A Project Report on

"A STUDY ON INLAND WATERWAYS TRANSPORTATION WITH A SPECIAL FOCUS ON KERALA AND GOA"

In partial fulfillment of the requirements for the award of the Degree of

MASTER OF BUSINESS ADMINISTRATION

(International Transportation and Logistics Management)

Submitted by

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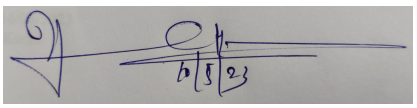
CERTIFICATE

This is to certify that the Project titled " **A STUDY ON INLAND WATERWAYS TRANSPORTATION WITH A SPECIAL FOCUS ON KERALA AND GOA**" submitted by Anjith R Nair register number 2105305005 student of MBA ITLM is a bonafide record of his project report and submitted to the School of Maritime Management, Indian Maritime University, Kochi campus, under the supervision of Dr. Yogamala H L, Head of the Department IMU, Kochi campus. It is also certifying that the above work has not previously formed or submitted for the award of any degree, diploma, associateship , fellowship, or other similar titles, and it is an independent work done by the candidate.

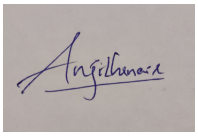
Dr. Yogamala H L



SELF DECLARATION

I, **ANJITH R NAIR** (Registration No: 2105305005) student of School of Maritime Management, Indian Maritime University, Kochi hereby declares that this project report titled "**A STUDY ON INLAND WATERWAYS TRANSPORTATION WITH A SPECIAL FOCUS ON KERALA AND GOA**" submitted in partial fulfilment of the requirement for the degree of Master of Business Administration in International Transportation and Logistics Management is my original work carried under the guidance of Dr. Yogamala H L.

I also confirm that the report is only prepared for my academic requirement, not for any other purpose. It might not be used with the interest of the opposite party of the corporation.



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ANJITH R NAIR

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INTRODUCTION

1.1 DEFINITION AND MEANING

Without the movement of goods across oceans, by air, on railroads, and on roads, the world economy cannot function. The shipping industry promotes domestic and international manufacturing and trade by transporting raw materials and completed goods as well as offering direct consumer delivery. The economies of many nations depend heavily on the movement of products by water. According to UNCTAD, shipping will account for over 80% of world trade by 2020. Along with ocean transit, inland water transportation is significant.

1.1.1 Inland Waterways

In many nations, shipping over inland waterways is more affordable than via road or rail. Non-sea regions of water that can be travelled on by boats are known as inland waterways. Inland rivers are economical and fuel-efficient for shipping freight. Inland waterways may become a more environmentally friendly alternative to highways and trains in the next decades as road freight movement becomes more congested and produces more pollutants in terms of energy efficiency, noise pollution, and emissions. Inland canal transportation, which has an estimated seven-fold lower external cost than road transportation, utilises less than 20% of the energy used by road transportation and around 50% of the energy used by rail transit.

The global experience has some intriguing commonalities. IWT makes up a large amount of inland transportation in a number of nations, including: 40 percent in Europe, 44 percent in Korea and Japan, 35 percent in China,14 percent in the US, 47 percent in China, and % in Bangladesh. A large portion of the rise in China has taken place recently, concurrent with the nation's spectacular economic and agricultural development. Particularly for bulk cargo, inland water transportation and coastal shipping are economical, environmentally responsible, and fuel-efficient forms of transportation. Heavy-duty road transport trucks produce 51 to 91 grammes of CO2 per ton-kilometer, compared to container ships, which release between 32 and 36 grammes. Additionally, the average cost of rail travel is Rs. 1, whereas the cost of road travel is Rs. Waterways cost 25 to 30 paisa every ton-kilometer, while land costs 1 rupee per ton-kilometer. 24 tonnes of freight can be transported by road, 85 tonnes by train, and up to 105 tonnes by sea using a single litre of gasoline. These data support the claim that rivers are much less expensive and environmentally friendly than land. If logistics costs are reduced from 14% of GDP to 9% of GDP, the nation will save $50 billion yearly. As logistical costs were decreased, retail prices would be lower.

1.1.2 Inland Water Transport in India- A Historical Overview

India's commercial history has detailed accounts of the growth of inland river transportation. The fact that there are numerous settlements on rivers that served as economic hubs even before there were railroads shows how important this mode of transportation was in the past.
In 1823, the Diana, the first powered ship, travelled 80 kilometers on the Hooghly from Kulpi Road to Calcutta while carrying 89 tonnes of passengers. To move East India Company employees and supplies, a monthly steamer service between Calcutta and upstream outposts on the Ganga was established in 1834. Beginning in 1842, a regular twice-weekly service ran down the Yamuna between Agra and Culcutta. Beginning in 1863, there was a consistent steam service between Assam and Culcutta. a system of steamboat Garh-Mukteshwar on the Ganga in Uttar Pradesh, about 645 kilometers from Allahabad, and Ayodhya on the Ghagra, about 325 kilometers from the confluence of the Ganga, were only the beginning of the services' rapid expansion.

Transportation by power crafts and country boats dominated the expansion of international trade along river banks regions of the navigable river and canal system in the nineteenth century. However, the majority of traffic was carried to Assam by country boats from Delhi and the Nepalese border. Approximately 180,000 freight boats were registered in Calcutta, 124,000 in Hooghly, and 62,000 in Patna at the height of the country boat traffic in 1876–1877.

