Chapter 19 Future Vessel Size of the IWT Fleet

19.1 Existing vessel fleet

Fleet capacity and average vessel size of IWT in Vietnam have been increasing in recent years according to Statistical Year Book of General Statistical Office, although this source is said to not fully reflect the actual situation (see **Table 19.1.1**).

According to VIWA, fleet capacity in Vietnam as of 31/12/1997 is as follows:

Pushing & towing tugboat:	90,500 CV
Barge:	454,500 DWT
Self-propelled vessel:	349,300 DWT
Small vessel:	396,200 DWT

On the other hand, registered IWT fleet as of January 2002 is 1.4 million DWT for cargo vessel, 1.0 million DWT for barge and 0.24 million seats for passenger boat according to the Vietnam Register database (see **Table 19.1.2**). Northern region accounts for 36% of DWT for cargo vessel/barge and 16% of seats for passenger boat according to the said source (see **Table 19.1.3**).

Peculiarities and the latest trends of vessel deployment of IWT in the RRD are as follows:

- Barge trains are mainly used for transport of bulk cargo such as coal and construction material. Prevailing size of barge is 200 DWT and barge trains of "4@200DWT+Pushing Tug" are commonly deployed.

- Barges of 300, 400 and 500 DWT have recently been introduced, however, barge trains consisting of these larger barges are deployed at specific locations (coal ports - offshore anchorages, Quanh Ninh - Pha Lai Power Plant or Ninh Binh) or in specific season (excluding low water season) with special caution in navigating for coal transport (see **Table 19.1.4** and **Table 19.1.5**).

- Self-propelled vessels of larger than 100 DWT are mainly used for transport of cargo in bag including import cargo unloaded at major northern seaports. Self-propelled river vessels of 600 DWT (draft=2.0m), which can pass through the Duong Bridge almost all the year round, have been introduced between Quang Ninh Port and river ports in the RRD since year

1999.

- Small vessels/barges of no more than 100 DWT are mainly used for short-haul transport (intra-province) or family use.

- Sea-cum-river vessels of 1000 DWT were introduced to IWT corridor 3 (Cua Day - Ninh Binh) in 2000 (see **Table 19.1.6**). This type of vessel is mainly deployed for coal transport from Quang Ninh to Ninh Binh through coastal route. Transit time of coastal route is 17 hours, which is less than half of IWT corridor 2 through Luoc River (38 - 48 hours). But for this type of vessel to operate smoothly, dredging work at 1 km section of Cua Day river mouth is indispensable.

- Average load factor is reported to be 60 - 65 %. Namely, when vessels are in fully laden condition at outbound voyage, only 20 - 30 % of them are in fully laden condition at inbound (returning) voyage and the rest 70 - 80 % of vessels are in ballast condition.

- Movable bridge (cabin) system, which can decrease the maximum height of vessel and facilitate passing through bridges of low air clearance, has recently been introduced in IWT with no significant cost.

- There is no scheduled (liner) service, but services on demand (tramp).

- Container barge train (4@36TEU+Pushing Tug) has recently been deployed in IWT between Hai Phong Port and its offshore lightering anchorages, or "roadshed". Container barge train requires reinforced hull and pusher with movable bridge (cabin) system.

Table 19.1.1 Fleet Capacity of IWT in Vietnam (GSO data)

Vessels	Unit	1995	1996	1997	1998	1999
Pushing &Towing Tugboats	Vessels	784	709	770	853	874
	HP	96,000	87,500	104,600	138,800	119,000
	Ave. HP	122	123	136	163	136
Cargo Ships	Vessels	21,014	20,778	25,044	26,737	33,878
	Tonnage	380,600	396,200	480,000	607,000	786,700
	Ave. Tonnage	18	19	19	23	23
Barges	Vessels	1,877	1,996	1,802	1,676	1,594
	Tonnage	268,500	324,700	311,300	256,700	342,400
	Ave. Tonnage	143	163	173	153	215

Source) Statistical Yearbook 2000, General Statistical Office

Table 19.1.2 Vessel Fleet for IWT in Vietnam by Type (VR data)

Type of Vessel		No. of Vessel	CV	Capacity		Average Age
Dry Cargo Vessel	State Sector	788	54,862	66,287	DWT	9.65
	Private Sector	49,983	1,255,521	1,233,044	DWT	8.99
	Total	50,771	1,310,383	1,299,331	DWT	
	Share of State	2%	4%	5%		
Liquid Cargo Vessel	State Sector	104	17,831	19,864	DWT	12.1
	Private Sector	727	106,020	107,000	DWT	7.53
	Total	831	123,851	126,864	DWT	
	Share of State	13%	14%	16%		
Dry Cargo Barge	State Sector	1,157		269,807	DWT	19.41
	Private Sector	4,104		634,003	DWT	10.79
	Total	5,261		903,810	DWT	
	Share of State	22%		30%		
Liquid Cargo Barge	State Sector	64		22,442	DWT	15.88
	Private Sector	322		57,352	DWT	10.09
	Total	386		79,794	DWT	
	Share of State	17%		28%		
Tug Boat	State Sector	735	119,402	1,118,478	kg	20.04
	Private Sector	2,231	299,717	2,812,632	kg	10.57
	Total	2,966	419,119	3,931,110	kg	
	Share of State	25%	28%	28%		
Passenger Boat	State Sector	627	58,641	24,292	Seat	7.95
	Private Sector	9,391	366,210	216,781	Seat	8.53
	Total	10,018	424,851	241,073	Seat	
	Share of State	6%	14%	10%		
Floating Crane	State Sector	102	1,666	2,315	DWT	15.22
	Private Sector	507	14,713	13,784	DWT	7.53
	Total	609	16,379	16,099	DWT	
	Share of State	17%	10%	14%		
Dredger	State Sector	97	18,342	38,299	sq. m/h	38.96
	Private Sector	114	12,963	16,308	sq. m/h	10.06
	Total	211	31,305	54,607	sq. m/h	
	Share of State	46%	59%	70%		
Others	State Sector	1,057	70,692	186,055		11.19
	Private Sector	1,999	68,421	48,272		8.07
	Total	3,056	139,113	234,327		
	Share of State	35%	51%	79%		
Total	State Sector	4,731	341,436			14.63
	Private Sector	69,378	2,123,565			9.04
	Total	74,109	2,465,001			
	Share of State	6%	14%			

Source) Vietnam Register, as of Jan. 2002

Table 19.1.3 Vessel Fleet for IWT in Vietnam by Region (VR data)

		No. of Vessel	CV	Capacity	
				(DWT)	(Seat)
Northern Region		10,978	582,793	862,220	38,186
	Red River Delta	6,858	401,003	644,349	16,179
	North East	3,892	173,726	215,959	19,438
	North West	228	8,064	1,912	2,569
Other Regions		63,131	1,882,208	1,547,579	202,887
Total		74,109	2,465,001	2,409,799	241,073
Share of Northern Region		15%	24%	36%	16%

Source) Vietnam Register, as of Jan. 2002

Table 19.1.4 Size of Barge Train System (NOWATRANCO)

Total DWT	Configuration	Total Length	Total Breadth	draft	Speed (km/h)	Power
800	4@200DWT +Pushing Tug	90m	14.4m	1.1m	(-)	135 - 185CV
1200	4@300DWT +Pushing Tug	101m	16.8m	1.35m	(-)	171 - 190CV
1600	4@400DWT +Pushing Tug	109m	18.4m	1.2m	(-)	223CV

Note) Large barge trains of "4@400DWT+Pushing Tug" of NOWATRANCO are mainly deployed in route from Quang Ninh to Pha Lai Power Plant. For safe navigation of these large barge trains, the common measures applied are the operation with caution and slowdown speed during passing narrow sections or sharp bends. During very low water level period, it may even require to split the barge train to make it shorter when passing sharp bends or reduced in width to pass through narrow channel section.

Source) NOWATRANCO

Table 19.1.5 Size of Barge Train System (Ninh Binh Port)

Total DWT	Configuration	Total Length	Total Breadth	draft	Speed (km/h)	Power
800	4@200DWT +Pushing Tug	91m	14.0m	1.2m	3.5-4.5	135CV
800	2@400DWT +Pushing Tug	95m	9.0m	1.6m	7.5-8.5	135CV
1600	4@400DWT +Pushing Tug	95m	18.0m	1.6m	(-)	(-)
2000	4@500DWT +Pushing Tug	(-)	(-)	(-)	(-)	(-)

Note) Large barge trains of "4@x 400-500DWT+Pushing Tug" of TUCIW are only deployed for coal transport in Ha Long bay routes from coal ports to Hon Net Ancorage to fill large ships berthing in this area. Barge trains of "2@400DWT- 500DWT+Pushing Tug" are deployed in Corridor 2 for around 2months per year during high water period with slowdown speed when passing through sharp bends.

Source) TUCIW (Ninh Binh Port)

Table 19.1.6 Size of Sea-cum-River Vessel (Ninh Binh Port)

DWT	Length	Breadth	Height	draft	Speed	Power
500	42.0m	8.0m	3.1m	2.6m	13.9 km/h	(-)
600	59.0m	9.0m	2.9m	2.0m	14.8 km/h	2@135CV
800	56.0m	10.0m	2.5m	2.0m	15.7 km/h	2@225CV
1,000	73.7m	10.8m	3.9m	3.0m	16.7 km/h	2@225CV

Note) data unavailable

Source) TUCIW (Ninh Binh Port)

Table 19.1.7 Size of Sea Vessel (900 -1100 DWT)

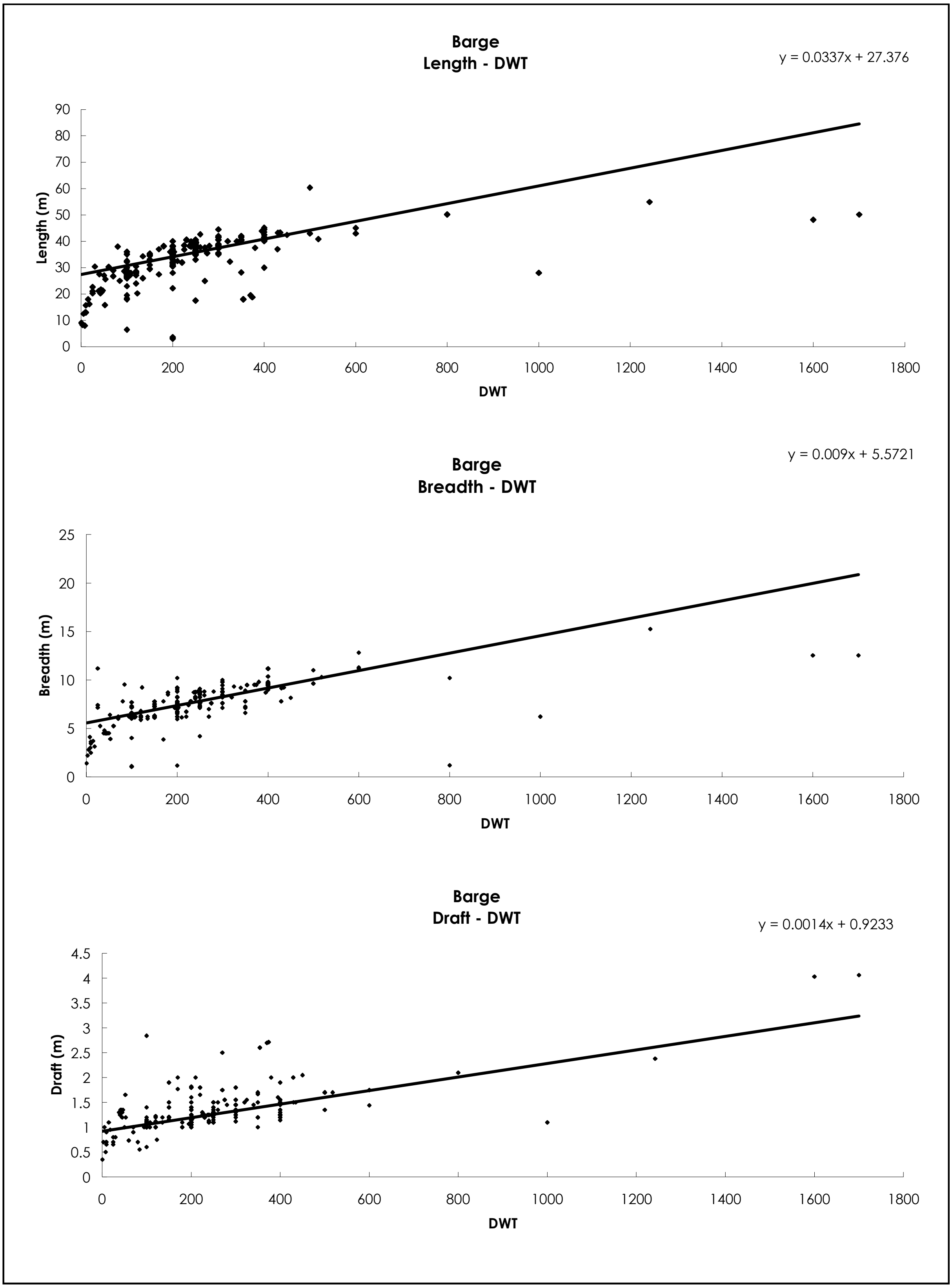
No	Vessel	DWT	L	B	d	Speed		Power	Year
						knot	km/h		Built
1	HOANG PHUONG 16	905	52.70	8.31	3.85	8.0	14.8	408	1995
2	HOANG DUNG 18	906	52.00	8.75	3.50	7.5	13.9	305	1997
3	MINH KHAI 09	911	53.14	9.00	3.60	10.0	18.5	520	2001
4	NGAN HA 09	915	53.65	8.82	3.75	7.5	13.9	408	1995
5	HOANG PHUONG 18	916	59.41	8.46	3.85	9.0	16.7	305	1986
6	THUAN PHAT	923	56.95	8.42	3.95	8.5	15.7	408	1988
7	HUU NGHI 27	929	49.35	8.92	3.60	8.5	15.7	526	1996
8	PHUONG NAM 19	934	49.66	8.67	3.88	8.0	14.8	325	1993
9	Dau Khi 108	941	53.34	11.60	3.81	12.0	22.2	3,000	1975
10	TAN VIET 09	942	55.20	8.18	4.10	8.8	16.3	305	1985
11	XLDC - 98	954	56.10	17.10	2.30	(-)	(-)	(-)	1998
12	TAI CHINH II	955	56.00	9.98	4.50	10.0	18.5	980	1978
13	HANG HAI	963	56.95	8.42	4.05	7.5	13.9	408	1990
14	THUY NGUYEN 09	963	56.95	8.44	4.05	7.5	13.9	408	1986
15	An Lu 05	980	52.80	8.65	3.95	8.0	14.8	408	1995
16	QUOC VIET 09	993	54.00	8.62	3.85	8.8	16.3	428	1995
17	THINH CUONG 12	999	57.10	8.42	4.15	8.0	14.8	400	1985
18	Ap Bac 01	1,000	67.00	9.92	4.10	9.0	16.7	640	1942
19	THANH BINH 09	1,000	73.32	10.52	2.70	10.0	18.5	610	1987
20	MINH TUAN 02	1,002	53.75	8.59	3.80	9.2	17.0	408	1998
21	QUANG VINH 07	1,046	58.10	9.30	3.60	10.0	18.5	408	2001
22	HONG LINH 06	1,047	56.80	8.22	4.05	8.0	14.8	305	1995
23	SONG HAU	1,064	61.90	10.04	3.96	11.0	20.4	800	1996
24	SAO MAI 02	1,080	64.40	14.30	4.70	12.0	22.2	7,040	1981
25	HADUCO 01	1,080	68.35	11.03	3.80	11.0	20.4	1,800	1997
26	HOANG DAT 27	1,086	60.60	8.22	4.15	8.0	14.8	470	1987
27	HUNG PHAT 09	1,090	54.50	7.52	4.40	8.0	14.8	400	1970
28	An Lu 09	1,093	57.45	8.85	4.20	8.0	14.8	408	1995
29	KY VAN 01	1,100	57.70	12.60	4.05	12.0	22.2	4,800	1983
30	KY VAN 02	1,100	57.70	12.60	4.00	12.0	22.2	4,800	1983

