National Inland Waterways in India

A Strategic Status Report

Shripad Dharmadhikary
Jinda Sandbhor

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Manthan Adhyayan Kendra and SRUTI

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In earlier times, we shaped our boats to fit our rivers. Now, we are shaping our rivers to fit the size of our vessels.

Inland waterways possibly represent the biggest intervention in our rivers, second only to large dams.

FOREWORD

We are very happy to share the *Strategic Status Report on National Inland Waterways in India* which is now becoming a new dimension of current development paradigm in India. Inland waterways has been among the priorities of the current government's development agenda. This concept of developing new ways for industrial purposes in addition to huge infrastructure of road transportation and freight corridors need to be understood from each aspect.

We do express our sincere gratitude and thanks to the authors Shripad Dharmadhikary and Jinda Sandbhor for their intensive research and dedicated efforts to bring the knowledge into wider public domain. We are also thankful to Waterkeeper Alliance for the financial support for this.

We hope this report will help all working on or are concerned with the environmental issues, especially water related issues.

Satyam and Shweta,

ŠRUTI
Society for Rural Urban & Tribal Initiative

National Inland Waterways in India

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Abbreviations

DWT	Dead Weight Tonnage
EAC	Expert Appraisal Committee
EC	Environmental Clearance
EIA	Environment Impact Assessment
EMP	Environment Management Plan
GRBMP	Ganga River Basin Management Plan
ILR	Inter Linking of Rivers
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
LAD	Least Available Depth
MoEFCC	Ministry of Environment, Forests, and Climate Change
MoWR,RD,GR	Ministry of Water Resources, River Development and Ganga Rejuvenation
NMCG	National Mission for Clean Ganga
NW	National Waterway
PPP	Public Private Partnership

NATIONAL INLAND WATERWAYS – EXTENT AND STATUS

Introduction

On 9th March 2016 Parliament enacted The National Waterways Act, 2016[1], which received the assent of the President on 25th March 2017, and came into force from 12 April 2017 as per the notification of the Government of India[2]. This act has declared 111 rivers or river stretches, creeks, estuaries as National (inland) Waterways. The passage of this legislation enables the Central Government to regulate these waterways for development with regard to shipping, navigation and transport through mechanically propelled vessels. Prior to this Act there were five national waterways, each declared as such by their own separate legislation[3].

While navigation in rivers, lakes and other water bodies has been around since centuries, this has been more in the form of smaller vessels, connecting places not too far from each other. In some cases, especially near ports and coastal areas, this has evolved to more large-scale, commercial shipping. The national waterways project now intends to create such large scale, commercial shipping and navigation systems in these 111 waterways. These are intended to realise the potential of cargo and passenger traffic, including tourism and cruise. In spite of five waterways being declared as national waterways many years back (NW 1 was declared in 1982), the development of inland water transport has been slow in the country. Inland water transport in India has only 0.5% modal share; China 8.7%; USA 8.3% and Europe 7%.[4] The new plans hope to change this.

Advantages of Waterways

Several advantages are put forward for such waterways. The most important advantage is that it is fuel-efficient compared to the other modes of transport, rail and road. For example, the *Integrated National Waterways Transportation Grid Study* states[5] that one litre of fuel will move 24 tons through one kilometre on road, 85 on rail and 105 kms on inland water transport. The National Waterways Bill, 2015 tabled in the Parliament mentioned that

> "…inland water transport is recognised as fuel efficient, cost effective and environment friendly mode of transport, especially for bulk goods, hazardous goods and over dimensional cargos. It also reduces time, cost of transportation of goods and cargos, as well as congestion and accidents on highways."

Other advantages mentioned are that the waterways will "help create seamless interconnectivity connecting hinterlands along navigable river coasts and coastal routes" and that "riverine routes are likely to play a crucial role in connecting the north-eastern states to the mainland."[6]

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[1] National Waterway Act, 2016, http://www.indiacode.nic.in/acts-in-pdf/2016/201617.pdf accessed on 6th October 2016.
[2] Gazette Extraordinary Part II Section 3 dated 11 April 2016
[3] These five separate legislations stand repealed by the Section 5 (1) National Waterway Act, 2016 as this Act has now included them in its ambit.
[4] Jal Marg Vikas Project -Frequently Asked Questions And Their Answers, Inland Waterways Authority 0f India. http://www.iwai.nic.in/showfile.php?lid=864
[5] *Integrated National Waterways Transportation Grid Study (Stage 1 of Phase II), Final Report*, RITES, Gurgaon. Published by Inland Waterways Authority of India, New Delhi, 2014. Page v.http://www.iwai.nic.in/WriteReadData/l892s/INT_NAT_WAT_TRA_GRI_STU_Part1_3-26947128.pdf Accessed 27 Feb 2017
[6] *Vision for Coastal Shipping, Tourism and Regional Development*, Ministry of Shipping, Government of India, 2015. Pages 19-20

However, these advantages are neither unqualified, nor automatic. They will manifest only when certain conditions are met, and only under certain circumstances. For example, a report on the sector development strategy and business development for capacity augmentation of Waterway 1 (Ganga waterway)notes[7]:

> "In respect to operating costs per ton-km, IWT [Inland Water Transport] shows the lowest costs compared to rail and especially road. However, this cost argument has to be put into perspective, as it is generally true for single mode carriages but not for door-to-door transports including cargo transfer and pre/end haul. The total cost advantage of IWT depends much on the length of transport on waterways and the distance of the consignee to or from the transfer point. Finally, there are different types of transfer needs, closely related to the commodity as well as to port facilities and these result in different costs. In unfavorable situations the costs of transfer are double the waterway transport costs…
>
> "Among the most visible weaknesses of IWT are the low transport speed and its limited area of operation, depending on the infrastructural premises and depth of the waterways. Moreover, there are only very few cases in which IWT can offer door-to-door transport of cargo. Possible related threats for IWT include operational disruptions due to weather."

Thus, the extent of the advantage offered will vary case by case, and hence, advantages may not always outweigh the cost. Each waterway would need to be assessed on its own situation and circumstances.

Extent of the Inland Waterways

The details of all 111 national waterways, including the latitude-longitude coordinates of the start and end points[8], are given in the National Waterways Act, 2016. These waterways pass through 24 states and two union territories[9], with an approximate total length of 20274 km[10].These waterways will pass through nearly 138[11] river systems, creeks, estuaries and related canal systems of India. State wise details of national waterways are given in Annexure 1.

The National Waterways Bill, 2015 was introduced by Shri Nitin Gadkari, Minister of Road Transport & Highways and Shipping, on 29th April 2015. This Bill was transferred to the Parliamentary Standing Committee on Transport, Tourism and Culture for study and comments[12]. This Bill had suggested 101 new national waterways in addition to existing 5 national waterways. The Standing Committee recommended some more waterways to be added and also asked the government to take cognizance of objections raised by some state governments on certain national waterways. After considering all the recommendations made by Standing Committee the Bill was amended and 13 proposed waterways were removed and 18 waterways were added. The details of these are given in Annexures 2 and 3. Annexure 3 also lists the waterways which the Parliamentary Committee had

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[7] *IWT Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1 from Haldia to Allahabad Volume I: Report Part A*, HPC Hamburg Port Consulting GmbH, Germany and UNICONSULT, Germany, IWAI. June 2016 Page 157, 161.

[8] Schedule to the National Waterways Act, 2016.

[9] Information compiled from various sources such as the Act and PIB releases by Ministry of Shipping.

[10] Compiled from Press information Bureau, Ministry of Shipping, dated 21st July 2016 http://pib.nic.in/newsite/PrintRelease.aspx?relid=147477

[11] http://pib.nic.in/newsite/PrintRelease.aspx?relid=133480 Accessed 6th march 2017

[12] Department-Related Parliamentary Standing Committee on Transport, Tourism and Culture Two Hundred Twenty Third Report, The National Waterways Bill, 2015 (*Presented To The Rajya Sabha On* 12th *August*, 2015), (*Laid On The Table Of Lok Sabha On* 12th *August*, 2015); Parliament of India, Rajya Sabha.

suggested for addition. The Bill was passed by Parliament with 111 waterways declared as National Waterways.

The national waterways go through almost all major rivers of the India. The map at Figure 1 gives all the 111 waterways at a glance[13].

Figure 3: Google earth image showing the proposed the 111 national waterways in India

[13]The map has been compiled by one of the authors Jinda Sandbhor, with the support of Ahemad Shaikh, Manthan Adhyayan Kendra. Since the National Waterways Act, 2016 only gives the coordinates for the start and end points, and details of the intervening path are only occasionally given, the waterways shown on the maps have been traced out using the end points and rivers/canals/water bodies as seen on the map. Hence, these should be considered as approximate and not exact representations.

The table below gives the number of waterways in each state. The details of these are given in Annexure 1.

Table 1: State wise number of waterways

Sr. No.	State	Total number of waterways
1	Andhra Pradesh	3
2	Arunachal Pradesh	1
3	Assam	17
4	Bihar	7
5	Delhi	1
6	Goa	6
7	Gujarat	5
8	Haryana	2
9	Himachal Pradesh	3
10	Jammu and Kashmir	4
11	Jharkhand	3
12	Karnataka	11
13	Kerala	5
14	Madhya pradesh	3
15	Maharashtra	15
16	Meghalaya	5
17	Mizoram	1
18	Nagaland	1
19	Odisha	6
20	Puducherry	2
21	Punjab	4
22	Rajasthan	3
23	Tamil Nadu	10
24	Telangana	6
25	Uttar Pradesh	11
26	West Bengal	16

RELATED INFRASTRUCTURE, LINKAGES WITH OTHER CORRIDORS

Apart from the waterways or the channels themselves, these national waterways will also need, and hence involve the construction of other related infrastructure facilities like riverside jetties and ports, navigational aids and control points, material handling sites, storage godowns, barge maintenance and repairing centers, refuelling points, associated dredging equipment, parking areas for vessels and so on. Some of the port/terminals are planned as multimodal hubs which will connect rail, road and waterways, for e.g., the multi-modal hub at Varanasi.

Moreover, there is a plan to link many of the national waterways to each other, to roads and railways and to major ports. This scheme is being called the Integrated National Waterways Transportation Grid. According to the National Waterway Transportation Grid Study[14] by Inland Waterway Authority of India:

> **"**Integrated National Waterways Transportation Grid study is undertaken with an aim to link all National Waterways …….to National/ State Highways, Railways and Sea Ports so that all these waterways become an integral part of the total transportation grid."

The study led to a Cabinet note proposing setting up of Integrated National Waterways Transportation Grid at an estimated cost of Rs. 2631 crore for phase I (2015-18) and Rs. 20132 crore for phase-II (2018-23) totaling to Rs. 22763 crores[15].

Another aim is to also connect the waterways to the different economic corridors being planned like Eastern Freight corridor, Western Freight Corridor as well projects like the Sagarmala Project, which aims to promote port-led direct and indirect development. According to the *Vision for Costal Shipping Tourism and regional Development* of the Shipping Ministry[16],

> "The Sagar Mala project at hand envisages seamless connectivity of sea-borne cargo with inland waterways for hinterland movement."

The Inland Waterway Authority of India has signed a MoU[17] with the Dedicated Freight Corridor Corporation of India Ltd to develop a multimodal hub at Ramnagar near Varanasi in Uttar Pradesh. This multimodal hub will connect the National Waterway 1 to the Eastern Freight Corridor as well as the highway. The rail line of the Eastern Corridor runs parallel to National Waterway 1 between Allahabad and Varanasi. Through this linkage commodities and cargo can be swapped/shifted from and to the National Waterway 1, the Eastern Freight Corridor and road transport.

Thus, the waterways project should be seen as a part and parcel of a much larger, ambitious project linking several big infrastructure projects.

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[14] Integrated National Waterways Transportation Grid Study (Stage 1 Of Phase II) RITES, 2014http://www.iwai.nic.in/WriteReadData/l892s/INT_NAT_WAT_TRA_GRI_STU_Part1_3-26947128.pdf Accessed 2 March 2017

[15] http://iwai.gov.in/showfile.php?lid=820

[16] http://shipmin.nic.in/writereaddata/l892s/183389537coastalvision.pdf Accessed 20 March 2017. Page 36

[17] http://shipmin.nic.in/writereaddata/l892s/183389537coastalvision.pdf Accessed 20 March 2017.

CURRENT STATUS OF NATIONAL WATERWAYS

Currently Operational

According to a PIB release by Ministry of Shipping dated 1 Aug 2016, there are six[18] operational national waterways in India. These are:

1. NW-1: Ganga-Bhagirathi-Hooghly river system (Allahabad-Haldia).
2. NW-2: River Brahmaputra.
3. NW-3: West Coast Canal (Kottapuram-Kollam) along with Udyogmandal and Champakara Canals.
4. NW -68: Mandovi River.
5. NW-97: Sundarbans waterways.
6. NW -111: Zuari River.

This press release further says that the Varanasi to Haldia stretch of NW 1 is operational. Haldia to Farakka stretch of NW1 is being used for transportation of coal and fly ash. Ro-Ro (Roll On Roll Off) service has been started in river Brahmaputra under NW 2. Iron ore is one of the major commodities transported in the NW 68 and NW 111 in Goa.

Additionally, the Arabian Sea to Dharamtar port section of NW 10 has been operational as a regular waterway for many years. This has now been declared as a National Waterway with its reach extending to Nagothane. This waterway mainly transports coal and iron ore[19].

The total cargo moved on the three national waterways, NW 1, NW 2 and NW 3 in the year 2013-14 was about 6.89 million tons. In terms of ton-km (total distance through which total cargo weight was carried), the three waterways carried 1.922 billion ton-km of cargo.[20] This represents a very low proportion of the total cargo movement in the country. Table 2 and Figure 2 show the cargo carried by these waterways over last few years. Unfortunately, the figures for the Goa waterways and Mumbai (Dharamtar) waterways given by different sources – IWAI and Shipping Ministry – are contradictory and hence we are not presenting them here. Similarly, figures for cargo carried by the three national waterways for years after 2014 are also inconsistent between various sources.

Table 2: Cargo handled by national waterways

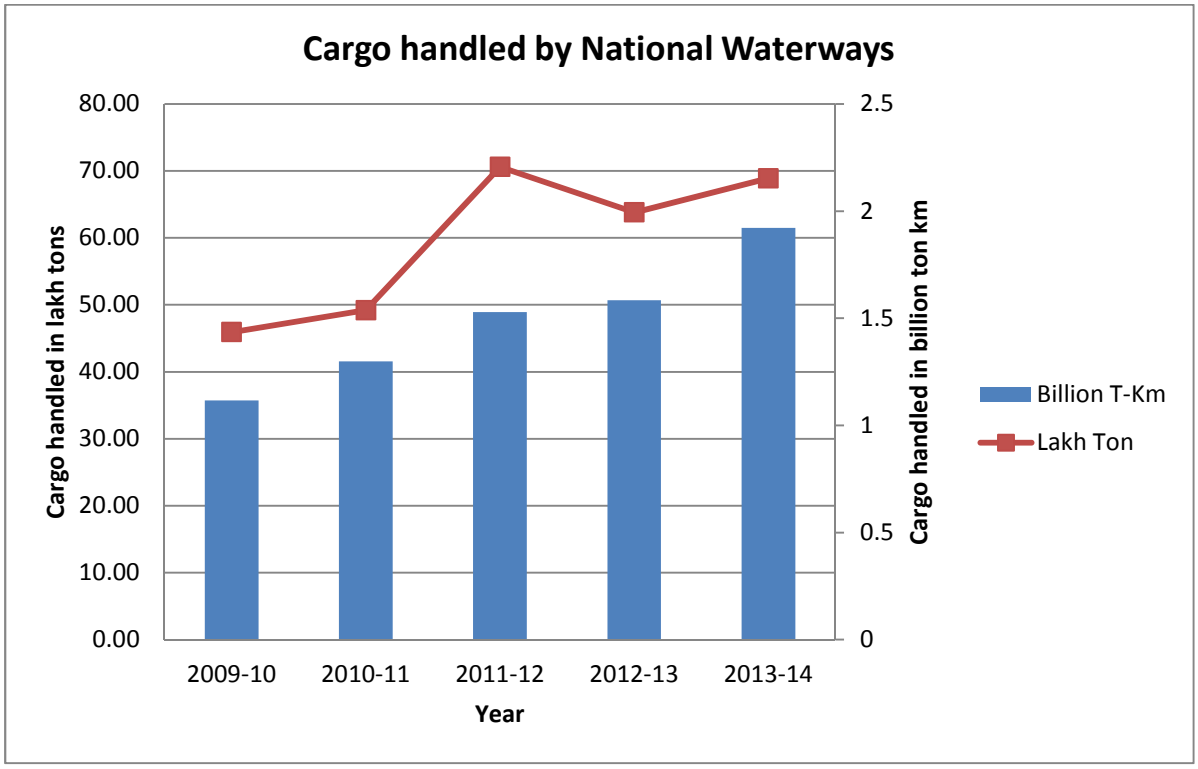
National Waterway	Year/Unit	2009-10	2010-11	2011-12	2012-13	2013-14
National Waterway - 1	Lakh Ton	18.11	18.71	33.10	27.16	33.49
	BTKM	1.048	1.228	1.454	1.512	1.851
National Waterway - 2	Lakh Ton	21.15	21.64	24.06	24.27	24.75
	BTKM	0.059	0.057	0.061	0.058	0.059
National Waterway - 3	Lakh Ton	6.67	8.86	13.44	12.36	10.66
	BTKM	0.01	0.014	0.013	0.014	0.012
Total	Lakh Ton	45.93	49.21	70.60	63.80	68.90
	BTKM	1.117	1.299	1.529	1.584	1.922

[18] Press release by Ministry of Shipping through Press Information Bureau dated 1 Aug 2016. http://pib.nic.in/newsite/PrintRelease.aspx?relid=148091 Accessed 6 March 2017

[19] Personal observations during field visit by authors.

