- Specialized River Ports

  The following main specialized river ports are operated by specific enterprises: Pha Lai (operated by Pha Lai Thermal Power Plant), Ninh Binh (operated by Ninh Binh Hydropower Plant), Uong Bi (operated by Uong Bi Coal Plant), Hoang Thach (operated by Hoang Thach Cement Plant) and Bac Giang (operated by Bac Giang Fertilizer Plant).

- Provincial River Ports

  The main provincial ports are An Duong (Hai Phong Province), Thi Xa (Thai Binh Province) and Cong Cau (Hai Hung Province).

(4) Inland Waterway Management

Most inland waterways are operated by the Inland Waterways Bureau (IWB). Its organizational structure is shown in Figure 2.5.2. IWB employs over 10,000 staff.

(5) Dredging

IWB is responsible for dredging inland waterways to maintain sufficient water depth. Because of a lack of funds, the dredging volume at present is only 300,000 m^3 per year, whereas it was 1,000,000 m^3 per year in the past. Dredging volumes are shown in Table 2.5.3.

Table 2.5.3 Dredging Volume of Inland Waterways in the Study Area

(in 1,000 m^3)

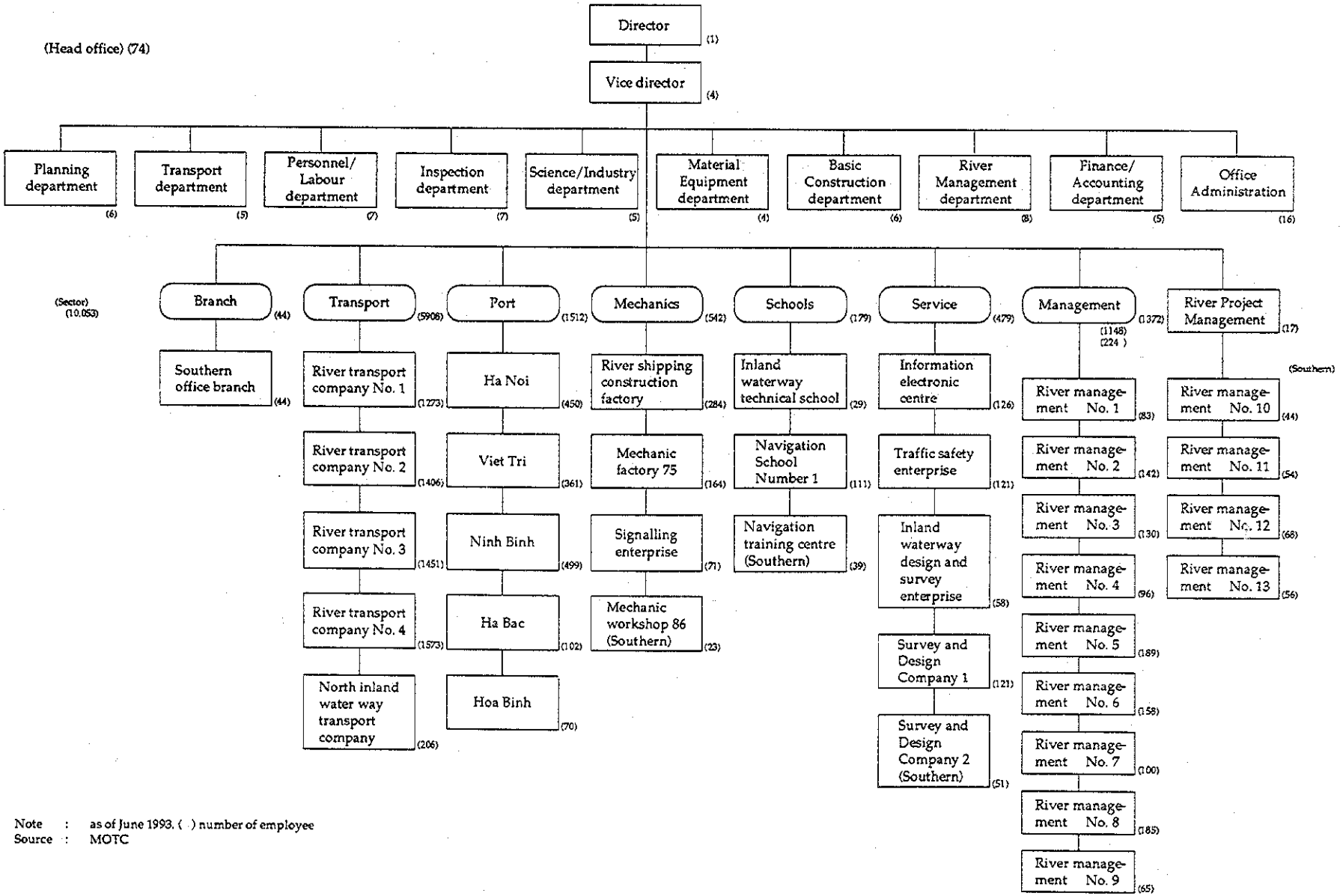
Dredging Year \ River	Duong	Kinh Thay	Red	Da	Ninh Co	Luoc	Lach Tray	Total Volume
• Minimum (1981 to 82)	-	22	-	105	-	136	28	291
• Maximum (1985 to 86)	104	257	340	112	271	125	201	1,410
• Average (1979 to 93)	88	114	174	135	112	117	107	847

Source: MOTC

2.5.3 Inland Waterway Transport

(1) Inland Waterway Fleet Capacity

The total inland waterway fleet capacity in the Study area is estimated at ten million tons per year. Table 2.5.4 indicates the inland waterway inter-province transport capacity by carrier in 1991 for the Red River and Mekong deltas. The state-owned fleet accounted for 51.5 % of the inland waterway fleet capacity in the Study area. The state-owned fleet offers shipping



Note : as of June 1993. ( ) number of employee
Source : MOTC

Figure 2.5.2 Organization of the Inland Waterway Bureau

services mainly for bulk cargo over long distances, including imported cargo from seaports. VISERITRANS has recently established a network of canals between the inland waterways of the Red River and Mekong deltas. So far the private sector fleet plays an important role for the shipping of agricultural products only in the Mekong Delta.

Table 2.5.4 Inland Waterway Inter-Province Transport Capacity by Carrier in 1991

Carrier	Red River Delta		Mekong Delta	
	(in 1,000 tons)	(%)	(in 1,000 tons)	(%)
Central Government	5,008	51.5	741	6.4
Provincial Governments	3,449	35.5	2,542	22.2
Cooperatives	1,189	12.2	1,213	10.6
Private Sector	75	0.8	6,978	60.8
Total	9,721	100.0	11,474	100.0

Source: UNDP, National Transportation Sector Review, Ha Noi 1992.
Note: Red River Delta is the study area.

(2) Inland Waterway Cargo Volume

Table 2.5.5 shows the inland waterway inter-province transport volume by commodity group for the Red River and Mekong deltas. Total cargo volume reached 11.6 million tons, of which 5.9 million tons were carried in the Study area. Coal and construction materials accounted for 85 % of the total cargo in the Study area.

Table 2.5.5 Inland Waterway Inter-Province Transport Volume by Commodity Group in 1991

Commodity Group	Total		Red River Delta		Mekong Delta	
	(in 1,000 tons)	(%)	(in 1,000 tons)	(%)	(in 1,000 tons)	(%)
Coal & Peat	3,601	31.0	3,595	60.6	6	0.1
Construction Materials	3,147	27.1	1,470	24.8	1,677	29.5
Agricultural Produce	2,484	21.4	139	2.3	2,345	41.2
Fertilizers	629	5.4	112	1.9	516	9.1
Food Industry Products	605	5.2	251	4.2	353	6.2
Wood & Forest Products	549	4.7	7	0.1	543	9.5
Petroleum Products	222	1.9	170	2.9	53	0.9
Manufactured Products	202	1.7	38	0.6	164	2.9
Ore	135	1.2	135	2.3	0	0.0
Industrial Products	52	0.4	19	0.3	33	0.6
Total	11,626	100.0	5,936	100.0	5,690	100.0

Source: NTSR 1991 River O/D Survey
Note: Red River Delta is the study area.

As a consequence of the deregulation of the inland waterway transport market, annual cargo volumes of the five major state-owned river ports have declined by one third since 1988 as indicated in Table 2.5.6.

Table 2.5.6 Annual Cargo Volumes of State-owned River Ports in the Study Area

(Unit: 1,000 tons)

	1988	1989	1990	1991	1992
Ha Noi	531	370	302	372	484
Ninh Binh	542	386	399	338	313
Viet Tri	368	288	207	203	230
Ha Bac	441	192	52	29	70
Hoa Binh	78	52	49	40	50
Total	1,960	1,288	1,009	982	1,147

Source: MOTC

(3) Transport Fee and Handling Charge

Transport fees of inland waterways are shown in Table 2.5.7. The fees are determined by kinds of goods and distance of transport. Handling charges of river ports are shown in Table 2.5.8. The port handling charge is classified by kinds of goods and mode of handling. The structure of transport fees and handling changes is most attractive for bulky cargo such as coal and construction materials. The total cost of the transport fee and handling charge is relatively more expensive for other cargo which is better suited to another transport mode.

(4) Revenue and Expenditure

The IWB has been founded since June 1993, so it has only collected the revenue and borne the expenditures of this branch since that year. The total income and expenditure of IWB in 1993 was as follows:

- Total revenue 158.3 billion dong
- Total expenditure 154.6 billion dong
- Net income 3.7 billion dong

(The total revenue of 5 transport sections is 11.3 billion dong)

If total revenue and expenditure are regarded as the only measures of operational performance, the efficiency of inland waterway operation is generally not very good.

Table 2.5.7 Inland Waterway Transport Fees

Level of Fees	Transport Distance		Kinds of Goods
	under 10 km	over 11 km	
	dong/t	dong/t•km	
level 1	11,477	89.5	bulky cargo (coal, ore, soil)
2	12,446	96.2	packaged goods, containers, etc.
3	13,867	107.3	bagged goods and general goods
4	14,985	116.2	foodstuffs
5	15,236	129.5	fragile articles and precious metals

Source : MOTC
Note : this table is applied on Waterways Classification Level 1
: Waterways Classification Level 2 and coastal route fees are higher by a factor of 1.5
: Waterways Classification Level 3 fees are 3.0 times higher
: other kinds of goods are transported for fees agreed between the shipper and carrier

Table 2.5.8 River Port Charges

Level of Charges	Mode of Handling (dong/ton)				
	barge - stock yard	barge - truck, train	barge - barge	Stock yard - truck	stock yard - train
1	5,733	3,902	3,492	2,817	3,100
2	6,861	4,606	4,143	3,228	3,453
3	11,453	6,116	5,493	3,804	3,945
4	13,775	7,552	6,762	4,228	4,765
5	21,325	12,071	10,858	6,116	6,252

Source : MOTC
Note : classification equals the level of transport fee

(5) Investment Budget

The total investment budgets for inland waterways in recent years are shown in Table 2.5.9. The budget increased by 20 - 30 % annually from the year 1991 onward. But there have been continuing annual declines in the proportion of investment for inland waterways in the total investment budget for all transport modes.

Table 2.5.9 Total Investment Budget of Inland Waterways

	Total Investment Budget (million dong)				Share of Waterways in Total Transport Budget (%)
	total	construction	maintenance	others	
1989	9,999	3,430	6,264	305	4.0
90	6,534	4,409	1,138	987	1.5
91	25,600	9,800	10,900	900	2.9
92	28,230	18,700	8,030	1,500	3.1
93	34,000	22,500	9,700	1,800	2.0

Source : MOTC

2.5.4 Obstacles and Problems

Inland waterways are facing the following main obstacles and problems:

- River ports must have two berths corresponding to fluctuations in the water level.
- Some parts of inland waterways require regular dredging due to river siltation and erosion.
- Inland waterway transport will gradually lose its share of the general cargo market to the trucking industry.
- Inland waterway port and handling facilities are either substandard or out of operation. Many yards and warehouses are not effectively used. The navigation aids system is not operational at night.
- Most inland waterway fleets are outdated and require rehabilitation.
- The transport fare structure requires urgent market-oriented changes so as to create incentives for private sector investments.
- IWB needs to be streamlined and restructured. Its transport, maintenance and port handling sections should be fully privatized.

Chapter 3 Socioeconomic Activities and Overall Framework

CHAPTER 3 SOCIOECONOMIC ACTIVITIES AND OVERALL FRAMEWORK

3.1 INTRODUCTION

3.1.1 Objective

The socioeconomic framework defined in this Study is one of the most significant items of input data for forecast of transport demand in each mode. Population and GDP of the Study area as well as each province are important indicators for demand forecasting.

3.1.2 Methodology and Analytical Environment

Generally speaking, projection of the socioeconomic framework should be formulated based upon the detailed analysis of present conditions of production and service sectors, existing physical development plans and national, regional and local development strategies. Since Vietnam is now experiencing the transition from planned to market economy under the "Doi Moi" program, historically reliable data for the analysis of socioeconomic trends are very limited. Mainly national indicators have been taken as a basis for the development framework of the Study area. The projected socioeconomic framework indicates the magnitude of future development anticipated for each province of the Study area.

3.2 PRESENT CONDITIONS

3.2.1 Population and Urbanization

In 1991, the Study area registered a population of 24.8 million with 16 % living in urban areas. The average population density was 215 persons per km^2. The Red River Delta accounts for 13.3 million people with an average density of 1,065 persons per km^2 and an urban population of 17 %. The North Mountain and Midland Region accounts for 11.6 million people with an average density of 112 persons per km^2 and an urban population of 14 %. Population density in the Red River Delta is almost 10 times higher than that in the North Mountain and Midland Region. Urban population ratios in both the Red River Delta and North Mountain and Midland Region are below the national average of 20 %.

Population of the Study area increased at an average annual growth rate of 2.39 % over the period from 1978 to 1989. Table 3.2.1 shows population, population density and average annual population growth rate of the regions in the Study area. Population density by province is illustrated in Figure 3.2.1. Urban population of the Study area increased at an average annual growth rate of 3.18 % from 1989 to 1991, while the national average was 1.77 %.

Table 3.2.1 Population Growth Rate (1979-1989) and Population Density

Region/Area	1979 (1000 persons)	1989	pop. growth rate (79'-89')	Area (sq. km)	population 1991 (1000')	population density, per sq. km
N. M & Midland	9,131	11,907	2.69%	102,949	11,566	112
Red River Delta	9,545	11,739	2.09%	12,457	13,267	1,065
STUDY AREA	18,676	23,645	2.39%	115,406	24,832	215
Whole country	52,742	64,376	2.01%	331,041	66,729	202

Source : VIETNAM POPULATION CENSUS - 1989 / STATISTICAL YEAR BOOK 1992

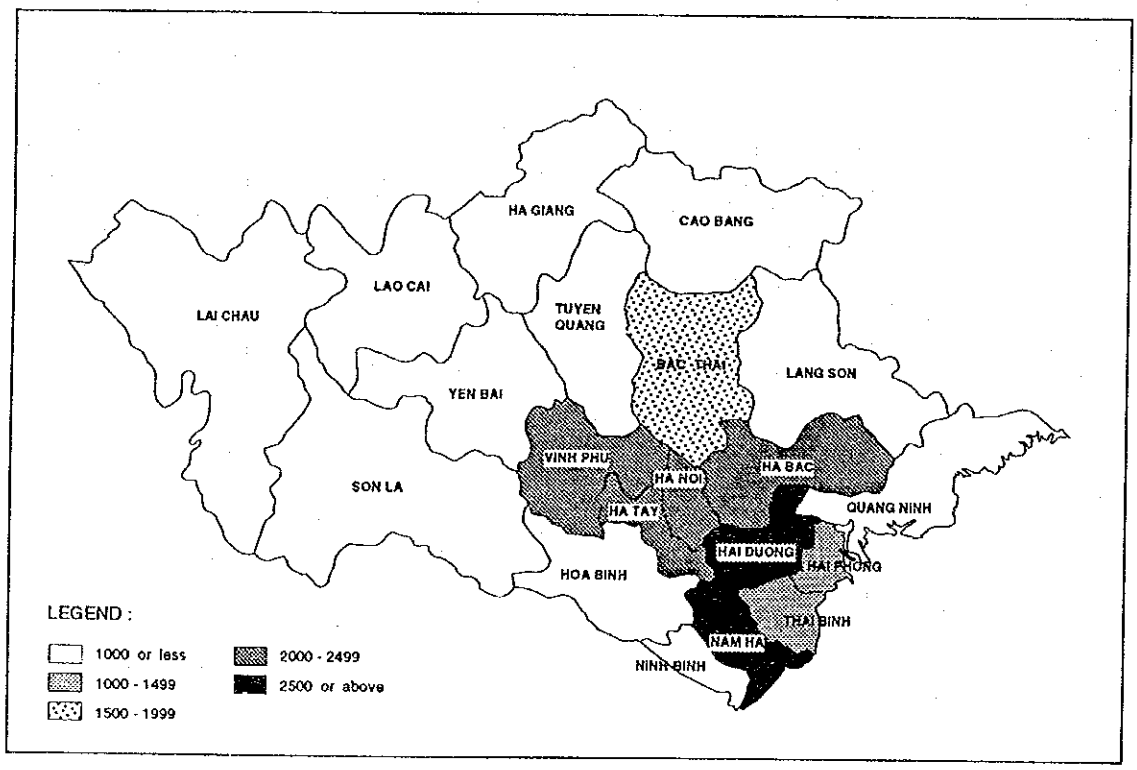


Figure 3.2.1 Population Density of the Northern Part of Vietnam

The primary sector plays the most important role for employment generation. It employs almost 80 % of the total labor force in the Study area. The secondary and tertiary sectors each employ around 10 %. The employment shares of secondary and tertiary sectors are comparatively higher in the Red River Delta than in the North Mountain and Midland Region. In the cities and provinces of Ha Noi, Hai Phong and Quang Ninh, which form the Northern Focal Economic Area, employment shares of secondary and tertiary sectors are much higher than average. Table 3.2.2 and Table 3.2.3 show population above 15 years of age (indicating the potential working age) and employment structure by sector.

Table 3.2.2 Population above 15 Years of Age

UNIT : 1000 persons

Region/Area	Population Total	Population over 15	percent over15	Employed Population	percent Employed
N. M. & Midland	10,068	5,602	56%	4,561	81%
Red River Delta	13,577	8,227	61%	6,246	76%
Study Area	23,645	13,829	58%	10,807	78%
Whole Country	64,376	37,739	59%	27,442	78%

Source : Vietnam population census 1989
Note : Red River Delta includes the population of Hoa Binh

Table 3.2.3 Employment Structure

Industry type Province/City	primary industry	secondary industry	tertiary industry	other	total
NORTH MOUTAIN	3,735,751	392,970	406,122	26,658	4,561,501
& MIDLAND	81.9%	8.6%	8.9%	0.6%	100.0%
(QUANG NINH)	*172,187*	*117,421*	*68,507*	*0*	*358,115*
	48.1%	*32.8%*	*19.1%*	*0.0%*	*100.0%*
RED RIVER DELTA	4,638,366	844,451	688,045	75,142	6,246,004
	74.3%	13.5%	11.0%	1.2%	100.0%
(HA NOI)	*701,598*	*343,979*	*281,020*	*30,766*	*1,357,363*
	51.7%	*25.3%*	*20.7%*	*2.3%*	*100.0%*
(HAI PHONG)	*412,056*	*140,841*	*104,809*	*16,303*	*674,009*
	61.1%	*20.9%*	*15.6%*	*2.4%*	*100.0%*
STUDY AREA	8,374,117	1,237,421	1,094,167	101,800	10,807,505
	77.5%	11.4%	10.1%	0.9%	100.0%

Source : Employed Population 16 Years of Age and Over by Occupation, Vietnam population census - 1989 Vol. III
Note : Employed population in HOA BINH is included in HA TAY in Red River Delta region

3.2.2 Economic Situation

Although the Study area accounts for 37 % of the country's population, its GDP share is 25 % and per capita GDP is estimated at US$162. This compares to 67 % of the estimated national per capita GDP of US$240. In the Southern part of Vietnam average per capita GDP is US$401. This is 67 % above the national average. The per capita GDP of the Central part of Vietnam is estimated at US$143. Concentration of economic activities in the Southern part of Vietnam and the consequent growth of regional disparities is one of the most significant issues for Vietnam. Table 3.2.4 shows estimated GDP of the Northern part of Vietnam in relation to national GDP estimates. Figure 3.2.2 shows the absolute and per capita Gross Provincial Product (GPP) of each province of the Study area.

Table 3.2.4 1993 GDP Value of the Northern Part of Vietnam

NAME OF REGION	GDP (million US$)	Percentage Share of GDP	Population (mill. pop.)	% share of population	Per capita GDP (US$)	% of average GDP/capita
NORTHERN REGION -STUDY AREA-	4,190	25%	25.9	37%	**$162**	**67%**
CENTRAL REGION	2,754	17%	19.4	28%	$142	59%
SOUTHERN REGION	9,760	58%	24.3	35%	$401	167%
WHOLE COUNTRY	16,704	100%	69.6	100%	**$240**	100%

Source : Estimated by Study Team based on information and data provided by the Institute of Long Term Planning and Regional Planning, SPC

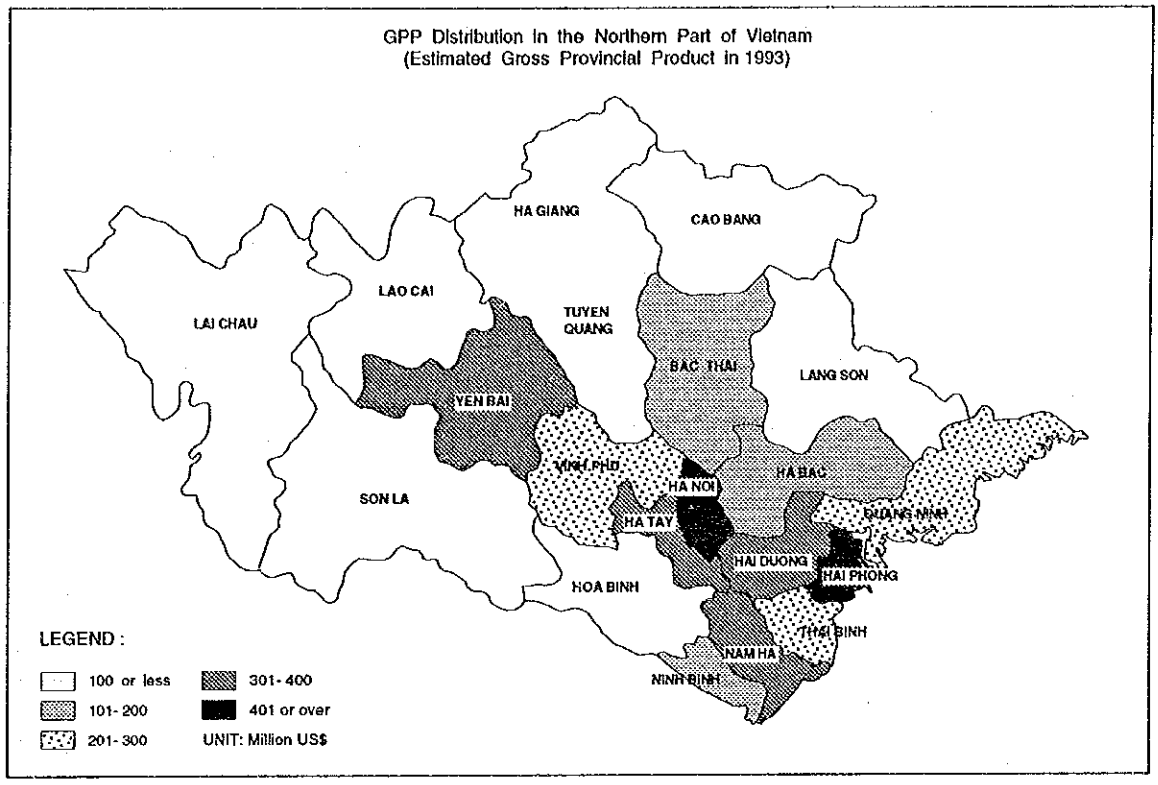
(1) Primary Sector

The primary sector, which includes agriculture, forestry and fishery, contributes to 80 % of employment generation and 40 to 50 % of GDP. The primary-sector GDP share in the Study area is estimated at 43 % in 1993. Rural per capita food production in the North Mountain and Midland Region and the Red River Delta are 239 kg and 315 kg, respectively. They are lower than the national average of 414 kg. Relatively low agricultural productivity combined with high population density are the main characteristics of the Study area. Table 3.2.5 shows the sown area of food crops and food production in paddy equivalent.

