The Feasibility Study
on The Can Tho Bridge Construction in
Socialist Republic of Viet Nam

CHAPTER 2

THE STUDY AREA

CHAPTER 2 THE STUDY AREA

2.1 Natural Conditions

2.1.1 Natural Conditions of Viet Nam and the Mekong Delta

(1) Location

Viet Nam is located in the east of Indochina extending from 8.35° to 23.4° north latitudes and 102.8° to 109.4° east longitudes. The bordering nations are China in the north, Cambodia in the southwest, and Laos in the northwest. The east is surrounded by sea, and the coast extends about 1,800 km from the South China sea to the Gulf of Thailand.

The total land area of the country is 325,490 sq. km of which 75% is mountainous. Lowlands are relatively few, and generally highly distributed in the Mekong Delta area in the west of the country. The forest area has been diminishing; it decreased by 27.3% between 1975 and 1990. These areas have been converted to agricultural lands, or for other utilities, or become grasslands.

(2) Climate

Except in the mountainous areas, the average temperature is above 22°C and belongs to the tropical monsoon climate. The temperature difference between Ho Chi Minh City in the west of the country and Hanoi (the capital in the north of the country) is only about 3.3°C (see Table 2.1). The average annual rainfall shows quite a dissimilar pattern. The average annual rainfalls are 4,000 - 5,000 mm in the mountainous areas, about 600 mm in the central part of the southeast, and 1,000 - 2,500 mm in the remaining areas. More than 80% - 90% of the precipitation occurs from May to October each year (see Table 2.2).

Table 2.1 Rainfall

(mm)

Month Location	1	2	3	4	5	6	7	8	9	10	11	12	Yearly Total
Hanoi	20	24	33	106	163	238	268	312	274	150	56	19	1,663
Max (1956)	122	95	132	243	455	579	884	810	841	637	214	93	5,105
Min (1960)	0	1	2	10	40	24	74	50	6	0	0	0	207
Ho Chi Minh	14	4	11	52	219	322	293	271	330	267	112	48	1,943
Max (1956)	111	10	129	178	561	522	595	499	507	603	286	173	4,174
Min (1960)	0	0	0	0	49	126	98	118	204	82	3	4	684
Da Nang	103	31	24	28	63	79	88	114	371	576	367	204	2,048
Bao Loc	48	34	83	172	237	243	412	384	370	318	131	81	2,513
Phan Thiet	1	1	1	35	142	154	179	164	190	167	47	15	1,096

Table 2.2 Temperature

(℃)

Month Location	1	2	3	4	5	6	7	8	9	10	11	12	Yearly Avg.
Hanoi	16.1	17.1	20.0	24.7	27.5	28.6	29.1	28.3	27.3	24.8	21.2	18.1	23.6
Ho Chi Minh	25.7	26.7	27.9	29.0	27.2	27.7	27.4	27.8	27.1	26.9	26.5	26.0	27.2

(3) Rivers

Viet Nam has 25 river systems. There are about 2,500 rivers and tributaries with a total length of more than 25,000 km. The Mekong and Red Rivers flow in the west and north, respectively. The present study area belongs to the part of the Mekong River which originates from the Tibetan plateau and drains into the South China Sea flowing through the Indochina mountain range, Chanson mountain range, Korat Plateau, Cambodia lowland, and the Mekong Delta. The catchment covers most of the Indochina countries, namely, Viet Nam, Cambodia, Thailand, Myanmar, Laos, and China. The catchment area is about 795,000 sq. km, and the length of the river itself about 4,200 km.

The downstream catchment area from the borders of Thailand, Myanmar, and Laos is referred to as the lower Mekong River basin. This area covers about 77% of the total area of the Mekong River catchment. The Mekong River catchment is shown in Fig. 2.1. River water level increases during the rainy season, and flows into the

surrounding low lands. Due to the inherent poor drainage, water logged areas remain for a considerable time until the river level falls. Each year, crops (which are mainly planted at the beginning of the rainy season) are severally affected by this phenomenon.

(4) Geology

Quaternary alluvium is found in the northern delta, southern delta, and in the central coastal plain of Viet Nam. The Mekong Delta largely consists of sand, saline soil, sulfuric acid soil, alluvial soil, old alluvial soil, hilly soil, and peat.

The saline soils (soda soil) includes sodium, calcium, and magnesium, while the sulfuric acid soil is normally found sticking to mangroves that grow in the marsh. Peat (having a non-decomposed organic layer) appears in the top 80 cm layer below the surface. The soil which is submerged deeper than 50 cm below the surface exhibits incomplete chemical neutralization due to a lack of oxygen caused by the poor drainage system.

(5) Flora and Fauna

Only marginal forest lands are available and these are mainly distributed in the high mountainous areas. Lowland areas are mainly used for paddy cultivation but in the mountain areas shifting cultivation, forest, and orchards can be found. In extremely steep mountainous areas some distribution of the broad leaf categories of tropical flora exist. Mangrove forests are located in the northern seacoast and the south coast at the Mekong River confluence points. Currently about 7,000 species of mangrove are recognized and out of which about 2,300 species are used for medicine, animal feed, and timber.

The fauna species that can be found in this area are considerable. About 273 species of mammals, 180 varieties of reptiles, 780 kinds of birds, 80 amphibian, and 471 types of freshwater fish are said to exist in the region. In the Viet Nam Red Book some of these species have been identified as endangered - 67 are on the verge on extinction, 97 are critically endangered situation, 124 are very scarce, 71 are abundant and 6 are not to be found at present in the area.

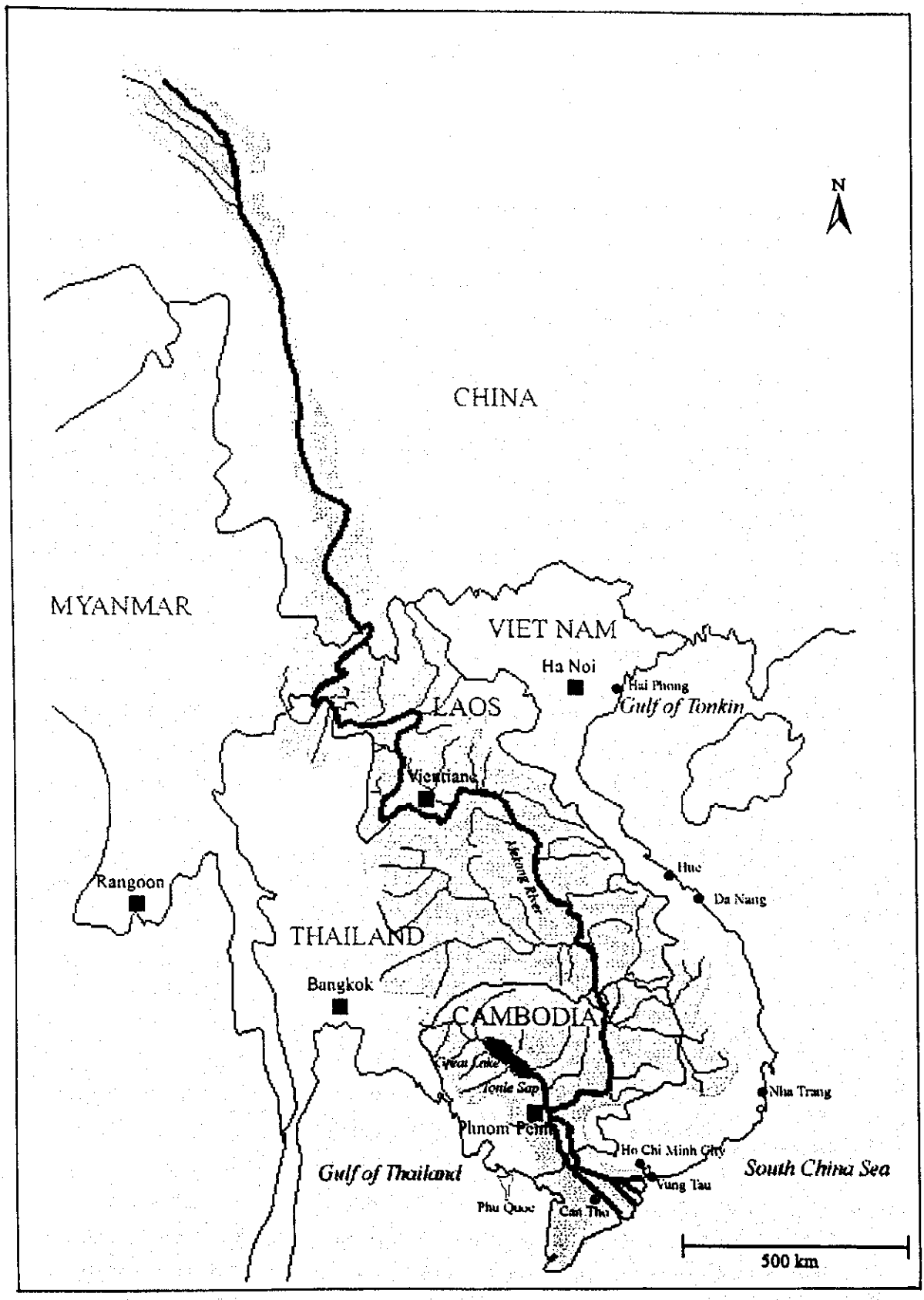


Fig. 2.1 The Mekong River Basin

2.1.2 Natural Conditions of Can Tho

(1) General Condition

Can Tho is situated in the central part of the Mekong Delta. This is an extremely flat area with only 2 to 3 meters of elevation above MSL. Soil in this area is alluvial in nature and mostly washed and deposited from the Hau River during the flooding season. The total Can Tho provincial area is about 2,970 sq. km, of which 83% is agricultural land. Forest areas are only 1% of the total surface area. The population of Can Tho city was 300,000 in 1992, and that of the provincial population about 1,740,000. In the 17th century this city was developed to link Cambodia and the South China Sea. This link helped to transport the agricultural products of the western Mekong Delta, and it is now expected that Can Tho city will play a major role in the future development of the region.

(2) Climate

The climate of the Mekong Delta, including Can Tho is typical of the monsoon weather pattern. Humid seasonal winds from the southwest prevail from May to October, and dry winds from the northeast from November to March. These two periods show a very distinct rainy season, which is associated with heavy tropical downpours. Data acquired from the Can Tho Observation Center has been analyzed, and the general weather patterns are summarized below;

a) Temperature and Humidity

The annual average temperature of the area is 26.7°C, with a maximum of 36.5°C and a minimum of 17.7°C. The humidity averages 87% in the wet season and 77% during the dry season. (see Table 2.3, 2.4 and 2.5)

Table 2.3 Maximum Ambient Temperature

(℃)

Return period (Year)	10000	100	20	10	5	2	-	-	-	-	-
Frequency (P%)	0.1	1	5	10	20	50	70	75	80	90	95
Maximum	42.2	40.5	39.1	38.5	37.7	36.3	35.6	35.4	35.3	34.8	34.4

Table 2.4 Minimum Ambient Temperature

(℃)

Return period (Year)	10000	100	20	10	5	2	-	-	-	-	-
Frequency (P%)	0.1	1	5	10	20	50	70	75	80	90	95
Maximum	12.1	13.8	15.2	15.9	16.6	17.8	18.5	18.7	18.9	19.4	20

Table 2.5 Humidity

(%)

Month	1	2	3	4	5	6	7	8	9	10	11	12
Relative Average	82	79	77	78	83	86	85	86	87	86	85	83
Relative Minimum	32	37	30	31	27	39	49	42	46	40	31	43

b) Rainfall

The weather pattern of Can Tho can be distinguished into two seasons; wet and dry. The wet season which prevails from May to November is characterized by having 90% of the annual precipitation with 15 - 20 rainy days per month. (see Table 2.6)

Table 2.6 Rainfall

Month Factor	1	2	3	4	5	6	7	8	9	10	11	12	Yearly
Monthly-Average (mm)	10	1	8	39	204	231	213	254	265	325	146	30	1,727
Max.-Daily (mm)	34	11	60	69	76	125	103	137	118	129	116	96	137
Monthly-Average Rainy days (day)	1.5	0.3	1.2	4.8	15.3	19.0	20.3	21.8	21.9	20.4	13.1	5.4	144.0

c) Wind

The characteristics of wind data in Can Tho is tabulated in Table 2.7. In general, Can Tho has relatively gentle breezes of about

2.5 to 3.5m/sec. However, typhoon gusts can take place during the southwest monsoon period from June to September.

Table 2.7 Wind

V_x - Maximum wind velocity in a month, and its directions

Month / Factor	1	2	3	4	5	6	7	8	9	10	11	12	Yearly Max
Vx (m/s)	14	14	14	24	21	30	31	31	28	20	18	13	31
Directions	E, NNE	SE	NE, SE	S	SE	SW, W	SW	SW	SW	W	E	ENE E	SW
Year Wise	1979 1981	1981	1979 1981	1980	1980	1970 1981	1979 1982	1979	1983	1983	1982	1977 1978	1979 1982

2.2 Transport System

2.2.1 Transport Infrastructure

(1) Roads

The total length of road network in the Mekong Delta is approximately 30,000 km. These roads are classified into national roads, provincial roads, and rural or feeder roads. Provincial and rural or feeder roads connect provincial capitals with district centers, or link the district centers to the national roads (Table 2.8). Judging from the current road network density of 0.77 km per sq. km, the road network is widely spread over the delta.

Generally however, the road condition is poor with the exception of the national roads. Most of the rural or feeder roads in the flood prone areas are inundated during the wet season, resulting in the emergence of vast areas which are not accessible by vehicle. Out of the 30,000 km of roads in the Mekong Delta (compiled from 1994 statistics), only 1,600 km or 5% were asphalted.

The total number of bridges in the Mekong Delta is about 20,000 due to the running waterways like net meshes and tributaries of the Mekong River. The gradients of the approach roads to bridges are generally steep for maintaining vertical clearances for the passage of boats and barges.

Thirty ferry sites are currently located in the delta, of which Can Tho, Vam Cong, An Hoa, and Chau Doc are along the Hau (Bassac) River.

The main national roads are National Road No.1 between Hanoi and Ca Mau (the primary trunk road connecting the north to the south in Viet Nam), National Road No. 80 between Vinh Long and Ha Tien and National Road No. 30 along the Mekong River to the Cambodian border (Fig. 2.2).

