



MEKONG RIVER COMMISSION

COUNCIL STUDY: Interim Report for Navigation Thematic Area

Cambodia ♦ Lao PDR ♦ Thailand ♦ Viet Nam

NAVIGATION PROGRAMME

June 2016

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INTERIM REPORT

NAVIGATION THEMATIC AREA

1 BACKGROUND

1.1 INTRODUCTION

This Report deals with the waterborne transportation sector and its relationship with other water related resources in the Greater Mekong Basin. The report has many references to the recently completed Design of the Master Plan (MP) for Regional Waterborne Transportation in the Mekong River Basin, because the MP is dealing with all opportunities for trade and transportation (positive impacts), and the (positive and negative) impacts on and from other sectors. The MP deals with physical and non-physical barriers and potentials. The MP team not only studied the infrastructure but also trade logistics which have a positive impact on the sector and which also forms an integrated part of the Council Study. All the aspects have been analysed in detail and translated into the Development Scenarios for 2020 and 2040. Moreover, we have 99 Actions in our Implementation Portfolio with dredging activities and channel regulating works specified in detail. The formulation of a “Master Plan for Regional Waterborne Transport on the Mekong River Basin” is part of the MRC Navigation Programme 2013-2015.

1.2 METHODOLOGY FOLLOWED

As stated before, most of the work is based on the design of the Master Plan. In the design of the Master Plan, six parts were identified:

1. Problem definition

To obtain agreement from all stakeholders, the approach and methodology for the design of a Master Plan for Regional Navigation on the Mekong River Basin was assessed and discussed before drafting the Inception Report.

2. Data collection

Economic data were collected, but also for vessels and fleet, waterway design, waterway safety, port development, socio-environmental aspects and legal aspects, data and information on the current situation and on planned and ongoing projects have to be collected. For all related items (legislation, ports, fleet, waterway design and safety, socio-environment) the current situation was assessed, opportunities and obstacles have to be identified and gaps were analysed.

3. Economic forecast:

The tools for this phase are the collected data and information on the baseline condition and a transport economy study. The result of this part were a current situation description and a long-term multimodal economic forecast of which the first five years can be considered as short term forecast

as used as a basis to plan “short term actions”. Therefore, data collection and transport (forecast) modelling was very important.

4. Development Scenarios

A future situation assessment for waterborne transport activities lead to a short-term (2020) and long-term (2040) development scenario for all related items.

5. Action Portfolio,

Where next to initiatives for regional cooperation, legal and socio-environmental actions, projects and actions were identified for fleet, waterway design, port development and navigation safety in order to achieve the proposed short term and long term development scenarios.

6. Socio-Economic and Environmental Assessments

The design of the “Master Plan for Regional Waterborne Transport in the Mekong River Basin” was concentrated on the upper part of the MRB (with special attention of the Quadrangle area between China, Myanmar, Lao PDR and Thailand), while for the lower part of the MRB, the study will be limited to the review, actualisation and harmonisation of the Cambodian Master Plan and Vietnamese Mekong Delta Sector plans.

2 CURRENT SITUATION OF NAVIGATION IN THE MEKONG BASIN

2.1 TRANSPORT AND TRADE SITUATION IN THE FOUR MRC MEMBER COUNTRIES

2.1.1 Demand for Transport to trade Agricultural, Commercial, Industrial and Tourism Resources in the four MRC Member Countries

Agriculture and Forestry

In 2013, agriculture contributed 12 percent of Thailand's national GDP, 27 percent of Lao PDR's national GDP, 34 percent of Cambodia's national GDP and 18 percent of Viet Nam's national GDP.

According to the US Department of Agriculture (USDA) Foreign Agricultural Service Production Supply and Distribution Database, rice production and export are projected as follows:

1000 metric tonnes, milled basis		1999-2001 Average (ton)	Annual growth	2009-2011 Average (ton)	Annual growth	2019-2021 Estimation (ton)
Thailand	Production	17,019	1.8%	20,327	1.5%	23,545
	Export	6,916	3.1%	9,105	4.3%	13,012
Lao PDR	Production	1,170	1.8%	1,395		NA
	Export	NA		NA		NA
Cambodia	Production	2,555	5.1%	4,186	3.8%	6,089
	Export	0		805	6.5%	1,329
Viet Nam*	Production	20,812	2.2%	25,940	0.8%	27,964
	Export	3,771	6.2%	6,094	1.5%	7,033

* About half of the Viet Nam rice production is produced in the Mekong Delta

An effort to diversify agro-forestry products has just started. Expected industrial crops for future development include cassava, maize and soybeans, and expected forestry products include rubber, palm and woodchips.

Fisheries

Estimates of total fisheries catch in the MRB have increased dramatically in recent years and are presently topping more than 2,5 million tonnes annually with a value exceeding US\$ 2 billion (excluding aquaculture and reservoir production). This means that there is considerable trade in fish within the Mekong Basin (for instance in Cambodia, at least 70,000 tonnes of freshwater fish are exported to Thailand annually) while exports out of the region are limited, but increasing.

Industry

According to the CIA World Fact Book, in **Thailand** industry represents 45 percent of the GDP and textiles and garments, food processing, beverages, cement, computers, furniture and plastics

represent the largest portion of Thailand's industry. In **Lao PDR**, industry represents one third of the GDP and is mainly composed of agricultural processing, garments and cement. In **Cambodia**, the garment industry represents the largest portion of Cambodia's manufacturing sector, accounting for 80 percent of the country's exports. Meanwhile in **Viet Nam**, the Mekong Delta is not strongly industrialised, and most of the industry is agricultural-based.

Minerals and energy

The region has a large potential for hydropower development, with several dams already in operation, in commission or in the planning phase. In addition to hydropower, energy resources include fuel, wood, oil, natural gas, coal and lignite. Oil, natural gas and coal occur in Myanmar, Cambodia and the Yunnan province but all MRC Member Countries still need to import oil products. There are high geological and economic potentials for the development of mineral commodities in the region (ADB/UNEP 2004). Mineral resources include gemstones, alluvial gold, alluvial cassiterite, silica, bauxite, copper, calcite and construction materials.

Tourism

Tourism makes a strong contribution to the GDP of all MRB countries, dominating their exports of goods and services. In 2010 they attracted 27 million international visitors and riverine environments figure prominently in much of the sub-region's tourism.

In **Thailand**, popular destinations such as Chiang Mai and Chiang Rai are located either on or adjacent to the Mekong River or its tributaries. In **Lao PDR**, where backpackers predominate, the most popular destinations are along the Vientiane/Luang Prabang/Huay Xay Corridor and the Siphandon region known as the 'Four Thousand Islands'. In **Cambodia**, most tourism is centered on the capital Phnom Penh, Siem Reap's ancient Angkor Complex and the Tonle Sap Great Lake. And finally in **Viet Nam**, the Mekong Delta, an area of great natural beauty, is an attractive and developing tourist destination.

2.2 TRANSPORT ECONOMICS

2.2.1 Annual Cargo Traffic Volumes

LAO PDR

Inland Waterway Transport (IWT) vessels cross the river border between Lao PDR and China near the Lao port of Ban Sai (294 km from Simao), while trucks cross the land border with China at Boten. Waterborne cargo volumes were provided for 7 ports or landings between Ban Sai and Vientiane and a border crossing volume of about 216,000 tonnes was identified in 2014, down from 218,000 tonnes in 2010.

Data on trade volumes collected from customs checkpoints at Boten and Huay Xay indicate that of the majority of cargo hauled by road through this checkpoint, approximately 65 percent moves along Route 13N, with the balance of 35 percent moving along Route 3A.

It is estimated that, within the corridor comprising the river route and Highway 13N, the road share of the cargo volume in 2014 was approximately 58 percent and the IWT share 42 percent. Moreover, while the road volume has recently been increasing at a rate averaging about 6 percent per annum, the IWT volume appears to have been declining, albeit slightly.

Statistics relating to the total volume of cargo moving by road and water nationwide are published in the Statistical Yearbook of Lao PDR for 2013. Overall cargo volume data for the 10-year period 2002-2012 was regressed against real GDP, in order to determine the "fit" between these series. This was done both for total cargo and for the volume of cargo reported as moving by road.

THAILAND

The principal transport routes linking Thailand with China and the Lao PDR are:

- The waterway route linking the ports of Chiang Saen and Chiang Khong with ports in Yunnan Province of China and ports in Lao PDR; and
- National Route 3A which links Chiang Khong with the Boten checkpoint on the China/Lao border and with other intermediate destinations in Lao PDR.

An estimate of road hauled cargo through the Chiang Khong/Huay Xay checkpoint is given in the table above. It is estimated that in 2014 nearly 700,000 tonnes of cargo passed through this checkpoint. Of this volume, it is estimated that about 380,000 tonnes was transported to and from China along Route 3A, with the balance (320,000 tonnes) being transported to and from locations in Lao PDR. When combined with the volume transported by IWT (about 600,000 tonnes), a total cargo volume in the corridor of 980,000 tonnes in 2014 is indicated, with the IWT and road shares standing at 61 percent and 39 percent respectively.

Future cargo flows in the corridor were estimated in relation to the forecast growth of total waterway traffic in Thailand. Statistics of the latter are available from the website of the Ministry of Transport Thailand.

Refined **petroleum products** (diesel and benzene) are transported from Bangkok and the Eastern Seaboard of Thailand by road to Hasiang Port near Chiang Saen, where they are loaded onto barges for transport to China. In 2014, this volume was 21,761 tonnes. Approximately 32 percent of all petroleum transported to China from Thailand in 2014 moved by barge from Chiang Saen, and the balance (68%) is estimated to be moved by road tanker along Route 3A.

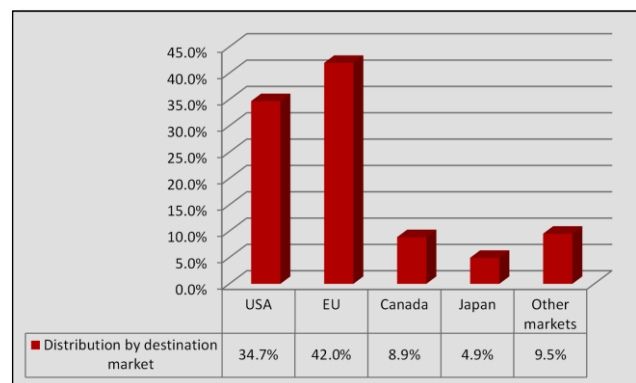
CAMBODIA-VIET NAM

In Cambodia, in 2014 total **container throughput** in Sihanoukville Port was 333,904 TEU and in Phnom Penh Port 133,666 TEUs. Data showed that the national container throughput has been growing rapidly. Indeed over the 12-year period 2002-2014 it grew at a rate averaging nearly 9 percent per annum, about one percentage point faster than the growth of GDP over the same period. Moreover, the share of Phnom Penh Port in the total flow of containers in and out of Cambodia has been increasing rapidly and in 2014 accounted for nearly 30 percent of the total container throughput of Cambodia. Between 2013 and 2014, there was a 17.8 percent year on year increase in the national container volume, with the throughput of Sihanoukville increased by 16.6 percent and that of Phnom Penh by an impressive 21 percent.

Finished garments are estimated to account for about 70 percent of Sihanoukville's export container volume and probably for a similar proportion of Phnom Penh's export container volume. Owing to the demand for import of textiles and yarn (inputs for the garment industry), loaded import and export container volumes have been reasonably well balanced at both ports.

Data published on the website of the Cambodian Garment Manufacturer's Association indicates the following distribution of garment exports, based on *value*.

If it can be assumed that the physical distribution of exports follows the same pattern as export values, then it appears that Phnom Penh Port would have an advantage to serve at least 48 percent of garment export volume, comprising exports to USA, Canada and Japan. Yet, it appears that two-



Distribution of Cambodian garment exports in 2014

thirds of loaded export containers are shipped through the Port of Sihanoukville. This would suggest that, despite Phnom Penh's distance advantage to serve North American export markets, a substantial volume of garment exports to those markets is being shipped through Sihanoukville and Singapore.

Cambodia imports its total requirement of **petroleum products**. There are two main sources of supply: Viet Nam and Singapore, but a new source is developing in Thailand. The major movement of petroleum on the inland waterway is from Nha Be on the Saigon River near Ho Chi Minh City to bulk petroleum depots in Phnom Penh. Petroleum is carried in specialized tanker barges with a capacity of 1,000 DWT. Petroleum is shipped from Singapore in 7,000 - 8,000 DWT feeder tanker vessels, which are discharged at Tomnop Rolork jetty, about 12 km north of Sihanoukville. Petroleum from Thailand, transported in 2,000T - 3,000 DWT vessels, is unloaded at Stoeung Hav jetty, about 25km north of Sihanoukville.

Between 2002 and 2014, the tonnage of petroleum imported into Cambodia grew from 691,300 to 1,684,000 tonnes, representing an average annual increase of 7.7 percent, which was only marginally short of the growth of GDP during this period. By contrast, over the same period, the tonnage of petroleum moved into Cambodia on the waterway grew from 369,000 to 605,000 tonnes, at an average annual rate of 4.2 percent and the tonnage moved through Sihanoukville grew from 323,000 to 987,000 tonnes, or just short of 10 percent per year, meaning that the Phnom Penh Autonomous Port (PPAP) share declined to 36 percent from 53 percent and the Sihanoukville share grew to 59 percent from 47 percent.

Concerning bulked and bagged cargo or **general cargo**, this category (agricultural products, steel, cement, fertilizer, etc.) sustained strong volume growth in PPAP within the past three years and in particular in 2014 when volume jumped by more than 60 percent up to 266,922 tonnes.

In 2014 the volume of Thai **cement** entering Cambodia is estimated to have amounted to more than 1.5 million tonnes in 2014 of which 925,155 tonnes was handled through the port system (Phnom Penh Port, Oknha Mong Port, Srei Ambel Port, Koh Kong Port).

Similarly, it is estimated that a substantial volume of **steel** is imported across land borders. In 2014, nearly 132,000 tonnes of steel entered Cambodia across the national boundary, about 50 percent each from Viet Nam via NR 1 and 50 percent from Thailand via NR 5.

Phnom Penh Port handles a substantial volume of **fertilizer**, most of it coming from Viet Nam, but also some from China. In 2014, fertilizer imports through Phnom Penh port jumped significantly, by more than 60 percent in a single year up to 87,540 tonnes (total volume of fertilizer import = 112,540 tonnes).

About 134,000 tonnes of **coal** is imported annually, all of it through the two major ports (91,000 tonnes by Sihanoukville and 43,000 tonnes by Phnom Penh Port).

And finally, the possibilities for the export of agricultural commodities from Kompong Cham have recently been raised by trade shipments of cassava from that province. It is estimated that during the period 2007-2014, the total production of cassava in Cambodia grew at an average annual rate of 20 percent, from 2.2 million tonnes in 2007 to 7.9 million tonnes in 2014. On the basis that two return voyages per month can be achieved per vessel during the 5 month navigation period, the total tonnage of cassava which can be shipped in a year may be calculated at 36,000 tonnes per year.

2.2.2 Annual Passenger Traffic

LAO PDR

Regional passenger traffic on the 596 km stretch of the Mekong from the Lao/China border near the port of Ban Sai, to Luang Prabang comprises:

- Passengers crossing the river and land borders between Lao PDR and China and between Lao PDR and Thailand. Somewhat limited data from immigration department sources have to be used to estimate the major regional passenger volumes.
- Tourists travelling on slow tourist boats or speedboats between Luang Prabang and Thame Tin Cave, a popular tourist site about 28 km upstream from Luang Prabang.

IWT cross border passenger traffic from China and Thailand to the Lao PDR

It is estimated that the majority of waterborne cross-border passenger traffic between Lao PDR and China and between Lao PDR and Thailand is now handled through the new International Immigration post in Ban Khouane. Lao immigration authorities have reported that 49,483 tourists passed through this post in 2013, increasing to 79,403 tourists in 2014.

IWT tourist traffic, Huay Xay-Luang Prabang

The baseline traffic data obtained by questionnaire are somewhat unreliable, but they do suggest that IWT tourists on the Huay Xay – Luang Prabang stretch make up just over 1 percent of all tourists arriving in Lao PDR and that this number has been declining slightly over the past seven years.

THAILAND

Cross border transport occurs between Thailand and China and Thailand and the Lao PDR via the Upper Mekong and the land border at the bridge between Chiang Khong (Thailand) and Huay Xay (Lao PDR).

CAMBODIA-VIET NAM

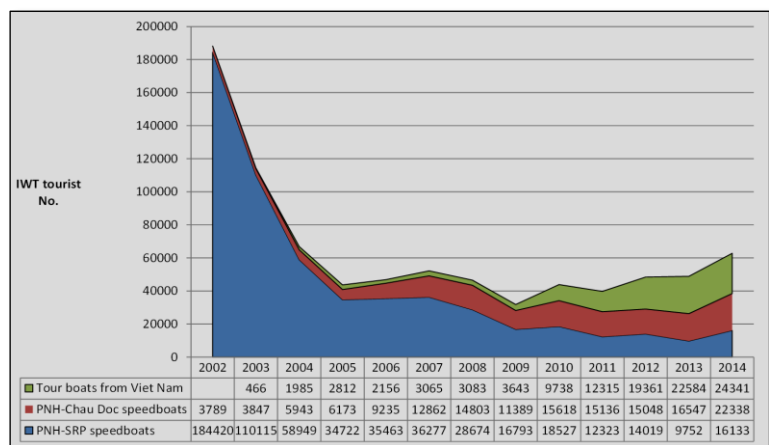
Passenger traffic on the Lower Mekong is of three types:

- Tourist passengers travelling from Phnom Penh to Siem Reap (Chong Kneas Port) on speedboats;
- Tourist passengers travelling by speedboat between Phnom Penh and Chau Doc Port, Viet Nam; and
- Tourists travelling on slow accommodation boats between Ho Chi Minh City and Phnom Penh, some of which extend their voyages to Siem Reap during the high water season.

Statistics of passenger volumes and passenger boat movements are maintained by the Phnom Penh Autonomous Port Authority. The trend in passenger volumes is given in the Figure below:

The average annual rate of growth for Chau Doc speedboat passengers between 2002 and 2014 was 15.9 percent, while that for Tour Boat Passengers from Viet Nam was 43.3 percent. During the same period, speedboat passengers to Siem Reap *declined* by an average of 18.4 percent per annum.

During the same period (2002-2014), international tourist arrivals into Cambodia increased at a rate averaging 16.5 percent per annum.



Passenger volumes Cambodia-Viet Nam

2.2.3 Major Traffic Flow Directions

UPPER PART OF THE MEKONG RIVER BASIN

The Upper part of the Mekong Basin encompasses the stretch of the Mekong between the Lao PDR / PR China border and the Khone Falls.

(i) **Corridor 1A:** Simao-Huay Xay/Chiang Khong, comprising:

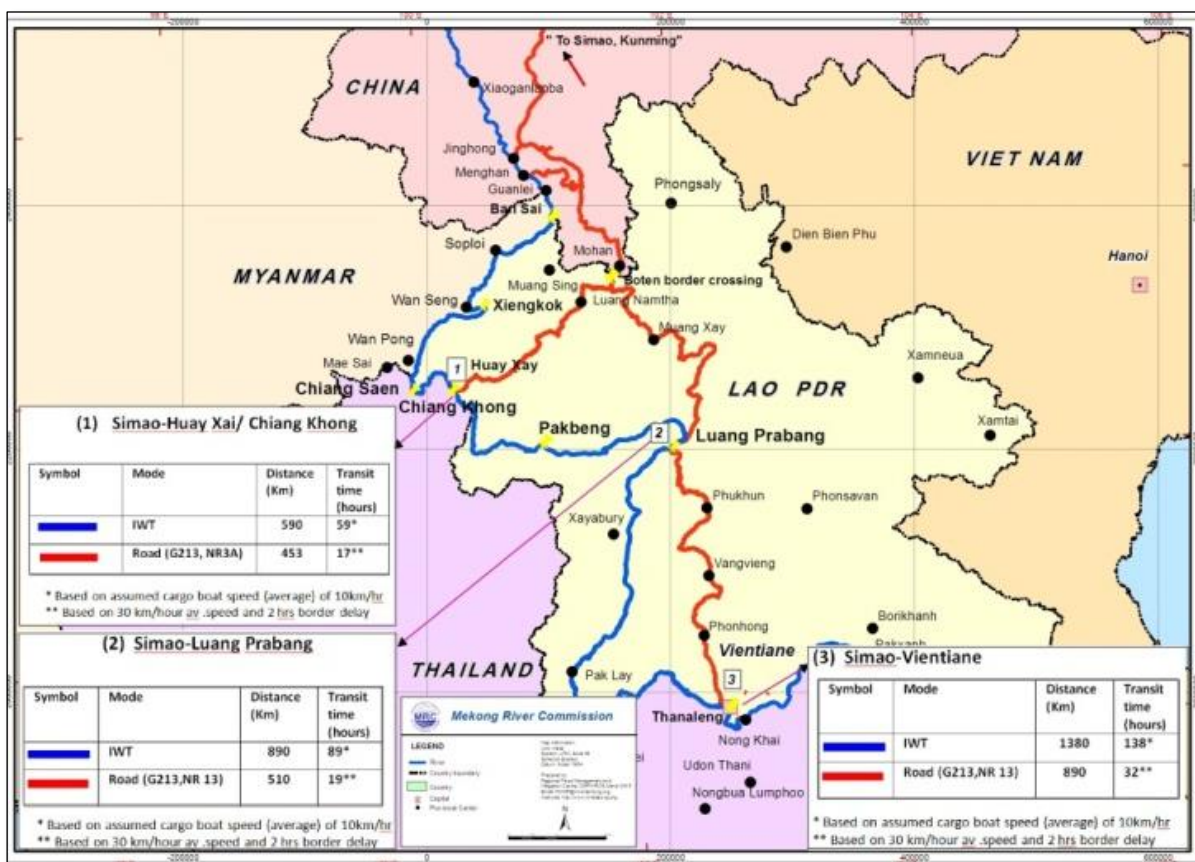
- The 590 km stretch of the Mekong between Simao Port in Yunnan Province of China and the opposed border posts of Huay Xay (Lao PDR) and Chiang Khong (Thailand); and
- A highway link of 450 km between Simao and the abovementioned Lao/Thai border crossing point.

(ii) **Corridor 1B:** Simao-Luang Prabang, comprising:

- An 890 km stretch of the Mekong between the two cities; and
- A highway link of 510 km between Simao and Luang Prabang, made up of 250 km on Highway G213 in China, 18 km on Route 3A in Lao PDR and 242 km on Route 13N in Lao PDR.

(iii) **Corridor 1C:** Simao-Vientiane, comprising:

- A 1,380 km stretch of the Mekong between the two cities; and
- A highway link of 890 km between Simao and Luang Prabang, made up of 250 km on Highway G213 in China, 18 km on Route 3A in Lao PDR and 622 km on Route 13N in Lao PDR.



Transport corridors, upper part of the Mekong Basin

LOWER PART OF THE MEKONG RIVER BASIN

The lower part of the Mekong Basin encompasses the stretch of the Mekong between the Khone Falls and its exits to the Sea.

Three corridors comprising existing road, waterway and, where relevant, railway transport routes have been identified as being relevant for the analysis of current and future transport flows in the lower region of the Mekong Basin. These are as illustrated in the Figure below:

- (i) **Corridor 2A: Phnom Penh-Cai Mep International Port** - This is the principal transport corridor in the region which comprises a 368 km stretch of the Mekong mainstream linking Phnom Penh with the Cai Mep International container Port in Viet Nam; and an inter-capital highway route (NR1) linking Phnom Penh with Ho Chi Minh City, with onward highway connections to Cai Mep International Port which is 320 km by road from Phnom Penh.
- (ii) **Corridor 2B: Phnom Penh-Sihanoukville Port** - This corridor comprises National Route 4, a tolled highway of some 226 km, which is in generally good condition and allows container transit times between Phnom Penh and Sihanoukville of about 5 hours and the Southern Line of the Cambodian Railway (now Toll Royal Railway) with a length of 269 km.
- (iii) **Corridor 2C: Phnom Penh-Bangkok and the Port of Laem Chabang** - This corridor comprises a 648 km highway route (NR 5 in Cambodia and Highways 33, 304, and 331 in Thailand) linking Phnom Penh with Bangkok and the Port of Laem Chabang and a 675 km potential railway connection between Phnom Penh and Laem Chabang which would involve joining up of the Northern Line in Cambodia and the Eastern Line in Thailand.



Transport corridors, lower part of the Mekong Basin

2.2.4 Fleet composition of registered public and private owned/operated vessels

LAO PDR

In 2014, 2,912 vessels were registered in the Lao PDR, of which 1,809 were passenger vessels without accommodation with a total capacity of 68,970 people.

Five local ports in the north have been promoted to international tourism ports with reduction of visa fees, following the Quadrangle Agreement on Commercial Navigation on the Lancang-Mekong River. These ports are Xiengkong, Ban Mom, Huay Xay, Pak Beng and Luang Prabang.

The stretch from Huay Xay to Luang Prabang is still famous for boat passenger and tourists transport. Meanwhile boat tourism is still limited from the section of Luang Prabang to Vientiane Capital. Downstream, tourists come from Ubon province in Thailand via the Mekong bridge to Pakxe district, where they take a cruise down from Pakxe to Champassak (about 50 km) by a local long tail riverboat.

THAILAND

The number of barges registered in Thailand for the Mekong River is very limited; only 11 vessels have to be considered. Thailand does make significant use of the Mekong River and its associated waterways for domestic transport or passenger services. Attention should be paid to the state of the numerous local ferries and the different ferry sites.

The main traffic lines are Chiang Saen-Tonpuang, Chiang Kong-Huay Xay, Palchum-Bolikunsai, Bungkarn-Bolikunsai, Nakon Phanom-Kummun and Mukdahan-Savannaket. Ferry crossings between Thailand and Lao PDR are situated at Chiang Khong, Bungkham and Mukdahan.

The different kinds of dangerous goods transported by inland waterway barges on the Mekong River are petroleum products, gasoline, diesel and asphalt. The cargo is traded for consumption in Thailand and Lao PDR.

CAMBODIA

In Cambodia, the Mekong River receives both kinds of vessels up to Phnom Penh: inland vessels and seagoing vessels up to 5,000 DWT. The main traffic is dedicated to inland shipping for the domestic market and cross-border trade with Viet Nam. The Ministry of Public Works and Transport registered some 250 inland vessels in April 2015. The average dimensions of inland waterway vessels operating in Cambodia are LOA = 53.1 m to 120.0 m, B = 8.8 m to 19.5 m, D = 3.3 m to 5.2 m, Capacity = 500 to 2,000 tonnes and container capacity = 72 to 120 TEU.

VIET NAM

About 755,000 inland waterway vessels are sailing on the inland navigation system in Viet Nam of which more than 3,000 are involved in shipping dangerous goods.

Inland waterway transport services are provided by public operators, several cooperatives in transport and handling services and numerous small and independent private operators.

In the Mekong Delta provinces, some 55,000 inland vessels are registered with a total capacity of about 1,100,000 DWT for cargo ships and 160,000 seats for passenger ships. Still part of the vessels are old, dating back to the 1960's and 1970's or earlier, and insufficiently renovated.

2.2.5 Overview of national plans

LAO PDR-THAILAND

Plans to improve the navigation channel between the Green Triangle and Luang Prabang are proposed in the “Development Plan on International Navigation on the Lancang-Mekong River (2015-2025)”, Department of Transport of Yunnan Province - Tianjin Research Institute for Water Transport Engineering, Ministry of Transport, PR China.

CAMBODIA

Plans to improve the navigation channel between Kratie and Phnom Penh are proposed in the “Feasibility Study on Waterway Improvement for Port Logistics Development in Cambodia, February 2015”, KOICA .

VIET NAM

Plans to improve navigation in the Mekong Delta are proposed in the “Master Plan for Viet Nam Inland Waterway Sector to 2020 and Orientation to 2030” and in the “Decision No. 1071/QD-BGTVT dated 24/4/2013 of Ministry of Transport with Amendment on the Inland Waterway Development Master Plan to 2020 and Vision to 2030”. Unfortunately, these plans only exist in Vietnamese language.

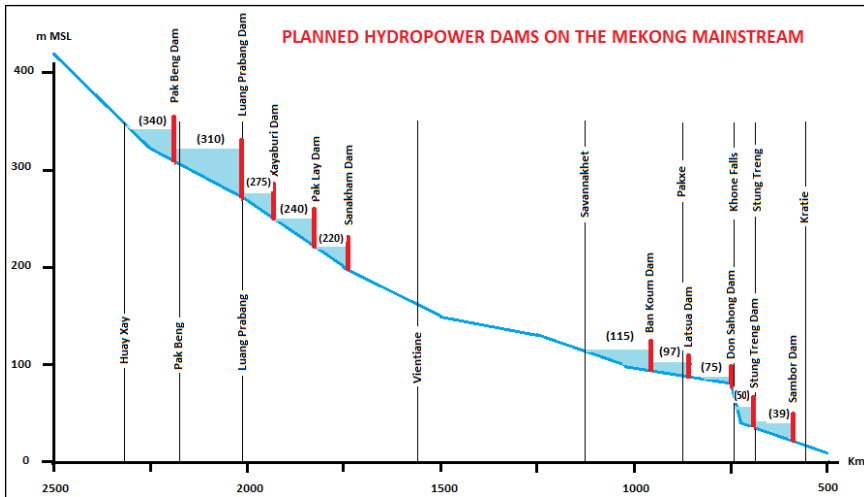
As mentioned before, the Quan Chanh Bo canal was approved by a Decree of the Ministry of Transport nr. 3744/QD-BGTVT of 30 November 2007, while adjustments to the project of Quan Chanh Bo canal were approved by Ministerial Decree nr. 2368/QD-BGTVT of 09 August 2013.

Finally, a major World Bank project consists of upgrading the canals between Can Tho, via the Mang Thi canal, to the Ham Luong River, with connection to the Tien Giang (Mekong Mainstream) via the Cho Lach canal, including the upgrading of the Cho Gao canal.

The upgrading of the Cho Gao canal to an inland waterway channel of class II is taking place in two phases: dredging one side of the canal was finished in 2014, while dredging the other side of the canal will start at end of 2015.

2.2.6 Hydropower Dam Projects

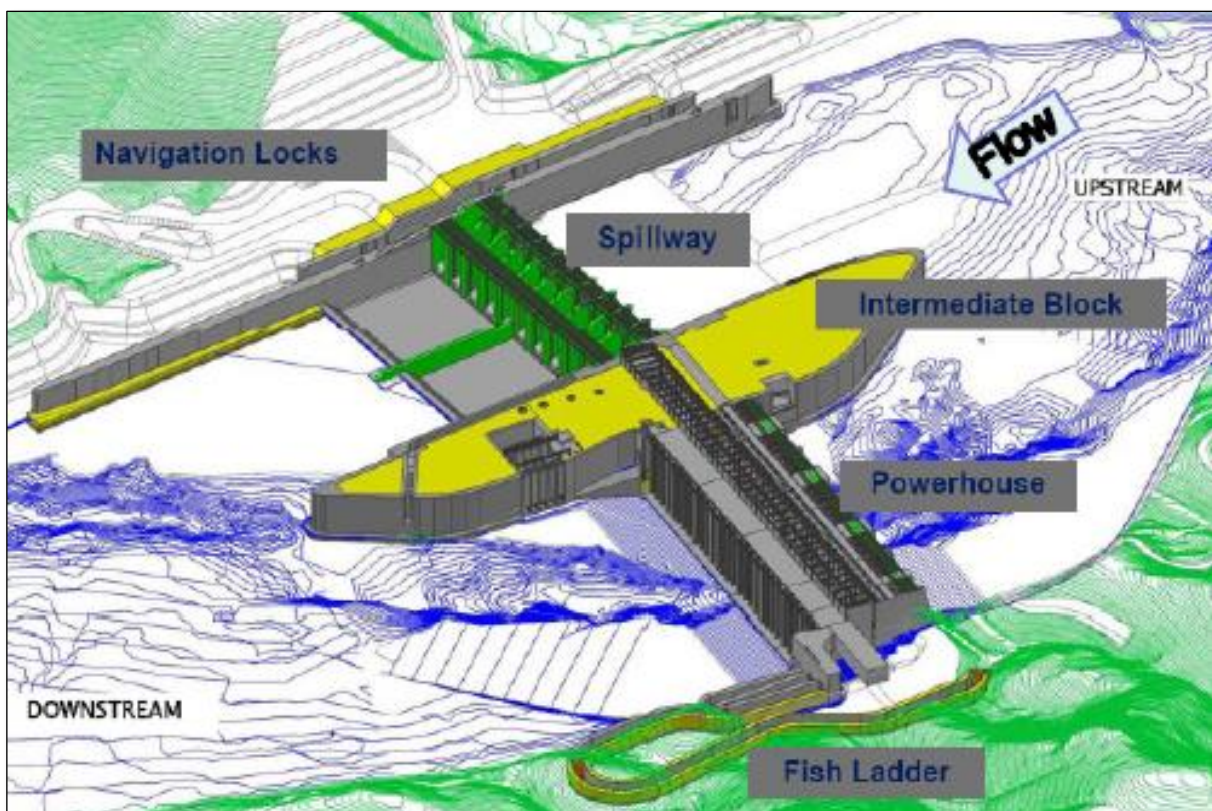
In the October 2010 final report on the “Strategic Environmental Assessment of Hydropower on the Mekong Mainstream”, prepared for the Mekong River Commission by ICEM – International Centre for Environmental Management, eleven planned hydropower dams on the Mekong Mainstream have been considered with a total capacity of 12,418 MW: six in the Chiang Saen – Vientiane stretch (Pak Beng Dam, Luang Prabang Dam, Xayabury Dam, Pak Lay Dam, Sanakham Dam and Pak Chom Dam) and five in the Savannakhet – Kratie stretch (Ban Koum Dam, Latsua Dam, Don Sahong Dam, Stung Treng Dam and Sambor Dam).



