A STUDY ON INLAND WATERWAY TRANSPORTATION WITH SPECIAL REFERENCE TO KERALA AND GOA

(Submitted for partial fulfilment of the requirements for the degree of)

MASTER OF BUSINESS ADMINISTRATION

In

International Transportation and Logistics Management

Submitted by:

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DECLARATION

I **ANJALI B NAIR (Registration No.: 2003305007)**, student of School of Maritime Management of INDIAN MARITIME UNIVERSITY- CHENNAI CAMPUS, declare that the project report titled **"A STUDY ON INLAND WATERWAY TRANSPORTATION WITH SPECIAL REFERENCE TO KERALA AND GOA"** is a bonafide record of work carried out by me under the supervision of **Dr. M Sekar**, Assistant Professor, School of Maritime Management, Indian Maritime University- Chennai Campus, submitted in partial fulfilment of the requirements for the award of the degree of Master of Business Administration in (International Transportation & Logistics Management). The information submitted is true to the best of my knowledge.

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ACKNOWLEDGMENT

I extend my heartfelt thanks to Dr. B Swaminathan, Head, School of Maritime Management, Indian Maritime University- Chennai Campus for availing me an opportunity to undertake this project.

With great pleasure, I express my sincere gratitude to Dr. M Sekar, Assistant Professor, School of Maritime Management, Indian Maritime University- Chennai Campus for the valuable guidance and suggestions that enabled me to complete the project successfully. I am extremely grateful to him for spending his precious time in guiding me at every stage and accomplish this work within the stipulated time.

I also thank all the faculty members of School of Maritime Management, Indian Maritime University- Chennai Campus, for the active motivation provided, invaluable guidance and encouragement for completion of this project.

I submit my grateful thanks to my family who motivated and encouraged me throughout the project period. I would profoundly thank all respondents who helped me in collecting the necessary information for the completion of this project.

ANJALI B NAIR

CERTIFICATE

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This is to certify that the project report entitled "A STUDY ON INLAND WATERWAY TRANSPORTATION WITH SPECIAL REFERENCE TO KERALA AND GOA.", 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 in International Transportation and Logistics Management, is a record of work carried out entirely by ANJALI B NAIR, Reg. No. 2003305007.

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CHAPTER 1

INTRODUCTION

1.1 DEFINITION AND MEANING

The global economy cannot run without commodities and things being moved across oceans, by air, and on railways and highways. By delivering raw materials and finished goods, as well as providing direct consumer delivery, the shipping sector encourages local and worldwide manufacturing and trade. The transfer of goods by water is critical to the economies of many countries. In 2020, UNCTAD estimates that maritime transportation will account for almost 80% of global trade. Inland water transport is important in addition to ocean transit.

1.1.1 Inland Waterways

In many countries, inland waterways are a more cost-effective option than road or rail shipping. Inland waterways are non-sea areas of water that are navigable by watercraft. For freight transportation, inland waterways are both cost-effective and fuel-efficient. As road freight movement grows more congested and generates more emissions in the next decades, inland waterways may become a more environmentally friendly alternative to roads and trains in terms of energy efficiency, noise pollution, and emissions. According to estimations, inland canal transportation uses less than 20% of the energy used by road transport and around 50% of the energy used by rail transport, resulting in a nearly seven-fold lower external cost than road transport.

Interesting parallels can be seen from the worldwide experience. IWT accounts for a significant portion of inland transportation in various countries:, 40 percent in Europe, 44 percent in Korea and Japan, 35

percent in Bangladesh, 14 percent in the United States and 47 percent in China. Much of the increase in China has occurred in recent decades, coinciding with the country's extraordinary industrial-agricultural development.

Inland water transport and costal shipping, especially for bulk cargo, are fuel-efficient, ecologically benign, and cost-effective modes of transport. The emissions from container ships range from 32 to 36 grammes of CO2 per ton-kilometer, whereas heavy-duty road transport vehicles emit 51 to 91 grammes of CO2 per ton-kilometer. In addition, on average, road transportation costs Rs. 1.5 per ton-kilometer, railways cost Rs. 1.0 per ton-kilometer, and waterways cost 25 to 30 paisa per ton-kilometer. One litre of gasoline can convey 24 tonnes of freight by road, 85 tonnes by train, and up to 105 tonnes by sea. These figures back up the argument that waterways are a significantly less expensive and do not harm the environment than land. The country will save $50 billion annually if logistics costs are cut from 14 percent to 9% of GDP. Retail pricing would be lower as logistics costs were reduced.

1.1.2 Inland Water Transport in India- A Historic Perspective

The development of transportation on inland waterways is chronicled in India's commercial history. The presence of a large lot of communities on waterways that were also centres of commercial activity even before railways demonstrates the importance of this means of transportation in the past.

The first propelled ship, the Diana, carrying 89 tonnes, sailed with people from Kulpi Road to Calcutta, a stretch of 80 kilometres on the Hooghly, in 1823. In 1834, a monthly steamer service between Calcutta and outposts upstream on the Ganga was created to transport East India Company officials and supplies. On the river Yamuna, a regular fortnightly service began in 1842 between Agra and Culcutta. A regular steam service connecting Assam and Culcutta began in 1863. A network of steamboat

services grew quickly, reaching far beyond Garh-Mukteshwar on the Ganga in Uttar Pradesh, about 645 kilometres from Allahabad, and Ayodhya on the Ghagra, about 325 kilometres from the Ganga's confluence.

The growth of international commerce along river banks regions of the navigable river and canal system was dominated in the nineteenth century by transportation by power crafts and country boats. The majority of traffic, however, was transported by country boats from Delhi and the Nepalese border to Assam. Country boat traffic peaked in 1876-77, with around 180,000 cargo boats registered in Calcutta, 124,000 cargo boats in Hooghly, and 62,000 cargo boats in Patna.

The introduction of railways and the subsequent expansion of their network represented a water-transport turning point in India. To begin with, the development of key railway lines boosted river traffic because the two modes complemented one another, with waterways serving as feeders for trains. However, the complementarity among IWT and railway was only temporary. Around 1860, navigation began to deteriorate. By that time, the East Indian Railways' expansion had begun to make an impact. With the expansion of the rail network, new economic hubs far from the rivers arose. IWT gradually lost its dominance.

1.1.3 Inland Water Transport in India

IWT was a major form of transit and navigation by country boats and powered crafts in the nineteenth century and the first half of the twentieth century, and it played a vital part in the growth of trade and commerce along various rivers and canals. In India, water transport was impacted by the introduction of railways and the expansion of their network. The IWT sector was neglected in the later years of the twentieth century, except in a few locations such as Assam, Goa, Kerala, Mumbai, West Bengal, and a few other coastal areas (where it had natural advantages and no developmental intervention was required).

However, given its inherent benefits, the need for a proper development of this sector has always been felt, as evidenced by the fact that many Committees have evaluated the country's IWT system from time to time and called for systematic growth of this method since independence. In its report from 1980, the National Transport Policy Committee suggested the establishment of a national authority for the development and management of inland waterways, which resulted in the establishment of the Inland Waterways Authority of India (IWAI) in 1986. Only those waterways that have been designated as National Waterways are under the control of the federal government, while the others are at the control of the states.

Through the Inland Waterways Authority of India Regulation 2006, the IWAI has previously classified inland waterways in India. Waterways are divided into seven classes based on their characteristics and the types of vessels that will pass through them.

However, inland waterways are not being used to their full potential. When we look at numerous modes of transportation in India, we can see that the country is primarily reliant on one mode of transportation. Road transport accounts for 74% of all travel. Even though India has a 14,500-kilometer inland waterway, just 1% of it is utilised for freight transit.

1.1.4 National Waterways

Till 2016, Govt. of India has declared 5 waterways as National waterways. They are:

1. Allahabad- Haldia stretch of Ganga-Bhagirathi- Hooghly river system for a length of 1620 km is the National Waterway- 1 (NW-1).