Table 3.2.5 Rural Per Capita Food Production by Area (1991)

	Rural population (1,000 persons)	Sown area of food crops (1,000 ha)	Production of food (1,000 ton)	Food production per rural population (kg)	Food production per sown area (kg/ha)
N. Mountain & Midland	9,913	1,145	2,367	239	2,068
Red River Delta	10,981	1,263	3,457	315	2,738
Study Area	20,894	2,407	5,824	279	2,419
Whole country	53,111	7,448	21,990	414	2,952

Source: Statistical Yearbook 1992, Statistical Publishing House



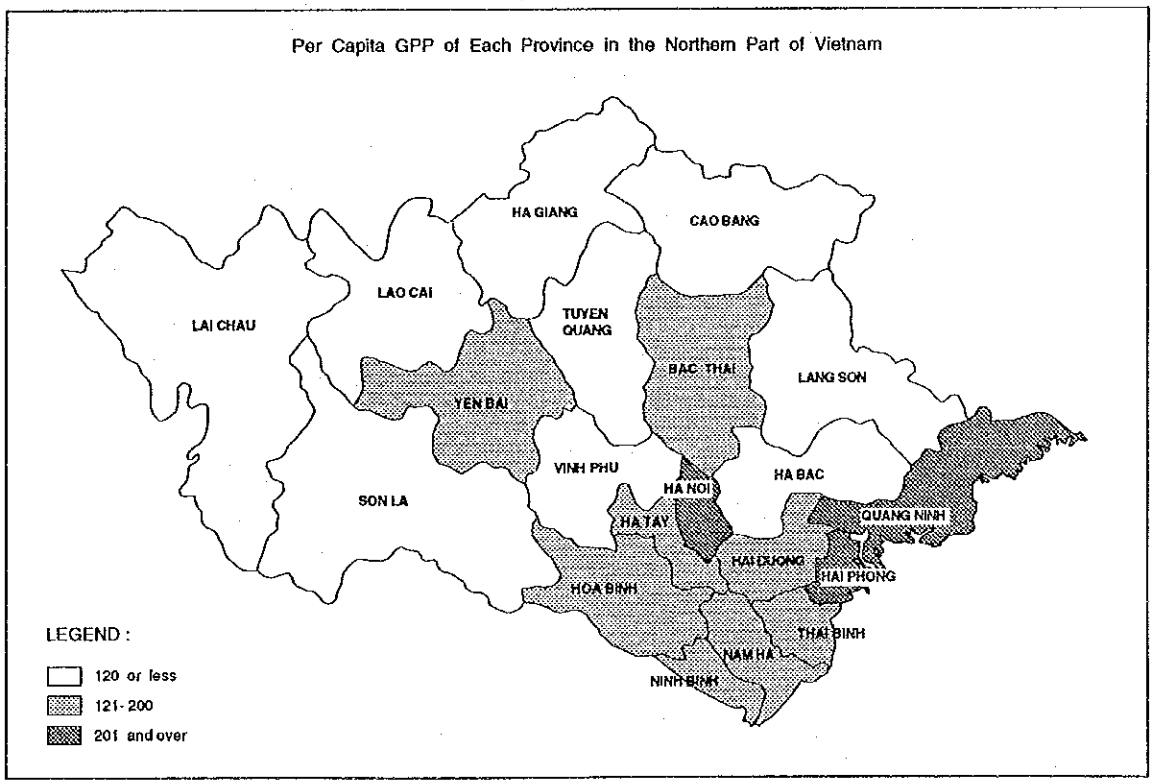


Figure 3.2.2 **Absolute and Per Capita GPP of Each Province in the Northern Part of Vietnam**

Primary sector production, especially food production, experienced higher growth rates in the past three years due to new incentives for the farmers under the economic reform policy. It grew by 6 % annually in the Study area compared to a national rate of 8.8 %. Table 3.2.6 shows the gross agricultural product for the past three years.

Table 3.2.6 Index of Gross Agricultural Product

(Unit: Constant 1989 Prices)

	1990	1991	1992	share(%)	Growth Rate 1990-92
Study Area	32	30	36	30	6.0%
North Mountain & Midland	13	12	14	12	5.1%
Red River Delta	19	18	22	19	6.6%
Central Area	22	23	26	22	8.0%
Southern Area	46	49	56	48	11.1%
Whole Vietnum	100	102	118	100	8.8%

Source: Statistical Yearbook 1992, Statistical Publishing House
Note: Whole Vietnam in 1989=100

(2) Secondary Sector

The Study area is known for its rich natural resources and concentration of heavy industries, such as manufacturing of cement, fertilizer and iron as well as coal mining. Also, the Study area has a high capacity for thermal and hydro-electric power supply. However, growth of the secondary sector was very low in the early 1980s because of low productivity and economic recession in COMECON countries. As a consequence of the privatization of enterprises under the "Doi Moi" reforms since 1989, foreign private companies started to invest in Vietnam.

Table 3.2.7 Index of Gross Industrial Product

(Unit: Constant Price of 1989)

	1990	1991	1992	share(%)	Growth Rate 1990-92
Study Area	25	26	30	24	9.5%
North Mountain & Midland	7	7	8	6	2.0%
Red River Delta	18	18	23	18	12.4%
Central Area	15	16	15	12	1.0%
Southern Area	60	71	83	65	18.0%
Whole Vietnum	100	112	129	100	13.5%

Source: Statistical Yearbook 1992, Statistical Publishing House
Note: Whole Vietnam in 1989=100

3.2.3 Development Plans

The Government has set forth Social and Economic Development Strategies up to the year 2000 in which three Focal Economic Areas are planned. The first one covers Ha Noi, Hai Phong and Quang Ninh in the Northern part of Vietnam, the second area includes Da Nang and the surrounding area and the third area is the core of the Southern part of Vietnam including Ho Chi Minh City. The Social and Economic Development Strategies encompass two alternative scenarios for the country's future economic development prospects. Average growth rates of GDP up to the year 2000 have been estimated for the pessimistic (option 1) and optimistic (option 2) scenarios at 6.9 % and 7.5 %, respectively. The major targets for the development period are shown in Table 3.2.8.

Table 3.2.8 Major Targets up to the Years 1995 and 2000

Targets (1)	Unit (2)	1991 - 1995 (3)	1996 - 2000 (4)	1991 - 2000 (5)
1. Average GDP growth rate:	%			
- Option 1		5 - 5.5	8.0	6.9
- Option 2		6 - 6.5	8.5	7.5
2. Average growth rate of agricultural output	%			
- Option 1		3.7 - 4.0	4.0 - 4.5	4.0
- Option 2		4.0 - 4.5	4.0 - 4.5	4.2
3. Average growth rate of industrial out put	%			
- Option 1		8.0 - 9.0	10.0 - 11.0	9.5
- Option 2		10 - 11	14 - 15	12.5
4. Total export value	US$ (in billions)			
- Option 1		12	25	37
- Option 2		15	30	45
5. Growth rate of consumption fund	%	3.5 - 4.1	5.0 - 6.0	4.5 - 5.0
6. Growth rate of accumulation fund	%	10 - 15	16 - 20	14 - 18
7. Total investment in capital construction	US$ (in billions)			
- Option 1		7.7	27.3	35
- Option 2		10.5	34.5	45

Source: 7th National Congress 1991

In both scenarios, the average growth rate of industrial output is estimated to be almost twice as high as the corresponding growth of agricultural output.

Based on the Government's assumptions on population growth, the national population growth rate is estimated to be 2.2 % in 1993 and to gradually decrease to 1.9 % in the year 2000.

Regional Development Plan

UNDP's currently formulating a Red River Delta Master Plan, comprising natural resources development, industries and infrastructural development, development of institutional and management support systems. Water resource management and agricultural development will be emphasized in the study.

For the Southern part of Vietnam, the government is preparing the Southern Focal Economic Area (SFEA) Development Plan financed by UNDP. SFEA includes the three growth poles of Ho Chi Minh City, Bien Hoa and Vung Thau. The government intends to set a high economic growth rate in the SFEA. It will be 10 to 14 % of the national average growth rate in the period from 1991 to 2010. Population of the planning area amounts to 5.5 million at present.

Regional Setting of Vietnam is shown in Figure 3.2.3.

Northern Focal Economic Area

It is the intention of the Government of Vietnam to establish the Northern Focal Economic Area (NFEA) comprising Ha Noi, Hai Phong and Quang Ninh. Hence, integration of different transport modes within this area as well as integration of the NFEA with the whole Study area are important to ensure a smooth transport of cargo and people.

The NFEA falls within the administrative boundaries of four provinces, namely Ha Noi, Hai Hung, Hai Phong and Quang Ninh. In the "List of Projects" published by the State Committee for Co-operation and Investment (SCCI), a total of 548 currently planned investment projects are listed for the whole country. 207 investment projects are listed for the Study area, of which some 136 projects, equivalent to 66 % of all projects, will be located within NFEA. The strongest concentration is within Ha Noi as the planned location for 89 projects (65 % of all projects in the area or 43 % of all projects in the Study area). Figure 3.2.4 shows the planned investment projects in each province of the Study Area.

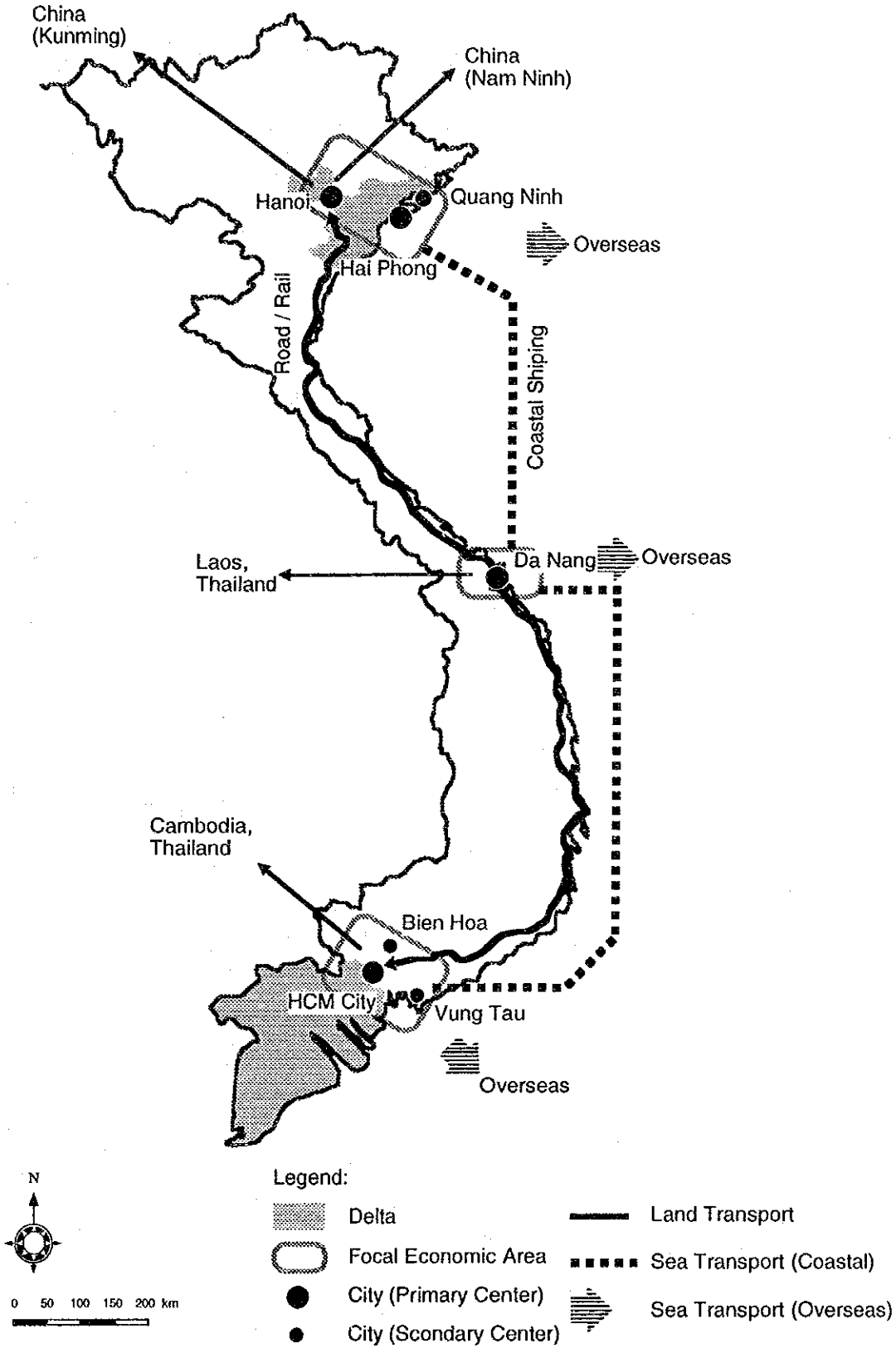


Figure 3.2.3 Regional Settings of Vietnam

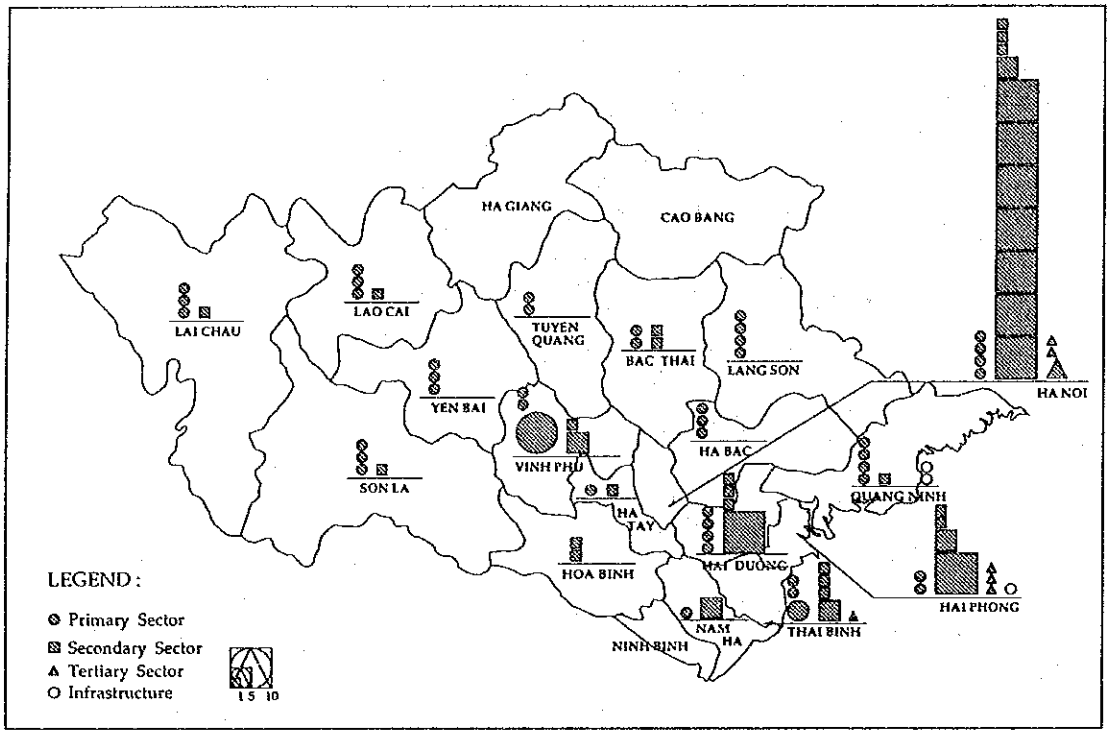


Figure 3.2.4 Planned Investment Projects in Each Province of the Northern Part of Vietnam

No.	Province/City	Number of Project(s)	Investment Amount (million US$)
1	HA GIANG	0	0.00
2	TUYEN QUANG	2	NA
3	CAO BANG	0	0.00
4	LANG SON	4	NA
5	LAI CHAU	4	NA
6	LAO CAI	4	30.00
7	YEN BAI	3	NA
8	BAC THAI	4	3.00
9	SON LA	3	NA
10	HOA BINH	2	NA
11	VINH PHU	18	72.26
12	HA BAC	3	6.50
13	QUANG NINH	7	60.61
	N. Mountain & Midland	**54**	**172.36**

No.	Province/City	Number of Project(s)	Investment Amount (million US$)
14	HA NOI	89	484.98
15	HAI PHONG	23	86.00
16	HAI HUNG	17	28.11
17	HA TAY	2	5.20
18	THAI BINH	16	90.61
19	NAM HA	6	5.50
20	NINH BINH	0	0.00
	Red River Delta	**153**	**700.39**
	STUDY AREA	**207**	**872.76**

Source : LIST OF PROJECTS, State Committee for Co-operation and Investment, 1992
Note : Investment Amount shown in this table is only the sum of items indicated on the LIST OF PROJECTS

3.3 FUTURE SOCIOECONOMIC FRAMEWORK

3.3.1 Population Growth and Distribution

Future population is estimated under the following assumptions;

(1) Population growth rate of each province is set at the same level as the national population policy stated in the 7th National Congress in 1991.

The national population growth rate is set as shown below.

1991 - 1995	2.2 % per annum.
1995 - 2010	0.05 % less than previous year

(2) No migration from the Northern region to the Central or Southern regions is considered. However, some migration from rural areas to the Focal Economic Areas is expected to occur.

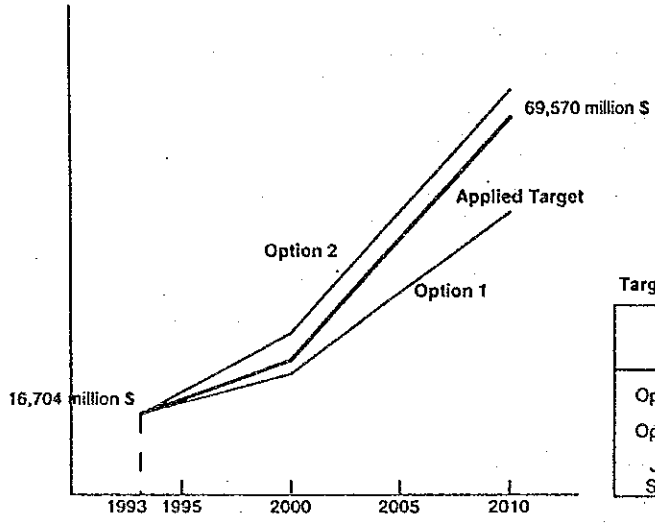
(3) Average growth rate of the urban population is considered to be 5 %. Generally speaking, rapid urban population growth leads to various urban problems, because urban facilities, such as water supply, housing, social infrastructure and transport system, can not accommodate the growing population sufficiently. However, provinces located next to the Ha Noi urban area will experience an urban population growth rate of more than 5 % per annum, because of urban fringe area of Ha Noi pushing into these provinces. Three provinces bordering Ha Noi belong to the North Mountain and Midland Region, and will experience a 10 to 15 % urban population growth. This will cause a slightly higher population growth rate in the North Mountain and Midland Region after the year 2005.

(4) Maximum urbanization level is set at 80 %. Less than 10 % of all the Ha Noi urban area is presently a Densely Inhabited District (DID). If the urban area expands to the rural area of Ha Noi, more than half of the land will remain as rural area. Rural population will remain at certain levels even though large numbers of rural inhabitants commute to urban areas to work.

(5) Rural population will be stable after year 2005 (saturation level).

Rural population is basically engaged in the primary sector, i.e. agriculture and forestry. Growth of the primary sector largely depends on the natural land conditions and marketing situation. Diversification of crops and introduction of agro-industry is indispensable so as to develop the rural areas. Even though that may be achieved, it is expected that scarcity of arable land will set limits on the rural population growth which can be sustained, consistent with improvements in rural living conditions. It is nevertheless assumed that, up to year 2005, rural population increase could be absorbed by rural communities and/or nearby provincial urban areas.

On the basis of the above conditions, population of the Study area by province is calculated as shown in Table 3.3.1.



Targets of GDP Growth Rate

	1993 -2000	2001 -2010
Option 1	6.9%	8.0%
Option 2	7.5%	10.0%
JICA Study	7.0%	10.0%

Figure 3.3.1 GDP Targets of the Whole Country

Table 3.3.2 GDP Forecast (Whole Country)

Year	GDP/capita (US$)	population (million)	population growth rate	GDP(mil $)	growth rate (GDP)	Remarks
1993	240	69.6	2.20%	16,704		
2000	333	80.5	2.09%	26,822	7.0%	
2005	491	88.0	1.80%	43,198	10.0%	
2010	732	95.0	1.55%	69,570	10.0%	
			Average growth rate (1993-2010)			*8.8%*

Table 3.3.1 Population Forecast for the Study Area

(Unit: '000' People)

Province/City	1993			urbaniz.	2000			urbaniz.	2010			urbaniz.
	urban	rural	total	ratio	urban	rural	total	ratio	urban	rural	total	ratio
HA GIANG	48	466	514	9%	68	526	594	11%	111	563	674	16%
TUYEN QUANG	67	558	625	11%	95	628	723	13%	155	669	824	19%
CAO BANG	64	560	624	10%	90	632	722	12%	146	674	821	18%
LANG SON	90	578	668	13%	127	646	772	16%	206	683	889	23%
LAI CHAU	66	424	490	13%	93	474	566	16%	151	501	652	23%
LAO CAI	65	454	519	13%	92	508	600	15%	150	539	689	22%
YEN BAI	124	513	637	19%	174	562	736	24%	284	582	866	33%
BAC THAI	228	925	1,153	20%	321	1,012	1,333	24%	523	1,048	1,571	33%
SON LA	107	655	761	14%	150	730	880	17%	244	771	1,015	24%
HOA BINH	114	598	712	16%	160	663	823	19%	261	695	956	27%
VINH PHU	274	1,938	2,212	12%	386	2,171	2,557	15%	793	2,174	2,967	27%
HA BAC	121	2,148	2,269	5%	171	2,453	2,624	7%	692	2,524	3,216	22%
QUANG NINH	454	442	896	51%	638	397	1,035	62%	1,040	317	1,357	77%
NORTH MOUNTAIN	1,822	10,258	12,080	15%	2,564	11,401	13,965	18%	4,754	11,741	16,495	29%
HA NOI	1,173	989	2,162	54%	1,650	849	2,499	66%	2,501	627	3,127	80%
HAI PHONG	558	1,022	1,580	35%	785	1,042	1,827	43%	1,613	733	2,346	69%
HAI HUNG	141	2,531	2,673	5%	199	2,891	3,090	6%	683	2,891	3,574	19%
HA TAY	148	2,076	2,224	7%	208	2,363	2,571	8%	541	2,475	3,016	18%
THAI BINH	109	1,677	1,786	6%	154	1,911	2,064	7%	250	2,061	2,311	11%
NAM HA	317	2,278	2,594	12%	445	2,554	2,999	15%	725	2,711	3,436	21%
NINH BINH	75	764	838	9%	105	864	969	11%	171	925	1,096	16%
RED RIVER DELTA	2,521	11,337	13,857	18%	3,547	12,473	16,019	22%	6,485	12,422	18,907	34%
STUDY AREA	4,343	21,595	25,938	17%	6,111	23,874	29,984	20%	11,239	24,163	35,402	32%

Note: Estimated by following conditions

1) population growth of each province is same as national average growth rate

2) no migration to other province

3) urban population growth rate is 5% per anum

4) urbanization will be limited to 80% in Ha Noi, Hai Phong and Quang Ninh

5) urban population growth rate will be higher than other provinces in Vin Phu, Ha Bac, Hai Hung and Ha Tay

6) population growth in rural areas will reach saturation level in 2005

3.3.2 National Economic Development Scenario

(1) National GDP Growth Rate;

In consideration of both the growth target set at the 7th National Congress in 1991, and national economic performance of the past years, an average GDP growth rate of 7 % up to the year 2000 and 10 % after the year 2001 are applied. Two options for GDP growth rate target are considered. Option 1 is a low growth case and option 2 is a high growth case. Applied targets in this Study mainly refer to Option 2.

