European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.17, No.8, 2025

Application of sustainable intermodal systems to expedite modal shift and increase the competitiveness of Chattogram Port in Bangladesh

Dr. Razon Chandra Saha*

Postdoctoral Research Fellow, Malaysia University of Science and Technology, Kota Damansara 47810, Petaling Jaya, Selangor, Malaysia.

* E-mail of the corresponding author: razon.chandra@phd.must.edu.my

Abstract

In recent years, the principal seaport of Bangladesh, Chattogram Port, has been handling 3 million TEUs (Twenty-foot Equivalent Units) regularly. Of these, some 70% are destined for or originate in the capital city Dhaka and its adjacent areas. The two main intermodal hubs in the country are Dhaka Rail Inland Container Depot (DICD) and Pangaon Inland Container Terminal (PICT). There is no connection of road intermodal as road-connected dry ports other than Chattogram are not available also, a drayage system is absent in Bangladesh in managing the hinterland or reaching the last mile by applying intermodal freight transportation systems. Due to excessive traffic congestion and nighttime movements allowed in DICD, it faces considerable delays in reaching the last mile. On the other hand, PICT remains underutilized due to various operational challenges and discouraged due to backward logistics and location problems. This research applied qualitative methods to explore the possible obstacles in allowing dry ports in Dhaka and road intermodal, why not alternative mode rail and inland waterways are not popular and not promoted by the government to apply sustainable intermodal systems, and how to avoid traditional trucks and covered vans in inland freight transport and introduce modern trucks and efficient terminals. In the findings, it was seen that Bangladesh relies exclusively on diesel-powered trucks and covered vans to transport containerized cargo from/to Chattogram Port which is not environmentally friendly and reasons for extreme CO2 emissions also affecting the passenger transportation. In addition, inland freight nodes are not developing due to policy problems and the arrangement of cargo security in the inland passage. The research's practical implications will enable Bangladesh to establish dry ports in Dhaka and its adjacent areas, an integrated intermodal system, and expedite modal shift also increase the competitiveness of Chattogram Port in Bangladesh.

Keywords: Chattogram Port, Intermodal Freight Transportation Systems, Backward Logistics, Inland Waterways, Environmentally Friendly, Dry Ports.

DOI: 10.7176/EJBM/17-8-05
Publication date: September 30th 2025

1. Introduction

1.1 Preliminaries

Shipping is a global activity that transcends national boundaries and operates far beyond the limits of seaport areas. It is a critical facilitator of international trade, enabling the movement of goods from the first mile to the last mile of shippers and consignees, regardless of geographical constraints (Rodrigue et al., 2017). This sector plays a pivotal role in global trade, as sea routes account for approximately 90% of international trade volume, reflecting their unmatched efficiency and indispensability for economic growth and connectivity (Goodarzi et al., 2024). In Bangladesh, the Chattogram Port serves as the primary maritime gateway, handling around 3 million TEUs annually, with approximately 70% of this cargo destined for Dhaka and its surrounding regions (Hasan et al., 2021; Wan et al., 2020: Saha, 2023). The significance of this port is undeniable, as it connects the nation's hinterland to international markets, making it a cornerstone of Bangladesh's logistics infrastructure. However, this heavy reliance on road freight transport for inland cargo movement has led to several environmental and operational challenges. Approximately 90% of containers moving along the Dhaka-Chattogram corridor are transported via road, creating congestion, increasing greenhouse gas emissions, and raising transportation costs (Munim & Haralambides, 2018). While road transport offers speed and flexibility, its environmental footprint and inefficiencies are concerning.

Bangladesh has two main intermodal hubs: DICD and PICT are designed to facilitate the movement of goods by combining different transport modes, such as rail, road, and inland waterways, to reduce the reliance on a single mode (Bangladesh Railway, 2020). However, their current utilization remains suboptimal due to infrastructural

and operational limitations. For instance, while rail transport offers the lowest cost per TEU, its share in freight movement has been declining rapidly, accounting for only 5-6% of the Dhaka-Chattogram corridor's freight traffic (Hasan et al., 2021). Similarly, inland water transport (IWT), despite being cost-effective and environmentally friendly, has a minimal share in containerized cargo movement (ESCAP, 2009).

The underutilization of PICT further exacerbates these challenges. This facility, connected to Chattogram Port via inland waterways, has the potential to alleviate road congestion but suffers from operational inefficiencies and locational disadvantages (Hasan et al., 2021; Kotowska, et al., 2018). For example, backward logistics systems and limited connectivity to other modes of transport have hindered its ability to attract significant cargo volumes. Strategic investments in PICT, coupled with improved intermodal connectivity, could unlock its potential and enhance the overall logistics framework of Bangladesh (Bangladesh Ministry of Shipping, 2013).

Environmental considerations are also critical in this context. Traditional road transport, which predominantly relies on diesel-powered vehicles, contributes significantly to air pollution, noise, and greenhouse gas emissions. These externalities have sparked a growing interest in shifting freight from road to more sustainable modes like rail and IWT (Goodarzi et al., 2024). Studies suggest that a modal shift can reduce both transportation costs and transit times, thereby providing a win-win solution for stakeholders and the environment (Munim & Haralambides, 2018). This shift is essential because logistics systems worldwide are evolving to address the challenges posed by global warming and the need for sustainable practices.

1.2. Problem Statement

The logistics and transport infrastructure in Bangladesh face significant challenges, particularly in developing a robust road intermodal system. The absence of road-connected dry ports, apart from Chattogram, hinders the establishment of a seamless intermodal transport network. This limitation restricts efficient cargo movement between transportation modes, a critical element for improving logistics and meeting the growing demand for freight services (Nasir et al., 2019). The drayage system, essential for moving goods between ports and inland locations, is notably absent. This gap leads to inefficiencies, as goods cannot be transported seamlessly to their final destinations. The Dhaka Inland Container Depot (DICD) highlights this issue, where nighttime movement restrictions exacerbate delays in last-mile deliveries. Additionally, traffic congestion along the Dhaka-Chattogram corridor increases costs and reduces supply chain reliability. These challenges collectively hinder Bangladesh's logistics performance (Saha, 2023). Inland Container Terminal PICT remains underutilized despite its potential due to operational inefficiencies, backward logistics systems, and an inconvenient location. This underutilization represents a lost opportunity for strengthening intermodal transport and alleviating pressure on Chattogram Port.