[20] Website of Inland Waterways Authority of India (IWAI).http://iwai.nic.in/WriteReadData/l892s/5785747672CARGO%20STATISTICS%202009-10%20to%202013-14.pdf Accessed 23 March 2017

Figure 2: Cargo handled by national waterways during year 2009-2014



Developments Planned in the Near Future

A press release[21] of the Shipping Ministry dated 17 Nov 2016 states that "It has been decided to undertake development of 37 NWs in the next three years."

More generally, talking about the various stages of all the 111 waterways, a FAQs document posted by the Inland Waterways Authority of India states [22]:

> "The Government of India with the objective of augmenting the average effective networks of Inland Water Transport has recently also declared 106 new National Waterways (NWs) spanning over 24 states in addition to the existing five NWs. These have been divided into three categories for carrying out studies on 106 NWs. The Category -1 consists of eight viable waterways on which development activities have been initiated. Category- II consists of 46 NWs. Out of these, 24 NWs have been shortlisted for Detailed Project Report (DPR) preparation after feasibility study. Further, on four NWs, more information is sought from the two stage DPR consultants. The rest of the 18 NWs are not viable technically and due to traffic issues identified during feasibility studies. For balance 52 NWs, reports are being assessed and final decision regarding their viability has to be taken."

It is not clear however, how these 18 non-viable waterways were included in the Act. The list of these 18 waterways is also not provided.

[21] Press Release of Shipping Ministry, 17 Nov 2016 http://pib.nic.in/newsite/PrintRelease.aspx?relid=153714 Accessed 27 Feb 2017

[22] FAQ related to Jalmarg Vikas Project http://iwai.nic.in/WriteReadData/l892s/1013443659FAQ%20JMVP%20Final%20PDF.pdf Accessed 20 March 2017

The 37 NWs on which work is to be undertaken in next three years are elaborated by the FAQs as:

> "NW-1 to NW-5, Eight NWs indicated in Category-II of the new waterways, namely, (Barak, NW-16), (Gandak, NW-37), (Ghagra, NW-40), (Kosi, NW-59), (Sunderbans, NW-97), (Mandovi, NW-68), (Zuari, NW-111) and (Cumbarjua, NW-27). DPR work of 24 new NWs selected for development have been awarded. DPRs would be available from February, 2017 onwards."

The names of the 24 waterways which would be developed in the first phase over next 3 years have not been given.

Out of the 37, six waterways seem to be slated for development in the first year. The press release by the Shipping Ministry mentioned above (dated 1 Aug 2016) states that:

> "Commencement of development of six more waterways is planned in this financial year. These waterways are 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 River) and NW-58 (Kosi).The development of NW-4 & 5 has already been initiated…"

MAKING AND MAINTAINING A WATERWAY

An inland or coastal waterway needs several things to make it functional. The most important is the existence of a channel or path in the water body (river, estuary, canal etc.) of sufficient depth, sufficient width, which has adequate water all-round the year. The depth and width of a waterway will determine the size (tonnage) of a vessel that can safely travel through it.

The channel is known as the Fairway. The depth is indicated as the Least Available Depth or LAD, and the tonnage is indicated as the Dead Weight Tonnage or DWT. DWT is the weight that the vessel can safely carry, and does not include the weight of the vessel itself[23].

The *Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulations, 2006* define various "Classes" of waterways, from Class I to Class VII, with the required depth, width and other parameters defined for each of these classes. In turn, the maximum tonnage of vessels that can ply in each Class of waterway is also given. The *Regulations* also require that the "Minimum depth of channel should normally be available for about 330 days of the year."

Rivers in India, in the natural state, often do not have the required depth and width. The depth is therefore created, either by cutting and dredging the riverbed, or by building barrages to elevate the water level. Sometimes, a combination of both can also be used.

Dredging is an excavation or digging activity carried out underwater that removes rock, mud, silt, sediments etc. from the bottom of the river bed or other water bodies. Dredging is used to dig and create a channel in the river bed of the required depth. Such a dredging is called Capital Dredging. Subsequently also, the channel needs to be dredged to clear silt and sediments that continue to be deposited by the river flow. Such dredging is called Maintenance Dredging. As can be seen, dredging is a significant intervention in the river morphology, ecology, hydrology etc. The disposal of the sediments excavated by the dredging process is also a significant issue.

[23] https://en.wikipedia.org/wiki/Deadweight_tonnage

Another way to maintain the required depth of water in a waterway is to construct barrages on the rivers. Since these structures create a step (a sharp change in water level) in the waterway, a system of locks and gates has to be installed to allow vessels to navigate this sudden change of water level. Similar provision of gates and locks would need to be constructed where barrages or large dams already exist.

For example, in the case of the Talcher to Mangalgadi (237km) stretch of the National Waterway 5, the DPR states[24]:

> "It is observed that discharge available in river Brahmani from Talcher to Jokadia works out to be 55 cumecs during lean season and discharge of 110 cumecs is required to ensure a navigable depth of 2 m in a channel of 45 m bed width. It is therefore proposed to provide a Nos. of barrages from Talcher to Jokadia to ensure 2m depth of water. From Talcher to Jakodia, a total no. of 5 barrages have been proposed at the locations as given below."

Rivers often have meandering channels, and follow paths that have bends and twists. Vessels, depending on their size, can have difficulty negotiating bends in rivers. The *Regulations* quoted above also specify the bend radius that needs to be maintained for each class of waterway. In some cases, if it's not possible to provide the required bend radius, then river straightening works are often undertaken that widen or cut-off major bends (See Figure 3). Sometimes, bank and river protection works are also needed to ensure channel stability.

For example, for the Sujanpur to Padanipal stretch of National Waterway 5, along River Tantighai / Kani, the Feasibility Report submitted by the authorities to the Ministry of Environment for obtaining the Environment Clearance states[25]:

> "In this reach of about 45 km in Tantighai / Kani River, there are 24 bends and the radius of curvature in these bends varies from 190 m to 620 m against the requirement of 700 mt as per Class-IV Waterways. Attempts may be made to provide cut-offs (where site conditions permit) to increase the radius of curvature or to avoid acute bends. This may involve land acquisition. It is also suggested that the width of dredged channel may be increased on bends which will facilitate better navigation along the bends."

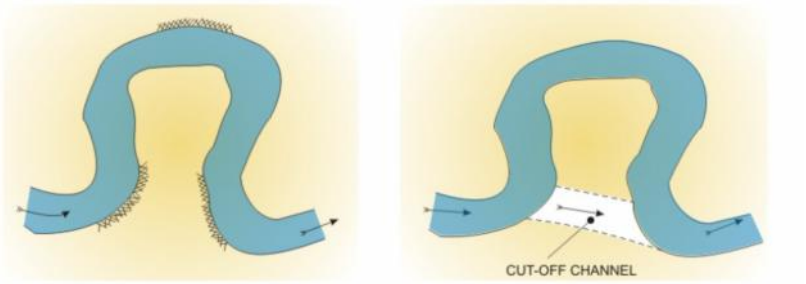


Figure 3: A typical instance of a cut-off to bypass a bend. Figure Courtesy NPTEL, IIT Kharagpur[26].

[24] Executive Summary, Detailed Project Report For Development of Inland Waterway Transport Along ECC and Brahmani/Kharsua River System: Final Report; WAPCOS Limited, March 2010. http://iwai.nic.in/WriteReadData/l892s/Executive_summary_-_April_2010nw5-30554743.pdf Accessed 30 July 2015 Page 11.

[25] http://environmentclearance.nic.in/writereaddata/Online/TOR/0_0_11_Nov_2014_1344215631Annexure-PrefeasibilityReport.pdf Downloaded on 22 Aug 2015.

Another important issue is dealing with existing, or proposed structures like bridges, water works and intakes, crossings of cables, underwater pipelines etc. The *Regulations* also specify vertical and horizontal clearances for the waterways. Such clearances will deal with, for example, the clearance to be left from the bottom-most portion of bridges, or the minimum clearance between pillars/piers of bridges. Sometimes, these structures can affect the very viability or desirability of waterways.

In their submission to the Parliamentary Standing Committee on Transport, Tourism and Culture, the Government of Kerala stated that[27]:

> "…they oppose the inclusion of the following rivers proposed as National Waterways on account of various reasons [Waterways numbers 48, 75, 65, 69, 70, 18, 46, 54, 23, 101]...The reasons given by the Government of Kerala for opposing the Waterways are:-
>
> "(i) Existing structures and drinking water sources:
> 25.4.1. As per the proposed Bill, more than 60km length of all the ten rivers from the river mouth are declared as National Waterways. Most of the rivers are 100 to 200kmlong and have several installations like drinking water intake well, check dams, regulators etc. along these stretches. In addition, several railway bridges, road bridges, foot bridges etc. are there which do not have the vertical clearance specified for National Waterways. It would be impractical to remove all these structures."

The basic feature of a waterway is that it should carry water. Given the seasonality of flows in most of India's rivers, and the fact that many rivers have been extensively dammed and their waters diverted, it will need special efforts and planning to ensure that the flow of water in the waterways is maintained. This may require release of water from upstream dams, and /or reallocation of water from existing uses.

The Executive Summary of the DPR for the Krishna river section of the National Waterway 4 says[28]:

> "The water requirement for the design channel depth of 1.8 m is 114 cumecs…If losses are added, the requirement will be 125 cumecs of water. The analysis of CWC records at Pondugala indicate that adequate discharge is available. Only small waterway improvement works (dredging and rock cutting) will be required for navigation by the designed vessel. However *Nagarjuna Sagar Dam authorities should ensure daily uninterrupted supply of 125 cumecs for smooth navigation exclusively*. If discharge is less, the navigation through rocky reaches would call for elaborate river training and control measures." (Emphasis added)

In waterways through natural water bodies like rivers (as against canals), floods and droughts pose special challenges.

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[26] http://nptel.ac.in/courses/105105110/pdf/m6l01.pdf Downloaded 23 Mar 2017

[27] Department-Related Parliamentary Standing Committee on Transport, Tourism and Culture
Two Hundred Twenty Third Report, The National Waterways Bill, 2015 (*Presented To The Rajya Sabha On* 12th *August*, 2015), (*Laid On The Table Of Lok Sabha On* 12th *August*, 2015); Parliament of India, Rajya Sabha.

In fact, Kerala also put forward several other reasons for opposing these waterways, including pollution, sea water ingress and ecological impact of dredging.

[28] Detailed Project Report for Development of Navigation in Kakinada -Puducherry Canal Along with River Godavari and Krishna (National Waterway-4): Final Report: Volume- I Executive Summary; WAPCOS Limited, March 2010. http://iwai.nic.in/WriteReadData/l892s/file112-54022272.pdf Downloaded on 30 July 2015 Page 8.

Since the waterway may sometimes form only a part of the total river channel, navigational markers are required to indicate the passage way. Night navigation brings in additional requirements of marking the path.

A waterway also needs associated infrastructure like jetties, river-ports, terminals, access roads etc. For example, the Ganga Waterway (National Waterway 1) has proposed to construct terminals at Allahabad, Varanasi, Gazipur in UP, Sahibganj in Jharkhand and Katwa in Bengal.

All these aspects are important in not only creating and operating a waterway, but also in its planning and designing, in assessing its viability and its social, environmental and financial impacts.

Indeed, the Inland Waterways Authority of India lists these as some of the biggest challenges in developing the waterways. According to the FAQs listed by IWAI[29]:

> "The major challenges are:
> (i) Development and maintenance of Fairway width of 2.5 m to 3.0 m depth.
>
> (ii) Recurring siltage and irregular siltation
>
> (iii) Speed Control regulations to avert bank erosion and safety of other users.
>
> (iv) Safety against cross ferries
>
> (v) Connectivity to Terminal Locations
>
> (vi) Clearance at Cross Structures/bridges
>
> (vii) Identification of navigational channel in a wide river.
>
> (viii) Discharge control by regulations
>
> (ix) Difficulty in land acquisition for development of terminals."

LEGAL AND POLICY REGIME

Constitutional Provisions

Rivers and canals have been used for transport and navigation since time immemorial in the country. At times, the Government has also undertaken systematic development of these. In the Constitution, inland waterways figure in all three lists – State, Concurrent and Central lists - of the Seventh Schedule. Indeed, they are also listed in the Eleventh Schedule, thus enabling the state governments to also delegate their operations to the *panchayats*.

By default it is the responsibility and power of the state governments to develop and regulate inland waterways. However, this is subject to the provisions of List I (Union List) and List III (Concurrent List), which, under certain circumstances give the Union government primacy to frame laws and regulations related to waterways, shipping and navigation on these waterways, carriage of goods and passengers on the waterways and the rule of the road on these waterways. These powers of the central government are effective with regards mechanically propelled vessels on all inland waterways (where states can also legislate), or with regards mechanically propelled vessels on

[29] FAQ related to Jalmarg Vikas Project
http://iwai.nic.in/WriteReadData/l892s/1013443659FAQ%20JMVP%20Final%20PDF.pdf Accessed 20 March 2017

waterways that are declared as "national waterways" by Parliament. In the latter case, the Union government has exclusive powers.

The relevant entries of the Constitution are reproduced below.

Entry 13 in the List II (State List):

> "13. Communications, that is to say, roads, bridges, ferries, and other means of communication not specified in List I; municipal tramways; ropeways; inland waterways and traffic thereon subject to the provisions of List I and List III with regard to such waterways; vehicles other than mechanically propelled vehicles."

Entries 24 and 30 in the List I (Union List):

> "24. Shipping and navigation on inland waterways, declared by Parliament by law to be national waterways, as regards mechanically propelled vessels; the rule of the road on such waterways.
>
> "30. Carriage of passengers and goods by railway, sea or air, or by national waterways in mechanically propelled vessels."

Entry 32 in List 3 (Concurrent List):

> "32. 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 of List I with respect to national waterways."

Legislation

The first waterway to be declared "National" was the Allahabad to Haldia stretch of the Ganga – Bhagirathi-Hoogly, in 1986. This National Waterway (NW) 1 is 1620 km long. NW 2 – along the Brahmaputra was declared in 1988, the West Coast Canal along with Udyogmandal and Champakara Canals in Kerala were declared NW 3 in 1993, and NW 4 and NW 5 - Kakinada- Puducherry canals along with Godavari and Krishna rivers (1078 km) and East Coast Canal integrated with Brahmani river and Mahanadi delta rivers (588 km) were so declared in 2008. Yet, only the first three have seen some development[30].

The government is now planning a many fold expansion of the national waterways network. As noted earlier, the *National Waterways Act 2016* was passed by Parliament on 9 March 2016, received the assent of the President on 25 March 2016, and came into effect on 12 April 2016.

The Act declared 106 river stretches as national waterways, in addition to the existing five listed above. The Acts which had declared the earlier five waterways as national waterways were also repealed by the new law, which took these five waterways under its ambit. Thus, now there are 111 national waterways in the country.

Several others laws regulate waterways in India, including national waterways.

[30] Press Note of Shipping Ministry, 31 July 2015

The Inland Waterways Authority of India Act, 1985, provides for "the constitution of an Authority for the regulation and development of inland waterways for purposes of shipping and navigation and for matters connected therewith or incidental thereto". This is the Inland Waterways Authority of India (IWAI) which "came into existence on 27th October 1986 for development and regulation of inland waterways for shipping and navigation. The Authority primarily undertakes projects for development and maintenance of IWT [Inland Water Transport] infrastructure on national waterways through grant received from Ministry of Shipping."[31] This is the most important nodal body for the national waterways in the country.

The Inland Waterways Authority of India Rules 1986 and a series of regulations have been drawn out under this Act, including the *Prevention of Collision on National Waterways Regulations, 2002*, *National Waterways, Safety of Navigation and Shipping Regulations, 2002* and the *Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulations, 2006*. The last set of regulations provides a system of classification of waterways and sets the required depth, vertical and horizontal clearances, bend radius of rivers and related technical parameters for each class of waterway.

The Inland Vessels Act of 1917, Amended in 2007 essentially 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. It empowers both Central and state governments to regulate these various aspects. A large number of Rules have been made under this Act, including by several state governments. A major revision of this Act is under consideration, and a draft of the proposed Act has been put up by the IWAI on its website[32]. Note that this Act does not deal only with "national" waterways but with all waterways.

Several other laws like *Indian Ports Act 1908, Major Port Trusts Act, 1963* would also affect the planning and operation of inland waterways.

The laws governing the environmental and other impacts of waterways like the *Forest Act 1980,* the *Environmental Protection Act 1986* and various notifications under it like *EIA Notification 2006, CRZ Notification 2011*, are being dealt separately so are not detailed here.

Inland Water Transport Policy

While the government is moving rapidly in creating new laws and regulations, its only formal policy document dealing with inland water transport (IWT) is the *Inland Water Transport Policy 2001*, that is now more than 15 years old[33].

