India’s National Waterways :
A Long Way To Go

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Prologue

The Author, who has considerable experience in development of inland waterway systems in India, has brought out in his Paper the special features of the different National Waterways in India. An overview of the global IWT scenario, especially of Europe, US and China, amongst others, has also been brought out. Though waterway transportation is one of the cheapest modes of transportation, for various reasons its development and traffic growth has not been as per expectations.

The Author points out that considering its potential, it still has a long way to go to become a significant transportation mode in India.

- Editor

Introduction

The Indian subcontinent is multisected by an array of rivers. The peculiar terrain of the Indian subcontinent bounded by the Himalayas along the north and a range of hills along the east and west coast supported by a chain of mountain ranges in the Deccan is eminently suitable for origin of rivers and tributaries. History and legends establish the navigability of the rivers through ages, for trade and other maritime activities. The growth of roads and railways and the diversity of commodities have progressively led to the extinction of commercial Inland Water Transport (IWT). Till the early sixties, Inland Water Transport continued to play a major role for transportation of cargo along the rivers Ganga and Brahmaputra. Being seized of the problems of high unit cost towards development of roads and railways, sympathetic to the expansion of waterways of the country, the Central and State Governments are anxious to expeditiously promote growth of the Inland Water Transport in major river systems and canals.

Though the inland waterways extend to about 14,500 km in the country, the potential waterways are limited and in fact only the following ten waterways are recommended by several committees constituted.
India’s National Waterways: A Long Way To Go

- The Ganga-Bhagirathi-Hooghly
- The Brahmaputra
- The Sunderbans
- The Narmada
- The Mahanadi
- The Tapi
- The Godavari
- The Krishna
- The Mandovi, Zuvari rivers and the Cumberjua canals in Goa
- The West Coast Canal (WCC) system in Kerala

Out of the above ten waterways, the following five waterways are declared as National Waterways by Government of India (Fig. 1).

- The Ganga-Bhagirathi-Hooghly river system from Haldia to Allahabad (1620 km) – (NW-1)
- The river Brahmaputra from Dhubri to Sadiya (891 km) – (NW-2)
- The West Coast Canal (WCC) from Kollam to Kottapuram including Champakara and Udyogamandal canals (205 km) – (NW-3)
- The Kakinada-Puducherry Canal (KPC) including rivers Godavari and Krishna (1095 km) – (NW-4)
- The East Coast Canal (ECC) integrated with rivers Brahmani and Mahanadi delta system (623 km) – (NW-5)

The Inland Waterways Authority of India (IWAI) was established in 1986 with the precise objective of providing a coordinated approach at the national level to the development of the water mode transport. RITES - A Premier Consultancy wing of the Indian Railways have ventured into this field and is rendering consultancy services for the last three decades to Inland Waterways Authority of India (IWAI) and other State Government organisations and is involved in various stages of development of National Waterways.
Waterway Transportation – A Global Scenario

Inland Waterways are economically and ecologically more viable than any other mode of transport. The Inland Waterway Transport is cost effective and fuel efficient. It is estimated that with Inland Water Transport, 1 litre of fuel would move 105 ton-km. On the other hand, 1 litre of fuel can move 85 ton-km by rail and 24 ton-km by road. The per ton-km cost of transportation by inland waterways was estimated at Rs 0.55, compared to Rs 1 by road. However, the relative lack of speed when compared to road and rail makes inland waterways less attractive.

Though five important National Waterways have been in operation in India, the potential of Indian Inland Waterway Transportation is still untapped, while in the developed countries, it is one of the important medium of transportation. In Asian region, the United Nations Economic and Social Commission for Asia and Pacific (UNESCAP) provides coordinated effort on IWT in the countries – India, Bangladesh, China, Indonesia, Thailand and the Mekong river system. The important waterways in Asian sub continent are – Ayeyarwady and Thanlwin in Myanmar, Ganga and Brahmaputra In India, Yangtze and Pearl in China, Chao Phraya in Thailand, Fly river in Papua New Guinea.

The status of IWT in some of the countries is as follows:

**North America:** In the United States, with its water transport infrastructure over the Missouri-Mississippi and the inter coastal traffic, together accounts for over 630 million tons of cargo per annum. Freight movements by IWT on the Great Lakes and the Mississippi continue to be important modes.

