

INLAND WATERWAYS AS AN ALTERNATIVE FREIGHT MODE

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ABSTRACT

The purpose of this research is to evaluate the economic viability of inland waterways as an alternative mode of transporting commodities in India by comparing the cost-effectiveness of canal, rail, and road systems. In this study, which relies on secondary data from academic sources and government publications, the cost per ton-kilometer, operational efficiency, and regulatory frameworks are investigated across all three modes of transportation. Although all three contribute to the expansion of the economy, inland water transport (IWT) is the most advantageous of the three in terms of the creation of employment, the reduction of the need to purchase land, and the reduction of freight prices. Although there are environmental benefits and cost-effectiveness associated with IWT, these factors are not sufficient to explain its very low utilisation rate. Because of the gaps in infrastructure and the absence of multimodal connections, it is unable to realise its full potential. On the other hand, efforts such as the Jal Marg Vikas Project and the National Waterways Act have the potential to accelerate IWT towards becoming a formidable and long-term alternative to transport by road and rail.

Keywords: *Inland Water Transport (IWT), Freight Transportation, Cost Competitiveness, National Waterways (India), Multimodal Logistics, Sustainable Transport, Economic Viability, Transportation Infrastructure*

INTRODUCTION

It is essential for India's growing economy to have a robust and diverse infrastructure for the transportation of commodities in order to reduce the costs of logistics, increase efficiency, and ensure the preservation of the environment. According to RITES (2021), the commodities sector has been dominated for a considerable amount of time by two forms of transportation: roads and trains[1]. However, there are issues associated with these means of transportation, such as pollution, congestion, and excessive fuel use. According to the World Bank (2020), when it comes to long-haul and bulk freight, inland water transport (IWT) is a more cost-effective, fuel-efficient, and ecologically benign alternative than other modes of transportation to consider.

Untapped Potential of Inland Waterways

Despite the huge river network that constitutes India, which encompasses more than 14,500 km of navigable rivers, inland waterways are only responsible for transporting 2% of India's total freight [2]. According to CRISIL (2023), there is a significant discrepancy in the utilisation of IWT in countries such as the United States of America and China, where it is a vital component of their logistical infrastructure[3]. The National Waterways Act of 2016, a landmark piece of legislation that designated

111 rivers as National Waterways, served as a confirmation of the government's renewed dedication to the promotion of integrated waterways (IWT).

Economic Viability and Cost Advantages

In terms of cost per ton-kilometer, IWT is more cost-effective than both road and rail transportation. Waterways were determined to have the lowest average transport expenses, with a cost of ₹1.06 per ton-kilometer, according to the findings of the Inland Waterways Authority of India. In comparison, rail and road incur costs of ₹1.36 and ₹2.50 per ton-kilometer, respectively. In addition, when compared to other modes of transportation, water transport has a variety of benefits, including a lesser effect on the environment, fewer costs for maintenance, and a lower rate of carbon dioxide emissions per ton-kilometer of commodities delivered [4]. Considering all of these advantages, IWT is in an excellent position to compete in India's drive to promote sustainable logistics.

Challenges and Need for Policy Support

IWT is plagued with issues, such as a lack of understanding among cargo owners, inadequate last-mile connectivity, difficulties with navigability during specific seasons, and gaps in infrastructure. Despite the fact that it has a lot of potential, some of these issues have been brought to light. Programs such as the Jal Marg Vikas Project (JMVP) have continuing objectives that include the creation of multimodal terminals, the stimulation of public-private partnerships (PPPs), and the enhancement of the navigability of National Waterway-1 (Ganga). Nevertheless, in order to get the most of IWT, policymakers need to maintain their focus on the matter, incorporate new technology, and include all parties who are pertinent[5].

OBJECTIVES

1. To assess how cost-effective inland waterways are in India as compared to rail and road freight transportation.
2. To evaluate policy initiatives influencing the expansion of inland water transport and identify infrastructural bottlenecks.

