Students’ Edition of BRINICLE
in Collaboration with
IIRE JOURNAL
of
MARITIME RESEARCH & DEVELOPMENT
(IJMRD)

ISF Institute of Research and Education (IIRE)

MARCH 2019
INDIAN MARITIME UNIVERSITY
MUMBAI PORT CAMPUS
(Marine Engineering & Research Institute, Former D.M.E.T.)

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ISSN: 2456-7035

Published by:

ISF INSTITUTE OF RESEARCH AND EDUCATION (IIRE)
410, Gemstar Commercial Complex, Ramchandra Lane Extn., Kachpada, Off Link Road, Malad West, Mumbai 400 064, INDIA.
Website: www.iire.in; www.inner-search.org; www.isfgroup.in

Link of Publication: - http://iire.in/ojs/index.php/IJMRD
Place of Publication: - Mumbai
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 28th & 29th 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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DEVELOPMENT OF INLAND WATERWAYS IN INDIA

Kartikey Malhotra
Tarun Karkera

Abstract
Water-based transport is compelling as a rule, working expenses of fuel are economic and ecological contamination is lower than for relating volumes of development by road, railways and the other hand by air. In India, survey the feasibility of development of travelers and cargo via. Inland water transport. Inland channel alludes to streams, waterways, lakes and so forth. There is a cover of this division with waterfront shipping where tidal streams are included.

Keywords: Waterways, Fuel and Energy Efficient, Cost Saving, Environment, Friendly, Advantages of Inland Waterways, Transportation.

1. INTRODUCTION:

In our civilization, rivers have played a crucial role as a mode of transport in carrying people and goods. Even in the present era, many countries depend heavily on inland water transport, especially for large and bulky cargo.

The movement of freight in India is achieved through the means of land approximately 65% and by means of rail approximately 27%.

India is a land of rivers. It has 7500-km long coastline with approximately 14,500 kms of navigable waterways making it the 9th largest waterway country. This offers a huge potential for developing a cheaper and greener mode of transport.
Some real examples of inland water ways in the world:

There are several strategic inland waterways which part of transportation systems are. For example, Manchester ship canal and Gloucester ship canal in the United Kingdom and Erie Canal as shown in Figure 2.
2. INTERNATIONAL COMPARISON:

Inland water transport in India has only 0.5% modal share; China 8.7%; USA 8.3% and Europe 7% (Source: JalMargVikasProject -Frequently Asked Questions and Their Answers, Inland Waterways Authority of India)

inland water transport (IWT) accounts for less than 1% of its freight traffic, compared with 35% in Bangladesh and 20% in Germany. (Source: Hindu Businessline, 29th March 2018)

• **IWAI and National Waterways Act, 2016**

  Constitutional Provisions

  1. According to item14 of the Central List of the Constitution, matters relating to shipping and navigation on inland waterways, declared by Parliament to be national waterways, as regards mechanically propelled vessels; and the rule of the road on such waterways are the responsibility of the Central Government.

  2. According to item 31of Concurrent List, matters relating to shipping and navigation on inland waterways as regards mechanically propelled vessels, and the rule of the road on such waterways, and the carriage of passengers and goods on inland waterways, subject to the provisions with respect to national waterways, fall under the purview of both the Centre and the States.

• **Inland Waterways Authority of India (IWAI)**, which came up in October 1986, acts as the nodal agency for optimum utilization of the vast untapped potential of our inland waterways but was not able to grow the waterway trade.

• **The National Waterways Act, 2016**, was an important watershed in the direction of developing the untapped potential of our inland waterways. Under the Act, 111 inland waterways across twenty-four states have been declared as National Waterways (NWs).

• **Indian Vessels Act of 1917 (amended in 2007)**: It deals with the survey and registration of inland vessels, removal of obstructions in navigation, carriage of goods and passengers, prevention and control of pollution etc.
• **Inland Water Transport Policy 2001:** Policy talks about IWT being economic, fuel-efficient and environment friendly mode of transport. It advocates large-scale private sector participation both for creation of infrastructure and for fleet operations.

3. **PROJECTS UNDERTAKEN:**

IWAI has started taking up projects for developing these waterways as environment friendly and sustainable modes of transport.

The first of such projects is the World Bank aided Jal Vikas Marg project on River Ganga, or the National Waterways 1. The objective of the project is to develop the stretch of river between Allahabad and Haldia to make it navigable for vessels with 1,500-2,000 tonne deadweight capacity. For this, the project will develop a navigational channel of 2.2 to 3.0 meters depth and 35 to 45 metre width. Phase-I of the project covers the Haldia-Varanasi stretch of the river. Once operational, the waterway will form part of a larger multi-modal transport network having linkage with the Eastern Dedicated Rail Freight Corridor and also with the area’s existing network of highways. The development of NW1 will help other states to send some of their freight to the Kolkata-Haldia complex, thus making the movement of freight more reliable with less logistical costs.