This policy talks about IWT being economic, fuel-efficient and environment friendly mode of transport. It mentions that India has navigable waterways of 14,500 km, out of which 5200 kms of major rivers and 485 km canals are suitable for mechanised crafts. Further, it estimates the total potential of cargo movement by national and other waterways at 50 billion tonne-km. It also presents some of the challenges. It says that "most of the waterways suffer from navigational hazards like shallow waters and narrow width of the channel during dry weather, siltation, bank

[31] Website of IWAI http://www.iwai.nic.in/index1.php?lang=1&level=0&linkid=1&lid=1 Accessed 8 March 2017
[32] http://www.iwai.nic.in/index1.php?lang=1&level=0&linkid=122&lid=859 Accessed 8 March 2017
[33] http://www.iwai.nic.in/index1.php?lang=1&level=1&sublinkid=7&lid=27 Accessed 8 March 2017

erosion, absence of infrastructure facilities like terminals and inadequacy of navigational aids." It also notes that the safety record of waterways has not been encouraging.

The numbers presented about the total potential of the waterways raise questions about the overall role it can play in the transport sector, considering that the total potential of the cargo movement by waterways is estimated at only 50 billion-ton km.

The policy also calls for "large-scale private sector participation both for creation of infrastructure and for fleet operations." Lastly, it proposes a number of support measures like bonds by IWAI, joint ventures by IWAI and equity participation by Government in private BOT (Build, Own, Transfer) projects, tax exemptions, subsidies on vessels, enhanced depreciation rates, custom duty concessions etc. Since the policy is so old, some of these measures may not be available.

There is a need for the government of articulate a more updated policy and / or vision document.

Legal Regime Related to Environmental Impacts of Waterways

Given that creating, maintaining and operating waterways has many serious impacts on rivers, river bank communities, riparian habitats, deltas etc. it is a cause for concern that the legal regime governing environmental impacts of waterways, particularly their prior environmental clearance, is ambiguous.

The EIA Notification 2006, which governs the prior environmental clearance (EC) for various projects, does not mention waterways at all. However, the item 7 (e) in the list of projects needing EC lists "Ports, Harbours, Breakwaters, Dredging"[34]. The item also clarifies that "Maintenance dredging is exempt provided it formed part of the original proposal for which Environment Management Plan (EMP) was prepared and environmental clearance obtained."

Since dredging is a critical component of most waterways, this clearly implies that waterways need to take prior environmental clearance. The MoEFCC's Expert Appraisal Committee (EAC) for *Infrastructure and Misc and CRZ* projects has also clearly interpreted the Sec 7(e) in this manner. For example, the EAC[35], while giving Terms of Reference for the EIA for "Development of Stretch of Mandovi River (NW-68), Zuari River(NW-111) and Cumberjua Canal (NW-27) of National Waterway in the State of Goa" not only appraised it under the EIA Notification 2006, but noted that

> "All the projects related to Ports and Harbour i.e. >5 million TPA of cargo handling capacity (excluding fishing harbours) as well as capital dredging are listed at 7(e) of schedule of EIA Notification, 2006 covered under category 'A' and appraised at central level."

In issuing the TORs, the MoEFCC also states[36] that "The proposed project falls under item 7 (e) of schedule of EIA Notification of 2006".

[34] Breakwater and dredging were added by an amendment in 2009.
[35] Minutes for 10th meeting of Expert Appraisal Committee (Infra-2) held on 24-25 October, 2016
[36] Letter Dated 29 Nov 2016 by MoEFCC to Inland Waterways Authority of India, http://environmentclearance.nic.in/writereaddata/Form-1A/TOR/FVPHR4ZK11302016110-66-16ToR.PDF

Yet, in a recent affidavit[37] dated 27 Oct 2016, filed in the National Green Tribunal, in a case related to the National Waterway 1, the MoEFCC has stated:

> "It is submitted that as per the provisions of EIA Notification, 2006 and its amendment from time to time, Ports, Harbours, break waters, dredging falls under item 7 (e) …and are required to obtain prior environmental clearance…
>
> "It is submitted that it does not mention jetty, multimodal terminal and Inland waterways. These are not covered under the EIA Notification,2006."

This creates an ambiguity about the legal requirement of EC for waterways, and also indicates the intention of the MoEFCC to exempt them from requirements of EC. In fact, given the serious impacts of waterways, one would expect the MoEFCC to amend the EIA Notification 2006 to explicitly include waterways in its ambit, rather than hide behind legal loopholes.

However, waterways still need to get the clearance under the Coastal Zone Management (CRZ) Notification 2011 where applicable, as will be the case for a number of waterway sections in the coastal and estuarine areas. Waterways would also need clearance from National Board for Wildlife where parts of the waterway are close to protected areas like National Park and Sanctuaries.

IMPACTS OF CREATING, MAINTAINING AND OPERATING INLAND WATERWAYS

Rivers, estuaries, creeks and deltas are among some of the most important ecosystems and hot spots of bio-diversity. They support rich flora and fauna not just aquatic, but also terrestrial. They sustain livelihoods of large populations. Waterways by definition are encroaching upon these ecosystems. Hence, waterways would have serious ecological and social impacts.

Waterways in Protected and Sensitive Areas

Even as rivers, estuaries are rich ecosystems in general, some specific areas are considered particularly valuable and important and have been declared as such. The waterways are likely to impact a number of such protected and sensitive areas.

The following table gives a sample of some such areas that are likely to be affected as some of the waterways pass through or in close vicinity of them.

Table 3: Protected and Sensitive Areas Impacted by Waterways

Sr. No.	Name of the Waterway	State	Eco-sensitive areas/protected areas directly affected or in close vicinity
1	National Waterway 1	Uttar Pradesh, Jharkhand, Bihar, and West Bengal	Gangetic Dolphin habitat, Kashi Turtle Sanctuary and Vikramshila Dolphin Sanctuary.
2	National Waterway 2	Assam	Dibru Saikhowa National Park, Majuali river island, Kaziranga National Park, Rajiv Gandhi Orang National Park and Dolphin Habitat.

[37] Affidavit of the MoEFCC, in O.A. No. 487 of 2015, National Green Tribunal, Principal Bench.

3	National Waterway 3	Kerala	Ashtamudi Wetland Ramsar site.
4	National Waterway 4	Andhra Pradesh	Pulicat Lake Bird Sanctuary.
5	National Waterway 5	Odisha	Bhitarkanika National Park, Kalibhanj Dian reserve forest areas, Hatamundai reserve forest area, Gahirmatha Olive Ridley Sanctuary, Bhitarkanika Ramsar site.
6	National Waterway 14	Odisha	Bhitarkanika National Park.
7	National Waterway 17	Punjab	Harike Ramsar Site.
8	National Waterway 24	Madhya Pradesh and Uttar Pradesh	National Chambal Sanctuary.
9	National Waterway 52	Karnataka	Anshi National Park and Kali Tiger reserve and western ghat ecosystem.
10	National Waterway 64	Odisha	Mahanadi Delta and Satakosia Tiger Reserve.
11	National Waterway 73	Gujarat, Maharashtra	Shoolpaneshwar Sanctuary
12	National Waterway 97	West Bengal	Sundarban National Park, which is a National Park, Tiger Reserve, and Biosphere Reserve.
13	National Waterway 100	Gujarat	Hazira Mangrove and Hazira Bird Sanctuary.

Apart from directly impacting protected areas, the process of creating and operating waterways will impact the ecology of rivers and livelihoods of people in several other ways. We examine the likely impacts in the construction, maintenance and operation stages.

Construction Stage

1. Capital Dredging

Capital dredging is the first time dredging of a river to construct the navigational channel of desired depth and width. At some placed there will be availability of required depth and width of water, so there will be no need of such dredging. However where there is less depth, dredging operations will be required. In case there is hard rock at the bottom of river bed even blasting may be needed.

Physical Modification of and Damage to Habitats

Dredging operations involve removal of silt, rock, sand and clay from river bed. The ecological continuum of river will be directly damaged due to this action. Dredging physically cuts and damages the river bed, and can lead to change in habitats for various aquatic flora and fauna.

Turbidity of Water due to Dredging

The water in a river turns turbid during any dredging operation as there is continuous generation of suspended solids. Due to turbidity, fish tend to run away from the site and this ultimately reduces fish catch in the area. The increased turbidity of the water reduces penetration of sunlight into the water and results into less photosynthesis. This can have a significant impact on the aquatic flora and fauna, and the entire food chain. The movement of aquatic animals like turtles and dolphins is directly affected due to turbid water.

For example, Nachiket Kelkar, an expert in fisheries, and a researcher who has been studying the endangered Ganges River dolphins in the lower Gangetic floodplains, writing *A summary analysis of the ecological impacts of the National Waterways Bill (2015),* says[38]:

> "The noise and disturbance caused by intensive dredging activities is known to have deleterious impacts on aquatic biodiversity, especially the National Aquatic Animal of India, the Ganges River Dolphin *Platanista gangetica gangetica*. The endangered Gangetic dolphin is a unique, blind mammal that relies entirely on the use of ultrasonic sound production to forage and navigate in murky river waters of the Ganga-Brahmaputra river system with the use of echolocation, i.e. production and hearing of echoes from ultrasonic-frequency sounds. Our research predicts that dredging for waterways at the scale envisaged by the Bill will further endanger this emblematic species that is endemic to the Indian Subcontinent."

Cutting of Aquifers

In case the channel creation requires cutting into the river bed, there is a good chance that the local aquifers would be cut. This can result in loss of water from river, or loss of groundwater from the surrounding areas.

Sea Water Ingress

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. Such ingress will directly affect ecology, fish varieties and mangrove forest in respective creek and estuaries. This is one of the reasons why the state of Kerala had opposed many of its proposed waterways in its submission to the Parliamentary Standing Committee which examined this Bill[39].

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[38] Kelkar Nachiket (2016): *Digging our river Graves?,* South Asian Network for Dams Rivers People, New Delhi. https://sandrp.wordpress.com/2016/02/19/digging-our-rivers-graves/ Accessed 24 March 2017.

[39] Department-Related Parliamentary Standing Committee on Transport, Tourism and Culture
Two Hundred Twenty Third Report, The National Waterways Bill, 2015 (*Presented To The Rajya Sabha On* 12th *August*, 2015), (*Laid On The Table Of Lok Sabha On* 12th *August*, 2015); Parliament of India, Rajya Sabha.

2. Construction of Jetties, River Ports

The handling and transport of material from inland waterways will require construction of jetties, ports and hubs at banks of rivers, estuaries and creeks. This construction will have its direct physical impact on the banks of rivers, estuaries and creeks. There will be removal of trees and mangrove forests in the area. Fishing activity and local access to river can be restricted due to construction of jetties and ports. The construction of jetties and ports also require dredging of the site which will have same impacts as stated above.

At Dharamtar port in NW 10 there is an under construction jetty. For such construction the mangrove forest belt which was there on the bank has been removed. (See Case Study on Dharamtar).

The construction of jetties and ports, storage areas and other facilities will also lead to land acquisition and displacement of people.

3. Construction of Barrages

Apart from dredging, another way of maintaining the required depth in the river is to construct barrages. Barrages also have impacts in terms of submergence of river bed, destruction of riverbed cultivation, alteration of river flows, modification of riverine habitats and impacts on aquatic as well as river bank flora and fauna. Barrages also block the sediment flow in a river with serious impacts both downstream and upstream.

During 2016 there was a flood situation in river Ganga. The Chief Minister of Bihar, which was worst affected due to flood in river Ganga, has said that excessive silt deposition downstream due to the Farakka barrage has increased the flood water inundation in Bihar. In fact, a conference "Incessant Ganga" organised by the Government of Bihar on Feb 25-26, 2017, in its Declaration[40] has called for launch of "FARAKKA KHOL DO, Bihar ko badh vibhisika se bachao" movement. (Open the Farakka Barrage, save Bihar from the tragedy of floods).

4. Straightening of Rivers, River Training

A river often takes a twisting path. If a bend in the river is very sharp, it may not be suitable for safe passage of barges. In such cases, river straightening work is undertaken. This activity brings radical changes in local physical environment. This can impact habitats, and aquatic flora fauna, disrupt fishing and other livelihoods.

5. Dust pollution at construction site

The construction sites will generate dust due to continuous transportation, handling of equipment and construction works. Such dust pollution will be right on the bank of rivers creeks and estuaries.

6. Movement of fish and other aquatic animals

All construction activities related to inland waterways near and in rivers will directly affect the movements of aquatic animals. The increase in turbidity, vibrations and sound will affect the

[40] http://incessantganga.com/patna_declaration_26thfeb.pdf Accessed 25 March 2017

movements of the aquatic animals. We have seen this impact in the NW 10. (See Case Study). In case of the Ganga waterway, it is the national aquatic animal, the Gangetic Dolphin that is threatened.

7. Disposal of dredged material

The dredged material like sand, silt, clay and rocks should be disposed properly. If this material is disposed in the river itself, or on the river bed, it will adversely impact the ecology of the river. The disposal of dredged material outside navigational channel will affect movement of fishing boats and their fishing. The disposal in mangrove forest area can harm the mangrove forest.

8. Possible contaminants in dredged material

When there is flow of polluted or contaminated water in a river (which is the case for most rivers in the country), some of the contaminants or toxic materials can settle on the river bed. Dredging will release these contaminants into the river water. These materials can also contaminate the areas where the dredged material is dumped.

<u>Impacts in the Operational stage</u>

1. Maintenance dredging

After development of a navigational channel in a river by capital dredging there is continuous deposition of sand and silt into it due to the flow of the river. This results in the reduction of water depth. To maintain the water depth regular maintenance dredging throughout the navigational channel is needed. This has impacts similar to capital dredging of increasing turbidity, noise, fish moving away from the area, problem of safe disposal of dredged material etc.

The dumping of dredged material outside navigational channel creates problems for the fishing boat movements and fishing activities. During year 2016 there was dumping of dredging material outside the navigational channel in Dharamtar creek area of NW 10. Due to this the fisherpeople had difficulty in navigating their boats in fishing areas[41].

2. Pollution due to oil and diesel from vessels

Barges and other vessels plying on the waterways often result in leakage of diesel, oil and lubricants. These are among the most significant impacts of the vessel movement. These pollutants directly affect biotic environment of the river, creek and estuaries. In the Ganga waterway, NW 1, it is being proposed that the barges will use LPG as fuel. This is a welcome step, but this will not eliminate the problem of lubricants which engines and machinery will still need to use.

3. Leakage and spilling of cargo from barges

In case of cargo like coal – which is likely to be the major commodity transported in the eastern waterways and NW 1 - there is a high risk of pollution due to coal dust, especially at the handling points. Accidents are another major risk. The safety record of inland waterways in India is acknowledged as being inadequate. Fisherpeople in Dharamtar creek area of NW 10have reported

[41]Narrated by fisherpeople to one of the authors during field visit to the area.

regular incidences of barge collapses and say that there is no removal of any material which sinks to the bottom of the creek.

One of the alarming things about transport on the waterways is that the Government is actually thinking of pushing more hazardous cargo on to the waterways. The RITES Report of 2014 on *Integrated National Waterways Transportation Grid (INWTG)* states[42]:

> "Water transport is also the safest mode of transporting large quantities of chemicals and toxic materials with the least danger to the surrounding cities."

And recommends that

> "IWAI may take up with concerned ministries for enacting Regulations for compulsory movement of hazardous cargo and certain percentage of bulk cargo by IWT mode, wherever feasible, to be in-built in MoEF guidelines."

The movement of hazardous goods by water transport may be safer for cities, but it would create severe risks for the river ecosystems, fish, communities that live by the river and people who are supplied the river waters. The consequences of an accident would be huge indeed.

4. Barge movement, bank erosion and depletion of mangrove forest

The continuous movement of barges erodes the banks of river creeks and estuaries. This can lead to bank collapse and other impacts. In Dharamtar, in the NW 10, there is erosion of the mangrove forest belt due to such impacts. The erosion effect can be seen in Fig 4.

Figure 4: Creek bank erosion and depletion of mangrove belt in Dharamtar creek of National Waterway 10 due to continuous movement of coal and iron ore barges.

[42] RITES Report, Page 1

5. Barge movement and loss of fishery

The movement of barges increases turbidity of water as well as vibrations and noise. This results into running away of fish from the area.

The MoEFCC had asked the operator / user of NW 1 (NTPC) to carry out a study on impact assessment of coal transportation. This study was conducted by ICAR-Central Inland Fisheries Research Institute (CIFRI), Kolkata on coal barge transportation from Haldia port to Farakka through river Hoogly. The report notes[43]:

> "Fish catch was measured before and immediately after barge movement. It reduced from 95 Nos./haul to 38 Nos./haul in the middle and upper stretch. Overall fish diversity was reduced from 15 species to 10 species after barge movement. International studies mentioned that it is practically difficult to identify the effects of inland navigation on fishes due to their ability to avoid disturbance by migrating to adjacent areas…
>
> "Approximately livelihood of 25,000 people is dependent on fishing on this 560 km stretch i.e. Sagar to Farakka stretch. The majority of the population is socioeconomically backward and 65-73% of their total income is generated from the fishing. 500 families have been surveyed along the whole stretch to study the impact of barge movement. Percentage of suspension of fishing operations due to barge movement is reported as 10%, 27% and 62% in the lower, middle and upper stretches from the surveyed families. Monetary loss due to decrease in fish catch was observed to be Rs.0.75/-, Rs.4.35/- and Rs. 18/- on an average per incidence of barge movement in lower, middle and upper stretch, respectively."