2. Dhubri- Sadiya stretch of River Brahmaputra for a length of 891 km is the National Waterway- 2 (NW-2).

3. Kollam- Kottappuram stretch of West Coast Canal along with Champakkara & Udyogmandal canals for length of 205 km is the National Waterway- 3 (NW-3).

4. Kakinada- Puducherry stretch of canals along with Kaluvelly tank and Bhadrachalam- Rajahmundry stretch of River Godavari &Wazirabad- Vijayawada stretch of River Krishna for a length of 1078 km is the National Waterway- 4 (NW-4).

5. Geonkhali- Charbatia stretch of East coast canal and Matai River along with Talchar- Dhamra stretch of Brahmani- Kharsua- Dhamra river system &Mangalgadi- Paradeep stretch of Mahanadi Delta Rivers for a length of 588 km is the National Waterway- 5 (NW-5).

In April of 2016, the Indian government designated 106 new rivers as National Waterways around the country. The improvement of these waterways to NW standards is expected to bring in a 2% increase in GDP, resulting in a massive increase in the IWT share in India. This has demanded the use of innovative approaches to speed up development in the IWT sector. To examine the potential and project components of these new waterways, a feasibility report and a DPR are being prepared.

Based on the results obtained by Detailed project Report(DRP) and the economic-technical feasibility of NWs, the Inland Waterways Authority of India (IWAI) has selected 25 national waterways that are viable for cargo/passenger movement, according to an official government study (National Waterways). Thirteen national waterways are currently undergoing development.

1.1.5 Inland Water Transport In Kerala

Rivers and backwaters are used for inland water transportation in Kerala. Since ancient times, this has played a significant part in transportation. In comparison to railways and highways, inland waterways have their own

set of natural advantages. In Kerala, there are 41 rivers that flow west, along with numerous backwaters. The total length of rivers, canals, and lakes in the state will be 2988.61 kilometres in 2020. The navigable length is 1613.24 kilometres. The inland canals are the conduits that connect the rivers. On the banks of these rivers are important commercially important locations. State has got the West Coast Canal (WCC) system, which is approximately 560 kilometres long. It begins in the south at Kovalam and ends in the north at Hosdurg. The Kollam-Kottapuram segment (168 km) was designated as National Waterway-3 (NW-3) by the Central Government in 1993, along with the Champakkara (14 km) and Udyogamandal canals (23 km), and is nearly completed. The extension of NW-3 between Kottapuram and Kozhikode was recently declared by the Central Government (160 km). The Central Government additionally proclaimed four canals as national waterways in April 2016, including Alappuzha-Changanassery (28 km), Alappuzha-Kottayam-Athhirampuzha (38 km), and Kottayam-Vaikom (42 km).

Sl. No	NW No	STRETCH	LENGTH (km)	OPERATIONAL (Y/N/P)
1	NW 3	Kollam- Kozhikode stretch of West Coast Canal Champakara Canal Udyogmandal Canal	365	Y
2	NW 8	Alappuzha- Changanassery Canal	28	Y
3	NW 9	Alappuazha- Kottayam-Athitampuzha Canal	38	P
4	NW 59	Kottayam- Vaikom Canal	28	N
		TOTAL	459	

Table 1.1 List of National Waterways in Kerala

(Source: Ministry of Ports, Shipping and Inland waterways)

1.1.6 Inland Water Transport in Goa

Inland waterways in Goa total 274 kilometres, with 249 kilometres navigable in 2019-2020. The rivers Mandovi and Zuari, as well as their tributaries, are involved chevaliers cheval chevaliers chevaliers chevaliers chevaliers chevaliers chevaliers chevaliers The export and mining industries employ the majority of their entire length to transport iron ore from loading stations in the hinterlands to the port of Mormugao and the Panaji outer anchorage. When these rivers are properly harnessed, they can provide speedy and cost-effective transportation for both passengers and freight.

Inland waterways have played a crucial part in the iron ore transportation and, as a result, in the economy of Goa's mining sector. The Mandovi, Zuari, and Cumberjua canals in Goa have offered natural waterways and aided the promotion of the iron ore industry with efficient methods of transportation since 1947, when commercial production of minerals (mostly iron ore) began.

SL. No	NW No	STRETCH	LENGTH (km)	OPERATIONAL (Y/N/P)
1	NW 25	Chapora River	33	N
2	NW 27	Cumbarjua River	17	N
3	NW68	Mandovi River	41	N
4	NW 71	Mapusa River – Moide River	27	Y
5	NW 88	Sal River	14	N
6	NW 111	Zuari River	50	Y
		TOTAL	182	

Table 1.2 List of National Waterways in Goa

(Source: Ministry of Ports, Shipping and Inland waterways)

1.2 OBJECTIVES OF THE STUDY

- To study about the operations of Inland waterway of Kerala and Goa.
- To study the efficiency of operations in Inland waterway of Kerala and Goa.
- To study the vessel operations in the Inland waterway of Kerala and Goa.
- To suggest findings from the above study.

1.3 SCOPE AND RATIONALE FOR THE STUDY

Over the years, the potential of inland transportation has been undeniable, and it now accounts for a major portion of global ton-kilometer movement. A well-functioning transportation system, particularly for the transportation of bulk items, is critical for every country's economic prosperity. Railways, highways, inland waterways, pipelines, and coastal shipping are all key forms of bulk goods transportation. In a liberalised economy like India, where the private and public sectors are expected to contribute a large share of GDP, the government must take adequate measures to develop all of these modes of transportation so that industries can provide the lowest cost of production to consumers by utilising an optimal mix of transportation networks that takes advantage of the strengths of each of these modes on a case-by-case basis.

Rail and road (the main modes of transportation for bulk goods in India) are overcrowded and saturated, making large-scale capacity expansion problematic. IWT is a fuel-efficient, environmentally friendly, and cost-effective method of transportation that has the potential to supplement overcrowded rail and congested highways.

In Kerala and Goa, the study focuses on the effectiveness of inland water transportation. We can understand the performance of these rivers so far by analysing this data. The inland waterway transportation system has

plenty of room for expansion and improvement. What action can be performed and what areas of improvement can be determined based on the efficiency of these? It's also clear whether greater investment in this industry is required. India has several rivers, canals, streams, and other waterways that could be developed into commercially viable waterways connecting ports to the hinterlands. As a result, it is critical that the IWT mode be developed to the point that it can compete in a multimodal transportation network. To summarise, inland transportation has a bright future as long as concerns like infrastructural gaps and institutional support are adequately handled.

1.4 RESEARCH METHEDOLOGY

The study is based on secondary data collected from various Annual reports on Inland waterways:

- Statistics of Inland Water Transport by Ministry of Ports, Shipping and Waterways
- Annual Report by Inland Waterways Authority of India

E-books, periodicals, and other online literature were also referred.

1.5 LIMITATIONS

Inland water transportation in India is a vast subject, and time has been a major restriction in this research. Because the confidentiality of data is followed to the data obtained largely through secondary sources, all of the data collected may not be exact. Because there is no primary research on the subject, only a few years of data were examined. The research is limited to the effectiveness of inland waterways in Kerala and Goa. As a result, the efficiency of India's total waterways is difficult to comprehend. Only two of Kerala's four national waterways are operational, while only two of Goa's six national waterways are functioning. As a result, we cannot study the precise efficiency of each stage and reach a conclusion.

CHAPTER 2

LITERATURE REVIEW

2.1 REVIEW OF LITERATURE

- INLAND WATER TRANSPORTATION IN INDIA: PAST, PRESENT AND FUTURE by Deepali.K.Hejiib and Mr. ChinmayPade (2021)

They cover the history of inland water transport in India, its evolution and development, its current state and prospects, and growth opportunities in this paper. The evolution of inland waterways is studied in such a way that policies and governance from the pre-Colonial period, the colonial period, and the current scenario are explored. Various infrastructural developments are investigated, as well as the effects of IWT development on the economy, environment, and employment. They also talk about IWT's future prospects in India. Inland water transport in India could be a good alternative to road and rail transport, according to the authors, if experienced and trained manpower is available for IWT operations and technology improves.