PepsiCo was the first one to come onboard for testing of the waterway, for which they sent 16 containers from Kolkata to Varanasi on MV RN Tagore. The vessel made a return journey with fertilizers belonging to IFFCO. Ro-Ro transportation has started between Dhubri and Hatsingimari and slipway facilities are being constructed at Pandu on River Brahmaputra, or NW-2.

Pilot movements on National Waterways were also conducted on various stretches, more than 15 waterways have been successfully completed, including integrated movements through NW-1 (Ganga), Indo-Bangladesh Protocol Route and NW-2 (Brahmaputra).

IWAI is in the process of developing thirty-seven more NWs in the next three years.
Normal development works are ongoing on NW-3. The development of NW-4 (Kakinada- Puducherry Canal along with Krishna & Godavari Rivers), NW-5 (East Coast Canal with Brahmani & Mahanadi Delta), NW-16 (Barak), NW-37 (Gandak), NW-40 (Ghagra) and NW-58 (Kosi) also are in progress.

A joint venture is afoot with Thompson Design Group, Boston (USA) and Infrastructure Architecture Lab of Massachusetts Institute of Technology, to identify the best locations for construction of 18 ferry terminals in six cities, namely, Allahabad, Varanasi, Patna, Munger, Kolkata and Haldia on NW1. The feasibility study takes into account the capacity of freight and passenger movements of each city with a view to integrating these terminals with the existing transportation networks and facilities of each city.

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

**Jal Vikas Marg or National Waterway 1:**
The NW1 has the future of emerging as the leading logistical artery for the entire northern India, which passes through one of India’s most densely populated areas and resource-rich regions, and generates an estimated 40 percent of India’s traded goods. The network of a water- road-rail link will help the region’s industries and manufacturing units to have a seamless flow of goods to markets in India and abroad. It will also give wider market access to the farmers of this agriculturally-rich Gangetic plain.

Since the river Ganga occupies a special place in the social, cultural and environmental milieu of our country, the Inland Waterways Authority of India (IWAI) follows the principles of ‘working with nature’ to protect the river's diverse fauna and aquatic biodiversity. For this, minimum dredging is being undertaken for passage of large barges carrying up to 2,000 tonnes of cargo. IWAI is also ensuring that water traffic does not impact the two aquatic wildlife sanctuaries that fall along this stretch of the river - the Kashi Turtle Sanctuary and the Vikramshila Dolphin Sanctuary.
Currently Operational: According to a PIB release by Ministry of Shipping dated 20th July 2018, the following NWs are operational:

<table>
<thead>
<tr>
<th>National Waterway (NW) No</th>
<th>Stretch</th>
<th>Length (km)</th>
<th>Location (State)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NW1</td>
<td>Ganga-Bhagirathi-Hooghly River System (Haldia - Allahabad)</td>
<td>1620</td>
<td>Uttar Pradesh, Bihar, Jharkhand, West Bengal</td>
</tr>
<tr>
<td>NW2</td>
<td>Brahmaputra River (Dhubri - Sadiya)</td>
<td>891</td>
<td>Assam</td>
</tr>
<tr>
<td>NW 3</td>
<td>West Coast Canal (Kottapuram - Kollam), Champakara and Udyogmandal Canals</td>
<td>205</td>
<td>Kerala</td>
</tr>
<tr>
<td>NW4</td>
<td>(Phase-I: Vijaywada to Muktyala)</td>
<td>82</td>
<td>Andhra Pradesh</td>
</tr>
<tr>
<td>NW10</td>
<td>Amba River</td>
<td>45</td>
<td>Maharashtra</td>
</tr>
<tr>
<td>NW85</td>
<td>Revadanda Creek - Kundalika River System</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>NW27</td>
<td>Cumberjua – confluence with Zuari to confluence with Mandovi river</td>
<td>17</td>
<td>Goa</td>
</tr>
<tr>
<td>NW68</td>
<td>Mandovi – Usgao Bridge to Arabian Sea</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>NW111</td>
<td>Zuari – Sanvordem Bridge to Marmugao Port</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>NW9</td>
<td>Alappuzha - Kottayam – Athirampuzha Canal Boat Jetty, Alappuzha to Athirampuzha</td>
<td>38</td>
<td>Kerala</td>
</tr>
<tr>
<td>NW100</td>
<td>Tapi River</td>
<td>173</td>
<td>Gujarat</td>
</tr>
<tr>
<td>NW97</td>
<td>Sundarban Watersways</td>
<td>201</td>
<td>West Bengal (through Indo-Bangladesh Protocol Route)</td>
</tr>
</tbody>
</table>
4. PUBLIC PRIVATE PARTNERSHIP:

Government and IWAI are working on two channels to draw private players in Physical infrastructure:
(a) Developing navigation, channel operation and maintenance, and external connectivity infrastructure.
(b) Navigable route development.
(c) External connectivity infrastructure.