6. Loss of water

Often, waterways will require water to be released from upstream storages to maintain water depths. Operation of locks and gates will also lead to release of water. This can result in diversion of water from other needs. It can and will also distort the flow quantity and patterns of the river.

<u>Social Cultural Impacts</u>

The impacts outlined above not only harm the ecology but can have serious implications for livelihoods of people dependent on the rivers and creeks. Fisherpeople are typical the worst affected. People dependent on riverbed cultivation can also face loss of livelihoods. Displacement is another serous issue as land is needed for number of facilities like ports, jetties, and other infrastructure.

For example, it is likely that the development of the waterway in the Mahanadi delta in Odisha will cut-off the access of hundreds of fishing boats to the best parts of the marine fishing areas. (See the Case Study of NW 5 in Odisha in this report).

Rivers are often the cultural and social centres for riparian communities. Activities like dredging, construction of related facilities, cutting-off of access to river etc. can also lead to serious impacts on people's cultural and social interactions with rivers.

Thus, it can be seen that the creation, maintenance and operation of waterways have multiple, and significant impacts. There is need to do a thorough impact assessment before taking a decision to go

[43] Minutes of Expert Appraisal Committee (Thermal Power Plants) meeting held on 14th Feb 2017.

ahead with any waterway. However, given the ambiguity of the environment ministry regarding the need for environmental assessment and clearance of waterways, there is a serious risk of many waterways being pushed ahead without the necessary studies.

ASSESSING VIABILITY OF WATERWAYS

As noted earlier, inland water transport is justified on the grounds of being cheap and environment friendly. It offers significant cost advantages in terms of fuel costs at least. However, these cost advantages are not always available, but depend on the circumstances, particularly on whether the entire transport chain is only through water or other modes of transport are also involved. Further, the costs and cost-advantages of water transport also depend significantly on the waterway itself, its depth availability (LAD), and several other factors. Thus, the viability of waterways needs to be worked out on a case by case basis for each of the waterways. We look at the various factors that determine the viability of waterways.

Multi-modal comparison

As per the RITES Report of 2014 on *Integrated National Waterways Transportation Grid (INWTG)* the cost comparison between Inland Water Transport (IWT) mode and rail and road transport is given below[44]:

Table 4: Cost comparison between Inland Water Transport (IWT) mode and rail and road transport

Mode	Pre-tax freight (Rs. per tonne km)	Post Service tax freight (Rs. per tonne km)
Railways	1.36	1.41
Highways	2.50	2.58
IWT	1.06	1.06

Thus, in theory, every kilometre that a tonne of cargo moves on water can save Rs. 1.52 as compared to the same cargo moved on road, and Rs. 0.35 if the same cargo was moving on rail.

But cost of transport is only one aspect. There are several other aspects that constitute the advantages (or disadvantages) of any mode of transport. The RITES Study notes[45]:

> "On the one hand road is comparatively costlier mode of transport when vehicle operating costs alone are compared, but it has an edge over other modes i.e. rail and IWT, as road transport offers door to door services, reducing local terminal costs. … Similarly, rail has its own operational advantages of carrying bulk cargo on longer leads".

[44] From the PIB Press Release, Ministry of Shipping, Government of India, dated 17 Nov 2016. http://pib.nic.in/newsite/PrintRelease.aspx?relid=153714 Also, RITES report, *Integrated National Waterways Transportation Grid Study (Stage 1 of Phase II), Final Report*, RITES, Gurgaon. Published by Inland Waterways Authority of India, New Delhi, 2014 Page vii.http://www.iwai.nic.in/WriteReadData/l892s/INT_NAT_WAT_TRA_GRI_STU_Part1_3-26947128.pdf Accessed 27 Feb 2017

[45] RITES Study, Final Report, Page 30

An Asian Development Bank Study[46] on viability of inland water transport in India notes that:

> "Freight handling in IWT involves movement to and from the water mode, including loading and unloading of material, and storage. IWT offers medium batch size possibilities, slow but secure movement, limited door-to-door opportunities, and cheap rates. In comparison, road offers small load options, faster movement, door-to-door service, but higher rates. Rail offers large batch economies, quick movement, partly door-to- door service, and medium rates.
>
> "The geographical advantage of freight transport by IWT is strongest if the entire movement is across a river. The next level of advantage is when one or both terminal points are near a river. For transport of material (construction material and equipment) relating to a particular river-based project activity (e.g. river bridges, hydroelectric plants), IWT is most attractive."

Of course, in some cases, it may not be an either-or exclusive situation; that is, a waterway may be looked at not as an alternative to road or rail transport but as an independent option. In that case of course, its cost advantage vis-à-vis other options is not so relevant, and other factors would be more critical in determining its viability. But in most cases, a waterway will need to be evaluated in context of other options.

Comparison with Rail Transport

The cost figures given above indicate that the cost advantage of waterway transport is significantly low if compared to rail transport. This factor - whether it provides an alternative to road or rail - is important when assessing the viability of waterway transport.

For example, the RITES report estimates how traffic would be diverted to various national waterways (NW 1 to 5, and what at that time was called NW 6, in Barak river)[47]. Table 5, drawn from the report shows that close to 40% of the traffic that the waterways are expected to carry would be a shift from rail, where cost advantages (and fuel saving, environmental benefits) are not that high.

Table 5: Divertible Traffic within National Waterways in Year 2021-22

	Estimated Divertible Traffic in million tons			
WATERWAY	**From Rail**	**From Road**	**Total**	**% of WW Traffic Coming from Rail**
NW 1	25.9	17.44	43.34	60%
NW 2	2.31	19.48	21.79	11%
NW 3	0.91	11.18	12.09	8%
NW 4	14.96	27.09	42.05	36%
NW 5	14.64	8.61	23.25	63%
NW 6	0.36	3.71	4.07	9%
TOTAL	**59.08**	**87.51**	**146.59**	**40%**

[46] Narayan Rangaraj and G. Raghuram, *Viability of Inland Water Transport in India*, ININRM Policy Brief No.13, ADB, 2007.Page 5 https://www.adb.org/sites/default/files/publication/30113/inrm13.pdfAccessed 30 Mar 2017

[47] RITES Report, Table 0.2, Page ii

Comparison with Roads

The cost advantage that is often attributed to waterways is essentially the fuel cost advantage – the fuel used per tonne-km of cargo moved. However, fuel costs or vehicle costs are only one part of the costs. Others parts of the transport chain also involve costs, and often, these costs for the waterway can nullify the fuel cost advantage. One such cost is the costs of terminals.

The RITES study points out[48]:

> "IWT is the cost effective mode of transport and offers least vehicle operating cost/ charges as compared to Rail and Road. The level of advantage offered by IWT is much higher when compared with road than that of rail, but corresponding advantage goes adverse when terminal costs involved in the case of IWT also forms cost of comparison.
>
> "Although IWT seems to be the cheapest mode of transport as for as operation costs are concerned, it fails to attract traffic when local or terminal costs are involved. …commodity wise level of diversion on proposed IWT services are strongly guided by the terminal costs that reduces the waver margin of benefits to very large extent".

A study on *Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1* states[49]:

> "Often times a price advantage of NW-1 shipments is levelled out by additional costs, as inland-waterway transport cannot offer door-to-door services where producers and/or users are not located directly on the waterway. Instead, pre- and onward carriage is usually required to cover for the 'last mile' with cost implications arising from additional cargo handling."

Length of Transport

Though waterways are cheaper in terms of fuel costs per tonne-km of transport, this advantage can be reduced if waterways require transport through longer distances. For example, Prof S.N Upadhyaya, Prof. Emeritus at IIT BHU, pointed out to these authors that the national waterway 1 from Haldia to Allahabad is about 1600 km long, but the distance between these two points by road is only around 900 kms.

Least Available Depth, Vessel Size

One of the most critical factors influencing viability of waterways is the size of the vessel, which in turn also depends on the depth of water that is available in the river.

The Inland Waterways Authority of India, in the FAQs, state that[50]:

> "It is generally considered that if an inland waterway is capable of plying 1000 DWT [Dead Weight Tonnage] vessels, it is commercially viable. For this, normally a depth of 2.5 meters in the fairway is

[48] RITES Study, Final Report, Page 12 and 30

[49] *IWT Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1 from Haldia to Allahabad Volume I: Report Part A*, HPC Hamburg Port Consulting GmbH, Germany and UNICONSULT, Germany, IWAI. June 2016 Page 15

[50] FAQ related to Jalmarg Vikas Project http://iwai.nic.in/WriteReadData/l892s/1013443659FAQ%20JMVP%20Final%20PDF.pdf Accessed 20 March 2017

essential under the present circumstances. For movement of 1000 to 2000 DWT cargo vessels, the navigational channel should have at least 45-meter width and 3-meter depth."

In their submission to the Parliamentary Standing Committee that was examining the National Waterways Bill, 2015, the IWAI stated[51]:

> "… with regard to cost, it is understood that it is marginally lower by 10 per cent or so in the case of Farakka. But as far as general comparison with road and rail is concerned, it depends on waterway to waterway also. For example, if the waterway's depth is only one metre, then, definitely inland waterways will not be cheaper. But, in general, if the waterways is well developed, say 2.5 to 3.5 or 4.5 metres depth, then, those figures are definitely right, almost 60-70 per cent of Railways, or even less than that. But everywhere it will not be necessarily so."

The problem of course is that maintaining such high depths can become very costly, even if environmental costs are not considered, and only financial costs are included. For example, the report on *Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1* states[52]:

> "The cost of dredging to attain and maintain depth of 2.5m up to Varanasi is exorbitantly high and same did not seem to be economically viable."

Two Way Carriage, Direction of Transport

Like with any other form of transport, if the carriage is only one way and the vessel has to come back empty, then the total cost can be much higher, often negating any advantage that the waterway many offer. For example, the NTPC, which is the foremost user of National Waterway 1 to transport coal for its power plant at Farakka, told the Parliamentary Standing Committee[53]:

> "…the transport cost through waterway is only slightly lesser compared to the railways right now, since the cargo is transported one way only."

The report on *Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1* notes that[54]:

> "As diesel constitutes the highest proportion of operating costs, the difference between upstream and downstream steaming is most significant. The following table indicates the total cost for inland-waterway shipping as between Rs 0.74 per ton-km for a 3,000-ton vessel downstream and Rs 2.00 per ton-km for a 1,000-ton vessel upstream. Due to the quite intense current of the river, the upstream direction requests much more performance by the vessel's engine than downstream."

[51] Department-Related Parliamentary Standing Committee on Transport, Tourism and Culture
Two Hundred Twenty Third Report, The National Waterways Bill, 2015 (*Presented To The Rajya Sabha On* 12th *August*, 2015), (*Laid On The Table Of Lok Sabha On* 12th *August*, 2015); Parliament of India, Rajya Sabha. Para 20.2

[52] *IWT Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1 from Haldia to Allahabad Volume I: Report Part A*, HPC Hamburg Port Consulting GmbH, Germany and UNICONSULT, Germany, IWAI. June 2016 Page 39

[53] Para 19.3 of the report of the Parliamentary Standing Commitee.

[54] *IWT Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1 from Haldia to Allahabad Volume I: Report Part A*, HPC Hamburg Port Consulting GmbH, Germany and UNICONSULT, Germany, IWAI. June 2016 Page 15

Floods, Droughts and Other Natural Phenomenon

Floods and droughts can create significant obstacles in the operations of waterways, and hence impact their viability. At the least, they will restrict the number of days in a year that vessels can ply. At worst, they can lead to accidents, grounding of vessels etc. In our visit to the under-construction Varanasi terminal on Ganga waterway, we were informed that the terminal would remain out of operation on days with high floods. They expected these to total to about 30 days in a year.

Apart from these, there are several other factors that will determine the viability of waterways, including the kind of commodities it transports, the economic activity in its catchment, the social and environmental impacts and so on. Since we have discussed the environmental impacts of waterways elsewhere, we are not repeating them here. However, we would like to mention one environmental factor that could be crucial in influencing the viability of waterways - climate change.

Climate Change Risks

Water is the most crucial part of a waterway. As is being recognised, precipitation and rivers flows are most directly impacted by climate change. This creates great uncertainty for the viability and feasibility of waterways, particularly in the snow-melt fed rivers. The report on *Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1* notes that[55]:

> "One of the primary sources of fresh water supply to the Ganges River, the 30.2 km long Gangotri glacier, has been found to have retreated by more than 1.5 km in the last 70 years. During the past decade, this process has accelerated… The GoI therefore needs to develop appropriate mitigation measures against the NW-1 losing too much of its primary ingredient: water."

It is very clear from the above that the viability of a waterway is subject to many factors and just because water transport uses less fuel does not automatically justify every waterway. To sum up, we list some of the important factors that determine the viability of a waterway.

1. Advantages and disadvantages of alternative options of transport
2. Whether the comparison is with rail or road, from which mode is shift expected
3. Whether one or both of the origin and destination points are on the waterway, or other modes of transport will be necessary to complete the movement
4. Whether door to door delivery is needed
5. Whether quick delivery is needed, whether perishable goods are to be transported
6. Comparative lengths of road, rail and waterway links
7. Availability of return cargo, upstream / downstream directions
8. Vessel size, availability of adequate depth of water
9. Natural phenomenon like floods and droughts
10. Other costs like social, environmental impacts, climate change

[55] *IWT Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1 from Haldia to Allahabad Volume I: Report Part A*, HPC Hamburg Port Consulting GmbH, Germany and UNICONSULT, Germany, IWAI. June 2016 Page 37

FUNDS AND FINANCING

Investments Needed

The development and operationalisation of waterways is a capital intensive exercise. Since even the prefeasibility studies of many of the waterways are not ready, there is no comprehensive estimate of the funds needed to implement the entire waterways program. But estimates for some individual waterways are available, which indicate that the projects require large amounts of funds, and also that the funds needed would vary on a case by case basis.

The Ganga waterway – NW 1 – is the one that is in the most developed stage in its implementation. The World Bank is partially funding this project. The World Bank's Project Information Document[56] of Nov 2016 states that the cost of the project would be US$ 800 million, that is roughly Rs. 5200 crores. The Bank will provide US $ 375 from this, roughly Rs. 2400 crores. However, it should be noted that the scope of this project covers mainly improving the navigability of the waterway, that too only in the Haldia-Varanasi stretch (and not up to Allahabad).

Another estimate[57] for developing waterways 1 to 5, and also what was then called waterway 6 (Barak river), and integrating them, gives the total costs for these 6 waterways as Rs. 22,763 crores (in 2014). The following table from the same source gives more details.

Table 6: Investment needed for waterways 1 to 6

	Investment Required (Rs. Crores)					
Phase	**Waterway Development**	**Terminals Development**	**Port Connectivity**	**Road Connectivity**	**Rail Connectivity**	**Total**
PHASE 1 (2014-17)	887	658	344	88	4	1,981
Phase 2 (2017-22)	17965	1389	809	232	387	20,782
TOTAL	**18852**	**2047**	**1153**	**320**	**391**	**22,763**

As can be seen, the largest part of the investment is needed for the fairway (channel) development.

However, this is the investment needed only for the development of the basic infrastructure. To make the waterway operational, investments will be needed for the barges, storage facilities, repair

[56] http://documents.worldbank.org/curated/en/786231480491655397/pdf/PID-Appraisal-Print-P148775-11-30-2016-1480491650536.pdf Accessed 25 March 2017

[57] RITES report, *Integrated National Waterways Transportation Grid Study (Stage 1 of Phase II), Final Report*, RITES, Gurgaon. Published by Inland Waterways Authority of India, New Delhi, 2014 Page vii.http://www.iwai.nic.in/WriteReadData/l892s/INT_NAT_WAT_TRA_GRI_STU_Part1_3-26947128.pdf Accessed 27 Feb 2017 Page 137

facilities etc. An extent of the investment that all these will need can be understood by the following estimate given by the same RITES report[58]:

> "The Integrated National Waterways Transportation Grid, with all the requisite infrastructure in place is anticipated to attract private investment to the tune of Rs.65,600 crores mostly in the form of barge and ship building yards and allied facilities…"

Recurring expenditure for the maintenance dredging will also be needed.

Sources of Funds

The funds are partly to come from budgetary support to the IWAI, which would mostly be used to develop the fairways and some other facilities. In 2016-17, the budget allocation for inland water transport, as a grant to the IWAI, was Rs. 362 crores, and the amount proposed for 2017-18 in the budget under the same head is Rs. 303 crores[59].

The government also plans to issue bonds to raise funds for the waterways. In the budget speech of 2016-17, the Finance Minister had announced the raising of Extra Budgetary Resources of Rs. 1000 crores for the waterways[60]. This was supposed to be a onetime measure.

As seen earlier, the World Bank is also providing some Rs 2400 crores. There is also some expectation that the terminals and some of the other facilities may be developed in a PPP mode, with the private sector bringing in at least some part of the investment.

Yet, all of this is much lesser than the scale of funds needed for the development of the waterways. It's not clear from where the huge sums of money needed for waterways are going to come from.

INTEGRATING WITH OTHER PLANS AND PROGRAMS

The Central Government has several different programs dealing with rivers. Water being a state subject, state governments also have many plans for rivers in their respective states. It is important that these programs and waterways integrate properly with each other. If this does not happen, there could be conflicts between various programs of the central government, and also centre-state conflicts.