(2) Per Capita GDP

It is estimated that the average per capita income in Vietnam in 1993 is US$240, and per capita income of the Study area is estimated at US$162, which is 67 % of the national average in 1993 as described in the previous section. Per capita GDP is used as an indicator for setting the target for economic conditions of the Study area.

Figure 3.3.1 and Table 3.3.2 show GDP targets for the whole country.

3.3.3 Regional Framework

(1) Regional Target:

It is estimated that GDP per capita of the Northern Region of Vietnam is half that of the Southern region and 67 % of the national average due to the facts that: (a) large numbers of farmers in the Red River Delta live under marginal living conditions and (b) minorities are living in the mountain areas at subsistence levels. The economic development potential in the Southern part of Vietnam is quite high as compared to the Study area because of the potential of oil and gas industry development, higher levels of infrastructure to be provided, and the better experience within the market economy.

However, a considerable advantage which the Northern region has is the status of the national capital with its concentration of central functions. In this regard, it is anticipated that the central function of service industries, such as head offices of banking and financing companies, trade and transportation industries, and manufacturing companies will be located here. This may make it attractive to locate various kinds of industries in the Northern part of Vietnam, especially in the vicinity of Ha Noi.

Considering the conditions mentioned above, the following regional development target has been set: Per capita GDP of the Study area will rise from its present 67 % of the national average to 90 % in 2010.

North Mountain and Midland Region and Red River Delta

The Study area is divided into two major parts, the Red River Delta and the North Mountain and Midland Region. Study team calculations based on 1991 TESI survey data show that the average income of the North Mountain and Midland Region is some 30 % of the national average.

In this transportation master plan study, it is assumed that GDP per capita in the North Mountain and Midland Region is 50 % of the national average at present.

It is usually anticipated that there will be a widening of the economic development gap between the Red River Delta and the underdeveloped areas such as the North Mountain and Midland Region, because of the rapid growth in the Red River Delta caused by industrialization in the large urban areas and concentration of investment there.

However, from the social and political point of view, the economic growth of the North Mountain and Midland Region should be kept at the same pace as national economic growth. Agricultural diversification and introduction of high value added crops in the mountainous area are being considered as means to achieve such a target. Provision of adequate market access by road will be indispensable.

From these points of view the target GDP per capita of the North Mountain and Midland Region is set at a ratio of 50 % to the national average up to the year 2000, and at slightly higher ratios of 52 % and 54 % in the years 2005 and 2010, respectively.

The aggregate Gross Regional Product (GRP) of the Study area and the two major subregions within it, are estimated on the basis of the above assumptions. Table 3.3.3 shows the results.

Table 3.3.3 GRP Forecast of the Study Area

GRP Forecast (Northern Part) (Unit: Constant 1993 US$)

Year	GDP/capita (US$)	population (million)	population growth rate	GRP(mil $)	growth rate (GDP)	Target % of GDP per capit to national Ave.
1993	162	*25.9*	2.20%	4,190		67%
2000	240	*30.0*	2.09%	7,197	8.0%	72%
2005	393	*32.8*	1.80%	12,879	12.3%	80%
2010	659	*35.4*	1.55%	23,334	12.6%	90%
		Average growth rate (1993-2010)			10.6%	

GRP Forecast (Northern Part / North Mountain Region) (Unit: Constant 1993 US$)

Year	GDP/capita (US$)	population (million)	population growth rate	GRP(mil $)	growth rate (GRP)	GDP/capita to National Average
1993	119	12.1	2.20%	1,439		50%
2000	167	14.0	2.09%	2,332	7.1%	50%
2005	256	15.3	1.80%	3,910	10.9%	52%
2010	399	16.5	1.56%	6,578	11.0%	54%

Average growth rate (1993-2010) 9.4%

GRP Forecast (Northern Part / Red River Delta) (Unit: Constant 1993 US$)

Year	GDP/capita (US$)	population (million)	population growth rate	GRP(mil $)	growth rate (GRP)	GDP/capita to National Average
1993	199	*13.9*	2.20%	2,751		83%
2000	304	*16.0*	2.09%	4,865	8.5%	91%
2005	512	*17.5*	1.80%	8,969	13.0%	104%
2010	886	*18.9*	1.54%	16,756	13.3%	121%

Average growth rate (1993-2010) 11.2%

2) Sector shares in GRP

The present sector shares in GRP in the Study area are assumed to be as follows;

Primary sector	:	43 %
Secondary sector	:	19 %
Tertiary sector	:	38 %

Hypothetical future sector shares in GRP in the Study area are determined by using the following assumptions.

i) The primary sector will grow at 6 % per annum up to the year 2000, which is the same pace as has been achieved over the past few years. A lower growth rate of 5 % is applied in the period 2001 to 2005, and 4 % from 2006 to 2010.

ii) The tertiary sector will expand its share in GRP up to 50 % in the year 2010. This is in the most commonly observed range of tertiary shares in GDP, in various countries and at various development levels.

iii) The secondary sector will grow rapidly to achieve the target GRP of each benchmark year. To achieve these targets the growth rate of this sector should become 17 to 20 % during the period 2000 to 2005. This should be realized by macroeconomic policy focusing on economic stabilization, in conjunction with a successful privatization policy. The scale of production anticipated for this sector is not unrealistic if all projects listed in the "List of

Projects" prepared by SCCI, described in the previous section, will actually materialize.

iv) The same sector shares are applied to both major subregions, the Red River Delta and North Mountain and Midland.

The GRP by sector in the Study area and two subregions, are derived from the aggregate GRP of Table 3.3.3 by employing the assumptions immediately above. Figure 3.3.2 and Table 3.3.4 show the sectoral results.

3.3.4 Provincial Socioeconomic Framework

Socioeconomic Framework of the Northern Part of Vietnam

The Gross Provincial Product (GPP) of each province has been estimated to provide the data required for the forecasts of future traffic demand. Since there are no officially confirmed GPP data available, estimations have been made by distribution of sectoral DP for the region, among the provinces on the basis of their relative population and urbanization levels.

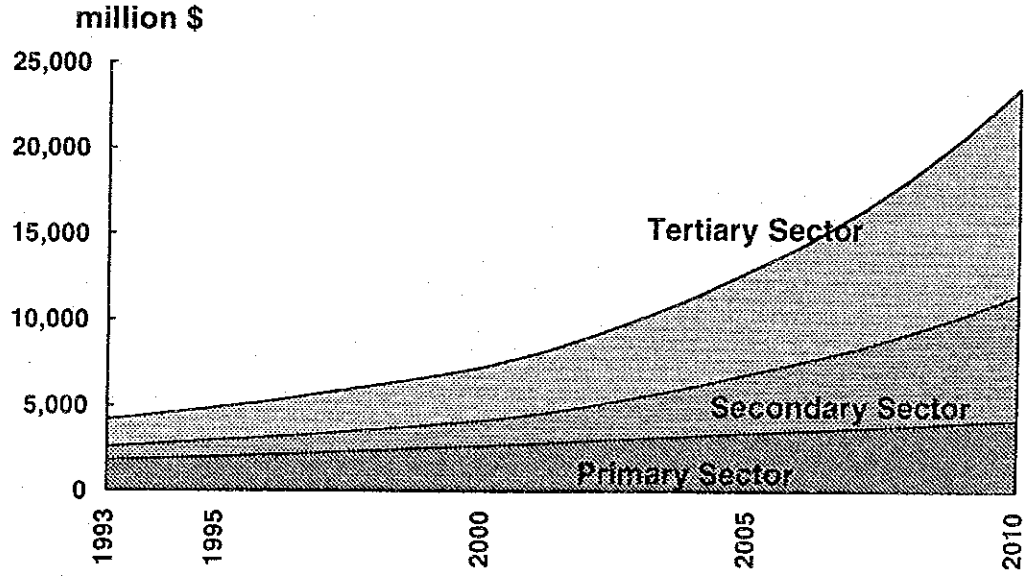


Figure 3.3.2 GRP by Sector in the Study Area

Table 3.3.4 GRP by Sector in the Study Area

(Study Area) (Unit: Constant 1993 US$)

Year	GRP BY SECTOR						GRP(mil $)
	Primary		Secondary		Tertiary		
	mill. $	Growth rate	mill. $	Growth rate	mill. $	Growth rate	
1993	1,801		796		1,592		4,190
	43%	6%	19%	9%	38%	10%	
2000	2,709		1,466		3,023		7,197
	38%	5%	20%	19%	42%	14%	
2005	3,457		3,498		5,924		12,879
	27%	4%	27%	16%	46%	15%	
2010	4,206		7,461		11,667		23,334
	18%		32%		50%		

(North Mountain Region) (Unit: Constant 1993 US$)

Year	GRP BY SECTOR						GRP(mil $)
	Primary	%/year	Secondary	%/year	Tertiary	%/year	
1993	619		273		547		1,439
2000	878	5%	475	8%	980	9%	2,332
2005	1,049	4%	1,062	17%	1,798	13%	3,910
2010	1,186	2%	2,103	15%	3,289	13%	6,578

(Red River Delta Region) (Unit: Constant 1993 US$)

Year	GRP BY SECTOR						GRP(mil $)
	Primary	%/year	Secondary	%/year	Tertiary	%/year	
1993	1,183		523		1,045		2,751
2000	1,831	6%	991	10%	2,043	10%	4,865
2005	2,408	6%	2,436	20%	4,126	15%	8,969
2010	3,020	5%	5,358	17%	8,378	15%	16,756

The primary sector's GRP is distributed according to the rural population of the Red River Delta and the North Mountain and Midland subregions. The secondary and tertiary sectors' GRP is distributed according to the urban population of each region. It is recognized that there are many cottage and resource based industries located in the rural area. However, it is assumed that the degree urbanization corresponds closely to the level of industrialization. Therefore, the distribution of GPP estimated by this method should be close enough to know the order of magnitude of the economic growth of each province in the future.

The GPP in the year 1993 has also been calculated in the same manner, while estimations reflect the direction and magnitude of economic development of the region in the future, which will mainly depend on the population and on the urbanization potential.

The estimated GPP by province is shown in Table 3.3.5.

Figure 4.4.3 Growth Rates of Transport Modes Relative to GDP (Northern Part of Vietnam)

GPP Forecast

(Unit: Constant 1993 US$)

	Province/City	1993 Population (x1000) urban	1993 Population (x1000) rural	1993 GPP total (mil.US$)	1993 GPP per capita (US$)	2000 Population (x1000) urban	2000 Population (x1000) rural	2000 GPP total (mil.US$)	2000 GPP per capita (US$)	urbaniz. 2010 Population (x1000) urban	urbaniz. 2010 Population (x1000) rural	2010 GPP total (mil.US$)	2010 GPP per capita (US$)
1	HA GIANG	48	466	50	97	68	526	79	133	111	563	182	271
2	TUYEN QUANG	67	558	64	102	95	628	102	141	155	669	243	295
3	CAO BANG	64	560	63	100	90	632	100	138	146	674	234	285
4	LANG SON	90	578	75	113	127	646	122	157	206	683	303	341
5	LAI CHAU	66	424	55	113	93	474	89	157	151	501	222	340
6	LAO CAI	65	454	57	109	92	508	91	152	150	539	224	325
7	YEN BAI	124	513	87	136	174	562	142	193	284	582	381	440
8	BAC THAI	228	925	159	137	321	1,012	260	195	523	1,048	699	445
9	SON LA	107	655	87	115	150	730	141	161	244	771	355	350
10	HOA BINH	114	598	87	123	160	663	142	172	261	695	366	383
11	VINH PHU	274	1,938	240	109	386	2,171	386	151	793	2,174	1,119	377
12	HA BAC	121	2,148	184	81	171	2,453	286	109	692	2,524	1,039	323
13	QUANG NINH	454	442	231	258	638	397	393	379	1,040	317	1,211	893
	N. MOUNTAIN & MIDLAND	1,822	10,258	**1,439**	**119**	2,564	11,401	**2,332**	**167**	4,754	11,741	**6,578**	**399**
14	HA NOI	1,173	989	833	385	1,650	849	1,536	615	2,501	627	5,449	1,742
15	HAI PHONG	558	1,022	454	287	785	1,042	824	451	1,613	733	3,595	1,532
16	HAI HUNG	141	2,531	352	132	199	2,891	595	192	683	2,891	2,150	602
17	HA TAY	148	2,076	309	139	208	2,363	525	204	541	2,475	1,747	579
18	THAI BINH	109	1,677	243	136	154	1,911	412	200	250	2,061	1,031	446
19	NAM HA	317	2,278	435	167	445	2,554	756	252	725	2,711	2,196	639
20	NINH BINH	75	764	126	150	105	864	217	224	171	925	587	536
	RED RIVER DELTA	2,521	11,337	**2,751**	**199**	3,547	12,473	**4,865**	**304**	6,485	12,422	**16,756**	**886**
	STUDY AREA	4,343	21,595	**4,190**	**162**	6,111	23,874	**7,197**	**240**	11,239	24,163	**23,334**	**659**

Note : Estimated by the following methods:

1) GRP of the primary sector is distributed by number of rural population of each province.

2) GRP of secondary and tertiary sectors are distributed by number of urban population.

Chapter 4 Transport Demand Forecast

CHAPTER 4 TRANSPORT DEMAND FORECAST

This Chapter sets forth the methodologies and techniques inherent to development and application of transport modeling as well as demand forecasting procedures. It is noted that topics are only addressed as necessary to provide a general understanding; additional, more detailed, descriptions are contained in a separate technical report entitled "Transport Modeling and Demand Forecasts"[1].

4.1 INTRODUCTION

A transport study such as the current effort rests on the fact that transport systems channel demand (flows) between a series of geographic subdivisions (zones). The 20 provinces, whose landuse composition and activities can be described in socioeconomic and demographic terms, are designated as comprising the Study area's internal zone structure. An additional two external zones (Route 1 and Route 15) represent transport activity between the 20 provinces and other parts of the nation. International border crossings (to/from Lao PDR and PR China) are represented through an additional six external zones; thus, the study area includes a total of 28 zones (Figure 4.1.1). It is therefore possible to simulate trips of which (a) both trip-ends lie within the study area (internal trips), (b) one trip-end lies within the Study area (internal-external or external-internal trips), and (c) no trip-end lies within the Study area (through trips). All analyses of road-based vehicle trip activity are performed using the 28-zone study area.

The realization of a 20-province structure in the Northern Part of Vietnam is a relatively recent event. Prior jurisdictions consisted of 16 provinces, a system adopted by previous studies, including the UN-sponsored "National Transportation Sector Review"[2]. Thus, the NTSR zoning system includes 17 domestic zones consisting of the 16 provinces plus activity to/from the rest of the nation (Figure 4.1.2). The NTSR zoning system continues to be used by the current study for ton commodity and rail passenger flows; conversion of these demands to the 20-province system is impractical within the current analytical framework.

Forecasts of demand for the years 2000 and 2010 address cargo movement via road, rail and inland waterway modes; rail passenger flows; and vehicle trips via car, bus and truck modes. The investigative level of effort is focused on the road medium due to the expected intensive future growth in activity for this mode.

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(1) "Transport Modeling and Demand Forecasts" , Master Plan on Transportation Development in the Northern Part of the Socialist Republic of Viet Nam, Japan International Cooperation Agency, October 1993.

(2) "National Transportation Sector Review", by BCEOM Consultants, Paris, for Ministry of Transport and Communication, Government of Vietnam, 1992.

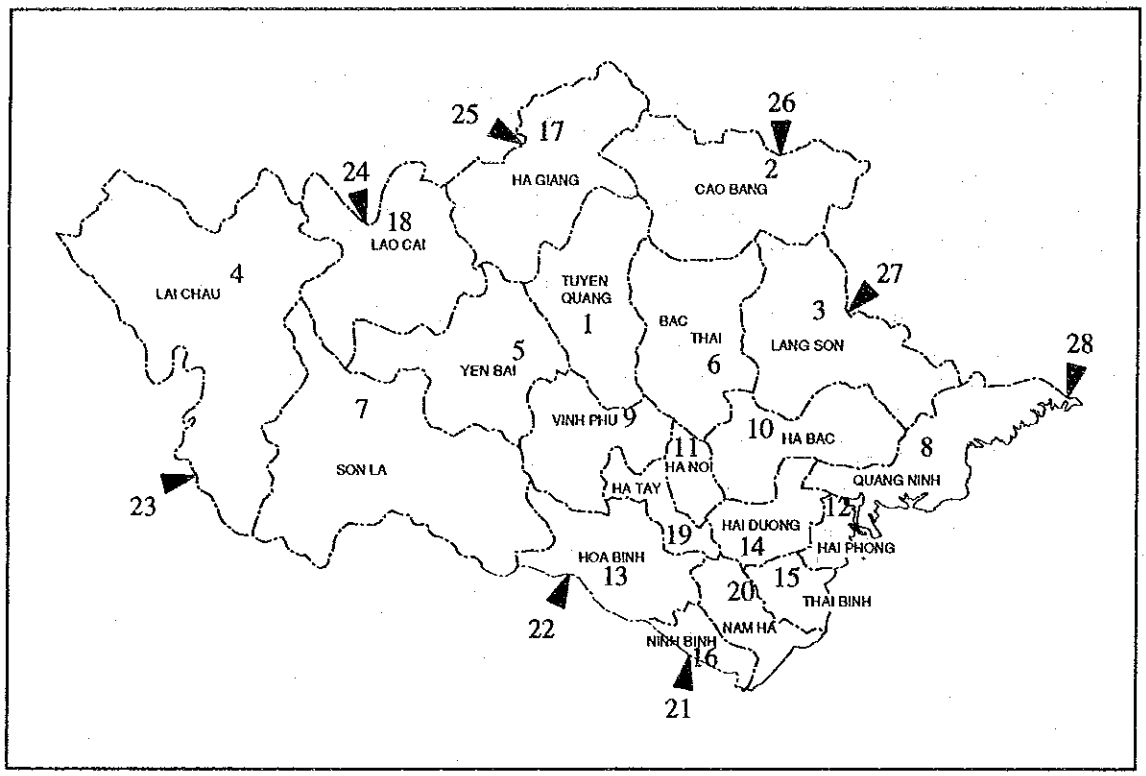

Figure 4.1.1 Study Area and Zone System

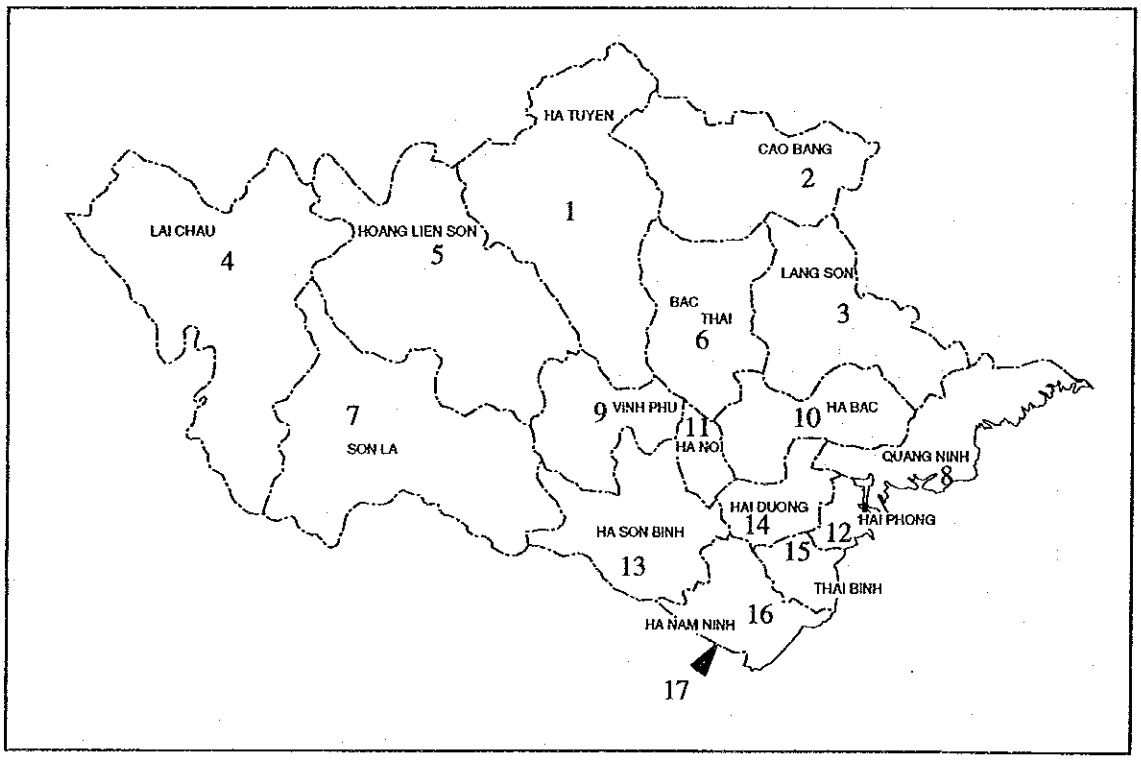

Figure 4.1.2 National Transportation Sector Review Domestic Zone Structure

4.1.1 Methodology Overview

Projections can, generally speaking, follow two possible paths: an extrapolation of historical patterns, or reliance upon future potential. The approach adopted for this study is a synthesis of both techniques. The continuing massive restructuring of the Vietnamese economy is likely to lead to new and unexplored horizons of activity, yet, recent evolution of the transport industry presents lessons which should not be ignored.

A two-tier technique termed "top-down" and "bottom-up" integrates these patterns within the socioeconomic framework defined for the Study (Figure 4.1.3):

- The top-down technique focuses on estimation of likely levels of national and regional development based on macro-economic and sociopolitical parameters which, in turn, are compared to indicators of historic transport evolution experienced by other Asian nations. Thus, a "likely" global scenario of Vietnam's future national transport demand can be developed.

- The bottom-up technique focuses on relative travel patterns experienced by each of the Study area's 20 provinces. It is expected that sizable shifts in demand will occur as the economy continues to move to free-market status. However, while some focused, capital-intensive improvements in transport infrastructure are expected over the next two decades, it is unlikely that a wholesale restructuring of Vietnam's physical transport facilities will take place within the Study's planning horizon. Likewise, locational aspects of cities, borders and natural terrain features will largely remain. Thus, relative distribution patterns are, to reasonable degrees, expected to evolve from existing patterns. This lends credence to linking changes in internal (within the Study area) trip demand with zonal (province) socioeconomic variables to include population, per capita income and mobility.