RESEARCH METHODOLOGY

The foundation of this research is comprised of analyses of secondary data that were pulled from a variety of publications, official records, and academic studies that are relevant to the transportation of commodities in India. In addition to determining the economic viability and cost-effectiveness of inland waterways in comparison to rail and road transport, the objective is to identify any gaps in infrastructure and policy efforts that may exist. The data that was used in this investigation came from a variety of reputable national and international sources, including the Inland Waterways Authority of India (IWAI), the Ministry of Ports, Shipping and Waterways of the Government of India, and the study conducted by RITES Total Transport System. Among the other references are the following: Howe Engineering Projects (India) Pvt. Ltd., the Transport Corporation of India Ltd., the United Nations Conference on Trade and Development (UNCTAD), the Bank for International Settlements, and the Federal Ministry of

Transport and Digital Infrastructure in Australia. Instead of conducting primary surveys on the cost structure of inland water transport (IWT), the emphasis of this research is on analysing secondary data obtained from surveys and other public sources. The major purpose is to collect data that is reliable and comparative on the operating efficiency, the limits of the infrastructure, the cost per ton-kilometer, and government projects such as the Jal Marg Vikas Project and the National Waterways Act, 2016. This data will be evaluated and synthesised in a systematic manner in order to offer an evidence-based analysis of the competitiveness of IWT as well as its capacity to serve as a viable and sustainable alternative to existing means of freight transportation in India.

RESULT

In this section, we go into the intricacies of government policies and plans, the development of infrastructure, the appraisal of financial resources, and the transportation of cargo.

Transport of Cargo

As a prerequisite for the uninterrupted flow of inland water transport, water was essential. During the summer months, water levels drop below the minimum depth required for navigation. However, during the monsoon season, water levels rise, making it almost difficult to travel in a controlled manner. Boats should be adapted to the particular characteristics of the water streams in order to provide guests with the most enjoyable sailing experience possible. IWT on NW 1 is most suited for the transportation of SPVs that are 70 meters long, 9.2 meters wide, and 3.2 meters tall and are going at a speed of 12 kilometres per hour, according to research that was conducted by Sarma in 2010[6]. Research has been conducted in order to better understand the continuous efforts that are being made to increase the capacity of low-draft boats. With a length of two meters in the sea and a carrying capacity ranging from 600 to 2450 tonnes, the ships that are constructed by DST Germany are capable of transporting three hundred and fifty vehicles [7]. Furthermore, there are designs that are based on surface-piercing propellers as well as roll-on/roll-off (Ro-Ro) boats that have the capacity to carry nineteen to twenty vehicles [8]. It is envisaged that the use of barge-trains would bring considerable benefits for industrial water transportation along NW 1 as well [9]. When it comes to transporting goods, the barge train is a method that operates effectively and reliably. A simple figure has been used in order to illustrate the capacity of cargo shipments in India. It is estimated that 17.3 million metric tonnes of products were transported across India's interstate waterway system (IWT) during the years 2001 and 2002. A total of around one billion ton-kilometers, this accounted for less than one percent of the domestic surface transportation. In spite of this, intra-continental water transport (IWT) had risen to account for around 0.34 percent of worldwide surface transit by the time 2007–2008 rolled around.

Table 1. Weight of goods transported by Indian National Waterway 1

Financial Year	Cargo Volume (in million metric tons)
2011	1.88

2012	3.31
2013	2.72
2014	3.35
2015	5.05
2016	6.24
2017	4.51
2018	5.48
2019	7.35
2020	8.19

