ANALYSIS OF INLAND WATERWAYS AND TRANSPORTATION IN INDIA

Submitted to the School of Maritime Management, Indian Maritime University in partial fulfilment for the award of degree in MBA Port and Shipping Management

Submitted

By

DANOUSH B
Reg. No. 2103304006

Under the supervision of
Dr. B. SWAMINATHAN
Associate Professor & Head

INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)

SCHOOL OF MARITIME MANAGEMENT
CHENNAI CAMPUS

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DECLARATION

I, **DANOUSH B (Reg. No. 2103304006)**, student of School of Maritime Management, Indian Maritime University –Chennai Campus, hereby declare that this Project report titled **ANALYSIS OF INLAND WATERWAYS AND TRANSPORTATION** submitted in partial fulfilment of the requirement for the degree of Master of Business (MBA) in Port and Shipping Management is my original work carried under the guidance of my project guide. It has not formed the basis for the award of any Degree/Diploma of any University/Institution. The information submitted is true and original to the best of my knowledge.

B. Danoush

DANOUSH B
(Reg. No. 2103304006)

Place: Chennai

Date: 11-MAY-2023.

CERTIFICATE

This is to certify that the project report entitled **ANALYSIS OF INLAND WATERWAYS AND TRANSPORTATION** submitted to the School of Maritime Management, Indian Maritime University, Chennai Campus., in partial fulfilment for the award of the degree of Master of Business Administration (MBA) in Port & Shipping Management, is a recordof work carried out entirely by **DANOUSH,** Reg. No. **2103304006**

Dr. B. Swaminathan
Project Guide

External
Examiner: —

Place: Chennai

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ABSTRACT

Inland waters and transportation have been integral to human civilization for thousands of years, providing a cost-effective and environmentally friendly means of moving people and goods. In recent years, there has been a renewed focus on the potential of inland waterways as an alternative to road and rail transport, particularly for heavier and bulkier goods.

Inland waterways include rivers, canals, lakes, and other bodies of water that are navigable by boats or ships. They are often used for the transportation of raw materials such as coal, timber, and agricultural produce, as well as finished goods such as steel and machinery. Inland waterway transport is particularly useful for connecting landlocked regions to major ports and markets. The advantages of inland waterway transportation include lower emissions compared to road and rail transport, reduced traffic congestion, and the ability to transport large quantities of goods at a lower cost. However, there are also some challenges to overcome, such as limited navigability in some regions, the need for investment in infrastructure and modernization of equipment, and coordination between different modes of transportation.

Inland waterways have the potential to play an important role in reducing greenhouse gas emissions and improving the sustainability of the transportation sector. However, this will require greater investment in infrastructure and modernization, as well as policy and regulatory support to encourage greater use of inland waterways. With the right investment and support, inland waterway transport can help to create a more efficient and sustainable transportation system that meets the needs of both industry and society.

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CHAPTER-I
INTRODUCTION

1.1 Background Of The Study

The legislative body in charge of India's waterways is the Inland Waterways Authority of India (IWAI). The Indian Parliament established it in accordance with the IWAI Act of 1985.Noida, Uttar Pradesh, is home to its corporate headquarters. Inland waterways in India include a vast network of rivers, canals, backwaters, and creeks. Out of the 14,500 km total navigable length, mechanized craft can use about 5200 km of the river and 4000 km of the canals. In comparison to other sizable nations and regions like the United States, China, and the European Union, India significantly underutilizes the use of rivers for the transportation of goods. The total cargo moved (in tonne kilometres) by the inland waterway was just 0.1% of the total inland traffic in India, compared to the 21% figure for the United States. Cargo transportation in an organised manner is confined to a few waterways in Goa, West Bengal, Assam, and Kerala.

It does the function of building the necessary infrastructure in these waterways, surveying the economic feasibility of new projects and also administration. On 31 August 2018, IWAI made 13 standardised state-of-art design public for the transportation of cargo and passengers keeping in mind Ganges complex river morphology, hydraulics, acute bends, currents etc. in National Waterway 1. The first implementation will be between Varanasi-Haldia stretch in assistance and investment from the World Bank. The Government of India established the Inland Waterways Authority of India on October 27, 1986, with the goal of developing and regulating inland waterways for shipping and navigation. The Ministry of Ports, Shipping and Waterways, Road Transport and Highways provides grants to the Authority, which it uses to construct and maintain Inland Waterway Terminal infrastructure on National Waterways. The headquarters are in Noida. The Authority also maintains sub-offices in Prayag raj, Varanasi, Bhagalpur, Farrakhan, and Kollam in addition to its regional offices in Patna, Kolkata, Guwahati, and Kochi. According to information on navigable waterways that was produced by the ministry of statistics and programme implementation, a total of 106 water bodies with a minimum length of 25 km (16 mi) had been designated as national waterways by the end of the 2015–16 academic year. These were divided into 8 clusters based on locations and financial viability, and into 3 categories based on those factors. Eight national waters (NW) of category 1 that are deemed to be the most viable will be developed in the first phase. In coastal areas with tidal portions, there are 60 category II NWs. Feasibility reports for 54 of them (6 are in phase-1) will be provided starting in May 2016.

National Waterway 1

Prayagraj–Haldia stretch of the Ganges–Bhagirathi–Hooghly River system.

- Estd = October 1986
- Length = 1,620 km (1,010 mi)
- Fixed terminals = Haldia, Kolkata, Sahib Ganj, Farrakka and Patna.
- Floating terminals = Haldia, Kolkata, Diamond Harbour, Katwa, Tribeni, Baharampur, Jangipur, Bhagalpur, Munger, Semaria, Doriganj, Ballia, Ghazipur, Chunar, Varanasi and Prayagraj
- Cargo Movement = 4 million tonnes.

National Waterway 2

- Sadiya — Dhubri stretch of Brahmaputra River
- Estd = September 1988
- Length = 891 km (554 mi)
- Fixed terminals = Pandu.
- Floating terminals = Dhubri, Jogighopa, Tezpur, Silghat, Dibrugarh, JamgurhiBogibil, Saikh owa and Sadiya
- Cargo Movement = 2 million tonnes.

National Waterway 3

- Kozhikode-Kollam stretch of the West Coast Canal, Champakara Canal and Udyogmandal Canal.
- Estd = February 1993
- Length = 205 km (127 mi)
- Fixed terminals = Aluva, Vaikom, Kayamkulam, Kottappuram, Maradu, Cherthala, Thrik kunnapuzha, Kollam and Alappuzha
- Cargo Movement = 1 million tonne

National Waterway 4

- Kakinada–Puducherry stretch of canals and the Kaluvelly Tank, Bhadrachalam – Rajahmundry stretch of River Godavari and Wazirabad – Vijayawada stretch of River Krishna
- Estd = November 2008
- Length = 1,095 km (680 mi).

National Waterway 5

Talcher–Dhamra stretch of the Brahmani River, the Geonkhali - Charbatia stretch of the East Coast Canal, the Charbatia–Dhamra stretch of Matai river and the Mangalgadi - Paradip stretch of the Mahanadi River Delta

- Established = November 2008
- Length = 623 km (387 mi).

National Waterway 6

NW-6 is a waterway between Lakhipur and Bhanga of the Barak River.

- In Assam, Lakhimpur to Bhanga stretch of Barak River.
- Estd = 2016
- Length = 121 km (75 mi).

1.2 Statement Of the Problem

The problem statement of inland waterways in India is multi-faceted and includes issues related to infrastructure development, operational inefficiencies, inadequate policy frameworks, and environmental concerns.

Firstly, India's inland waterway system suffers from underdeveloped infrastructure, including ports, terminals, and navigational aids, which leads to operational inefficiencies and reduces the overall effectiveness of the system. This lack of infrastructure also limits the capacity of inland waterways to carry cargo and compete with other modes of transport.

Secondly, the operational inefficiencies of the inland waterways in India include delays due to insufficient maintenance of waterways, poor navigability, and inadequate capacity, leading to higher transportation costs and lower reliability.

Thirdly, the lack of comprehensive policy frameworks, including regulatory and institutional mechanisms, limits the growth of inland waterways in India. A lack of clear policies, guidelines, and standard operating procedures hampers investment, innovation, and modernization.

Fourthly, the environmental concerns surrounding inland waterways in India include pollution, depletion of aquatic resources, and negative impacts on riverine ecosystems. Inadequate environmental regulations, weak enforcement mechanisms, and lack of public awareness exacerbate these issues. Overall, the problems associated with inland waterways in India need to be addressed through a comprehensive and coordinated approach that involves stakeholders from the public and private sectors, civil society, and academia sustainability.

1. Cost estimation: In respect to operating costs per ton-km, IWT has lower cost than rail and road transport. However, this cost argument is challengeable. There are two factors which distinguishes how freight moves on land versus on water:

1. A road travels straight while rivers bend and curve; therefore, the difference between freight costs for IWT and road/ railways is not much.

2. Cost of loading and unloading freight:

2.Inadequate depth: To be viable for a navigable inland waterway, river needs enough depth throughout the year However, in their natural state; many Indian rivers simply do not have that level of water which will necessitate extensive dredging. Moreover, Indian rivers (especially rivers in the northern plains) face severe problems of siltation round the year.

3. Impact on other activities: Water in rivers has competing demands, including dams and farming. To maintain the water levels in the river to the degree needed for them to function as inland waterways, the water use for such other activities might get curbed.

4. Inadequate Air Draft: Multiple bridges with low vertical clearance obstruct the passage of bigger inland water transport vessels on many inland waterways such as NW 3

5. Lack of night navigation infrastructure: Rudimentary night navigational facilities and markings are also a major issue.

6. Shortage of IWT vessels: Vessel building is highly capital intensive and faces difficulties in obtaining project finance from banks and financial institutions.

7. Shortage of MRO facilities: There is severe shortage of MRO (Maintenance, Repair and Overhaul) facilities for IWT vessels.

8. Inadequate industries: Inadequate number of Industrial units on the riverside, especially not along the Brahmaputra is a major discouragement hindering development of inland waterways. At National Policy Dialogue on transboundary cooperation related to the Ganga and the Brahmaputra rivers – states, it was highlighted that due to inadequate industrial units result in no cargo commitments by the private players

9. Lack of funds: Dredging as well as infrastructure for IWT requires huge investments. However, both public and private funding in the sector is low.

10. Environmental Impact: Dredging operations will damage river bed, and can lead to change in habitats for various aquatic flora and fauna. Dredging may also impact aquifers along the river, damaging the ability of water to percolate underground. In estuaries and creeks of rivers the removal of river bed material during capital dredging can result in the ingress of excess saline water into the creek or rivers. This is one of the reasons why the state of Kerala had opposed many of its proposed waterways. Construction of jetties, river ports will necessitate removal of trees/ mangrove forests in the area.

The Major Inland waterways in the world face several challenges, including:

1. Insufficient funding: In many countries, there is a lack of sufficient funding to maintain and upgrade inland waterways infrastructure, including locks, dams, and channels.

2. Environmental concerns: Inland waterways often pass through ecologically sensitive areas, and their construction and maintenance can have a negative impact on the environment, including fish habitats and water quality.

3. Competition from other modes of transport: Inland waterways face competition from other modes of transport such as rail and road, which can often offer faster and more efficient transportation.

4. Limited capacity: Inland waterways can have limited capacity for vessels, particularly larger vessels, which can limit their usefulness for transporting goods.

5. Political and regulatory barriers: The development and operation of inland waterways can be subject to political and regulatory barriers, such as conflicting interests between different countries or regions, or environmental regulations that limit their use.

6. Climate change: Climate change can have a significant impact on inland waterways, including changing water levels and patterns of precipitation, which can make navigation more difficult and reduce the capacity of the waterways. Overall, these challenges can make it difficult to maintain and develop inland waterways as a sustainable and efficient mode of transportation.

1.3 Objective of the Study

The objectives of inland waterways can vary depending on the specific waterway and the needs of the region it serves. However, in general, the following are some common objectives of inland waterways:

1. To study the current state of India's inland water transportation infrastructure and regulations.
2. To study the economic viability of inland water transportation in India.
3. To study the environmental impacts of inland water transportation in India.
4. Identify best practices and innovative approaches from other countries to promote inland water transportation.
5. To recommend the strategies to promote and enhance the role of inland water transportation in India's transportation system.

Overall, the objectives of inland waterways can help support economic development, environmental sustainability, and social well-being. Around 95 percent of India's trade by volume and 70% by value are transported via sea.

India has 205 designated small and intermediate ports, along with 12 large ports. The National Perspective Plan for Sagarmala calls for the construction of six additional mega ports across the nation. For port and harbour building and maintenance projects, the automated route allows for up to 100% foreign direct additional ports, among other Sagarmala-related projects, and hasten their completion. Banks may include financing for inland vessels in their priority sector lending programmes. To boost throughput, a single-window facility for cargo clearance and infrastructure for completely mechanised cargo handling must be established. Increase the use of technology at ports and, when practical, learn from highly effective international ports like Rotterdam, Felixstowe, and Singapore to increase efficiency investment (FDI). Additionally, it has made it possible for businesses that build, manage, and run inland waterways, inland ports, and ports to enjoy a 10-year tax holiday. In FY20, the capacity of India's major ports was 1,534.91 million tonnes per year (MTPA). All of India's major ports handled 672.60 million tonnes (MT) of cargo in FY21. In order to enhance and sustain draught depth at ports, attract large vessels, and make them hub ports, the government must open up the dredging business to attract additional participants, particularly multinational firms. Improve port connectivity, create coastal economic zones (CEZs), and develop.

Inland transport

As per the National Waterways Act, 2016, 111 have been declared as National Waterways (NW)

These waterways pass through 24 states and two union territories, with an approximate total length of 20274 km

These proposed waterways will pass through nearly 138 river systems, creeks, estuaries and related canal systems of India.

