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in Collaboration with

IIRE JOURNAL
of
MARITIME RESEARCH & DEVELOPMENT
(IJMRD)

ISF Institute of Research and Education (IIRE)

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Maritime sector has always been influencing the global economy. Shipping facilitates the bulk transportation of raw material, oil and gas products, food and manufactured goods across international borders. Shipping is truly global in nature and it can easily be said that without shipping, the intercontinental trade of commodities would come to a standstill.

Recognizing the importance of research in various aspects of maritime and logistic sector, IIRE through its Journal of Maritime Research and Development (IJMRD) encourages research work and provides a platform for publication of articles, manuscripts, technical notes, papers, etc. on a wide range of relevant topics listed below:

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ABOUT INDIAN MARITIME UNIVERSITY – MUMBAI PORT CAMPUS

Indian Maritime University – Mumbai Port Campus comprises of two premier institutes, Lal Bahadur Shastri College of Advanced Maritime Studies and Research (LBS CAMSAR) & Marine Engineering and Research Institute (Former D.M.E.T.). LBS CAMSAR is the post sea training institute whereas MERI Mumbai is the pre – sea training institute.

LBS CAMSAR was founded in October, 1948 under the recommendations of the Merchant Navy Training Committee as Central Government premier post sea training institute for Merchant Navy Officers of Navigation & Engineering. And since then, it is offering the comprehensive range of courses for Merchant Navy Officers.

Marine Engineering and Research Institute (M.E.R.I.), formerly known as Directorate of Marine Engineering Training (D.M.E.T.), was established in the year 1949 by the Govt. of India, when the need was felt to train Marine Engineers separately. And since then, it is imparting the education and training to the cadets with a goal of producing the best marine engineers and nautical officers for the world with adopting the latest technology to meet the latest and demanding requirements of the shipping fraternity.
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MESSAGE FROM THE CONVENER

It is very heartening to note that Indian Maritime University – Mumbai Port Campus (Marine Engineering & Research Institute) is organizing a two days Technical Fest Brinicle in association with Maritime Training Trust, D.G Shipping on 28\textsuperscript{th} & 29\textsuperscript{th} March, 2019. This fest is an initiative taken by Maritime Training Trust with an objective of enhancing the maritime knowledge of the participants and to provide all the stakeholders of Maritime Industry an opportunity to gain a great deal of insight into the “emerging technologies”.

I am thankful to IIRE Journal of Maritime Research and Development for collaborating with us. It is pleasing to note that the twelve accepted papers dwell on maritime subjects ranging from Artificial Intelligence, IoT, Inland waterways in India, Sustainable Development, which will dominate the industry in the coming years.

As the success of the event depends ultimately on the people who have worked in planning and organizing it, so I would like to thank the members in all the committees for their great efforts on this success.

Hare Ram Hare
Convener, Brinicle
Editorial

IIRE efforts to ingrain culture of research continues unabated.

A specific seminar is planned in March 2019 at Mumbai bringing researchers, industry and academia together to discuss and highlight the importance of research in the maritime sector.

Yet another opportunity arose when the Indian Maritime University – Mumbai Port Campus invited IIRE to collaborate in the presentation and publication of research based papers of their young cadets pursuing graduate maritime courses. Twelve papers were selected after a process of review which are now being published in a Special edition of the IIRE Journal of Maritime Research and Development. It was heartening to see papers dwelling on some contemporary themes like, Technology inroads into shipping, Sustainable Shipping, Coastal & Inland Waterways that is finding lot of thrust in India. Block-chain technology, Artificial intelligence, Energy efficiency are the areas covered in some of these selected papers. Papers chosen for publication in the Journal was the reward propagated and this brought in much encouragement and healthy competition. The moot idea was once again to engrain the discipline of research in the impressionable minds of the young cadets finding their sea-legs in a dynamic and highly operationalized and challenging shipping environment.

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PROSPECTS OF INLAND WATERWAYS IN INDIA

Shagun Singh
Parth Raizada
Ajay Kumar

Abstract
With the increasing impacts of the transportation services leading to a lot of damage to the environment, the need to find alternative and sustainable means of transport is at an all-time high. One such method of the task being Transportation through Inland waterways. India has the potential for development in the sector of inland transportation but the various constraints regarding the geographical conditions in certain areas need consideration before implementation. Also, considering the implementation barriers, the government also has to calculate appropriately if or not investment in such a high-end project is worth it. Some of the factors that influence the implementation of the Inland waterway transport (IWT) in India are the commercial potential of the system, the operational potential, the traffic or the cargo movement, etc. For all these factors different steps have to be take but given the growth of major cities (especially port cities), development of water-based transportation has become a necessity. The implementation is also necessary because of the fact that a water-based transport system is not just important for in-city based traffic but also because of its sustainability. Water based transportation today is one of the cleanest modes of transportation and an efficient water transportation system has always boosted the economy of a country as a whole.