**Europe:** IWT is estimated to carry about 7% of freight traffic which in fact is in a growing stage in the European Union (EU) states. The rivers Rhine and the Danube are major IWT rivers in Europe. A network of 30,000 km of waterways linking the North Sea to the Black Sea carried 425 million ton in the EU. The modal share in European Union by ton-kilometre percentages are – Road 42%, Rail 10% and Waterway is 48%.

**China:** IWT accounts for almost 10% of the total freight tonnage carried in the country, and of that, two thirds is carried on the Yangtze river (including bulk commodities like coal, steel, cement, containers and LPG).

**Thailand:** IWT is estimated to transport about 20 million ton of cargo annually, representing 4.5% of total inland cargo volume better than rail, which has a share of only 1.9%, and well below road, which has a commanding share of 93.6%.

**Bangladesh:** Inland Waterways are estimated to carry approximately 14% of the country’s annual passenger volume and about 35% of its annual freight volume.
India: In India, about 17.3 million ton of cargo was moved in 2001-02 by IWT, out of which the contribution of the Goa waterways is of the order of 15.7 million ton. The corresponding transport task amounted to about 1 billion ton-km (btkm). This represented only 0.1% of the domestic surface transport task of about 838 billion ton-km as compared with 68% for road and 30% for rail. As per Trans REporter Study, the share of each mode in 2006-07 out of the total cargo moved by surface transport is – Road 54%, Rail 34%, Coastal Shipping 7.85%, Pipeline 4% and IWT 0.15%. However, in the last few years, movement of cargo by inland waterways has shown an upward trend and increased from 1.63 billion ton km in 2003-04 to 3.38 btkm in 2007-08, accounting for about 0.34% of total surface cargo movement. The Goa waterways have contributed the maximum for this upward trend in IWT sector growth.

Types of Inland Waterways

Inland navigation channels for commercial traffic are generally of three types: open river waterways, canalised waterways, and canals.

Open river navigation: There are few rivers where the discharge is adequate throughout the year to provide suitable channel dimensions for year round commercial navigation of modern vessels and barges. The natural factors which restrict open river navigation particularly, in the freshet reaches include high velocity currents, decreased depth in low water periods, sediment deposition in the channel and natural hazards in the form of rapids/outcrops. Under such circumstances, engineering measures are needed to improve navigation conditions. Engineering measures (river training or rectification and stabilisation) include construction of spurs, dykes, longitudinal dykes, revetments and so on for channel regulation to provide and maintain adequate channel dimensions for navigation. The National Waterway No. 1 (Ganga-Bhagirathi-Hooghly river system) and National Waterway No. 2 (the river Brahmaputra) come under open river navigation.

Canalised waterways: A canalised river is one that has been transformed from a free flowing stream to a series of slack water pools by construction of a number of locks and dams. The flow in canalised waterway is to a greater or smaller degree controlled by engineering works. In India no such waterway has been exclusively developed for navigation.

Canals: Canals are developed for navigation by connecting two or more water bodies. Navigation canals are thus entirely artificial waterways whose water is obtained by diversion from rivers/reservoirs. The National Waterway No. 3 (WCC), National Waterway No. 4 (KPC) and National Waterway No. 5 (ECC) come under this classification.
The river system in India basically developed due to monsoon rains and melting snow from the Himalayan ranges. The Himalayan rivers like the Ganga and the Brahmaputra (National Waterways No 1 and 2) have stable discharges to maintain navigation depths round the year when compared to peninsular river systems like Godavari, Krishna, Mahanadi and Brahmani (National Waterways No. 4 and 5). On the other hand the coastal waterways depend upon the sea water to maintain navigable depths (National Waterways No. 3, 4, and 5).

**National Waterway No. 1 (Ganga-Bhagirathi-Hooghly River System)**

The Ganga-Bhagirathi-Hooghly river system connecting Haldia-Kolkata-Farakka-Semaria-Patna-Varanasi-Allahabad was declared as National Waterway No 1 in the year 1986 (Fig. 2).