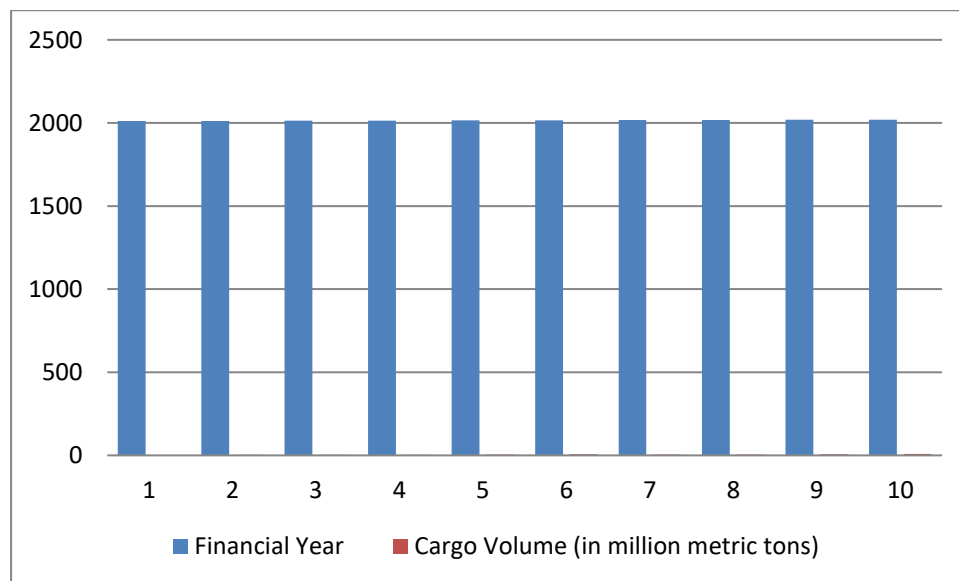


Figure 1. Weight of goods transported by Indian National Waterway 1

Figure 1 is a graph that illustrates the yearly volume of items that NW 1 transported from 2011 to 2020 (the time period covered by this graph). In spite of the fact that the numbers shown here are subject to a great deal of variation, they do demonstrate an increase of around 6.31 million metric tonnes from the first to the most recent year. During my time in office, we were successful in completing a number of noteworthy cargo shipments, including the following[10]: (i) On February 5, 2017, the IWAI vessel MV Zakir Hussain transported 350 tonnes of cement from Haldia to Bihar for export. The MV VV Giri, which was transporting Maruti automobiles, conducted a test voyage from Varanasi to Kolkata on the 12th of August on the year 2016. The MV Joy Basudev, which was transporting building supplies, conducted a

test voyage from Varanasi to Ghazipur on August 12, 2016, as part of its trial run. (iv) On August 12, 2016, the MV RN Tagore, which was carrying food and snacks from PepsiCo India, had a return voyage packed with fertilisers made by the Indian Farmers Fertiliser Cooperative (IFFCO) from Phulpur. This journey was filled with the fertilisers. As part of this major effort to expedite the movement of goods along the National Waterway1, the government constructed a multi-modal port at each of the three cities of Varanasi, Haldia, and Sahibganj.

Table 2: Transportation of Goods via National Waterway 1 (in lakh tonnes)

Commodity	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18
Building Material	63.6	59.6	40.5	38.4	60.0	65.1
Fertilizers	1.9	1.1	2.6	2.0	16.1	0.0
Food Items	12.7	11.8	10.4	8.0	3.1	0.7
Miscellaneous	0.5	0.3	0.4	0.1	1.3	0.1
Mix	0.8	0.2	1.3	0.0	0.0	3.9
Ore/Minerals	8.4	3.3	4.8	0.5	0.4	0.0
POL/POL Products	9.1	6.3	5.0	4.4	3.6	0.0
Coal	2.9	16.8	34.4	45.6	14.8	2.9
Iron & Steel	0.4	0.7	1.0	0.6	0.3	—

Table 2 [11] provides a list of the items that were transported via NW 1 from the years 2012 to 2018. Building materials continue to demonstrate consistent growth year after year, and they now have the largest proportion of the market among all other kinds of products. In the years 2017 and 2018, the majority of the cargo movement consisted of a combination of different commodities and building materials, which accounted for around 96% of the total. In the context of this discussion, the term "transfer" refers to the movement of a wide variety of materials, including coal from Haldia/Sand-heads to the power plant at Farakka owned by NTPC, fertiliser from Haldia to Fatuha in Patna by M/s Tata Chemicals, and fertiliser from M/s IFFCO's Phulpur facility in Fatuha to Kolkata by M/s IFFCO [12]. Nevertheless, there is a significant gap between the predicted and actual quantities of commodities that are transported via the nation's rivers across the country. On the other hand, the government of India intends to accomplish the goal of moving 21.89 metric tonnes of commodities on NW 1 by the year 2021, with the purpose of expanding the amount to 150 metric tonnes by the year 2025 [13].