In India, the introduction of railroads and the ensuing growth of their network marked a turning point for water transportation. First of all, the construction of important railway lines increased river traffic because the two means of transportation were complementary, with waterways acting as feeders for trains. IWT and railroads were complementary, although this relationship was only fleeting. The state of navigation started to decline around 1860. The East Indian Railways' expansion had started to have an effect by that point. New economic hubs further from the rivers emerged as a result of the expansion of the rail network. IWT rapidly lost the upper hand.

1.1.3 Inland Water Transport in India

The development of trade and commerce along numerous rivers and canals was greatly aided by IWT, which was a significant mode of transit and navigation for country boats and motorised crafts during the nineteenth and first half of the twentieth centuries. The advent of railways and the growth of their network in India had considerable impact on water transport. Except for a few places like Assam, Goa, Kerala, Mumbai, West Bengal, and a few other coastal districts,

the IWT sector was ignored in the final years of the 20th century (where it had natural advantages and no developmental intervention was required).

But given its inherent advantages, there has always been a need for this industry to properly develop, as shown by the fact that numerous Committees have periodically assessed the nation's IWT system and recommended for its methodical expansion since independence. The National Transport Policy Committee recommended in its report from 1980 the creation of a national agency for the development and control of inland waterways, and as a result, the Inland Waterways Authority of India (IWAI) was established in 1986. The federal government only has control over waterways that have been designated as National Waterways; all other waterways are under state administration.

The Inland Waterways Authority of India (IWAI) has categorised Indian inland waterways in the past through its regulations from 2006. Based on their characteristics and the types of vessels that will pass through them, waterways are categorised into seven groups.

Inland rivers aren't being utilised to their maximum capacity, though. When we examine India's various modes of transportation, we can observe that the nation is mostly dependent on one. 74% of all transportation is via road. Only 1% of India's 14,500 km of inland waterways are used for freight transportation.

1.1.4 National Waterways

The Indian government designated 5 waterways as national waterways up until 2016. As follows:

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 theNational 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).

The Indian government declared 106 new rivers as National Waterways across the country in April 2016. The upgrading of these waterways to NW standards is predicted to result in a 2% increase in GDP, leading in a significant increase in India's IWT share. This has necessitated the employment of novel ways to accelerate growth in the IWT sector. A feasibility report and a DPR are being created to analyse the potential and project components of these additional waterways.

According to an official government study (National Waterways), the Inland Waterways Authority of India (IWAI) has selected 25 national waterways that are viable for cargo/passenger movement based on the results of the Detailed Project Report (DRP) and the economic-technical feasibility of NWs. Thirteen national waterways are currently being built.

1.1.5 Inland Water Transport In Kerala

In Kerala, rivers and backwaters are used for inland water transportation. This has played an important role in transportation from ancient times. In comparison to railways and roadways, inland waterways have unique natural benefits. Kerala has 41 rivers that run west, as well as numerous backwaters. In 2020, the entire length of the state's rivers, canals, and lakes will be 2988.61 kilometres. The navigable distance is 1613.24 km. The inland canals serve as conduits between rivers. Commercially important locations can be found along the banks of these rivers. The West Coast Canal (WCC) system, which is approximately 560 km long, is owned by the state. It runs from Kovalam in the south to Hosdurg in the north. Together with the Champakkara (14 km) and Udyogamandal (23 km) canals, the Kollam - Kottapuram segment (168 km) was designated as National Waterway-3 (NW-3) by the Central Government in 1993, and it is essentially finished.The Central Government has declared that NW-3 would be expanded from Kottapuram to Kozhikode for a distance of 160 km. A total of four canals, including Alappuzha - Changanassery (28 km), Kottayam - Vaikom (42 km), Alappuzha - Kottayam - Athhirampuzha (38 km), were classified as national waterways by the Central Government in April 2016.

Sl. No	NW No	STRETCH	LENGTH (km)	OPERATIONAL (Y/N/P)
1	NW 3	Kollam- Kozhikode stretch ofWest 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

Goa has 274 miles of inland waterways, of which 249 are navigable in 2019–2020. It involves the Mandovi and Zuari rivers, as well as their tributaries. chevaliers Horses, horses, horses, horses Iron ore is transported from loading stations in the hinterlands to the port of Mormugao and the Panaji outer anchorage by the export and mining sectors using the majority of their full length. These rivers can offer quick and affordable freight and passenger transit when they are effectively utilised.

The economy of Goa's mining industry has benefited greatly from the role that inland waterways have played in the delivery of iron ore. Since 1947, when commercial production of minerals (mostly iron ore) began, the Mandovi, Zuari, and Cumberjua canals in Goa have provided natural waterways and assisted in the promotion of the iron ore industry with effective means of transportation.

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 learn more about Kerala's and Goa's inland waterways' activities.
- To investigate the effectiveness of activities on Kerala's and Goa's inland waterways.
- To research vessel operations in Kerala's and Goa's inland waterways.
- To suggest findings from the above study.

1.3 SCOPE AND RATIONALE FOR THE STUDY

Since inland transportation has so great potential, it already makes up a significant share of the world's tonne-kilometer movement. Every country's economic growth depends on a well-functioning transportation system, especially for the movement of bulk goods. Inland rivers, pipelines, motorways, railroads, and coastal ships are all important modes of transport for large products.The government must take adequate steps to develop all of these modes of transportation in a liberalised economy like India, where the private and public sectors are anticipated to contribute a sizable portion of GDP. This will enable industries to offer consumers the lowest possible cost of production by utilising an ideal mix of transportation networks that individually capitalises on the advantages of each of these modes.