Extensive technical liaison was maintained throughout the conduct of this task. Numerous valuable comments were received from counterpart staff of the Transport Economic Scientific Institute (TESI) regarding latest available estimates of industrial development potential, and likely resulting impacts upon forecasting procedures. In addition, JICA harbor and inland waterway sectoral specialists conducted independent reviews of existing conditions as well as likely future potentials for harbor and river cargo transport, to include estimates of import/export activity. These findings were cross-correlated with results of the "top-down" and "bottom-up" techniques to ensure consistency of effort among all Study participants.

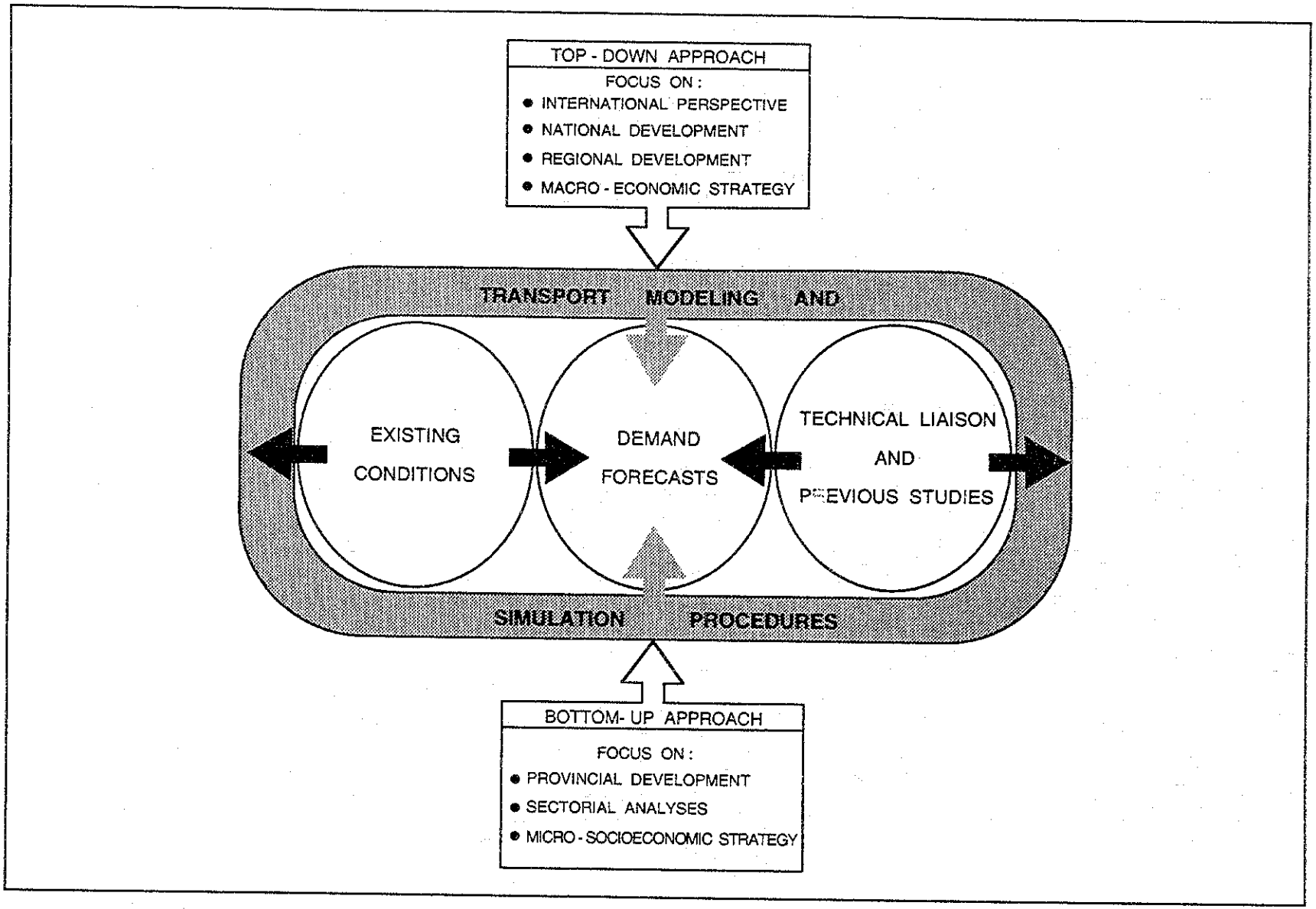

Figure 4.1.3 Overview of Forecasting Methodology

4.1.2 Synopsis of Findings

Forecasting methodologies for vehicle trips address future demand from two perspectives: expected internal activity and international (external) activity. The former sets the basic tone for future internal demands (trips with both ends in the Northern part of Vietnam) and as well for trips between the Study area and the rest of the nation, as these activity levels are strongly influenced by the future evolution of the Vietnamese economy. International demand, on the other hand, focuses on potential future activities related to imports, exports and transit traffic. These activity levels, while partially influenced by the Vietnamese economy, are more directly impacted by sociopolitical developments, many of which lie beyond the control of the Vietnamese Government.

In summary, based on approaches described in subsequent sections of this Chapter, findings for the Study area suggest that (Table 4.1.1):

- Vehicle trips are expected to more than double by year 2000, and then again quadruple by year 2010. Trips by car are expected to grow more rapidly than those by bus and truck.
- Rail passenger travel will roughly double by year 2010.
- Cargo will increasingly flow by truck, although shipments by rail and inland waterway will expand from current levels.

A relative comparison of future-year activity to present activity reveals that:

- Car vehicle trips and truck cargo shipments are forecast to grow at a much faster rate than per capita GDP.
- Rail and inland waterway cargo shipments are expected to grow at slightly below the national income rate, with the rail mode exhibiting stronger relative growth in the longer term.
- Growth in bus vehicle trips is likely to equal growth in national income, and rail passenger trip growth is expected to lag somewhat.

The expected evolution of these future transport activities is based on assumption of a free-market environment; that is, users of transport systems are presented with choices, and will typically choose the mode that is most convenient, fastest and/or cheapest relative to their personal needs.

4.2 OVERVIEW OF EXISTING CONDITIONS

This section presents a summary of transport-related conditions existing in the Study area. It is noted that within the framework of the transport modeling process, demand reflects interzonal (inter-province) activity.

Table 4.1.1 Overview of Existing and Forecast Transport Demand Indicators (Northern Part of Vietnam)

ITEM (1)	MODE	UNITS	AMOUNT			AVERAGE ANNUAL PERCENT CHANGE		
			Base Year	2000	2010	Base–2000	Base–2010	2000–2010
Population	*	Persons (000)	25938	29984	35402	2.1	1.8	1.7
GDP	*	Million 1993 Constant US$	4190	7197	23334	8.0	10.6	12.5
GDP/Capita	*	1993 Constant US$	162	240	659	5.8	8.6	10.6
Vehicle Trips(2)	Car	Daily Trips	8633	26936	127759	17.7	17.2	16.8
	Bus	Daily Trips	2154	3731	12333	8.2	10.8	12.7
	Truck	Daily Trips	9080	16878	59044	9.3	11.6	13.3
	Total	Daily Trips	19867	47545	199136	13.3	14.5	15.4
Domestic Passengers(3)	Rail	Annual Persons (000)	6429.9	8206.7	13458.8	2.2	3.6	5.1
Domestic Cargo (4)	Road	Annual Tons (000)	6745.5	15151.2	57926.2	9.4	12.0	14.4
	Rail	Annual Tons (000)	1987.7	3851.6	9452.4	7.6	8.6	9.4
	Inld Wtwy (5)	Annual Tons (000)	5936.2	12516.1	22000.0	8.6	7.1	5.8
	Total	Annual Tons (000)	14669.4	31518.9	89378.6	8.9	10.0	11.0

(1) Background data required for derivation of population and GDP forecasts are presented in reports issued by sectorial specialists.
(2) Interzonal trips by four-wheeled vehicles. Northern Vietnam zone system based on 20 internal zones and eight external zones (refer to Figure 4.1.1). Base year reflects year 1993 conditions.
(3) Interzonal trips. Northern Vietnam zone system based on 16 internal zones and one external zone (Southern Vietnam). Base year reflects year 1989 conditions.
(4) Interzonal cargo flows. Northern Vietnam zone system based on 16 internal zones and one external zone (Southern Vietnam). Base year reflects year 1991 conditions.
(5) Inland waterway (river) mode; excludes coastal shipping.

Thus, shorter-distance intrazonal or intraurban flows are not included in the analysis.

4.2.1 Vehicle Registrations

Up-to-date vehicle registration statistics at the province level of detail do not, as yet, appear to be routinely available. Several sources were consequently utilized in order to gain an understanding of recent vehicle ownership patterns within the Study area. These include TESI (1985 and 1991 data), the Ministry of Heavy Industries (1991 data)[3] as well as findings of a 1991 license plate survey conducted during the course of the NTSR study.

TESI data suggest that the number of 1991 national registrations aggregated to about 103,700 vehicles, an increase of some one fourth over the 82,000 vehicles shown as being registered in 1985.

The bus category exhibited strong growth, while the truck fleet appears to have declined in size. The overall average annual growth rate of 4 % is modest. However, questions persist as to the compatibility of these two data sets given that some changes in classification terminology as well as data collection techniques may have occurred in intermediate years.

While the TESI data provide valuable insight to ownership patterns, very large discrepancies do unfortunately exist vis-a-vis information supplied by the Ministry of Heavy Industries. This places 1991 national registrations nearer to 205,000, about twice the level suggested by the TESI data. The reasons for this discrepancy are not known. The NTSR license plate survey of 1991, conducted as part of the roadside interview survey administered then, provides further insight as to potential levels of provincial vehicle ownership. A review has been made of survey records which include license plate numbers, taking account of the letter-number system employed in the Vietnamese vehicle license plate numbering scheme. Findings of this review suggest that the registration totals of the Ministry of Heavy Industries are likely to be more accurate than the TESI totals.

It is therefore concluded that some 68,000 vehicles were registered within the Study area during 1991, accounting for about one third of the nationaltotal. The highest number of vehicles by far was registered in Ha Noi (about 24,800 cars, buses and trucks). Other provinces with sizable ownership include Ha Tay (5,000 vehicles), Hai Phong and Quang Ninh (each with 4,100 vehicles) and Nam Ha (3,900 vehicles). On average, the Study area fleet consisted of 31 % cars, 10 % buses and 59 % trucks, although considerable variation existed among individual provinces (Table 4.2.1). The composite average ownership aggregated to 2.8 vehicles per 1,000 persons, a very modest total by international standards, but not surprising given the low level of per capita income, of $162 in 1993.

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(3) "Demand Forecasts for the Vietnamese Automobile Market", Mitsubishi Corporation, July 1992.

Table 4.2.1 1991 Vehicle Registration Data (Northern Part of Vietnam and Nation)

ZONE		REGISTERED VEHICLES				REGISTRATION PERCENTAGES				MODAL PERCENTAGES			
Number	Name	Cars	Buses	Trucks	Total	Cars	Buses	Trucks	Total	Cars	Buses	Trucks	Total
1	Tuyen Quang	330	119	545	994	1.6	1.8	1.3	1.5	33.2	12.0	54.8	100.0
2	Cao Bang	283	121	833	1237	1.3	1.8	2.1	1.8	22.9	9.8	67.3	100.0
3	Lang Son	391	260	769	1420	1.8	3.9	1.9	2.1	27.5	18.3	54.2	100.0
4	Lai Chau	176	211	323	710	0.8	3.2	0.8	1.0	24.8	29.7	45.5	100.0
5	Yen Bai	256	126	1143	1525	1.2	1.9	2.8	2.2	16.8	8.3	75.0	100.0
6	Bac Thai	694	155	1860	2709	3.3	2.3	4.6	4.0	25.6	5.7	68.7	100.0
7	Son La	199	172	514	885	0.9	2.6	1.3	1.3	22.5	19.4	58.1	100.0
8	Quang Ninh	892	391	2798	4081	4.2	5.9	6.9	6.0	21.9	9.6	68.6	100.0
9	Vinh Phu	787	172	2315	3274	3.7	2.6	5.7	4.8	24.0	5.3	70.7	100.0
10	Ha Bac	917	454	1421	2792	4.3	6.8	3.5	4.1	32.8	16.3	50.9	100.0
11	Ha Noi	7678	1627	15450	24755	36.2	24.5	38.1	36.2	31.0	6.6	62.4	100.0
12	Hai Phong	935	750	2455	4140	4.4	11.3	6.1	6.1	22.6	18.1	59.3	100.0
13	Hoa Binh	726	121	745	1592	3.4	1.8	1.8	2.3	45.6	7.6	46.8	100.0
14	Hai Hung	835	325	1551	2711	3.9	4.9	3.8	4.0	30.8	12.0	57.2	100.0
15	Thai Binh	1274	364	1655	3293	6.0	5.5	4.1	4.8	38.7	11.1	50.3	100.0
16	Ninh Binh	508	168	590	1266	2.4	2.5	1.5	1.9	40.1	13.3	46.6	100.0
17	Ha Giang	274	97	449	820	1.3	1.5	1.1	1.2	33.4	11.8	54.8	100.0
18	Lao Cai	207	104	933	1244	1.0	1.6	2.3	1.8	16.6	8.4	75.0	100.0
19	Ha Dong	2263	381	2328	4972	10.7	5.7	5.7	7.3	45.5	7.7	46.8	100.0
20	Nam Ha	1567	515	1822	3904	7.4	7.8	4.5	5.7	40.1	13.2	46.7	100.0
TOTAL STUDY AREA		21192	6633	40499	68324	100.0	100.0	100.0	100.0	31.0	9.7	59.3	100.0
REST OF NATION		41208	39127	56441	136776					30.1	28.6	41.3	100.0
TOTAL VIETNAM		62400	45760	96940	205100					30.4	22.3	47.3	100.0

Source: JICA Team based on data obtained from TESI, Ministry of Heavy Industries and NTSR 1991 license plate survey.

4.2.2 Traffic Volume

Up-to-date vehicle trip patterns in the Study area were ascertained through a roadside interview and traffic count survey administered at 34 locations. Data, stratified by 10 vehicle types, were collected either for one day (16 hour or 24 hour period) or two days (two 16 hour periods). An origin-destination interview survey of a sample of drivers was carried out at 5 locations.

Volumes of passage by vehicles with four or more wheels varied across a wide spectrum: from less than 100 to about 4,000 vehicles-per-day. Highest volumes were invariably recorded in the Red River Delta; portions of Routes 1, 5, 6 all carry more than 3,000 vehicles per day in the vicinity of Ha Noi (Table 4.2.2). These volumes are still modest, not surprisingly so given the overall low level of vehicle ownership. Highest two-wheeled vehicle activity was encountered on Route 10 east of Nam Dinh, and on Route 6 between Ha Noi and Ha Dong. The traffic stream tends to typically consist of one fourth to one third of cars, 10 to 15 % buses, and the remainder trucks. The dominant form of truck is a 2-axle configuration (larger than pick-up truck), while trucks with four or more axles are only found in appreciable numbers on Route 5 (between Ha Noi and Hai Phong) as well as Route 1 (South of Ha Noi).

4.2.3 Commodity Flows

Inter-province freight flows were tabulated by NTSR for the 44 national provinces then existing. Two major data collection efforts were carried out:

- Road and inland waterway surveys in the Red River and Mekong River deltas during early 1991; and
- Railway dispatch records were analyzed to determine load/unload patterns during 1988, 1989 and 1990.

The NTSR results were utilized in this study to develop inter-province ton flows (production and consumption), ultimately for 15 commodity groupings. Data were extracted for the Northern part of Vietnam to gain an understanding of Study area demand patterns. NTSR's conclusions are that, in 1991, some 14.7 million tons were transported across a province boundary; 46 % of this traveling by road and 41 % by inland waterway, the remainder via rail. Cargoes shipped via the inland waterway and rail modes were heavily biased toward specific commodities: 61 % of inland waterway tons consisted of coal, while roughly 60 % of rail shipments consisted of coal, apatite and industrial/manufactured products. The road (truck) mode exhibited more diversity, with construction materials being the most-carried commodity (22 % of total) (Table 4.2.3).

Table 4.2.2 Daily 1993 Traffic Volume (Study Area Roadway Network)

ROUTE	SURVEY POINT(1)	LOCATION (2)	FOUR-WHEELED VEHICLES										TWO-WHEELED VEHICLES		
			Car			Bus	Truck					Grand Total			
			Sedan	Van	Subtotal		Pick-up	2 Axles	3 Axles	4+ Axles	Subtotal		Bicycle	MCycle	Grand Total
1	16	South of Dong Dang	167	18	184	6	21	40	20	0	81	271	168	3478	3645
	24	North of Kep	232	332	563	102	42	298	86	0	425	1090	1352	937	2289
	33	South of Tien Son	635	597	1232	200	357	716	140	17	1230	2662	5706	7899	13605
	4	South of Phu Xuyen	839	275	1114	646	126	1429	260	31	1846	3606	6300	3815	10115
	1	North of Bim Son	377	123	500	348	59	684	174	9	926	1774	1288	981	2269
1B	26	North of Vo Nhai	3	27	30	22	0	77	6	0	83	135	2379	1408	3788
2	28	West of Phuc Yen	522	72	594	195	125	935	75	17	1152	1941	2974	2611	5585
	12	North of QL 70	93	35	128	63	60	140	17	0	217	408	2300	1698	3999
	10	South of Vinh Tuy	39	18	57	23	3	53	3	0	58	138	464	375	839
3	27	South of Pho Yen	317	128	445	156	74	569	89	10	742	1343	2297	2335	4632
	14	North of Phu Luong	76	24	99	58	14	103	6	0	123	280	192	522	714
4B	15	South of That Khe	11	4	16	5	36	13	0	0	49	70	874	290	1163
	17	North of Tien Yen	0	0	0	0	0	12	3	0	14	14	155	79	234
	18	South of Mong Cai	156	101	256	71	103	211	14	0	328	655	2239	7872	10111
5	32	West of Mi Van	1034	391	1424	281	117	961	161	67	1306	3011	2299	4380	6679
	20	West of Quan Tanh	700	251	951	145	98	945	151	92	1286	2382	3785	2265	6050
6	31	Between Hanoi and Hadong	1069	1194	2263	423	90	1004	112	15	1221	3907	23503	19589	43092
	6	East of Luong Son	203	33	236	93	25	482	60	9	576	905	2880	1408	4288
	7	West of QL 15	38	14	53	19	1	100	3	0	104	176	101	328	430
	8	Near Thuan Chau	32	10	42	14	11	71	0	0	82	138	291	394	685
10	2	North of Ninh Bin	136	77	213	92	94	321	11	0	426	731	6661	2340	9001
	3	East of Nam Dinh	146	187	333	105	237	346	21	0	604	1042	17574	4618	22192
	34	South of Vinh Bao	53	31	84	87	108	194	5	3	310	481	2459	1240	3699
	19	West of Yen Hung	167	81	248	72	14	70	5	1	90	410	1453	1198	2651
18	22	At Pha Lai Ferry	96	24	119	25	49	173	46	8	276	420	1959	1311	3270
	21	West of Mao Khe	197	67	265	122	140	465	67	13	684	1071	2300	1993	4292
21	5	East of Lac Thuy	2	0	2	5	28	25	1	0	54	61	2248	476	2723
32	30	East of Ban Phuong	264	130	394	37	84	249	15	1	349	780	10538	4663	15201
	29	North of Son Tay	76	16	93	31	54	131	19	0	204	328	1578	953	2531
70	11	Near QL 379	156	13	169	42	23	204	18	5	251	462	2134	1850	3984
	9	South of Bao Yen	33	31	64	8	3	35	3	3	43	115	75	108	183
379	13	East of Son Duong	50	4	54	22	32	110	0	0	142	218	3948	1714	5662
	25	East of Trai Cau	6	0	6	0	11	6	0	0	16	22	871	591	1463
	23	South of Luc Nam	0	0	0	0	22	0	0	0	22	22	499	70	569

Count locations sited to coincide with province boundaries to ensure monitoring on interprovince trips.
Data source: JICA Team field surveys, August 1993.

Table 4.2.3 Domestic Inter-Province Commodity Flows in 1991 (Northern Part of Vietnam)

COMMODITY		TOTAL FLOW (000 TONS) (1)				FLOW PERCENTAGE			
Number	Type	Road	Rail	Inld Wtwy	Subtotal	Road	Rail	Inld Wtwy	Subtotal
1	Food Crops	840.9	59.2	126.2	1026.3	12.5	3.0	2.1	7.0
2	Vegetables	56.8	0.0	0.0	56.8	0.8	0.0	0.0	0.4
3	Agricultural Products	136.5	1.3	12.8	150.6	2.0	0.1	0.2	1.0
4	Food Stuffs	265.9	45.3	171.8	483.0	3.9	2.3	2.9	3.3
5	Salt	73.9	25.2	79.5	178.6	1.1	1.3	1.3	1.2
6	Fertilizers	885.9	150.4	112.3	1148.6	13.1	7.6	1.9	7.8
7	Cement	964.0	191.9	376.4	1532.3	14.3	9.7	6.3	10.4
8	Construction Materials	1487.0	166.0	1093.4	2746.4	22.0	8.4	18.4	18.7
9	Coal	647.8	683.9	3595.2	4926.9	9.6	34.4	60.6	33.6
10	Apatite	14.6	224.1	46.2	284.9	0.2	11.3	0.8	1.9
11	Other Ores	25.6	115.4	88.7	229.7	0.4	5.8	1.5	1.6
12	Indust. & Manuf. Products	896.5	243.5	57.1	1197.1	13.3	12.3	1.0	8.2
13	Logs	23.9	0.0	1.2	25.1	0.4	0.0	0.0	0.2
14	Other Wood and Forest Products	209.6	20.3	5.7	235.6	3.1	1.0	0.1	1.6
15	Petroleum Products	216.5	61.2	169.7	447.4	3.2	3.1	2.9	3.0
	TOTAL	6745.4	1987.7	5936.2	14669.3	100.0	100.0	100.0	100.0
	PERCENT	46.0	13.6	40.5	100.0				

Source: JICA Team based on data derived from NTSR sources.

4.2.4 Rail Passenger Activity

NTSR analyzed VNR passenger data for the years 1989 and 1990, again within the context of the then existing 44-province system. Data for the Northern part of Vietnam were extracted to obtain an understanding of Study area demand patterns. Results indicate that some 6.43 million inter-province rail passenger journeys were made in 1989. Ha Noi served as a trip end for some 37 % of cases, making it the most popular location by far. Rail journeys to/from other parts of the nation ranked second with some 10 % of journeys. Based on latest VNR statistics, the number of total (inter and intra-province) rail passenger journeys have steadily declined in recent years:

Year	Passengers (1000)	Million Person Km
1989	11,768	2,109
1990	10,443	1,913
1991	9,518	1,767
1992	8,719	1,752

4.3 ROAD TRANSPORT MODEL AND CURRENT DEMAND SIMULATION

This section sets forth the techniques and methodologies employed in transport modeling processes, as well as results of base year (1993) simulation efforts of the road system.

4.3.1 Overview

The modeling approach can, in its most basic sense, be summarized as consisting of four essential steps (Figure 4.3.1):

- Network development : road inventory data are first converted to the format of the transportation planning modeling software (TRANPLAN), then assembled to simulate the 1993 road network. Inclusion of anticipated improvements, such as upgrading of existing sections or construction of new segments, leads to development of alternative future - year networks.

- Demand model calibration : The NTSR 1991 vehicle trip matrixes are calibrated to 1993 conditions via data derived from the roadside interview and traffic volume survey. Zonal demand is correlated with base year socioeconomic data.

- Transport demand projections : The framework defined by "top-down" and "bottom-up" forecasting techniques is used to estimate likely future trip activity. Key aspects of this process are national, regional and province development indicators coupled with experiences of other Asian countries.

