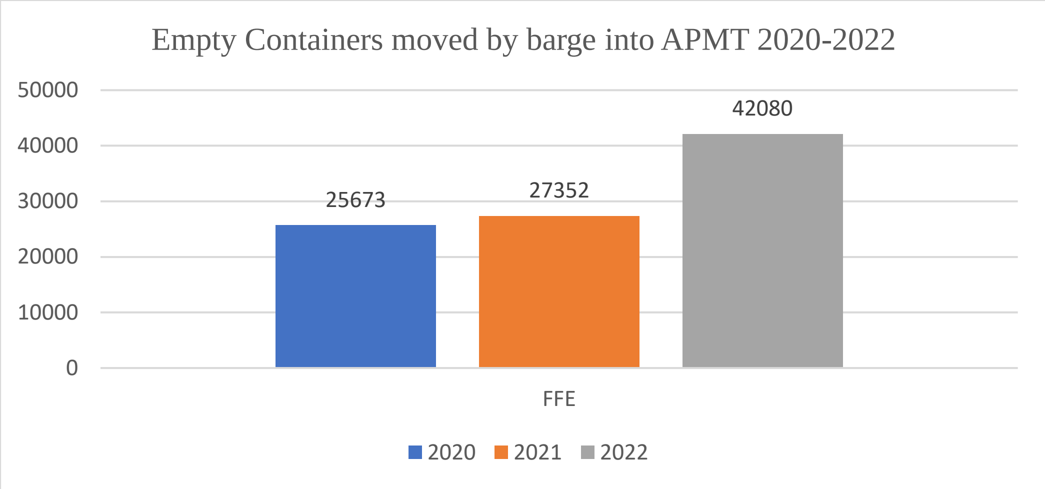
Table 3: Volume of empty containers moved into the port 2020-2022

Empty Containers In- Barge				
Year	20ft	40ft	TEU	FFE
2020	10,842	20252	51,346	25673
2021	7,948	23,378	54,704	27352
2022	22378	30891	84,160	42080
		Total	190,210	95,105

Source: APMT

In 2020, 10,842 twenty-foot empty containers were barged into APMT, while 20,252 forty-foot empty containers were barged into the terminal in the same period, with an FFE value of 25,673. Also, in 2021, there was a drop in twenty-foot empty containers moved to APMT by barge to 7,948 compared to 2020, while the volume of forty-foot containers barged into APMT in the same period was 23,378, with a total FFE value of 27,352. This is a 7% increase, comparing 2021 vs 2020. 2022 recorded a massive jump in the number of twenty- and forty-foot empty containers moved into APMT to 22,378 and 30,891 respectively, with a FFE value of 42,080. The volume of containers moved up by 54% in 2022 compared to 2021.

Figure 4: Empty containers moved by Barges into APMT 2020-2022



It can be concluded that a total of 33,310.5 FFE containers (Import gate out, export gate in, and empty gate in) were moved by barge in 2020, which translates to the number of trucks taken out of the road for that year. This number went up by 70% in 2021, to 56,513.5 FFE. The total number of containers moved by barge to and from APMT in 2022 grew by 62% to 91,693 FFE when compared with 2021. This implies that 91, 693 40ft trucks were taken out of the road for the year 2022.

Import-Laden Containers moved by Rail

According to the data gathered from APMT for the period under review (2021-2023), the total number of import containers moved by rail (Outbound) is shown in Table 4.

Table 4: Volume of import containers moved out of port by rail 2021-2022

Import Full Containers Out – By Rail				
Year	20ft	40ft	TEU	FFE
2021	227	272	771	386
2022	470	297	1,064	532.0
2023	433	152	737	366.5
		Total	2,572.0	1,284

In 2021, the volume of 20ft import containers moved out of the terminal by rail was 227, while 272 40ft containers were moved out for the same period, with a total FFE value of 386. This represents the potential number of 40ft trucks taken off the road through movement by rail in that year. In 2022, a total of 470 imported twenty-foot containers were moved out of the terminal by rail, while 297 forty-foot containers were moved out of the port by rail. This represents 532 FFE, which translates to the number of trucks taken off the road for 2022 through rail movement. Also, in 2023 Year-to-Date (YTD) September, 433 imported twenty-foot containers and 152 forty-foot containers were evacuated by rail. This gives an FFE value of 366.5. This means that 366 40ft trucks and one 20ft truck were taken off Apapa roads due to movement by rail.