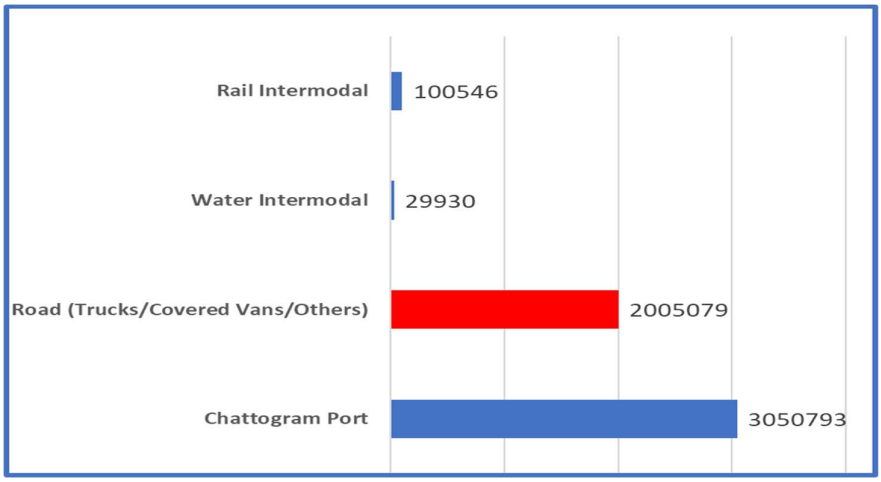

Figure 1. Performance of Chattogram Port in 2023 (CPA, 2024)

Figure 1 illustrates Chattogram Port's performance in 2023, highlighting the pressing need for diversification and infrastructure development to reduce bottlenecks (CPA, 2024). Currently, conventional trucks and covered vans dominate the freight landscape, transporting the majority of imports and exports along the Dhaka-Chattogram main freight corridor. This dependence on traditional road transport increases congestion and environmental concerns while limiting opportunities for innovation. Without road intermodal infrastructure, Bangladesh struggles to transition to sustainable and efficient freight solutions. Figure 1 also reveals the underdeveloped state of intermodal infrastructure, reflecting a disparity between its capacity and actual utilization. This gap stems from the limited integration of alternative transport modes, such as rail connections and drayage systems. These constraints restrict Chattogram Port's potential to operate at optimal efficiency. Furthermore, the reliance on road transport leads to

higher operational costs, increased carbon emissions, and supply chain delays. These inefficiencies highlight the need for intermodal solutions to alleviate pressure on the port and enhance logistics operations (CPA, 2024).

In response, a comprehensive intermodal strategy is critical. Investments in road-connected dry ports, a robust drayage system, and the integration of rail-road intermodal solutions can mitigate these issues. Nasir et al. (2019) emphasize that government-supported strategies for intermodal transport are essential for sustainable freight systems. Developing such solutions aligns with global best practices and can unlock significant economic and environmental benefits for Bangladesh.

1.3. Literature Review

The growing need for container handling necessitates the establishment of these facilities, which offer essential infrastructure support. Businesses will be able to take advantage of transportation choices that are both quicker and more dependable as a result of improved connectivity (Hasan et al., 2021; ESCAP, 2009). This will ensure that they smoothly integrate into the global supply chain. By using intermodal systems, Bangladesh can enhance the movement of cargo and expedite logistics operations, thus contributing to the development of a transportation network that is more environmentally friendly and cost-efficient (Hasan et al., 2021: Kotowska, et al., 2018). The hub-and-spoke strategy facilitates the effective distribution of cargo from central hubs to periphery locations, maximizing transportation costs and minimizing greenhouse gas emissions. It promotes the utilization of rail and inland waterways as essential elements of the freight network, facilitating a transition to sustainable logistics practices (López-Navarro, 2014; Ambra et al., 2019).

Intermodal systems are a promising part of freight transport. Jacyna-Gołda et al. (2023) argued for sustainable features for transport in the modern world. Incorporation of consolidation strategies within intermodal transport networks introduces specific challenges that can exacerbate vulnerability to disruptions (Goodarzi et al., 2024). Browne et al. (2023) found that rail intermodal is often treated as a disappointment and a complicated system encompassing a wide variety of relationships between actors, activities, and technical resources. Coastal ports have become the primary hubs for container rail-water intermodal transport (Wang et al., 2024). Intermodal transport is constantly trying to compete with road transport and one way to do it is to optimize transport processes (Jakara and Brnjac, 2023).

By decreasing its dependency on diesel-powered vehicles, Bangladesh has the potential to contribute to the achievement of global sustainability goals while simultaneously improving its efficiency in the logistics sector (ESCAP, 2009; Muni et al., 2024; Guillossou, 2007). Nonetheless, the variety of goods managed at these facilities is still restricted, as only 38 distinct items are presently being processed. This indicates that there is potential for diversification and optimization in the types of goods handled at these ports, which could further improve trade efficiency (Xu et al., 2023). According to Muni et al. (2024) and Guillossou (2007), such an approach is necessary when it comes to optimizing the whole logistics network in Bangladesh and developing a more resilient transportation system. Enhancing rail infrastructure to facilitate container transit and establishing inland water terminals with advanced handling capabilities can diminish reliance on road transport. These initiatives will not only diversify transportation methods but also establish a more equitable and sustainable logistics framework (Gohari et al., 2022).

Therefore, integrating sustainable intermodal systems, including rail and inland waterways, has become a pressing need to mitigate these issues (Goodarzi et al., 2024). This is the reason why policymakers are exploring intermodal solutions to improve logistics efficiency and sustainability. NIMTP (2013) underscores the need for a comprehensive approach to logistics planning in Bangladesh. This policy aims to establish additional dry ports and enhance connectivity between seaports and inland hubs through public-private partnerships (Bangladesh Ministry of Shipping, 2013). Furthermore, Bergqvist & Pruth (2006) explored the scope of partnerships that has expanded to include public/private partnerships in structures such as networks. For instance, expanding rail and IWT services could help decongest Chattogram Port and improve the efficiency of freight transport along the Dhaka-Chattogram corridor. Additionally, the policy highlights the importance of integrating digital technologies to streamline logistics operations, such as implementing centralized platforms for tracking and managing cargo movements (Rodrigue et al., 2017).

2. Site Description

Chattogram Port serves as a prime center for Bangladesh's logistics network, and a total of 22 dry ports. Of these, 18 are currently operational, two have recently received licenses, one has been closed, and another is an unoccupied yard (Saha, 2023). This varied collection of facilities highlights the region's vital role in overseeing and promoting trade activities (Xu et al., 2023). An extensive network facilitates the efficient movement of goods, which is essential for satisfying the increasing demands of both domestic and international trade. Figure 2 sketched the freight transport nodes in Bangladesh.

Alongside Chattogram, the Dhaka region significantly contributes to the logistics network by accommodating one ICD and two Inland Container Terminals (ICTs). These facilities serve as essential links, connecting the vibrant

capital city with the ports of Chattogram. Consequently, businesses in Dhaka experience improved access to international markets, facilitating a smooth exchange of goods and services between these areas (Xu et al., 2023). This interconnected system enhances economic growth while optimizing trade routes, leading to reduced costs and delays.