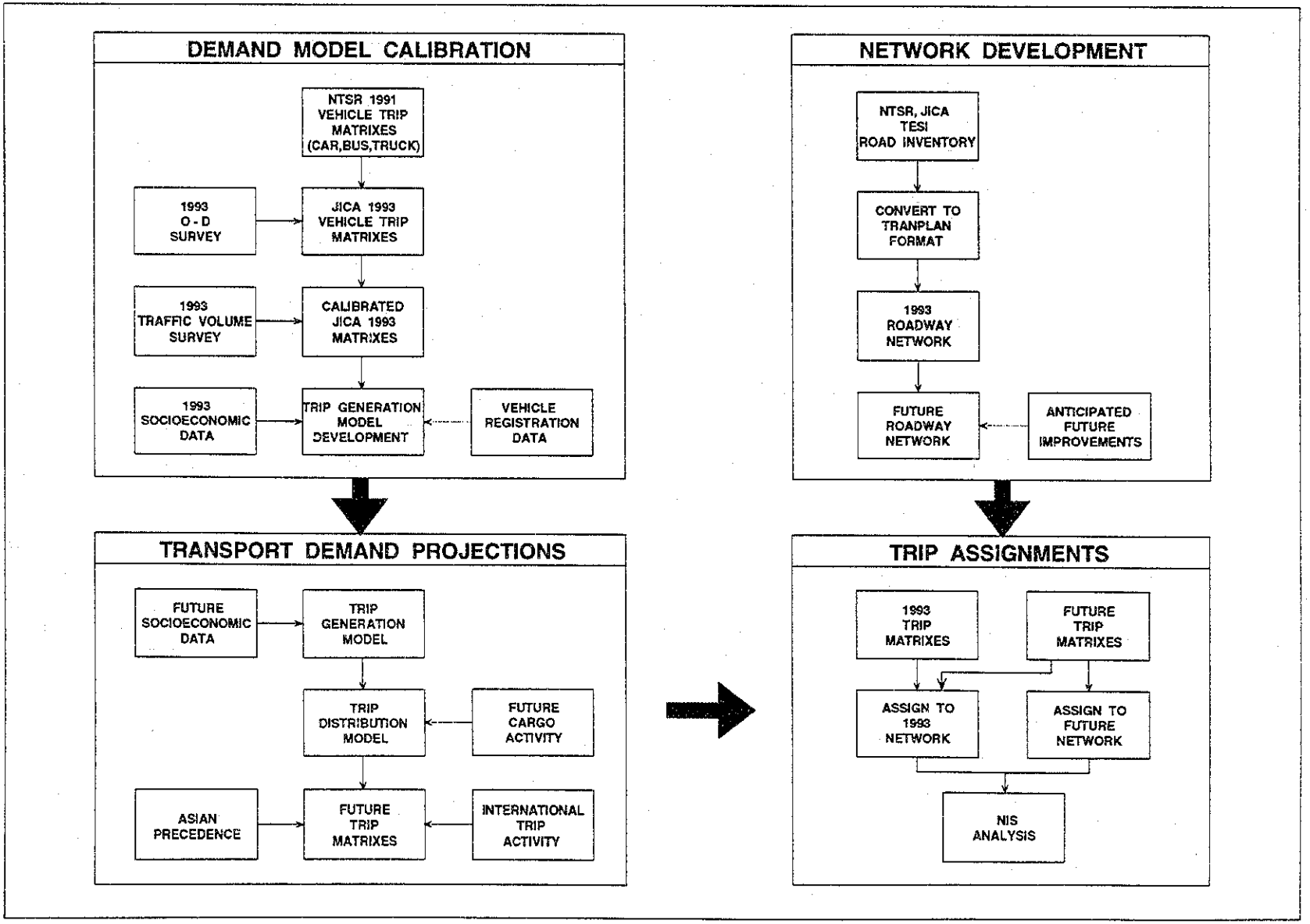

Figure 4.3.1 Overview of Simulation Process : Road Transport Model

- Trip assignments : Trip demand is loaded onto the base year and future networks, thus providing the basis for the evolution of the Master Plan Road System.

Execution of these tasks is complex, thus, the capabilities of TRANPLAN and the Network Information System (NIS) software[4] were employed during all steps of the modeling process. It is also desirable, given the extensive nature of the transport model, that coordination with other studies and/or modeling efforts be optimized to the highest degree possible. This is achieved via the use, among others, of the TESI and NTSR road inventory data base (supplemented via field surveys by the JICA Team) and the uncalibrated year 1991 vehicle trip matrixes developed by the NTSR study. Little opportunity has, as yet, existed in Vietnam for research related to road operations, particularly the empirical interplay of speed, capacity and volume. Two sources were principally used to overcome this deficiency : the "Highway Capacity Manual" (HCM)[5] for the Level of Service concept, and the IBRD - sponsored "Road User Cost Model" (RUCM)[6] for road capacity and speed relationships. Calibration to local conditions was undertaken, as far as practical and possible. The application of overseas documentation should, of course, be reviewed once transport engineering in Vietnam evolves to a more self - sufficient level.

4.3.2 Aggregations and Definitions

Simulation techniques used in this study rely on various terminologies. The following introductory descriptions are provided so that a more accurate and complete appreciation of transport modeling procedures may be obtained.

- The study area is subdivided into a series of analysis zones, the use of which implies that all movement to and from a zone can be adequately represented as starting or ending at a single point in the zone (the centroid). This point represents the zonal center of transport activity.

- The zone structure includes 20 internal zones (provinces), two external zones for trips between the study area and the rest of the nation as well as six zones representing major international border crossings with Lao PDR and PR China. Thus, trips between all combinations of zones are contained in a matrix featuring 28 x 28 elements.

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(4) TRANPLAN (Transportation Planning Modeling Software) and NIS (Network Information System) are linked propriety transportation planning programs distributed by The Urban Analysis Group, Danville, California, U.S.A.

(5) "Highway Capacity Manual, Special Report 209", Transportation Research Board, USA 1985.

(6) "Road User Cost Model", for the Government of Indonesia, Ministry of Public Works, Directorate General of Highways, by Hoff & Overgaard, et al, May 1992. The use of this study is judged as appropriate given that many similarities exist between Indonesian and Vietnamese road systems.

- A road trip is defined as a one-way movement from an origin zone to a destination zone. The trip may be completed as a trip by a vehicle (any motorized form of transport excluding motorcycles) or as a "passenger car unit" (PCU) trip. This stratification accepts that vehicle types exert differing impacts upon the traffic stream in which they operate. The PCU conversion for cars is 1.18, buses 2.50 and trucks 2.21.
- Trip matrixes contain daily travel demand segregated by three vehicle types : cars (sedans, utilities, vans), buses and trucks (all types including pick-ups).
- The definition of a trip is identical to that employed by the NTSR, namely, a vehicle or PCU journey which crosses a province boundary. Thus, short intra-province or intra-urban journeys are not included in trip matrixes.

4.3.3 The Role of Two-wheeled Vehicles

It is obvious in urban areas, such as Ha Noi, that two-wheeled vehicles (TWV) - bicycles and motorcycles - form a sizable portion of the traffic stream. This is consistent with international findings in cities with similar per capita incomes. In Vietnam, TWV constitute a lesser, but still considerable, part of the inter-province traffic stream, with usage influenced by a variety of factors, among them terrain (the use of TWV in rolling/hilly and mountainous terrain is much reduced), proximity of major cities, overall level of roadway activity and relative province wealth. Results of the traffic count survey (refer to Table 4.3.1) are used to identify a net impact (in terms of daily, two-way PCU) of interzonal TWV trips on road capacity. These range from a low impact (400 PCU/day) on virtually all roads outside of the Red River Delta, to a very high impact (10,000 PCU/day) in the Ha Noi - Ha Dong corridor (Figure 4.3.2).

Experience in Indonesia supports the view that within the US$350 to 550 per capita income range, motorcycle ownership can be expected to grow roughly in proportion to total four-wheeled vehicle ownership[7]. However, a recent major study encompassing the islands of Java, Sumatra, Kalimantan and Sulawesi[8] confirms that while motorcycle supply is abundant, the use of motorcycles for (longer-distance) interzonal trips is very limited - less than 5 to 10 % of total trips. In other words, motorcycles tend most typically to be used for short intra-urban or intra-province trips.

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(7) It is of interest to note that the use of bicycles is virtually non-existent in Indonesia, particularly so in the case of inter-urban trips. While it must be recognized that buses, which are essentially absent in Vietnam, fulfill a sizable portion of transport demand in Indonesia, available data nevertheless suggest that, as Vietnam develops from its current US$240 per capita GDP to higher ranges, motorcycles will increasingly be used for journeys now accomplished by bicycle.

(8) "Heavy Loaded Road Improvement Study", for Government of Indonesia, Ministry of Public Works, Directorate General of Highway, by Pacific Consultants International, May 1993.

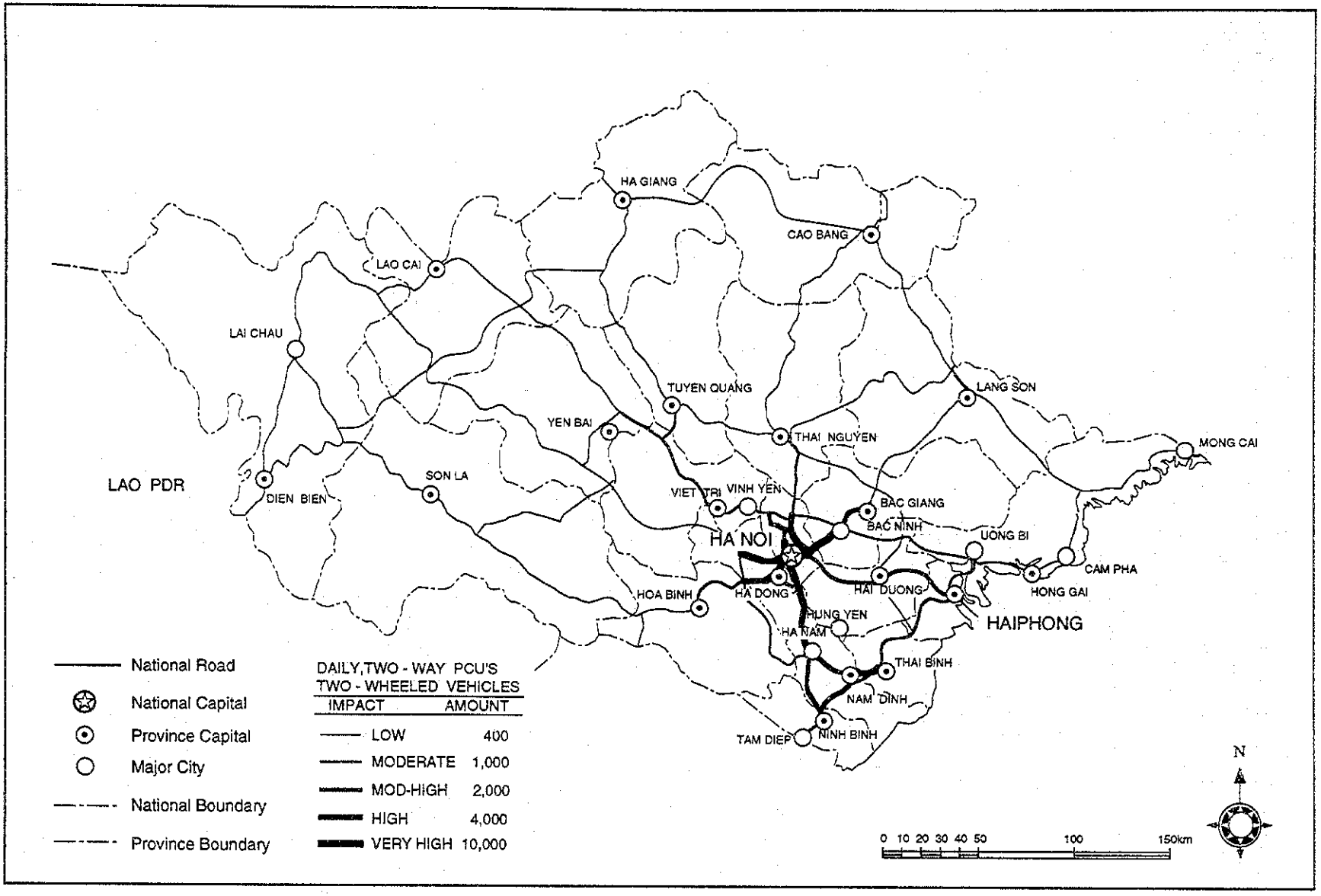


Figure 4.3.2 Impact of Two-Wheeled Vehicles on 1993 Roadway Network (Study Area)

The approach to integrating TWV impacts within the modeling process was therefore accomplished as follows:

- Existing network: subtract 1993 PCU impact from link capacities prior to analysis of trip activity by four-wheeled vehicles; and

- Future networks: increase 1993 PCU impact by 3.5 to 4.5 % per annum, then subtract from link capacities prior to analysis of four-wheeled vehicle trip activity.

The future growth rate for TWV impact therefore suggests that interzonal TWV trips will grow at about one third of the total vehicle ownership rate (i.e. the surrogate for TWV ownership). For most roads in the Red River Delta, this implies that by year 2010, up to 25 to 35 % of unimproved road capacity is absorbed by interzonal TWV trips. This approach is consistent with current findings; namely, while the absolute impact of inter-province TWV trips can be substantial in some corridors, the relative impact varies with overall utilization levels, and does not appear to exceed approximately 30 to 40 % of road capacity as the volume to capacity ratio (Level of Service C/D) approaches unity.

4.3.4 Trip Matrix Development

Trip matrixes contain data as to vehicle trip or PCU trip interchanges between all zones within the Study area. The calibration of 1993 vehicle trip matrixes was accomplished via a series of cascading work tasks.

- The "beginning point" was formed by the NTSR 1991 vehicle trip matrixes. These were presented in the national 44-zone format existing then, stratified by vehicle types; the latter were subsequently compressed to the car, bus and truck categories used in the Study.

- Following extraction of the NTSR 17-zone system for the Study area from national data, the internal zone structure was modified to 20 provinces. This resulted in the creation of new zone pairs 1/17; 5/18; 13/19 and 16/20.

- In order to obtain up-to date trip patterns for these new zone pairs, as well as for flows between the Study area and the rest of the nation (zones 21 and 22), a roadside interview survey was conducted (refer to Section 4.2). Following verification and checking procedures, results of the survey were expanded to a 24-hour basis. Thus, select cells in the 1993 car, bus and truck matrixes were updated via the insertion of accurate origin-destination data. This is particularly relevant for demand between zone pairs 1-17; 5-18; 13-19 and 16-20 which, in 1991, were considered intrazonal flows, that is, zero trip interchanges.

- Officially-recorded travel by car, bus or truck across national frontiers is still infinitesimal at the "open" borders (Dien Bien - Lao PDR, zone 23 and Lao Cai - PR China, zone 24). However, visits to "closed" borders, such as Mong Cai - PR China (zone 28) reveal that sizable "unofficial" cross-border activity exists in terms of both persons and goods. Thus, after reloading or transshipment, vehicle trips are generated at the Vietnamese side of the border as a result of this activity. In order to reflect both official and unofficial demand, trip generation is shown at all border crossings (zones 23 - 28), even though indicated vehicles may or may not physically pass the frontier.

The resultant matrixes are uncalibrated, that is, they contain results of origin-destination surveys, but have not yet been tested against observed traffic conditions. The uncalibrated matrixes were consequently assigned onto the base-year highway network, and resultant link volumes compared to observed traffic data obtained via the 1993 volume count survey. The content of each modal trip matrix was then interactively adjusted using analogies available through TRANPLAN until assigned interzonal trip demand correlated closely with observed traffic volume. Results confirm that excellent correlation was achieved at all locations. It can therefore be stated with confidence that the calibrated 1993 vehicle trip matrixes are capable of reproducing base - year road demand.

The 1993 calibrated vehicle trip matrixes contain almost 20,000 vehicle trips (Table 4.3.1).

- The most dominant zone is Ha Noi, accounting for around one third (6,284 trips) of total trips. Zone 19 (Ha Tay) accounts for about 2,100 trips.

- The principal interchange is Ha Noi - Ha Tay: over 1,400 trips in each direction. Other important linkages carrying more than 600 trips in each direction are Ha Noi - Ha Bac, Ha Noi - Hai Phong and Ha Noi - Nam Ha.

- The vast majority of trips have both trip-ends within the 20 provinces : 17,795 trips or almost 90 %.

Cars, buses and trucks constitute 44, 11 and 45 percent of vehicle trips, respectively. However, in terms of actual impact on highway capacity, that is, demand in terms of PCU trips, the role of trucks is much more pronounced. For all three modes, Ha Noi is the dominant trip generator (Table 4.3.2). This is not surprising, given the overall distribution of vehicle registrations.

Table 4.3.1 Year 1993 Interzonal Vehicle Trip Matrix (Car, Bus and Truck Modes) for the Study Area

FROM/TO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
1	0	32	0	0	16	37	10	3	12	10	51	3	0	1	8	0	7	0	0	5	0	0	0	0	0	0	0	0	195
2	32	0	15	0	0	34	0	1	13	9	42	0	0	0	0	4	4	0	0	5	4	0	0	0	0	4	0	0	167
3	0	17	0	0	0	9	0	10	27	227	292	12	1	10	6	0	0	0	8	0	18	0	0	0	0	0	4	2	643
4	0	0	0	0	0	0	42	0	0	0	22	0	0	0	0	1	0	12	0	2	0	0	6	0	0	0	0	0	85
5	15	0	0	0	0	16	5	0	38	2	49	10	4	1	1	5	4	11	2	3	4	0	0	0	0	0	0	0	170
6	39	31	10	0	16	0	0	5	63	18	373	26	5	3	10	9	10	4	58	24	14	0	0	0	0	0	0	0	718
7	10	0	0	42	4	0	0	0	3	2	41	0	11	0	0	0	0	0	4	1	0	1	0	0	0	0	0	0	119
8	3	2	10	0	0	5	0	0	20	182	150	127	1	108	16	15	0	0	5	13	10	0	0	0	0	0	0	19	686
9	13	13	26	0	39	64	3	19	0	26	378	49	18	17	20	11	8	15	29	20	8	0	0	0	0	0	0	0	776
10	11	9	225	0	2	18	2	181	28	0	798	27	7	34	5	0	5	2	67	4	21	0	0	0	0	0	0	11	1457
11	50	43	292	22	50	372	41	150	377	798	0	688	171	357	88	189	25	15	1467	612	438	11	0	2	2	1	4	19	6284
12	2	0	12	0	10	26	1	128	48	27	689	0	9	330	30	35	2	5	30	19	41	0	0	0	0	0	0	15	1459
13	0	0	2	0	5	4	10	1	18	8	169	10	0	1	0	4	0	0	190	13	12	15	0	0	0	0	0	0	462
14	1	1	10	0	1	4	0	107	18	35	356	328	2	0	17	6	1	0	52	26	8	0	0	0	0	0	0	0	973
15	8	0	6	0	2	9	0	16	20	4	89	31	0	18	0	8	2	0	4	146	32	0	0	0	0	0	0	0	395
16	0	4	0	0	4	10	0	16	11	0	191	34	4	6	9	0	1	6	10	173	144	0	0	0	0	0	0	0	523
17	8	5	0	0	5	9	0	0	8	5	25	1	0	1	1	1	0	17	2	0	1	0	0	0	4	0	0	0	93
18	0	0	0	13	9	5	0	0	15	2	16	4	0	0	1	7	16	0	2	1	0	0	0	11	0	0	0	0	102
19	0	0	8	2	2	57	4	5	30	67	1464	30	190	51	4	11	2	1	0	122	83	0	0	0	0	0	0	0	2133
20	4	5	0	1	3	25	1	13	19	5	613	19	13	25	147	171	0	1	123	0	83	0	0	0	0	0	0	0	1271
21	0	6	18	0	4	15	0	10	8	21	437	41	11	9	32	144	2	0	84	81	0	0	0	0	0	0	0	0	923
22	0	0	0	0	0	0	2	0	0	0	9	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
23	0	0	0	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
24	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	13
25	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	5
26	0	4	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
27	0	0	5	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
28	0	0	3	0	0	0	0	20	0	10	18	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66
TOTAL	196	172	642	86	172	719	121	685	776	1456	6284	1455	462	972	395	821	93	99	2137	1270	921	27	6	13	6	5	8	66	19867

Note : Refer to Figure 4.1.1 for zone system.

Table 4.3.2 Year 1993 Zonal Trip Activity (Study Area)

	DAILY VEHICLE TRIPS (2)				PERCENT OF TOTAL			
ZONE (1)	Car	Bus	Truck	Total	Car	Bus	Truck	Total
1	65	34	96	195	0.8	1.6	1.1	1.0
2	54	34	79	167	0.6	1.6	0.9	0.8
3	326	66	251	643	3.8	3.1	2.8	3.2
4	23	14	48	85	0.3	0.6	0.5	0.4
5	60	18	92	170	0.7	0.8	1.0	0.9
6	228	78	412	718	2.6	3.6	4.5	3.6
7	35	14	70	119	0.4	0.6	0.8	0.6
8	238	82	366	686	2.8	3.8	4.0	3.5
9	237	69	470	776	2.7	3.2	5.2	3.9
10	724	90	643	1457	8.4	4.2	7.1	7.3
11	3020	695	2569	6284	35.0	32.3	28.3	31.6
12	560	117	782	1459	6.5	5.4	8.6	7.3
13	133	65	264	462	1.5	3.0	2.9	2.3
14	533	69	371	973	6.2	3.2	4.1	4.9
15	162	58	175	395	1.9	2.7	1.9	2.0
16	159	52	412	623	1.8	2.4	4.5	3.1
17	32	20	41	93	0.4	0.9	0.5	0.5
18	43	21	38	102	0.5	1.0	0.4	0.5
19	1283	193	657	2133	14.9	9.0	7.2	10.7
20	449	148	674	1271	5.2	6.9	7.4	6.4
21	244	176	503	923	2.8	8.2	5.5	4.6
22	5	6	15	26	0.1	0.3	0.2	0.1
23	2	2	3	7	0.0	0.1	0.0	0.0
24	3	5	5	13	0.0	0.2	0.1	0.1
25	1	1	3	5	0.0	0.0	0.0	0.0
26	1	1	5	7	0.0	0.0	0.1	0.0
27	3	1	5	9	0.0	0.0	0.1	0.0
28	10	25	31	66	0.1	1.2	0.3	0.3
TOTAL	8633	2154	9080	19867	100.0	100.0	100.0	100.0

(1) Refer to Figure 4.1.1 for zone system. Demand represents interzonal travel.
(2) Trip origins or trip destinations.

	Vehicle Trips		PCU Trips	
Mode	Number	Percent	Number	Percent
Car	8,633	43.5	10,180	28.6
Bus	2,154	10.8	5,387	15.1
Truck	9,080	45.7	20,041	56.3
Total	19,867	100.0	35,608	100.0

The calculated average trip length for interzonal trips within the Study area is 84.1, 115.8 and 110.6 kilometers for cars, buses and trucks, respectively. The pronounced differences between the car, bus and truck populations is also reflected in the cumulative trip length distribution : the 15th percentile for cars lies below 20 kilometers; the 85th percentile near 120 kilometers. Similar statistics for buses and trucks are 55 and 180 kilometers, respectively.

4.4 FORECAST OF FUTURE DEMAND

The approach to forecasting adopted, as specified in Section 4.1, relies upon a synthesis of "top-down" and "bottom-up" approaches. These are guided by, respectively, macro-economic and micro-economic components of the socioeconomic framework.