Source) Register of Ship 2000-2001, Vietnam Register

Table 19.1.8 Standard Vessel Size for IWT (VIWA)

Type	Size	Length	Breadth	draft	air draft
River Barge	100 - 150 DWT	30.2m	6.4m	1.0m	(-)
	200 DWT	36.0m	7.0m	1.15m	(-)
	400 DWT	41.5m	11.2m	1.25m	(-)
	600 DWT	57.0m	12.2m	1.45m	(-)
Self-propelled Vessel	100 - 200 DWT	32.0m	8.0m	1.5m	(-)
	250 - 300 DWT	40.0m	9.0m	1.6m	(-)
Tugboat	135 CV	18.0m	4.0m	1.4m	(-)
	150 CV	19.6m	3.7m	1.4m	(-)
	270 CV	20.0m	6.0m	1.5m	(-)
Sea-cum-river Vessel	200 DWT	36.35m	7.0m	1.95m	9.75m
	400 DWT	48.50m	8.2m	2.8m	18.3m
	650 DWT	51.50m	9.0m	3.0m	19.3m
	1000 DWT	80.75m	10.5m	3.0 - 3.2m	19.1m

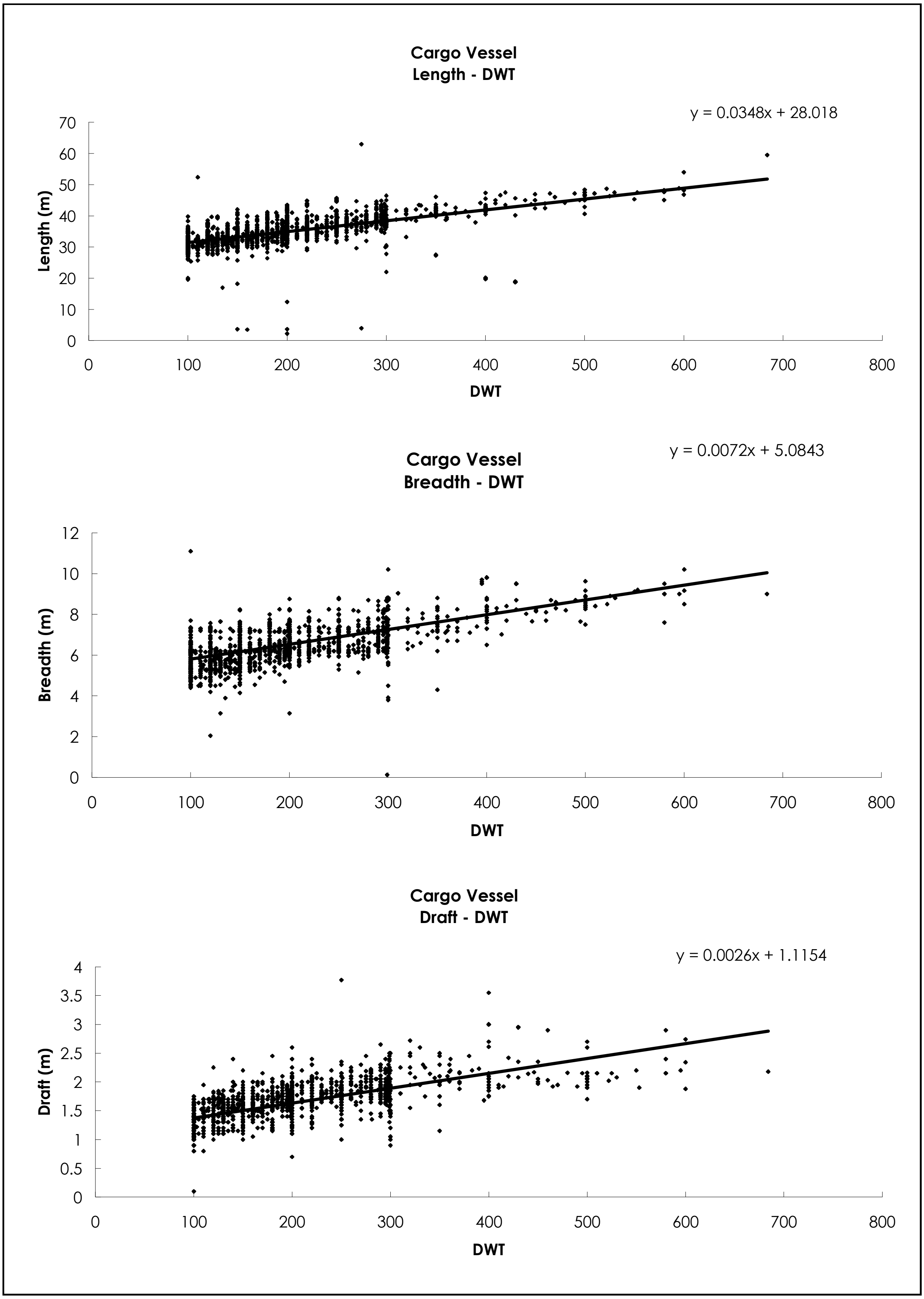
Source) VIWA



Note) Incomplete data is omitted.

Source) Analyzed by JICA Study Team based on VR database of 2001

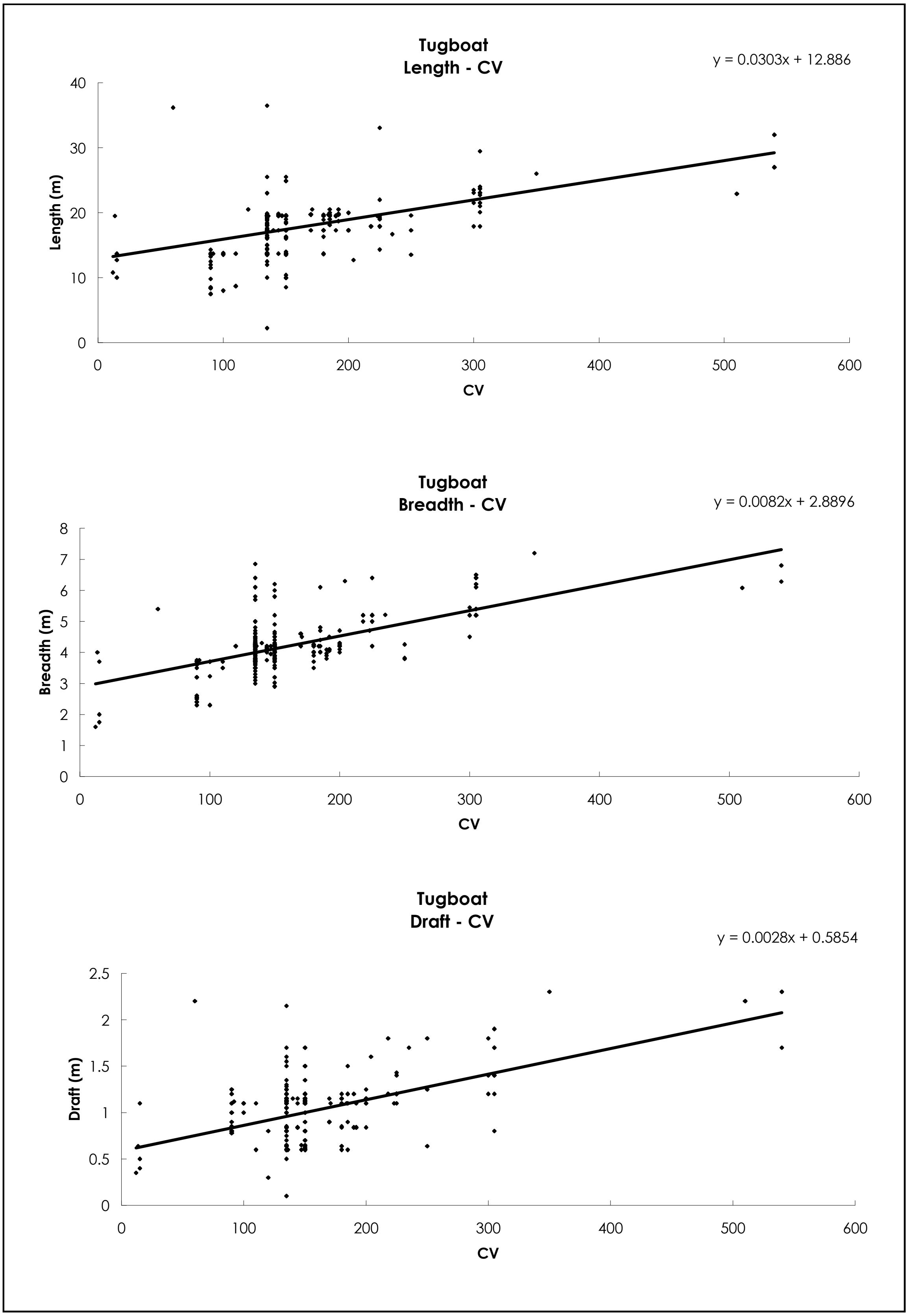
Figure 19.1.1 Dimensions of Barge for IWT in the Northern Region



Note) Incomplete data and data less than 100 DWT are omitted.

Source) Analyzed by JICA Study Team based on VR database of 2001

Figure 19.1.2 Dimensions of Self-propelled vessel for IWT in the Northern Region



Note) Incomplete data is omitted.

Source) Analyzed by JICA Study Team based on VR database of 2001

Figure 19.1.3 Dimensions of Tugboat for IWT in the Northern Region

Table 19.1.9 Trial Calculation of Vessel Size for IWT

Average Size of Barge Train

Barge train		Pushing Tug CV
Unit	DWT	
4	200	135

	Barge tr.	Pushing Tug	Total
Length	68.23	16.98	85.21
Breadth	14.74	4.00	14.74
draft	1.20	0.96	1.20

Barge train		Pushing Tug CV
Unit	DWT	
2	400	250

	Barge tr.	Pushing Tug	Total
Length	81.71	20.46	102.17
Breadth	9.17	4.94	9.17
draft	1.48	1.29	1.48

Barge train		Pushing Tug CV
Unit	DWT	
2	600	200

	Barge tr.	Pushing Tug	Total
Length	95.19	18.95	114.14
Breadth	10.97	4.53	10.97
draft	1.76	1.15	1.76

Barge train		Pushing Tug CV
Unit	DWT	
4	400	250

	Barge tr.	Pushing Tug	Total
Length	81.71	20.46	102.17
Breadth	18.34	4.94	18.34
draft	1.48	1.29	1.48

Barge train		Pushing Tug CV
Unit	DWT	
2	800	250

	Barge tr.	Pushing Tug	Total
Length	108.67	20.46	129.13
Breadth	12.77	4.94	12.77
draft	2.04	1.29	2.04

Barge train		Pushing Tug CV
Unit	DWT	
4	600	400

	Barge tr.	Pushing Tug	Total
Length	95.19	25.01	120.20
Breadth	21.94	6.17	21.94
draft	1.76	1.71	1.76

Barge train		Pushing Tug CV
Unit	DWT	
4	800	500

	Barge tr.	Pushing Tug	Total
Length	108.67	28.04	136.71
Breadth	25.54	6.99	25.54
draft	2.04	1.99	2.04

Average Size of Self-propelled Vessel

DWT	100	200	300	400	500	600	700
Length	31.50	34.98	38.46	41.94	45.42	48.90	52.38
Breadth	5.80	6.52	7.24	7.96	8.68	9.40	10.12
draft	1.38	1.64	1.90	2.16	2.42	2.68	2.94

Source) Calculated by JICA Study Team based on VR database 2001.