(2) Inland Waterways

There are many canals, waterways, and rivers in the delta. According to the Transport Infrastructure Survey in 1994, the navigable length is about 2,700 km out of some 5,000 km of waterways. The density of the waterway network is 0.68 km per sq. km. This figure is almost comparable to that of road. Waterways are still functioning as a major transport means for economic and the inhabitants' daily activities, due to the flooding in the rainy season.

The waterway transport is concentrated on two principle corridors from Ho Chi Minh City to Ca Mau (320 km) and from Ho Chi Minh City to Kien Luong (330.3 km). The navigability of the waterways is generally in poor condition in terms of least available depths and navigational aids.

During the high water level of the Mekong River navigability is quite favorable for local boats and seagoing ships, but during the low water level season transport for heavy commodities by inland underways becomes problematic.

(3) Ports

For coastal and seagoing vessels, Tran Quoc Toan, Vinh Thai, My Thoi, Can Tho, Hon Chong, and Nam Can ports are located in the Mekong Delta. Of these ports My Thoi and Can Tho ports are located on the Hau (Bassac) River. Can Tho port has been constructed with the status of an international port, and can accommodate 5,000 DWT capacity vessels and handle some 300,000 tons of cargo per year. However, only fully loaded 3,000 DWT vessels can reach the port due to the shallow depth at the mouth of Dinh An and larger vessels must wait during low tide.

Corresponding to the well developed waterway network, Long Xuyen (Hau River), My Tho (Binh Duc), Tra Cu, and Cao Lanh (Tien River) are located as river ports accessible by 1,000 DWT class vessels.

2.2.2 Transport Pattern

(1) Modal Share

Transport modes in the Mekong Delta depend on inland waterways, road, sea, and air. The railway has suspended its operations. Roads act as the major means of transporting passenger, and the inland waterways are used for major freight transport.

According to 1995 official statistics, a cargo volume of some 18.8 million tons was transported in the Mekong Delta, of which 38% was transported by road and 60% by inland waterways. Since the share of road in cargo transport in 1991 was 33%, a gradual shifting from inland waterways to road can be recognized in the modal share for cargo transport in the delta.

Roads kept almost the same share between 1991 and 1995 for passenger transport. In 1995, roads accounted for 66% of passenger traffic in the delta.

(2) Transport Pattern

With regard to transport volume, rapid expansion of both passenger and cargo transport was achieved in the delta. Between 1991 and 1995 freight transport volume expanded more than two-fold, with an average growth rate of over 20% p.a. The situation was almost same for passenger transport with a growth rate of around 15% p.a. (Table 2.9). The traffic volume crossing the Hau River at Can Tho ferry has steadily increased, with 1,800 veh./day, 1,800 motorcycles/day and 800 bicycles/day observed in 1996. With respect to vehicle type, trucks occupied some 40% of the total vehicle volume followed by buses. The relatively low growth rate of traffic volume at the Can Tho ferry site compared with the overall traffic growth rate in the Delta is attributable to the expansion of traffic volume at other ferry servicing sites on the Hau River such as Vam Cong and An Hoa which have absorbed transport volumes across the Hau River. Though a small

fluctuation has been observed, the traffic volume crossing Can Tho ferry has been generally stable (Table 2.10).

Agricultural products and processed agricultural foods to other regions and foreign countries; goods for livelihood, chemical fertilizer, and construction materials from other regions to the delta have been the main commodity types of long distance freight transport in the Delta. However, as shown by the rapid growth of the industrial sector in the Mekong Delta, it is likely that the transport demand for industrial products has begun to increase.

Rice and construction materials dominate the cargo transported by inland waterways. Although roads and waterways compete with each other for the transport of agricultural products, an informal supplementary cooperation system all the year round can be observed in the delta.

Rice or other non-perishable agricultural products from farmhouses (where no access road exists) are usually transported by small boat to the collective center and then transported to Ho Chi Minh City by barge. Public buses, motorcycles and bicycles are the main means of transport by road for agricultural products between farmhouses and the agriculture produce market.

2.3 Socio-economic Situation

2.3.1 Population

The population in the delta was 16.2 million in 1995, and the overall population growth rate between 1991 and 1995 was 2.1% p.a. (Table 2.11).

The delta is scarcely urbanized, with only 15 % of population classified as urban population. Urban areas, defined as settlements of at least 4,000 inhabitants, comprise a limited number of cities, towns, and townlets.

The labor force in the Mekong Delta was estimated at 63% of the delta population in 1995. The unemployment rate in the delta was 4.5% in 1995, and this figure was below that of whole country and Ho Chi Minh City. In the rural area of the Mekong Delta, it was reported that underemployment was common with about half of workers in agriculture and cottage industries working less than 200 days a year.

2.3.2 Economic Activities

Viet Nam has been traditionally regarded as an agrarian country, with 70% of the labor force working in the agricultural sector. Although the agricultural sector continues to grow, the industrial and service sectors have grown faster to contribute to the recent remarkable economic growth.

The Mekong Delta (with an area of 39,500 sq. km covering about 12% of the country's total area and a population of 16 million constituting about 22% of whole country's population) has been an important region for country's economy especially in agricultural production. It provides 10 to 13 million tons of paddy or nearly 50% of the national paddy production. The region has contributed to the national economy by exporting surplus rice and processed fishery products.

The GDRP growth rate in the Mekong Delta (in 1989 constant price terms) between 1991 and 1995 was 10.2% p.a., which surpassed the national GDP growth rate of 8.8% p.a. (Table 2.12). Growth in the delta has been confined to primary sector output and agro-industry and has been accelerated by domestic and international trade. However, its high GDRP growth rate has not been evenly achieved at the provincial level and provinces with relatively weak transport conditions such as Ca Mau, Bac Lieu, Ben Tre and Long An, have been left out of the rapid economic growth.

The structure of the economy in the Mekong Delta comprises (at 1995 current price terms) the agricultural sector accounting for 62% of the GDRP in 1995, the industrial sector at 16%, and the service sector at 22%. The industrial and service sectors have contributed a relatively small portion to the GDRP. Its economic structure to a considerable extent differs from that of the whole country comprising 28% of the agricultural sector, 30% of the industrial sector and 42% of the service sector. In the economic structure of Mekong Delta, secondary and tertiary sectors have gradually increased their importance. This tendency is expected to continue with the progress of modernization, industrialization, and the current large share of the agricultural sector in GDRP compared with that of the whole country (Tables 2.13 and 2.14).

Until recently, direct foreign investment had been confined to the area around Ho Chi Minh City and investment in the secondary sector in the

Mekong Delta area has just begun gradually to increase. Can Tho, located almost at the center, has grown up as a marketing and agro-processing center in the Mekong Delta.

2.3.3 Financial Situation

In the 1990's a series of new taxes were introduced in Viet Nam, and the reformed taxation system has been successful at raising revenue, with the result that the budget deficit has been kept small at below 2% of GDRP. In Viet Nam the transport sector has long suffered from underfunding and disinvestment and only one quarter of the necessary road maintenance expenditures have been funded each year.

The yearly investment requirement including essential rehabilitation, small amounts of upgrading and expansion, and the necessary maintenance expenses were estimated in 1994 at 814 million US$ per year from 1994-2000. This amount is almost 5.2% of Viet Nam's 1994 GDP and some 20% of the 1994 state budget. Such a level of expenditure seems too much for the government to afford, and the government is, therefore, compelled to identify a transport investment program which supports the economic growth to double per capita income by the year 2000 with macro-economic constraints. New projects, therefore, are primarily determined by the availability of local or foreign funds and political considerations.

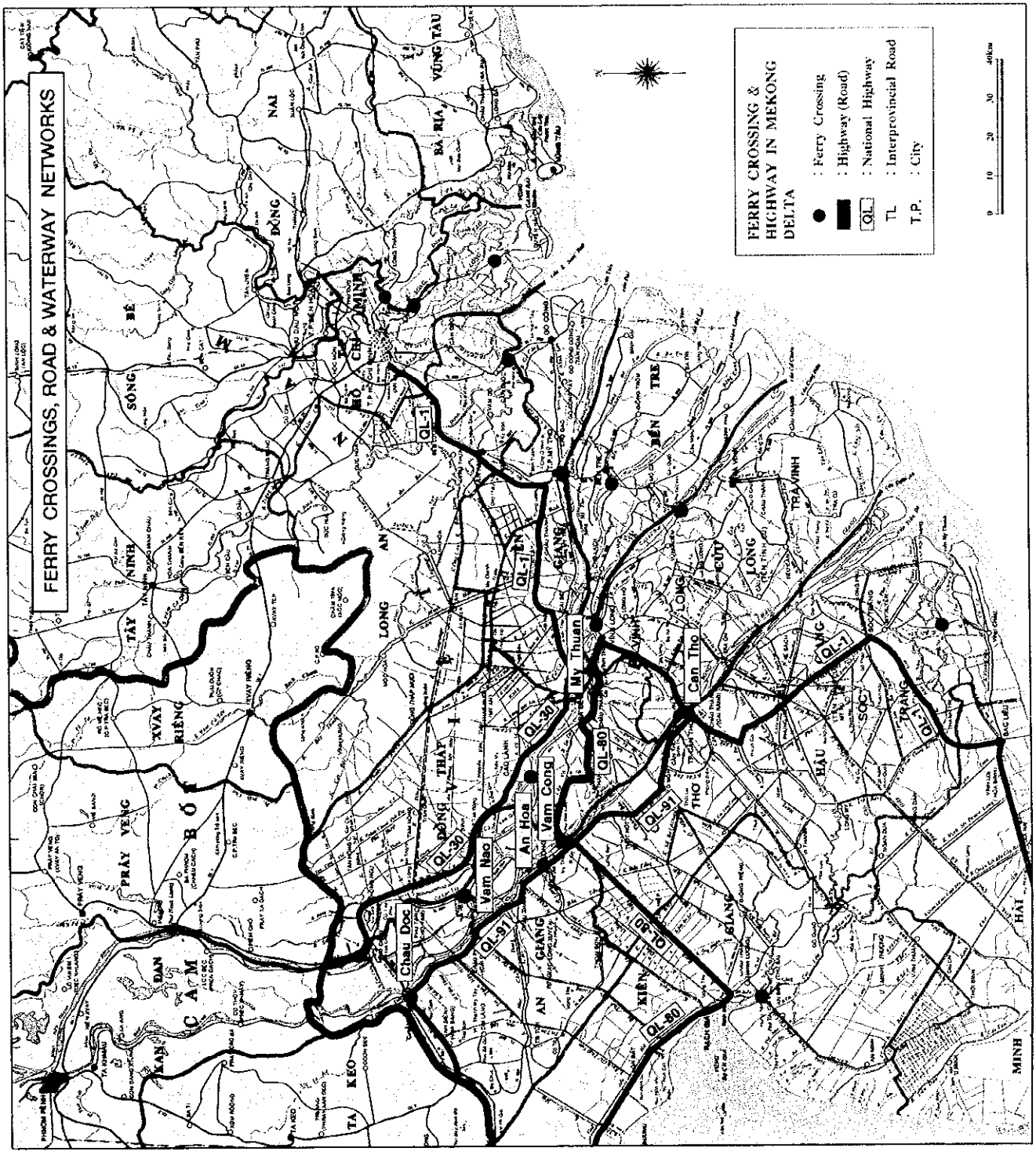


Fig.2.2 Main National Roads

Table 2.8 Transport Infrastructure in the Mekong Delta, 1994

				Whole	Mekong
Road	Total length	(a)	(km)	177,259	30,044
	Asphalted road length	(b)	(km)	15,070	1,577
	Rate of asphalted road length	(b) / (a)		9%	5%
Bridge	Number of bridges			39,482	20,107
	Total length	(c)	(m)	556,558	273,743
	Rate of bridge length	(c) / ((a)+(c)+(d))		0.31%	0.90%
Ferry	Number of ferry sites			132	30
	Total length	(d)	(m)	35,779	17,317
	Rate of ferry length	(d) / ((a)+(c)+(d))		0.02%	0.06%
Network density		((a)+(c)+(d)) / area	(km / sq.km)	0.54	0.77
Servicing population per km		pop. / ((a)+(b)+(c))	(pers. /sq.km)	408	523
Waterway	Total length		(km)	40,988	26,906
	Waterway density		(km / sq.km)	0.12	0.68

Source: Statistical Yearbook 1994, Central Statistical Office

Table 2.9 Transport Volume in the Mekong Delta

		1991				1995			
		Whole country		Mekong Delta		Whole country		Mekong Delta	
Freight transport									
Rail	(1,000s tons)	2,567	5%	N.A.	-	4,515	5%	N.A.	-
Road	(1,000s tons)	33,962	60%	2,892	33%	55,952	64%	7,245	38%
Inland	(1,000s tons)	15,566	28%	5,711	66%	20,051	23%	11,323	60%
Sea	(1,000s tons)	4,330	8%	101	1%	6,670	8%	273	1%
Total	(1,000s tons)	56,425	100%	8,704	100%	87,188	100%	18,841	100%
Rail	(million tons-km)	1,103	7%	N.A.	-	1,751	9%	N.A.	-
Road	(million tons-km)	1,815	11%	172	18%	2,968	15%	513	28%
Inland	(million tons-km)	1,765	11%	657	68%	2,248	11%	1,095	59%
Sea	(million tons-km)	12,519	78%	130	14%	14,803	74%	234	13%
Total	(million tons-km)	16,099	100%	959	100%	20,019	100%	1,842	100%
Passenger transport									
Rail	(million pax.)	10	2%	N.A.	-	9	1%	N.A.	-
Road	(million pax.)	333	77%	78	67%	472	80%	134	66%
Inland	(million pax.)	93	21%	38	33%	110	19%	69	34%
Sea	(million pax.)	N.A.	-	0	0%	N.A.	-	0	0%
Total	(million pax.)	435	100%	116	100%	591	100%	203	100%
Rail	(million pax.-km)	1,767	14%	N.A.	-	2,133	13%	N.A.	-
Road	(million pax.-km)	9,438	76%	2,509	75%	12,775	78%	3,980	76%
Inland	(million pax.-km)	1,186	10%	837	25%	1,428	9%	1,225	23%
Sea	(million pax.-km)	55	0%	6	0%	29	0%	22	0%
Total	(million pax.-km)	12,446	100%	3,352	100%	16,366	100%	5,227	100%

Source: Economy and Society 1991-1995, Statistics Department of Ho Chi Minh City, Sept. 1997

Table 2.10 Transport Volume at the Can Tho Ferry

(veh./year)

	Pedestrian (pers./year)	Bicycle	Motorcycle	M/C w/trailer	Sedan	Bus	Truck	Special veh.
1990	6,012,143	246,144	569,977	29,443	147,250	137,977	200,070	45,443
1991	5,639,607	388,929	592,693	33,816	112,208	174,218	126,103	6,947
1992	6,104,445	267,319	601,183	44,587	75,415	238,731	114,192	15,379
1993	5,874,614	313,365	587,037	46,480	111,563	167,678	129,126	7,577
1994	5,903,845	306,279	386,174	48,253	120,325	171,166	153,845	5,786
1995	5,944,115	298,661	591,342	56,717	114,675	201,805	176,183	3,877
1996	7,035,716	422,641	690,211	51,544	117,581	292,972	256,534	3,440

Source: Hau Giang Ferry Company, The Regional Road Management Union No.7

Table 2.11 Population by Province

(unit: 1,000s pers.)