Infrastructure Development

We need the necessary infrastructure to keep goods flowing smoothly on inland waterways. Warehouses, water bunkers, automated loading and unloading equipment, gantries, cold storage centres, jetties, barrages, freight towns and other efficient setups are included. Forklift trucks, storage buildings, trailers, shore cranes, open stacking yards, night illumination, mobile cranes, cargo handlers/trackers, and GPS are too. The Indian government is developing cargo designs with higher carrying capacities. Over 350 automobiles may be transported at 1.5–2 meters using a five-deck car carrier [14]. Cargoes that can convey 2500 metric tonnes at 3 meters are also being designed. In addition to operating properly, they are inexpensive and eco-friendly. They must mostly follow the canal, using rails and roads at the entry and exit. According to Praveen and Jegan [15], this feeder-assisted transport network would be "fish-bone" shaped.

The multimodal facility would boost IWT efficiency, resilience, and competitiveness. Designing cargo handling facilities technically requires consideration of vessel size, river conditions, and cargo capacity. NW 1 has permanent endpoints at Haldia, Farakka, Kolkata, Patna, and Pakur. Katwa, Haldia, Diamond Harbour, Kolkata, Shantipur, Farakka, Chunar, Manihari, Ballia/Buxer, Varanasi, Allahabad, Behrampur, Ghazipur/Kaithi, Bhagalpur, Doriganj, Semaria, Jangipur, Rajmahal, and Sahibganj all have floating terminals. Barrages at Farakka and Jangipur provide a 2 m navigable depth year-round [16]. The government has built 13.62-tonne multimodal ports at Varanasi, Uttar Pradesh, and Sahibganj, Jharkhand, along the Ganges. Another terminal like this one is being built in Farakka, West Bengal, where NW 1 will have a new navigational lock. NW 1 may also extend NH 2 along the Eastern Dedicated Freight Corridor. The combined method would constitute the Indian Eastern Transport Corridor, connecting the NCR to east and northeast states. Ramnagar, Varanasi, Ganga might become a multimodal hub for rail-road freight transit.

The initiative will also improve relations between India and Bangladesh, Thailand, Nepal, and Myanmar. River Information Systems (RIS) relay detailed data on water levels along navigable inland rivers to enable cargo delivery. This agreement requires cargo movers to get river warnings every 15 days with water depth, changing water course, available draft, and more. Maps may be used to generate river atlases and nautical charts [17]. An sophisticated vessel tracking and monitoring system designed utilising cutting-edge methods may be combined with this RIS. This will boost freight transportation efficiency. IIT Kharagpur also has a cutting-edge research and testing tank facility and a shallow water test centre to develop IWT. Modern technologies are used to construct high-capacity, high-performance vessels. The Indian Central Government also plans a River Traffic Control System to reduce IWT-related river pollution. The IWT sector has asked the Ministry of Shipping to create guidelines to streamline trade. Training and practical sessions are being held to prepare interested parties to operate advanced IWT facilities [18]. The National Inland Navigation Institution opened in Patna, Bihar in February 2004. The purpose was to bring in skilled specialists from many sectors to IWT. The institution trains individuals well in white- and blue-collar industries from entrance to seniority [19].

Financial Evaluation

Several publications, most notably the research conducted by the Government of India in 1980, have shown that river transportation is economically feasible. It is estimated that the initial investment

necessary for IWT is around 5 to 10% cheaper than the spending required for the construction of a 4-lane railway or highway, with maintenance accounting for a pathetic 20% of the total [20]. Using Economic Internal Rate of Return (EIRR) measurements, Sarkar et al. [21] proved that it is possible to implement IWT across both NW 1 and NW 2. In accordance with the criteria established by the World Bank, the estimated values for the feasibility of the project and the benefit-cost ratio demonstrated a positive conclusion. Water travel is one of the most cost-effective modes of transportation available since it consumes less fuel than other modes of transportation such as vehicles and trains.