1.4 Research Questions

- Water Flow: Due to Industrial, Agriculture and habitation the water flows have been decreased over the years this also may have decreased due to impact of dams of on the rivers. Inadequate water channel Depth: Large vessels cannot traverse without adequate waters in the rivers. This along with the seasonal dependency of rivers makes operation of many ports difficult.
- Excessive Siltation: -Deforestation and erosion activity of the river leads to problem of siltation making navigation difficult. Poor Skills and low technology adaptation: -Lack of automation in processes and low multi operation skills affect efficient utilisation of ports.
- It is a slower mode as compared to Rail and Road by its very nature. So improper navigational aids further hurt its competitiveness with other modes. Jal Marg Vikas Project (JMVP) and Sagarmala are measures taken by Government to support inland water transportation.
- The Indian Government should focus more and put some special efforts and funds on the development of commercially significant IWT. It requires the maintenance of a specified water depth and width depending upon the size of vessels expected to use that waterway. This necessitates the release of adequate discharges. There is a strong need to provide effective rail, road and coastal connections from the waterways for multi-modal logistics. The terminals should be located close to industrial hubs or consumption centers and should provide connectivity to both rail and Road. Preservation of existing canals, lakes etc. is an essential ingredient of environmental protection. Inland waterway should not pollute the water way itself.

1.5 Limitations Of The Study

India has an extensive network of inland waterways in the form of rivers, canals, backwaters and creeks. Freight transportation by waterways is highly underutilized in the country as compared to developed countries. India's hinterland connectivity is mainly based on road and rail with domestic waterways— both coastal shipping and inland waterways—playing a limited role. Waterways are found to be cost effective as well as an environmentally friendly means of transporting freight. In India, Inland Water Transport (IWT) has the potential to supplement the over-bur dined railways and congested roadways. In addition to cargo movement, IWT sector also provide a convenient function in related activities such as carriage of vehicles {on Roll-on-Roll-off (Ro-Ro) mode of cross ferry} and tourism. The National Waterways Act, 2016 has declared 111 inland waterways as 'National Waterways' (NWs) in the country to promote shipping and navigation on them. The total length of NWs is 20,275 km spread across 24 States in the country. Inland Waterways Authority of India (IWAI), is an autonomous organization constituted on 27th October, 1986 under the Inland Waterways Authority of India Act, 1985. IWAI is primarily responsible for development, maintenance and regulation of those waterways which have been declared as NWs under National Waterways Act, 2016. The head office of IWAI is at Noida, UP. The policy guidelines and directions issued by IWT Wing are implemented by IWAI. A ship or boat can safely cross inland waterways, which include rivers, canals, backwaters, and streams that are deep enough. India has 14,500 km of navigable rivers, which account for 1% of the nation's total transportation distance. Only 2,000 km of the 3,700 km of major rivers that can currently be navigated by mechanised flat bottom vessels are actually in use. A few waterways in Goa, West Bengal, Assam, and Kerala are the only places where cargo transit is done in a systematic manner. The statutory body in charge of India's waterways is the Indian Waterways Authority of India (IWAI). It serves the purpose of constructing the essential infrastructure in these waterways, evaluating the viability of new projects from an economic standpoint, as well as administration and regulation. A well-coordinated network of inland waterways could bring about a profound shift in the country's logistical scenario. It reflects a network of ready-made facilities that can be used without any additional spending in resources. Waterways do not entail land acquisition issues, which have often been a sensitive issue, creating time and expense overruns on various schemes. Through - the usage of rivers, the massive expenditure that India requires to develop its road/highway infrastructure network can be maintained. Waterways are a quicker mode of transport, which

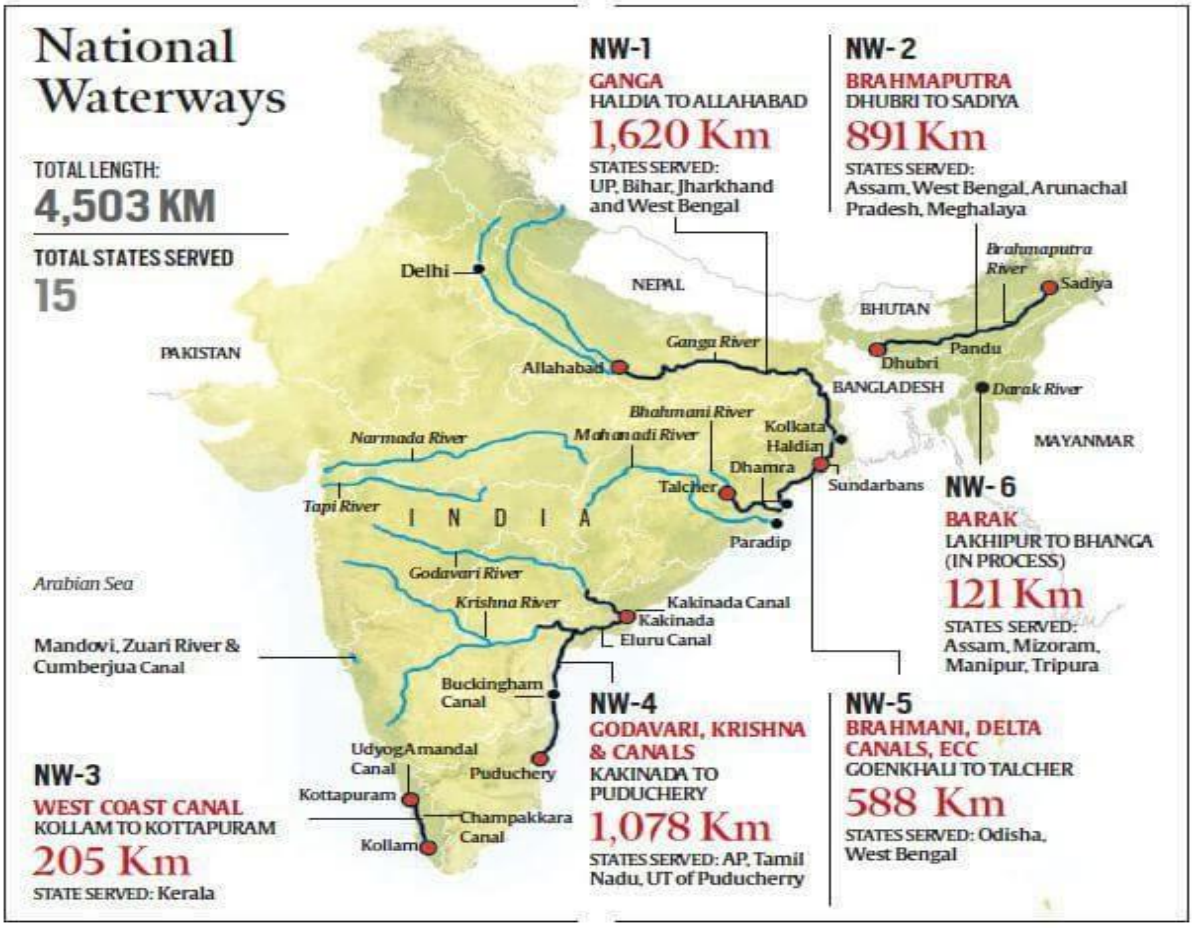
greatly decreases the point-to-point expense of moving goods from the available alternatives. Among the early commercial drivers of pre-independence India was the cargo traffic of tea, jute, and spices in the eastern region, linked to the river port in Kolkata. While the transportation of cargo across waterways has lost importance, the Mandovi-Zuari Cumbrous method transported over 30 million tonnes of iron ore in recent times.
In post-independent India, growth in cargo via inland waterways has generally been slow, due to lack of policy incentives, infrastructure unavailability, viz. Jetties of waterways, width of channels, number of boats, right of way, etc. However, the introduction of the national network of waterways is rife with difficulties. The draught channel for national waterways is not standardised, as is required, at 2 metres during the year. Any of these rivers are seasonal and do not provide year-round navigability. An inland waterway is a navigable channel used to transport goods, materials, or other movable objects. Inland waterways consist of rivers, lakes, canals and backwaters. Rivers and lakes are natural waterways, whereas canals and backwaters are artificial. The inland waterways are used for transporting heavy loads through the water. The transportation system on the water is commonly referred to as marine transport. They can also transport passengers, and this is commonly known as canal boat cruises. The inland waterways have played a vital role in the country's development. Before the railways were constructed in India, river transport was the only means to carry enormous quantities of goods from one destination to another. Almost all the rivers and lakes are navigable, but canals are used only by barge traffic. With the use of inland waterways all over the world, it can be confirmed that there is less environmental pollution. There are lesser chances of ground subsidence and liquefaction. The infrastructure cost is also less when compared to other modes of transport. PIPES are not affected by most natural calamities such as tropical cyclones, earthquakes, floods and sea waves. Sea waves or storm waves have little effect on PIPES continuing to operate without interruptions.

1. Inland waterways transport is a highly environmentally friendly mode of transportation. It causes no air pollution and less noise pollution. The CO2 emission of this mode of transportation is also very low.
2. The inland waterways are very space-efficient compared to other modes of land transport. It needs only a small amount of land to develop this transport system.

3. It has high labour productivity per unit of transport output. This means that the inland waterway is characterised by its high output over a comparatively lesser input on labour work.
4. The material requirement per unit of transport volume is very low for the inland waterways. It is claimed that the energy requirement per unit of transport volume is less compared to other transport modes.
5. Inland waterways have low operation costs and lower fixed costs compared to other modes of transportation. The operation cost per ton-kilometre is less in the case of inland waterways compared to railways and highways.

Geographical constraints:

- Seasonal nature of rivers: Most of the peninsular rivers are seasonal in nature i.e only during the rainy season they flow with full capacity and in summer water flow will be minimum which is not favourable for navigation.
- River regime change: the regimes of the Himalayan Rivers are both monsoonal and glacial. On the other hand, the regimes of the Peninsular Rivers are only monsoonal as they are influenced only by rainfall. There also exist the intra-peninsular differences in the river regimes. This is due to differences in the seasonal distribution of rainfall in various parts of the plateau.
- Siltation: Himalayan rivers are in the young stage which carries huge loads of sediments get deposited in the plains and it, in turn, reduces navigability. Examples Bhagirathi-Hooghly stretch.
- Meandering rivers: Meanders are the result of both erosional and depositional processes. They are typical of the middle and lower course of a Himalayan River.
- Presence of cataracts and waterfalls: these geographical formations pose problems in smooth navigation of cargo vessels as in Narmada and Tapi.
- Other constraints: it includes Inadequate air draft, Lack of terminals, Lack of modern navigation infrastructure. etc
- Government has taken up special programmes such as Jal Marg Vikas project (JMVP), River Information Services (RIS), etc to facilitate the inland waterway development.



1.6 Methodology

1. Define research objectives and questions:

The first step in any research study is to define the research objectives and questions. For the study of inland water transportation, the research objectives could be to identify the current state of inland water transportation, the challenges faced by the sector and the potential for improvement. The research questions could be:

- What is the current state of inland water transportation in the study area?

- What are the challenges faced by the inland water transportation sector?

- What are the potential solutions to improve inland water transportation in the study area?

2. Review of literature:

The next step is to conduct a review of the relevant literature on the topic. This could involve reviewing academic papers, reports and other relevant documents related to inland water transportation.

3. Identify data sources:

After the literature review, the next step is to identify the data sources required for the study. This could involve primary data collection through surveys, interviews and observations, as well as secondary data sources such as government reports, statistical data and other relevant documents.

4. Data collection:

Collecting data on transport infrastructure, waterways, cargo volumes, and other relevant factors through site visits and observations.

5. Data analysis:

Once the data has been collected, the next step is to analyze it. This could involve using statistical methods such as regression analysis, correlation analysis, and other relevant techniques to identify trends and patterns in the data.

6. Reporting of findings:

Finally, the results of the study can be presented in a report that includes the research objectives, questions, methodology, findings and recommendations. The report should be structured in a way that is clear and easy to understand, with tables, graphs and other visual aids to help illustrate the findings.

1.7 Structure of the Report

The organization of the study in inland waterways typically follows a systematic approach that includes the following components:

1. Background and Context: This section provides an overview of the inland waterways under consideration, including their geographic location, physical characteristics, historical context, and significance in terms of their economic, social, and ecological values.

2. Objectives and Research Questions: This section outlines the specific objectives of the study and the research questions that the study aims to answer. These may include questions related to the current condition and future prospects of the inland waterways, as well as questions related to the potential impacts of different management and development scenarios.

3. Methodology: This section describes the methods and techniques that will be used to gather and analyze data, including both qualitative and quantitative approaches. It may also include a description of the sampling strategy and data collection procedures.

4. Results: This section presents the findings of the study, including both descriptive and analytical results. These may include data on the physical, economic, and social characteristics of the inland waterways, as well as projections of future trends and scenarios.

5. Discussion: This section interprets the results of the study in light of the research questions and objectives. It may also consider the implications of the findings for policy and management, and identify key knowledge gaps and areas for further research.

6. Conclusions: This section summarizes the key findings of the study and draws conclusions based on the evidence presented. It may also offer recommendations for policy and management, and suggest areas for future research.

7. References: This section provides a list of the sources cited in the study, including relevant literature, reports, and data sources.

Overall, the organization of the study in inland waterways follows a logical and structured approach, designed to provide a comprehensive understanding of the characteristics, challenges, and opportunities associated with these important aquatic resources.

CHAPTER-II
REVIEW OF THE LITERATURE

2.1 The Literature Review

The scope and purpose of the literature review for Inland waterways will depend on the specific research question or problem being investigated. However, in general, the literature review for inland waterways will aim to:

Scope:

- Identify and evaluate existing research, theories, and practices related to inland waterways management, navigation, environmental sustainability, and economic development.
- Analyze and synthesize relevant literature in order to provide a comprehensive understanding of the current state of knowledge on the topic.
- Identify gaps in the existing literature and suggest areas for further research.
- Provide a context for the research and support the development of research questions and hypotheses.

Purpose:

- To provide a critical overview of the existing literature and identify key themes, concepts, and debates.
- To provide a foundation for the research and ensure that the study is grounded in the existing knowledge on the topic.
- To identify potential challenges, limitations, and opportunities related to inland waterways management and navigation.
- To provide recommendations for policy and practice based on the findings of the literature review.

