

JAPAN INTERNATIONAL COOPERATION AGENCY

HANOI PEOPLE'S COMMITTEE  
SOCIALIST REPUBLIC OF VIET NAM

THE MASTER PLAN OF URBAN TRANSPORT  
FOR HANOI CITY  
IN VIET NAM

MAIN VOLUME

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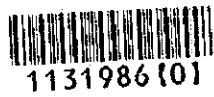
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**JANUARY 1997**

**YACHIYO ENGINEERING CO.LTD  
KATAHIRA & ENGINEERS INTERNATIONAL**

Mr. Kimio Fujita  
President  
Japan International Cooperation Agency  
Tokyo, Japan

January 1997

Letter of Transmittal

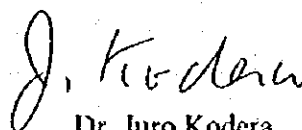
Dear Sir,

We are pleased to submit to you the report on the Master Plan of Urban Transport for Hanoi City in the Socialist Republic of Vietnam. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and you agency as well as the comments made by the Hanoi People's Committee, and the authorities concerned in the Socialist Republic of Vietnam. The report consists of a main report, an executive summary and a drawing volume.

This report deals with the present and future transportation demand in Hanoi based on the land use and socio-economic frame work. The report contains a Master Plan and a Feasibility Study parts. The master plan concludes that the well organized development in the present suburbs will reduce the future transportation burden in Hanoi City. The subsequent feasibility study on a land development in Xuan La area concludes that the project will be technically, financially, economically and socially viable, will be acceptable from the environmental aspects, and will contribute to the financial constraints of Hanoi People's Committee.

We wish to take this opportunity to express our sincere gratitude to your agency, the Ministry of Foreign Affairs, the Ministry of Construction and the Ministry of Transport. We also wish to express our deep gratitude to the Hanoi People's Committee and the Government agencies concerned in the Socialist Republic of Vietnam for the close cooperation and assistance extended to us during our study. We hope this report will contribute to the effort made in the development of the Socialist Republic of Vietnam.

Very truly yours,



Dr. Juro Koderu  
Team Leader

The Master Plan of Urban Transport  
for Hanoi City in Vietnam

## Preface

In response to a request from the Socialist Republic of Vietnam, the Government of Japan decided to conduct the Master Plan of Urban Transport in Hanoi and entrusted the study to the Japan International Cooperation Agency (JICA).

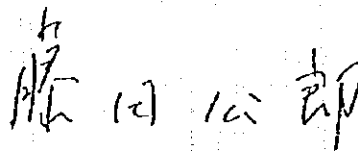
JICA sent to Vietnam a study team headed by Dr. Juro KODERA of Yachiyo Engineering Co. Ltd. (YEC) two times between September 1995 and October 1996.

The team held discussions with the officials concerned of the Government of Vietnam, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Socialist Republic of Vietnam for their close cooperation extended to the team.

January 1997



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Kimio Fujita  
President

Japan International Cooperation Agency





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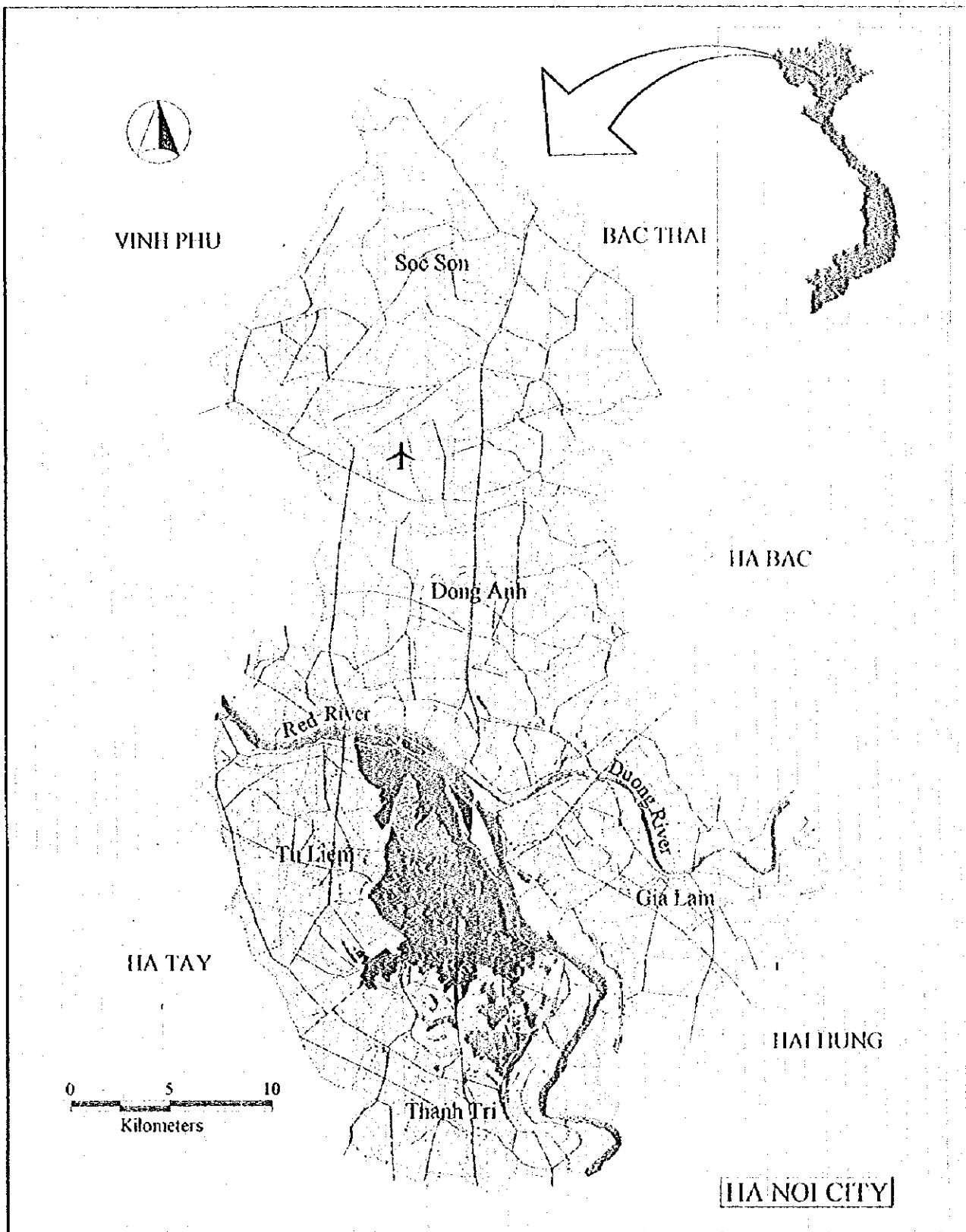
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THE STUDY AREA



**PART I**

**PRESENT CONDITION**

**CHAPTER 1 GENERAL SITUATION**

**CHAPTER 2 PRESENT ROAD NETWORK**

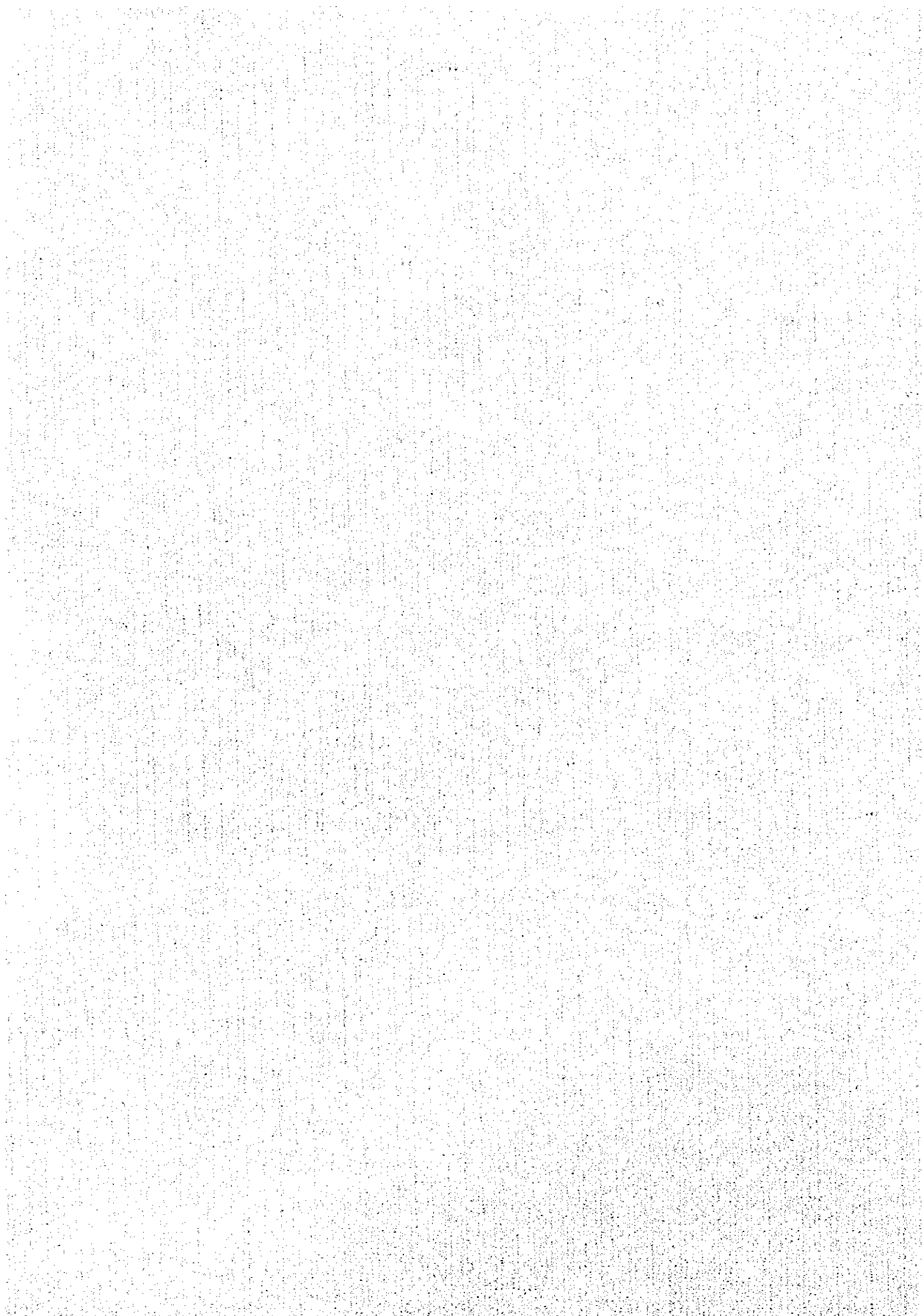
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**CHAPTER 4 PUBLIC TRANSPORTATION**

**CHAPTER 5 ENVIRONMENTAL CONDITION**

**CHAPTER 6 PERSON TRIP DEMAND**

**CHAPTER 7 TRAFFIC MANAGEMENT**



# Introduction

## 1. Background of the Study

In recent years major cities in Asia have been confronted with serious issues resulting from increased road traffic congestion caused by the rapid growth of motorized traffic. This growth is the result of rapidly increasing economic prosperity and the associated trend towards increased urbanization.

Since the "*Doi Moi*" policy was introduced 10 years ago, Vietnam's economic growth has been rapid. Although motorization and urbanization have increased over this period Hanoi City has not yet been seriously affected by traffic congestion. However, given Vietnam's continuing rapid growth it is only a matter of time before Hanoi is subjected to high levels of traffic congestion, which will retard its further economic development.

The main area of traffic growth on Hanoi has been the rapid increase on motorcycle use. These have replaced the bicycle as the main mode of transport. These two wheeled vehicles are most suitable for Hanoi, which are not accessible to larger vehicles. The proportion of 4 or more wheeled vehicles is currently low, but growing rapidly. Public transport is very poor with few bus routes and no effective urban rail system. In consequence, the vast majority of trip makers use private transport modes.

The Government of Vietnam and the authorities of Hanoi City were well aware of the problems which would be caused by traffic congestion. They are also aware that such congestion would hamper Hanoi's development as the natural administrative centre and a major centre for business and tourism. They, therefore decided that a Master Plan of Urban Transport should be developed with a time horizon of 2015, to ensure that Hanoi is not subjected to the traffic congestion which is strangling other major Asian cities.

## 2. Objectives

The objectives of the study were as follows:

- To formulate a Master Plan for strategic urban transportation for Hanoi City.
- To conduct feasibility and solution for selected top priority projects in response to future transport demand.

The target year of the Master Plan was set at 2015. The target year for the short term priority projects was set at 2005. The study area covers the city of Hanoi with an area of 923 km<sup>2</sup>, including four Hanoi urban (since 1996 it changed to five) and five rural districts.

## 3. Study Progress

The Scope of Work for the Study was agreed upon between Japanese Preparatory Team and the Vietnamese Government, and signed on March, 1995. Following the submission of Inception report on Sept. 1995, Progress Report (1) on Dec., Interim Report on

March, 1996, and Progress Report (2) on July 1996, the Draft Final Report on Oct. 1996.

Item	1995				1996								1997					
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Traffic Surveys	■	■	■															
Analysis			■	■	■	■	■	■	■	■	■	■	■	■	■			
Master Plan					■	■	■	■	■	■	■	■	■	■	■	■		
Feasibility Study						■	■	■	■	■	■	■	■	■	■			
Seminar																■		
Report	▲ IC/R		▲ [PR/R-1]			▲ [IT/R]					▲ [PR/R-2]			▲ [DF/R]				▲ [F/R]

Fig. 1 Study Schedule

#### 4. Study Organization

The Hanoi Peoples' Committee (HPC) acted as a counterpart agency to the Japanese study team and also as a coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

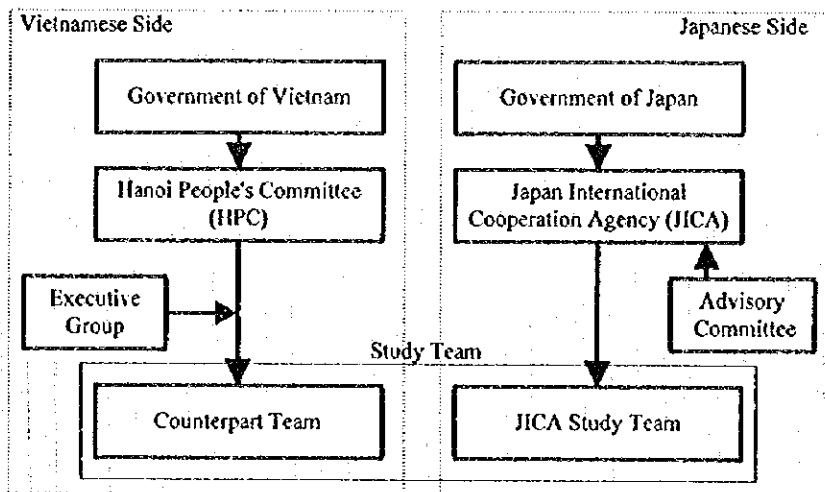


Fig. 2 Study Organization

#### Vietnamese Side

##### Vietnamese Executive Group

Mr. Hoan Van Nghien	Chairman, Hanoi Peoples Committee (HPC)
Mr. La Ngoc Khue	Deputy Minister, Ministry of Transport and Communication
Mr. Do Hoan An	Vice Chairman, HPC
Mr. Nguen Lan	Hanoi Chief Architect, HPC
Dr. Nguyen Thanh Binh	General Director, Hanoi Authority for Planning and Investment (HAPI)
Mr. Pham Quoc Truong	Director, Transportation and Urban Public works Services (TUWPS)

#### Japanese Side

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Mr. Koji Nakayama	Ministry of Transport
Mr. Tomoyoshi Omuro	Overseas Economic Cooperation Fund (OECF)

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Mr. Tetsuo Kawamura	Public Transport Planner
Mr. Shigeo Takashima	Land Use Planner
Mr. Minoru Kobayashi	Public Information Planner
Mr. Masahisa Tsuchihashi	Road Engineer
Mr. Chifuyu Horiuchi	Road Planner
Mr. Yasuki Muramoto	Structure Planner
Mr. Nobutugi Chida	Structure Engineer
Mr. Mahmoud S. Riad	Traffic Surveyor
Mr. Fumiaki Shino	Environment Analyst
Mr. Julian Elsdon	Natural Condition Surveyor
Mr. E. John Fearon	Economist





# CHAPTER 1 GENERAL SITUATION

## 1.1 Physical Profile

Hanoi city, the national capital, is located in the center of northern Vietnam about 70Km inland from the gulf of Tonkin with a latitude of 20°53' - 21°23' north and a longitude 105°44' - 106°02' east. Its highest altitude is 462m in the Chan Chin hill area in the north and the lowest point is 12m below sea level at Gia Thuy commune in the east. The city borders the five provinces of Bac Thai to the north, Ha Bac and Hai Hung to the east, Ha Tay to the south and Vinh Phu to the west. As the smallest province in the country, the total area of Hanoi is about 937 Km<sup>2</sup> with a maximum length of about 50Km from north to south and a maximum width of 30Km from east to west.

