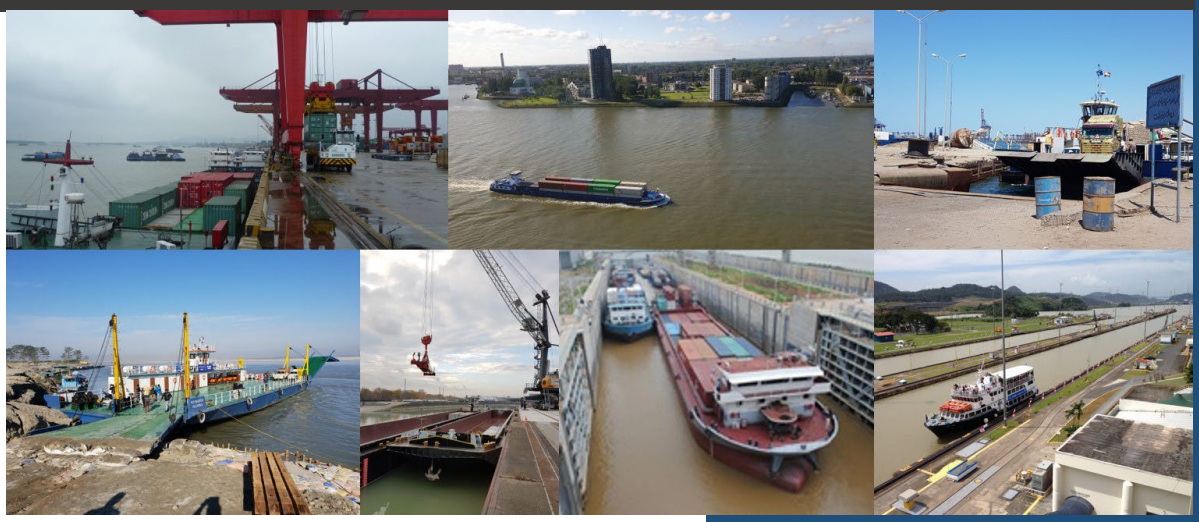
Report 165820

INLAND WATERWAYS TRANSPORT IN PAKISTAN

An Implementable Vision for Revival and Development

Final Report | February 2022



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Acknowledgements

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This report was prepared on the request of Ministry of Maritime Affairs (MoMA), Government of Pakistan and provides a roadmap for revival and implementation of Inland Waterways Transportation (IWT) in Pakistan. The methodology for the preparation of this report relied on the review of previous IWT studies and benefited greatly from extensive consultation with relevant stakeholders from both the public and private sectors in Pakistan. The information provided and numerous discussions held are gratefully acknowledged.

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Abbreviations

BCR	Benefit to Cost Ratio
CAREC	Central Asia Regional Economic Cooperation
CO_2	Carbon Dioxide
CPEC	China - Pakistan Economic Corridor (CPEC)
DST	Development Center of Ship Technology and Transport Systems
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
EXIM	Export and Import
GDP	Gross Domestic Product
GES	Good Environmental Status
GHG	Green House Gas
GNS	Good Navigation Status
IFI	International Financing Institution
IRSA	Indus River System Authority
IWAI	Inland Waterway Authority of India
IWAP	Inland Waterways Authority of Pakistan
IWT	Inland Waterways Transport
KPK	Punjab and Khyber Pakhtunkhwa
MoT	Ministry of Transport
MTA	Million Ton per Annum
NEPRA	National Electric Power Regulatory Authority
NOx	Nitrogen Oxides
O/D	Origin/Destination
O&M	Operations & Maintenance
PIANC	Permanent International Commission for Navigation Congresses (World Association for Waterborne Transport Infrastructure)
PM	Particulate Matter
PMO	Prime Minister's Office
PR	Pakistan Railways
RIS	River Information Services
RSV	River-Sea-Vessel
SCBA	Socio-economic Cost Benefit Analysis
SEZ	Special Economic Zone
SOP	Standard Operating Procedures
SOx	Sulphur Oxides
VIWA	Vietnam Inland Waterways Authority
WAPDA	Water & Power Development Authority
WWF	World Wildlife Fund

Executive Summary

The transportation of goods and people via inland waterways has lost its position in Pakistan during the last decades due to the development of land transport systems and the prioritization of other uses of waterways. Despite a series of studies and even pilot projects in the past, inland waterways transport (IWT) has received limited attention at the highest levels of government, resulting in limited action towards IWT revival and development. No entity is currently responsible for IWT development in Pakistan and a regulatory authority for the sector does not exist.

Many countries have successfully revived their inland waterway systems after decades of neglect, and the question comes up whether Pakistan can do the same and revive this low-cost, natural, high-capacity, and clean and safe mode of transport. Although the waterways in Pakistan have their own characteristics and specifics, valuable lessons can be learnt from other countries.

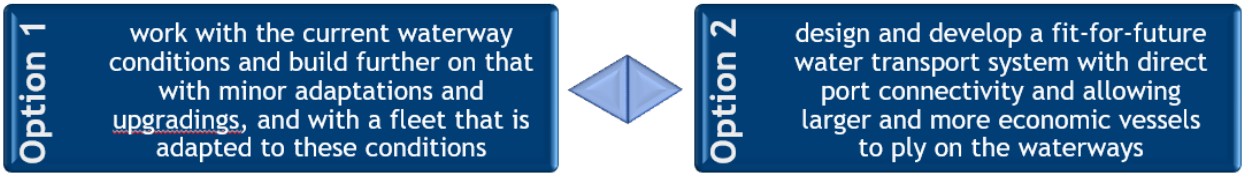
The growing attention for IWT has to do with the many advantages and the great contributions that it can offer for the national and local economies, environment, and the role it can play in realizing a better-balanced transport matrix, relieving congestion on roads. Transport via the waterways offers societal benefits; its emissions, energy use, accident rates, and noise per ton and ton-kilometer are lower compared with those of alternative systems. In addition, IWT is the safest way to transport (hazardous) cargoes. When designed appropriately, inland waterways transport fits neatly into modern multimodal supply chains, offering attractive solutions to shippers and alternative hinterland connectivity for seaports. IWT supports economic development along the waterways, providing jobs and income for people and thus local / regional societies.

In view of the benefits IWT has to offer, the Ministry of Maritime Affairs in Pakistan has requested the World Bank to provide technical support to launch the development of this very promising sector. This report is the result of the work carried out by a consultancy team between November 2020 and July 2021, which reviewed the existing legislative and regulatory framework, assessed current IWT infrastructure conditions, analyzed future markets for IWT, assess the feasibility of developing IWT (through freight flow projections, multimodal transport analysis and socio-economic cost benefit analysis) and provides recommendations for strengthening IWT infrastructure and governance in Pakistan.

Apart from restricted navigation in the form of short hauls and river crossings, IWT is very limited in Pakistan. The development of inland navigation has been seriously constrained by prioritization of other uses of waterways, limited infrastructure capacity development, lack of political support and preferred development of other modes of transportation. The current inland waterway and infrastructure conditions have serious limitations which hinder the development of a modern and fit-for-future IWT system. These include limited navigability, missing port connections, absence of terminals and a lack of standardized locks and vessels.

The other uses of the waterways in Pakistan, notably the use of the water for irrigation and hydropower generation and together with flood protection, are dominant and more

important than inland waterways transport. Any solution on the waterways network to improve navigation conditions may not hamper these other uses. With this as a starting point, the team has defined two main possible development directions for inland waterways transport in Pakistan:

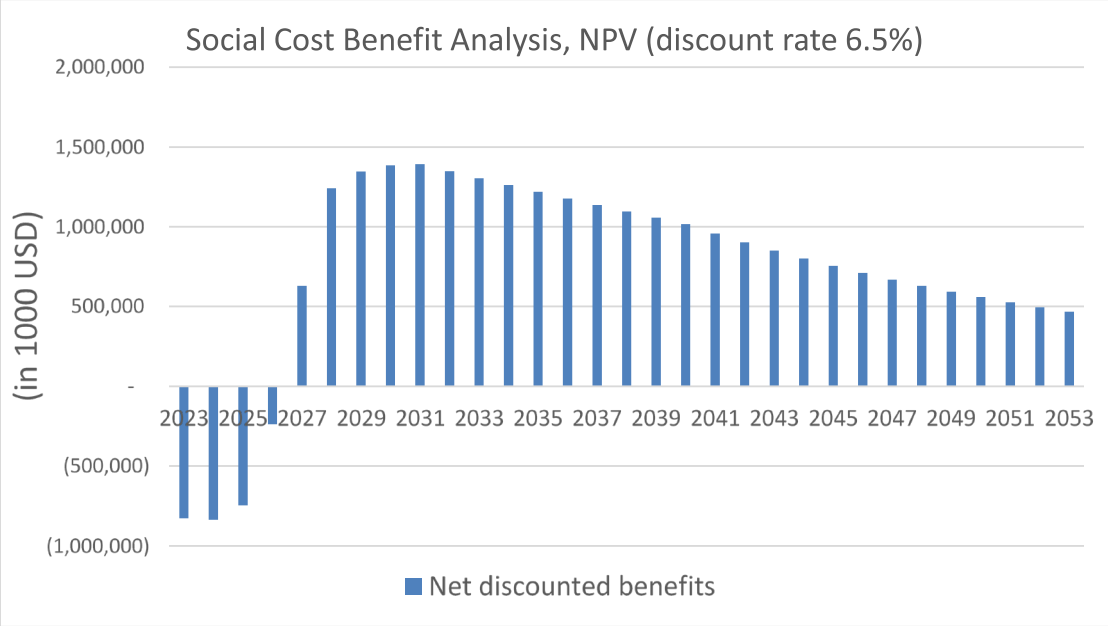


The analysis in this report demonstrates that choosing Option 1 would most likely result in the IWT system playing only a marginal role in Pakistan's transport system. The full set of advantages offered by IWT would not be realized. The creation of logistics zones along waterways would remain a possibility, but without port connectivity, the market would remain limited to local flows as it would be unable to capture the biggest freight potential which is offered by export and import (EXIM) cargoes via major seaports. Small-scale vessels, adapted to the size of existing locks and limited draft depths, from the perspective of IWT, would result in relatively high costs per ton-kilometer and limited external savings.

Option 2 is strongly recommended for developing a long-term, economically viable and sustainable IWT solution for Pakistan. It would require major investments for infrastructure development, but upon maturity, the system would a) enable possibilities for alternative supply chains via waterways with significant cost reduction, b) promote regional connectivity and international trade via port connectivity and, c) benefit communities by creating additional economic activities along waterways. The fit-for-future IWT system for Pakistan can be gradually developed, one step at a time, starting with the utilization of existing infrastructure, with a long-term development plan which identifies clearly defined intermediate steps. Moreover, long-term IWT infrastructure investments can go in parallel and/or in combination with investments in irrigation, hydropower, and flood prevention to create a WIN-WIN situation for all waterway uses. IWT solutions can be developed in a way that they do not impact prime waterway uses but are in fact beneficial for irrigation and flood prevention.

Developing IWT is socio-economically viable and is likely to result in major economic gains for the country as demonstrated by freight and passenger flow projections, multimodal transport cost modeling, multimodal shift potential estimation and simplified Socio-economic Cost-Benefit Analysis. Although limited because of data availability, a socio-economic cost-benefit analysis has been carried out to determine whether Option 2 could eventually lead to a feasible IWT system in Pakistan, and whether it is worthwhile to follow-up with detailed feasibility studies. The answer is clearly positive. In different scenarios, the analyses lead to positive results even when only transport cost advantages are considered. These advantages are further increased when adding external benefits of IWT including the creation of several logistics zones along the waterways and the integration of IWT development with better irrigation and flood prevention. The figure below summarizes the results of an integrated vision of IWT linked with economic development and other uses of the waterways.

ENPV	22,885,300	(x1000)	$	22.89 billion
BCR	6.2			
EIRR	35.1%			



In order to realize long-term sustainability and to maximize the positive aspects of the inland waterways transport system, the choice for Option 2 is an obvious one. However, additional technical studies are required to detail the fit-for-future waterways transport system and its alignment with the other uses of the waterways in Pakistan.

The other important consideration is the institutional arrangements for developing IWT in Pakistan. Currently only provincial assemblies can legislate on matters related to shipping and navigation on inland waterways. Indus River runs through three different Provinces, i.e., Khyber Pakhtunkhwa, Punjab and Sindh, meaning three different Provinces will have to legislate of this subject-matter and thereafter the question of coordination between the three authorities could also complicate the matter. Therefore, it would be more appropriate if an 'Inland Waterways Authority' is established at the Federal Level.

Although the subject-matter has been devolved to the Provinces, especially after the 18th Amendment to the Constitution of Pakistan, there are options available in the Constitution to overcome such difficulty. (i) under Part V (Relations between Federation and Provinces), Chapter 1 (Distribution of Legislative Powers). Under the provisions of Article 141, the Parliament is empowered to make laws having extra-territorial operation, (ii) in terms of Article 144 of the Constitution, the Parliament has been empowered to legislate for one or more Provinces by consent, (iii) or by a direct approach by using entry No.27 of the Federal Legislative List, which is the basic 'Commerce Clause' of the Constitution, allowing it to legislate to formulate institutional structure for an Inland Waterways Authority at the Federal level. There are a number of precedence e.g. National Electric Power Regulatory Authority ("NEPRA"), Indus River System Authority (IRSA) etc.

The IWA can be set up at the Federal level under the Ministry of Maritime Affairs, to oversee, manage and develop IWT, with representation of relevant federal ministries and provincial departments in the board. Active stakeholder participation should be an important element at all stages of development.

The following strategic development directions are recommended to the Government of Pakistan for the revival and development of the IWT system in the country:

Strategic Development Directions for IWT Revival in Pakistan

- Establish an IWT Cell at the Ministry of Maritime Affairs to streamline current IWT operations and lay the groundwork for IWT revival and institution-building.
- Establish an Inland Waterway Authority (IWA) at the Federal level under the Ministry of Maritime Affairs for developing, regulating, monitoring, and standardizing IWT in Pakistan.
- Ensure that the future Inland Waterway Authority (IWA) has a clear mandate, covering a) IWT policy formulation and implementation; b) regulation, monitoring and standardization of the IWT Sector; c) IWT market development. Its mandate should not include any other water management issues.
- Develop a legislative and regulatory framework for inland navigation in Pakistan.
- Establish IWT monitoring and support systems.
- Promote the IWT Cell to be the Pakistan Inland Waterways Authority (PIWA) at the Federal level under the Ministry of Maritime Affairs for developing, regulating, monitoring, promoting and standardizing IWT in Pakistan.
- Building upon this report, conduct a detailed feasibility assessment to inform the development of a comprehensive strategy and an elaborate action plan for IWT development under the aegis of IWA.
- Develop a fit-for-future Inland Waterways Transport system instead of relying on the existing IWT infrastructure as the current waterway conditions will not lead to economically viable and sustainable operations.
- Adopt a proactive approach to IWT market development with ongoing support programs in order to realize an IWT breakthrough in Pakistan.
- Ensure that long-term IWT infrastructure investments go in parallel and/or in combination with investments in irrigation, hydropower, and flood prevention to create a WIN-WIN situation for all waterway uses.
- Strengthen the IWT infrastructure and services in Pakistan to maximize the economic gains offered by IWT by: establishing direct port-IWT connectivity; establishing logistics zones, industrial activities and freight villages along waterways; and, developing and promoting an IWT fleet.
- Ensure that IWT development goes together with environment protection and nature conservation to preserve the freshwater ecosystem and biodiversity of the Indus River System, following a “working-with-nature” approach.

1. Introduction

1.1. Background

1. **Transport sector is one of the most integral elements of an economy as it serves as the backbone for growth and development.** In addition to playing an integral role in linking other sectors in the economy, it contributes to both domestic and international trade. In Pakistan, the transport sector constitutes more than 13 percent of the GDP and provides 5.3 percent of the employment in the country. Catering to a population of 216 million, the sector handled an estimated transport load of 118 billion ton-kilometer per annum and is expected to grow nearly by 40 percent in the next decade. Road transport is the backbone of Pakistan's transport system, carrying 98 percent and 94 percent of the total freight traffic and passenger traffic, respectively. However, the road network is heavily stressed as 80 percent of the total traffic load is borne by the National Highway and Motorway network.[1]

2. **The transport sector in Pakistan is severely constrained due to structural inadequacies, operational inefficiencies, fragmentation, modal imbalance, and a lack of holistic development of transport modes.** Consequently, the transport network is under severe strain with significant transportation delays, resulting in high costs of doing business in the country. Further, a lack of implementation of regulatory guidelines and reforms on truck manufacturing, permissible axle load and general road safety have deteriorating effects on transport infrastructure, society and the environment. These challenges restrict Pakistan's economic growth and competitiveness in the global market.

3. **However, Pakistan's transport sector is undergoing a significant transformation under the National Transport Policy of 2018, the National Transport Master Plan and the Pakistan Vision 2025** which aim to address the aforementioned sectoral challenges, boost the sector's contribution to the national economy and tap into the opportunities offered by the country's strategic location. The strategy is to holistically rehabilitate the transport sector through reforms and investments aimed at strengthening the existing network and its utilization by developing infrastructure, upgrading systems, achieving optimal modal balance, enhancing safety systems, improving enforcement of regulations, strengthening regional connectivity, and reducing environmental impact.

4. **Pakistan's elaborate river and canal systems hold immense untapped potential for developing Inland Waterways Transport (IWT).** The National Transport Master Plan envisages the revival of IWT in the country via the Indus River System, which comprises of the Indus River, its four major tributaries (Jhelum, Chenab, Ravi and Sutlej) and 10 smaller rivers (Kabul, Swat, Chitral, Shyok, Gilgit, Kurram, Gomal, Hunza, Soan and Suru). Reviving IWT will not only provide road networks with much-needed relief by providing an alternative cost-efficient

[1] National Freight and Logistics Policy 2020 and National Transport Policy 2018

mode for moving people and for freight, but also reduce the transport sector's overall carbon footprint. However, the lack of an institutional, legal and regulatory framework has inhibited the development of the sector despite the advantages it has to offer. Currently, it is not possible to utilize IWT potential because there is no entity responsible for this sector and the management of inland waterways is divided amongst several institutions.

Figure 1: Major rivers and lakes in Pakistan

5. **The Ministry of Maritime Affairs has requested the World Bank to provide technical support in assessing the feasibility of IWT revival in Pakistan and developing this promising sector**. The World Bank – through a team of consultants – conducted feasibility assessments to holistically examine the viability for establishing an IWT network and help setup a new Inland Waterways Authority, that shall hold responsibility for developing, maintaining, and operating inland waterways in Pakistan. This report is the result of the work of a consultancy team, carried out between November 2020 and March 2021.