ILR Program

One such program is the Inter Linking of Rivers. It's a moot question how interlinking of rivers would fit with the waterways project. The former wants to divert water from "surplus" rivers, while the latter needs substantial water to continue to flow in the rivers. We have not seen either the waterway reports or the interlinking reports address this issue. This is not a statement on the feasibility and desirability of the interlinking of rivers program. It's only to point out possible conflicts between two government programs that don't seem to have been considered each other. The

[58] Page vii

[59] Budget for the Shipping Ministry, Government of India, 2017-18 Accessed 20 March 2017 http://indiabudget.nic.in/ub2017-18/eb/sbe87.xlsx Budget for the Shipping Ministry, Government of India, 2017-18

[60] http://www.iwai.nic.in/showfile.php?lid=994 Accessed 23 March 2017. These are 10 year, GoI fully serviced bonds, Unsecured, Redeemable, Taxable

Ministry of Water Resources has also expressed its apprehensions to the Parliamentary Committee[61], stating that:

> "The Central legislation needs to be in consonance with the programme of Interlinking of Rivers of this Ministry. The legislation should keep in consideration and sustain the technical feasibility of Interlinking of Rivers programme."

Ganga River Basin Management Plan

Several years back, the Government of India had commissioned a consortium of seven IITs to prepare a comprehensive Ganga River Basin Management Plan (GRBMP). The team, after intensive and comprehensive studies, submitted their report in 2015. The report submitted by the IIT Consortium has been adopted by the Government as the basis for the National Mission for Clean Ganga (NMCG), and as a basis to shape its interventions in the basin. For example, the Vision for the NMCG[62] is "restoring the wholesomeness of the river defined in terms of ensuring "Aviral Dhara" (Continuous Flow"), "Nirmal Dhara"("Unpolluted Flow"), Geologic and ecological integrity.". This is as defined by the IIT Consortium Report on GRBMP.

But the Report of the IIT Consortium unequivocally points out that[63]:

> "Ecological restoration of National River Ganga is urgently needed since river biodiversity is being rapidly lost. Eight main factors affecting the river habitat are identified for causing this loss ... (vii) Habitat Disturbances by plying of noisy vessels, dredging, etc… Hence, the measures recommended are: ... (4) Restrictions on river bed farming, gravel and sand mining, plying of vessels, dredging, and bed and bank modifications."

The report further emphasises[64] that there should be restriction of environmentally harmful activities in the national River Ganga basin, including "allowance, prohibition or regulation… of Sand mining, dredging, stone crushing, sediment removal, and mining of other materials from river beds…Plying of noisy vessels, dredging, and river bed and bank modifications" by taking into consideration the actual environmental impacts assessed in specific situations as also their social and economic implications.

It's not clear how the Government will accept the recommendations of the IIT Consortium report to restrict any dredging, plying of vessels and bed and bank modifications, and yet go ahead with the waterway in the Ganga.

CENTRE STATE DISPUTES

With water essentially being a state subject, and waterways shifting a part of this jurisdiction to the centre, there are high chances of centre-state disputes unless an approach of consensus building and sensitivity to concerns of states is shown.

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[61] Parliamentary Committee report, Para 18

[62] http://nmcg.nic.in/vision_key.aspx Accessed 20 March 2017

[63] Ganga River Basin Management Plan -2015, Main Report, by consortium of 7 Indian Institute of Technologies (IITs) http://52.7.188.233/sites/default/files/GRBMP-MPD_March_2015.pdf accessed on 20 March 2017 Page xxiv

[64] Ganga River Basin Management Plan -2015,Main Report, by consortium of 7 Indian Institute of Technologies (IITs), Page 55 http://52.7.188.233/sites/default/files/GRBMP-MPD_March_2015.pdf Accessed on 24 Mar 2017

The IWAI maintains that declaration of waterways would not encroach on the rights of the state. In its submission to the Parliamentary Standing Committee, IWAI states[65]:

> "As regards rights of State Governments, after the declaration of National Waterways, there is no right of usage of water or usage of earth beneath the water or on the appurtenant land which will vest away from State Governments to the Central Government. So, all the rights, as existing as of date, will continue with State Governments. The only rights, which the Government of India and the IWAI will have are (i) to do the dredging in a certain portion of the river, through a channel of 50 mts or 40 mts, depending on the size of the vessel which will move, and (ii) maintain a channel for the purposes of shipping and navigation. IWAI cannot remove the water, and even the soil … The IWAI gets the authority to ensure that no construction takes place over the river without its clearance. … If the designs meet the requirements of horizontal and vertical clearances, the clearance would be given very easily. And there is no other right which vests with the Government of India."

However, this seems to be a playing down of the issue and potential problems.

The report[66] on *Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1* points out that:

> "The problem is that most of the waterways included in the list of 101 new waterways are fresh water rivers, which even dry up completely during post monsoon period. The diversion of water for navigation should not be at the cost of other priority use such as drinking and irrigation. According to some, unless a very detailed study is done on the balanced use of water, the 101 NW proposals is bound to face opposition from many state governments."

States like Kerala[67] have expressed their unease at the situation and had called for allaying these apprehensions by insertion of specific clauses in the Act. This has not been done.

It is not only about balanced use of water, but even if a state government has a different approach to management of rivers in its boundaries, there can be opposition to waterways from the state.

We are already seeing this happen in Bihar, with the Chief Minister recently having publicly articulated his Government's opposition to the Ganga waterway. Inaugurating an International Conference on "Incessant Ganga" organised by the Bihar Government on 25-26 Feb. 2017, Shri Nitish Kumar, Chief Minister of Bihar has opposed construction activities under proposed National Waterway 1. Some of his statements, as reported by the media are quite clear:

> "Chief Minister Nitish Kumar today reiterated that the Bihar government was "strictly opposed" to the National Waterway-1 as the Centre had plans to construct a series of barrages along the Ganga that would affect its flow and ultimately convert it into a cluster of "big ponds"."[68]

> "If dredging is done for the national inland waterways project, it is bound to destroy this river. I strongly fear that the river Ganga will become extinct for such moves, as it will create more problems for an incessant Ganga…"[69]

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[65] Report of Parliamentary Committee, Para 15.1

[66] *IWT Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1 from Haldia to Allahabad Volume I: Report Part A*, HPC Hamburg Port Consulting GmbH, Germany and UNICONSULT, Germany, IWAI. June 2016 Page 39

[67] Report of Parliamentary Committee, Para 24.4.5 (b)

[68] News report in The Telegraph, dated 26 Feb 2017.https://www.telegraphindia.com/1170226/jsp/frontpage/story_137787.jsp Accessed 26 March 2017.

The Declaration[70] adopted at the same conference also stated:

> "Dredging for National Waterways – 1 is increasing erosion in Bihar. The project should be put on hold until a scientific study of impact of dredging on erosion is done."

Such situations arise partly because the waterways are being pushed ahead with inadequate consultations and discussions not only with the people of the river valleys but also the state governments.

KEY EMERGING ISSUES

Based on all the above, certain important findings and issues are clear.

One, that waterways potentially offer substantial advantages in terms of cost and fuel savings, decongestion, provision of alternative paths and means of transport.

Two, these advantages are by no means certain and automatic. The extent of these advantages varies from waterway to waterway, and some of the proposed waterways could also be economically unviable.

Three, the creation of waterways needs very significant interventions in rivers, estuaries, creeks etc. in the form of dredging, channelisation of rivers, river training and straightening, bank protection, barrages, locks and gates, ports, terminals and so on. The impacts of these interventions are serious, including destruction of habitats, destruction of river ecosystems, their flora-fauna, damage to sensitive areas like estuaries and deltas, and in turn wide-spread implications for the livelihoods of people dependent on these rivers and water bodies. Higher the intervention, higher the impacts.

Four, the maintenance and operation of waterways also can have significant impacts on rivers, their ecosystems and livelihoods of people.

Five, the social and environmental impacts are hardly being assessed properly.

Six, the absence of adequate impact assessment is partly due to the neglect of these aspects, and partly due to the lack of any mandatory legal requirement for comprehensive assessment. The MoEFCC, instead of clarifying the ambiguity, has allowed it to persist, saying dredging and ports need environmental clearance, but not "waterways".

Seven, much of the work on waterways – the planning, the preparation of project reports, even implementation – is going on without adequate public awareness, public consultation and public participation.

Eight, there is no clear policy or vision document that considers all the above points and charts out the desired way forward for inland waterways. The existing policy is of 2001, clearly outdated.

Nine, the assessment of viability of individual waterways need to be done in a much better way. In particular, the plans, designs and assessments of viability do not consider or incorporate adequate,

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[69] News report in Economic Times, 25th Feb 2017.http://economictimes.indiatimes.com/news/politics-and-nation/nitish-kumar-opposes-centres-inland-waterways-project-on-ganga/articleshow/57347194.cms Accessed 25th March 2017.

[70] http://incessantganga.com/patna_declaration_26thfeb.pdf Accessed 25 March 2017

or even at all, the social and environmental costs. Also, they are being done in a non-transparent manner. Both these gaps need to be corrected.

Ten, in examining the options, there is no attempt to examine whether waterways can be designed to work with the natural flows, depths and widths of rivers. This is important because the biggest costs and impacts of creating and maintaining waterways come from the interventions – like dredging - necessary to develop artificial channels and fairways.

Eleven, there are many risks of various conflict situations arising in the execution of waterways. These include conflicts between the Centre and State governments, between waterways and other uses of the water like drinking or irrigation, and between the waterways and those impacted by it.

WAY FORWARD

The key issues identified above offer some important ideas for going forward.

Creating a Larger Public Discourse

Though waterways represent huge interventions in rivers with potentially large adverse impacts, they are being pushed through with very little public discussion and debate. We found that in many places, even the people living in the areas where waterways are planned were not aware about these plans. It is important that the plans and key issues for waterways be discussed widely and thoroughly, both in the areas where these are planned and also as a part of the larger discourse around development of our rivers and water bodies, before moving ahead on these plans.

Bringing Out a Vision and Policy Document

There is need to bring out a vision and policy with respect to the development of inland waterways based on the above mentioned public discourse and after examining all the critical issues related to waterways.

Using the Naturally Available Depth and Width

Some of the most significant costs – financial, social, and environmental – come from the need to artificially create and maintain channels/ fairways of a large widths and large depths. If waterways can be developed to use and adapt to the naturally available depths and widths in the rivers, then not only would they be cheaper but also less destructive of rivers. This may mean some compromises in the size of vessels and the waterway's ability to operate year round. But some of these compromises are also required in waterways that are artificially created. The report on *Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1* notes that: [71]

> "Delays / turnaround time and water depth is another big problem in Inland waterways. Sustainable depth in terms of river morphology and environment should also be the basis for classification to avoid conflicts and delays."

[71] *IWT Sector Development Strategy and Business Development Study for Capacity Augmentation of National Waterway 1 from Haldia to Allahabad Volume I: Report Part A*, HPC Hamburg Port Consulting GmbH, Germany and UNICONSULT, Germany, IWAI. June 2016 Page 37

When designing and planning waterways, it would be very important to explore options based on the naturally available depths, widths and flows of rivers. Unfortunately, this is not happening today.

It must be made mandatory to develop these scenarios and plans as one of the options when planning waterways.

Transparent and Participatory Processes

The entire process of planning of the waterways must be done in a fully transparent manner, and with the involvement of local communities, civil society groups, river protection and environmental groups and other concerned citizens. The process needs to be fully participatory, from the planning stage itself all the way to the decision-making. The various assessment processes like assessment of feasibility, impact assessments etc. also must be transparent and participatory.

Mandatory Environmental and Social Impact Assessment

The MoEFCC must immediately dispel all ambiguity surrounding the need for environmental clearances for waterways, and must make it mandatory – through appropriate amendments in the EIA Notification 2006 – for each and every component of waterways, and the entire waterways themselves to seek prior environment clearance. Further, each waterway must be assessed in its entirety and not in pieces; and the entire river basin should be assessed for cumulative impacts if there are likely to be more than one waterway in the basin.

Comprehensive Assessments of Feasibility, Viability and Desirability

The assessments for feasibility, viability and desirability of waterways must be comprehensive and must bring together financial, social, environmental and economic aspects together. The economic benefits of waterway as the preferred option must be rigorously evaluated, as these are by no means given. As mentioned above, the options should include waterway designs based on natural flow and depths.

CONCLUSIONS

Waterways have the potential to offer significant advantages in terms of transportation options. At the same time, they are likely to have huge adverse impacts - social and environmental, as well as require large financial investments. Moreover, their advantages are not a given fact, but depend on the specific situation in each case. Given all this, it is critical that the ideas and plans for waterways be first thoroughly discussed and debated, and the advantages and disadvantages for proposed individual interventions be examined in detail, including social and environmental impacts. All these processes must be done in a transparent and participatory manner. In the process, it is also critical to examine the options of developing waterways based on naturally available depths, widths and flows in rivers. A sound legal framework that also makes it mandatory for proper environmental and social impact assessment and prior environmental clearance should be put in place.

It is only when such a process is adopted that we will be able to realise the potential offered by water transport in a manner that maximises its developmental benefits and minimises its costs and impacts.

SIGNS OF TIMES TO COME

CASE STUDY: DHARMATAR CREEK, MAHARASHTRA, PART OF PROPOSED NW 10[72]

BACKGROUND

The National Waterways Act 2016 has declared the Amba river stretch in Raigad district of Maharashtra, from Nagothane to the Arabian Sea through the Dharamtar creek, as National Waterway (NW) 10. A part of this stretch - from Jawaharlal Nehru Port Trust (JNPT) Port through Arabian Sea and then through Dharamtar creek till Dharamtar port[73] - has been operational as a waterway since many years. There are jetties of JSW steel plant on the both sides of Dharamtar creek at Dharamtar port. Barges mainly carry coal and iron ore from the JNPT port and through the Dharamtar creek to jetties at Dharamtar port. The left bank jetties have cranes which lift material from barges and load it on a conveyor belt which is connected directly to the JSW steel plant at Dolvi village. At right side of the creek there are jetties without cranes and conveyor belt so material, mainly coal, is lifted from barges by excavators directly loaded into trucks.

HISTORY OF WATERWAY DEVELOPMENT IN DHARAMTAR CREEK

According to fishermen from Tamsibandar village of Pen block, district Raigad, in 1989 Nippon Dendro Ispat Ltd[74], first bought land at Dolvi village near a small jetty of the Maharashtra Maritime Board[75] near Dharamtar to establish a steel plant. Tamsibandar village is situated on the left bank of Dharamtar creek. Nippon Dendro developed a captive jetty during 1992 to transport coal and iron ore from JNPT port to Dharamtar port by barges. As the big barges loaded with coal and iron ore started to navigate along the Dharamtar creek, there were incidences of breakage of fishing nets by the barges. The fisherpeople who were fishing in the creek started protesting. Fisherpeople organized themselves under banner of Dharamtar *Khadi Bachao Sangharsh Samiti* to raise issues related to barge transportation and loss of fishery. Around 1995, during various agitations and submission of memorandums to the Collector, Raigarh district, the fisherpeople got to know that the Maharashtra Maritime Board and Revenue Department of the state had declared a 135 meter wide navigational channel from Arabian Sea to Dharamtar port and a 50 meter wide navigational channel from Dharamtar Jetty to Nagothane. This came as a surprise to the local fisherpeople as there was no consultation or dialogue with them during process of such decision making.

IMPACTS: BANK EROSION AND SALINE WATER INTRUSION

Almost all the fisherpeople from this area are also involved in agriculture activity for their family needs. Traditionally fisherpeople and local farmers have raised embankments on the banks of Dharamtar creek to protect farmlands from intrusion of saline water. According to Arun Shivkar, leader of Dharamtar *Khadi Bachao Sangharsh Samiti*, the area around Dharamtar creek near village Tamsibander is nearly 5.5 feet below mean sea level. This often results in the breaching of embankments. However fisherpeople told us that the incidences of breaches of embankments increased many fold after the start of the barge movement in the creek from 1992. Bank erosion is a

[72] Based on a field visit by one of the authors.
[73] Dharamtar port is a facility developed by Jindal Steel Works Ltd.
[74] The Dharamtar port and steel plant at Dolvi village was first developed by Nippon Dendro Ispat Ltd. On 21st Dec 2010 it was taken over by JSW steel Ltd.
[75] The Maharashtra Maritime Board is established under the Maharashtra Maritime Board Act 1997.

well-known impact of vessel movements in inland waterways. Since 2005 more than 10,000 acres of farm land from Ganeshpatti area, nearly 700 acres farmland from Bhaal village and nearly 150 acres of farm land from Tamsibunder village have turned saline and non-fertile due to breaches of embankments. As a result of this there is a growth of mangrove forests on such lands. Fishermen and local farmers live in fear that they will lose their remaining farmlands in coming future. As there is on-going construction of a new jetty at Dharamtar, and with the declaration of the waterway as a national waterway, there will be more number of barges in the creek which will increase this effect by multiple folds.

Figure 5: Google image showing Dharamtar creek area during year 1991, red circled area showing area under agriculture.

Figure 6 : Google image showing Dharamtar creek area during year 2016. The red circled areas show area under mangrove forest which was under agriculture earlier.

From mouth of the creek at the Arabian Sea till village Tamsibandar there is a curvature to the creek. According to fishermen, after start of barge movement through the creek, the right bank at the curve of the creek started eroding. Due to this there is depletion of the mangrove belt. At one place the erosion has reached till the embankment. (See Figures 7 and 8) Jindal Steel plant officials are strengthening the embankment with sand bags. However the erosion has not stopped and it's continuing to damage the embankment and the mangrove belt. These incidences have increased the risk of embankment breaching and flooding of saline water into agricultural land. The depletion of mangrove forest is resulting into more erosion and less breeding and feeding ground for fish.