Hanoi is one of three special cities of Ho Chi Min City (HCMC) and Hai Phong which ranks equal in political autonomy with the other 50 provinces of Vietnam. Hanoi comprises 10 districts, five of which are the urban districts of Hoan Kiem, Hai Ba Trung, Dong Da, Ba Dinh, and Tay Ho (since 1996). *Phuongs* are a subdivision of urban districts and *xa*'s and *thi tran*'s are a subdivision of rural districts. *Thi tran* is a small township in rural districts. There are 89 *phuong*s within the five urban districts. The rural areas of Hanoi are divided into five districts of Soc Son, Dong Anh, Tu Liem, Thanh Tri, and Gia Lam. They are further subdivided into 123 *xa*'s and 11 *thi tran*'s. Each *phuong* and *xa* has its people's committee as an administrative organ. Each *phuong* is further divided into smaller units of *cums* which are further divided into *to*. There are about 40 - 50 households within a *to* and 3-5 *tos*' form one *cum*. Each rural district is divided into *xa* and below *xa* is a *xom*. There are about 40 to 70 households within a *xom*. Fig. 1-1-1 shows boundary of *Phuong/Xa*

Table 1-1-1 Study Area

District	Area(Km <sup>2</sup> )
Hanoi	936.9
Urban district	48.5
Hoan Kiem	4.9
Dong Da	15.6
Hai Ba Trung	15.5
Ba Dinh	12.6
Rural District	888.4
Soc Son	302.5
Dong Anh	192.0
Gia Lam	178.8
Tu Liem	105.1
Thanh Tri	110.0

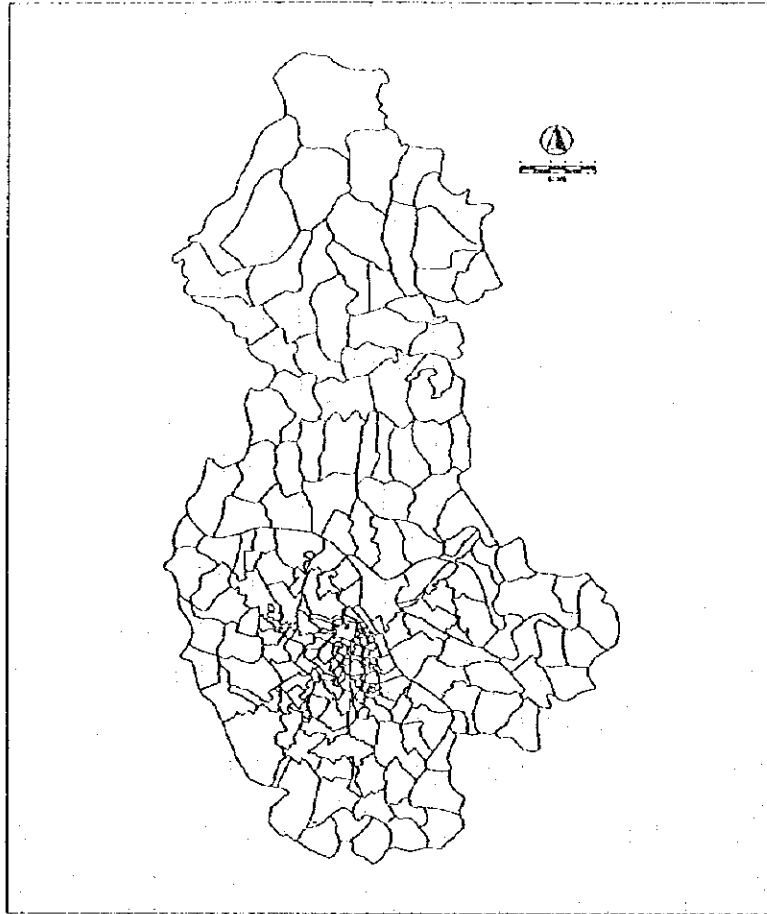


Fig. 1-2-1 Map of *Phuongs and Xas*

### 1.1.1 Topography

The topography of Hanoi city is mostly flat with an average land level of 5m above the sea level, Hanoi is situated at the delta of the Red and Duong rivers. The northern and north-western areas of the city have hill features with elevations ranging from 20m to over 400m. The elevation of the city decreases gradually from west to east and from north to south.

Hanoi is mainly on a plain composed of alluvium from the rivers passing through the area. The Red River's source is the Nguy Son mountains, at a height of 1,776m, in Yunnan province in China. The main stream of the river is 1,160 Km long of which 556 Km are in Vietnam. It passes through Hanoi territory from Thuong Cat district to Thanh Tri district covering a length of 30 Km. Floods in the city are caused by the waters from the Da and Lo rivers, tributaries of the Red River. The flooding season lasts for about 5 months, from June to October every year with its peak in August.

A tributary of the Red River, the Duong River, links two main waterways in northern Vietnam, the Red River and Thai Binh River. The portion of the Duong River that flows through the territories of Hanoi is about 17.5 Km. It diverges from the Red River in Gia Lam district and flows southeast. Hanoi also has many natural ponds and lakes and a network of rivers and canals which are used for irrigation and drainage purposes.

### 1.1.2 Geology

Since ancient times, Hanoi has had fertile lands and long-standing traditions of agricultural production. It has four main kinds of soil: alluvial soil inside the dikes, alluvial soil outside the dikes, degraded soil and hilly soil. The alluvial soil outside of the dikes is renewed annually by the rivers, while the soil inside the dikes does not have the annual supply of alluvium.

Most of the soil of Hanoi is alluvium from the Red and Cau rivers, ranging from less acidic to neutral and fairly rich in mud contents and nutrients, with a physical composition suitable for many kinds of plants. The group of the alluvial soil is evenly distributed through all the districts of Hanoi. Northern districts also have degraded acidic soil which is poor in nutrients, deprived of substance with a light physical composition. Hill soil, mainly concentrated in the northern hill areas, is subjected to severe erosion due to deforestation. It has a thin surface layer and in some cases the soil is replaced by gravel.

The report of the "Geological Survey of Vietnam" classifies the geological status for Hanoi as follows:

- Alluvial Deposits
  - a. Thai Binh: composed of sand, sandy clay and silt up to 15m depth
  - b. Hai Hung: composing humid clay with depths between 5m to 20m
- Diluvial Deposits
  - a. Vinh Phu: composed of sand with depths between 15m and 40m
  - b. Hanoi: composed of sandy gravel lying below 35m

### 1.1.3 Meteorology

The location of Hanoi City, in the center of the northern area of the country gives it a tropical to sub-tropical meteorological pattern, which differ from the climate of other areas to the south. As most of northern part of Vietnam, it has warm tropical monsoon climate with a hot summer with heavy rainfalls from May to September. The winter, from November to March, is dry and cold with little rain. Between the two seasons there are two transitional months, April and October. The values of the main meteorological parameters observed during 1994 are presented in Table 1-1-2.

Table 1-1-2 Hanoi's Main Meteorological Parameters - 1994

Month	1	2	3	4	5	6	7	8	9	10	11	12
Rainfall (mm)	12	40	122	19	416	384	468	596	319	103	23	71
Humidity (%)	80	85	83	86	81	81	84	82	85	78	78	79
Temperature(°C)												
Low	13	14	17	21	23	26	26	26	24	22	18	15
High	20	21	23	28	32	33	33	32	31	29	26	22
Average	18	19	18	25	28	29	28	29	27	24	23	20

## 1.2 Socioeconomic Profile

### 1.2.1 Demography

The estimated population of Hanoi in 1994 was 2.3 million. Comparison of the two periods of 1979-89 and 89-94 shows that the population increase has accelerated in the recent years (see Table 1-2-1). The acceleration was more conspicuous in all the urban districts, Ba Dinh, Hoan Kiem, Hai Ba Trung and Dong Da. The districts which exceeded 3% in annualized population growth were Ba Dinh, Hai Ba Trung, Dong Da. Hoan Kiem is the old center of Hanoi, a large part of which is the so-called Ancient City and French Quarter. The average density of population in Hoan Kiem is over 1,000 people per hectare. Nevertheless the population expansion accelerated to 1.7% per annum in the 1990's.

In rural areas the trends diverged. In Tu Liem and Gia Lam, the population increase accelerated while Soc Son, Dong Anh, and Thanh Tri, the rate of increase slowed down. Tu Liem is located the west of the urban districts and its eastern fringe, which is adjacent to the urban areas, is becoming urbanized rapidly. This district includes five towns, *thi tran* (officially recognized small urban areas). Gia Lam is located at the crossroads of national highways of No.1 and No.5. It has 4 towns and it is becoming industrialized rapidly. Soc Son and Dong Anh, located in the north of the Red River, comprise largely of agricultural households. Thanh Tri is the district located southeast corner of Hanoi. This area is subject to frequent flooding and water bodies comprise a large proportion of the district.

Table 1-2-1 Population Changes in Districts of Hanoi

District		1979 census	1989 census	1994 estimate	Average Annual Increase (%)	
					79-89	89-94
Urban	Ba Dinh	15,0544	18,5342	215,436	2.1	3.1
	Hoan Kiem	15,3575	16,2955	177,594	0.6	1.7
	Hai Ba Trung	22,0673	26,6161	318,750	1.9	3.7
	Dong Da	21,8843	29,1481	349,997	2.9	3.7
	Sub Total	74,3635	90,5939	1,061,777	2.0	3.2
Rural	Soc Son	14,4474	19,9243	224,334	3.3	2.4
	Dong Anh	16,4597	21,3092	236,099	2.6	2.1
	Gia Lam	22,1195	26,0668	295,610	1.7	2.5
	Tu Liem	19,0060	22,7023	272,748	1.8	3.7
	Thanh Tri	16,2827	19,0610	201,657	1.6	1.1
Sub Total	88,3153	109,0636	1,230,448	2.1	2.4	
Total		162,6788	199,6575	2,292,225	2.0	2.9

Statistical Office of Hanoi "Statistical Data on population in Urban Hanoi in 1979,1989,1994

Fig. 1-2-1 shows the population distribution of Hanoi in 1994. It indicates a heavy concentration in urban areas, especially in the Ancient City, gradually thinning out towards the west and south. The comparison of maps between 1979 and 1994 reveals the directions of urban development. Along the corridors of National Highways No.1, No.6 and No. 32, the population spreads out to west and south as shown in Fig. 1-2-7. It is also easily observed that the Red River has effectively limited the expansion of urban areas to the east.

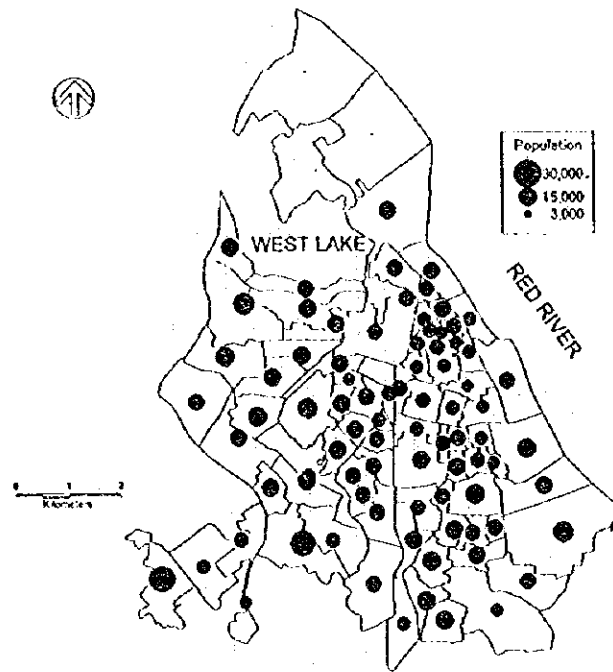


Fig. 1-2-1 Population of Urban Hanoi in 1994

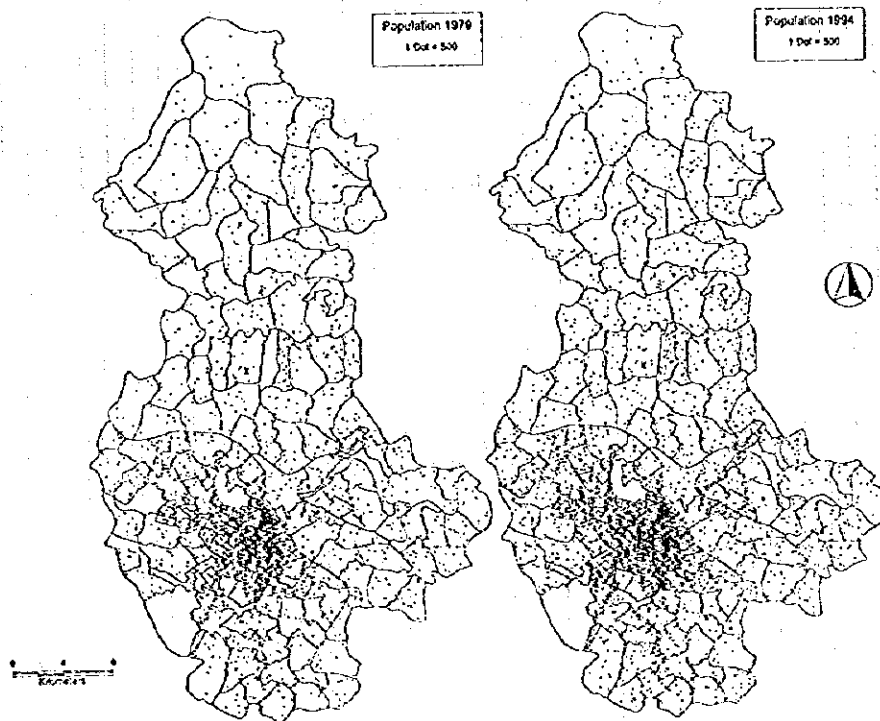


Fig. 1-2-2 Population Distribution Changes 1979 - 1994 in Hanoi

## 1.2.2 Economy

### (1) Overall Economy

Economy of Vietnam has grown at a remarkable pace in the 1990's as shown in Table 1-2-2. The economy grew at the rate of 7.9% annually between 1990 and 1994. Over the same period, per Capita GDP increased from 648,000 VND to 2,397,000 VND in current price and 455,000 VND to 563,000 VND in real terms at 1989 prices. The increase was 23% during the four years which is equal to a 5.4% annual growth.

Table 1-2-2 Gross Domestic Product (GDP) of Vietnam

Gross Domestic Product in 1989 constant price						unit: billion VND
Sector	1990	1991	1992	1993	1994	Annual Growth(%)
Industry	5,500	6,042	6,925	7,766	8,771	12.4
Construction	1,129	1,186	1,317	1,558	1,860	13.3
Agriculture	11,642	11,894	12,751	13,235	13,751	4.3
Other Productive Sectors	361	370	381	399	418	3.7
Transportation and Communication	744	792	842	897	960	6.6
Commerce	3,486	3,654	3,877	4,109	4,478	6.5
Finance	368	448	496	578	710	17.9
State and Education	2,628	2,841	3,040	3,322	3,760	9.4
Housing & Tourism	3,668	4,059	4,362	4,871	5,272	9.5
Total	29,526	31,286	33,991	36,735	39,980	7.9

Statistical Publishing House "Statistical Yearbook 1994"

The agricultural sector is the largest sector in Vietnam. However, as shown in Fig. 1-2-3, the manufacturing sector is catching up quickly. Manufacturing grew at an annual rate of 12.4% while agriculture grew at 4.3%. The fastest growing sector was finance which expanded at an annual rate of 17.9%, followed by construction at 13.3%.

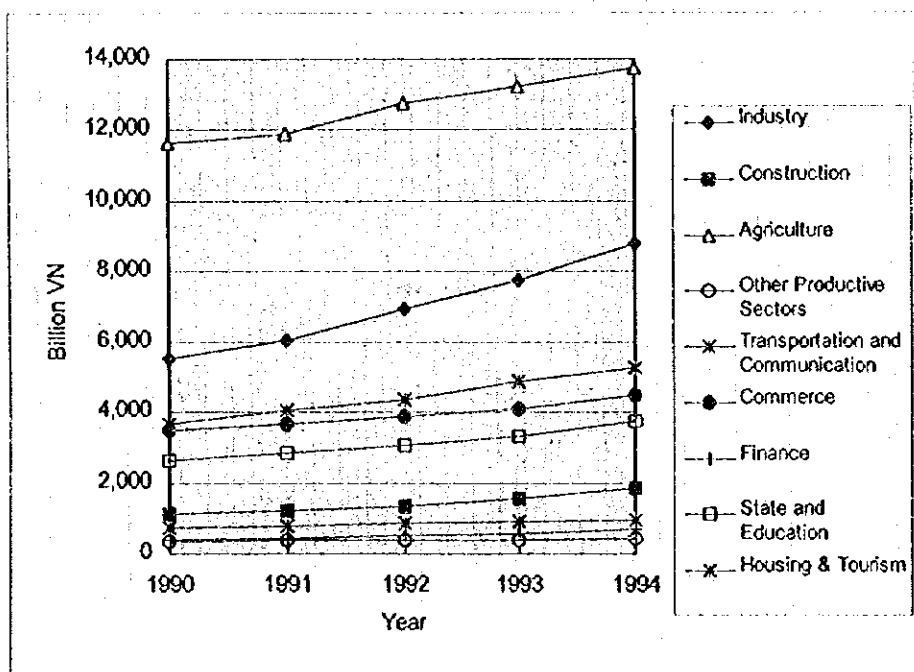


Fig. 1-2-3 Economic Growth by Sector

## (2) Labor Productivity

Table 1-2-3 shows the labor force of Vietnam by sector. In 1994 out of a total labor force of 32.7 million, 73% were engaged in agriculture. The labor force in industry constituted only 11%.

Table 1-2-3 Labor Structure of Vietnam

Sector	(Thousand Persons)				
	1990	1991	1992	1993	1994
Industry	2,800	3,392	3,394	3,450	3,522
Construction	831	818	820	825	848
Agriculture	18,979	21,895	22,483	23,208	23,898
Other Productive Sectors	45	30	30	30	31
Transportation and Communication	479	513	527	534	549
Commerce	1,117	1,681	1,719	1,735	1,776
Finance	76	91	118	114	117
State and Education	1,354	1,443	1,449	1,478	1,509
Housing & Tourism	340	431	435	444	468
Total	26,020	30,295	30,974	31,819	32,718

Statistical Publishing House "Statistical Yearbook 1994"

Table 1-2-4 shows the labor productivity by sector. Agriculture suffers from low productivity due to over-employment in this sector. The other productive services was the fastest growing sector during the period, recording a 14.4% annual increase, followed by construction (12.7%) and state and education (6.4%). The other productive services had the highest labor productivity in 1994, which is almost 24 times higher than the agriculture sector.

Table 1-2-4 Labor Productivity of Vietnam

(Thousand VND in 1989 constant price)

Sector	1990	1991	1992	1993	1994	Average Annual Growth(%)
Industry	1,964	1,781	2,040	2,251	2,491	6.1
Construction	1,358	1,450	1,606	1,880	2,193	12.7
Agriculture	613	543	567	570	575	-1.6
Other Productive Sectors	7,969	12,211	12,574	13,212	13,660	14.4
Transportation and Communication	1,552	1,544	1,599	1,679	1,748	3.0
Commerce	3,120	2,174	2,255	2,368	2,521	-5.2
Finance	4,940	4,912	4,211	5,061	6,053	5.2
State and Education	1,942	1,968	2,098	2,248	2,492	6.4
Housing & Tourism	10,788	9,415	10,032	10,963	11,270	1.1
Average of all the sectors	1,135	1,034	1,097	1,155	1,222	1.9

Statistical Publishing House "Statistical Yearbook 1994"

Fig. 1-2-4 shows annual changes in productivity by sector in Vietnam. There were significant fluctuations in the growth rate of productivity for the most of the sectors.