Pak Beng is the northern-most of the Mekong Mainstream dams, located upstream of the town of Pak Beng, in Lao PDR. It has an installed capacity of 1,230 MW with a dam 943 m long, 76 m high and a water head of 31 m. It has a reservoir area of 87 km² and live storage of 442 million m³. As originally designed with a Full Supply level at 345 m MSL, it would have inundated land back into Thailand, but under the Lao Government Optimization Study for the cascade, the FSL was lowered to 340 m MSL.

Luang Prabang is the second dam in the cascade, located above Luang Prabang town, about 3 km above the confluence with the Nam Ou, and the Pak Ou caves. It has an installed capacity of 1,410 MW and a dam 1,106 m long and 68 m high with a rated head of 40 m and a FSL of 320 m MSL. It has a reservoir area of 90 km² and live storage of 734 million m³.

Xayaburi, the third dam in the cascade, is located about 150 km downstream of Luang Prabang town and is under construction now. It has an installed capacity of 1,260 MW with a dam 810 m long and 32 m high with a water head of 24 m and a FSL of 275 m MSL. It has a reservoir area of 49 km² and live storage of 225 million m³.



Artistic view of the Xayaburi dam

It has an installed capacity of 1,320 MW and a dam 630 m long and 35 m high with a water head of 26 m and a FSL of 240 m MSL. It has a reservoir area of 108 km² and live storage of 384 million m³.

Sanakham, the final dam of the cascade to be located fully in Lao PDR, is situated just upstream of the Thai-Lao border, between Loei and Vientiane provinces. It has an installed capacity of 700 MW and a dam 1,144 m long and 38 m high with a water head of 25 m and a FSL of 220 m MSL. It has a reservoir area of 81 km² and live storage of 106 million m³.

The exact location of the **Pak Chom** dam site, at the time of drafting this report, was not known yet. The international hydropower consultants Pöyry have even said that the Pak Chom dam would not be built. There are reports that this dam would be merged with the planned Sanakham dam in the upstream direction at Km 1,743, some 7 km upstream of the Nam Heung River (which is the borderline with Thailand) in order to have the entire construction and reservoir on full Lao territory instead of building the dam and the reservoir on the shared river stretch with Thailand.

With these Full Supply Levels, the air clearance of the Huay Xay Bridge should be 19.8 m, of the Pak Beng Bridge 20.0 m, of the Luang Prabang Bridge 20.0 m, of the Tcheua Pachon Bridge 12.0 m and of the Pak Lay Bridge only 7.3 m.

Ban Koum is located about 10 km above the confluence of the Mun/Chi River with the Mekong, in a narrow valley with sandstone hills on each side. It has an installed capacity of 1,872 MW and a dam 780 m long and 53 m high with a water head of 19 m and a FSL of 115 m MSL. It has a reservoir area of 133 km² and little live storage.

Lat Sua has been relocated to a site 10 km downstream of Pakxe. The original site was between Pakxe and the Mun/Chi confluence, but since the reservoir would have flooded back to the Mun/Chi River, it was decided to relocate it and reduce the height, so that Pakxe would not be affected. It has an installed capacity of 686 MW and dam 1,300 m long and 27 m high with a water head of 10.6 m and a FSL of 97,5 m MSL. It has a small reservoir area of 13 km² and very little live storage.

Don Sahong dam blocks off the Hou Sahong channel, one of more than ten channels that flow over the Khone falls at the southern end of Siphandone. It has an installed capacity of 240 MW and a dam 720 m long and 8.2 m high with a water head of 17 m and a FSL of 7 m MSL. It has a small reservoir area of 290 ha and a live storage capacity of 115 million m³.

Stung Treng is the uppermost of the two Cambodian dams, and is located about 10 km upstream of Stung Treng town and the confluence with the Sekong/Sesan/Sre Pok Rivers. It has an installed capacity of 980 MW with an 11 km long and 22 m high dam with a water head of 15 m and a FSL of 55 m MSL. The reservoir would extend up to the Cambodia/Lao border covering 211 km² with an active storage of 70 million m³. The dam site lies within the Stung Treng Ramsar Site which effectively obliges the Royal Cambodian Government to 'actively support' the Ramsar Convention.

Sambor is the lowest of the Mekong Mainstream dams and largest one in Cambodia. It is located near the village of Sambor, upstream of Kratie and would inundate the river channel to just south of Stung Treng town. It would have an installed capacity of 2,600 MW and a dam over 18 km long and 56 m high with a water head of 33 m and a FSL of 40 m MSL. It would create a reservoir of 620 km² with an active storage of 465 million m³.

Although navigation locks should be provided at all dams (except the Don Sahong dam), almost no information is available concerning the planned dimensions of the locks, but MRC insisted firmly that all dams should have locks with the dimensions 120 x 12 x 4 m.

2.3 PORT DEVELOPMENT AND MANAGEMENT

2.3.1 The Mekong River Port System

LAO PDR

There are 21 river port facilities on the Lao PDR side of the river. All river ports and facilities are under the responsibility of the provincial government. Most of these river ports are small and still in their natural condition or consist of a reinforced concrete ramp parallel to the riverbank. These berthing facilities make it difficult for vessels to berth. Most ports have none, or limited, landing facilities and no maintenance nor a management system in place.

THAILAND

In Thailand, there are four main ports located on the Mekong River: Haciang Commercial Port (HCCP), Chiang Sean Passenger Port, Chiang Sean Commercial Port (CSCP) and Chiang Khong Port. Chiang Sean Commercial Port, Chiang Port and Chiang Khong port are owned and operated by the Port Authority of Thailand (PAT). Haciang Commercial Port is a private-owned and operated port.

As a result of the low water level at CSCP and in the navigation channel, HCCP started exporting petroleum products (diesel and gasoline) in 2012. The petroleum products are mainly exported to mainland PR China and the Union of Myanmar. The export of fuel products through Haciang Commercial port reached 27 million liters in 2014.

CAMBODIA

The cities and provinces where all international and domestic ports are located are Phnom Penh, Kompong Cham, Kratie, Stung Treng, Kandal, Kompong Chhnang, Siem Reap, Kompong Thom, Po Sat and Prey Veng. However, it should be noted that, apart from Phnom Penh, all the inland waterway ports are mainly just ramps or simply riverbanks used by domestic boats for landing to discharge and load various kinds of food stuffs, groceries, construction materials and passengers.

To sum up, for Cambodia as a whole, the ports handling domestic cargoes and passengers are located in Phnom Penh, Kampong Cham, Kratie and Stung Treng on the Mekong River, and in Kampong Chhnang, Chhnok Trou and Siem Reap on the Tonle Sap River and Lake.

VIET NAM

Most containers that are shipped from the NCT LM-17 in Phnom Penh, Cambodia are part of an intermodal transport chain. The containers come from the manufacturer in Cambodia and are transported by road to NCT LM 17, where they are loaded on barges to Cai Mep seaport in Viet Nam. From there, the goods are transferred on ocean-going vessel with different destinations such as the US and Europe or on feeder vessels going to Singapore where cargoes are consolidated and then go on ocean vessels to their destination in the US or Europe. In Cai Mep there are several (about seven) big container terminals. As most of the containers shipped from Cambodia are intended for Cai Mep International Terminal, only this terminal will be discussed.

2.4 ONGOING BILATERAL AND REGIONAL PLANS AND PROJECTS

2.4.1 MRC: Regional Action Plan for Sustainable Transportation of Dangerous Goods along the Mekong River, 2014, MRCS NAP

Increase in transport volumes of dangerous goods on the Mekong River requires the Member Countries to adhere to a consistent and coordinated development of their policies on transport infrastructure, especially with regards to inland waterway safety and environmental protection.

Therefore, the MRCS NAP prepared a Regional Action Plan (RAP), acting as the guiding document for the Member Countries and MRC on inland waterway safety and environmental protection.

In 2010, the MRCS Navigation Programme commenced Phase 1 “Risk Analysis of the Carriage, Handling and Storage of Dangerous Goods”. Phase 2 began in June 2013 to prepare the “Regional Action Plan for Sustainable Transport of Dangerous Goods along the Mekong River” (RAP) consisting of National and Cross-Border project documents as a basis to reduce the risks of accidents, spillages and pollution and enhance emergency response and regional coordination.

Phase 3 is expected to run from 2015 to 2020 with the implementation of the RAP.

Projects to be implemented:

Vessels

- (1) Mekong Tanker Safety Management;
- (2) Minimum Standards for Vessel Design, Construction and Equipment;
- (3) Safe Manning on Inland Waterway Vessels;
- (4) Implementation of the International Maritime Dangerous Goods (IMDG) Code and Provision of the Material Safety Data Sheet (MSDS) for Inland Waterway Vessels; and
- (5) Emergency Response onboard Vessels.

Ports and terminals

- (1) Standards for the Planning, Design and Construction of Ports and Terminals;
- (2) Maintenance, Inspection and Testing of Critical Equipment;
- (3) Port Safety, Health and Environmental Management System (PSHEMS); and
- (4) Emergency and Oil Spill Response in Ports and Terminals.

Environment

- (1) National Vessel and Port Waste Management ; and
- (2) Cross-Border Vessel and Port Waste Management.

Waterways

- (1) Introducing Geographical Zones in the Mekong River and related Technical and Operational Requirements for Tankers.

2.4.2 MRC: Formulation of a Training Plan to Implement the Activities under the Navigation Programme, December 2014, MRCS NAP

The MRCS NAP project “Formulation of a Training Plan to Implement the Activities under the Navigation Programme” is part of MRC’s Navigation Programme 2013-2015. The objective of this Training Plan is to assist the Member Countries, their line agencies, the MRCS and relevant stakeholders, in strengthening their institutional mechanisms and their capacity to effectively implement the MRC Navigation Programme.

Although most of the MRC NAP outputs and activities are focused on only one or two of the four MRC member countries, this NAP Training Plan is based on a Training Needs Assessment for NAP disciplines and topics. Even some countries not involved in NAP outputs and activities have nonetheless a need for training.

Based on this, it is proposed that the “NAP Training Plan” is formed, approximately, as follows: 25 national seminars/workshops, 25 national short courses, 5 bilateral seminars/workshops, 10 bilateral short courses, 5 regional seminars/workshops and 5 training of trainers’ courses, all MRC NAP related.

2.4.3 JICA: Connectivity enhancement of Inland Waterway Transport and logistics between Cambodia and Viet Nam

In August 2014, the Cambodian Ministry of Public Works and Transport had a meeting with a Japan delegation, headed by H.E. Minister Akihiro Ohta, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) where they discussed and approved a cooperation program for improving the transportation on the Mekong River between Phnom Penh and the seaports in Viet Nam.

A trial voyage between the Phnom Penh New Container Terminal in Cambodia and the Cai Mep International Terminal in Viet Nam was conducted in January 2015 in order to make infrastructure improvements (such as the depth of some sections of the route and the equipment for aids to navigation), as well as to streamline the procedures for custom clearance and port entering and departing.

The conclusions of this Trial Voyage were:

- (1) **Infrastructure:** Captains and pilots make use of the Hydrographic Mekong River Atlas 1999 in order to navigate in Cambodia, although in many places, depths and river banks have changed due to dredging and bank erosion.
- (2) **Formalities at the Cambodia – Viet Nam border:** For a variety of reasons, the implementation of the Agreement on Waterway Transportation between Cambodia and Viet Nam, which entered into force on 20 January 2011, has not progressed as expected.
- (3) **Using the shortcut canal for navigation:** A shortcut is always useful to reduce oil consumption. However, safety of navigation, safety of crew, safety of cargo and safety of environment are more important than saving oil.

Intermodal Freight Simulation in the Southern Mekong Region: Route Choice Model for International Container Shipping, The Overseas Coastal Area Development Institute of Japan (OCDI), Proceedings of T-LOG 2014

JICA developed a logit model for route choice of Cambodian international containers including the Mekong River route, cross-border route to Cai Mep/Thi Vai port by land, the Laem Chabang port route and the Sihanoukville port route. The following scenarios were presented:

- Scenario 1:** average capacity of the vessels is increased from 85 to 170 TEUs and the vessel speed is assumed to increase from 8,2 knots to 10 knots.
- Scenario 2:** improvement of road infrastructure between Phnom Penh and Ho Chi Minh City (including opening of Neak Loeng Bridge).
- Scenario 3:** improvement of efficiency of cargo handling in Sihanoukville port.

2.4.4 KOICA: Feasibility Study on Waterway Improvement for Port Logistics Development in Cambodia, February 2015, KOICA (with a proposal to dredge between Phnom Penh and Kratie).

In the framework of the MOU between the Ministry of Land, Transport and Maritime Affairs (MLTM) of Korea and the Ministry of Public Works and Transport (MPWT) of Cambodia, signed in March 2012, MPWT requested Korea International Cooperation Agency (KOICA) to conduct a “Feasibility Study on Waterway Improvement for Port Logistics Development in Cambodia”.

During a kick-off meeting in January 2015, the following scope of work was presented:

- (1) Establishment of a Master Plan for the Phnom Penh–Kratie stretch of the Mekong River (medium and long term strategy, economic analysis, environmental assessment and guidelines for waterway development and management of new ports – Km. 6 Port and Tonle Bet Port – operation).
- (2) Bathymetric Survey and Soil Investigation;
- (3) Basic and detailed design;
- (4) Supply of survey equipment;
- (5) Education and training; and
- (6) Promotion: Prepare and recommend methods to promote the project and to make a sustainable project and financing plan.

During an Inception Workshop in April 2015, the status of the project was discussed:

- (1) Baseline Logistics Situation Analysis with a survey of important data on the current situation;
- (2) Medium and long term strategy for waterway development and operation;
- (3) Guidelines for waterway development and management (numerical modelling);
- (4) Waterway design (target vessel specifications 3,000 DTWT to Kompong Cham and 2,000 DWT to Kratie, estimated dredging volumes 14,250,000 m³ capital dredging and 3,570,000 m³/year maintenance dredging);
- (5) Rules and regulations;
- (6) Schedules for bathymetric surveys;
- (7) Soil investigations;
- (8) Future planning for the project (education and training, supply of equipment, data to be collected and requested).

2.4.5 JCCCN: Development plan on International Navigation on the Lancang-Mekong River (2015-2025), Department of Transport of Yunnan Province – Tianjin research Institute for Water Transport Engineering, Ministry of Transport, PR China.

This project is in line with the “Agreement on Commercial Navigation on the Lancang-Mekong River among the governments of the People’s Republic of China, the Lao People’s Democratic Republic, the Union of Myanmar and the Kingdom of Thailand”, signed by the four countries in April 2000.

The 10th meeting of the Joint Committee on Coordination of Commercial Navigation on the Lancang-Mekong River (JCCCN) held in 2011 agreed to prepare a master plan for future development of international shipping in the Upper Mekong River. At the 11th JCCCN meeting in 2012, all contracting

parties reached a consensus to form a joint working group and a joint expert group in order to put together the master plan and provide relevant data needed.

According to the Quadripartite Agreement, the current navigable river section is 890 kilometers long from Simao, China, to Luang Prabang, Lao PDR. Simao to boundary marker 244 (290 km) will have grade V in 2015 for vessels of 300 DWT. Boundary marker 244 to Huay Xay (300 km) is a grade VI channel for vessels of 150 DWT throughout the year and 200-300 DWT seasonally. Huay Xay to Luang Prabang (300 km) has never been improved and maintained and is navigable for vessels of 60 ton in the dry season.

According to the Quadripartite Agreement, there are a total of 15 ports open to navigation. In China, the ports are: Simao, Jinghong, Menghan and Guanlei. In Lao PDR, they are Ban Sai, Xiengkok, Muongmom, Ban Khouane, Huay Xay and Luang Prabang. In Myanmar, they are Soploi, Wan Seng and Wan Pong; in Thailand, Chiang Saen, and Chiang Khong. This Plan includes two more ports which are Pak Beng, and Chiang Saen Commercial Port.

The planning goals are:

- To make the total length of the JCCCN Lancang-Mekong navigable for 500 DWT vessels by 2025;
- To upgrade the ports of Ban Sai, Xieng Kok, Muong Mom, Ban Khouane, Huay Xay, Pak Beng, Luang Prabang, Chiang Saen and Chiang Khong; and
- To establish a “Channel Management and Maintenance System”, a “Communication and Navigation Search and Rescue System” and a “Navigation Management System”.

The proposed implementation scheme is as follows:

Phase I Projects

- (1) **Preliminary work:** environmental impact assessment, geological survey, design, training;
- (2) **Improvement of Channel:** a 631 kilometer-long channel from China-Myanmar Boundary Marker 243 to Luang Prabang will be upgraded to be navigable for vessels of 500 DWT;
- (3) **Construction of ports:** three cargo berths will be built in Guanlei, Xiengkok, Wan Pong, Pak Beng and Luang Prabang ports;
- (4) **Establishment of a support system:** three channel maintenance and emergency response bases and four emergency response and rescue ships will be built.
- (5) Estimated funds needed: 2.2889 billion RMB: 6,15 = 372 million US\$

Phase II Projects

- (1) Preliminary work
- (2) **Improvement of channel:** a 259 kilometer-long channel from Simao Port to China-Myanmar Boundary Marker 243 will be upgraded to be navigable for vessels of 500 DWT;
- (3) **Construction of ports:** one passenger berth will be built in Simao, Jinghong, Ban Sai, Xiengkok, Muongmom, Wan Pong, Chiang Saen, Huay Xay, Chiang Khong, Pak Beng and Luang Prabang ports. Three cargo berths of 500 tonnage will be built in Simao, Menghan, Suploi, Wan Seng, Ban Khouane, and Chiang Saen ports.
- (4) **Estimated funds needed:** 1.80570 billion RMB: 6,15 = 294 million US\$

2.4.6 ASEAN: ASEAN-Mekong Basin Development Cooperation (AMBDC) including an ASEAN Initiative on Inland Waterway Management, Phnom Penh, March 2015 and a Master Plan on ASEAN Connectivity – Strategies for Water Transport Connectivity.

The Second ASEAN Initiative Seminar on Inland Waterway Management was held on 23-25 March 2015 in Phnom Penh, Cambodia. The seminar proposed a number of recommendations based on group discussions of ASEAN Member State officials from customs, port authorities and the police, on customs border management, improvement of safety and security in ports and waterways, capacity building and the establishment of a committee in the Mekong Sub-Region under the Mekong River Commission.

In the Master Plan on ASEAN Connectivity (2009) and the ASEAN Strategic Transport Plan 2011-2015 (October 2010), most of the attention is given to land transport (road and rail), maritime transport, air transport and transport facilitation. ASEAN completely relies on the GMS' strategies and scenarios for Inland Waterway Transport (IWT) on the Mekong River.

In the final report on the ASEAN Strategic Transport Plan 2011-2015, only some general comments and reasons for the under-utilisation of the existing IWT are given.

2.4.7 GMS: Greater Mekong Sub-region Economic Cooperation - Transport and Economic Corridors, 2009, ADB and Overview of the GMS Regional Investment Framework (2013-2022).

The backbone of the GMS Economic Cooperation Program is to create road and rail transport corridors, including:

- The East-West Corridor connecting Thailand, Lao PDR and Viet Nam.
- The Southern Corridor connecting Thailand, Cambodia and Viet Nam.
- The North-South Corridor connecting southern China through Lao PDR or Myanmar to Thailand.

The Regional Investment Framework 2013-2022 was endorsed at the 19th GMS Ministerial Conference in Lao PDR in December 2013, detailing the pipeline of investment and technical assistance projects for the third decade of the GMS program.

Concerning IWT on the Mekong River, only the following projects are withheld in the Regional Investment Framework:

- **Upgrade of Xiengkong River Port, Lao PDR:** Indicative timeline 2014–2017, estimated cost 15.0 million US\$, high priority;
- **Upgrade of Ban Mom River Port, Lao PDR:** Indicative timeline 2014–2017, estimated cost 12.0 million US\$, high priority;
- **Upgrade of Huay Xay River Port, Lao PDR:** Indicative timeline 2015–2018, estimated cost 13.0 million US\$, low priority;
- **Upgrade of Pak Beng River Port, Lao PDR:** Indicative timeline 2015–2018, estimated cost 15.0 million US\$, low priority; and
- **Upgrade of Luang Prabang River Port, Lao PDR:** Indicative timeline 2015–2018, estimated cost 15.0 million US\$, low priority.

3 DEVELOPMENT TRENDS AND SCENARIOS

An economic assessment was carried out in order to determine future development strategies and actions for the Master Plan for the upper and lower Mekong regions Master Plan.

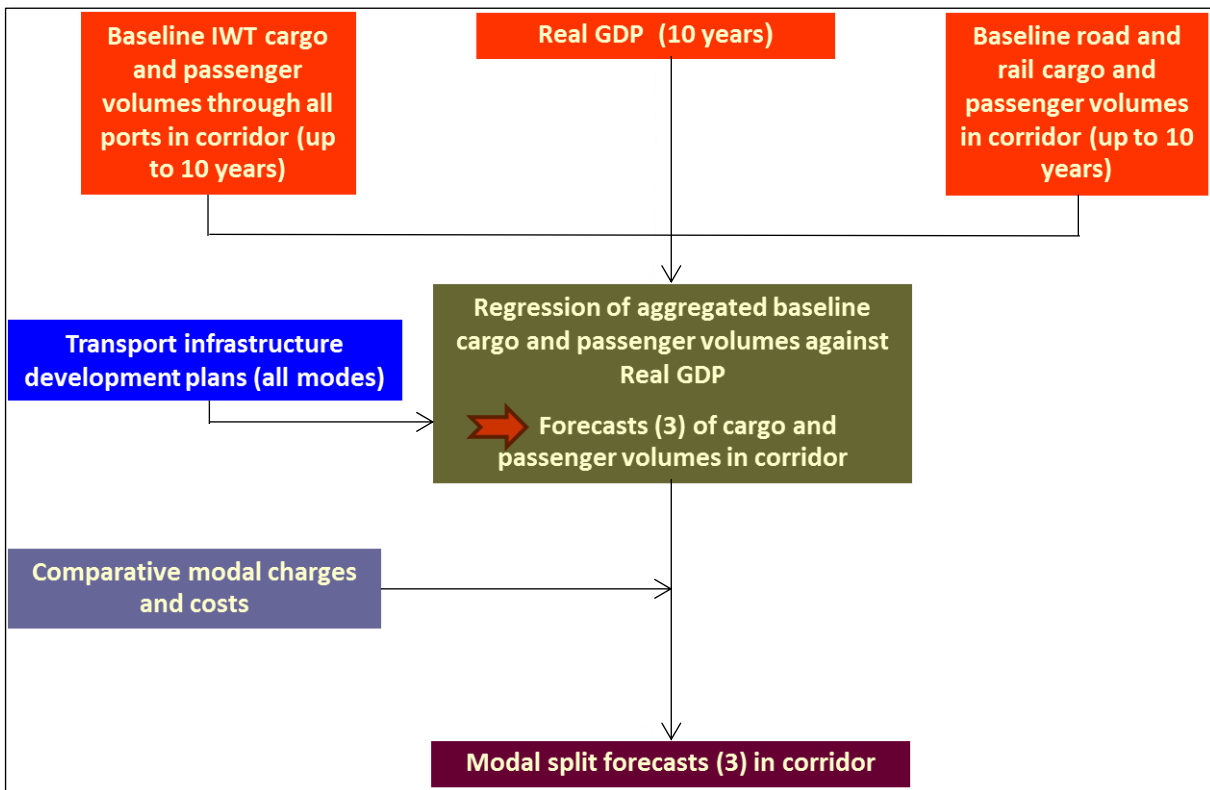
The economic assessment considers the socio-economic factors, market factors and transport policies and development plans which influence, or are likely to influence, the level of transport demand within each region. The ultimate goal of the assessment is to produce a set of transport-demand forecasts.

The focus of the forecasts is the demand for IWT services and infrastructure, taking into account the potential influences on the development of other transport modes such as road and, where relevant, rail. The forecasts encompass both passenger and cargo traffic. However due to time and resource constraints, the forecasts have had to focus on regional or cross-border traffic.

3.1 FORECASTS INLAND WATERWAY TRAFFIC

3.1.1 Forecast Methodology

The forecasts cover a 25-year horizon, from 2015-2040, and have been calculated taking 2014 as the base year. The methodology used is constrained by data availability. In general, where adequate traffic data is available, the methodology used for forecasting transport flows within regions and corridors is as shown in the figure below:



The essential feature of this methodology is the use of regression techniques to establish a relationship between transport demand and real GDP growth. Based on this relationship and GDP

forecasts developed by the International Monetary Fund (IMF), forecasts of overall passenger and cargo transport flows were derived by corridor.

While, ideally, the modal splits of the overall transport-demand forecasts should be determined by transport costs as perceived by users, i.e. effectively passenger fares and cargo haulage charges, time constraints prevented the assembly of such information for transport modes other than IWT. Consequently, estimates of comparative mode operating costs were used as the basis for deriving modal share estimates. These cost estimates (IWT, road and, where relevant, rail) were generated by running specialized transport cost models developed for the Master Plan project.

The forecasting methodology used for this Master Plan involves the application of regression analysis in order to indicate the level of correlation between transport volume and real GDP. As can be seen in the baseline conditions report, in most cases the analysis revealed a very close correlation between these two variables. In most cases, the application of regression equations (showing transport demand as a function of real GDP) indicated that transport demand was growing considerably faster than GDP. Indeed, throughout the Mekong region, GDP growth very often defines a *lower bound* for transport demand growth.

The IMF's 5-year forecasts were extended to 2040 in order to provide a demand-forecasting base up until the end of the forecast period adopted for the Master Plan.

Data for the four riverine countries in the Mekong Basin are given in the Table below. GDP growth has been particularly robust in Lao PDR and Cambodia with growth rates in the order of 7 to 8 percent in recent years. Meanwhile in Viet Nam GDP growth has been moderate at about 5.4 percent, down from the about 7 percent growth experienced in the first decade of the millennium. In Thailand, political upheaval has resulted in a sharp fall in GDP growth and in one year (2009) GDP actually contracted.

In forecasting the future GDP growth over the 25-year Master Plan timeframe, it is assumed that with the exception of Thailand, which is expected to return to a higher growth path, growth will moderate slightly as the national economies mature. The expectation is that all four economies will end up with GDP growth of around 5 percent by 2040.

3.1.2 Upper part of the Mekong River Basin

3.1.2.1 LAO PDR

IWT cross border passenger traffic between China and Thailand to the Lao PDR

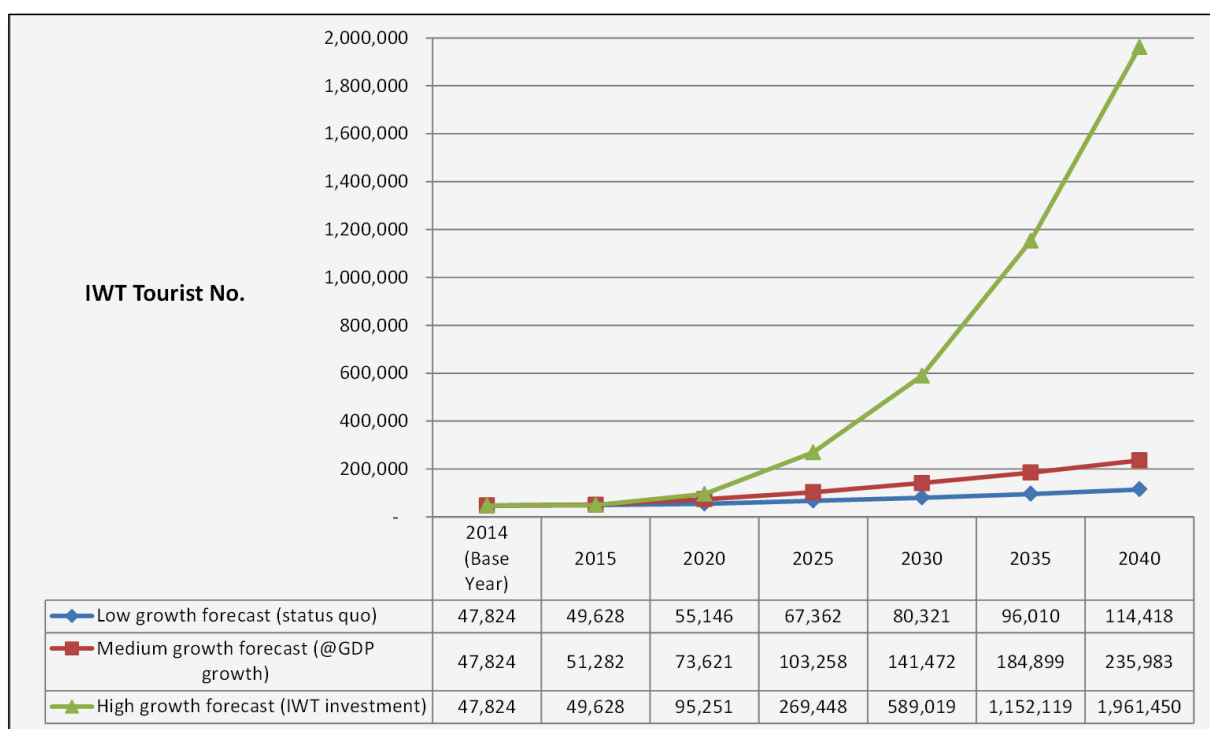
Two projections of tourist arrivals through the Huay Xay checkpoint were made.

The first, representing a higher growth forecast, involves the application of the regression equation $y=0.0496x^{1.4124}$ (which expresses tourist arrivals (y) as a function of real GDP (x)) to derive future tourist arrival numbers up until the end of the forecast period (2040).

The second, representing a lower growth forecast, involves the direct application of the projected growth of real GDP throughout the forecast period.

The actual growth of tourist arrivals through the Huay Xay border checkpoint averaged 12.4 percent per year from 2005-2013. For the higher and lower growth scenarios, growth is estimated, respectively, at rates averaging 9.1 percent and 6.3 percent per year.

The estimated numbers of tourists arriving at the river border in 2013 and 2014 were added to the numbers of tourists arriving at the Huay Xay land border, in order to deduce an estimate of all tourist arrivals in the Upper Mekong region of Lao PDR. The IWT share of total arrivals was estimated at 13.1 percent in 2013 and at 18.8 percent in 2014. It is possible that this share could rise to 20 percent by 2020.



Forecast number of tourists travelling by boat between Huay Xay and Luang Prabang

Cargo volume forecasts were made for border crossing IWT and road traffic.

IWT vessels cross the river border between Lao PDR and China near the Lao port of Ban Sai (294 km from Simao), while trucks cross the land border with China at Boten, opposite Mohan, China.