Province	1991	1992	1993	1994	1995	Avg. annual growth rates
Long An	1,174	1,197	1,227	1,255	1,283	2.2%
Dong Thap	1,404	1,444	1,472	1,488	1,522	2.0%
An Giang	1,860	1,896	1,933	1,970	2,007	1.9%
Tien Giang	1,558	1,592	1,624	1,656	1,686	2.0%
Ben Tre	1,264	1,286	1,308	1,331	1,343	1.5%
Vinh Long	1,004	1,022	1,042	1,062	1,083	1.9%
Tra Vinh	-	915	937	957	978	2.2%
Can Tho	1,696	1,739	1,779	1,819	1,856	2.3%
Soc Trang	-	1,145	1,172	1,197	1,222	2.2%
Kien Giang	1,265	1,296	1,332	1,368	1,399	2.5%
Minh Hai	1,642	1,682	1,720	1,766	1,817	2.6%
Sub-total	12,867	15,214	15,546	15,869	16,196	2.1%
Ho Chi Minh City	4,259	4,426	4,582	4,694	4,795	3.0%
Whole country	67,774	69,405	71,026	72,510	73,959	2.2%

Source: Economy and Society 1991-1995, Statistics Department of Ho Chi Minh City, Sep. 1996

Table 2.12 GDRP by Province (at constant prices of 1989)

(unit: billion dong)

Province	1991	1992	1993	1994	1995	Avg. annual growth rates
Long An	581.6	564.0	601.7	644.2	754.6	6.7%
Dong Thap	632.4	700.7	779.2	836.3	912.2	9.6%
An Giang	923.0	1,026.5	1,124.0	1,246.9	1,385.1	10.7%
Tien Giang	751.0	864.0	1,085.0	1,245.0	1,403.0	16.9%
Ben Tre	551.8	573.4	625.2	661.2	712.9	6.6%
Vinh Long	514.2	549.2	593.7	646.1	701.7	8.1%
Tra Vinh	-	390.7	441.7	499.1	577.0	13.9%
Can Tho	788.9	855.8	922.6	1,058.4	1,196.0	11.0%
Soc Trang	-	444.8	465.2	561.4	671.4	14.7%
Kien Giang	976.0	1,078.0	1,187.0	1,319.0	1,509.0	11.5%
Minh Hai	846.1	907.9	979.6	1,021.9	1,096.2	6.7%
Sub-total	6,565.0	7,955.0	8,804.9	9,739.5	10,919.0	10.2%
Ho Chi Minh City	5,241.9	5,856.8	6,588.9	7,549.0	8,704.0	13.5%
Viet Nam	31,286.0	33,991.0	36,735.0	39,982.0	43,797.0	8.8%

Source: Economy and Society 1991-1995, Statistics Department of Ho Chi Minh City, Sep. 1996

Table 2.13 Socio-economy of the Mekong Delta

		1991			1995		
		Whole country	Mekong Delta		Whole country	Mekong Delta	
		(a)	(b)	(b)/(a)	(a)	(b)	(b)/(a)
Population	(1,000s pers.)	67,774	14,894	0.22	73,959	16,196	0.22
Area	(sq.km)	331,042	39,568	0.12	331,042	39,568	0.12
Pop. density	(pers./sq.km)	205	376	1.84	223	409	1.83
Agri. area	(sq.km)	70,079	24,606	0.35	73,575	27,091	0.37
Food crops prod.(paddy equiv.)	(1,000s tons)	21,990	10,464	0.48	27,571	12,991	0.47
Per capita food crops prod.(paddy equiv.)	(kg./pers.)	324	703	2.17	373	802	2.15
Industrial production (at current prices)	(billion dong)	18,252	1,651	0.09	66,804	5,978	0.09
Per capita industrial production	(1,000s.dong/pers.)	269	111	0.41	903	369	0.41
GDP/GDRP	(billion dong)	76,707	18,084	0.24	222,840	41,670	0.19
Per capita GDP/GDRP	(US$/pers.)	121	129	1.07	274	234	0.85

Note: at current prices

Source: Statistical Yearbook 1995, Central Statistical Office and Statistical Data of Agriculture, Forestry and Fishery 1985-1995, General Statistical Office

Table 2.14 Main Socio-economic Indicators of Provinces in the Mekong Delta, 1995

Province	Population	Area	Pop.density	Agr.area	Food crops production	Per capita food crops production	Industrial production	Per capita industrial production	GDRP	Per capita GDRP
					(paddy equiv.)		(at current prices)		(at current prices)	
	(1,000s pers)	(sq.km)	(pers./sq.km)	(sq.km)	(1,000s tons)	(kg./pers.)	(billion dong)	(1,000s dong/pers.)	(billion dong)	(US$/pers.)
Long An	1,283	4,338	296	2,371	1,025	799	517	403	2,982	211
Dong Thap	1,522	3,276	465	2,267	1,629	1,070	295	194	3,361	201
An Giang	2,007	3,424	586	2,413	1,955	974	659	328	5,618	254
Tien Giang	1,686	2,328	724	1,690	1,200	712	474	281	4,457	240
BenTre	1,343	2,247	598	1,526	329	245	350	260	3,257	220
Vinh Long	1,083	1,474	735	1,183	880	812	309	286	2,694	226
Tra Vinh	978	2,373	412	1,648	665	679	231	236	1,929	179
Can Tho	1,856	2,964	626	2,446	1,718	925	903	487	5,029	246
Soc Trang	1,222	3,200	382	2,459	1,099	899	372	304	2,860	213
Kien Giang	1,399	6,243	224	3,004	1,463	1,046	1,047	749	4,383	285
Minh Hai	1,817	7,689	236	5,534	1,031	567	821	452	5,101	255
Sub-total	16,196	39,556	409	26,541	12,991	802	5,978	369	41,670	234
HCMC	4,795	2,090	2,294	921	241	50	13,456	2,806	38,811	736
Viet Nam	73,959	331,042	223	79,072	27,511	372	66,804	903	222,840	274

Source: Economy and Society 1991-1995, Statistics Department of Ho Chi Minh City, Sep.1996

The Feasibility Study
on The Can Tho Bridge Construction in
Socialist Republic of Viet Nam

CHAPTER 3

IMPLICATION OF FUTURE DEVELOPMENT

CHAPTER 3 IMPLICATION OF FUTURE DEVELOPMENT

3.1 Economic Policies and Plans

3.1.1 Economic Policies and Plans

The Eighth Party Congress in 1996 adopted a new economic program called "The 1996-2000 Five-year Plan for Socio-economic Development" (Five-year Plan). It aimed at modernization and industrialization of Viet Nam toward the year 2000 similar to the strategic principles of "Socio-Economic Stabilization and Development Strategy to the Year 2000" in 1991. It projected annual GDP growth of 9-10% to double per-capita GDP over that of 1990, based on growth of about 4.5-5% in agriculture, 14-15% in industry and 12-13% in services. An economic structure with industry and construction accounting for 34-35% of GDP, agriculture, forestry and fishery, about 19-20%, and services, about 45-46% by the year 2000 was projected. It is assumed that these targets would require the investment rate to rise to 30% of GDP by the year 2000. Tax and fee contribution to the state budget revenues is expected to amount to 21-22% of GDP and the budget deficit is to be kept at 4.5% of GDP or lower. The plan calls for 41 billion US$ of investment over a five-year period. Of this total some 7 billion US$ is projected to be financed by ODA and 13-15 billion US$ by Foreign Direct Investment (FDI).

Key notes for this Study from the Five-year Plan for the future of Mekong Delta are:

- Population growth rate is to have been brought down to less than 1.8% by the year 2000.
- Urban employment rate is to have been reduced to below 5%, and employment in rural areas is to be increased to over 75% of available labor time.
- By the year 2000, food output is expected to have reached about 30 million tons, and food per capita, 360-370 kilograms.
- By the year 2000, industrial crops are to have accounted for about 45% of the total output of cultivation.
- Efforts are to be made to ensure for animal husbandry about 30-35% of the total agricultural production by the year 2000.

- The program on control of salinity and acidity, and water logging in the Mekong Delta will be carried out.
- Efforts will be concentrated on ensuring road access to the Mekong Delta.
- Rehabilitating and upgrading sections of vital roads, especially national roads will be concentrated on and a number of major bridges will be constructed.
- Airports in Ca Mau and Can Tho provinces will be upgraded as auxiliary airports.
- The Can Tho port will be built into the central port of the Mekong Delta, raising its capacity to 0.5 million tons in 2000.
- Dredging and redirecting river flows, and upgrading the main river ports will be carried out to ensure smooth river navigation for up-to 2,000-ton capacity vessels into the hinterland in the southern delta.

The Prime Minister's Decision No.99-TTg on long-term orientation and the five-year plan of 1996-2000 for development of irrigation, transportation, and construction in rural areas of the Mekong Delta was made in February 1996.

The decision aimed at ensuring national food security and accelerating the economic growth of the agricultural economy and rural development through the development of those works along the lines of industrialization and modernization.

The main contents of the decisions in each sector are as follows:

(1) Transport

The transport system in the Mekong Delta is to be formed into a perfect system suitable for the delta containing the waterways, road and irrigation systems without obstructing the flow of floods and rise of flood tides.

The road network to form the linkage between urban areas and roads along the border is emphasized.

The formation of favorable inter-provincial and inter-zonal waterway systems is to be pursued.

(2) Residential Quarters

Ensuring safe and stable living conditions for industrial production and service establishments is to be pursued.

Populous conglomerations and liner residential areas in rural areas, and towns and urban centers in urban areas are to be formed on elevated ground for protection from floods.

The targets in numerical terms to be achieved up to 2000 are as follows:

a) Reclamation of 500,000 hectares for rice cultivation, increasing the total to 3.5 million hectares under rice cultivation in the Mekong Delta.

b) 15-16 million tons of total food output a year by land potential development.

3.1.2 Economic Growth Prospects

The Mekong Delta has a high agricultural potential to produce surplus rice in the future and to diversify into high value added crops. The delta mainly consists of young, heavy alluvial soils of marine and fluvial origin. The soils in the delta are generally deficient in phosphorus and need a relatively large amount of fertilizers, with the heavy soils being most suitable for cultivation. Large areas of acid sulphate soils are unutilized, or undeveloped, supporting a single traditional rice crop in the wet season only. Since the estimated space for new agricultural land development is restricted agricultural development should be orientated to intensification. The constraint of developing the delta's agricultural potential is the alternating vagaries of water surpluses and shortages and the poor transport conditions. If water control measures are fully taken, the change from a single-cropping to a double cropping rice system will be accelerated, however continued production of rice for export is questionable because of the uncertain market prospects in terms of volume and price.

Conditions in the delta are favorable for diversification of crops including a wide range of upland crops and high value tree crops. However, planting almost all tree crops requires investment capital beyond the farmer's financial resources. The main issue for diversification in the Mekong Delta, therefore, is marketability which includes accessibility to market and market

prospects. For instance, the poor transport conditions for prompt access to the market discourage the farmer's intent for crop diversification. To some extent farmers near Ho Chi Minh City are already growing these crops and it is naturally considered that these diversified cropping systems will be expanded from the areas where accessibility to Ho Chi Minh City is favorable.

With regard to brackish water aquaculture, shrimp farming is the other main foreign currency earner in the Mekong Delta. In this sector semi-intensive shrimp culture will replace extensive culture. However, sustainable semi-intensive shrimp culture is questionable as the evidence against can be seen elsewhere in the southeast asia region.

Presently a considerable inter-relationship between the Mekong Delta and the triangle of Ho Chi Minh City/Bien Hoa/Ba Ria-Vung Tau has been established. Agricultural products in the Mekong Delta are exported to and processed in Ho Chi Minh City, and delta related products and commodities are transported and traded from there. However, constraints for the development of industry and services to absorb surplus labor in rural areas, poor transport conditions, shortage of electricity supply, retarded technical skills, shortage of investment funds, lack of information on market and technology and insufficient consumer's income are serious issues which need to be addressed.

Improving intra-delta and industrial infrastructure will change the situation into processing at closer locations from production areas. Currently proposed projects in the Mekong Delta, represented by the improvement of N.H. No.1, improvement of the Can Tho port, and construction of IP and EPZ at Can Tho City, will contribute to industrialization from the agro-industry to other industries in the delta.

Urbanization and concentration of service industries are not well developed as yet, though the 16 million populations are inhabiting nearly 40 thousand sq. km of land. Can Tho City, which is designated as the development center in the Mekong Delta, contains about 0.4 million inhabitants with a much smaller population in My Tho or Vinh Long. Urbanization and industrialization are still expanding. Considerable room is still available for urbanization and for increasing the population in Can Tho and other core cities in the Mekong Delta.

3.2 Socio-economic Framework

3.2.1 Population Growth

The population growth rates projected in the national five-year plan and previous studies are as follows:

Plan/Study	Population Growth Rate
1) The 1996-2000 Five-year Plan for Socio-economic Development in the Mekong Delta	down to 1.8% p.a. by the year 2000
2) Mekong Delta Master Plan	down to 1.6% within a 25 years period in the whole country
3) My Thuan Bridge Project	2.1% p.a. (1993-2000) 1.7% p.a. (2000-2015)

In the Mekong Delta Master Plan (Ministry of Transportation 1993) the total population in the Mekong Delta was forecasted to be 23.7 million in 2015. The population forecast was updated during the study of the My Thuan Bridge Project by a local consulting institute, resulting in a forecast of 23.9 million in 2015. The update was carried out through consultation with provincial and national planning authorities and the best available population forecast and economic growth statistics used, with regard to the regional and national economic development objectives. The population concentration in Ho Chi Minh City has recently decelerated, and the possibility of provinces in the delta of retaining the population is growing because of the current tendency of increased employment opportunities through industrialization. Taking account of the above circumstances, population growth rates were adopted (Table 3.1).