- INLAND WATER TRANSPORT IN INDIA: CAN WE THINK IT TO BE MORE SUSTAINABLE, GREEN AND CONNECTED? By Parveen Kumar and Shravani Sharma (2020)

The benefits of inland water transportation are discussed, as well as how successful it is as a rail and road alternative. They claim that India is an oil-importing country, and that in order to combat pollution produced by fossil fuels, we are currently transitioning to electric road transportation. However, it is critical to apply this to water transport vessels as well. According to the authors, electric motor-powered boats are preferable to diesel-powered boats. The impact of electric-powered vessels is discussed

in the article. Electric boats offer lower maintenance and operating costs because electric engines do not require regular fuel or oil to operate. Kerala has already shown the viability of solar-powered boats; now they must scale up and build the necessary infrastructure, including proper integration of water transport with road transport via a convenient and safe exchange point, as well as last and first-mile connectivity with IOT for more efficient, seamless, and clean modes of transportation in our cities.

- AN OVERVIEW ON INDIAN INLAND WATERWAYS by Abhishek Soni & Amit Kumar Sinha (2019)

The article examines the expansion and restrictions of India's inland water transportation sector, as well as the major issues that organisations in this sector face. They also looked into various inland waterway policies. Inland water transport is also explored in several countries. According to them, inland water transport accounts for only 0.5 percent of India's modal share, while China accounts for 8.7%, the United States for 8.3%, and Europe for 7%. Inland water transportation (IWT) accounts for less than 1% of total freight traffic, compared to 20% in Germany and 35% in Bangladesh. According to the paper, the development of inland waterways in India has enormous potential for the country's growth and development. Furthermore, suitable precautions and procedures are required to make inland water transportation more efficient and long-term sustainable.

- INTEGRATING INLAND WATERWAYS WITH OTHER MODES TO CREATE AN INTERMODAL TRANSPORTATION SYSTEM IN INDIA by Aditya Gupta (2018)

The researcher identified several variables in the research report that will enable an inland waterways-based multimodal transportation system. The research offers the Indian government and practitioners of IWT with other modes a series of recommendations and a conceptual model for building a

resilient and sustainable multimodal transportation system. The main idea was that India should focus all of its efforts on a single major waterway and make it successful. They also proposed a framework for IWT to promote containerized shipping.

- KEY ISSUES & CHALLENGES FOR INLAND WATER TRANSPORTATION NETWORK IN INDIA by Praveen S & Jegan J (2015)

The authors look at inland water resource transportation and trade as two large service areas. With the developing awareness of India's inland water transportation system, an attempt is made to identify the important concerns and challenges in this sector. The paper outlines the history of India's inland water transportation business, as well as the concerns and challenges it faces. According to the authors, inter-state cooperation and coordination is a vital aspect in expanding India's inland water transportation network beyond state borders. The report paints a clear image of ineffective port handling in India, which discourages not only inland water transportation but also maritime trade in general. They proposed a seamless merger of Inland water transportation and costal shipping, which would only be viable if vessels could profitably operate in both sectors. According to the study, without a national water transportation policy, inland waterway expansion can only be done administratively and gradually.

- VIABILITY OF INLAND WATER TRANSPORT IN INDIA by Narayan Rangaraj and G. Raghuram (2007)

They cover passenger movement, issues impacting passenger movement, and freight flow along India's inland waterways in this paper. They also discuss the inland waterways' business potential. They make it obvious that the geographical benefit of IWT freight transit is greatest when the entire movement takes place over a river. They use instances such as the Mandovi and Zuari rivers in Goa, which have iron ore mining, and Kerala

waterways to demonstrate the importance of inland waterways in cargo transit. Various difficulties confronting inland waterways, as well as their environmental impact, are highlighted. The authors also discuss policy challenges in India and offer recommendations.

- POTENTIAL FOR ECONOMIC GAINS FROM INLAND WATER TRANSPORT IN INDIA by P.K. Sarkar, Veni Mathur, Vinay Maithri and Kanika Kalra (2007)

The journal focuses on the financial elements of India's inland water transportation. They claim that, despite a global cargo market of 1,000 billion tonne kilometres in 2000, IWT freight traffic was only about 1.5 billion tonne kilometres (i.e., a modal share of 0.15 percent). If the requisite infrastructure investments in fairways, terminals, boats, and navigational aids are made in India, IWT has significant promise as an affordable and environmentally beneficial means of transport. To establish the viability of such investments, the authors conducted a pilot study on two key national waterways, NW1 (Ganges-Bhagirathi - Hoogly River system) and NW2 (Brahmaputra River system). Their findings support the government of India's judgement that, in its 10th and 11th Five Year Plans, it should make swift and significant efforts to create national IWT.

- IMPACT OF FERRY TRANSPORTATION by Teresa M Adams (2006)

Teresa considers the financial implications of ferry travel. Many travellers regard ferry travel as an adventure and an experience that they cannot have from any other means of transportation. The ferries, according to Teresa, boost the state's economy by creating tourism and providing support for local businesses. She claims that the ferry operations have a minor economic impact when compared to other modes of transportation; however, an economic impact analysis demonstrates that the ferry operations are significant to local economies.

- INLAND WATER TRANSPORT IN INDIA by Ravinder (1992)

Ferries, according to Ravinder, are an essential and irreplaceable aspect of today's globalised and connected globe, and are often the only reliable mode of transit in some areas. He further claims that ferry travel is riskier than other modes of transportation because there is always the chance of sinking ships and boats. Failure of the monsoon, he claims, causes a drop in river water levels, making passage problematic.

- PROBLEMS OF INLAND WATER TRANSPORTATION by Carl. J. Baer (1920)

In his research, Baer claims that transportation and production are so intertwined that they can't be considered separately, and that the enormous transportation problem can only be solved satisfactorily by utilising our navigable inland waterways. He suggested a consistent strategy for dealing with the issue.

2.2 LITERATURE GAP

In India, various studies and research have been conducted on inland waterways and inland water transportation. The primary goal of this research is to better understand the operational efficiency and diverse vessel operations in Kerala and Goa's inland waterways. According to published studies, India's inland waterways have enormous potential for contributing to the country's economy. Since years, the advantages and environmental gains of inland water transportation have been discussed and appreciated. Our inland waterways, however, appear to be underutilised. Improvements in cargo movement through the inland rivers have been made. The project demonstrates the operating effectiveness of Kerala and Goa's inland waterways. What is the cargo movement like along these waterways,

how efficient are they, and what conclusions may be drawn. As a result, the content focuses on a new aspect of inland water transportation.

CHAPTER 3

COMPANY AND INDUSTRY PROFILE

3.1 INLAND WATERWAYS AUTHORITY OF INDIA (IWAI)

Fig 3.1 Logo-IWAI

On October 27, 1986, the Inland Waterways Authority of India (IWAI) was established to develop and regulate inland waterways for shipping and navigation. Through a subsidy from the Ministry of Shipping, the Authority principally pursues projects for the maintenance and development of IWT infrastructure on national waterways. The Authority's headquarters are located in Noida. Kolkata, Patna, Kochi, anD Guwahati are the Authority's regional offices, while Varanasi, Allahabad, Farakka, Sahibganj, Hemnagar, Swroopganj, Dibrugarh, Haldia, Dhubri, Kollam, Bhubaneshwar, Silchar and Vijayawada are its sub-offices.