19.2 Future vessel size in the Red River Delta

19.2.1 Standard dimensions of navigation channel

In Vietnam, standard dimensions of navigation channel are applied according to "Design Standard on Channel Training Work for River Vessels (registered as 22 TCN 241-98, promulgated with Decision No. 184 QD/KH-KT issued by Minister of Transport)". Outline of standard dimensions of navigation channel is summarized as follows:

(1) Standard LAD

Standard LAD is defined according to the following formula:

$$\mathbf{H = t + \Delta H} \qquad \mathbf{(19.2.1)}$$

where H: Standard LAD of channel (m)

t: Standard draft of vessel (m)

ΔH: Required water depth allowance (m)

for riverbed of sand/mud

$\Delta H = 0.2 - 0.3$ where LAD < 1.5m

$\Delta H = 0.3 - 0.4$ where LAD = 1.5m - 3.0m

$\Delta H = 0.4 - 0.5$ where LAD > 3.0m

for riverbed of stone/gravel

It is necessary to add 0.1 - 0.2m to the above value.

(2) Standard channel width

Standard width of two-lane straight channel is defined according to the following formula:

$$\mathbf{B = b_1 + L_1 \sin\vartheta + b_2 + L_2 \sin\vartheta + 2D + \Delta b} \qquad \mathbf{(19.2.2)}$$

where B: Standard width of two-lane straight channel (m)

b_1, b_2: Widths of vessel/barge train (m)

L_1, L_2: Lengths of vessel/pushed barge train (length of longest barge in case of towed barge train) (m)

ϑ: Drifting angle of vessel/barge (3 - 5 degree)

D: Allowance between vessel side and channel limit (m)

Δb: Allowance between vessel sides (m)

Note In ADB study in 1998, a design channel width of 4B (3B - 4.4B) is recommended on condition that two design ships can meet with caution (both must slow down).

Standard width of single-lane straight channel is defined according to the following formula:

$$B = b + L\sin\vartheta + 2D \qquad (19.2.3)$$

At the bend section of channel, it is necessary to decide the width taking into account the bend radius, current velocity etc. and through vessel operation test if possible.

$R > 6L$	no need to increase the width
$R = 3L - 6L$	depends upon current velocity, etc.
$R < 3L$	need to increase the width

If it is impossible to carry out vessel operation test, additional width in bend section can be defined according to the following formula:

$$\triangle B = L^2/(2R + B) \qquad (19.2.4)$$

where $\triangle B$: Additional width in bend section (m)

R: Bend radius of centerline (m)

B: Channel width in straight section (m)

L: Lengths of vessel/pushed barge train (length of longest barge in case of towed barge train) (m)

(3) Minimum bend radius of channel

Minimum bend radius of channel can be defined as 3 times of the length of pushed barge train or 4 times of the length of longest barge in towed barge train according to the following formula:

$$R_{min} = 3L_p \quad \text{or} \quad 4L_t \qquad (19.2.5)$$

where R_{min}: Minimum bend radius of channel (m)

L_p: Length of pushed barge train (m)

L_t: Length of longest barge in towed barge train (m)

Note R_{min} can be reduced up to 2 times of the length of pushed barge train or 3 times of the length of longest barge in towed barge train if channel expanding is applied or if there is a smooth current regime and good visibility for navigation.

19.2.2 Future vessel size

For the future, vessels of larger size and higher speed are considered to be introduced in order to meet the IWT demand which is forecast to considerably increase and to raise the quality and efficiency of services. Peculiarities of annual operating cost of barge train (see **Figure 19.2.1**) can be summarized as follows:

- Annual cost per DWT is greatly affected by the capacity of pushing tug.
  Example: 4 x 200DWT + 135HP: 90US$/DWT ----(h)
  4 x 200DWT + 270HP: 128US$/DWT ----(b = 142% of h)
  2 x 400DWT + 135HP: 75US$/DWT ----(i)
  2 x 400DWT + 270HP: 113US$/DWT ----(c = 151% of i)
- In case HP-DWT ratios are the same, annual cost of larger total DWT is cheaper than that of smaller total DWT.
  Example: 2 x 200DWT + 135HP: 135US$/DWT ----(a)
  4 x 200DWT + 270HP: 128US$/DWT ----(b = 95% of a)
- In case both HP-DWT ratios and total DWTs are the same, annual cost of larger barge is cheaper than that of smaller barge.
  Example: 4 x 200DWT + 270HP: 128US$/DWT ----(b)
  2 x 400DWT + 270HP: 113US$/DWT ----(c = 88% of b)
  4 x 200DWT + 135HP: 90US$/DWT ----(h)
  2 x 400DWT + 135HP: 75US$/DWT ----(i = 83% of h)
- Accordingly, larger barge and barge train have an advantage in view of cost. Furthermore, the introduction of barge train of higher speed which needs a pushing tug of higher power is considered to be accompanied by the introduction of larger barge and barge train.

Table 19.2.1 Annual Operating Cost of Barge Train

Case	Total DWT	Barge Formation	Pushing Tug (HP)	HP-DWT Ratio (HP/DWT)	Annual Cost (US$)	Cost-DWT Ratio (US$/DWT)
a	400	2 x 200DWT	135	0.338	54,054	135
b	800	4 x 200DWT	270	0.338	102,570	128
c	800	2 x 400DWT	270	0.338	90,402	113
d	1,600	4 x 400DWT	540	0.338	172,848	108
e	1,600	4 x 400DWT	400	0.250	144,352	90
f	600	2 x 300DWT	135	0.225	56,082	93
g	1,200	4 x 300DWT	270	0.225	106,678	89
h	800	4 x 200DWT	135	0.169	72,332	90
i	800	2 x 400DWT	135	0.169	60,164	75

Source) Red River Waterways Project, January 1998, ADB

However, larger vessel/barge train requires larger dimensions of waterways. **Table 19.2.2** shows least dimensions of waterways for each type and size of vessel/barge train. Dimensions of vessel/barge train in this table are calculated by the Study Team (see **Table 19.1.9**).

Table 19.2.2 Trial Calculation of Least Dimensions of Waterways

Dimensions of Vessel/barge train					Least Dimensions of Waterways						
Type	Source	Total Length	Total Breadth	draft	Depth (m)	Width (m)			Additional Width (m) at Bend	Bend Radius (m)	
		L (m)	B (m)	d (m)	(m)	3B	4B	5B		3L	4L
Barge Train (4@200DWT+Tug)	VR database	85.21	14.74	1.20	1.6	44	59	74	8	256	341
Barge Train (4@200DWT+Tug)	NOWATRANCO	90.00	14.40	1.10	1.4	43	58	72	9	270	360
Barge Train (4@200DWT+Tug)	TUCIW (NB Port)	91.00	14.00	1.20	1.6	42	56	70	10	273	364
Barge Train (2@400DWT+Tug)	VR database	102.17	9.17	1.48	1.9	28	37	46	12	307	409
Barge Train (2@400DWT+Tug)	TUCIW (NB Port)	95.00	9.00	1.60	2.0	27	36	45	11	285	380
Barge Train (4@400DWT+Tug)	VR database	102.17	18.34	1.48	1.9	55	73	92	12	307	409
Barge Train (4@400DWT+Tug)	NOWATRANCO	109.00	18.40	1.20	1.6	55	74	92	14	327	436
Barge Train (4@400DWT+Tug)	TUCIW (NB Port)	95.00	18.00	1.60	2.0	54	72	90	10	285	380
Barge Train (2@600DWT+Tug)	VR database	114.14	10.97	1.76	2.2	33	44	55	15	342	457
Barge Train (2@800DWT+Tug)	VR database	129.13	12.77	2.04	2.4	38	51	64	20	387	517
Barge Train (4@600DWT+Tug)	VR database	120.20	21.94	1.76	2.2	66	88	110	16	361	481
Barge Train (4@800DWT+Tug)	VR database	136.71	25.54	2.04	2.4	77	102	128	21	410	547
Self-propelled Vessel (300DWT)	VR database	38.46	7.24	1.90	2.3	22	29	36	2	115	154
Self-propelled Vessel (400DWT)	VR database	41.94	7.96	2.16	2.6	24	32	40	2	126	168
Self-propelled Vessel (500DWT)	VR database	45.42	8.68	2.42	2.8	26	35	43	2	136	182
Self-propelled Vessel (600DWT)	VR database	48.90	9.40	2.68	3.2	28	38	47	3	147	196
Self-propelled Vessel (800DWT)	VR database	52.38	10.12	2.94	3.4	30	40	51	3	157	210
Sea-cum-river Vessel (600DWT)	VR database	59.00	9.00	2.00	2.4	27	36	45	4	177	236
Sea-cum-river Vessel (650DWT)	VIWA	51.50	9.00	3.00	3.5	27	36	45	3	155	206
Sea-cum-river Vessel (800DWT)	VR database	56.00	10.00	2.00	2.4	30	40	50	4	168	224
Sea-cum-river Vessel (1000DWT)	VR database	73.70	10.80	3.00	3.5	32	43	54	6	221	295
Sea-cum-river Vessel (1000DWT)	VIWA	80.75	10.50	3.10	3.6	32	42	53	8	242	323

Note) Least depth=draft+0.3m (LAD<1.5m), +0.4m (LAD=1.5-3.0m), +0.5m (LAD>3.0m)

Note) Additional width at bend is calculated in case that bend radius is 400m and channel width in straight section is 4B.

On the other hand, possible future dimensions of waterways in the time range of the Long-term Strategy can be assumed as **Table 19.2.3** taking into account present dimensions of waterways and the effort of VIWA for the development of inland waterways.

Table 19.2.3 Possible Future Dimensions of Waterways

No	Corridor	LAD (m)		LAW (m)		Bend Radius (m)	
		Present	Future	Present	Future	Present (<400m)	Future
1	Quang Ninh - Hai Phong Hai Phong - Hanoi Hanoi - Viet Tri	 1.5 1.5	 2.5 2.5	 30 30	 50 50	 10 bends 0 bends	 400 700
2	Quang Ninh - Hai Phong Hai Phong - Ninh Binh	 1.8	 2.5	 30	 50	 29 bends	 300
3	Cua Day - Ninh Binh	3.6	3.6	30	50	2 bends	400
4A	Lach Giang - Hanoi	2.0	3.6	30	50	2 bends	400
4B	Cua Day - Hanoi	2.0	3.6	30	50	2 bends	400

Note) There may be some locations where it is difficult to realize future dimensions of waterway because of the site condition such as narrow width between dykes.

Accordingly, the following maximum vessel size in the time range of the Long-term Strategy can be assumed taking into account the progress of shipbuilding technology and the effort of VIWA for the development of inland waterways. It should be noted, however, that vessel/barge train deployment of maximum size would sometimes be accompanied with a decline of traffic speed and capacity of navigation channels.

Barge train: 2units@600DWT + Pushing Tug@200CV
(Length=115m, Breadth=11m, draft=1.8m, Speed=8-12km/h)
For: Corridor 1, 3, 4 (except Corridor 2: Quang Ninh - Ninh Binh)
Note: Corridor 2 is excluded taking into account the difficulty in satisfying the requirement of bend radius and the future shifting of coal transport route (Quang Ning - Ninh Binh via Luoc River) to the new route (coastal + Corridor 3).

Barge train: 4units@400DWT + Pushing Tug@250CV
(Length=95-109m, Breadth=18-19m, draft=1.2-1.6m, Speed=8-12km/h)
For: Corridor 1, 2, 3, 4
Note: Although this size of barge train requires LAW of 55m (for 3B) - 75m (for 4B), this size of barge train is actually deployed in the RRD. This size of barge train should be deployed in specific season (excluding low water season) and operated with special caution. Restriction in width may be eased to some extent by optimizing the dimensions of barge, namely by deepening the draft and

narrowing down the breadth as far as possible.

Self-propelled vessel: 300DWT (400DWT - 600DWT of shallow draft type)
(Length=38-50m, Breadth=7-10m, draft=1.9-2.1m, Speed=14-20km/h)
For: Corridor 1, 2, 3, 4
Note: Self-propelled vessel of 600DWT (draft=2.0m) has recently been introduced in the RRD.

Sea-cum-river vessel: 1,000DWT
(Length=73-81m, Breadth=10-11m, draft=3.0-3.2m, Speed=18-20km/h)
For: Corridor 3 (Cua Day - Ninh Binh) and Corridor 4 (Sea - Hanoi)
Note: Movable bridge (cabin) system, which can decrease the maximum height of vessel and facilitate passing through bridges of low air clearance, is needed for Corridor 4 (Sea - Hanoi). As to Corridor 3, the introduction of further large vessel (sea-vessel of 2,000DWT for example) may be possible since restriction of waterway is only the depth at 1km section of Cua Day river mouth.

19.2.3 Future fleet mix

As to the future fleet mix for the IWT in the RRD, the share of vessels of larger than 300DWT must be raised along with the increase of transport demand. On the other hand, smaller vessels of less than 100DWT, which are mainly deployed for family use or intra-provincial transport, are considered to drop their share for the future.

Although the fleet mix must have different configurations by waterway and by segment, JICA Study Team sets two kinds of fleet mix, namely average fleet mix in the whole Red River Delta (**Table 19.2.4**) and that in only the Hanoi segment (**Table 19.2.5**), because of the availability of data and information. The fleet mix in the Hanoi segment has a peculiarity that the share of middle size vessels is higher than that in the whole Red River Delta.