3.2.2 GDRP Growth

Taking account of the government growth-conducive policy for developing the Mekong Delta and the current projects proposed based on the government policy of which some big projects are being undertaken, the economic growth in the Mekong Delta is assumed to be accelerating compared with the natural economic growth.

The economic structure in the Mekong Delta in future can be characterized by i) accelerated economic growth, ii) a high increasing rate of primary

sector output (yet below the rate of overall GDRP), and c) a limited scope for expanding the cultivated area.

Based on the above characteristics, two GDRP growth scenarios of the Mekong Delta can be assumed.

The first scenario is based on the assumption that the secondary and tertiary sectors would drive the economy by successful investment.

The second scenario is that the economic growth would be driven by the primary sector by policy measures and investment in connection with primary sector development and processing.

The government's target of Viet Nam's GDP growth rate for the period to the year 2000 is 9-10% per year. Though the officially targeted GDRP growth rate in the Mekong Delta is not available as yet, the Mekong Delta Master Plan in 1993 adopted a GDRP growth rate of 8% p.a. by the year 2000 with a 4.5% p.a. of primary sector growth rate, a 9.0% p.a. of secondary sector growth rate, and an 8% p.a. of GDRP growth rate by the year 2015. However, according to the official statistics the actual GDRP growth rate in the Mekong Delta achieved over 10% p.a. between 1991 and 1995, which was beyond expectations and surpassed the growth rate assumption in the Mekong Delta Master Plan. The evidence suggests that a secondary and tertiary sector driven economy has been proceeding in the Delta.

In the span of a decade, however, GDP growth rates in those countries where remarkable economic development was achieved (East and Southeast Asia) were about 8-9% on average. The economics of those countries are now suffering from a fall of the currency exchange rate and stock prices and struggle for transition to higher tier of economy.

Considering the current vibrant economic activity and ongoing projects expected to underpin the regional economy, a GDRP growth rate of 8% is not unrealistic in the Mekong Delta until 2005. After the initial rapid growth, deceleration to a slightly lower growth rate would be expected. The assumed economic growth rates are shown in Table 3.1.

Table 3.1 Population and GDRP Growth Rates

	1997 - 2010	2010 - 2020	2010	2020
Population	Growth rate (%)		Population (pers.)	
	1.6	1.4	20.6	23.6
GDRP	Growth rates (%)			
Rapid growth	10	8		
Medium growth	9	7		
Slow growth	8	6		

3.3 Transport Plans and the Provincial Master Plan

3.3.1 Transport Plans

The most comprehensive development plan for the Mekong Delta to date has been the *Mekong Delta Master Plan* in 1993 funded by UNDP. The World Bank and the Mekong Secretariat acted as the executing agency with the State Planning Committee having the responsibility for overall coordination. In this plan projects were selected from a long list proposed by the various ministries. Water resource development, forestry, agriculture, water supply and transportation projects were contained in the Plan and the construction of the Tien (Mekong) River bridge, the Hau (Bassac) River bridge, extension of N.H. No.1 from Ca Mau to Nam Can, and dredging of the Dinh An river mouth were proposed. However, to date only a few of these projects have reached the status of "Project" in the sense of the promised fund or progress of the study.

The current transport development plan in the Mekong Delta by the Ministry of Transport was reported in the *"Summary of Development Plan on Transport and Communications in the Mekong Delta, Period: 1997-2000 and 2001-2010", March 1997.* The outlines of the transportation plans proposed for the delta are stated in this report (Fig. 3.1). They are as follows:

(1) National Arterial Road

a) Between 1996 and 2000 all possible available funds for improvement of N.H. No.1A will be mobilized for rehabilitation. After improvement this road will be at least 12 m in width and to meet the design standard type III.

b) Construction of bridges over the Hau (Bassac) River and the Tien (Mekong) River

(2) Regional Road

a) Construction of the N1 road is planned along the border with Cambodia and is scheduled to be completed by the year 2020.

b) Construction of the N2 road is planned between the new North-South Highway and Rach Gia across the delta and is scheduled to be completed by the year 2020.

c) Improvement and widening of National Highways No.30, 50, 53, 54, 60, 61, 70, 91, 62 will be implemented. (National Road No.54 is located on the left bank of the Hau River and is proposed to connect with the approach road of the planned Can Tho Bridge.)

(3) Road in Rural Area

Construction of roads to those communities where no access road is provided.

(4) Waterway

a) Improvement of the waterway between HCMC and Kien Luong (330 km) is planned.

b) Improvement of the waterway between HCMC and Ca Mau (330.3 km) is planned.

c) Construction of the waterway between HCMC and Ha Tien via Long Xuyen is planned.

d) Dredging of the Dinh An entrance of the Bassac River mouth for 8,000 to 10,000 DWT ships is planned.

(5) Port

Many port improvement plans are proposed in the delta. The following are planned for locations along the Hau (Bassac) River.

a) Improvement of the existing Can Tho Port in which wharves are to be expanded and dredged for 10,000 DWT ships by the year 2010. The handling capacity will be increased to 1.5 ~ 2.0 mil. tons per year.

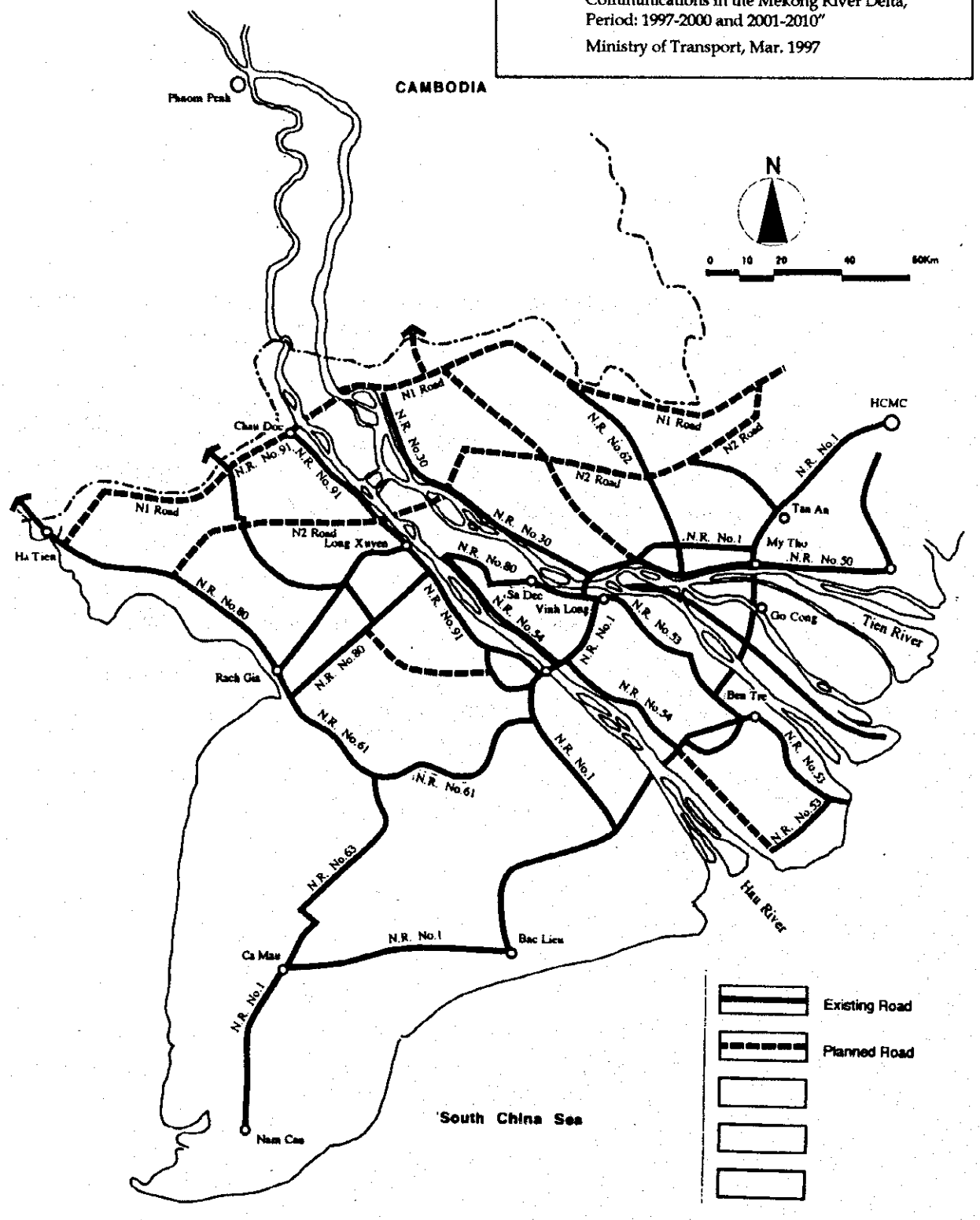
b) Improvement of the My Thoi Port in which wharves will be improved to accommodate 2,000 - 3,000 DWT ships to handle 0.2 to 5 mil. tons of cargo per year.

c) Improvement of the Long Xuyen and Cao Lanh Ports is planned to increase the handling capacity to 0.5 mil. tons per year.

For the international road network, the Economic Cooperation Program in the Greater Mekong Subregion (GMS) was agreed upon in the fourth international conference held in Chiang Mai in 1994. This conference with ministerial level attendants from its member countries was held by the Asian Development Bank for the promotion of economic cooperation among the six riparian countries in the Mekong River Basin. The road projects relating to the delta are as follows:

a) The R1 road connecting Bangkok and Ho Chi Minh City via Phnom Penh and further extending to Vung Tau.

b) The R10 road was newly included in the program. It connects Trat (Thailand) with Ha Tien through the coastal area of the Gulf of Thailand.



THE FEASIBILITY STUDY ON
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPUBLIC OF VIET NAM

Fig. 3.1 Road Plan in the Mekong River Delta 1996 - 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

3.3.2 Provincial Master Plan

The *"Development Plan of Can Tho City toward the year 2000 "*was made available for the Study team. In this plan the following projects are proposed.

(1) Land Use

Two industrial and processing zones are projected in the first period (1993-2000).

a) Tra Noc (Can Tho) Industrial Zone (500 ha., 113 US$); and
b) Southern Industrial Zone (300 ha., 180 bil. VND).

The Tra Noc Industrial zone was approved in Nov. 1995 by the Vietnamese government. This consists of 57 ha. of Export Processing Zone with estimated cost of 8.1 mil. US$. Several factories have been located in the Tra Noc Industrial Zone.

The Southern Industrial Zone will be located on the southern area of the Can Tho River . The year of completion expected is 2005.

After the completion of these industrial and processing zones, two thirds of the agricultural and fishery products in Can Tho province, (which are currently mostly transported to Ho Chi Minh City), are expected to be concentrated to these zones.

Coupled with the above processing and industrial zone development, the following housing zone developments are projected.

a) Tra Noc housing zone (100 ha., 10,000 inhabitants)
b) Urban housing zone (100 ha. including 80 ha. of renewal area, 10,000 inhabitants)
c) Chai - Hung Phu housing zone (150 ha. including a new construction area of 100 ha., 18,000 inhabitants)

Other than these zones a hillock area is projected to develop as a tourism and public servicing area (500 ha.).

(2) Transport

Several transport projects are proposed in the Five-year Plan, one of which is the Can Tho Bridge Construction Project. The others are listed as follows:

a) Improvement of National Road No.1 (Can Tho - Ca Mau)
b) Bridge construction over the Hau River at Vam Cong (near Long Xuyen)
c) Bridge construction over the Hau River at Can Tho
d) Construction of National Road 91B
(This road will function as a bypass of the existing National Road No.1. Traffic across the Hau River from the northern region of Can Tho City is expected to pass this road.)
e) Improvement of Tra Noc Airport to meet international standards (50million US$).
f) Construction of a bus terminal along the National Road No 91B (4 ha.)
g) Construction of a new road between Quang Trung - Mau Than and Tra Noc Airport (expansion of a runway to 2,400 m. 120 billion VND).
h) Rehabilitation and improvement of Hoang Dieu, Tra Noc and Hai Quan ports
i) Construction of Hung Phu port (New Can Tho Port. 10 million tons of cargo a year is planned as handling tonnage).
j) Construction of bridges over the Can Tho River (one bridge is called the Quang Trung Bridge)

The transport plans in Can Tho City are shown in Fig. 3.2.