4.4.1 Population and Income

Details of the socioeconomic framework are discussed in Chapter 3. Highlights relevant to the transport modeling process are again presented at this juncture(9). Population is expected to continue steady growth toward a national total of 95 million persons by the year 2010 (ratio of 1.36 relative to 1993). Within the Study area, the 1993 population of 25.9 million persons is expected to reach 30.0 million by the year 2000 and 35.4 million (37 % of the national total) by the year 2010. Urban population is forecast to grow much more rapidly than total population, reaching 11.2 million persons by 2010 (factor of 2.59 relative to 1993).

National GDP within the socioeconomic framework is shown as increasing from 16,704 million US$ in 1993 to 26,822 million constant 1993 US$ in 2000, and 69,570 million 1993 dollars in 2010. The commensurate total for per capita GDP in those three years is US$240, 333 and 732 (all at constant 1993 value). GDP per capita within the Study area is likewise forecast to grow dramatically, particularly after the turn of the century: from US$162 in 1993 to $240 in 2000 and $659 in 2010. At the province level, Ha Noi and Hai Phong are expected to lead economic performance of the region, with 2010 GDP per capita of $1,692 and $1,495, respectively.

(9) The socioeconomic parameters used in the transport modeling process represent a "likely scenario" as derived by JICA sectoral specialists from the numerous options analyzed.

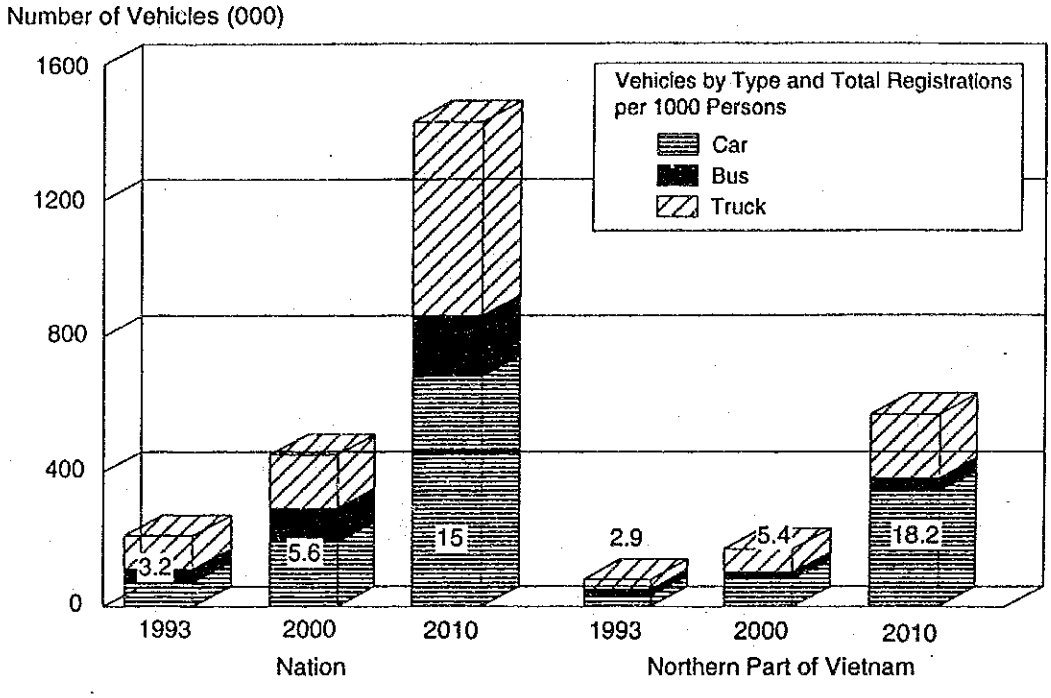
4.4.2 Vehicle Ownership

The 1991 level of vehicle ownership in Vietnam was 3.1 vehicles per 1,000 persons. Data on other countries maintained by the IBRD and other international agencies clearly verify that motorization and national income are closely related. Based on Asian precedence, it is expected that, for the national income forecast within the future socioeconomic framework, year 2010 national ownership will increase to eight, two and five vehicles per 1,000 persons for cars, buses and trucks, respectively. This suggests that the national fleet, which in 1991 numbered some 205,100 vehicles, will grow to 1.43 million vehicles by the year 2010. The year 2000 fleet, based on proportionate growth vis-a-vis forecast GDP, is likely to total some 453,000 vehicles. The share of cars as a proportion of total vehicles is forecast to expand in both years, given that the current registration pattern is heavily biased toward trucks.

The growth in vehicle registrations within the Study area is linked to forecast changes in and relationships among GDP of the regions contained within the socioeconomic framework. Thus, for the Northern part of Vietnam:

- The vehicle fleet is expected to grow to 163,000 vehicles by year 2000, and 645,100 vehicles by year 2010 (Figure 4.4.1).
- Cars, which represent 31 % of the current fleet, are forecast to total 44 and 53 % by the years 2000 and 2010, respectively.
- The Study area, while containing about one third of national registrations in 1991, is likely to contain about 45 % of national registrations in year 2010.
- The motorization rate of the Study area, which stood at 2.8 vehicles per 1,000 persons in 1991, is expected to grow to 5.4 and 18.2 persons per 1,000 vehicles in 2000 and 2010, respectively. It is of interest to note that the year 2010 rate of the Study area (18.2 vehicles per 1,000 persons) exceeds the composite national rate (15 vehicles per 1,000 persons.)
- The increase in vehicle registrations is expected to average 10.4 % per annum between the years 1993 and 2000 and 12.2 % per annum between the years 2000 and 2010. While these rates are quite substantial, it must be remembered that the "base condition", that is, current registrations, are very low.

As part of the "top-down" forecasting procedure, total car, bus and truck vehicle trips within the Study area are expected to increase proportionally to growth in vehicle registrations. Relative to 1993, these rates are 3.09, 1.63 and 1.77 (year 1993 to year 2000) and 4.76, 3.09 and 3.37 (year 2000 to year 2010) for cars, buses and trucks, respectively.



Source: MOTC and Estimated by Study Team

Figure 4.4.1 Existing and Forecast Registered Vehicles (Northern Part of Vietnam and Nation)

4.4.3 Commodity Flows

The development of future-year commodity flows is based on three key steps (Figure 4.4.2):

- Analysis of NTSR forecasts for freight flows (15 commodities) by road, rail, and inland waterway;
- Derivation of revised forecasts as appropriate to growth indicators embedded in the Study's socioeconomic framework; and
- Integration of mode-specific improvement projects recommended by JICA sectoral specialists, as well as technical liaison with TESI counterpart staff regarding latest estimates of industrial growth potential.

NTSR developed detailed year 2000 economic growth scenarios for the 44 provinces existing nationally at the time it was prepared. The "low growth" estimate featured an average annual increase in GDP of 5.6 %, and the "high growth" estimate an increase of 8.2 %. Under each scenario, production - consumption forecasts were developed for 15 commodity groups, with industrial potentials drawn from a number of sources including UN-sponsored investigations, such as the "Forest Sector Review" and "Agricultural Sector Review" as well as local sources, such as the National Institute for Agricultural Planning and Projection. The production - consumption movements (i.e. unbalanced to - from cargo flows) were then assigned to multi-modal transport network with modal split determined by minimum total trip cost. Results are number of directional tons between zones by rail, road and inland waterway, plus trans-shipments among these three modes. Full details of all calculation procedures are contained in the NTSR report series.

A review of NTSR findings permits the development of modal elasticities, that is, for a given change in GDP, what change in domestic modal activity (production - consumption) is catalyzed according to NTSR analytical processes and conclusions. Findings indicate that, for a change in GDP ranging from 5.6 % to 8.2 % (Figure 4.4.3):

- Road cargo is likely to grow some 1.15 times the GDP rate;
- Inland waterway cargo is likely to grow some 0.9 times the GDP rate; and
- Rail cargo is likely to grow some 0.8 times the GDP rate.

The NTSR year 2000 domestic cargo matrixes of the Study area were subsequently extracted from the national 44 zone grid. The "high growth" rail road and inland waterway forecasts were selected since the embedded economic growth rates and patterns are similar to those contained in the Study's socioeconomic framework. Modal elasticities were subsequently applied to more accurately reflect the JICA Team's assumed GDP growth rate and:

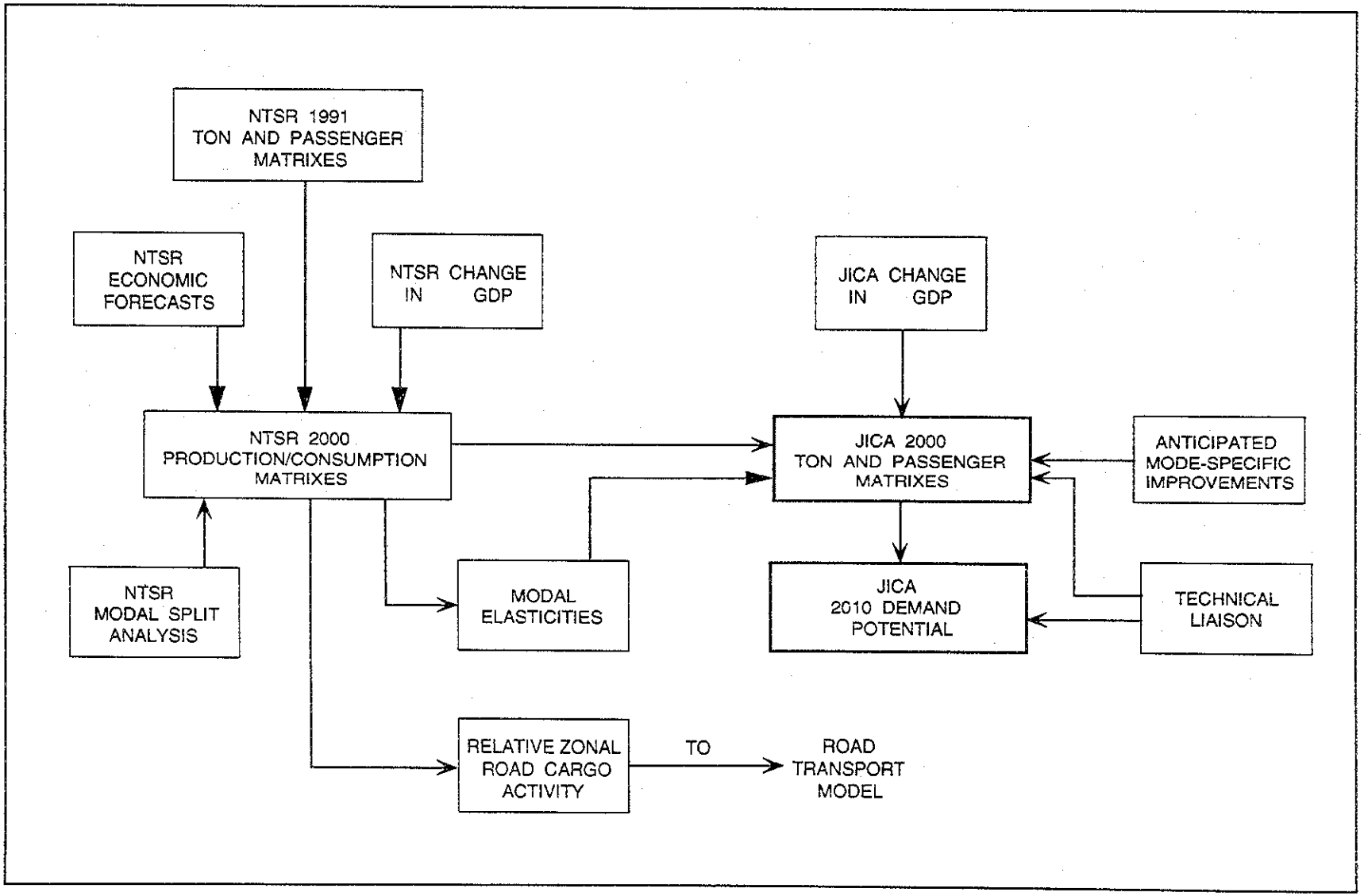
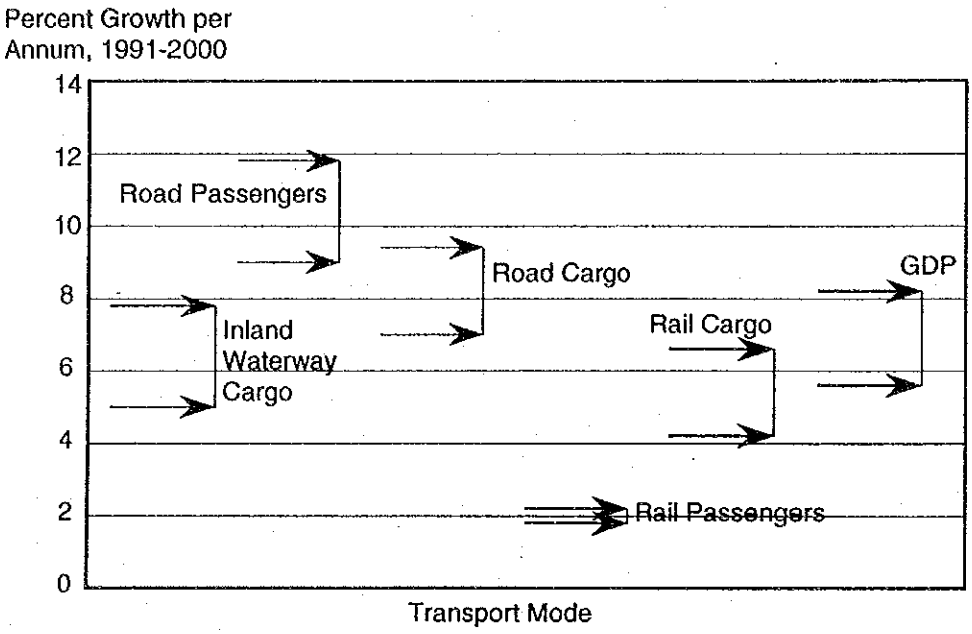


Figure 4.4.2 Overview of Domestic Demand Estimation Procedure for Cargo (Road, Rail, Inland Waterway) and Rail Passenger Activity



(1) Source: Derived from "National Transportation Sector Review" data
(2) Demand reflects interzonal flows.

Figure 4.4.3 Growth Rates of Transport Modes Relative to GDP (Northern Part of Vietnam)

- To fine-tune the year 2000 road, rail and inland waterway domestic matrixes to obtain cargo flows (unbalanced to/from ton movements) reflective of the Study's socioeconomic framework; and

- To estimate a modal year 2010 potential (zonal matrixes could not be developed within the temporal limitations of the Study).

Projections suggest that total domestic interzonal cargo flow will grow from 14.7 million tons in 1991 to 31.5 million tons in 2000 and 89.4 million tons in 2010 (refer to Figure 4.1.2). The importance of the road mode is noted as the share of tons moving by truck is expected to grow from 46 % in 1991 to 65 % by 2010 (Table 4.4.1).

	1991		2000		2010	
Mode	Mill. Tons	Percent	Mill. Tons	Percent	Mill. Tons	Percent
Road	6.75	46.0	15.15	48.1	57.93	64.8
Rail	1.99	13.5	3.85	12.2	9.45	10.6
Inld. Wtwy	5.94	40.5	12.52	39.7	22.00	24.6
Total	14.68	100.0	31.52	100.0	89.38	100.0

The previous cargo forecasts are of a domestic nature. The volume of international cargo is very difficult to quantify for a variety of reasons, however, it is likely to play a decisive role only vis-a-vis the Lao Cai Line. The existing single-track line has a capacity of some 2.5 to 3.0 million tons per year, or roughly 2 to 2.5 million tons reserve capacity, if domestic activity is considered. Rather than considering vague demand estimates, it is suggested that:

- Cross-border trade, particularly via the rail mode, should be encouraged to the highest possible degree,

- Roughly 2 to 2.5 million tons per annum can be shipped via the Lao Cai Line without a need for improvements beyond those contained in the Study, and

- Should actual shipments approach the 2 to 2.5 million ton plateau, negotiations should commence with PR China for cost-sharing approaches to double tracking appropriate portions of the rail system.

Table 4.4.1 Existing and Forecast Domestic Cargo Volumes (Northern Part of Vietnam and Nation)

ANNUAL CARGO FLOW (000 TONS) (2)

	ROAD MODE						RAIL MODE					
	1991		2000		2010		1991		2000		2010	
ZONE(1)	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW
1	31.3	40.9	81.8	167.1	312.7	638.9	0.0	0.0	0.0	0.0	0.0	0.0
2	12.1	18.2	26.5	43.5	101.3	166.3	0.0	0.0	0.0	0.0	0.0	0.0
3	127.6	56.0	312.2	129.3	1193.6	494.3	126.4	25.4	591.1	39.3	1090.1	100.8
4	12.7	34.9	25.9	61.1	99.0	233.6	0.0	0.0	0.0	0.0	0.0	0.0
5	29.0	56.4	90.3	188.5	345.2	720.7	233.2	101.2	605.4	133.1	1552.7	341.4
6	506.3	288.0	1053.0	607.9	4025.8	2324.1	67.4	48.5	99.9	68.0	256.2	174.4
7	58.7	43.1	122.7	77.9	469.1	297.8	0.0	0.0	0.0	0.0	0.0	0.0
8	376.7	60.4	1440.0	752.5	5505.4	2877.0	484.0	5.7	684.4	19.4	1755.3	49.8
9	481.8	325.7	1949.1	683.1	7451.8	2611.6	156.3	358.0	227.2	717.1	582.7	1839.1
10	194.3	489.6	477.6	1321.4	1826.0	5052.0	15.7	58.8	37.5	472.8	96.2	1212.6
11	1103.4	3080.8	2065.8	5985.8	7898.0	22884.9	129.7	388.1	228.5	664.5	586.0	1704.2
12	1280.8	253.4	3281.3	1132.6	12545.1	4330.2	267.5	133.4	468.3	396.8	1201.0	804.7
13	375.9	261.1	1190.3	939.4	4550.8	3591.5	0.1	3.3	61.5	181.3	157.7	465.0
14	467.0	413.3	883.5	926.9	3377.8	3543.7	4.3	354.7	18.3	236.2	46.9	392.8
15	13.8	137.6	32.3	282.6	123.5	1080.4	0.0	0.0	0.0	0.0	0.0	0.0
16	786.6	487.0	968.5	859.7	3702.8	3286.8	228.5	38.5	279.1	134.3	715.8	344.4
EXT	887.4	699.0	1150.4	991.9	4398.3	3792.3	274.6	472.2	550.4	788.8	1411.7	2023.1
TOTAL	6745.4	6745.4	15151.2	15151.2	57926.2	57926.2	1987.7	1987.7	3851.6	3851.6	9452.4	9452.3

	INLAND WATERWAY MODE						ALL MODES					
	1991		2000		2010		1991		2000		2010	
ZONE(1)	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW	OUTFLOW	INFLOW
1	0.0	0.0	0.0	0.0	0.0	0.0	31.3	40.9	81.8	167.1	312.7	638.9
2	0.0	0.0	0.0	0.0	0.0	0.0	12.1	18.2	26.5	43.5	101.3	166.3
3	0.0	0.0	0.0	0.0	0.0	0.0	254.0	81.4	903.3	168.6	2283.7	595.1
4	0.0	0.0	0.0	0.0	0.0	0.0	12.7	34.9	25.9	61.1	99.0	233.6
5	0.0	0.0	0.0	0.0	0.0	0.0	262.2	157.6	695.7	321.6	1897.9	1062.0
6	0.0	0.0	0.0	0.0	0.0	0.0	573.7	336.5	1152.9	675.9	4282.0	2498.5
7	0.0	0.0	0.0	0.0	0.0	0.0	58.7	43.1	122.7	77.9	469.1	297.8
8	3797.7	444.2	6269.7	411.4	11020.3	723.1	4658.4	510.3	8394.1	1183.3	18281.0	3649.8
9	1044.6	491.4	2584.9	819.2	4543.6	1440	1682.6	1175.1	4761.2	2219.4	12578.1	5890.8
10	9.5	135.6	27.8	35.3	48.9	62	219.5	664.0	542.9	1829.5	1971.0	6326.6
11	98.3	1355.3	486.4	4874.5	855	8567.9	1331.4	4824.2	2780.7	11524.8	9339.0	33157.1
12	687.5	1235.2	1008.1	1910.1	1772	3357.5	2235.9	1622.0	4757.7	3439.5	15518.1	8492.4
13	1.0	75.2	3.1	13.6	5.4	23.9	377.0	339.6	1254.9	1134.3	4713.9	4080.4
14	111.0	1052.4	461.6	1978.4	811.4	3477.6	582.3	1820.4	1363.4	3141.5	4236.1	7414.1
15	4.6	73.2	8.7	202.1	15.3	355.2	18.4	210.8	41.0	484.7	138.8	1435.6
16	40.6	1005.7	1314.7	1983.8	2310.9	3487.1	1055.7	1531.2	2562.3	2977.8	6729.5	7118.3
EXT	141.3	68.0	351.1	287.7	617.2	505.7	1303.3	1239.2	2051.9	2068.4	6427.2	6321.3
TOTAL	5936.2	5936.2	12516.1	12516.1	22000.0	22000.0	14669.3	14669.3	31518.9	31518.9	89378.6	89378.6

(1) Totals represent domestic interzonal flows per the NTSR zone structure (refer to Figure 4.1.2).
(2) Year 2010 demand should be viewed as a target potential.

Source: National Transportation Sector Review, UNDP, 1992

4.4.4 Rail Passenger Activity

In conjunction with cargo flows referenced in the previous section, NTSR developed estimates of growth in persons travelling road and rail. These estimates were arrayed in origin-destination format by provinces. A review of underlying modal elasticities suggests that road passenger activity is likely to grow significantly faster than GDP, and rail passenger activity significantly less than GDP. This is not surprising given recent experiences in other parts of the world, which clearly reflect a decreasing trend in rail passenger activity, with the notable exception of high-speed operations between urban conurbations.

Findings suggest that domestic interzonal patronage will likely increase from 6.43 million persons in 1991 to 8.21 million persons in 2000 and 13.46 million persons in 2010. The orientation of the rail network ensures a desire line pattern that resembles the spokes of a wheel, with Ha Noi located at the hub. Thus, in year 2000, almost 40 % of interzonal domestic trips have one end in zone 11. Principal demand corridors to and from Ha Noi include the Southern part of Vietnam, the Hai Hung/Hai Phong corridor and the Lao Cai/Yen Bai corridor (Table 4.4.2).

4.4.5 Road Trip Generation Model

Domestic trip generation models were developed for each of the three vehicle modes to forecast the number of daily interzonal road vehicle trips originating in and destined to each of the 20 internal zones. The model is based on a detailed analysis of trip ends, from the calibrated base year trip matrixes and 1993 zonal socioeconomic data, using a stepwise multiple regression technique. Model structure was constrained by socioeconomic data availability as well as reliability with which forecasts of these data can be prepared for future years. For these reasons, the JICA Team was restricted to using population (urban, rural, total), zonal GDP, zonal per capita GDP and vehicle registrations. Other potentially promising variables, such as employment could not be used as these are not maintained by governmental authorities to the province level of detail.

In the case of cars and buses, statistically significant models were obtained using urban population and zonal GDP as independent variables (other independent variables were rejected as not meeting significance criteria). In the case of trucks, the change in zonal activity was guided by change in road cargo tons produced (growth factor for vehicle trip origins) and change in road cargo tons consumed (growth factor for vehicle trip destinations).
Results of the trip generation analysis provide, for all three modes, a relative pattern of change compared to observed zonal vehicle trips. The ability of this process to forecast absolute totals should be viewed with caution given that (a) uncertainties in zonal patterns could arise and (b) a comprehensive socioeconomic data base, from which additional independent regression variables might be drawn, does not exist. Consequently, independent controls on the number of vehicle trips were established to ensure that the total level of forecast demand is reasonable.