This paper aims on discussing the potential of Inland waterway transportation system being developed in India and the various areas that need investments for the same along with the potential of enrichment in all the factors affecting the implementation.

Keywords: Inland waterways, water transportation the cargo movement, Passenger movement.

1. INTRODUCTION:

Water transport is effective in general due to the low cost to the environment and specifically low costs of operation in general as compared to their contemporary travel methods (air and road transportation). The availability of the method of the transportation, waterway is naturally available, which is then modified according to usage. Transportation between port cities has proved to be extremely useful in the long run.

1.1. Policy Motivation:
Even though funds have been allotted in the 9th and the 10th plans to the sector, the sector has not been able to utilize the funds allotted effectively. It still continues to be eyed for investments. For example, an ADB (Indian infrastructure, 2004) planned 300 crore investment. The IWT is recognized as an important segment of the overall
maritime policy of the country. The following can be the main policy questions (in the context):

1. Is the IWT worth investing? Where precisely and to what extent?

2. How do major institutions play a role in this? (IWAI being the most important)

3. Who exactly are the major collaborators in the sector and how are their concerns taken into account?

1.2. Scope of the Research:
Forming about a ton-km movement amongst the countries across the world, this mode of transportations unquestionably holds a lot of potential. IWT holds 32% of the transportation and 20% in Bangladesh (Rahman Mushfequr, 2004). In India however, the usage of the IWT has been marginally reduced to a mere 0.15% (Raghuram G, 2004) of the total transport movement in absolute terms along with sharing of other modes. The research also focuses on pin-pointing the exact reason of this. Though the investments made in this sector are not paralleled to the investments in the railway sector in the former few years or to the investments made in road transportation in the earlier times, proposals for investing in this sector have now started becoming prominent. The research finally provides an opinion for the government and other players on the commercial potential of their investments and involvement both.

1.3. IWT in India.
In some areas, historically, the IWT has been a viable means of transport. At the present, there exist 3 national waterways in India, namely: NW-1, the Ganga-Bhagirathi-Hooghly system, extending from Prayagraj to Haldia, NW-2, the Brahmaputra system in Assam and the NW-3, the west coast canal system in Kerala. The most important section being the small tidal riverine system in Goa, commercially, consisting of the Zuari and the Mandovi rivers and the Cumbarjua canal. According to the in-principle navigable waterways, there exists a large number of possibilities. But the ones holding potential are the inlets of the riverine along the coast. These also consist of the ports and some of the canal systems that belong to large water development projects. If the
river interlinking project in India is found of consisting of potential, an opportunity is possible. Though this seems to a long stretch at the moment.

Quite a number of studies (some being listed in the references) have revealed that for the waterways to be considered as an environment friendly mode of movements of freight on inland waterways.

Figure 1: National Waterways 1

Source: IWAI, 2004

Figure 2: National Waterways 2

Figure 3: National Waterways 3
### Details of National Waterway

<table>
<thead>
<tr>
<th>Waterway Description</th>
<th>Distance (kms)</th>
<th>1998-99 Lakh Tons</th>
<th>1999-00 Lakh Tons</th>
<th>2000-01 (P) Lakh Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Waterway 1 (Allahabad-Haldia stretch of Gangetic-Hooghly river system)</td>
<td>1620</td>
<td>8.52</td>
<td>7.31</td>
<td>3.52</td>
</tr>
<tr>
<td>National Waterway 2 (Sadiya-Dhubri stretch of Brahmaputra river system)</td>
<td>891</td>
<td>0.09</td>
<td>0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>National Waterway 3 (Kollam-Kottapuram stretch of West Coast Canal along with Champakara Canal and Udyog-Mandal Canal)</td>
<td>205</td>
<td>10.27</td>
<td>11.12</td>
<td>10.85</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2716</strong></td>
<td><strong>18.88</strong></td>
<td><strong>18.49</strong></td>
<td><strong>14.41</strong></td>
</tr>
</tbody>
</table>

*(P): Provisional

Note: Cargo handled in Calcutta—Bangladesh—Calcutta route is taken in National Waterway 1. This route is a link between NW-1 and NW-2 through Bangladesh.
2. PASSENGER MOVEMENT:

The main passenger movement in India is carried out by ferries on the inland waterways at numerous locations, on short stretches for the purpose tourism (Northern regions of Sunderban, Goa, Kerala).