**Waterway Characteristics**

The Ganga river is the flow combination of the two rivers, namely, the Alaknanda and the Bhagirathi, which meet at Deva Prayag in Uttaranchal State of India within the mountain ranges of the Himalayas. After flowing 200 km through the narrow Himalayan valley, the Ganga enters the plains at Haridwar, where a dam diverts some of its waters into the Ganga canal. Further, the river follows on about 800 km meandering course passing through the city of Kanpur before being joined from the southwest by the Yamuna at Allahabad. Further downstream, the Ganga is joined by numerous rivers such as the Ghagra, the Son, the Gandak and the Kosi and forms a formidable course up to Farakka (Fig.2). The flow of the river Ganga is augmented longitudinally downstream up to Farakka due to joining of tributaries on either side. At Farakka, the river begins its attrition with the branching away of it first distributary, the Bhagirathi-Hooghly which goes on to form the Hooghly river. Near the border with Bangladesh, the Farakka barrage was built in 1974 to control the flow of the Ganga, diverting some of the water into a feeder canal linking the Hooghly. The main branch of the river Ganga in Bangladesh, downstream of Farakka, is known as the Padma river until it is joined by the Jamuna river, the largest distributary of the river Brahmaputra. Further downstream, the Ganga is fed by the Meghna river and finally empties into the Bay of Bengal. (RITES has carried out Master Plan Studies for Navigation on National Waterway No.1, Ganga-Bhagirathi-Hooghly and several others for the development of the waterway.)

The navigation on the River Ganga depends upon the seasonal water level fluctuations. The stage of the Ganga river is low from January to May and starts rising in June and reaches its peak during August and then recedes progressively till December. The rise of the river is rather abrupt during onset of monsoon that is, during June and July. The water level of the river Ganga rises by about 8 to 10 m from lean season to flood season. The discharge of the river Ganga almost follows the trend of water level variations. The discharge is as low as 2000 cubic metres per
India’s National Waterways: A Long Way To Go

second (cumecs) during May and reaches a peak flood discharge of 50,000 cumecs during August.

In accordance with the hydrological changes, the fairway is maintained with Least Available Depths (LAD) of 3 m in the reach Haldia-Farakka, 2 m in Farakka-Varanasi reach and 1.5 m in Varanasi-Allahabad reach. Annual river conservancy works including hydrographic surveys, bandalling, dredging are being carried out in the shallow upper reaches. Dredging is a periodical activity on the river Ganga near Farakka barrage to clear the choking mouth where feeder canal takes off. Such maintenance dredging and river training works are the important activities in this waterway to maintain depths for navigation particularly during the lean period from November to May.

National Waterway No. 2 (River Brahmaputra)

The Brahmaputra connecting Dhubri-Tezpur-Guwahati-Dibrugarh-Sadiya was declared as National Waterway No. 2 in the year 1988 (Fig. 3).

Waterway Characteristics

The Brahmaputra river, known as the Yarlong Tsangpo or Yarlung Zangbo in Tibet, the Siang or Dihang in Arunachal Pradesh, and the Jamuna in Bangladesh, is one of the world’s longest river. The Yarlong Tsangpo, originating from a glacier in the north Himalayas, is the highest river in the world, with an average altitude of more than 4,000 m. The 2,880 km long Brahmaputra traverses its first 1,625 km in Tibet, the next 918 km in India, and the remaining 337 km in Bangladesh. It is reported that the river slope is steep in the upper stretches i.e., the Sadiya-Dibrugarh-Neamati reach has an average fall of 18–20 cm per km, compared to 12 cm per km for Neamati-Guwahati and 9.5 cm per km for Guwahati-Dhubri. RITES has carried out River Management works for five years from 1990 to 1995 and developed this waterway for navigation.

The river Brahmaputra is classified as a braided river channel as shown in Fig. 4. The channel varies considerably in width, ranging from less than 2 km to more than 15 km. During low flow the channel shifts back and forth between the high banks, which are often 5 to 10 km apart. The aerial view of the river shows many channels, shoals, and islands, which indicate a river of low hydraulic efficiency and heavy sediment load.

The river is literally choked with sand bars. The inflow of the sediment load is greater than the sediment carrying capacity of the flow and results in an aggrading channel bed characterised by such sand bars and islands. The major contributing factor for formation of sand bars and shifting of the river channel is the amount of sediment and the inability of the river to transport it. During low stage, the river width is excessive for the amount of water it must contain, and the channel forms complicated
patterns of pools and riffles. Hence, the low flow moves in quite sinuous channels which are separated by numerous bars as shown in Fig.4. On the other hand, during the high flow the sand bars get submerged and the flow takes a comparatively straight course. The channel configuration thus molded at one time will be destroyed and subjected to modification once there is a large change in discharge.