1.2. Objectives of the Report

6. **The following are the objectives of this report:**
   i. Assess current IWT infrastructure conditions in Pakistan and define parameters for developing a fit-for-future IWT network in the country.
   ii. Analyze future markets for IWT in Pakistan and provide recommendations for developing a strategy for IWT to serve the identified markets.
   iii. Assess the feasibility of reviving and developing IWT in Pakistan through freight flow projections, multimodal transport analysis and socio-economic cost benefit analysis to estimate the socio-economic costs and benefits for different IWT development options.
   iv. Outline an implementable vision for reviving and developing IWT in Pakistan so that IWT can make a positive contribution towards developing a sustainable transport system in Pakistan.
   v. Review existing legislative and regulatory framework for IWT in Pakistan and provide recommendations for developing the institutional framework for IWT governance in Pakistan.

1.3. Methodology

7. **A range of methodological tools have been used for the development of this report, the details of which are as follows:**

1.3.1. Review and Analysis of Previous Studies on IWT in Pakistan

8. **A desk review and analysis of 23 previous studies on IWT development in Pakistan was conducted.** These studies were published by various consultants, development agencies and government institutions between 1962 and 2017. The key findings of these studies have been summarized in Section 3.5 of this report, whereas a detailed review of the previous studies has been provided in Annex A.

1.3.2. Legal Review

9. **A review of the existing legislative and institutional framework related to the management of inland waterways in Pakistan has been conducted, with the aim of identifying existing gaps** (see Section 3.3 and 3.4) and providing recommendations for developing a governance system that promotes and supports IWT development in Pakistan (see Section 4.2). It assesses

the possibility of setting up a dedicated authority for IWT in Pakistan and provides specific recommendations for setting up the authority while outlining its mandate and functions.

1.3.3. Traffic Forecasting

10. **As the main potential for a future IWT system lies in hinterland transportation from Karachi Port and Port Qasim, a 20-year freight forecast has been worked out for the two ports as part of a parallel World Bank Port Study (2020).** A rough estimate has been made on the basis of a targeted IWT modal share analysis for freight volumes between the downstream area (Karachi Region) and the upstream point (Daudkhel/Kalabagh) with certain assumptions regarding the share of IWT in specific transport sectors. Although the focus is on freight volume forecast, passenger transport potential for the IWT system has also been estimated based on surveys in the framework of the Punjab IWT pilot project, public transport data, and estimates by the consultants. Please refer to Section 5 for the freight and passenger flow projections, the details of which have been provided in Annexes B, C and D.

1.3.4. Multi-modal Freight Flow Analysis

11. **To estimate the future potential IWT volumes and share in the modal mix (road, rail, IWT), a multimodal transport cost model is developed to compare freight flows on origin/destination level.** The model assesses the existing and projected port-hinterland cargo flows in Pakistan, and distribution of these flows on the Pakistan territory. In additional to the forecasted traffic volumes in annexes B to D, based on a multimodal cost comparison, comparing alternative IWT development options with alternatives via multimodal rail and direct road, the multimodal modal shift potential for the selected origin/destination combinations is determined. Please refer to Annex E for the multi-modal freight flow analysis, the summary and key findings of which have been provided in Section 5.

1.3.5. Simplified Socio-economic Cost-Benefit Analysis (SCBA)

12. **Based on the multimodal transport analysis and preliminary assessment of investments in IWT infrastructure, a socio-economic cost benefit analysis has been carried out** in line with international practices and guidelines from most of the International Financing Institutions (IFI). The simplified SCBA takes into account both direct and indirect benefits, including transport cost savings, economic development along waterways, creation of employment opportunities, environmental benefits. It also considers benefits related to the realization of Good Navigation Status to ensure minimum service levels for navigation in combination with win-win solutions for other waterway uses, such as irrigation and flood control. The SCBA methodological approach and its key findings have been summarized in Section 5, whereas the detailed version has been provided in Annex E.

1.3.6. Country Case Studies

13. **Country case studies have been developed to study and analyze the management and governance of the IWT sector in three countries: China, India and Vietnam.** The aim of

developing these case studies was to analyze and learn from the measures adopted by these countries to address various challenges in reviving and developing their IWT systems, while shedding light on their governance mechanism for IWT development and integration. The case studies provide practical examples on policies, pilot projects, and application of new multimodal and logistics approaches in this conventional type of transport. Pakistan can greatly benefit from the experiences of these countries as they have been able to transform IWT from a dormant mode of transportation into a highly vivid and modern mode of transportation that serves the economy, works with the environment and adds value to society. The key findings and lessons learnt from the case studies have been outlined in Section 2.2 of this report whereas the detailed country case studies have been provided in Annex F.

1.3.7. Consultative Workshop with Key Stakeholders

14. **On 8 June 2021, an online consultative workshop was held with 65 representatives from federal and provincial government stakeholders, Civil Society Organizations, research institutions, think-tanks and private sector organizations.** The objectives of the consultative workshop were to:
    I. Build consensus on a shared vision for developing Pakistan Inland Waterways Transportation (IWT).
    II. Reach agreement on the governance and institutional arrangement for managing IWT.
    III. Develop a blueprint for a phased approach to implementing IWT system in Pakistan.

    The findings of the consultative workshop have incorporated into this report whereas the consultation report has been provided in Annex G.

1.3.8. Peer-review

15. **The report has been reviewed by a team of World Bank experts that have been extensively involved in previous and ongoing studies on IWT development across the globe.** Detailed feedback and suggestions from the reviewers on the findings have been incorporated in this report.

1.4. Limitations of the Report

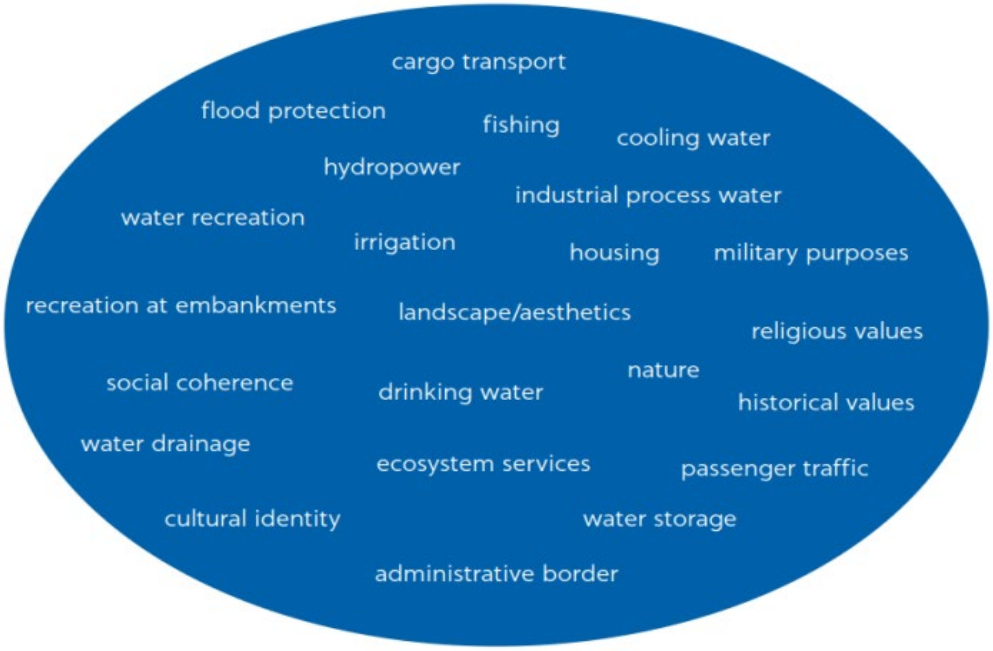
16. **The report is the first one in Pakistan that addresses IWT development in an integrated manner by taking into account various aspects related to infrastructure, markets, governance, multimodality, environment and competing waterway uses. However, this report primarily relies on existing literature and available data and no new empirical research was carried out for the development of this report.** Due to non-availability of data in a number of study areas (which also has to do with the fact that IWT is practically non-existing in Pakistan), assumptions have been made in a number of cases on the basis of reference data from other countries. As freight flow data at origin/destination level is not available for Pakistan, estimates have been made and certain components have been omitted. Despite these limitations, the transparent nature of the report and its methodological components invite and encourage

further studies and assessments to fill in the missing gaps as part of potential next steps. With reference to the financial feasibility or "bankability" of IWT in Pakistan, the results of the 'simplified' SCBA should be considered as preliminary, paving the way for comprehensive follow-up research to analyze the socio-economic feasibility of developing IWT in Pakistan in greater detail.

2. Why Inland Waterways Transport (IWT)?

17. **IWT has been one of the oldest modes of transportation utilized by humans, offering a naturally available, low-cost and high-capacity mode for transporting both goods and people.** However, besides transportation, inland waterways also served as key sources of fresh water for drinking, irrigation, fishing, washing and sanitation for early human settlements. Over time, innovation and technological advancements opened new avenues for inland waterway utilization, such as hydropower generation and industrial water usage. Figure 2 illustrates some of the major uses of inland waterways in the modern era.

Figure 2: Major uses of inland waterways



Source: PIANC WG 139 2013

18. **The diverse uses of inland waterways often compete. This inevitably results in conflict of interest among users and beneficiaries, because of which, other uses of waterways are prioritized with IWT often taking the backseat.** In the case of Pakistan, IWT has disappeared over time because of the prioritization of two other uses of inland waterways due to their socio-economic importance: irrigation and hydropower. The construction of dams, barrages, and hydropower complexes with small-scale or no ship-locks rendered IWT via large-scale vessels which can carry high volumes of cargo over long distances unviable.

Figure 3: Multiple uses of riversides in Pakistan

Source: Punjab IWT pilot project

2.1. Benefits of Inland Waterways Transport (IWT)

19. **IWT is an efficient, cost-effective, and environmentally friendly way to move freight over long distances. As international experiences show, it can also be a viable mode on shorter distances and for non-bulk commodities once the conditions are right.** Efficient use of waterways to transport cargo can reduce transport cost, fuel consumption, road congestion and vehicle emissions. IWT development can lead to safety benefits with the replacement of heavy goods vehicles which are responsible for an alarmingly significant number of traffic accidents each year. In the case of Pakistan, a modal shift from road transport to inland navigation would also significantly boost the economy by lowering logistics costs and providing support to local communities along waterways.

20. **Furthermore, IWT also has the potential to support regional cooperation and integration, by creating a common transport route across several countries that share the same river.** This is demonstrated by how Europe has utilized rivers such as the Danube and Rhine to promote trade across the continent. If the regulatory framework and master plan for IWT development is done right, this sector can not only improve traffic efficiency, safety, and the environment, but it may also prove to be catalytic for South Asian regional integration by providing an opportunity to connect to the East (India and Bangladesh) or the West and North (Afghanistan and Central Asia). IWT can holistically promote local and regional trade, attract investment, and stimulate development.

21. **The drive for sustainable transportation that meets economic goals while reducing the impact on the environment and society has refocused the attention of policy makers on**

the potential of IWT, which has significant advantages over or in combination with other modes in logistics chains. In countries that have developed IWT, it has provided an alternative low-carbon mode for moving people and freight, and its advantage increases with transport distance and cargo volume. In mature IWT systems that are characterized by modern vessels with low energy use and efficient operations, IWT is also cost-effective for shorter distances and smaller shipments — especially in cases without pre- and end haulage by road. IWT reduces road congestion, energy consumption, emissions, accidents and noise per ton kilometer. It is also the safest way to transport hazardous cargoes. When designed appropriately, IWT fits neatly into modern multimodal supply chains, offering attractive solutions to shippers.

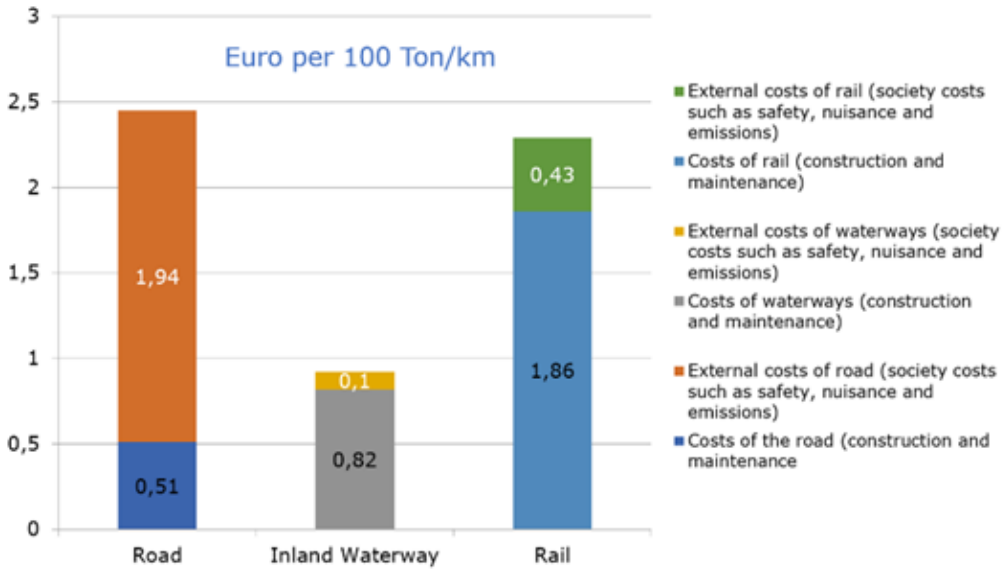
22. **IWT's emissions per ton and ton-kilometer are lower in comparison with alternative modes.** Recent European data indicate that IWT's environmental performance per ton-kilometer for a bulk vessel is only 10 percent of that of a truck for carbon dioxide (CO_2) emission, 13 percent of a truck for nitrogen oxides (NOx), and 50 percent of a truck for particulate matter (PM)[2]. Data from the United States indicate that CO_2 emissions per unit turnover of barges are just 8 percent of highway transport's, NOx emissions are 4 percent and PM emissions are 25 percent of that of highway transport, respectively.[3]

23. **While credible and reliable data is not available for comparing IWT costs with other transportation modes in South Asia, we can use the EU's example to demonstrate the economic and societal benefits offered by IWT**. Figure 4 provides a comparison of infrastructural and external costs of rail, road and inland waterways transportation in the EU in euro per 100 ton-kilometer.

[2] CE Delft, 2017.

[3] US Environmental Protection Agency, 2018.

Figure 4: Cost comparison of the inland transport modes in the EU



Source: Dutch Inland Shipping Information Agency; The Power of Inland Navigation, 2009

24. **At this moment a number of countries are in a similar position as Pakistan, notably this concerns waterway basins where IWT has lost its position in recent years, and where governments are struggling with how to create a good starting position for the redevelopment of the IWT system.** The focus logically first is at providing the proper production means such as the infrastructure conditions, the fleet and the governance. A new thinking however spreads quickly and the value of the waterway as a shared resource is rapidly gaining ground. The example countries described in the case study report, are illustrations of the adaptation of this new thinking and of less conventional and innovative approaches in redeveloping IWT systems. Different values of the waterways are taken into account and are more balanced, in case of IWT this means that improvements in the IWT system preferably go parallel with improvements in other areas, leading to a win-win situation for the waterway system as a whole.

2.2. IWT Success Stories from the Asia-Pacific Region

25. **The case of IWT decline in Pakistan is not unique as there are many countries where inland navigation has been neglected for many years, and where IWT infrastructure has not been maintained or developed.** Many of the world's rivers that used to anchor national freight and associated economic activities no longer do so (for example, the Amazon, the Nile, the Ganges, and the Volga). However, an increasing number of countries are now discovering the economic, social and environmental value of inland navigation and are setting up programs to redevelop their IWT systems.

26. **The "Country Case Studies on the Management and Governance of IWT Sector" (provided in Annex F) outline in detail the valuable lessons learnt from the experiences of IWT**

revival in China, India and Vietnam by providing examples of effective policy reforms and pilot projects, as well as the successful application of new approaches to multimodal transportation and logistics in IWT. The case studies show that it is possible to change IWT from a dormant transport mode into a highly vivid modern type of transport that serves the economy and society. The key lessons are summarized below and are valuable for the preparation of the Strategic Plan for IWT development in Pakistan.

3.2.1. Lessons learnt from China

27. The redevelopment of IWT in China took several decades but has resulted in the largest and one of the most innovative IWT systems in the world. Starting as an infrastructure program, it changed to a broader sector approach focusing more and more at quality improvements and supporting policies. The five key lessons from the Chinese experience with IWT are:

i. Strong and sustained support from the highest level of government coupled with coordinated central planning and support systems are a prerequisite for addressing the multisector and multiuser challenges in reviving IWT.
ii. Strong institutions with clear roles and responsibilities are needed for coordinated development of inland waterways transport.
iii. After several years of non-investment, public sector funding is inevitable, especially during the nascent stages of IWT development.
iv. The improvement of infrastructure and fairways, the standardization of vessels, and the classification of waterways need to be synchronized.
v. Dedicated education and learning institutions for all aspects of IWT are needed to revive the sector.

3.2.2. Lessons learnt from India

28. India had an IWT sector that had nearly disappeared over the years. The federal government adopted an IWT development program, established a federal Inland Waterway Authority of India (IWAI), declared a number of waterways as national waterways and piloted modern principles in its development projects. The following key lessons can be taken away from the revival of IWT in India:

i. After decades of neglect, the IWT sector in IWT is reviving and volumes are increasing fast. Although modal share is still modest, the development of a number of waterways has started and the showcase project on national waterway 1 (Ganga/Hoogly Basin) is paying off. The approach followed in India is an example for the development of the other waterways in India, as it gets away from the conventional 'build and they shall come' principle and adopts a new and modern vision on IWT development and management.
ii. A main driver behind IWT development is the PMO office which adopts the development of IWT as a main policy goal, and a means to develop poor areas along the waterways. A new program (Arth Ganga) is developing waterways as a self-sustainable, economical, safe & environment friendly mode of transport.

iii. The Ministry of Shipping, Ports and Waterways and its implementing body IWAI, are strong institutions with a clear vision, role and functions where IWT is concerned. Notably IWAI goes beyond the boundaries of a typical waterway authority and takes up its promotion and development in an exemplary manner. Unfortunately, it is constrained by capacity limitations, particularly with respect to human resource. Capacity building in the sector is one of the areas that needs to be addressed, possibly combined with the setting up of a R&D and knowledge cluster.

iv. The India case study shows that with high level political support, a long-term vision, and a clear implementation structure, the revival of IWT system is possible.

3.2.3. Lessons learnt from Vietnam

29. The situation in Vietnam is different from China and India, as Vietnam has always had an important IWT sector, with a very high modal share in transport. Large part of the IWT system in Vietnam focuses on local transport with very small vessels, and the system is now in a process of modernization the development of new markets and fleet-upgradation to meet modern logistics requirements. The following lessons can be drawn from the Vietnam case study:

i. Due to IWT sector's importance, the government is fully aware of the potential of a growing IWT sector and relevance for a more sustainable transport system.

ii. The same goes for shippers and industries, for which the use of IWT is common business and the need for market development, active promotion and support may be less in comparison to other countries.

iii. There is a need to upgrade the IWT sector for better performance and improved multimodal connectivity, considering the age and size of the inland fleet.

iv. Vietnam Inland Waterways Administration (VIWA) is managing the sector and does this in a conventional manner. The mandate of VIWA is clear and relates to policy implementation, infrastructure development and maintenance, and the management of the IWT sector. Although the mandate of VIWA also includes functions as market monitoring or analysis, there does not seem to be much involvement, possibly due to the prioritization of the operational field, and budgetary and human resource constraints.