Table 3: Comparison of Freight Tariffs (/ton-km) on NW-1 - Road, Rail and IWT

Cargo Type	Road (Haldia MMT)	Rail (Haldia MMT)	Road (Kolkata)	Rail (Kolkata)	Road (Sahibganj MMT)	Rail (Sahibganj MMT)	IWT (NW-1)
Dry Bulk	1.95	2.14	2.00	2.26	3.62	2.41	1.30
Liquid Bulk	—	—	4.00	—	—	—	6.70
Bagged	2.39	—	2.28	2.23	2.61	1.62	1.10
General	—	—	—	—	3.50	—	—
Neo-Bulk	—	2.50	3.11	2.17	—	—	1.40
Ro-Ro	—	—	—	2.47	—	—	7.00
Container	7.95	—	6.33	—	—	—	4.50

Table 3 shows road, railway, IWT, and NW 1 goods tariffs. The table above illustrates that container freight is the most costly cargo category. Container freight at Haldia is Rs 7.95/ton, whereas IWT containers are Rs 4.5/ton. Dry bulk IWT shipping is cheaper than roads or railroads. The World Bank estimates that one tonne of freight across India's rivers costs one cent per km, compared to two cents by rail and three cents by road. As cargo per litre of fuel, international water transport (IWT) is four times more efficient than land transport. Rail and road can carry 85 and 24 ton-km, respectively, whereas a litre of petrol can carry 105 ton-km. Although not door-to-door, these interior rivers provide long-haul transport at reasonable costs while being slow and secure [22]. As port distance increases, shipping costs tend to drop. For three of India's most significant national rivers, Mishra et al.[23] studied this extensively. Improving port efficiency can lower transportation costs per tonne-km.

Table 4: Modal Operating Cost Comparisons in India

Mode	Vehicle Operating Costs (₹/ton-km)	Effective Taxes	Total Cost (₹/ton-km)
IWT	1.16	0	1.16
Rail	1.36	3.71%	1.41
Road	2.50	3.09	2.58

Table 4 shows three Indian transportation methods' operating costs. Comparative cost model can inform you how to travel. Road transport costs more than rail or water, according to the operational cost model. The operational advantages of these transfers are different. Rail can deliver large things, but road's door-to-door service reduces local prices. Although IWT has reduced operational costs, local and terminal expenses prevent it from attracting traffic.

Table 5: Cargo Transportation Expenses (per ton-kilometer)

Cost Component	Rail (Electrified, Double Line, Ghat Terrain)	Truck (16 tons)	Truck (24 tons)	Barge 1000 tons Upstream	Barge 1000 tons Downstream	Barge 2000 tons Upstream	Barge 2000 tons Downstream	Barge 3000 tons Upstream	Barge 3000 tons Downstream
Fuel & Oil	0.23	1.87	1.30	0.51	0.30	0.30	0.15	0.22	0.10
Labour	0.15	0.15	0.10	0.03	0.00	0.02	0.01	0.01	0.00
Terminal	0.04	0.31	0.30	0.31	0.31	0.31	0.31	0.30	0.30
Repair & Maintenance	0.04	0.09	0.10	0.04	0.00	0.02	0.02	0.01	0.00
Overhead	0.05	0.32	0.20	0.06	0.00	0.03	0.02	0.02	0.00
Capital	0.43	0.27	0.20	0.10	0.10	0.05	0.05	0.03	0.00
Tolls / User Charges	0.34	0.20	0.05	0.10	0.05	0.05	0.05	0.10	0.00

Total Cost (₹/ton-km)	0.94	3.04	2.00	1.10	0.80	0.78	0.6		
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Rail, road, and IWT goods transportation costs are shown in Table 5. When ports are mechanised and equipped with night navigation, two-way communication costs should drop by INR 2.11 for 100 km short haul and INR 0.56 for 2000 km long haul. Land costs greatly affect transit project viability. Ground-based transfers cost more than IWTs because they directly influence transit costs. NW 1 transit land purchase is expected to cost 5%, compared to 50% for highways. Private companies may also develop and manage waterway commerce infrastructure on the purchased site. Despite not going door-to-door, these interior canals provide safe, fast long-haul transport. As port distance increases, shipping costs tend to drop. This topic was extensively studied by Mishra et al. For three major Indian rivers. Improving port efficiency can lower transportation costs per tonne-km. However, losses from insufficient packing, transit delays, unpredictability of arrival, theft, document maintenance, staffing demands, and others must be considered when determining IWT's financial viability.