**National Waterway No. 3 (West Coast Canal)**

The West Coast Canal (WCC) in the stretch from Kollam to Kottapuram (168 km) along with Champakkara Canal (14 km) and Udyogamandal Canal (23 km) was declared as National Waterway No. 3 in the year 1993 (Fig. 5).

**Waterway Characteristics**

The WCC system extending over a length of about 560 km along the Kerala coast from Kovalam to Hosdurg is formed by advantageously linking the natural water bodies like rivers, backwaters, lagoons etc. Out of the 560 km length of the WCC, the stretch between Kottapuram and Kollam (168 km) was considered initially for development as a National Waterway. The navigational route has to negotiate several locks, cross over bridges, sluice gates etc. RITES has carried out Detailed Project Report and other Feasibility studies for development of IWT on WCC.

The morphology and hydrology of the WCC vary depending upon the discharges as well as sea water entry into the canal. A number of east to west flowing small rivers along with their distributaries meet this waterway. In addition, the sea water enters through several openings into the west coast waterway. Hence, the flow pattern in the canal is controlled by oscillations of the tide as well as fresh water discharges. The influence of the sea and tidal range is high, of the order of 1.5 to 2.0 m from Kottapuram to Thannermukkom reach of the waterway as witnessed by the wide waterway (Fig.5). From Thannermukkom to Thrikkunnappuzha the canal waterway is restricted between two locks and as a result the fluctuation of the water level is negligible. Further south of Thrikkunnappuzha up to Kollam, though the waterway is connected to sea the variation in water level is moderate, of the order of 0.3 to 0.5 m due to formation of frequent sand bars across the sea mouths. A navigable channel of 38/32 m width and 2 m depth has been developed for navigation.

**National Waterway No. 4**
*(Kakinada – Puducherry Canal including rivers Godavari and Krishna)*

The integrated coastal canal waterway viz., Puducherry Canal, Buckingham Canal, Comammur Canal, Eluru Canal and Kakinada Canal connecting the sea ports - Kakinada, Machilipatnam, Krishnapatnam, Ennore, Chennai and Puducherry including the rivers Godavari and Krishna was declared as National Waterway No. 4
in 2008 (Fig.6). RITES has carried out several feasibility studies for development of IWT on KPC including the rivers Godavari and Krishna.

**Waterway Characteristics**

*River Godavari:* The River Godavari is a major waterway in central India, originating in the Western Ghats at Triambakeshwar in the Nasik district of Maharashtra and flows across the Deccan Plateau and enters Andhra Pradesh before emptying into the Bay of Bengal after traversing a length of about 1465 km. There is a dam on the river just after source of the river at Triambakeshwar in Maharashtra and another dam located at Sri Ram Sagar (Pochampadu) besides a barrage at Dowleiswaram in Andhra Pradesh. The end reach of the river from Bhadrachalam to Dowleiswaram/Rajahmundry (171 km) is considered as part of the National Waterway No. 4.

*River Krishna:* The River Krishna rises at Mahabaleswar in Maharashtra in the west and travels in the states of Karnataka and Andhra Pradesh before confluencing in the Bay of Bengal on the east coast after traversing a length of about 1400 km. There are many dams and barrages constructed across the river viz., Almatti Dam (Bagalkot, Karnataka), Basavasagar Dam (Narayanpur, Karnataka), Srisailam Dam (Srisailam, Andhra Pradesh), Nagarjunasagar Dam (Andhra Pradesh), and Prakasam Barrage (Vijayawada, Andhra Pradesh). The last reach of the river from Wazirabad to Vijayawada (157 km) is considered as part of the National Waterway No. 4.

The river Godavari and Krishna typically exhibit straight channels. The thalweg of straight channels is generally sinuous in plan, moving from one bank to the other. As a result, lateral bars are formed and are arranged alternately along the banks (Fig.7). The longitudinal profile of such a stream therefore shows alternation between deep pools (opposite the lateral bars) and shallow riffles (between the lateral bars). This type of stream, although quite distinctive, is essentially transitional, showing features comparable to both meandering and braided streams. The riffles correspond to a semi-braided reach and the lateral bars and pools, to a meander loop.