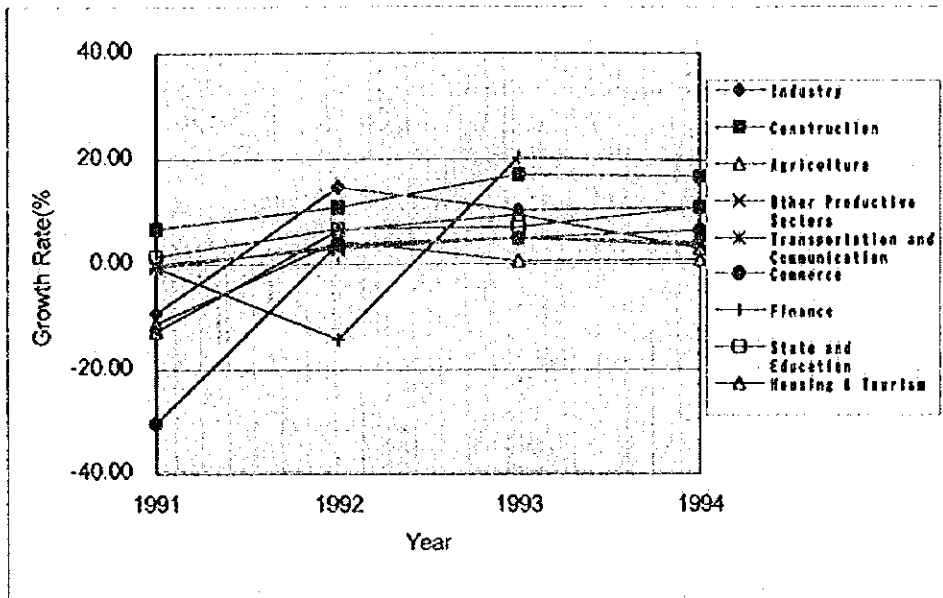


Fig. 1-2-4 Labor Productivity Change by Sector

### (3) Agriculture and Non-agricultural Sector

Vietnam is predominantly an agricultural society. The largest segment of the work force are farmers. As Fig. 1-2-5 shows, the cultivated areas have grown rapidly in the recent years and the labor force grew constantly as well. As population pressure continues to burden the capacity of the agricultural land, the economic structure of Vietnam is moving away from an agro-centered economy.

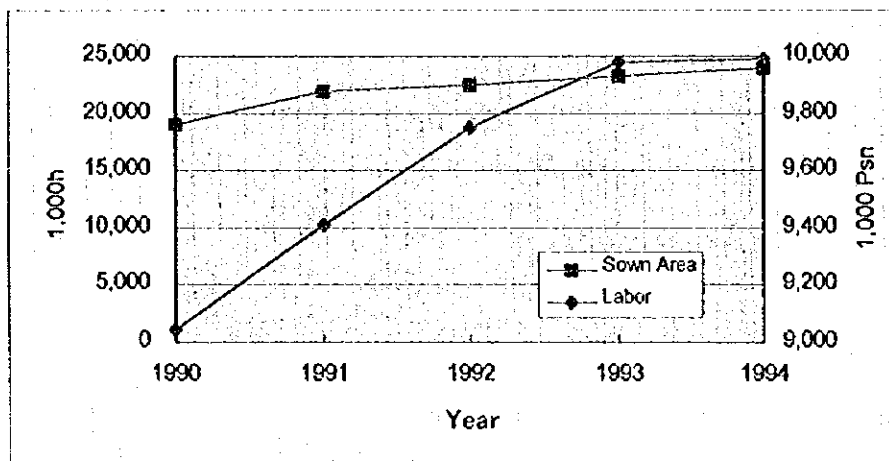


Fig. 1-2-5 Sown Area and Labor in Agriculture Sector

Although the agricultural sector continues to expand its cultivated area and is growing in terms of GDP, the value-added production per worker has stagnated. Table 1-2-5 shows the analysis on the productivity of the agricultural sector. While the value added production by agriculture grew at 4% annually between 1990 and 1994 and the sown area grew at 2.5% per annum the value added production per hectare grew at 1.7% per annum. However, in terms of the value added productivity per person, the figure shows negative value of -1.6% per annum.



Table 1-2-5 Agricultural Productivity of Vietnam

Items	1990	1991	1992	1993	1994	Average Annual Growth (%)
Value Added Production (B.VND)	11642	11894	12751	13235	13751	4.3
Sown Area (1,000 ha)	9040	9410	9752	9979	9992	2.5
Agricultural Labor Force (1,000 psn)	18979	21895	22483	23208	23898	5.9
Value Added Productivity per ha (B.VND)	1287	1263	1307	1326	1376	1.7
Value Added Productivity per person (B.VND)	613	543	567	570	575	-1.6

Agriculture is still the most important sector which supports the lives of the majority of the people in Vietnam. However, the above analysis of the agricultural sector indicates that agriculture cannot push the economy of Vietnam ahead, and will not absorb more population into this sector. Expansion of the economy has to come mainly from the industrial and service sectors.

#### (4) Economy of North Vietnam

As the population forecast is based on the northern region of Vietnam, the economic structure of the region has to be examined. Due to a lack of availability of data on gross regional domestic product (GRDP) of the region, a rough estimation was carried out based on various indicators of the economy. The north has a substantial share of industry and education in Vietnam. Table 1-2-6 shows the result of the Study Team's estimation.

Table 1-2-6 GRDP Estimate of North Vietnam

(Billion VND in 1989 constant price)

Sector	1990	1991	1992	1993	1994	Annual Growth(%)
Industry	1,320	1,489	1,658	2,115	2,368	15.7
Construction	657	647	563	615	725	2.5
Agriculture	4,577	4,238	5,108	5,604	5,187	3.2
Other Productive Sectors	88	91	91	109	113	6.4
Transportation and Communication	352	370	376	405	432	5.2
Commerce	990	1,214	1,260	1,307	1,471	10.4
Finance	104	149	161	184	233	22.2
State and Education	1,418	1,554	1,690	1,866	2,087	10.1
Housing & Tourism	1,042	1,349	1,418	1,550	1,732	13.6
Total	10,549	11,100	12,326	13,754	14,348	8.0
Agricultural	4,577	4,238	5,108	5,604	6,099	7.4
Non-Agricultural	5,972	6,862	7,218	8,150	9,083	11.1

Study Team Estimate

On the basis of this estimate, the economy of the North continued to grow between 1990 and 1994 in spite of a decline in agricultural output in 1991. The fastest growing sector is finance with 22.2% annual growth, as is the case with the national economy. Industry and housing and tourism, rank second and third in terms of growth with 15.7% and 13.6%, respectively. The overall economy grew at an annual rate of 11.1%.

A decline in agriculture in 1991 was caused by a decline in agricultural output. Paddy production declined from 6.96 million tons in the previous year to 6.26 million tons in 1991. This set-back in agricultural production did not halt the growing economy.

### (5) Economy of Hanoi

In 1993 the economy of Hanoi constituted 5.6% of the National Economy and 17.4% of the North's economy. The economy grew at a constant rate of 12% during the period of 1990 and 1993. The fastest growing sector was non-profit making organizations followed by the tourism sector at 34.6%. The agricultural sector in Hanoi grew at 6.9%, a much faster rate than the national average. (See Table 1-2-7)

Table 1-2-7 GRDP of Hanoi

(Million VND in 1989 constant price)

Gross Domestic Product	1990	1991	1992	1993
Industry	418,370	438,493	517,836	588,402
Construction	90,907	68,109	90,638	119,039
Agriculture	126,367	119,474	138,173	154,159
Transportation and Communication	76,725	78,789	94,057	102,736
Commercial	423,887	425,693	485,683	544,261
Other productive sectors	24,034	25,909	15,398	15,842
Finance	33,419	43,494	52,929	66,304
State and Education	62,408	71,737	98,636	107,500
Science	79,551	94,578	115,991	124,095
Culture	277,390	320,529	336,776	353,034
Tourism	29,443	35,133	49,301	71,759
Utility	66,597	93,260	58,903	55,877
No profit	9,529	21,552	24,396	27,761
Houses serves	36,456	49,569	54,946	64,324
Total	1,755,083	1,886,319	2,133,663	2,395,093

### (6) Labor Structure of Hanoi

The single largest sector of Hanoi is agriculture employing 700,000 workers or 51.5% in 1989. This indicates that a large section of Hanoi consists of rural areas. The next largest sector is the manufacturing sector, which employs over 220,000 workers or 16.5%. Hanoi stands out in comparison with other provinces with its concentration of employment in health and educational institutions (5.9%).

Table 1-2-8 Labor Structure of Hanoi

Sector	Number of Workers	
	(Persons)	(%)
Agriculture Forestry	701,598	51.5
Mining	802	0.1
Manufacturing-resource	56,686	4.2
Manufacturing	73,355	5.4
Manufacturing-heavy	93,680	6.9
Utility	4,184	0.3
Construction	48,827	3.6
Commerce	61,986	4.6
Transportation/communication	42,915	3.2
Health	25,498	1.9
Finance, business service	1,000	0.1
Education	54,959	4.0
Government	79,567	5.8
Others	116,210	8.5
Total	1,361,267	100.0

## (7) Household Income

SIDA conducted household income surveys together with their person trip surveys in 1994 within the urban areas of Hanoi. Fig. 1-2-6 shows the average monthly household income levels of household in each *phuong* which were derived from these surveys. It shows that within urban areas there is a large difference in income levels. As shown in the figure, the highest income households are concentrated in the Ancient City areas of Hoan Kiem, indicating that the commercial opportunities in the area are the source of wealth.

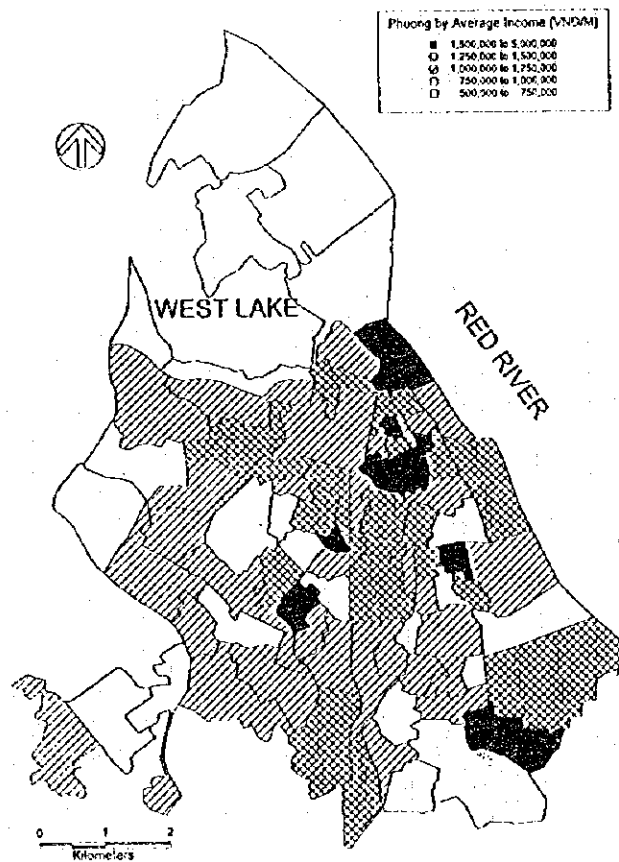


Fig. 1-2-6 Average Income Levels of Household in Each *Phuong*

To cover the lack of available data on regional household income within the Study Area, the study team conducted an additional small survey based on a sample of 300 households, (in 22 *xas* and 8 *phuong*s) to measure the level of income and other activities for both rural and urban areas.

Based on this survey, as shown in Table 1-2-9, the average monthly household income of Soc Son, the poorest region at the northern end of Hanoi, is less than one third of that of the wealthiest district of Hoan Kiem. Gia Lam is the second to Hoan Kiem surpassing the income levels of the three other urban districts. The second from the bottom is Thanh Tri District. Despite its proximity to urban Hanoi, this area is generally known as

a poor area, often suffering from floods of the Red River. Some villages interviewed had less than one *sao* (340m<sup>2</sup>) per person in an agricultural household which considered to be a threshold for subsistence.

Table 1-2-9 Average monthly Household Income of Districts of Hanoi

District	Average(VND)
Soc Son	544,925
Dong Anh	787,750
Gia Lam	1,730,100
Tu Lien	1,496,180
Thanh Tri	755,000
Hoan Kiem	1,972,500
Hai Ba Trung	1,538,200
Ba Dinh	1,387,450
Dong Da	1,421,000

Table 1-2-10 shows the results of the Study Team's survey of agricultural households. The differences in the average total income of agricultural households correspond well with a general perception of income levels of each district. Contrary to the general perception, the average farming household depends on non-agricultural employment for the major portion of the income. Only in Soc Son does the agricultural income exceeded non-agricultural income. It is obvious that the closer the district is to the urban Hanoi, the higher is the portion of non-agricultural income. From this analysis it can be generally concluded that the income level of farming households depends on access to non-agricultural employment.

Table 1-2-10 Average monthly Income of Agricultural Household

unit:1,000 VND

District	Agricultural Income (A)	Non-Agricultural Income (B)	Total Income	Ratio A/B
Soc Son	346	201	547	0.63
Dong Anh	262	395	657	0.40
Tu Lien	428	707	1135	0.38
Thanh Tri	340	368	708	0.48
Gia Lam	375	783	1158	0.32

### 1.2.5 Present Land Use

The land use for the main urban area of Hanoi is shown in Fig. 1-2-7, and the area by main land use are summarized in Table 1-2-11 by District. "Others" includes agriculture land and water area of river and lakes.

A 96.5% of residential area concentrates to the 4 urban and Gia Lam districts, and 95.7% of commercial area to the 4 urban districts. The industrial areas are located in Hai Ba Trung districts in the urban area and in Gia Lam district in the rural area. The followings are characteristics of the present land use in Hanoi.