Table 4.4.2 Year 2000 Interzonal Domestic Rail Passenger Matrix (Northern Part of Vietnam)

FROM/TO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	TOTAL
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	196148	174831	0	1773	0	0	0	0	372752
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	212594	0	313376	0	587	0	0	0	0	526557
6	0	0	0	0	0	0	0	124	0	7134	300525	0	0	22	0	0	0	307805
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	124	0	0	0	49764	7190	0	0	7279	0	0	0	64357
9	0	0	0	0	212594	0	0	0	0	0	298832	0	12669	0	0	0	0	524095
10	0	0	196148	0	0	7134	0	49763	0	0	110089	0	0	4551	0	0	0	367685
11	0	0	174832	0	313375	300525	0	7190	298832	110088	0	274756	161462	399222	0	377870	663002	3081154
12	0	0	0	0	0	0	0	0	0	0	274756	0	0	261236	0	0	0	535992
13	0	0	1773	0	588	0	0	0	12669	0	161462	0	0	0	0	23763	5347	205602
14	0	0	0	0	0	22	0	7280	0	4551	399221	261236	0	0	0	0	0	672310
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	377871	0	23763	0	0	0	239187	640821
17	0	0	0	0	0	0	0	0	0	0	663002	0	5347	0	0	239186	0	907535
TOTAL	0	0	372753	0	526557	307805	0	64357	524095	367685	3081155	535992	205601	672310	0	640819	907538	8206865

(1) Cargo flows based on NTSR zone structure (refer to Figure 4.1.2).

- The trip generation model, based on zonal GDP and urban population for cars and buses, as well as road cargo activity for trucks, was used to estimate future zonal vehicle trips.

- Future control totals for the years 2000 and 2010 were calculated from ratios of expected change in car, bus and truck ownership.

- Trips estimated via the generation model were prorated to the respective modal control total.

Internal vehicle trips, that is, trips having both ends within the Study area, are consequently expected to increase from 17,800 trips in 1993 to 42,000 trips in 2000 and 175,700 in 2010.

	Internal Vehicle Trips by Mode			
Year	Car	Bus	Truck	Total
1993	8,100	1,722	7,937	17,759
2000	25,117	2,810	14,100	42,027
2010	119,400	8,669	47,605	175,674

Vehicle trips crossing the international border are very few at present; their future status is virtually impossible to predict with reasonable accuracy given that a key catalyst is political motivation. Recent efforts by the ADB reveal that for official trade among members of the subregion:

- PR China generates highest absolute totals, but Thailand achieves highest relative (per capita) totals.

- The Vietnamese contribution is still small although, with one of the largest populations in the region (70 million), potential for change seems promising.

- Strong regional trade links are gradually evolving, for example, some 20 % of Lao PDR's and Cambodia's official exports go to Thailand, as do significant shares of Vietnamese and Myanmar exports.

- Vietnam's official trade activity is strongly linked with nations outside of ASEAN: some 80 to 90 % of exports, and over 90 % of imports. However, since 1987, exports outside of ASEAN have been decreasing, possibly signaling a shift in trade orientation.

The ADB is expected to issue more definitive trade data, including activity forecasts. Until that time, and until real progress is achieved in terms of vehicle crossings of the frontier, the major border crossings (zones 24, 27 and 28) are shown as growing to 500 vehicles-per-day by the year 2000, and 3,000 vehicles-

per-day by year 2010. Remaining crossings (zones 23, 25 and 26) exhibit more modest growth reaching 300 to 400 vehicles-per-day by the year 2010.

Results of the trip generation process indicate that significant total growth is expected; from 19,900 trips annually in 1993 to 47,500 trips in the year 2000 and almost 200,000 trips in the year 2010. This represents an average growth rate of 14.5 % per annum over the coming 17-year period. Some 90 % of trips are internal in nature (both trip ends are within the 20 provinces of the Study area), while the highest numbers of trip ends are recorded in zone 11 (Ha Noi), zone 19 (Ha Tay), zone 10 (Ha Bac) and zone 12 (Hai Phong) (Table 4.4.3).

4.4.6 Road Trip Distribution Model

The technique via which trips generated by each zone are linked with all other zones is termed trip distribution (refer previous section). The approach used in the Study is a Fratar Technique, a TRANPLAN function via which trip matrix rows and columns are interactively balanced until row and column totals replicate indicated changes in zonal origins and destinations. The resultant year 2000 (Table 4.4.4) and year 2010 (Table 4.4.5) matrixes therefore contain all internal, internal - external and external trips. The distribution is very much centered in the Red River Delta, not surprisingly so since this is the area expected to experience highest economic growth. Particularly strong linkages are the Ha Noi - Hai Phong - Hong Gai corridor, as well as the Ha Noi - Nam Ha - Southern Vietnam corridor.

4.4.7 Road Sufficiency Analysis

The sufficiency of the 1993 roadway network was tested via the assignment of the trip matrixes for the years 2000 and 2010. This represents a status quo scenario which seeks to establish whether the current network can cope with future traffic and, if not, where problems are likely to arise. System-wide indicators provide several insights:

- PCU kilometers of travel increase by factors of 2.4 and 10.2 from 1993 to 2000 and 2010, respectively.

- PCU hours of travel increase roughly at the same rate as PCU kilometers of travel by the year 2000, however, by 2010 the rate of PCU hour increase is roughly three times as high as the rate of PCU kilometer increase.

Table 4.4.3 Existing and Forecast Vehicle Trip Activity Analysis Zones (Study Area)

	VEHICLE TRIPS(3)			PERCENT CHANGE (4)		
ZONE(1)(2)	1993	2000	2010	1993–2000	1993–2010	2000–2010
1	195	740	3038	21.0	17.5	15.2
2	167	632	2885	20.9	18.2	16.4
3	643	2058	8587	18.1	16.5	15.4
4	85	398	2024	24.7	20.5	17.7
5	170	437	1553	14.4	13.9	13.5
6	718	1369	3985	9.7	10.6	11.3
7	119	246	815	10.9	12.0	12.7
8	686	2689	8052	21.5	15.6	11.6
9	776	1776	7915	12.6	14.6	16.1
10	1457	3455	18688	13.1	16.2	18.4
11	6284	13032	49422	11.0	12.9	14.3
12	1459	3656	16610	14.0	15.4	16.3
13	462	1174	3714	14.3	13.0	12.2
14	973	2220	11845	12.5	15.8	18.2
15	395	875	3259	12.0	13.2	14.1
16	623	1161	5138	9.3	13.2	16.0
17	93	231	1121	13.9	15.8	17.1
18	102	703	3751	31.8	23.6	18.2
19	2133	5680	25547	15.0	15.7	16.2
20	1271	2247	9417	8.5	12.5	15.4
21	923	1869	6523	10.6	12.2	13.3
22	26	51	171	10.1	11.7	12.9
23	7	35	210	25.8	22.1	19.6
24	13	251	1506	52.6	32.3	19.6
25	5	25	150	25.8	22.1	19.6
26	7	35	210	25.8	22.1	19.6
27	9	250	1500	60.8	35.1	19.6
28	66	250	1500	21.0	20.2	19.6
TOTAL	19867	47545	199136	13.3	14.5	15.4

(1) Refer to Figure 4.1.1 for zone system.
(2) Base-year trip flows at external zones 23 - 28 represent simulated demand based on observed cross-border activity.
(3) Trip origins or trip destinations.
(4) Average percent change per annum, compounded.

Table 4.4.4 Year 2000 Interzonal Vehicle Trip Matrix for Car, Bus and Truck Modes (Study Area)

FROM/TO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
1	0	176	0	0	70	128	20	29	46	50	142	9	0	0	34	0	29	0	0	7	0	0	0	0	0	0	0	0	740
2	176	0	102	0	0	114	0	9	58	10	115	0	0	0	0	4	9	0	0	7	8	0	0	0	0	20	0	0	632
3	0	102	0	0	0	23	0	55	83	767	763	41	3	17	10	0	0	0	19	0	33	0	0	0	0	0	135	7	2058
4	0	0	0	0	0	0	137	0	0	0	89	0	0	0	0	1	0	138	1	2	0	0	30	0	0	0	0	0	398
5	70	0	0	0	0	30	8	0	82	3	80	37	12	2	3	6	9	74	8	5	8	0	0	0	0	0	0	0	437
6	127	115	24	0	30	0	0	35	108	32	557	66	6	5	12	14	19	8	146	41	24	0	0	0	0	0	0	0	1369
7	21	0	0	137	7	0	0	0	3	2	46	0	18	0	0	0	0	0	9	1	0	2	0	0	0	0	0	0	246
8	29	9	56	0	0	35	0	0	206	729	489	506	9	276	55	57	0	0	63	39	18	0	0	18	0	0	20	75	2689
9	47	57	84	0	82	111	3	206	0	49	576	188	45	22	36	21	16	106	81	31	15	0	0	0	0	0	0	0	1776
10	50	10	766	0	3	32	3	726	50	0	1402	56	10	43	6	0	9	3	174	6	40	0	0	0	0	0	15	51	3455
11	142	114	764	90	79	558	43	488	580	1402	0	1468	306	841	191	237	40	58	3685	846	895	23	0	50	10	5	50	67	13032
12	8	0	41	0	37	65	1	507	186	56	1467	0	30	725	70	65	6	38	117	43	74	0	0	43	0	0	30	47	3656
13	0	0	3	0	12	6	20	9	44	13	308	30	0	2	0	4	0	0	655	22	20	26	0	0	0	0	0	0	1174
14	2	0	18	0	1	3	0	275	21	42	839	723	2	0	33	25	1	0	177	43	15	0	0	0	0	0	0	0	2220
15	33	0	11	0	3	12	0	56	37	6	190	69	0	35	0	6	3	1	10	333	70	0	0	0	0	0	0	0	875
16	0	5	0	2	6	14	0	59	20	0	237	63	6	25	6	0	1	68	20	341	288	0	0	0	0	0	0	0	1161
17	30	9	0	0	8	21	0	0	16	9	41	6	0	0	4	1	0	57	7	0	2	0	0	0	20	0	0	0	231
18	0	0	0	137	74	9	0	0	107	3	58	41	0	0	2	68	57	0	5	2	0	0	0	140	0	0	0	0	703
19	0	0	18	1	8	147	10	64	80	173	3683	116	654	178	10	17	8	5	0	315	193	0	0	0	0	0	0	0	5680
20	7	7	0	1	6	40	1	37	33	7	846	44	22	43	331	340	0	2	315	0	165	0	0	0	0	0	0	0	2247
21	0	13	32	0	9	26	0	18	15	37	893	74	18	17	69	288	5	0	194	161	0	0	0	0	0	0	0	0	1869
22	0	0	0	0	0	0	4	0	0	0	18	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	51
23	0	0	0	30	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
24	0	0	0	0	0	0	0	18	0	0	50	43	0	0	0	0	0	140	0	0	0	0	0	0	0	0	0	0	251
25	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	25
26	0	20	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35
27	0	0	135	0	0	0	0	20	0	15	50	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250
28	0	0	12	0	0	0	0	80	0	49	62	47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250
TOTAL	742	637	2066	398	435	1374	250	2691	1775	3454	13026	3657	1170	2231	872	1154	232	696	5686	2245	1868	51	30	251	30	25	250	247	47545

Note : Refer to Figure 4.1.1 for zone system.

Table 4.4.5 Year 2010 Interzonal Vehicle Trip Matrix for Car, Bus and Truck Modes (Study Area)

FROM/TO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
1	0	915	0	0	264	378	39	56	195	444	375	26	0	2	137	0	184	0	0	23	0	0	0	0	0	0	0	0	3038
2	915	0	424	0	0	534	0	21	351	26	402	0	0	0	0	17	21	0	0	27	27	0	0	0	0	120	0	0	2885
3	0	425	0	0	0	54	0	113	290	4818	1646	133	5	68	28	0	0	0	48	0	107	0	0	0	0	0	810	42	8587
4	0	0	0	0	0	0	554	0	0	0	352	0	0	0	0	5	0	926	2	5	0	0	180	0	0	0	0	0	2024
5	263	0	0	0	0	53	20	0	345	8	227	135	30	5	7	26	43	320	17	26	28	0	0	0	0	0	0	0	1553
6	379	533	54	0	53	0	0	51	345	180	1250	150	12	12	23	56	60	19	602	130	76	0	0	0	0	0	0	0	3985
7	40	0	0	554	19	0	0	0	10	5	117	1	41	0	0	0	0	0	18	4	0	6	0	0	0	0	0	0	815
8	56	22	114	0	0	52	0	0	802	2161	1180	1598	20	757	133	207	0	0	114	102	56	0	0	108	0	0	120	450	8052
9	193	352	289	0	348	347	10	802	0	317	2400	1075	157	122	162	127	81	510	363	211	49	0	0	0	0	0	0	0	7915
10	444	26	4821	0	8	179	6	2163	317	0	7491	256	30	395	14	0	125	9	1838	36	134	0	0	0	0	0	90	306	18688
11	378	401	1643	352	226	1250	117	1178	2400	7491	0	5688	747	3031	556	917	138	172	15507	2915	3140	83	0	300	60	30	300	402	49422
12	26	0	133	0	135	150	1	1598	1076	256	5689	0	92	4996	254	355	16	237	397	242	237	0	0	258	0	0	180	282	16610
13	0	0	5	0	31	11	41	19	157	30	749	92	0	6	0	19	0	0	2332	80	60	82	0	0	0	0	0	0	3714
14	2	0	68	0	5	13	0	759	121	396	3029	4997	6	0	200	188	1	0	1787	225	48	0	0	0	0	0	0	0	11845
15	139	0	28	0	8	21	0	134	160	15	557	253	0	203	0	24	7	3	25	1427	255	0	0	0	0	0	0	0	3259
16	0	18	0	5	25	56	0	207	128	0	915	357	18	186	24	0	2	390	77	1732	998	0	0	0	0	0	0	0	5138
17	184	21	0	0	44	60	0	0	81	124	137	17	0	1	7	3	0	305	11	0	6	0	0	0	120	0	0	0	1121
18	0	0	0	926	322	18	0	0	508	9	174	236	0	0	5	390	305	0	12	6	0	0	0	840	0	0	0	0	3751
19	0	0	49	2	17	603	18	113	363	1838	15507	398	2332	1786	25	76	12	12	0	1660	736	0	0	0	0	0	0	0	25547
20	23	27	0	5	26	130	4	103	210	36	2916	242	79	225	1427	1731	0	6	1661	0	566	0	0	0	0	0	0	0	9417
21	0	46	100	0	34	81	0	56	50	117	3133	237	54	54	252	998	18	0	739	554	0	0	0	0	0	0	0	0	6523
22	0	0	0	0	0	0	12	0	0	0	65	0	94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171
23	0	0	0	180	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	210
24	0	0	0	0	0	0	0	108	0	0	300	258	0	0	0	0	0	840	0	0	0	0	0	0	0	0	0	0	1506
25	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	120	0	0	0	0	0	0	0	0	0	0	0	150
26	0	120	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	210
27	0	0	810	0	0	0	0	120	0	90	300	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1500
28	0	0	72	0	0	0	0	480	0	294	372	282	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1500
TOTAL	3042	2906	8610	2024	1565	3990	822	8081	7909	18655	49433	16611	3717	11849	3254	5139	1133	3749	25550	9405	6523	171	180	1506	180	150	1500	1482	199136

Note : Refer to Figure 4.1.1 for zone system.

- The year 2010 PCU kilometer - PCU hour imbalance implies a chronic reduction in speed; this is indeed the case as the year 2010 average system speed is only around one third of the 1993 system speed.

- The drop in speed, caused by increasing congestion, is clearly reflected in the 1993, 2000 and 2010 speed distributions. In the former case, the highest number of PCU kilometers are expended at speeds of 61 to 70 km/h; however, in the latter case, the most pronounced speed group is 21 to 30 km/h.

- V/C ratios increase sharply and, by 2010, ASG groups 3 and 4 (multilane and high-order two lane roads) are no longer capable of operating at Level of Service C/D. This is particularly problematic as these road types are expected to form the backbone of the Red River Delta road system.

The network was also examined on a link-specific basis using the capabilities of NIS. For year 2000 demand conditions, three problematic corridors appear:

- Route 1 between Bac Giang - Ha Noi - Ha Nam,

- Route 5 between Ha Noi and Route 183; and

- Segments of Route 18 between Route 183 and Hong Gai.

In addition, narrow bridges pose capacity constraints, particularly on Route 2 east of Vinh Phu and Route 5 east of Route 183. The year 2010 demand analysis confirms that the current network can no longer cope with forecast demand, particularly in the Red River Delta (Figure 4.4.4):

- Very critical sufficiency constraints, interpreted as requiring multilane cross-sections, can be observed in all corridors radiating from Ha Noi.

- The Ha Noi - Hai Phong - Hong Gai corridor carries in excess of 60,000 interzonal PCU trips. Inclusion of shorter distance intra-province or intraurban trips will likely increase this total, particularly in the vicinities of Ha Noi, Hai Phong, Hai Duong and Hong Gai.

- The Ha Noi - Bac Giang corridor carries some 40,000 PCU trips, as does the Ha Noi - Ha Nam - Southern Vietnam corridor. The impact of congestion between Ha Nam and Ha Noi can be seen via the large number of trips "forced" into the Route 21 corridor due to intense congestion along Route 1 (Figure 4.4.4).

- Numerous sections exhibit critical sufficiency constraints implying, at a minimum, a need for high-standard two-lane cross-sections.

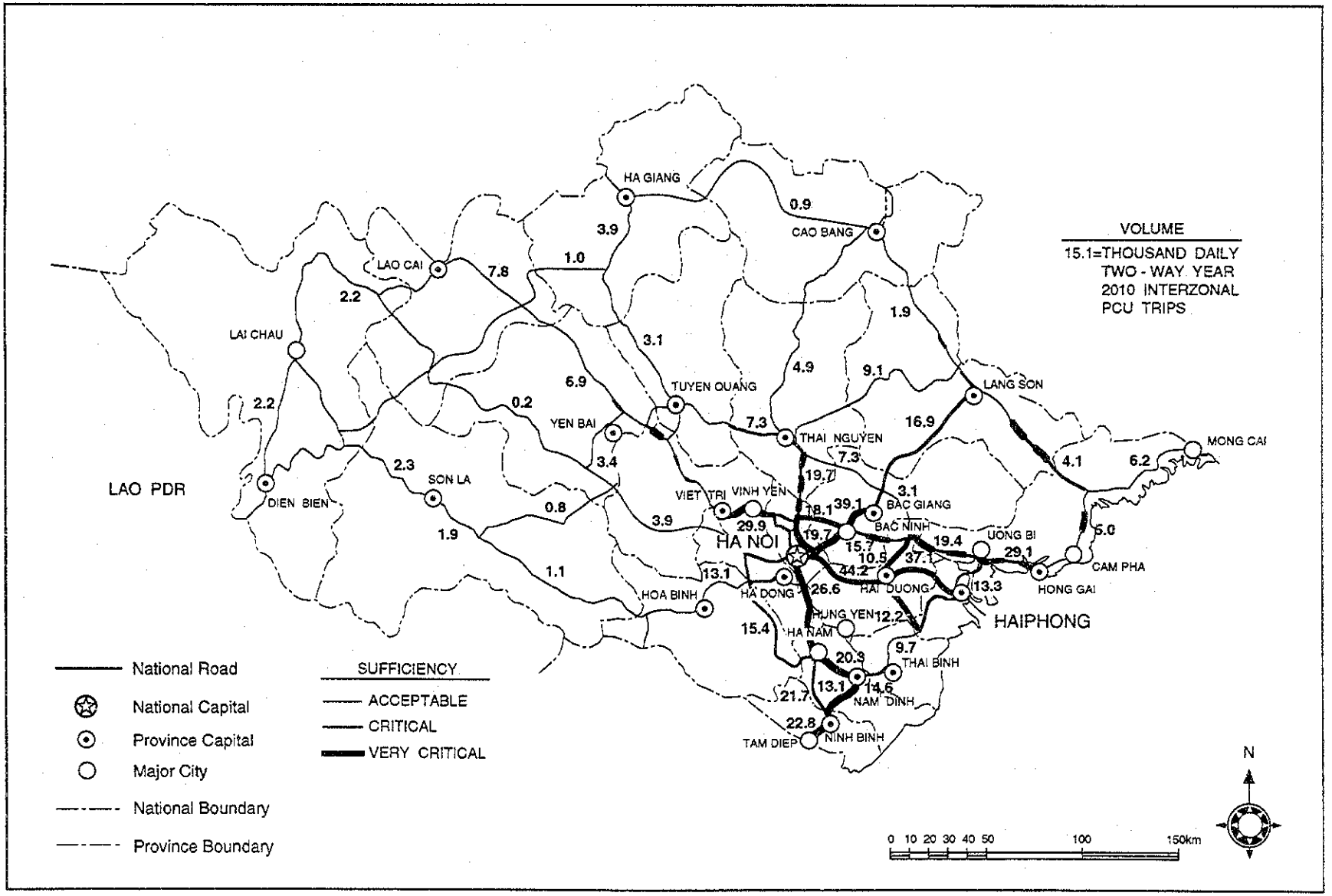


Figure 4.4.4 Year 2010 Sufficiency Indicators for the 1993 Roadway Network (Northern Part of Vietnam)

4.4.8 Road System Implications

The analysis leads to several conclusions regarding sufficiency of the 1993 roadway network. It is appropriate to surmise that upgrading of road facilities emerges as a critical priority given anticipated future trends in vehicle ownership, person travel and truck cargo transport.

- Superimposition of the years 1993, 2000 and 2010 demand onto the 1993 road network, the vast majority of which is of substandard design and quality, reveals that 1993 demand can be accommodated with no major problems largely due to very low traffic volumes. However, by the year 2000, major corridors emanating from Ha Noi can no longer cope with forecast demand and, by the year 2010, the network has essentially broken down, particularly in the Red River Delta.

- An interim scheme which is commensurate with the year 2000 demand and compatible with longer-term year 2010 needs, is required. This concept should embrace the judicious provision of multilane, rural highway-class facilities in key corridors of demand.

- It is anticipated that extensive four-lane cross-sections are appropriate in the Red River Delta in order to meet projected year 2010 demand. However, given the presence of local traffic and likely intense industrial development in the Ha Noi - Hai Phong and Ha Noi - Ninh Binh corridors, higher - order facilities such as freeways may warrant further consideration. Such facilities would also be an optimum solution in separating longer-distance traffic from slow-moving local traffic, including two-wheeled vehicles.

- Capacity constraints, such as narrow bridges, ferries and strip development hinder interregional flow under all scenarios tested.

- Future-year demand warrants widespread upgrading of currently deficient two-lane roads to high-order status (7 meter carriageway plus shoulders), particularly in the Red River Delta. Lower volumes and difficult terrain prevent the uniform application of this standard to roads in the North Mountain and Midland Region. Instead, judicious upgrading can be justified with cross-sections ranging from a paved 5.5 to 7 meters, with or without shoulders, depending on right-of-way and terrain conditions.

- National roads within Vietnam are expected to link with similar facilities provided in neighboring countries, particularly PR China. Current border crossings are of minor importance, but likely to increase in the future in line with political conditions. It is therefore vitally necessary that border facilities and legal formalities be improved to the highest degree possible in order to optimize the vehicle throughput of each border crossing and to maximize the capacity and speed advantages realized through the implementation of any road improvement.

4.4.9 Other Modes

Freight transport demands for rail and inland waterway are estimated based on the analysis of modal elasticities, socioeconomic framework, and improvement plans by mode, together with the future role and function of each mode as described in the previous section.