Overall, the literature review is an important component of any research project related to inland waterways as it provides a critical examination of the existing knowledge base and sets the stage for the research to follow.

2.2 Evolution of The Research Area

Inland waterways have been a significant means of transportation for goods and people for centuries. The evolution of the research area in inland waterways has been shaped by various factors, including changes in technology, economic developments, and environmental concerns. In the early days, research in inland waterways focused primarily on developing techniques and technologies for navigating rivers and canals, such as developing more efficient sailboats, improving locks and dams, and dredging channels. Much of this research was conducted by engineers and focused on practical applications to improve transportation and commerce. As industrialization progressed, inland waterways became increasingly important for the transportation of goods and raw materials. This led to a shift in research towards optimizing the use of inland waterways for transportation and improving the efficiency of the associated infrastructure. Studies on the capacity of waterways, the design of cargo ships, and the development of canal networks were some of the key areas of focus during this time. In the latter half of the 20th century, research in inland waterways began to focus more on environmental concerns, as pollution and habitat destruction became more prominent issues. Researchers began to examine the impact of shipping on water quality, as well as the effects of dredging and the construction of new infrastructure on the ecology of waterways. In recent years, the research area in inland waterways has expanded to include a wider range of topics, including the impact of climate change on water levels and the navigation of waterways, the development of new technologies such as autonomous ships, and the promotion of sustainable transportation practices. Overall, the evolution of the research area in inland waterways has been influenced by a variety of factors, including technological advancements, economic developments, and environmental concerns. As these factors continue to evolve, it is likely that research in inland waterways will continue to focus on finding new and innovative ways to optimize the use of this vital transportation network while also minimizing its impact on the environment. The existence of IWT is acknowledged in Hindu mythology. Another mention of Alexander using boats to cross the river Jhelum and attack Porus. IWT in India has a history that dates all the way back to the Indus Valley Civilization. On a meticulously carved seal, a depiction of a boat is visible. Due to the region's geology and other regulating natural elements, such as the abundance of water sources, inland water transportation evolved mostly in the north Indian plains. The Ganga, Brahmaputra, and Indus have traditionally been the river basins used for passenger and cargo transit. In the absence of modern modes of transportation such as airways, railways and

roadways, Consequently, the boats and the rivers became a part and parcel of social and cultural life of the people.

2.2.1 The History of Development and Present Scenerio Of IWT.

A. Policies and Governance

1. Pre-Colonial Era

It was under the Mauryan‟s and Gupta Empire the inland water transportation was significantly developed. This was because these powers ruled the significant and large part of the subcontinent and provided a stable economy for development. The power was fragmented due to fall of great empires and one river basin was divided to many powers restricting the overall development of trade route. Then in late 15th century, During the Mughal period, there was comparative peace. India experienced a stable economy after the series of invasion. Trade and communication started to flourish under the Mughal reign. As a large area of river basin was single handedly ruled by one empire.

2. Colonial Area

As the East India Company started to spread its roots in India, the improvement and amendments in law and order started. This improvement encouraged the inland water transportation system. During this period pattern of trade however was completely changed. India, earlier was a supplier finished products now became a supplier of raw material. With a need of moving all these bulky goods to the ports the inland water transportation developed. It was though a temporary development .In the 18th century with the of industrial revolution gaining momentum in Europe the Englishmen introduced railways and machines vehicles in all their colonies. With the Development of alternative means of transport the inland water transportation system declined. But the governance of the major navigable routes was under British control. The major drawback of British rule in context with inland water transportation system is considered as destruction of indigenous shipping industries. This was with the introduction of steamships by the British East India Company in mid-19th century.

3. Present Scenario

After independence 1947 there were many committees formed by the government with the help of central board of transport. These committees surveyed and identified the potential and need of the existing and possible navigable waterways.

Inland Waterways Authority of India (IWAI)

It was created by Government of India on 27 October 1986 with the aim of development and regulation of Inland waterways for shipping and navigation, with its headquarters at Noida and regional offices at Guwahati, Patna, Kolkata and Kochi.

The Inland Vessels (Amendment) Act, 2007

An Act of the Parliament of India enacted to facilitate the extension and usage of inland waterways by vessels. It is an amendment to an original Act passed in 1917.Inland water traffic amounts to only 0.17% of total inland traffic in India. The act address the extension of inland water limits, facilitating safety of vessels by dividing the inland water area into three zones based on maximum significant wave height criteria, employment of manpower from Army, Navy and Coast Guard in this sector, controlling pollution and regulating the insurance regime on par with motor vehicles.

National Waterways Act,2016

Prior to this act coming into existence there were five different acts which have declared five national waterways. This act merges all these five acts and proposes additional 106National Waterways. An Act to make provisions for existing national waterways and to provide for the declaration of certain inland waterways to be national waterways and also to provide for the regulation and development of the said waterways for the purposes of shipping and navigation and for matters connected therewith or incidental thereto. Inland Vessel Building Subsidy Scheme and setting up of National Inland Navigation Institute (NINI) by Inland Waterways Authority of India (IWAI) were also the major steps taken for boosting the IWT.

2.3 Conceptualizing and Identifying Key Concepts

Conceptualizing and identifying key concepts are crucial steps in any research study. In this section, we will discuss the key concepts related to the study of inland water transportation for a project. Inland water transportation refers to the transportation of goods and people through navigable waterways such as rivers, canals, and lakes, within a country or region. It is an important mode of transportation for goods that are bulky, heavy, or non-perishable, and is typically used for long-distance transportation. The study of inland water transportation involves several key concepts, which are discussed below.

1. Transport infrastructure:

Transport infrastructure refers to the physical infrastructure required for the movement of goods and people, including waterways, ports, terminals, and vessels. Inland water transportation requires a well-developed infrastructure to support the movement of goods and people. This infrastructure includes navigable waterways that are maintained for safe and efficient navigation, ports and terminals for loading and unloading of cargo, and vessels that are specifically designed for inland water transportation.

2. Cargo volumes:

Cargo volumes refer to the amount of goods transported by inland water transportation. Cargo volumes are influenced by several factors, including the availability of suitable cargo, the demand for goods, the distance to be covered, and the efficiency of the transport system. Understanding cargo volumes is important for determining the economic viability of inland water transportation and for identifying potential areas for improvement.

3. Regulatory framework:

The regulatory framework refers to the legal and regulatory environment that governs inland water transportation. This framework includes laws and regulations related to safety, environmental protection, and the management of water resources. The regulatory framework is important for ensuring the safety and sustainability of inland water transportation and for creating a level playing field for all stakeholders.

4. Economic impact:

The economic impact of inland water transportation refers to the contribution of the sector to the overall economy. This impact includes the direct contribution of the sector to GDP, as well as the indirect benefits to the economy through the creation of jobs, the development of related industries, and the reduction in transportation costs. Understanding the economic impact of inland water transportation is important for policymakers and investors who are considering investment in the sector.

5. Environmental impact:

The environmental impact of inland water transportation refers to the effect of the sector on the natural environment, including water quality, aquatic habitats, and biodiversity. Inland water transportation can have both positive and negative environmental impacts, depending on factors such as the type of vessel used, the quality of fuel, and the management of water resources. Understanding the environmental impact of inland water transportation is important for policymakers and stakeholders who are concerned with the sustainability of the sector.

6. Technological advancements:

Technological advancements refer to innovations in vessels, equipment, and processes that improve the efficiency and safety of inland water transportation. These advancements include improvements in vessel design, navigation equipment, cargo handling, and fuel efficiency. Understanding technological advancements is important for identifying potential areas for improvement and for ensuring the sustainability of the sector in the long term.

In conclusion, the study of inland water transportation for a project involves several key concepts, including transport infrastructure, cargo volumes, regulatory framework, economic

impact, environmental impact, and technological advancements. By conceptualizing and identifying these key concepts, researchers can develop a clear understanding of the sector and identify areas for improvement. This understanding can inform policy and decision-making, leading to a more efficient and sustainable inland water transportation sector.

Water transport is the most cost effective and fuel-efficient mode of transport. According to estimates, one litre of fuel can move 24 tonne km of freight by road, 85 by rail and 105 by IWT. Also, government figures establish the fact that a shift of one billion tonne km of freight to IWT will bring down the fuel coast by about INR 250 million and the coast of transportation by about INR 450 million. Data presented in table 1 in annexure makes is easier to understand why IWT is the most fruitful mode of transportation with the increasing cost of logistics, Inland waterways after a potential scope of improving the bottom line for the companies. Inland waterways especially make a strong case for transportation of bulky and heavy materials likes steel, iron ore, coal, cement, and fertilizers etc. which occupy large volume and are very heavy. These materials are usually transported in large quantities and require high shipment capacity, Fuel consumption per tonne of freight shipped by water is only 15% of that of road and around 54% of that used by railways [Integrated logistics strategy, National Transport development policy committee, and september2011] Fixed coast for transportation per tonne can be reduced by 17.1% if handling of goods on one of port is mechanised and by 26.1% if handling of goods on one of the port is mechanised and by 35.3% if both the ports are mechanised for two way navigation [Raghuram G, 2004]

1. "Inland Water Transport and Ports: Linkages and Opportunities" by the World Bank

The World Bank discusses the importance of inland water transportation and its linkages to ports, highlighting the potential economic and environmental benefits. The report emphasizes the need for investment in infrastructure and the development of regulatory frameworks to promote sustainable inland water transport.

2. "Inland water transport in Europe: Prospects and challenges" by the European Parliament

This report examines the challenges and opportunities of inland water transport in Europe. It discusses the potential benefits of increased use of inland waterways, such as reduced greenhouse gas emissions and congestion on roads and railways. The report also highlights the need for investment in infrastructure and the development of a sustainable transport system.

3. "A review of inland waterway transportation in India" by A. Sinha et al.

This paper provides a review of the inland waterway transportation system in India, highlighting the potential for increased use of inland waterways for cargo transportation. The authors discuss

the challenges faced by the sector, including inadequate infrastructure, lack of investment, and insufficient regulatory frameworks.

4. "Challenges and opportunities of inland waterway transportation in Brazil" by V. M. Guimaraes et al. This paper examines the potential for inland waterway transportation in Brazil, highlighting the benefits of reduced transportation costs and improved access to remote regions. The authors discuss the challenges faced by the sector, including inadequate infrastructure, insufficient regulation, and a lack of intermodal connections.

5. "Inland waterway transportation in China: An overview" by Z. Liu et al.

This paper provides an overview of the inland waterway transportation system in China, discussing the potential benefits of increased use of inland waterways for cargo transportation. The authors examine the challenges faced by the sector, including inadequate infrastructure, limited navigational capacity, and lack of intermodal connectivity.

6. "The potential of inland waterways for sustainable transport in Southeast Asia" by the United Nations Economic and Social Commission for Asia and the Pacific

This report examines the potential of inland waterways for sustainable transport in Southeast Asia, highlighting the benefits of reduced greenhouse gas emissions and improved access to remote regions. The authors discuss the challenges faced by the sector, including inadequate infrastructure, lack of investment, and insufficient regulatory frameworks.

7. "Inland Waterway Transportation in the United States: An Overview" by the Congressional Research Service. This paper provides an overview of the inland waterway transportation system in the United States, discussing the potential benefits of increased use of inland waterways for cargo transportation. The authors examine the challenges faced by the sector, including aging infrastructure, funding constraints, and insufficient regulatory frameworks.

8. "The role of inland waterways in a sustainable transport system" by the International Transport Forum This report examines the role of inland waterways in a sustainable transport system, highlighting the potential benefits of reduced greenhouse gas emissions and improved access to remote regions. The authors discuss the challenges faced by the sector, including inadequate infrastructure, lack of investment, and insufficient regulatory frameworks.

9. "Inland waterway transport and sustainable development: A global perspective" by the United Nations Conference on Trade and Development This paper examines the role of inland waterway transport in sustainable development, highlighting the potential benefits of reduced transportation costs and improved access to remote regions. The authors discuss the challenges faced by the sector, including inadequate infrastructure, lack of investment, and insufficient regulatory frameworks.

10. "Inland waterway transport in Africa: A review" by A. G. A. Ahmed et al.
This paper provides a review of the inland waterway transportation system in Africa, highlighting the potential for increased use of inland waterways for cargo transportation.

11. The "Statistics of Inland Water Transportation 2014-15" report published by the Transport Research Wing of the Ministry of Road Transport and Highways in India provides valuable insights into the state of inland water transportation in India. The report presents data on various parameters such as the number of vessels, cargo traffic, and the length of inland waterways. The information provided in the report can be useful for researchers, policymakers, and industry practitioners to understand the current state and potential of inland water transportation in India. One of the key findings of the report is that the volume of cargo transported through inland waterways has been steadily increasing in recent years, highlighting the growing importance of this mode of transportation. The report also highlights the need for infrastructure development, particularly the construction of new terminals and the modernization of existing ones, to support the growth of inland water transportation.

However, the report also identifies several challenges that need to be addressed, such as inadequate infrastructure, limited connectivity to hinterlands, and operational inefficiencies. Addressing these challenges will require concerted efforts from policymakers, industry players, and other stakeholders to promote the development of a robust inland water transportation system in India. Overall, the "Statistics of Inland Water Transportation 2014-15" report provides important insights that can inform efforts to promote sustainable and efficient transportation systems in India.

2.4 Research Gap

Inland water transportation is an important mode of transportation that can offer significant economic, social, and environmental benefits. However, despite its potential, there are several gaps in the existing research on inland water transportation in India. In this section, we will discuss some of the key research gaps that need to be addressed to improve our understanding of this mode of transportation and its potential in India.

1. Lack of comprehensive data: One of the major gaps in the research on inland water transportation in India is the lack of comprehensive data. While some data is available, it is often incomplete, outdated, or unreliable. This makes it difficult to accurately assess the current state of inland water transportation and its potential in India. More comprehensive and reliable data is needed to inform policy decisions and support investment in this sector.

2. Limited understanding of the economic potential: While there is some research on the economic benefits of inland water transportation, there is limited understanding of its full potential. For example, studies have focused on the potential for reducing transportation costs and congestion, but have not fully explored the potential for job creation, regional development, and other economic benefits. There is a need for more comprehensive studies that can capture the full range of economic benefits associated with inland water transportation.