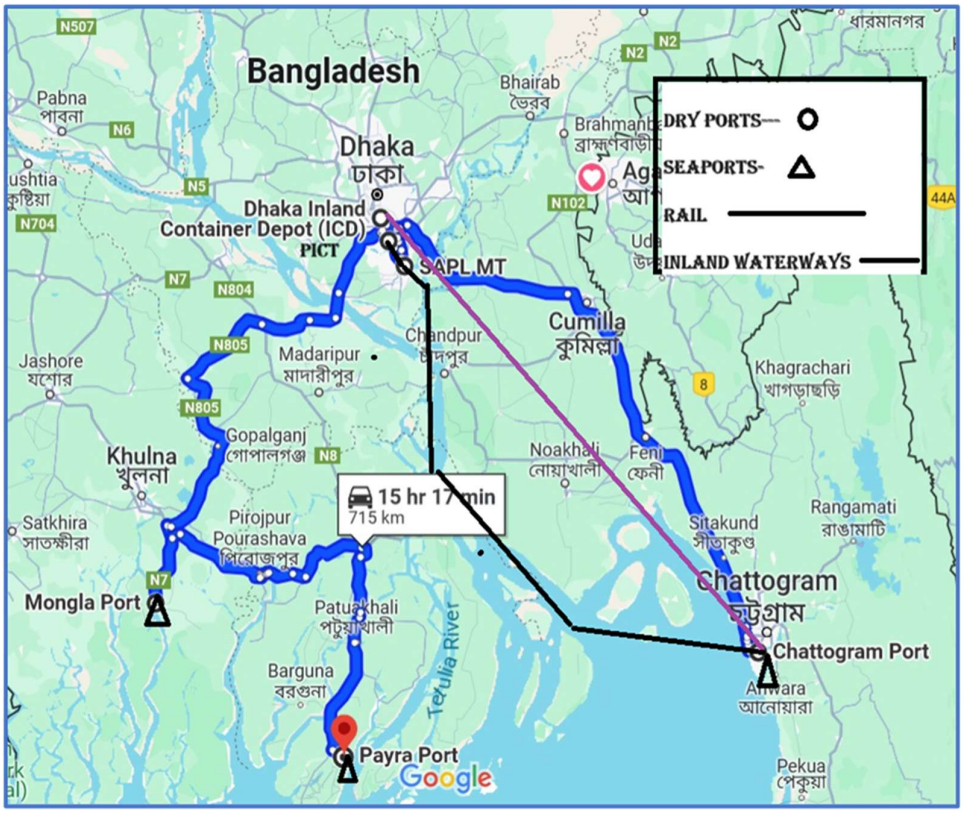

Figure 2. Major Freight Transport Nodes in Bangladesh developed by Author

The volume of container traffic managed by the Chattogram Port Authority (CPA) underscores its pivotal position in Bangladesh's trade environment. In 2023, the CPA handled around 3.05 mTEUs, showcasing the significant volume of goods processed through this gateway. The impressive throughput highlights the port's ability and effectiveness in addressing the logistics needs of the country (CPA, 2024). The dry ports in Chattogram are essential in facilitating the country's trade operations. These facilities manage a substantial share of the nation's import and export containers, processing 41.12% of import containers and 71.30% of export containers. This illustrates their decisive function in the supply chain, as they facilitate the effective handling and transportation of goods to and from the seaports (Xu et al., 2023). In the Dhaka region, the Dhaka Rail ICD and Pangaon ICT play a role in the broader logistics network, albeit on a smaller scale than Chattogram. The facilities managed 3.06% and 0.98% of the container traffic, respectively. Even with their relatively modest contributions, their roles are essential for ensuring that goods from the capital can smoothly integrate into the broader trade network. This integration enhances regional trade and complements the operations of Chattogram's logistics facilities (CPA,2024).

The operational framework that oversees these ports and terminals is underpinned by clearly articulated policies and regulations. These consist of standard transport policies, a dedicated dry port operations policy enacted by the port and customs authorities, and the National Integrated Multimodal Transport Policy-2013(NIMTP-2013). The purpose of these policies is to improve the efficiency of the transport system by tackling operational challenges, optimizing processes, and encouraging coordinated development among various modes of transport (Saha, 2023). Through the promotion of a cohesive strategy, these frameworks guarantee that the logistics network is capable of adjusting to the changing requirements of trade and transportation.

3. Methodology

This research employed qualitative methods to gain insights into the obstacles hindering the establishment of dry ports in Dhaka and the implementation of a road intermodal system. The focus was on understanding the reasons behind the limited popularity of alternative transport modes, such as rail and inland waterways, and the lack of

government promotion for sustainable intermodal systems. This qualitative approach allows for a deeper exploration of the complexities surrounding these issues, providing a comprehensive understanding of the current transport landscape in Bangladesh (Bergqvist, 2007).

The research methodology as per Figure 3, was divided into two main components: Key Informant Interviews (KII) and a qualitative research survey. The KII involved discussions with representatives from various authorities, including rail, road, waterways, and seaport authorities. A total of five key informants were selected to provide expert opinions and insights into the operational challenges and potential solutions for enhancing intermodal transport. This method facilitated the collection of rich, detailed information from individuals with firsthand experience in the sector (Delbart et al., 2021).

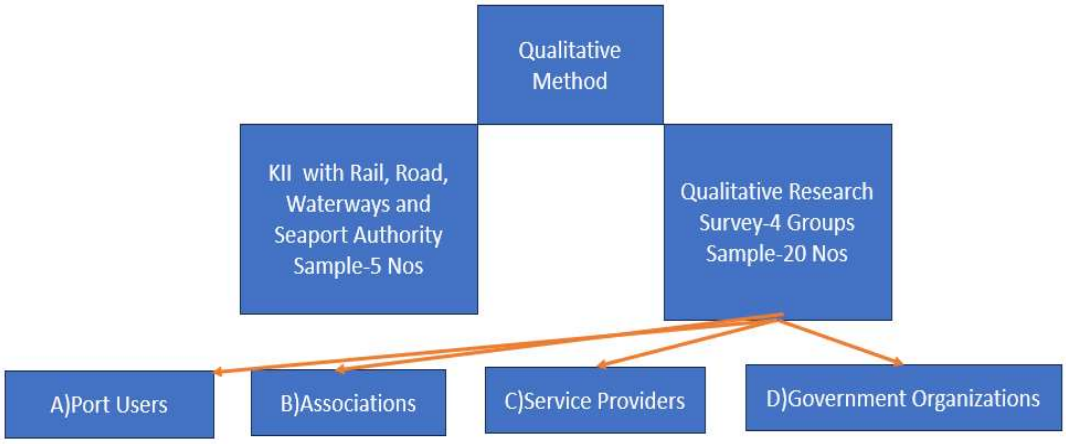

Figure 3. Research Program in exploring the potentiality of Intermodal System

The second component of the methodology involved a qualitative research survey, which targeted four distinct groups of stakeholders involved in the logistics and transport sectors. A sample of 20 participants was selected to represent diverse perspectives, including logistics providers, transport operators, and government officials. This survey aimed to gather qualitative data on the perceptions and attitudes towards the current transport systems, as well as the barriers to adopting modern trucks and efficient terminals in inland freight transport (Gohari et al., 2022).

The qualitative approach was particularly beneficial in identifying the underlying factors contributing to the reliance on traditional trucks and covered vans for inland freight transport. By engaging with stakeholders through interviews and surveys, the research was able to uncover the systemic issues that perpetuate the status quo, such as regulatory constraints, infrastructure limitations, and lack of investment in modern transport solutions (Ceulemans et al., 2024). Additionally, the research sought to explore the potential benefits of introducing modern trucks and efficient terminals in the inland freight transport system. By analyzing the insights gathered from the KII and qualitative survey, the study aimed to propose actionable recommendations for transitioning towards a more sustainable intermodal transport framework. This includes advocating for policy changes, infrastructure development, and investment in technology to enhance the efficiency and reliability of the transport system (Ceulemans et al., 2024).