Estimates of future cargo volumes by mode in the Upper Mekong transport corridors was based on the share of these volumes *vis a vis* the overall cargo volume moved in the Lao PDR. Statistics relating to the total volume of cargo moved by road and water nationwide are published in the Statistical Yearbook of Lao PDR for 2013. Overall cargo volume data for the 10-year period 2002- 2012 was regressed against real GDP, in order to determine the “fit” between these series. This was done both for total cargo and for the volume of cargo reported as moving by road.

In both cases the R² values indicate an acceptable correlation between the two series. The regression equations derived from this analysis were used to estimate the future volume of overall and road-hauled cargo, as shown in the table below. Water-borne cargo volumes were derived as the difference between these series.

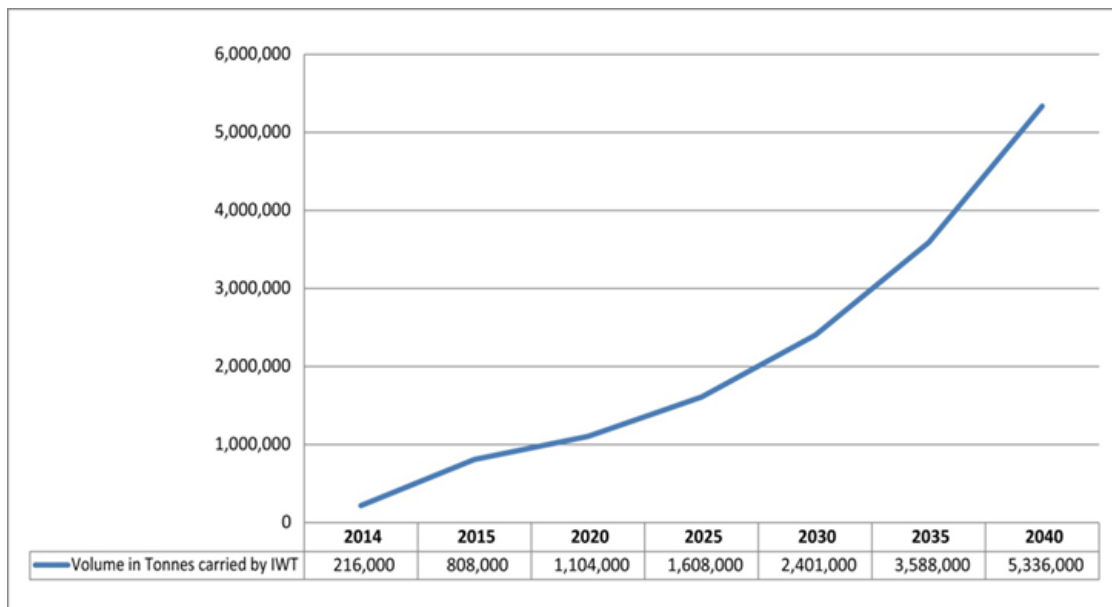
Year	GDP Growth rate	Lao PDR			Upper Mekong (investment case IWT 500 DWT)			
		Overall cargo volume	Cargo volume by road	Cargo volume by IWT	Share of total road cargo volume	Forecast road volume	Share of total cargo volume	Forecast IWT volume
		%	'000 tonne	'000 ton	'000 tonne	%	'000 tonne	%
2012	7.9	5,968	4,548	1,418	22.8	1,037		
2014	7.4	6,765	5,594	1,171	6.5	302	3.2	216
2015	7.2	7,234	6,029	1,205	7.0	392	3.0	214
2020	7.5	10,266	8,912	1,353	8.0	713	17.0	296

2025	7.0	14,212	12,816	1,396	7.0	897	17.0	458
2030	6.5	19,236	17,972	1,265	6.0	1,078	17.0	741
2035	5.5	24,884	23,957	926	5.0	1,198	17.0	1,160
2040	5.0	31,462	31,131	330	4.0	1,245	17.0	1,759
AARG 2002-2012		8.1%	8.9%					
AARG 2014-2040			6.8%			5.6%		8.4%

Calculation of future road and IWT cargo volumes in the Upper Mekong (Lao PDR)

Two sets of forecasts were produced for IWT cargo volumes in the upper part of the Mekong Basin. The first set assumes a continuation of the status quo in which there is no increase in average vessel size (assumed to be about 100DWT) and there is a gradual decline in IWT cargo volume. The second set assumes that investments in the improvement of IWT infrastructure and in larger vessels, of up to 500 DWT, will begin by 2020 and will result in a reduction in IWT operating costs and a reversal of road and IWT shares (with IWT share increasing to 60% and road share reducing to 40%) by 2040.

These forecasts are illustrated in the figures below:



3.1.2.2 Thailand

Passenger forecasts

Two forecasts were produced: one, a higher growth forecast which assumes that Chiang Saen – China tourist traffic will grow at about the same rate as that projected for real GDP (5.1% per annum) and a lower growth forecast which assumes a continuation of historical growth (at a rate of 4.3% per annum) up until 2040.

Cargo forecasts

Cargo forecasts have been prepared for the principal transport routes linking Thailand with China and the Lao PDR, namely:

- The waterway route linking the ports of Chiang Saen and Chiang Khong with ports in Yunnan Province, China and ports in Lao PDR;
- National Route 3A, which links Chiang Khong with the Boten checkpoint on the China/Lao border and with other intermediate destinations in Lao PDR.

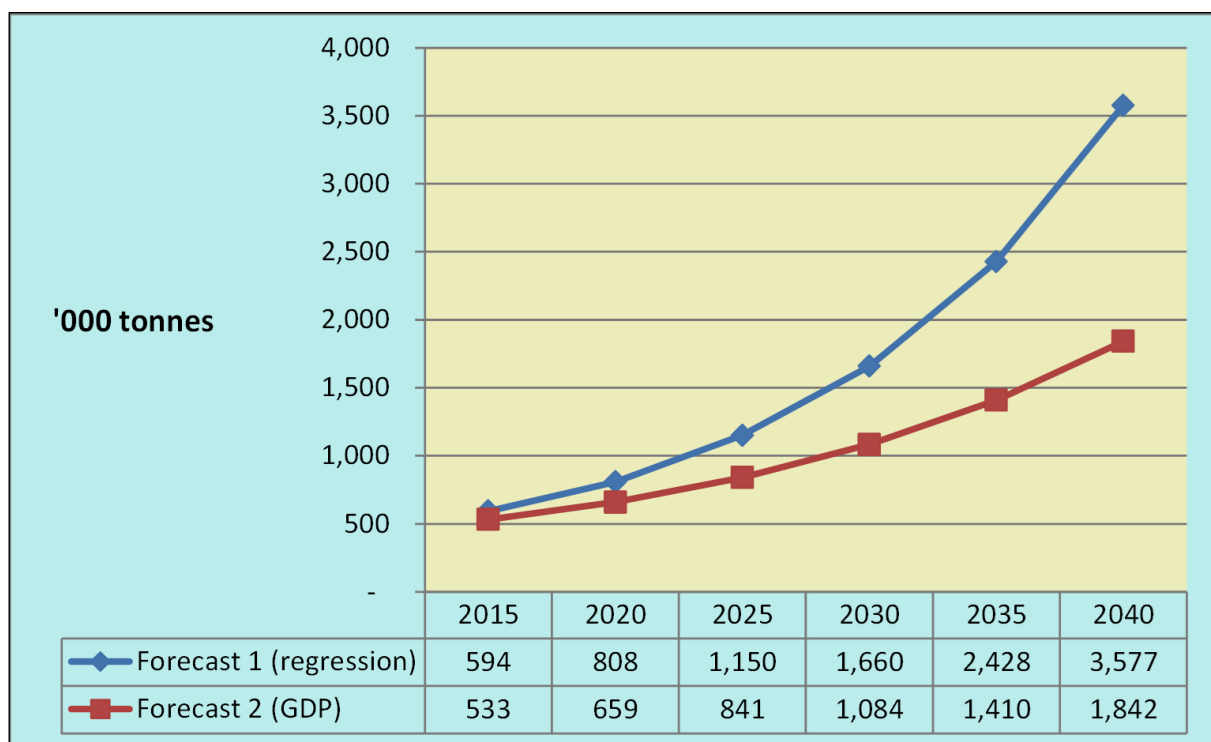
Future cargo flows in the corridor were estimated in relation to the forecast growth of total waterway traffic in Thailand. Statistics of the latter are available from the website of the Ministry of Transport Thailand. Data extracted from this source was adjusted to exclude local traffic in sand and raw construction materials, and the volume of traffic in the upper part of the Mekong River Basin (which is excluded from the MoT series) was added. Total IWT cargo volumes for the period 2005-2013 were then regressed against real GDP to establish a robust base for forecasting.

The results of the regression analysis reveal an acceptable correlation of cargo volume with GDP.

Two sets of forecasts were generated for Thailand. The first set (**Forecast 1**) was derived through application of the regression equation, while the second set (**Forecast 2**) reflects the direct application of GDP rates of growth, as shown in the table below:

Forecast 1: represents a higher growth scenario and shows that IWT cargo between China and Thailand would grow at an average annual rate of 7.4 percent over the 26-year period between 2014 and 2040. This compares with an achieved annual growth rate of 12.4 percent over the period 2004-2014, but this was influenced by the dramatic increase in the export cargo volume in 2013.

Forecast 2: representing a lower growth scenario, shows IWT cargo in the Upper Mekong corridor growing in line with GDP at an average rate of just over 5 percent per annum.



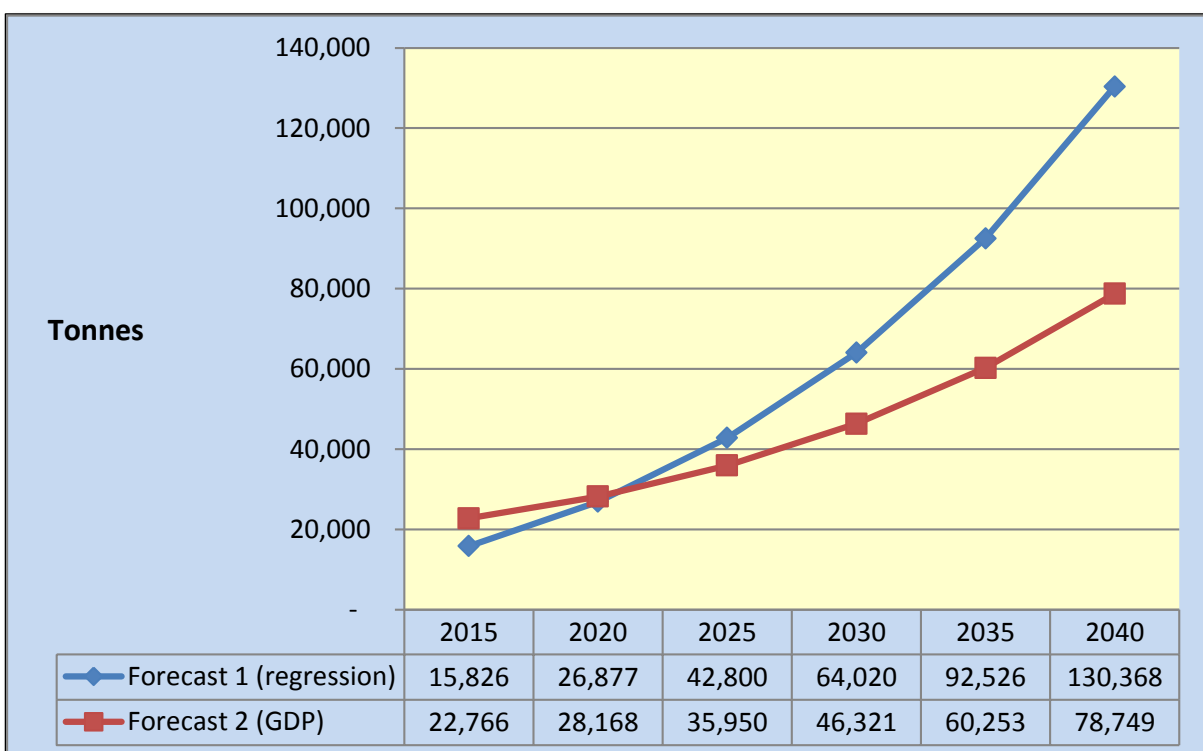
IWT border crossing cargo volume forecasts, Thailand

Petroleum forecasts

Two sets of forecasts were generated for IWT petroleum traffic from Chiang Saen to China. The first set (**Forecast 1**) was derived through application of the regression equation between real GDP and petroleum volumes, while the second set (Forecast 2) reflects the direct application of GDP rates of growth. The calculations for both sets of forecasts are shown in the table below:

Year	GDP at constant 2002 prices	GDP Growth rate	Actual IWT petroleum	Forecast 1 (regression analysis)	Forecast 2 (GDP growth)
	Billion THB	%	tonne	'000 tonne	'000 tonne
2012	4,898.19	6.5	9,329		
2013	5,039.79	2.9	15,791		
2014	5,088.28	1.0	21,761		
2015	5,323.49	4.6		15,826	22,766
2020	6,586.48	4.5		26,877	28,168
2025	8,406.20	5.0		42,800	35,950
2030	10,831.25	5.2		64,020	46,321
2035	14,089.05	5.4		92,526	60,253
2040	18,413.82	5.5		130,368	78,749
AARG 2007-2014	4.1%		20.3%		
AARG 2015-2040	5.1%			7.1%	5.1%

These forecasts are illustrated in the figure below. The higher growth forecast envisages growth at a rate averaging 7.1 percent up until the end of the forecasted period in 2040. Meanwhile the lower growth forecast would see average growth of 5.1 percent over the same period.



IWT regional petroleum forecast 2015-2040

3.1.3 Lower part of the Mekong River Basin

Transport forecasts for the Lower Mekong region were focused on regional passenger and cargo flows in the Phnom Penh-Cai Mep and Ho Chi Minh City corridor. Forecasts were prepared separately for passenger traffic, container traffic, bulk or bagged cargo traffic to/from Phnom Penh, and agricultural exports from Kampong Cham.

Passenger forecasts

Passenger traffic on the Lower Mekong is of three types:

- Tourist passengers travelling from Phnom Penh to Siem Reap (Chong Kneas Port) on speedboats;
- Tourist passengers travelling by speedboat between Phnom Penh and Chau Doc Port, Viet Nam, near the Cambodia/Viet Nam border; and
- Tourists travelling on slow accommodation boats which ply between Ho Chi Minh City and Phnom Penh, some of which extend their voyages to Siem Reap during the high water season on the Tonle Sap River and Lake.

The share of IWT passenger numbers in the overall number of tourist arrivals in Cambodia was used as a basis for the forecast over the 25-year timeframe 2015-2040. The number of tourist arrivals, in turn, was projected by application of the regression equation $y = 0.0014x^{2.0653}$ with y = tourist arrivals and x = real GDP. The resulting forecasts are shown in the table below:

Year	GDP growth %	International tourist arrivals	IWT Tourism traffic actual and forecast (growth at GDP rate)				
			PHN-SRP	CHAU DOC speedboats	Tour boats	TOTAL	% of arrivals
2013	7.4	4,210,165	9,751	16,547	22,584	48,883	1.2%
2014	7.2	4,539,307	16,133	22,338	24,341	62,812	1.4%
2015	7.3	5,251,733	10,503	23,972	26,121	60,596	1.2%
2020	7.4	11,033,086		34,340	37,419	71,759	0.7%
2025	7.0	22,188,532		48,164	52,482	100,646	0.5%
2030	6.5	42,516,185		65,988	71,905	137,894	0.3%
2035	6.0	77,602,428		88,307	96,226	184,533	0.2%
2040	5.0	128,435,951		112,705	122,811	235,516	0.2%
AARG 2002-2013	7.9%	16.5%	-23.5%	14.3%	47.4%	-8.2	
AARG 2014-2040	6.4%	13.7%		6.4%	6.4%	5.2	

Aside from this forecast, which may be considered a lower growth forecast, a second forecast was made in which passenger volumes grow at rates in line with the projected growth in international tourist volume, which is more than double the projected rates of GDP growth for Cambodia. In fact, in this case a projected growth in tour boat passengers at 14.9% per annum, exceeds that of tourist arrivals. This would be considered a higher growth forecast.

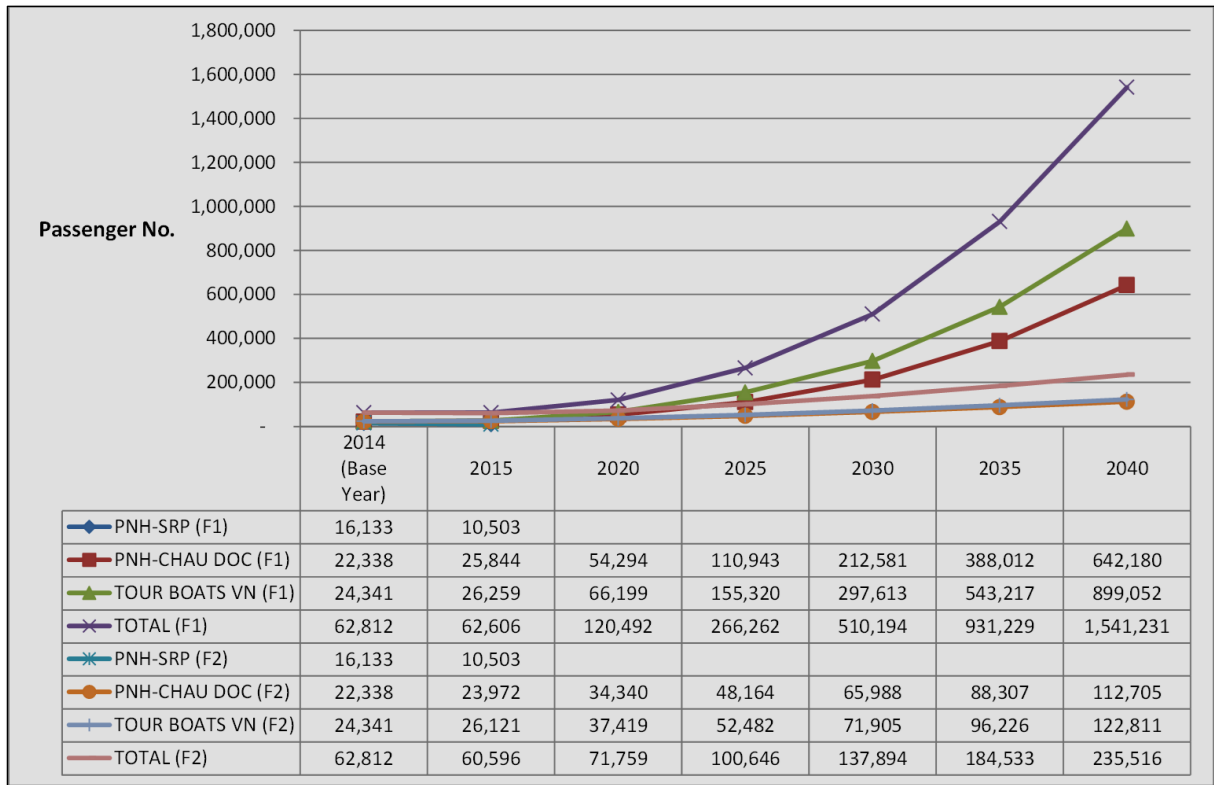
Underlying these forecasts are the following assumptions:

- It is assumed that fast boat services to Siem Reap will be discontinued completely by about 2017, since both the fares paid by foreigners and transit times are about double those of air-

conditioned buses. In addition, there are concerns about the safety and comfort of these services.

- It is considered that cross-border services of both fast and slow boat tourist boats are unlikely to be influenced by competition from bus services, since the very nature of a trip along the river is an essential part of the tour experience. In most cases, tickets for these services are purchased as part of a tour package.

The trends in these two sets of forecast are shown in the figure below:



Regional passenger volume forecasts, Lower Mekong

Container Forecasts

a) Volume forecasts Phnom Penh – Cai Mep/Ho Chi Minh City Traffic:

- Two sets of forecasts were generated. The first, described as a higher growth forecast, was based on the regressed relationship of container volume with GDP growth, effectively the result of applying the regression equation $y = 0.0053x - 93.76$. This forecast reflects an annual average rate of growth in container volume of 8 percent over the 26 years between 2014 and 2040. The second forecast, a lower growth forecast, was derived by applying GDP growth directly to container volumes. This forecast reflects growth at the projected annual average rate of growth for GDP (6.4%).

The resulting forecasts of overall and IWT container volumes are shown in the table below:

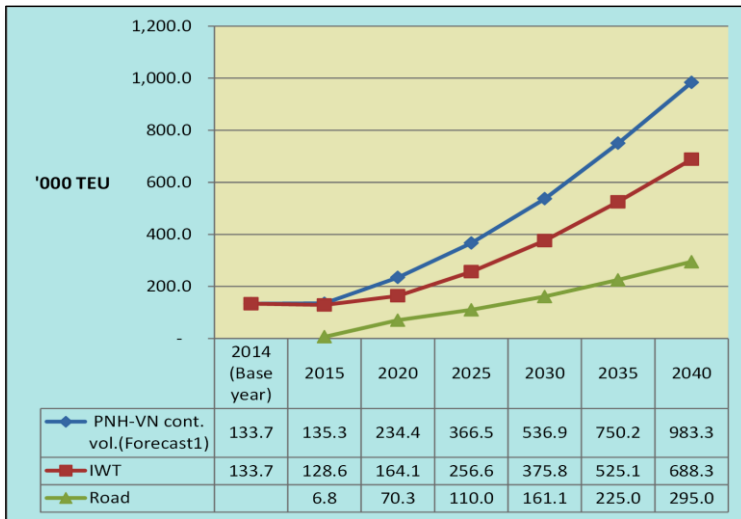
Year	GDP Growth	PHN-VN container volume forecast 1	PHN-VN container volume forecast 2	Modal share		IWT and road volume forecasts			
				IWT	Road	Forecast 1		Forecast 2	
	%	'000 TEU	'000 TEU	%	%	'000 TEU	'000 TEU	'000 TEU	'000 TEU
2013	7.4	110.5	110.5	100	0				
2014	7.2	133.7	133.7	100	0	133.7	0.0	133.7	0.0
2015	7.3	135.3	143.4	95	5	128.6	6.8	136.3	7.2
2020	7.4	234.4	205.5	70	30	164.1	70.3	143.8	61.6
2025	7.0	366.5	288.2	70	30	256.6	110.0	201.7	86.5
2030	6.5	536.9	394.9	70	30	375.8	161.1	276.4	118.5
2035	6.0	750.2	528.4	70	30	525.1	225.0	369.9	158.5
2040	5.0	983.3	674.4	70	30	688.3	295.0	472.1	202.3
AARG 2002-2014	7.9%	54.1%	54.1%						
AARG 2014-2040	6.4%	8.0%	6.4%			6.5%	16.3%	5.0%	14.3%

Analysis and forecast of IWT container volume in the Lower Mekong

Forecast 1 would result in growth of overall container volume from 133,700 TEUs in 2014 to 983,000 TEUs by 2040. By contrast, Forecast 2 would result in a container volume of 674,000 TEUs by 2040.

b) Modal share forecast:

- Up until the present, 100 percent of the Port of Phnom Penh's container throughput has been transported by barge to Viet Nam. However, with the opening of the new bridge over the Mekong at Neak Loeng on 6 April 2015, and subject to the relaxation of truck load limits on the bridge, it would be possible for truck operators to carry containers directly to terminals within the Cai Mep ports (a distance of 320 km from Phnom Penh) in an elapsed time of about 9 hours, including a delay at the border of about 2 hours. This compares with a transit time for barges of 36-38 hours, depending on the route used for navigation (Mekong mainstream or Cho Gao Canal in Viet Nam).
- It is difficult to forecast the extent to which road transport will succeed in diverting container traffic from barges, but an estimate may be made on the basis of the relative operating costs (or haulage charges) and transit times of the two modes. Ideally, freight rates or haulage charges, not operating costs, should be used for this assessment, since they represent the cost of transport as perceived by shippers when they make their modal choices. However, in the absence of adequate data, the estimated operating costs of each mode may be used as alternative indicators of perceived transport cost.
- The assembly of reliable data on road haulage charges proved to be problematic in Cambodia, but it was considered that a rate of US\$ 750 per TEU, as quoted in the meeting with GMAC, would be representative of container haulage by road between Phnom Penh and Cai Mep/Ho Chi Minh City. The corresponding IWT rate is about US\$ 300 per TEU, about 60 percent lower than the road rate.

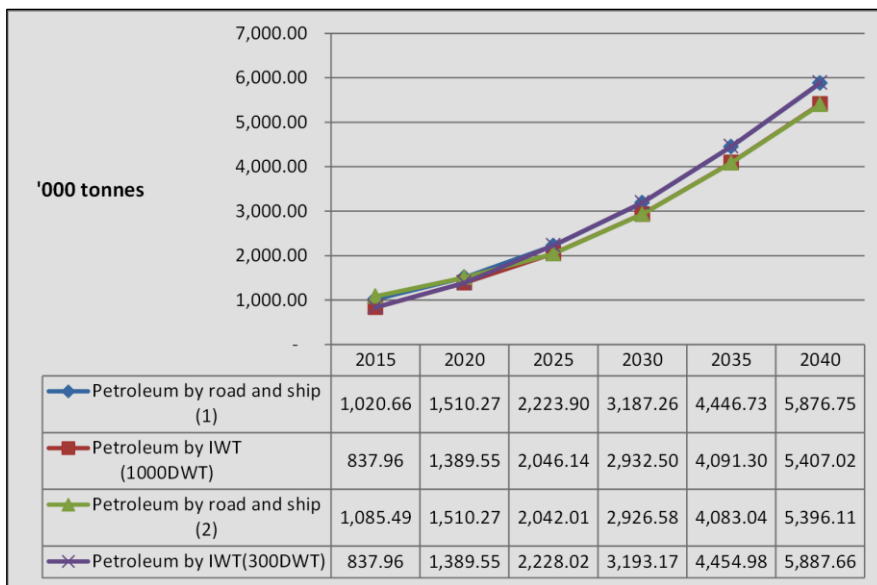


Petroleum forecasts

a) Volume forecast

- The equation derived from the regression of petroleum tonnage against real GDP was applied to generate forecasts of the overall petroleum market volume for Cambodia. This resulted in the market volume growing at a rate averaging 7.6 percent over the 26-year forecast timeframe, somewhat faster than the projected GDP growth rate of 6.7 percent. The forecast result is provided in the table below:

Year	GDP Growth	Total petroleum	Forecast status quo 1,000 DWT vessels				Forecast 3,000 DWT vessels by 2025			
			Petrol. by road/ship		Petroleum by IWT		Petrol. By road/ship		Petroleum by IWT	
	%	'000 ton	'000 ton	% of tot.	'000 ton	% of tot.	'000 ton	% of tot.	'000 ton	% of tot.
2013	7.4	1,683.9	987.0	58.6	604.4	35.9	987.0	58.6	604.4	35.9
2014	7.2	1,774.4	1,020.7	57.5	753.7	42.5	1,020.7	57.5	753.7	42.5
2015	7.3	1,923.4	1,085.5	56.4	838.0	43.6	1,085.5	56.4	838.0	43.6
2020	7.4	2,899.8	1,510.3	52.1	1,389.6	47.9	1,510.3	52.1	1,389.6	47.9
2025	7.0	4,270.0	2,223.9	52.1	2,046.1	47.9	2,085.2	48.8	2,184.9	51.2
2030	6.5	6,119.8	3,187.3	52.1	2,932.5	47.9	2,988.4	48.8	3,131.3	51.2
2035	6.0	8,538.0	4,446.8	52.1	4,091.3	47.9	4,169.3	48.8	4,368.7	51.2
2040	5.0	11,283.8	5,876.8	52.1	5,407.0	47.9	5,510.1	48.8	5,773.7	51.2
AARG 2002-2014	7.2%	7.7%	9.8%		4.2%		9.8%		4.2%	
AARG 2014-2040	6.7%	7.6%	7.1%		8.8%		6.8%		9.1%	



Petroleum volume and modal share forecast - Cambodia/Viet Nam

3.2 DEVELOPMENT SCENARIOS FOR IWT FOR 2020 AND 2040

3.2.1 INTRODUCTION

The Development Scenarios are derived from the Master Plan for Regional Waterborne Transportation in the Mekong Basin which formulation was finalised in December 2015. The **main objective** of the Design of the Master Plan was *“To design a short term and a long term development programme which implementation will rehabilitate and improve the national and international transport network using the Mekong River in the Mekong River Commission Member Countries”* including:

- To fully realise the regional trade and transport potential of the Mekong River which is the most cost-effective mode of the regional transport system and to attract foreign and domestic investments;
- To fully use the vast potential for waterborne tourism and ecotourism as well in the upper part as in the lower part of the Mekong River Basin as a major impulse to private sector growth in all MRC Member Countries;
- To gear, where possible, the economic and financial function of navigation also towards opportunities for poverty reduction. For many riparian people, the river is the lifeline to the outside world and the only way to access basic social services and this transport of people and goods by small craft might grow considerably if rural navigation networks can be linked to regional networks;
- To make navigation safer and more sustainable for the people and for the environment.

3.2.2 BASELINE INFORMATION AND ASSUMPTIONS

Baseline information

- The current situation and baseline conditions, as delivered by the National Experts and completed by the International Consultants;
- The ongoing and planned studies and projects and national strategies and development plans, as well for the upper part of the Mekong River as for the lower part;
- The economic forecasts, providing scenarios for which the sustainability of waterborne transport on the Mekong River Basin should be guaranteed;

Assumptions

- That in the long term, ASEAN will lead to higher integration and transport facilitation in and between the member countries; and
- That in the long term, all planned dams in the PR China and five dams in the Huay Xay - Vientiane stretch of the River will be built (all except Pakchom dam).

Based on the above baseline information and assumptions, short and long-term development scenarios for Regional Waterborne Transport on the Mekong River Basin have been prepared.

3.2.3 GOAL OF THE MASTER PLAN

“The goal of the Master Plan for Regional Waterborne Transport in the Mekong River Basin is to increase waterborne transport in the MRB to at least 125% of the actual waterborne transport volume in 2020 and to at least 250% of the actual waterborne transport volume in 2040 and to make navigation safer and more sustainable for the people and for the environment.”

This goal should be achieved by:

- The use of larger ships used over the total length of the Mekong River and over the whole year, including the use of sea-river ships in the Mekong Delta;
- The improvement of safety of all types of ships, including the use of more save passenger ships and ships carrying dangerous goods;
- The promotion of the concept of “clean” river transportation, focusing on strategic prevention of environmental damage from waterway infrastructures or from shipping or port accidents;
- The development of safe and efficient passenger ports and multimodal nodal points in the main cargo ports and dry ports;
- The creation of a safe navigation channel, able to accommodate the larger ships over the whole year;
- The coordination of a regional river information service and waterborne transport marketing;
- The establishment of education and training courses on all aspects of inland waterway transport;
- The full implementation of cross-border agreements and harmonization of standards, rules and regulations;
- The integration of Strategic Environment Assessment (SEA)/Environmental Impact Assessment (EIA) into IWT planning to effectively manage social and environmental impacts, including the predicted impacts of climate change;
- The creation of socio-economic opportunities to link local IWT transport with national and regional routes; and
- The creation of positive social and environmental impacts in the global MRB transport sector.

3.2.4 Short-term Development Scenario (2020)

In order to manage and coordinate *The Implementation of the Master Plan for Regional Waterborne Transport in the Mekong River Basin*, a “Regional Mekong Navigation Center” should be established under the supervision of the Mekong River Commission and the National Mekong Committees.

Moreover, national, bilateral and regional IWT education and training actions should be implemented according to the “Training Plan to implement the Activities under the Navigation Programme”.

National IWT data management and river information services and IWT promotion and marketing agencies should be established. Finally, to enhance cooperation between the Mekong Countries, opportunities for bilateral and/or regional cooperation on IWT data management and river information services, on IWT promotion and marketing and on hydrodynamic, sedimentological and navigation research should be studied.