Table 19.2.4 Future Fleet Mix in the Red River Delta (DWT share by size class)

Year	<50DWT	51-100DWT	101-300DWT	>300DWT	Total
Ave. Size in 2001	31 DWT	81 DWT	151 DWT	461 DWT	113DWT
2001	8%	25%	41%	26%	100%
2010	7%	20%	41%	32%	100%
2020	5%	15%	40%	40%	100%

Note) A barge train (e.g. Pusher + 4 barges) is counted as 1 vessel not 5 vessels.
Note) Effects by SRV and container in 2010 and 2020 are excluded.
Source) Data in 2001: based on passing vessels in the Red River Delta, VIWA
Data in 2010 & 2020: JICA Study Team estimation

Table 19.2.5 Future Fleet Mix in Hanoi Segment (DWT share by size class)

Year	<50DWT	51-100DWT	101-300DWT	>300DWT	Total
Ave. Size in 2001	38 DWT	76 DWT	145 DWT	411 DWT	127DWT
2001	3%	24%	47%	26%	100%
2010	3%	20%	45%	32%	100%
2020	2%	15%	43%	40%	100%

Note) A barge train (e.g. Pusher + 4 barges) is counted as 1 vessel not 5 vessels.
Note) Effects by SRV and container in 2010 and 2020 are excluded.
Source) Data in 2001: based on passing vessels in sections nearby Hanoi, VIWA
Data in 2010 & 2020: JICA Study Team estimation

Chapter 20 Future Performance of Major River Ports

Based on the Basic Policy for the IWT System in the RRD, the transport demand perspective and the future vessel size, the future performance of major river ports can be set as follows:

(1) To handle increasing traffic at port groups

Cargo throughputs by province in the Northern region in 2001 and 2020 are shown in **Table 20.1.1**. and **Table 20.1.2**, and their total are as follows:

Total cargo throughput in the Northern region: 37 million tons (2001)
103 million tons (2020)

Note) SRV cargoes (Hanoi: 1.0 million tons, Ninh Binh: 1.3 million tons) and containers (Hanoi: 67,000TEUs) are excluded.

Within the total, cargo throughputs handled at ports managed by central and local level as well as private Berths (landing stages) excluding intra-provincial cargoes are roughly estimated as shown in **Table 20.1.3** and **Table 20.1.4** based on the following assumptions.

Assumption:

a. Unloading and loading of all cargoes handled at specialized ports are excluded (Pha Lai Power Plant, Thai Binh Power Plant, Hoang Tach Cement Plant, But Son Cement Plant, etc.).
b. Unloading and loading of all cargoes in Hai Phong and Quang Ninh are excluded since these operation are mostly conducted at seaports or specialized ports
c. Loading of construction material (Lo River, etc.) and clay (Hai Duong) is excluded since this operation is mostly conducted at sites of exploitation.
d. Unloading of all cargoes at construction sites of dam (Son La, etc.) is excluded.

As a result, cargo throughputs in 2020 at ports managed by central and local level as well as private Berths (landing stages) excluding intra-provincial cargoes in eight provinces are more than 0.8 million tons. In these 8 provinces, major river ports of which cargo throughput capacity is more than some 0.5 million tons will be needed, although some minor ports and private Berths would handle a part of cargoes of their provinces (see **Table 20.1.1**).

Table 20.1.1 Major River Ports in the Red River Delta (2020)

City / Province	Cargo throughput (million tons)				Major river port in 2020		
	2001 total	2001 (*)	2020 total	2020 (*)	Major river port	Throughput (million tons) Low case	High case
Hanoi	6.0	6.0	16.2	16.2	Hanoi, Khuyen Luong, New Nort, New East, Chem	8.1	13.0
Ninh Binh	1.4	1.2	3.2	2.8	Ninh Binh &Ninh Phuc	1.4	2.2
Bac Ninh	0.5	0.4	1.8	1.4	Dap Cau	0.7	1.1
Nam Dinh	0.6	0.4	1.6	1.1	Nam Dinh	0.6	0.9
Thai Binh	0.6	0.3	3.2	1.1	Thai Binh	0.6	0.9
Phu Tho	4.7	0.5	14.0	1.0	Viet Tri	0.5	0.8
Hai Duong	6.5	0.4	14.9	0.9	Cong Cau	0.5	0.7
Bac Giang	0.6	0.5	1.2	0.8	A Lu	0.4	0.6

Note) SRV cargoes (Hanoi: 1.0 million tons, Ninh Binh: 1.3 million tons) and containers (Hanoi: 64,000TEUs) are excluded.
Note) Container handling port: New East Port, SRV calling port: Hanoi Port, Khuyen Luong Port and Ninh Phuc Port.
Note) Cargo throughput in column of (*) is that excluding specialized ports, seaports, exploitation sites, etc.
Note) Cargo throughputs of major ports are set assuming the following shares in their provinces.

Low case:	50%
High case:	80%

Source) JICA Study Team

As to passenger traffic, the following service routes have potential to be realized. In order to become obvious potential passenger demand of service route 2 and 3, it is indispensable to provide a service almost as same as that of bus in terms of transit time and fare.

Service route 1: Hai Phong - Quang Ninh (existing)
Passenger demand (million PAX): 0.4 in 2010, 0.6 in 2020

Service route 2: Hanoi - downstream of Red River
Potential passenger demand (million PAX): 0.4 in 2010, 0.6 in 2020
Hanoi - Hung Yen: 0.21 in 2010, 0.31 in 2020
Hanoi - Thai Binh: 0.16 in 2010, 0.22 in 2020
Hung Yen - Thai Binh: 0.03 in 2010, 0.06 in 2020

Service route 3: Hanoi - upstream of Red River
Potential passenger demand (million PAX): 0.2 in 2010, 0.3 in 2020
Hanoi - Viet Tri: 0.14 in 2010, 0.19 in 2020
Hanoi - Phu Tho: 0.10 in 2010, 0.14 in 2020
Viet Tri - Phu Tho: 0.00 in 2010, 0.01 in 2020

In addition to normal passenger traffic, it is important to promote the river cruse for international and domestic tourists in Hanoi segment in particular.

Table 20.1.2 Cargo Throughput by Province in the Northern Region (2001)

unit: 1,000 tons/year

	Unloading						Loading						Total
	CM	Cement	Fertilizer	Coal	Others	Total	CM	Cement	Fertilizer	Coal	Others	Total	
Hanoi	3,772	1,177	0	500	543	5,993	0	0	0	0	3	3	5,996
Hai Phong	674	341	1	481	483	1,980	288	785	125	0	1,266	2,463	4,443
Hai Duong	369	227	4	2,312	547	3,458	1,264	1,332	0	0	417	3,014	6,472
Hung Yen	109	30	9	52	39	239	58	0	0	0	126	184	423
Thai Binh	149	148	2	86	62	447	75	0	0	0	46	120	567
Nam Dinh	184	78	27	91	125	505	46	0	0	0	52	99	604
Ninh Binh	73	65	41	926	173	1,279	39	10	10	0	23	82	1,360
Ha Nam	78	18	1	159	205	461	729	365	0	0	49	1,143	1,604
Ha Tay	106	21	22	115	72	336	65	0	0	0	61	127	463
Cao Bang	0	0	0	0	0	0	0	0	0	0	0	0	0
Lang Son	0	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ninh	872	288	15	522	35	1,732	86	0	44	6,115	291	6,537	8,268
Thai Nguyen	68	0	1	50	27	147	68	0	0	0	27	95	242
Bac Can	0	0	0	0	0	0	0	0	0	0	0	0	0
Bac Ninh	148	55	37	45	35	320	64	0	0	0	129	193	513
Bac Giang	62	0	35	310	87	494	55	0	23	0	74	152	646
Phu Tho	193	44	1	211	166	615	4,027	0	0	0	32	4,059	4,674
Vinh Phuc	27	0	1	53	28	109	27	0	0	0	28	55	164
Lao Cai	13	0	1	29	16	59	13	0	0	0	16	29	87
Yen Bai	15	0	1	33	17	66	15	0	0	0	17	32	98
Tuyen Quang	14	0	1	33	17	65	27	0	0	0	17	45	110
Ha Giang	0	0	0	0	0	0	0	0	0	0	0	0	0
Son La	24	0	1	43	23	92	24	0	0	0	23	47	139
Lai Chau	25	0	1	29	16	71	25	0	0	0	16	41	111
Hoa Binh	85	0	1	37	22	144	64	0	0	0	26	90	235
Total	7,060	2,493	202	6,115	2,740	18,610	7,060	2,493	202	6,115	2,740	18,610	37,219

(Source) JICA Study Team

Table 20.1.3 Cargo Throughput by Province in the Northern Region (2020)

unit: 1,000 tons/year

	Unloading						Loading						Total
	CM	Cement	Fertilizer	Coal	Others	Total	CM	Cement	Fertilizer	Coal	Others	Total	
Hanoi	11,030	3,408	0	861	924	16,223	0	0	0	0	9	9	16,231
Hai Phong	2,247	590	1	3,409	1,193	7,440	683	1,956	433	0	3,229	6,301	13,741
Hai Duong	830	353	6	4,226	1,017	6,431	3,667	4,341	0	0	473	8,481	14,912
Hung Yen	455	112	23	31	93	714	182	0	0	0	339	522	1,236
Thai Binh	634	557	5	1,492	145	2,832	237	0	0	0	97	334	3,166
Nam Dinh	710	237	34	55	322	1,358	118	0	0	0	114	233	1,590
Ninh Binh	323	245	85	1,820	476	2,949	129	28	17	0	48	222	3,170
Ha Nam	339	44	1	1,237	802	2,424	2,249	1,438	0	0	136	3,824	6,247
Ha Tay	382	72	50	70	161	734	184	0	0	0	130	314	1,049
Cao Bang	0	0	0	0	0	0	0	0	0	0	0	0	0
Lang Son	0	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ninh	1,875	838	47	1,193	80	4,033	115	0	112	15,250	809	16,286	20,319
Thai Nguyen	76	0	1	31	57	165	76	0	0	0	57	133	299
Bac Can	0	0	0	0	0	0	0	0	0	0	0	0	0
Bac Ninh	570	293	269	28	83	1,243	185	0	0	0	350	535	1,777
Bac Giang	150	0	69	387	220	826	125	0	67	0	182	374	1,200
Phu Tho	427	158	4	253	385	1,226	12,715	0	0	0	69	12,783	14,010
Vinh Phuc	33	0	2	32	60	127	33	0	0	0	60	92	219
Lao Cai	14	0	3	18	33	69	14	0	0	0	33	47	116
Yen Bai	21	0	3	20	37	81	21	0	0	0	37	58	139
Tuyen Quang	353	571	4	20	87	1,035	97	0	0	0	37	134	1,169
Ha Giang	0	0	0	0	0	0	0	0	0	0	0	0	0
Son La	357	571	10	26	99	1,063	37	0	0	0	49	86	1,150
Lai Chau	33	0	2	18	33	86	33	0	0	0	33	66	153
Hoa Binh	127	0	7	22	48	204	82	286	0	0	61	429	633
Total	20,984	8,049	628	15,250	6,352	51,263	20,984	8,049	628	15,250	6,352	51,263	102,526

Note) SRV cargoes (Hanoi: 1.0 million tons, Ninh Binh: 1.3 million tons) and containers (Hanoi: 64,000TEUs) are excluded.

(Source) JICA Study Team

Table 20.1.4 Cargo Throughput excluding Specialized Ports, Seaports, etc. (2001)

unit: 1,000 tons/year

	Unloading						Loading						Total
	CM	Cement	Fertilizer	Coal	Others	Total	CM	Cement	Fertilizer	Coal	Others	Total	
Hanoi	3,772	1,177	0	500	543	5,993	0	0	0	0	3	3	5,996
Hai Phong	0	0	0	0	0	0	0	0	0	0	0	0	0
Hai Duong	221	0	4	80	110	414	0	0	0	0	4	4	418
Hung Yen	51	30	9	52	12	154	0	0	0	0	99	99	253
Thai Binh	74	148	2	86	17	327	0	0	0	0	0	0	327
Nam Dinh	137	78	27	91	77	410	0	0	0	0	4	4	414
Ninh Binh	34	55	31	926	151	1,197	0	10	10	0	0	20	1,217
Ha Nam	55	0	1	38	0	94	0	0	0	0	46	46	139
Ha Tay	41	21	22	115	11	210	0	0	0	0	0	0	210
Cao Bang	0	0	0	0	0	0	0	0	0	0	0	0	0
Lang Son	0	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ninh	0	0	0	0	0	0	0	0	0	0	0	0	0
Thai Nguyen	0	0	1	50	0	51	0	0	0	0	0	0	51
Bac Can	0	0	0	0	0	0	0	0	0	0	0	0	0
Bac Ninh	121	55	37	45	11	269	0	0	0	0	105	105	374
Bac Giang	22	0	33	310	49	414	0	0	23	0	36	59	472
Phu Tho	99	44	1	211	134	489	0	0	0	0	0	0	489
Vinh Phuc	0	0	1	53	0	54	0	0	0	0	0	0	54
Lao Cai	0	0	1	29	0	30	0	0	0	0	0	0	30
Yen Bai	0	0	1	33	0	34	0	0	0	0	0	0	34
Tuyen Quang	0	0	1	33	0	34	0	0	0	0	0	0	34
Ha Giang	0	0	0	0	0	0	0	0	0	0	0	0	0
Son La	0	0	1	43	0	45	0	0	0	0	0	0	45
Lai Chau	0	0	1	29	0	30	0	0	0	0	0	0	30
Hoa Binh	21	0	1	37	2	61	0	0	0	0	7	7	68
Total	4,648	1,609	174	2,760	1,117	10,307	0	10	33	0	303	346	10,653