30. **These abovementioned case studies and experiences show that development and revival of IWT is worth considering.** But it requires a long-term strategy, an integrated vision, alignment of IWT with other waterway needs, high level political commitment, strong guidance, and institutions with a clear role and mandate.

3. Overview of the IWT Sector in Pakistan

3.1. History of IWT in Pakistan

31. **The use of the River Indus System for transportation in Pakistan traces its origins to the Harappan Civilization.** During that period, these waterways were not only used as transportation channels by sailboats carrying trading materials meant for Mesopotamia and rafts transporting building materials from the upper reaches of the Indus and its tributaries, but also as a direct medium for transportation as wood was floated down to the Indus Basin from the Kashmir region. The Indus River System continued to be widely used for transportation well into the latter half of the 19th century.

32. **During the British Raj, the Indus Flotilla Company was established in 1859 which employed steamers and barges to move mail, people and freight all the way from Arabian Sea to the city of Makhad** (located in current day District Attock in Northern Punjab). Incoming cargo was first unloaded at Karachi's Kimari Harbor and then loaded onto smaller boats which took a circuitous route to the Jhirk Terminal on the banks of Indus. At Jhirk, cargo was shifted to Indus Flotilla steamers, which took it upstream to Multan (connected to Lahore and Delhi via railway) and Kalabagh. With the opening of Karachi-Kotri railway link in 1861, Jhirk terminal lost its significance as incoming cargo was carried via rail directly to Kotri where it was then loaded on Indus Flotilla — saving almost 250 kilometer of river travel distance. Following the establishment of rail-link between Karachi and Lahore in 1878, the Company lost its relevance and experienced a steady decline until it was eventually abolished in 1882-83. [4]

33. **The Indus is the most important supplier of water resources to Punjab and Sindh, forming the backbone of agriculture and food production in Pakistan.** The river is especially critical since rainfall is meagre in the lower Indus valley. Modern irrigation was introduced by the British East India Company in 1850 with the construction of modern canals accompanied with the restoration of old canals. At the time of Independence in 1947, Pakistan inherited a well-developed riverine and canal system that extended from Sindh to Khyber Pakhtunkhwa. Fearing the stoppage of water in eastern rivers, link canals were constructed to overcome a perceived shortage of irrigation waters in the eastern half of the irrigation system. This irrigation system has also been extended substantially through the construction of dams, barrages with locks and canals, thereby providing an opportunity of introducing waterborne transportation. All the perennial canals have a navigable depth (not less than 2 meters) but have low bridges. Some canals have the sizes of rivers, like the Nara Canal that has a width of 100m and a depth of 11-20ft and the Link Canals with a width of 100m and 9ft draft. Over the years, construction of barrages to support irrigation, neglected maintenance, global warming and inadequate depths due to shortage of water have restricted navigation in long stretches. In plains, the river

[4] https://www.irfca.org/articles/indus-flotilla.html

meanders and shifts a few hundred meters to kilometers, making it impossible to select a permanent channel for navigation.

Figure 5: Images of Pakistan's rivers and canals

Source: Punjab IWT pilot project – World Bank

34. **Following the construction of dams and barrages after the Indus Water Treaty, Pakistan no longer has a link between its main waterway — the Indus, and the sea.** There was thus little appeal for multimodal IWT traffic. The result of these interventions and low political attention is that, even though Pakistan is blessed with substantial riverine and canal waterways, IWT has become irrelevant, except for some localized traffic on the rivers in the form of ferries across rivers and some wider canals.

Figure 6: Guddu Barrage

Source: World Bank

Figure 7: Ship-lock at Chashma Barrage

Source: Punjab IWT pilot project

35. **Re-establishing IWT in Pakistan has been on the drawing boards since 1959 when a Presidential Order was issued to examine the feasibility of transportation along the country's river and canal systems.** This was based on economic as well as strategic considerations since the existing rail and road networks were deemed vulnerable because they ran parallel to each other and a rail-road bridge between Kotri and Sukkur provided the only link between Punjab and Sindh.

36. **As an extension to the construction work under the Indus Water Treaty, inland navigation was first examined in a 1962 study by consultants from WAPDA for the Indus Basin link canals of Tipton and Kalm Bach.** It explored the possibility of using the link canals as a means of transportation. Since then, more than a score of studies and papers have examined the potential and feasibility of IWT development in Pakistan. The focus of these studies was to support a substitute and inexpensive mode of transportation for the movement of international freight to and from the port at the mouth of River Indus and the hinterland commercial centers. However, no positive decision was taken to promote this sector. The recommendations in these reports included the need to carry out further studies for the development of missing connectivity between Port Qasim and inland waterway network in Sindh, Punjab and KP. In total more than 23 studies (see Section 4.3) were carried out between 1962 and 2017, and although most studies confirmed the navigation potential and the technical feasibility no actions were taken to start implementation. A 1993 study by Louis Berger reconfirmed the potential and provided a roadmap as well, but it was not implemented. Please refer to Section 3.3 for more details.

37. **For almost seven decades this important resource remained undeveloped, when in 2017, Government of Punjab took the initiative to shift the focus from international trade to domestic movements, thereby introducing a pilot project that covers less than 500 km stretch of the River Indus between Attock and Daudkhel, and Daudkhel and Taunsa.** The pilot project proved the technical feasibility, and economic feasibility (EIRR 21.61%, BCR 1.8 and ENPV at 12% discount rate = Rs. 8,372 million). Unfortunately, the specially set up public company, Punjab IWT Development Company was dissolved after the pilot project and the recommendations of the pilot study were not implemented.

38. **The draft of the National Transport Policy, prepared in 2009, for the first time identified a major role for IWT. The stated objective was identified as the provision of an efficient, effective transport alternative to road and rail transport, thereby reducing costs and environmental impacts.** It is, presumably, within this context that most recently, and for the first time, IWT finds a place in the development and enunciation of the Five-Year Plan by the Planning Commission. In the forthcoming 11th Five Year Plan, a budgetary provision of Rs. 60 million has been made for IWT in the Public Sector Development Program. In addition, Private financing of Rs.300 million is also envisaged.

3.2. Current IWT operations in Pakistan

39. **Apart from restricted navigation in the form of short hauls and river crossings, IWT is very limited in Pakistan in terms of distribution and scale.** There is limited local traffic in the lower plains of Jhelum, Chenab, Ravi, and Sutlej, and on the Indus River in the stretches between Kalabagh and Sukkur, as well as Sukkur and Hyderabad. As previously discussed, the development of inland navigation was seriously constrained by prioritization of other uses of waterways, limited infrastructure capacity development, lack of political will and preferred development of other modes of transportation.

3.3. Legal Framework for IWT Regulation in Pakistan

40. **As a post-colonial state, Pakistan inherited most of its laws from British India and many such colonial laws continue to exist with minor adaptations.** The following laws that were enacted by the British Raj to regulate the canal and irrigation systems, continue to be on the statute book with minor changes as the primary laws for regulating waterways and waterbodies in modern-day Pakistan:

    i. The Canal and Drainage Act, 1873
    ii. The Punjab Minor Canals Act, 1905

    The preamble of the Canal and Drainage Act, 1873 (the "Act of 1873") reads as follows:

    > *"Preamble: Where throughout the territories to which this Act extends, the Provincial Government is entitled to use and control for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes, sub-soil water and other natural collection of still water; and whereas it is expedient to amend the law relating to irrigation, navigation and drainage in the said territories, it is hereby enacted as follows:"*
>
> (Emphasis supplied)

41. **In so far as 'navigation' is concerned, this law is limited to section 49 to 54 of the Act of 1873 [PART VI titled 'OF CANAL NAVIGATION'].**

    Section 49 of the Act of 1873 is reproduced below for ease of reference:

    > *"49. Detainer of vessels violating rules: -- Any vessel entering or navigating any canal contrary to the rules made in that behalf by the Provincial Government, on so as to cause danger to the canal or the other vessels therein, may be removed or detained, or both removed and detained by the Divisional Canal Officer, or by any other person duly authorized in this behalf."*

    It is interesting to note that as per definition provided in sub-section (4) of section 3 of the Act of 1873], a 'vessel' is defined as follows:

"(4) "Vessel" includes boats, rafts, timber and other floating bodies;"

42. **There were Rules made by the Provincial Government under section 75 of the Act of 1873 but to the extent of PART VI NAVIGATION (section 49-50) only Rule 39 was made, which is reproduced below:**

"39. Ferry and steam boats. Ferry and steam boats shall not be permitted to ply on the canal, except under written licences which shall be in the form contained in Appendices II and II-A, respectively from the Divisional Canal Officer, and subject to the conditions therein laid down. An appeal against an order revoking such licences may be preferred within 15 days to the Superintending Canal Officer, whose order shall be final"

The above Rule was applicable only to the Chenab Inundation Canals but it was subsequently omitted by the Provincial Government through a notification No. SO (Rev) I&P-3-98/2007 dated 13 August 2007.

43. **The most recent development in the legal regime was the "Punjab Irrigation and Drainage Authority Act, 1997" (the "Act of 1997"). It is very interesting that in the preamble, the term 'navigation' is conspicuously missing.**

"Preamble.—Whereas it is expedient to establish the Punjab Irrigation and Drainage Authority to implement the strategy of the Government of Punjab for streamlining the Irrigation and Drainage System; to replace the existing administrative set-up and procedures with more responsive, efficient and transparent arrangements; to achieve economical and effective operation and maintenance of the irrigation, drainage and flood control system in the Province; to make the irrigation and drainage network sustainable on a long-term basis and introduce participation of beneficiaries in the operation and management thereof; "

44. **Under section 2 of the Act of 1997, an authority called "the Punjab Irrigation and Drainage Authority" was established. Section 5 of the Act of 1997 contained the powers and duties of the Authority.** Certain powers and duties of the Authority (sub-sections (3), (6), (12) and (27) of section 5 of the Act of 1997) which are relevant for the purpose of this study are reproduced below:

"(3) To exercise all the powers under the Canal and Drainage Act, 1873, the Soil Reclamation Act, 1952 and any other law for the time being in force relating to the subject-matter of these Acts."

"(6) To formulate and implement policies in the water resources sector with a view to continuously improve and achieve effective, economical and efficient utilization, preservation and improvement of such water resources by the water users of the Province on a sustainable basis."

"(12) To plan, design, construct and improve the irrigation, drainage, storage, reservoirs and flood control system with a view to ensure optimal utilization of the water resources of the Province on an equitable and efficient basis."

"(27) To formulate and implement policies with a view to ensure that the Authority and other entities as the case may be under this Act become fully operative a self-supporting and financially self-sustaining entities to the extent of full recovery of O&M cost of canals and subsidiary drains within a period of 7 to 10 years."

45. **In terms of section 8 of the Act of 1997, the Authority has the control over Provincial water resources. Section 8 is reproduced below:**

"8. Control of Provincial water resources.—Subject to the Indus Water Treaty (1960) and Water Apportionment Accord (1991), the Authority shall have control over all the rivers, canals, drains, streams, hill torrents, public springs, natural lakes, reservoirs (except such reserves as are under the control of WAPDA) and underground water resources within the Province to give effect to schemes to be prepare under the Act in relation to public purposes."

46. **During the year 1997, Irrigation and Drainage Authorities were also established in the Provinces of Sindh, Balochistan and Khyber Pakhtunkhwa by replicating the same law.**

3.4. Institutional Framework for IWT Administration in Pakistan

47. **Under Article 70 of the Constitution of the Islamic Republic of Pakistan, 1973, the Parliament has been empowered to legislate on all matters contained in two lists provided under sub-Article (4) of Article 70.** These were the "Federal Legislative List" and the "Concurrent Legislative List". The only difference was that the Parliament could exclusively legislate on all matters contained in the Federal Legislative List, whereas the Parliament as well as the Provincial Legislatures were both empowered to legislate on matters contained in the Concurrent Legislative. In terms of the provisions and scheme of legislation under the Constitution, the subject of IWT was provided in entry No. 32 of the erstwhile Concurrent Legislative List of the Fourth Schedule to the Constitution of the Islamic Republic of Pakistan, 1973, which was as follows:

"32. Shipping and navigation on inland waterways as regards mechanically propelled vessels, and the rule of the road on such waterways; carriage of passengers and goods on inland waterways."

Subsequently, due the Eighteenth Amendment to the Constitution of Pakistan (2010), this Concurrent Legislative List was omitted, meaning thereby that going forward only the Provincial Legislatures were exclusively empowered to legislate on Entry No. 32 which entails shipping and navigation on inland waterways.

Unfortunately, no such legislation for providing an institutional structure for shipping and navigation on inland waterways has been enacted by any Provincial Legislatures till date.

3.5. Previous Studies on the IWT Sector in Pakistan

48. **A review 23 studies conducted in the past has been provided in Annex A. In general, most studies confirmed the navigation potential and the technical navigability of inland waterways in Pakistan.** Although several of these studies were carried out decades ago, most of their conclusions and recommendation are still valid and applicable. The summary of some of the most relevant studies has been provided below:

49. **In 1926, the US Army Corps of Engineers undertook a detailed survey[5] and observed that**:
    - The rivers in the Indus system, in general, have low and somewhat unstable banks, substantial meanderings, and exhibit braiding characteristics to a marked extent. During the dry weather they have sluggish discharge, shallow depths, and exposed sand or silt bars.
    - Indus River is navigable from Sukkur to Daudkhel. Downstream of Sukkur there is practically no water in the Indus during winter months. From Sukkur to Kotri, navigation is possible along Nara Canal down to Jamrao Weir and then a new link canal, to outfall the Indus at about 12km upstream of Kotri Barrage.
    - From Kotri, Pinyari feeder on the left, may serve as the first part of the navigation canal to the sea, through Indus. The reach of the Indus downstream of Thatta was subject to tidal action and could easily be made fit for navigation through various creeks up to Keti Bunder.

50. **A 1975 NESPAK Report[6] established technical requirements of a navigable channel and proposed a new route:** Sukkur to Kotri Barrage via Nara Canal, Jamrao Canal and link to Indus 23km upstream of Kotri Barrage, then to the sea by Kalri Beghar Feeder to Kalri Lake and a 50km still water link from Kalri Lake to Gharo Creek, Port Qasim.

51. **In 1976, WAPDA surveyed[7] the main Indus River from Kalabagh to Sukkur and concluded that no major obstructions existed**, and it was navigable throughout the year for 1.3m draft boats.

52. **An Indus River Navigation Study[8] by Louis Berger in 1993 reviewed various options which are combinations of IWT and rail/road transshipment, and IWT-Sea to Kalabagh.** The study reviewed multiple alternate routes:

[5] US Corps of Engineers, Delft Hydraulics Laboratory, Maritime Research Institute Nederland; 1985; Inland Water Transport Mission Report; Delft and Washington
[6] NTRC/NESPAK; October 1975; Inland Water Route Port Qasim to Sukkur Reconnaissance Report; Islamabad
[7] NTRC/NESPAK And WAPDA; 1975-76; Inland Water Route Port Qasim to Sukkur Reconnaissance Report; Islamabad.
[8] Louis Berger International and Bahria Maritime Services; 1993; Indus River Navigation Study; Karachi.

- Port Qasim to Kotri: Gharo Creek from Port Qasim to Gharo Town, still water channel connecting to KB Feeder lower to just below Kalri Lake. KB Feeder upper from Kalri Lake to upstream of Kotri Barrage.
- Kotri Barrage to Sukkur Barrage:
  a) Kotri Pond to Sukkur Pond via Indus River and new lock at Sukkur Barrage;
  b) using Nara Canal: from Kotri Pond 18.5 miles upstream, new channel to Jamrao Canal to Sukkur Pond; and,
  c) second option is Indus River from Kotri Pond to 45 miles upstream near Hala to new link to Nara Canal to Sukkur Pond.
- The waterway system generally attracts relatively low volumes. In this case, less than 3 million tons by year 2000 and less than 4.5 million tons by 2020.
- The best rate of return and benefit cost ratio was obtained under the optimistic demand and present rail scenario with the water segment between Sukkur and Port Qasim utilizing the Indus River above Kotri.
- This is the option that has an IRR close to the 15% cost of capital under optimistic demand scenario, no rail improvements and no loss of traffic when closed for 120 days and use of 900/1200-ton barges.

53. **Royal Haskoning (2017) carried out a feasibility study[9] of the Punjab IWT pilot project for reaches between Attock-Daudkhel & Daudkhel-Taunsa.** The consultants carried out multi-beam surveys, demarked correct "Thalweg" alignment and calculated dredging requirements. In Reach 1 from Attock to Daudkhel (170km), the river has high currents and turbid waters with eddies and vortices forming at many locations. A barge fleet was proposed with 25.0 m length x 5.0 m beam x 1.5 m draft which can pass through Jinnah and Chashma barrages. Two or three barges may be joined and pulled in tow with a tug to transport up to 500 Tons cargo. Four sites in Reach-1, (Attock, Khushalgarh, Makhad and Daudkhel) were selected as river ports. A detailed viability analysis indicated positive results. In Reach 2 — Daudkhel to Taunsa (340 km), the river spreads from few meters to kilometers at places, highly braided and meandering pattern with a dendritic system of arteries/branches. The river oscillates significantly, up and down within the flood plain, making it a highly unstable system. Dredging and demarking a sustainable "Thalweg" in this section, is virtually impossible as any capital works would vanish in few months. In this section, three sites were selected as river ports (Chashma, Bhakkur and Taunsa). After consideration of various alternatives, recommended construction of a 60 m wide x 3 m deep flood control cum navigation channel on Punjab Side, within the riverbed width. In addition, the channel has 1.5 m high flood protection bunds on both sides. The pilot project was continued, which meant that the specially set up public company, the Punjab IWT Development Company, was dissolved, and the study recommendations were not implemented.

[9] Techno Consult International and Royal Haskoning (2017) - Pilot Project for Inland Waterways Transport (IWT) in Punjab - Reaches between Attock to Daudkhel and Daudkhel to Taunsa.

54. **The following key conclusions that can be drawn from the review of previous studies on IWT in Pakistan**:
    - In the past, IWT fell victim to high initial investments and was abandoned. As the alternative mode of transportation, it should be introduced in phases depending on response of stake holders. The connection Port Qasim to Kotri is a necessary element in the water network.
    - Commensurate with new IWT based development foreseen along the proposed waterways, introduction of industries and other recreational cum socio-economic activities are likely to open the dull corridors.
    - Unlike past attempts on inland navigation for limited river travel length, the approach should be altered and IWT operations across the country should be evaluated, and small pilot projects should be derived from it.
    - Multimodal transportation needs to be holistically encouraged on national level to support water transport development.
    - The alternative of 60m wide flood control cum navigation channel needs to be actively considered further. Such a channel should be provided all along the Indus River from Daudkhel to Port Qasim.

55. **While several studies are pessimistic about the prospects of IWT in the riverine and canal systems of Pakistan, the global economic environment has changed substantially.** The high cost of fossil-based energy in terms of both financial and ecological costs, provide an incentive for serious consideration of IWT as an alternative mode of transportation. This is particularly so if one factors in the implications of the China-Pak Economic Corridor (CPEC) which will not only open a new route for the anticipated transit trade emanating to/from China and Central Asian, but also promote further links with countries along the Central Asia Regional Economic Cooperation (CAREC).