Large-scale capacity development is troublesome because to the overcrowding and saturation of the rail and road, India's primary sources of transportation for bulk commodities. IWT has the potential to replace clogged-up roads and overloaded train systems since it is economical, ecologically benign, and fuel-efficient.

The study focuses on inland water transportation's efficiency in Kerala and Goa. By evaluating this data, we can comprehend the performance of these rivers thus far. There is a plenty of opportunity for growth and development in the inland waterway transportation sector. Based on the effectiveness of these, what course of action may be taken and what areas need improvement? It is also obvious whether further investment in this sector is needed. Many of India's rivers, canals, streams, and other waterways have the potential to be developed into economically viable waterways that link ports to the interior. In order to compete in a multimodal transportation network, it is crucial that the IWT mode be developed to that point. In conclusion, inland transportation has a promising future as long as issues like insufficient infrastructure and institutional support are properly addressed.

1.4 RESEARCH METHEDOLOGY

The research is based on secondary data gathered from different Annual reports on inland waterways:

- Inland Water Transport Statistics from the Ministry of Ports, Shipping, and Waterways
- Annual Report of the Indian Inland Waterways Authority

E-books, magazines, and other online publications were also mentioned.

1.5 LIMITATIONS

The issue of inland water transportation in India is large, and time has been a key constraint in this research. Because data confidentiality is applied to data received mostly from secondary sources, all data collected may not be correct. Only a few years of data were studied because there is no original study on the issue. The study only looks at the efficacy of inland waterways in Kerala and Goa. As a result, understanding the efficiency of India's overall waterways is challenging. Only two of Kerala's four national waterways are operating, while only two of Goa's six are operational. As a result, we are unable to determine the specific effectiveness of each stage.

CHAPTER 2

LITERATURE REVIEW

2.1 REVIEW OF LITERATURE

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

According to his studies, transportation and manufacturing are so linked that they cannot be treated individually, and that the massive transportation problem can only be adequately managed by using our navigable interior rivers. He proposed a consistent approach to dealing with the problem.

- INLAND WATER TRANSPORT IN INDIA by Ravinder (1992)

Ferries, according to Ravinder, are a crucial and irreplaceable component of today's globalised and interconnected world, and are sometimes the only reliable method of transportation in some locations. He further says that ferry travel is riskier than other types of transportation since sinking ships and boats are always a possibility. He believes that the failure of the monsoon produces a decline in river water levels, making passage difficult.

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

Teresa thinks on the financial aspects of boat travel. Many tourists consider boat riding to be an adventure and an experience that they cannot have from any other mode of transportation. According to Teresa, the ferries help the state's economy by generating tourists and offering assistance to local companies. She says that ferry operations have a modest economic impact when compared to other forms of transportation; yet, an economic impact analysis shows that ferry operations have a large economic influence on local economies.

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

The magazine is concerned with the financial aspects of inland water transportation in India. They argue that in 2000, despite a worldwide cargo market of 1,000 billion tonne kilometers, IWT freight traffic was only approximately 1.5 billion tonne kilometres (a modal share of 0.15

percent). If the necessary infrastructure investments in fairways, terminals, boats, and navigational aids are completed in India, IWT has great potential as a cost-effective and ecologically friendly mode of transportation. The authors conducted a pilot study on two critical national waterways, NW1 (Ganges-Bhagirathi-Hoogly River system) and NW2 (Brahmaputra River system), to assess the practicality of such investments. Their findings justify the Indian government's decision to undertake rapid and major efforts to build national

IWT in its 10th and 11th Five Year Plans.

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

In this article, they discuss passenger mobility, factors affecting passenger transportation, and freight flow along India's interior rivers. They also discuss the commercial possibilities of inland rivers. They demonstrate that the geographical benefit of IWT freight transportation is highest when the whole trip occurs on a river. They utilise examples like the Mandovi and Zuari rivers in Goa, which are used for iron ore mining, and Kerala waterways to highlight the importance of inland waterways in freight transportation. The many challenges that inland waterways face, as well as their environmental effect, are discussed. In addition, the writers address policy difficulties in India and provide recommendations.

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

The authors consider inland water resource transportation and trade to be two significant service areas. As public knowledge of India's inland water transportation system grows, an effort is made to identify the major problems and challenges in this sector. The article discusses the history of India's inland water transportation industry, as well as the issues and problems it confronts. Inter-state collaboration and coordination, according to the authors, is critical in developing India's inland water transportation network beyond state lines. The research offers a clear picture of inefficient port operations in India, which inhibits both inland water transportation and marine trade in general.They advocated a seamless integration of inland water transportation and coastal shipping, but only provided boats could operate economically in both sectors. According to the report, inland waterway growth can only be done administratively and gradually in the absence of a national water transportation policy.

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

In the research paper, the researcher identified numerous characteristics that will enable an inland waterways-based multimodal transportation system. The study provides the Indian government and practitioners of IWT in conjunction with other modes with a set of suggestions as well as a conceptual model for developing a resilient and sustainable

multimodal transportation system. The primary notion was that India should concentrate all of its efforts on a single important canal and see it through to completion. They also proposed an IWT architecture to encourage containerized transportation.