Figure 7: Google image showing mangrove belt at a turn of Dharamtar creek during year 2005.

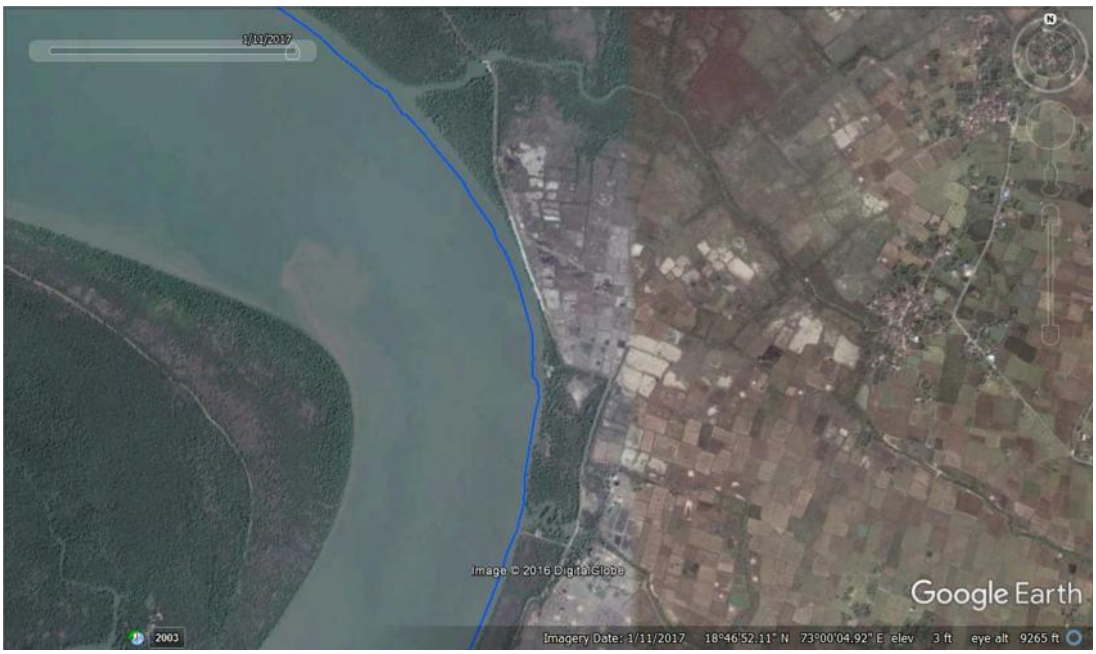

Figure 8: Google image showing loss of mangrove belt at the same point due to erosion in year 2017.

Figure 9: Picture showing eroding embankment of creek being strengthened by sand bags.

Figure 10: Picture showing eroding mangrove belt at Dharamtar creek.

IMPACT OF DREDGING

To maintain required depth of the navigational channel in Dhararmtar creek there are maintenance dredging operations on a regular basis. At the time of visit to the creek the maintenance dredging was being carried out by backhoe dredger. In this dredging there is an excavator mounted on a pontoon. The excavator head goes deep into the water and collects silt/sand from the channel and dumps it into a transporting barge. The barges carrying this silt/sand and dump it at newly developed dumping ground near Karanja village. The local activists alleged that last year there was dumping into the creek itself but outside the navigational channel area. This resulted in disruptions of the navigation of the boats of fisherpeople as they collide with the dumps of silt and sand. After protests by fisherpeople these dumps were removed. Local activists told us that the barges also collapse into the navigational channel a number of times. However there is no removal of material which gets dumped into the creek due to this.

Figure 11: A backhoe dredger in operation at Dharamtar Creek.

Recently the fisherpeople forced the dredging to stop for a couple of months. The dredging operations make the water highly turbid and the fish run away from the area, which directly affects the fish catch of local fisherpeople. The fisherpeople complain that fish also run away from the area due to the noise and vibrations of the barges and dredgers. The dredging operations in the creek also pose other threats like salinity ingress, possible pollution from silt sand if it is contaminated and

destruction of the river bed, its ecology and the habitats it provides for aquatic flora fauna. All these also have a big impact on the fish, and in turn, the livelihoods of the fisherpeople.

Figure 12: Picture showing barge loaded with coal in the Dharamtar creek.

FISHERPEOPLE IMPACTED AND FRUSTRATED

According to local activist Rajan Zhemase, there are nearly 3500 fishing boats operational in Dharamtar creek area. With this nearly 7000 small fisherpeople are dependent on Dharamtar creek for fishing. Once the 135 meter wide channel for navigation of big barges becomes a reality, there will be a direct and serious impact on the livelihoods of all these fisherpeople. As such, every day the fisherpeople have to fight with the barge movement as they put their nets in and around the navigational channel. Local fishermen are frustrated with this daily battle with barges and dredgers. First, they are unable to do proper fishing due to barge movement in the creek; second, due to turbid waters and vibrations the fish go away from the creek, and third, due to breaches in embankments fishermen are losing their agricultural land.

Figure 13: Picture showing fishing activity in Dharamtar creek in background mangrove forest of the creek.

Gowardhan Patil, a local activist said that the Dharamtar creek area is one of the best breeding ground for fish due to its huge mangrove forest areas. This creek area had become an excellent site for breeding of tiger prawns and other important fish varieties. However due to continuous movements of heavy barges, maintenance dredging operations and pollution due to material handling at ports there is direct threat to fish and biodiversity of Dharamtar creek.

Figure 14: A leaf from the mangrove covered with dust particles due to dust pollution at Dharamtar port.

IMPACT OF DUST

At Dharamtar port there is continuous generation of dust due to handling of coal, iron ore and other material. As one comes closer to the port area the big barges parked at jetties are unloaded by huge cranes and excavators. There is absence of any dust preventive measures seen at the site. The coal barges which are being unloaded by excavators are lifting the coal at the bank of the creek and directly loading it into trucks. Almost all these operations which create lots of dust are conducted on the bank of the creek and to some extent in the creek also. The dust gets settled on mangrove trees of the creek and makes thick layers on it. The trucks which transport the coal and other material from port also generate additional dust during transportation. As a result of this the area around Dharamtar port is polluted. The coal stockpiles are right on the bank of the creek. This creates a threat to the creek ecosystem as the water draining out from such stockpiles will directly enter into creek water.

Figure 15: Picture showing crane and conveyor belt in operation at Dharamtar port.

Figure 16: Excavator in operation at jetty of Dharamtar port. Coal stock is seen in the background.

In sum, the operations of the waterway are resulting into ecological destruction of creeks, rivers and mangrove forests. It is also snatching away the livelihood sources of the people who are dependent on it.

The operations of the part of NW 10 from JNPT port to Dharamtar gives us a picture about what will happen in other areas where new waterways for transportation of minerals like coal and iron ore are under development.

A HUB OF WATERWAYS
CASE STUDY: VARANASI CITY[76]

INTRODUCTION

Varanasi, as is well-known, is situated on the banks of River Ganga. Two smaller tributaries of the Ganga called Varuna and Asi flow through the city and meet river Ganga. Indeed, Varanasi is said to have got its name from the names of these two rivers.

Varanasi is a city famous for its religious, spiritual, cultural, historical and tourist importance. The city is known the world over for its magnificent *ghats* on river Ganga. The Ganga, and other rivers of the city, are indeed its very soul.

Four river stretches in and near Varanasi find a place in the 111 waterways that have been declared by the Government of India as national waterways. Additionally, a mutli-modal hub, consisting of a river-road-rail terminal is also coming up at Ramnagar in the city. The multi-modal hub will link the Ganga waterway with the Eastern Dedicated Freight Corridor[77].

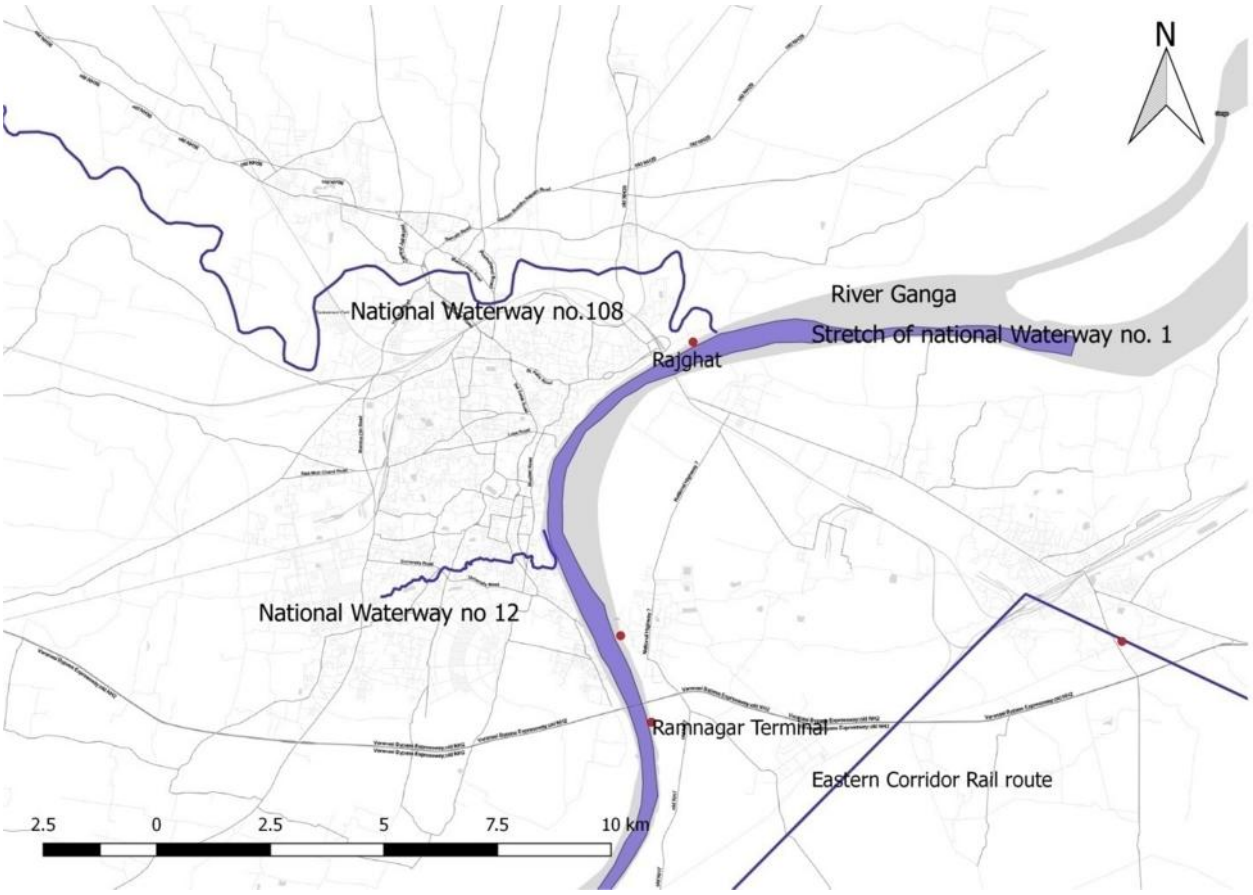

Figure17: Map showing Varanasi city and National Waterways 1 (Ganga, stretch within Varanasi), 12 (Asi), and 108 (Varuna). Map prepared by Jinda Sandbhor.

[76] Based on a visit to Varanasi by the authors.

[77] The Eastern Dedicated Freight Corridor is being developed by the Dedicated Freight Corridor Corporation of India Ltd. This rail corridor starts from Dankuni in West Bengal and ends in Ludhiana in Punjab. It goes parallel to the National Waterway 1 between Allahabad and Varanasi.

NATIONAL WATERWAY 1

This national waterway is the longest inland waterway in India. It starts from Haldia port on river Hoogly and running along the river Ganga ends at Allahabad city. This waterway passes through the states of West Bengal, Jharkhand, Bihar and Uttar Pradesh. Near Varanasi it goes parallel to the Eastern Freight Corridor. A multimodal hub is under construction at Ramnagar[78] on the bank of River Ganga. This multimodal hub will be connected to the Eastern Freight Corridor by a rail extension and also to the nearby highway.

Figure 18: The Ramnagar terminal of National Waterway 1 under construction in Varanasi on the banks of River Ganga.

There is strong reason to believe that the construction of the terminal is going on without an environmental clearance[79] from the MoEFCC, even though given the capacity of the terminal (3.5 million tons per annum, mtpa, in first phase from 2018, and 18 mtpa in the second phase), it would need environmental clearance. A draft EIA and EMP for Ramnagar terminal has been prepared by Inland Waterways Authority of India. However this seems to have been prepared at the instance of

[78] The Ramnagar terminal (which is part of national waterway 1) is being developed under the World Bank assisted project "Development of Haldia-Allahabad stretch of National Waterway-1 (River Ganga) for Navigation with Least Available Depth (LAD) of 3 Meters."

[79] Personal communication with petitioners who have filed a case related to the National Waterway 1 in the National Green Tribunal.

the World Bank, which is funding the project, and is not being done as a part of the statutory environmental clearance process under the EIA Notification 2006.

It also appears that there has been no local consultation or public hearing around the terminal, or the waterway itself. At least, the local activists had not heard or were not aware of any such consultations.

Figure 19: Fishermen laying fishing net in river Ganga for fishing near Ghats of Varanasi city.

On 12 August 2016 Minister of Shipping, Shri Nitin Gadkari flagged off two major vessels from the Aghoreshwar Bhagwan Ram Ghat in Varanasi for Haldia port via the Ganga National Waterway[80]. With this it was announced that the Varanasi to Haldia stretch of National Waterway 1 is operational. However there is no transportation activity happening after that.

[80] According to the press release by Ministry of Shipping on 12th Aug 2016 through Press Information Bureau of India. "*Shipping and Transport Minister Shree Nitin Gadkari Flags off Two Cargo Vessels from Varanasi and Lays Foundation Stone of the Multi Modal Terminal at Ramnagar*". http://pib.nic.in/newsite/PrintRelease.aspx?relid=148879 Accessed on 20 March 2017.

Figure 20: One of the ghats on the Ganga in Varanasi. The NW 1 passes along these ghats.

To operationalize the National Waterway 1 in the Varanasi to Sahibganj stretch, a 2.2 meter deep and 45 meter wide navigational channel will be required in the river Ganga[81]. This will involve capital dredging of the riverbed of Ganga by large dredgers.

The *mallah*[82] community is the community engaged in running boats in river Ganga near the ghats of Varanasi for tourists and pilgrims. According to local activists, large number of boats are operational in this area. Due to the large pilgrim and tourist traffic, the *mallahs* have shifted their occupation from fishing to running the small boats. The construction and operation of activities of the National Waterway 1 are likely to directly impact these people.

[81] Personal discussion with engineer at Ramnagar terminal site.

[82] *Mallah* is the mainly fishing community in river Ganga of Varanasi area. Due to pilgrim and tourist traffic the *Mallahs* have shifted their occupation from fishing to public transport by boats. One of the main income sources for the *mallahs* is the evening Ganga *aarti* when viewers take rides in the boats to see the *aarti* from the river Ganga.

Figure 21: Boats carrying tourists and pilgrims in River Ganga near the ghats of Varanasi.

Figure 22: A woman cleaning the ghats of Varanasi. Clean Ganga is an important mission of the Government of India.

NATIONAL WATERWAY 12

This proposed national waterway goes through River Asi in Varanasi city. It starts near the Golf Club area of city and ends at the confluence point of river Asi with Ganga near Assi Ghat. Asi River is facing huge encroachments on its both the banks. At some places the river flows through a narrow channel or through cement pipes. This river is highly polluted with sewage and garbage. The polluted water directly enters into river Ganga without any treatment.

Figure 23: River stretch of Asi River Near Saket Nagar in Varanasi City. The river is highly polluted and under encroachments.

Seeing the condition of the river Asi, the first question that comes to one's mind is how the waterway would be operationalised through all these encroachments and polluted water? The Asi river neither has water, not a way!

A citizens' group in the city "Asi Nadi Mukti Abhiyan" is active in trying to clean and free the river, but it surely has an uphill task.

There is a good chance that Asi waterway may be one of the 18 waterways that have been found to be not viable technically[83].

[83] FAQ related to Jalmarg Vikas Project http://iwai.nic.in/WriteReadData/l892s/1013443659FAQ%20JMVP%20Final%20PDF.pdfAccessed 20 March 2017

NATIONAL WATERWAY 108

This national water way goes through river Varuna. It starts at the road bridge near Kuru on river Varuna and ends at the confluence point with river Ganga near Rajghat. Like River Asi the Varuna River is also heavily polluted, carrying mainly the city sewage. The river water is black in colour with loads of garbage dumped on its banks. The same question as Asi arises here as to from where the water would come for operationalisation of this waterway. Parts of the river are also being channelized under an on-going riverfront development project. This project has narrowed the river channel. The land outside this channel which is also part of the river bed and floodplain will be utilized for other commercial activities.

Figure 24: Polluted Varuna River near Varanasi city. Garbage dumps can be seen on the bank of river. National Waterway 108 goes through this river.