56. **From the plethora of previous studies, one can conclude that technically IWT is feasible in Punjab and could be extended to the whole of Pakistan.** However, its commercial feasibility will depend on a number of factors, such as the country's economic and spatial development plans, the integration of the provincial pilot project into a nation-wide program, the design and implementation of an enabling environment, and an updated evaluation with all costs and benefits factored into the equation.

4. Addressing IWT Challenges in Pakistan

57. **The Indus River needs to be developed for IWT with a long-term vision in mind, as IWT development is a long-term affair and requires long term commitment.** The system development not only relates to the rivers and canals, but also requires attention to the other IWT areas such as construction and operation of vessels, development of inland terminals for safe movement of cargo and passengers, as well as maintenance and upkeep of inland fleets. The importance of sea-port connectivity was mentioned before, and for year-round safe navigation best is to provide a still water channel from Port Qasim Gharo Creek to Kotri Barrage Lake via KB Feeder and Kalri lake.

4.1. IWT Infrastructure Development

58. **The current inland waterway and infrastructure conditions have serious limitations which hinder the development of a modern and fit-for-future IWT system.** These include limited navigability, missing port connections, absence of terminals and a lack of standardized locks and vessels.

4.1.1. Seaport-hinterland Connectivity

59. **International experiences show that port-hinterland connectivity is vital for an effective and efficient IWT system, especially for ports with large cargo flow potential.** Therefore, it is important to connect the future IWT system in Pakistan with major seaports — namely Karachi Port and Port Qasim — so efficient IWT services can be developed at a large scale over long distances.

60. **Karachi Port and Port Qasim are 110km and 130km away from the mouth of the Indus River. Between its mouth and the Kotri Barrage, the Indus almost dries up during winter months.** Uninterrupted connectivity between the ports and Indus would require the development of linkages with ports that are accessible throughout the year. The following options have been identified for establishing such connections:

    i. **Direct River-Sea connectivity between Karachi Port, Port Qasim and Kotri Riverport**: For direct feeding of IWT, River-Sea Vessels (fitted with sea-worthy equipment and low draft for river navigation) can be used to transport freight between the major seaports (Karachi/Qasim) and Kotri, where a riverport would have to be established. From Kotri, the freight can be transferred to inland vessels for onward navigation.
        - This option has a major drawback: River-Sea Vessels cannot navigate this route throughout the year as this stretch of the Indus dries up during winter.
        - Enabling all-year-round navigability for River-Sea vessels would probably require canal capacity augmentation through dredging/deepening and construction or expansion of navigational locks.

- Custom-designed vessels with very low draft would be required which would be unsafe and extremely risky during high winds and unfavorable weather conditions.

ii. **Coastal connectivity between Karachi Port, Port Qasim and Keti Bunder**: Freight from seaports can be transported by coastal vessels to Keti Bunder, a small fishing port about 90km south-east of Karachi, which would have to be upgraded and developed into a transshipment point that can cater to sea-worthy vessels. At Keti, freight can be transferred from coastal vessels to inland vessels and vice versa. From Keti, inland vessels can transport the cargo via creeks to Kotri and beyond.
   - Transshipment at Keti Bunder would involve cumbersome transfer operations with river vessels moving through creeks at a heightened safety risk.
   - Although transshipment at the mouth of the river (known as the 'extended gate' concept) is doable, it is still risky as unexpected high-speed winds can disrupt operations.
   - This option would also require the capacity augmentation of the river in terms of draft and lock capacity.

iii. **Still Water Channel Connectivity between Gharo Creek and Kotri**: Freight from Port Qasim can be transported to Gharo Town via the Gharo Creek. A river terminal with storage facilities will have to be set up at the start of Gharo Creek, where cargo from the seaports can be loaded onto inland vessels. From there, inland vessels can navigate upwards to Kalri Lake via a Still Water Channel provided by the 26km Kalri-Baghar Feeder Canal (Lower). Vessels can continue moving upstream from Kalri Lake to Kotri via the 56km Kalri-Baghar Feeder Canal (Upper). The Still Water Channel can be extended from Kotri to Sukkur and from Sukkur to Daudkhel through construction within the deeper portion of the river. The road network between Karachi Port and Port Qasim has sufficient capacity to bear the increased transport load between the two ports. If the traffic increase cannot be managed, a short-sea shipping service can be started between the two ports. For a long-term sustainable solution, a 60m wide and 3m deep channel with 1.5m high bunds on sides for flood protection is a minimum requirement (see Figures 10 and 13). Such a channel would be navigable for two-way traffic of barges with up to 60m to 80m length, 8.5m beam and 2.5m draft.
   - This connectivity option has been identified by several past studies, such as Nespak (1975) and Louis Berger (1993).
   - A 60m still water channel from Daudkhel to Taunsa was also proposed by the Punjab IWT Pilot Project Study in 2017 (see Figure 10)
   - In comparison with the first two options, this option would not only be safer and less costly but would also be accessible throughout the year.

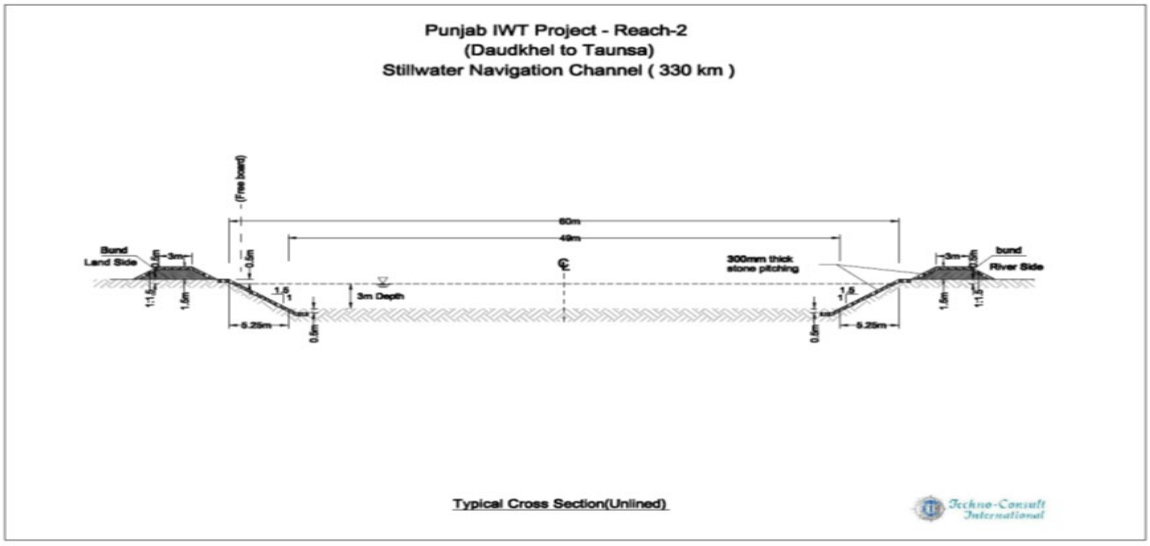
Figure 8: Karachi Port

Source: Karachi Port Trust - S. Malik

Figure 9: Port Qasim

Source: S. Malik – Port Qasim Authority - National Seaports Development Plan

Figure 10: Dimensions of the proposed channel in the Punjab IWT project



Source: Techno-Consult International

4.1.2. Canal Networks

61. **Among the 5 major and more than 75 smaller rivers in Pakistan, the Indus River is the longest as well as the largest in terms of average annual flow.** The river has sixteen tributaries and the Chenab flows into it with its own set of three major rivers and several tributaries. It has six main barrages with 18 major perennial canals, with some providing links between the various rivers under the Indus Water Treaty.

62. **As road transport is the prime mode for transportation in Pakistan, canals are often intersected by the road network in the form of low bridges (less than 1.0 m headroom) at an average interval of 1.5 kilometers.** This restricts long-distance canal navigation and cuts of navigational connections between rivers and canals. Enabling navigation across the canal network would require the canals to be deepened and lined, with cross bridges raised for barges and other crafts to navigate freely.

Figure 11: Bridges at Chashma and Attock

Source: Punjab IWT pilot project

4.1.3. Barrages, Dams and Navigational Locks

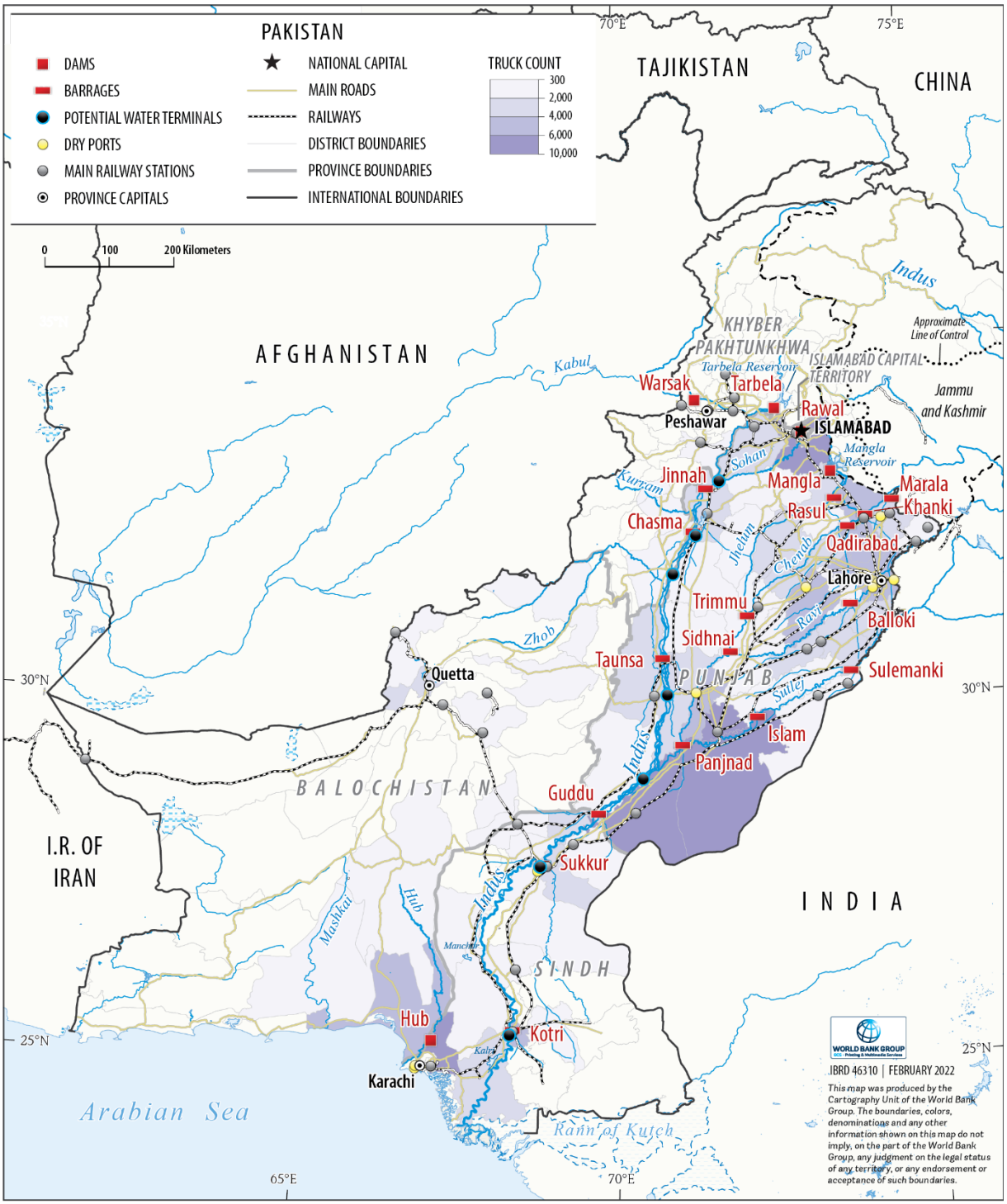
63. **Indus and its tributaries have been integrated into the irrigation system through the construction of barrages and dams.** The barrages on the Indus are large structures, with multiple vertical lift gates and lift machinery located on bridges over the piers. A highway bridge is generally provided at each barrage as well. With the exception of Sukkur Barrage, all barrages on the Indus River are equipped with navigational locks. The navigational locks provided at the barrages on the Indus River have the following specifications:

I. Kotri Barrage/Ghulam Muhammad Barrage, Hyderabad, Sindh (60 feet x 208 feet)
II. Guddu Barrage, Kashmore, Sindh (60 feet x 250 feet)
III. Taunsa Barrage, DG Khan, Punjab (20 feet x 126 feet)
IV. Jinnah Barrage, Kalabagh, Punjab (20 feet x 90 feet)

64. **Ensuring efficient IWT operations would require the lock dimensions to be standardized so that standardized vessels can be developed to navigate these channels.** This means that a lock will have to be developed at Sukkur Barrage and the existing locks at Taunsa Barrage and

Jinnah Barrage will have to be remodeled and enlarged. Alternatively, bypasses may be constructed at these barrages to enable uninterrupted IWT operations.

Figure 12: Major rivers, canals and barrages in Pakistan



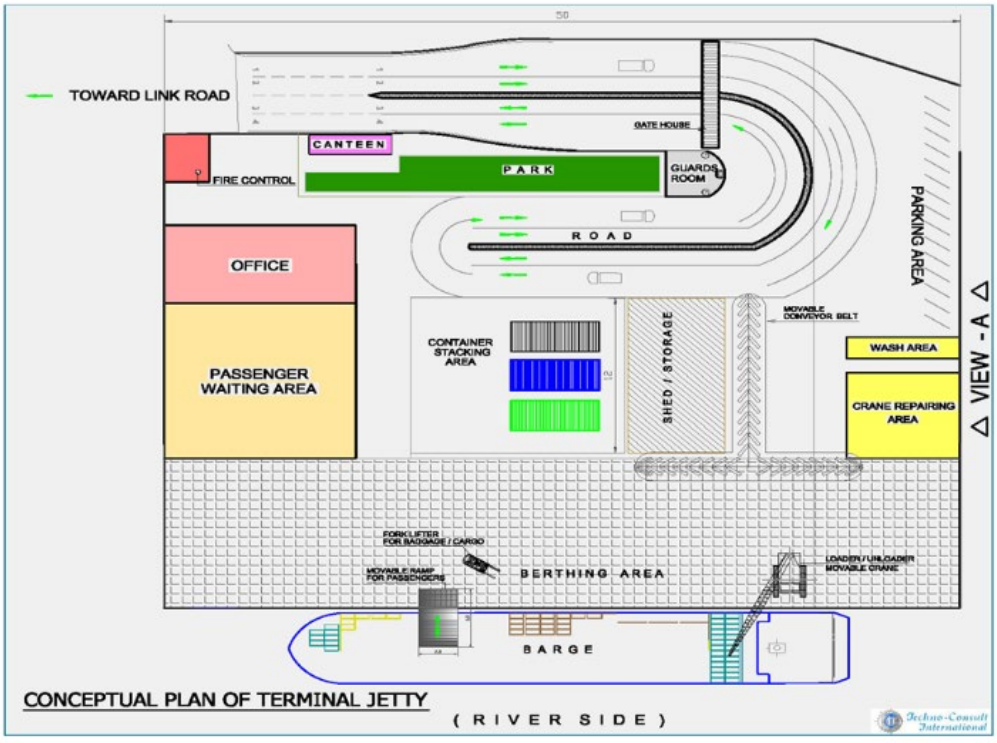
Source: IRSA

4.1.4. Terminals

65. **Studies done in the past have suggested terminals with good road connections at four river ports: Sukkur, Ghazighat, Dera Ismail Khan and Kalabagh.** Six intermediaries were proposed at Gotki, Guddu, Mithankot, Taunsa, Leiah and Chashma. The handling of passengers and cargo has been considered together as an integrated combined terminal. Space for bank, restaurant, passenger waiting room and other facilities are to be provided. For main terminals at Gharo Creek, Port Qasim and Daudkhel, custom clearance, scanners and other checking & security facilities may be needed (see the typical plan in Figure 16).

66. **Based on previous studies, the construction cost of a typical terminal is estimated at PKR 180 million.** The cost of a typical intermediary is estimated at PKR 35 million. All Terminals and Intermediaries are well connected with the road network for multimodal hinterland connections. Railway lines also run in parallel and within 1-2 km from the river and can be connected in the long run.

Figure 13: Layout of a modal terminal



Source: Techno-Consult International

4.1.5. Inland Waterways Transport Fleet

67. **To ensure smooth IWT operations, the following vessels and crafts will be required:**
    - Service Boats for mooring
    - Pushers or Stan Tugs as support vessels
    - Passenger Ferries
    - Survey Boats
    - Self-propelled Barges

68. **Several types and sizes may be used in the future, like already proposed in the Louis Berger (1993) study, which should be further studied in view of technical and economic optimization:**
    I. 650-ton barges: (48m length x 7.5m beam x 1.9m draft)
    II. 900-ton barges: (55m length x 8.0m beam x 2.0m draft
    III. 1,200-ton barges (60m length x 8.5m beam x 2.2m draft).

69. **The Punjab IWT Pilot Project proposed smaller barges — 150 tons barges (25 m length x 5.0 m beam x 1.5 m draft) — which can pass through even smaller locks.** 3 barges in toe and pushed by tug can move eight containers and up to 500 tons. These barges will have to be designed for stability check. However, small vessels on shallow waterways will have a high cost per ton km and may not lead to an economic feasible solution.

70. **Small vessels on shallow waterways will have a high cost per ton-kilometer and transshipment between water and road/rail to provide port access leads to additional cost.** The main challenge is to provide a cost-efficient mode of transport that can play a significant role in Pakistan's future transport matrix. International benchmarks show that the cost per ton-km is related to waterway conditions, and with increased vessel capacity the cost per ton-km will go down significantly. At the same time, fuel consumption increases exponentially operating below 2m water depth without applying hull optimization techniques.

Figure 14: Vessel "Haathi" (35m x 9.5m x 1.5m) fabricated by IWTDC sailing north of Makhad

Source: Punjab Inland Waterways Transport Pilot Project

Figure 15: Images from the Punjab IWT pilot project

Source: FPCCI

4.2. IWT Governance

71. **The establishment of an Following the Eighteenth Amendment to the Constitution of Pakistan, only provincial assemblies can now legislate on matters related to shipping and navigation on inland waterways**, as outlined in Section 3.5. As per numerous studies carried out over a number of years, the most efficient waterway course for navigation/transport would be the Indus River. However, Indus River runs through three different Provinces, i.e., Khyber Pakhtunkhwa, the Punjab and Sindh, so there is an imminent requirement for fresh legislation. But in the present scenario, three different Provinces will have to legislate of this subject-matter and thereafter the question of coordination between the three authorities could also complicate the matter.

    Therefore, it would be more appropriate if an 'Inland Waterways Authority' is established at the Federal Level.