The findings from this research are expected to contribute to the ongoing discourse on improving intermodal transport in Bangladesh. By highlighting the challenges and opportunities within the current system, the study aims to inform policymakers and industry stakeholders about the necessary steps to promote sustainable intermodal solutions that can alleviate congestion and improve overall logistics performance (Bergqvist, 2007). Ultimately, this research methodology provides a structured approach to understanding the complexities of intermodal transport in Bangladesh, paving the way for future studies and initiatives aimed at enhancing the efficiency and sustainability of the country's logistics network (Gohari et al., 2022).

4. Results

To follow the research methodology as stated in the earlier Chapter 3, a research questionnaire was developed for KII, and a qualitative research survey that resulted below:

4.1. Node Preferences for Doing International Shipping Trade (Appendix 2: Table 1)

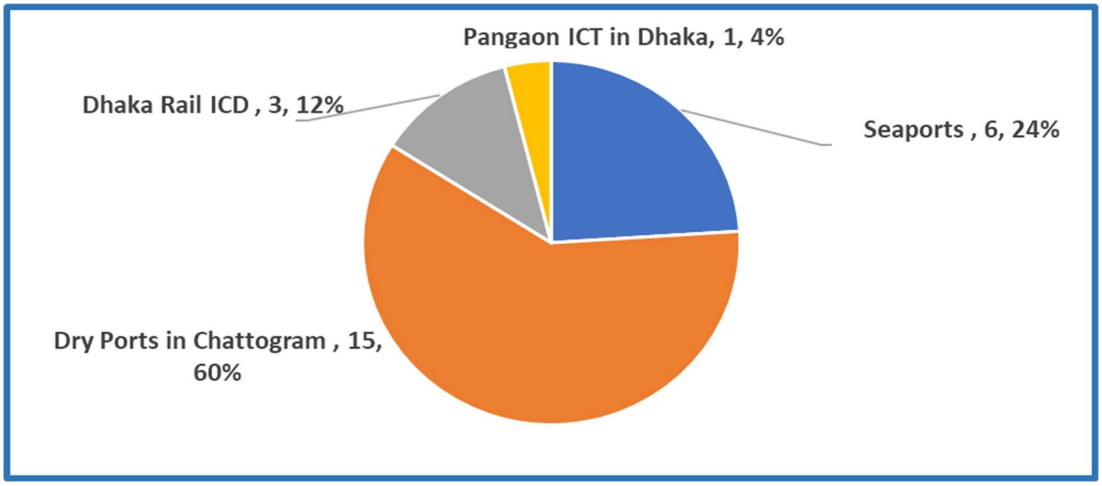

Figure 4. Node Preferences for Doing International Shipping Trade

In contrast, 24% of respondents favored seaports, showing that maritime ports continue to play an important role in direct shipping. Although seaports offer wider access to international trade routes, their frequent congestion diminishes their efficiency. Only 12% of respondents chose Dhaka ICD, indicating its limited accessibility and utilization. The underutilization of Pangaon Inland Container Terminal (ICT) is even more pronounced, as only 4% preferred it. This highlights the logistical and locational challenges facing Pangaon ICT. The over-reliance on dry ports in Chattogram and seaports signifies the need for a more distributed and integrated logistics system. Developing additional dry ports near industrial hubs, particularly in Dhaka, could help decentralize operations. Additionally, enhancing rail and water intermodal connectivity to dry ports could address inefficiencies and promote sustainable freight systems.

4.2. Factors for International Shipping in Bangladesh (Appendix 2: Table 2)

Cost is the main pillar but time is also a factor for doing international shipping and inland transport. The shipper/consignee also shows interest in cargo protection and saving the environment significantly. The data on factors influencing port users' decisions reflects diverse priorities. 24% of respondents ranked time as their top consideration, while 52% listed it as their second priority. Inefficiencies in the existing system, such as congestion at Chattogram port or delays in customs clearance, often hinder timely delivery, which is key for international shipping. Cost was the most prioritized factor for 28% of respondents, demonstrating that economic efficiency is central to decision-making. However, cost considerations also ranked lower (third priority) by 48%. Suggesting that while cost is important, other factors, such as the condition of commodities and environmental concerns, are gaining traction.

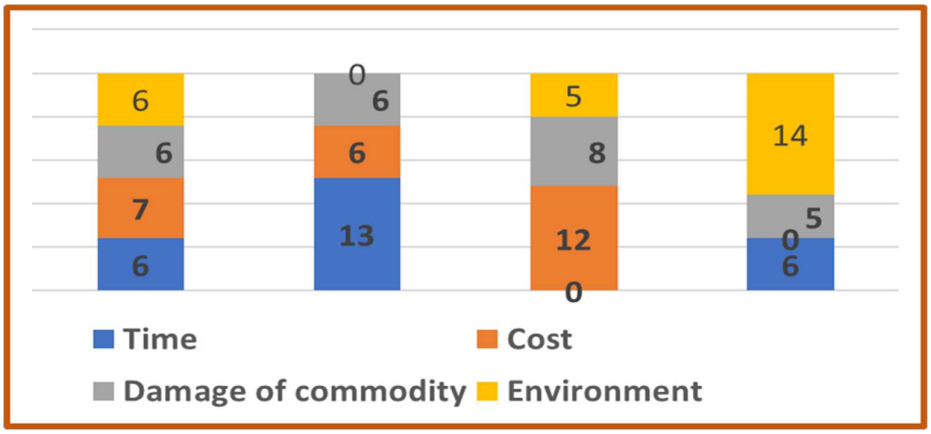

Figure 5. Factors considered by port users in doing international shipping

Interestingly, 24% of respondents identified the risk of commodity damage as a primary factor. This highlights the need for better cargo handling facilities, such as secure terminals and advanced equipment, to minimize losses. 56% of respondents (14 out of 25) rated environmental concerns as the fourth priority. While this might seem less significant, it is essential to note that 24% (6 out of 25) of respondents considered environmental protection a top priority. The findings indicate that improving the logistics system requires a multi-faceted approach. It needs to achieve time and cost efficiencies without compromising cargo safety or environmental goals. Adopting intermodal solutions, such as rail and water transport, can help balance these priorities while reducing reliance on carbon-intensive road transport.