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

The article investigates the growth and constraints of India's inland water transportation sector, as well as the significant difficulties that companies in this sector confront. They also investigated different inland waterway policies. In various nations, inland water transport is being investigated. Inland water transport accounts for barely 0.5 percent of India's modal share, while China accounts for 8.7%, the US for 8.3%, and Europe accounts for 7%. In comparison, inland water transport (IWT) accounts for less than 1% of total freight traffic in Germany and 35% in Bangladesh. The development of inland waterways in India, according to the study, offers immense potential for the country's growth and development. Furthermore, appropriate safeguards and procedures are essential to improve the efficiency and long-term sustainability of inland water transportation.

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

The advantages of inland water transportation are highlighted, as well as its effectiveness as a rail and road alternative. They argue that India is an oil-importing country, and that we are actively moving to electric road transportation to tackle pollution caused by fossil fuels. It is vital, however, to apply this to water transport boats as well. Electric motor-powered boats, according to the authors, are better than diesel-powered boats. The essay discusses the impact of electric-powered watercraft. Because electric engines do not require regular gasoline or oil to function, electric boats have fewer maintenance and running expenses. Kerala has previously demonstrated the potential of solar-powered boats; now they must prove it.

Increase and construct the required infrastructure, including effective integration of water transport with road transport via a simple and safe exchange point, as well as last and first-mile connectivity with IOT for more efficient, seamless, and clean forms of transportation in our communities.

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

  In this article, they discuss the history of inland water transport in India, its evolution and development, its current situation and prospects, and potential opportunities. Inland waterways are investigated in such a way that policies and governance from the pre-Colonial period, the colonial period, and the contemporary scenario are examined. Various infrastructure projects, as well as the implications of IWT development on the economy, ecology, and jobs, are explored.

  They also discuss IWT's possibilities in India. According to the authors, inland water transport in India might be a suitable alternative to road and rail freight provided experienced and trained labour is available for IWT operations and technology improves.

2.2 LITERATURE GAP

Various studies and research on inland waterways and inland water transportation have been undertaken in India. The fundamental purpose of this research is to get a better understanding of the operational efficiency and diversity of vessel operations on the inland waterways of Kerala and Goa. According to published assessments, India's interior rivers offer significant potential for economic contribution. The benefits and environmental gains of inland water transportation have been debated and acknowledged for many years. Our interior rivers, on the other hand, appear to be underutilised. Improvements have been made in freight transit across inland waterways. The project displays the efficiency with which Kerala and Goa's inland waterways operate. What is the status of freight flow along these rivers, how efficient is it, and what conclusions may be drawn. As a result, the text emphasises a novel component of inland water transportation.

CHAPTER 3

COMPANY AND INDUSTRY PROFILE

3.1 INLAND WATERWAYS AUTHORITY OF INDIA (IWAI)

Fig 3.1 Logo-IWAI

The Inland Waterways Authority of India (IWAI) was created on October 27, 1986, with the goal of developing and regulating inland waterways for trade and transportation. The Authority primarily pursues initiatives for the upkeep and development of IWT infrastructure on national waterways with funding from the Ministry of Shipping. The Authority's administrative centre is in Noida. The Authority has regional offices in Kolkata, Patna, Kochi, and Guwahati, and sub-offices in Varanasi, Allahabad, Farakka, Sahibganj, Hemnagar, Swroopganj, Dibrugarh, Haldia, Dhubri, Kollam, Bhubaneshwar, Silchar, and Vijayawada.

The 14,500 km of navigable waterways in India are made up of rivers, streams, canals, backwaters, and other waterways. Over 55 million tonnes of goods are transported by inland water transport (IWT), a mode that is ecologically friendly and efficient in terms of fuel use. Its current operations are restricted to a Several stretches of the Ganga, Hooghly, and Bhagirathi Rivers, the Barak and Brahmaputra Rivers, the rivers of Goa, the inland waterways of Mumbai, the backwaters of Kerala, and the deltaic sections of the Krishna and Godavari Rivers. Country boats of all sizes operate in several rivers and canals in addition to these organised operations by mechanised vessels, conveying a sizable amount of cargo and people in this unorganised sector.

3.1.1 Functions of IWAI

National Waterways:

- Pilotage,
- Fairway Development,
- Survey
- IWT Coordination with Other Modes
- Rules, Infrastructure, and Navigation

General:

- Help State Governments by Advising the Central Government.
- conducting hydrographic surveys

- Establish consulting services
- Standards and safety,
- classification of waterways, and
- research and 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. This company was created by the merger of the 1974-founded Kerala Shipping Corporation and the 1975-founded Kerala Inland Navigation Corporation (KINCO). The organization's strengths are its barge operations and Ro-Ro service. It also includes two yards for the construction and repair of small vessels. In order to satisfy a variety of client demands, KSINC has shown its experience in every aspect of vessel building, maintenance, and operation. The unique luxury cruise Nefertiti as well as the premium cruise ships SagarRani (1&2) are now accessible.

3.1.2 Vision

A professionally managed organisation that provides high-quality service.

KSINC wants to be the ideal organisation in pursuit of the highest standards of excellence in the shipping and inland navigation industry. While meeting the demands of its customers, KSINC maintains the highest ethical and professional standards, paying close attention to environmental precautions. KSINC wishes to capitalise on the enormous potential of inland waterways. When it comes to growing its operations, the firm believes there are no boundaries. Meeting obstacles is an inevitable aspect of life. With a strong feeling of synergy and collaboration, our devoted and motivated personnel will work diligently to give the finest service possible.