72. **Although the subject-matter has been devolved to the Provinces as outlined in Section 4.4 and 4.5, there is another way provided in the Constitution to overcome such difficulty** under Part V (Relations between Federation and Provinces), Chapter 1 (Distribution of Legislative Powers). Under the provisions of Article 141, the Parliament is empowered to make laws having extra-territorial operation. Article 141 is reproduced below:

    "141. Extent of Federal and Provincial Laws — Subject to the Constitution, Majlis-e-Shoora (Parliament) may make laws (including laws having extra-territorial operation) ***for the whole or any part of Pakistan****, and a Provincial Assembly may make laws for the Province or any part thereof."*

    (Emphasis supplied)

Furthermore, in terms of Article 144 of the Constitution, the Parliament has been empowered to legislate for one or more Provinces by consent:

> *"144. Power of Majlis-e-Shoora (Parliament) to legislate for one or more Provinces by consent.— (1) If one or more Provincial Assemblies pass resolutions to the effect that Majlis-e-Shoora (Parliament) may by law regulate any matter not enumerated in the Federal Legislative List in the Fourth Schedule, it shall be lawful for Majlis-e-Shoora (Parliament) to pass any Act for regulating that matter accordingly, but any act so passed may, as respects any Province to which it applies, be amended or repealed by Act of the Assembly of that Province."*

73. **For legislation at the Federal level, resolutions on behalf of one or more Provincial Assemblies giving consent to legislation by the Parliament for establishing an Inland Waterways Authority at the Federal level would be required**. This procedure would need to be routed through the Council of Common Interests established under Article 153 of the Constitution. However, this procedure may take a lot of time.

74. **Another option could be a direct approach by using entry No.27 of the Federal Legislative List, which is reproduced below**:

> *"27. Import and export across customs frontiers as deemed by the Federal Government, inter-provincial trade and commerce, trade and commerce with foreign countries; standard of quality of goods to be exported out of Pakistan."*
>
> (Emphasis supplied)

This entry is the basic 'Commerce Clause' of the Constitution and by using it, the Parliament can legislate to formulate institutional structure for an Inland Waterways Authority at the Federal level. A summary could be initiated through the appropriate Ministry by seeking concurrence of the Ministry of Inter-Provincial Coordination.

There are a number of regulatory authorities established under Federal Law, which have the institutional structure to handle matters throughout Pakistan, e.g., National Electric Power Regulatory Authority ("NEPRA") established under section 3 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997, which is reproduced below:

> *"3. Establishment of the Authority. (1) As soon as may be, but not later than thirty days after the commencement of this Act, the Federal Government shall, by notification in the official Gazette, establish a National Electric Power Regulatory Authority consisting of a Chairman to be appointed by the Federal Government and Four members, one from each Province, to be appointed by the Federal Government after considering the recommendations of the respective Provincial Governments.*

(2) There shall be a Vice-Chairman of the Authority, appointed from amongst the members for a period of one year, by rotation, in the following order, namely:

(i) the member representing the Province of Balochistan;
(ii) the member representing the Province of Khyber Pakhtunkhwa;
(iii) the member representing the Province of the Punjab; and
(iv) the member representing the Province of Sindh.

75. **Although shipping and navigation on inland waterways was a subject-matter of entry No.32 of the erstwhile Concurrent Legislative List of the original Constitution as adopted on 12 April 1973, but no legislation was ever made on this subject-matter till the year 2010**, when this list was omitted by the introduction of the Eighteenth Amendment to the Constitution in 2010. Even after devolution of this subject-matter exclusively to the Provinces, no new legislation was made by any of the Provinces in the last eleven years.

76. **The pilot project of the 'Inland Waterways Transport Company' initiated by the Government of the Punjab during the previous Government, was also shelved due to disinterest by the irrigation authority of Punjab** but this pilot project highlighted the urgent need for legislation in respect of various aspects on which there are no laws, rules or regulations till date. Some of the most important aspects are: (i) safety and security of persons and vessels plying in the rivers and canals; (ii) training and licensing regime for inland waterways transport; and, (iii) SOPs regarding Rule of the Road while navigating in inland waterways.

77. **An inland waterways authority is essential for regulating and monitoring navigation/transport of vessels in the rivers and canals throughout Pakistan and for further development.** The international benchmark shows that there is no set blueprint for the governance of the IWT sector. Strategy and policymaking and the legal framework is typically the responsibility of the Ministry of Maritime Affairs or Ministry of Transport. In some countries the role of the inland waterway authority contains both policy implementation and monitoring, in other countries the second activity is assigned to a dedicated agency (such as Maritime Administration or Transport Inspection). At a nascent stage of IWT it seems logical to combine the two functions, which is proposed for Pakistan. Also, in the role and mandate of the waterway authority, there are differences between the countries. A limited functionality includes infrastructure development and maintenance, traffic management, and emergency response as basic tasks, whereas a wider mandate entails market development including promotion, active market development, management of support and incentive programmes, research and development, knowledge production and market observation. In some countries the waterway authority also takes responsibility for several water management issues.

78. **The preferred model for Pakistan is:**

I. a combination of policy implementation and the control and monitoring of IWT sector;
II. a wide mandate containing the market development task, but no other water management issues (which remain with the water management agencies).

79. **An inland waterways authority could have the following powers and functions, which would not only help in IWT development but would also provide a legal cover to all connected activities:**
    - Grant licenses under the Act;
    - Make rules/regulations for the safety and security of persons, passengers, goods and vessels;
    - Specify procedures and standards for registration of persons and vessels providing services for inland waterways transport;
    - Specify rules/regulations for proper and safe navigation in the inland waterways;
    - Aid and advise the Federal Government in formulation of national water plan;
    - Specify procedures and standards for investment programmes by inland waterways transport companies and persons licensed or registered under the Act;
    - Promote development of waterways and making rules/regulations for construction of terminals;
    - Specify fees including fees for grant of licenses and renewal thereof;
    - Review its orders, decisions or determinations;
    - Settle disputes between licenses in accordance with the specified procedure;
    - Issue guidelines and standard operating procedures;
    - Promote development of a market, including trading in accordance with the national water plan;
    - Coordinate with the irrigation authorities for streamlining irrigation system & flood control.
    - Perform any other function which is incidental or consequential to any of the aforesaid functions.

80. **The inland waterways authority can be set up at the Federal level under the Ministry of Maritime Affairs, to oversee, manage and develop IWT.** The Authority should consist of several departments or sections, amongst others technical (infrastructure, navigational aids, hydrography), operations (vessel and crew requirements, traffic rules, standard operating procedures), commercial (market development and logistics), and finance. Representatives of relevant federal ministries and provincial departments should have a seat in the board, in addition to key stakeholders (port authorities and industry associations) as well. Active stakeholder participation should be an important element at all stages of development.

4.3. Environmental Performance of IWT

81. **The limitations of the study do not allow a detailed assessment of the impact of IWT development on nature and the environment in Pakistan.** Large parts of waterway systems in Pakistan have been developed for irrigation, hydropower and flood control through canalling and the construction of barrages and dams on major riverways. However, these have significantly impacted the natural flow of the waterways. Today, the Indus River's unique freshwater

ecosystem, biodiversity and human habitats stand endangered. Low water flow, barrage construction and pollution have fragmented aquatic habitats and threaten unique species.

Figure 16: Smooth-coated Otter – an endangered species found in Sindh.

Source: Aijaz, Nasir

82. **Logically, there is great concern about the impact of IWT on environment and nature, and in a continuation of the project, detailed attention should be given to this issue by adopting a proactive approach in line with international best practices and guidelines.** Experiences of other countries with IWT show that improved IWT can go hand in hand with nature conversation. This requires the adoption of a pro-active approach in this field and the Active involvement of all stakeholders, including communities along waterways, CSOs as well as relevant government agencies responsible managing other waterway uses, such as irrigation, hydropower generation, etc.

83. **A good example is the World Bank financed project capacity augmentation of the Ganga River**, which works according to the building with nature principle, and has resulted amongst others in development of clean vessels, adopted navigation (less vibration and lower speed) in dolphin and tortoise sanctuaries, in minimal interventions in special areas.

84. **From environmental point of view, IWT transport has a very positive record as compared with railways, and especially when compared with road transport,** as outlined in Section 2.1. This concerns energy use, emission, noise, congestion, road wear (overloading), and applies to operations as well as the construction and upgrading of infrastructures. This puts IWT in a good spotlight, and at the same time it must be concluded that the environmental performance in IWT can significantly be improved. This has to do with the fact that the existing fleet in many countries is generally old, same goes for the engines, and for fueling diesel oil is used, in some cases even heavy oil. The emission levels (NOx, SOx, CO2, and PM) are high compared with alternate fuels. After treatment systems can be applied, but better solutions are the move to alternate fuels (such as LNG/CNG, bio-fuels, hydrogen, electric). In advance IWT countries in EU but also in China the development is towards zero-emission IWT, and road maps have been defined. For Pakistan there is no existing IWT fleet and no need for costly retrofitting of existing vessels, and the step

can be made to clean vessel technologies right from the start. Emission level standards could be introduced in the technical guidelines for new vessels (to be developed by the Water Transport Authority to be established).

85. **In the European Union (EU), development programs are underway to attain the goal of zero-emission IWT.** These efforts are part of the European Green Deal — a set of policy initiatives by the European Commission with the overarching aim of making Europe climate neutral by 2050. The European Green Deal aims to produce and demonstrate zero-emission solutions for all major ship types and shipping services before 2030, paving the way for enabling zero-emission waterborne transport by 2050. Similarly, China is investing heavily in clean IWT solutions, starting with the promotion of Liquified Natural Gas (LNG) vessels, and now focusing on Research and Development for shifting to electric and hydrogen vessels

86. **The environmental performance of IWT can be greatly improved with the development of a robust waste management system**. This relates to different kinds of waste generated by vessels, such as oily residues (bilge water), sanitary water and cargo waste. The Water and Power Development Authority (WAPDA) would have to develop a system for monitoring and regulating IWT waste management to minimize any negative impact on the environment. Similarly, the provision of shore power in terminals and ports can greatly minimize emissions, waste and noise by allowing vessels to turn off their engines and generators when berthed.

87. **In view of the Indus River System's biodiversity and ecological sensitivity, it is important to build a fit-for-future IWT system for Pakistan**, which takes into account regional and international best practices, as well as green development approaches, such as 'Good Navigation Status' (GNS), 'Good Environmental Status' (GES), 'Building with Nature' (BwN), and 'Room for the River'.

88. **The GNS concept is used for developing the waterway infrastructure through a process of continuous improvement cycles** that seeks to achieve the following attributes of integrated waterway management (GNS has now been integrated in the guidelines for developing waterway infrastructure in EU):
    - targeted: every waterway maintenance or management activity should be performed within the framework of defined targets (maintainable waterway dimensions, levels of service, and so forth);
    - strategic: for the coordinated, effective, and efficient achievement of targets, a specific waterway management strategy should be applied, with the goal of achieving and maintaining GNS (by no later than 2030 in the case of European waterways);
    - multidisciplinary: waterways are not only traffic routes; they are used for a variety of other purposes, which often have conflicting interests;
    - participatory: because of the multidisciplinary character of waterways, participatory management is advisable in order to understand and respect all uses of waterways. All relevant stakeholders should be engaged in the planning process to achieve and maintain

GNS, building a case for (further) integrative IWT development by infrastructure and services and improving other functionalities like irrigation, nature, leisure, industry, drinking water, etc. at the same time.

Figure 17: New Canal in the European inland waterway network fulfilling economic and aesthetic functions

Source: De Vlaamse Waterweg,

89. **The development of green ports and green terminals will increase energy conservation and reduce emissions** at ports, promote clean production of port facilities and equipment, and gradually eliminate and upgrade port equipment that causes high pollution and high emissions. And application of modern ICT applications will lead to increased efficiency and improved safety on the waterways (River Information Services, emergency response, spill detection, electronic navigation charts).

5. Feasibility of IWT Development in Pakistan

90. **This section explores the feasibility of reviving and developing IWT in Pakistan.** It presents the methodological framework as well as the main findings of the following:
    I. Estimation of current freight flows and freight flow projections for future years.
    II. Multimodal transport analysis based on transport cost at O/D level (Origin/Destination) for road, rail and IWT.
    III. Estimation of socio-economic costs and benefits for different IWT development options through a simplified Socio-economic Cost Benefit Analysis (SCBA).

91. **Firstly, freight and passenger flow projections are assessed explore IWT freight flow and passenger flow projections in Section 5.1. Based on these projections, a transport economic model has been developed in Section 5.2 to examine the multimodal potential for IWT in Pakistan as outlined in Section 5.3. Based on this potential, a simplified Social Cost-Benefit Analysis has been done in Section 5.4 to ascertain whether investments in IWT in Pakistan would yield profitable returns and favorable results.**

92. **It is important to point out that the scope of the World Bank Studies that have informed the development of this Strategic Plan is not focused on collection of new empirical data on freight flows and ODs.** Rather the studies rely mostly on projections of traffic at the Port of Karachi and Port Qasim. Since IWT is still marginal in Pakistan, proposed IWT solutions are based on international practices and building on to previous IWT experience in Pakistan like the IWT pilot study in Punjab. It is also not feasible to conduct a sound and full-fledged SCBA due to data limitations and information gaps. Therefore, estimates have been made and certain components have omitted due to data limitations. However, the methodology adopted provides sufficient indication that IWT has strong potential in Pakistan that is worth exploring. Rather than interpreting the results of the 'simplified' SCBA as a concrete financial feasibility assessment, they should be considered as a preliminary study to pave way for comprehensive follow-up research to analyze the socio-economic feasibility of developing IWT in Pakistan.

5.1. Freight & Passenger Flow Projections

5.1.1. Market segmentation

93. **The IWT system can serve different market segments with different customer requirements, some of which can be considered as captive markets,** e.g., passenger transport in rural areas on the banks of inland waterways with limited or no road or rail connectivity. The following market segments can be considered for the development of a future IWT system in Pakistan:

i. **Cargo Transport:**
   - Hinterland transportation from seaports via a direct water connection.
   - Hinterland transportation from seaports with rail or road connectivity between Karachi Port, Port Qasim and an inland port, with further upstream transportation via inland waterways.
   - Domestic transportation with origin and destination along or close to inland waterways.
   - River crossings.

ii. **Passenger Transport:**
   - Regular longitudinal passenger transportation (where passengers can take along small cargo volumes).
   - River crossings.
   - Tourism and cruising.

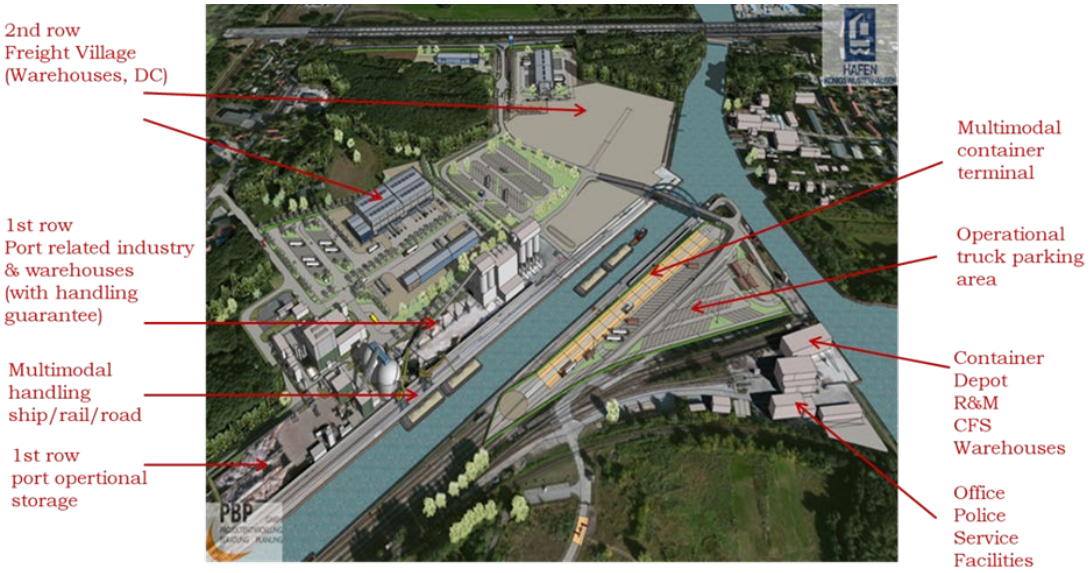
94. **International experiences point that import/export flows to and from seaports provide the base loads and are the main carriers of IWT systems.** Domestic flows are developed in addition to that. While multimodal solutions are becoming increasingly popular across the globe, they can only develop when integrated multimodal services can be offered and extra handling cost can be balanced by lower cost of long haul water-borne transport. As industrial and logistics activities are currently not located along waterways, most domestic flows will require last mile transportation, handling at both ends and low transport cost per ton and ton-kilometer to become competitive with direct rail and road transportation. An important element for IWT development is the construction of logistics zones and freight villages along waterways, with a concentration of logistics activities and light industries, as it solves the last mile connectivity issue and lowers the barrier for shifting to IWT.

95. **River crossings can play an important role in lowering transportation and logistical costs in areas with limited connectivity between rivers banks via bridges or tunnels.** While such IWT users do not constitute a specific market segment, they can be considered as part of the conventional truck market (for cargo) and conventional road transportation market (for passengers). These types of transportation are referred to as RoRo (cargo) or RoPax (cargo and passengers) transport.

96. **Although longitudinal passenger transport via inland waterways used to be an important market segment some decades ago, it is not likely to redevelop due to the existence of alternative road transportation options which are much faster than water-borne transportation.** On the other hand, recreational forms of IWT can become popular with the development of tourism and an increase in the consumers' purchasing power. This includes cruises (both short and longer trips), day trips, dinner boats, excursions, etc. In urban areas with favorable waterway conditions, IWT passenger services can also be integrated with the public transport system to play a positive role in city distribution.

97. **Analyses of freight flows and forecasted freight volumes have been carried out in the following sections along with simulations for different development scenarios.** For the IWT system to be feasible and to justify the investments to be made in IWT infrastructure, the port flows will have to provide the base loads. This can be achieved not only through already existing and forecasted flows, but also through generated flows at freight villages. As rule of thumb, a 100-acre logistics zone along a waterway, generates about 30-50,000 TEU (300-500,000 tons) of cargo for the waterway.

Figure 18: An example of integrated water terminal and freight village / logistics zone



Source: Lutra GmbH, edited by Wagener & Herbst

5.1.2. Port traffic

98. **The main potential for the IWT system lies in the hinterland transportation from Karachi Port and Port Qasim.** A 20-year freight forecast has been worked out for the two ports in a parallel World Bank Port Study (2020) which has been provided in Annex B. Table 1 and Table 2 provide a summary of the freight forecast. All Special Economic Zones (SEZs) located in the north of Pakistan, in Khyber Pakhtunkhwa, Punjab and Balochistan are adjacent to, and in easy reach of the new Xinjiang-Gwadar CPEC Highway and would therefore rely on the Gwadar Port for the import of raw material and export of manufactured items. Only the SEZs at Dhabeji and Pak. Steel Mill (which will be developed in the next 5 to 10 years) will utilize Port Qasim for import and export. Therefore, these two SEZs have been added to Port Qasim's freight forecast with an estimated 0.5 mta imports and 1.0 mta exports starting from 2024-25 having an optimistic annual increase rate of 10%.