The integrated PKC waterway viz., Puducherry Canal, Buckingham Canal, Commamur Canal, Eluru Canal and Kakinada Canal interlinking the two major south Indian rivers Godavari and Krishna was originally designed and constructed during the pre-independence era by the British engineer, Sir Arthur Cotton for irrigation cum navigation purposes. While the Buckingham Canal is a tidal canal with sea confluences at many places the other canals are irrigation cum navigation canals.

There are a number of navigation locks, cross over bridges and other hydraulic structures which restrict the vessel size along National Waterway No. 4. Till 1975, there had been an active navigation in this canal waterway by country crafts of 40 to 50 tons capacity. Over the years, the inland water transport on this canal system has
lost its existence due to the advent of roads and railways parallel to the canal. Interestingly, the waterway not only links the two rivers Godavari and Krishna but also intersperses with the sea ports enroute viz., Kakinada, Machilipatnam, Krishnapatnam, Ennore, Chennai and Puducherry to promote coastal shipping.

NATIONAL WATERWAY No. 5
(East Coast Canal including rivers Brahmani and Mahanadi)

The ECC integrated with Brahmani and Mahanadi delta river system in West Bengal and Orissa is one of the important waterways declared as National Waterway No. 5 in 2008 (Fig.8).

Waterway Characteristics

The canal system running between Paradip in the state of Orissa and Haldia in the state of West Bengal was one of the greatest links in the transportation system from 1883 till the middle of the 20th century. Due to simultaneous development of railways and road network the canal system could not be utilised to the extent envisaged. The canal portion in Orissa is called as Orissa coast canal and the portion in Bengal is named as Hijli tidal canal, together called the East Coast Canal (ECC). The ECC runs from Geonkhali on the right bank of the river Hooghly (68 km downstream from Kolkata port) to the Charbatia lock where the canal connects to the river Matai and thereafter through the river section to the port of Paradeep. The Brahmani-Kharasuan-Mahanadi river system which flows along the Talcher coal deposits and iron ore mines at Daiteri provides navigation link to Paradeep port. The present National Waterway consisting of East Coast Canal including the rivers Brahmani and Mahanadi river system has a total length of 623 km.

River Brahmani: The River Brahmani is the second largest river in Orissa; it originates at Nagri in the Ranchi district of Jharkhand state and passes through Sundargarh, Sambalpur, Dhenkanal and Cuttack districts in Orissa. Out of a total length of 799 km, 258 km length is in Jharkhand and the remaining 541 km is in Orissa. The stretch of river Brahmani from Talcher to Dhamra in Orissa of length 265 km is considered as a part of the National Waterway No. 5.

River Mahanadi: The river Mahanadi rises in Raipur district of Chhattisgarh flows through Orissa state and passes through the cities of Cuttack and Paradeep. The length of the river is about 860 km and the width of the river during floods is 3 km with a maximum flood discharge of 51,000 cumecs.

The Mahanadi and Brahmani rivers together form a large delta before they meet the Bay of Bengal. The deltaic reach of Mahanadi from Mangalgadi to Paradeep (101 km) is considered as part of the National Waterway No. 5.
Having established the physical characteristics of the waterways, the studies led to the design of craft characteristics suitable to the waterway.

**Inland Water Transport Crafts**

In sympathy with the differing characteristics of the rivers, the characteristics of the crafts also varied over the regions and also over the same river. It is appropriate to visualise that in swift streams with naturally shallow depths in hilly areas crafts must have been narrower and longer. In more placid waters with higher depths, they are broader with bigger drafts. In braided channels, crafts are broader and shallower.

Again, perhaps crafts characteristics must have varied over the same river to negotiate the monsoon and the critical summer depths. The characteristics of crafts in National Waterways are furnished in Table 1. Higher draft vessels of about 2.5 m draft can ply on rivers the Ganga and the Brahmaputra (NW-1 and NW-2). The same vessels in the river Ganga and the Brahmaputra would be loaded less to reduce the draft suitable to the lean season depths. Since the Ganga and the Brahmaputra waterways are broader and shallower, low draft broader barges are used in combination of two and four barges either pushed or pulled by a tug to increase the efficiency. The combination of canal and river waterways such as WCC, KPC and ECC are ideally suitable to ply Self Propelled Vessels (SPV). The navigation locks on canals can easily be negotiated by SPV. The narrow canals, navigation locks and low level bridges drastically reduce the size of the vessel in canal waterways.