(Source) JICA Study Team

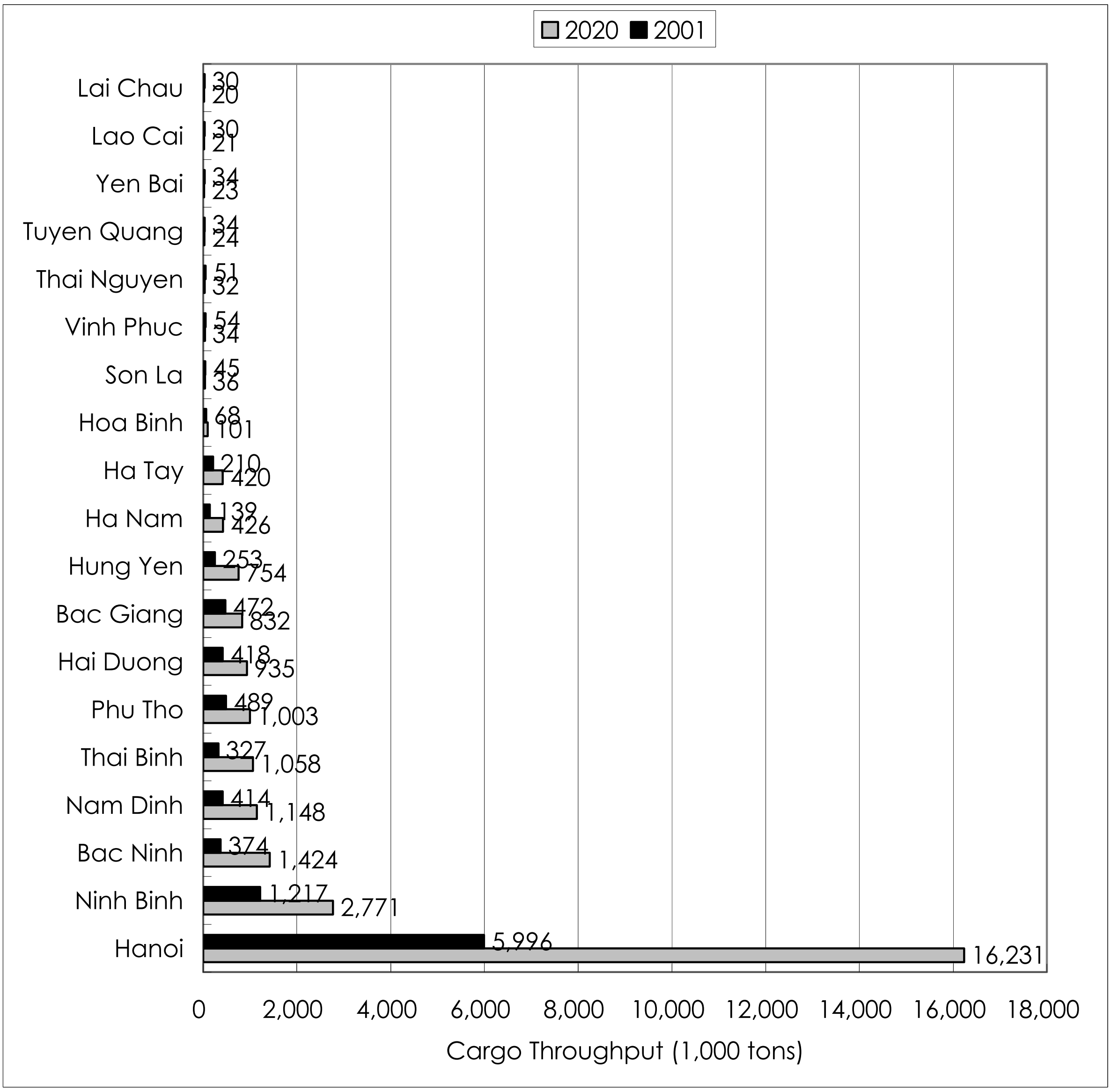
Table 20.1.5 Cargo Throughput excluding Specialized Ports, Seaports, etc. (2020)

unit: 1,000 tons/year

	Unloading						Loading						Total
	CM	Cement	Fertilizer	Coal	Others	Total	CM	Cement	Fertilizer	Coal	Others	Total	
Hanoi	11,030	3,408	0	861	924	16,223	0	0	0	0	9	9	16,231
Hai Phong	0	0	0	0	0	0	0	0	0	0	0	0	0
Hai Duong	557	0	6	49	312	924	0	0	0	0	11	11	935
Hung Yen	272	112	23	31	34	473	0	0	0	0	281	281	754
Thai Binh	396	557	5	52	48	1,058	0	0	0	0	0	0	1,058
Nam Dinh	591	237	34	55	219	1,136	0	0	0	0	11	11	1,148
Ninh Binh	193	217	68	1,820	428	2,727	0	28	17	0	0	44	2,771
Ha Nam	272	0	1	23	0	296	0	0	0	0	130	130	426
Ha Tay	198	72	50	70	30	420	0	0	0	0	0	0	420
Cao Bang	0	0	0	0	0	0	0	0	0	0	0	0	0
Lang Son	0	0	0	0	0	0	0	0	0	0	0	0	0
Quang Ninh	0	0	0	0	0	0	0	0	0	0	0	0	0
Thai Nguyen	0	0	1	31	0	32	0	0	0	0	0	0	32
Bac Can	0	0	0	0	0	0	0	0	0	0	0	0	0
Bac Ninh	505	293	269	28	31	1,126	0	0	0	0	298	298	1,424
Bac Giang	72	0	67	387	139	664	0	0	67	0	101	167	832
Phu Tho	272	158	4	253	316	1,003	0	0	0	0	0	0	1,003
Vinh Phuc	0	0	2	32	0	34	0	0	0	0	0	0	34
Lao Cai	0	0	3	18	0	21	0	0	0	0	0	0	21
Yen Bai	0	0	3	20	0	23	0	0	0	0	0	0	23
Tuyen Quang	0	0	4	20	0	24	0	0	0	0	0	0	24
Ha Giang	0	0	0	0	0	0	0	0	0	0	0	0	0
Son La	0	0	10	26	0	36	0	0	0	0	0	0	36
Lai Chau	0	0	2	18	0	20	0	0	0	0	0	0	20
Hoa Binh	45	0	7	22	6	81	0	0	0	0	20	20	101
Total	14,404	5,054	560	3,817	2,487	26,321	0	28	83	0	861	972	27,293

Note) SRV cargoes (Hanoi: 1.0 million tons, Ninh Binh: 1.3 million tons) and containers (Hanoi: 64,000TEUs) are excluded.

(Source) JICA Study Team



Note) Unloading and loading of all cargoes handled at specialized ports are excluded.
Unloading and loading of all cargoes in Hai Phong and Quang Ninh are excluded.
Loading of construction material (Lo River, etc.) and clay (Hai Duong) is excluded.
Unloading of all cargoes at construction sites of dam (Son La, etc.) is excluded.
Note) SRV cargoes (Hanoi: 1.0 million tons, Ninh Binh: 1.3 million tons) and containers (Hanoi: 64,000TEUs) are excluded.
Source) JICA Study Team

Figure 20.1.1 Cargo Throughput excluding Specialized Ports, Seaports, etc.

(2) To raise cargo handling efficiency

Bulk cargo at major ports: 2,000 tons/m/year (2001)
4,800 tons/m/year (2020)
(see **Table 20.1.6**)

Non-bulk cargo at major ports: 900 tons/m/year (2001)
2,400 tons/m/year (2020)

(see **Table 20.1.7**)

Mechanization rate: almost 100% (excluding hooking process, 2020)

Unitization: introduction of the unitization in cargo handling

Table 20.1.6 Handling Capacity of Berth for Bulk (2020 at ports)

1	Type of vessel			Barge Train			Self-prop		
2	Tonnage of Vessel	D	DWT	1,200	800	400	600	400	200
3	Berth Length		m	80	80	80	40	40	40
4	Number of Handling Equipment	?k		2	2	2	1	1	1
5	Reduced Factor of Handling Capacity	?		1.0	1.0	1.0	1.0	1.0	1.0
6	Handling Capacity per shift per equipment	qcm	tons/shift	720	720	720	720	720	720
7	Handling Time of Vessel at Berth	tbx	hours/vessel	5.83	3.89	1.94	5.83	3.89	1.94
8	Troughput Capacity per operating day	Png	tons/day	2,563	2,130	1,413	1,281	1,065	707
9	Troughput Capacity per year	Pn	tons/year	482,046	400,574	265,801	241,023	200,287	132,901
10	Troughput Capacity per year-m		tons/year-m	6,026	5,007	3,323	6,026	5,007	3,323

Note) tbx = (7*a*D)/(?*?k*qcn)
Png = (a*D*tng)/(tbx+tf)
Pn = BOR*Doy*Png

a: Load Factor of Vessel	1.0
tng (hours/day): Operating hours of Berth per day	21
tf (hours/vessel): Idling Time of Vessel at Berth	4
Handling Capacity per hour per equipment (tons/h)	120
BOR: Berth Occupancy Ratio	0.55
Doy (days/year): Operating days of Berth per year	342

Source) JICA Study Team

Table 20.1.7 Handling Capacity of Berth for Non-bulk (2020 at ports)

1	Type of vessel			Self-prop			SRV	Barge Train	
2	Tonnage of Vessel	D	DWT	600	400	200	1,000	800	400
3	Berth Length		m	40	40	40	80	80	80
4	Number of Handling Equipment	?k		1	1	1	2	2	2
5	Reduced Factor of Handling Capacity	?		1.0	1.0	1.0	1.0	1.0	1.0
6	Handling Capacity per shift per equipment	qcm	tons/shift	240	240	240	240	240	240
7	Handling Time of Vessel at Berth	tbx	hours/vessel	17.50	11.67	5.83	14.58	11.67	5.83
8	Troughput Capacity per operating day	Png	tons/day	586	536	427	1,130	1,072	854
9	Troughput Capacity per year	Pn	tons/year	110,235	100,854	80,341	212,561	201,707	160,682
10	Troughput Capacity per year-m		tons/year-m	2,756	2,521	2,009	2,657	2,521	2,009

Note) tbx = (7*a*D)/(?*?k*qcn)
Png = (a*D*tng)/(tbx+tf)
Pn = BOR*Doy*Png

a: Load Factor of Vessel	1.0
tng (hours/day): Operating hours of Berth per day	21
tf (hours/vessel): Idling Time of Vessel at Berth	4
Handling Capacity per hour per equipment (tons/h)	40
BOR: Berth Occupancy Ratio	0.55
Doy (days/year): Operating days of Berth per year	342

Source) JICA Study Team

(3) To reduce total vessel staying time at port

- Reduction of waiting and idle time

  By constructing adequate numbers of permanent berths, operating ports 24 hours a day and handling cargoes in 3 shift.

- Reduction of handling time

  By raising cargo handling efficiency at berth and providing adequate handling equipment

(4) To accommodate larger vessels/barge trains

Barge train: 2units@600DWT + Pushing Tug@200CV

(Length=115m, Breadth=11m, draft=1.8m, Speed=8-12km/h)

For: Major ports in Corridor 1, 3, 4 (except Corridor 2: Quang Ninh - Ninh Binh)

Note: Corridor 2 is excluded taking into account the difficulty in satisfying the requirement of bend radius and the future shifting of coal transport route (Quang Ning - Ninh Binh via Luoc River) to the new route (coastal + Corridor 3).

Barge train: 4units@400DWT + Pushing Tug@250CV

(Length=95-109m, Breadth=18-19m, draft=1.2-1.6m, Speed=8-12km/h)

For: Major ports in Corridor 1, 2, 3, 4

Note: Although this size of barge train requires LAW of 55m (for 3B) - 75m (for 4B), this size of barge train is actually deployed in the RRD. This size of barge train should be deployed in specific season (excluding low water season) and operated with special caution. Restriction in width may be eased to some extent by optimizing the dimensions of barge, namely by deepening the draft and narrowing down the breadth as far as possible.

Self-propelled vessel: 300DWT (400DWT - 600DWT of shallow draft type)

(Length=38-50m, Breadth=7-10m, draft=1.9-2.1m, Speed=14-20km/h)

For: Major ports in Corridor 1, 2, 3, 4

Note: Self-propelled vessel of 600DWT (draft=2.0m) has recently been introduced in the RRD.

Sea-cum-river vessel: 1,000DWT

(Length=73-81m, Breadth=10-11m, draft=3.0-3.2m, Speed=18-20km/h)

For: Ninh Phuc Port, Khuyen Luong Port and Hanoi Port through Corridor 3 (Cua Day - Ninh Binh) and Corridor 4 (Sea - Hanoi)

Note: Movable bridge (cabin) system, which can decrease the maximum height of vessel and facilitate passing through bridges of low air clearance, is needed for Corridor 4 (Sea - Hanoi). As to Corridor 3, the introduction of further large vessel (sea-vessel of 2,000DWT for example) may be possible since restriction of waterway is only the depth at 1km section of Cua Day river mouth. As to Corridor 4 (Sea - Hanoi), careful feasibility study will be needed before initiating the project.

(5) To clarify role and function of each port within a port group

When planning several ports within a certain area, it is important to clarify the role and function of each port and to arrange them in rational places taking into account the connection with hinterland, the access roads and conditions of navigation channel. Ports handling dirty and dusty cargo should be arranged outside of the city center.

Characteristics of port:

General port:	port handling many kinds of cargo
Construction material port:	port handling mainly construction material
Specialized port:	port handling particular cargo for a factory

Chapter 21 Future Performance of Major Inland Waterways

Based on the Basic Policy for the IWT System in the RRD, the transport demand perspective and the future vessel size, the future performance of major inland waterways can be set as follows:

(1) To make it possible for increasing traffic to pass through waterways

Cargo transport volume in the RRD:		19 million tons (2001)
		51 million tons (2020)
		2.0 billion ton-km (2001)
		5.6 billion ton-km (2020)
Vessel traffic:	Heaviest traffic stretch:	approx. 240 - 280 vessels/day (2001)
		approx. 450 - 490 vessels/day (2020)
	Average of 32 stretches:	approx. 100 - 110 vessels/day (2001)
		approx. 180 - 200 vessels/day (2020)

(see **Table 21.1.1** through **Table 21.1.4**)

Generally, the traffic capacity of waterways increases in proportion to vessel speed (while vessel speed is low level) and decreases in inverse proportion to interval of vessels. Traffic capacity calculation for double-way channel (see **Table 21.1.5** through **Table 21.1.8**) shows that the future traffic capacity is great enough for increasing traffic to pass through waterways on condition that average vessel size becomes larger and average vessel speed becomes faster as mentioned in **Chapter 19**.