4.3. Traditional Transport vs Intermodal Systems (Appendix 2: Table 3)

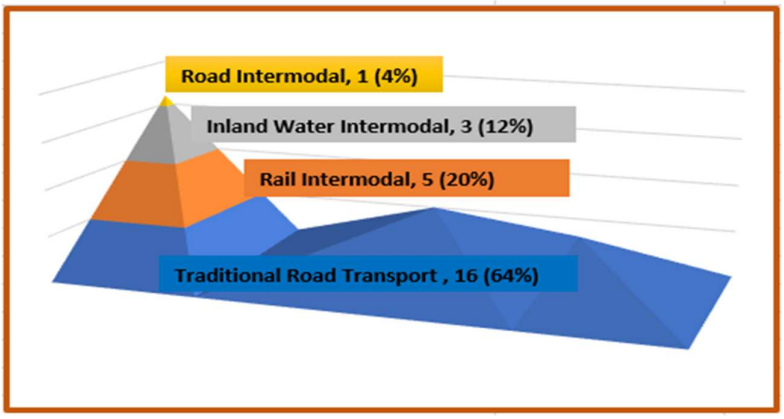

Figure 6. Traditional transport vs intermodal choice by port users

To date, traditional road transport is popular (64%). After that rail is good as stated by 20% of respondents for transferring cargo from Chattogram Port to Dhaka rail ICD only. Road intermodal is not allowed for all and least in choice where water intermodal has a good response to save the environment. The data on transport modes highlights the dominance of traditional road transport, which accounted for 64% of responses. This reliance on road transport stems from its accessibility and widespread use for freight movement in Bangladesh. However, the article emphasizes that this mode is environmentally unsustainable and contributes to high CO_2 emissions. Moreover, the heavy reliance on traditional trucks and covered vans exacerbates traffic congestion, particularly along the Dhaka-Chattogram corridor.

Rail intermodal was the second most preferred option, with 20% of responses. This reflects a moderate interest in rail transport, which is often more efficient and environmentally friendly than road transport. However, the limited capacity and connectivity of rail systems in Bangladesh have hindered their widespread adoption. 12% of respondents highlighted inland water intermodal as a potential alternative mode of transport. Waterways offer significant cost and environmental advantages but remain underutilized due to inadequate infrastructure and policy support. Only 4% of selected road intermodal, suggesting that Bangladesh has not effectively implemented this mode.

4.4. Current Dry Port Facilities Assessment for Bangladesh (Appendix 2: Table 4)

Most of the respondents are not satisfied with the current dry port facilities in Bangladesh. However, a satisfaction share came on the performance of dry ports in Chattogram. The assessment of dry port facilities reveals widespread dissatisfaction among respondents. 40% of respondents stated that the current facilities are “not enough” to meet the demands of international shipping. This reflects significant capacity gaps and operational inefficiencies in existing dry ports. The fact that only 20 considered the facilities “good enough” indicates that the majority of stakeholders perceive a need for improvement.

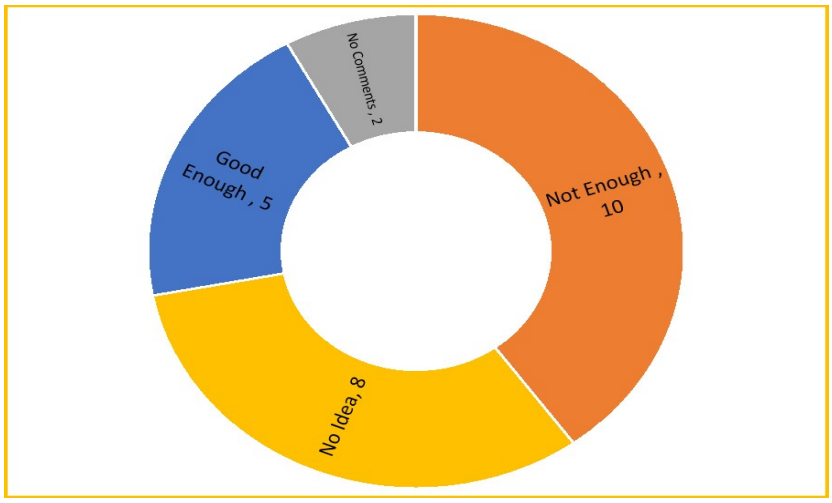

Figure 7. Current dry port facilities assessment for Bangladesh

Interestingly, 32% of respondents selected “no idea” or “no comments,” which may suggest a lack of awareness or engagement with dry port operations. This could be due to limited access to dry ports or inadequate communication from port authorities. Addressing this gap requires better outreach and education efforts to inform stakeholders about the benefits and potential of dry port systems.

4.5. Challenges and Barriers for Imports-Exports

Respondents identified several challenges and barriers when exporting or importing goods through the Chattogram and Mongla ports. Approximately 40% believed that inadequate infrastructure, such as outdated equipment and limited handling facilities, slows down operations, leading to inefficiencies in cargo handling. Similarly, 20% of respondents cited excessive congestion both inside and outside the ports as a major bottleneck. This congestion causes delays, increases costs, and often disrupts delivery timelines. Additionally, respondents highlighted bureaucratic hurdles, such as prolonged customs clearance processes and a lack of coordination between port authorities and other stakeholders.

To address these barriers, respondents emphasized the need for a coordinated approach to modernizing the port infrastructure. For example, expanding the capacity of Mongla Port and integrating it into a national logistics strategy could alleviate pressure from Chattogram Port. Furthermore, implementing advanced digital solutions, like RFID (Radio Frequency Identification) tracking systems, would streamline cargo clearance. It is suggested to introduce incentives for stakeholders, such as exporters and importers, to adopt environmentally friendly and efficient practices in port usage. Respondents also advocated for dedicated freight corridors to reduce congestion and ensure smoother operations. These measures would not only enhance port functionality but also contribute to boosting Bangladesh's competitiveness in international trade.

4.6. Inspiration and Motivation to Develop More Dry Ports in Bangladesh

The respondents identified several factors that could motivate dry port owners and investors to expand their operations in Bangladesh. Greatly, pointed out that financial incentives, such as tax breaks and subsidies, would be a key driver for attracting investment. They argued that the high initial costs of setting up dry port facilities often deter potential investors.

Additionally, respondents suggested that the government should provide long-term policy support to ensure the sustainability of dry port projects. For example, integrating dry ports into the national logistics strategy and offering land at subsidized rates could significantly boost investor confidence. Highly emphasized the role of technological innovation in inspiring investors. They argued that implementing innovative solutions, such as automated cargo handling systems and green technologies, would make dry port operations more efficient and profitable. Respondents also highlighted the importance of fostering collaboration between the public and private sectors. By establishing PPP models, the government could share the financial risks associated with dry port projects while ensuring their long-term viability. These measures would not only encourage investment but also contribute to the development of a more integrated and sustainable logistics network in Bangladesh.

4.7. Suggestions and Recommendations

The respondents provided a range of suggestions to improve Bangladesh's logistics sector's efficiency and

sustainability. A significant 40% strained the need for a comprehensive dry port policy that aligns with national transport and logistics strategies. This policy should address key issues such as land acquisition, environmental impact assessments, and stakeholder coordination. Additionally, respondents recommended the adoption of environmentally friendly practices in freight transport. For instance, replacing diesel-powered trucks with electric trailers and promoting rail and inland water intermodal systems would significantly reduce carbon emissions. Approximately 24% also emphasized the importance of digitalization in streamlining logistics operations. They suggested implementing centralized software platforms for tracking and managing cargo across dry ports and seaports.