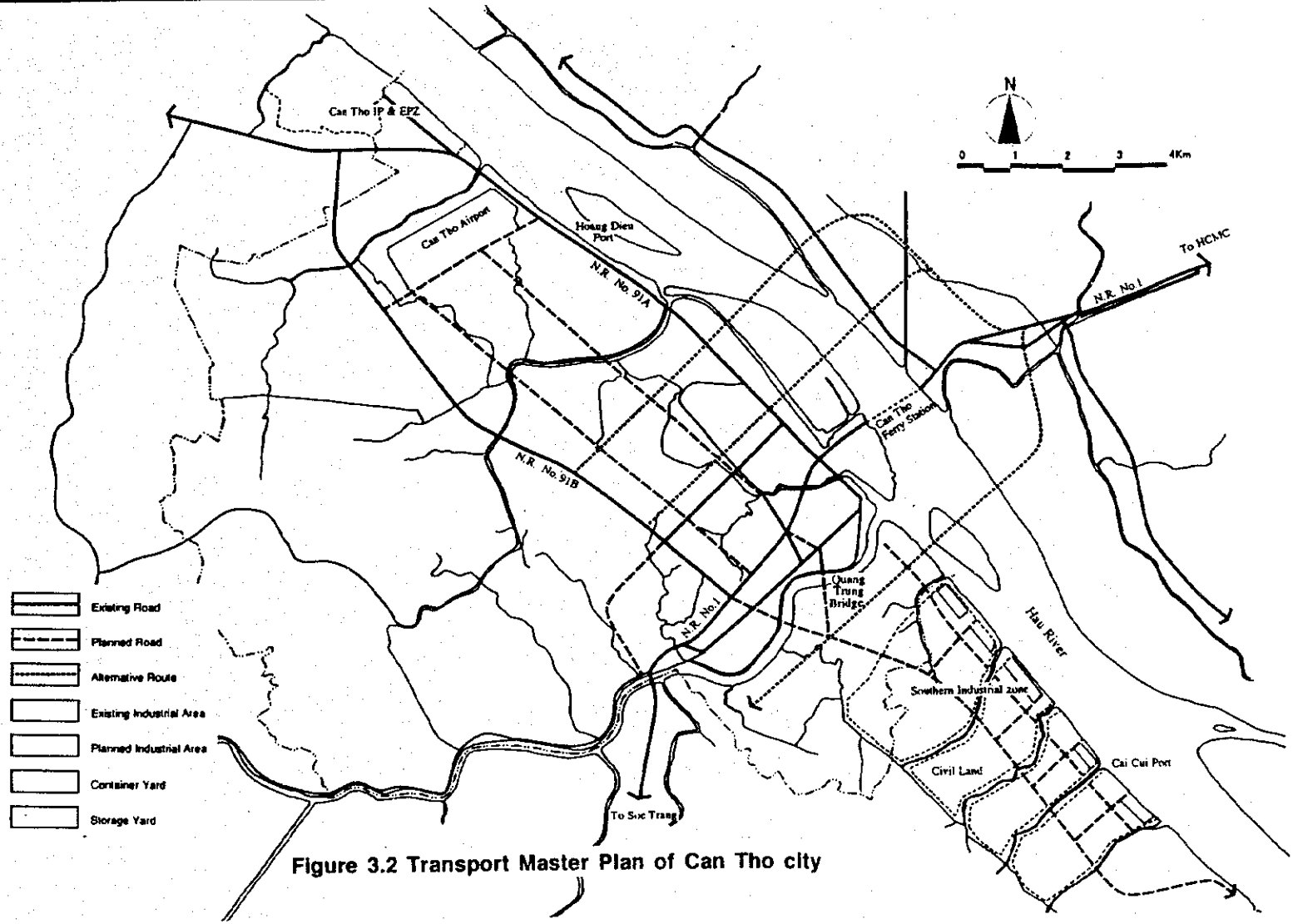


Figure 3.2 Transport Master Plan of Can Tho city

THE FEASIBILITY STUDY ON THE CAN THO BRIDGE CONSTRUCTION IN SOCIALIST REPUBLIC OF VIET NAM	Fig.3.2 Transport Master Plan of Can Tho City
	JAPAN INTERNATIONAL COOPERATION AGENCY

3.3.3 Current Projects

The following projects are now underway.

(1) Road

a) Improvement of N.H. No.1A

- Ho Chi Minh City - Can Tho

  Improvement work is underway. Work for the road portion is funded by the World Bank, and work for the bridges is funded by OECF.

- Can Tho - Ca Mau

  The feasibility study is scheduled to begin in 1997 and is funded by the World Bank.

b) Construction of the My Thuan Bridge

The feasibility study was finished in October 1995 and the detailed design work in 1996. Both were funded by the Australian Government. The My Thuan Bridge is a prestressed Concrete, Cable-stayed bridge with a vertical clearance of 37.5 m and a main span length of 350 m as proposed in the feasibility study. This project is to be jointly funded by Australia and Viet Nam. The construction period of this bridge is scheduled between 1997 and 2000.

-	project cost	74 million US$
-	overall bridge length	1,600 m
-	vertical clearance	37.5 m
-	length of main span	640 m
-	width of bridge deck	21.5 m
-	length of approach road	722 m

c) The R1 road project of which the D/D survey for the section between Ho Chi Minh City and Phnom Penh was already finished in 1996 and for which the construction work will begin in 1998 (funded by the ADB).

d) Construction of the bridge over the Can Tho River (Quang Trung Bridge) is now under construction. Construction work began in 1989. The estimated cost was 10 billion VND. and this bridge will connect the Southern Industrial Zone with the present urban area of Can Tho City.

(2) Waterway

a) Improvement of the waterway between HCMC and Kien Luong of which the feasibility study has been finished. This project is assumed to be funded by the World Bank.

b) Improvement of the waterway between HCMC and Ca Mau of which the feasibility study has been finished. The World Bank is again assumed to be the funding agency.

c) Dredging of the Dinh An entrance of which the feasibility study will be completed in October 1998 (financed by the Belgian Government).

3.3.4 Prospects of Transport Pattern

With regard to the characteristics of the present the transport pattern and demand in the delta the prospects of the transport pattern can be considered from the following major viewpoints; i) dependency on waterway transport, ii) demand for paddy transport, iii) transport demand to/from HCMC, iv) trip generation rate of passengers, and v) modal share of motorcycles.

(1) Dependency on Waterway Transport

At present the modal share of water transport is high and large areas of land (where only accessible by waterway) exist in the delta. With the construction of bridges over the Hau and Tien Rivers and the government transport policy to provide service roads to all communities, it is expected that communities in the delta will be provided with alternative transport means. The improvements of transportation in the future will be made in the road and inland waterway transport sectors in the transport market, and those improvements will bring about an intensification of the competitive relationship between road and waterway. The change of modal shift

to create an effective transport pattern between waterway and road would be realized from the viewpoint of the national economy through the transport sector. It is more than likely that road transport will take a more important position in the transportation sector in the delta.

As seen in central Viet Nam, it is a common phenomenon that agricultural products are transported to the district collective centers by motorcycle and truck and then exported to the market. Also, in transport for industrial products (which is characterized by relatively high time cargo costs) a gradual shift of transport means from waterway to road transport is expected to occur.

(2) Demand for Paddy Transport

Paddy has been the dominant transport commodity from the delta and is expected to be in the future. The present cropping pattern in the delta depends highly on cereal cultivation especially rice cultivation. This is mainly due to the natural agricultural condition of the delta and partly due to the agricultural policy applied to the delta. In the flooding areas floating rice cultivation dominates and unless appropriate water control is provided, the present cultivation system which intakes the flood waters for utilization in the dry season is assumed to continue. However, water control projects planned in the delta will enable farmers to change the cultivation system. If the water control problem is solved, transport conditions would be a very important component for any change of the cropping pattern. According to the data in the *Master Plan for the Mekong Delta in Viet Nam*, 1993 funded by the UNDP and the World Bank, the surplus paddy in the Mekong Delta can be estimated at around nearly 4 million tons in 2016 (Table 3.2).

The extent of accessibility to the agricultural market and scale of the accessible agricultural market would be a decisive factor for any change to the cropping pattern at this stage. The major assumed impact by transport infrastructure on the cropping pattern would be the diversion from single crop rice to industrial cropping.

Improvement of National Road No. 1 to Nam Can and construction of bridges over the Hau and Tien River on the National Road No. 1 will intensify the accessibility to Ho Chi Minh City or Can Tho where IP,

EPZ, and Can Tho port are located and will bring about rapid transport to the agricultural markets. Basically transport demand is defined by the characteristics of the transported commodity and the agricultural production shift to industrial crops will cause a transport demand in the delta not only in terms of transport volume but also in the type of goods transported.

(3) Transport Demand to/from HCMC

Although the delta area is about 40,000 sq. km, the industrial and service sectors are relatively inactive and major cities with large advanced service sectors have not as yet emerged. Most economic and transport demand activities in the delta are inseparably related to the southern growth triangle and especially to HCMC. The two growth paths that are assumed for the delta's future economic activities are; (a) that HCMC would expand its economic influencing area to intensify its dominance over the delta, and (b) that main cities such as Can Tho City would enhance their status as a regional center for investment including transport infrastructure, EPZs and IPs. Usually in other agriculture based countries it can be observed that the one most prominent city has absorbed investments, industries and labor force, and has grown faster and expanded its influencing area for the growth of the national economy. Considering the recent trend of investments and plans concentrated in the growth triangle, the latter path is likely to occur. However, there is still some possibility remaining that some main cities in the delta will grow as regional core cities, taking into consideration the continuous but slow generation of surplus labor force and urbanization. If the necessary investment suitable for the proper characteristics of the location is realized, it is probable that cities endowed with good transport conditions and ample supporting rural areas such as Can Tho, My Tho, and Vinh Long will grow as regional core cities.

In case any path of economic growth is traced, at least some of the cities invested in for the improvement of economic circumstances will intensify their cooperative relationship with their dominating areas. Corresponding to the intensification of such a relationship between the core cites in the delta and their surrounding rural areas, transport

demand between the core cities and the surrounding areas will increase.

(4) Trip Generation Rate of Passengers

Though the data on trip generation rate is lacking, the rates were observed to be low first hand. The reasons for this are as follows:

The everyday activities of farmers (comprising 80% of the labor force in the delta) occur within a very limited area and the activities generally evade the category of a motorized vehicle trip or long distance trip which can be the subject of traffic demand. The lack of service roads to communities and the low dissemination rate of vehicles hamper the outcome of motorized trips.

However, there are some ways to enhance trip generation rates. The economic structure in the delta can be changed by shifting from the primary to the secondary and tertiary sectors where more frequent and extensive trips are required, and transportation infrastructure can be improved.

The trip generation rates in the countries where transport means are well served with considerably developed economy have been stable for a long time, however, the trip generation rates in the delta have the possibility to rise.

(5) Modal Share of Motorcycles

Motorcycles are the most commonly used for road transport in the delta. For transporting cargo motorcycles with a trailer are commonly used. However, congestion on the road by motorcycles is not a serious problem in the delta compared with HCMC where congestion of motorcycles has been observed for a decade. The factors influencing the modal share, namely, the rise of income level, improvement of road, and improvement of public transport system, will function as a negative factor for the expansion of trip volumes by motorcycle. In nearby countries where the income level has risen to an affordable level for purchasing vehicles, the motorcycle has now slipped from being the protagonist of passenger road transport.

The volume of motorcycle traffic is expected to expand for years, but it is quite likely that with the rise of income level and the improvement of transport facilities, the motorcycle will lose its share of transport means in the future. Those changes are assumed to begin in the field of cargo transport by replacing motorcycles with light trucks. However, the time of such a decrease of the modal share by motorcycle needs further study. A study by the World Bank has shown that car ownership is closely related to GDP per capita and that the rate of car ownership reaches the level of 50 cars per 1,000 inhabitants when GDRP per capita attains US$1,000. In these cities it was observed that motorcycles were no longer a major means of urban transportation. The GDRP per capita in the Mekong Delta is assumed to reach US$1,000 in the year 2020, and it is assumed that motorcycles would play a major role of individual transportation until the late 2010s.

Table 3.2 Paddy Production in the Mekong Delta

		1992/1993	2015/2016
Land area	(1,000 ha)	3,956	3,956
Population	(1,000 pers.)	15,546	22,389
Cultivable area	(1,000 ha)	2,544	2,544
Total cropped area	(1,000 ha)	3,312	4,351
Paddy	(1,000 ha)	2,964	3,385
Beans	(1,000 ha)	34	511
Pineapple	(1,000 ha)	21	25
Mixed fruit gardens	(1,000 ha)	56	154
Forest	(1,000 ha)	237	226
Rate of cultivable area		64%	64%
Cropping intensity		144%	188%
Crop diversification		11%	22%
Paddy production	(1,000 tons)	10,116	15,237
Regional consumption	(1,000 tons)	6,308	9,753
Surplus production	(1,000 tons)	2,291	3,961

Source: "Master Plan for the Mekong Delta in Viet Nam", NEDECO, funded by the UNDP, the World Bank, incorporation with the Mekong Secretariat as associated executing agency and the State Planning Committee of Viet Nam as the national implementing agency, Oct. 1993

Note: The figures are those based on the moderate scenario in the Master Plan Report.
Cropping intensity = cropped area/cultivable area excluding forest
Crop diversification = non-paddy cropped area/total cropped area
Rice consumption was assumed at 158 kg per capita and the conversion factor from paddy to rice was assumed at 64.5%. Seed requirement was assumed at 5% of production. On-farm losses are assumed at 10% of production in 1992/1993 and 5% in 2015/2016.

CHAPTER 4

TRAFFIC SURVEYS AND FUTURE TRAFFIC DEMAND

CHAPTER 4 TRAFFIC SURVEYS AND FUTURE TRAFFIC DEMAND

This chapter summarizes the results of surveys on ferry and road traffic, ferry traffic origin-destination interviews, vehicle waiting time at the ferry stations, inland waterway origin-destination interviews, and inland waterway traffic. This chapter also summarizes the road-based traffic forecasting methodology and results for vehicular volume across the Hau River, with special emphasis on the proposed Can Tho Bridge.

4.1 Road Traffic Surveys

4.1.1 Ferry Services

The three main ferries crossing the Hau River are the Can Tho, Vam Cong, and An Hoa ferries. A fourth, relatively small ferry at Chau Doc serves primarily local traffic. Both the Can Tho and Vam Cong ferries are owned and operated by PMU 7, a branch of the Ministry of Transportation and Communications. The An Hoa and Chau Doc ferries are administered by An Giang Province.

The Can Tho Ferry operates seven boats, comprising two 200-ton ferries and five 100-ton ferries. During the peak season from January to May, all seven boats are reportedly in operation; however, during the remainder of the year only four boats are utilized on average. The Vam Cong Ferry also operates seven boats, comprising two 100-ton ferries, two 60-ton ferries, and three 30-ton ferries. Similar to Can Tho, all seven boats are reportedly in operation during the holiday season from January to May, with only four boats utilized on average during the rest of the year. The An Hoa Ferry operates six boats, comprising two 100-ton ferries, two 60-ton ferries, one 30-ton ferry, and one 10-ton ferry. All six boats are reportedly in operation during the holiday season, with only four boats utilized on average during the rest of the year. The Chau Doc Ferry operates five boats, comprising two 20-ton ferries and three 5-ton ferries. All five boats are reportedly in operation during the holiday season, with only three boats utilized on average during the rest of the year.

The Can Tho, Vam Cong, and An Hoa ferries can easily accommodate heavy trucks and buses, while the Chau Doc Ferry cannot transport trucks with loads greater than 7 tons. The Chau Doc Ferry can transport a 54-seat

bus, but all passengers are required to alight from the bus prior to its boarding the ferry. All four ferries are operational 24 hours per day.