It should be noted, however, that the traffic capacity would fall short of forecasted future vessel traffic in heaviest traffic stretch, if average vessel size becomes larger but average vessel speed does not change for the future.

(2) To make it possible for larger vessels/barge trains to pass through waterways

Barge train: 2units@600DWT + Pushing Tug@200CV
(Length=115m, Breadth=11m, draft=1.8m, Speed=8-12km/h)
For: Corridor 1, 3, 4 (except Corridor 2: Quang Ninh - Ninh Binh)
Note: Corridor 2 is excluded taking into account the difficulty in satisfying the requirement of bend radius and the future shifting of coal transport route (Quang Ning - Ninh Binh via Luoc River) to the new route (coastal + Corridor 3).

Barge train: 4units@400DWT + Pushing Tug@250CV

(Length=95-109m, Breadth=18-19m, draft=1.2-1.6m, Speed=8-12km/h)

For: Corridor 1, 2, 3, 4

Note: Although this size of barge train requires LAW of 55m (for 3B) - 75m (for 4B), this size of barge train is actually deployed in the RRD. This size of barge train should be deployed in specific season (excluding low water season) and operated with special caution. Restriction in width may be eased to some extent by optimizing the dimensions of barge, namely by deepening the draft and narrowing down the breadth as far as possible.

Self-propelled vessel: 300DWT (400DWT - 600DWT of shallow draft type)

(Length=38-50m, Breadth=7-10m, draft=1.9-2.1m, Speed=14-20km/h)

For: Corridor 1, 2, 3, 4

Note: Self-propelled vessel of 600DWT (draft=2.0m) has recently been introduced in the RRD.

Sea-cum-river vessel: 1,000DWT

(Length=73-81m, Breadth=10-11m, draft=3.0-3.2m, Speed=18-20km/h)

For: Corridor 3 (Cua Day - Ninh Binh) and Corridor 4 (Sea - Hanoi)

Note: Movable bridge (cabin) system, which can decrease the maximum height of vessel and facilitate passing through bridges of low air clearance, is needed for Corridor 4 (Sea - Hanoi). As to Corridor 3, the introduction of further large vessel (sea-vessel of 2,000DWT - 3,000DWT for example) may be possible since restriction of waterway is only the depth at 1km section of Cua Day river mouth.

(3) To meet the technical standard of waterway classification for major corridors

Corridor 1: Quang Ninh - Hai Phong - Hanoi - Viet Tri (through Duong River)

Classification: Quang Ninh - Hai Phong: II

Hai Phong - Hanoi: II (LAD=2.5m)

Hanoi - Viet Tri: II (LAD=2.5m)

Corridor 2: Quang Ninh - Hai Phong - Ninh Binh (through Luoc River)

Classification: Quang Ninh - Hai Phong: II

Hai Phong - Ninh Binh: II (LAD=2.5m)

Corridor 3: Cua Day - Ninh Binh

Classification: I (LAD=3.6m)

Corridor 4A: Lach Giang - Hanoi

Classification: I (LAD=3.6m)

Corridor 4B: Cua Day - Hanoi (through Day - Nin Co Canal)

Classification: I (LAD=3.6m)

Note) There may be some locations where it is difficult to realize future dimensions of waterway because of the site condition such as narrow width between dykes.

Note) As to air clearance of bridge for Class II, 7m seem to be enough although Class II requires 9m.

Note) As to the Corridor 4, it is necessary to select the route, 4A or 4B since the development of both routes is not economical. For the moment, Corridor 4B seems to be favorable since the section of Cua Day is partly dredged every year as a part of Corridor 3 and the construction of Day - Ninh Co Canal and related facilities does not need such significant maintenance cost as dredging at Lach Giang river mouth. Careful feasibility study will be needed before initiating the project.

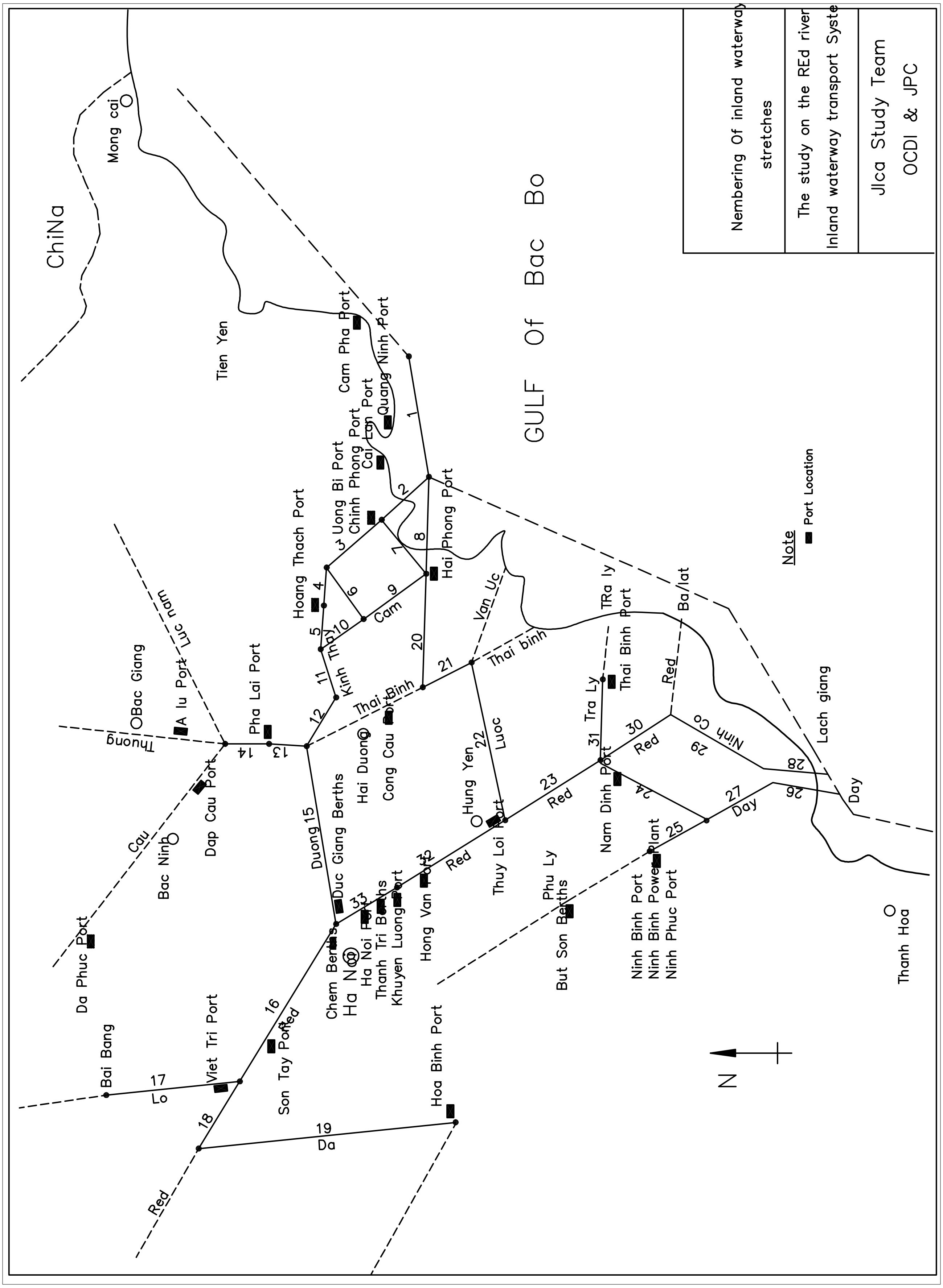


Figure 21.1.1 Numbering of Inland Waterway Stretches

Table 21.1.1 Vessel Traffic by Stretch (2001, case-1:Fleet Mix=RRD)

Stretch	River (main)	Cargo Traffic (million tons)	Vessel Traffic (million DWT)	Daily Vessel Traffic (vessels/day)				
				<50DWT	51-100DWT	100-300DWT	>300DWT	Total
1	coastal	8.3	13.9	98	117	103	21	340
2	Chanh	4.4	7.4	52	63	55	11	181
3	Da Bach	4.5	7.4	52	63	55	11	182
4	Mao Khe	0.5	0.8	6	7	6	1	20
5	Mao Khe	1.1	1.9	13	16	14	3	45
6	Phi Liet	4.0	6.6	47	56	49	10	162
7	Bach Dang	0.0	0.0	0	0	0	0	0
8	Cam	3.9	6.5	46	55	48	10	159
9	Cam	1.7	2.8	20	24	21	4	69
10	Han	5.6	9.4	66	79	70	15	230
11	Kinh Thay	6.8	11.3	80	95	84	17	276
12	Kinh Thay	6.5	10.9	77	92	81	17	267
13	Thai Binh	4.7	7.8	55	66	58	12	190
14	Thai Binh	0.9	1.4	10	12	11	2	35
15	Duong	3.1	5.2	37	44	39	8	127
16	Red	4.7	7.8	55	66	58	12	192
17	Lo	4.5	7.5	53	64	56	12	185
18	Red (Thao)	0.2	0.4	2	3	3	1	9
19	Da	0.1	0.2	2	2	2	0	6
20	Lach Tray	2.4	4.1	29	34	30	6	99
21	Van Uc	2.5	4.1	29	35	31	6	101
22	Luoc	2.5	4.1	29	35	31	6	101
23	Red	3.0	5.1	36	43	38	8	124
24	Dao ND	2.6	4.4	31	37	32	7	107
25	Day	2.6	4.4	31	37	32	7	107
26	Day	0.6	1.0	7	8	7	2	25
27	Day	0.6	1.0	7	8	7	2	25
28	Ninh Co	0.1	0.2	1	1	1	0	4
29	Ninh Co	0.1	0.2	1	1	1	0	4
30	Red	0.1	0.2	1	1	1	0	4
31	Tra Ly	0.3	0.6	4	5	4	1	13
32	Red	0.7	1.2	9	10	9	2	30
33	Red	3.1	5.1	36	43	38	8	125
Maximum								276
Average								109

Note) Load Factor= 0.6

Fleet Mix=

	<50DWT	51-100DWT	100-300DWT	>300DWT
Average Size	31	81	151	461
2001 Share	8%	25%	41%	26%

The values of maximum and average daily vessel traffic exclude stretch 1 because of coastal route.

Source) JICA Study Team

Table 21.1.2 Future Vessel Traffic by Stretch (2020, case-1:Fleet Mix=RRD)

Stretch		Cargo Traffic (million tons)	Vessel Traffic (million DWT)	Daily Vessel Traffic (vessels/day)				
				<50DWT	51-100DWT	100-300DWT	>300DWT	Total
1	coastal	18.8	31.3	138	159	227	74	598
2	Chanh	7.6	12.7	56	64	92	30	242
3	Da Bach	7.6	12.7	56	65	92	30	243
4	Mao Khe	1.1	1.9	8	10	14	4	36
5	Mao Khe	3.9	6.5	29	33	47	15	124
6	Phi Liet	6.5	10.8	48	55	79	26	207
7	Bach Dang	0.0	0.0	0	0	0	0	0
8	Cam	11.2	18.6	82	94	135	44	356
9	Cam	4.9	8.2	36	42	59	19	157
10	Han	11.4	19.0	84	96	138	45	363
11	Kinh Thay	15.3	25.5	113	129	185	61	488
12	Kinh Thay	14.7	24.5	108	124	178	58	468
13	Thai Binh	9.9	16.5	73	84	120	39	316
14	Thai Binh	2.3	3.8	17	19	27	9	72
15	Duong	7.3	12.1	53	61	88	29	231
16	Red	14.1	23.5	104	119	171	56	450
17	Lo	14.0	23.3	103	118	169	55	446
18	Red (Thao)	0.9	1.4	6	7	10	3	27
19	Da	0.8	1.4	6	7	10	3	26
20	Lach Tray	6.9	11.4	51	58	83	27	219
21	Van Uc	7.1	11.8	52	60	85	28	225
22	Luoc	7.1	11.8	52	60	85	28	225
23	Red	9.7	16.1	71	82	117	38	308
24	Dao ND	7.3	12.2	54	62	88	29	233
25	Day	7.3	12.2	54	62	88	29	233
26	Day	2.3	3.8	17	19	28	9	73
27	Day	2.3	3.8	17	19	28	9	73
28	Ninh Co	0.3	0.5	2	3	4	1	10
29	Ninh Co	0.3	0.5	2	3	4	1	10
30	Red	0.3	0.5	2	3	4	1	10
31	Tra Ly	2.5	4.2	18	21	30	10	80
32	Red	2.9	4.9	22	25	36	12	94
33	Red	9.8	16.3	72	83	118	39	312
Maximum								488
Average								199

Note) Load Factor= 0.6

Fleet Mix=

	<50DWT	51-100DWT	100-300DWT	>300DWT
Average Size	31	81	151	461
2020 Share	5%	15%	40%	40%

The values of maximum and average daily vessel traffic exclude stretch 1 because of coastal route.