Another critical recommendation was the introduction of incentives for exporters and importers to utilize dry ports. Respondents argued that reducing the dependency on Chattogram Port would not only alleviate congestion but also enhance the overall efficiency of the logistics sector. Finally, respondents highlighted the importance of public awareness campaigns to educate stakeholders about the benefits of sustainable intermodal systems. By fostering a culture of collaboration and innovation, Bangladesh can transform its logistics landscape and position itself as a competitive player in global trade.

The logistics business in Bangladesh predominantly depends on diesel-powered trucks and covered vans for the transportation of containerized cargo from Chattogram Port. This reliance substantially increases CO2 emissions, impacting both the environment and the efficacy of passenger transportation networks. The utilization of such vehicles underscores a significant issue in reconciling trade expansion with sustainable environmental policies (ESCAP, 2009). In 2023, the Chattogram Port handled 3.05 mTEUs which is a substantial volume that illustrates the port's pivotal function in Bangladesh's trade activities. Forecasts suggest that container handling will surpass 6.76 million TEUs by 2050, prompting development projects such as the Patenga Container Terminal and the Bay Terminal. These advancements seek to address the increasing demand and maintain the port's competitiveness in the worldwide market (CPA, 2024). In the absence of these developments, efficiently managing the rising trade volumes will prove challenging. The dry ports in Chattogram exhibit robust efficiency in processing export containers, overseeing 71.30% of export containers (661,152 TEUs) in 2023. Nevertheless, they manage merely 41.12% of import containers (216,537 TEUs), signifying an operational discrepancy. This disparity indicates the necessity for increased infrastructure for processing import containers to improve trade efficiency on both sides (CPA, 2024). Rectifying this deficiency is essential for sustaining a resilient and equitable logistics network.

The Dhaka ICD is located in the Dhaka region and active since 1987, possesses an annual capacity of 87,000 TEUs, although it is presently overutilized. The excessive utilization underscores the pressing requirement for increased capacity, so the long-delayed Dhirasram ICD project continues to be a priority. This project will enhance capacity, thereby reducing strain on current infrastructure and accommodating the increasing trade requirements of the capital region (Saha, 2023). In the absence of such advancements, the logistics network in Dhaka will face challenges in accommodating trade expansion. To mitigate capacity concerns, the Container Company of Bangladesh (CCBL) has launched a tender for a new ICD project in Ghorasal. This site is strategically beneficial because of its proximity to Dhaka and essential industrial areas. The project seeks to expedite container transfers from Chattogram, thereby diminishing transit durations and enhancing overall efficiency (ESCAP, 2009). This effort represents a proactive measure to tackle logistical bottlenecks in the region.

Notwithstanding its capacity, the Pangaon Inland Container Terminal (ICT), which can accommodate 116,000 TEUs annually, processed merely 29,930 TEUs in the previous year. This underutilization arises from inadequate inland links and a lack of attractiveness to port users, who frequently favor direct shipping from Chattogram. To enhance its appeal, inland connectivity must be improved, and operating procedures should be reassessed to ensure more convenience for customers (ESCAP, 2009).

Furthermore, the establishment of inland freight nodes encounters obstacles stemming from policy complications and insufficient cargo security during transit. These issues disrupt the logistics environment and impede the effective transportation of commodities. Addressing these difficulties is imperative for establishing a cohesive and secure logistics network that facilitates Bangladesh's trade objectives (ESCAP, 2009). By overcoming these obstacles, the nation can attain a more efficient and sustainable logistical framework.

Stakeholder feedback also emphasizes the necessity for intermodal integration. Surveys reveal that 64% of respondents criticize the current over-reliance on road transport, citing its adverse environmental and economic impacts. Conversely, 32% advocate for the inclusion of rail and inland waterways in freight transport planning to optimize cargo movement and reduce congestion. This feedback reflects a growing recognition of the benefits of sustainable intermodal systems among industry stakeholders.

Furthermore, public awareness and targeted incentives can play a spirited role in promoting the use of dry ports and intermodal systems. For instance, educating exporters and importers about the environmental and economic benefits of these systems could encourage their adoption. Incentives such as reduced port charges or priority handling for goods transported via sustainable modes could also incentivize stakeholders to shift away from road transport (Goodarzi et al., 2024).

5. Discussions

The findings of this study highlight the necessity of testing road intermodal systems for international shipping. These systems play an important part in improving the effectiveness of freight transportation across Bangladesh, and the research highlights the importance of evaluating them. This technique tries to combine diverse modes of transportation, such as rail, road, and waterways, to minimize reliance on traditional methods, which frequently contribute to inefficiencies and higher environmental impacts. It is essential to establish dry ports in strategic places, particularly in Dhaka and other important cities, to improve logistics and facilitate the flow of cargo in a more streamlined manner. The implementation of intermodal systems in Bangladesh has the potential to significantly reduce the amount of freight that diesel-powered trucks and covered vans transport. Many years have linked these conventional practices to high levels of carbon dioxide emissions and environmental degradation. As a result, the shift to environmentally responsible transportation practices is necessary to reduce the negative effects and bolster the development of environmentally friendly alternatives.

The research's valuable policy recommendations can guide the government in designing a comprehensive port plan. The plan focuses on enhancing inland freight transit connectivity by leveraging intermodal systems. This will ensure that the country's logistics infrastructure continues to be flexible enough to accommodate the ever-changing demands of commerce. The purpose of these practical implications is to build a framework for the transportation of goods that is more effective, less harmful to the environment, and economically viable. Through the implementation of cutting-edge multimodal systems, Bangladesh can bring its transportation practices in line with international sustainability best practices. This not only contributes to the development of the nation but also places the nation in a position of leadership within the area in terms of environmentally responsible logistics (ESCAP, 2009). Enhancing inland connections is a basic item for augmenting the role of rail and inland waterways in freight transportation. Public-private partnerships (PPP) offer a feasible method for accomplishing this goal. Public-private partnership arrangements can attract investment and foster innovation in transportation infrastructure, resulting in the modernization and enhanced efficiency of the logistics network.

A strategic approach to improve multimodal transportation in Bangladesh entails implementing a hub-and-spoke model that connects seaports and dry ports. This methodology provides a systematic framework in which seaports serve as principal hubs, while dry ports operate as subsidiary spokes. This approach diminishes dependence on conventional road transport networks, which are frequently less sustainable and more susceptible to congestion and environmental deterioration. Research highlights the increasing significance of multimodal transport in attaining sustainability within freight systems. Jacyna-Gołda et al. (2023) underscore the economic and environmental benefits of multimodal transport, accentuating its capacity to revolutionize conventional logistics networks. The capacity of multimodal solutions to harmonize economic efficiency with diminished environmental impact propels the transition toward their use. This transition is crucial for Bangladesh as it aims to update its transport infrastructure to accommodate rising trade volumes and adhere to international sustainability norms.

Strategic investments in infrastructure are essential for the success of multimodal networks. This includes the enhancement of current rail networks, the establishment of new inland container depots (ICDs), and the augmentation of the capacity of inland water transport facilities. Government and business sector parties must collaborate to generate essential resources and ensure the effective implementation of infrastructure projects. Moreover, the adoption of sophisticated technology like RFID systems for cargo tracking and tracing can improve intermodal operations, ensuring the seamless transit of commodities between different modes. A vital element in advancing multimodal transport is policy endorsement. The government must implement comprehensive policies that promote the utilization of rail and inland waterways while discouraging excessive dependence on vehicle transport. For instance, providing subsidies for intermodal freight services or levying increased fees on diesel-powered trucks might foster a conducive climate for intermodal solutions. Furthermore, to guarantee consistency in planning and execution, policies must conform to national transport strategies.