3.2.5 Long-term Development Scenario (2040)

For the Long Term (2040) there are 2 possible scenarios:

Long Term Scenario 1: all planned dams in the PR China and four dams in the Huay Xay - Vientiane stretch of the River are built

Long Term Scenario 2, all planned dams in the PR China and four dams in the Huay Xay - Vientiane stretch of the River are built AND ALL four dams between Savannakhet and Kratie are built

3.2.6 Different Aspects for the Development Scenarios

Fleet

In the short-term scenario no changes are proposed to the actual situation (with the assumption that the JCCCN plan to improve the navigation channel between the Golden Triangle and Luang Prabang will be postponed), except for the use of reinforced sea-river barges and seagoing ships for the Phnom Penh Mekong Mainstream and Phnom Penh – Bassac navigation to Cai Mep and overseas.

Moreover, it will be important to have a standardized vessel classification system developed and in use, in harmony with the existing Chinese vessel classification system for the Upper part of the Mekong Basin and with the recently drafted Viet Nam vessel classification system for the Lower part of the Mekong Basin.

Furthermore, to have an increased and more efficient use of the Mekong River, favourable conditions for IWT will have to be created. Therefore, the inland waterway transport sector should be promoted and facilitated by the government. The government needs to make a plan, including an ambitious short-term fleet policy on how to encourage stakeholders to use inland waterway transport and what strategy will be followed to reach sustainable development.

In the long-term scenario, creating a 500 DWT navigation between the Golden Triangle and Kratie (with the assumption that all dams between Huay Xay and Sanakham should be built) is proposed. However if one of the downstream dams (Ban Koum Dam, Latsua Dam, Don Sahong Dam, Stung Treng Dam and Sambor Dam) should not be built, then the actual situation between Savannakhet and Kratie should remain the same. From Kratie to Kompong Cham, 2,000 DWT navigation of seagoing vessels is proposed, and for the Kompong Cham – Phnom Penh stretch, 3,000 DWT navigation is proposed.

It should be noted that for the stretches, where the Mekong mainstream forms the borderline between Thailand and the Lao PDR, this development can only start when the official border demarcation between the two countries is finalized.

Also for the Phnom Penh – Kompong Chhnang – Chong Kneas stretch, in the long-term scenario, 500 DWT navigation is proposed. For the Phnom Penh – Ho Chi Minh – Cai Mep stretch and Phnom Penh – overseas navigation, it is strongly recommended to use reinforced sea-river barges and/or seagoing ships over the Bassac River and the Quang Chang Bo Canal.

Moreover, the governments need to develop a policy to encourage new vessel construction according to approved vessel standards and requirements and to facilitate new and existing ship yards.

Waterway Design

In the short-term scenario, recent channel conditions for all dangerous areas should be collected (where not available) and channel design proposals made.

Regarding river design development scenarios, in light of the ongoing uncertainties of the hydropower dam constructions, it was agreed that for the short-term scenario no major physical work to the channel improvement should be carried out (except for the usual and ongoing river maintenance works such as dredging and bank protections, river groynes and construction of navigational aids).

In terms of river design, the short-term scenario would therefore mainly focus on things such as channel studies, clearance of rapids, reefs, shoals and rock outcrops, eliminating dangerous areas and sharp bends, studies of improved access channels to port and landing places, among others. These studies all have to be done in line with the principles of environmental protection and be in line with the outcome of environmental screenings and impact assessments.

For the long-term scenario, in the upper part of the Mekong River Basin, a navigation channel with LAD = 3 m and LAW = 60 m has to be created upstream Huay Xay, in some remaining “natural free-flow areas” downstream of the dams, and between the Sanakham Dam and Savannaketh.

Between Savannakhet and the Khone Falls, only in the long-term scenario 2, a navigation channel with LAD = 3 m and LAW = 60 m should be created in the Siphandon area.

It should be noted that for the stretches, where the Mekong mainstream forms the borderline between Thailand and the Lao PDR, all these developments can only start when the official border demarcation between the two countries is finalized.

For the Khone Falls, a bypass-canal of about 11 Km long with two or three ship locks of between 15 and 20 meter-level difference is proposed in long-term scenario 2.

Between the Khone Falls and Kratie, only in the long-term scenario 2, a navigation channel with LAD = 3 m and LAW = 60 m should be created in the free flow areas downstream of the Stung Treng and Sambor Dams.

Downstream between Kratie and Phnom Penh, extensive river works have to be carried out to reach a navigation channel for 2,000 DWT ships between Kratie and Kompong Cham and a navigation channel for 3,000 DWT ships between Kompong Cham and Phnom Penh.

At the Great Lake entrance in Chhnock Trou and in the lake, a navigation channel with LAD = 3 m and LAW = 60 m will be created to accommodate ships up to 500 DWT between Phnom Penh and Chong Kneas all year-round.

For the shortcut canals in the Mekong Delta, a World Bank project to improve navigability in these canals will be completed and for the Phnom Penh to Cai Mep navigation over the Bassac River, only some minor channel adaptations on the Mekong Mainstream between Phnom Penh and the Vam Nao Pass and in the Vam Nao Pass will be carried out.

Fleet and Navigation Safety

The short-term scenario should focus on the transport conditions of passengers and the carriage and handling of dangerous goods that are presently very unsafe for various reasons. Therefore priority should be to immediately increase safety and create acceptable living conditions for passengers and tourists on passenger vessels and safe carriage and handling of dangerous goods. The necessary law and regulations need to be implemented by the respective waterway department.

Furthermore, safety should be increased by the implementation of the Regional Action Plan on Dangerous Goods and the implementation of search and rescue units. In the lower part of the MRB (downstream of the Khone Falls) the obligatory use of AIS is proposed.

The long-term scenario should focus on increased safety, efficiency and protection of the environment by improving vessel design and construction and by the installation of VTS and RIS over the total length of the Mekong River.

Especially for the Mekong Delta (downstream of Phnom Penh), an efficient waterway maintenance plan and the use of an AIS system, VTS, RIS and pilotage should increase safety of navigation.

Aids to Navigation

In the short-term scenario, between the Green Triangle and Luang Prabang only daytime navigation will be possible but it will be safer and more efficient due to the introduction of a GPS navigation guided system and the rehabilitation of French markers. Between Luang Prabang and Kompong Cham, navigation will become easier because French markers are rehabilitated over the whole stretch and low water alert gauges are installed at critical places. Downstream of Kompong Cham to the sea, day and night navigation will be possible with installed buoys and beacons.

In both the short and long-term, marking of the highest flooded obstacles in the impounded sections upstream of the dams is a priority and should be done before impounding the reservoirs.

In the long-term scenario, between the Green Triangle and Kompong Cham, all commercial boats need compulsory GPS navigation guided systems except between Savannakhet and Kratie, where one of the downstream dams should not be build.

Floating visual aids can be reintroduced in the reservoirs upstream of the dams.

Downstream of Kompong Cham to the sea and from Phnom Penh to Chong Kneas, further installation of visual aids to navigation, fitted with GMS and AIS locators and virtual aids to navigation in line with ENC's should be introduced.

Ports

In the short-term scenario, focusing on to the rehabilitation and construction of new, safe and efficient passenger ports over the total length of the Mekong River is proposed. The infrastructure of these ports should be compliant with the forecasted passenger throughput and should be managed with a focus on the safety of both port users and port workers, security, the environment and efficiency.

In the long-term scenario, a focus on the development of ports with adequate and well-maintained infrastructure for the efficient and safe handling, storage and transfer of both cargo (including dangerous goods where applicable) and passengers, is proposed. The infrastructure of these ports should be compliant with the forecasted passenger and cargo throughput and should be managed with a focus on the safety of both port users and port workers, security, the environment and efficiency. The improvement of hinterland connections should be taken into consideration when new facilities are constructed.

Moreover, the proposed outstanding actions of the "*Master Plan for Waterborne Transport on the Mekong River System in Cambodia (2006)*" should be executed. Kompong Cham: New passenger port infrastructure (floating pontoon) and new general cargo infrastructure (ramp) at the right bank of the river. Construction of an oil distribution facility and development of a container facility at the left bank of the river; Kompong Chhnang: New passenger port infrastructure (floating pontoon); Chong Kneas: Development and construction of a new port with a cargo terminal, a fish market, a passenger terminal and a bunkering jetty.

Legal Aspects

For the short-term scenario, the harmonized rules adopted under the “Agreement on Commercial Navigation on the Lancang-Mekong River among the Governments of the People’s Republic of China, the Lao People’s Democratic Republic, the Union of Myanmar and the Kingdom of Thailand” and under the “Agreement between the Royal Government of Cambodia and the Government of the Socialist Republic of Viet Nam on Waterway Transportation” should be fully implemented.

Common safety rules should be adopted and implemented by Lao PDR and Thailand and by Cambodia and Viet Nam.

For the long-term scenario, a comprehensive, fully harmonized and effectively implemented legal framework is necessary.

Environmental Aspects

For the short-term scenario, SEA/integrated planning is needed for IWT sector strategies and plans and EIAs are needed for specific port and terminal constructions and waterway improvement projects. Standards and guidelines should be drafted for environmental assessment in order to achieve sustainable navigation. Ecoregions, protected areas, fisheries conservation zones, socio-economic conditions and important wetlands should be included in assessments for specific stretches.

The increased environmental impact from inland waterway transport (water pollution and air emissions) requires urgent attention to reduce water pollution. The implementation of a DEMP for navigation dredging and EIAs for sand mining are required.

The conservation of fishing zones, wetlands and flooded forest on the Tonle Sap Lake requires special consideration.

For the long-term scenario, SEA, EIAs and EMP and monitoring needs to be incorporated into integrated planning for the IWT sector. Meanwhile, energy efficient vessels, pollution control and environmental monitoring are needed for sustainable inland waterway navigation. DEMP must be implemented for all modification and maintenance of waterways.

Increased conservation in National Protected Areas (NPAs) to restore social and natural conditions is needed. Zones could be developed to restrict the transport of dangerous goods, dredging, rock blasting and other navigation activities in specific stretches to enhance environmental protection.

Sustainable ‘green’ navigation has to be achieved in order to protect water quality, the environment, livelihoods and to reduce carbon emissions.

Climate Change adaptation plans for sea level rise and increased flooding have to be in place in order to protect IWT infrastructure and IWT vessels. This can be incorporated into contingency planning for flooding.

Social Aspects

For the short-term scenario, socio-economic risks and opportunities have to be integrated into the EIAs. Planning for linking local IWT with domestic and cross-border transport is required.

A socio-economic survey to determine future risks and opportunities for rural/domestic IWT should be completed.

For the long-term scenario, the development of rural/domestic cargo and passenger transport should be fully integrated and IWT should be also integrated with hydropower, agricultural, mining, industrial and other sectors.

Landing facilities will be installed at priority locations to link local transport and eco-tourism with national ports.

Education, Training and Institutional Aspects

For the short-term scenario, national, bilateral and regional IWT education and training actions should be planned and implemented.

A regional “Mekong River Navigation Commission” to coordinate the implementation of the actions of the Master Plan and national IWT data management and river information services and IWT promotion and marketing agencies should be established.

Finally, the need and scope of bilateral and/or regional cooperation on IWT data management and river information services, of bilateral and/or regional cooperation on IWT promotion and marketing and of regional cooperation on hydrodynamic and nautical research should be studied.

For the long-term scenario, depending on the results of the short-term studies, a regional “Mekong River Navigation Commission”, bilateral or a regional “Mekong River IWT Information Management Centre” and “River Information Services”, bilateral or a regional “Mekong River IWT Promotion and Marketing Agency” and a regional “Hydrodynamic and Nautical Research Centre” could be established.

3.3 ACTIONS UNDER THE IWT MASTER PLAN THAT ARE RELEVANT FOR THE COUNCIL STUDY

3.3.1 Fleet actions

Short-Term Fleet Actions (2016-2020)

SFL2: Conduct a Feasibility Study on the use of reinforced sea-river barges in the Lower part of the Mekong Basin, in particular for regional and coastal trade

This involves the Phnom Penh Mekong Mainstream and Phnom Penh – Bassac navigation to Cai Mep. Sea-river vessels have important advantages as they can be used on inland waterways (bridge and mast can be lowered) as well as on sea stretches with restrictions for wind force and wave height.

SFL4: Implement the Fleet Projects of the Regional Action Plan for Sustainable Transport of Dangerous Goods along the Mekong River

For vessels that carry dangerous goods (a number of the projects are also applicable for other vessels), this involves the implementation of five projects, two national and three with cross-border impact:

- Implementation of the IMDG Code and provision of MSDS for Inland Waterway Vessels;
- Emergency Response on Board Vessels;
- Mekong Tanker Safety Management;
- Minimum Standards for Vessels Design, Construction and Equipment;
- Safe Manning on Inland Waterway Vessels.

Long-Term Fleet Actions (2021-2040)

LFL2: Implement standards for construction of new vessels.

Construction of vessels should be done according to approved standards and the designed DWT of the river stretch (vessel and channel classification), and taking into account restrictions such as the LAD (Least Available Depth), lock dimensions, bridge clearances and port limitations.

3.3.2 Waterway Design Actions

Short-Term Waterway Design Actions (2016-2020)

SWD1: Perform condition survey of the dangerous areas for navigation between the Green Triangle and Huay Xay and between Sanakham and Kratie to have recent information on the needed optimization works.

The stretch between the Golden Triangle and Huay Xay and the stretch downstream of Sanakham are not impounded stretches (until the planned dams at Ban Khoum and Latsua are constructed).

Pakxe is situated between the two planned dams of Ban Khoum and Latsua. Navigation upstream of Kratie depends on the hydropower schemes and the economic development of navigation.

Between Huay Xay and Savannakhet, some of the rapids and dangerous areas have already been condition surveyed and channel design projects have been made.

SWD2: Standardize the waterway classification in harmony with the Chinese waterway classification in the Upper part of the Mekong Basin related to modern shipping.

SWD3: Standardize the waterway classification in harmony with the Vietnamese waterway classification in the Lower part of the Mekong Basin related to modern shipping.

SWD4: Design river training works at the Sdao Canal in Cambodia.

The Sdao canal in Cambodia at Km 385 is a continuous nightmare for shipping. The more the canal is dredged, the more it is silted up.

SWD5: Carry out experimental test dredging in the Tonle Sap and the Great Lake.

Experimental test dredging and deposition test should be carried out, including a couple of trapping observations by placing special collector tubes to study the bed-load movement of the Great Lake.

Long-Term Waterway Design Actions (2021-2040)

LWD1: Provide the Mekong River with a minimum 500 DWT navigation channel between the Green Triangle and Vientiane through dredging and/or excavating:

- (1) Between the Green Triangle and Huay Xay;
- (2) In the free flow section upstream of the Pak Beng hydropower dam;
- (3) In the free flow section upstream of the Luang Prabang dam;
- (4) In the free flow section upstream of the Xayabury dam;
- (5) In the free flow section upstream of the Paklay hydropower dam;
- (6) In the free flow section upstream of the Sanakham hydropower dam;
- (7) In the section between the Sanakham hydropower dam and Vientiane.

Each waterway improvement should correspond to the design study, which has been made after the condition survey and is in line with the recommendations from the environmental screening.

LWD2: Improve and clear the navigation channel of the rapids in the Vientiane – Savannakhet stretch (Keng Sam Hong at Km 1,288, Keng Muoang at Km 1,214, Keng Ka Phouang at Km 1,156 and Keng Ka Bao at Km 1,151).

These rapids and dangerous areas are situated in the stretch Vientiane – Savannakhet.

LWD3: (Scenario 2) Improve and clear the navigation channel of rapids and dangerous areas between Savannakhet and the Khone Falls through excavation, dredging, rock blasting, removal of scattered rock outcrops, bedrock deepening and/or river training works, among others.

This stretch contains 77 known rapids and dangerous areas from which only three have been condition surveyed.

LWD4: (Scenario 2) Construct an 11 km long bypass canal around the Khone Falls, including bank protection and two or three ship locks with dimensions of the lock chamber 120 x 12 x 4.00 meters.

From this project, it is recommended to make a “turn-key” project which should also include all the studies required for implementation.

LWD5: (Scenario 2) Improve the navigation channel between the Khone Falls and Kratie by dredging, rock excavation and bedrock deepening, clearance of reefs and rock outcrops, and river training works like groynes and overflow dikes.

The project heavily depends on the decision to construct the hydropower dams at Sambor and/or Stung Treng. Without this decision, no further useful or practicable planning for waterway improvement can be made.

LWD6: Improve the navigation channel between Kratie and Kompong Cham up to 2,000 DWT through dredging and excavation including eventual river training works.

This particular stretch has a navigation potential well identified by the KOICA project, which aims to dredge a channel between the new container terminal of the Phnom Penh port and Kratie.

LWD7: Improve the navigation channel for sea going vessels up to 3,000 DWT between Kompong Cham and the New Container Port of Phnom Penh, by dredging and river training works.

Since maintenance dredging has resumed in this stretch, sea-going vessels can again sail up the river to Kompong Cham (Tonle Bet). The KOICA project and the Port of Phnom Penh only dredge for the Sdao Canal, even though river training works have been suggested but never been envisaged.

LWD8: Improve the navigation channel for vessels up to 500 DWT all year round between Phnom Penh (Chaktomuk) and Chong Kneas (Siem Reap) by dredging the Tonle Sap.

The project foresees a channel to be dredged in the Great Lake with a bottom width of 30 meters, slopes of 1/10 and an average depth to be dredged of 1.3 meters.

LWD9: Improve the navigation channel between the New Container Port of Phnom Penh and Ho Chi Minh City/Cai Mep ports for self-propelled barges of 3,000 DWT via the Cho Gao canal.

The World Bank has a project (WB 5 project) of approximately 200 million US\$ for the upgrading of two canals in the Mekong Delta.

LWD10: Improve the navigation channel for sea going vessels 10,000 DWT between the New Container Port of Phnom Penh and the Quang Chanh Bo Canal.

The project will require some dredging in the Vam Nao pass and in the Mekong mainstream in Cambodia.

LWD11: Conduct a morphology study producing feasible proposals for river training works in the areas between Phnom Penh and the sea to reduce yearly maintenance dredging in order to keep the required water depths for sea going vessels.

Having bigger ships enter the Mekong mainstream or the Bassac and the Vam Nao pass will definitely require yearly maintenance dredging, which in some places may incur in cost

overruns. Cheaper solutions exist to keep certain water depths in case the river has sufficient scouring effect.

3.3.3 Navigation Safety Actions

Short-Term Navigation Safety Actions (2016-2020)

SNS3: Develop a contingency plan for efficient accident response.

Developing a contingency plan involves making decisions in advance about the management of human and financial resources, coordination and communications procedures, and being aware of a range of technical and logistical responses and restrictions.

This involves procedures for accident reporting, the establishment of a response team and defining the roles and responsibilities in the response system. This includes planning and coordinating responses, providing guidance to regional or local response teams, coordinating a national program of preparedness planning and response, and facilitating research to improve response activities.

Long-Term Navigation Safety Actions (2021-2040)

LNS1: Develop Electronic Navigation Charts (ENC) for the whole Mekong River.

This involves the hydrographic office making vector charts with digitized data that records all the charted features necessary for safe navigation such as riverside, bathymetry, buoys and lights.

LNS2: Implement River Information Services (RIS) over the total length of the Mekong River.

This involves information technology (IT) related services designed to optimise traffic and transport processes in inland navigation, i.e. to enhance a swift electronic data transfer between water and shore through in-advance and real-time exchange of information.

3.3.4 Aids to Navigation Actions

Short-Term Aids to Navigation Actions (2016-2020)

SAN2: Construct and install clearly visible low water alert gauges in all remaining important places for navigation along the Mekong to indicate the water levels above the local chart datum.

These constructions should be clearly visible from the middle of the channel and constructed near shallow areas where groundings are occurring frequently. The locations have to be indicated by the MRC. In 2015 the Thai Marine Department will conduct a Feasibility Study on AIS, Radio Communication and Low Water Alert Systems. The results of the study will be used to select the locations.

Long-Term Aids to Navigation Actions (2021-2040)

LAN1: (Scenario 1) Develop and install the GPS Navigation Guidance System and make it compulsory for all commercial boats carrying cargo and/or passengers along the Mekong River between Luang Prabang and Savannakhet to carry it.

This involves updating echo sounding and charting, initiating a new law, and law enforcement.

In addition, and when and where applicable, there will be buoys and beacons marking the access to the ship's locks but these are the responsibility of the dam developers.

LAN2: (Scenario 2) Develop and install the GPS Navigation Guidance System and make it compulsory for all commercial boats carrying cargo and/or passengers along the Mekong River between Luang Prabang and Kratie to carry it.

This involves updating echo sounding and charting, initiating a new law, and law enforcement.

In addition, there will be buoys and beacons marking the access to the ship's locks but these are the responsibility of the dam developers.

3.3.5 Port Development Actions

Short-Term Port Development Actions (2016-2020)

SPD3: Implement the “Regional Action Plan for Sustainable Transport of Dangerous Goods along the Mekong River 2015-2020” for ports handling dangerous goods (see DG RAP Projects 6, 7, 9, 10 and 11).

THE “Regional Action Plan for Sustainable Transport of Dangerous Goods along the Mekong River” consists of national and cross-border project documents that serve as a basis to reduce the risks of accidents, spillages and pollution and enhance emergency response and regional coordination. For ports there are three national project documents, one with cross-border impact:

- Standards for the Planning, Design and Construction of Ports and Terminals;
- Maintenance, Inspection and Testing of Critical Equipment;
- Port Safety Health and Environmental Management System (PSHEMS);
- Emergency and Oil Spill Response in Ports and Terminals.

SPD4: Rehabilitate, extend and/or reconfigure the existing passenger ports and landing facilities in Chiang Saen Port, Haciang Commercial Port (passengers going to Ban Khouane) and Phnom Penh Passenger Port in order to increase the capacity of the passenger ports and to allow for more efficient and safe embarking and disembarking of the passengers.

Existing passenger ports are currently not always provided with proper landing facilities and infrastructure for passengers, or they are not adjusted to the current and forecasted passenger volumes. Emphasis should be on the safe landing of passengers, sufficient quay capacity, parking facilities in the area, luggage handling facilities, security, immigration and customs facilities and waste disposal facilities.

SPD5: Construct new passenger ports and landing facilities in Ban Sai Port, Muong Mom Port (Ban Mom) and Ban Khouane, Huay Xay, Pak Beng, Luang Prabang, Kratie, Kompong Cham, Kompong Chhnang and Chong Kneas suitable to handle the forecasted passenger volumes. These ports should be constructed for efficient and safe processing of passengers.

The new ports should be developed with an emphasis on the safe landing of passengers, sufficient quay capacity, parking facilities in the area, luggage handling facilities, security, immigration and customs facilities and waste disposal facilities.

SPD 6: Construct new port infrastructure for cargo ports with proper berthing and cargo handling facilities in Xieng Kok, Pak Beng and Luang Prabang. The new cargo ports should be located in order to assure good hinterland connection (road and rail) - Two fully equipped vertical 500 DWT berths and one sloping ramp berth.

These new ports should be developed with an emphasis on the safe and efficient handling of the anticipated cargo and volumes. The ports should be suitable to handle the forecasted cargo volumes and be equipped with proper cargo handling facilities, sufficient quay

capacity, cargo storage area, container yard, parking facilities, security, immigration and customs facilities, office space, necessary IT equipment and waste disposal facilities.

SPD7: Expand the existing container yard at New Phnom Penh Container Terminal – NCT LM 17 in order to accommodate forecasted container traffic.

Current capacity of 140,000 TUE will not be sufficient to handle the forecasted container traffic. The container yard needs to be expanded in order to be able to handle the forecasted container traffic.

SPD8: Rehabilitate the existing petrochemical transfer ports in Viet Nam according to the Vietnamese Master Plans.

Viet Nam has many fuel transfer ports. The condition of these ports depends on the owner/operator. Substandard facilities should be identified and rehabilitated.

Reference: *“Master plan for Viet Nam Inland Waterway Sector to 2020 and Orientation to 2030”.*

SPD9: Rehabilitate the existing cargo ports in Viet Nam according to the Vietnamese Master Plans.

Viet Nam has many (often small) cargo ports. The condition of these ports depends on the owner/operator. Substandard facilities should be identified and rehabilitated.

Reference: *“Master plan for Viet Nam Inland Waterway Sector to 2020 and Orientation to 2030”.*

SPD10: Update and amend the “Master plan for Viet Nam Inland Waterway Sector to 2020 and Orientation to 2030”.

Viet Nam has requested the MRC’s assistance to update the “Master Plan for Viet Nam Inland Waterway Sector to 2020 and Orientation to 2030” for the ports that are under the agreement between Cambodia and Viet Nam (currently 40 Vietnamese ports are part of the agreement).

Reference: *“Master plan for Viet Nam Inland Waterway Sector to 2020 and Orientation to 2030” and “Decision No. 1071/QĐ-BGTVT dated 24/4/2013 of Ministry of Transport approved the amendment Inland waterway development master plan to 2020 and vision to 2030”.*

Long-Term Port Development Actions (2021-2040)

LPD2: Construct new passenger ports and landing facilities in Pak Lay, Vientiane Capital City (Laksi Port), Nakhon Phanom, Savannakhet and Pakxe suitable to handle the forecasted passenger volumes. These ports should be constructed for efficient and safe processing of the passengers.

The new ports should be developed with an emphasis on the safe landing of passengers, sufficient quay capacity, parking facilities in the area, luggage handling facilities, security, immigration and customs facilities and waste disposal facilities.

LPD3: Construct new port infrastructure for cargo ports with proper berthing and cargo handling facilities in Ton Pheung, Haciang Commercial Port (private port), Pak Lay, Vientiane, Nakhom Phanom, Savannakhet, Pakxe (only scenario 2) and Stung Treng (only scenario 2). The new cargo ports should be located in order to assure good hinterland connection (road and rail) - Two fully equipped vertical 500 DWT berths and one sloping ramp berth.

These new ports should be developed with an emphasis on the safe and efficient handling of the anticipated cargo and volumes. The ports should be suitable to handle the forecasted

cargo volumes and be equipped with proper cargo handling facilities, sufficient quay capacity, cargo storage area, container yard, parking facilities, security, immigration and customs facilities, office space, necessary IT equipment and waste disposal facilities.

LPD4: Analyse/study what ports are suitable to handle containers in the Green Triangle to Savannakhet stretch and determine which ports need extra infrastructure to handle containers.

LPD5: Expand the existing container yard at the New Phnom Penh Container Terminal – NCT LM 17 in order to accommodate forecasted container traffic.

Current capacity of 140,000 TEU will not be sufficient to handle the forecasted container traffic. The container yard needs to be expanded in order to be able to handle the forecasted container traffic (forecasted TEU throughput 2040 about 700,000 TEU).

LPD6: Develop a cargo port in Kratie able to accommodate two seagoing barges up to 2,000 DWT suitable to handle the forecasted cargo volumes on an efficient and safe way.

At present this port is basic with insufficient landing facilities and almost no proper cargo handling facilities. The cargo port should be able to accommodate two vessels of 2,000 DWT and consist of an office building, parking lot, warehouse, open storage yard and a silo.

Reference: “Master Plan for Waterborne Transport on the Mekong River system in Cambodia 2006” Action B10: Kratie Port Development.

LPD7: Develop a cargo port in Kompong Cham (Tonle Bet) with vertical quays, able to accommodate two seagoing vessels up to 3,000 DWT (containers and general cargo), a domestic general cargo port for inland barges (ramp) and an oil distribution facility (jetty) suitable to handle the forecasted cargo volumes in an efficient and safe manner.

At present this port is basic with insufficient landing facilities and almost no proper cargo handling facilities.

The international cargo port should be able to accommodate two vessels of 3,000 DWT (*cf. KOICA plan*) and consists of an office building, parking lot, warehouse, open storage yard and a silo.

The domestic cargo port and the oil distribution facility should be developed according to the Cambodian Master Plan.

Reference: “Master Plan for Waterborne Transport on the Mekong River system in Cambodia 2006” Action B9: Kompong Cham Port development

LPD8: Develop a cargo port in Kompong Chhnang able to accommodate vessels of up to 500 DWT suitable to handle the forecasted cargo volumes in an efficient and safe manner.

Currently this port is basic with insufficient landing facilities and almost no proper cargo handling facilities.

The cargo port should be able to accommodate two vessels of 500 DWT and consist of an office building, parking lot, warehouse, open storage yard and a silo.

Reference: “Master Plan for Waterborne Transport on the Mekong River system in Cambodia 2006” Action B8: Kompong Chhnang Port Development.

LPD9: Construct a new port in Chong Kneas. The port should have a new passenger terminal, cargo terminal, fish market and a bunkering jetty.

The port is currently in concession. However, the concession will terminate in the near future.

Reference: “Master Plan for Waterborne Transport on the Mekong River system in Cambodia 2006” Action A15: Upgraded passenger facilities at Chong Kneas Port and Action A16: Development of Chong Kneas Port facilities.

3.3.6 Regulatory Actions

Short-Term Regulatory Actions (2016-2020)

SRE1: Implement the Cambodian-Vietnamese Agreement on Waterway Transportation.

A number of actions need to be undertaken to effectively implement the Agreement between Cambodia and Viet Nam on Waterway Transportation, which was signed in 2009. This includes:

- (1) Operationalize the Mekong Navigation Facilitation Committee
- (2) Issue documents and permits for inland waterway vessels
- (3) Implement the rules on formalities and dues and taxes
- (4) Harmonize, implement and enforce rules and regulations
- (5) Elaborate a third party liability insurance system

SRE3: Adopt, implement and enforce harmonized safety and anti-pollution rules for Lao PDR and Thailand.

In order to address serious safety issues, Lao PDR and Thailand should work towards the adoption of a set of common safety standards for those stretches of the Mekong outside the scope of the Quadripartite Agreement (i.e. downstream of Luang Prabang to the Khone Falls). To the extent that no national rules are available, it is preferable to immediately draft a common instrument rather than first elaborate two national instruments which would subsequently be harmonized. Safety rules should include a mechanism for the inspection of ships.

Long-Term Regulatory Actions (2021-2040)

LRE1: Further implement the Cambodian-Vietnamese Agreement on Waterway Transportation.

Further actions are needed to effectively implement the Agreement between Cambodia and Viet Nam on Waterway Transportation including the elaboration and adoption of:

- (a) Rules and regulations on aids to navigation;
- (b) Rules and regulations on vessel traffic services;
- (c) Rules and regulations on search and rescue services and on the provision of adequate salvage capacity;
- (d) Rules and regulations laying down common training and certification standards;
- (e) Rules and regulations on the use and operation of floating structures.

LRE2: Further implement the Quadripartite Agreement on Commercial Navigation on the Lancang-Mekong River.

In order to further elaborate and update the regulatory framework for navigation under the Quadripartite Agreement, a number of additional sub-actions will be needed, including:

- (1) A study on gaps and updates of the regulatory framework for registration of vessels, including the drafting of a proposal for new rules and regulations;
- (2) A study on gaps and updates of the regulatory framework for safety of vessels, including the drafting of a proposal for new rules and regulations;

- (3) A study on gaps and updates of the regulatory framework for training, qualifications and certification of crews, including the drafting of a proposal for new rules and regulations and a proposal for the creation of a Mekong Navigation Certificate for ship masters;
- (4) A study on gaps and updates of the regulatory framework for safety of and aids to navigation including collision regulations ('rules of the road'), including the drafting of a proposal for new rules and regulations;
- (5) A study on gaps and updates of the regulatory framework for environmental protection and management, including the drafting of a proposal for new rules and regulations.

LRE3: Further elaborate and harmonize the regulatory framework for waterborne transportation between Luang Prabang and the Khone Falls.

The elaboration of a harmonized regulatory framework will facilitate international and cross-border waterborne transportation of cargo and passengers, increase the competitiveness of the Lao and Thai economies and enhance safety and sustainability of navigation and port operations. The governments of both countries may also wish to consider extending the territorial scope of the Quadripartite Agreement and its Annexes or agreeing on a specific bilateral navigation agreement among themselves.

3.3.7 Environmental Actions

Short-Term Environmental Actions (2016-2020)

SEN1: Develop environment assessment guidelines for IWT, including SEA, EIA and EMP and monitoring and consider trans-boundary impacts for port, vessel and waterway improvements.

This would include developing technical guidance and capacity building for environmental assessment and monitoring of future IWT planning and project/activities in the Mekong Basin.

Considering the type/scope, location and effect of proposed IWT projects, determine mechanisms for trans-boundary assessment and management.

SEN2: Conduct Strategic Environment Assessment (SEA) for the Lancang Mekong Development Plan on International Navigation on the Lancang - Mekong River (2014-2025).