3.1.3 Mission

- To continue to be the industry leader and to provide a better, safer, and more affordable way of

shipping both people and goods,

- KSINC has set high standards for itself and thinks that shipping over inland waters should be both safe and affordable. We will always work to provide efficient service, lower prices, safe, and dependable practises in order to attain the best level of client satisfaction.

3.1.4 Objectives

- establishing, maintaining, and operating shipping services; purchasing, chartering, hiring, and building ships, tankers, and other vessels
- carrying on the trade and business of shippers, ship-owners, ship-brokers, ship agents, underwriters, ship managers, shipping and forwarding agencies.
- To build, manage, and operate high-quality transportation services for products in inland waters in the State of Kerala and in the Kerala Coastal Region.
- To plan, carry out, and oversee Workshops, Repair Shops, and Service Stations for the upkeep and repair of maritime vessels in Kerala State or elsewhere.
- To create, provide, support, and run research and training institutions and lab centres.
- To play a significant role in the tourist industry.

3.1.5 Major Activities

- Bulk raw material, fuel, and water freight transportation across inland waters.
- Ferry services to the islands around Kochi are in operation.
- Docking and fixing maritime craft.
- Construction of inland boat made of steel and wood.
- Waterway-related travel.
- Speedboat operation, as well as the use of opulent boats for hosting parties on board.

3.3 RIVER NAVIGATION DEPARTMENT - GOVERNMENT OF GOA

Fig 3.3 Logo-River Navigation Department Government of Goa

The River Navigation Department of the Goa State Government is essential in providing commuters with conveyance across rivers, especially for islands in the state of Goa who lack access to roadways. It is in charge of transporting automobiles and goods seven days a week, twenty-four hours a day. This service attempts to reduce traffic congestion on roads while also conserving petrol by using underdeveloped rivers.

The River Navigation Department (RND), which operates a fleet of 39 ferry boats, has been recognised as a "important public utility service" for providing 24-hour ferry service to commuters on 20 ferry routes across Goa. Every day, over 2.5 lakh people and 18000 cars utilise the ferry service. The pre-liberation era saw the establishment of the River Navigation Department, which is now a crucial means of transportation for Goans. True, Goa's extensive inland rivers have been abused.

With a 131-kilometer coastline, Goa should be high on any traveler's list of places to visit. Goa is a very popular tourist destination, with almost as many tourists as residents. Goa has seen a steady rise in both domestic and foreign tourists in recent years. The infrastructure of the state is under severe duress. A extensive network of interior canals, including two, is also present in Goa.

Smaller rivers including Terekhol, Chapora, Mapusa, and Sal, as well as bigger rivers like the Zuari and Mandovi, all have sufficient draught for navigation. Therefore, Goa needs to develop its inland water transportation system.

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.

3.4 STATE WATER TRANSPORT DEPARTMENT- KERALA

Fig 3.4 Logo- State Water Transportation Department

One of the several state government organisations is the State Water Transportation Department. It refers to providing the necessary transportation for those living in the flooded areas in the districts of Kasargode, Kannur, Ernakulam, Kottayam, Kollam, and Alappuzha. Even though this is a business department, it runs in a customer-focused way. The addition of "Transportation" to "Essential Service" has given this Department the appearance of an Essential Service Department. Around 150 lakh passengers are transported annually on wooden, steel, and fibre glass passenger boats.

The Alappuzha District is home to the State Water Transport Department's Directorate, which was formed in 1968.The Director is in charge of the department. During formation, the service operation was restricted to the districts of Kottayam, Alappuzha, and Kollam. At that time, the Alappuzha Head Office functioned as the hub for all operations and activities. The roles and operations were further dispersed by setting up an office for the mechanical engineer and three regional offices in the districts of Ernakulam, Kottayam (Chaganacherry), and Kasargode, supervised by three Senior Superintendents.

The Department's duties are broken down into three categories:

1)Management

2)Operation

3) Repair and upkeep.

The Operations wing is directed by the Traffic Superintendent, while the Management wing is under the direction of the Administrative Assistant. The Mechanical Engineer is in charge of the Repair & Maintenance wing.

The Department has just recently begun using traditional wooden passenger boats to transport people. The Department has switched to new steel passenger boats to keep up with technical improvements.

The Department has developed roads and bridges, it is in competition with the rising amount of traffic on the highways. The biggest obstacle is a deficiency in speed. Water transportation, however, offers considerable cost savings and is less harmful than road and rail transit. However, passengers choose speed above efficiency. The traffic on the roadways is becoming worse every day. The state's navigation canals are also constantly open, offering a wide range of transit choices. During the duration of its existence, the Water Transportation Department will cohabit alongside this facility.

CHAPTER 4

ANALYSIS AND INTERPRETATION

Inland water transportation is examined using the states of Kerala and Goa. States with substantial potential for inland water transportation include Kerala and Goa. Both states benefit from a favourable geographic arrangement that enables them to use their interior rivers for a variety of uses, including passenger and commercial transit.

Inland waterways are a preferable mode of transportation over roads and trains, as was previously stated. State and federal waterways are active in both states. There are several uses for these inland streams. The vessels travel the interior rivers of Kerala and Goa carrying a variety of goods. These interior rivers serve as a fantastic conduit between the foreland and the hinterland. These rivers, streams, and canals, which also include canals, may transport goods from the interior hinterland to the port area. Therefore, inland waterways constitute a crucial form of transportation.