The information and details about the statistics on the topic in the summary produced by IWAI, The Ministry of Shipping and state level authorities like West Bengal (TRW, 2001; TRW, 20014), Kerala, etc. Some of the factors affecting passenger movement are discussed below.

Travel time of the alternate land-based route: Though time by land-based routes is generally reduced, the construction of more routes for a single destination and the construction of bridges, etc. can lead to quite variable ETA’s, in which case, it is both easier and feasible to travel by ITW for areas connected directly by water. Faster ferries is an opportunity of increasing traffic on this mode.

Cost: Even though for passengers the cost of travelling by ferries is not high, it has to be added to the cost of subsequent mode of transportation which can be used to achieve the end to end requirement of transport.

Interchange convenience The other modes of transportation should be able to work fluently with the waterway transportation.
Quite a number of studies have convincingly depicted the use of inland waterway transportation to play a major role in the transportation planning in urban areas. In Cochin, a study suggested that the use of Inland waterway for transportation is a method that cannot be ignored for traffic management in light of the growth of the city in the recent times.

Mumbai has already been able to experiment with faster transport such as hovercrafts but still needs a mix of sustainable transportation system.

Inland transportation can also be used for providing easier services and related activities, some of them are listed below.

**Carriage of vehicles:** A number of states (example Kolkata and Kerala) already have inculcated this service and ferries for the same matter. But the sector still stands at the potential for development for more with faster mode of transport.

**Tourism:** With the economic potential in tourism given the rich culture of the country, this has become a growing area with a lot of potential. Boats that provide music and dining are becoming increasingly popular in Mumbai and Goa. In Kerala, Alappuzha and to some extent, Kozhikode are centers of this activity, especially houseboats. Long distance river cruises, both as per schedule and as per a group demand are also available, though they retain an exclusive flavor. (Outlook Publishing, 2004).

**Water sports** This is a new sector that has some possibilities and potential in Northern and Eastern India. White water rafting and trekking on iced mountainous stretches of river are examples. (CMYK, 2005).

3. **CARGO MOVEMENT:**

Location of industries and related activities have always been determined by the availability of water-based transport for obvious tasks, especially at a time when roads and land transport were not so well developed. As of today, though the road transport is well developed, but the consideration of availability of water-based transportation is still an important consideration.
The potential of movement of goods through the IWT has to be calculated by the potential of technology and physical potential along with commercial potential. As in the case in any mode of transport, there are factors that affect the economics and operation are the availability of canner, service at both the ends of a channel along with the management structure and other infrastructural support offered by that mode of transport to manage the flows. In the case of Inland based transportation, it comes down to the availability of the waterway, necessary facilities like the availability of smaller boats and ports and finally the management component.

Well before the rail and road transportation, in India, the transportation through the Ganga provided us with an organized transport movement and the earliest as well. Although the issue is not being discussed here, Movement and export of commodities like tea, jute, spices in the eastern parts connected to the port of Kolkata has been one of the earliest methods of commercial drivers even before the pre-independence era.

The aggregate statistics clearly state that the sector has only been growing very steadily in the National Waterways and remaining major waterways. One exception being the tidal river-canal system in Goa, which saw an unprecedented growth and saw about 30 million tons of iron ore being moved by barges on the Mandovi-Zuari-Cumbarjua system in 2003-04 (GMOEA, 2004). Providing insights and learning in the matter, this example is individually enough to state and demonstrate the potential in the sector and exploration in different dimensions.

Figure 5: Cargo Carried by IWT
4. TECHNOLOGICAL AND PHYSICAL POTENTIAL:

**Water flow:** The only basic pre-requirement of a water-based transport comes down to the availability of water flow. In the major waterways though, this flow has decreased due to the growth of habitat, industrial and agricultural needs. Construction of dams has also been a major factor in the decrease of the extent of regular flow.

**River training, dredging and navigation:** The next requirement comes down to the river being trained to provide an appropriate depth especially for the type of vessels expected to ply on it. Some types of river beds need this along with maintenance of banks and periodic dredging of the river bed, in order to help maintain the required depth. Recent cost estimates of river training on Sabarmati river provide a figure of about Rs 10 to 11 crores/km (SRFDCL, 1998) on each bank. In rural areas the figures may be lower, say 8 to 9 crores/km.

In principle, the IWAI is committed to maintaining, along the National waterways, a complete year-draft of 2m. (Planning commission, 2001). Though in reality, this is not the case. One possibility stands at providing this draft strategically on appropriate channels by the calculation of potential commercial traffic on each waterway. The other method being the trail method.

**Locks:** The river cannot have too much of a physical drop, or else in order to manage the high difference locks have to be provided. For example, Three Gorges on the dam of Yangtze will have 5 locks for descent. (www.travelchinaguide.com)
Access of Cargo: In the waterway, cargo has to be provided at both ends in order to ensure fluent movement.