3. Limited focus on environmental and social impacts: While there is growing interest in sustainable transportation, there is limited research on the environmental and social impacts of inland water transportation in India. For example, studies have not fully explored the potential for reducing carbon emissions and improving air quality. Similarly, there is limited understanding of the social impacts of inland water transportation, such as its potential to improve access to healthcare and education in remote areas. More research is needed to fully understand the environmental and social impacts of inland water transportation in India.

4. Limited focus on policy and regulatory issues: While there is some research on the policy and regulatory issues related to inland water transportation, there is limited understanding of the broader policy and regulatory framework needed to support the growth of this sector. For example, studies have not fully explored the potential for public-private partnerships, the need for regulatory reform, and the role of international cooperation. More research is needed to fully understand the policy and regulatory issues related to inland water transportation in India.

5. Limited research on the potential for innovation: While there have been some innovations in inland water transportation, such as the use of electric and hybrid vessels, there is limited research on the potential for further innovation. For example, studies have not fully explored the potential for digitalization, automation, and other emerging technologies. More research is needed to fully understand the potential for innovation in inland water transportation and its implications for the future of this sector.

In conclusion, there are several research gaps that need to be addressed to improve our understanding of inland water transportation in India. Addressing these gaps will require concerted efforts from policymakers, researchers, and other stakeholders to promote a more comprehensive and integrated approach to research on this important mode of transportation.

2.5 Summary and Critique of The Literature

The literature on inland water transportation in India is extensive and covers a wide range of topics, including its economic potential, environmental and social impacts, policy and regulatory issues, and potential for innovation. The available literature highlights the significant potential of inland water transportation to offer economic, social, and environmental benefits, particularly in a country like India with a large network of rivers and waterways. However, there are also several gaps and limitations in the existing research that need to be addressed.

One of the key strengths of the literature is its focus on the economic potential of inland water transportation. Several studies have highlighted the potential for reducing transportation costs, increasing efficiency, and improving connectivity, particularly for the movement of bulk commodities. The literature also highlights the potential for job creation, regional development, and other economic benefits associated with the growth of inland water transportation. However, some studies have also highlighted the challenges associated with the development of this sector, including the need for infrastructure investment, regulatory reforms, and public-private partnerships.

Another strength of the literature is its focus on the environmental and social impacts of inland water transportation. Studies have highlighted the potential for reducing carbon emissions, improving air quality, and promoting sustainable transportation. There is also growing interest in the potential for improving access to healthcare, education, and other social services through the development of inland water transportation. However, there is limited research on the broader social and cultural implications of inland water transportation, particularly in areas with a strong dependence on rivers and waterways.

Despite these strengths, there are several gaps and limitations in the existing research. One of the key limitations is the lack of comprehensive data on inland water transportation in India. While some data is available, it is often incomplete, outdated, or unreliable, making it difficult to accurately assess the current state of inland water transportation and its potential. There is a need for more comprehensive and reliable data to inform policy decisions and support investment in this sector. Another limitation of the literature is the limited focus on policy and regulatory issues related to inland water transportation. While some studies have explored these issues, there is limited understanding of the broader policy and regulatory framework needed to support the growth of this sector. There is a need for more research on the potential for public-private partnerships, regulatory reform, and the role of international cooperation in promoting the development of inland water transportation. Finally, there is limited research on the potential for

innovation in inland water transportation. While some studies have explored the potential for emerging technologies such as electric and hybrid vessels, there is limited understanding of the broader potential for digitalization, automation, and other innovations in this sector. More research is needed to fully understand the potential for innovation in inland water transportation and its implications for the future of this sector.

In conclusion, the literature on inland water transportation in India highlights the significant potential of this mode of transportation to offer economic, social, and environmental benefits. However, there are also several gaps and limitations in the existing research that need to be addressed. Addressing these gaps will require concerted efforts from policymakers, researchers, and other stakeholders to promote a more comprehensive and integrated approach to research on this important mode of transportation. By addressing these gaps, we can unlock the full potential of inland water transportation in India and contribute to a more sustainable, efficient, and equitable transportation system.

CHAPTER III
CURRENT STATE OF INDIA'S INLAND WATER TRANSPORTATION INFRASTRUCTURE AND REGULATIONS

3.1 Overview

India's inland water transportation infrastructure has been underutilized and neglected for a long time, with much of the focus on road and rail infrastructure. However, with growing concerns over the environmental and social impacts of traditional modes of transport, there is renewed interest in exploring the potential of inland waterways for freight and passenger transport. This objective seeks to analyse the current state of India's inland water transportation infrastructure and regulations, including the availability and condition of waterways, ports, and terminals, as well as the regulatory framework governing the sector.

India has an extensive network of rivers, canals, and backwaters, covering over 14,000 km of navigable waterways. The National Waterway Act was enacted in 1986 to develop inland waterways as a mode of transport and facilitate their integration with other modes of transport. The Act declared five waterways as national waterways, which were later increased to 111 waterways. The Inland Waterways Authority of India (IWAI) was established in 1986 as the nodal agency for the development and regulation of inland waterways in the country.

Despite this, the potential of inland waterways has not been fully realized in India. Most of the waterways are underutilized and lack adequate infrastructure, including navigational aids, terminals, and port facilities. Many of the waterways are shallow, and during the dry season, they are not navigable. Furthermore, there are significant challenges related to the maintenance of the waterways and ensuring their safety and security.

To illustrate this point, we can consider the case of the Ganga River, which is one of the longest and most important rivers in India, with a length of over 2,500 km. The river has immense potential for inland water transportation, and the government has launched several initiatives to develop it as a national waterway. However, the river faces several challenges, including pollution, silting, and flooding, which make navigation difficult and increase the risk of accidents. There is also a lack of infrastructure, including terminals, jetties, and berths, which makes it challenging for cargo and passengers to access the river.

In addition to infrastructure challenges, there are also regulatory challenges that hinder the development of inland water transportation in India. For instance, there are different agencies responsible for the regulation of inland waterways, including the IWAI, state governments, and port authorities. This leads to overlapping responsibilities and a lack of coordination, which

affects the efficiency and effectiveness of the sector. There is also a lack of clarity regarding the tariffs and fees for using inland waterways, which makes it difficult for shippers and carriers to plan and price their operations.

To address these challenges, the Indian government has launched several initiatives, including the Jal Marg Vikas Project, which aims to develop the Ganga River as a national waterway. The project includes the development of multi-modal terminals, construction of navigational infrastructure, and dredging of the river to make it more navigable. The government has also launched several policy initiatives to promote inland water transportation, including the National Waterways Bill, which seeks to declare several additional waterways as national waterways and provide a regulatory framework for their development and management.

In conclusion, the current state of India's inland water transportation infrastructure and regulations presents significant challenges that hinder the development of the sector. The lack of adequate infrastructure, regulatory ambiguity, and the lack of coordination between agencies all contribute to the underutilization of the potential of inland waterways in India. However, the government has launched several initiatives to address these challenges and promote the development of the sector. The success of these initiatives will depend on the government's ability to address the underlying infrastructure and regulatory challenges and provide a supportive policy environment for the sector to thrive.

Water transport is the cheapest and the oldest mode of transport. It operates on a natural track and hence does not require huge capital investment in the construction and maintenance of its track except in case of canals. The cost of operation of water transport is also very less. It has the largest carrying capacity and is most suitable for carrying bulky goods over long distances. It has played a very significant role in bringing different parts of the world closer and is indispensable to foreign trade.

Kinds of Water Transport:

Water transport consists of:

- Inland water transport
- Ocean transport

Inland water transport

They are artificial waterways made for the purpose of irrigation or navigation or both. Canal transport requires a huge amount of capital investment in construction and maintenance of its track i.e., the artificial waterways. The cost of the canal transport is, therefore, higher than that

of river transport. To add to it, the cost of providing water for the canals is also a very big problem of canal transport.

Advantages:

1. Low Cost:

Rivers are a natural highway which does not require any cost of construction and maintenance. Even the cost of construction and maintenance of canals is much less or they are used, not only for transport purposes but also for irrigation, etc. Moreover, the cost of operation of the inland water transport is very low. Thus, it is the cheapest mode of transport for carrying goods from one place to another.

2. Larger Capacity:

It can carry much larger quantities of heavy and bulky goods such as coal, and, timber etc.

3. Flexible Service:

It provides much more flexible service than railways and can be adjusted to individual requirements.

4. Safety:

The risks of accidents and breakdowns, in this form of transport, are minimum as compared to any other form of transport.

Disadvantages:

1. Slow:

Speed of Inland water transport is very slow and therefore this mode of transport is unsuitable where time is an important factor.

2. Limited Area of Operation:

It can be used only in a limited area which is served by deep canals and rivers.

3. Seasonal Character:

Rivers and canals cannot be operated for transportation throughout the year as water may freeze during winter or water level may go very much down during summer.

4. Unreliable:

The inland water transport by rivers is unreliable. Sometimes the river changes its course which causes dislocation in the normal route of the trade.

5. Unsuitable for Small Business:

Inland water transport by rivers and canals is not suitable for small traders, as it takes normally a longer time to carry goods from one place to another through this form of transport.

Ocean transport

Ocean transport is indispensable for foreign trade. It has brought the different parts of the world closer and has knitted together all the nations of the world into one big world market. It operates on a natural track, i.e., the sea and does not require any investment in the construction and maintenance of its track. It is, obviously, the cheapest mode of transport.

Ocean transport includes:

Coastal Shipping

Overseas Shipping

1. Coastal Shipping:

It is one of the most important means of transport for carrying goods from one part to another in a country. It is a cheaper and quicker mode of transport and is most suitable for carrying heavy, bulky and cheap traffic like coal, iron ore, etc. to distant places. But it can serve only limited areas. Earlier, coastal shipping in India was mainly in the hands of foreign shipping companies. But now from 1951 onwards, it is exclusively reserved for Indian ships.

2. Overseas Shipping:

There are three types of vessels employed in the overseas shipping:

(i) Liners, (ii) Tramps,

(iii) Tankers.

(i) Liners:

Liners are the ships which have regular fixed routes, time and charges. They are, usually, a collection of vessels under one ownership, i.e., a fleet. They provide a uniform and regular service. Liners sail on scheduled dates and time, whether full of cargo or not.

(ii) Tramps:

Tramps are ships which have no fixed routes. They have no set rules or rate schedule. Usually, they do not sail till they have full cargo. They can be chartered by exporters and are ready to sail anywhere and at any time. They are not as fast in speed as liners. Tramps are more suitable to carry seasonal and bulky goods.

(iii) Tankers:

Tankers are the vessels which are specially designed to carry oil, petrol and such other liquids. They have a large capacity, 2 to 3 lakh tons of oil, and very shortly, we may have super tankers with a capacity of about 10 lakh tons of oil.

Advantages:

- It operates on a natural track as sea provides a readymade ‘road bed’ for the ships to sail. Hence, it does not require huge amount of capital investment in the construction and maintenance of its track.
- Due to the smooth surface of sea, comparatively less tractive power is required for its operation which results in a lesser cost of operation. Thus, it is the cheapest mode of transport.
- It has the largest carrying capacity as compared to any other transport.
- The risk of damage in transit of the goods is also less as compared to other modes of transport. But the goods are exposed to the ‘perils of sea’.
- It is the only suitable mode of transport for carrying heavy and bulky goods to distant places.
- It is indispensable to foreign trade.

Water Transport India

Around 95% of India’s trading by volume and 70% by value is done through maritime transport. India has 12 major and 205 notified minor and intermediate ports. Under the National Perspective Plan for Sagarmala, six new mega ports will be developed in the country.

Foreign Direct Investment (FDI) of up to 100% under the automatic route for port and harbour construction and maintenance projects. It has also facilitated a 10-year tax holiday to enterprises that develop, maintain and operate ports, inland waterways and inland ports.

India’s key ports had a capacity of 1,534.91 million tonnes per annum (MTPA) in FY20. In FY21, all key ports in India handled 672.60 million tonnes (MT) of cargo traffic.

Merchandise exports reached US$ 255.92 billion in FY21 (until February 2021).

India is expected to begin full operations in Iran’s Chabahar Port by the end of May 2021. India is building two terminals at the port and will operate them for 10 years

In Union Budget 2020-21, the total allocation for the Ministry of Shipping was Rs. 1,702.35 crore (US$ 233.48 million).

The finance minister proposed to double the ship recycling capacity of ~4.5 million light displacement tonnes (LDT) by 2024; this is expected to generate an additional ~1.5 lakh employment opportunities in India.

In Union Budget 2021, the government announced subsidy funding worth Rs. 1,624 crore (US$ 222.74 million) to Indian shipping companies to encourage merchant ship flagging in the country.

in February 2021, the Major Port Authorities Bill, 2020 was passed by the Parliament of India. The bill aims to decentralise decision-making and reinforce excellence in major port governance.

Major Ports Authorities Bill 2020

The Bill provides for the regulation of major ports and will replace the Major Port Trusts Act of 1963,

The Bill will apply to the major ports of

Chennai,

Cochin,

Jawaharlal Nehru Port,

Kandla,

Kolkata,

Mumbai,

New Mangalore,

Mormugao,

Paradip,

VO Chidambaranar,

Vishakhapatnam.

The Bill provides for the creation of a Board of Major Port Authority for each major port. It will replace the port Port trust provided by the former act. It will have a member each from the state governments, the Railways Ministry, the defence ministry, and the customs department.

Board will have financial power – To meet its capital and working expenditure requirements, the Board may raise loans from any scheduled bank or financial institution within India, or any financial institution outside India.

The Board will determine these rates for services that will be performed at ports. At present, the Tariff Authority for Major Ports fixes the scale of rates for assets and services available at ports.

Under the new Bill, any person contravening any provision of the Bill or any rules or regulations will be punished with a fine of up to Rs one lakh.