Comparing Year-on-Year (YoY) 2021 vs 2022, there was a 38% increase in the number of containers moved by rail out of the study terminal. Considering that we have 3 months to the end of the year, it can be estimated that the figure for 2023 will surpass 2022, as we have recorded 366.5 FFE moved by rail YTD September.

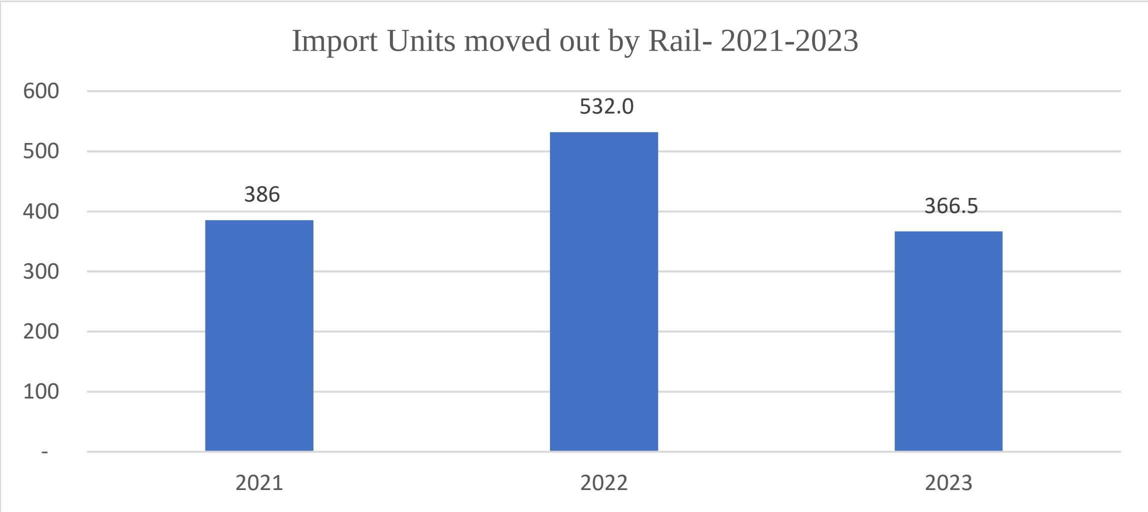


Figure 5: Import units moved by rail 2021- YTD August 2023

Export Containers moved by Rail

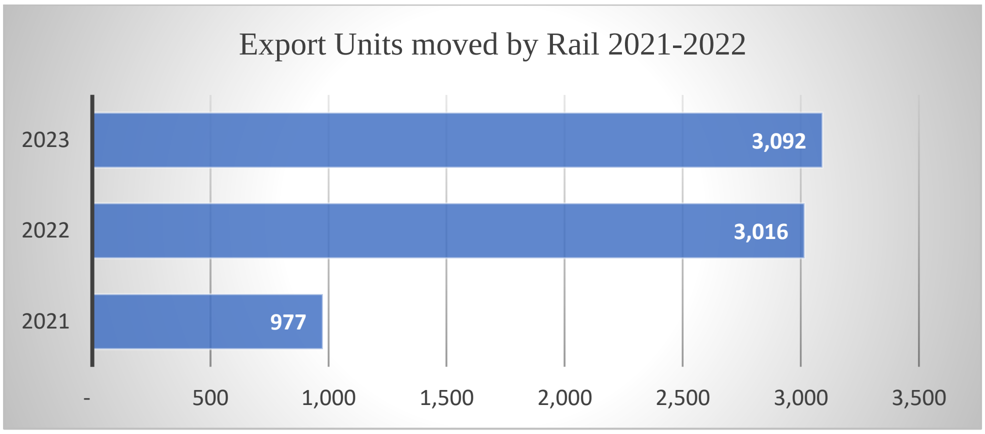
From the data received on export containers transported into the terminal by rail (Inbound), Table 5 can be extracted.