**Table 1: Crafts in Different National Waterways**

<table>
<thead>
<tr>
<th>Waterway</th>
<th>Type of Vessels</th>
<th>Vessel dimensions (m)</th>
<th>Draft of the vessel (m)</th>
<th>Speed (kmph)</th>
<th>Carrying capacity in Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Length</td>
<td>Breadth</td>
<td>Depth</td>
<td></td>
</tr>
<tr>
<td>The Ganga-Bhagirathi-Hooghly (NW-1)</td>
<td>SPV</td>
<td>70</td>
<td>9.20</td>
<td>3.2</td>
<td>2.6, 2.0, 1.8</td>
</tr>
<tr>
<td>The Brahmaputra (NW-2)</td>
<td>SPV</td>
<td>55</td>
<td>9.50</td>
<td>2.8</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Push / Tow SPV</td>
<td>65</td>
<td>10.00</td>
<td>2.9</td>
<td>1.75, 2.0</td>
</tr>
<tr>
<td>WCC (NW-3)</td>
<td>SPV</td>
<td>50</td>
<td>8.50</td>
<td>2.1</td>
<td>1.5</td>
</tr>
<tr>
<td>KPC (NW-4)</td>
<td>SPV</td>
<td>29</td>
<td>4.25</td>
<td>2.0</td>
<td>1.2</td>
</tr>
<tr>
<td>ECC (NW-5)</td>
<td>SPV</td>
<td>30</td>
<td>6.50</td>
<td>2.0</td>
<td>1.25, 1.25</td>
</tr>
</tbody>
</table>
Cargo Handling Terminals

The cargo handling terminals are in accordance with the size of the vessel, quantum of the cargo and hydro-morphological characteristics of the waterways. Multi-level jetties suitable to operate against the varying stages of the river are required for the Indian National Waterways. However, these are expensive and may require strong cargo support to workout the economics. A two-level fixed jetty on National Waterway No.1 at Patna can be seen in Fig. 9. On the other hand floating pontoons with steel gangways are less expensive and more ideal for fluctuating water levels as shown in Fig. 10.

Fixed terminals on National Waterway No.1 exist at Haldia, Kolkata, Pakur, Farakka and Patna and floating terminals are there at Haldia, Kolkata, Diamond Harbour, Katwa, Tribeni, Shantipur, Behrangpur, Jangipur, Farakka, Rajmahal, Sahibganj, Manihari, Bhagalpur, Semaria, Doriganj, Ballia/Buxer, Gazipur/Kaithi, Varanasi, Chunar and Allahabad.

Low level fixed terminal exists on National Waterway No. 2 at Pandu and floating terminals are there at Dhubri, Jogighopa, Tejpur, Silghat, Jamuguri, Neamati and Dibrugarh.

Fixed terminals exist on National Waterway No. 3 at Aluva, Vaikam, Kayamkulam, Kottapuram, Maradu, Cherthala, Thrikkunnapuzha, Kollam and Alappuzha.

Cargo Transportation on National Waterways

Currently, cargo transport by IWT mode on National Waterways No. 4 and 5 is virtually non-existent, but for movement of sand, bricks and other small items in limited parts of the stretches, mostly in an unorganised way by country crafts, since these waterways are yet to take off for commercial operations. The river navigation on the Ganga and the Brahmaputra has been serving as an important means of transport in Bihar, Uttar Pradesh, West Bengal and Assam for a long time. The water route is linked to Kolkata through the Jamuna river in Bangladesh and the Sunderbans Delta. The joint steamer companies during pre-independence era had operated services between Kolkata – Assam and Kolkata – Patna and provided an economical means of transportation. The traffic however, gradually declined with the advent of roads and railways.

The organised Inland Water Transport cargo moving on WCC is only along a short stretch of 20 km from Kochi port to the two Fertilizers and Chemicals Travancore Ltd (FACT) plants located at Udyogamandal and Ambalamugal serving Udyogamandal and Champakkara canals. FACT manufactures fertilisers and chemicals. It imports
its raw materials and exports finished products through Kochi port by barges plying between the Plants and Kochi port. As per available records, FACT had moved on an average about 0.2 to 0.3 million tons per annum of its cargo between the years 1986-87 and 1990-91 on Champakkara and Udyogamandal canals between the Plants and Kochi port even before declaration of the waterway as National Waterway. The traffic studies carried out for the National Waterway declaration studies by RITES have projected that this cargo alone would be increased to 0.6, 0.7 and 0.8 million tons for the years 1999-2000, 2004-05 and 2009-10 respectively.