A detailed study of these parameters might affect transportation mode choice [24]. Thus, supply chain managers favour IWT over trains and roads because to its better intermodal connection, greater frequency, closer proximity to industry, more reliable transit, better storage facilities, and well-maintained supporting infrastructure. The suggested legislation will make transporting bulk items like fly ash, coal, grains, steel, cement, and energy simpler, lowering our logistic cost from 13% of GDP to 10%. Shipping prices drop and new employment are generated with inland canal building. Creating direct and indirect jobs for skilled and unskilled individuals would boost employment more than any other option. The economy grows and living quality increases. JMVP creates about 1.5 lakh employment in Jharkhand, Bihar, West Bengal, and Uttar Pradesh, according to a World Bank study. Environmentally friendly, cost-effective, and fuel-efficient, inland water transport. Energy and external expenses of the three modes of transport are compared below: The following tables demonstrate canal, highway, and railway energy usage.

Table 6: Transport Modes' External Costs (₹ per ton-km)

External Cost Type	Waterway	Road	Rail
Air Pollution	0.015	0.084	0.030
Noise Pollution	Nil	0.002	0.0005
Accident Costs	Nil	0.028	0.000

Table 7: Energy Use (litres per ton-kilometer)

Mode of Transport	Energy Consumption (liters/ton-km)
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Waterways	0.0048
Road	0.0310
Rail	0.008

The external costs of canals, roads, and rail are shown in Tables 6 and 7, respectively. These three modes of transportation are responsible for the external cost, which includes the pollution of the air and noise, the occurrence of accidents, and the use of energy. As shown in the external cost table, the cost of air transportation for waterways is lower than the cost of road and rail transportation, while the cost of noise and accidents for waterways is completely nonexistent. Additionally, the energy consumption for waterways (0.0048 litres per km) is less expensive than the energy cost for roads and rail cars.

Govt Policies And Strategies

The long-neglected IWT business needs a huge financial injection to recover. Even though the government invested more in IWT in the ninth and tenth five-year plans, additional public and private funds were needed. Adequate rules were needed to attract user agencies and investors. Easing cabotage restrictions, reducing GST on bunker fuel, subsidising vessel construction, lowering coastal shipping taxes, and easing customs duties on IWT-supporting machinery and equipment were proposed to raise funds. Many IWT proposals sought new markets, revitalised river ports, enhanced regional economies, increased regional connections, and logistical competitiveness. Rangaraj and Raghuram advocated charging customers in addition to subsidies and a cess to generate revenue. PPP models drew investors from throughout the globe, including foreigners, owing to new rules that allowed 100% equity FDI. The Inland Waterways Authority of India (IWAI) and Danish business DevCo have started a public-private partnership (PPP) to develop terminals at Kolkata and Patna along the NW 1 corridor between Haldia and Allahabad with the support of the IFC. Many rivers cross state and federal boundaries.

To enable seamless procedures, good legislative frameworks and trade agreements are needed [25]. Unfortunately, stakeholders, state governments, and municipal authorities seldom collaborate on IWT regulation. The Indian government requested World Bank and IFC aid to revive the Indo-Bangladesh and Indo-Nepal trade agreements. This reduced policy gaps, addressed security problems, clarified custom laws, and eliminated institutional limitations. Thus, building material shipping traffic on NW 1 increased during 2018 and 2019 [26]. Connecting interior waterways with coastal ports would boost profit margins and relieve land-based mode pressure and develop hinterlands. Sriraman's 2010 research found that integrating the Ganga-Brahmaputra-Sunderbans river system with Haldia-Kolkata port will boost its potential. The government launched Sagarmala to connect major Indian ports to smaller ones. Improved hinterland-port connections should make transporting coal, food grains, and iron ore safe, rapid, reliable, and affordable. Due to multimodal transit, port freight volume is expected to double by 2025 from 6%. Indian authorities launched the Jal Marg Vikas Project (JMVP) in 2014 to rehabilitate NW 1's Varanasi-Haldia portion. Technical assistance and 5,000 crores from the World Bank were provided. To compete with rail, goods handling abilities of 1500–2000 tonnes were the major goal. The project also sought to build locks and barrages, mechanised equipment, fairways, river information stations, round-the-clock navigation facilities, repair and revamp existing facilities from Haldia to