Rivers, creeks, canal, backwater, and other navigable waterways make up around 14,500 km of India's navigable waterways. Inland Water Transport (IWT), a fuel-efficient and environmentally benign mode, moves over 55 million tonnes of freight each year. Its operations are now limited to a few portions of the Ganga, Hooghly, and Bhagirathi Rivers, the Barak, the Brahmaputra River, the rivers of Goa, Mumbai's inland waters, Kerala's backwaters and the deltaic regions of the Krishna and Godavari Rivers. Aside from these structured activities by mechanised vessels, country boats of various sizes operate in numerous rivers and

canals, transporting a significant amount of merchandise and passengers in this unorganised sector.

3.1.1 Functions of IWAI

National Waterways:

- Pilotage
- Fairway development
- Survey
- Coordination of IWT with other modes
- Navigation,Infrastructure and Regulations

General:

- Advise Central Govt.
- Assist State Governments
- Carry out hydrographic surveys
- Develop consultancy services
- Classification of waterways
- Standards & safety
- Research & Development

3.2 KERALA SHIPPING AND INLAND NAVIGATION CORPORATION Ltd.(KSINC)

Fig 3.2 Logo-KSINC

The Kerala Shipping and Inland Navigation Corporation is a government-owned company that pioneered inland navigation in Kerala's rivers. The Kerala Inland Navigation Corporation (KINCO), founded in 1975, and Kerala Shipping Corporation, founded in 1974, merged to form this

corporation. The Ro-Ro service and barge operations are the organization's strengths. It also has two yards for small vessel building and repair. KSINC has demonstrated expertise in every phase of vessel construction, maintenance, and operation, meeting a wide range of customer needs. The premium cruise ships SagarRani (1&2) and the exclusive luxury cruise Nefertiti are now available.

3.2.1 Vision

A professionally managed company delivering the highest quality service.

Being in the shipping and inland navigation sector, KSINC aspires to be the ideal organisation in pursuit of the highest standards of excellence. While meeting customer needs, KSINC maintains the highest ethical and professional standards with full attention for environmental safeguards.

KSINC wants to take use of the huge potential of inland waterways. When it comes to expanding its activities, the corporation feels there are no limits. Meeting challenges is simply a part of life. Our dedicated and motivated employees will work tirelessly to provide the best service possible, with a strong sense of synergy and teamwork.

3.2.2 Mission

- To offer a better, safer and cheaper mode of passenger and cargo transportation and to remain as the leader in the field.
- KSINC believes that transport through the inland waters is to be safe and cheap, while at the same time meeting the high expectations of our clients. We shall always endeavor to achieve the highest level of customer satisfaction through efficient service, reduced costs, safe and reliable practices.

3.2.3 Objectives

- To establish, maintain and operate shipping services and to purchase, charter, hire and build ships, tankers, and other vessels.
- To undertake and carry on the trade and business of shippers, ship-owners, ship- brokers, ship agents, underwriters, ship managers, shipping and forwarding agents.
- To establish, maintain and operate transportation of high-quality services for the transport of goods in inland waters in the State of Kerala and in the Kerala Coastal Region.
- To organize, conduct and manage Workshops, Repair shops, Service stations for repair and maintenance of marine vessels within the State of Kerala or elsewhere
- To establish, provide, maintain and conduct Research and training Institutions and Lab centres.
- To be a key player in the tourism sector.

3.2.4 Major Activities

- Transportation of bulk raw materials, petroleum products and water cargo through inland waters.
- Operation of ferry services to the islands around Kochi.
- Docking and repair of marine vessels.
- Construction of wooden and steel inland watercrafts.
- Waterway linked tourism.
- Operation of Speed Boats.
- Luxury vessels for conducting on-board events.

3.3 STATE WATER TRANSPORT DEPARTMENT- KERALA

Fig 3.3 Logo- State Water Transportation Department

The State Water Transportation Department is one of the state's several government agencies. It stands for meeting the transportation demands of residents in the flooded parts of Kasargode, Kannur, Ernakulam, Kottayam, Kollam and Alappuzha districts. Despite the fact that this is a business department, it operates in a service-oriented manner. This Department has taken on the shape of an Essential Service Department when 'Transportation' was added to "Essential Service." Wooden/Steel and Fiberglass Passenger Boats transport around 150 lakhs of passengers each year.

The State Water Transport Department was established in 1968, with headquarters (Directorate) in the Alappuzha District.the Head of the Department is the Director. The service operation was limited to the districts of Kottayam, Alappuzha and Kollam during formation. The Head Quarters in Alappuzha served as the nerve centre for all functions and activities at the time. Later, by establishing an office for the Mechanical Engineer and three Regional Offices in the districts of Ernakulam, Kottayam (Chaganacherry), and Kasargode, led by three Senior Superintendents, the functions and operations were decentralised.

The Department's functions are divided into three sections:

1) Management

2) Operation

3) Repair and maintenance.

The Administrative Assistant is in charge of the Management wing, while the Traffic Superintendent is in charge of the Operations wing, and the Mechanical Engineer is in charge of the Repair & Maintenance wing, which is overseen by the Director.

In recent years, the Department has exclusively used traditional wooden passenger boats to ferry passengers. In order to keep up with technological advancements, the Department has shifted to modern steel passenger boats.

The Department is now competing with the mode of road traffic, which is growing as a result of the Department's development of roads and bridges. The most significant stumbling block is a lack of speed. However, as compared to road/rail transportation, water transportation offers significant cost savings and is less polluting. Passengers, however, value speed over efficiency. Every day, the roads become more and more congested. At the same time, the state's navigation canals are always open, providing a full range of transportation options. Water Transportation Department will coexist with this facility as long as it exists.

3.4 RIVER NAVIGATION DEPARTMENT - GOVERNMENT OF GOA

Fig 3.4 Logo-River Navigation Department Government of Goa

The Government of Goa's River Navigation Department is critical in providing transportation across rivers for commuters, particularly for islanders in the state of Goa who lack access to roads. It is in charge of providing public ferry service and moving vehicles and products 24 hours a day, seven days a week. By exploiting undeveloped waterways, this service aims to minimise traffic congestion on roadways while also saving gasoline.

With a fleet of 39 ferry boats, the River Navigation Department (RND) has been designated as a "important public utility service" for providing 24 hour ferry transportation to commuters on 20 ferry routes throughout Goa. The ferry service is used by roughly 2.5 lakh commuters and 18000 vehicles per day. The River Navigation Department was founded during the pre-liberation period and is currently an important source of transportation for Goans. It is true that Goa's huge inland waterways have been misused.

Goa is an important tourism site on every tourist's itinerary, with its 131-kilometer-long coastline. Tourism is so popular in Goa that the number of visitors virtually matches the population of the state. The number of local and international visitors to Goa has steadily increased in recent years. The strain on the state's infrastructure has increased dramatically. Similarly, Goa has a vast network of inland waterways, including two major rivers, the Zuari and Mandovi, as well as smaller rivers like

Terekhol, Chapora, Mapusa, and Sal, all of which have adequate draught for navigation. As a result, inland water transportation in Goa must be developed.

RND wants to concentrate on public transportation, which is central to its goal, while identifying non-core operations such as quick ferry service between major cities for public, automobiles, and goods. Ferry service between Panaji and Vasco has been highlighted as one of the possible development choices for improving waterways and complementing our objective of promoting alternative modes of transportation in Goa.

CHAPTER 4

ANALYSIS AND INTERPRETATION

The state of Kerala and the state of Goa are used to investigate inland water transport. Kerala and Goa are two states with significant inland water transportation potential. Both states have an excellent geographical layout that allows them to exploit their interior waterways for a variety of purposes, including commercial and passenger transportation.

As previously said, inland waterways are a better option to road and rail transportation. Both states have National and State waterways that are operating. These inland waterways are used for a variety of purposes. Various commodities pass through the vessels on the Kerala and Goa inland waterways. These inland rivers provide an excellent link between the hinterland and the foreland. These waterways, which include canals, creeks, and rivers, can bring commodities from the inner hinterland to the port region. Inland waterways are therefore an essential mode of mobility.