Challenges faced in respect of existing ports include

Inadequate road networks within the port area,

Inadequate cargo-handling equipment and machinery,

Inefficiency due to poor hinterland connectivity through rail, road, highways, coastal shipping and inland waterways,

Inadequate navigational aids, facilities and IT systems,

Insufficient dredging capacity,

Lack of technical expertise and

A lack of equipment for handling large volumes.

The turnaround time at ports in India therefore remains abysmal.

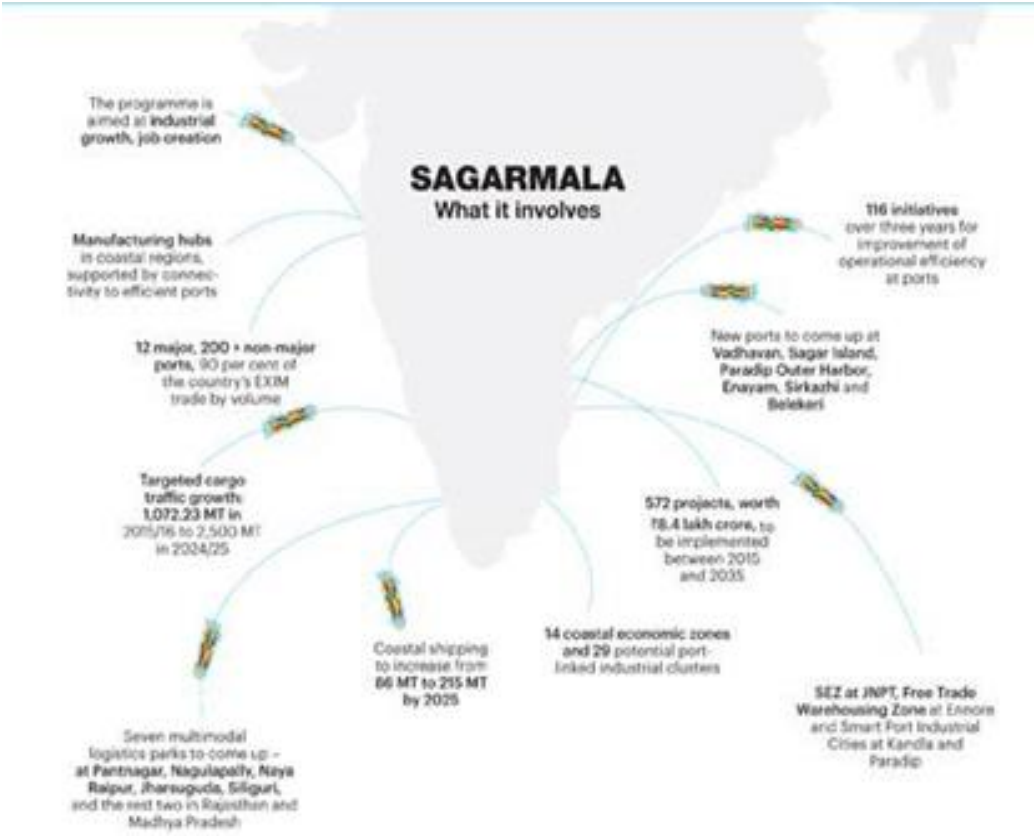
Government initiatives.

3.2 Major Challenging In Regulation In IWT

1. Sagarmala program

It focuses on modernizing and developing ports, enhancing port connectivity, supporting coastal communities, and stimulating port-linked industrialization. Sagarmala aims

to reduce the logistics costs for foreign and domestic trade. It also aims to double the share of water transportation in the modal mix.



1. Jal Marg Vikas project

Jal Marg Vikas Project (JMVP) is a project for the development of National Waterways in India. JMVP was implemented as an initiative towards national integration with an aim to reduce rail and road congestion, carbon footprint, and minimal resource depletion.

2. Central Road and Infrastructure Fund

The Ministry of Finance has amended the Central Road Fund Act, 2000 to include a list of projects and infrastructure sub-sectors, including inland waterways, for which the CRF could be used. The CRF has since been renamed the Central Road and Infrastructure Fund.

Way forward

The government needs to open up the dredging market to attract more players, particularly international players, in dredging activities to increase and maintain draft depth at ports to attract large vessels and enable them to become hub ports.

Expedite the completion of various projects under Sagarmala, especially those aimed at improving port connectivity, setting up coastal economic zones (CEZs), and establishing new ports.

Financing for inland vessels could be made part of priority sector lending by banks.

The setting up of a single-window facility for cargo clearance and putting in place fully mechanized cargo handling infrastructure will be critical to increase throughput. Enhance technology use in ports and, wherever feasible, draw lessons from successful global ports such as Rotterdam, Felixstowe, and Singapore to improve efficiency.

Inland transport

As per the National Waterways Act, 2016, 111 have been declared as National Waterways (NW) These waterways pass through 24 states and two union territories, with an approximate total length of 20274 km

These proposed waterways will pass through nearly 138 river systems, creeks, estuaries and related canal systems of India.

Advantages of Inland Waterways:

- Cost savings:
- Fuel and Energy Efficient: It is fuel-efficient compared to the other modes of transport, rail and road. For example, the Integrated National Waterways Transportation Grid Study states that one litre of fuel will move 24 tons through one kilometre on road, 85 on rail and 105 km on inland water transport. Further, 1 HP can 150 kg on road, 500 kg on rail and 4000 kg on water.
- Cost of developing waterways is much lower than rail & road.
- Reduces transportation and transition losses
- Environment Friendly:
- Least fuel consumption per tonne-km

- Carbon dioxide emission is 50% of trucks
- Negligible land requirement as compared to rail and road transport
- Supplementary Mode:
- Reduces pressure on road and rail
- Reduces congestion and accidents on road
- Optimal Modal Mix: It will provide optimal modal mix by converging river transport with other modes
- Better connectivity: It help create seamless interconnectivity connecting hinterlands along navigable river coasts and coastal routes. Further, riverine routes are likely to play a crucial role in connecting the north-eastern states to the mainland
- Inland Waterways hold huge potential for domestic cargo transport, cruise, tourism and passenger traffic.
- Development of inland waterways will help in the generation of job opportunities

Disadvantages of Inland waterways:

- Inland waterways have low transport speed thus not suitable where time is an important factor
- It has limited area of operation, depending on the infrastructural premises and depth of the waterways
- There are only very few cases in which Inland water transport (IWT) can offer door-to-door transport of cargo
- Operational disruptions due to weatherise a major disadvantage

Legislation:

1.The Inland Waterways Authority of India Act, 1985:

The Act provides for the constitution of an Authority for the regulation and development of inland waterways for purposes of shipping and navigation and for matters related to it

The Inland Waterways Authority of India was formed in 1986. It undertakes projects for development and maintenance of IWT infrastructure on national waterways through grant received from Ministry of Shipping

- Indian Vessels Act of 1917 (amended in 2007): It deals with the survey and registration of inland vessels, removal of obstructions in navigation, carriage of goods and passengers, prevention and control of pollution etc.

- Inland Water Transport Policy 2001: Policy talks about IWT being economic, fuel-efficient and environment friendly mode of transport. It advocates large-scale private sector participation both for creation of infrastructure and for fleet operations.
- National Waterways Act 2016 The Act declared 111 rivers or river stretches, creeks, estuaries as National (inland) Waterways. It enables the Central Government to regulate these waterways for development with regard to shipping, navigation and transport through mechanically propelled vessels.

Laws related to environmental and other impacts:

Forest Act 1980, Environmental Protection Act 1986 and various notifications under it like EIA Notification 2006, CRZ Notification 2011

Initiatives:

Jal Marg Vikas Project:

Jal Marg Vikas Project (JMVP) aims at capacity augmentation of navigation on National Waterway-1 (NW-1). The project is being implemented by GOI with technical assistance and investment support of the World Bank.

Sagarmala Project:

Along with development of coast shipping routes, the project seeks to inland waterways to drive industrial development. It aims to reduce the logistics costs by doubling the share of domestic waterways in the modal mix from current 6 per cent (PIB)

Interlinking of Rivers Programme: The project is expected to offer potential benefits to the transport sector through navigation.

Issues and Challenges

- Cost estimation: In respect to operating costs per ton-km, IWT has lower cost than rail and road transport. However, this cost argument is challengeable. There are two factors which distinguishes how freight moves on land versus on water: i) A road travels straight while rivers bend and curve; therefore, the difference between freight costs for IWT and road/ railways is not much ii) Cost of loading and unloading freight
- Inadequate depth: To be viable for a navigable inland waterway, river needs enough depth throughout the year However, in their natural state; many Indian rivers simply do not have that level of water which will necessitate extensive dredging. Moreover, Indian rivers (especially rivers in the northern plains) face severe problems of siltation round the year.

- Impact on other activities: Water in rivers has competing demands, including dams and farming. To maintain the water levels in the river to the degree needed for them to function as inland waterways, the water use for such other activities might get curbed.
- Inadequate Air Draft: Multiple bridges with low vertical clearance obstruct the passage of bigger inland water transport vessels on many inland waterways such as NW 3
- Lack of night navigation infrastructure: Rudimentary night navigational facilities and markings are also a major issue.
- Shortage of IWT vessels: Vessel building is highly capital intensive and faces difficulties in obtaining project finance from banks and financial institutions.
- Shortage of MRO facilities: There is severe shortage of MRO (Maintenance, Repair and Overhaul) facilities for IWT vessels.
- Inadequate industries: Inadequate number of Industrial units on the riverside, especially not along the Brahmaputra is a major discouragement hindering development of inland waterways. At National Policy Dialogue on transboundary cooperation related to the Ganga and the Brahmaputra rivers – states, it was highlighted that due to inadequate industrial units result in no cargo commitments by the private players
- Lack of funds: Dredging as well as infrastructure for IWT requires huge investments. However, both public and private funding in the sector is low.

3.3 Environmental Impact Assessment

Dredging operations will damage river bed, and can lead to change in habitats for various aquatic flora and fauna. Dredging may also impact aquifers along the river, damaging the ability of water to percolate underground. In estuaries and creeks of rivers the removal of river bed material during capital dredging can result in the ingress of excess saline water into the creek or rivers. This is one of the reasons why the state of Kerala had opposed many of its proposed waterways Construction of jetties, river ports will necessitate removal of trees/ mangrove forests in the area. For example, At Dharam tar port in NW10, for construction of a jetty, the mangrove forest belt on the bank has been removed.

Other environmental concerns include pollution due to oil and diesel from vessels, leakage and spilling of cargo

Note: Dredging is an excavation or digging activity carried out underwater that removes rock, mud, silt, sediments etc. from the bottom of the river bed or other water bodies. Dredging is used to dig and create a channel in the river bed of the required depth.

11.Social impact:

Ecological impacts can have implications for livelihoods of people dependent on the rivers and creeks. For example: impact on fishing community, people dependent on riverbed cultivation

Displacement is another major concern as land is needed for number of facilities like ports, jetties, and other infrastructure.

NITI Aayog Recommendations (Action Agenda, Three-Year2017-2020)

According to IWAI, the major challenges in developing National waterways are:

- Development and maintenance of Fairway width of 2.5 m to 3.0 m depth.
- Recurring siltage and irregular siltation
- Speed Control regulations to avert bank erosion and safety of other users.
- Safety against cross ferries
- Connectivity to Terminal Locations
- Clearance at Cross Structures/bridges
- Identification of navigational channel in a wide river.
- Discharge control by regulations
- Difficulty in land acquisition for development of terminals.

1.Streamline the governance of inland waterways: NITI Aayog recommends streamlining the regulatory structure and bringing an overarching body to oversee Inland Water Transport such as the IWAI to more consistency in the rules and strategy of the sector.

2.Develop measures for year-round navigation: Efforts should be made to develop deeper stretches of the river, i.e., at least 2.5 m to 3 m to achieve year-around navigation adequate maintenance of rivers, including continuous dredging to maintain adequate water depth for servicing shipping lines should be ensured

3.Ease restrictions on river-sea movement: Utilizing a single vessel for both inland and coastal waters, lowers transport costs and minimizes handling. Thus, by 2020, state authorities should draw up coordinates for inland vessel limits under the Inland Vessel Act for their coastal waters

4.Develop inland waterways transport to facilitate movement of goods to neighbouring countries and the Northeast: By 2018, state governments should commence work on dredging and channel stabilization to create about 20 new ports in the Brahmaputra and Barak rivers.

The protocol for Inland Waterways between Bangladesh and India should be extended for at least 10 years to reduce uncertainty.

3.4 Economic viability of inland water transportation in India.

Inland water transportation (IWT) is considered a cost-effective and energy-efficient mode of transport, particularly for bulky goods and commodities, such as coal, iron ore, and grains. The economic viability of IWT in India is influenced by several factors, including operating costs, revenues, and potential benefits for shippers, manufacturers, and other stakeholders.

One of the main advantages of IWT is its relatively low operating costs compared to other modes of transportation, such as road and rail. According to a report by the Inland Waterways Authority of India (IWAI), the operating cost per ton-kilo meter of IWT is about 1/3rd to 1/4th that of road transport and about 1/2nd to 1/3rd that of rail transport in India. The lower operating costs are mainly due to the lower fuel consumption and labour costs associated with IWT.

In addition to lower operating costs, IWT can also generate revenue for the government and private sector through various sources, such as tolls, port charges, and cargo handling fees. According to the IWAI, the total revenue earned from IWT in India was about Rs. 1,363 crores in the financial year 2018-19. This includes revenue earned from cargo handling, port charges, and other services provided by the IWAI.

There are also potential benefits for shippers and manufacturers who use IWT. For example, IWT can reduce transportation costs and improve supply chain efficiency by providing a reliable and cost-effective mode of transport for bulk commodities. It can also help to reduce road congestion and improve road safety by reducing the number of heavy vehicles on the roads.

However, the economic viability of IWT in India is also influenced by several challenges and constraints. One of the main challenges is the limited availability and reliability of IWT infrastructure, such as navigable waterways, ports, and terminals. This can result in longer transit times, higher costs, and lower reliability for shippers and manufacturers.