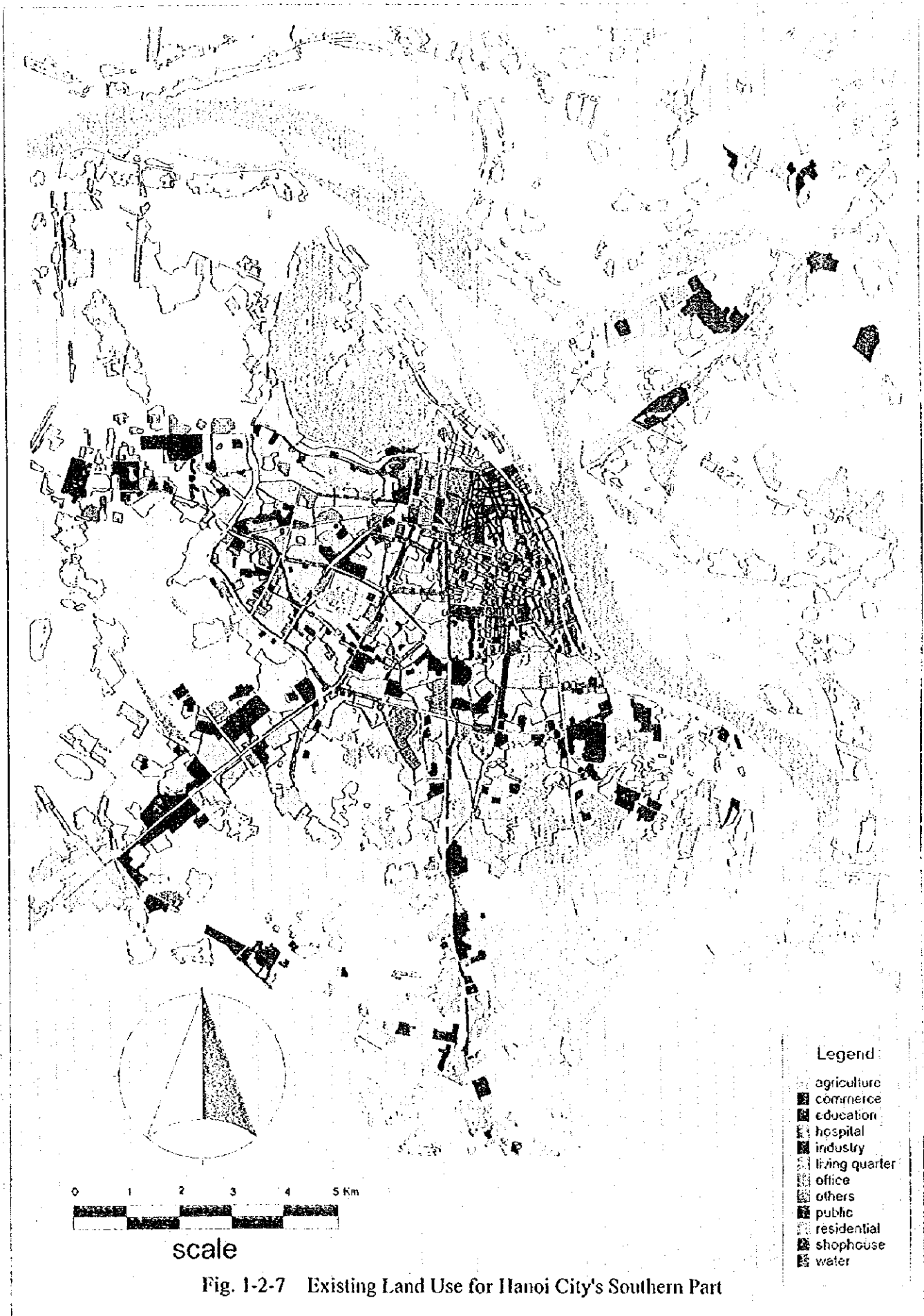


Fig. 1-2-7 Existing Land Use for Hanoi City's Southern Part

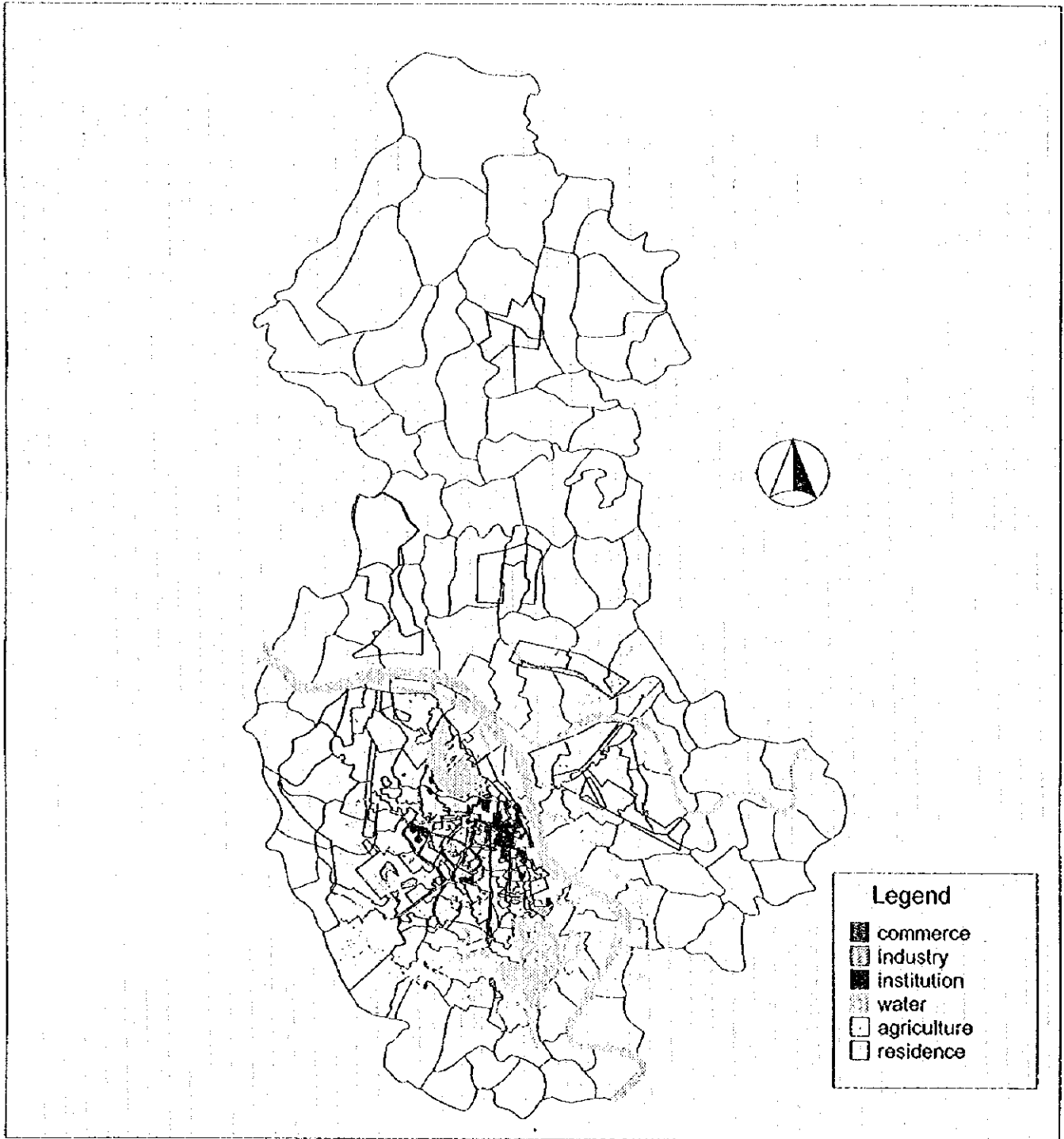


Fig. 1-2-8 Present Land Use

Table 1-2-11 Land Use by District

							Unit:ha
District		Commercial	Industrial	Institutional	Residential	Others	Total
Urban District							
	Hoan Kiem	70	5	113	138	159	485
	Ba Dinh	24	12	59	559	601	1,255
	Hai Ba Trung	32	70	33	803	608	1,546
	Dong Da	30	35	52	882	562	1,561
	Sub Total	156	122	257	2,382	1,930	4,847
Rural District							
	Soc Son	1	2	1	19	30,223	30,246
	Dong Anh	1	8	1	13	19,178	19,201
	Gia Lam	3	36	1	248	17,590	17,878
	Tu Liem	1	18	1	42	10,447	10,509
	Thanh Tri	1	16	1	20	10,967	11,005
	Sub Total	7	80	5	342	88,405	88,839
Total		163	202	262	2,724	90,335	93,686

### (1) Commercial Locations

There is an obvious lack of western-style commercial establishments such as department stores and supermarkets. There are mass markets called *cho*, where small traders gather to sell fresh produce and clothes. One of the largest market places was *Dong Xuan* Market located in the center of the Ancient City. The market is under reconstruction after a fire in 1994. The incident forced the traders to spread out onto the streets of the Ancient City. The Ancient City itself is the largest commercial district in Hanoi. It serves as the most important wholesale market for Hanoi and its surrounding areas. Some traders travel over 100 km's to this market to purchase goods for local markets.

Another prominent feature in Hanoi's commercial locations is the dominance of "shop/houses". A shop/house is defined as a mixed use of residence for commercial activities. The commercial businesses in the Ancient City are mostly shop/houses. The study team's assessment is that shops/houses cover over 3 km<sup>2</sup> in Hanoi. In the transition to a market economy, it appears that every individual is taking business opportunities. All the houses facing streets have opened some kind of retail business for extra income. The streets are lined with these retail shops. Most of the shops carry daily goods such as canned drinks and foods, soaps and toothbrushes. Even in small villages there are shops and cafes. Most prevalent are *karaoke*'s, sing-along bars.

Be it a *cho* or Shophouse of Ancient City, the tradition of fine specialization in trades remains strong today in Hanoi. Casual observation reveals that often one street is characterized by one product. Some streets have many shops that sell only refrigerators and others industrial equipment. Some streets in the Ancient City are dedicated to food wholesale while others specialize in female clothes or even coffins. In the west, Giang Vo Street is full of woodworking shops and furniture shops. This street connects to Duong La Thanh Street which is lined with steel pipe and bar sellers.

Trades in fresh produce in Hanoi are very decentralized. Individual traders, often the producers themselves, carry their products in *ganh* a balanced carrier, early in the morning, traveling from street corner to corner of the town on foot. Many street corners are filled with street sellers, waiting for customers. There is little need for housewives to go far to shop for the preparation of food. Grocery shopping is done every day. Taking into account of the current size of household space, (the average space for one person is 6m<sup>2</sup> in a congested urban area), it is not possible to store much in the house. The current life-style has its own logic of maintaining efficiency.

## (2) Office locations

Public administration offices are located in the central areas of Hanoi. Many state government agencies are located in Ba Dinh and Hoan Kiem Districts. As the buildings in these areas were constructed some time ago, the building density is fairly low. Many sites have less than 50% building area density with classic styles inherited from the French colonized period. The buildings in the southern part of Hoan Kiem District are subject to historic preservation due to their historic value.

As a new comer to Vietnam, private enterprises find it very difficult to secure adequate space in Hanoi. The southern part of the French Quarter is now undergoing land use change from shophouses and residences to office buildings.

## (3) Educational Institutions

Larger blocks are generally universities and colleges. There are 29 universities and colleges in Hanoi and 13 vocational schools. Hanoi is the national center of higher education. With the progress of the economy, college attendance will rise accordingly, although there has been some economic backlash of *doi moi* on college education costs in recent years. Hanoi will stay as the national center for college education in the future. There will be more private institutions as seen in the proliferation of foreign language schools. Such additions to the current institutions will reinforce the position of Hanoi as the national center. The location patterns of universities in Hanoi follows the recent urban development directions of south, southwest, and west. The majority of the institutions are located outside of Ring Road No.2.

## (4) Industrial Locations

Fig. 1-2-7 indicates that factories are concentrated in the south side of the urban areas and east of the river. As trucks are not allowed to enter most of the urban areas, highway No.1 - Minh Khai - Dike Road through Chuong Duong Bridge serves as the major trunk road for industrial activities. The concentration of factories along this route corresponds to the industrial needs. Some locations along highway No 6 will be future residential areas when Ring Road No. 3 is constructed. This will pose some future problems for new residential development in the area. The industrial areas along National Highway No. 1 through Minh Khai are located adjacent to the large water bodies of Hanoi where aqua-culture is undertaken. In terms of water pollution, the mixture of these two uses in one vicinity poses a future threat to the health of the population of Hanoi. Some locations in the west of Hanoi are now considered for industrial development. Judging



from the natural water flow in Hanoi, such locations pose some danger of contaminating irrigation water as well as drinking water in Hanoi.

Gia Lam, which is located on the east side of the Red River, offers an attractive location in terms of goods transport. It is located at the cross-roads of highway No. 1 and No. 5. Compared to the locations in urban Hanoi, this area has good access to Hai Phong Port which is located in 150 km's southeast of Hanoi. It also has a good access to the north side of Hanoi and Noi Bai Airport through National Highways No. 1 and No. 3. This area is considered to be one of the promising areas for future industrial development.

#### (5) Characteristics of the Present Land Use

##### Characteristics of Four Districts of Hanoi

The each four districts of urban Hanoi has its own distinct character.

- Hoan Kiem centers around Hoan Kiem Lake contains the Ancient City and the northern part of the French Quarter. This area remains the commercial center of Hanoi.
- The East half of Ba Dinh district is the seat of government administration with its center at the Ho Chi Minh Mausoleum.
- Hai Ba Trung located south of Hoan Kiem Lake and contains the southern part of the French Quarter. It contains mix of residential, commercial, administrative, and educational land uses.
- The eastern part of the urban areas, namely Hoan Kiem and Hai Ba Trung, are planned areas while most of the western area, consisting of Don Da district and the western half of Ba Dinh district shows haphazard development.

##### Residential Areas with No Automobile Accessibility

A main reason for such haphazard development is the urban expansion of the city into adjacent villages. There are large areas of multiple dwellings in Dong Da District which stand in rows in a regular fashion juxtaposed with the low residential areas penetrated by only narrow maze-like streets. When the government started to construct apartment houses to the west of the station to house people in Hanoi, the area consisted of farming villages with large areas of paddy fields. Multiple dwellings of modern structure were constructed surrounding the existing villages. Later urban development filled in the gaps, leaving narrow winding streets inside the present urban areas west of the station. These areas are largely automobile inaccessible since the physical structure of villages was unaltered. There have been some attempts by the government to widen the streets in these areas but these attempts have not generally achieved any results yet. For instance, a *phuong* adjacent to the railway station, Lang Trung, has no automobile accessibility inside the entire *phuong* because only two narrow alleys penetrate from north to south.

##### Linear Development of Residential Areas

While the government tried to establish what they call living quarters, i.e. apartment buildings, to offer more modern residential structure, the majority of private development spread along major streets is linear development of residential areas. These

residential areas are now converted to shophouses to tap the commercial potential offered by their accessibility. This linear development does not allow for the construction of automobile accessible road development to house backyards. Leaving space for road construction means a loss of residential or productive space for the land occupants while it is an immeasurable benefit to the community as a whole. As a result extremely dense urban residential sections have materialized. A lack of planning and implementation of transport accessibility by the public authority has left a situation which is difficult to improve. It has proved both economically and politically costly to relocate inhabitants in the dense urban environment.

Density increases the price of land occupation. It is generally known that the price of leasing of one square meter in central district is around US\$ 1,000/m<sup>2</sup> and US\$500/m<sup>2</sup> at the periphery. The expensive prices of land compared to the income levels of Vietnamese workers make the development of dense housing inevitable. Even recent development oriented toward higher income classes is still only provided with a minimum width of streets.

## 1.3 Registered Vehicles

### 1.3.1 Bicycle and Motorcycles

The break-down data for motorcycles based on the engine capacity from 1987 to 1995 is set out in Fig. 1-3-1 for the total existing and annually registered motorcycles as per the registration records of the Hanoi Police Department. The registered bicycles are estimated figures. The total motor cycles in 1995 were 462,000. In 1994 the motorcycles were 390,000 and the bicycles was 790,000.

At the beginning of the 1990's a decrease in the number of registered motorcycles occurred due to governmental regulations regarding the imports of used motorcycles. However, the number of motorcycles is increasing rapidly with the annual growth rate of 18.5% between 1994 and 1995, and there is some decrease in the number of bicycles. With the economic growth in Vietnam and the convenience of the private means of transport, the transition from the bicycle mode to the more popular motorcycles has been the predominant cause of the decreasing the number of bicycles and increasing the number of motorcycles. The estimated numbers of bicycles, however, still composed about double of the total motorcycles in the city in 1994.

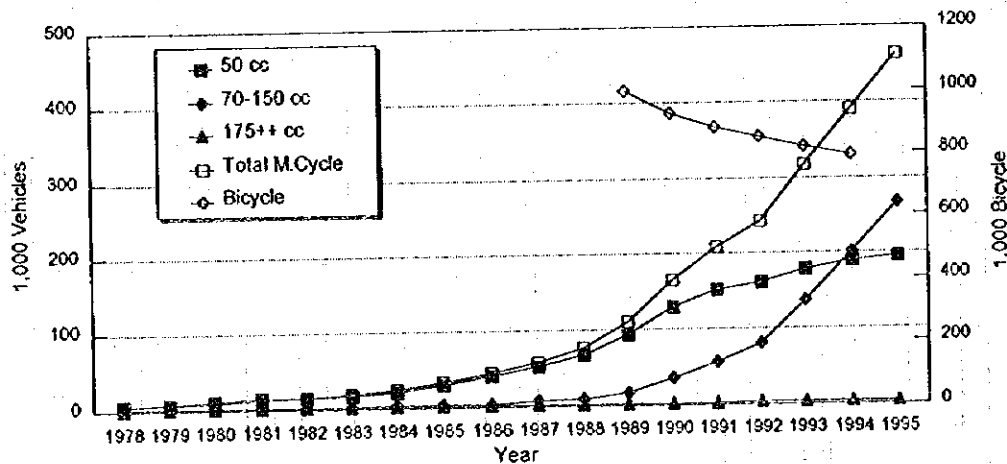


Fig. 1-3-1 Registered Motorcycles in Hanoi

A sharp increase in the number of larger-sized motorcycles (70-150cc), with simultaneous decrease in the annual registration of small motorcycles (50 cc), is clearly noticed during the last few years. This is probably the result of the recent economic growth. Based on the registration data, the total number of motorcycles in Hanoi was very close to the half million in 1995.

### 1.3.2 Motor Cars

Motor car registration data for each category of car was also obtained from the Hanoi Police Department for the years 1986-1995, including the number of deregistered due to movement to another area. The trend is shown in Fig. 1-3-2 by the vehicle type, while Table 1-3-1 presents the number of registered and deregistered cars. The number of existing cars in 1995 was 47,251. The annual growth rate between 1994 and 1995 was

10.7%. The passenger car ownership including van and others, which may be taxis, in 1995 was 11.5/1,000 inhabitants when the residents in all the study area is applied as a denominator, and 24.8/1,000 inhabitants when the population only in the urban area is applied.

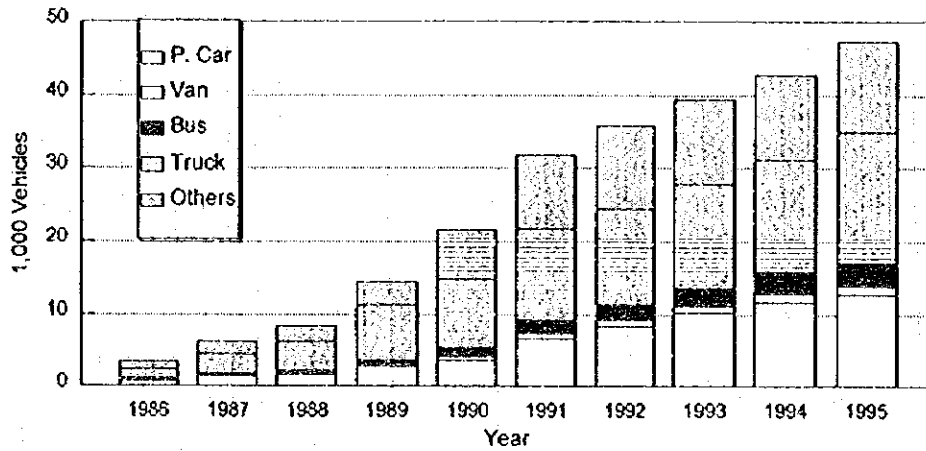


Fig. 1-3-2 Motor Vehicle Registration by Vehicle type in Hanoi

Table 1-3-1 Number of Registered Vehicles

Year	Passeng-er Car	Van	Light Bus	Medium Bus	Heavy Bus	Light Truck	Medium Truck	Heavy Truck	Other	Total Registered	Deregist-ered	Total Exist
1986	902	1	92	4	26	3	1213	192	1068	3501	1138	2363
1987	1469	2	142	7	75	6	2461	343	1677	6182	803	5379
1988	1843	3	170	9	131	11	3682	420	1974	8243	579	7664
1989	2798	154	341	24	232	22	7014	512	3329	14426	1604	12822
1990	3750	537	496	57	404	63	9012	528	6651	21498	1683	19815
1991	6502	1016	784	135	649	182	11847	535	10082	31732	1995	29737
1992	8190	1048	882	207	785	238	12547	538	11304	35740	646	35094
1993	10051	1175	1025	366	852	450	13209	539	11563	39230	169	39061
1994	11341	1355	1165	574	908	1066	13901	539	11684	42733	32	42701
1995	12581	1411	1250	646	952	2608	14942	547	12293	47261	10	47251

To obtain information on car ownership in Hanoi, the registration data was analyzed for both state-owned and privately-owned vehicles. Fig. 1-3-3 shows the percentage of private cars for five groups of vehicle categories as well as the total average. In 1988, there was only one registered private truck in Hanoi and private ownership began at a considerable rate during 1989 for the two categories of vans and vehicles other than those for passengers and commodities.

The total average rate of private cars in 1995 reaches the level of about 25% with most of the vehicle categories has a rate between 20 to 25% except for the van cars which are mostly under the private ownership. As shown also in the figure, the trend of private ownership increased at a moderate rate up to 1992 which can be considered as a turning point for higher rates of private ownership of cars.

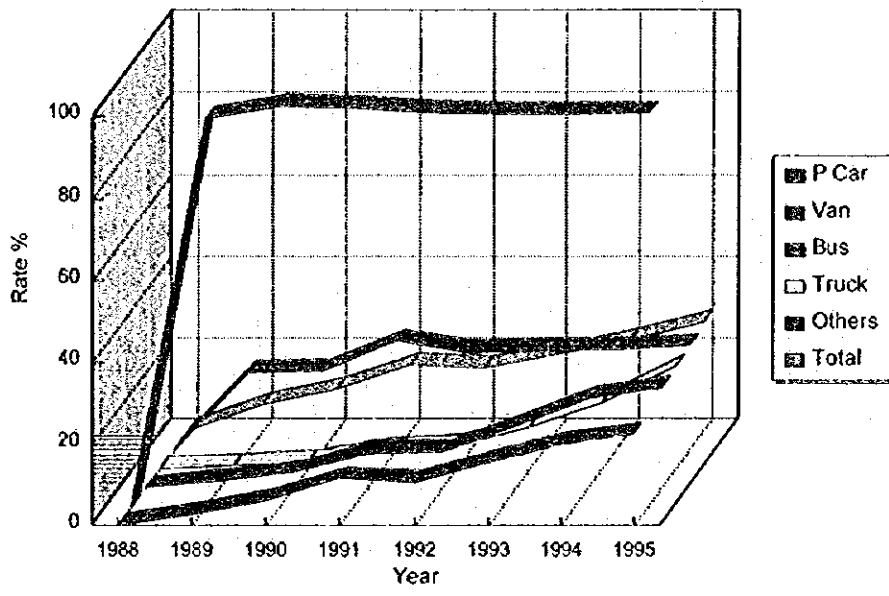


Fig. 1-3-3 Private Cars Share

## 1.4 Relevant Studies and Ongoing Projects

To solve the existing problems of the transport sector in Hanoi city, and to prepare the city for the future expected high transport demand as a result of the fast growing economic development, several studies and plans have been carried out in the last few years. There have been conducted either by the Vietnamese concerned authorities or through international cooperation agencies. From these studies, many plans and recommendations were established and some of the proposed projects are being implemented at present.