Table 1: 20-year freight forecast for Karachi Port (000 tons)

	2015-16	2019-20	2025-26	2030-31	2035-36	2040-41
Imports	40,259	27,206	32,834	39,638	52,826	67,962
Exports	9,787	14,634	17,867	21,803	29,279	39,489
Total	50,046	41,840	50,701	61,441	82,105	107,451

Source: World Bank Port Study (2020)

Table 2: 20-year freight forecast for Port Qasim including addition from CPEC. (000 tons)

	2015-16	2019-20	2025-26	2030-31	2035-36	2040-41
Imports	26,237	39,184	47,281	55,511	69,306	87,576
Exports	8,406	8,964	11,115	13,800	19,811	28,488
SEZs	--	--	1,500	2,415	3,889	6,263
Total	34,643	48,148	59,896	71,726	93,006	122,327

Source: World Bank Port Study (2020), Consultant analysis

99. **While data limitations do not allow a detailed analysis of IWT potential in Pakistan, a rough estimate can be been made on the basis of a targeted IWT modal share analysis for freight volumes between the downstream area (Karachi Region) and the upstream point (Daudkhel/Kalabagh) with certain assumptions regarding the share of IWT in specific transport sectors** (See Table 3). The estimation is based on an assumed IWT modal share for coal at 5%, fertilizers at 2.5%, containers at 1% and POL at 1%. LNG pellets and LPG have high IWT potential and up to 5% of LNG and 10% of LPG could be transported via IWT to North Pakistan after the next two terminals are constructed in 2025. For down country traffic, the assumptions are as follows: cement/clinker: 10%; minerals: 2.5%; and, containers: 2.5%. The IWT system is best suited for transporting the empty containers of LNG and LPG back to the seaports. A detailed market study and cost analysis of all elements of the future IWT system is required for more accurate IWT modal share estimations and cargo volume projections.

Table 3: Inbound and outbound IWT cargo volume projections (in 1,000 tonnes per annum)[10]

	2024-25	2029-30	2034-35	2039-40
Karachi to Daudkhel	2,657	3,280	4,352	5,751
Daudkhel to Karachi	1,703	2,297	3,248	4,357
Total	4,360	5,577	7,600	10,108

Source: Consultant analysis

[10] Figures shown include local traffic from Karachi to Kalabagh and Kalabagh to Karachi, respectively.

5.1.3. Domestic cargo flows

100. **No data could be retrieved for domestic cargo flows at origin-destination level that could be attributed to water-borne transportation.** The same can be concluded for the potential of river crossings for goods and cargo.

5.1.4. Passenger movements

101. **The movement of passengers over inland waterways can be categorized as follows: social, recreational, cultural, familial, work, leisure, and access to services and markets.** Passenger movements can vary from short ferry rides to much longer distances with passengers carrying luggage. Currently, traditional country boats ply with passengers from riverside stations on short journeys and medium distances. There are also informal yacht and boating operations in waterways near main towns. A number of 'off-shore' and 'on-shore' restaurants can also be found across major waterways.

102. **Although the focus is on freight volume forecast to assess the feasibility of an upgraded IWT system, passenger transport potential for the IWT system has also been estimated in Section 7** of the IWT Traffic Forecast provided in Annex C. Table 4 below provides a summary of the IWT passenger potential forecast. The data is based on surveys in the framework of the Punjab IWT pilot project, public transport data, and estimates by the consultants. While passenger transport potential is much limited in comparison with the freight potential for IWT, this market segment is worth further exploration, particularly for river-crossings, short-haul connectivity, recreational and tourism purposes.

Table 4: IWT passenger potential forecast (in numbers per annum)

	2024-25	2029-30	2034-35	2039-40
Karachi to Daudkhel	51,900	64,069	85,009	112,336
Daudkhel to Karachi	51,900	70,003	98,985	132,782
Total	103,800	134,072	183,994	245,118

Source: Consultant analysis

5.1.5. Competitive position of IWT

103. **During the Punjab IWT Pilot Project, a detailed comparative analysis of the operating costs and freight rates charged by Road transport, Rail transport and IWT was done** (See Table 5). It was estimated that significant savings could be realized by diverting from rail and road transport to IWT due to difference in freight rates.

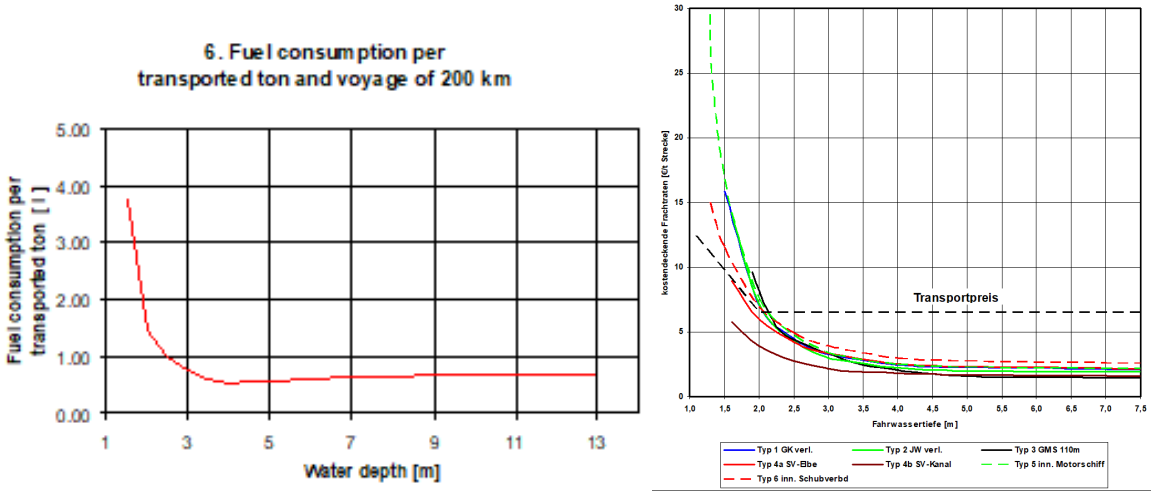
Table 5: Operating cost and freight rates for rail, road and IWT

	Operating cost (Rs/ tonkm)	Freight rate (Rs/tonkm)	Factor cost/rate	Profit margin (Rs/tonkm)
Road transport	3.92	16.00	4.08	12.08
Rail transport	10.33	10.28	1.00	-0.05
IWT	3.50	7.00	2.00	3.50

Source: Punjab Inland Waterways Transport Pilot Project

It is important to point out that the pilot project in Punjab worked with small vessels and limited draft, but the cost per ton-kilometer will be significantly lower with increased vessel capacity if IWT is developed in Pakistan. International experiences also show that fuel consumption increases exponentially below 2m draft availability without hull optimization, resulting in an overall increase in IWT operational cost (See Figure 18).

Figure 19: Relationship between: draft and fuel consumption (left); draft and transport cost (right)



Source: DST

Although new technologies are available for shallow draft vessels with better efficiency, increasing draft and accommodating larger vessels will improve the overall competitive position of IWT. In the scenario analyses and the cost benefit analysis in Section 5.4, several alternatives have been considered in this regard.

5.2. Multimodal Transport Cost Modeling

104. **To estimate potential IWT volumes and IWT share in the modal mix (road, rail, IWT), complementary to section 5.1, a multimodal transport cost model is used to compare freight flows at Origin-Destination level.** Such a model has been developed for Pakistan through the following step-by-step process:

(i) Assessment of existing cargo flows in Pakistan.
(ii) Calculation of O/D-based cargo projections for Pakistan.
(iii) Designing of a multimodal network.
(iv) Determination of the multimodal modal shift potential for selected O/D combinations.
(v) Identification of supporting policies.
(vi) Socio-Economic Cost Benefit Analysis.

5.2.1. Assessment of Existing cargo flows in Pakistan

105. **Typically, both rail and IWT could attract freight share from road transport by providing a cheaper alternative to shippers for both port-hinterland transportation as well as continental-domestic transportation.** Therefore, it is crucial to obtain information on existing road transport volumes. However, one of the main shortcomings in the available freight data is the absence of a comprehensive O/D cargo transport matrix, which would provide information on inter-city flow and commodity types. This applies to both port-hinterland freight flows as well as continental/domestic flows.

106. **Registered transport volumes only take into account transshipment at seaports. Karachi Port (KPT) and Port Qasim (PQA) are the international gateways to Pakistan.** According to the National Transport Master Plan, these two ports together export and import over 95% of the country's freight. In countries with a mature IWT system, port-hinterland cargo flows are an important cargo base for IWT. If IWT operations could be introduced between KPT and PQA and to inland destinations from these ports, carrying port-hinterland flows via multimodal IWT services could be very cost-efficient. The combined existing transshipment volume at KPT and PQA exceeds 90 million tons, and therefore could potentially provide a cargo base for IWT operations.

107. **A summarized assessment of existing cargo projections and projections for KPT and PQA have been provided in Section 5.2** and the detailed assessment has been provided in Annex B.

5.2.2. Calculation of O/D-based cargo projections for Pakistan

108. The cargo volumes from KPT and PQA, taking dry bulk, liquid bulk, general cargo and container have been distributed over Pakistan to create an Origin-Destination matrix, on the basis of:

I. **Population of main cities**: The population of main cities has been taken as a direction to allocate port-hinterland import and export cargo. To simplify, cities with inhabitants of 50.000 and above have categorized as 'main city'. This provides a list of 131 main cities.
II. **Truck Counts**: For preparation of the Pakistan National Transport Master Plan, a traffic survey was conducted consisting of traffic counts and origin/destination surveys at 218

points on the network. Truck movements which were recorded separately can be used as an indicator for the allocation of port-hinterland freight flows.

109. **Based on the location of survey points, truck movements have been attributed to the 131 main cities** (see Figure 20 for total truck movements and location of main cities). Combined with the population of the main cities, the truck movements give an indication of main production and consumption areas. Truck movements usually give a good indication of an OD-relation in freight flow analysis. Therefore, the truck counts are chosen as a dominant indicator to allocate import and export freight flows between the seaports and the hinterland (e.g. main production areas). A weighted average is determined based on population (20%) and truck movements (80%).

110. **The growth factors for each cargo type used to forecast expected port volumes in KPT and PQA for dry bulk, liquid bulk, general cargo/break bulk and containers (see 5.2.1), have been used to estimate the projected volumes on commodity level.** The result is an OD-matrix consisting of freight flows (import and export) transported between seaports and main cities in Pakistan per commodity type. By means of regression analysis, the freight flows have been extrapolated to 2024-25, 2029-30, 2034-35 and 2039-40 based on aforementioned growth factors per cargo type (See Annex E for more details).

5.2.3. Multimodal Network Design

111. A multimodal network has been developed through the following steps:

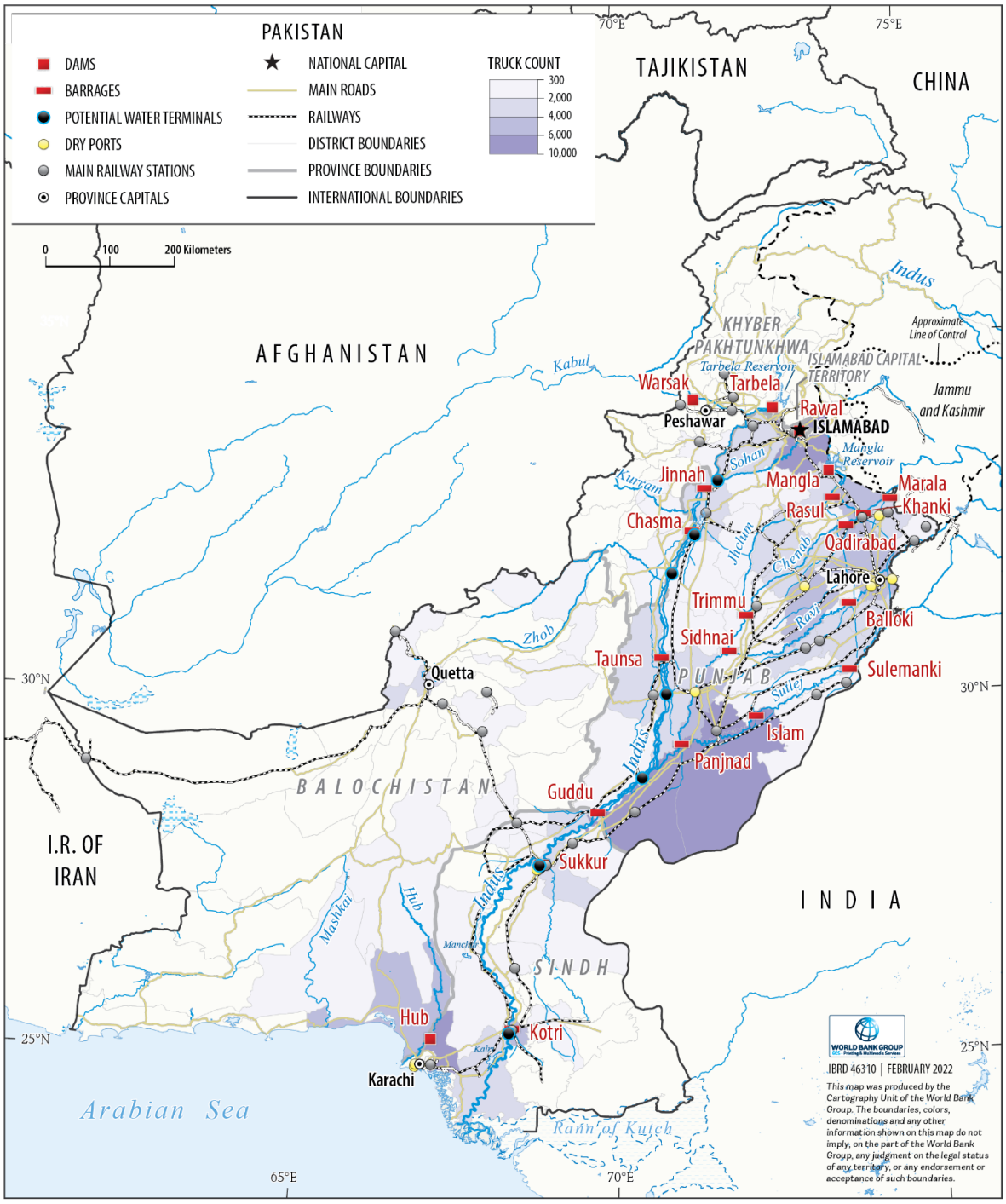
- **Alignment of IWT options**: The preliminary technical feasibility study on IWT on the Indus indicates a navigational channel could be realised until Daudkhel (Jinnah barrage) / Mari Indus (See Section 5.1). Not far upstream from Jinnah barrage, the Indus flows through some narrow sections with accompanying higher velocities, which makes IWT operations more difficult or even impossible. For this reason, two options for 60m wide navigational channel were suggested:
  - Option 1: KPT/PQA following the coastal route via the mouth of the Indus at the Indus Delta going upstream as far as Mari Indus (Jinnah Barrage) – see map Coastal and Indus River.
  - Option 2: KPT following coast route to PQA, following a route via Gharo Creek and expanded / new canals to Kotri following the Indus up to Mari Indus (Jinnah Barrage).

- **Location of River Terminals:** Based on proposed River Terminal locations in Annexure D (Mari Indus, Chashma, DI Khan and DG Khan) and additional locations (Chachran Sharif, Sukkur and Kotri) that facilitate multimodal connectivity to (nearby) agricultural production areas, 7 preliminary locations have been added to study multimodal IWT solutions between the seaports and main cities in the hinterland (see map).

- **Alternative via rail and dry ports / rail freight stations**: Although in need of improvement (double track on some sections, transshipment facilities at rail freight stations), Pakistan has a quite extensive rail network that can be an alternative for road transport and IWT. Therefore, the option for multimodal transport via rail also has to be analyzed in the comparative multimodal analysis, for which main railway lines, dry ports (if connected to rail) and main rail freight stations have been selected.

- **Preparing a consolidated network**: Based on abovementioned input, a consolidated multimodal network is prepared for further analysis. See map below. Based on the abovementioned input, a consolidated multimodal network has been prepared for further analysis (see Figure 20).

Figure 20: Consolidated multimodal transport network



Source: Prepared by STC-NESTRA, partly based on open-source GIS data

5.2.4. Determination of Multimodal Shift Potential for selected O/D combinations

112. **To determine the modal shift potential from direct trucking to multimodal transport via IWT and rail for the selected cargo commodities and O/D combinations, a top-down transport economic (cost) model has been developed.** Based on the port-hinterland O/D road matrix, transportation cost via direct trucking has been compared with multimodal transport cost via IWT and via rail (including pre- and end haulage as well as handling costs). Availability of lower cost for a multimodal rail or multimodal IWT option, in comparison with direct road transportation, is considered a potential shift for that specific option.

113. **In this preliminary study, the comparison between modes is based on transport costs only,** as logistic operators, transport companies, cargo owners and traders will opt for the least expensive option. This is in fact the main advantage that IWT can offer and is hence the precondition for future IWT use.

114. **The transport model for this study is based on an O/D total cost comparison,** starting with present transportation cost data for the modes of transport, transhipment cost etc., with the possible to apply options to change transport costs due to improvements/changes in infrastructure (e.g. a wider/deeper channel), different operating concepts for IWT (e.g. a larger design vessel), policy measures, etc. It takes into account the following costs:

I. Costs between terminals and key nodes
II. Transshipment costs
III. Costs for pre-/end haulage to and from the inland terminals in the network
IV. Multimodal costs

115. **Table 6 outlines the transport costs that have been taken into account** (Please refer to Annex E for more details regarding assumptions and calculations).

Table 6: Transport cost for the simplified SCBA

Type of transport costs	Costs	Source
Direct road transport	0.08 USD/t.km	IWT Study Punjab / Annexure E
Road transport pre-/end haulage for IWT and RAIL	0.10 USD/t.km	Consultants' estimate
Rail transport	0.064 USD/t.km	IWT Study Punjab / Annexure E
IWT with River Sea Vessel – 500 DWT (Option 1)	0.050 USD/t.km	KPMG for WB India
IWT with inland vessel – 1,360 DWT (Option 2)	0.023 USD/t.km	KPMG for WB India
Shortsea / Coastal vessel – 6,000 DWT (Option 2)	0.020 USD/t.km	KPMG for WB India
Transhipment costs	5 USD/ton	Consultants' estimate

Source: Consultant analysis

116. **Per selected O/D, the modal calculations determine whether multimodal transport is less or more expensive than direct trucking.** When the alternative of multimodal transport is less expensive for a specific O/D, the freight flow is earmarked as multimodal potential and considered as modal shift in the transport model. On this basis, the potential reduction of external costs is also estimated (e.g., due to carbon and air pollution emission reductions).