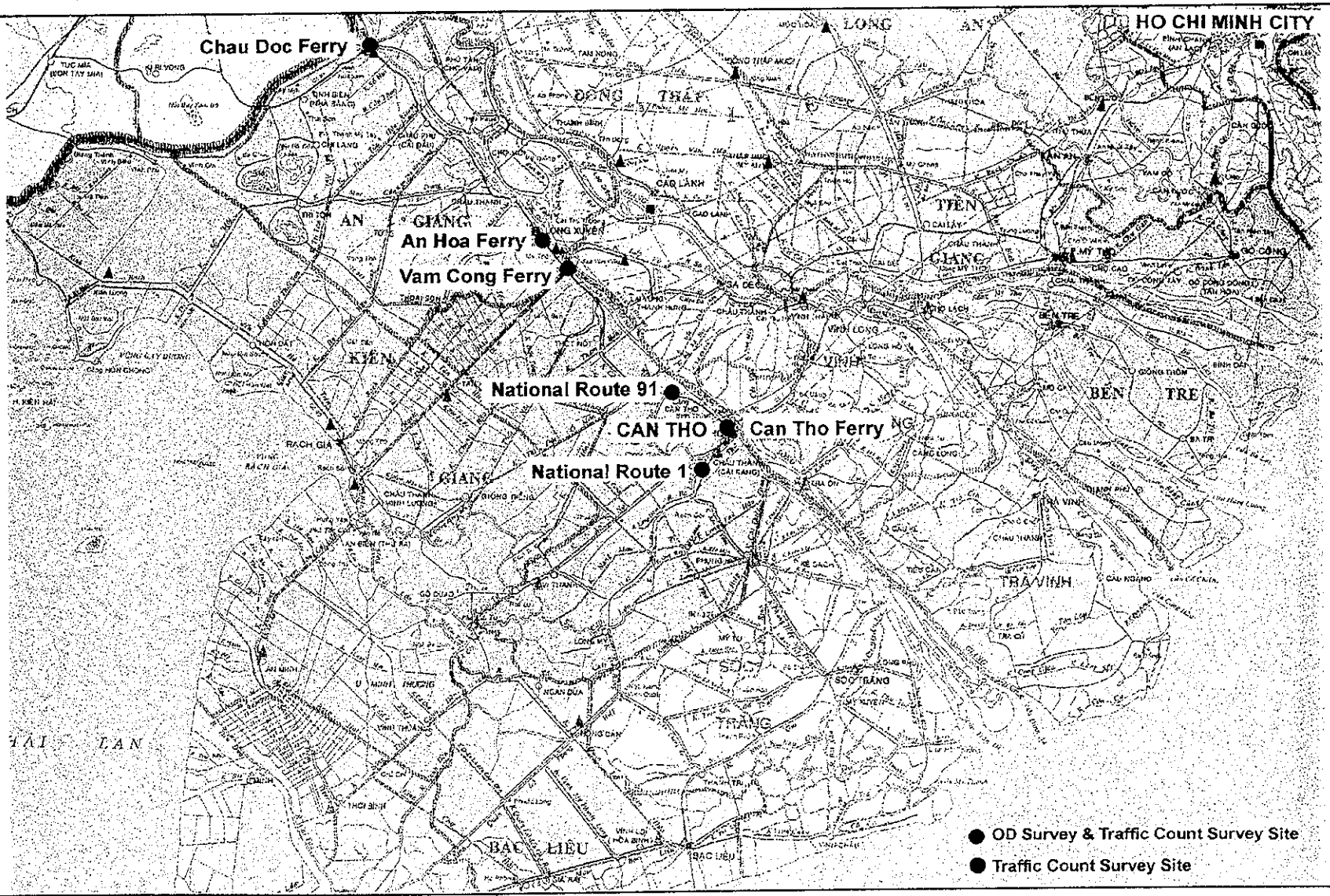
More details regarding ferry operations are presented later in section 4.3.

4.1.2 Road Traffic Volumes

Traffic counts were conducted for this study at six locations in the study area in late September 1997, including the Can Tho, Vam Cong, An Hoa, and Chau Doc ferries, and N.H. No. 1 and No. 91 (see Fig. 4.1). At each location traffic was surveyed for a five day period, 12 hours per day (i.e., 06:00-18:00), with volumes in each direction recorded at 15-minute intervals for pedestrians and 11 different vehicle types. A 24-hour traffic count was conducted on one of the five days.

Average daily traffic (ADT) results, which were adjusted to reflect average annual daily traffic (AADT), are summarized in Table 4.1. Vehicular traffic is highest at National Route 1 and National Route 91, followed by the ferries at Can Tho, An Hoa, Vam Cong, and Chau Doc. The majority of vehicular traffic crossing the Hau Giang via the Can Tho Ferry consists of non-motorized vehicles (NMVs) and motorcycles, with vehicular traffic shares of 27% and 49%, respectively. By contrast, sedans, minibuses/buses, and trucks represent approximately 7%, 6%, and 8% respectively of the total vehicular river crossing volumes at this location.

The existing peak hourly rate at the Can Tho ferry crossing was relatively low at 7.5% of ADT in both direction. The peak hourly rates at the An Hoa, Vam Cang, and Chou Doc ferry crossings were 7.4%, 8.9%, and 14.6%, respectively. National Route 1 and 99 had peak hourly rates of 6.9% and 8.6%, respectively.



THE FEASIBILITY STUDY ON
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPUBLIC OF VIET NAM

Fig.4.1 Road-Based Traffic Survey Locations

JAPAN INTERNATIONAL COOPERATION AGENCY

Table 4.1 Summary of 24-Hour Average Daily Road-Based Traffic Count Results, 1997

Vehicle Type	Can Tho Ferry	Vam Cong Ferry	An Hoa Ferry	Chau Doc Ferry	National Route 1	National Route 91
Pedestrian/Handcart	6,365	12,291	2,516	2,607	487	376
Bicycle	2,334	770	1,871	1,003	6,682	5,388
Bicycle-with-trailer/Cyclo	5	42	35	45	4	9
Motorcycle	4,285	2,179	2,912	1,362	12,129	10,320
Motorcycle-with-Trailer	131	34	26	20	3,436	4,383
Passenger Car/Sedan	623	164	65	19	480	361
Microbus	5	15	0	1	436	73
Minibus/Van	368	247	95	15	540	278
Standard Bus	192	79	95	14	344	309
Truck with 2 axles	700	444	69	14	721	510
Truck with 3 axles	24	14	3	0	53	81
Police or Military Vehicle	39	6	3	2	17	36
Total	15,072	16,285	7,691	5,101	25,329	22,124
Total No. of Vehicles	8,707	3,994	5,175	2,494	24,842	21,748
Total No. of MVs	3,368	3,182	3,269	1,446	18,156	16,351
Total No. of MVs not incl. MCs	1,952	969	331	64	2,591	1,648

Note: MV = motorized vehicle; MC = motorcycle.

Table 4.2 compares traffic counts between this study and those conducted in 1994 at the Can Tho Ferry for the My Thuan Bridge Project Feasibility Study. The 1994 counts were also reportedly adjusted to reflect seasonal traffic movement variations.

Table 4.2 Comparison of Traffic Count Survey Results at the Can Tho Ferry

Vehicle Type	1994 AADT	1997 AADT	Percent Difference
Motorcycle	2,223	4,285	+93
Passenger Car/Sedan	455	623	+37
Bus < 15 Seats	152	373	+145
Bus ≥ 15 Seats	262	192	-27
Truck	428	724	+69
Total Vehicles	3,520	6,197	+76

Source: 1994 count data are from Australian Agency for International Development, *My Thuan Bridge Project, Feasibility Study, Final Report*, October 1995, p. B15.

According to this comparison, the number of vehicles has increased by 76% since 1994, corresponding to a very high vehicular traffic growth rate of 21% per year. Interestingly, there also seems to have been a significant shift from large buses to minibuses.

4.1.3 Vehicle Utilization

Average vehicle occupancies, determined from the origin-destination survey results, are shown in Table 4.3 for five different vehicle types at the Can Tho, Vam Cong, An Hoa, and Chau Doc ferry crossings. From this table, it is clear that most vehicles have relatively high person/passenger

occupancy rates. Consider, for example, that the overall average occupancy is 1.8 persons for motorcycles, 7.2 for sedans, 10.2 for minibuses, and 40.3 for standard buses.

Table 4.3 Average Vehicle Occupancies by Vehicle Type, 1997

Vehicle Type	Can Tho Ferry	Vam Cong Ferry	An Hoa Ferry	Chau Doc Ferry	All Four Ferries
Motorcycle	2.1	1.8	1.6	1.5	1.8
Passenger Car/Sedan	7.9	5.8	5.6	4.2	7.2
Minibus	10.4	10.2	9.8	9.5	10.2
Standard Bus	39.5	47.9	37.0	31.7	40.3
Truck	1.8	2.2	2.4	2.4	2.0

Truck utilization figures, summarized in Table 4.4, indicate that the average truck load for loaded trucks is highest at the Can Tho Ferry at 4.7 tons, followed by the Vam Cong Ferry at 4.4 tons. Similarly, the empty-truck ratio (i.e., percentage of empty trucks) is lowest at the Vam Cong and Can Tho ferries. The average Hau Giang crossing empty-truck ratio was determined to be a relatively low 20.7%, relatively consistent with an assumed 25.0% empty-truck ratio (in a previous study) for Vietnam as a whole at this stage of its development. The average Hau Giang crossing unutilized-capacity ratio (i.e., percentage of unutilized capacity tonnage for all trucks combined) was observed to be 31.4%.

Table 4.4 Truck Utilization Results, September 1997

Category	Can Tho Ferry	Vam Cong Ferry	An Hoa Ferry	Chau Doc Ferry	All Four Ferries
Avg. Load (tons)	4.7	4.4	1.5	2.0	4.5
Load:Capacity Ratio	86.5	83.1	59.3	72.5	84.7
Empty-Truck Ratio	20.3	15.1	47.2	74.1	20.7
Unutilized-Capacity Ratio	30.7	28.4	71.9	79.3	31.4

Additional truck utilization results are shown in Table 4.5. At present medium trucks are the predominant truck type, comprising 62% of observed trucks, 80% of tonnage hauled, and 77 % of capacity provided.

Table 4.5 Truck Utilization Results by Truck Type, September 1997

Truck Type	Avg. Load (tons)	Percentage Share of All Trucks with Respect to		
		Number of Trucks	Tonnage Hauled	Capacity Provided
Light Truck (LT)	1.9	34.7	14.0	15.6
Medium Truck (MT)	5.5	61.9	79.9	77.3
Heavy Truck (HT)	8.1	3.3	6.1	7.1

4.1.4 Trip Purposes and Types of Commodities

The percentage shares of different vehicle trip purposes, also ascertained from the origin-destination survey results, are shown for motorcycles and sedans combined at the four ferries in Table 4.6. In all cases, trips made for personal business reasons were those most frequently observed at the four locations, with shares ranging from 34% to 55%. Also, a relatively high proportion of trips were for family/social reasons, with shares ranging from 18% to 33%. Out of the four ferries, commuting trips represented the highest proportion of total trips at the An Hoa Ferry, and education trips were most frequently observed at the Can Tho Ferry.

Table 4.6 Shares of Vehicle Trip Purposes in Both Directions for Motorcycles and Sedans Combined, September 1997

Trip Purpose	Can Tho Ferry	Vam Cong Ferry	An Hoa Ferry	Chau Doc Ferry	All Four Ferries
To/From Work	6.6	10.2	20.2	16.3	12.1
Employer's Business	7.0	10.4	4.5	5.2	6.9
Personal Business	38.3	55.2	38.7	33.8	41.9
Education/School/Training	23.3	1.5	7.8	5.1	12.4
Medical	0.1	0.7	2.5	1.2	1.0
Family/Social	18.4	19.1	23.7	33.1	21.3
Recreation/Leisure/Tourism	0.8	2.7	2.4	5.2	2.1
Shared Taxi	5.6	0.3	0.3	0.0	2.4
Total	100.0	100.0	100.0	100.0	100.0

The percentage shares of different commodity types hauled by trucks at the four ferries are shown in Table 4.7. Agricultural products, food/drinks, and manufactured goods are frequently transported at all four ferries, with shares of agricultural products (including grain and rice) ranging from 20% to 42%, those for food/drinks ranging from 11% to 36%, and those for manufactured goods ranging from 4% to 24%. Construction materials were most commonly observed at the Can Tho Ferry at 9%.

Table 4.7 Commodity Types Weighted by Tonnage per Week for Trucks

Commodity Type	Can Tho Ferry	Vam Cong Ferry	An Hoa Ferry	Chau Doc Ferry	Average of the Four Ferries
Grain/Rice	8.5	3.2	2.4	0.0	6.4
Other Agricultural Products	23.3	39.0	37.4	20.2	29.5
Ready-to-Eat Food/Drinks	10.5	11.2	28.1	36.1	11.0
Fertilizer	0.6	3.6	1.5	0.0	1.8
Timber	3.3	0.6	6.3	0.0	2.3
Steel/Machinery	3.6	2.8	3.0	21.7	3.3
Petroleum Products	4.0	3.8	1.7	0.0	3.9
Construction Materials	8.5	6.9	0.8	0.0	7.8
Manufactured Goods	24.1	10.3	16.5	4.3	18.7
Other	13.5	18.6	2.4	17.7	15.3
Total	100.0	100.0	100.0	100.0	100.0

It is important to note that 60% of the total tonnage of cargo hauled by truck across the Hau Giang by ferry travels via the Can Tho Ferry. The Vam Cong ferry represents 38% of total cargo tonnage, while the An Hoa and Chau Doc ferries comprise the remaining 2%.

4.1.5 Origins and Destinations

As referred to earlier, a comprehensive origin-destination survey was conducted at the Can Tho, Vam Cong, An Hoa, and Chau Doc ferry locations for three days, 12 hours per day, at each location (see Fig. 4.1). This survey, therefore, covered the majority of road transport crossing the Hau Giang. Drivers of vehicles waiting to board ferries at both sides of the river were questioned regarding (1) trip origin, (2) trip destination, (3) time of leaving origin, (4) expected arrival time at destination, (4) vehicle capacity in tons, (5) load in tons, (6) type of cargo, (7) trip purpose, and (8) average number of round trips per week. Surveyors also recorded the vehicle type, occupancy, and time of interview.