### 1.4.1 Relevant Studies

In the following sections are set out the main concepts and recommendations of the available reports on relevant studies which were examined under the scope of this study.

#### Urban Transport in Hanoi, Diagnostic Study 1993, SIDA

In 1993, a diagnostic study carried out by SIDA (the Swedish International Development Authority) recommended the formulation of a supply-leading demand-controlling policy for the urban transport development in the future, using the experiences of other countries. The study also proposed different groups of actions defined into the following eight programs or project packages, to be considered and carried out separately under a comprehensive policy framework for the development of urban transportation in Hanoi:

- (1) **Development of an Urban Transport Data Bank:** To start a number of surveys and data collection efforts in order to develop a data bank with facilities of processing and up-dating. The objectives of this project are to make the development process more efficient since all parties will have access to the same data, to prepare for the situation when Hanoi is able to undertake large investment projects, and to support the reform process.
- (2) **Institution Development:** To strengthen the local authorities and to create an organizational framework and an agency with executive powers for the planning, monitoring and control of urban transport. The process toward the realization of this task includes giving Hanoi the status of a special zone, the formation of an urban transport task force and the institutional development of TUPWS.
- (3) **Traffic Systems Management:** To elaborate a multi-component traffic systems management plan for the central area of Hanoi which should be combined with high-capacity circumferential road. The proposed management package includes a medium term strategic transport plan, a traffic management plan for the central area, an action plan for the railway station area, a traffic restraint scheme for the ancient city, a parking plan and an encroachment management plan.
- (4) **Road and Street Network Development:** To establish a plan for a well-structured primary road network dedicated to motorized traffic, with high priority to the circumferential road around Hanoi and to the main axis to the central area. This plan should be based on different scenarios for the development of the total transport system reflecting different modal split strategies, and different rates of population growth and motorization.

- (5) **Railway System Development:** To design an improvement process including the rerouting of railway traffic and constructions of limited elevated structures and underpasses at certain locations and a new station building in Hanoi combined with a regional bus terminal. Developing the railway system will also improve the traffic situation on the street network in the central areas of Hanoi.
- (6) **Development of Public Transport:** To develop a strong public transport sector with a new structure based on the principle of the privatization of the actual operation, while the planning, monitoring, control and licensing are the responsibility of HPC. An implementation plan for the public transport system as an efficient business sector should be established with the features of the high commercial speed and provision of feeder and bus priority systems.
- (7) **Traffic Rules and Enforcement:** To undertake a project with the purpose of reviewing problems and conflict situations in order to design comprehensive local traffic regulations, emphasizing safety and environmental protection and including the training of traffic police. It was also recommended that Hanoi should be given the possibility of introducing special rules and regulations for traffic.
- (8) **Preservation Program for the Old City:** To develop a comprehensive traffic plan aimed at the preservation and careful development of the central area, in coordination with other related projects such as a traffic management plan for the whole central area.

The Master Plan Study of the Transport Development in the Northern Part in Vietnam, 1994, JICA

The main objective of this study was to formulate a comprehensive transport master plan for the northern part of Vietnam, with 2010 as the target year, in order to establish an optimum overall transport system covering the four major surface transport modes of road, railway, sea and inland waterway. The study also included, as a separate issue, an urban road development plan for the urban areas in the northern region. In Hanoi, the study recommended basically the construction of one or two ring roads according to the future expansion of the urban area. As the National Highways No. 1, 2, 3, 5, 6 and 32 exist currently as radial roads from the center of Hanoi, there is only one ring road with a diameter of about 5 km. This road should be widened to at least 4 lanes and additional ring roads may be needed in line with the future expansion of the urban area. Other measures required to accommodate the increasing traffic volumes include:

- (1) Channelization of at-grade intersections and installation of traffic signals.
- (2) Installation of traffic safety facilities.
- (3) Establishment of a public transport system (Bus and LRT).
- (4) Incentives and safety-protection measures for users of non-motorized transport
- (5) Provision of systematic traffic safety education for road-users.
- (6) Enforcement of traffic regulations, including restrictions on horn-use.

In addition, the study recommended improvements and upgrading of the facilities of other transport modes, such as the railway and inland waterway, in order to capture higher market shares, especially for goods transport.

The Hanoi Planning and Development Control Project - Hanoi General Plan, 1991, Hanoi Institute for Urban Planning

This project encompassed an overall assessment of the present situation of the city, and established parameters for space development until the year 2010. It is concluded that in the infrastructure sector, public works satisfy only 30% to 60% of the demand. The project identified some problems in the transport system of the city including the insufficiency and unbalanced distribution of the street network, public transport and safety systems. Planning directions were established by the project for the transportation network including the construction of new axes and upgrading others. Other recommendations included removing the railway line which passes through the city, establishing a new planning concept for intersections, upgrading the existing airports and river ports, reducing the number of bicycles and motorcycles in the city and supporting the public transport system make it able to handle 50% of the trips in Hanoi.

National Transport Sector Review, 1992, BCEOM-UNDP

The NTSR project covered the transport system in the whole country devoting one volume out of ten of the final report to the urban transport. The project investigated different transport related aspects in Hanoi and identified possible bottlenecks in urban transport, by using the foreseeable trends in urban development. In order to prevent further traffic deterioration, the project urgently recommended overall traffic and transport studies with the following main objectives:

- (1) establishing a traffic management plan in order to reach a suitable network use by low-cost improvements;
- (2) reviewing existing regulation and law enforcement, and making proposals to improve the existing situation;
- (3) improving the existing public transport modal share to reduce traffic flows;
- (4) proposing a training plan to improve traffic control, understanding of the highway code, basic safety regulations and user basic knowledge.

In the medium term, a city development plan, with an extended area to about 100 Km<sup>2</sup> and drastic changes in the land-use structure, and a transport master plan are required in order to prevent other basic infrastructure from suffering the same deterioration. For the external traffic flows, a belt highway study is required as a part of the medium term urban development plan.

Red River Delta Master Plan, 1995, UNDP

A comprehensive study on the integrated development of the region to improve the living conditions of people and their general welfare. In addition to the development of the natural resources, secondary industries and appropriate administrative and management systems, plans to develop the infrastructure system of the area were established providing a broad outline of development options.

Upgrading national roads in Hanoi to four lane divided highways with non-motorized lanes and all district roads to all-weather roads was also recommended. The project,



however, did not provide many options on an urban transport plan with only some recommendations to improve traffic management and establish a comprehensive transport plan for Hanoi to develop medium-term solutions as well as longer-term planning. Such a plan is recommended to give adequate emphasis to public transport in a manner which would attract commuters and to concentrate on medium-term and cost-realistic solutions rather than unrealistic and over-sophisticated solutions.

An immediate action was proposed to be taken to reduce traffic congestion and improve safety through traffic management measures, while simultaneously studying appropriate and cost-effective short-to-medium term developments. Details of these would be worked out as a part of comprehensive urban transport plans and it is likely that such a plan for Hanoi would include some form of urban light railway system. In the long-term plans, an improved national highway network with new expressways will be required.

#### Vietnam Urban Transport Management Study (VNTMS) Nov. 1995, IBRD

This report is prepared by MVA Asia Ltd. for the World Bank to identify the issues related to the expansion of traffic demand in urban areas in Vietnam particularly in Hanoi and HCMC. As the title of the report indicates (herein after referred to as VNTMS), the prime objectives of the VNTMS were as follows:

- To identify short-term investments for improving the capacity and efficiency of road infrastructure.
- To improve road safety and to strengthen the administrative management and regulation of transport.

The report emphasis the urgent need to develop and introduce traffic management measures to maximize the potential of the current transport systems in these two cities. A range of recommendations are made for improving road safety and improving the effectiveness of agencies concerned with the enforcement, management and development of the transport system. The education, enforcement and institutional development proposals provide a foundation for the future traffic management system.

As the immediate target area for implementation in Hanoi, the study selected one isolated but heavily congested junction and four main corridors as followings:

- Cau Giay Junction.
- Tay Son Corridor.
- Le Duan Corridor.
- Tran Quang Khai Corridor.
- Bach Mai Corridor.

Also, schemes for the Ancient Quarter and French Quarter will be implemented. Recently, the World Bank submitted to Vietnam Government a plan for implementation including the above mentioned area with a budget of US\$ 24.8 million, plus an additional, US\$ 2.8 million for traffic police enforcement. The recommendations of this study are closely related with our scope of work and as far as possible, overlapping of issues should be carefully avoided.

This report was prepared by the Transport Economic Science Institute, TESI, and its planning concept concentrates on the following items:

- (1) Construction of the belt high-speed Ring Road 3 of 28.8 km in length.
- (2) Upgrading and newly constructing of 7 grade-1 roads with a total length of 79.2 km, 11 grade-2 roads with a total length of 97.6 km and 16 interzonal roads with a total length of 100.2 km.
- (3) Construction and improvement of 73 main circulation nodes consisting of 38 grade separated nodes and 35 at grade intersection nodes.
- (4) Upgrading of Noi Bai international airport to receive 6-8 million passengers and 80,000 ton of cargo by the year 2010.
- (5) Upgrading of 2 river ports to assume the cargo throughput of 2 million tons by the year 2010.
- (6) Preparing the economic and technical foundations for investments to construct an elevated electrified urban railway system.
- (7) Organizing a bus network consisting of 64 lines. Other improvements are to increase the capacity of airports and river ports in the area.

#### 1.4.2 Ongoing Transport Projects

At present, several traffic and transportation projects are being implemented in Hanoi city together with other socioeconomic development projects and new urban areas which may generate development traffic on the urban transport system. In addition, there are more plans and studies for projects which are not yet completed or committed by the authorities for implementation. In the transport sector, the ongoing projects in the implementation stage include:

##### National Highway No.1 Improvement Project:

Upgrading highway No.1 has for a long time been a major concern for the government and international financial institutions. This highway is regarded as the transportation backbone of the country connecting the northern areas of the country to the south and internationally from China to Cambodia, it has a great impact on the social and economic development of the country.

The length of the highway through Hanoi city is about 23 Km. As the total length of the highway is about 2,300 Km, it was divided into several sections to be upgraded two main phases. The first is focusing on the restoration of two lanes 3.5m wide for cars and two lanes 1.5m wide for smaller vehicles. Three major investors are providing financial assistance to the project. The ADB is dealing with sections north of Hanoi including the realignment by means bypassing routes to avoid land acquisition in populated areas. The World Bank is financing the improvement works of sections south of Hanoi, while the OECF of Japan has agreed to provide loans to build and renew more than 38 bridges along the highway.

### National Highway No.5 Improvement Project:

National Highway No.5 is about 106 Km in length connecting Hanoi to the main port of Haiphong. It is considered as the main highway for Hanoi's international trade through that port.

The highway starts at its junction with the National Highway No.1 just north of Hanoi city center and up to the boundary of Hanoi city it has a length of about 10.5 kilometers. The improvement project involves the works of widening the existing carriageway from 2-lane to 4-lane, with the first 6.7 Km from Hanoi from 4-lane to 6-lane for motorized vehicles in addition to two lanes for non-motorized vehicles. The existing pavement will be rehabilitated and strengthened and other construction works include bypasses, bridges, road appurtenances and support facilities. Inter-city sections of the highway are designed to accommodate non-paved shoulders and suitable separating strips while the city sections will be provided with sidewalks on both sides. The works are at present at the end of the detailed design-review stage and the construction activities began in case 1995 and will run for a period of about three years.

### Traffic Management Campaign:

A traffic management campaign was launched on the streets and roads of Vietnam at the beginning of August 1995 to restore traffic order. Obstacles on the streets were removed and the traffic rules are better applied than before. As the campaign is still in its early stages, there is no clear assessment of its results and achievements. It is providing training courses on traffic regulations for households and central and local organizations in addition to the attention given to the road infrastructure system

Since 1992 the annual increase of road accidents in the country was about 7-8%, killing more than 19,000 and injuring more than 53,000 others. The campaign resulted in a dramatic reduction of about 19% in the traffic accidents according to the initial reports of the Traffic Police Department. Another result of the traffic campaign is that many illegal drivers have decided to become legal drivers and are applying for licenses. With the large number of motorcycles, authorities in Hanoi traffic centers are finding it difficult to cope with the demand. Regarding financing issues, the sum of the funds collected as fines for traffic violations and other charges is planned to be used in financing the measures required to improve traffic safety.

### Intersection Signalization Project:

A feasibility study was carried out in 1994 on the signalization of 150 intersections in the urban area of Hanoi. The project also includes the installation of 10 video cameras at main intersection and the utilization of a traffic control center instead of the local controllers used at present at 32 intersections. The traffic control center is under construction on an area of 200 m<sup>2</sup> at the compound of the Hanoi Traffic Police Department. The map in Fig. 1-4-1 shows the location of the intersections proposed to be signalized or equipped with video cameras as well as the traffic control center.

Signal installation of Phase-1 of the project is expected to start by the end of 1995 and to continue up to June 1996 through a French grant finance. This phase includes the installation of traffic signals and controllers at a total of 35 intersections and 6 video cameras at some main intersections in addition to providing equipment for the traffic control center.

The first phase provides an opportunity for monitoring an advanced traffic signal system under the local road and traffic conditions. Subsequent phases, which will cover the remaining 115 intersections as well as 4 more video cameras, are expected to continue up to the year 2000, but the financing system is still not yet confirmed.

The Vietnam Urban Transport Management Study (1995) also investigated some schemes for main corridors and central area of Hanoi and proposed that, in addition to the 35 intersections to be signalized in Phase 1, about 100 intersections should be signalized in an integrated system with other signals.

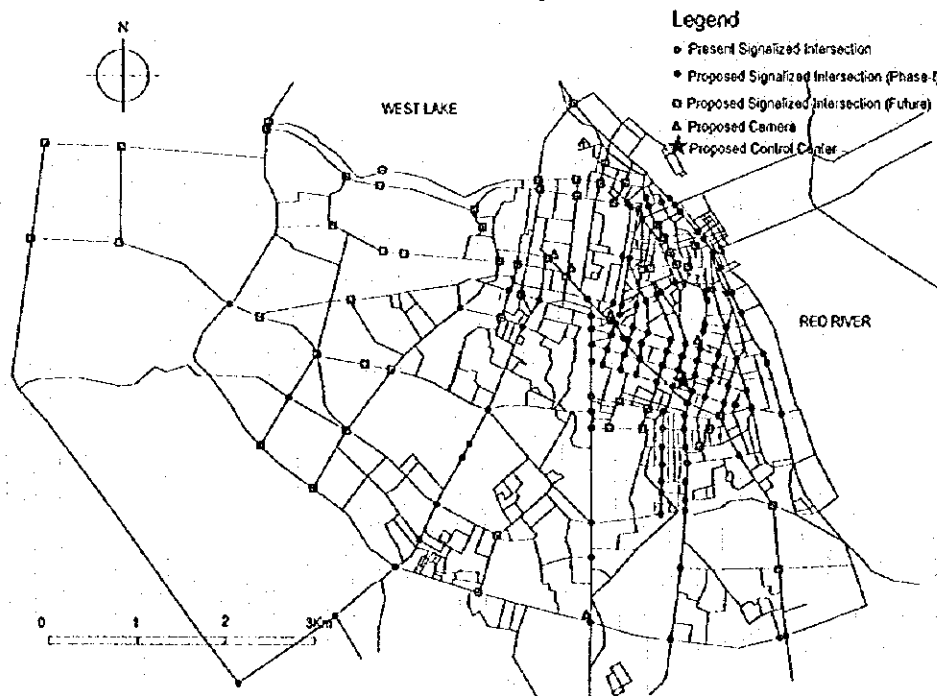


Fig. 1-4-1 Hanoi Traffic Control System Plan

### Elevated Railway System

This plan is not yet confirmed or committed by the authorities in-charge but it is included here as it has some importance for the conceptual planning of the public transportation system in Hanoi. The plan comprises two main lines; the first a 10.5 Km line will link the eastern suburbs to the southern areas through the city center, and the second line of 24.4 Km will run from the west to central Hanoi and then to the southwest. Finance of the project is expected to be through the official development assistance capital from foreign countries, and if implemented as planned, it will be operational by the year 2000. The hourly capacity of the railway system is between 40,000 - 60,000 passengers, and the system will be integrated with an upgraded bus

system. Hanoi railway station will be utilized to develop a passenger transfer center as the focal point of the transport system in the city.

#### Noi Bai International Airport Terminal:

Construction has started of a new terminal at the Hanoi's Noi Bai international airport to accommodate the 2.5 million passengers initially expected to use the facility annually. The number of passengers is forecast to reach about 4 millions by the year 2000 and 6 millions by the year 2005. The project is a part of the master plan of the airport approved by the government this year. The five-story building will occupy an area of 53,000 m<sup>2</sup> with an area of 22,000 m<sup>2</sup> for the basement and 15,000 m<sup>2</sup> for the car park.

#### Street Illumination Project:

The project has been being implemented for a few years. At present, a total of 365 Km of streets are illuminated with a lightening rate of about 88%. The objectives of the project are not only to provide safety during night driving but also to make Hanoi much better at night and insuring people's safety in general.

#### Feasibility Study on the Highway No. 18 in Vietnam

This study is being carried out by JICA as a part of the technical assistance program of Japan in order to support the transport system connecting the Noi Bai international airport of Hanoi to the planned industrial areas and main ports in northern Vietnam. At present, the highway has inferior geometric design features and is still unpaved of badly deteriorated rock surfaced status.

A total length of about 250 Km is subject to the feasibility study in which the preliminary design of the highway and its facilities is included. The project will be evaluated technically, environmentally, economically and financially and an implementation plan will be established.



## CHAPTER 2 PRESENT ROAD NETWORK

### 2.1 Introduction

The transport system in Hanoi City relies mainly on the road transport sector which handles more than 85% of the passenger and freight movements in the city either as motorized or non-motorized traffic. Recognizing the importance of the road transport, not only in Hanoi City but all over the country, the transport sector investment of the government has long been focused on the development of the road network.