Passenger transport demand for rail was also estimated in the same way. The detailed process of demand forecast on each line of railway is described in the later chapter that discusses development plans of each mode.

Demands for port and sea transport are separately forecasted as described in the chapter "PORT AND SEA TRANSPORT". The role of the ports in the future international and domestic sea transport system in the study area is a major concern which will influence the scale of development in the future. The forecasted demand for port facilities is compared with the capacity of land transport systems to check the sufficiency of the transport system as a whole in the study area.

Chapter 5 Environmental Consideration and Traffic Safety

CHAPTER 5 ENVIRONMENTAL CONSIDERATION AND TRAFFIC SAFETY

5.1 NATURAL ENVIRONMENT

The following items are suggested on environmental considerations relevant to transport in the Study area.

(1) Protection for Vegetation in General

Vietnam has a wide range of natural vegetation types. The most valuable ecological function of natural vegetation is protection of water catchments. Associated with catchment protection are the benefits of better water quality and freshwater fisheries. Other important functions are climatic regulation and the containment of loose sand and soil. At the project planning stage, environmental consideration of protection for vegetation is required.

(2) Protection for Forestry Land

Forestry land totals 19 million ha or 58 % of the country, but, in fact, only 9 million ha is actually forested. 13 million ha or almost 40 % of the country is classified as bare lands (Figure 5.1.1). About one million of this is accounted for by rocky mountains, but the rest is land that was formerly forest and has been cleared for a number of reasons, and subsequently degraded to a condition of very low productivity. The several reasons for loss of forest cover include logging, forest fire, war damage and overcollecting of fuel. But, by far the greatest loss has been caused by shifting cultivation practiced by some of the ethnic minority groups, and by farmers forced by land hunger to use hillsides that are unable to support permanent agriculture. Therefore, the Ministry of Forestry has been implementing a major reforestation programme, at first by planting mainly the eucalyptus species since they grow quickly. However the ministry has now replaced the eucalyptus in its planting stock with pine trees all over the country. This is because eucalyptus inhibit the growth of other vegetation. This tendency is due to two of its features: (1) the eucalyptus remove too much water from streams or underground water supplies, and (2) their leaf litter has adverse effects on soil humus and nutrient supply, and works against the prevention of erosion. At the project planning stage, environmental consideration of forest protection is required.

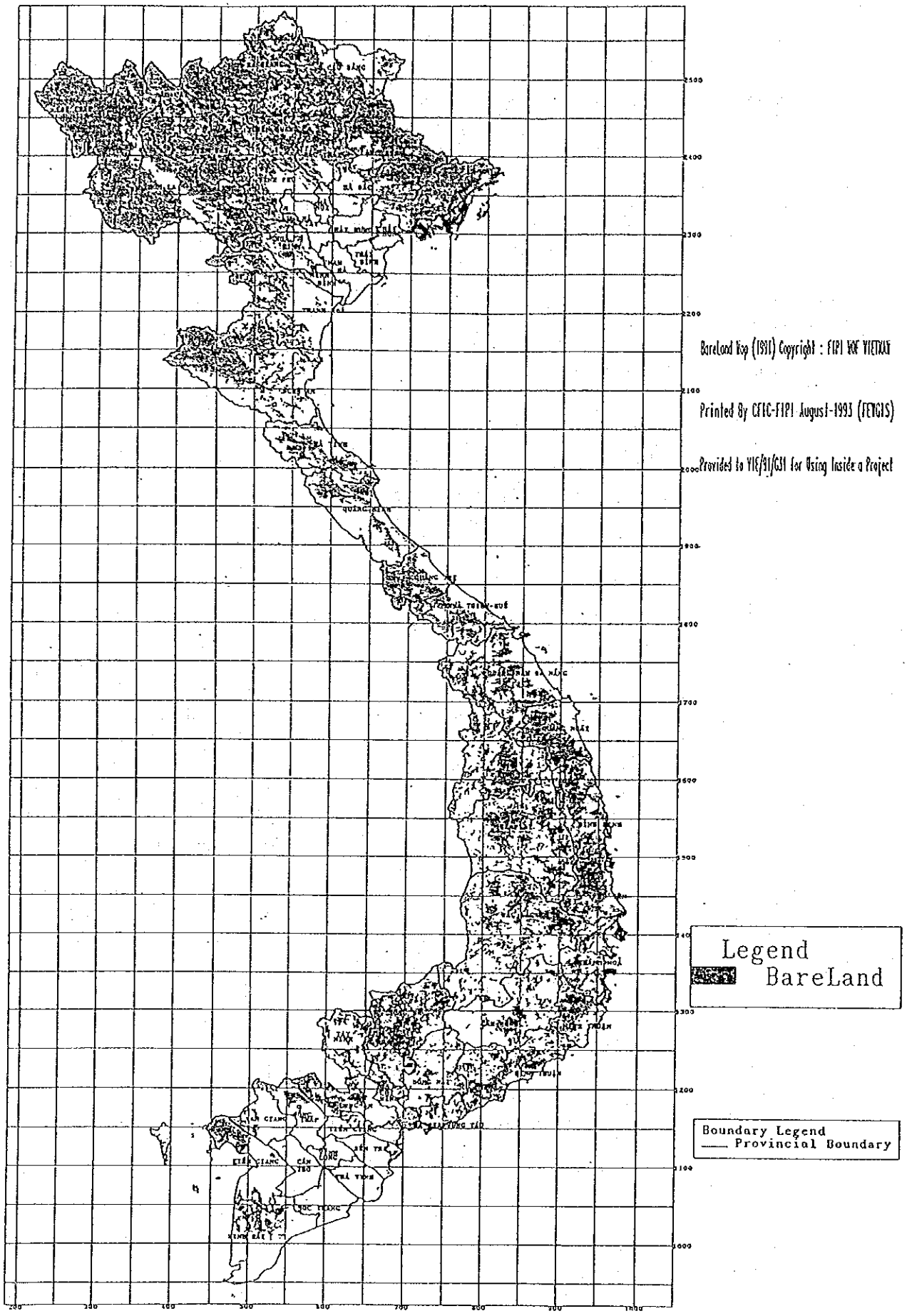


Figure 5.1.1 Bareland Area of Vietnam

(3) Marine and Lowland Area Conservation

A broad, shallow continental shelf follows the shape of the coastline, and it is especially wide in the north. The seabed is muddy off the Red River Delta. Coral reefs exist on rocky islands of Ha Long Bay. 295 species of corals are recorded in Vietnamese waters. These marine areas support a rich fauna and some valuable algae beds.

Marine habitats are threatened by overfishing, especially in areas near shore, and pollution (particularly oil) discharged from river mouths and seaports. Canalization of the Red River Delta has greatly increased siltation of the North Tongkin Gulf. Coral reefs are threatened by sedimentation, and by breakage of corals and scattering of associated marine plants and animals due to dynamiting, dredging, and turbulent wave action generated by passage of large ocean-going vessels, as well as pollution from such vessels. Large bulk-cargo vessels in particular are vulnerable to accidents causing spillages, especially when navigating in shallow waters and narrow channels like those which typify the North Tongkin Gulf and Ha Long Bay. Not only coral reefs, but also other kinds of marine and estuarine ecological communities are similarly affected. The mangrove areas face some present threats from local farmers clearing mangrove to make shrimp ponds, and when coastal areas are developed for settlements, industry and seaports, loss of mangroves on a much larger scale is likely to occur unless firm preventive action is taken.

40 species of freshwater and estuarine fish are already listed in the Sach Do Viet Nam (Vietnam Red Data Book of endangered species). The main threats identified are overfishing (including the use of unsuitable and destructive methods such as poisons, explosives and fine mesh nets), pollution (especially agricultural wash-off of pesticides and fertilizers) and deterioration of habitat (siltation, reclamation). The policy of the Ministry of Fisheries is to develop improved technology for raising and harvesting fish in a sustainable manner. The idea of marine protected areas is under consideration and should be supported.

In case any transport or other project area is planned in or near the marine and lowland areas, thorough and unbiased environmental consideration, without prejudgement of conclusions, is essential. Especially in case of port and inland waterway projects, careful attention is required before any decision is taken to proceed with development.

(4) Protection for Nature Reserves

By 1986, 87 protected areas totaling 1,079,937 ha had been declared in Vietnam. 24 terrestrial areas have been proposed for addition to the system, consisting of 18 reserve extensions and 4 new reserves in Vietnam. This does not include coverage of the marine ecosystems which will also require a protected-area system. The Ministry of Forestry have approved the revision of the protected area system and is now in the process of surveying

and enlarging the main reserves to a new total area of over 2 million ha. Management plans have now been completed for 18 reserves, 10 of these being designated as National Parks. Table 5.1.1 below gives details of the most important reserves in the Northern part of Vietnam only. In case any project area is planned in or near natural reserves, thorough environmental consideration is required before any decision is taken to proceed with development.

Table 5.1.1 Major Natural Reserves in the Study Area

Name	Province	Original Area	Proposed Area
Muong Nhe	Lai Chau	180,000 ha	300,000 ha
Cuc Phuong N.P.*	Nam Ha, Ninh Binh, Hoa Binh	25,000	25,000
Vi N.P.*	Ha Noi	70,000	70,000
Ba Be N.P.*	Cao Bang	5,000	30,000
Cat Ba N.P.*	Hai Phong	27,700	35,000
Tam Dao N.P.*	Vinh Phu	19,000	25,000
Huu Lien	Lang Son	3,000	30,000
Hoang Lien Son	Lao Cai	5,000	15,000

* : indicates Management Plan is prepared.
N.P. denotes National Park

(5) Protection for Species Richness

Vietnam is rich in almost all animal and plant groups examined. A higher proportion of species are regional or endemics than in any other country in Indochina. The country can be divided into a number of different biogeographical units (biounits) on the basis of differences in species composition and the limits of distribution of indicative forms.

The Northern part of Vietnam (known biologically as Tongkin) shows several levels of division where it is cut by several large rivers (Den, Da, Ca etc.). The distribution of endemic forms of primates and some birds show the importance of these rivers as faunal boundaries. The Hoang Lien Mountains, a range in the north-west of the country, are a distinct unit connected by the Chinese Hengduan mountains to the eastern Himalayas. These mountains are much higher than the rest of Vietnam and show a quite distinct vegetation and fauna. The several animals previously unknown to science, which have been discovered in Vietnam just in the last few years, includes one horned mammal as large as a goat.

Figures 5.1.2 and 5.1.3 show that this distribution of endemism is far from uniform, but is concentrated in the main mountain areas of the country. At the project planning stage, environmental consideration is required on protection of vegetation, animals, and social structure of the mountain-dwelling tribal minorities. See also "Minorities" in section 5.2, below. Especially in case that any project area is planned in the mountain areas, careful attention is required before any decision is taken to proceed with development.

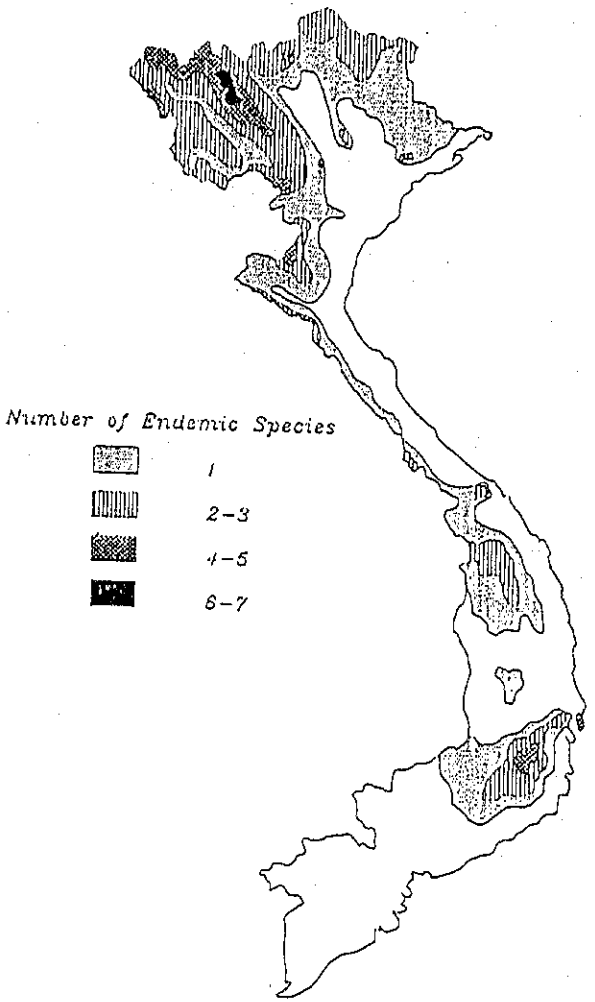


Figure 5.1.2 Distribution of Bird Endemism in Vietnam

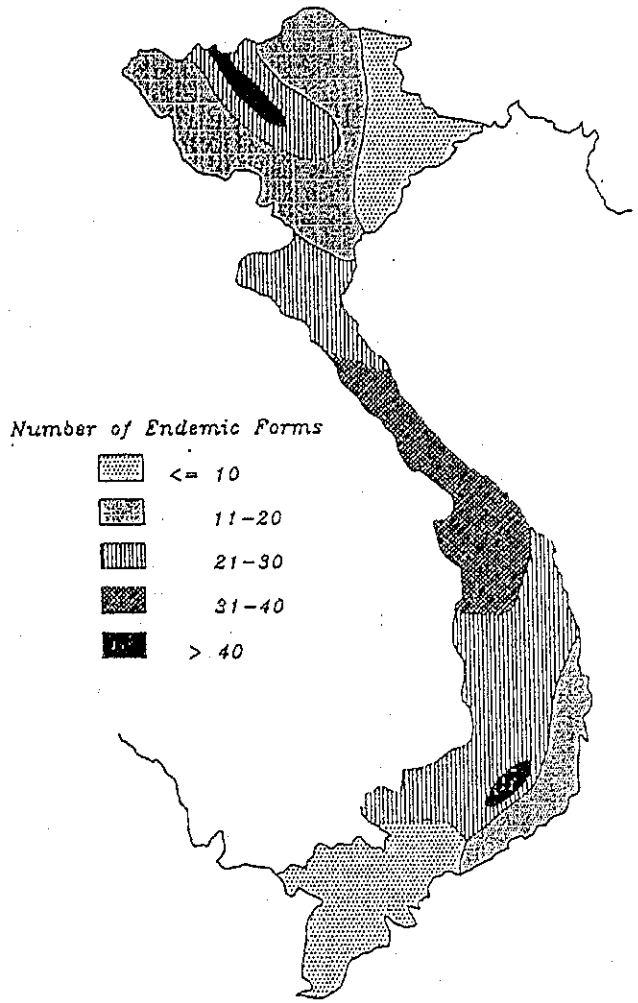


Figure 5.1.3 Distribution of Endemism of Coniferous Plants in Vietnam

5.2 SOCIAL ENVIRONMENT

(1) Minorities

11 % of the population in Vietnam is made up of more than 40 ethnic minorities. Figure 5.2.1 shows the distribution of the main ethnic groups in the Study area. Discrimination against ethnic minority-group people is strictly forbidden, and each ethnic group has the right to use its own language and writing form, and to preserve its own cultural traditions and customs. However, continuation of shifting cultivation is prohibited in order to maintain sustainable environments for the minorities. A programme of sedentarisation is in progress in the country to help former shifting cultivators become settled. The value to Vietnam of this cultural heritage is shown by the fact that even at roadside in Lao Cai and Ha Giang provinces, and elsewhere, one encounters twenty or more different colorful traditional costumes. The possibly-harmful side of any project carelessly planned, can be gauged by realizing that right down to this decade, many of Vietnam's minorities have kept their place as some of Asia's (and the world's) last old-time horse people; yet today many of the men say they feel more proud riding a motorbike. It is therefore essential to recognize that transport projects, while bringing significant benefits to such traditional communities, are also likely to expose them to many destructive influences from which they have previously been protected by their isolation. At the project planning stage, thorough consideration for minorities is required.

(2) Economic Activities

Commercial forest and forest-related products presently extracted include commercial timber, bamboo, rattan, charcoal, fuelwood, honey, geckos, wildlife for food and medicine, and the harvest of 2,300 species of useful plants (for medical use, wild fruit, thatch, fiber and plant resins).

Marine fisheries are based on shrimps, lobsters, crabs, squid, mackerel, pomfret, sardines, sharks, bream, bass and marine turtles. The total value of marine fisheries is about US$ one billion per year and constitutes one of the country's most important sources of foreign exchange. Fishing efficiency in onshore waters is declining due to overfishing, but this can be relatively easily restored by firm regulation. In coastal areas much more extreme and irreversible threats to fisheries could be associated with development of settlements, industry and seaports.

Freshwater habitats supply an estimated 20 to 30 thousand tons of fish, turtles, frogs and some crustaceans per year. Marine and mangrove areas provide very significant economic resources of fish, shrimps, squids, prawns, crabs and mollusks. Marine fisheries provide a living for 300,000 people working on some 60,000 boats.

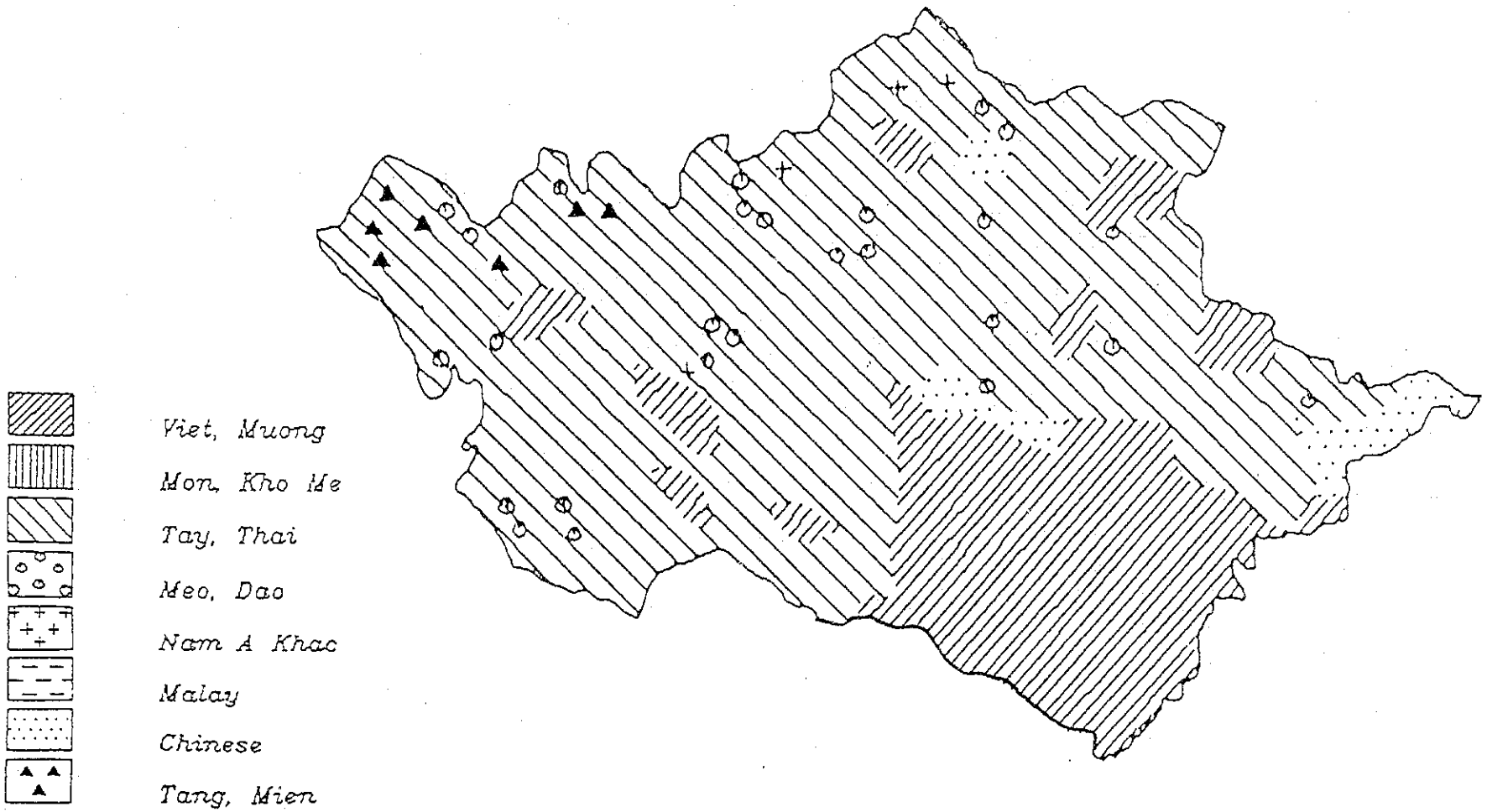


Figure 5.2.1 Distribution of Main Ethnic Groups in the Study Area

At the project planning stage, consideration for economic activities depending on undisturbed coastal and other natural areas is required. Appropriate usage restrictions and other preventive measures, should be defined zone-by-zone through the establishment of land use planning.

5.3 POLLUTION CONTROL

(1) Obedience of Laws and Regulations on the Environment

The Ministry of Science, Technology and Environment is gradually introducing a series of environmental standards to control pollution as well as regulations requiring Environmental Impact Assessments (EIA) on all major planned developments. A draft Environment Law will be soon enacted. At the project planning stage, environmental consideration on pollution control, such as implementation of EIA's and establishment of environmental management plans, is required. It is important to insure that completing the EIA does not become only an end in itself. Findings of the EIA must be followed-up and implemented, by making changes in the project or even by setting aside its implementation if necessary.

(2) Pollution Control

In industrial areas, air pollution caused by exhaust gases from factories, and water pollution by waste water from factories have occurred. In urban areas, air pollution and noise problems caused by vehicles, have already occurred, even though the present numbers of motor vehicles and their usage is many times smaller than envisaged by the end of this study period in 2010. There is also a waste disposal problem. At the project planning stage, environmental consideration on pollution control is required. In urban areas, excessive and unnecessary use of vehicle warning horns is a particularly acute form of noise pollution. See also remark under traffic safety, below.

5.4 TRAFFIC SAFETY

Traffic accidents are increasing mainly in urban areas. The rapid growth of motorization will be expected in the future if it is not restrained, not only in urban areas, but also in rural areas. Therefore, immediate implementation of traffic safety measures is required.

(1) Improvement of the Road Environment

Existing road environment conditions are poor. The road environment consists of the structure of road, and the traffic safety facilities provided. The structure of the road includes route, width, pavement, gradient, side slip, etc. The traffic safety facilities include signals, separation of pedestrian road and vehicle ways, pedestrian bridges, lighting, guardrails and delineators, indication signs, road markings, median strips, curve mirrors, etc.

(2) Propriety in Traffic Use

Propriety in traffic use is important for safety and smooth traffic flow. It consists of self-discipline, and traffic control. Self-discipline in traffic is the idea of the driver voluntarily keeping the rules which prohibit illegal parking, drunken driving, exceeding the speed limit, overtaking etc. Traffic control is enforcement of the traffic law in cases where voluntary compliance has failed. In urban areas of Vietnam, at present the street environment is already very severely deteriorated by one particular habit: over-use of motorbike horns, to a degree greater than needed for safety. It seems that "pride of ownership" is the reason. Fortunately this could be easily halted by greater traffic propriety.

(3) Improvement of Driver Competence

It is suggested to introduce a driver license system, a certified driving school system, a driver re-education system, and penalty point system.

(4) Campaign for Traffic Safety

In this approach, the traffic problem is solved by developing public awareness of the need for traffic safety. It is suggested to implement campaigns for the development of a traffic safety movement, including safety guidance at schools and in the community.

(5) Preparation of an Emergency Care System

The establishment of emergency hospitals and a network to transport accident victims to the hospital, is necessary.