A total of 7,309 interviews were included in the analysis reported throughout this chapter. The sampling ratio was 20.9% for all motorized vehicles, including motorcycles. If motorcycles are excluded, 71.5% of all motorized vehicles were surveyed.

A total of 57 zones was adopted, as shown in Fig. 4.2 and summarized in Table 4.8; most zones correspond to provincial and district boundaries. For the purposes of this study, Dong Thap Province was subdivided along the Tien Giang, and An Giang Province was subdivided along the Hau Giang. Can Tho District was split into Can Tho City and the remainder of Can Tho District to better enable analysis of the different bridge alternative locations. All districts in Can Tho Province were designated with exclusive zone numbers.

Table 4.8 Description of Traffic Zones

Province	District(s)	Zone No.
Ca Mau Province	(all districts, provincial capital is Ca Mau)	1
Bac Lieu Province	Bac Lieu, Vinh Loi (Hoa Binh), Gia Rai	2
"	Hong Dan	3
Kien Giang Province	Vinh Thuan	4
"	An Minh (Thu Muroi Mot, Dong Hung)	5
"	An Bien (Thu Ba)	6
"	Go Quao	7
"	Giong Rieng	8
"	Chau Thanh (Minh Luong, Rach Soi)	9

Province	District(s)	Zone No.
Kien Giang Province	Rach Gia	10
"	Tan Hiep	11
"	Hon Dat	12
"	Ha Tien, Kien Hai	13
"	Phu Quoc (Duong Dong)	14
An Giang Province	Tri Ton	15
"	Chau Doc, Tinh Bien (Nha Bang), Chau Phu (Cai Dau)	16
"	An Phu, Tan Chau (Phu Chau)	17
"	Phu Tan (Cho Vam)	18
"	Cho Moi	19
"	Long Xuyen, Chau Thanh (An Chau)	20
"	Thoai Son (Nui Sap)	21
Can Tho Province	Thot Not	22
"	O Mon	23
"	Can Tho (outside central city area)	24
"	Can Tho (central city area, downtown)	25
"	Chau Thanh (Cai Rang)	26
"	Vi Thanh	27
"	Long My	28
"	Phung Hiep	29
Soc Trang Province	(all districts, provincial capital is Soc Trang)	30
Tra Vinh Province	(all districts, provincial capital is Tra Vinh)	31
Ben Tre Province	(all districts, provincial capital is Ben Tre)	32
Vinh Long Province	Vung Liem	33
"	Long Ho, Mang Thit	34
"	Vinh Long	35
"	Tam Binh (Binh Quy)	36
"	Tra On	37
"	Binh Minh (Cai Von)	38
Dong Thap Province	Sa Dec, Chau Thanh	39
"	(Lap Vo) Thanh Hung, Lai Vung	40
"	Cao Lanh, Thap Muoi (My An)	41
"	Tam Nong, Thanh Binh	42
"	Tan Thanh (Tan Hong), Hong Ngu	43
Long An Province	Vinh Hung, Duc Hoa, Duc Hue, Tan Thanh, Thanh Hoa, Moc Hoa, Tan Hung	44
"	Tan An, Tan Tru (Vam Co), Chau Thanh, Can Giuoc, Can Duoc, Ben Luc, Thu Thua	45
Tien Giang Province	Go Cong, Go Cong Dong (Tan Hoa) , Go Cong Tay (Vinh Binh), Cho Gao	46
"	My Tho	47
"	Chau Thanh, Tan Phuoc	48
"	Cai Lay	49
"	Cai Be	50
Ho Chi Minh Prov.	(all districts, including Ho Chi Minh City)	51
Tay Ninh Province	(all districts, provincial capital is Tay Ninh)	52
Song Be Province	(all districts, provincial capital is Thu Dau Mot)	53
Dong Nai Province	(all districts, provincial capital is Bien Hoa)	54
Ba Ria-Vung Tau P.	(all districts, provincial capital is Vung Tau)	55
Other Vietnam	(all other provinces)	56
Cambodia	(all provinces)	57

The analysis indicates that the daily tonnage from Ho Chi Minh City makes up 8.3% of the total cargo tonnage crossing the river by ferry, while daily tonnage to Ho Chi Minh City represents 7.3% of the total. Therefore, of the total cargo tonnage crossing the Hau Giang by ferry, on average 15.6% has an origin or destination in Ho Chi Minh City. Approximately 10.7% of the total cargo tonnage has an origin or destination in Can Tho Province. No trips were observed having an origin or destination in Cambodia. Base and future year O-D matrices will be presented in the Final Report.

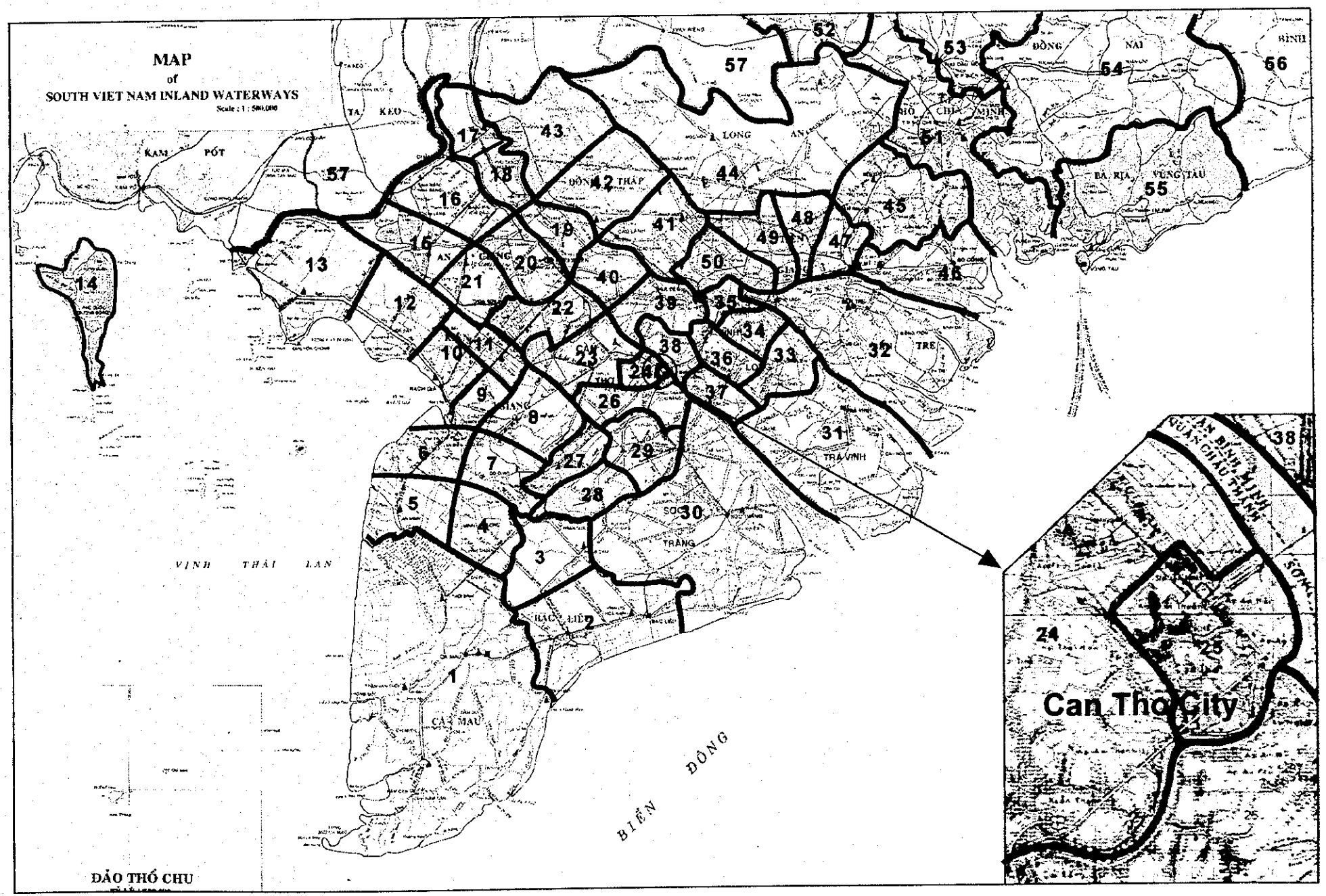


Figure 4.2 Traffic Zone System

4.2 Inland Waterway Traffic Surveys

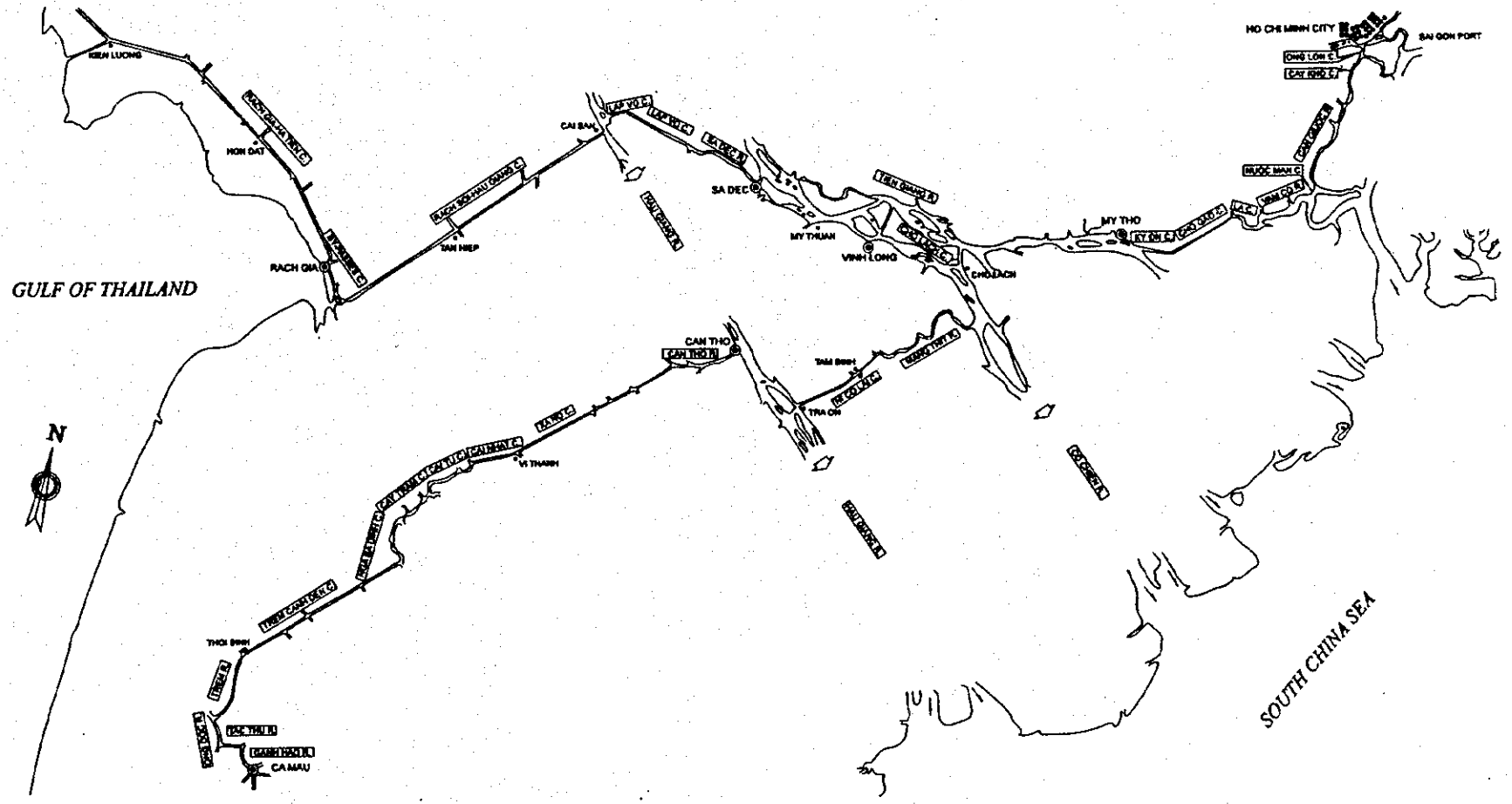
4.2.1 Inland Waterway Routes

There are two main inland waterway stretches between Ho Chi Minh City and the Lower Mekong Delta: (1) a southwestward route to Ca Mau in Ca Mau Province, and (2) a westward route to Kien Luong in Kien Giang Province. These two stretches are illustrated in Fig. 4.3, and their canal and river components are summarized in Table 4.9. Because the presence of a bridge across the Hau Giang has the potential to attract certain types of traffic that previously traveled by inland waterway, appraisal and analysis of waterway traffic on both of these inland waterway stretches was undertaken.

Table 4.9 Main Inland Waterway Stretches in the Mekong Delta to/from Ho Chi Minh City

Ho Chi Minh City - Ca Mau				Ho Chi Minh City - Kien Luong			
No.	Name of Canal, River	Dist. (km)	Accum. Dist. (km)	No.	Name of Canal, River	Dist. (km)	Accum. Dist. (km)
1	Ong Lon Creek	4.8	4.8	1	Ong Lon Creek	4.8	4.8
2	Cay Kho Creek	3.5	8.3	2	Cay Kho Creek	3.5	8.3
3	Can Giuoc River	25.7	34.0	3	Can Giuoc River	25.7	34.0
4	Nuoc Man Canal	2.5	36.5	4	Nuoc Man Canal	2.5	36.5
5	Vam Co River	10.0	46.5	5	Vam Co River	10.0	46.5
6	La Creek	10.0	56.5	6	La Creek	10.0	56.5
7	Cho Gao Canal	13.0	69.5	7	Cho Gao Canal	13.0	69.5
8	Ky On Canal	6.8	76.3	8	Ky On Canal	6.8	76.3
9	Tien Giang (up to Cho Lach Canal)	35.5	111.8	9	Tien Giang (up to Cho Lach Canal)	35.5	111.8
10	Cho Lach Canal	9.0	120.8	10	Tien Giang (up to My Thuan Canal)	33.0	144.8
11	Tien Giang	11.0	131.8	11	Tien Giang (up to Sa Dec confluence)	3.0	147.8
12	Mang Thit River	29.8	161.6	12	Sa Dec River	27.5	175.3
13	Mang Thit River	12.4	174.0	13	Lap Vo Canal	19.0	194.3
14	Ni Co Lai Canal	3.9	177.9	14	Lap Vo Creek	5.5	199.8
15	Hau Giang	18.7	196.6	15	Hau Giang	1.5	201.3
16	Can Tho River	16.0	212.6	16	Rach Soi-Hau Giang Canal	54.6	255.9
17	Xa No Canal	39.6	252.2	17	By-Passes Canal	7.8	263.7
18	Cai Nhat Canal	3.1	255.3	18	Rach Gia-Ha Tien Canal	61.3	325.0
19	Cai Tu Creek	12.5	267.8	19	Factory	3.0	328.0
20	Cay Tram Creek	5.0	272.8				
21	Nga Ba Dinh Creek	11.6	284.4				
22	Trem Canh Den Canal	33.5	317.9				
23	Trem River	12.5	330.4				
24	Ong Doc River	4.9	335.3				
25	Tac Thu River	4.7	340.0				
26	Ganh Hao River	5.6	345.6				

Source: Vietnam Inland Waterway Department (PMU-SW), *Inland Waterways and Port Modernization Project, Volume II, The Inland Waterway Improvement Project (Main Report)*, March 1996, p. 4.