NATIONAL WATERWAY 42

This waterway starts at Bada Imambara at Lucknow in river Gomati and ends at the confluence point with river Ganga near Kaithi. This location is downstream of Varanasi. This waterway will connect to National Waterway 1 on river Ganga. According to the locals there was a survey by officers of the Inland Waterways Authority of India at the confluence point of Gomati and Ganga Rivers for the construction of port and storage area. However this plan was abandoned due to the low height of selected land and submergence of site during normal floods.

Figure 25: Confluence point of river Gomati and Ganga. This is the junction of National Waterway 1 and 42.

CONCLUSION

If we look at the Varanasi area, there is some construction activity going on on the National Waterway 1 at the Ramnagar terminal on River Ganga. Other than this there seems to be no on-going construction activity in any of the four national waterways in the Varanasi area.

What is most significant and serious however is the lack of awareness amongst and lack of consultation with the local people, who should be informed and taken into confidence before any such activities are taken up.

Another important aspect will be how the activities of construction and operation of the waterways will integrate with other efforts around the Ganga like the *Namami Gange* (or clean Ganga mission). There seems to be little thought given to this.

DISRUPTING SENSITIVE DELTA SYSTEMS
CASE STUDY OF NATIONAL WATERWAY 5 IN ODISHA[84]

INTRODUCTION

Odisha has six national waterways. These waterways will pass through most major rivers of the state. These waterways are National Waterway 14 which will go through Baitarani River, National Waterway 22 which will go through Birupa Badi Genguti Brahmani River, National Waterway 23 which will go through Budha Balanga River, National Waterway 64 which will go through Mahanadi River and National Waterway 96 which will go through Subarnrekha River.

The National Waterway 5, the longer amongst these, had been declared as a national waterway in 2008 itself, but the work on it has begun in right earnest only in the recent years.

The entire National Waterway 5 is depicted in the map at Figure 26. The National Waterway 5 (NW 5) starts from Geonkhali near Haldia port in the estuary of Hooghly river of West Bengal. It passes through Hijli Tidal Canal till Rasulpur river in West Bengal. From Rasulpur river to Charbatia in Odisha it passes through the Odisha Coast Canal. Both these canals (Hijli Tidal Canal and Odisha Coast Canal) together are known as the East Coast Canal. The construction work of the canal started during 1880-81 and the canal was fully opened for traffic during 1888. However after development of rail and road transport the use of this waterway was reduced. NW 5 will recondition – desilt, deepen – the stretch of East Coast Canal from Geonkhali to Charbatia. From Charbatia this waterway will go through the Matai River which meets River Dhamra near port Dhamra in the Brahmani river delta system. From Dhamra port to Paradip port the waterway goes through Brahmani River till Mangalgadi[85].From Mangalgadi it will go through Hansua, Karnasi and Mahanadi Rivers along the coastline of Bay of Bengal, through the Hatamundai reserved forest area and onward to Paradip. From Mangalgadi the waterway goes inland all the way to Talcher through river Brahmani.

There will be seven terminals on this water way, five of them in Odisha[86]. In this Case Study, we limit our discussion to the parts of NW 5 that falls in Odisha.

[84] Based on documents and an earlier field visit by one of the authors.

[85] As per the pre-feasibility report titled *Development of Stretch Pankapal/Jokadia to Dhamra and Paradip of National Waterway No. 5 in the State of Odisha*, there was a proposal to take the Mangalgadi- Paradip IWT route through rivers Hansua, Babar, Nuna, Gobri, Ramchandi Galia, Kharnasi and Mahanadi. But, this "was not suitable for safe navigation of the vessels of economical size due to the existence of number of cross structures, river bends, shallow and narrow waterways etc. Hence it was decided to inspect and survey an alternative route running along Hansua, Karnasi and Mahanadi rivers and through the bay along the coastline near Jambu Dweep." It is this route that has been finalised now.

[86] Executive Summary, Detailed Project Report For Development of Inland Waterway Transport Along ECC and Brahmani/Kharsua River System: Final Report; WAPCOS Limited, March 2010. Page 30 http://iwai.nic.in/WriteReadData/l892s/Executive_summary_-_April_2010nw5-30554743.pdf Accessed 30th July 2015

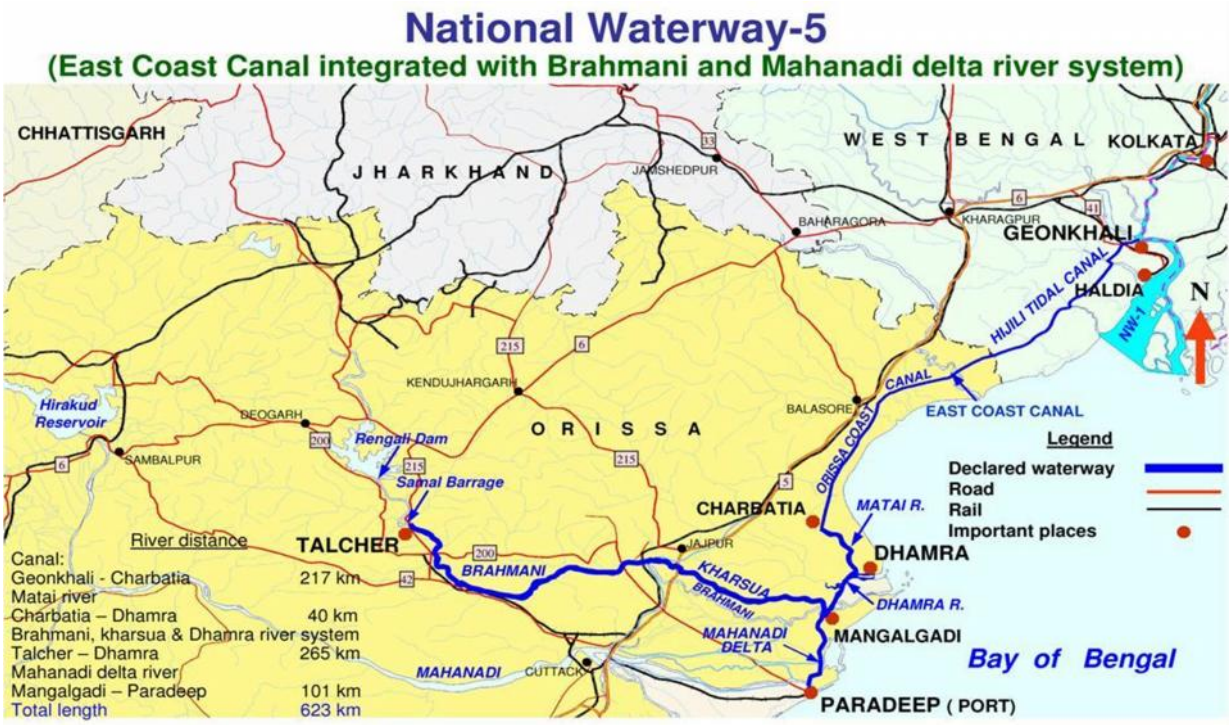

Figure 26: Map showing National Waterway 5[87]

Connected to National Waterway 5 will be the National Waterway 64 which will start from Paradip port on the coast and go up to the Sambalpur barrage along the Mahanadi river. This waterway will be 425 km long. This NW 64 will be connected with the NW 5 through Paradip. The satellite image below shows the two waterways, NW 5 and NW 64 together.

Figure 27: Google image showing National Waterway 5 and 64. (Line in blue shows alternative routes proposed for parts of NW 5).

[87]Website of Inland waterway Authority of India. http://iwai.nic.in/WriteReadData/l892s/image2-64882188.jpg

At the time of writing of this report, work has not begun on the NW 64. However, work has begun on the NW 5.

The Inland Waterways Authority of India has prepared a prefeasibility report, and with this has approached the Ministry of Environment, Forest and Climate Change (MoEFCC) for environmental clearance for the stretch between Pankapal/ Jokadia to Dhamra-Paradip. The TORs for an Environment Impact Assessment have been sanctioned by MoEFCC on 12th Jan 2015. The details of the progress on this are not known. The website of MoEFCC dealing with environmental clearance does not show any progress beyond issue of TOR to the project.

IMPACTS OF THE WATERWAYS

The waterways will involve significant interference in the sensitive ecosystems of the delta as well as the Mahanadi and Brahmani rivers. There will be activities like widening and deepening of canals and rivers, large scale dredging, construction of barrages, landing sites, locks and gates etc. All these will have many impacts on the local ecosystem, livelihoods and communities. The operation of the waterways will also have its own impacts.

BARRAGES TO MAINTAIN WATER LEVEL

The stretch between Talcher to Mangalgadi is 237 km long and goes through river Brahmani. In this stretch, from Talcher to Jokadia there is a need to maintain water level of 2 meters for easy transport of loaded ships through the waterway. In this stretch the riverbed is shallow and it will need barrages to maintain the required water level for navigation. According to the executive summary[88] of the *Detailed project report for development of inland water transport along East Coast Canal and Brahmani/Khasura*, there will be five barrages between Talcher to Jokadia stretch of Brahmani River, at Renthapat, Indrajit, Gobindapur, Bartanda and Matila[89]. These barrages, by blocking the flow of water and sediments, will have impacts on the river ecology, the fishing and on the riverbed cultivation.

Five other barrages are also proposed to be constructed at different points of the NW 5 in Odisha itself, on river Kharsua, on Tantighai river, on Naunai river, on Kani river and possibly on Dahikhai river[90].

DREDGING AND IMPACTS ON ECOSYSTEM AND FISHERMEN

To create and maintain the water depth throughout the waterway there will be also be need of dredging the riverbed, the creeks and estuaries. Dredging will be of two types. The first is the capital dredging which is undertaken during the construction phase to deepen the river channels. This would include removal of hard earth at bottom of the riverbeds. The second type of dredging will be maintenance dredging which involves regular removal of silt and sediments which get accumulated in the navigational path throughout the year. Dredging can have many adverse impacts on local

[88] WAPCOS (2010): *Detailed project report for development of inland water transport along East Coast Canal and Brahmani/Khasura river system final report Volume I: Executive summary*, Inland Waterways Authority of India. http://iwai.nic.in/WriteReadData/l892s/Executive_summary_-_April_2010nw5-30554743.pdf Accessed 30th July 2015. Page 11

[89] Inland Waterway Authority of India :*Feasibility report for Development of Stretch between Pankapal / Jokadia to Dhamra and Paradip of National Waterway No. 5 in the State of Odisha*, Government of India.

[90] *Consultancy Services for the Study for Revising the DPR of National Waterway-5 for developing the stretch between Pankapal / Jokadia to Dhamra & Paradip in the State of Odisha*, Final Report, WAPCOS Ltd, Page no 196, http://www.iwai.nic.in/WriteReadData/l892s/4854732748NW5DPR_Jan%202016.pdf accessed on 20 March 2017.

ecosystem, including fish. Due to dredging there will be increase in turbidity of water which will affect aquatic fauna and fisheries. Likely dumping of dredged out material in mangrove belt areas can impact the mangroves. Dredging activities at ports and creeks and inland sea channels are known to have resulted in salinity intrusion (Kudale, 2010)[91]. Such an impact is likely in the Mahanadi delta and other parts of the NW5. The increase in salinity could have adverse and irreversible effect on brackish water ecosystem of estuaries and mangroves. This will also have serious impacts on the livelihoods of the people.

FORMING THE NAVIGATION CHANNEL

The revised Detailed Project Report of one stretch of National Waterway 5 talks about[92]:

> "…route from Pankapal to Dhamra/Paradip Port along Kharsua / Tantighai / Kani to develop a navigation channel of 50 m width (base width of 45 m) with slope of 1:3 and 3 m depth with respect to CD based on the survey charts given by IWAI."

Almost all of the river stretch of river Kharinasi (which is a part of the above mentioned stretch) from the point of branching of Kharinasi River from Mahanadi to confluence with Bay of Bengal has a width ranging from 30 to 45 meter with depth of 1 to 1.5 meter during low tide. There is thick mangrove forest on the both bank of river. That means that the entire width (and at places more) of the river will be converted into the navigational channel. This will severely impact the river ecology and the fisherpeople dependent on it. (See Figures 28 and 29).

Figure 28: River Kharinasi going through mangrove forest of Hatamundai. The national waterway 5 will be going through this river by widening of the river stretch and increasing depth through dredging. Both these activities will affect mangroves and aquatic ecosystem in river and surrounding areas, as well as impact the livelihoods of fisherpeople in the area.

[91] Kudale, M D. "Impact of Port Development on the Coastline and the need for Protection "Indian Journal of Geo-Marine Sciences 39, no. 4 (Des 2010): 597-604. http://nopr.niscair.res.in/bitstream/123456789/10808/1/IJMS%2039(4)%20597-604.pdf

[92] *Consultancy Services for the Study for Revising the DPR of National Waterway-5 for Developing the Stretch between Pankapal / Jokadia to Dhamra & Paradip in the State of Odisha, Final Report*, WAPCOS Ltd, Page no 196, http://www.iwai.nic.in/WriteReadData/l892s/4854732748NW5DPR_Jan%202016.pdf Accessed 20 March 2017.

Figure29: Local fisherman preparing *Byad Jaal* (side net) for catching fishes on the bank of River Kharinasi. This fishing activity will be not be possible after construction of national waterway no 5 as entire river width will be converted to waterway.

DENIAL OF ACCESS TO FISHERMEN

This waterway goes through a very fragile ecosystem which has the second largest mangrove forest after Sundarban in India. The flora and fauna of region is mainly dominated by mangrove forest. There are Kalibhanj Dian, Bhitarkanika and Hatamundai reserved forest with four protected areas with dominance of mangrove forest. In Hatamundai forest area this waterway will go through the Kharinasi River. This river is used by nearly 700 fishing boats from Paradip, Ramnagar, Kharnasi, Thubi, San Thubi, Jambu Dweep and Sundaripal villages to venture into sea near mouth of Gorbri, Hansua and Kharnasi River (See map at Figure 30). This area is known for its good fish catch due fish population in the mouth region of rivers. Once the Kharinasi river is converted to a waterway, it is likely that the fisher people will not be able to use it for venturing into the sea and going to their fishing areas. Fishermen in this region are already facing closure of fishing during the nesting period of Olive Ridley turtles. In fact, even the Kharinasi river itself is used by fisher people for fishing and once it is converted into a part of the waterway, this fishing is likely to be severely affected. This is because they catch fish by dangling and suspending their nets in the river across the water, and the vessels would certainly drag and tear away their nets.

Figure 30: Google Earth image showing Mahanadi and Brahmani delta with fishing villages (indicated by numbers), Kharnasi, Gobri and Hansua river (rivers in red), the waterway along the coast (in blue, overlapping with Kharnasi river) and waterway in Mahanadi (in green). Highlighted area is the fishing area.

RISKS FROM TRANSPORTED GOODS

This waterway will be used mainly for transportation of minerals like coal and iron ore from the mineral rich areas of Talcher to Dhamra and Paradip ports. According to the executive summary of the *Detailed project report for development of inland water transport along East Coast Canal and Brahmani/Khasura*, by 2034 the main good transported on this waterway will be coal, accounting for 20 million tons per annum, out of total cargo of 23.4 million tons per year[93].

This will create the risk of coal dust pollution due to coal handling at terminals and uncovered coal transport through waterways which will pass through one of the most eco-sensitive areas. Already, many ports in India handling coal are impacted with severe coal dust pollution (see Dharamtar case study in this report) and some have even been asked to shut down coal handling, like the Mumbai port. Another danger is from accidental spill of coal and other cargo. In October 2015 a vessel with coal cargo capsized in the Sundarban in Bangladesh. Several such incidents have highlighted the risks to flora, fauna, ecology and fish from the transport of such goods in the waterways. These accidents will unfortunately impact the local communities the most.

PEOPLE NOT TAKEN INTO CONFIDENCE

What is equally serious is that such a major intervention as the waterways – that will affect lakhs of people and their livelihoods, is being carried out without informing the people, let alone their participation. In a field visit by one of the authors to this area in Nov 2015, it was found that the local people had no idea that such a project was being planned. Confirming with the local people again as

[93] *Executive Summary, Detailed Project Report For Development of Inland Waterway Transport Along ECC and Brahmani/Kharsua River System: Final Report*; WAPCOS Limited, March 2010. http://iwai.nic.in/WriteReadData/l892s/Executive_summary_-_April_2010nw5-30554743.pdf Accessed 30th July 2015

this report is being written, we find that even now, no information has been shared with local communities nor have any consultations been held. It is not in larger public interest that such a huge intervention be pushed without involving the people and without their informed participation and consent.

CONCLUSION

Massive interventions are being proposed in Odisha in the Mahanadi and Brahmani basins and the delta though the expansion of the National Waterway 5 and the creation of the new National Waterway 64. These are likely to have severe impacts on the ecology, livelihoods and communities of this entire area, which is highly eco-sensitive at the same time which provides livelihoods to lakhs of people. The EIA processes do not inspire much confidence and it is not clear if the economic benefits will outweigh the many costs. We would suggest that this unilateral push to go ahead with the waterways must be put on hold. A full and comprehensive exercise of assessing the desirability of the waterways, along with their impacts must be carried out with the full involvement of the people and civil society before taking a final decision on the waterways.