Table 5: Volume of export containers brought into the terminal by rail 2021-YTD 2022

Export Containers moved in – by Rail				
Year	20ft	40ft	TEU	FFE
2021	1,301	326	1,953	977
2022	3,779	1,126	6,031	3,016
2023	2,777	1,703	6,183	3,092
		Total	14,167.0	7,084

A total of 1,301 twenty-foot export containers were moved into the terminal by rail in 2021, while 326 forty-foot containers were moved by rail to the port, with a total FFE value of 977. In 2022, there was a massive jump in the number of containers moved by rail. 3,779 twenty-foot export containers were moved by rail, while 1,126 forty-foot containers were moved by the same mode of transport in the same period. This gives 3016 FFE. This represents a 209% jump when comparing YoY 2021 vs 2022. YTD August 2023, a total of 2,777 twenty-foot export containers entered the terminal, compared to 1,703 forty-foot export containers. This translates to 3,092 FFE. Hence, YoY 2022 vs 2023 stands at 3%. This is expected to rise by the end of the year. This means that a potential 3,092 forty-foot trucks were taken off the road in 2023 due to movement by rail.

Figure 6 Export units moved by rail 2021-YTD August 2023



Source: APMT

Empty Container Inbound – by Rail

According to the data received on empty returns to the terminal via rail (Inbound), the extrapolation in Table 6 can be made.

Table 6: Volume of empty containers returned to the terminal by rail 2021-2023

Empty Containers in – by RAIL				
Year	20ft	40ft	TEU	FFE
2021	16	30	76	38
2022	-	37	74	37
2023	-	-	-	-
		Total	150.0	75

From the table above, it is evident that empty returns to the terminal via rail recorded very low patronage. In 2021, just 16 twenty-foot empty containers were returned to the terminal by rail, while 30 forty-foot units were returned for the same period. This is a paltry 38 FFE

Also in 2022, only 37 40ft empty boxes were returned to the port by rail. YTD for 2023 was zero, as not a single empty container was returned to the port by rail during the study period.

Summary.

The evaluation of the impact of barging activities and other forms of transportation such as rail on road decongestion in Apapa revealed several key findings. Barging, as an alternative transportation mode, has the potential to significantly alleviate road congestion in the Apapa area, which is known for its perennial traffic problems. The study assessed the effectiveness of barging in reducing road congestion, analyzed its environmental and economic implications, and identified key recommendations for optimizing its benefits. Another area that could be more effectively utilized to reduce traffic in the Apapa corridor is rail transport. The number of units moved by rail rose between 2021 and 2023, particularly for delivering imported containers and receiving empty containers. This could help to take trucks off the road and lessen congestion in Apapa.

Key Findings

The practice of barging has a significant effect on reducing road congestion in Apapa. Diverting a substantial portion of cargo transportation from trucks to waterways has led to smoother traffic flow and reduced travel times for commuters. While rail transport of containers has a positive impact, it is not as significant as barging.

Barging activity also helps to reduce air pollution and road wear, promoting sustainability (Jones & Brown, 2021). Barging has the potential to boost economic efficiency by reducing transportation costs for businesses. This can eventually result in lower prices for consumers. Additionally, it can create employment opportunities in the maritime and logistics industries (Clark, 2019). According to a recent study, investments in port and waterway infrastructure are crucial to take full advantage of barging. To ensure the smooth transfer of goods between ships and barges, there is a need for better facilities such as jetties and berthing areas (Davis, 2018).

Recommendations

Infrastructure Development: From the study, investment in efficient waterway infrastructure, including jetties, terminals, and navigational aids, to support increased barging activity is advisable, as well as the development of dry ports to enhance rail movement. Also, clear regulations and guidelines must be established for barging services to ensure safety, security, and environmental sustainability. Public awareness campaigns should be promoted to educate stakeholders about the benefits of barge transportation, encouraging more businesses to shift their transportation methods to waterways. Moreover, improved collaboration among government agencies, private sector stakeholders, and the maritime industry is imperative to facilitate the growth of the barge industry. Furthermore, implementation of a comprehensive monitoring and evaluation system to assess the impact of barging on road congestion, environmental sustainability, and economic development in Apapa.

Conclusion

The evaluation of barging activity's impact on road congestion in Apapa has shown that this mode of transport can be effective in addressing the traffic problems in the area. By diverting cargo transport from congested roads to waterways, barging can contribute to reduced road congestion, environmental benefits, and economic efficiency. Barging is a viable and efficient way to reduce traffic in Apapa. However, to fully realize these benefits, significant investments in infrastructure, regulatory framework development, and public awareness campaigns are required. With collaborative efforts and continuous monitoring, Apapa can leverage barging to enhance its transportation system, improve the quality of life for its residents, and support sustainable economic growth.

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