5. ADVANTAGES OF INLAND WATERWAYS:

- **Fuel and Energy Efficient:** It is fuel-efficient compared to the other modes of transport, rail and road. For example, the Integrated National Waterways Transportation Grid Study states that one litre of fuel will move 24 tons through one kilometre on road, 85 on rail and 105 km on inland water transport. Further, 1 HP can 150 kg on road, 500 kg on rail and 4000 kg on water.

- **Cost savings:** Cost of developing waterways is much lower than rail & road. It reduces transportation and transition losses.

- **Environment Friendly:** One of the benefits enjoyed can be efficient means of transport of goods without the emission of harmful gases in the air. In a time where global warming is becoming a leading concern let's see how the introduction of potential inland waterways would help us in creating a sustainable and comparatively less harmful environment. One litre of fuel can move 24 tonnes of cargo via roadways, 85 tonnes of cargo via railways and it moves 105 tonnes of cargo on water.

  o Carbon dioxide emission is 50% of trucks
  o Negligible land requirement as compared to rail and road transport
  o Reduces pressure on road and rail
  o Reduces congestion and accidents on road
  o Optimal Modal Mix: It will provide optimal modal mix by converging river transport with other modes
Better connectivity: It help create seamless interconnectivity connecting hinterlands along navigable river coasts and coastal routes. Further, riverine routes are likely to play a crucial role in connecting the north-eastern states to the mainland.

- Inland Waterways hold huge potential for domestic cargo transport, cruise, tourism and passenger traffic.
- Development of inland waterways will help in the generation of job opportunities.

6. ECONOMIC EFFICIENCY:

It has been found that logistics costs in India account for about 18 percent of the country’s GDP, which is much higher than China, USA, UK and many other countries. This makes Indian goods costlier and hence less competitive. As per World Bank analysis, the cost of transport of one tonne of freight over a km by road is Rs 2.28, by rail Rs 1.41 and Rs 1.19 for waterways. So, logistics costs in the country can be brought down considerably by transporting more and more goods by waterways. In this era of energy crisis, waterways have been found to be a fuel efficient, environment friendly and cost-effective mode of O
7. ISSUES AND CHALLENGES:

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

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

- **Impact on other activities**: Water in rivers has competing demands, including dams and farming. To maintain the water levels in the river to the degree needed for them to function as inland waterways, the water use for such other activities might get curbed.
• **Inadequate Air Draft:** Multiple bridges with low vertical clearance obstruct the passage of bigger inland water transport vessels on many inland waterways such as NW 3

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

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

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

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

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

• **Environmental Impact:** Dredging operations will damage river bed and can lead to change in habitats for various aquatic flora and fauna. Dredging may also impact aquifers along the river, damaging the ability of water to percolate underground. In estuaries and creeks of rivers the removal of river bed material during capital dredging can result in the ingress of excess saline water into the creek or rivers. This is one of the reasons why the state of Kerala had opposed many of its proposed waterways, Construction of jetties, river ports will necessitate removal of trees/ mangrove forests in the area. For example, At Dharamtar port in NW10, for construction of a jetty, the mangrove forest belt on the bank has been removed. Other environmental concerns include pollution due to oil and diesel from vessels, leakage and spilling of cargo
• **Social impact:** Ecological impacts can have implications for livelihoods of people dependent on the rivers and creeks. For example: impact on fishing community, people dependent on riverbed cultivation. Displacement is another major concern as land is needed for number of facilities like ports, jetties, and other infrastructure.

8. **POLICY INTERVENTION/VISION:**

Incentivizing cargo transport through inland waterways. To ensure there is enough freight to make physical infrastructure development viable, the following measures can be taken:

a) Offer incentives, including tax subsidies, for transporting a portion of industry cargo through IWT.

b) The Government can mandate/incentivize industries in the proximity of national waterways to use this mode for a portion of their shipments.

c) Higher road taxes can be levied on transportation of coal and inflammable material over longer distances because they are harmful to environment or pose a danger to those in proximity.

d) Government can promote industrial corridors along riverbanks and foster waterways-based industrialization.

e) Capital dredging, along with different waterways, will also offer opportunities to reclaim land along riverbanks.

f) Promoting passenger transportation and tourism.

g) Resolving the protocol route issue with Bangladesh.

9. **CONCLUSION:**

It is very much important to incorporate inland waterways into multipurpose transport arrange in the request to reinforce its position available. It is important to raise the level of inland waterways transport unwavering quality and effectiveness by guaranteeing a high caliber of the vehicle base keeping in the mind the end goal to incorporate inland conduit transport to multipurpose transport system. Another improvement cycle has to be started for a percentage of the port foundation. This is primarily identified with
furnishing ports with an essential port base and also with limits fundamental for trans-
shipping uncommon sorts of freight taking after business sector request. Every single
universal port needs to meet natural security prerequisites, principally by developing
separate gathering offices for fluid waste and oils.

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