5.2.5. Identification of Support Policies

117. **The macro analysis described above estimates the modal shift potential, but it does not directly result by itself in a real modal shift.** Therefore, given the existing and expected transport network and freight flows, international best practices in policy implementation have been identified to provide input on required transport infrastructure investments and smart logistics solutions to improve the competitive position of IWT in Pakistan. The supporting policies include aspects related to:

I. Attracting multimodal cargo.
II. Developing win-win solutions for multimodal as well as road transportation sector.
III. Developing and spreading benefits of broader regional economic developments across Pakistan with multimodal solutions.

5.2.6. Socio-economic Cost-Benefit Analysis

118. **Based on the multimodal transport analysis and preliminary assessment of investments in IWT infrastructure for the two options identified in Section 5.2.3, a simplified Socio-economic Cost-Benefit Analysis has been carried out** (See Section 5.4) in line with international practices and guidelines from International Financing Institutions (IFI).

5.3. Multimodal Shift Potential for IWT in Pakistan

119. **On the basis of the port-hinterland O/D's as included in the transport modal matrix, the potential multimodal volume has been analyzed on the basis of transport costs for Option 1 and Option 2 identified in Section 5.2.3.**

120. **As shown in the tables below, option 1 making use of small River-Sea-Vessels (RSVs) is not likely to provide a competitive option for road and rail.** At the same time the multimodal comparison does provide an indication that, if IWT should not be developed, for port-hinterland cargo flows, rail transport is an alternative to reduce logistics costs in Pakistan. However, option 2 does provide significant potential to investigate the option to introduce IWT in Pakistan in greater detail. In this option, it is considered, that first the connection between Gharo Creek is constructed, and a channel in the Indus is realized upstream until Sukkur. After completion both Sukkur and Kotri could be operated as "extended gates" of KPT and PQA, offering value added services (e.g. custom clearance) as similarly provided in the ports. In this first stage, this could already attract almost 10 million tons of cargo.

Table 7: Modal split Option 1: 500DWT River-Sea-Vessels for coastal transport and sailing the Indus

Option 1: RSV – 500 tons	Multimodal analysis [mln tons]			
	2025	2030	2035	2040
Direct Road Transport	23.3	28.6	35.5	42.4
Multimodal Rail	93.0	113.9	141.1	168.5
Multimodal IWT	0.1413	0.1738	0.2182	0.2632
Total [mln tons] *	**116.5**	**142.7**	**176.8**	**211.1**

Source: Consultant analysis

** Results show slightly larger sums in comparison to KPT and PQA traffic projections as a consequence of applying growth factors on community level*

Table 8: Modal split Option 2: A tailored 1,350 DWT IWT vessel for Indus conditions making use of a dedicated connection from PQA to the Indus via Gharo Creek

Option 2: IWT vessel – 1350 tons	Multimodal analysis [mln tons]				
	2025	2030	2035	2040	% 2040
Direct Road Transport	22.0	22.9	28.3	33.9	**16%**
Multimodal Rail	85.0	50.4	63.2	76.3	**36%**
Multimodal IWT	9.5	69.4	85.2	100.9	**48%**
Total [mln tons] *	**116.5**	**142.7**	**176.8**	**211.1**	**100%**

Source: Consultant analysis

** Results show slightly larger sums in comparison to KPT and PQA traffic projections as a consequence of applying growth factors on community level*

121. **Despite the potential, in practice, it is hard to effectuate potential modal shift in real modal shift.** From both supply side and demand side, various determining factors can be decisive in whether a shipper or freight forwarder will shift cargo from road transport to multimodal transport solutions (see Annex E for more details on Modal Choice for key indicators and success factors for Modal Shift). To better reflect the concept of shippers' modal choice, and to translate the theorical modal shift potential into a more realistic estimate (with reference to modal split figures in other countries having IWT in the modal mix), the results from the multimodal analysis have been decreased by 50% (see Table 9 below).

Table 9: Modal split Option 2: A tailored 1,350 DWT IWT vessel for Indus conditions making use of a dedicated connection from PQA to the Indus via Gharo Creek

Option 2 – IWT vessel – 1350 tons: Corrected (50%)	Multimodal analysis [mln tons]				
	2025	2030	2035	2040	% 2040
Direct Road Transport	69.2	82.8	102.5	122.5	**58%**
Multimodal Rail	42.5	25.2	31.6	38.1	**18%**
Multimodal IWT	4.7	34.7	42.6	50.5	**24%**
Total [mln tons] *	**116.5**	**142.7**	**176.8**	**211.1**	**100%**

Source: Consultant analysis

**Results show slightly large sums in comparison to KPT and PQA traffic projections as a consequence of applying growth factors on community level*

122. **The multimodal analysis shows that making use of small River-Sea-Vessels (RSVs) is not likely to provide a competitive option for road and rail.** Modal shift potential for IWT for this option is negligible and not interesting to further explore. However, option 2 does provide significant potential.

5.4. Socio-economic Cost Benefit Analysis (SCBA) for IWT Development in Pakistan

123. **The methodology developed for the simplified SCBA is based on the methodology used by STC-NESTRA in previous IWT projects** (e.g., upgrading of ship-locks, waterway improvements, aids to navigation and service fleet, etc.). Please see Annex E for the methodology and its limitations. The SCBA provides condensed indicators allowing measuring and comparing impact of various interventions of IWT on social and economic welfare. Within the SCBA, benefits are measured as consumer and producer surplus, while costs are based on investment and maintenance and operating costs. Externalities caused by the implementation of the waterway infrastructure program are to be described and assessed qualitatively and quantitatively according to international guidelines.

124. **The outcome of a SCBA is summarized in three complementary figures – the economic rate of return (EIRR), the economic net present value (ENPV), and the benefit to cost ratio (BCR).** The EIRR of a project is the average annual return to society on the capital invested over the entire life of the project. It is, in other words, the interest rate at which the project's discounted benefits equals the discounted costs, both valued from the entire society's point of view. The EIRR should be equal to or exceed a certain threshold (the social discount rate). The ENPV of a project is the difference between discounted benefits and costs at a given discount rate, projects are required to have a positive ENPV. BCR is an indicator showing the relationship between the relative costs and benefits of a proposed project, if a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value.

The first step in the SCBA methodology is to determine the investments and costs that have to be taken into account. With reference to the multimodal analysis (See Sections 5.2 and 5.3), limited investments in combination with the use of low-draught River Sea Vessel with a capacity of 500 tons, is not seen as an economic viable option to further study in the SCBA. Therefore, only option 2 (Connection Gharo Creek to Indus) is assessed in the SCBA.

125. **For the simplified SCBA, the investment and maintenance costs have been estimated, for which the following input values have been considered:**

I. <u>Basic assumption</u>:

- The time horizon of 30 years is according to what is common for waterway projects. It has to be taken into account that the investments could have a residual value, and the determination of that value will have a significant impact on the result of the SCBA. For this SCBA, the residual value at the end of the project has been assumed to be zero.
- Project implementation between 2023 and 2053
- Calculation in USD
- Conversion factor / Exchange rate used: PKR 1 = USD 0.0064
- Applied social discount rate: 6.5%
- 1 ha = 2.47105381 acres
- Constant prices: transport costs, external costs (for except GHG), construction costs, maintenance costs, etc. assumed to remained at a constant level. No indexation of costs has been considered.
- No toll or fee has been applied for IWT.

II. <u>Waterway construction costs</u>:

- Waterway construction Phase 1 – connection from Port Qasim via Gharo Creek to Indus at Kotri and channel along bank Indus up to Sukkur:
- At Rs. 270 mln / km = USD 1.73 mln / km (source: Punjab IWT project - Annexure D)
- Total length of stretch : 624km
- Assumed construction time between 2023 – 2025
- Waterway Construction Phase 2 – connection from Sukkur to Mari Indus (Jinnah Barrage) upstream:
- At Rs. 270 mln / km = USD 1.73 mln / km (source: Punjab IWT project - Annexure D)
- Total length of stretch : 800km
- Assumed construction time between 2023 – 2027
- Maintenance costs per year have been estimated at 2.5% of investment costs, which include locks (see below).

III. Construction of new locks and approach channels at barrages:

- Preliminary assessment: 4 locks required to overcome vertical height difference at barrages of Sukkur, Guddu, Taunsa and Chasma.
- Lock dimensions will approx. 90 – 100 meter in length and 11m width, assuming only 1 vessel will use the lock at the same time.
- Investment costs of USD 25 mln per lock (50% based on investment of the new lock at Farraka, National Waterway 1 in India, assuming the construction of locks can be carried out in dry conditions).
- Construction time of 1 lock per year between 2023 – 2026.

IV. Aids to Navigation (ATONs):

- LED / Solar based ATONs.
- Capital investment of Rs. 2.7625 mln for 340 km of waterway, extrapolated to 1,426 km of waterway channel ((source Annexure D, which comes to USD 74,000.
- Implementation related to construction of waterway channel, between 2023 – 2027.
- Maintenance Rs. 1.134 mln per year for 340km, extrapolated to 1,426km of waterway channel.

V. Service fleet for surveying and monitoring:

- Service vessel Rs. 10 mln (USD 64,000) per vessel (source: Punjab IWT project - Annexure D).
- Assumed 10 are tendered / built between 2025 – 2029.
- Maintenance costs per year assumed to be 5% of investment costs.

VI. Land acquisition:

- Assumed to be part of investments cost for construction.

VII. Construction of River terminals and loading platforms:

- 3 River terminals: Sukkur, DG Khan, Chashma against an investment cost of Rs. 180 mln, which is USD 1.152 mln per terminal. Assumed to be constructed between 2025 – 2027 (1 per year, starting with Sukkur).
- 4 loading platforms: Kotri, Chachran, DI Khan, Mari Indus against an investment costs of Rs. 35 mln, which is USD 224,000 per platform. Assumed construction time: 2 per year between 2026 – 2027.
- Road connectivity: assumed to be in port/terminal costs.
- Maintenance costs per year have been estimated at 2.5% of investment costs.

VIII. **Contingency**:

- SCBA is rough estimate, therefore a contingency of 20% on all investment costs is considered.

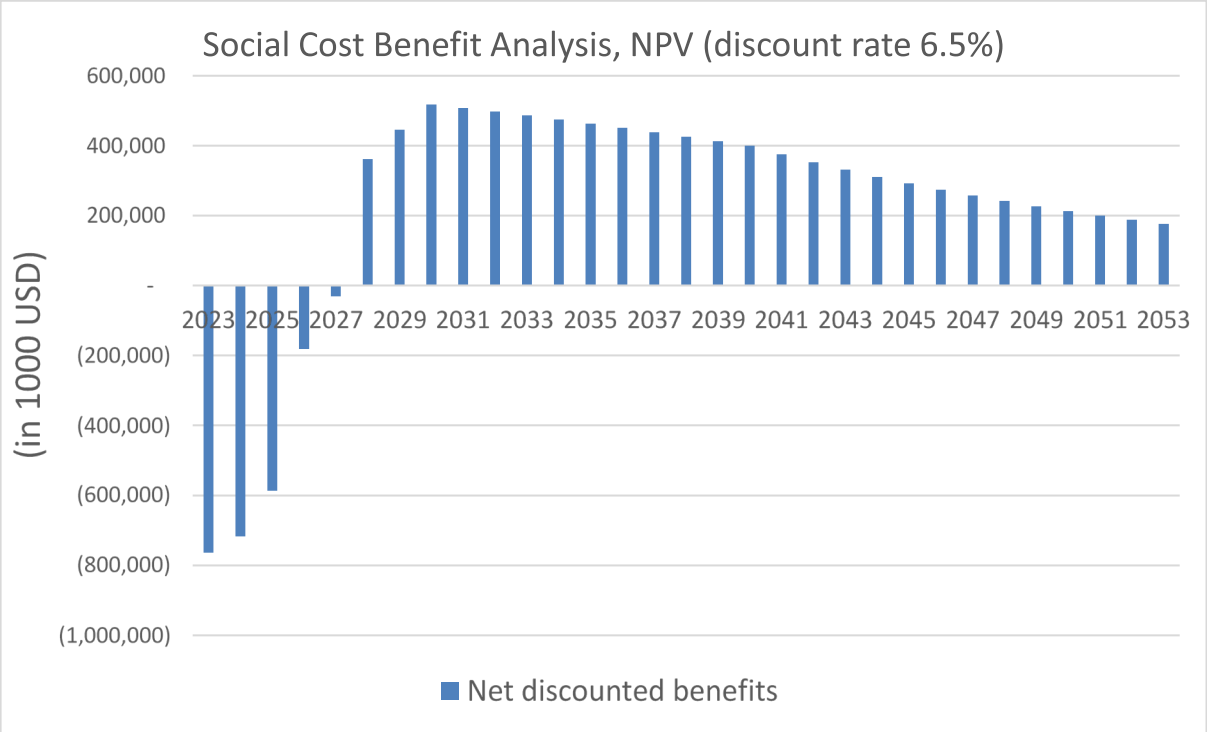
126. The presentation of the SCBA results below has been done in such a manner that they distinguish between benefit types.

5.4.1. Benefits from Transport Costs Only

The SCBA shows that the said IWT development scenario already has a positive economic result based on reduced logistics/transport costs. This is mainly the consequence of the significant modal shift (potential) and cost advantage of IWT over other modes.

Figure 21: Result 1 - benefits from transport costs only

ENPV	7,035,085	(x1000)	$	7.04	billion
BCR	3.0				
EIRR	20%				



Source: Consultant analysis

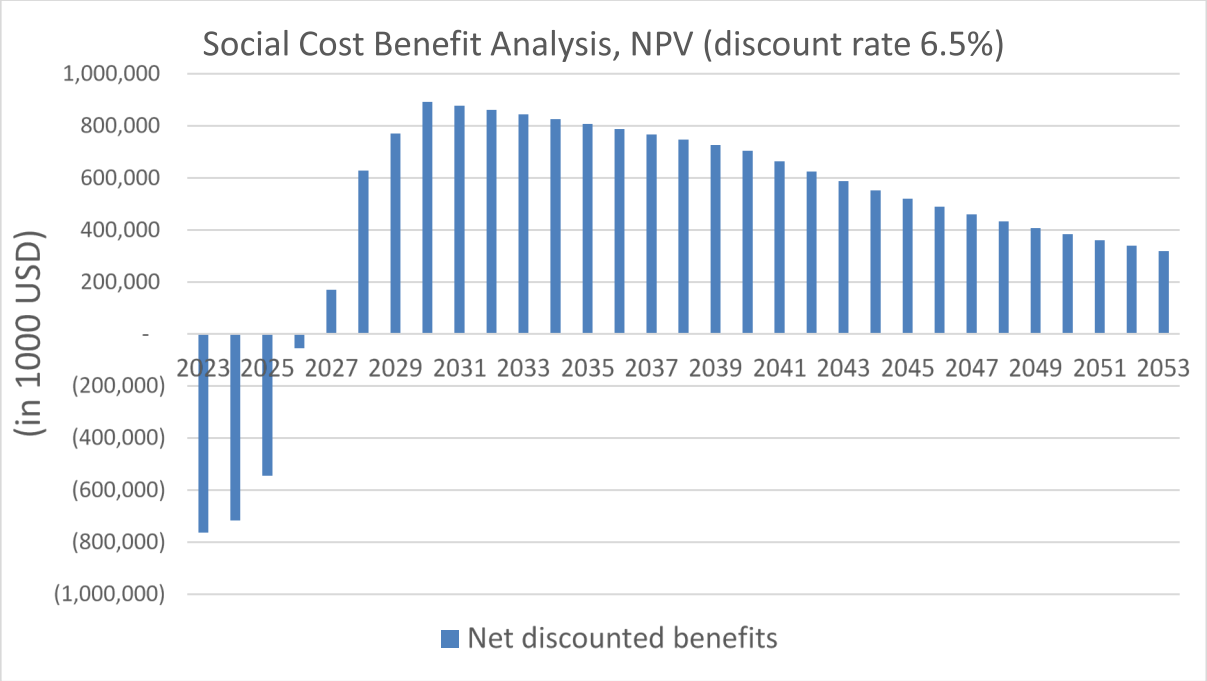
5.4.2. Benefits from Transport and External Costs

127. **Based on Well-to-Wheel emission factors and monetization of external costs. the benefits of avoided externalities have been estimated as: GHG, air pollutant emissions (NOx and PM), accidents and noise.** Congestions costs have not been considered. The

externalities are extrapolated by means of regression analysis in 5-year intervals. After 2040 the volumes are considered at a constant level, and therefore also the externalities are kept at constant level. By adding external benefits, the SCBA improves significantly (EIRR +9%).

Figure 22: Result 2 - benefits from transport + external costs

ENPV	14,469,476	(x1000)	$	14.47 billion
BCR	5.1			
EIRR	29.0%			



Source: Consultant analysis

5.4.3. Added Value of Logistics Zones

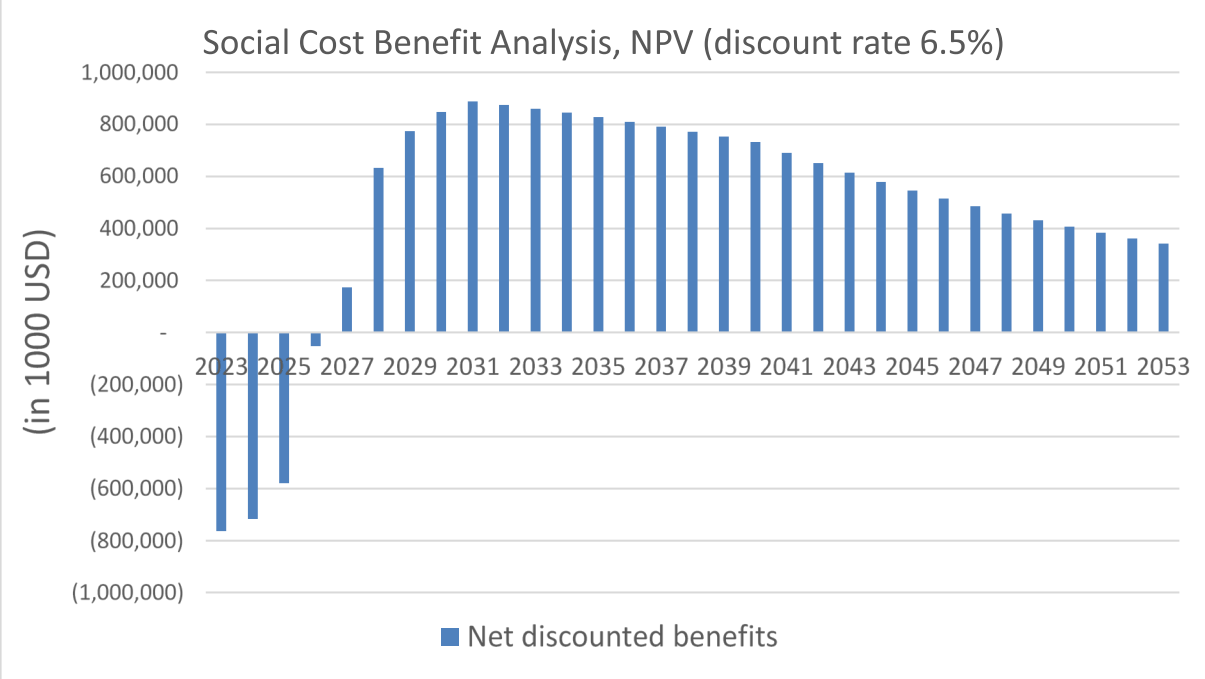
128. **A logistic zone, also called freight village or freight platform, is a combined and concentrated development of a multimodal terminal or port, with logistics companies, warehouses, and in most cases light industries.** The chances to develop the Indus River for IWT into a feasible project is expected to increase when the creation of logistic activities is included in the scope of the project. Based on international experiences in developed as well as developing economies, the (regional) benefits to develop logistic zones have been estimated.