5. COMMERCIAL POTENTIAL:

From a supply point of view, inland waterway system is also efficient because of the fact that it effectively reduces cost when used for end to end logistical requirement for cargo movement.

Geographical advantage of water bridging: When the movement is across river, this is the strongest. Passenger ferry system is an example.

River based origin/destination: When the place of origin of a commodity and the destination are both on a river location, the advantage is increased.

Project based requirement of commodities: The materials required for a specific project are the requirements that lie in this area. It consists of construction material and materials related to that project. This is especially viable when the project is river based itself.

Service requirement: Physical handling is the basic requirement from door to door as far as freight is concerned. The IWT involves the loading and unloading of cargo from the ships as well as its movement through the IWT along with the storage of the cargo on the docks.

IWT’s are generally slow in movement, hence expensive cargo does not move through the IWT’s unless there are physical constraints through the other modes of movement.

Competing modes: In case of the IWT’s the competing modes are mainly railways and the road. In the case of load management, roads provide much lesser options though movement is faster, but the movement rates are also high. Rail provides much broader load carriage, faster movement and about medium rates.
There are examples in Kerala where load management has shifted from the IWT to other modes in the last decade.

6. OPERATIONAL POTENTIAL:

**Costs:** IWT is considered an intensive capital investment industry as a huge amount of investment is required in the number of vessels to start at the very beginning. Investments in infrastructure are also required to maintain and develop the waterways too. Along with the IWAI, only a few Large customers can participate in the investments.

Operating costs can be categorized as below.

- Vehicle costs
- Fuel costs
- Crew costs
- Maintenance costs.
- Loading unloading costs.

Costs regarding the contingencies are also required like running aground and the damage to vessels. These are not rare, under current given scenarios of insufficient draft, even in the national waterways.

**Systems perspectives:** A detailed study presented by the authors Raghuram and Rangraj in 2005 provides the insight on emphasizing the analysis of the IWT mode. This study, drawing illustrative examples of Goa and scenarios over NW-1, highlights the principles of supply chain management and the possible use of network flow models for analysis.

**Fleet planning:** The movement of freight also depends upon the scale of movement, as the fixed costs of the crew as well as the vessels are high. Larger vessels more draft and hence the higher water depth, but have lower operating costs. The traffic considerations are also limited by the type of traffic. Larges vessels may lead to operating restrictions and smaller vessels can cause too much congestion. This leads to a different range of sixes ad costs being offered to the customers.
7. ENVIRONMENTAL IMPACT:

Water, for some time now, has been a scarce resource in the country. A justifying explanation for facilitating transport through such a resource can be difficult. The drawing of water for drinking, construction, irrigation and other activities can lead to a decrease in the overall flow in some downstream regions, making the transport very difficult. Given such constraints, IWT mode of transportation is no more the first choice of bulk transport, a position it has enjoyed for centuries.

Although, in the all the areas it is physically possible, it is the most economical and environmental option available. Low costs of operation, low fuel usage, the ability to carry commodities in bulk and low fuel emissions back this argument.

8. CONCLUSIONS:

Freight and passenger movement, being the earliest mode of transportation The potential is sufficient enough for justifying a national body like IWAI about the nurturing of this sector. The conclusions of our study are stated below:

- **Should the government invest in the IWT?**

The sector turns up about 110 crores annually, the investments made by the government in the past decade has not been economically viable. A sufficient volume of driving cargo stream has to be developed in order to justify the investments where the natural depth of water and the navigability of the route are not adequate.

Faster vessels and goods interchange facility is required for passenger movement, which is viable in cost, but the technology lacks in the specified area. Launches carrying road vehicles offer a good opportunity and is a cost-effective proposition for the country.

With appropriate local investment, tourism and related possibilities offer good opportunities for the sector, wherever possible.
**Answering the question finally,** the Government should invest in the sector with considerations of the traffic and the geographical area potential. A tie up with the industrial location policy to drive demand would be essential.

- **Where should the government invest?**

  The possibilities and potential for each major waterway are as follows:
  1. Investment on the NW-1 should be based on integrated water use for irrigation, drinking and industry and for controlled flow.
  2. NW-2 investment should be strategically planned for the NW-2 to act as an alternate route for bulk carriers.
  3. NW-3 tourism and related activities.
  4. New canal systems.
  5. River linking projects, if pursued by the government, should explicitly provide for the IWTs.

  Because of the interface with ports and a huge marine supply chain, freight traffic on some locations is successful on the IWT. A greater potential lies if the vessels are both capable of inland and coastal waters or if there is a good interlinking between the vessels of the above-mentioned areas.

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