Source) JICA Study Team

Table 21.1.3 Vessel Traffic by Stretch (2001, case-2:Fleet Mix=Hanoi)

Stretch	River (main)	Cargo Traffic (million tons)	Vessel Traffic (million DWT)	Daily Vessel Traffic (vessels/day)				
				<50DWT	51-100DWT	100-300DWT	>300DWT	Total
1	coastal	8.3	13.9	30	120	123	24	297
2	Chanh	4.4	7.4	16	64	66	13	159
3	Da Bach	4.5	7.4	16	64	66	13	159
4	Mao Khe	0.5	0.8	2	7	7	1	17
5	Mao Khe	1.1	1.9	4	16	16	3	40
6	Phi Liet	4.0	6.6	14	57	59	11	141
7	Bach Dang	0.0	0.0	0	0	0	0	0
8	Cam	3.9	6.5	14	56	58	11	139
9	Cam	1.7	2.8	6	24	25	5	60
10	Han	5.6	9.4	20	81	83	16	201
11	Kinh Thay	6.8	11.3	24	97	100	19	241
12	Kinh Thay	6.5	10.9	24	94	97	19	233
13	Thai Binh	4.7	7.8	17	67	69	13	166
14	Thai Binh	0.9	1.4	3	12	13	2	30
15	Duong	3.1	5.2	11	45	46	9	111
16	Red	4.7	7.8	17	68	69	14	167
17	Lo	4.5	7.5	16	65	67	13	161
18	Red (Thao)	0.2	0.4	1	3	3	1	7
19	Da	0.1	0.2	1	2	2	0	5
20	Lach Tray	2.4	4.1	9	35	36	7	87
21	Van Uc	2.5	4.1	9	36	37	7	88
22	Luoc	2.5	4.1	9	36	37	7	88
23	Red	3.0	5.1	11	44	45	9	108
24	Dao ND	2.6	4.4	9	38	39	8	94
25	Day	2.6	4.4	9	38	39	8	94
26	Day	0.6	1.0	2	9	9	2	21
27	Day	0.6	1.0	2	9	9	2	21
28	Ninh Co	0.1	0.2	0	1	1	0	4
29	Ninh Co	0.1	0.2	0	1	1	0	4
30	Red	0.1	0.2	0	1	1	0	4
31	Tra Ly	0.3	0.6	1	5	5	1	12
32	Red	0.7	1.2	3	11	11	2	26
33	Red	3.1	5.1	11	44	45	9	109
Maximum								241
Average								95

Note) Load Factor= 0.6

Fleet Mix=

	<50DWT	51-100DWT	100-300DWT	>300DWT
Average Size	38	76	145	411
2001 Share	3%	24%	47%	26%

The values of maximum and average daily vessel traffic exclude stretch 1 because of coastal route.

Source) JICA Study Team

Table 21.1.4 Future Vessel Traffic by Stretch (2020, case-2:Fleet Mix=Hanoi)

Stretch		Cargo Traffic (million tons)	Vessel Traffic (million DWT)	Daily Vessel Traffic (vessels/day)				
				<50DWT	51-100DWT	100-300DWT	>300DWT	Total
1	coastal	18.8	31.3	45	169	254	83	551
2	Chanh	7.6	12.7	18	68	103	34	223
3	Da Bach	7.6	12.7	18	69	103	34	224
4	Mao Khe	1.1	1.9	3	10	15	5	33
5	Mao Khe	3.9	6.5	9	35	53	17	115
6	Phi Liet	6.5	10.8	16	58	88	29	191
7	Bach Dang	0.0	0.0	0	0	0	0	0
8	Cam	11.2	18.6	27	101	151	50	328
9	Cam	4.9	8.2	12	44	66	22	144
10	Han	11.4	19.0	27	103	154	51	335
11	Kinh Thay	15.3	25.5	37	138	207	68	450
12	Kinh Thay	14.7	24.5	35	132	199	65	432
13	Thai Binh	9.9	16.5	24	89	134	44	291
14	Thai Binh	2.3	3.8	5	20	31	10	66
15	Duong	7.3	12.1	17	65	98	32	213
16	Red	14.1	23.5	34	127	191	63	415
17	Lo	14.0	23.3	34	126	189	62	411
18	Red (Thao)	0.9	1.4	2	8	12	4	25
19	Da	0.8	1.4	2	7	11	4	24
20	Lach Tray	6.9	11.4	16	62	93	30	202
21	Van Uc	7.1	11.8	17	64	96	31	208
22	Luoc	7.1	11.8	17	64	96	31	208
23	Red	9.7	16.1	23	87	131	43	284
24	Dao ND	7.3	12.2	18	66	99	32	215
25	Day	7.3	12.2	18	66	99	32	215
26	Day	2.3	3.8	6	21	31	10	67
27	Day	2.3	3.8	6	21	31	10	67
28	Ninh Co	0.3	0.5	1	3	4	1	9
29	Ninh Co	0.3	0.5	1	3	4	1	9
30	Red	0.3	0.5	1	3	4	1	9
31	Tra Ly	2.5	4.2	6	23	34	11	74
32	Red	2.9	4.9	7	26	40	13	86
33	Red	9.8	16.3	24	88	132	43	288
Maximum								450
Average								183

Note) Load Factor= 0.6

Fleet Mix=

	<50DWT	51-100DWT	100-300DWT	>300DWT
Average Size	38	76	145	411
2020 Share	2%	15%	43%	40%

The values of maximum and average daily vessel traffic exclude stretch 1 because of coastal route.

Source) JICA Study Team

Table 21.1.5 Average Interval of Vessels (case-1:Fleet Mix=RRD)

	Average DWT	LOA (m)	Interval of Vessels 7 x LOA (m)		2001				2010				2020			
			for Upstream	for Downstream	DWT Share	Vessel Share	Average Interval of Vessels (m)		DWT Share	Vessel Share	Average Interval of Vessels (m)		DWT Share	Vessel Share	Average Interval of Vessels (m)	
							for Upstream	for Downstream			for Upstream	for Downstream			for Upstream	for Downstream
<50DWT	31	25	200	300	8%	29%	250	316	7%	28%	260	322	5%	23%	278	332
51-100DWT	81	30	210	300	25%	34%			20%	30%			15%	27%		
101-300DWT	151	40	280	300	41%	30%			41%	33%			40%	38%		
>300DWT	461	50 - 100	560	560	26%	6%			32%	9%			40%	12%		
Total					100%	100%			100%	100%			100%	100%		

Note) Least interval: 200m for upstream, 300m for downstream

Source) JICA Study Team

Table 21.1.6 Traffic Capacity of Double-way Channel (case-1, Fleet Mix:RRD)

Year	Average Interval of Vessels (m)		Speed up	for Upstream			for Downstream			Total Daily Capacity (vessel/day)	
				Speed	Hourly Capacity	Daily Capacity	Speed	Hourly Capacity	Daily Capacity	2 times for Upstream	For Upstream and Downstream
	for Upstream	for Downstream		(km/h)	(vessel/hour)	(vessel/day)	(km/h)	(vessel/hour)	(vessel/day)	(vessel/day)	(vessel/day)
2001	250	316		4	13	178	10	25	353	357	531
				10	32	446	16	40	565	892	1,010
2010	260	322	without	4	12	171	10	25	353	343	524
				10	31	429	16	40	565	857	993
			with	5	15	214	11	28	388	429	602
				12	37	514	18	46	635	1,029	1,149
2020	278	332	without	4	12	161	10	25	353	322	514
				10	29	402	16	40	565	804	966
			with	7	20	281	13	33	459	563	740
				14	40	563	20	51	706	1,125	1,268

Note) Hourly capacity = (Speed) / (Average interval of vessels) x 0.8
where discount rate of 0.8 is introduced in order to avoid congestion accruing from Poisson's distribution of vessel arrival.

Note) Daily capacity = (Hourly capacity) x 12 / 0.86
where 86% of daily transit vessels navigate during 08:00 - 20:00.

Source) JICA Study Team

Table 21.1.7 Average Interval of Vessels (case-2, Fleet Mix=Hanoi)

	Average DWT	LOA (m)	Interval of Vessels 7 x LOA (m)		2001				2010				2020			
			for Upstream	for Downstream	DWT Share	Vessel Share	Average Interval of Vessels (m)		DWT Share	Vessel Share	Average Interval of Vessels (m)		DWT Share	Vessel Share	Average Interval of Vessels (m)	
							for Upstream	for Downstream			for Upstream	for Downstream			for Upstream	for Downstream
<50DWT	38	25	200	300	3%	10%	266	321	3%	11%	276	328	2%	8%	294	339
51-100DWT	76	30	210	300	24%	40%			20%	36%			15%	31%		
101-300DWT	145	40	280	300	47%	41%			45%	42%			43%	46%		
>300DWT	411	50 - 100	560	560	26%	8%			32%	11%			40%	15%		
Total					100%	100%			100%	100%			100%	100%		

Note) Least interval: 200m for upstream, 300m for downstream

Source) JICA Study Team

Table 21.1.8 Traffic Capacity of Double-way Channel (case-2, Fleet Mix=Hanoi)

Year	Average Interval of Vessels (m)		Speed up	for Upstream			for Downstream			Total Daily Capacity (vessel/day)	
				Speed	Hourly Capacity	Daily Capacity	Speed	Hourly Capacity	Daily Capacity	2 times for Upstream	For Upstream and Downstream
	for Upstream	for Downstream		(km/h)	(vessel/hour)	(vessel/day)	(km/h)	(vessel/hour)	(vessel/day)	(vessel/day)	(vessel/day)
2001	266	321		4	12	168	10	25	348	335	515
				10	30	419	16	40	556	838	976
2010	276	328	without	4	12	162	10	25	348	324	510
				10	29	404	16	40	556	809	961
			with	5	14	202	11	27	382	404	585
				12	35	485	18	45	626	971	1,111
2020	294	339	without	4	11	152	10	25	348	303	499
				10	27	379	16	40	556	759	936
			with	7	19	265	13	32	452	531	718
				14	38	531	20	50	695	1,062	1,226

Note) Hourly capacity = (Speed) / (Average interval of vessels) x 0.8
where discount rate of 0.8 is introduced in order to avoid congestion accruing from Poisson's distribution of vessel arrival.
Note) Daily capacity = (Hourly capacity) x 12 / 0.86
where 86% of daily transit vessels navigate during 08:00 - 20:00.
Source) JICA Study Team

Table 21.1.9 Future Performance of Major IWT Corridors

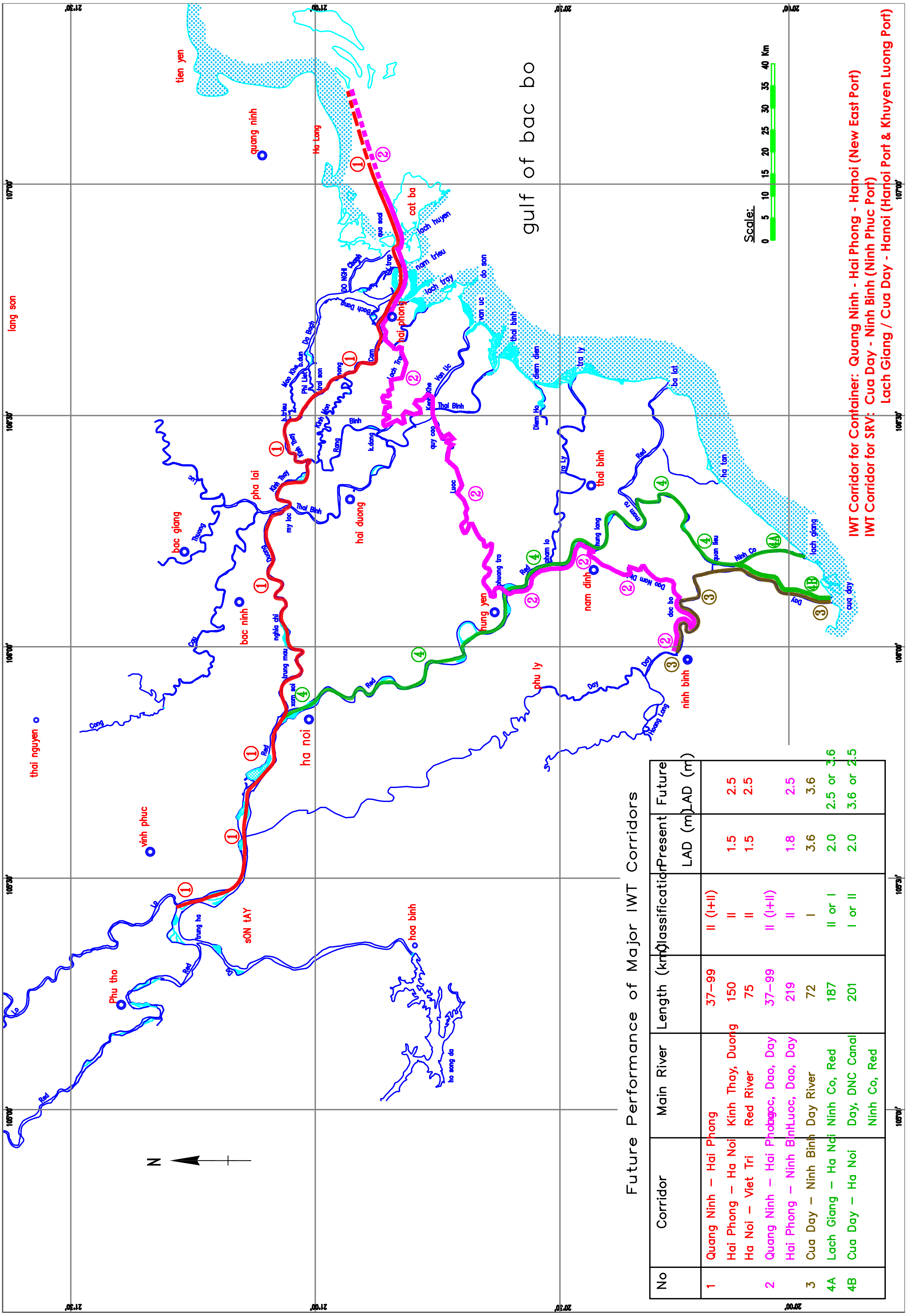
No	Corridor	Main River	Length (km)	Classification	Present LAD (m)	Future LAD (m)
1	Quang Ninh - Hai Phong		37 - 99	II (I+II)		
	Hai Phong - Hanoi	Kinh Thay, Duong	150	II	1.5	2.5
	Hanoi - Viet Tri	Red	75	II	1.5	2.5
2	Quang Ninh - Hai Phong		37 - 99	II (I+II)		
	Hai Phong - Ninh Binh	Luoc, Dao, Day	219	II	1.8	2.5
3	Cua Day - Ninh Binh	Day	72	I	3.6	3.6
4A	Lach Giang - Hanoi	Ninh Co, Red	187	II or I	2.0	2.5 or 3.6
4B	Cua Day - Hanoi	Day, DNC Canal, Ninh Co, Red	201	I or II	2.0	3.6 or 2.5