Another challenge is the lack of coordination and integration between different modes of transportation, such as road, rail, and IWT. This can result in inefficiencies and higher costs for shippers and manufacturers who need to use multiple modes of transport to move their goods.

Furthermore, IWT faces competition from other modes of transport, particularly road and rail, which are often perceived as more reliable and flexible. This competition can result in lower volumes of cargo being transported by IWT, which can make it difficult to achieve economies of scale and lower operating costs.

Despite these challenges, there are several examples of successful IWT operations in India. For instance, the National Waterway 1 (NW-1), which runs along the Ganges River, has seen a significant increase in cargo volumes in recent years. According to the IWAI, the cargo volume

on NW-1 increased from 3.1 million tons in 2014-15 to 6.79 million tons in 2018-19, mainly due to the increased use of IWT for coal transportation.

Another example is the successful partnership between the IWAI and the private sector for the development of new IWT terminals and infrastructure. For instance, the IWAI has signed a Memorandum of Understanding (MoU) with the Adani Group for the development of a new container terminal at the Kamarajar Port in Ennore, Tamil Nadu. This partnership is expected to boost the use of IWT for container transportation and improve supply chain efficiency in the region.

In conclusion, the economic viability of inland water transportation in India is influenced by several factors, including operating costs, revenues, and potential benefits for shippers, manufacturers, and other stakeholders. While there are several challenges and constraints facing IWT in India.

3.5 Environmental Impacts of Inland Water Transportation in India

Inland water transportation has the potential to provide an environmentally sustainable alternative to other modes of transportation, particularly in terms of reducing greenhouse gas emissions and air pollution. However, the impact of inland water transportation on the environment is not completely benign, and it is essential to study and understand these impacts to develop effective strategies for mitigating them. In this section, we will examine the environmental impacts of inland water transportation in India.

One of the significant environmental benefits of inland water transportation is its potential to reduce greenhouse gas emissions. According to a report published by the Inland Waterways Authority of India (IWAI), inland water transportation in India emits 50% less carbon dioxide (CO2) per ton-kilometre than road transportation and 30% less than rail transportation. Furthermore, it emits significantly less particulate matter, sulphurv dioxide, and nitrogen oxide than road transportation, which are major contributors to air pollution in India. Inland water transportation also has the potential to reduce traffic congestion on roads, thereby reducing emissions from idling vehicles.

However, inland water transportation can have adverse environmental impacts as well. One of the significant environmental concerns associated with inland water transportation is the potential for water pollution. Inland waterways can act as a conduit for the discharge of untreated or partially treated wastewater, industrial effluents, and other pollutants. These pollutants can

have adverse impacts on aquatic ecosystems, including fish and other aquatic species, and can also make water unsuitable for human use.

The construction and maintenance of inland water transportation infrastructure can also have adverse environmental impacts. For example, dredging of waterways can disrupt aquatic habitats, and construction of ports and terminals can lead to land use changes and habitat fragmentation. The use of fuel-powered vessels in inland water transportation can also contribute to air and noise pollution.

Despite these potential environmental impacts, there is a lack of systematic data on the environmental performance of inland water transportation in India. Some studies have attempted to estimate the environmental benefits of inland water transportation, but these studies tend to be limited in scope and have not considered the full range of environmental impacts associated with the sector. Furthermore, there is a lack of comprehensive regulations and standards governing the environmental performance of inland water transportation in India.

One example of efforts to promote sustainable inland water transportation practices is the Green Freight Initiative (GFI) launched by the IWAI in 2018. The GFI aims to reduce the environmental impact of inland water transportation in India by promoting the adoption of cleaner and more fuel-efficient vessels, reducing waste and emissions from vessels, and promoting the use of renewable energy sources. The GFI also aims to develop and implement environmental performance standards for inland water transportation and to promote sustainable practices among stakeholders in the sector.

In conclusion, inland water transportation has the potential to provide an environmentally sustainable mode of transportation in India, particularly in terms of reducing greenhouse gas emissions and air pollution. However, it is essential to address the potential environmental impacts of inland water transportation, particularly with regard to water pollution and habitat destruction. Developing comprehensive regulations and standards governing the environmental performance of inland water transportation, as well as promoting sustainable practices among stakeholders in the sector, can help to mitigate these impacts and ensure that inland water transportation remains a sustainable transportation option in the future.

CHAPTER IV
ANALYSIS OF THE STUDY

4.1 Introduction

India has a wide range of Inland Waterways with a high potential to connect transportation mediums throughout the nation that is cost-effective and sustainable in nature. The all the national waterways present in India and the total distance they cover in the area.

SLNO	INLAND TRADE ROUTE
1	CHANDPUR -PANDU-SILGHAT-KOLKATA
2	KOLKATA-CHANDPUR-KARIMGANJ-PANDU-SILGHAT
3	RAJSHAHI-DHULIAN-RAJSHAHI
4	SILGHAT-PANDU-ASHUGANJ-KARIMGANJ-PANDU-SILGHAT
5	KOLKATA-CHANDPUR-ASHUGANJ

The first two are considered the most cost-effective trade corridors for sustainability. The diplomatic connections that can be induced with improvement in the IWT of India with other neighbouring countries are an area open for further research. There are a few topics related to this section of maritime trade that can be enhanced and benefitted globally with further research and development, leading towards a more sustainable global transportation.

4.2 Development of Inland Waterways in India:

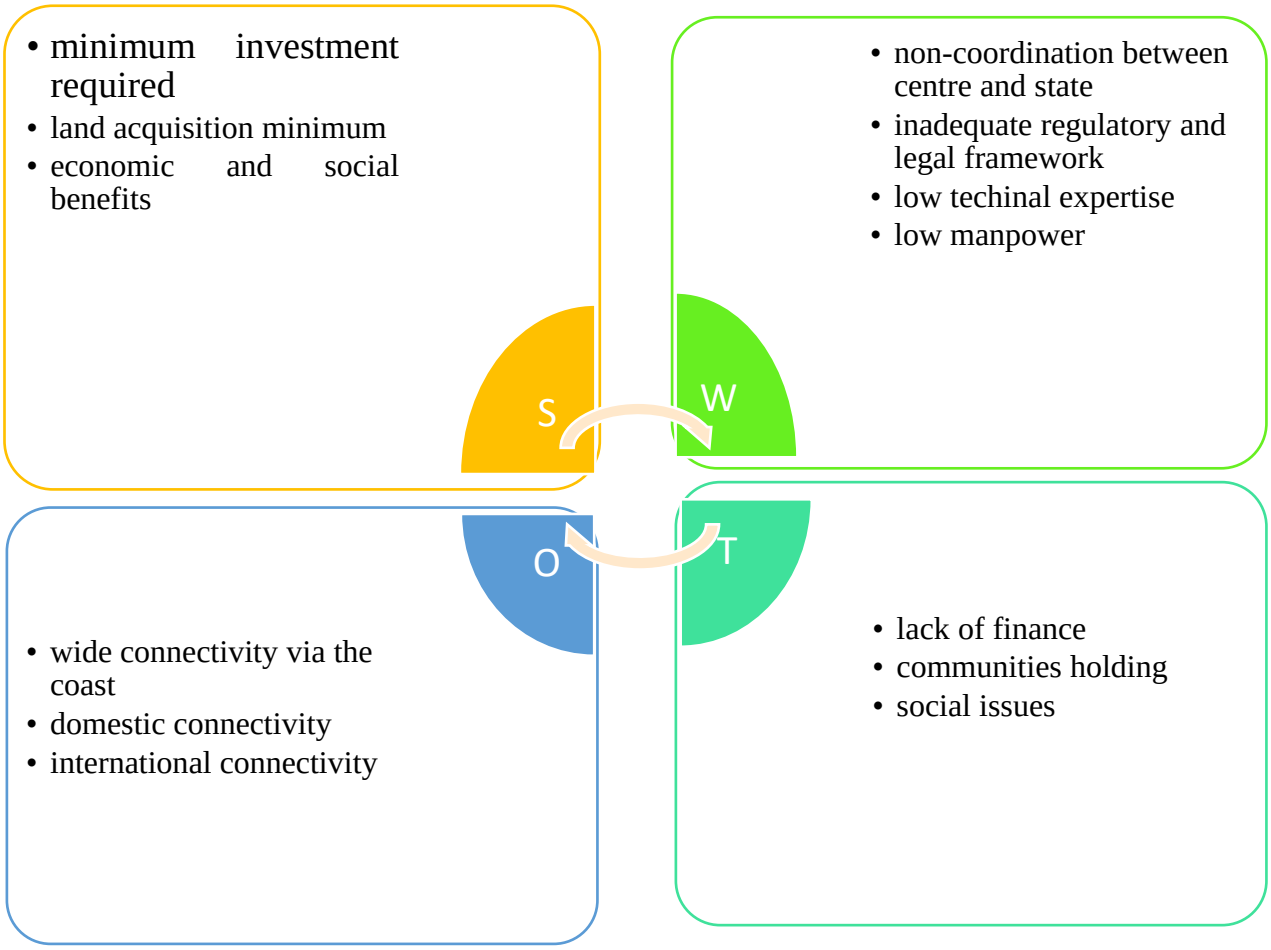
Lothal is the oldest trading dock in the world. It was in use around 2400 BC. It highlights the trade relations and transport of goods between India and countries like Rome and Egypt. As time progressed, India also had trade relations with China. The inland transport routes offer the opportunity of extending into new markets, enhancement in energy sources, and also the diplomatic relations between the counties. Even the colonization era of India saw massive maritime trade, as the merchants from Portugal and Britain exported Indian goods via, water. So, India Navigation Company was the first from India to sail under the domination of Britain on sea routes. India has a navigable area of waterways of about 14,500 km, with canals that stretch over 4000 km It has been used for transportation purposes. India being a country having a network of inland waterways through rivers, canals, backwater, etc, IWAI was appointed to look over it. Inland Waterways Authority of India was established by the Indian Government to develop navigable waterways. The Indian waterways have been the mode of transporting goods and cargo since colonial rule under the British. British rule had an Inland Vessels Act, 1917

which governed the vessels in the water. The Indian constitution presented amendments to it under the Inland Vessels Amendment act, 2007. The new modifications paid attention to centralizing database, insurance, and pollution control measures to improve inland water navigation.

4.3 Institutional Framework for IWT In India:

The post-colonization era of India saw a lot of activities by the government of India for the improvement and the maintenance of the inland water transport mediums present in the country. Some measures were constitutional, while others were strong institutionalized frameworks to shape the maritime trade of the nation. While some of those steps needed a legal and voluntary retirement, others continue to thrive and shape the trading institution of India. The Indian Waterways Authority of India was set up by the government in 1986. It mostly supervised the regulations and development that pertained to navigation and shipping in the inland waterways. The Ministry of Ports, Shipping and Waterways grants funds to IWAI for the maintenance and development projects of infrastructure on IWT national highways (IWAI, 2022). The Inland Waterways Authority of India was initially established under the IWAI Act, 1985. It is bound to follow the Prevention of Collision on National Waterways Regulations, 2002, and the National Waterway, Safety of Navigation and Shipping Regulations, 2002 (PIB, 2022). Central Inland Water Transport Corporation Limited or CIWTC was another company under the government of India to look after the inland waterway trade and transportation. It was consolidated under the constitutional law of the Companies Act, 1956(www.pmindia.gov.in). Henceforth, established in Feb 1967, the CIWTC mainly took control of the liabilities and assets of the previously known River Steam Navigation Company Limited. However, the CIWTC was put under a Voluntary Retirement Scheme in the year 2015. It was becoming evident that CIWTC was incurring heavy losses over time as it took over the liabilities of River Steam Navigation Company Limited (www.pmindia.gov.in). The Indian Waterway Authority of India or IWAI needed an institute to develop and look after the human resource department of the IWT of India. Hence, under the Inland Vessel Act, 1917, National Inland Navigation Institute (NINI) was set up. Apart from the operation of inland vessels and the development of inland waterways, NINI also arranges vocational courses on the same.

4.4 SWOT analysis of the IWT of India



Waterway Transport of India is bestowed with. IWT has a wide coverage of sea area, with 111 national waterways transportation routes. But it also has disadvantages that are legal and constitutional in nature. Furthermore, the IWT provides a number of benefits including inter-linked connectivity to internal states as well as external. But it has obstacles like social and financial challenges in its path of development. It becomes essential for the Govt of India to come out with strategies that balance the pros and cons, alongside, offering its citizens a sustainable mode of freight transportation. India shares a history with other nations through its marine transportation qualities. It was a hub of trade during the Mesopotamian rule, with Lothal being the center. Furthermore, it was through the same sea route that the British came into India for trade and colonized it. The Govt of India understands the value of its Waterway freight transport medium and has authorized institutions to maintain and enhance it. Some institutes of

Indian IWT like CIWTC shut down due to financial reasons, while others like NINI and IWAI continue to provide their service in maritime transportation.