Public awareness campaigns can contribute to the promotion of the advantages of multimodal transport. Informing logistics providers and shippers of the financial benefits and ecological advantages of intermodal systems can motivate them to embrace these solutions. Collaborative seminars and training programs can enhance stakeholders' capability to function within an intermodal framework, promoting a culture of innovation and sustainability in the logistics sector.

The enduring advantages of implementing multimodal transport in Bangladesh are significant. Enhancing the share of intermodal solutions enables the nation to diminish its carbon footprint, optimize the efficiency of its logistics network, and foster economic growth. Moreover, intermodal networks might augment the competitiveness of Bangladeshi exports by reducing transportation expenses and guaranteeing punctual deliveries. This is particularly significant as the nation persists in growing its involvement in international commerce.

Implementing RFID technology is important for improving the efficiency and accountability of container management in Bangladesh. This system facilitates accurate tracking and tracing of containers between seaports and dry ports, ensuring uninterrupted operations across the logistics chain. To enhance its efficacy, the RFID

system must function on a cohesive software platform overseen collaboratively by the Chattogram Port Authority (CPA) and the National Board of Revenue (NBR). This joint supervision will guarantee transparency and reduce delays in container management. This effort is essential as it addresses the increasing demand for improved container logistics and mitigates inefficiencies in the supply chain (Munim & Haralambides, 2018).

A major advancement in the modernization of freight transportation is the implementation of electric trailers for container transport. This effort seeks to decarbonize freight operations and advance sustainable logistics techniques. Electric trailers generate much reduced emissions in contrast to conventional diesel-powered trucks, which are recognized for their detrimental environmental effects. Consequently, the Port Authority, the Ministry of Shipping, and the Roads and Highways Department (RHD) must spearhead this change. In doing so, Bangladesh can synchronize its freight transport operations with global sustainability objectives and enhance its environmental impact (ESCAP, 2009).

Considering the logistical expertise acquired by overseeing container operations in Chattogram, the establishment of dry ports in Dhaka and other significant industrial centers has been more vital. These facilities will promote more efficient cargo movement and improve the overall efficacy of freight transit. The implementation of a road intermodal or drayage system is an effective means to attain this objective. This technology enhances connectivity between seaports and dry ports, hence decreasing transit durations and expenses. It also guarantees that the logistics network is sufficiently resilient to accommodate the increasing demands of commerce and industry (Hasan et al., 2021; Gohari et al., 2022).

The creation, operations, and management of dry ports in Bangladesh are presently regulated by two distinct policies under the NBR and CPA. Although these strategies offer a degree of structure, they are deficient in the coherence necessary for sustained development. A comprehensive Dry Port Policy is essential for the integration of various existing frameworks. This strategy must conform to national transport and logistics plans, establishing a cohesive framework for the development and operation of dry ports. This integrated structure will guarantee that dry ports operate as effective nodes within the broader logistics network, facilitating the nation's economic development (Macharis et al., 2009).

The NIMTP (2013) significantly enhances Bangladesh's logistics infrastructure. Nonetheless, its execution has been constrained, diminishing its potential effect. It is essential to coordinate its implementation with all pertinent parties, including governmental bodies, private sector entities, and foreign collaborators, to ensure success. The successful execution of this policy will enable the establishment of road intermodal systems, vital for enhancing the logistics network. This cooperation will guarantee that transport systems are both efficient and sustainable, tackling the problems presented by rising trade volumes and environmental issues (McKinnon & Piecyk, 2012).

In summary, the modernization of Bangladesh's logistics sector necessitates strategic initiatives like RFID technology, electric trailers, the creation of dry ports, and integrated policy frameworks. When executed proficiently, these methods will improve connection, diminish environmental impact, and establish a more efficient and sustainable logistics network. By resolving current deficiencies and utilizing new technologies, Bangladesh can synchronize its logistics processes with worldwide norms and bolster its expanding economy.

6. Conclusion

Sustainable intermodal transport is progressively acknowledged as a viable approach for improving freight transportation systems owing to its economic and environmental advantages. Notwithstanding its benefits, the present proportion of intermodal transport within Bangladesh's entire freight system is around 5%. This low percentage signifies considerable potential for enhancement. By emphasizing the advancement of multimodal systems, the nation may rectify logistical inefficiencies and synchronize its transportation network with global sustainability objectives (López-Navarro, 2014).

Implementing these measures can substantially increase the proportion of intermodal transport inside Bangladesh's freight system. An augmented dependence on multimodal transport corresponds with global initiatives to enhance sustainability and rectify significant inefficiencies within the current logistics system. Utilizing intermodal transport can alleviate the strain on road transport, which presently predominates the freight sector and significantly contributes to elevated CO_2 emissions. Moreover, by diversifying transportation modes, the nation may enhance the resilience of its logistics network, rendering it less susceptible to disruptions from road congestion or environmental concerns (Agbo and Zhang, 2017).

In conclusion, intermodal transport offers a pivotal opportunity for Bangladesh to upgrade its freight transportation infrastructure and tackle significant sustainability concerns. Enhancing inland freight transport connections via strategic investments and implementing a hub-and-spoke model will diminish the nation's reliance on conventional road transport. Supportive policies, along with public-private partnerships, are essential for achieving the complete potential of multimodal solutions. As global trade dynamics change, multimodal transport provides Bangladesh with a means for sustainable growth and enhanced resilience in its logistics network to develop the Chattogram Port’s hinterland.

References

Agbo, A. A., & Zhang, Y. (2017), "Sustainable freight transport optimization through synchromodal networks", Cogent Engineering, 4(1), 1421005. https://doi.org/10.1080/23311916.2017.1421005

Ambra, T., Caris, A., & Macharis, C. (2019), "Towards freight transport system unification: Reviewing and combining the advancements in the physical internet and synchromodal transport research", International Journal of Production Research 57, no. 6 (2019): 1606-1623, https://doi.org/10.1080/00207543.2018.1494392

Bangladesh Ministry of Shipping. (2013), "National Integrated Multimodal Transport Policy", Retrieved from http://www.mos.gov.bd/policies.

Bangladesh Railway. (2020), "Annual Report 2020", Retrieved from http://www.railway.gov.bd/annualreport

Bergqvist, R. (2007), "Studies in regional logistics: the context of public-private collaboration and road-rail intermodality", Retrieved from https://trid.trb.org/View/891796

Bergqvist, R., & Pruth, M. (2006, January). Public/Private collaboration in logistics: An exploratory case study. In Supply Chain Forum: An International Journal (Vol. 7, No. 1, pp. 106-116). Taylor & Francis.

Browne, M., Dubois, A., & Hulthén, K. (2023), "Transportation as a loosely coupled system: a fundamental challenge for sustainable freight transportation", International Journal of Sustainable Transportation, 17(7), 804-814.