THE FEASIBILITY STUDY ON
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPUBLIC OF VIET NAM

Fig. 4.3 Inland Waterway Stretches from Ho Chi Minh City to Ca Mau and Kien Luong

JAPAN INTERNATIONAL COOPERATION AGENCY

4.2.2 Inland Waterway Traffic Volumes

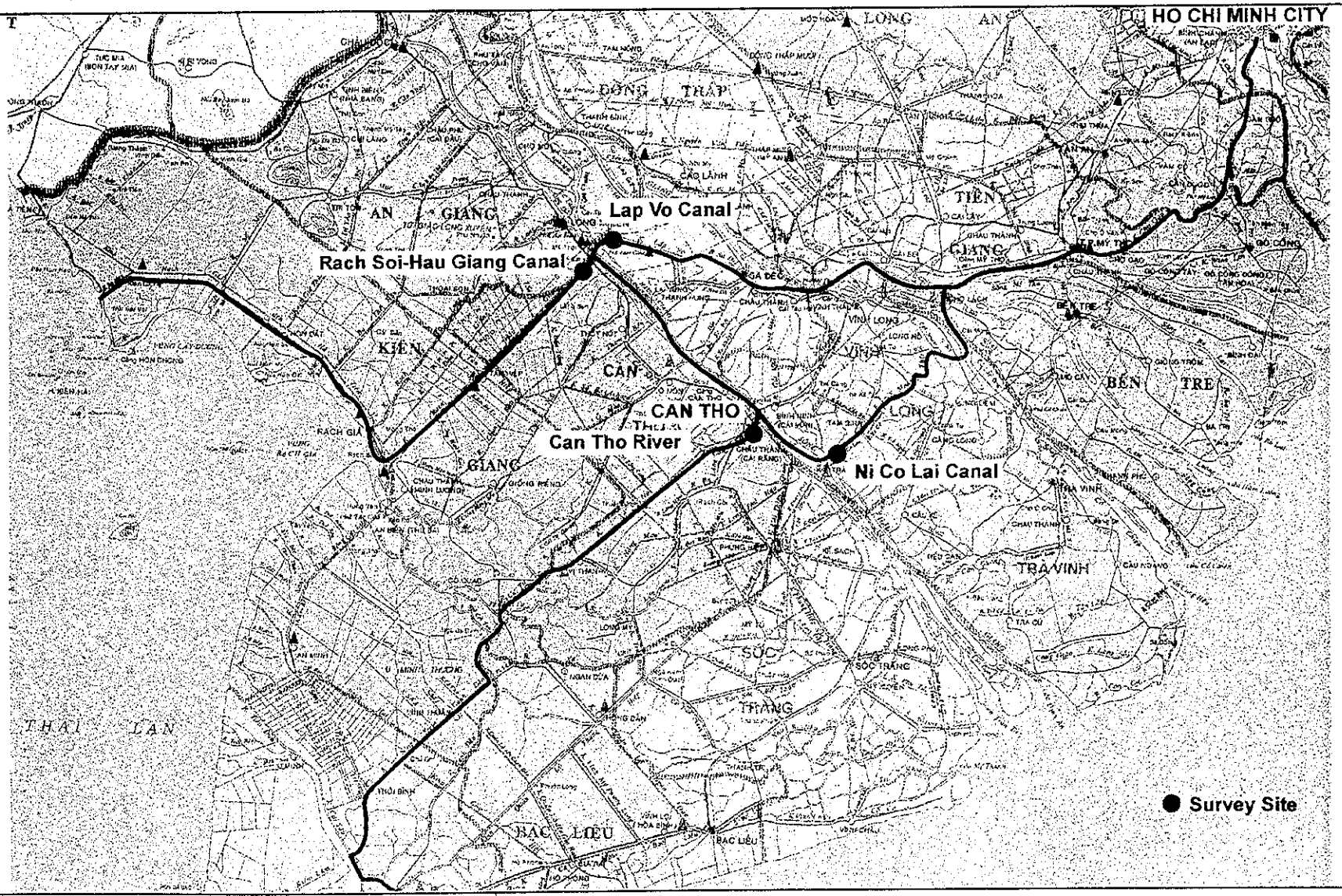
Traffic counts were conducted for this study at four locations in the study area in late September 1997, including the Ni Co Lai Canal, Can Tho River, Rach Soi-Hau Giang Canal, and Lap Vo Canal; each location was surveyed for a three day period, 12 hours per day (i.e., 06:00-18:00), with volumes recorded at 30-minute intervals for six different vessel sizes. Four teams were employed: each based near their respective survey location.

The survey locations are shown in Fig. 4.4, and the traffic count results are summarized in Table 4.10. From this table, it is clear that the majority of vessels crossing the Hau Giang consists of 1-10 ton vessels and 11-50 ton vessels, with 62.7% and 31.1% traffic shares, respectively. By contrast, 51-100 ton vessels, 101-500 ton vessels, and 501-1,000 ton vessels represent 3.6%, 2.3%, and 0.2% of the total vessel river crossing volumes. No vessel with a capacity greater than 1,000 tons was observed during the three-day survey period.

Table 4.10 Traffic Count Survey Results at the Four Inland Waterways, 12-Hour Average Daily Traffic (combined for both directions), September 1997

Vessel Capacity (tons)	Ni Co Lai Canal	Can Tho River	Rach Soi-Hau Giang Canal	Lap Vo Canal	Total
1-10	270	203	249	343	1,065
11-50	140	188	83	117	538
51-100	34	12	8	7	61
101-500	19	7	9	5	40
501-1,000	1	2	1	1	4
1,001-2,000	0	0	0	0	0
Total No. of Vessels	464	412	350	473	1,698

The highest traffic volumes were observed along the Rach Soi-Hau Giang Canal and the Ni Co Lai Canal, with average daily 12-hour volumes of 473 and 464 vessels, respectively. Vessels with a capacity greater than 50 tons were most widely observed at the Ni Co Lai Canal.



THE FEASIBILITY STUDY ON
THE CAN THO BRIDGE CONSTRUCTION
IN SOCIALIST REPUBLIC OF VIET NAM

Fig.4.4 Inland Waterway Survey Locations

JAPAN INTERNATIONAL COOPERATION AGENCY

4.2.3 Types of Commodities and Vessel Utilization

The percentage shares of different commodity types hauled by all (loaded) vessel types crossing the Hau Giang via each of the four inland waterways are shown in Table 4.11. Interestingly, the four inland waterways show a wide variety of commodities with no one cargo type dominant at all four locations. On average, construction materials, petroleum products, agricultural products (including grain and rice), and manufactured goods were the most commonly transported commodities in terms of tonnage per month at the time of the survey, with shares of 29.1%, 26.6%, 16.1%, and 15.5%, respectively.

Table 4.11 Percentage of Commodity Types Weighted by Tonnage per Month for All Loaded Vessels across the Hau Giang, September 1997

Commodity Type	Ni Co Lai Canal	Can Tho River	Rach Soi-Hau Giang Canal	Lap Vo Canal	Average of the Four Waterways
Grain/Rice	9.7	5.7	9.8	28.7	10.5
Other Agricultural Products	0.1	11.9	12.6	5.2	5.6
Ready-to-Eat Food/Drinks	0.9	1.3	3.4	0.8	1.6
Fertilizer	9.4	0.0	0.8	15.6	6.2
Timber	2.7	0.1	0.0	1.9	1.5
Steel/Machinery	0.8	0.4	0.0	0.1	0.5
Petroleum Products	46.8	0.0	11.3	0.1	26.6
Construction Materials	26.3	2.6	53.7	24.2	29.1
Manufactured Goods	2.9	77.3	2.4	10.2	15.5
Other	0.5	0.7	6.1	13.2	2.9
Total	100.0	100.0	100.0	100.0	100.0

Except for construction materials, these survey results differ significantly from the 1991 survey data results of the so-called State General Transport Project (VIE 88/040) as reported in the MDMP Feasibility Study of May 1993. The 1991 survey data, summarized in Table 4.12, show total annual tonnage of cargo transported by inland waterway throughout the Mekong Delta. The reason for this large difference is probably due to the timing of the surveys, and due to the limited number of survey locations (i.e., only the four major inland waterways nearest to the proposed Can Tho Bridge). It is also important to note that while the tonnage of petroleum products was relatively high in the 1997 survey due to the very high average load per vessel, the traffic count share of these vessels was only 2.0%. Regardless, it is believed that the tonnage of petroleum products shown in the MDMP report (i.e., 53,000 tons per year in 1991) was underestimated and is likely to be 10-20 times higher today. Average loads and traffic count shares are summarized in Tables 4.13 and 4.14.

Table 4.12 Annual Tonnage of Goods Transported by Inland Waterway in the Mekong Delta, 1991

Commodity Type	Tonnage	Percent
Rice, Agricultural Products	2,345,000	41.2
Food	353,000	6.2
Fertilizer	516,000	9.1
Timber, Timber Products	543,000	9.5
Machinery/Equipment	164,000	2.9
Petroleum Products	53,000	0.9
Construction Materials	1,677,000	29.5
Other	39,000	0.7
Total	5,690,000	100.0

Source: Ministry of Transportation, *Mekong Delta Master Plan (VIE/87/031), Rehabilitation and Improvement of the Main Waterways in the Mekong Delta, Feasibility Study, Volume 2, Main Report*, May 1993, p. 8 [citing Report No. 13 - VIE 88/040].

Table 4.13 Average Load and Capacity Figures by Commodity Type for All Loaded Vessels across the Hau Giang at the Four Inland Waterways, September 1997

Commodity Type	Average Load (Tons)	Average Capacity (Tons)	Average Load:Capacity Ratio (Percent)
Grain/Rice	13.4	15.6	86.4
Other Agricultural Products	4.7	7.7	61.1
Ready-to-Eat Food/Drinks	5.9	13.3	44.1
Fertilizer	45.6	52.6	86.7
Timber	15.1	17.4	87.2
Steel/Machinery	9.2	19.5	47.1
Petroleum Products	186.0	215.2	86.4
Construction Materials	42.1	47.8	88.2
Manufactured Goods	4.6	13.2	35.1
Other	10.1	24.4	41.2
Total	14.3	21.4	66.7

Table 4.14 Percentage of Commodity Types Weighted by *Round Trips* per Month for All Loaded Vessels across the Hau Giang, September 1997

Commodity Type	Ni Co Lai Canal	Can Tho River	Rach Soi-Hau Giang Canal	Lap Vo Canal	Average of the Four Waterways
Grain/Rice	12.2	3.5	28.1	25.9	11.2
Other Agricultural Products	0.5	19.1	18.9	23.0	16.8
Ready-to-Eat Food/Drinks	3.7	1.5	9.0	9.2	3.9
Fertilizer	10.0	0.1	0.5	3.6	1.9
Timber	8.8	0.2	0.0	0.7	1.4
Steel/Machinery	4.0	0.2	0.0	0.8	0.8
Petroleum Products	9.3	0.0	3.8	0.7	2.0
Construction Materials	28.7	2.0	22.5	7.7	9.9
Manufactured Goods	22.0	71.6	5.8	19.0	48.0
Other	0.8	1.9	11.4	9.3	4.1
Total	100.0	100.0	100.0	100.0	100.0

Another aspect of vessel utilization is (1) the empty-vessel ratio, which is simply the percentage of empty vessels, and (2) the unutilized-capacity ratio, which is the percentage of unutilized capacity tonnage for all vessels combined. According to the survey results, the average Hau Giang

crossing empty-vessel ratio was determined to be 53.9%, and the unutilized-capacity ratio was 44.8%.

4.2.4 Origins and Destinations

As referred to earlier, a comprehensive origin-destination survey was conducted at the Ni Co Lai Canal, Can Tho River, Rach Soi-Hau Giang Canal, and Lap Vo Canal for three days, 12 hours per day, at each location (see Fig. 4.4) for vessels traveling toward the Hau Giang. This survey, therefore, covered a significant amount of inland waterway transport crossing the Hau Giang in the vicinity of the proposed Can Tho Bridge. As with the road-based origin-destination survey, vessel operators were questioned regarding (1) trip origin, (2) trip destination, (3) date and time left origin, (4) expected arrival date and time at destination, (4) vessel capacity in tons, (5) load in tons, (6) type of cargo, (7) trip purpose, and (8) average number of round trips per month. Surveyors also recorded the vessel type, occupancy, and time of interview. The carrying out of this survey required substantial assistance and cooperation from the waterway police.

A total of 1,742 interviews were conducted. However, of these interviews, only 1,163 (67%) had origin and destination on opposite sides of the Hau Giang. Only these river-crossing interviews were included in the analyses reported throughout this chapter, because only such trips would be potentially affected by the presence of a bridge across the Hau Giang (i.e., potential to divert to road-based transport).

The sampling ratio for the inland waterway O-D survey was a remarkably high 78.8%. In fact, 100.0% of all vessels with a capacity greater than 50 tons were stopped and interviewed.

The analysis indicates that the daily tonnage from Ho Chi Minh City makes up 34.1% of the total cargo tonnage crossing the river by inland waterway, while daily tonnage to Ho Chi Minh City represents 13.8% of the total. Therefore, of the total cargo tonnage crossing the Hau Giang by inland waterway in the vicinity of the proposed Can Tho Bridge, on average 47.9% has origin or destination in Ho Chi Minh City.