Varanasi, and deploy digital global positioning systems [27]. Frequent dredging was needed to reduce siltation and keep goods flowing. However, typical dredging takes time and resources, including human labour. There are cutting-edge dredging procedures that last. The IWAI uses Cutter Suction Dredgers (CSD), Hydraulic Surface Dredgers (HSD), and Amphibian Dredgers to protect NW 1's riverbanks.

The Indian government changed various laws to promote IWT. For instance, the 1978 Inland Steam Vessels Act modification incorporated vessel and passenger insurance and prohibited overloading to impose discipline. There have been discussions of forming Waterways Dispute Councils to resolve canal business disputes. The National Waterways Act of 2016 raised the number of National Waterways from five to eleven to improve federal-state financial and policy collaboration. In 2019, the Asian Development Bank (ADB) created an action plan to improve coastal infrastructure. It helps power firms transport domestic coastal coal with a budget of INR 300 crore. Government creates Central Sector Scheme to promote IWT in North Eastern states. The project got INR 757 crores in 2018–19 and INR 891.13 crores in 2017–18 to finance all authorised projects.

The Indian government offers zero import taxes and financial incentives for barge purchases and capacity increases. The November 2016 increase of the Nutrient Based Subsidy (NBS) for coastal and IWT fertilisers was another significant step. IWT offers employment security and good compensation to attract shippers [28]. The objective is to keep all commodity tariffs cheaper than ground-based alternatives. The public is being told about IWT's potential benefits over alternative transportation. The government's efforts have attracted various IWT private and public limited firms. The most noteworthy include Hindustan Lever, IOC, ONGC, Ambuja Cements, Haldia Petrochemicals, Hindustan Paper Corporation, and FCI [29]. They handle large amounts of low-value commodities including coal, oil, grains, cement, iron, fly ash, and fertilisers that may be transported over great distances. Recent years have seen a steady growth in Indo-Bangladesh commodity traffic. However, the government is always seeking to detect bulk products and is pressuring merchants to utilise IWT. Modal share should reach 20 billion tonne km by 2025. IWT advancement in India is not commensurate with efforts. More work is needed to prove IWT's practicality and deploy it to its full 50 billion tonne miles [30]. In this context, a more focused strategy, more specialist regulatory agencies, Renewable Energy Certificates (REC) to show environmental friendliness, and employment security are needed immediately.

CONCLUSION

Inland Waterway Transport (IWT) along NW-1 is cheaper, more energy efficient, and less polluting than conventional Indian freight routes. Despite its dominance, IWT fell due to rail and road expansion. However, new research and regulations indicate a desire to revive and expand this method to compete with India's logistics and freight businesses. Compare to rail and road, IWT has the lowest operating expenses per ton-km, energy consumption, and external costs due to pollution and accidents. Despite its merits, poor infrastructure, shallow draft limitations, and a lack of multimodal integration limit its utilisation. Incentives, infrastructure improvements, innovative barge designs, and public-private partnerships are some of the Indian government's initiatives to revive the business. IWT might become an important element of India's freight transportation network with multi-modal logistics hubs, improved dredging management, and better

terminal

connections.

The industry has developed slower than predicted, although there is positive development. Through sustained investment in inland waterways, notably NW-1, and stakeholder support, the Indian economy may benefit from a more robust and cost-efficient logistics system. This will make rivers a sustainable freight medium, relieving highways and railroads.

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