Prior to this project being approved, a full SEA or a more detailed EIA for specific ports and waterway improvement stretches should be carried out.

SEN3: Conduct an optimisation study of dredging sand from the Mekong River at various places that does not create negative impacts on river behaviour or ecological status.

A morphological feasibility study should indicate the places where sand dredging or excavation (of dry sand banks) has no negative impact on river behaviour or ecological status.

SEN4: Determine the extent of oil spill pollution from existing ports, petroleum terminals and vessel operations to determine regional and national contingency planning and develop specific water quality parameters to monitor IWT operations.

Review and analyse MRC data and information to develop relevant scenarios of oil spills and/or water quality incident model simulation. The water quality parameters would include surface water and sediment, and include ports, vessels and dredging operations.

- Provide parameters for procedures for water quality;
- Include transport and storage of other dangerous goods;

- Results would feed into contingency planning: early warning and notification systems; Tier 1 (<20 tonnes), 2 (20-500 tonnes) or 3 (>500 tonnes); and local/national/trans-boundary response.

SEN5: Start awareness and education campaigns to reduce pollution by vessels and ports.

Inform crewmembers and port workers of the consequences of waste disposal in the river and the dangers of pollution for the environment. The crew and port workers should be trained in dealing with different kinds of waste generated on board and the use of the ship's waste management plan.

SEN6: Prepare an inventory of air emissions from key inland cargo ports in the Mekong Basin.

Determine approaches for reducing CO₂ and GHG emission from the IWT sector.

SEN7: Review the energy efficiency of existing vessels in the Mekong Basin and develop a case study in Cambodia and Viet Nam to compare the most sustainable routes from Phnom Penh to the sea.

The assessment could also take into account waterway safety, operational efficiency and a comparison with road transport in relation to CO₂ and GHG emissions.

Long-Term Environmental Actions (2021-2040)

LEN1: Establish trans-boundary environmental management and monitoring systems to ensure the effective management of wastes, water pollution, oil spill response and contingency planning for IWT.

The short-term actions for water pollution and environmental assessment would need to be completed prior to the long-term actions. The core function for water quality monitoring and pollution needs to be evaluated.

LEN2: Conduct further environmental assessment to determine zones or restrictions for port/vessel operations, the transport of DG, dredging/sand mining activities and location of waste management facilities.

An assessment of the environmental and socio-economic conditions, ecotourism, waterway conditions (reefs, rapids, shoals, sandbars, etc.) and significance of existing and planned navigation activities would be required. It would need to reference the DG RAP.

LEN3: Conduct an IWT sector planning for climate change adaptation and mitigation integrated into regional and national actions plans and green growth/low carbon development strategies.

Design requirements for future IWT planning, navigation clearance (e.g. bridges) and regional and national plans for responding to floods. This action could reduce the costs and environmental impacts of waterway modification and maintenance.

3.3.8 Social Actions

Short-Term Social Actions (2016-2020)

SSO1: Conduct further analysis of a Social Impact Monitoring Vulnerability Assessment (SIMVA) and other household surveys (e.g. household income and expenditure survey (HIAS)) in the Mekong corridor for employment and education, access to infrastructure and ownership of transport assets.

Developing cargo and passenger transport on the Mekong River can provide direct and indirect economic benefits, improving livelihoods for rural communities. The socio-economic conditions require more assessment in relation to IWT.

SSO2: Undertake further surveys of passengers, boat owners and rural communities and develop case studies to determine how local boat transport can be integrated with national and regional Inland Waterway Transport.

Local passenger transport, ecotourism and the transport of local products (agricultural, fisheries, garments) to markets and ports can create economic opportunities for rural communities. It may be important to consider incentives and mechanisms to encourage rural communities to utilise IWT for the transport of local goods and passengers.

SSO3: Identify and promote eco-tourist and river-related tourism areas along the Mekong River to create employment opportunities for rural communities.

The Kampong Cham-Kratie-Stung Treng stretch and the Tonle Sap are important areas for eco-tourism.

Long-Term Social Actions (2021-2040)

LSO1: Develop landing facilities for local passenger transport to improve safety and create further economic opportunities for rural IWT users.

Ten sites will be prioritised in Lao PDR and Cambodia on the Mekong mainstream based on the socio-economic survey of rural IWT users and river-related tourism sites.

Smaller boats could be used to transport passengers upstream or downstream from national ports to smaller landing facilities on the Mekong, thereby improving passenger safety and creating more opportunities for river-related tourism.

3.3.9 Capacity Building Actions

Short-Term Capacity Building Actions (2016-2020)

SCB1: Plan and implement national, bilateral and regional IWT education and training actions on navigation techniques and equipment (crew certification); navigation safety, including carriage and handling of dangerous goods; hydrodynamics, hydrography and waterway design and maintenance; IWT vessel design and construction; registration and inspection, and IWT Socio-Environmental Issues (EIAs, SIAs, Environmental Management Plans, sand mining, dredging Environmental Management Plans, etc.).

The “Training Plan to implement the Activities under the Navigation Programme” is part of the MRC Navigation Programme 2013-2015 (Outcome 5 Institutional Arrangements and Capacity Building).

3.3.10 Institutional Actions

Short-Term Institutional Actions (2016-2020)

SIN1: Establish a “Regional Mekong Navigation Center” in order to implement and coordinate the actions of the Regional Master Plan.

In order to centralise efforts for the implementation of the Master Plan, a “Regional Mekong Navigation Centre” should be established, that is directly connected to the National Mekong Committees and the Waterborne Transport related ministries and authorities.

SIN2: Set up “Mekong Navigation Data and Information Management Centers” in the four MRC Member Countries and study the need for and scope of bilateral and/or regional cooperation on Mekong Inland Waterway Transport data management and River Information Services.

Lack of data with respect to trade and traffic production and attraction, intra- and inter-regional trade and traffic flows and modal split is of concern. Without vital time-series of trade, port and transport statistics, O/D traffic flows and modal split, master planning and cost-benefit analyses of proposed infrastructure developments is an ineffective exercise.

Therefore, a “Regional Mekong Navigation Data and Information Management Centre” and a “River Information System” to support planning and policy formulation and to provide daily services on a regional level for safe and efficient passage by inland and sea-going vessels on the Mekong River System, should be considered.

SIN3: Set up “Mekong Navigation Promotion and Marketing Agencies” in the four MRC Member Countries and study the need for and scope of bilateral and/or regional cooperation on IWT promotion and marketing.

An essential pre-requisite of any move to support the IWT sector is to increase its visibility, and the recognition amongst policy makers and others of the sector’s importance in the economic development of the region and the lives of rural people. A public relations and promotion program should be developed aimed at policy makers, financing agencies and the media to portray the importance of Mekong Inland Waterway Transport.

SIN4: Study the need for and eventual scope of regional cooperation on hydrodynamic, sedimentological and navigation research.

There is almost no knowledge about the hydraulic, hydrodynamic and sedimentological behaviour of the Mekong River system. Moreover, in almost all study and research projects, foreign expertise is needed.

Due to the fact that this is a task for the whole Mekong River system, establishing a “Regional Hydraulic and Nautical Research Centre”, working in close co-operation with MRC, is proposed.

Long-Term Institutional Actions (2021-2040)

LIN1: Study the need for and scope of a regional “Mekong River Navigation Commission”

In the (likely) event of better interconnection between the various navigable stretches of the Mekong and of stronger integration between the economies of the riparian countries, it appears logical to reinforce the current institutional mechanisms and further harmonize the legal framework, which governs the management of the waterway. In a scenario of unhampered 500 DWT navigability between China and the sea there might be a case for the establishment of a single intergovernmental navigation commission, which is competent for the entire Mekong (at least for the territory of the current MRC Member States). Such an integrated commission should have as its task the gradual elaboration of a fully harmonized legal framework for navigation for all the countries concerned. Its establishment should be based on a thorough preparatory legal and institutional study.

LIN2: Set up a “Mekong water level monitoring and management body” in Lao PDR.

The project has to investigate under whose authority this water monitoring management body should operate, being responsible for the water management of the hydropower dams, the water levels in the impounded stretches throughout the year, the coordination and operating rules for each of the dams and the daily monitoring of the water levels.

LIN3: Depending on the results of the short-term study, establish two bilateral, or one regional, “Mekong Navigation Data and Information Management Centre” and “River Information Service”.

To support planning and policy formulation and to provide daily services on a regional level for safe and efficient passage by inland and sea-going vessels on the Mekong River system,

two bilateral (**scenario 1**) or one regional (**scenario 2**) “Mekong Navigation Data and Information Management Centre” and “River Information Service” should be set up.

LIN4: Depending on the results of the short-term study, establish two bilateral, or one regional, “Mekong River IWT Promotion and Marketing Agency”.

The project has to create one or two independent agencies that would actively pursue promotional and marketing activities in order to bring as much cargo as possible to the inland waterways, thus contributing to a more competitive position for Inland Waterway Transport.

LIN5: Depending on the results of the short-term study, establish a regional “Hydrodynamic and Nautical Research Centre”.

There is almost no knowledge about the hydraulic, hydrodynamic and sedimentological behaviour of the Mekong River system. Moreover, in almost all study and research projects, foreign expertise is needed. Due to the fact that this is a task for the whole Mekong River system, establishing a “Regional Hydraulic and Nautical Research Centre”, working in close co-operation with the MRC Secretariat, is proposed.

4 DIRECT IMPACTS

4.1 ENVIRONMENTAL ASPECTS

4.1.1 General Inland Waterway Transport Environmental Aspects

IWT is promoted as a safe and sustainable mode of transport due to lower CO₂ emissions per ton-km compared to road transport. To take advantage of more energy efficient transport, the environmental impacts of IWT must be effectively managed. Potential impacts are derived from the following activities:

- (1) Construction of navigation infrastructure e.g. ports and landing facilities;
- (2) Operational e.g. water pollution from oil spills, solid and liquid wastes, navigation accidents; and
- (3) Maintenance of the navigation channel and waterway conditions (e.g. dredging) and commercial extraction of sediment (e.g. sand mining).

Sustainable Development

Integrated planning has been promoted in Europe to ensure that sustainable development is achieved in the IWT sector. During the planning and design stages, development alternatives should be identified that minimise the adverse impacts on river basins.

The assessment of master planning or projects (ecological, economic and social aspects) should be carried out as a whole, rather than individually, considering all alternatives and taking into account integrated water resources management (IWRM) objectives (ICDPR 2010).

A Strategic Environment Assessment (SEA) ensures integrated planning by assessing environmental and sustainability opportunities and risks of strategic options (e.g. master plan or policy). A SEA or integrated planning process for the IWT sector should also incorporate:

- Environmental aspects such as water quality, environmental flow, sediment management, hydro morphology, biodiversity and climate change;
- Economic assessment of multi-modal transport i.e. road, rail and maritime shipping;
- Competing uses of the waterway (e.g. hydropower, flood protection, agriculture, industrial use, recreation, water supply); and
- Tranboundary management for IWT sector (e.g. shared maintenance of waterways, accident prevention, and emergency response).

The definition that SEA applies to policies and master plans and that EIA applies to specific projects is outdated. SEA is about the integration of environmental issues into development processes, while EIA is one of the instruments used to implement SEA guidelines or follow up actions.

Operational Aspects

Concerns of IWT operations include risks of water pollution from fuel and oil spillage, from accidents and from disposal of waste and wastewater from vessels, from activities such as vessel maintenance and from dangerous goods storage and handling in inland ports, terminals and landing facilities.

Air Emissions: IWT vessels can carry larger volumes of cargo relative to the extra fuel needed, resulting in lower emissions per ton-km compared to road transport. However, if improvements are

not made for vessels to use more energy efficient engines and cleaner fuels, it is estimated that in 2020 ships will emit more SO_x and NO_x than all other land transport in the EU combined.

Air emissions in developing countries may be even higher with old technology and limited regulations or public awareness to reduce sulphur content of marine fuels. An inventory of air emissions in the IWT sector must consider a wide range of sources, including:

- IWT vessels (cargo, tankers, passenger, ferries, cruise ships, fishing vessels, tugboats);
- Ports and terminals (vehicles, cargo handling equipment, cranes, and infrastructure)
- Dredging (vessels, trucks); and
- Vehicles (on-road trucks or other port vehicles).

Oil Spills and Operational Discharges: Oil spills in inland waters are highly likely to contaminate water supplies, impacting aquatic ecosystems and riparian populations. Fixed facilities and vessels are the major sources of oil spills in inland waters. The impacts of oil spills are highest for heavy fuels, followed by crude oil, and lower for light oils and gasoline.

Another threat to the environment is caused by the operational discharges of bilge oil, heavy oils and lubricants, as well as organic substances, mainly polycyclic aromatic hydrocarbons (PAH) and wastes.

Transport of Dangerous Goods (DG): A possible incident involving the transportation of DG can have severe consequences for the environment and people, including, but not limited to, the following:

- Increased pollution from transportation of petroleum products (e.g. cargo residues, spills and leakages, solid and liquid wastes);
- Risk of spillages and pollution from shipping accidents as well as ports and terminal operations;
- Loss or damage to habitats and species due to reduced water quality and pollution; and
- Impacts on human health as a result of pollution, fire and explosion

Waste Management: The operations of ports, terminals and vessels have the potential to generate both domestic and hazardous wastes. Direct dumping of untreated wastes into rivers can alter the aquatic habitats and harm fisheries, other aquatic organisms and riparian vegetation. Uncontrolled disposal of wastes can cause contamination to groundwater, while direct dumping to rivers can impact both surface and groundwater aquifers.

Construction of Infrastructure

The construction of inland port and landing facilities development can cause significant direct and indirect impacts on the environment and socio-economic characteristics of a river basin. The social and environmental impacts need to be considered during siting, planning construction and operational phases of the port. The baseline report will determine the legal framework for Environmental Impact Assessment (EIA) for new ports and waterway developments and whether Environmental Management Plans (EMP) need to be developed by port operators to manage impacts during operations.

Maintenance and Modification of Navigation Channels

Maintenance dredging of navigation channels can have significant impacts on the environment including: biodiversity loss, loss of livelihoods for those dependent on natural resources from the river, conflict with other uses (e.g. drainage, flood protection, water supply and tourism), hydrological changes (e.g. alteration of surface flows and drainage), destruction of floodplains, increased erosion, flooding risk and drainage of wetlands.

Water Quality: Dredging Activities pose a threat to the aquatic environment not only through the disposal of dredged material, but also through the dispersal of pollutants into surface waters during dredging. If the sediments are contaminated with industrial discharges there can be severe impacts on water quality.

Hydromorphological Impacts: Hydromorphological changes can have far-reaching impacts upstream and downstream from dredging activities, significantly affecting river system dynamics and interfering with the exchange of water and sediments between the mainstream river and its tributaries and flood plains. Maintaining the waterway can result in a stabilised uniform channel, lacking both natural in-stream structures and connectivity with floodplains, leading to ecosystem degradation and loss of species. In-stream structures include shoals, deep pools, reefs, rocks, rapids and sandbars. These provide critical habitats for fish and other aquatic organisms.

Assessment and Planning: The impacts discussed above must be incorporated into an EIA and planning for the modification and maintenance of waterways for IWT. It is important that new projects are assessed with consideration for the main natural functions of river systems, including the morphological processes (e.g. erosion, sediment transport and sedimentation), the maintenance of the hydrological balance (e.g. flood pulse), the maintenance of the sediment balance, the provision of habitat (ecosystem connectivity) and the maintenance of biological and chemical processes (nutrient cycles).

Sandmining: Dredging and sand mining would usually be considered as two separate issues, as modern waterway dredging strategies prohibit commercial extraction and require refilling of dredged material in the system. To date, the issue of sediment mining in the Mekong River channel has been a politically sensitive issue. In-channel extractions are contributing to a reduced sediment load in the Mekong Delta causing large-scale erosion.

4.1.2 Specific Mekong River Environmental Aspects in the four MRC Member Countries

The degree of human impact on water quality in the 17 Mekong and 5 Bassac water quality monitoring stations from 2007 to 2011 were mostly rated as “impacted” or “severely impacted”.

Water Quality Monitoring

In 2011 MRC conducted a **Multi-Media Monitoring** and Assessment Program (MMMAP) to assess the levels of persistent micro-pollutants in water, sediment and biota in the Mekong Basin. A total of 28 stations were included in the field survey. The findings relevant to navigation include the detection of phenol, oil and great and heavy metals (lead and mercury).

Phenol: Most phenol values in water were low, but levels at the Chiang Saen Pier, Chiang Khong, Vientiane, Pakxe and Phnom Penh Port exceeded the MRC Water Quality Criteria for the Protection of Aquatic Life.

Oil and grease (O&G): Elevated levels of O&G were detected in Luang Prabang, Vientiane and Phnom Penh port.

Heavy metals: Urban areas such as Luang Prabang, Vientiane and Phnom Penh show trends of increasing levels of lead and mercury.

Risk analysis of the transport of DG: The ‘MRC Risk Analysis of the Carriage Handling and Storage of Dangerous Goods’ identified pollution downstream due to high levels of petroleum and cargo transport. The table below describes these areas in relation to navigation activities.

Location of Monitoring Station	Potential pollution source
Lao PDR/China border	Commercial shipping between China and Thailand
Luang Prabang (Lao PDR)	Large volume of tourist-boat traffic
Vientiane (Lao PDR)	High population density
Kratie (Cambodia)	Medium volume of boat traffic for tourism and transport
Prek Kdam, Tonle Sap (Cambodia)	Boat traffic and some industrial activities
Neak Leang, Mekong (Cambodia)	Downstream of Phnom Penh
Tan Chau, Mekong (Viet Nam)	High population density in the Mekong Delta
Chau Doc, Bassac (Viet Nam)	High population density in the Mekong Delta

Contingency Planning: There are limited emergency response mechanisms along the waterways to respond to accidents or oil spills. In addition, solid and liquid waste management facilities along the Mekong River are limited. Emergency response plans do not involve consultation with local communities and several terminals are in densely populated areas.

The MRC Environment Programme (EP) is currently drafting 'Chapter 4: Water Quality Emergency Response and Management', developed to ensure timely and effective cooperation between Mekong Countries in response to water quality emergencies, and to minimise the extent and mitigate the negative effects on water quality in the Mekong River.

Climate Change

Regional: Analysis of daily data for historical and future climate data at six mainstream stations in the Mekong Basin indicates that the nature of change is consistent along the Mekong and can be summarized by four key changes:

- (1) **Increase in flood magnitude and volume:** Climate change will increase the flow during the flood season and the size of the flood peak. In terms of the percentage change in volume, a 25 percent increase in flow in Chiang Saen, approximately 20 percent between Vientiane and Pakxe, and 15 percent from Paxse to Kratie.
- (2) **Increase in flood duration:** Across all stations, climate change will increase the duration of the flood season.
- (3) **Shortening of transition seasons and onset of flooding:** Climate change will shorten the transition seasons at all stations and increase the rate of increase of discharge.
- (4) **Increase in dry season water levels:** Climate change will increase dry season flows in response to increases in dry season rainfall for most areas of the Mekong catchment.

Transport Sector in Viet Nam: The ADB undertook a climate change threat and vulnerability assessment of existing and future transport projects in Viet Nam due to concerns about the impacts of climate change on project bridges, approach roads and interconnecting roads. ADB (2014) reported that if mean sea level rises by one meter in the Mekong Delta, it is estimated that 11,000 km of roads could be submerged and that up to 695 km of national highways would be at risk of inundation.

To allow the future passage of 10,000 DWT vessels upstream to Phnom Penh port, the water levels for the navigation channel and floodplain will provide navigational clearance of 37.5m. However, climate change would increase the number of periods in the year when the full navigation clearance of 37.5 m would not be available at the Cao Lanh and Vam Cong bridges.

Hydropower Development: The changes in flow regime due to potential hydropower and climate change could result in higher flows in both wet and dry seasons, lower flow in the high-flow season and increased flow in the low-flow season (MRC 2011).

Moreover, the Mekong delta is vulnerable to projected reductions in sediment transport (of up to 75%) that could cause destabilisation of riverbanks from down cutting and bed erosion, potentially impacting port and waterway infrastructure.

Habitats, Species, Aquatic Life, Sensitive Areas

Ecosystem services: The Mekong Basin is one of the most productive and diverse river systems in the world and is particularly rich in migratory fish species. Ecosystem connectivity and natural flood pulses drive both its productivity and basin-wide fish migrations. The Mekong River aquatic and wetland ecosystems provide unique habitats for both aquatic and terrestrial plants and animals. Natural habitats provide distinct services to society. The connectivity that the river and its tributaries bring to the wetlands of the Mekong through the seasonal flooding caused by the flood pulse is critical for the productivity and diversity of the Mekong Basin fisheries.

Fisheries and natural resources: Maintaining and improving the natural productivity of the river basin is essential to both the local populations and the national economies of the countries within the basin. The people of the Mekong have the highest per capita consumption of fish in the world. Of the Mekong’s fish species, nearly 200 are migratory “white” fish, some of them travelling long distances from the Tonle Sap or the Delta up the Khone Falls and further up the Mekong in Lao PDR and Thailand.

The rural poor are heavily dependent upon ecosystem services, as livelihoods are derived from activities relating to agriculture, fisheries, livestock and non-timber forest products. Threats to the provision of these ecosystem services, such as climate change and major infrastructure projects, can have large development impacts.

Ecoregions: Limited research exists on the impacts of modifications of waterway channels on ecosystems, fisheries and livelihoods in the Mekong River Basin. Planned developments for port construction, dredging and reef removal in the upper and lower part of the Mekong Basin need to be assessed against the significance of the ecological areas. There are more than 114 officially designated protected areas in the Mekong Basin and also more than 100 important wetland sites, other sites including fish conservation zones, community managed forests and biosphere reserves.

The specific eco-regions, protected areas, important wetlands and critical habitats sites need to be incorporated into EIA and planning. In addition, it will be important to determine further ecologically sensitive areas, protected areas and ecotourism sites along the Mekong River.

Social Impact Monitoring and Vulnerability Assessment (SIMVA): The SIMVA was carried out to provide data on the number of people who rely on the Mekong’s natural resources for livelihoods and their vulnerability to changes. More than 29.6 million people are estimated to live within 15km of the Mekong mainstream, defined as the Mekong corridor. The table below shows the number of people living in the Mekong corridor:

Population living within 15 km of the Mekong mainstream

Country	Corridor population	Percentage living in the corridor	Percentage of corridor population
Cambodia	9,895,525	70	33
Lao PDR	3,430,040	53	12
Thailand	2,499,395	4	8
Viet Nam	13,851,600	16	47
All Countries	29,676,560		100

Based on data from this study, it can be concluded that the most vulnerable populations due to declining resources are those living within 5 km of the Mekong particularly in the fishing zone of the

Tonle Sap, Cambodia, where land is limited and alternative occupations are rare and in Siphandone, Lao PDR, where there is a high level of dependence on natural resources, especially fish, for food and income.

Conclusions

It is important that proposed IWT projects are assessed with consideration of the main natural functions of river systems in specific waterway sections as the environmental and socio-economic characteristics are unique throughout the Mekong Basin. The eco-regions are important to use as a first step in preliminary assessments (e.g. initial environmental impact assessment or examination) to determine the existing environmental degradation, biodiversity and protected areas in relation to the specific location of existing and planned IWT projects/activities in specific stretches. Further assessment would be required to consider the critical ecosystems, fisheries conservation zones, water quality, ecological status and socio-economic conditions. The eco-regions could also be used to determine zones or restrictions for port/vessel activities, transport of dangerous goods and dredging/sand mining activities.

The SIMVA provides baseline data on socio-economic conditions of people living in the Mekong corridor and their dependence on water resources. As identified in the SIMVA, the 29.6 million people living in the Mekong corridor are important to consider for navigation activities, to ensure that all rural communities have access to IWT.

Water quality pollution is increasing in the Lower Mekong Basin (LMB); high levels of phenol, oil and grease and heavy metals (lead and mercury) were detected by MMAP and WQMN.

Elevated values of phenol indicate possible leakage of petroleum products close to cities and navigation routes. The elevated levels of O&G detected in Luang Prabang, Vientiane and Phnom Penh port could be due to navigation/port activities and rubbish, or from the high-density communities living in these areas. The concentration of heavy metals in bottom sediment along the Mekong River may increase the significance of the environmental impacts of dredging. High levels of heavy metals including copper, zinc, mercury and cadmium have been reported in the Mekong Delta, Viet Nam. Further water quality monitoring is required to ensure that the operational impacts of IWT are effectively monitored and effective pollution control plans are implemented.

Climate change threat and vulnerability assessments in the Mekong Delta have found that transport infrastructure is under threat from rising sea levels and increased flooding. In the future these assessments need to be applied to ports, terminal and IWT activities. The climate change predictions in the Mekong Basin suggest an increase in annual mean flow of 4-13 percent during the wet season and 10-30 percent during the dry season. The increased flow in the Mekong River would boost water availability in the dry season for navigation, but it would also increase the risk of flooding in the wet season.

Climate change could have positive impacts by improving navigability in the wet and dry season. Increases in frequency and duration of rainfall, sea level rise, and increasing river flow would result in elevation of river water levels. Therefore, climate change threat and vulnerability assessments should consider the impacts of flooding and rising sea levels on existing and planned IWT infrastructure (e.g. ports, landing facilities and terminals) and navigation clearance (e.g. bridges and power lines).

IWT should be incorporated in green/sustainable transport and climate mitigation plans to reduce carbon emissions in the transport sector. Vessels can reduce CO₂ and GHG emissions, but improvements need to be made in the energy efficiency of IWT vessels and port/terminal operations.

4.1.3 Overview of National plans

Environmental Protection and Environmental Impact Assessment

LAO PDR

The Environmental Protection Law 2013 in Lao PDR defines the principles, regulations and measures related to environmental management, including the monitoring protection, control, preservation and rehabilitation of the natural environment. This law includes two articles on the impact on social and natural environment with the assessment procedures for Initial Environment Examination (IEE), Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA) and Social and Natural Environment Impact Assessment (SNIA).

THAILAND

The Thailand National Environmental Quality Act (NEQA) 1992 outlines requirements to prepare an EIA report for different project types and sizes. For the IWT and shipping sectors EIAs are required and must be prepared for the construction of new ports and navigation infrastructure along the Mekong River. The Thailand Marine Department (MD) and Ministry of Transport (MOT) reported that an EIA is required before making a decision to build transport projects, including the construction of inland ports and terminals. Ports/terminals, shipping companies and dredging/sand mining operators are required to develop EMPs. The main environmental issues reported for the IWT sector on the Mekong River are water pollution and soil degradation.

CAMBODIA

The Ministry of Environment (MOE), MPWT and Ministry of Water Resources and Meteorology (MOWRAM) reported that an EIA study and report is required for the construction of new ports and landing facilities, channel dredging and bank protection works. All public and private investment/development projects must submit an IEIA and full EIA report to the MOE. Specific legislation, sub-decrees or prakas (guidelines) for the IWT sector have not been developed. However, existing environmental legislation can be applied to the operation of cargo ports, passenger ports, ferries and inland vessels.

The MOE reported that the main environmental impacts from IWT are the incorrect disposal of solid and liquid waste and water quality emergencies (e.g. oil spills and accidents).

The Cambodian government is currently advancing further discussion on a new EIA law, following public consultation in December 2014. The principles of the draft law promote public participation and integrating social impacts into the EIA process, including a health impact assessment for people living in or surrounding the project area.

VIET NAM

For the development of inland ports, the decision on SEA, EIA and environmental protection commitment (*Decree No. 29/2011/ND-CP*) outlines the projects that are subject to EIA:

- Inland port that can receive ships of more than 1000 DWT need to prepare EIA; and
- Inland ports that can receive ships of less than 1000 DWT need to register an environmental protection commitment (EPC).

The Ministry of Natural Resources and Environment (MONRE) and Ministry of Transport (MOT) are both responsible for monitoring IWT operations. The appraisal of an EIA is required by MONRE for projects that may have serious impacts or that are being undertaken in more than one province. MOT will undertake the appraisal of an EIA when the investment in the project is made by MOT.

Local authorities shall assess EIAs of investments in their area if they are considered low risk and have only been undertaken in one province.

MONRE reported that EIA legislation requires private transport enterprises and port/terminal operators to develop EMPs, however, the inspection and supervision of environmental functions is not implemented or enforced. The capacity of port authorities, environmental and local authorities for inspecting, monitoring and handling violations related to environmental protection is limited due to a lack of technical equipment, operating funds and the awareness, skills and knowledge of port and vessel staff on environmental protection.

TRANSBOUNDARY EIA

The MRC, in consultation with Member Countries, has been preparing “Technical Guidance for Conducting and Considering Trans-boundary Environmental Impact Assessment (TbEIA)” process for proposed development projects/activities in connection with the national EIA process. The TbEIA guides when and how two or more Member Countries should conduct a joint TbEIA study in order reach a common understanding of any potential impacts of a development project/activity.

Water Quality Monitoring

LAO PDR

Chapter 2 of the Environment Protection Law 2013 relates to pollution control, air, soil, water and disturbance such as noise, light, odour, vibration and heat. Article 17 includes environmental prevention against chemical leakages due to accidents and limitation of impacts caused by construction. This can be applied to the construction of ports/landing facilities and also the operational impacts of IWT. The water quality parameters and guidelines are outlined in the National Environmental Quality Standard No: 2734/PMO-WREA, December 2009, which includes drinking water quality, groundwater quality and surface water quality standards.

In Lao PDR, monitoring of water quality is not undertaken for specific locations in relation to navigation activities and ports.

THAILAND

Under the NEQA, the National Environment Board prescribes the following environmental quality standards:

- Water quality standards for river, canal, swamp, marsh, lake, reservoir and other public inland water sources according to their use and classifications in each river basin or water catchment;
- Water quality standards for coastal and estuarine water areas;
- Groundwater quality standards;
- Atmospheric ambient air standards;
- Ambient standards for noise and vibration; and
- Environmental quality standards for other matters.

The Pollution Control Department (PCD) under MONRE is responsible for water quality and management, hazardous materials and pollution control.

CAMBODIA

MOWRAM reported that water quality monitoring is undertaken in surrounding ports/terminals and IWT operations. The water sampling stations include: Phnom Penh Port, Bak Prea, Kompong Luong, Neak Luong and Phnom Krom.

A specific water quality standard has not been developed to measure the potential impacts from IWT. However, several national standards from the Sub-Decree on Water Pollution Control 1999 can be applied. MOWRAM and MOE do not specifically monitor or report water quality in the navigation sector.

VIET NAM

The function and organisational structure of the Department of Water Resource Management (DWR) is issued by MONRE (*Decision No. 1686QD-BTNMT September 5, 2013*). The DWR is responsible for water quantity (flow) and does not undertake water quality monitoring for ports/terminals; this is done by the Environmental Management Agency. Water quality issues can be discussed with the Environmental Management Agency and the National Hydrometeorology Service. The implementation of environmental monitoring responsibilities and data management is detailed further under the 'Law on Environmental Protection 2014'. This new law will take effect from 2015 and the government is preparing regulations to support implementation. Port/ship operators must also comply with standards for environment and water quality.

Pollution Control and Waste Management

LAO PDR

Chapter 3 (toxic, chemical control and waste disposal) and Chapter 4 (environmental certification and permission) of the Environment Protection Law 2013 will ensure that investments comply with the national environmental quality standards and the national pollution control standards. There is currently limited pollution control and contingency planning for the existing ports and IWT activities in Lao PDR.

THAILAND

The PCD is responsible for water quality and management, hazardous materials and pollution control. Section 78 of the NEQA 1992 relates to water pollution from the collection, transport and disposal of garbage/solid wastes and the discharge of oil and the dumping of wastes from sea-going vessels, tankers and other types of vessels. The main issue with establishing systems to monitor and respond to water pollution incidents is the implementation of water quality emergency plans at the regional and national level.

CAMBODIA

The MOE is responsible for monitoring the existing IWT operations for pollution control and the management of solid and liquid wastes, including ballast water discharge. There are no adequate waste reception facilities or systems to monitor and respond to water pollution incidents along the Mekong River.

It is the responsibility of the port and terminal operator to arrange for the collection of wastes.