4.1 ROLE OF INLAND WATERWAYS IN KERALA

Fig 4.1 NW 3

The West Coast Canal's Kollam-Kottapuram section has been extended northward (160 km) to Kozhikode and is now included in NW-3. NW-8 is a 28-kilometer canal that runs between Alappuzha and Changanacherry. The Alappuzha-Changanacherry Canal, which extends from Alappuzha to C Block, links Kavalam and Changanacherry. This route offers greater income potential for the transportation of rice, hay, manure, and other agricultural goods as well as coconuts and associated things, building materials, lime shell, and other labour movements. There are 28 km in this route. Only 1.3 km, or 5.9 to 7.2 kilometres, make up Vembanad Lake.The 38-kilometer Alappuzha-Kottayam-Athirapuzhacanal is part of NW-9. Alappuzha marks the beginning of the canal path between C and SB locks goes via the Munro lighthouse to Kottayam. In addition, the Alappuzha-Kottayam canal passes through a farmland that was formerly part of the Vembanad Lake, complete with rice fields organised into "Blocks," man-

made canals, and embankments. Because there is a shortage of agricultural labour in the region, the only means to transfer employees to the recovered blocks is via the Waterway. The Vembanad Lake, which spans the whole A-K, is just 3 km long (Chainages 3 to 6). The Athirampuzha canal (Chandakkulam) starts at Athirampuzha. The canal connects Athirampuzha, Mannanam, and Cheeppunkal over a distance of 15 miles. The canal from Athirampuzha enters the Kottayam-Vaikom Canal at Maniyamparambu, which is close to Pulikkuttissery.

The 42-kilometer-long Kottayam-Vaikom canal is referred to as NW-59. It starts at the brand-new Kodimatha terminal in Kottayam and proceeds along the A-K canal till Kanjiram Junction, where it abruptly turns right and travels via Illikal, Prappuzha, Pulikuttycherry, Mania Parambu, and Cheepumkal on its way to Vaikom. The inner route between the mainland and the abandoned coconut plantation (Swamikkalle) is followed until it ultimately joins the National Waterway-3 in Before the Thannermukkom barrage, Vembanad Lake. The section that runs from Kottayam to Kanjiram is around 3.5 km long. From Cheepumkal to Vaikom, the National Waterway-3 is 14 km long. The K-V waterway will only be built for 24.5 km between Cheepumkal and Kanjiram.

A system of rivers, inlets, estuaries, lakes, and natural canals connects Kerala's coastal areas. With over 900 km of navigable waterways, Kerala's backwaters constitute a network of interconnecting waterways. Foreign tourists love taking traditional houseboat rides around these backwaters to soak in the landscape since it is such an amazing experience.

A leisurely voyage through Kerala's famed backwaters offers an up-close view of the state's rural livelihoods, including coir production, rice cultivation, and prawn farming. A beautiful view of the sea, land, birds, and human habitation coexisting peacefully on the waterside will also be available.

The backwater tourist hub of Kerala, Alleppey or Alappuzha, is the region between the sea and the rivers that feed into it. Backwaters, which are defined as "a section of a river not touched by the stream, where the water is stagnant," are especially stunning in Alappuzha, Kerala. While travelling via Kottayam, Alappuzha, Kollam, Kumarakom, and Kuttanad, travellers may enjoy incredible houseboat rides through these canals and backwaters.

4.2 ROLE OF INLAND WATERWAYS IN GOA

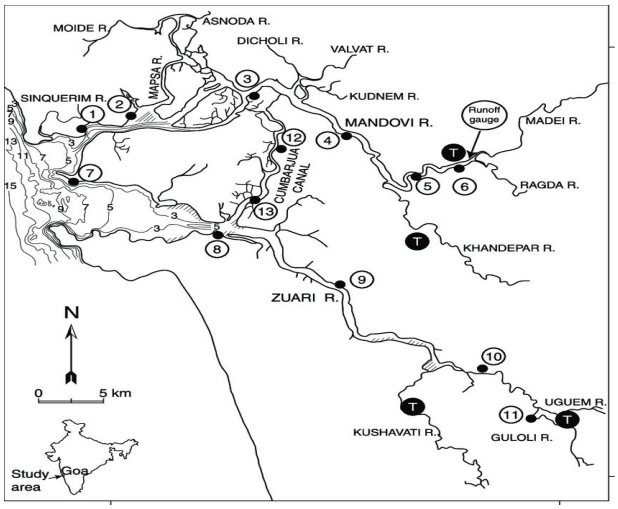

Fig 4.2 Mandovi- Zuari river system

Inland waterways have been critical in the transportation of iron ore and, as a result, in the economic development of Goa's mining sector. Since 1947, when commercial production of minerals (mainly iron ore) began, the Mandovi, Zuari, and Cumberjua canals in Goa have provided a natural waterway and assisted the promotion of the iron ore industry with efficient modes of transportation. Goa's iron ore industry is largely dependent on exports. Goa's iron ore is entirely exported to China, Japan, Korea, Taiwan, and a few European nations. The iron ore mined in Goa is not suitable for steel production. Goan iron ore is of poor grade (Fe concentrations range from 50 to 62 percent), it cannot be used to build a steel mill. Nonetheless, Goan ore is in great demand worldwide because it is regularly used in product mixes to attain optimal Silica and Alumina ratios.

Goa has long been India's largest iron ore exporter. In recent years, Goa has surpassed other Indian ports in terms of exporting the greatest proportion of the country's total exported iron ore. Goa's export to India has averaged approximately 40% in terms of volume during the previous decade.