The road classification in Vietnam in general can be derived according to the function and supervising authority, and not to the engineering design or the type of pavement, into the following classes:

- National Road
- Provincial Road
- District Road
- Urban Road
- Village Road
- Special-Purpose Road

In urban Hanoi, it is difficult to practically classify the streets based on the land-use pattern and roadside activities, due to the strong interaction between the commercial and residential activities on main and sub-main streets and even small alleys. There is, however, a functional classification according to the design standards of urban streets as follows:

- Highway (Expressway)
- Main Street Grade I
- Main Street Grade II
- Inter-zonal street
- Cargo-loading Street
- Living-quarter Road
- Industrial-area Road
- Small Path

In the study area, roads in the four urban districts are classified under the urban street network while other roads in the rural five districts are considered to be in the rural road network.

## 2.2 Urban Street Network

The urban street network covers the four urban districts in Hanoi, which are Hoan Kiem, Hai Ba Trung, Dong Da and Ba Dinh, and extends to a total length of more than 189km. The area of urban Hanoi is about 40 Km<sup>2</sup>, out of 921 Km<sup>2</sup> for the whole Hanoi city area.

### 2.2.1 Urban Streets

The street network in the urban area of the city has different characteristics for each of the four urban districts. An inventory of the urban streets in Hanoi was prepared based on the information collected and road surveys. The inventory includes basically all the streets used by cars and few of the main paths which are currently used by bicycles and motorcycles and can be considered for widening schemes in the future. The inventory includes the basic information and data as up to date as possible which can be utilized in the planning procedures for the road network in Hanoi. The existing street network in urban Hanoi is shown in Fig. 2-2-1.

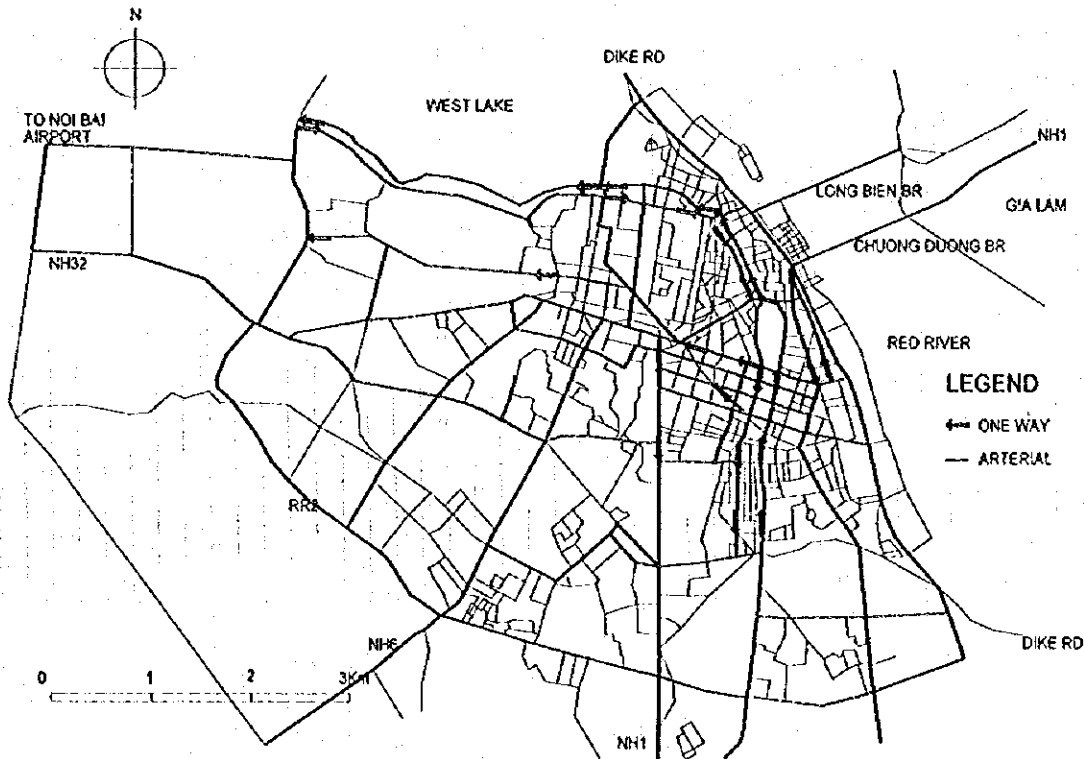


Fig. 2-2-1 Hanoi Urban Street Network

#### 1) Street Density Assessment

In assessing the street network for each urban district, two indicators were concluded, the first is the street area rate in accordance with the total area of the district, and the second is the road density in which the population in the district is also considered. As the road requirement in any area depends on both land area and population served by the network, both urban and rural networks are assessed based on the road density factor which is defined as an indicator to assess the adequacy of the road length. The indicator



is used for evaluation purposes and the high values show greater serviceability and accessibility for the network but in general values more than 1.0 can be considered as satisfactory. The indicator is determined by applying the following formula:

$$\text{Road Density} = L / \sqrt{PA}$$

where:  $L$  : road length in km  
 $A$  : land area in square kilometer  
 $P$  : population in 1,000

Table 2-2-1 presents the assessment results which are shown graphically in Fig. 2-2-2, in which the street area includes both sidewalks.

Table 2-2-1 Streets Area Rate and Density in Urban Hanoi

District	Area (km <sup>2</sup> )	Population 1994	Street Length (km)	Street Area (km <sup>2</sup> )	Area Rate %	Road Density
Hoan Kiem	4.900	177,594	61.386	1.029	22.87	2.17
Dong Da	15.600	349,997	32.243	0.441	3.15	0.46
Hai Ba Trung	15.500	318,750	41.893	0.849	7.72	0.71
Ba Dinh	12.600	215,436	53.540	0.743	7.08	1.13
Urban Hanoi	48.500	1,061,777	180.062	3.062	7.65	0.92

Hoan Kiem district, as the oldest area of the city, has very narrow streets in its northern and ancient parts, and moderately wider streets, with old trees on both sides, in its southern parts. With a total length of about 61 Km of streets in an area of 4.5 Km<sup>2</sup> and compared with other districts in the city this district has in general the highest rate of streets of about 23% and road density rate of 2.17. Dong Da, on the other hand, has only 32 Km of streets while it is the most populated district with the largest area.

Hai Ba Trung district has a total street length of about 42 Km in an area of 11 Km<sup>2</sup> which gives a rate of 7.75. Streets in Ba Dinh district have a length of about 54 Km in an area of 10.5 Km<sup>2</sup> with a rate of 7.1%. The district has some wide lateral streets

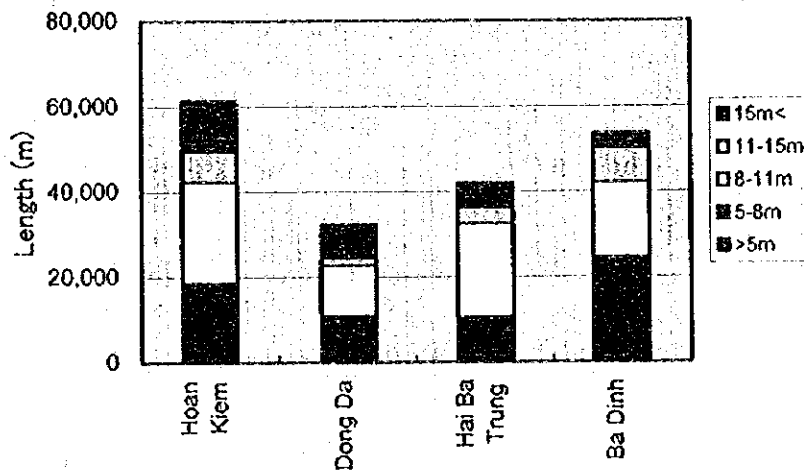


Fig. 2-2-2 Hanoi Urban Street Network Characteristics (1)

## 2) Network Shape

The urban street network has in general a radial and circumferential shape with some missing links. The main radials were originally the national highways functioning as main streets inside the urban area. The network in Hoan Kiem district and the northern sections of Hai Ba Trung district is grid-shaped with high frequency of intersections. Other districts have no defined shape for the sub-main streets. The rural road network depends basically on the fairly good condition national highways as the main corridors. The alignment of branch roads has some topographical constraints due to the existence of many rivers and lakes.

## 3) Road Density

The road density indicators, which considers the area and population together with the road network length in each district, show a high value of 2.17 in urban Hanoi for Hoan Kiem, followed by Ba Dinh district. Dong Da has a very low density of about 0.46 with a minimum area rate of 3.15%. The rural road network shows inadequate road density values for all the districts.

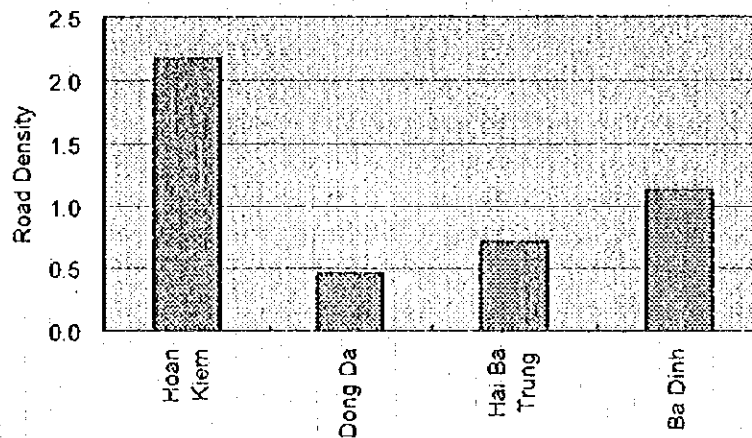


Fig. 2-2-2 Hanoi Urban Street Network Characteristics (2)

Urban Hanoi with a street length of 190 Km, in total, has a very low rate of street area, and also road density, but the function of the road network is much more inadequate as given the concluded road area rate per district, it is clear that the street network is not efficiently used. The district disparity in urban street density is quite noticeable and the street quality should be taken into consideration in assessing the street network, since there are many streets which are not accessible to motorized vehicles at all times even if enough width is provided to accommodate cars.

## 4) Function

The road infrastructure in urban Hanoi is composed of about 326 streets and the existing streets of the city are short and narrow with fair to poor surface conditions. The network

has several radial roads which handle both the traffic going to the city and the traffic passing through the city to other destinations. Existing circumferential roads do not carry out their assumed function either due to discontinuity or lack of required width and other traffic management problems.

The main arteries and one way street systems in the network are shown in Fig. 2-2-1 in which the directions of the traffic flow are derived for the present condition and the management plan to be applied in 1996-2000. The railway line divides the city into east and west parts and the access between the two parts is limited to a small number of crossing points especially south of the central railway station. There are some plans to either remove the railway line from the city center or to construct viaduct for an elevated railway system, but conversely, there are opinions to keep the railway line as a safeguard measure to protect the ancient city from easy access of vehicles.

#### 5) Flyovers and Underpasses

The street network does not include any flyovers or underpasses, as flyovers are not suitable for the dominant bicycle flow and underpasses are expected to face drainage problems due to the low elevation of the city combined with high rain intensity. There are some plans to provide flyovers at the intersections of the second circumferential road with the main radial arteries at which there are high volumes of motorized traffic.

#### 6) Width and Number of Lanes

The street width in urban Hanoi varied widely ranging between less than five meters to more than 30m, but as shown in Fig. 2-2-3, the majority of streets have width of 5-8m in Hoan Kiem and Ba Dinh districts, and 8-11m in Dong Da and Hai Ba Trung districts. Dong Da district has the highest share of narrow streets of less than 5m width and also has wide streets of more than 15m width. The average street width in each district is presented in Table 2-2-2.

The number of lanes of the streets is not clearly identified as there is no marking lines for flow channelization. Wide arterials are divided by medians with rails as separators to segregate the motorized and non-motorized traffic. In some other main streets, the rails are used to divide the carriageway for both directions of traffic.

Table 2-2-2 Average Street Width

District	Average Street Width (meters)	
	Average Street Width (with sidewalks)	Average Street Width (Without sidewalks)
Hoan Kiem	16.77	10.13
Dong Da	13.67	10.22
Hai Ba Trung	20.26	12.27
Ba Dinh	13.88	8.70
Urban Hanoi	16.19	10.22

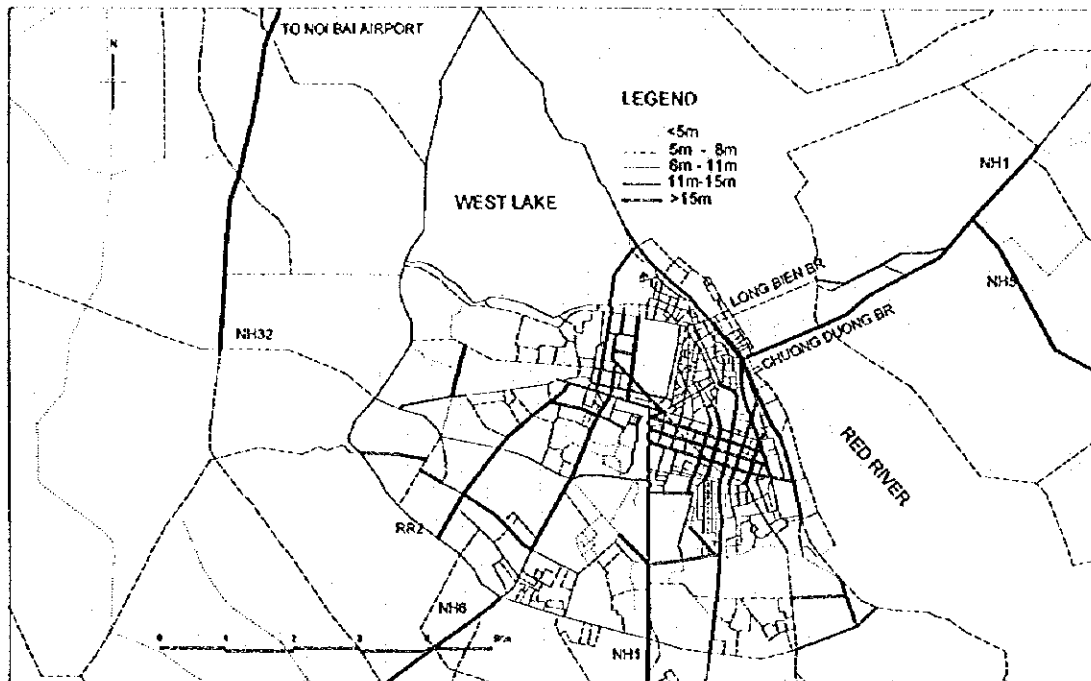


Fig. 2-2-3 Width Distribution of Urban Streets

### 2.2.2 Intersections

There is a high intersection frequency on the streets in the central area of urban Hanoi. Most of the intersections on main streets have no means of control with only 36 signalized intersections in the central area at present, which are shown on Fig. 1-3-1. The operating system of the signals depends on the manual control or pre-setting local controllers installed at each intersection. Some of the other main intersections are designed with small roundabouts to be supervised by policemen especially during the peak hours.

The traffic flow at the uncontrolled intersections shows a complicated pattern in which all the modes, with their different characteristics, and directions are mixed giving many conflict points. The design of most intersections does not provide for control facilities for mode segregation or islands and markings for channelization.

Several studies have been carried out on traffic control plans for the signalization of intersections and others to provide grade separation for heavy traffic directions. In section 1.3.2 of this report, the available information on the present situation of the signalization plans are presented, in which the existing signals are planned to be replaced by a more advanced system to be managed by an area control center. The old signals are to be used at lower priority intersections in suburban areas. The first phase of the project will cover 35 intersections out of 150 intersections to be signalized up to the year 2000.

Signalization may only provide less conflict points between crossing flows which will result mainly in higher safety level, but the efficiency of the system can be improved through the implementation of a more comprehensive traffic management plan considering the different characteristics of the transport modes used.

### 2.2.3 Parking Areas

The authority which is in charge of the parking areas in urban Hanoi is the Footpath Management Unit (FMU) under TUPWS. This unit is supervising at present a total of 48 parking areas with a total space of 9,341 m<sup>2</sup> designated for 366 vehicles with an average of 15.5 m<sup>2</sup>/vehicle. The FMU standard area for each car in the parking area is 25 m<sup>2</sup>. Most of the parking areas have limited capacity for just a few number of vehicles. The FMU is also supervising also 33 parking areas designated for taxis with a total capacity of 327 vehicles. Parking fees are collected at most of these parking areas but the total revenue may just cover the operating cost. The locations of the existing and planned car parking areas are shown in Fig. 2-2-4.

The parking area rate considering the total district population is about 0.01-0.4 m<sup>2</sup>/person and occupies about 0.05% of the total area of urban Hanoi on average as shown in Fig. 2-2-5. Dong Da district has the lowest present area for public parking, however, as it is planned to develop a parking area for about 500 vehicles in the district, it may have the highest rate in the near future. Other districts have also low rates of parking area at present without firm parking planning for the future.