4.1 **ROLE OF INLAND WATERWAYS IN KERALA**

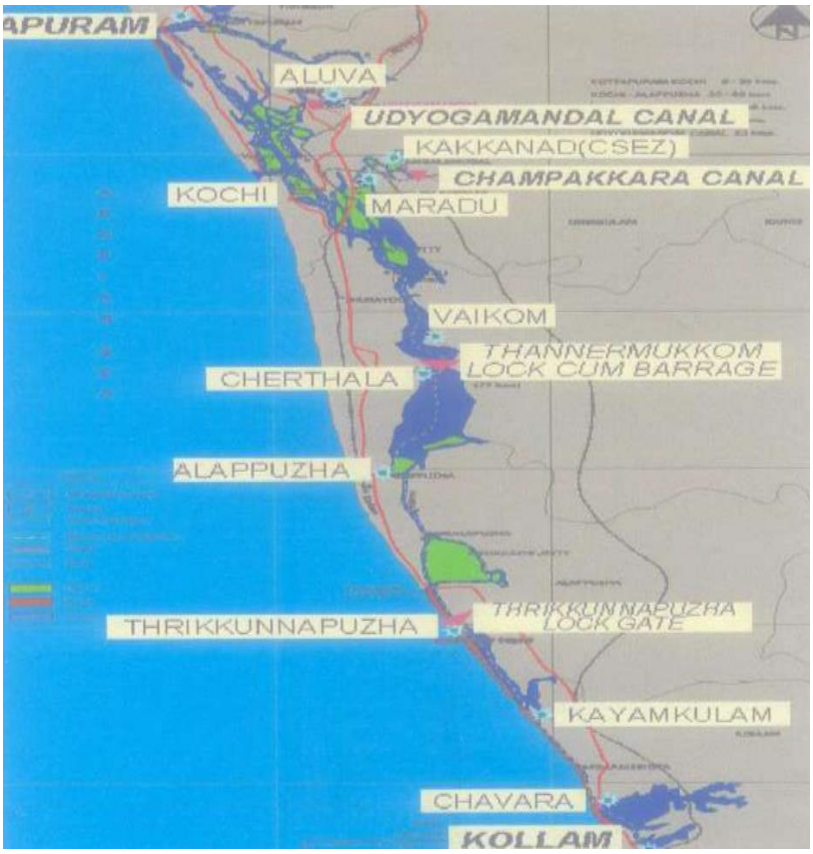

Fig 4.1 NW 3

Kollam- Kottapuram stretch of West Coast Canal is further extended to the north upto Kozhikode (160 km) and made part of NW-3.

NW-8 is a 28-kilometer canal between Alappuzha and Changanacherry. The Alappuzha- Changanacherry Canal connects Kavalam and Changanacherry and runs from Alappuzha to C Block. In the transportation of paddy, hay, manure, and other agricultural products, coconuts and related items, construction materials, lime shell, and other labour movements, this route offers superior revenue potential. This route covers 28 kilometres. Vembanad Lake is only 1.3 kilometres long (Chainage 5.9 to 7.2 kilometres long).

NW-9 is the 38-kilometer long Alappuzha-Kottayam-Athirapuzhacanal. Between C and SB locks, the canal path begins in Alappuzha and

continues to Kottayam through Munro lighthouse. The Alappuzha-Kottayam canal also travels through a farmed area recovered from the Vembanad Lake, with paddy fields arranged in 'Blocks' and artificial canals and embankments. Agricultural labour is in short supply in the area, thus workers must be transported to the recovered blocks via the Waterway, which is the only option. The Vembanad Lake is only 3 km long (Chainage 3 to 6) and runs the whole length of the A-K. Athirampuzha is where the Athirampuzha canal begins (Chandakkulam). The canal runs for 15 kilometres between Athirampuzha, Mannanam, and Cheeppunkal. At Maniyamparambu near Pulikkuttissery, the canal from Athirampuzha joins the Kottayam-Vaikom Canal.

NW-59 is the name given to the 42-kilometer long Kottayam-Vaikom canal. It begins at Kottayam's new Kodimatha terminal and continues along the A- K canal until Kanjiram Junction, when it makes a dramatic right angle turn towards Vaikom, going through Illikal, Prappuzha, Pulikuttycherry, Mania Parambu, and Cheepumkal. It continues on the inner path between the mainland and the reclaimed coconut plantation (Swamikkalle), eventually connecting with the National Waterway-3 in Vembanad Lake before the Thannermukkom barrage. The portion between Kottayam and Kanjiram is approximately 3.5 kilometres long. The National Waterway-3 runs 14 kilometres from Cheepumkal to Vaikom. Only 24.5 kilometres of the K-V waterway will be constructed between Cheepumkal and Kanjiram.

Kerala's coastal regions are connected by a network of rivers, inlets, estuaries, lakes, and natural canals. The backwaters of Kerala are a network of interconnected waterways with about 900 kilometres of navigable waterways. Traveling through these backwaters in traditional houseboats to take in the scenery is a fantastic experience that is very popular with foreign visitors.

A leisurely cruise around Kerala's famous backwaters provides direct experience of the state's village life and rustic enterprises such as coir-making, paddy planting, and prawn farming. It will also provide a breathtaking view of the sea, land, birds, and human habitation coexisting harmoniously on the water side.

Alleppey or Alappuzha, Kerala's backwater tourism centre, refers to territory between the sea and a network of rivers that pour into it. Backwaters are "a section of a river not touched by the stream, where the water is stagnant," and Kerala's backwaters are particularly beautiful in Alappuzha. Houseboat rides along these canals and backwaters can provide tourists with an amazing experience as they pass through Kottayam, Alappuzha, Kollam, Kumarakom, and Kuttanad.