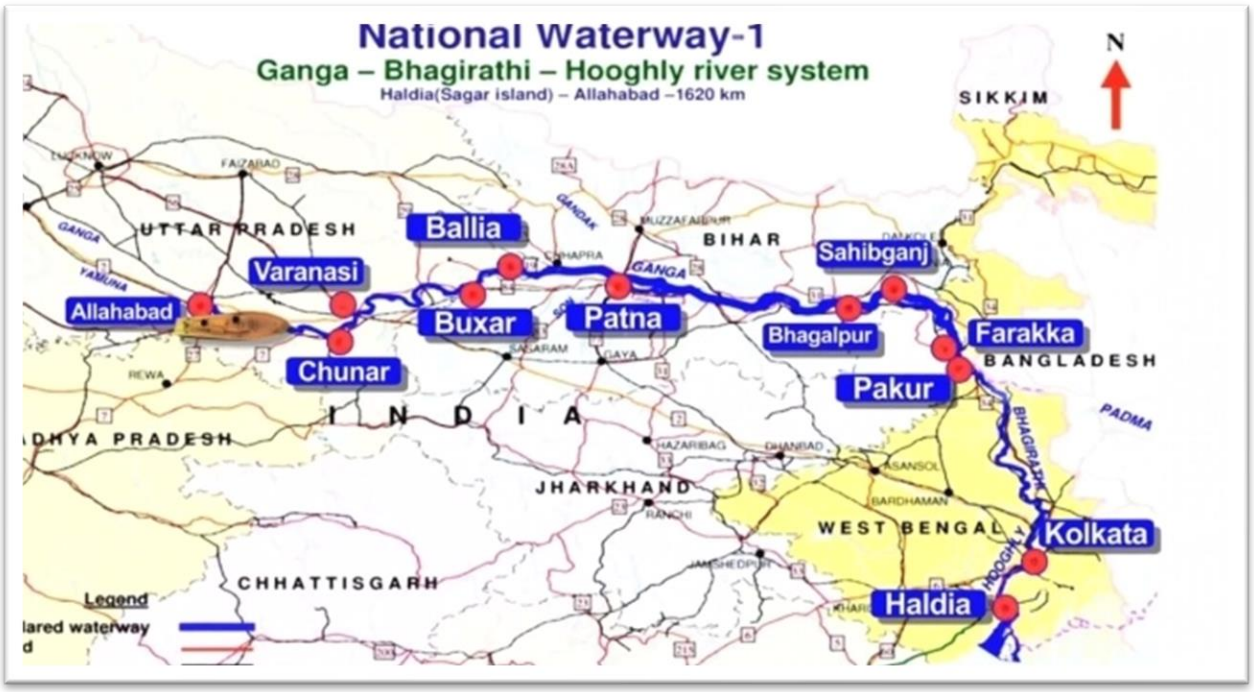
4.5 Challenges of Inland Waterways in India:

India has the widest connection of Inland waterways that can be utilized for transportation purposes and reduce the pressure on other modes of transportation. Unfortunately, IWT of India has its share of lacunas which hinder the process of attaining it. In order to have a sustainable development of maritime through the inland waterways of India, it is important to pay attention to the hydraulic workings in the freight transportation systems and vessels. Harmful chemicals have the potential to destroy the marine ecosystem, while banning them completely may affect the infrastructural development of the vessel. Regulation becomes an essential part of Inland waterway transportation of India, especially having 111 national waterways. The constitution has divided the authority over various aspects under different lists. Countries like the EU and Canada have an organized agency established. Unfortunately, developing countries like India struggle with regulatory authorities over maritime trade (Solomon et al, 2021). In order to have inland waterway travel, it is also important to have acceptance among all the domestic and geopolitical players. There are pending projects like inter-River Linking Projects under Water Resource Ministry with budgets of Rs. 350.05 crores hindering the connection and potential relation between domestic and international states through the development of inland waterways (Mehta, & Mehta, 2018). A certain degree of financial stabilization is required to focus on the sustainable aspect of freight transportation through inland waterways. Economic sustainability is attained through the creation of opportunities, both technical and technological in nature. With respect to the Indian scenario, there has been a crisis of investment for infrastructural building between the govt and the private sectors. Integrated development is an essential component of establishing a sustainable transportation mode via waterways. Many countries depend on it for cheaper access to cargo products via waterways than road or rail.

Case study

National Waterways 1 or NW1

- It starts from Allahabad (Prayagraj) to Haldia with a distance of 1620 km.
- The NW 1 run through the Ganges, Bhagirathi, and Hooghly River system with having fixed terminals at Haldia, Farrakka, and Patna and floating terminals at most of the riverside cities like Kolkata, Bhagalpur, Varanasi, and Allahabad.
- It is be the longest National Waterways in India.



One of the key examples of inland water transportation in India is the National Waterway 1 (NW-1) which runs along the Ganges River from Haldia in West Bengal to Prayagraj in Uttar Pradesh, covering a distance of about 1620 km. NW-1 is India's longest inland waterway and connects some of the major industrial and commercial centers in the region.

One of the ports situated along NW-1 is the Haldia Dock Complex (HDC) located in the state of West Bengal. HDC is an all-weather riverine port that handles a variety of cargo, including coal, iron ore, fertilizer, and containers. The port has a cargo handling capacity of over 40 million tonnes per annum and has state-of-the-art facilities for cargo handling, storage, and transportation. In recent years, there have been several initiatives to promote inland water transportation along NW-1. The government has invested in the development of new terminals, navigational aids, and cargo handling facilities to improve the infrastructure along the waterway. In addition, there have been efforts to diversify the types of cargo transported along NW-1, with a focus on non-bulk cargo such as automobiles and containerized cargo.

The development of inland water transportation along NW-1 has led to several benefits for the region. Firstly, it has resulted in a reduction in transportation costs, as inland water transportation is a more cost-effective mode of transportation compared to road or rail. Secondly, it has led to a reduction in air pollution, as inland water transportation is a more eco-friendly mode of transportation. Lastly, it has led to an increase in trade and commerce in the region, as the port has become more accessible to shippers and traders.

However, there are still several challenges that need to be addressed in order to fully realize the potential of inland water transportation along NW-1. These include the need for further infrastructure development, the need for a simplified regulatory environment, and the need for more efficient and modern vessels for transportation.

In conclusion, the case study of the Haldia Dock Complex along National Waterway 1 highlights the potential of inland water transportation in India's transportation system. The development of NW-1 has resulted in several benefits for the region, and there is significant scope for further growth and development in the sector. However, there are still several challenges that need to be addressed, and concerted efforts are required from the government and private sector to fully realize the potential of inland water transportation in India.

Passenger movement

In India, the main passenger movements by inland waterways that are viable are ferry operations across rivers (at numerous locations on all waterways), on short stretches along rivers and tourism-based passenger traffic (in Goa, Kerala, Sundarbans and Northern regions). Details of such movement are given in the statistical summaries produced by IWAI, the Ministry of Shipping, the Planning Commission working group on IWT and State level authorities like West Bengal [TRW, 2001; TRW, 2002], Kerala etc. Some factors that affect passenger movement are discussed below.

Travel time vis-a-vis the alternate land-based route: While time by land routes is generally reducing, with more and more bridges being constructed, it is still sometimes quite viable and direct to have ferry-based services in many parts. Faster ferries and launches are a possibility to encourage traffic on this node.

Cost: For passengers, the typical costs of ferry, while not high, have to be added to the costs of the subsequent mode of transport which may have to be used to achieve the end-to-end requirement of transport.

Interchange convenience: The waterway movement should be able to move seamlessly to other modes, e.g., bus and train. A few studies have shown quite convincingly that inland waterways can have a major role to play in the integrated passenger transport planning in an urban area. For example, a study in the Cochin metro area suggests that IWT will be an option that is impossible to ignore in the future growth of the city and calls for integrated investments to increase complementarity with other modes, faster vessels, unified pricing, ticketing and targeted subsidies in the area. Mumbai has experimented with faster modes of water transport such as hovercrafts (apart from continuing ferry systems), but a sustainable service mix has not been

found, as of now. Inland waterways provide a convenient function in related activities. Some of them are given below.

Carriage of vehicles (preferably in the roll-on-roll-off mode): West Bengal, Kerala and Goa have significant number of these ferry services, but there is potential for much more, with faster boats, proper landing facilities and interchange with other modes.

Tourism, including stay and entertainment: This is a growing activity with economic potential. In Kerala, Alappuzha and to a smaller extent, Kozhikode are centres of this activity, especially for houseboats. Boats that provide music and dining are becoming increasingly common in Mumbai, Goa and Kochi. Long distance river cruises, both as per schedule and as per a group demand are also available, though they retain an exclusive flavour.

Water sports: This is a new sector that has some possibilities in the rivers in North and East India. White water rafting and trekking on iced mountainous stretches of river are examples.

Cargo movement

Historically, location of industrial activity has been influenced by logistical convenience of riverine transport possibilities, at a time when road and rail networks were not so well developed. This may not be true to the same extent today, although access to water for processing and in some cases effluent treatment is still a consideration in location. The viability of goods movement using IWT is to be analysed from the perspectives of technological and physical viability, commercial potential and operating policy of carriers and associated agencies. As in any mode of transport, some factors that affect the economics and operation of a transport are the availability of the channel or right-of-way, facilities at the ends of travel and the carriers or vessels, together with all the managerial and supporting infrastructural systems to manage the flows. In IWT, these translate to the availability of the waterway, terminal facilities like jetties and ports, barges and other vessels capable of navigation, and finally the management component. In India, inland water transport on the Ganga may have provided among the earliest organized transport movements over significant distances, well before rail and road networks developed. Although the issue is not examined in detail here, movement and exports of commodities like tea, jute, spices in the eastern sector, connected to the riverine port in Kolkata have been among the early commercial drivers of the pre-independence subcontinent. It is clear from aggregate statistics that the sector has been growing only very slowly in the National Waterways and other major waterways. The glaring exception is the tidal river canal system in Goa, which saw unprecedented growth and where some 30 million tons of iron ore moved by barges on the Mandovi-Zuari-Cumbarjua system in This solitary example is enough to

demonstrate the economic potential per se and may provide some learning points in a variety of dimensions. This is explored in Appendix 6. In the rest of the document, we examine the technological and physical viability, followed by the traffic potential (including a consideration of other competing modes), and finally the economics of IWT. The management of the sector at the policy level is also addressed.

4.6 Technological and physical viability Water flow:

The basic prerequisite for water-based transport is the availability of water flow. In the main waterways, this may have decreased over the years because of increased usage arising from habitation, industrial and agricultural needs. The extent of regular flow may also have decreased because of the impact of dams on river streams.

River training, dredging and navigation: The next requirement is that the river is trained and consistently provides a sufficient depth vis-à-vis the draft of the vessels that are expected to ply on it. This is possible for some types of river beds and may require maintenance of banks and dredging of the river bed periodically, to maintain the required depth. Recent cost estimates of river training on Sabarmati River provide a figure of about Rs 10 to 11 crores/km on each bank. In rural areas, the figure could be lower, say Rs 8 to 9 crores/km. In India, IWAI, in principle, commits to maintaining a year-round draft of 2 m along the National Waterways. This is not found to be the case, in practice. One possibility is that it is strategically justified to provide this draft on appropriate channels, by an assessment of the commercial traffic potential on each waterway. The other option is for operators to plan for a realistic draft of 1.5 m and see if that is operationally viable. The requirements for navigation are channel markings, night navigational aids, including the possible deployment of GPS and river maps and charts for navigation. The National Inland Navigation Institute in Patna has been set up to oversee this development by the use of appropriate technology.

Locks: The physical drop of the river channel cannot be too much, or else locks have to be provided to manage the height differential. For example, the planned Three Gorges Dam on the Yangtze will have five locks for descent.

Access of cargo: The cargo has to be accessible to the waterway at both ends, to ensure door to door movement.

Availability of vessels and associated infrastructure: India has a long history of river-based water transport. Among operators, the government owned CIWTC (Central Inland Water Transport Corporation) is the largest owner of vessels and barges. Private operators have a

substantial fleet, but have not been investing in new vessels in the last decade. In fact, there has been scrapping vessels of late, and all operators may require some help in reviving them and investing in new vessels. The role of the (government owned) shipyards here is important, including the CIWTC owned and operated Raja Bagan Dock Yard in Kolkata. CIWTC can provide repair facilities for other operators in the area as well. There is a well-established industry of manufacture, maintenance and repair of barges in Goa, some of which are operated by mining companies which use barges for transport of ore, and some other organizations. IWT is a sustained economic activity in Goa, and there are many support services available in the state.

4.6.1 Commercial potential

From a supply chain perspective, the main reason for using inland waterways as a mode of transport is the fact that it decreases the total cost, when used as part of the end-to-end logistical requirement of cargo movement.

Geographical advantage of water bridging: This is strongest when the movement is across the river, but can be present in some other movements. Examples of these are passenger ferry services across rivers and transport in the Sundarbans areas in India and Bangladesh.

River based origins/destinations: The next level of advantage is when there is either an origin or a destination, or both, at a river location. This can be classified as follows.

Project based requirements of commodities: This demand is for material relating to a particular project activity. It consists of construction material and transport of equipment related to the project. Where the project is river based (e.g., river bridges, hydro-electric plants), it is most attractive, as the destination is the water site itself. Even otherwise, it may be viable in some cases.

4.6.2 Large customers with regular demands:

Existing traffic: By far the biggest example here is the iron ore export requirement from mines in north and south Goa, which access the Mandovi and Zuari rivers. This movement is expected to continue, along with movement of ore from Karnataka, after blending, for the next five to seven years at least. Appendix 6 has some details on inland waterways in Goa. FACT in Kerala has been a steady customer for most of its input raw materials (Appendix 5).

Potential traffic: Oil refineries in the north east: Numaligarh, Dibrugarh and Digboi. Oil refineries elsewhere on river bank locations such as Haldia and Barauni. Thermal power plants, for bringing in coal and carrying away fly-ash at locations like Barh and Bandel.

4.6.3 Environmental impact

Water is per se a scarce resource in the country. The use of water for facilitating transport may be sometimes difficult to justify. Related to this is the increased drawing of water for drinking, irrigation, construction and other activity, which reduces the overall flow of water in downstream regions. This makes transport operations difficult. Dams provide another level differential barrier to smooth transport. Given all these constraints, inland water transport is not at all the automatic first choice for movement of goods – a position that it enjoyed for many centuries in the past. However, where it is physically possible and commercially viable as part of a supply chain for a shipper, it is usually the most appealing environmentally. The basic reason for this is low fuel usage and therefore low pollution from emissions, and ability to carry in bulk, thereby reducing handling related pollution and congestion.