The cargo moved on three national waterways (NW 1, 2 and 3) over the last few years has been presented in Fig. 11 to examine the trend and the order of magnitude of the traffic. The traffic moved on NW-1 reduced from 0.8 million tons in 1998-99 to 0.34 million tons in 2000-01 and then progressively increased to 1.32 million tons in 2006-07. The cargo moved on NW-2 from 1998-99 to 2002-03 was of the order of 0.02 to 0.08 million tons per annum which was very low. However, the cargo picked up to about 0.8 to 1 million tons per annum during the last four years from 2003-04 to 2006-07. A steady traffic flow of about 1 million tons per annum is seen on NW-3. On an average about 0.8, 0.3 and 1.0 million tons per annum of cargo moved on NW-1, NW-2 and NW-3 respectively over the period from 1998-99 to 2006-07.

The projected cargo based on various studies has been compared with the actual movement of cargo on National Waterways 1, 2 and 3 to study the extent of realisation of estimates (Fig. 12). The cargo projections are based on assumptions of certain percentage (15 to 20%) of possible diversion of traffic from the next best competitive mode of highways provided the waterways are made available for navigation with requisite infrastructure facilities. The quantum of the actual cargo moved on NW-1 and NW-2 when compared to projections is far lower though the waterways are made navigable with a draft of 1.5 to 1.8 m round the year. On an average only about 13 % of the projected cargo estimates have seen the light of the day on NW-1 and NW-2. The projected cargo movement on NW-1 by 2006-07 was 6.83 million tons but the actual cargo moved was only 1.32 million tons with an average annual increase of 0.11 million tons. If this average annual growth of (0.11 million tons / year) is considered the projected quantum of cargo of 6.83 million tons would be achieved by the year 2055.

As far as NW-2 is concerned, the projected cargo movement by 2006-07 was 3.23 million tons but the actual cargo moved was only 1.1 million tons with an average annual increase of 0.12 million tons. If this trend of growth (0.12 million tons / year) continues, the projected quantum of the cargo (3.23 million tons) would be achieved by the year 2031. In NW-3, the actual cargo moved by 2006-07 was 1.03 million tons as against the projected cargo movement of 3.62 million tons. The cargo moved on this waterway was almost constant for the last ten years period (1998-99 to 2006-07) with an average annual quantum of 1.05 million tons. As discussed earlier, the present cargo moved on NW-3 is by FACT. Considering a growth of 0.1 million tons / year of
FACT and other cargo, the projected quantum of 3.62 million tons would be achieved by the year 2035. Thus, the National Waterways have to go a long way before they achieve the projected quantum of the cargo.

The reasons for less cargo movement on these waterways can perhaps be attributed to non attractiveness of this mode due to its disadvantages of slow movement and multi-handling. The inherent advantages of less fuel consumption and environment friendly mode are however not well traded off over its disadvantages.

The above comparative study between the projected and actual movement of cargo in National Waterways from 1998-99 to 2006-07 reveals that none of the waterways have picked up momentum even after the Government continuously put in efforts to maintain the navigable waterways and create infrastructure facilities. The comparative studies of projected and actual cargo moved on National Waterways have further shown that the waterways have a long way to go to pick up the estimated momentum and the Government may need to change its strategy not only to maintain the waterways but also to attract the shippers for movement of the cargo.

The cargo projections for the next 20 years on the recently declared National Waterways (NW-4 and NW-5) are shown in Fig. 13. The projected cargo movement on NW-4 would be about 10 million tons and on National Waterway 5 would be about 25 million tons by 2029-30. The bulk cargo movement identified for NW-4 is Fertilisers and Agricultural products and for NW-5 is Coal movement from Talcher mines (located along the Brahmani river) to Paradeep port. The current scenario on the three operational National Waterways together (NW 1, 2 and 3) shows that the actual cargo moved on these waterways was only 3.4 million tons in 2006-07 as against a projected quantity of 13.8 million tons. Hence, it is essential not only to develop and make navigable the newly declared National Waterways 4 and 5, but also to attract the shippers to move the cargo using this cheapest mode of waterway transport to achieve the projected quantum of cargo movement. Narayan Rangaraj (2006), Brahma G D (2006), Sriraman S (2010) had extensively studied the perspectives of Inland Water Transport in India and made suggestions to revive this neglected age old viable transport mode. Sriraman S (2010) has suggested that the Inland Water Transport in India should be viewed as an integrated mode along with coastal shipping and further pointed out that the waterway mode should be properly integrated with other modes of transport particularly road and rail.