ANNEXURE 1 : STATE WISE DETAILS OF NATIONAL WATERWAYS[94]

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
1	Uttar Pradesh	11	National Waterway 1	1620	Allahabad-Haldia Stretch of the Ganga—Bhagirathi-Hooghly Rivers	Interstate with - Bihar, Jharkhand and West Bengal
2			National Waterway 12	5.5	Asi River	
3			National Waterway 19	68	Betwa River	
4			National Waterway 24	60	Chambal River	Interstate with - Madhya Pradesh
5			National Waterway 40	340	Ghaghra River	Interstate with - Bihar
6			National Waterway 42	580	Gomti River	
7			National Waterway 54	86	Karamnasa River	Interstate with - Bihar
8			National Waterway 103	73	Tons River	Interstate with - Madhya Pradesh
9			National Waterway 108	53	Varuna River	
10			National Waterway 37	300	Gandak River	Interstate with - Uttar Pradesh
11			National Waterway 110	1089	Yamuna River	Interstate with - Haryana and Delhi
12	Andhra Pradesh	3	National Waterway 4	2890	Kakinada-Puducherry Stretch of Canals and the Kaluvelly Tank, Nashik-Bhadrachalam-Rajahmundry Stretch of River Godavari and Bridge near village Galagali-Wazirabad-Vijayawada Stretch of River Krishna	Interstate with - Maharashtra, Telangana, Karnataka, Tamil Nadu and Puducherry
13			National Waterway 79	29	Pennar River	
14			National Waterway 104	230	Tungabhadra River	Interstate with - Telangana, Karnataka
15	Arunachal Pradesh	1	National Waterway 62	100	Lohit River	Interstate with - Assam
16	Assam	17	National Waterway 2	891	Sadiya-Dhubri Stretch of Brahmaputra River	

[94] Waterway lengths taken from the press release of the Shipping Ministry dated 17 Nov 2016. http://pib.nic.in/newsite/PrintRelease.aspx?relid=153714 Accessed 27 Feb 2017. Other details of waterways derived from list and details given in the National Waterways Act, 2016.

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
17			National Waterway 6	71	Aai River	
18			National Waterway 7	96	Ajoy (Ajay) River	
19			National Waterway 16	121	Barak River	
20			National Waterway 18	73	Beki River	
21			National Waterway 30	114	Dehing River	
22			National Waterway 31	110	Dhansiri/Chathe River	
23			National Waterway 32	63	Dikhu River	
24			National Waterway 33	61	Doyans River	
25			National Waterway 38	62	Gangadhar River	Interstate with - West Bengal
26			National Waterway 39	49	Ganol River	Interstate with - Meghalaya
27			National Waterway 50	43	Jinjiram River	Interstate with - Meghalaya
28			National Waterway 57	46	Kopili River	
29			National Waterway 62	100	Lohit River	Interstate with - Arunachal Pradesh
30			National Waterway 82	72	Puthimari River	
31			National Waterway 95	111	Subansiri River	
32			National Waterway 102	86	Tiwang (Dhaleswari River)	Interstate with - Mizoram
33	Bihar	7	National Waterway 1	1620	Allahabad-Haldia Stretch of the Ganga—Bhagirathi-Hooghly Rivers	Interstate with - Uttar Pradesh, Jharkhand and West Bengal
34			National Waterway 37	300	Gandak River	Interstate with - Uttar Pradesh
35			National Waterway 54	86	Karamnasa River	Interstate with - Uttar Pradesh
36			National Waterway 58	236	Kosi River	
37			National Waterway 81	35	Punpun River	
38			National Waterway 94	160	Sone River	

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
39			National Waterway 40	340	Ghaghra River	Interstate with - Uttar Pradesh
40	Delhi	1	National Waterway 110	1089	Yamuna River	Interstate with - Haryana and Uttar Pradesh
41	Goa	6	National Waterway 25	33	Chapora River	
42			National Waterway 27	70	Cumberjua River	
43			National Waterway 68	41	Mandovi River	
44			National Waterway 71	27	Mapusa/Moide River	
45			National Waterway 88	14	Sal River	
46			National Waterway 111	50	Zuari River	
47	Gujarat	5	National Waterway 48	590	Jawai-Luni Rivers and Rann of Kutch	Interstate with - Rajasthan
48			National Waterway 66	248	Mahi River	
49			National Waterway 73	227	Narmada River	Interstate with - Maharashtra and Madhya Pradesh
50			National Waterway 87	212	Sabarmati River	
51			National Waterway 100	436	Tapi River	Interstate with - Maharashtra
52	Haryana	2	National Waterway 110	1089	Yamuna River	Interstate with - Delhi and Uttar Pradesh
53			National Waterway 45	650	Indira Gandhi Canal	Interstate with - Rajasthan and Punjab
54	Himachal Pradesh	3	National Waterway 84	42	Ravi River	Interstate with - Punjab and Jammu and Kashmir
55			National Waterway 17	191	Beas River	Interstate with - Punjab
56			National Waterway 98	377	Sutlej River	Interstate with - Punjab
57	Punjab	4	National Waterway 17	191	Beas River	Interstate with - Himachal Pradesh
58			National Waterway 45	650	Indira Gandhi Canal	Interstate with - Rajasthan, Haryana

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
59			National Waterway 84	42	Ravi River	Interstate with - Himachal Pradesh and Jammu and Kashmir
60			National Waterway 98	377	Sutlej River	Interstate with - Himachal Pradesh
61	Jammu and Kashmir	4	National Waterway 26	53	Chenab River	
62			National Waterway 46	35	Indus River	
63			National Waterway 49	110	Jhelum River	
64			National Waterway 84	42	Ravi River	Interstate with - Himachal Pradesh and Punjab
65	Jharkhand	3	National Waterway 1	1620	Allahabad-Haldia Stretch of the Ganga—Bhagirathi-Hooghly Rivers	Interstate with - Uttar Pradesh, Bihar and West Bengal
66			National Waterway 56	23	Kherkai River	
67			National Waterway 96	314	Subarnrekha River	Interstate with - Odisha and West Bengal
68	Karnataka	11	National Waterway 4	2890	Kakinada-Puducherry Stretch of Canals and the Kaluvelly Tank, Nashik-Bhadrachalam-Rajahmundry Stretch of River Godavari and Bridge near village Galagali-Wazirabad-Vijayawada Stretch of River Krishna ,	Interstate with - Maharashtra, Telangana, Andhra Pradesh,Tamil Nadu and Puducherry
69			National Waterway 21	139	Bheema River	Interstate with - Telangana
70			National Waterway 41	112	Ghataprabha River	
71			National Waterway 43	10	Gurupur River	
72			National Waterway 51	23	Kabini River	
73			National Waterway 52	54	Kali River	
74			National Waterway 67	94	Malaprabha River	
75			National Waterway 74	78	Netravathi River	

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
76			National Waterway 76	23	Panchagangavali (Panchagangoli) River	
77			National Waterway 90	29	Sharavati River	
78			National Waterway 104	230	Tungabhadra River	Interstate with - Andhra Pradesh and Telangana
79	Kerala	5	National Waterway 3	365	Kollam-Kozhikode Stretch of West Coast Canal and Champakara and Udyogmandal Canals	
80			National Waterway 8	28	Alappuzha-Changanassery Canal	
81			National Waterway 9	38	Alappuzha-Kottayam Athirampuzha Canal	
82			National Waterway 13	11	AVM Canal	Interstate with - Tamilnadu
83			National Waterway 59	28	Kottayam-Vaikom Canal	
84	Madhya Pradesh	3	National Waterway 24	60	Chambal River	Interstate with - Uttar Pradesh
85			National Waterway 73	227	Narmada River	Interstate with - Maharashtra and Gujarat
86			National Waterway 103	73	Tons River	Interstate with - Uttar Pradesh
87	Maharashtra	15	National Waterway 4	2890	Kakinada-Puducherry Stretch of Canals and the Kaluvelly Tank, Nashik-Bhadrachalam-Rajahmundry Stretch of River Godavari and Bridge near village Galagali-Wazirabad-Vijayawada Stretch of River Krishna	Interstate with - Telangana, Andhra Pradesh, Karnataka Tamil Nadu and Puducherry
88			National Waterway 10	45	Amba River	
89			National Waterway 11	98	Arunawati Aran River	
90			National Waterway 28	45	Dabhol Creek Vashishti River	
91			National Waterway 53	145	Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River	
92			National Waterway 70	242	Manjara River	Interstate with - Telangana
93			National	60	Nag River	

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
			Waterway 72			
94			National Waterway 73	227	Narmada River	Interstate with - Gujarat and Madhya Pradesh
95			National Waterway 78	265	Penganga Wardha River	Interstate with - Telangana
96			National Waterway 83	31	Rajpuri Creek	
97			National Waterway 85	31	Revadanda Creek Kundalika River	
98			National Waterway 89	46	Savitri River (Bankot Creek)	
99			National Waterway 91	52	Shastri River Jaigad Creek	
100			National Waterway 100	436	Tapi River	Interstate with - Gujarat
101			National Waterway 109	164	Wainganga Pranahita River	Interstate with - Telangana
102	Nagaland	1	National Waterway 101	42	Tizu and Zungki Rivers	
103	Meghalaya	5	National Waterway 39	49	Ganol River	Interstate with - Assam
104			National Waterway 61	28	Kynshi River	
105			National Waterway 93	62	Simsang River	
106			National Waterway 106	20	Umngot (Dwaki) River	
107			National Waterway 50	43	Jinjiram River	Interstate with - Assam
108	Mizoram	1	National Waterway 102	86	Tiwang (Dhaleswari River)	Interstate with - Assam
109	Odisha	6	National Waterway 5	588	Talcher-Dhamra Stretch of Brahmani-Kharsua-Tantighai-Pandua Nala-Dudhei Nala-Kani Dhamra-river system, Geonkhali-Charbatia Stretch of East Coast Canal, Charbatia-Dhamra Stretch of Matai River and Mahanadi Delta Rivers	Interstate with - West Bengal
110			National Waterway 14	49	Baitarni River	
111			National Waterway 22	156	Birupa Badi Genguti Brahmani River	
112			National Waterway 23	56	Budha Balanga River	

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
113			National Waterway 64	425	Mahanadi River	
114			National Waterway 96	314	Subarnrekha River	Interstate with - Jharkhand and West Bengal
115	Puducherry	2	National Waterway 4	2890	Kakinada-Puducherry Stretch of Canals and the Kaluvelly Tank, Nashik-Bhadrachalam-Rajahmundry Stretch of River Godavari and Bridge near village Galagali-Wazirabad-Vijayawada Stretch of River Krishna	Interstate with - Maharashtra, Telangana, Andhra Pradesh and Tamil Nadu
116			National Waterway 80	125	Ponniyar River	Interstate with - Tamilnadu
117	Rajasthan	3	National Waterway 48	590	Jawai-Luni Rivers and Rann of Kutch	Interstate with - Gujarat
118			National Waterway 63	327	Luni River	
119			National Waterway 45	650	Indira Gandhi Canal	Interstate with - Rajasthan, Haryana
120	Tamil Nadu	10	National Waterway 4	2890	Kakinada-Puducherry Stretch of Canals and the Kaluvelly Tank, Nashik-Bhadrachalam-Rajahmundry Stretch of River Godavari and Bridge near village Galagali-Wazirabad-Vijayawada Stretch of River Krishna	Interstate with - Maharashtra, Telangana, Andhra Pradesh, Karnataka and Puducherry
121			National Waterway 13	11	AVM Canal	Interstate with - Kerala
122			National Waterway 20	94	Bhavani River	
123			National Waterway 55	364	Kaveri Kollidam River	
124			National Waterway 69	5	Manimutharu River	
125			National Waterway 75	141	Palar River	
126			National Waterway 77	20	Pazhyar River	
127			National Waterway 80	125	Ponniyar River	Interstate with - Pudducherry

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
128			National Waterway 99	64	Tamaraparani River	
129			National Waterway 107	45	Vaigai River	
130	Telangana	6	National Waterway 4	2890	Kakinada-Puducherry Stretch of Canals and the Kaluvelly Tank, Nashik-Bhadrachalam-Rajahmundry Stretch of River Godavari and Bridge near village Galagali-Wazirabad-Vijayawada Stretch of River Krishna	Interstate with - Maharashtra, Andhra Pradesh, Karnataka Tamil Nadu and Puducherry
131			National Waterway 70	242	Manjara River	Interstate with - Maharashtra
132			National Waterway 78	265	Penganga Wardha River	Interstate with - Maharashtra
133			National Waterway 104	230	Tungabhadra River	Interstate with - Andhra Pradesh and Telangana
134			National Waterway 21	139	Bheema River	Interstate with - Karnataka
135			National Waterway 109	164	Wainganga Pranahita River	Interstate with - Maharashtra
136	West Bengal	16	National Waterway 1	1620	Allahabad-Haldia Stretch of the Ganga—Bhagirathi-Hooghly Rivers ,	Interstate with - Uttar Pradesh, Bihar and Jharkhand
137			National Waterway 5	588	Talcher-Dhamra Stretch of Brahmani-Kharsua-Tantighai-Pandua Nala-Dudhei Nala-Kani Dhamra-river system, Geonkhali-Charbatia Stretch of East Coast Canal, Charbatia-Dhamra Stretch of Matai River and Mahanadi Delta Rivers	Interstate with - Odisha
138			National Waterway 15	137	Bakreswar Mayurakshi River	
139			National Waterway 29	135	Damodar River	
140			National Waterway 34	130	DVC Canal	
141			National Waterway 35	113	Dwarakeswar River	
142			National	121	Dwarka River	

Sr. No.	State	Total number of waterways	Name of the waterway	Length (km)	River stretch	Remarks
			Waterway 36			
143			National Waterway 38	62	Gangadhar River	Interstate with - Assam
144			National Waterway 44	64	Ichamati River	
145			National Waterway 47	131	Jalangi River	
146			National Waterway 60	77	Kumari River	
147			National Waterway 65	81	Mahananda River	
148			National Waterway 86	72	Rupnarayan River	
149			National Waterway 92	26	Silabati River	
150			National Waterway 96	314	Subarnrekha River	Interstate with - Jharkhand and West Bengal
151			National Waterway 97	654	Sunderbans Waterways	

ANNEXURE 2 : WATERWAYS REMOVED FROM NATIONAL WATERWAYS BILL 2015

Sr. No.	**Waterways removed from Bill 2015**
1	National Waterway 18 Bharathappuzha River
2	National Waterway 23 Chaliyar River
3	National Waterway 46 Kadalundy River
4	National Waterway 48 Kallada River
5	National Waterway 54 Korapuzha River
6	National Waterway 56 Krishna River
7	National Waterway 65 Manimala River
8	National Waterway 69 Meenachil River
9	National Waterway 70 Muvattupuzha River
10	National Waterway 75 Pamba River
11	National Waterway 99 Ulhas River
12	National Waterway 101 Valpattnam River
13	National Waterway 104 West Coast Canal

Complied by authors from National Waterways Bill 2015 and the National Waterways Act 2016.

ANNEXURE 3 : ADDITIONAL WATERWAYS INCLUDED IN THE NATIONAL WATERWAYS ACT 2016

Sr. No.	**New waterways added in Act 2016**
1	National Waterway 8 Alappuzha-Changanassery Canal
2	National Waterway 9 Alappuzha-Kottayam Athirampuzha Canal
3	National Waterway 20 Bhavani River
4	National Waterway 28 Dabhol Creek Vashishti River
5	National Waterway 39 Ganol River
6	National Waterway 43 Gurupur River
7	National Waterway 48 Jawai-Luni Rivers and Rann of Kutch
8	National Waterway 50 Jinjiram River
9	National Waterway 51 Kabini River
10	National Waterway 59 Kottayam-Vaikom Canal
11	National Waterway 61 Kynshi River
12	National Waterway 80 Ponniyar River
13	National Waterway 83 Rajpuri Creek
14	National Waterway 85 Revadanda Creek Kundalika River System
15	National Waterway 90 Sharavati River
16	National Waterway 93 Simsang River
17	National Waterway 105 Udayavara River
18	National Waterway 106 Umngot (Dwaki) River

Complied by authors from National Waterways Bill 2015 and the National Waterways Act 2016.

The Parliamentary Standing Committee had recommended the addition of the following waterways to the National Waterways Bill, 2015:

i) The estuarine creeks and rivulets in the Sundarbans in parts of North and South 24 Parganas comprising rivers in the estuarine delta like Bidya, Matla, Thakurran, Raimangal, Saptamukhi, Muriganga, Gomar, Hogal, Chhoto Kalergachi, Sahebkhali, Karbhenga, Katakhali, and Kalandi fromWest Bengal;

ii) Ponniyar from Sathanur Dam to confluence with Bay of Bengal at Cuddalore of Tamil Nadu;

iii) (a) Alappuzha-Changanassery Canal (28 km); (b) Alappuzha- Kottayam Canal (23km); (c) Kottayam-Vaikom Canal (42 km); and (d) Athirampuzha Canal (15 km) from Kerala;

iv) Extension of Northern limit of West Coast Canal upto Kasaragod instead of Kozhikode and Southern limit up to Kolachal (Tamil Nadu) instead of Kovalam in the proposed National Waterway-104 (existing waterway NW-3) from Kerala; and

v) (a) Vasai Creek-Creek entrance to Kalian via Kasheli-Kasheli to Mumbai (Thane creek)-Mumbai to Dharamatar covering an approximate distance of 140km; (b) Rajpuri creek-creek entrance to Mandad via Vashi covering an approx. distance of 28 km; and (c)Dabhol Creek/Vasishti river- from entrance till Karkhavane covering approximate distance of 42 km, all from Maharashtra.