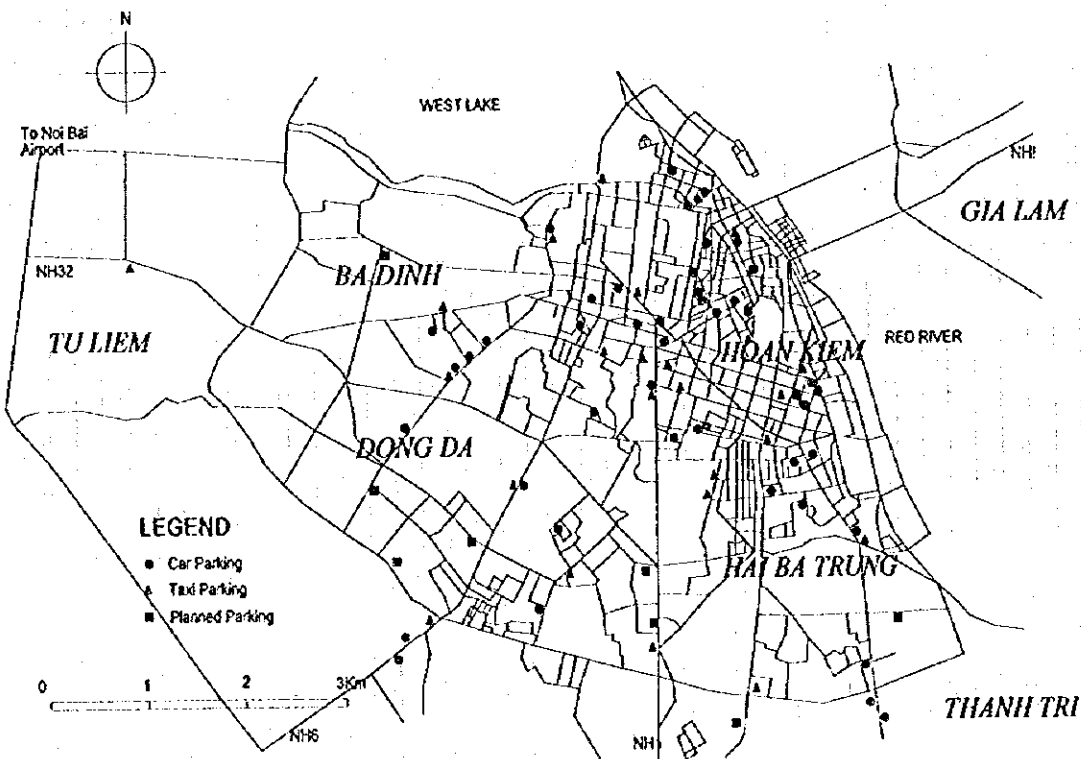


Fig. 2-2-4 Existing Car Parking Areas in Hanoi

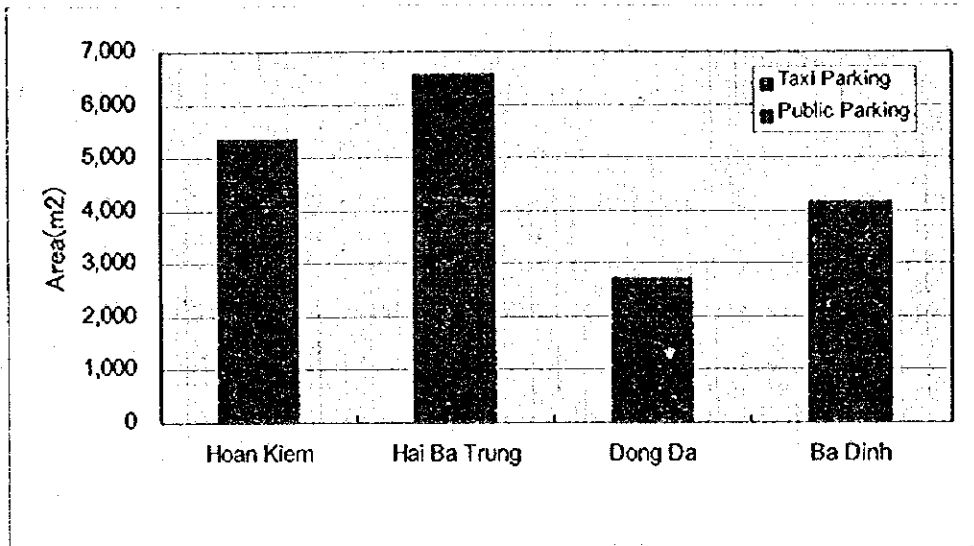


Fig. 2-2-5 Parking Characteristics in Hanoi (1)

For bicycles and motorcycles, which compose the dominant modes of transport in Hanoi at present, the parking areas are those occupying some parts of the pedestrians' sidewalks which cause serious problem regarding the safety of pedestrians.

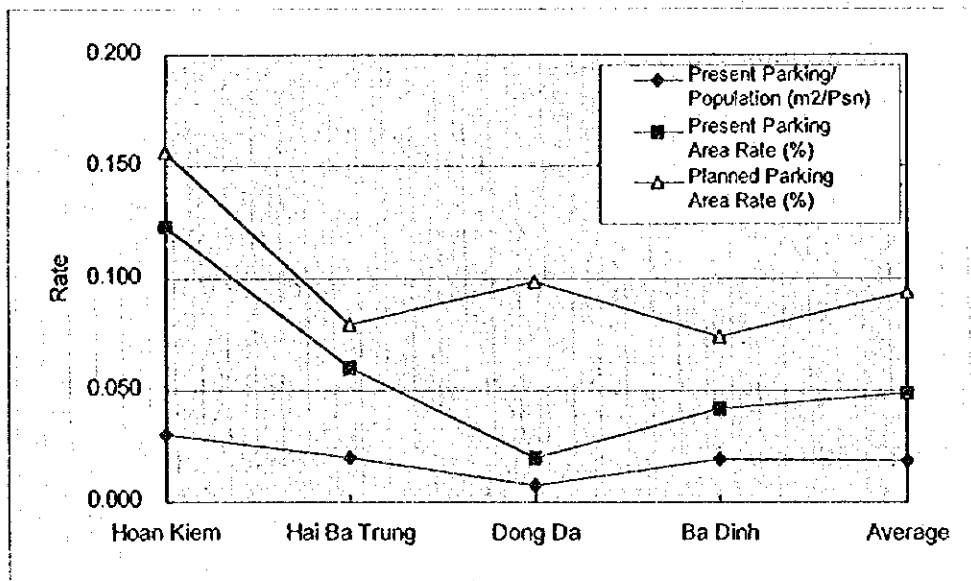


Fig. 2-2-5 Parking Characteristics in Hanoi (2)

Given the anticipated increase in the number of vehicles and motorization demand, the shortage in the parking space is expected to become one of the serious problems faced by the road network in the city. Many development projects and urban centers are planned to be implemented in Hanoi during the next few years, such projects will generate high volumes of vehicular traffic which will require more supply of off-street parking space which should be provided according to a comprehensive management plan taking into consideration the preservation of the city environment.

### 2.3 Rural Road Network

The rural road network in Hanoi city has a total length of about 770 Km and covers five districts with a total area of 880 Km<sup>2</sup> which gives a low area rate of about 0.88 Km/Km<sup>2</sup>. Fig. 2-3-1 shows the rural road network in Hanoi administratively. The network can be roughly classified according to the supervising authorities. The national highways are under the supervision of the Ministry of Transport and Communications (MOTC), the provincial roads are under TUPWS and the district roads are under the district transport offices. The road lengths for each road class of the network in the five districts are presented in Table 2-3-1.

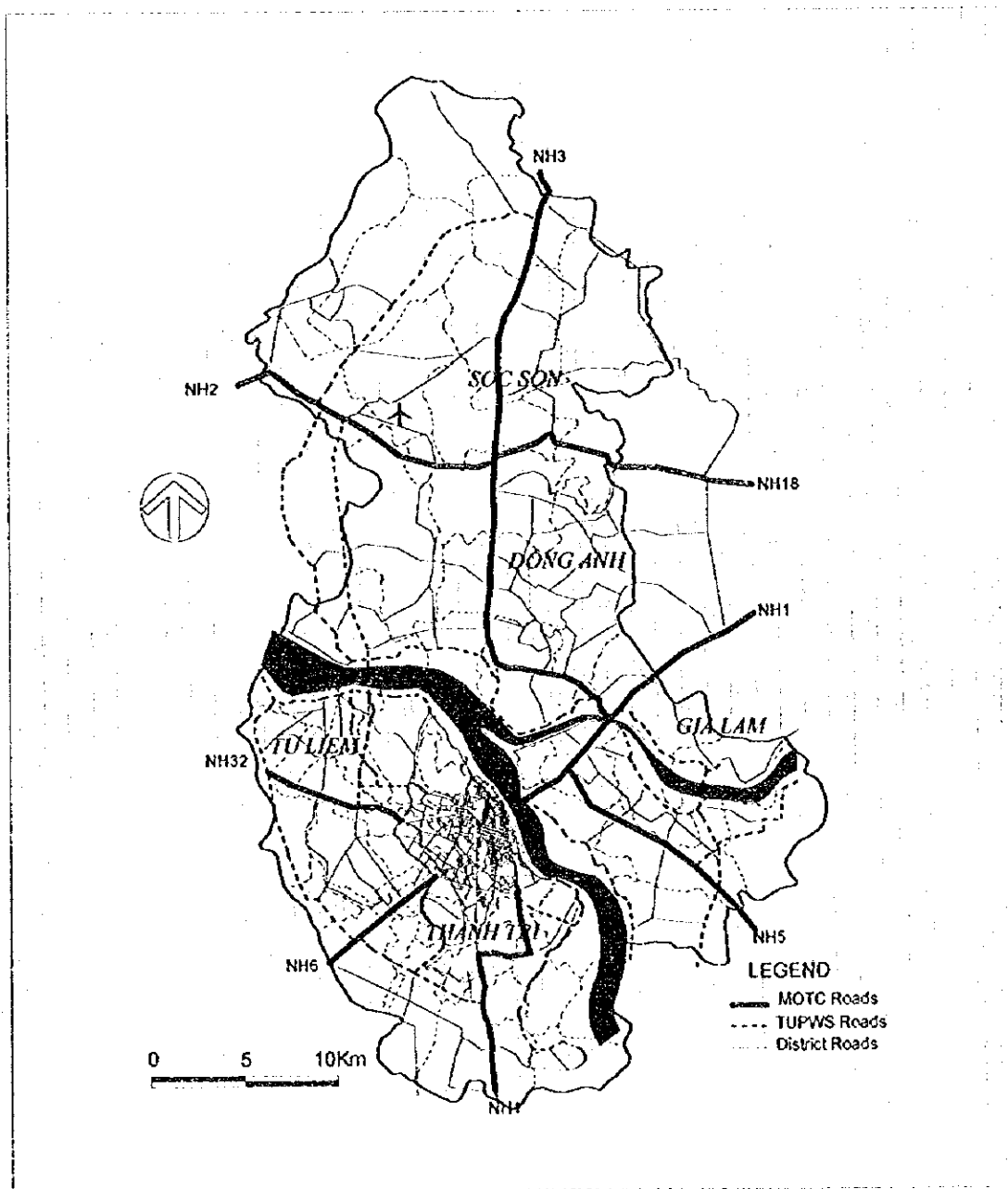


Fig. 2-3-1 Rural Road Network in Hanoi

Table 2-3-1 Rural Road Network Classification

District	National Highways	TUPWS Roads	District Roads	Total
Soc Son	30.70	25.00	171.30	227.00
Dong Anh	32.50	39.20	99.30	171.00
Gia Lam	20.50	69.90	61.57	151.97
Tu Liem	0.00	77.64	36.90	114.54
Thanh Tri	13.70	47.70	43.90	105.30
Rural Hanoi	97.40	259.44	412.97	769.81

Soc Son district has more roads than other districts, mostly under their district office supervision and the lowest share of TUPWS roads. In general, the TUPWS share of the road network is high in the districts of Gia Lam and Tu Liem, which are close to Hanoi City, than in other districts. In Tu Liem district there are no national highways and the only high standard road is a section of Noi Bai highway under the supervision of TUPWS.

The rural road inventory for roads and bridges in each district separately, prepared by the use of the information collected from TUPWS and different district offices, and supplemented and updated through several road surveys, was presented in the Progress Report (I) on the same basis of the above classification.

Fig. 2-3-2 shows the road condition of the network. Fig. 2-3-3 presents the share of each supervising authority and also includes the road condition share of the network. The road surface conditions of the national highways in general are good as all of them are paved using asphalt concrete. The condition of the provincial roads varies from fair surface condition for paved roads and bad condition for gravel, laterite or earth surface roads. The district roads are in general in bad condition as they are mostly unpaved, except for a few paved by the use of the bituminous penetration macadam.

Fig. 2-3-4 shows the width distribution. The values of the road density indicator were calculated as presented in Table 2-3-2 and Fig. 2-3-5. All the districts have a low road density in general especially the two districts of Gia Lam and Tu Liem.

Table 2-3-2 Road Density in Rural Hanoi

District	Road Length(Km)	Population	Area (km <sup>2</sup> )	Road Density
Soc Son	227.00	224,334	313.3	0.86
Dong Anh	171.00	236,099	184.2	0.82
Gia Lam	151.97	295,610	175.7	0.67
Tu Liem	114.54	272,748	109.7	0.66
Thanh Tri	105.30	201,657	95.7	0.76
Total	769.81	1,230,448	878.6	0.74



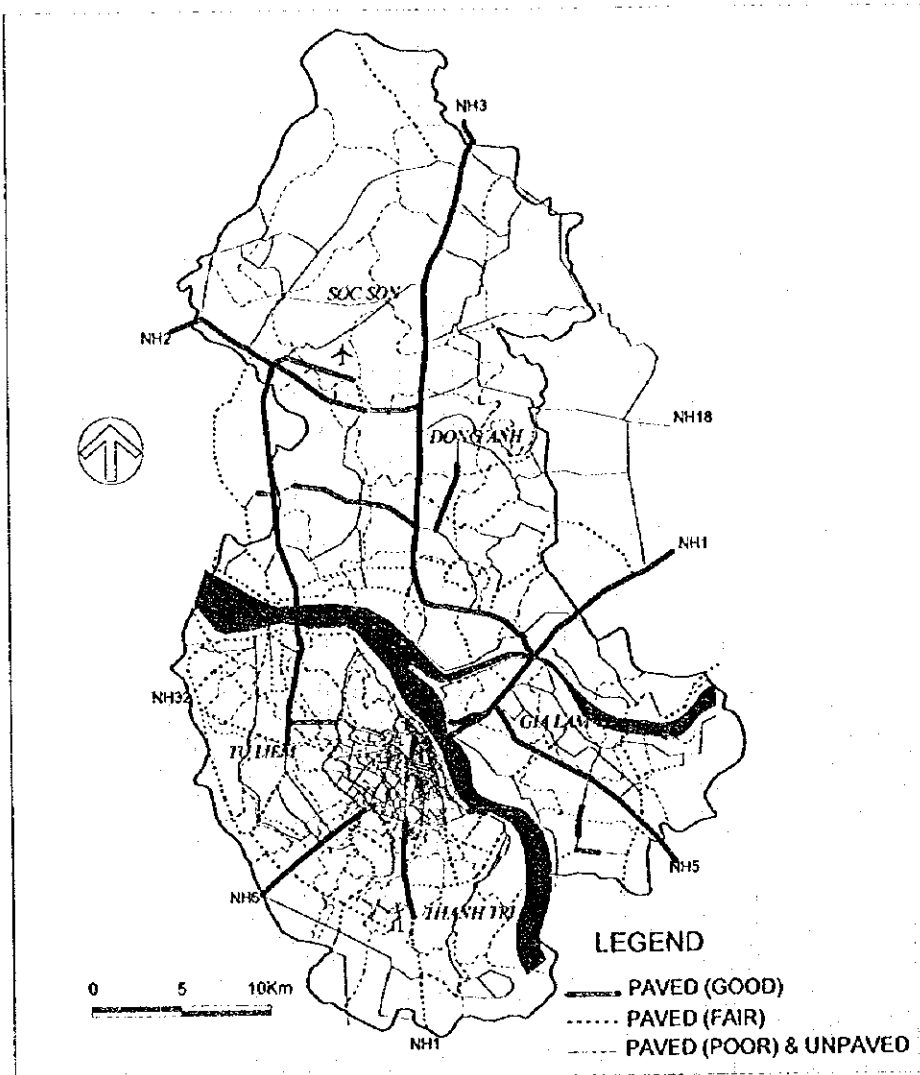


Fig. 2-3-2 Rural Road Network Condition

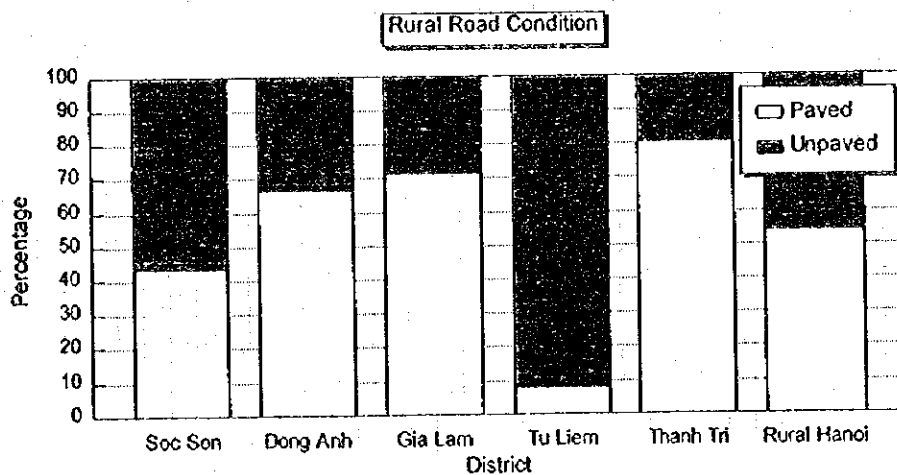


Fig. 2-3-3 Rural Road Pavement Condition

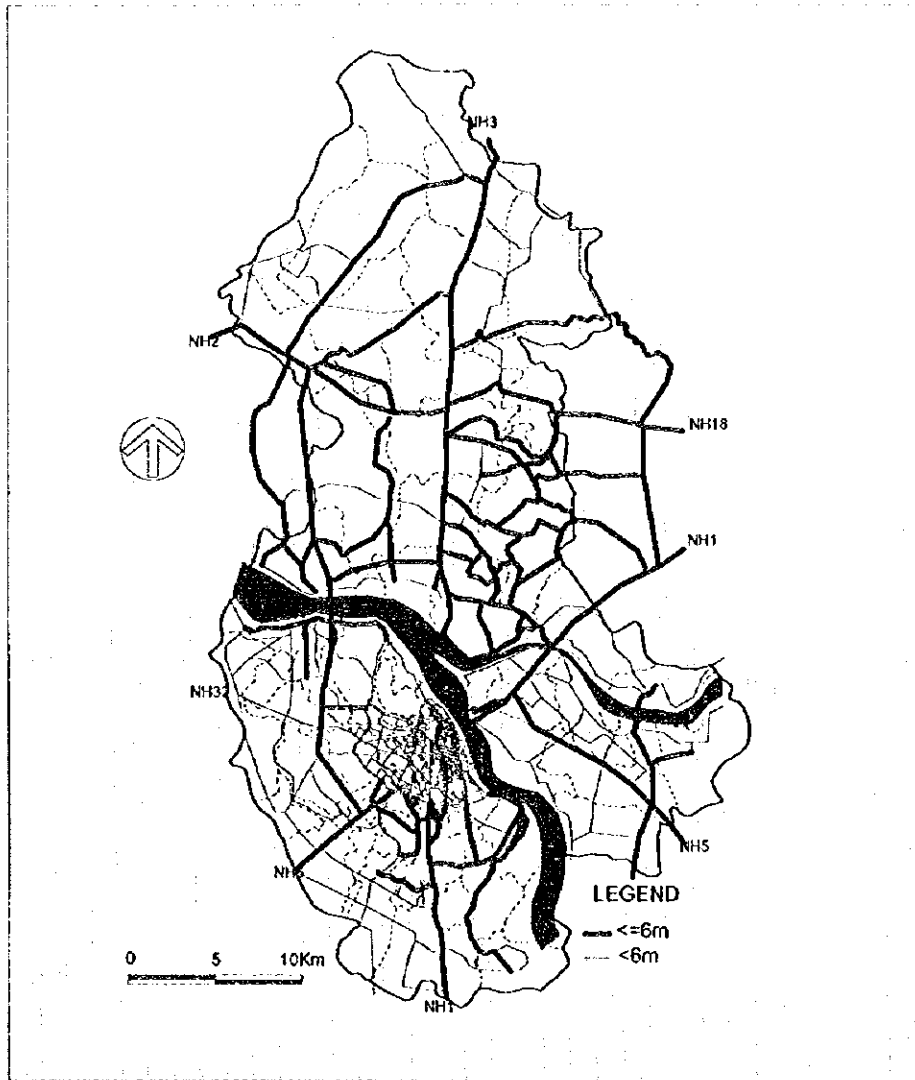


Fig. 2-3-4 Rural Road Network Width Distribution

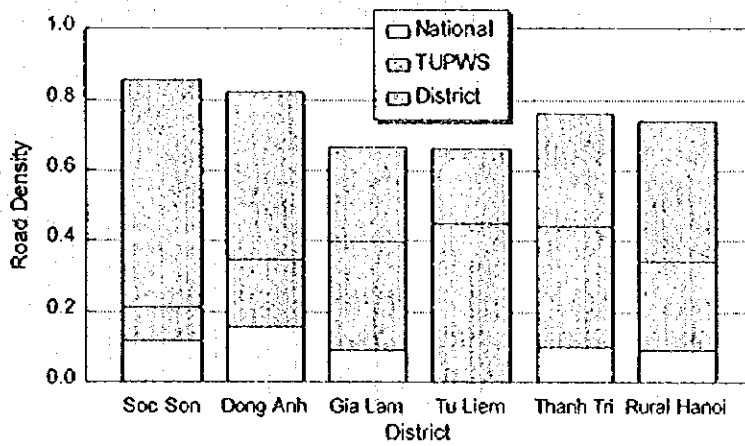


Fig. 2-3-5 Rural Road Density by District

## 2.4 Bridges

There are total of 126 road and railway bridges crossing the water causes in Hanoi. An inventory for all the road and railway bridges was included in Progress Report (1). Data on the inventory is summarized in Fig. 2-4-1 to indicate the general characteristics of these bridges. Bridges in urban Hanoi are in general in good condition and bridges on rural roads are in good to fair condition. The railway bridges are old and in bad condition. The average bridge width in rural areas is higher in districts south of the Red River directly adjacent to urban Hanoi.