4.7 Policy issues in India

National

The key issues here are investments in national waterways and associated infrastructure. The proportion of traffic carried by IWT is very small. One of the reasons is the development of road and rail traffic, which have become very viable modes of transport. But a case can also be made that investment in the IWT sector has been small, compared to the other two. Worldwide experience suggests that strategic investments in some modes of transport can impact shares of movement significantly and with the resulting impact on overall costs and competitiveness. In this context, IWT can be examined, at least for selective enhancement of the sector. The general principle of investment by the government in such sectors is that it concerns those facilities and operations which go outside a normal commercial domain. Large investments with long term impact and which are likely to be used by numerous commercial entities are candidates for government participation. River training, including dredging, mapping of the river and providing navigational support are some tasks in this domain. Tasks such as terminal construction and operation are viable for private participation where appropriate. The operations in Goa indicate that the private sector has the capability and will to invest in barge ownership, operation and supporting services such as barge building, maintenance and repair. A significant facilitator is the terminal facility for handling iron ore at Mormugao Port. Emerging private participation in port activities is an interesting possibility in the future. At Mormugao also, there is private operation of some berths and coal handling and dry dock repair operations already. Exhibit 1 summarizes the various facets of inland waterway activities and participation and a

representative existing mix of actors in this sector. The role of regulation and waterway provisioning is currently only with IWAI and limited to the National Waterways.

		Government Agencies	Public Sector Enterprises	Private Sector Enterprises
	Regulator →	**IWAI ***	-	-
Waterway	Construction of Waterway	IWAI *	CIWTC in Sunderbans	-
	Maintenance of Waterways	IWAI *	Subcontracted Dredging	Subcontracted Dredging
	Navigational Support	IWAI *	Ports, near port areas (KPT, Port of Panaji)	GPS Suppliers
Carriers (vessels)	Vessel Manufacturing	-	CIWTC, Hooghly Docks, GRSE	Several
	Vessel Ownership	IWAI *	CIWTC/ KSINCL and others	Several, including mine owners
	Vessel Maintenance/ Repair	-	CIWTC/ KSINCL and others	Several
	Vessel Operation	-	CIWTC/KSINCL	Several
Terminals (Jetties)	Terminal Construction	IWAI *, State Governments	Mormugao Port Trust, CIWTC	Several
	Terminal Operation	-	Mormugao Port Trust, CIWTC	Several

(Source: Viability of Inland Water Transport (IWT) in India)

International

The main issue is the protocol with Bangladesh. This is important for the following reasons.

- Export traffic to Bangladesh and a small amount of import from Bangladesh is a component of trade on both NW-1 and NW-2. River movement is especially viable as there are a number of inland and riverine ports in Bangladesh which are oriented to cargo handling.

While the protocol permits vessels of either country to carry Indo-Bangladesh trade cargo and prohibits one country's vessels carrying intra-country traffic of the other, the Bangladesh vessels are permitted to carry Indian domestic cargo passing via Bangladesh. Further, Bangladesh vessels carrying their domestic cargo have a short empty lead to come to Haldia/Kolkata for picking up import cargo (which is significantly higher), while the same economics would not apply for Indian vessels. Consequently, Bangladesh vessels are able to offer more competitive rate.

CHAPTER-V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Innovative approaches from other countries to promote inland water transportation.

Several countries have successfully promoted inland water transportation and implemented best practices and innovative approaches that could be adapted to the Indian context. One example is the Netherlands, which has an extensive inland water transportation network that has contributed significantly to the country's economic growth and sustainability.

The Netherlands has a well-developed system of canals, rivers, and ports, which are used for a variety of purposes, including the transportation of goods and passengers. The country's inland water transportation system is interconnected with its rail and road networks, allowing for seamless multimodal transportation.

One best practice that the Netherlands has implemented is the use of intelligent transport systems (ITS) to optimize inland water transportation. These systems use real-time data and analytics to optimize route planning, cargo handling, and vessel traffic management. For example, the Port of Rotterdam, the largest port in Europe, uses a network of sensors and data analytics to optimize the use of its waterways and reduce congestion.

Another best practice is the implementation of sustainable and innovative technologies in inland water transportation. The Netherlands has been a leader in the use of electric and hybrid vessels, which are more environmentally friendly and cost-effective than traditional diesel-powered vessels. The Dutch company Port-Liner, for example, has developed a fleet of all-electric barges that can transport up to 280 shipping containers at a time.

The Netherlands has also implemented a range of policies and programs to support the development of its inland water transportation system. For example, the government has invested in the maintenance and expansion of its waterway infrastructure, including the construction of new locks and canals. It has also provided financial incentives for companies to use inland water transportation, such as reduced fees and taxes for vessels that meet certain environmental standards. These best practices and innovative approaches have resulted in significant benefits for the Netherlands' economy and environment. Inland water transportation accounts for approximately 43% of all freight transport in the country, reducing the reliance on road transport and reducing congestion and emissions. Additionally, the use of electric and hybrid vessels has helped to reduce greenhouse gas emissions and improve air quality in the country's urban areas.

The Indian government can learn from the best practices and innovative approaches implemented in the Netherlands to promote inland water transportation in India. For example, the use of ITS systems could help to optimize the use of India's waterways and improve the efficiency and reliability of inland water transportation. Similarly, the adoption of sustainable and innovative technologies could help to reduce emissions and improve the environmental sustainability of the sector. One potential case study for the implementation of these best practices in India is the National Waterway 1 project, which involves the development of a 1,620-kilometer waterway along the Ganges River from Haldia in West Bengal to Varanasi in Uttar Pradesh. The project is expected to significantly increase the use of inland water transportation in India and provide a more cost-effective and environmentally friendly alternative to road and rail transport.

The implementation of ITS systems, sustainable technologies, and supportive policies and programs in the National Waterway 1 project could help to optimize the use of the waterway, reduce emissions and improve the efficiency and reliability of inland water transportation in India. Additionally, the project could provide significant economic benefits by reducing transport costs, creating new jobs, and promoting regional development.

In conclusion, the Netherlands provides a useful case study for the implementation of best practices and innovative approaches to promote inland water transportation. The use of ITS systems, sustainable technologies, and supportive policies and programs has resulted in significant benefits for the Netherlands' economy and environment. By adapting these practices to the Indian context, the government can promote the development of a more sustainable, efficient, and cost-effective inland water transportation system in India.

5.2 Developed recommendations and strategies to promote and enhance the role of inland water transportation in India's transportation system.

To develop recommendations and strategies for promoting and enhancing the role of inland water transportation in India's transportation system, it is important to consider the challenges and opportunities associated with the sector. Some possible strategies and recommendations are:

1. Infrastructure development: To promote inland water transportation, it is essential to develop and maintain the necessary infrastructure, including waterways, ports, and terminals. This requires significant investment in dredging, maintenance, and modernization of existing infrastructure, as well as the construction of new facilities where needed. The government can consider public-private partnerships (PPP) to mobilize private sector investment in infrastructure development.

2. Technology innovation: Technology can play a critical role in improving the efficiency and safety of inland water transportation. The use of digital technologies such as GPS, real-time monitoring systems, and automation can improve navigation and reduce the risk of accidents. The use of alternative fuels such as biofuels and electric power can reduce greenhouse gas emissions and other pollutants. The government can incentivize private sector investment in technology innovation through tax breaks and other incentives.
3. Stakeholder engagement: Stakeholder engagement is essential for promoting the growth of inland water transportation. It is important to engage with shippers, manufacturers, and other stakeholders to understand their needs and challenges, and to develop policies and programs that address these issues. The government can establish a consultative forum comprising stakeholders to facilitate regular dialogue and collaboration.
4. Regulatory framework: A clear regulatory framework is essential to promote the growth of inland water transportation. The government can work to streamline regulations and reduce bureaucratic hurdles that impede the growth of the sector. This can include the development of a single-window clearance mechanism for permits and licenses.
5. Capacity building: Capacity building is critical to support the growth of inland water transportation. This includes training programs for operators and maintenance staff, as well as programs to support research and development in the sector. The government can establish training centers and provide incentives for private sector investment in capacity building initiatives. By implementing these strategies and recommendations, India can promote the growth of inland water transportation and enhance its role in the country's overall transportation system. This can provide significant economic, environmental, and social benefits, including reduced transportation costs, improved access to remote areas, and reduced greenhouse gas emissions and other pollutants.

5.3 Recommendations and strategies to promote and enhance the role of inland water transportation in India's transportation system

Inland water transportation is one of the most cost-effective and eco-friendly modes of transportation. It plays a vital role in India's transportation system by connecting the major cities and towns situated along the various waterways. Despite its numerous advantages, inland water transportation has not been able to reach its full potential in India. In this essay, we will analyse the current state of inland water transportation in India and develop recommendations and strategies to promote and enhance its role in the country's transportation system.

Current state of inland water transportation in India

Inland water transportation in India is primarily carried out through the Ganga-Brahmaputra River system, the Brahmani-Baitarani River system, the Godavari-Krishna River system, and the West Coast Canal. The total length of navigable waterways in India is about 14,500 km, out of which only 5,685 km are currently used for commercial transportation. The major challenges faced by inland water transportation in India are as follows:

1. Poor infrastructure: The waterways in India lack proper infrastructure, such as modern terminals, cargo handling facilities, and navigational aids. The lack of infrastructure results in increased transit time and higher transportation costs, which makes inland water transportation less competitive.

2. Insufficient fleet size: The number of vessels used for inland water transportation in India is inadequate. The vessels are old and outdated, which affects their efficiency and increases maintenance costs.

3. Regulatory issues: The regulatory environment for inland water transportation in India is complex and fragmented. There are multiple agencies involved in regulating water transportation, which leads to delays and confusion.

4. Limited cargo types: Inland water transportation in India is limited to certain types of cargo, such as coal, cement, and fertilizer. The lack of diversity in cargo types reduces the potential of inland water transportation as a viable mode of transportation.

Recommendations and strategies to promote and enhance inland water transportation in India

To promote and enhance inland water transportation in India, the following recommendations and strategies can be implemented:

1. Infrastructure development: The government should invest in developing modern terminals, cargo handling facilities, and navigational aids along the waterways. This will reduce transit time and transportation costs, making inland water transportation more competitive.

2. Fleet modernization: The government should encourage private investment in the inland water transportation sector by providing incentives for fleet modernization. This will result in the acquisition of newer vessels that are more efficient and cost-effective.

3. Simplification of regulatory environment: The regulatory environment for inland water transportation should be simplified by consolidating the multiple agencies involved in regulating water transportation. This will reduce delays and confusion, making inland water transportation more attractive to shippers.

4. Diversification of cargo types: Efforts should be made to diversify the types of cargo transported through inland waterways. This can be done by promoting the transportation of non-bulk cargo, such as containerized cargo and automobiles.
5. Multimodal transportation: The government should promote multimodal transportation by integrating inland water transportation with other modes of transportation, such as road and rail. This will increase the reach and accessibility of inland water transportation, making it more attractive to shippers.
In conclusion, inland water transportation has the potential to play a significant role in India's transportation system. However, its development has been hindered by poor infrastructure, insufficient fleet size, regulatory issues, and limited cargo types. To promote and enhance inland water transportation in India, the government should invest in infrastructure development, encourage fleet modernization, simplify the regulatory environment, diversify cargo types, and promote multimodal transportation. These measures will help to make inland water transportation more competitive, cost-effective, and eco-friendly, and will enable it to reach its full potential as a viable mode of transportation in India.

5.4 Conclusion

Inland waterways and transportation have long been important to human civilization, and they continue to play a vital role in the modern world. The potential benefits of inland waterway transportation are numerous, including reduced emissions, lower costs, and improved access to markets. However, there are also challenges to be overcome in order to fully realize these benefits.
One of the key challenges is the need for investment in infrastructure and modernization. Many inland waterways are in need of upgrades and repairs, and there is a need for more modern equipment and technologies to improve efficiency and safety. Governments and private investors must work together to provide the necessary funding and support to make these upgrades a reality. Another challenge is the need for better coordination between different modes of transportation. Inland waterway transport must be integrated with other modes of transport, such as road and rail, in order to provide a seamless and efficient system for moving goods and people. This will require greater cooperation between government agencies, private companies, and other stakeholders. Despite these challenges, the potential benefits of inland waterway transportation are significant. It offers a cost-effective and environmentally friendly alternative

to road and rail transport, particularly for heavier and bulkier goods. It also has the potential to reduce traffic congestion and improve access to markets, particularly for landlocked regions.

Inland waterway transport can also play an important role in reducing greenhouse gas emissions and improving the sustainability of the transportation sector. As the world continues to face the challenges of climate change and environmental degradation, the importance of sustainable transportation solutions will only increase.

In conclusion, inland waterways and transportation have a vital role to play in the modern world. They offer a range of potential benefits, including reduced emissions, lower costs, and improved access to markets. However, realizing these benefits will require greater investment, better coordination between different modes of transport, and strong policy and regulatory support. With the right investment and support, inland waterway transport can help to create a more efficient, sustainable, and resilient transportation system for the future.

5.5 Recommendation

India has a vast network of inland waterways, which have the potential to play a significant role in the country's transportation system. However, there are several challenges that must be addressed in order to fully realize the potential of inland waterway transport in India.

One of the key recommendations for improving inland waterway transport in India is the need for greater investment in infrastructure and modernization. Many of India's waterways are in need of upgrades and repairs, and there is a need for more modern equipment and technologies to improve efficiency and safety. The government should allocate more funds towards this sector and promote public-private partnerships for the development of modern terminals, navigation aids, and other supporting infrastructure.

Another important recommendation is to improve the coordination between different modes of transportation. Inland waterway transport must be integrated with other modes of transport, such as road and rail, in order to provide a seamless and efficient system for moving goods and people. The government should encourage the development of intermodal transport hubs, which would allow for the easy transfer of goods and passengers between different modes of transport.

The third recommendation is the need for greater regulatory support and incentives to promote inland waterway transport in India. This could include providing tax incentives for companies that use inland waterways for transportation, developing regulatory frameworks to ensure safety and efficiency, and promoting public awareness of the benefits of inland waterway transport.

Finally, there is a need for greater collaboration between different stakeholders, including government agencies, private companies, and other stakeholders. This would help to identify and address the challenges facing the inland waterway transport sector in India, and develop innovative solutions to improve efficiency and sustainability.

In conclusion, inland waterway transport has the potential to play a significant role in India's transportation system. To fully realize this potential, there is a need for greater investment in infrastructure and modernization, improved coordination between different modes of transport, greater regulatory support and incentives, and greater collaboration between different stakeholders. With the right investment and support, inland waterway transport can help to create a more efficient, sustainable, and resilient transportation system for India.