Conclusion

The waterway characteristics vary widely among the five National Waterways depending upon their geographic region. The rivers Ganga (NW-1) and Brahmaputra (NW-2) being the Himalayan rivers undergo large seasonal fluctuations in flow and sediment load and are largely braided with many channels. The frequent shifting of
the thalweg pose navigation problems with least available depths varying not only from season to season but also longitudinally from one reach to the other along the waterway. The waterways (NW-1 and NW-2) occupy a highly dynamic environment with extreme variability in stage of the river, discharge and sediment load. Consequently, the waterways are characterised by frequent changes in navigable depths. In comparison, the hydro-morphological changes in peninsular rivers (NW-4 and NW-5) are much smaller in magnitude and the waterways are more controlled due to linkages with coastal backwaters and canals. The National Waterways 1 and 2 come under open river navigation and on the other hand the National Waterways 3, 4 and 5 are canal waterways connected to rivers and tidal back waters.

The characteristics of the crafts vary in accordance with the characteristics of the waterway. While 600 to 1000 tons vessels can ply in National Waterways 1 and 2, the vessel size in canal waterways is reduced to 350 tons in West Coast Canal (NW-3) and 200 tons in East Coast Canal (NW-5) and 100 tons in Kakinada – Puducherry canal (NW-4). The number of navigation locks, low level bridges and other physical constraints viz., aqueducts, regulators etc. dictate the vessel size in canal waterways.

As the water levels vary widely from lean season to flood season, the floating jetties are more suitable for National Waterways 1 and 2 when compared to the fixed jetties. On the other hand the fixed jetties are more suitable for canal waterways (NW-3, NW-4 and NW-5) since the water levels are more controlled.

The traffic studies have revealed that the quantum of the traffic moved on National Waterways 1 and 2 fluctuates widely from year to year. It is low when compared to market surveys despite the waterways being maintained with requisite depths and other infrastructure facilities. On an average about 0.8, 0.3 and 1.0 million tons per annum of cargo was moved on NW-1, NW-2 and NW-3 respectively during a decade of the data studied from 1998-99 to 2006-07. The cargo movement on NW-3 is more or less stable due to dedicated cargo movement by Fertilisers and Chemicals Travancore (FACT) between their plants located on the banks of West Coast Canal and Kochi port. The comparative study of cargo projections based on several surveys with the actual cargo movement has revealed that the estimated quantities have widely differed with the actual quantities of cargo movement. On an average only about 13% of the projected cargo estimates have seen the light of the day on National Waterways No. 1 and 2 despite the waterways being maintained for the last 25 years or so by incurring huge expenditure. The National Waterway No. 3 on the other hand has witnessed a cargo movement of about 36% of its projected quantum. The present growth of cargo movement on national waterways is about 0.1 million tons per annum. If this growth continues, the National Waterways have to go a long way to achieve the estimated quantum of the cargo. It is clear from the study that the IWT sector has been growing slowly in the country despite constant efforts by declaring certain
waterways as National Waterways. More focus is needed to identify the dedicated bulk cargo and effort should be put in to attract private shippers to make it a successful transport system.

When compared with other countries such as the US, EU, China and other Asian countries, freight transportation by inland waterways is highly under developed in India. Road and railways dominate India’s inland freight transportation scenario with 54% and 34% shares respectively of the total inland freight transported, whereas inland waterways contributed less than 1% in 2006-07. However, in the last few years, movement of cargo by inland waterways has shown an upward trend and increased from 1.63 billion ton km in 2003-04 to 3.38 btkm in 2007-08, accounting for about 0.34% of total surface cargo movement. The target is to increase the modal share of IWT to 20 btkm by 2025 and its achievement depends upon identifying dedicated bulk cargo and involvement of private entrepreneurs.

IWT in India still has a long way to go.

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The farther backward you can look, the farther forward you are likely to see.

- Winston Churchill

Be the change you want to see in the world.

- Mahatma Gandhi