4.2 ROLE OF INLAND WATERWAYS IN GOA

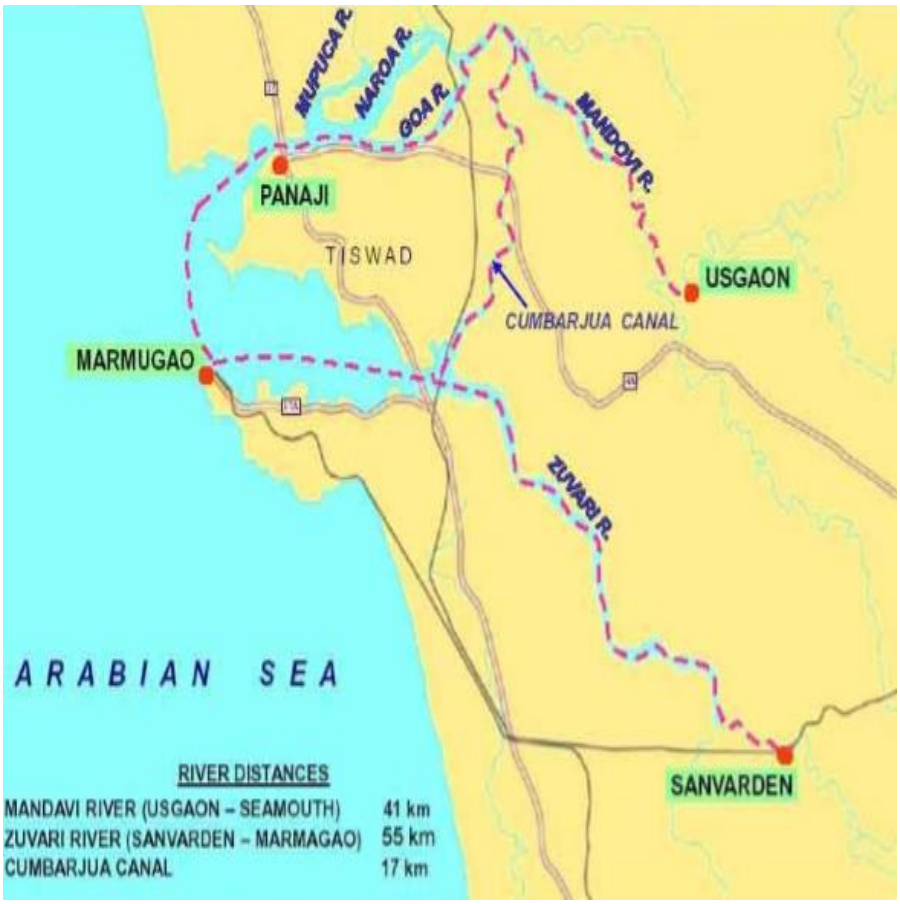

Fig 4.2 Mandovi- Zuari river system

Inland waterways have played a crucial part in the transportation of iron ore and, as a result, in the economy of Goa's mining sector. The Mandovi, Zuari, and Cumberjua canals in Goa have supplied a natural waterway and aided the promotion of the iron ore industry with efficient methods of transportation since 1947, when commercial production of minerals (mostly iron ore) began.

The state of Goa's iron ore industry is entirely reliant on exports. All of Goa's iron ore is shipped to China, Japan, Korea, Taiwan, and a few European countries. The iron ore mined in Goa isn't ideal for steel manufacture. Goan iron ore is of low quality (Fe concentration ranges from 50 to 62 percent) and so does not warrant the construction of a

steel factory based on it. Nonetheless, Goan ore is in high demand around the world because it is frequently employed in product blends to achieve ideal Silica and Alumina levels.

The state of Goa has been India's leading exporter of iron ore. In recent years, Goa has topped other Indian ports for exporting the largest share of the country's total exported iron ore. In terms of volume, Goa's export to India has averaged around 40% during the last decade.

To transport iron ore to ports for export, Goa takes advantage of the logistical advantages of inland water transportation. Goa's iron ore exports are dependent on the barge industry. It has essentially developed on its own, with little or no government intervention or assistance. For more over 50 years, private operators have grown the barge sector. When compared to waggons, the cost of carrying ores to ports via inland waterways works out to be a more efficient mode of transportation, providing cost competitiveness to exports of even low Fe content fines and lumps.

Goa's tidal riverine system, which includes the Zuari and Mandovi rivers, the Cumberjua canal, and connections to the Mormugao and Panaji ports, accounts for more than 90% of the country's commercially viable inland water freight transit. As a result, the IWT mode is the most efficient and commercially appealing option for transporting iron ore from mines to ports.

4.3 OBSERVATIONS, ANALYSIS AND INTERPRETATONS

4.3.1 Total and Navigable Length of Waterways

Year	Total Length of the Rivers/ Canals/ Lakes in State (Km.)		Navigable Length (Km.)		Percentage of Navigable Length to Total Length	
	KERALA	GOA	KERALA	GOA	KERALA	GOA
2015-2016	2779	274	845.2	249	30.41	90.88
2016-2017	3311	274	1772	249	53.52	90.88
2017-2018	3553.46	274	1967.25	249	55.36	90.88
2018-2019	3256.13	274	1897.49	249	58.27	90.88
2019-2020	2988.61	274	1613.24	249	53.98	90.88

Table 4.1 Total and Navigable length of waterways

(Source: Statistics of Inland water transport by Ministry of Ports, Sipping and Inland waterways)

The length of waterways, as well as their navigable length, is a measure of a state's inland water potential. Table above gives the Total and Navigable length of Waterways reported in Kerala and Goa. The total length of the rivers, lakes and canals has been varying from year to year.

In 2019-2020 the total length of rivers in state of Kerala is 2988.61 km. In the previous year it was 3256.13 km. This means a decrease of 267.52 km in the total length of waterway has been occurred. Only a small portion of the total length of rivers is available for navigational purposes. Out of 2988.16 km length waterway, only 1613.24 km is available for navigational facilities. That is, 53.98% is only utilized for navigation with respect to total available length of rivers. The percentage of navigable length to total length was just 30.41% in the 2015-2016 time periods. In the next year itself it improved and reached to a percentage of 53.52%. Still with no further improvements the percentage of navigable length to total length is just above 50%.

The total length of rivers is Goa is 274 km for last five years. Out of that, 249 km is available for navigational purposes. That makes a percentage of 90.88% utilization of waterways in Goa. The percent continues for last five years. Within the available 274 kms of river stretch, they are utilizing the maximum part for navigational purposes.

4.3.2 Types of vessels

The table below shows the number of IWT Vessels with Valid Certificate of Survey.

Self-propelled						
State	Year	Cargo	Passenger	Cargo cum passenger	Tugs & Pushers	Total
KERALA	2020	3	60	2	0	65
	2019	268	270	0	0	538
	2018	806	967			1773
	2017	7	59			66
	2016	111	287	42	2	442
	2015	111	287	42	2	442
GOA	2020	82	146	13	3	244
	2019	112	117	18	2	249
	2018	133	116		16	265
	2017	184	126			310
	2016	81	38		2	121
	2015	114	81		8	203

Table 4.2 List of various Self-propelled vessels

(Source: Statistics of Inland water transport by Ministry of Ports, Sipping and Inland waterways)

Non self-propelled							
State	Year	Dumb Barge	Dumb Tankers	Dumb Flat	Boats	Others	Total
KERALA	2020	32	0	0	5086	407	5525
	2019	27	0	4	275	5109	5415
	2018	26	3	2	770	5082	5883
	2017				5430	60	5490
	2016		3		4283	9091	13377

	2015		3		4283	9091	13377
	2020						0
	2019	1	0	0	0	0	1
	2018	1					1
	2017	1					1
	2016	2				36	38
GOA	2015	3				19	22

Table 4.3 List of various non-self-propelled vessels

(Source: Statistics of Inland water transport by Ministry of Ports, Sipping and Inland waterways)

The total number of certified vessels in Kerala was 13819 in 2015. But by 2020 it reduced and reached to 5590 vessels only. A gradual decrease can be seen in both self-propelled and non-self-propelled vessels. In case of Goa, the total number of vessels moving through the waterways was 225 in 2015. It decreased to 159 vessels in 2016. Again an addition of 152 vessels happened in the next year. Currently, in 2020 there are 244 different types of vessels serving for various activities in inland waterways of Goa.

4.3.3 Cargo moved by Vessels

Year	Cargo Moved (tonnes)		Number of Vessels		Efficiency(Cargo moved/No.of vessels)	
	KERALA	GOA	KERALA	GOA	KERALA	GOA
2015-2016	1061000	4975000	13819	159	76.77834865	31289.30818
2016-2017	1033000	15768000	5556	311	185.925126	50700.96463
2017-2018	428000	11162000	7656	266	55.90386625	41962.40602
2018-2019	420000	3772000	5953	250	70.55266252	15088
2019-2020	546000	2952000	5590	244	97.6744186	12098.36066

Table 4.4 Cargo moved and No. of vessels

(Source: Statistics of Inland water transport by Ministry of Ports, Sipping and Inland waterways)

Various commodities move along the waterways of Kerala and Goa. There are different types of vessels which carry these cargoes. The above table shows the cargo moved in tonnes and thus an efficiency calculation is done to understand the performance of cargo movement by vessels of Kerala and Goa.

Kerala moved 10.61 lakh tonnes of cargo in the year 2015-2016. But the cargo movement decreased after that. In 2018-2019, it was 4.2 lakh tonnes. Now a slight increase in the cargo movement is there during the 2019-2020 year. From 4.2 lakh tonnes it reached to 5.46 lakh tonnes.