Ceulemans, E., Cardenas, I., Van Hassel, E., & Vanelslander, T. (2024), "Synchromodal transport vs. conventional hinterland transport: a stakeholder theory analysis", *Transport Reviews* 45, no. 1 (2025): 1-25, https://doi.org/10.1080/01441647.2024.2403471.

CPA. (2024). Annual cargo statistics. Chattogram Port Authority. Retrieved from https://cpa.gov.bd

Delbart, T., Molenbruch, Y., Braekers, K., & Caris, A. (2021), "Uncertainty in intermodal and synchromodal transport: Review and future research directions", Sustainability, 13(7), 3980. https://doi.org/10.3390/su13073980

ESCAP. (2009), "Intermodal freight transport and logistics development in Asia", United Nations Economic and Social Commission for Asia and the Pacific.

Gohari, A., Ahmad, A. B., Balasbaneh, A. T., Gohari, A., Hasan, R., & Sholagberu, T. (2022), "Significance of intermodal freight modal choice criteria: MCDM-based decision support models and SP-based modal shift policies", Transportation Policy, https://doi.org/10.1016/j.tranpol.2022.03.015.

Goodarzi, M., et al. (2024), "Intermodal freight transport and its role in addressing global warming challenges", Journal of Sustainable Transportation, 12(3), 45–67.

Guillossou, J. (2007), "Freight transportation challenges in Bangladesh", International Transport Journal, 14(2), 102–115.

Hasan, K. R., Zhang, W., & Shi, W. (2021), "Barriers to intermodal freight diversion: A total logistics cost approach", Springer Nature Limited. https://doi.org/0.1057/s41278-020-00182-3

Jacyna-Gołda, I., Shmygol, N., Gavkalova, N., & Salwin, M. (2023), "Sustainable Development of Intermodal Freight Transportation—Through the Integration of Logistics Flows in Ukraine and Poland", Sustainability, 16(1), 267.

Jakara, M., & Brnjac, N. (2023), "Foliated Transport Networks in Intermodal Freight Transport" Sustainability, 15(9), 7384.

Kotowska, I., Stanev, R., & Wilms, A. (2018), "Efficiency of inland water transport systems. Transport", Reviews, 38(5), 635–654.

López-Navarro, M. Á. (2014), "Environmental factors and intermodal freight transportation: Analysis of the decision bases in the case of Spanish motorways of the sea", Sustainability, 6(3), 1544–1566. https://doi.org/10.3390/su6031544.

Macharis, C., Janssens, G. K., Jourquin, B., Pekin, E., Caris, A., & Crépin, T. (2009), "Decision support system for intermodal transport policy", Science for a Sustainable Development (SSD).

McKinnon, A., & Piecyk, M. (2012), "Measuring and managing CO2 emissions of European chemical transport', Logistics Research Centre, Heriot-Watt University. Retrieved from www.cefic.org

Muni, M. S. H., Khan, M. M. R., Zafri, N. M., & Chowdhury, M. M. H. (2024), "Relationships between service quality and customer satisfaction in rail freight transportation: A structural equation modeling approach", Journal

of Rail Transport Planning & Management, 32, 100485. https://doi.org/10.1016/j.jrtpm.2024.100485

Munim, Z. H., & Haralambides, H. E. (2018), "Intermodal freight transport in Bangladesh: Challenges and prospects", International Journal of Transport Economics, 45(3), 567–590.

Nasir, S., Bang, K.-L., Nelldal, B.-L., & Muhammad, A. (2019), "Strategies to enhance intermodal movement in Malaysia", Revista Publicando, 6(19), pp.173-181.

Rodrigue, J. P., Comtois, C., & Slack, B. (2017), "The geography of transport systems (4th ed.)", Routledge.

Saha, R. C. (2023), "Chattogram Port: A dedicated service institution to evolve the country boldly", Maritime Technology and Research, 5(1), 258294-258294.

Wan, W., Wang, L., & Jiang, Y. (2020), "Logistics cost competitiveness in the Dhaka-Chittagong corridor", Asian Economic Studies, 12(3), 45–58.

Wang, Y., Zhou, R., Wang, M., Li, X., & Zhu, L. (2024), "Study on the Sustainable Development Strategy of Container Rail-Water Intermodal Transport in Chinese Ports", in E3S Web of Conferences (Vol. 512, p. 03024). EDP Sciences.

Xu, X.; Wang, H.; & Deng, P. (2023, "Exploring the Optimization of Synchromodal Transportation Path under Uncertainties". Journal of Marine Science and Engineering 11, no. 3 (2023): 577. https://doi.org/ 10.3390/jmse11030577.

Appendix 1: Qualitative Research Questionaries

Q1: Where will you get the maximum services for exports/Imports for doing international shipping trade?
Ans: a) Seaports b) Dry Ports in Chattogram c) Dhaka Rail ICD d) Pangaon ICT in Dhaka.
Q2: In what factors, will you emphasize in doing international shipping? List 1 to 4.
Ans: a) Time b) Cost c) Damage of commodity d) Environment.
Q3. Which mode is your preference to accomplish inland freight transport?
Ans: a) Traditional Road Transport b) Road Intermodal c) Rail Intermodal d) Inland Water Intermodal
Q4. There are 3 seaports, 22 Off Docks/Dry Ports (operational 18, new licensed 2, closed 1, empty yard 1) in Chattogram, 1 ICD in Dhaka, and 2 ICTs nearby Dhaka. Do you feel that all of these facilities are enough to manage international shipping?
Ans: a) Good Enough b) Not Enough c) No comments d) No idea
Q5: What are the challenges and barriers to exporting/importing through the Chattogram/Mongla port? Do you think intermodal systems can remove these barriers?
Q6: What will be your role in developing Dry Ports out of Chattogram and introducing the Drayage System/Road Intermodal to lessen traffic in the Dhaka-Chattogram Corridor and the usage of conventional trucks and covered vans?
7: Any suggestions or recommendations from your end?

Appendix 2: List of the Tables for qualitative survey responses

Table 1. Node Preferences for Doing International Shipping Trade (Q1: Section 6.1)

Node	Response
a) Seaports	6
b) Dry Ports in Chattogram	15
c) Dhaka Rail ICD	3
d) Pangaon ICT in Dhaka	1
Total	**25**

Table 2. Factors for International Shipping in Bangladesh (Q2: Section 6.2)

Factors	1st	2nd	3rd	Fourth	Total
a) Time	6	13	0	6	25
b) Cost	7	6	12	0	25
c) Damage of commodity	6	6	8	5	25
d) Environment	6	0	5	14	25

Table 3. Traditional Transport vs Intermodal Systems (Q3: Section 6.3)

Mode	Response
a) Traditional Road Transport	16
b) Road Intermodal	1
c) Rail Intermodal	5
d) Inland Water Intermodal	3
Total	**25**

Table 4. *Current Dry Port Facilities Assessment for Bangladesh* (Q4: Section 6.4)

Supply vs Demand	Response
a) Good Enough	5
b) Not Enough	10
c) No Comments	2
d) No Idea	8
Total	**25**