Goa makes advantage of the logistical benefits of inland water transportation to carry iron ore to ports for export. The barge business is crucial to Goa's iron ore exports. It evolved mostly on its own, with little or no government interference or help. Private operators have expanded the barge sector for more than 50 years. When compared to waggons, the cost of transporting ores to ports through inland rivers works out to be a more efficient means of transportation, allowing exports of even low Fe content fines and lumps to be cost

competitive.

More than 90% of the country's economically viable inland water freight transit is provided by Goa's tidal riverine system, which comprises the Zuari and Mandovi rivers, the Cumberjua canal, and links to the Mormugao and Panaji ports. As a result, for moving iron ore from mines to ports, the IWT method is the most efficient and financially viable choice.

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 toTotal 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)

Waterway length, as well as navigable length, is a measure of a state's inland water potential. The total and navigable lengths of waterways recorded in Kerala and Goa are shown in the table above. The entire length of the rivers, lakes, and canals varies year to year.

The total length of rivers in Kerala in 2019-2020 is 2988.61 km. It was 3256.13 kilometres the prior year. This indicates that the entire length of the canal has decreased by 267.52 kilometres. Only a small part of the overall length of rivers is navigable. 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%.

For the previous five years, the total length of rivers in Goa has been 274 km. A total of 249 kilometres is accessible for navigation reasons. This equates to 90.88% use of Goa's

waterways. The percentage has been constant throughout the previous five years. They are utilising the majority of the available 274 km of river stretch for nautical 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	2015	111	287	42	2	442
	2016	111	287	42	2	442
	2017	7	59			66
	2018	806	967			1773
	2019	268	270	0	0	538
	2020	3	60	2	0	65
	2021	16	85			101
GOA	2015	114	81		8	203
	2016	81	38		2	121
	2017	184	126			310
	2018	133	116		16	265
	2019	112	117	13	2	249
	2020	82	146	18	3	244
	2021	116	170			286

Table 4.2 List of various Self-propelled vessels
(Source: Statistics of Inland water transport by Ministry of Ports, Sipping and Inlandwaterways)

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
GOA							
	2020						0
	2019	1	0	0	0	0	1
	2018	1					1
	2017	1					1
	2016	2				36	38
	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 of152 vessels happened in the next year. Currently, in 2020 there are 244 different types of vessels serving for various activities in inland waterwaysof 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
2021-2022	15,39,367	37,15,103	7321	286	210.267313	12989.87062
2020-2021	7,33,977	84,61,093	5241	226	140.0452203	37438.464601
2019-2020	546000	2952000	5590	244	97.6744186	12098.36066
2018-2019	420000	3772000	5953	250	70.55266252	15088
2017-2018	428000	11162000	7656	266	55.90386625	41962.40602
2016-2017	1033000	15768000	5556	311	185.925126	50700.96463
2015-2016	1061000	4975000	13819	159	76.77834865	31289.30818

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. Thereare 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 washigh. 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 decreaseto 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. In 2020-2021,a vessel operating in the inland waterway of goa is carying a huge amount of rs 37438.464601 tonnes of cargo.In 2021-2022 the vessel operating in the inland waterway of goa is again gained the cargo by a vessel carrying amount

of 12989.87062 .As compared to kerala , goa is making more number of cargo by vessels.

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
2019-2020	5590	244	56098800	8200000	10035.56351	33606.55738
2018-2019	5953	250	262350	14839400	44.0702167	59357.6
2017-2018	7656	266	447980	71902100	58.51358412	270308.6466
2016-2017	5556	311	326640	116600800	58.79049676	374922.1865
2015-2016	13819	159	2912060	429966000	210.7287069	2704188.679

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. In2019-2020 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 calculatedas 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
2020-2021	1866.92	248	3.98	149	189.8756546
2021-2022	1900	249	4.34	152	221.98276

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:

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

Where,

o = Observed value

E= Expected value

The Hypothesis for the calculation is as follows:

Hypothesis: There is no significant difference between the observedvalues 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, Chivalue 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% significantlevel is 9.488.

Calculated Chi square value = 2582.79906

Table value for Chi square = 9.488

ie.; **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 fundamental benefit of employing inland waterways as a means of transportation in the supply chain is that, when used as part of end-to-end logistical operations for cargo transfer, it lowers overall cost.

- When compared to Goa, Kerala has more inland waterways overall. Kerala also has other inland waterways with a total navigable length. However, Goa has a higher ratio of navigable length to total length of inland waterways. Waterways have a 90.88% navigable component of their overall length.

- When opposed to Kerala, Goa makes greater use of the inland waterways that are accessible. Kerala has a long stretch of river, however it is not used to its full potential. Along with it, Goa continues to use all of its waterways consistently and without changing. Over 90% of the overall length has been passable over the past five years.

- Compared to Kerala, Goa's canals have higher cargo flow. However, Kerala's interior waterways are seeing a steady growth in cargo traffic year after year. That indicates that Kerala is becoming more dependent on inland waterways to move goods. On the other hand, less freight is being transported across Goa's inland waterways.

- When compared to Kerala, Goa has a fairly small number of boats. However, Goa's fleet size has somewhat increased while Kerala's has significantly decreased in recent years.

- Goa is outperforming Kerala in terms of the efficiency of cargo carried per vessel. The efficiency of Goa hasn't been as good as it had been during the preceding four years, according to the year-by-year pattern. Kerala's performance has improved over the previous three years, in contrast.