Note) There may be some locations where it is difficult to realize future dimensions of waterway because of the site condition such as narrow width between dykes.
Note) As to air clearance of bridge for Class II, 7m seem to be enough although Class II requires 9m.
Note) As to Corridor 4, careful feasibility study will be needed before initiating the project.
Source) JICA Study Team

Table 21.1.10 Future Waterway Classification of Major IWT Corridors

Corridor	Waterway	from	to	Distance (km)	Classification Present	Classification Future 2020
1A	Quang Ninh - Hai Phong - Hanoi - Viet Tri (Cam route)					
	Ha Long Cay Channel	Hon Gai Port	Vung Dai island	9.5	I	I
	Ba Mom Channel	Vung Dai island	Qua Xoai	15.0	I	I
	Chanh	Qua Xoai	N3 Chanh, Bach Dang	20.5	II	II
	Bach Dang	N3 Chanh	N3 Dong Vang Chau	8.0	I	I
	Cam, Ruot Lon	N3 Dong Vang Chau	Hai Phong Port	8.5	II	II
	Cam	Hai Phong Port	N3 Nong	18.0	II	II
	Han	N3 Nong	N3 Trai Son	7.0	III	II
	Kinh Thay	N3 Trai Son	N3 Lau Khe	44.5	III	II
	Thai Binh	N3 Lau Khe	N3 My Loc	3.0	III	II
	Duong	N3 My Loc	Ben Ho	32.0	III	II
	Duong	Ben Ho	N3 Cua Dau	36.0	III	II
	Red	N3 Cua Dau	Hanoi Port	10.0	II	II
	Red	Hanoi Port	N3 Viet Tri	74.5	II	II
	Lo	N3 Viet Tri	Viet Tri Port	1.0	II	II
			Total Distance	287.5		
1B	Quang Ninh - Hanoi - Viet Tri (Da Bach route)					
	Ha Long Cay Channel	Hon Gai Port	Vung Dai island	9.5	I	I
	Ba Mom Channel	Vung Dai island	Qua Xoai	15.0	I	I
	Chanh	Qua Xoai	N3 Chanh, Bach Dang	20.5	II	II
	Da Bach	N3 Chanh, Bach Dang	N3 Dung	23.0	I	I
	Phi Liet	N3 Dung	N3 Trai Son	8.0	III	II
	Kinh Thay	N3 Trai Son	N3 Lau Khe	44.5	III	II
	Thai Binh	N3 Lau Khe	N3 My Loc	3.0	III	II
	Duong	N3 My Loc	Ben Ho	32.0	III	II
	Duong	Ben Ho	N3 Cua Dau	36.0	III	II
	Red	N3 Cua Dau	Hanoi Port	10.0	II	II
	Red	Hanoi Port	N3 Viet Tri	74.5	II	II
	Lo	N3 Viet Tri	Viet Tri Port	1.0	II	II
			Total Distance	277.0		
2	Quang Ninh - Ninh Binh (Luoc route)					
	Ha Long Cay Channel	Hon Gai Port	Vung Dai island	9.5	I	I
	Ba Mom Channel	Vung Dai island	Qua Xoai	15.0	I	I
	Chanh	Qua Xoai	N3 Chanh, Bach Dang	20.5	II	II
	Bach Dang	N3 Chanh	N3 Dong Vang Chau	8.0	I	I
	Cam, Ruot Lon	N3 Dong Vang Chau	Hai Phong Port	8.5	II	II
	Cam	Hai Phong Port	N3 Cement Factory	1.5	II	II
	Dao HP	N3 Cement Factory	N3 Lach Tray	3.0	III	II
	Lach Tray	N3 Dao HP	N3 Kenh Dong	32.5	III	II
	Kenh Khe, Van Uc	N3 Kenh Dong	Quy Cao ferry	25.5	II	II
	Luoc	Quy Cao ferry	N3 Cua Luoc	72.0	III	II
	Red	N3 Cua Luoc	N3 Hung Long	30.0	II	II
	Dao N. D.	N3 Hung Long	N3 Doc Bo	33.5	II	II
	Day	N3 Doc Bo	Ninh Binh	21.0	I	I
			Total Distance	280.5		
3	Cua Day - Ninh Binh					
	Day	Cua Day	Ninh Binh	72.0	I	I
			Total Distance	72.0		
4A	Lach Giang - Hanoi (Ninh Co route)					
	Ninh Co	Lach Giang	N3 DNC Canal	16.0	II	II or I
	Ninh Co	N3 DNC Canal	N3 Mom Ro	39.0	II	I
	Red	N3 Mom Ro	Hanoi	131.3	II	I
			Total Distance	186.3		
4B	Cua Day - Hanoi (DNC Canal route)					
	Day	Cua Day	N3 DNC Canal	30.0	I	I
	DNC Canal	N3 Day	N3 Ninh Co	1.0	-	I or -
	Ninh Co	N3 DNC Canal	N3 Mom Ro	39.0	II	I
	Red	N3 Mom Ro	Hanoi	131.3	II	I
			Total Distance	201.3		

Note) There may be some locations where it is difficult to realize future dimensions of waterway because of the site condition such as narrow width between dykes.
Note) As to air clearance of bridge for Class II, 7m seem to be enough in reality although Class II requires 9m.
Note) As to Corridor 4, careful feasibility study will be needed before initiating the project.
Source) JICA Study Team



Future Performance of Major IWT Corridors

No	Corridor	Main River	Length (km)	Classification	Present LAD (m)	Future LAD (m)
1	Quang Ninh – Hai Phong		37–99	II (I+II)		
	Hai Phong – Ha Noi	Kinh Thay, Duong	150	II	1.5	2.5
	Ha Noi – Viet Tri	Red River	75	II	1.5	2.5
2	Quang Ninh – Hai Phong	Luoc, Dao, Day	37–99	II (I+II)		
	Hai Phong – Ninh Binh	Luoc, Dao, Day	219	II	1.8	2.5
3	Cua Day – Ninh Binh	Day River	72	I	3.6	3.6
4A	Lach Giang – Ha Noi	Ninh Co, Red	187	II or I	2.0	2.5 or 3.6
4B	Cua Day – Ha Noi	Day, DNC Canal Ninh Co, Red	201	I or II	2.0	3.6 or 2.5

Figure 21.1.2 Future Performance of Major IWT Corridors

As to inland waterways outside the Red River Delta, the Study Team proposes future direction for their development as follows:

1) Thao River route (Red River segment from Viet Tri to Lao Cai)

Thao River route has a great potential to serve cargo transport between upstream regions including both Vietnam and China territories, and the Red River Delta.

In future, seaports in the Northern region have potential to become international gateways for the Yun Nan Province of China. On that occasion, the IWT is considered to be most possible mode of transport since development of new road or railway must be more costly taking into account necessity of construction of many tunnels and bridges in the mountainous region.

Provinces of Yen Bai and Lao Cai have abundant natural resources such as marble stone, iron ore, apatite and manganese. When once these natural sources are fully exploited, the IWT through Thao River and waterways in the Red River Delta is expected to play an important role.

Taking into account the above situation, Thao River route is proposed to be developed in the long run up to class III on condition that careful feasibility study is conducted.

2) Da River and Lo River routes

Son La Hydroelectric Plant will be built at Muong La District in Son La Province in the near future. In the course of constructing the plant, a great quantity of materials and heavy equipment will be transported from Hai Phong and other provinces in the Red River Delta. A large part of these cargoes must be transported through IWT.

In addition to Son La Hydroelectric Plant, there is a possibility that other dams are constructed along Lo River and Da River in future.

Accordingly, Da River and Lo River routes are proposed to be developed as the need arises to serve specialized plants.

Chapter 22 Scenario for Improving IWT System

22.1 Measures for improving IWT system

The following four measures are needed to improve IWT system.

- Realization of set performance of waterways
- Realization of set performance of river ports
- Promotion of shipbuilding industry
- Realization of proper management and operation of IWT system

Detailed items for each measure are as follows:

(1) Realization of set performance of waterways

- To deepen/widen and maintain LAD and LAW of waterways according to set class of technical classification.
- To conduct feasibility study on the corridor 4 (sea - Hanoi) from the viewpoint of traffic forecast and selection of route (Cua Day + DNC (Day-Ninh Co) Canal or Lach Giang) in particular.
- To coordinate with relevant authorities in order to have them construct new bridges with sufficient vertical and horizontal clearances or to reconstruct bridges without sufficient clearance such as Duong Bridge.
- To modify bends of waterways.
- To install sufficient navigation aids and upgrade their performance.
- To provide waterway users with sufficient, latest and urgent information on navigational conditions such as navigation maps for safety navigation.
- To stabilize segments of navigation channel where instability of talweg makes safety navigation difficult and it may bring fatal sedimentation at ports.
- To prepare reliable statistics on vessel traffic at major channel sections.

(2) Realization of set performance of river ports

- To rehabilitate existing port facilities and to construct new facilities or create new ports at rational locations.
- To replace outdated and inefficient handling equipment with higher performance one.
- To improve road and railway access from/to port hinterland.
- To construct passenger berths and relating facilities taking into account the promotion of tourism.

- To arrange ports with different roles and functions in appropriate places.
- To prepare reliable statistics on port cargo and shipcalls at all ports and other berths.

(3) Promotion of shipbuilding industry

- To increase vessel fleet capacity in order to meet the increasing traffic demand.
- To develop vessel/barge with larger capacity, lower draft and cost as well as higher speed in order to strengthen the competitiveness among transport modes.

(4) Realization of proper management and operation of IWT system

- To enact a basic and comprehensive law covering the IWT sector.
- To regulate and consolidate organizations in charge of management and operation of IWT system.
- To provide waterway users with sufficient, latest and urgent information on navigational conditions such as navigation maps for safety navigation.
- To prepare and disclose reliable statistics on port cargo and shipcalls at all ports and private berths as well as on vessel traffic at major channel sections.
- To introduce management information system (MIS).
- To allocate proper budget, personnel and equipment in order to enhance state management and development capacity.

22.2 Organization and investment fund

(1) Organization

Organizations responsible for inland waterway facilities or port facilities and equipment should be clearly defined taking into account the traffic volume, dimensions and other socio-economic importance of each waterway or port. Provisional roles distribution of organization in master planning, investment and management is as follows:

Major corridors (IW class I, II, III): Master planning and investment of major corridors mainly consisting of class I, II and III shall be conducted by MOT (PMU-Waterways), while their management by VIWA.

Other waterways (IW class IV, V, VI): Master planning, investment and management of other waterways than major corridors mainly consisting of class IV, V and VI shall be conducted by provinces after getting approval of MOT. The district or commune level organization seems to be insufficient for the management of a safe and efficient IWT system in fully compliance with laws and standards.

Major river port: Master planning and investment of major river port, of which annual throughput capacity is more than 0.5 - 1.0 million tons, shall be conducted by MOT or other central government after getting approval of MOT. Management shall be conducted by VIWA. Operation shall be conducted by port operating organization including private company. Port operator can make small-scale investment after getting approval of MOT.

Specialized port: Master planning, investment and operation of specialized port shall be conducted to meet the production demand of a factory/plant.

Minor port/berth: Master planning of minor river port/berth, of which annual throughput capacity is less than 0.5 - 1.0 million tons, shall be made by central government, provincial government, private company, etc. after getting approval of MOT.

(2) Investment fund

Many of the current problems and issues on the IWT system accrue from the shortage of funds. Budget of central and local governments has been and will be the principal funds for development, improvement and maintenance of inland waterways and ports. In addition, it should be examined to make use of foreign funds such as ODA, BOT and FDI schemes by making favorable conditions to attract them. A wide variety of alternatives to raise fund is important.

1) Alternatives of investment fund for ports

Several alternatives investment fund for ports can be proposed as follows:

- Central government or local government allocates funds in order to construct ports and to procure cargo handling equipment.
- A private company/factory constructs a port and procures cargo handling equipment with its own funds.
- BOT and FDI schemes.

- A port operator (generally a private company) builds in cases where required investment is not large.

In general, BOT and FDI schemes have a good chance to succeed in the following cases:

- when handling a considerable amount of high-priced cargoes such as containers.
- when able to collect expensive port charges.
- when there is no strong competitor.

As far as road is concerned, construction of a highway or bridge where traffic is heavy could be successfully implemented by such schemes. However, main cargo items at ports in Hanoi Segment are low-priced cargoes such as construction materials, cement etc. and the volume is not so large. In addition, private berths are tough competitors handling the same cargoes.

Therefore, sizable support from a government may be needed in order to realize BOT or FDI. Container berths at New East Port are estimated to handle no more than 67,000 TEUs in 2020, therefore, EDI or FDI scheme will be difficult quite a while.

2) Tonnage dues

Tonnage dues are collected from vessels deployed in inland waterways, although they are not directly used for development and maintenance of waterways.

It is not advisable to raise the tonnage dues and to appropriate them to development of inland waterways. Inland waterways correspond to roads in land transport and road traffic is basically free of charge. Raising drastically the tonnage dues would lead to increase road transport. However, raising moderately the tonnage dues for maintenance of IW may be necessary if needs arise.

On the contrary, shift from road transport to IWT should be promoted because of the following reasons:

- Safety of road transport is growing worse. For example, more than 10 thousand people in a year were killed by traffic accidents.
- IWT has an advantage over road transport in terms of influence on environment.

It seems to be proper that the government budgets more for developing IWT. In many European countries, too, central government develops and maintains IWT waterways with its own budget.

3) Deciding investment

As for not only international funds but also domestic ones, priority investment for inland waterways and ports according to a master plan is indispensable. When deciding the investment, it must be confirmed how the industrial and urban development in the hinterland and means of access is progressing.