129. **For now, three zones have been considered in the SCBA, to be developed sequentially in the project period along with development of limited scale (40 ha) river terminals at Sukkur, DG Khan and Chashma** Each zone is to be divided into public utility areas, a multimodal terminal, warehouses and distribution centers (DCs), private commercial areas, office buildings, and connecting infrastructure. Typical throughput of such a zone is estimated at 500,000 tons

per year on the multimodal side, so summing up to 1,500,000 for 3 logistics zones if full capacity is reached. As shown in the results below in Figure 23, the overall effect of the logistics zones on the SCBA seems limited in terms of economic internal return rate. However, in terms of benefit generated the Net Present value shows an increase of USD 460 million over the lifetime of the project, which is not insignificant.

Figure 23: Result 3 – added value of logistics zones

ENPV	14,932,014	(x1000)	$	14.93 billion
BCR	5.1			
EIRR	28.9%			



Source: Consultant analysis

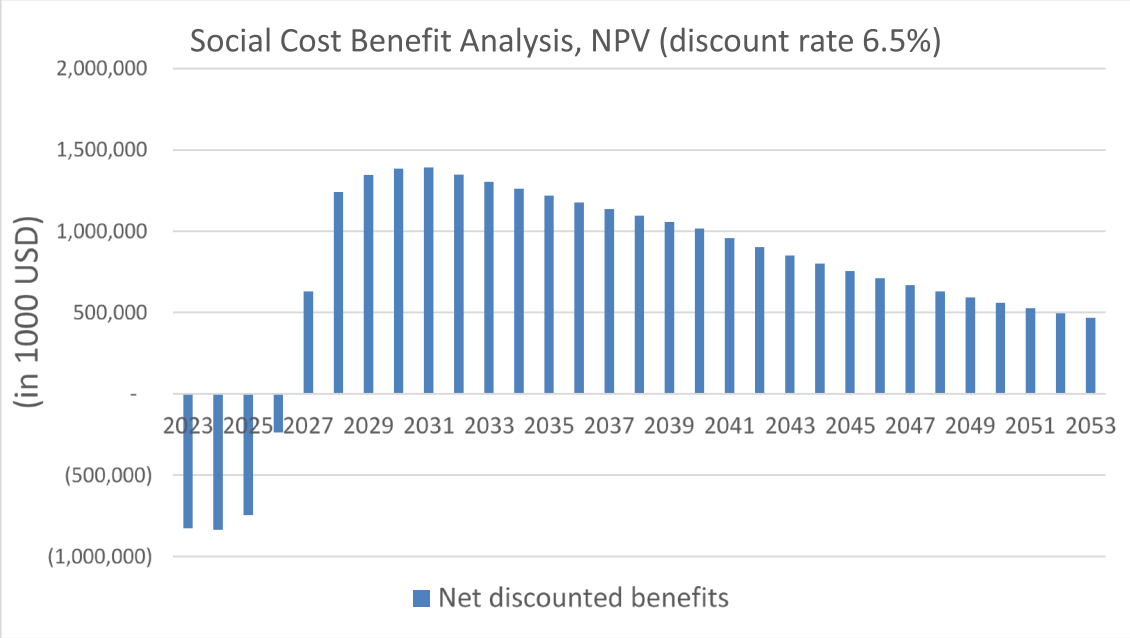
5.4.4. Integrated IWT Development with win-win solutions for irrigation & flood control

130. **Inspired by international practices, an integrative approach should be followed for IWT development in Pakistan** to build the case for IWT by aiming for a Good Navigation Status while creating win-win solutions for other economic, cultural, social and environmental functions of the Indus River at the same time. In this SCBA variant, the effects of such an integrative approach are estimated taking into account investments costs and benefits of improved irrigation systems due to improved water management and water control and more efficient irrigation technologies (e.g. less water spillage, less seepage) and reduced flood damage costs as a result of improved flood control.

131. **As shown in the results below, an integrative project focused on win-win solution for navigation, irrigation, and flood control, could have a large positive effect on the profitability of the project.** The EIRR increases with more than 6%, and the benefit generated in terms of Net Present value increases with approx. USD 8 billion over the lifetime of the project.

Figure 24: Result 4 – Integrated IWT development with win-win solutions for irrigation and flood control

ENPV	22,885,300	(x1000)	$	22.89	billion
BCR	6.2				
EIRR	35.1%				



Source: Consultant analysis

5.4.5. Sensitivity Analysis

132. **Overall, the SCBA as presented incrementally looking into the impact of various value-added components, is very positive.** Obviously, there are a few indicators that can influence the SCBA, such as the multimodal transport costs. With reference to Option 1, the cost difference between road and multimodal transport is a precondition for a successful business case. Based on international cost comparisons, if IWT is to developed according to a serious approach with dedicated IWT vessels of significant size (e.g. > 1,000 DWT), such cost difference in transport costs is feasible. Next, there is the simulated O/D matrix for port-hinterland transport and the assumption of long-distance transport. When long distance transport is less, this influences the potential in a negative way. At the same time, domestic transport is not taken into account, and this could increase the potential. And finally, the SCBA is influenced by the investment costs for

waterway construction, irrigation and flood control, and the related benefits. Therefore, as a sensitivity analysis, the SCBA scenarios are re-assessed based on higher investment costs. For this report, only the last variant is presented, including all of the four effects (transport cost, external benefits, logistics zones and irrigation and flood control). The annexure provides the data for the individual effects.

133. **The SCBA results considering higher investment and maintenance costs still show a positive business case to develop IWT in Pakistan.** Although there are some reservations to keep in mind, the SCBA results show that an IWT solution could provide a substantive reduction of logistics costs that can carry a large part of investments in the IWT system. Effects stemming from following an integrative approach, creating win-win solutions for logistics, irrigation and flood control, provide further benefits to the business case.

- Benefits from Transport Costs Only: The SCBA shows that also with higher investment costs, the project has a positive economic result based on reduced logistics / transport costs.
- Benefits from Transport + External Costs: The benefits of avoided externalities have the similar positive effect as in Option 2A. The By adding external benefits, the SCBA improves significantly (EIRR +6%) and USD 7.5 billion in terms of NPV.
- Added Value of Logistics Zones: the overall effect of the logistics zones on the SCBA is similar as in Option 2A. The economic internal return rate improves with 0.2%.
- Integrated IWT Development with win-win solutions for irrigation and flood control: Considering the higher investment costs for the waterway channel, an integrative project focused on win-win solution for navigation, irrigation and flood control, has an additional effect of about 3% in terms of EIRR summing up to a total of 16.2% and an NPV of USD 15.3 billion.

134. **The SCBA considering higher investment and maintenance costs also shows a positive business case to develop IWT in Pakistan.** Although there are some reservations to keep in mind, the SCBA results show that IWT solution could provide a substantive reduction of logistics costs that can carry a large part of investments in the IWT system. Effects stemming from following an integrative approach, creating win-win solutions for logistics, irrigation, and flood control, provide further benefits to the business case.

5.4.6. Interpretation of SCBA Results

135. **The SCBA shows a positive business case for IWT, even in a situation when higher investment costs are considered for investments in IWT infrastructure (capital and maintenance for navigational channel, locks, etc.).** Developing the navigation channel as economic corridor (e.g., logistics zones), and creating win-win solutions for irrigation (higher productivity of agricultural lands) and flood control (avoided damage costs by flooding's), increases an economic surplus to the already positive business case based on reduced transport costs only.

6. Strategic Development Directions for IWT Revival in Pakistan

136. **Developing IWT is socio-economically viable and is likely to result in major economic gains for the country** as demonstrated by freight and passenger flow projections, multimodal transport cost modeling, multimodal shift potential estimation and simplified Socio-economic Cost-Benefit Analysis provided in Section 5. There is a strong positive case to be made for IWT development, even in a situation when higher investment costs are considered for investments in IWT infrastructure. International good practices also indicate that IWT systems can be developed to play an integral role in national and regional economies, provided that the conditions are right. Successful IWT development requires an integrated vision and a long-term strategy coupled with strong political commitment and guidance.

For the development of the IWT system in Pakistan, the Government of Pakistan is recommended to:

137. **Establish an IWT Cell at the Ministry of Maritime Affairs to streamline current IWT operations and lay the groundwork for IWT development and institution-building**. The IWT Cell should be tasked with the following functions that require immediate government attention:

- Conducting a detailed feasibility assessment to inform the development of a comprehensive Strategy and Implementation Plan for IWT development in Pakistan, as outlined below in para 142.
- Preparation of a comprehensive Strategy and Implementation Plan for IWT Development through an inclusive multistakeholder process.
- Building stakeholder consensus and securing high-level approval for the Strategy and Implementation Plan for IWT Development.
- Laying the groundwork and building stakeholder consensus for setting up of an Inland Waterway Authority, as outlined in para 143.
- Working on IWT legal and regulatory framework as well as financing mechanism, starting with development of Standard Operating Procedures (SOPs) for current IWT operations and a monitoring framework for improving of safety levels.

138. **Establish an Inland Waterway Authority (IWA) at the Federal level under the Ministry of Maritime Affairs for developing, regulating, monitoring, promoting and standardizing IWT in Pakistan.** The IWA should be a multi-stakeholder body with representation from relevant government and private sector stakeholders. The Government may opt for one the following legislative pathways for establishing the IWA:

- Through resolution(s) on behalf of one or more Provincial Assemblies giving consent to the Parliament to legislate for the establishment of IWA at the Federal level.
- Through direct legislation by the Parliament (using the 'Commerce Clause') for the establishment of IWA at the federal level. A summary could be initiated through the

appropriate Ministry by seeking concurrence of the Ministry of Inter-Provincial Coordination. (See Section 4.2)

139. **Ensure that the future Inland Waterway Authority (IWA) has a clear mandate, covering a) IWT policy formulation and implementation; b) regulation, monitoring and standardization of the IWT Sector; c) IWT market development. However, its mandate should not include any other water management issues** which must remain with existing authorities and agencies tasked with managing other waterway uses (such as irrigation and hydropower). The IWA should have the following functions and powers:

- Grant licenses under the IWA Act.
- Make rules and regulations for the safety and security of persons, passengers, goods and vessels.
- Specify procedures and standards for registration of persons and vessels providing services for inland waterways transport.
- Specify rules/regulations for proper and safe navigation in the inland waterways.
- Aid and advise the Federal Government in formulation of national water plan.
- Specify procedures and standards for investment programs by inland waterways transport companies and persons licensed or registered under the Act.
- Promote development of waterways and making rules/regulations for construction of terminals.
- Specify fees including fees for grant of licenses and renewal thereof.
- Review its orders, decisions or determinations.
- Settle disputes between licenses in accordance with the specified procedure.
- Issue guidelines and standard operating procedures.
- Promote development of a market, including trading in accordance with the national water plan.
- Coordinate with the irrigation authorities for streamlining irrigation system & flood control.
- Perform any other function which is incidental or consequential to any of the aforesaid functions.

140. **Develop a legislative and regulatory framework for inland navigation in Pakistan.** Following its foundation, the IWA must develop a comprehensive legislative and regulatory framework which deals with technical specifications for vessels, educational qualifications for crews and operators, environmental standards and safeguards, traffic rules and Standard Operating Procedures (SOPs) for IWT operations.

141. **Establish IWT monitoring and support systems under the aegis of IWA**. The IWT monitoring system should work in synergy with existing transport inspection units to closely monitor and inspect IWT operations to ensure compliance with the national regulatory framework and international best practices. The support systems should work in collaboration with maritime institutes to develop and implement capacity building programs aimed at

enhancing the capacity of government institutions involved in IWT governance as well as IWT operators and crews.

142. **Building upon this report, conduct a detailed feasibility assessment to inform the development of a comprehensive strategy and an elaborate action plan for IWT development under the aegis of IWA.** While the results of the Punjab IWT Pilot Project can form the basis of short-term infrastructure improvements needed to kick-start IWT operations, a detailed feasibility assessment needs to be carried out to update the pilot study results and expand to other areas that are not included in the study.

The detailed feasibility assessment should be aimed at determining the future IWT network, identifying possible options for developing connections, specifying draft requirements, proposing vessel specifications, identifying accompanying infrastructure needs such as River Information Services (RIS), proposing port and terminal upgradations and sites for establishing logistics zones.

In addition to a thorough freight flow analysis for all modes of transportation at Origin-Destination Level, the detailed feasibility assessment should also include a comprehensive environmental impact assessment to identify environmental risks and possible mitigation measures.

143. **Develop a fit-for-future Inland Waterways Transport system instead of relying on the existing IWT infrastructure as the current waterway conditions will not lead to economically viable and sustainable operations.**

The following two major development directions are available to the Government of Pakistan:

i. Introduce IWT in Pakistan using the current IWT infrastructure with minor adaptations and upgradations, with a fleet that is adapted to these conditions.
ii. Design and develop a fit-for-future IWT system with direct port connectivity which would allow larger and more economic vessels to navigate inland waterways.

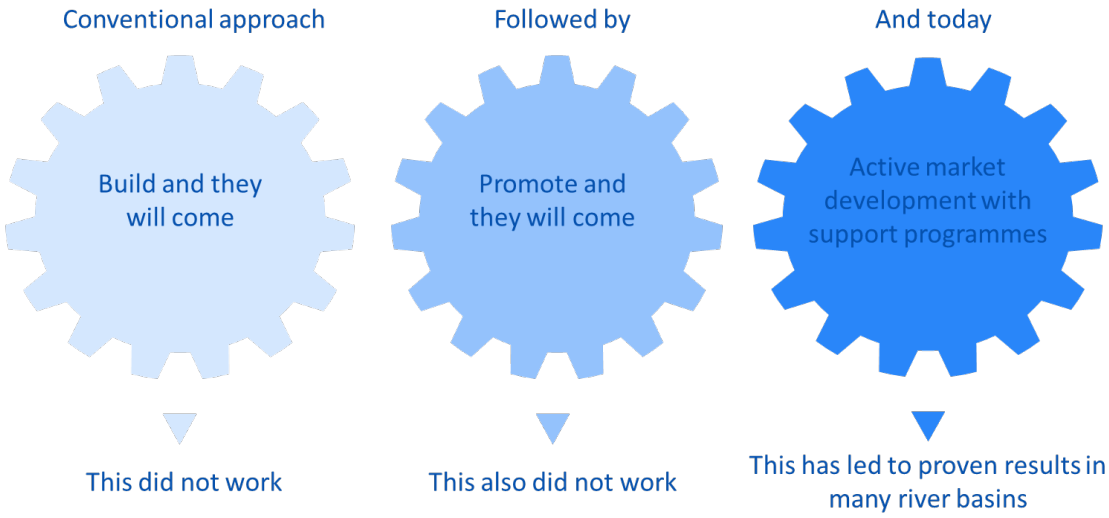
However, the first development direction is not recommended for a long-term IWT solution. The analysis in Section 5 clearly demonstrates that choosing the first option would most likely result in the IWT system playing only a marginal role in Pakistan's transport system. The full set of advantages offered by IWT would not be realized. The creation of logistics zones along waterways would remain a possibility, but without port connectivity, the market would remain limited to local flows as it would be unable to capture the biggest freight potential which is offered by export and import (EXIM) cargoes via major seaports. Small-scale vessels, adapted to the size of existing locks and limited draft depths, would result in very high costs per ton-kilometer.

The second development direction is strongly recommended for developing a long-term, economically viable and sustainable IWT solution for Pakistan. It would require major investments for infrastructure development, but upon maturity, the system would a) enable possibilities for alternative supply chains via waterways with significant cost reduction, b) promote regional connectivity and international trade via port connectivity and, c) benefit communities by creating additional economic activities along waterways.

The fit-for-future IWT system for Pakistan can be gradually developed, one step at a time, starting with the utilization of existing infrastructure, with a long-term development plan which identifies clearly defined intermediate steps.

144. **Adopt a proactive approach to IWT market development with ongoing support programs in order to realize an IWT breakthrough in Pakistan**. The conventional approach towards IWT development — build and they shall come — in which the waterway authority develops infrastructure and waits for the private sector to step in and start using the IWT system, may not lead to significant positive results in Pakistan as most producers, traders and transporters are not familiar with IWT and are likely to continue relying on road and rail transportation. Therefore, a proactive approach needs to be adopted, which should entail balanced measures aimed at stimulating the private sector to benefit from IWT, invest in green technologies and locate industries along inland waterways. While awareness campaigns aimed at promoting and highlighting the benefits offered by IWT may lead to limited modal shift towards IWT, active market development with integrated support programs is essential for realizing an IWT breakthrough in Pakistan (See Figure 25).

Figure 25: Stages in IWT project approaches



Source: STC-NESTRA

145. **Ensure that long-term IWT infrastructure investments go in parallel with investments in irrigation, hydropower, and flood prevention to create a WIN-WIN situation by balancing waterway uses.** IWT solutions should be developed in a way that they do not impact prime waterway uses but are in fact beneficial for irrigation and flood prevention.

146. **Strengthen the IWT infrastructure in Pakistan to maximize the economic gains offered by IWT, with a particular focus on the following:**

I. Establishment of direct Port-IWT Connectivity to enable uninterrupted IWT operations, ideally through the development of a Still Water Channel between Gharo Creek and Kotri via KB Canal (See 4.1.1).
II. Standardization of existing navigation locks at barrages and the development of a new navigation-lock at Sukkur Barrage (See 4.1.3).
III. Development of canal networks for improved navigability by deepening and lining canals and raising the height of the cross-bridges.
IV. Development of logistics zones, industrial activities and freight villages along waterways.
V. Development and promotion of an IWT fleet as specified in (See 4.1.5).
VI Development of a 60m wide and 3m deep channel with 1.5m high bunds on sides for flood protection as a long-term investment in IWT infrastructure (See para 60).

147. **Ensure that IWT development goes together with environment protection and nature conservation to preserve the freshwater ecosystem and biodiversity of the Indus River System**. The following measures are recommended in this regard:

I. Design and conduct a comprehensive environmental impact assessment to identify potential environmental impact of IWT development and possible mitigation measures.
II. Develop green ports and green terminals, increase energy conservation at ports and terminals, reduce emissions at ports, promote clean production of port facilities and equipment, and gradually eliminate or upgrade port equipment that produces high amount of pollution.
III. Introduce and promote vessels operating on alternate fuels to minimize greenhouse gas emissions.
IV. Construct fish passages at all navigation-locks.
V. Adopt international best practices for environment protection, such as the Good Navigation Status and Good Environmental Status (GNS/GES) system by the EU.

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