VIET NAM

Small oil spills during IWT activities are reportedly common, but only a few ports have adequate equipment for collecting oil, diesel and other liquid wastes. The handling of oil spills is difficult as there is limited funding and investment, limited training, out of date technology and low

effectiveness of treating oil spills in fast flowing rivers. There are no facilities to receive vessel wastes on shore and ships are not equipped with adequate waste collection systems.

According to 2009 statistics from a survey of 24 port companies operating in the southern region of Viet Nam, 66 per cent reported managing solid and hazardous waste in accordance with national regulations. However, only 30 per cent of those surveyed had invested in environmental protection and wastewater treatment systems.

Article 16 of 'Decision 02/2013/ND-CP dated Jan 14th 2013' requires all port operators (maritime, military and inland) to develop emergency and oil spill response plans. Port authorities are responsible for coordinating local monitoring and evaluating the effectiveness of the response plans.

The 'Law on Environmental Protection 2014' outlines actions against causing serious environmental pollution from activities such as discharges of wastewater, exhaust gases, dust, solid wastes, noise, vibration, and other pollutants. MONRE is responsible for enforcing these laws.

The same law requires ministries/departments to report environmental aspects to MONRE, including condition reports, environmental complaints, compliance with regulations, list of entities causing pollution, investigations and environmental protection plans and solutions.

Dredging and Sand Mining Operations

LAO PDR

The responsibility for dredging the navigation channel and licensing sand mining operators requires further investigation. It could not be determined from laws or guidelines if private and public operators are required to prepare an EIA or EMP for dredging or sand mining activities (Decree No 7737/MPWT, dated 8/08/2010 and 467/MPWT.WD, dated 15/01/2013 on the responsibility for the dredging of the navigation channel and licensing for sand mining operators only in Lao language).

THAILAND

Under the NEQA, activities that involve dredging of more than 100,000 m³ are considered as serious impacts to the environment. It was reported that MONRE is responsible for monitoring dredging and sand mining operations in Thailand. The Thailand Marine Department (MD) is responsible for maintaining the navigation channel; there are no specific licensing or environmental requirements for dredging and sand mining in the Mekong River.

CAMBODIA

The process for licensing and managing the environmental impacts of dredging the navigation channel and sand mining operations is complex. The MPWT is responsible for dredging the navigation channel and waterway conditions and the Ministry of Industry, Mines and Energy (MIME) for sand mining.

The MPWT is preparing a technical guideline on managing the environmental impacts of navigation dredging that will require private-sector dredging of more than 5,000 m³ to submit an EIA to MOE and develop an EMP. Due to concerns around sand mining, the government recently established the Committee on Sand Resources Management with relevant ministries and institutions (dated 20th March 2015) and issued an Inter-Ministries Prakas (MIME-MOE) on EIAs for all kind of sand mining activities (dated 24th March 2015).

VIET NAM

The dredging extraction of sand and gravel is widespread along the waterways and is becoming increasingly complex, affecting the navigation channel and also the safety of IWT operations. The government requires dredging and sand mining operators to comply with an EIA (Decree No.

29/2011/ND-CP dated 18 April 2011) if the volume is higher than 50,000 m³ or the area is higher than 10,000 m². If the volume is below 50,000 m³ and the dredging area is less than 10,000 m², then an EPC is required.

To strengthen the management of sand mining, the government has issued specific instructions for the survey, transportation and extraction of gravel and sand from the riverbed (Directive No.29/2008/CT-TTg). Under this directive the Provincial People's Committee consult with other ministries to restrict illegal sand mining activities. Meanwhile MONRE coordinates with provincial People's Committees to raise local awareness on the relevant laws, and MOT reviews and approves the dredging plans and ensures that the operator registers the volume of sand and gravel to be extracted. VIWA or the Department of Transportation (DOT) evaluate the maintenance of inland waterway plans for dredging, and then submit them to MOT for approval (Circular No. 17/2013 /TT-BGTVt dated 05 Aug. 2013 of MOT).

Climate Change

LAO PDR

In 2010 the National Strategy on Climate Change of the Lao PDR was adopted. In June 2011, the Department of Disaster Management and Climate Change (DDMCC) under the MONRE was formed. The main duties of the DDMCC are:

- To research, disseminate, and implement directions, policies, resolutions, orders, strategies, laws and legislations of the government on national disaster and climate change; and
- To research and apply directions, policies, strategy plans, orders, agreements, notifications, and other legislation of MONRE to become work plans, detailed projects and implement these in an effective way.

In the meantime, the '*National Climate Change Adaptation Action Plan for 2013-2020*' is being implemented with the followings priority activities:

- Strengthening institutional and human resource capacity on climate change;
- Enhancement of adaptive capacity for coping with climate change;
- Climate change mitigation through reduction of GHG emissions; and
- Strengthening education and public awareness on climate change.

THAILAND

Thailand Climate Change Master Plan is a framework of integrated policies and action plans. Its purpose is to support climate change preparedness initiatives so that they are in line with Thailand's economic and socio-cultural contexts as well as economic development.

The Safety and Planning Bureau of the Transport and Traffic Policy and Planning Office has developed the "Master Plan for Sustainable Transport and Climate Change Mitigation". The master plans enable the integration of information among stakeholders, build up capacity and develop infrastructure. It could not be determined whether any IWT projects are under the Master Plan for Sustainable Transport and Climate Mitigation.

CAMBODIA

Cambodia has developed and documented action plans to respond to climate change, including:

- Cambodia Climate Change Strategic Plan 2014-2023;
- National Adaptation Programme of Action to Climate Change (NAPA);

- Sectoral action plans (e.g. MOWRAM, Ministry of Agriculture, Forestry and Fisheries, MPWT, National Committee of Disaster Management and other line agencies); and
- National Strategic Development Plan (NSDP) 2014 – 2018.

The climate change strategic and sector plans are being developed for transport infrastructure including roads, bridges, and maritime and inland ports.

VIET NAM

In recent years, the weather and hydrology in the Mekong Delta has been reported as more variable. Reduced rainfall, low flow during the dry season and sediment deposition in the waterway channel has reduced the depth available for navigation. Inland ports and navigation infrastructure in the Mekong Delta are extremely vulnerable to climate change.

According to the National Climate Change Scenarios 2012 the following is predicted for the low, medium and high emissions scenarios in Viet Nam: A sea level rise of 54 to 72 cm in the low emission scenario (B1), a rise of 62 to 82 cm in the medium emissions scenario (B2), and a sea level rise of 85 to 105 cm in the high emission scenario (A1).

Climate change is predicted to adversely affect transportation infrastructure in the Mekong Delta. Rising sea levels may impact on low lying inland ports and sea ports and, combined with increased water levels, affect navigation clearance under bridges and power lines crossing over the river. Predicted heavy rains and flooding may lead to increased erosion, damage to port infrastructure, road works and railway.

The government has implemented the National Program to Respond to Climate Change (Decision No. 158/2008/QĐ-TTg dated 12/02/2008) and MOT has developed specific adaptation and mitigation plans (Decision No 199/QĐ-BGTVT dated 26 Jan 2011) for transport infrastructure including roads, bridges, and maritime and inland ports.

Coordination

LAO PDR

Further analysis is required to determine the coordination mechanisms between MONRE and the Department of Waterways to ensure that the social and environmental impacts of future IWT development is effectively managed.

THAILAND

Coordination mechanisms exist between MD, MOT and ONEP to manage the environmental and social impacts of IWT.

CAMBODIA

The Department of Planning in the MPWT is responsible for managing social and environmental impacts and for coordinating with MOE. The MPWT reported that environmental and social issues are addressed in project planning and implementation through education/awareness programs and by establishing authority and teams for monitoring and assessing potential impacts.

VIET NAM

MOT is required to coordinate with MONRE and relevant ministries to implement and monitor laws on environmental protection for construction of traffic infrastructure and transport activities (Decree No. 107/2012/ND-CP). The MOT reported that good coordination exists between MONRE and the Ministry of Labor, Invalids and Social Affairs (MOLISA).

VIWA does not have any inspectors and relies on MONRE to inspect ports and terminals. More coordination between VIWA, MONRE and port authorities would improve this process.

Regional Plans

Waterway Improvement for Port Logistics Development in Cambodia (KOICA):

The Korea International Cooperation Agency (KOICA) is developing a feasibility study for waterway improvement from Phnom Penh to Kratie including: electronic navigation chart, soil investigation report, environmental review system, waterway improvement plan and dredging and disposal plan. The KOICA ‘environmental review system’ should fully comply with Cambodia’s Environmental Protection Law by ensuring that EIA and EMPs are completed for each individual port and waterway improvement.

The location of dredging and disposal of dredging wastes would need to consider the biodiversity, critical habitats (e.g. fish spawning and migration, floodplains, riparian zones), and livelihoods in specific sections between Phnom Penh and Kratie. The hydromorphological impacts of dredging would most likely have the most significant impact on the Mekong River and would need to be carefully assessed.

The 2nd phase of the project will see the port development plan for Tonle Bet port, Kilometer No. 6 port and Phnom Penh New Port (Phase 3). Grain ports are also planned in Kompong Chhnang and Kratie, up to 3,000 DWT capacity. Each of these ports would require a separate EIA to be conducted and approved prior to construction, in line with environmental protection laws in Cambodia.

The “**Master Plan for Waterborne Transport on the Mekong River System in Cambodia**”, 2006 had the following environmental actions:

Environmental actions	Progress
A26: Adoption of Dredging Environmental Management Procedure (DEMP)	Start Task Force Prepare draft Prakas
B19: Implementation of a Waste Management Plan for ships	Final review of the draft Prakas + guidelines (MPWT, PPAP, MOE, KAMSAB)
B20: Approval of the Navigation Spill Contingency Plan for the Mekong and its tributaries	Adaptation and actualisation existing draft NSCP (2005) to Mekong and tributaries
B21: Designation of key personnel for the implementation of the Navigation Spill Contingency Plan	Meeting with Cambodian National Committee for Disaster Management (NCDM) on responsibilities
B22: Arrangements with third parties for response to navigation spills	Draft project proposal
B23: Specific actions for navigation spill response preparedness	
C3: Strategic Environmental Impact Assessment (SEIA) for the Master Plan for Waterborne Transport on the Mekong River in Cambodia	MPWT- MOE: If additional procedures are necessary, a project proposal should be prepared for C5 Implementation of an “Environmental Safeguarding Methodology”
C4: Establishment of an Environment Focal Point (EFP) in the MPWT	
C5: Implementation of the environmental safeguarding methodology for the Master Plan	

Development Plan on International Navigation on the Lancang-Mekong River 2014-2025 (Joint Committee on Coordination of Commercial Navigation - JCCCN):

The development plan proposed on the Lancang-Mekong will improve the navigation channel from China-Myanmar to Luang Prabang in Lao PDR to allow navigation for vessels up to 500 DWT. Ports will also be constructed and built in Guanlei, Xiengkok, Wan Pong, Pakbeng and Luang Prabang Ports.

The Lancang-Mekong Development Plan (2014-2025) is sure to draw criticism from civil society and potentially downstream countries due to the magnitude of environmental and social impacts. The development plan outlines the proposed 'Environmental Impact and Protective Measures'. However, these measures fail to adequately consider:

- The impacts and costs of dredging, reef blasting and maintaining the waterway channel;
- Assessment of eco-regions and critical habitats for fish and aquatic species;
- The hydromorphological impacts from reef blasting, dredging and other activities on the river and its flood plains;
- Environmental and social impacts of construction of ports and landing facilities and increased shipping and waterway use; and
- Future volumes of cargo and passenger transport.

An EIA will be conducted as part of Phase 1. However it could not be determined to what level the EIAs would be conducted, whether the EIA would cover the whole project or be separated for specific ports and waterway improvement sections. Specific EIAs should be undertaken for each of the ports constructed and for different sections of waterway improvement. The JCCCN should also consider TbEIAs to ensure that trans-boundary and cumulative impacts are considered.

Transportation Development Plan for the Mekong Delta in 2020:

Section V of the '*Transportation Development Plan for the Mekong Delta in Viet Nam 2020*' includes a detailed section on SEA. The following issues were reported in the current status of the environment in the Mekong Delta:

- (1) Increasing trends in air pollution and noise pollution caused by transportation activities;
- (2) Increasing trends of water pollution from port and shipping activities in the Mekong Delta;
- (3) Port areas, channel, river and coastal areas are contaminated by oil and heavy metals; and
- (4) Solid waste and hazardous waste generated from port activities is increasing.

Other environmental pressures in the Mekong Delta are from the overuse of fertilizers in agriculture, incorrect disposal of domestic wastes, flooding, rising sea levels, salinity and riverbank erosion. Twenty percent of the population in the Mekong Delta is living below the poverty line due to a lack of employment opportunities and income. The educational level is lower and unemployment rate higher in the Mekong Delta than the national average in Viet Nam. Therefore, investing in human resources and education is critical.

The development priorities of the 2020 plan are to:

- Balance economic development with social development, poverty alleviation, job creation and reducing disparities between regions and between ethnic minorities; and
- Balance economic development with environmental protection to achieve sustainable development.

The development planning for terminals, ports and shipping channels will consider the impacts of oil spills and dredging, and improving ambient air quality and reducing greenhouse gas emissions. Inland waterway ports must have water collection systems and adequate wastewater treatment to protect

water quality. To manage dredging activities, control plans will be developed to manage sediment during construction activities and to consider longer-term impacts to bank instability and erosion.

Conclusions

There is an appropriate legal framework in all of the Member Countries to ensure that environmental and social assessment, management and monitoring is undertaken for existing and future IWT projects. The type of environmental and social assessment is determined by the size and type of the project and activities specified under environmental protection and EIA laws.

The environmental assessment framework can be applied to port developments, dredging, waterway improvements and increased waterway use. The main issues reported were the limited capacity of line agencies to monitor and enforce law and regulations for environmental protection in the inland navigation sector. The following measures are required to improve environmental and social assessment in the Mekong Basin:

- Enhance coordination between ministry/departments of transport, environment and water resources and the private sector to manage and monitor the impacts of IWT;
- Promote education and awareness campaigns for the private sector and local populations of the consequences of waste disposal in the river and the dangers of pollution for the environment;
- Develop environmental assessment guidelines for the IWT sector to improve understanding of assessing and managing social and environmental impacts. This would include developing technical guidance and capacity building for environmental assessment and monitoring of future IWT planning and project/activities in the Mekong Basin.

An SEA and integrated planning approach should be applied to both the 'Lancang-Mekong Development Plan (2014-2015)' and the 'Waterway Improvement for Port Logistics Development in Cambodia'. A SEA or CIA would allow a program of EIA, EMP and monitoring to be developed to ensure the cumulative impacts of both plans are fully considered. The KOICA 'environmental review system' should fully comply with Cambodian EIA environmental protection and ensure that EIAs are conducted for port construction and dredging. Specific EIAs should be undertaken for each of the ports constructed and for different sections of the waterway improvement in the Lancang-Mekong Plan, in order to comply with Thailand and Lao PDR environmental protection laws.

4.2 SOCIAL ASPECTS - OPPORTUNITIES FOR RURAL INLAND WATERWAY TRANSPORT

4.2.1 Overview

With such a large proportion of rural communities living within 15 km of the Mekong River and its tributaries, IWT is a popular mode of short and medium distance transport and has increased people's access to social services and markets, as well as created employment opportunities.

The future development of IWT in the Mekong region is essential to achieving the goals of poverty reduction and provides the following opportunities:

- Economic: agricultural and industrial production, markets and tourism; and
- Administrative: access to education, health, cultural and social services.

4.2.2 Approach

On-the-spot surveys of local waterway users at passenger ports in order to determine the current situation and how access to IWT can be improved. The local questionnaires were developed with

Member Countries to identify and provide better understanding of waterway users in the Mekong River Basin.

4.2.3 Lao PDR

Survey of Local IWT Users

Participants were interviewed at the following small cargo and passenger ports in Lao PDR: Huay Xay port, Pak Tha port, Pak Beng port, Luang Prabang port, Watnong port, Ban Donmai port and Nakasang port (Pakxe province). A total of 91 participants were interviewed, including 54 passengers and 37 non-passengers.

The passengers all indicated that a ‘passenger boat’ was the type of boat they were travelling on. All 37 non-passengers surveyed were owner/operators of the boats, 23 percent of these were female. The types of boats owned were 21 small cargo boats, 10 river cruises and six private boats. Forty-six percent had been operating their boats for 6 - 10 years and 27 percent for 0 - 5 years. Only 8 percent had been operating their boats for more than 15 years.

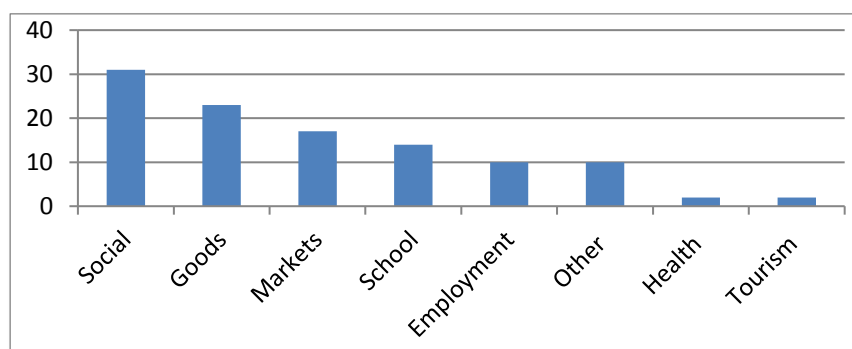
Frequency and Distance

Twenty percent of passengers used transport monthly and weekly, 18.5 percent daily and 16.7 percent used it 3-4 times per week. Participants were asked to indicate if they used IWT for short (0 - 30 minutes), medium (30 minute to three hours) or long (more than three hours) trips. Twenty-six passengers used it for long trips, 25 for medium and only 3 used it for short trips. All passengers reported that IWT is cheaper than other modes of transport.

With regards to the boat owners, 45.9 percent use their boats on a monthly basis and 29.7 percent on a daily basis. Fifty-four percent of owners use their boats for long trips (more than three hours), 29.7 percent for medium trips (30 minutes to three hours) and 16.2 percent for short trips (0 - 30 minutes). The boats undertaking short trips were involved in cross border transport from Huay Xay to Chiang Khong (Thailand), running multiple trips in a day.

Use of IWT

The passengers and boat owners were asked what they used IWT for. More than one answer could be provided for this question. The results for passengers is shown in the adjacent figure.

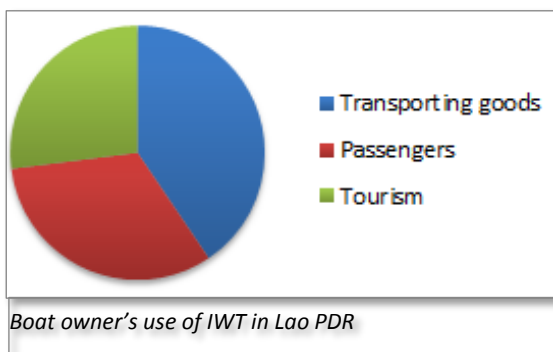


Passanger uses of IWT in Lao PDR

Fifty seven percent of passengers indicated that they used IWT for ‘social’ reasons, for example

passengers reported travelling from Huay Xay and Pak Beng to visit family and friends in Luang Prabang. A number of passengers used IWT for economic reasons. Forty three percent used IWT to transport goods and 31.5 percent for accessing markets, while and 18.5 percent used it for employment. Nearly twenty-six percent used IWT to access schools.

Boat owners were asked to report what they use their boats for as shown in the adjacent figure.



Nearly forty-one percent used their boats for transporting goods, 32.4 percent for passenger transport and 27 percent for tourism. A number of passengers use boats to go from village to village or from one province to another e.g. Huay Xay to Pak Beng to Luang Prabang.

Transport of Goods

Both passengers and boats owners reported using IWT for transporting goods. From the data it was evident that some passengers that selected 'markets' and 'social' also used IWT for transporting goods. Fruit/vegetables (53.7 percent) and rice (46.3 percent) were the main goods transported by passengers on local boats.

Boat owners were also asked to report what types of goods they carried. Based on the responses it is clear that passenger boats are also used to transport goods. Construction materials (e.g. cement, steel, wood) and agricultural products (e.g. rice, fruit/vegetables and livestock) were the most common materials transported. None of the boat operators in Lao PDR reported using boats for transporting fuel, chemicals or fertilisers. According to the Department of Public Works and Transport, in Luang Prabang province there were 49 boats registered to transport goods in 2014. A total of 63,709 tonnes of goods were transported in 2014, the main goods transported were rice, construction materials and livestock (e.g. buffalo, chicken, pig).

Passenger Transport

For the boats carrying passengers, 59.5 percent were used for local transport, 43.2 percent for international tourism (foreigners) and 16.2 percent for cross-border transport from Huay Xay to Chiang Khong. The questionnaires indicated that passenger boats are used to carry both local people and international tourists.

At Huay Xay port the passengers indicated that they were travelling along the Mekong downstream to Pak Beng and Luang Prabang. The Pak Beng Port Association recorded a total of 75,645 passengers in 2014. Most of these passengers were international tourists. The passenger boats in Pak Beng also provide access to markets in Luang Prabang to local passengers who own guesthouses in Pak Beng.

In the Southern province of Pakxe, the Nakasang port provides access to the main Don Khone and Don Det islands. The 4,000 islands (*Siphandon*) is a popular destination for international tourists. Local people living on Don Khone, Don Det or other islands use passenger boats to access Nakasang province for schools, health centers and markets. Cargo vessels are used to transport food, fuel and other items to guest houses and restaurants.

The Boat Association at Nakasang port reported that there are 148 boats registered, including 120 small boats with carrying capacity of less than 19 persons and 28 larger boats for carrying up to 50 persons. In 2014, 26,333 foreigners and 5,475 local passengers were transported.

Access to national and cross-border ports

Fifty percent of passengers indicated that local IWT provides them with access to other local ports, 42 percent to larger national passenger ports and 7.4 percent to cross-border transport. Nearly thirty-eight percent of the boat owners reported that IWT provides access to national cargo ports (e.g. Huay Xay, Pak Beng and Luang Prabang), 32.4 percent reported access to the cross border port at Chiang Khong, Thailand and 16.2 percent indicated that they only had access to local ports.

Pak Tha is a good example of a local passenger and cargo port linking to larger national/cross-border ports. Local passengers at Pak Tha port and local boat operators reported using IWT to access Huay Xay and then cross-border to Chiang Khong (Thailand). The Pak Tha boat association reported that in 2014 there were 6,586 round trips made from Pak Tha port to Huay Xay carrying a total of 29,421 local passengers and 32,002 foreigners.

The Huay Xay Port Association reported that there are 22 small cargo vessels registered to transport goods from Huay Xay port to Chiang Khong in Thailand. Lao people travel by boat from Huay Xay to the market in Chiang Khong to buy fruit/vegetables and construction materials. The type and amount of goods transported through Pak Tha port in 2014 is shown in the Table below:

Goods	Amount
Corn	32 tonnes
Rice	86 tonnes
Motorcycles	228
Construction materials	2,468 tonnes
Fruit/vegetables	54 tonnes
Beer	7,500 boxes

Source: Public Works and Transport Office in Pak Tha District

Issues and opportunities for improvement

The passenger and boat owners were asked to provide further details on why they use IWT, what the main issues are and how IWT can be improved. The participants reported that the main reasons they use IWT are:

- IWT is cheaper and more comfortable than transport by car;
- Passengers enjoy travelling by boat due to the environment; and
- Safer and less accidents than road transport.

The participants reported that IWT could be improved by:

- Providing more safety, emergency response and communications equipment for passenger vessels;
- Improving the legal system to ensure sustainable development of navigation activities;
- Promoting IWT and water-related tourism for international and local tourists;
- Enhancing the existing port and warehouse facilities;
- Building capacity of captains, crewmembers and port workers;
- Considering financial incentives and reducing tax to promote IWT to transport operators;
- Conducting safety inspections of boats e.g. enforcing the restrictions on number of passengers;
- Improving the navigation channel, installing more aids to navigation and providing more waterway information for boats and port operators; and
- Improving coordination between provincial Departments of Public Works and Transport, Boat Associations and Port Authorities.

4.2.4 Thailand

National

Thailand has been an active partner in GMS cooperation, particularly in transport, transport and trade facilitation, energy, agriculture, environment, human resource development, tourism, telecommunications, and trade and investment. Unfortunately, Thailand is mostly focusing on the regional integration of road and rail networks.

The GMS Core Environment Program and Biodiversity Conservation Corridor Initiative, which aims to promote environmentally sound and sustainable GMS development, is being implemented through the GMS Environment Operations Center, based in Bangkok.

Survey of Local IWT Users

IWT is really important for economic development and poverty alleviation in Thailand, as it stimulates domestic and international trade along the Mekong River. In Thailand, there are no studies that show the contribution of IWT or transport in terms of employment or economic benefits at the national level. There are also no studies that determine the significance of IWT for rural communities in terms of accessing services such as school and health, or accessing employment and markets.

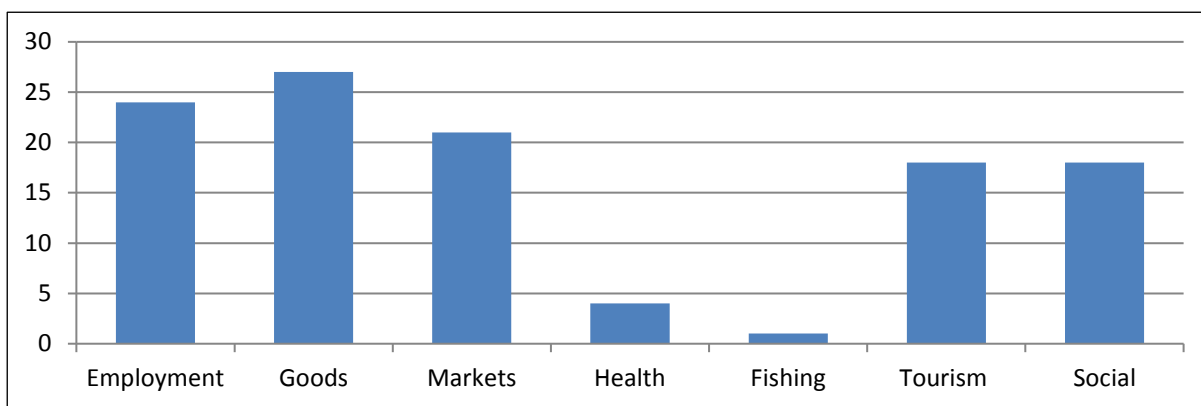
The Thai National Experts interviewed local passengers and boat owners at the following three ports along the Mekong River in Thailand: Chiang Kong port, Nakorn Phanom Municipality Port and Mukdahan Municipality Port. A total of 50 participants were interviewed: 42 passengers and 8 boat owners. From these eight boat owners, three were real owners, four were boat operators and one was a boat worker. The types of boats were: 48 percent small cargo and 36 percent used to transport local passengers. All participants were asked to indicate the type of transport assets that they own and 76 percent owned a boat (motorised), 22 percent a motorcycle and 18 percent a car.

Frequency and Distance

Eighteen participants used IWT weekly, 11 persons daily and five persons used the IWT 3-4 times per week. Fifty-seven percent of participants indicated using IWT for long trips (more than three hours), 19.8 percent for medium trips (30 minutes to three hours) and 23.1 percent for short trips (less than 30 minutes). In terms of cost, 79.5 percent found IWT cheaper than other means of transport, 4.5 percent found that it was about the same and 15.9 percent found that it was more expensive.

Use of IWT

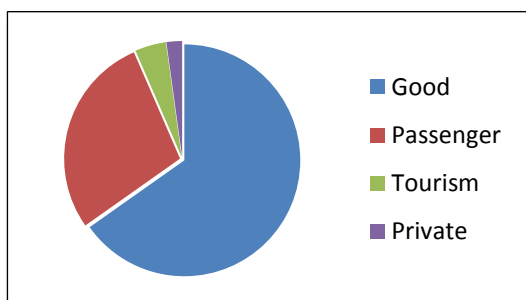
The passengers and boat owners were asked what they used IWT for and they could provide more than one answer. The results for passengers is shown below:



Uses of IWT

IWT was mainly used for economic activities: 54 percent used IWT for transporting goods, 48 percent for employment and 42 percent for accessing markets. Meanwhile, 36 percent used IWT for social reasons, such as visiting friends and family.

The boat owners were also asked to report what activities they use their boats for as shown in the graph below:



Sixty-five percent used their boats for the transport of goods (national and local) and 28.3 percent for the transport of passengers. Meanwhile 59 percent of the participants reported that IWT provided access to cross-border cargo ports with Lao PDR, 29.5 percent reported access to cross border passenger ports and 11.4 percent reported access to local ports only.

Uses of boats by boat owners

Transport of Goods and Passengers

IWT is mainly used for transporting agricultural products: 72.7 percent reported transporting fruit/vegetables, 50 percent transported rice and 40.9 percent livestock. Nearly forty-eight percent reported using IWT to transport construction materials and 25 percent transported fuel. In terms of passenger boats, 46.2 percent were used for cross border transport, 21.2 percent for international passengers and 17.3 percent for local transport

Issues and Opportunities for Improvement

The following issues were reported for IWT:

- The main problem is the authority of each country to manage the river; and
- Water transportation is difficult in the dry season due to low water levels.

The participants had the following suggestions for IWT improvement:

- Improve laws and regulations of both Thailand and Lao PDR;
- Apply the international standards for managing IWT;
- Increase boat capacity to respond to the increase of the demand for markets;
- Strict enforcement of safety rules for passengers;

- The transportation should be sustainable and not lead to environmental degradation; and
- Enhance the collaboration among China, Thailand, Lao PDR and Myanmar to manage hydropower projects and IWT.

4.2.5 Cambodia

National

There are currently no studies that show the contribution of IWT in terms of employment or economic benefits in Cambodia. The Ministry of Social Affairs and Veterans Youth Rehabilitation (MOSAVYR) could not provide specific information on socio-economic data or studies related to IWT.

Several ministries suggested focusing on the following key issues for the inland navigation sector and socio-economic development:

- There are limited laws and regulations to promote 'green' navigation and the implementation of an IWT master plan to ensure everyone benefits;
- Low flow during the dry season only provides rural communities transport from one area to another and limits access to larger or national ports;
- The management of solid and liquid wastes has not been fully applied at port/terminals and onboard vessels;
- Vessels sailing on the Mekong River are carrying dangerous goods that may have serious consequences on the environment; and
- Consideration of the positive and negative impacts of climate change on IWT is needed.

Rural IWT Users

There are no statistics related to the use, access to services (e.g. health and education) or significance of IWT to rural communities. The MPWT also reported that there are no existing studies that show the contribution of IWT in terms of employment and economic benefits for rural communities. On-the-spot surveys of local IWT users were conducted at three sites in Cambodia: Kompong Chhnang, Chong Kneas and Kompong Cham.

Survey of Local IWT Users

One hundred and five people were interviewed in total: 35 people at each site, with a total of 56 passengers and 49 non-passengers. Of the 49 non-passengers interviewed, 43 were boat owners, four were boat operators and two were workers.

Frequency, Distance and Costs of IWT

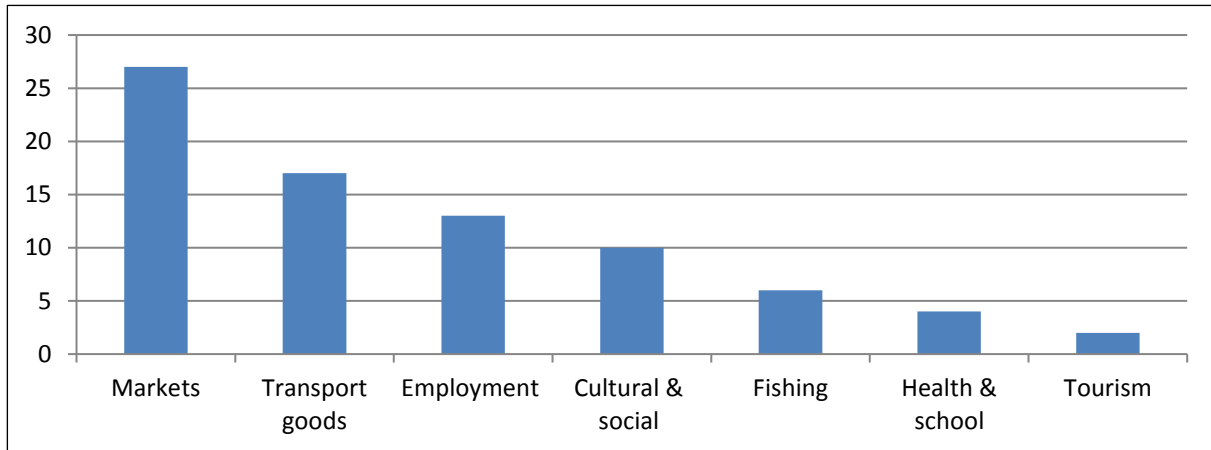
The majority of passengers use IWT at least weekly: 37.5 percent daily, 23.2 percent 3-4 times per week and 10.7 percent weekly. Passengers were asked to indicate if they used IWT for short trips (0-30 minutes), medium trips (30 minute to three hours) or long trips (more than three hours). Forty passengers reported using IWT for medium trips, 10 for long trips (more than three hours) and six for short trips. Eight of the 17 passengers surveyed at Chong Kneas reported that they were taking a long journey. Passengers were asked to consider the costs of IWT compared to other modes of transport: 39.3 percent reported it to be cheaper, 30.4 percent said it was more expensive and 30.4 percent said it was about the same.