Iron ore is the major cargo moved through Goan waterways. The cargo moved along the waterways of Goa is quite impressive. During 2015-2016, Goan waterways moved 49.75 lakh tonnes of cargo. In the very next year it reached to 157.68 lakh tonnes of cargo. From 2017 onwards, we can see a gradual decrease in the cargo movement along the Inland waterways of Goa. In 2019-2020 it was 29.52 lakh tonnes.

During 2019-2020, Kerala's NW 3 alone accounted for 0.80% of total cargo moved along the Indian waterways and Goan waterways transported 4.31% of cargoes out of the total cargo moved through the waterways of India.

Kerala had 13819 vessels during 2015-2016. But the number of vessels decreased year by year. In 2019-2020, Kerala had only 5590 vessels. By the time period 2015 to 2020, the vessel strength of Goa has increased from 159 to 244.

An Efficiency calculation was done on the basis of cargo moved and number of vessels. We calculated the efficiency from 2015 to 2020. Through this efficiency calculation we are trying to understand how much cargo each vessel moved on an average basis during respective years.

Efficiency = Cargo moved/No of vessels

The results in the above table show that, a single vessel of Kerala must have carried 76.77 tonnes of cargo during 2015-2016. It was during that period Kerala moved maximum cargo and the number of vessels was high. In the very next year, the efficiency of cargo moved by a single vessel increased and it reached up to 185.92 tonnes. But huge decrease to 55.9 tonne cargo carriage by a vessel happened in 2017-2018. Currently in 2019-2020, the efficiency of cargo moved by a vessel in Kerala is improving and reached around 97.67 tonnes.

The efficiency of Goan vessels in cargo movement is too high when compared to Kerala. During 2015-2016, the efficiency of a single vessel was 31289.30 tonnes. In 2016-2017 it again increased and reached up to 50700.96 tonnes of cargo moved by one vessel. It is clear from the table that, it was during this time Goa had maximum number of vessels and also it moved the maximum amount of cargo. Thus the efficiency is also the maximum. Then in the following years a decrease in the efficiency of average cargo carried by a vessel can be seen. In 2019-2020, a vessel operating in the inland waterway of Goa is carrying an average amount of 12098.36 tonnes of cargo.

Thus in this efficiency study, Goa ranks first for last five years and Kerala is trying to improve its performance.

4.3.4 Volume of Cargo Carried by Number of Vessels

Year	Number of Vessels		Volume of Cargo Carried (tonnage)		Efficiency(Volume of cargo carried/No. of vessels)	
	KERALA	GOA	KERALA	GOA	KERALA	GOA
2015-2016	13819	159	2912060	429966000	210.7287069	2704188.679
2016-2017	5556	311	326640	116600800	58.79049676	374922.1865
2017-2018	7656	266	447980	71902100	58.51358412	270308.6466
2018-2019	5953	250	262350	14839400	44.0702167	59357.6
2019-2020	5590	244	56098800	8200000	10035.56351	33606.55738

Table 4.5 Volume of cargo carried and No. of vessels

(Source: Statistics of Inland water transport by Ministry of Ports, Sipping and Inland waterways)

The table shows the number of vessels deployed and the volume of cargo handled in Kerala and Goa's inland waterways.

The Volume of cargo carried along the Inland waterways was 2912060 tonnages in Kerala during 2015-2016. In the followings years the volume got decreased and reached up to 262350 tonnages in 2018-2019. But the volume of cargo carried had a great increase of 55836450 tonnages by 2019-2020.

The volume of cargo carried by the Inland waterways of Goa was 429966000 tonnages in the year 2015-2016. The volume of cargo carried was at a maximum of 71902100 tonnages during 2017-2018. But then a gradual decrease can be seen. The tonnage is just 8200000 in 2019-2020. A decrease of 6639400 tonnages can be seen from 2018-2019 periods to 2019-2020 periods.

An Efficiency calculation was done on the basis of volume of cargo carried in tonnages and number of vessels. We calculated the efficiency from 2015 to 2020. Through this efficiency calculation we are trying to

understand how much volume of cargo is carried by each vessel on an average basis during respective years.

Efficiency = Volume of Cargo Carried/ Number of Vessels

According to the calculated efficiency, a single vessel of Kerala carried around 210.728 tonnages volume of cargo in the year 2015-2016. In the following years, the efficiency decreased and reached up to 44.07 tonnages volume of cargo 2018-2019. But a huge hype in the efficiency can be seen in the year 2019-2020. During this time a single vessel in Kerala moving through the Inland waterways must have carried around 10035.56 tonnage volume of cargo.

In case of Goa, the efficiency was 2704188.679 tonnage volume of cargo carried by a vessel. Year by year the performance according to the efficiency of vessels to carry an average volume of cargo is decreasing. In 2019-2020 year the cargo handling by a single vessel is just 33606.55738 tonnages. A decrease of 25751.04262 tonnages is there from the 2018-2019 time periods to 2019-2020 time periods. Thus from last five years a drastic decrease is there in the volume of cargo carried by each vessel in the Goan Inland waterways.

The efficiency study shows that the vessels moving in the Inland waterways of Goa is handling more volume of cargo when compared to Kerala. However, when individually taking the efficiency of vessels of each state for last five years, it is clear that Kerala is improving its cargo handling and Goa is having a decrease.

4.3.5 Hypothesis testing

In order to understand the performance of the inland waterways of Kerala and Goa, a Chi square test is done by taking the cargo moved in lakh tonne and the navigable length of rivers in each state.

In the year 2015-2016, Goa had 249 km navigable Inland waterway. Through that length, they carried 49.57 lakh tonnes of cargo. Keeping

this as a benchmark, we are trying to calculate an expected value for the cargo carried along the Inland waterway of Kerala. The navigable length was 845.2 km during 2015-2016. Thus the expected value was calculated as follows:

$$\text{Expected value} = \frac{(\text{Navigable length of Kerala} \times \text{Cargo moved in Goa})}{\text{Navigable length of Goa}}$$

With the above equation, keeping Goa as a benchmark, an expected value for the cargo moved in Inland waterways of Kerala is calculated. The results are shown in the table below.

Years	Navigable Length (Km.)		Cargo Moved (lakh tonnes)		Expected value
	KERALA	GOA	KERALA	GOA	
2015-2016	845.2	249	10.61	49.75	168.8702811
2016-2017	1772	249	10.33	157.68	1122.124337
2017-2018	1967.25	249	4.28	111.62	881.865241
2018-2019	1897.49	249	4.2	37.72	287.4430635
2019-2020	1613.24	249	5.46	29.52	191.2564048

Table 4.6 Expected cargo movement in Kerala

(Source: Statistics of Inland water transport by Ministry of Ports, Sipping and Inland waterways)

With the obtained expected value and the original values of cargo moved along the Inland waterways of Kerala, a Chi square test is done to understand the performance of Inland waterways of the states.

Chi Square test

The discrepancy between the observed and expected frequencies of the outcomes of a set of events or variables is measured by the chi-square statistic.

Chi-square is a valuable tool for analysing categorical differences, especially ones that are nominal in character.

The extent of the discrepancy between actual and observed values determines the value of 2. It can also be used to compare the fit of an actual frequency distribution to a theoretical frequency distribution.

The formula of Chi square is:

$$\chi^2 = \Sigma((o - e)^2)/e$$

Where,

o = Observed value

e = Expected value

The Hypothesis for the calculation is as follows:

Hypothesis: There is no significant difference between the observed values and expected values.

Expected value	Observed value	o - e	(o - e)^2	((o - e)^2)/e
168.8702811	10.61	-158.26	25046.32	148.3169
1122.124337	10.33	-1111.79	1236087	1101.55943
881.865241	4.28	-877.585	770155.9	873.326013
287.4430635	4.2	-283.243	80226.63	279.104432
191.2564048	5.46	-185.796	34520.3	180.492277
	Chi square value			**2582.79906**

Table 4.7 Chi square table

With the calculated expected values and the original observed values, Chi value is calculated.