- Kerala behind Goa in terms of cargo handled per vessel efficiency. The effectiveness of Kerala has increased over the previous year. However, Goa's effectiveness is lower than it was the year before.

- The amount of merchandise moving through Kerala's interior waterways was computed using Goa as a baseline. The predicted value exceeds the observed value by a wide margin. The cargo transported across Kerala's interior waterways falls short of expectations.

- The actual volume of goods transported via Kerala's interior waterways and the projected value gained varied significantly. This demonstrates how much the cargo movement along Kerala's interior waterways may be enhanced.

5.2 CHALLENGES AND ISSUES

- The iron ore trading landscape has evolved substantially in the last five years. Increased demand for iron ore in China has resulted in an unexpected increase in Goa's iron ore export volumes. As a result, the inland water transport industry in Goa has encountered new challenges.

- Development efforts are not carried out in a comprehensive manner to meet the demands of stakeholders such as shippers and operators.

- Inadequate infrastructure, low productivity, and a lack of private maritime activity.

- Land accessible on navigation canal edges has long been encroached upon, and eviction is impossible without sufficient rehabilitation efforts.

    - Local people protest against bank protection and deepening activities including piles and concrete.
    - Local villagers protest the illegal acquisition of their land.
    - Massive volumes of excavated earth cannot be dumped on government land.
    - Traditional fishermen and navigators have opposing interests.
    - Road-IWT operators are at odds.
    - The lock/bridge does not provide enough nautical clearance.
    - Interior terminals and container handling systems are obsolete.
    - Inadequate allocation of plan funds, project execution delays, and low money utilisation.

5.3 SUGGESTIONS

- Better use of Kerala's abundant rivers, canals, creeks, and backwaters.
- Carrying more cargo in one trip allows for optimal vessel utilisation, which reduces operational costs.
- Increasing reliance on a single business will have an impact on vessel operation since boats will be idle on non-working days for the firm.
- Further utilisation of container and cargo movement via National Waterway 3 outside the limits of Kochi, making it less expensive for customers, more time efficient, and safer transportation than land or road transport.
- Compare yourself against the greatest competitor in the field across all criteria. This will help discover areas for improvement.
- There are certain NWs that are not functioning. Activities along these lines should be launched.
- Government laws and regulations should be established and applied more quickly.
- Both states have a lot of potential for utilising interior rivers for tourism.
- The size and quantity of boats using the Goa waterways should be raised, and then the present infrastructure must be updated on the following fronts:
    - Shallow patches, shoals, and sand bars that block navigation, particularly at low tide, must be dredged to provide a minimum depth of 3.6 metres for the barges already in operation (2500 DWT), enabling for 24-hour passage even at low tide.
    - To meet the increasing demand for iron ore transportation, the boat size must be expanded to 3000 DWT.
    - Greater draught is necessary to ply 3000 DWT boats, which needs a minimum available depth (LAD) of 3.9 m to 4.0 m.
    - The rising quantity and size of barges raises concerns about the safety of Goa's river traffic. To overcome this issue, the channel should be demarcated with nautical markers, and navigational aids should be supplied to ensure smooth sailing both during the day and at night.
    - To deal with anticipated congestion on the canals, appropriate traffic management procedures must be put in place.
    - Safe anchoring sites and awaiting berths must be provided for barges at all tides.

5.4 CONCLUSION

It is becoming increasingly challenging to provide an efficient and cost-effective means of transportation while reducing traffic congestion, accidents, and pollution. Inland water transportation (IWT) is a critical resource for India. India has around 14,500 miles of navigable waterways, including 5,700 kilometres navigable by mechanically propelled vessels. The country's coastline stretches for nearly 6,000 miles and is dotted with small and large ports. IWT offers a number of benefits, including being a less expensive form of transportation, being safer and more energy efficient, being more ecologically friendly, and generating the least CO2.

The above research discusses the effectiveness of Kerala and Goa's inland waterways. In terms of inland waterways, both states have a lot of promise. There is a significant opportunity to improve inland waterway use in a variety of ways. However, greater infrastructure and development initiatives are required to improve performance. Dealing with the difficulties will need a great amount of effort on the part of both the government and the business sector.

The urgent need for a massively effective transport system for the transfer of bulk products, such as food grain, fertilisers, building materials, petroleum, oil and lubricant, and over-dimensional consignments, has arisen as a result of the Indian economy's opening up and rapid GDP growth. Transit systems on the rails and on the roads are already busy and backed up. They will need to invest a lot of money, time, and effort in their expansion, which makes it a challenging proposition.

As a result, it is necessary to construct and integrate both coastal and inland water transportation networks. The contribution of coastal shipping to the nation's overall transportation system might be increased by combining coastal shipping with inland water transport. Only when boats can operate economically in both areas of the market will seamless integration of coastal shipping and inland water transport be conceivable. Inland rivers may provide significant design and construction challenges for a vessel of competent build, resulting in a lack of suitable water depth.

5.5 DIRECTION FOR FUTURE RESEARCHER

India's inland rivers are a large subject. Changes occur annually, and the subject is one that may be continuously researched. In terms of Kerala and Goa, both states offer a significant amount of potential for passenger and cargo transportation via inland waterways. The inland rivers of India are the site of several development operations. The government is attempting to utilise

utilise inland waterways to their fullest extent. Future research can examine how the various initiatives affect the effectiveness of these rivers. Additionally, information on the kinds of goods handled can be taken into account for the same study. It is possible to examine the effectiveness of the boats owned by the federal and state governments individually.

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