Fifty-three percent of owner/operators used their boats for daily trips and 24.5 percent made 3-4 trips per week. Only 6.1 percent of participants do multiple trips in a day and 6.1 percent do less than one trip per month. Fifty-nine percent of participants use their boats for medium trips (30 minutes to

three hours), 28.6 percent for long trips (more than three hours) and 14.3 percent for short trips (0-30 minutes).

Use of IWT

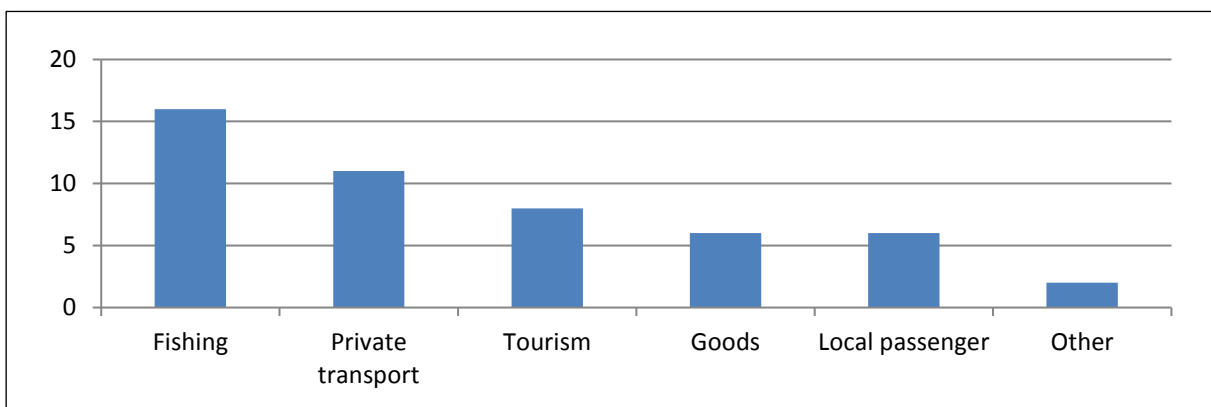
Participants were asked what they use IWT for, and could provide more than one answer. The results for passengers is shown below:



Passenger use of IWT

Passengers indicated accessing markets, transporting goods and employment as the main reasons they were using IWT. All these uses provided economic benefits to rural communities. From the data, it is evident that some participants that selected ‘markets’ also used IWT for transporting goods.

Boat owners/operators were asked to report what they use their boats for as shown in the chart below:



IWT uses for boat owners/operators

Nearly thirty-three percent used their boats for fishing and 22.4 percent for private transport. Eight of the 18 participants at Chong Kneas used their boats for tourism, the only site reporting tourist activities.

Owner/operators using boats for passengers were asked to indicate the type of passengers they were carrying; more than one type could be selected. Nearly eighty-four percent used passenger boats for local transport, 18.4 percent for tourists (foreigners) and 12.2 percent for tourists (locals).

Transport of Goods

Passenger reported that agricultural products such as fruit/vegetables (48.2 %), rice (37.5 %) and fertilizers (19.6 %) were the most commonly transported goods. Overall, participants at Kompong Chhnang indicated the highest number and range of goods transported.

The owners/operators/ were asked to report what types of goods are carried. Based on the responses it is clear that goods are carried on all types of boats (e.g. private or local transport boats are used to transport goods and passengers).

Owners/operators reported that agricultural products such as fruit/vegetables (38.8 %), rice (28.6 %) and livestock (14.3 %) were most commonly transported. Fourteen percent used boats to transport fuel, and 12.2 percent used it to transport timber/logs; the other goods carried included sand, wastes, scrap metals and fish products.

Ownership of Transport Assets

Passengers were asked to indicate the different types of transport assets that they own (more than one could be selected). Nearly seventy-seven percent of participants owned a motorized boat, 42.9 percent owner a bicycle and 32.1 percent owned a motorcycle. Boat ownership had the highest prevalence in Kompong Chhnang. Owners/operators were asked to indicate the different types of transport that they own (more than one could be selected). Nearly eighty-two percent of participants owned a motorized boat, 30.6 percent owned a motorcycle and 18.4 percent owned a bicycle. The non-passengers had a higher ownership of boats (motorized) and motorcycles than the passengers.

Issues and Opportunities for Improvement

The passenger and owner/operators were asked to provide further details on why they use IWT and to list the main issues and opportunities for improvement. The participants reported that the main reasons they use IWT are:

- Close to farming and employment opportunities along the river;
- No access to roads and bridges, especially during the wet season;
- Unsafe roads and long distance from housing; and
- High costs of other transport modes.

The participants reported that IWT could be improved by:

- Developing a safe, cheaper and more efficient ferry service;
- Considering the use of larger passenger and cargo vessels;
- Establishing better port/passenger facilities and waste management plans;
- Increasing participation from the private sector by raising awareness of IWT;
- Reviewing pricing of fuel and transport costs;
- Implementing a legal framework and improving cooperation among line agencies and between line agencies and local authorities;
- Promoting education to boat owners to maintain, control and inspect engines and equipment for safety; and
- Notifications for weather and navigation conditions to reduce accidents.

4.2.6 Viet Nam

National

The Mekong River delta has a dense network of rivers and canals as reported by VIWA. In 2014 there were 160,000 vessels and 2,500 inland ports/terminals operating, transporting up to 50 million tonnes of goods and 300,000 passengers. The proportion of goods carried in the Mekong Delta has increased from 30 percent in 2009 to 62 percent in 2012, with an average annual growth of about 10 percent.

IWT plays a vital role in cargo and passenger transport and creates millions of jobs, contributing to poverty alleviation and economic development. There are a number of studies that show the contribution of IWT in term of employment or economic benefits at the national level.

Moreover, the MOT reported that many projects, studies and workshops have been conducted to promote the development of IWT in the Mekong Delta and for rural areas, and that the following plans have been approved:

- Transport Development Planning of the Mekong Delta's Key Economic Zones to 2020 with the Outlook to 2030 (Decision No. 11/2012/QD-TTg by the Prime Minister dated 10/02/2012);
- Detailed Planning of Port Groups in the Mekong River Delta (group 6) to 2020 with the Outlook to 2030 (Decision No. 1746 /QD- BGTVT by the MOT dated 3/8/2011);
- Irrigation Planning in the Mekong River Delta Phase 2012 - 2020 with the Outlook to 2050 in the Context of Climate Change, Sea Level rRse (Decision No. 1397 /QD- TTg by the Prime Minister dated 25/9/2012);
- Development Planning of Inland Fleets by 2020 with the Outlook to 2030 (Decision No. 639 / QD-BGVT by the Ministry of Transport dated 14/3/2013); and
- A Master Plan for Development of Viet Nam Inland Waterway Transport by 2020 with the Outlook to 2030 (Decision No. 1071 / QD-BGTVT by Ministry of Transport dated 24/4/2013).

Survey of Local IWT Users

The questionnaires were conducted at three main passenger terminals on the Mekong and Bassac rivers in Viet Nam: Ninh Kieu Cruise Terminal, Can Tho Maritime port (fishing village area) and Chau Doc Port of Tourism.

The national experts randomly selected people for the survey at all three sites. Generally the participants could be divided into three types: i) local residents living in the surrounding port area ii) tourists and iii) ship-owners, ship operators, ship workers and crew members.

A total of 104 participants were interviewed, including 68 passengers and 36 non-passengers.

The participants reported that they travelled on different types of boats; as a result more than one option was selected as shown in the table below:

Boat	Total
Passenger ship (inland transport)	54
Passenger ship (tourist)	21
Small sized cargo vessel	19
Private small sized cargo vessel	19
Cruise ship	7
Other	6

Nearly thirty-nine percent of participants indicated that they used passenger ships (tourist), 34.6 percent used passenger ship (inland transport) and 18.3 percent used small cargo and private vessels.

The non-passengers were asked whether they were a ship owner, operator, worker or other as shown in the table below:

Type	Total
Owner	16
Operator	19
Worker	12
Other	1

Participants indicated that in some cases they were both the owner and operator of the vessels. The owner and workers reported that they had merchant mariner licenses to work on the vessels. Forty-seven percent had been operating their boats for 6-10 years, 33.3 percent for 11 - 15 years and only 11.1 percent for 0 - 5 years. Nearly six percent had been operating their boats for more than 15 years.

Frequency and Distance

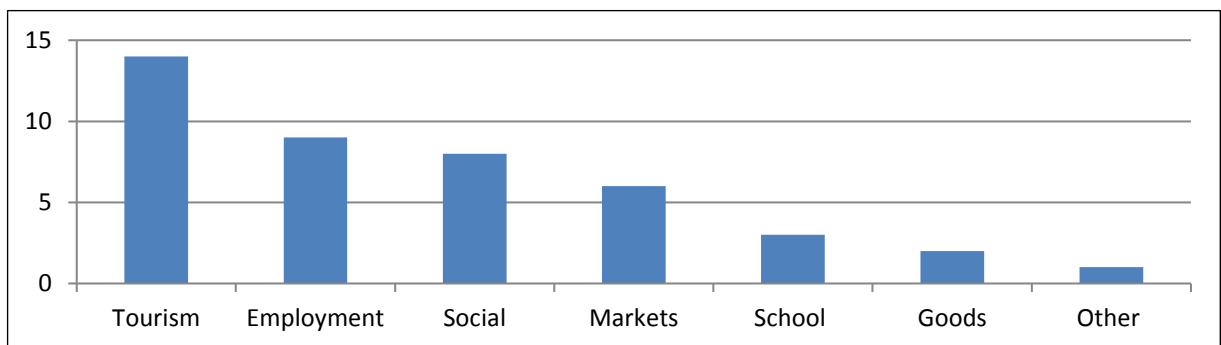
Nearly thirty-nine percent of passengers used transport on a weekly basis, 22.1 percent on a daily basis and 17.6 percent used it 2-3 times per week. Only 1.5 percent indicated that they used IWT monthly and 8.8 percent made multiple trips in day.

Participants were asked to indicate if they used IWT for short (0-30 minutes), medium (30 minute to three hours) or long (more than three hours) trips. Thirty-three passengers reported using IWT for short trips, 28 for medium trips and only 7 used IWT for long trips. In relation to costs, 70.6 percent found that IWT was cheaper than other modes of transport, 13.2 percent found that it was about the same and 7.4 percent found that it was more expensive.

Concerning the frequency of trips undertaken by the owners/operator, 50 percent of owner/operators indicated that they used their boat 'sometimes', 33.3 percent used it on a daily basis and 13.9 percent used it 4-5 times per week. Nearly forty-two percent of owners/operators use their boats for short trips (0 - 30 minutes), 33.3 percent use it for medium trips (30 minutes to three hours) and 11.1 percent use it for long trips (more than three hours).

Use of IWT

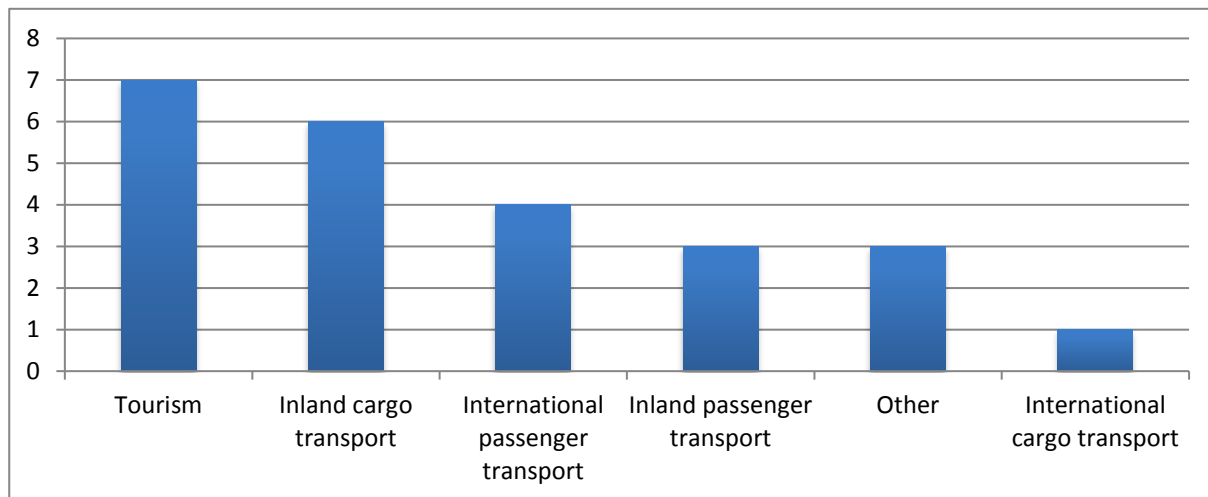
The participants were asked what they use IWT for and could provide more than one answer. The results for passengers is shown below:



Passenger use of IWT

Nearly twenty-one percent of passengers reported that they used IWT for tourism, 13.2 percent used it for employment, 11.8 percent for social reasons (e.g. visiting family) and 8.8 percent used it for accessing markets.

The use of boats for owner/operators is shown in below. Nineteen percent of owner/operators indicated that they used their boats for tourism, 16.7 percent use it for inland cargo transport, 11.1 percent for international passenger transport and 8.3 percent for inland passenger transport. International passenger transport referred to cross-border (i.e. Chau Doc to Phnom Penh) and inland passenger transport for local transport. This question had a low response rate with 23 passengers and 12 non-passengers not indicating what they used IWT for.

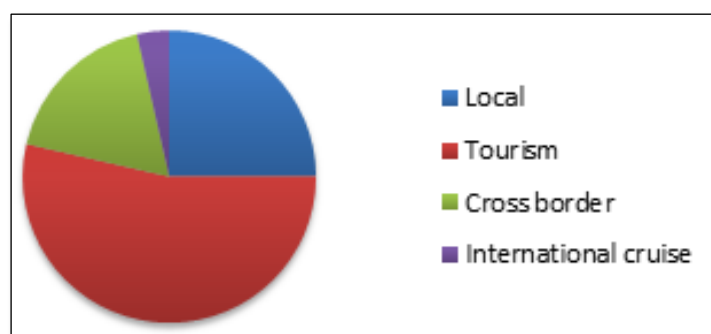


Transport of Goods

The main goods transported along the waterways in Viet Nam are fruit, vegetables, dried foods and other products for local residents and tourists. Specialized vessels are used to transport fuels (e.g. gasoline, diesel, gas), chemicals (e.g. fertilizer or pesticides) and livestock. Small cargo boats are also used to take people across the Bassac River to access markets. Generally these ships were reported to be poorly maintained, carrying limited safety, communications and emergency equipment and unable to transport long distances.

Passenger Transport

The different types of passenger services provided by the owner/operators are shown in the chart below:



Nearly forty-one percent of passenger ships are used for tourism, 18.9 percent are used for local passengers and 13.5 percent for cross border transport. Some passenger ships are used to transport both national and international tourists.

It was reported that there has been a significant decline in demand for waterborne transport due to improved

roads in the Mekong Delta. However, for transporting large quantities of fruit/vegetables, IWT was still the preferred mode of transport. Tourist and visitor numbers have also been decreasing, with some ship owners/operators responding by converting their passenger ships into cargo vessels.

Chau Doc Passenger Port

A representative of the Chau Doc port reported that there has been a significant decline in tourist numbers for waterborne transport tours including the routes from Can Tho to Chau Doc and Chau

Doc to Ha Tien. The demand for cross-border water transport route from Can Tho to Phnom Penh remains steady.

There are three types of passenger ships operating in the in Chau Doc area:

- (1) **Small speedboats:** 15 to 30 passengers;
- (2) **Speedboats:** 30 to 35 seats; and
- (3) Large speedboat of 120 to 150 seats.

The number of ships and passengers for Chau Doc port from 2008-2014 is shown the table below:

Year	Ship			Passengers
	Cruise	Passenger	Total	Tourist
2008	-	58	-	3,217
2009	45	630	675	16,436
2010	153	400	553	20,216
2011	224	601	825	12,086
2012	214	743	957	20,450
2013 (8 months)	84	393	417	8,314
2014	209	689	898	14,352

Source: Inland Waterway Port Authority, Region IV

Ownership of Transport Assets

The participants were asked to indicate the type of transport assets that they own, as shown in the table below:

Asset	Passenger	Non-passenger
Boat (non-motorised)	0	5
Boat (motorised)	0	16
Car	3	2
Motorcycle	13	10
Bicycle	11	10

Nine of the participants owned no transport assets, and use ferries, private or passenger boats to take them to markets or across the river. The ship owner/operators and tourists own boats, motorcycles and bicycles. The data also indicates that non-passengers owned more than one asset. This answer had a low response rate, with 32 passengers not indicating what type of assets they owned.

Issues and Opportunities for Improvement

The passenger and owner/operators were asked to provide further details on why they use IWT, what the main issues are and how IWT can be improved. The participants reported that the main reasons they use IWT are:

- Convenient to get from home to work and to visit tourist attractions and entertainment;
- Visiting family, friends and enjoying the scenery on the river;
- Going to the floating markets in Viet Nam and tourist attractions in Cambodia; and

- Employment, access to markets and transporting goods.

The passengers reported that IWT can be improved by:

- Enhancing the awareness of the Law on Inland Waterway Transport as well as traffic safety for local boat operators;
- Ensuring that passenger boats are carrying the appropriate lifesaving and other equipment to improve safety; and
- Increasing the number of ferries and passenger services operating to reduce waiting times.

The ship owner/operators reported that IWT can be improved by:

- Reviewing the pricing structure of fares and monitoring tour operators/travel agencies to ensure consistency;
- Promoting awareness for local people and ship owners to reduce pollution and solid wastes in the Cai Rang and Phong Dien floating markets;
- Maintaining the navigation channel at Chau Doc port to ensure access for large passenger vessels during the dry season;
- Enhancing coordination between the Inland Waterborne Port Authority - Region IV and customs to reduce the burden of administrative procedures for cross-border transport;
- Simplifying the procedures and requirements for ship owners to transport passengers across the border to Cambodia; and
- Improving the connections between Can Tho/Chau Doc and Phnom Penh port for cross border transport.

4.2.7 Conclusions

People in the Mekong use IWT for local passenger transport, ecotourism and the transport of local products (agricultural, fisheries, garments) to markets, creating economic opportunities for rural communities. The reasons for use, issues and areas for improvement relating to IWT are summarised below for each of the Member Countries.

Summary of the local survey results are included in ANNEX 3

5 OUTSTANDING DATA GAPS

MISSING DATA ON WATERWAY DESIGN AND WORKS ALONG THE RIVER THAT IMPACT NAVIGATION	
1	ONGOING WORKS, NATIONAL PLANS AND PROJECTS
1.1 ONGOING WORKS, NATIONAL PLANS AND PROJECTS FOR DREDGING	
<ul style="list-style-type: none"> Special note: Sand Mining for construction and landfill is being conducted at a much higher scale than Dredging for Navigation. Since Sand Mining is not a part of the goals of Navigation, this is not considered by the Navigation Thematic Area 	
<p><i>Detail all known ongoing dredging works, national plans and project proposals for the period 2010-2040 for the 15 stretches + quantification of how much. It should also be stated when it is capital dredging and when it is maintenance dredging</i></p>	
Stretch 1: Green Triangle – Huay Xay	Some data available under The Lancang-Mekong Navigation Development Plan led by PR China – no past or current data
Stretch 2: Huay Xay – Luang Prabang	Some data available under The Lancang-Mekong Navigation Development Plan led by PR China– no past or current data
Stretch 3: Luang Prabang – Pak Chom Dam	No data on past and current dredging works, no data for plans
Stretch 4: Pak Chom Dam - Vientiane	No data on past and current dredging works, no data for plans
Stretch 5: Vientiane - Savannakhet	No data on past and current dredging works, no data for plans
Stretch 6: Savannaketh – Khone Falls	No data on past and current dredging works, no data for plans
Stretch 7: Khone Falls	No data on past and current dredging works, no data for plans
Stretch 8: Khone Falls – Sambor Dam	No data on past and current dredging works, no data for plans
Stretch 9: Sambor Dam - Kratie	No data on past and current dredging works, no data for plans
Stretch 10: Kratie – Kompong Cham	some references for future work on the KOICA project are given
Stretch 11: Kompong Cham – Phnom Penh	Some data of ongoing dredging at Sdao Channel received
Stretch 12: Phnom Penh (Chaktomuk) – Chong Kneas	reference to dredging for ferry services in Kampong Hau Commune, Kampong Leng District, Kampong Chngang Province
Stretch 13: Phnom Penh – border - Ho Chi Minh – Cai Mep by Cho Gao Canal	To the border quite detailed dredging volumes and locations are provided here, including plans.
Stretch 14: Phnom Penh – Cai Mep, via the Mekong	Details on (1) Co Chien Estuary construction project are given. (2) The project on upgrading the Ham Luong River, section from Tien river confluence to Ham Luong estuary.
Stretch 15: Phnom Penh – Cai Mep, via the Vam Nao and Bassac	<p>Details given on</p> <ol style="list-style-type: none"> 1. Quan Chanh Bo channel project are given. 2. Package 6A: Tat channel dredging and embankment works Km0-650 Km3 ÷ + 628 3. Package 6B: Tat channel dredging and embankment works Km3+628 ÷ Km8+175 4. Package 10A – South wave protection dyke 5. Package 10B: sea channel section construction and enbankment 6. Package 11: Quan Chanh Bo channel dredging và channel section of Hau river
1.2 ONGOING WORKS, NATIONAL PLANS AND PROJECTS FOR RIVER REGULATING WORKS (GROYNES – OVERFLOW DIKES ...)	

<i>Details of all known ongoing river regulating works, national plans and project proposals for the period 2010-2040 for the following stretches + quantification of the works</i>	
Stretch 1: Green Triangle – Huay Xay	Data on Groynes received from the Thai Marine department
Stretch 2: Huay Xay – Luang Prabang	No data on past and current activities Plans for dredging, rock removal and river regulating works are detailed in the Chinese navigation Development Plan to accommodate 500 DWT vessels
Stretch 3: Luang Prabang – Pak Chom Dam	Some information received on planned bank protections
Stretch 4: Pak Chom Dam - Vientiane	Some information received on planned bank protections
Stretch 5: Vientiane - Savannakhet	Some information received on planned bank protections
Stretch 6: Savannaketh – Khone Falls	Some information received on planned bank protections
Stretch 7: Khone Falls	No data
Stretch 8: Khone Falls – Sambor Dam	No regulating works or plans are known
Stretch 9: Sambor Dam - Kratie	No regulating works or plans are known
Stretch 10: Kratie – Kompong Cham	No data on past or existing works. Some plans on the KOICA project
Stretch 11: Kompong Cham – Phnom Penh (PPAP NTC LM17)	Some plans for the Sdao Channel
Stretch 12: Phnom Penh – Chong Kneas	No regulating works or plans are known
Stretch 13: Phnom Penh (PPAP NTC LM17) – border - HCMC – Cai Mep by Cho Gao Canal	No regulating works or plans are known
Stretch 14: Phnom Penh – Cai Mep, via the Mekong	No regulating works or plans are known
Stretch 15: Phnom Penh – Cai Mep, via the Vam Nao and Bassac	No regulating works or plans are known, except Quan Chan Bo Canal
1.3 ONGOING WORKS, NATIONAL PLANS AND PROJECTS FOR BRIDGES AND POWER LINES	
<i>Detail all known ongoing bridge construction works or power cables over the river, national plans and project proposals for the period 2010-2040 for the following stretches + give height above Highest High Water Level + Main span, air clearance, reduction of wet section under the bridge, velocity increase of the current compared to the pre-construction period.</i>	
Stretch 1: Green Triangle – Huay Xay	Data of existing bridges supplied
Stretch 2: Huay Xay – Luang Prabang	Data of existing bridges supplied but clearance heights and proposed Highest Operating levels of the dams are not always correct.
Stretch 3: Luang Prabang – Pak Chom Dam	Data of existing bridges supplied but clearance heights and proposed Highest Operating levels of the dams are not always correct. Power lines missing ?
Stretch 4: Pak Chom Dam - Vientiane	Data of existing bridges supplied but clearance heights and proposed Highest Operating levels of the dams are not always correct.
Stretch 5: Vientiane - Savannakhet	Data were supplied
Stretch 6: Savannaketh – Khone Falls	Data were supplied
Stretch 7: Khone Falls	Past, current and planned information unknown
Stretch 8: Khone Falls – Sambor Dam	All details on the existing bridges are known but not all the plans
Stretch 9: Sambor Dam - Kratie	All details on the existing bridges are known but not all the plans

Stretch 10: Kratie – Kompong Cham	All details on the existing bridges are known but not all the plans
Stretch 11: Kompong Cham – Phnom Penh (PPAP NTC LM17)	All details on the existing bridges are known but not all the plans
Stretch 12: Phnom Penh (Chaktomuk) – Chong Kneas	All details on the existing bridges are known but not all the plans
Stretch 13: Phnom Penh (PPAP NTC LM17) – border - Ho Chi Minh – Cai Mep by Cho Gao Canal	Down to the border, all details on the existing bridges are known but not all the plans. From the border to the sea all details on the existing bridges are known but not all the plans.
Stretch 14: Phnom Penh – Cai Mep, via the Mekong	Down to the border, all details on the existing bridges are known but not all the plans. From the border to the sea all details on the existing bridges are known but not all the plans.
Stretch 15: Phnom Penh – Cai Mep, via the Vam Nao and Bassac	Down to the border, all details on the existing bridges are known but not all the plans. From the border to the sea all details on the existing bridges are known but not all the plans.
1.4 ONGOING WORKS, NATIONAL PLANS AND PROJECTS FOR PIERS EXTENDED INTO THE NAVIGATION CHANNEL, KNOWN SHIP WRECKS INSIDE THE CHANNEL	
<i>Detail all known piers that extend into the river, ship wrecks inside the channel.</i>	
Stretch 1: Green Triangle – Huay Xay	Plans for dredging, rock removal and river regulating works are detailed in the Chinese navigation Development Plan to accommodate 500 DWT vessels
Stretch 2: Huay Xay – Luang Prabang	Plans for dredging, rock removal and river regulating works are detailed in the Chinese navigation Development Plan to accommodate 500 DWT vessels
Stretch 3: Luang Prabang – Pak Chom Dam	No data
Stretch 4: Pak Chom Dam - Vientiane	No data
Stretch 5: Vientiane - Savannakhet	No data
Stretch 6: Savannaketh – Khone Falls	No data
Stretch 7: Khone Falls	No data
Stretch 8: Khone Falls – Sambor Dam	No data
Stretch 9: Sambor Dam - Kratie	No data
Stretch 10: Kratie – Kompong Cham	No data on piers, but believe the wrecks have been removed
Stretch 11: Kompong Cham – Phnom Penh (PPAP NTC LM17)	No data on piers, but believe the wrecks have been removed
Stretch 12: Phnom Penh (Chaktomuk) – Chong Kneas	No data on piers, but believe the wrecks have been removed
Stretch 13: Phnom Penh (PPAP NTC LM17) – border - HCMC – Cai Mep by Cho Gao Canal	No data on piers, but believe the wrecks have been removed
Stretch 14: Phnom Penh – Cai Mep, via Mekong	No data on piers, but believe the wrecks have been removed
Stretch 15: Phnom Penh – Cai Mep, via Bassac	No data on piers, but believe the wrecks have been removed

2	ONGOING WORKS, NATIONAL PLANS AND PROJECTS FOR HYDROPOWER
2.1 ONGOING WORKS, NATIONAL PLANS AND PROJECTS FOR HYDROPOWER	

<ul style="list-style-type: none"> - exact location (in UTM coordinates, and river km marker) - Dam crest - Exact Highest Operating Level - Exact Medium Operating Level - Exact Lowest Operating Level - Extent of the Tailwater upstream 	
stretch 1: Green Triangle – Huay Xay	No data
Stretch 2: Huay Xay – Luang Prabang	Data supplied but still some uncertainties regarding the High, Mean and Low Operating ;levels of the dams
Stretch 3: Luang Prabang – Pak Chom Dam	Data supplied but still some uncertainties regarding the High, Mean and Low Operating ;levels of the dams
Stretch 4: Pak Chom Dam - Vientiane	No data
Stretch 5: Vientiane - Savannakhet	Data supplied but still some uncertainties regarding the High, Mean and Low Operating ;levels of the dams
Stretch 6: Savannaketh – Khone Falls	Data supplied but still some uncertainties regarding the High, Mean and Low Operating levels of the dams
Stretch 7: Khone Falls	No data
Stretch 8: Khone Falls – Sambor Dam	Data on the Stung Treng Run-of-River Dam
Stretch 9: Sambor Dam - Kratie	Data on the Sambor Dam
Stretch 10: Kratie – Kompong Cham	No hydropower plans
Stretch 11: Kompong Cham – Phnom Penh (PPAP NTC LM17)	No hydropower plans
Stretch 12: Phnom Penh (Chaktomuk) – Chong Kneas	No hydropower plans
Stretch 13: Phnom Penh (PPAP NTC LM17) – border - Ho Chi Minh – Cai Mep by Cho Gao Canal	No hydropower plans
Stretch 14: Phnom Penh – Cai Mep, via the Mekong	No hydropower plans
Stretch 15: Phnom Penh – Cai Mep, via the Vam Nao and Bassac	No hydropower plans
2.2 ONGOING WORKS, NATIONAL PLANS AND PROJECTS FOR HYDROPOWER SHIP LOCKS	
<p><i>Give the following details:</i></p> <ul style="list-style-type: none"> - Number of locks - Exact dimensions (Length, beam, depth) - how many per dam - will there be a means to transport small boats over/next to the dam ? 	
Stretch 1: Green Triangle – Huay Xay	No data
Stretch 2: Huay Xay – Luang Prabang	Data supplied
Stretch 3: Luang Prabang – Pak Chom Dam	Data supplied
Stretch 4: Pak Chom Dam - Vientiane	No data
Stretch 5: Vientiane - Savannakhet	No data
Stretch 6: Savannaketh – Khone Falls	Data supplied

Stretch 7: Khone Falls	No data
Stretch 8: Khone Falls – Sambor Dam	Hydropower shiplock, data are not available
Stretch 9: Sambor Dam - Kratie	Hydropower shiplock, data are not available
Stretch 10: Kratie – Kompong Cham	No hydropower plans
Stretch 11: Kompong Cham – Phnom Penh	No hydropower plans
Stretch 12: Phnom Penh– Chong Kneas	No hydropower plans
Stretch 13: Phnom Penh (PPAP NTC LM17) – border - Ho Chi Minh – Cai Mep by Cho Gao Canal	No hydropower plans
Stretch 14: Phnom Penh – Cai Mep, via Mekong	No hydropower plans
Stretch 15: Phnom Penh – Cai Mep, via Bassac	No hydropower plans

ANNEX 1 : WATERWAY CHARACTERISTICS

Stretch 1: Green Triangle to Golden Triangle (233 km)

The information available on the actual situation of this stretch is provided by the “Development Plan on International Navigation on the Lancang-Mekong River (2014-2025), August 2014”, submitted by the Department of Transport of Yunnan Province, Tianjin Research Institute for Water Transport Engineering, Ministry of Transport, China.