The Chi value obtained is 2582.79906.

The degree of freedom for the above table is:

Degree of freedom = (No. of column-1) × (no. of row-1)

= (2-1) × (5-1)

= 4

With this degree of freedom, the table for Chi square at a 5% significant level is 9.488.

Calculated Chi square value = 2582.79906

Table value for Chi square = 9.488

i.e.; **Chi square table value < Chi square calculated value**

Hypothesis rejected – There is significant difference between the observed value and the expected value.

There is a significant difference between the cargos moved along the inland waterway of Kerala by keeping the cargo movement in Goa as a benchmark. If Goa is moving 49.75 lakh tonne of cargo along the 249 km navigable inland waterway, then Kerala should move 168.870 lakh tonne of cargo through 8452 km length waterway. But the amount of cargo actually moved in that year is only 10.61 lakh tonne. There is a huge difference between the cargo movements.

CHAPTER 5

CONCLUSION

5.1 FINDINGS

- The main reason for using inland waterways as a mode of transportation in the supply chain is that it reduces total cost when employed as part of the end-to-end logistics operations of cargo movement.

- The total length of Inland waterways is more in Kerala when compared to Goa. The total navigable length of Inland waterways is also more for Kerala. But, the percentage of navigable length to total length of inland waterways is more for Goa. The percentage of navigable portion of waterways is 90.88% out of total length.

- Goa's utilization of available Inland waterways is done in a better manner when compared to that of Kerala. Even though Kerala has a lengthy river stretch, the utilization of that is not up to the mark. Along with that Goa is also maintaining its available waterways utilization continuously without any change. For last five years the percentage of navigable length to total length is above 90%.

- Cargo movement is more in Goa's waterways when compared to Kerala. But the cargo movement through the inland waterways of Kerala is showing a steady increase year by year. That means, Kerala is increasing its dependency on Inland waterways for transportation of cargoes. On the other side, the amount of cargo moved through Inland waterways of Goa is declining yearly.

- The number of vessels in Goa is very few when compared to Kerala. But the fleet size of Kerala is decreasing in recent years and that of Goa is slightly increasing.

- In cargo carried per vessel efficiency, Goa is performing better than Kerala. But the year wise trend shows that for last four years, the efficiency of Goa is not as the previous years. Whereas the performance of Kerala is improving in last three years.

- In volume of cargo carried per vessel efficiency, Kerala is behind Goa. An improvement is there in the efficiency of Kerala compared to the previous year. But the efficiency of Goa is less when compared to that of previous year.

- By keeping Goa as a benchmark cargo moved along the inland waterways of Kerala was calculated. The expected value is much more than the observed value. The cargo moved along the inland waterways of Kerala is not up to the mark.

- There is a significant difference between the actual amount of cargo moved along the inland waterways of Kerala and the expected value was obtained. This shows that the cargo moved along the inland waterways of Kerala can be improved a lot.

5.2 ISSUES AND CHALLENGES

- In the previous five years, the iron ore trade scenario has shifted dramatically. Increased demand for iron ore to China has resulted in an unexpected surge in iron ore export volumes from Goa. As a result, the inland water transport business in Goa has been faced with additional obstacles.

- Development activities are not being carried out in a holistic approach to fulfil the needs of stakeholders such as shippers and operators.

- Low productivity, lack of private shipping activity, and inadequate infrastructure.

- Land available on the margins of navigation canals has long been encroached upon, and eviction is impossible without adequate rehabilitation measures.

- Local residents demonstrate against pile and concrete type bank protection and deepening operations.

- Local residents demonstrate against the illegal seizure of their land.

- Government land is unavailable for dumping massive amounts of excavated soil.

- Traditional fishermen and navigation operators have competing interests.

- Operators of Road-IWT are at odds.

- The lock/bridge has insufficient navigational clearance.

- Inland terminals and container handling systems are out-dated.

- Inadequate plan fund allocations, project implementation delays, and low fund usage.

5.3 SUGGESTIONS

- Better utilization of available rivers / canals /creeks / backwaters of Kerala.

- Optimal utilization of vessels can be done by carrying more cargo in one trip so that the operating expenses will be reduced.

- Extending scope – more dependency on one single firm will affect the vessel operation since vessels will be idle on non-working days for the firm.

- Further utilization of container and cargo movement through National Waterway 3, beyond scope of Kochi making it cheaper for clients and time saving and safer transportation compared to land or road transport.

- Benchmark against the best competitor in the field across all metrics. This will assist in identifying areas for improvement.

- There are NW's which are non-operational. Activities along these should be initiated.

- Government policies and regulations should be implemented and made effective faster.

- There is a huge scope of using inland waterways as a part of tourism in both states.

- The size and number of boats using the Goa waterways should be increased, then it is critical to update the existing infrastructure on the following fronts:

    - Shallow patches, shoals, and sand bars that obstruct navigation, particularly at low tide, must be dredged to give a minimum depth of 3.6 metres for the barges now in service (2500 DWT), allowing for round-the-clock navigation even at low tide.

    - To fulfil the growing demand for iron ore transportation, the size of the boats must be increased to 3000 DWT.

    - To ply 3000 DWT vessels, greater draught is required, which necessitates a minimum available depth (LAD) of 3.9 m to 4.0 m.

    - The increased number and size of barges raises worries about the safety of river traffic in Goa. To address this situation, the channel should be marked with nautical markers and navigational aids should be provided to guarantee smooth operation navigation during the day and night time.

    - Appropriate traffic management arrangements must be put in place to deal with predicted congestion on the waterways.

    - At all tide circumstances, safe anchoring sites and awaiting berths must be provided for barges.

5.4 CONCLUSION

It is becoming increasingly difficult to provide an efficient and cost-effective mode of transportation while also lowering congestion problems, traffic accidents, and air pollution. For India, inland water transportation (IWT) is a vital resource. There are over 14,500 kilometres of navigable waterways in India, with 5,700 kilometres navigable by mechanically driven vessels. The country's coastline covers over 6,000 kilometres and is peppered with small and big ports. IWT has several advantages, including being a less expensive mode of transportation, being safer and energy efficient, being more environmentally friendly, and emitting the least CO2.

In the above study, the efficiency of the Inland waterways of Kerala and Goa ids discussed. Both states have got a lot of potential in the inland waterways. A huge scope of better utilization of the inland waterways is there in different aspects. But, there should be better infrastructure facilities and developmental activities for improving the performance. For dealing with the issues will need a massive amount of work from both the government and the private sector.

Due to the Indian economy's opening up and rapid GDP growth, there has been an urgent need for a huge efficient transportation system for the movement of bulk goods, such as food grain, fertilisers, building supplies, petroleum, oil and lube, and Over-Dimensional Consignments, among other things. Rail and road transit systems are already overcrowded and congested. Their expansion will necessitate a large financial investment, effort, and land acquisition, making it a difficult proposition.

As a result, both coastal and interior water transportation systems must be developed and integrated. Coastal shipping and inland water transport could be combined, enhancing coastal shipping's contribution to the country's total transportation system. Seamless integration of coastal shipping and inland water transport will be possible only when boats can

profitably operate in both sectors. Inland rivers may pose substantial design and construction difficulties for an adequately made vessel leading to a shortage of appropriate water depth.

5.5 DIRECTION FOR FUTURE RESEARCHER

Inland waterways in India are a vast topic. Changes happen every year and a continuous study can be done on the topic. In case of Kerala and Goa, both states have a huge scope in transporting goods and passengers through their inland waterways. Various developmental activities take place in the Inland waterways of India. Government is trying to use the Inland waterways to its maximum potential. How the various projects effect the efficiency of these waterways can be studied in future. Also, data's related to the type of cargos handled can be considered for the same study. Efficiency of the vessels owned by the Central and state Governments can be studied separately.

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