Some 50 rapids and dangerous areas are described in this report, where it is also mentioned that in 2006, PR China cleared 11 rapids and 10 shoals between the “Green Triangle” (the China-Myanmar-Lao PDR boundary marker Km 244) and the Golden Triangle (the Myanmar-Thailand-Lao PDR border).

Stretch 2: Golden Triangle (km 2,373) to Chiang Saen - passenger pontoon (km 2,363) (10 km)

The river is on average 500 metres wide and water depths easily reach 22 to 30 meters, except where the channel shifts from the right bank to the left bank or vice versa.

Stretch 3: Chiang Saen - passenger pontoon to Huay Xay (50 km)

The new commercial port of Chiang Saen is 6.5 km downstream of the former pontoon port and adjacent to the Mae Nam Kok river mouth, which has a high water outlet through the port harbor basin. The sharp river bend downstream of the port (Km 2,356) has a radius of $R = 1,100$ m. Water depths are in the order of 2.0-2.5 m with even a scour hole of 9.5 meters deep.

For this stretch, some nine rapids, shoals and dangerous areas are described in the “Waterway Design Report”.

Stretch 4: Huay Xay to Luang Prabang (306 km)

The condition of most of the dangerous areas in this stretch has been surveyed and a proposal for a channel design (ships of 2,000 tonnes) has been made for eventual improvement for every dangerous area.

The channel is a continuation of the Chiang Saen – Chiang Khong/Huay Xay stretch, with many rapids and dangerous areas. The river in average is 500 to 600 m wide with many sand banks or rocky islands, whilst the navigation channel width varies between 180 and 220 m (average).

The river just downstream Chiang Khong/Huay Xay, is shallow (Hat Kham) where the channel shifts between riverbanks and/or between two sandy islands. Water depths are poor (at locations only 0.3 m) but the scarcity of the soundings renders them unreliable. In a narrow section of the river (73 m at Km 2,302.5) the river is more than 44 meters deep.

Some 30 rapids and dangerous areas have been identified between Huay Xay and Pak Beng. In addition some 30 rapids and dangerous areas have been identified between Pak Beng and Luang Prabang on the UHA maps and GPS Navigation Guidance System Base Charts and/or during boat travel between Huay Xay and Luang Prabang in March 2015.

Some of these rapids are real challenges to navigation and a few of them are famous for their accidents: Keng Phouang (two channels from which one is dangerously narrow and not recommended by the navigational aids) and Keng Leuk, known for its sharp bends, multiple islands and strong side currents. Many boats have perished in these rapids.

Stretch 5: Luang Prabang to planned Sanakham Dam¹ (279 km)

This stretch is not different from the upstream one, except for one big feature: the on-going construction of the Xayabury hydropower dam at Km 1,931. The dam, which at the time of writing this report was almost 65 percent completed, will create an impounded section upstream of about 80 km long with a highest operational water level (HOL) at +275 m, reaching the tail water level of the planned Luang Prabang hydropower dam. This means that under these highest operational water levels there will be no more section of free flow in the Mekong between the Luang Prabang hydropower dam and the Xayabury dam.

A number of dangerous rapids will also be submerged, amongst others the notorious Keng Luang rapid.

Some 15 rapids and dangerous areas amongst others were identified for condition survey and still exist at the time of reporting. Some features of 8 dangerous areas have already been surveyed under the previous MRC-study called “*Conditions Survey of Dangerous Areas for Navigation between Luang Prabang and Pakxe in the Lao PDR and Thailand*” (October 2009).

The river downstream of the dam site of Xayabury is characterized by a relatively straight and small channel (during low water level conditions) with multiple islands and rock outcrops and vast rocky areas (platforms, terraces) adjacent to the channel which all are flooded during the rainy season. Channel widths during the dry season (between rocky river banks) are often no more than 70 meters.

Other areas (e.g. Keng Sao: Km 1,791 – 1,792) are extremely complex channels and rocky islands, which all get flooded during the monsoon season. Six kilometers downstream (Don Sang at Km 1,786), the navigation channel contains an abundance of rock outcrops from which the majority gets submerged during the monsoon season.

Stretch 6: Planned Sanakham Dam to Vientiane - Laksi Port (148 km)

This stretch is characterized by narrow channels forming a braided Mekong River during the dry season. Every channel is wedged between rocky riverbanks about 4 to 5 meters high during the low water season and submerged during the monsoon season. Mid-water levels are extremely difficult and dangerous and ships often get stuck on top of the rocks of the riverbank, having to wait for the next monsoon season to get afloat again.

A huge number of scattered rock outcrops are making navigation extremely tricky during most of the time of the year and only extensive and durable navigational aids can be helpful.

In this stretch between the planned Sanakham Hydropower Dam and Vientiane Laksi Port (km 4), some 8 rapids and dangerous areas were identified, from which some characteristic features of 4 dangerous areas have been surveyed under the previous MRC-study from 2009.

Stretch 7: Vientiane - Laksi Port to Savannakhet (455 km)

This stretch in the upper Mekong (upstream of the Khone Falls) is probably the best natural navigation stretch of the entire Mekong. The waters are deep, the channel is straight with a steady flow and no strong currents or turbulences. The channel is between 350 and 500 m wide with gentle curves of more than $R = 1,800$ m. A number of bank protection works or simple river training works have been spotted at the Lao side between Km 1,338 and 1,335 and more substantial groynes (river training works) on the Thai side between Km 1,320 and Km 1,316. The river, which is between 600 m and 900 m wide looks stable and has a few sand banks and sand deposits, on the left and right banks

¹ According to the latest information obtained from the hydropower consultant POYRY in Laos, the Pak Chom dam will not be constructed but merged with the Sanakham dam upstream in the border with Thailand.

and even sometimes in the middle of the river. The banks are all submersed during the monsoon season. It is observed that many of these sandbanks have moved or shifted from the middle of the river towards one of the riverbanks by several tens of meters. Comparing the UHA-maps with the more recent Google earth aerial pictures reveals that the UHA-maps are outdated and need thorough revision. A typical example is in front of Tha Uthen (river mouth of Nam Hinboun).

Some 34 shoals (less than 4.0 m) and dangerous areas between Vientiane and Savannakhet have been identified of which only 4 rapids or dangerous areas for navigation have been selected for condition survey and channel design.

Keng Ka Bao at Km 1,151 is the only (condition surveyed) “dangerous area” between Vientiane and Savannakhet which is raising some navigation channel concern. Keng Ka Phouang at Km 1,157 is another example where a difficult channel has to be beacons between rocks and islands.

However, here again the actual situation on navigational aids mainly relies on the old French markers, which are still functional and valuable although during mid- and high water levels some of them become an obstacle on their own.

Stretch 8: Savannakhet to Pakxe (256 km)

The stretch is characterized by a wide river (monsoon riverbed) but narrow navigation channel, hindered by many scattered rocks, islands and reefs that are creating a very difficult stretch for navigation. Most of these rapids and dangerous areas are, both in the dry season and in the monsoon season, a real problem for navigation. They are dispersed in average every 3 to 4 km. The longitudinal profile shows the Km location of the numerous dangerous areas and rapids, mostly concentrated between Km 908,0 and 1,100.0. In some places the river is very deep: often more than 40.0 to 50.0 m. These places are concentrated around the section Km 910.0 to Km 1,070.0 where the bottom gradient is greater than the up- or downstream sections.

The complete list of rapids and dangerous areas between Savannakhet and Pakxe shows some 80 locations of which only 10 rapids, shoals and dangerous areas have been identified for condition survey, indicated as being the most dangerous.

Stretch 9: Pakxe (km 869) to the Khone Falls (km 735) (134 km)

Close to the Khone Falls, the river splits in tens of branches, separated by islands and reefs where navigation is almost random between the hundreds of islands. The area is called “Siphandon” (translated into 4,000 islands).

The biggest of these islands is called Don Khong (Khong island) measuring 7 Km North-South and 7 Km East-West.

The navigation channel is situated in the left channel. Just downstream of Km 740.0 there is a bridge over the Mekong, connecting the mainland on the left bank with the Don Khong Island. The bridge has a main span of 6 x 90.0 m and the air clearance and navigation quadrangle = 60.0 m x 10.0 m.

This stretch has little or no commercial navigation, except for tourist passenger boats or local transport. Not a single rapid or dangerous area has been condition surveyed and little is known about the navigation condition in this area, except that it is often shallow, complex, intricate and purely domestic.

THE KHONE FALLS

There is no navigation at the Mekong Khone falls. The total drop is approximately 60 meters and the river splits into several branches, amongst others: Khone Lipy, Don Sahong branch, Khon Papaeng, and a number of smaller river arms all falling the same level down. Not a single of these river branches is navigable or shows any potential of being made navigable.

The French, during the Indochina period, constructed a multi-modal transport system consisting of two river ports (one downstream and one upstream) linked by a small decauville railroad between the two river ports. The railroad crossed a bridge between the islands of Don Khon and Don Det and has now become a tourist attraction, as it has not been used in over 30 years!

Stretch 10: Khone Falls (km 735) to planned Sambor Dam (km 593) (142 km)

Downstream of the Khone Falls, the river remains divided into several branches, from which only a few are navigable but shallow and braiding through a 2.0 a 3.5 km wide monsoon river bed. There are, however, a few exceptions (e.g. Km 710.0 to Km 714.0) where the river is narrow, shallow, with sharp bends and quiet waters. It is the habitat of many exotic bird species, the extinguished/threatened Irrawaddy dolphins and other aquatic life.

The navigation channel is hopelessly complex, often even confused and only small domestic boats are plying on the river.

During the flood season, the waterway system becomes fully submerged and with little or no adequate navigational aids. The river system is about 4.0 km wide. The narrow channels are usually deep (more than 8.0 m and sometimes >30.0 m) but other places do not have more than 1.0 m water depth.

Further downstream in Stung Treng, the river is wide and navigable but requires a lot of skills from the pilot/captain in passing the rapids and often the narrow gaps are not more than 70.0 m (Km 660.5) in a 2,350 m wide waterway (monsoon river bed). The river is obstructed with scattered rocks and islands, most of them with vegetation (bushes) bended from being pushed during long months of flooding. A great number of parallel-aligned reefs (directed North-South) are crossing the channel and hindering navigation.

However, the navigation channel remains deep (20.0 to 40.0 m) but obstructions from reefs and rock outcrops, sometimes across the waterway, makes navigation without the French markers a difficult undertaking.

At some places there are two channels, both marked by French markers. One of the channels is usually very narrow but both are deep enough. However, this situation only occurs during low water.

There is an even more confusing channel marking (French markers) at Km 600.0, but the multitude of French markers is absolutely necessary due to submerged and scattered rock outcrops just under the water line which are totally invisible even during the low water season. The river is very wide (1,730 m) at this place and the water is flowing gently without ripples so that the pilots cannot “read” the water.

Stretch 11: Planned Sambor Dam (km 593) to Kratie (km 561) (32 km)

This is no doubt the most vulnerable ecological place on the entire river. It is also the habitat of the Irrawaddy dolphins and home to many other soft fresh water species and a multitude of colorful birds.

The river is very wide (2,300 m) and in some places shallow. The braiding river width is 4.0 km wide. The numerous islands are covered with white sand and low vegetation grows abundantly. The navigation channel leans close to the right bank where water depths are over 3.0 m and in some places even 24.0 m.

Stretch 12: Kratie to Kompong Cham (114 km)

Downstream from Kratie up to Kompong Cham, the river is wide, has a gentle flow, and is relatively deep. Kratie port is at Km 560.7 on the left bank (steel floating pontoon port connected with concrete stairs up the slope). Some 12 sandy shallow areas (water depth less than 2.0 m) are making navigation difficult during the dry season.

However, a lot of precaution has to be taken in the interpretation of the thalweg and hence the Least Available Depth (LAD). It sounds very suspicious that the LAD between Kratie and Kampong Cham should be - 0.5 m or - 0.6 m. In any case, more soundings are needed in such areas, not only for defining the LAD but also for designing a waterway channel either by dredging or by river training works.

The stretch Kratie-Kompong Cham, apart from these shallows, does not show any particular obstacle to the design of a commercial navigation channel. From Kratie on and further downstream in Kompong Cham towards the sea, the riverbed is moveable (non-cohesive material) and consists of silt, sand, coarse sand or gravel.

Stretch 13: Kompong Cham to Phnom Penh Chaktomuk (100 km)

Sea going vessels used to sail on the river up to Kompong Cham - Tonlé Bet. The Kizuna bridge over the Mekong at Kompong Cham - Tonlé Bet has a middle span of 200.0 m and a navigation clearance rectangle above the HHW level of 120.0 x 15.0 m. Sea going vessels cannot go further.

When the wooden port collapsed in 1992, no more sea-going cargo vessels sailed up the river but recently, on 14 April 2015, a Vietnamese vessel An Trung (3,075 DWT) sailed to Tonlé Bet and loaded 1,594 Tonnes of Cassava. On 1 May 2015 another ship, the G. Lucky (4,600 DWT and Togo-flagged), arrived at Tonlé Bet and loaded 2,000 Tonnes of cassava. Both vessels managed to pass the “shallow” Sdao channel at Km 385.0.

There are some 5 places where the water depths are less than 8.00m (with the view of considering the possibility of a future reinstatement of the sea going vessels up to Kompong Cham).

A number of hydrographic surveys have been carried out in the Sdao canal since 2010. Many proposals for dredging the Sdao canal have been made, all with a length of about 2,800 m to 3,500 m and a width of 100.0 m (suitable for sea-going vessels of 3,000 DWT).

All suggested solutions for improving this Sdao canal so far have been by dredging only. Almost every year a substantial quantity of sand/silt has to be dredged from this canal. After every flood season the channel is almost completely silted up and the dredging work has to start again. River training works have never been seriously considered, although they were suggested in previous studies (Cambodian Navigation Master Plan).

Further downstream (Km 365.0), the River splits again in two branches from which the western branch (right bank) is the main channel. However, boats with less draught can use the Eastern channel as well. The LAD is 1.5 m according to the UHA atlas. This is confirmed by the latest hydrographic survey from 9 and 10 November 2008.

A dredging proposal was established to allow small ships to take the channel. However, it was clear that the dredging solution was more intended to obtain quality sand from the river for construction or for reclamation, rather than to create a secondary navigation channel.

Stretch 14: Phnom Penh Chaktomuk (km 347) to Kompong Chhnang (122 km) and Stretch 15: Kompong Chhnang to Chong Kneas (122 km)

The Tonlé Sap waterway and the Great Lake are a particularity in the Mekong River System. The flow in the Tonlé Sap changes twice its direction per year. The Great Lake is the largest freshwater body in Southeast Asia and a vital part of the Mekong hydrological system. It is furthermore called “the nursery of all migrating fish species in the Mekong”.

The Tonle Sap's mean water-surface area changes from 2,500 Km² to 3,500 Km² during the dry season (January to April-May) to a maximum of up to 14,500 Km² during the wet season (**4-5 times larger**). Water depths up to 9.0 m can be reached (in the dry season not more than 0.7 to 1.0 m²) from late September to early October. However, the seasonal storage of water stored in the Great Lake goes from as low as 1 to 2 km³ (= 1 to 2 million m³) to 50 or 80 km³ (= 50 to 80 million m³), or in average **50 times more** in the flood season. The differences between the water level in the Great Lake and the water level at Chaktomuk cause the unique flow reversal in the Tonlé Sap River.

The Tonlé Sap navigation branch starts from a width of 420.0 m at the river mouth at Chaktomuk to barely 80.0 m midway (because the main Tonlé Sap river branch is used by the fishermen over the entire width of the channel for their fishing activities). The small western river arm is also the only channel that passes the port of Kompong Chhnang.

Chhnock Trou is the last river port before the Great Lake. The river is extremely wide and very shallow. The UHA atlas gives negative water depths for the channel entrances (above chart datum), whilst the earlier referenced feasibility study on dredging in the Tonlé Sap mentions that the average water depth of the Great Lake is not more than 0.7 m during the low water season.

Stretch 16: Phnom Penh Chaktomuk (km 347) to Phnom Penh NCT LM17 (km 322) (25 km)

The Chaktomuk area is a four-river water distribution system. All water comes from the upper Mekong and, during a certain period of the year, from the Tonlé Sap, which is returning the water it had caught (and stored in the Great Lake) a few months before. The river bottom of the Chaktomuk is unstable and sand banks are moving back and forth according to the period of the year and the flow patterns. Nevertheless, this stretch of the Mekong River upstream of the Phnom Penh Autonomous Port (PPAP) keeps its importance due to its accessibility for sea going vessels (3,000 DWT) going up the Mekong until Tonlé Bet.

There used to be extensive maintenance dredging in the Chaktomuk area to create access to the former Phnom Penh port in the Tonlé Sap and to activate a better inflow in the Tonlé Sap for filling the Great Lake. However, nowadays the dredging has shifted downstream to guarantee continuous accessibility for the new Container Terminal of the PPAP for sea-going vessels (up to 5,000 DWT) and self-propelled barges sailing to Ho Chi Minh City and the Cai Mep - Thi Vai ports. The Ksom channel in front of the new Container Terminal of the PPAP is therefore a priority.

Yearly maintenance is now a fact. Ships and barges can reach the new Container Terminal of the PPAP without any problem. However, upstream of the Container Terminal there are a few shoals around Km 341.0 to Km 343.0. The natural Mekong at this place only has 4.5 m water depth below chart datum. Towards the left riverbank of the Mekong at Chaktomuk there are water depths of 8.2 to 8.5 m which are not a problem for shipping.

Stretch 17: Phnom Penh NCT LM17 (km 322) to Cambodia - Viet Nam border (km 251) (71 km)

The river is generally deep, straight and shows only a few shallows in this area. There is heavy erosion of the right bank between km 307.0 and Km 314.0 and many bank protections in front of industrial land and LPG-tank farms have failed. The channel leans close to the right bank, which consists of over-saturated, unconsolidated fine sand to silt with little to no resistance to erosion.

² Reference: MRC study named: "Technical Feasibility study of Dredging the Tonlé Sap Lake for Navigation", September 2008

A shoal is quickly growing just upstream the right river arm of the Kaoh Kandal island where a sandbank is emerging, obstructing the navigation channel (Km 316.0). The water used to be deep enough but is now silting up to water depths of merely 0.3 to 0.5 m. A dredging authorization has been issued by the Ministry of Mines and Energy for the PPAP to dredge the Koh Keo channel (estimated volume = 7.4 million m³ sand). There are no other difficulties worth mentioning for shipping, even for sea going vessels with a draught of 7.0 m, between the border and the new Container Terminal of the PPAP.

Stretch 18: Cambodia – Viet Nam border (km 251) to Junction Vam Nao River (km 218) (33 km)

The Mekong mainstream is generally deep, with large bend radii for sea going vessels and few shallows. The entire stretch is well equipped with aids to navigation: buoys, shore marks and leading lines. The “physical” barriers or navigation problems are mainly related to shallows and sometimes short bend radii with poor visibility.

The next drawing shows the river just downstream Tan Chau. Starting from a narrow section in front of the city of Tan Chau, the Mekong river splits into three branches, named A, B and C. Branch A is only navigable for smaller boats and vessels: LAD = 3.4 m. In Branch B, which was the recommended navigation channel, LAD = 4.5 m. Branch C is now the actual channel with depths of over 7.3 m below chart datum.

Further downstream there is a split between the [Northern] Vam Nao pass access (Western branch) and the Mekong mainstream (Eastern branch). Seagoing vessels and big barges taking the Western branch have to go to the Vam Nao pass and further to the Bassac (Hau). Seagoing vessels and barges taking the Eastern branch will have to stay in the Mekong mainstream in order to reach Ho Chi Min City and Cai Mep.

Stretch 19: Junction Vam Nao River (km 218) to Entrance to Cho Gao Canal (km 66) (152 km)

The Mekong Mainstream here has water depths of minimum 7.0 m deep below chart datum except in a few sections. Downstream of the My Thuan bridge (km 125.0), the river splits in two arms: the Northern branch being the Mekong mainstream (830.0 m wide) and the Southern branch being the Co Chien river (900.0 m wide). The main navigation channel (Northern River branch) becomes less deep (from over 20.0 m deep to less than 9.0 m deep at Km 120.0). At Km 115.0 there is a sharp bend to the right ending in a narrow section of not more than 310.0 m wide but 30.0 m deep. At Km 112.0, there is another split of the mainstream leading to the busy Cai Be River in Cai Be town. The mainstream channel is the Southern channel, which has water depths of over 8.0 m.

Where the Northern branch meets the Mekong mainstream again (Km 99.5) the river is remarkably narrow (355.0 m) and very deep (45.0 m). At Km 95.0 the Mekong splits again in two branches: a Northern and a Southern Branch, the latter called Ham Luong River. Just before the split, the river is 2.0 km wide, but the Northern branch remains 8.0 m deep. The Ham Luong River (Southern river arm) is one of the nine river mouths of the Mekong delta estuary.

Navigation continues along the Northern river arm, relatively straight and deep. However, between Km 88.5 and Km 90.5, the navigation channel is only 7.1 to 7.5 m deep. Until the city of My Tho (Km 70.0) the river keeps its water depth of 8.0 m. However, navigation in this area is very dense and sea going vessels have been allocated their own channel, which is properly marked by buoys.

The entrance of the Cho Gao canal is at Km 66.0 and the last 5 km have only a water depth of 7.2 to 7.5 below chart datum.

Stretch 20: Cho Gao Canal to Ho Chi Minh and Cai Mep (116 km)

This shipping route is a labyrinth of canals and rivers (belonging to the Saigon River Delta) to reach the ports of Cai Map by barge. All of them are extremely busy and a great number of small domestic vessels and local passenger boats are all over the place, making it even more difficult for bigger vessels and barges to proceed through the canals. Therefore, bigger vessels and barges are requested to reduce their speed and use extreme precaution, especially in the bends.

Statistics show that, per day, 1,400 boats between 200 DWT and 1,000 DWT circulate on the canal. In peak days, this can even reach 1,800 boats per day. Traffic congestion and accidents are therefore frequent. The canal is actually being upgraded in different phases. The canal is being dredged, deepened and widened side by side, including bank protections, with the first half completed in 2014. The second half will start at end of 2015. The intention is to connect the port of Can To with Ho Chi Minh City and Cai Mep through the Ho Chi Minh - Chanh canal – Nuyen Van Tiep canal – Tien River (= Mekong mainstream) – Hau River (= Bassac) – Tri Ton – Tam Ngan Canal.

As long as the upgrading works are ongoing, no vessels bigger than 200 DWT and self-propelled barges of 70-80 TEU can use these canals which has the ultimate advantage of avoiding the open sea in order to reach Cai Mep.

Stretch 21: Entrance to Cho Gao Canal (km 66) to Cua Tieu - Mekong Mainstream Mouth (km 0) (66 km)

The Mekong Mainstream mouth in the Sea (Cua Tieu) is only navigable for commercial navigation at high tide. Water depth at low tide over the bar of Cua Tieu, which extends 11 miles from the entrance, can be less than 1.2. Due to the tidal currents and corresponding sediment transport, it is impossible to maintain a sufficiently deep navigation channel.

Therefore, the allowable draft of a vessels crossing the Cua Tieu depends on the depth of water on the bar plus the tide at Mui Vung Tau (tidal LLW = - 0.3 m, tidal HHW = + 4.0 m at spring tide).

Stretch 22: Junction Mekong - Vam Nao River (km 218) to Entrance Vam Nao Pass in Bassac River (km B188) (24 km)

The Western channel (towards the Vam Nao and the Bassac) has water depths of 8.0 m or higher until the entrance of the Vam Nao pass.

The Vam Nao pass is a natural connection between the Mekong mainstream (Tien) and the Bassac River (Hau) being 6.0 Km long and about 490.0 m wide. It is the only natural connection between these two important waterways; the others are man-made canals from which a few are to be/will be upgraded to have access for vessels and barges of up to 2,000 DWT.

The Vam Nao pass connects to the Hau (Bassac) with a sharp curve of approximately 1,500 m radius. Sea going vessels of 5,000 DWT and 10,000 DWT have problems as they need about 2,500 m radius (PIANC recommendations). During the flood season the current may be another additional problem, especially for downstream vessels. The Cambodian Master Plan recommended the dredging of the inner circle of the curve, which was estimated at 7 million m³.

The entire Vam Nao pass is over its entire length deeper than 11.0 m, making it a suitable navigation channel for sea-going vessels over the Bassac (Hau) river.

STRETCH 23: ENTRANCE VAM NAO PASS IN BASSAC RIVER (KM B188) TO CAN THO (KM B106) (82 KM)

A few kilometers downstream of the junction with the Bassac, the Bassac splits into two river branches. The northern river branch is suitable for vessels of not more than 5.0 m draught (km B166.0) whilst the southern branch has water depths of minimum 12.0 m deep. However, 2.6 Km

downstream of the split, there is a bundle of high-tension cable lines crossing the river from which the air clearance reportedly is only 15.0 m.

Where the two branches join again at the southern tip of the island, there is the city of Long Xuyen and the river mouth of the Long Xuyen River. The river remains deep (17.0 m) but only 340.0 m wide. There follows a long straight and deep stretch with lots of industrial settlements at the right river bank and numerous jetties.

At Km B149.0, the Bassac splits again in two branches, of which the northern branch is the deepest and the navigation channel. The river is straight, deep (14.0 m) and wide (1,150 m).

The Bassac continues to be straight, deep (avg. 14.0 m) and wide (avg. 750 - 800 m).

Stretch 24: Can Tho (km B106) to Entrance Quan Chanh Bo Canal (km B33) (73 km)

Downstream of Can Tho, the Bassac River splits into a number of braiding branches parallel to each other, each taking the share of "Bassac" discharge towards the sea (Sông Trà Ôn and Sông Hậu). At Km B77.0, the total width of the river arms is 3.2 km. Nevertheless, the water depths remain between 20.0 and 9.0 m.

However, at Km B71.0 there is a shallow that requires almost yearly dredging, where water depths in the navigation channel are only 5.7 m.

Further downstream until the entrance of the Quan Chanh Bo canal (Km B33.0), the river remains straight and deep (never less than 8.0 meters).

The entrance to the Quan Chanh Bo canal is at the left river bank but the navigation channel follows the right river bank. Hence, a shoal has to be crossed, about 4 km and 100 m wide, in order to enter the shortcut canal. It is believed that this channel to the entrance of the Quan Chanh Bo canal will be part of the project of Quan Chanh Bo canal, but maintenance dredging is likely to be done on a regular basis.

Stretch 25: Entrance Quan Chanh Bo Canal to Quan Chanh Bo Canal mouth in the sea (32 km)

The Quan Chanh Bo canal was approved by a Decree of the Ministry of Transport nr. 3744/QĐ-BGTVT of 30 November 2007, while adjustments to the project of Quan Chanh Bo canal were approved by Ministerial Decree nr. 2368/QĐ-BGTVT of 09 August 2013. The major works consist of a navigation channel 44.0 km long (12.0 km in the Hau River, 19.0 km in the Quan Chanh Bo Canal, 8.0 km in the Tat Channel and 5 km sea channel), a South breakwater 2.4 km long, bank revetments along the Tat channel, 5 km of road construction for the local residents, one new ferry, a barge berth (500 t), a channel management station and an Aids to Navigation system over the entire project of Quan Chanh Bo canal.

Total cost of the works of Quan Chanh Bo canal is estimated at 9,781 billion VNDong (450 million US\$). These works have been financed by Ministerial budget. They are scheduled to be completed in 2017.

The project of Quan Chanh Bo canal will allow ships of 10,000 DWT fully laden and 20,000 DWT with reduced load to enter the Bassac.

ANNEX 2 : NATIONAL SURVEYS OF LOCAL IWT

Summary of local survey results in Lao PDR

Lao PDR

Survey areas: Huay Xay, Pak Tha, Pak Beng, Luang Prabang, Ban Donmai, Wat Nong and Nakasang passenger port

Reasons for using IWT	Issues	Improvements
<ul style="list-style-type: none"> Transporting goods (agricultural) to and from markets IWT is cheaper and there is limited access to roads Passengers enjoy travelling by boat due to the environment Safer and less accidents than road transport Access to cargo and national ports 	<ul style="list-style-type: none"> Boats do not have lifejackets, buoys or fire extinguishers onboard No warning facilities for navigation accidents Poor access to ports and/or no cargo facilities exist Larger boats are required for passengers Low water levels restricts navigation and rapids/reefs are hazardous Water pollution from oily wastes and re-fuelling activities, solid wastes/garbage 	<ul style="list-style-type: none"> Providing safety, emergency response and communications equipment Improving the legal system to ensure sustainable development Promoting IWT and tourism Enhancing the existing port facilities; Improving the navigation channel and aids to navigation Building capacity and improving coordination between line agencies

Summary of local survey results in Thailand

Thailand

Survey areas: Chiang Saen, Chiang Khong, Nakhon Phanom and Mukdahan

Issues	Improvement	Cross-border
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- The main problem is the different standards in Lao PDR and Thailand for managing IWT
- Water transportation is difficult in the dry season due to low water levels
- Improve laws and regulations of both Thailand and Lao PDR
- Apply international standards for managing IWT
- Increase boat capacity for cargo and passengers
- Enforcement of safety rules for passengers
- Sustainable and not lead to environmental degradation
- Enhance the collaboration between China, Thailand, Lao PDR and Myanmar
- Simplifying procedures and regulations for cross-border transport between Lao PDR and Thailand
- More staff are required to monitor the condition of vessels, passenger safety and customs
- IWT could be expanded to relieve congestion on the friendship bridge
- Identify more economic opportunities for local people

Summary of local survey results in Cambodia

Cambodia		
Survey areas: Kompong Cham, Kompong Chhnang, Chong Khneas		
Reasons for using IWT	Issues	Improvements
<ul style="list-style-type: none"> • Farming and employment along the river • No access to roads and bridges • Unsafe roads and long distance from housing • High costs of other transport modes 	<ul style="list-style-type: none"> • High transport costs due to the price of fuel • Relatively low carrying capacity of the vessels • Low water levels in the dry season and storms/flooding impact on safety and efficiency • Legal instruments for IWT have not yet been fully implemented 	<ul style="list-style-type: none"> • Developing safer, cheaper and more efficient services • Using larger passenger and cargo vessels • Establishing better port/passenger facilities and waste management plans • Increasing participation from the private sector • Reviewing pricing of fuel and transport costs • Implementing a legal framework and improving cooperation among line agencies

Summary of local survey results in Viet Nam

Viet Nam: Passengers		
Ninh Kieu Cruise Terminal, Can Tho port (fishing village area), Chau Doc port		
Reasons for using IWT	Issues	Improvements
<ul style="list-style-type: none"> • Employment, access to markets and 	<ul style="list-style-type: none"> • Delays for ferry and 	<ul style="list-style-type: none"> • Enhancing awareness on Law on Inland Waterway Transport as

transporting goods	passenger services	well as vessel safety
<ul style="list-style-type: none"> • Visiting family, friends and tourist attractions/entertainment • Going to the floating markets in Viet Nam and tourist attractions in Cambodia 	<ul style="list-style-type: none"> • Pollution at Cai Rang and Phong Dien floating markets and the waterway • Solicitation by tour operators/travel agencies • Prices vary between different travel agencies 	<ul style="list-style-type: none"> • Ensuring passenger boats are carrying lifesaving and other equipment • Increasing the number of ferries and passenger services operating in order to reduce wait time

Viet Nam: Boat owners and operators		
Survey areas		
Ninh Kieu Cruise Terminal, Can Tho port (fishing village area), Chau Doc port		
Issues	National	Cross-border
<ul style="list-style-type: none"> • Limited knowledge on traffic safety • Declining tourist number for IWT is affecting income • Current passenger fares are too low • Environmental issues along the waterway, especially at the floating markets • Procedures for passenger transport and Chau Doc border are still very complicated 	<ul style="list-style-type: none"> • Reviewing pricing structure of fares and monitoring tour operators • Promoting awareness to reduce pollution and solid wastes • Maintaining the navigation channel at Chau Doc port to ensure access for large passenger vessels • Upgrading the Chau Doc passenger port 	<ul style="list-style-type: none"> • Enhancing coordination between the Inland Waterborne Port Authority - Region IV and Vinh Xuong customs • Simplifying procedures for cross-border passenger transport • Improving the connections between Can Tho/Chau Doc and Phnom Penh

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