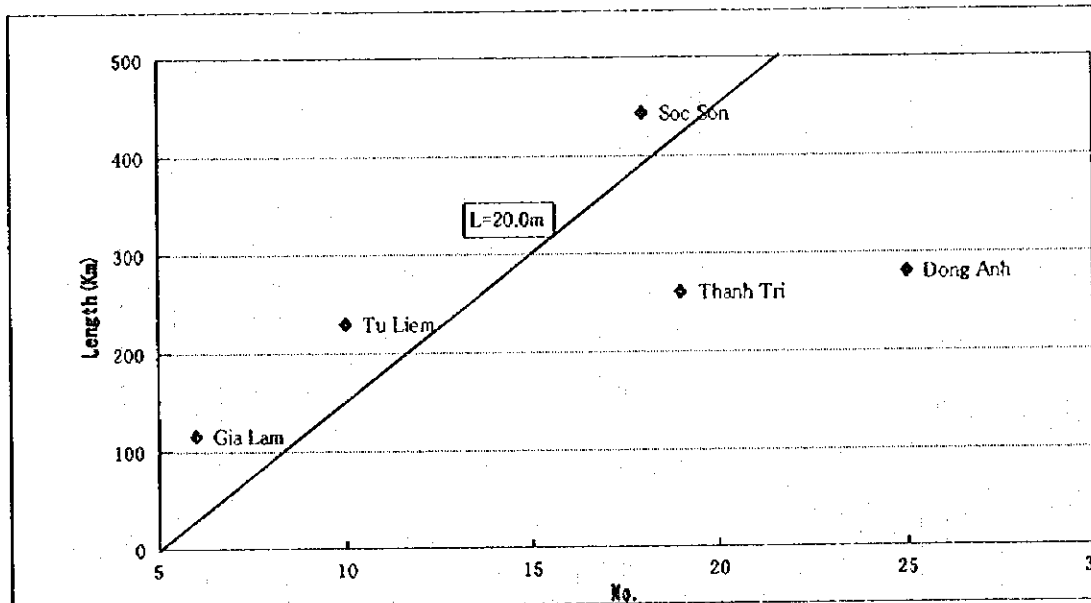


Fig. 2-4-1 Bridge Characteristics in Hanoi

Fig. 2-4-1 show the relationship between the bridge length and the bridge nos. by districts in the rural area. The bridges in Soc Son, Tu Liem, and Gia Lam have the total length of more than 20m, while those in Thanh Tri and Dong Da districts have rather short length of less than 20m. Especially the bridges in Dong Da district are short with the average length of about 12m. They are crossing over small canals in the agricultural fields by one or two spans, by T-girder or slab type bridges. It is noted that the bridges on the main river of the Red River, where bridge total length will be more than 1Km are not included in this inventory.

## 2.5 Maintenance and Operation

One of the main problems regarding road transport in Hanoi is the road surface condition which varies significantly with few roads in good condition and the majority suffering from deterioration. With the high ground water levels and the geological soil structure, the roads are easily damaged and in continuous need of maintenance. The present condition of roads, even with mainly light-vehicle traffic, shows that the maintenance management system is inadequate and does not provide for the requirements of the existing urban street standards. The planning, financing and supervising activities of the urban transport sector in Hanoi are basically under the responsibility of Hanoi People's Committee (HPC). As the road network in Hanoi is divided into national, provincial and district roads, the maintenance management is carried out mainly by the following authorities:

- The management unit of the Vietnam Road Administration (VRA), under the Ministry of Transport and Communications (MOTC), is responsible for managing a length of 84.0 km of national roads
- The management unit of TUPWS, under Hanoi People's Committee (HPC), has three construction companies for maintenance works of mainly provincial roads and some other national and district roads.
- The district management units are supervising the municipal, village and district roads.

The road lengths break-down for each authority are as presented in Table 2-5-1.

Table 2-5-1 Road Length by Management Unit

Road Type	Road Length (km)		
	VRA	TUPWS	District
National Road	71.700	28.386	-
Special Road (State)	12.300	14.000	-
Provincial Road	-	134.588	-
Special Road (TUPWS)	-	90.533	-
District Road	-	19.814	-
District/Municipal Road	-	-	427.000
Total	84.000	461.691	427.000

Three construction companies, under TUPWS, manage the road maintenance works for the road under the supervision of TUPWS. In addition, there is a fourth construction company dealing with the new road construction projects and other building projects. The geographical road distribution for each of the three construction companies is as follows:

- Construction Company I (CC-I): Responsible for the district of Soc Son and Dong Anh north of the Red River.
- Construction Company II (CC-II): Responsible for the districts of Tu Liem, Thanh Tri and Gia Lam south of the Red River.
- Construction Company III (CC-III): Responsible for streets in the urban districts of Hoan Kiem, Hai Ba Trung, Dong Da and Ba Dinh

Table 2-5-2 gives the activities, number of employees and capital investment of each of the three companies.

Table 2-5-2 Investments of TUPWS Construction Companies

Company	Managed Length (km)	Roads Area (m <sup>2</sup> )	No. of Employees	Investment Capital (million VND)	
				1994	1995
CC-I	121,040	469,591	331		
CC-II	146,467	539,701	400	2,900	3,500
CC-III	194,184	1,926,379	502	29,700	37,907
Total	461,691	2,930,671	1,233	32,600	41,407

During the last few years, the investment of the government in the road rehabilitation and maintenance has been increased significantly for both the urban and rural roads. In the urban areas of Hanoi, about 60% of the streets have bituminous-treated surface. The pavement maintenance standards, however, are inadequate and the shortage of funds may also contribute to the existing condition of road surface. A more advanced pavement maintenance management system is required so that the scheduling and cost of each treatment type can be assessed with regard to the savings in the vehicle-operating costs (VOC), in order to select the optimum timing and method of application.

The equipment operated by each of the three maintenance companies in Hanoi is listed in Table 2-5-3. As shown in the table, there is a severe shortage of equipment in addition to the fact that most of this equipment is out-dated and not in a good functioning condition.

Table 2-5-3 Road Maintenance Equipment

Company	Roller 8-10t	Bulldozer 75/100HP	Truck 8-10t	Leveling Machine	Excavator	Asphalt Plant	Asphalt Complex
CC-I	12	3	10	1	2	-	-
CC-II	8	2	6	1	1	-	1 (J)
CC-III	11	2	15	0	1	1 (R-25t/h)	2 (J)
Total	31	7	31	2	4	1	3

## 2.6 Design Standards

The design standards and specifications used by the Ministry of Construction (MOC), which is responsible for the urban development projects, if applied, cover different elements of the geometric design procedure in the geometrical design specifications for urban streets (Code 20TCN-104-83). For some particular items, the standards do not consider the local conditions in the country and propose over-standard design. The standards do not give enough attention to local problems such as the segregation between motorized and non-motorized traffic.

The most of the road planning and design standards follow those of the Former Soviet Union (FSU), where one lane has 3.75m and the road design speed varies between 60 Km/h to 120Km/h. The followings are the some comparisons with AASHTO and other Western standards.

Table 2-6-1 shows the traffic capacity in terms of vehicles/hour/lane. The lane capacity of car on the highway ranges between 1,200 - 1,500 vehicles/hour, which is lower than the basic capacity of 2,500 vehicles/hour in Japan. However the figures in Table 2-6-1 are similar to the practical capacity after adjusted by the effects of heavy vehicles and land use along the roads, and by the service level.

Table 2-6-1 Traffic Capacity (veh./hr)

Vehicle Category	Interchange		Intersection
	Highway	Main Street	
Car	1200-1500	1000-1200	600-700
Truck	600-800	500-650	300-400
Bus	200-300	150-250	100-150
Tram		110-130	70-90

Table 2-6-2 shows the Passenger Car Equivalence (PCE). The figures are almost same as in the Western Standards.

Table 2-6-2 Passenger Car Equivalence

Vehicle Category	Equivalent Factor
Car	1.0
Truck: less than 2 ton	1.5
2 - 5 ton	2.0
5 - 8 ton	3.0
8 - 14 ton	3.5
more than 14 ton	3.5
Trailer	6.0
Bus	2.5
Tram	3.0
Articulated Bus or Tram	4.0
Motorcycle	0.5
Bicycle	0.3

Table 2-6-3 shows the lane distribution factors and the carriageway distribution factors. When the multi-lane road is designed, the total capacity is calculated by multiplying the single lane capacity with Carriageway Distribution Factor, which is the accumulation of the lane distribution factors, i.e. the divided 6 lane road will have  $1.0+0.9+0.8=2.7$  times

of 2 lane road capacity.

Table 2-6-3 Lane Distribution Factor

No. of Lane	Lane Distribution Factor	Carriageway Distribution Factor
First lane	1.0	1.0
Second lane	0.9	1.9
Third lane	0.8	2.7
Forth lane	0.8	3.5

Table 2-6-4 shows the pedestrian capacity by type of pedestrian. The unit width of sidewalk/pedestrian lane is 0.75m.

Table 2-6-4 Pedestrian Capacity

Sidewalk Type	Pedestrian Capacity (Pedestrian/hour)
Sidewalk with shops/houses	700
Sidewalk without shops/houses	800
Sidewalk with trees	1,000
Footpath in parks	600
At-grade road crossing	1,200

Besides these unique design standards, there is a standards on motorcycle and bicycle. Segregation of bicycle traffic is applied in the following cases:

- Vehicular ADT is more than 2,000 vehicles/day
- Bicycle and motorcycle traffic is more than 250 vehicles/day

In such case, a bicycle lane with a minimum width of 0.8m should be separated on both sides of the main road by trees or special safety barriers. The capacity of the bicycle lane is 300 bicycles/hr. The main technical specifications of bicycle roads are shown in Table 2-6-5.

Table 2-6-5 Standards for Bicycle Road

Item	New Construction Scheme	Improvement Scheme
Design Speed (kph)	25	
Lane Capacity (bicycle/h)	300	
Horizontal Curve Radius (m)		
Desirable	150	60
Minimum	50	15
Vertical Curve Radius (m)		
Convex curve	600	400
Concave curve	150	100
Longitudinal Gradient (%)		
Slope length 50m	4.0	4.0
Slope length 100m	3.5	3.5
Slope length 150m	3.0	3.0
Slope length 200m or more	2.0-0.5	2.0-0.5
Minimum Safe Width (m)		
1-lane 1-way	1.00	0.70
2-lane 1-way	1.75	1.50
2-lane 2-way	2.00	1.70

## 2.7 Organization and Budget

The transport system in Hanoi is under the administrative control of both the Ministry of Construction (MOC) and Ministry of Transport and Communications (MOTC) in addition to the Hanoi People's Committee (HPC). In addition to the national highways which are under the responsibility of the MOTC, HPC is the authority who finance the construction of new roads and the maintenance works for the other roads in the city. Transport and Urban Public Works Services (TUPWS) is the department with direct responsibility for such activities and receives its budget from the HPC for all the works on the provincial road network. In addition, the district offices of the nine districts composing Hanoi City also receive funds from HPC for construction and maintenance works on the district road networks under their jurisdiction.

Fig. 2-7-1 shows the organization chart of MOTC. The planning and investment department is responsible for the highway network and investment planning, and the a public corporation of Transport Engineering Design Incorporated (TEDI) and a project unit, which will be established in ad-hoc bases will be in charge of the implementation.

The share of the transport sector budget in all the state budget has been decreasing as shown in Table 2-7-1. According to 1990 estimate, the almost 3/4 of the transport sector budget was spend to road sub-sector.

Table 2-7-1 Transport Sector Budget

Unit: Billion VND in Current Price

Item	1991	1992	1993
State Budget	9,946	17,105	36,590
Transport Sector Budget	753	660	449
Share(%)	7.6	3.9	1.2

Source: Key Indicators of Developing Asia and Pacific Countries 1993, ADB

The organizational chart of the HPC is presented in Fig. 2-7-2 and also includes the organization of TUPWS. TUPWS was set up in 1990 and employs at present about 20,000 persons. TUPWS is carrying out its activities through 9 management and administrative departments. Under these departments, there are 23 companies and enterprises covering many different tasks of transportation and public works as shown in the organizational chart.



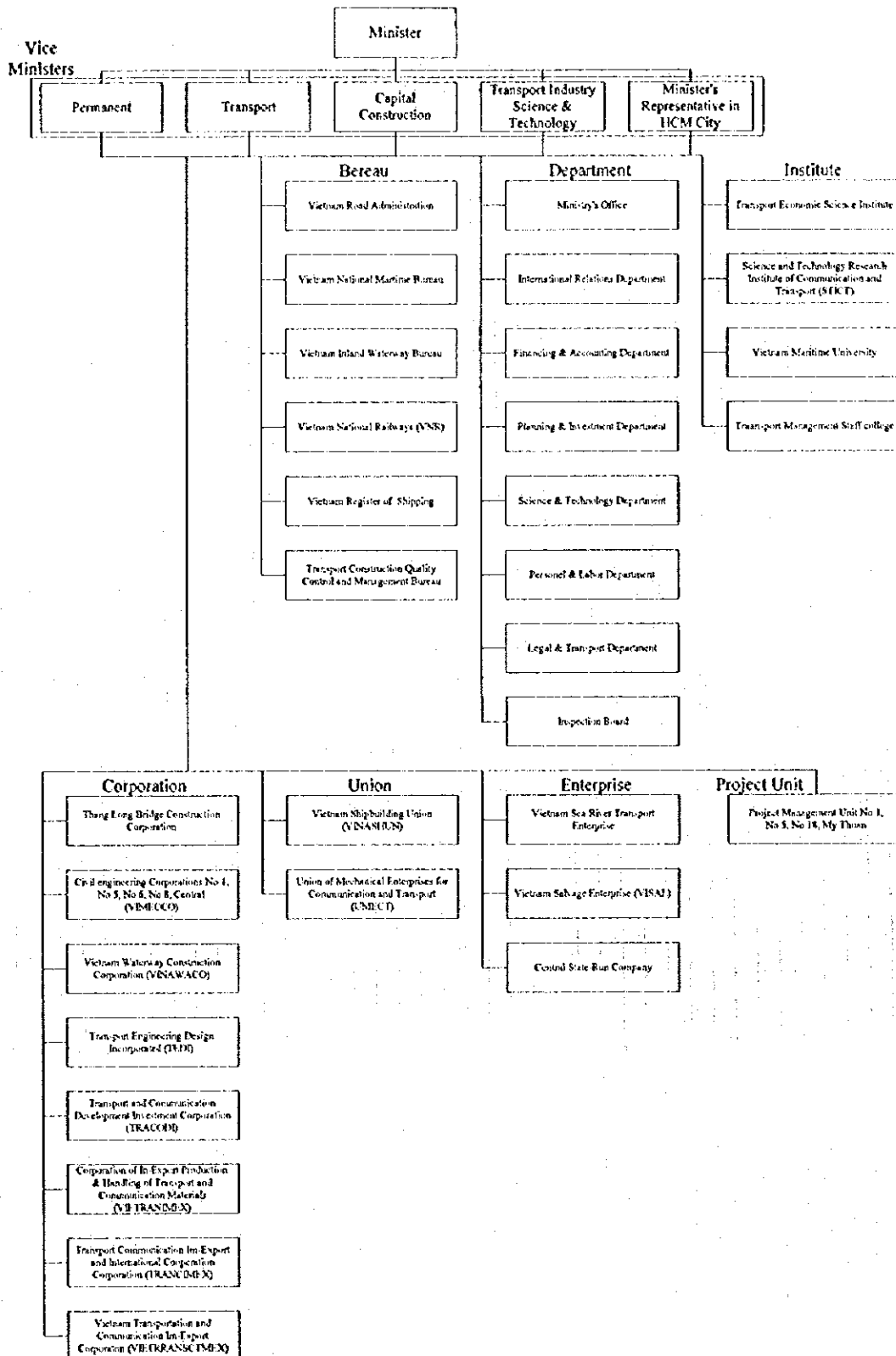


Fig. 2-7-1 Organization of MOTC

Fig. 2-7-3, which gives the trend of the annual budget of TUPWS between 1993 and 1995, shows that the total budget for both new construction and maintenance activities for road and bridges was almost constant and the budget allocation for each task varied

depending on the priorities of the projects.

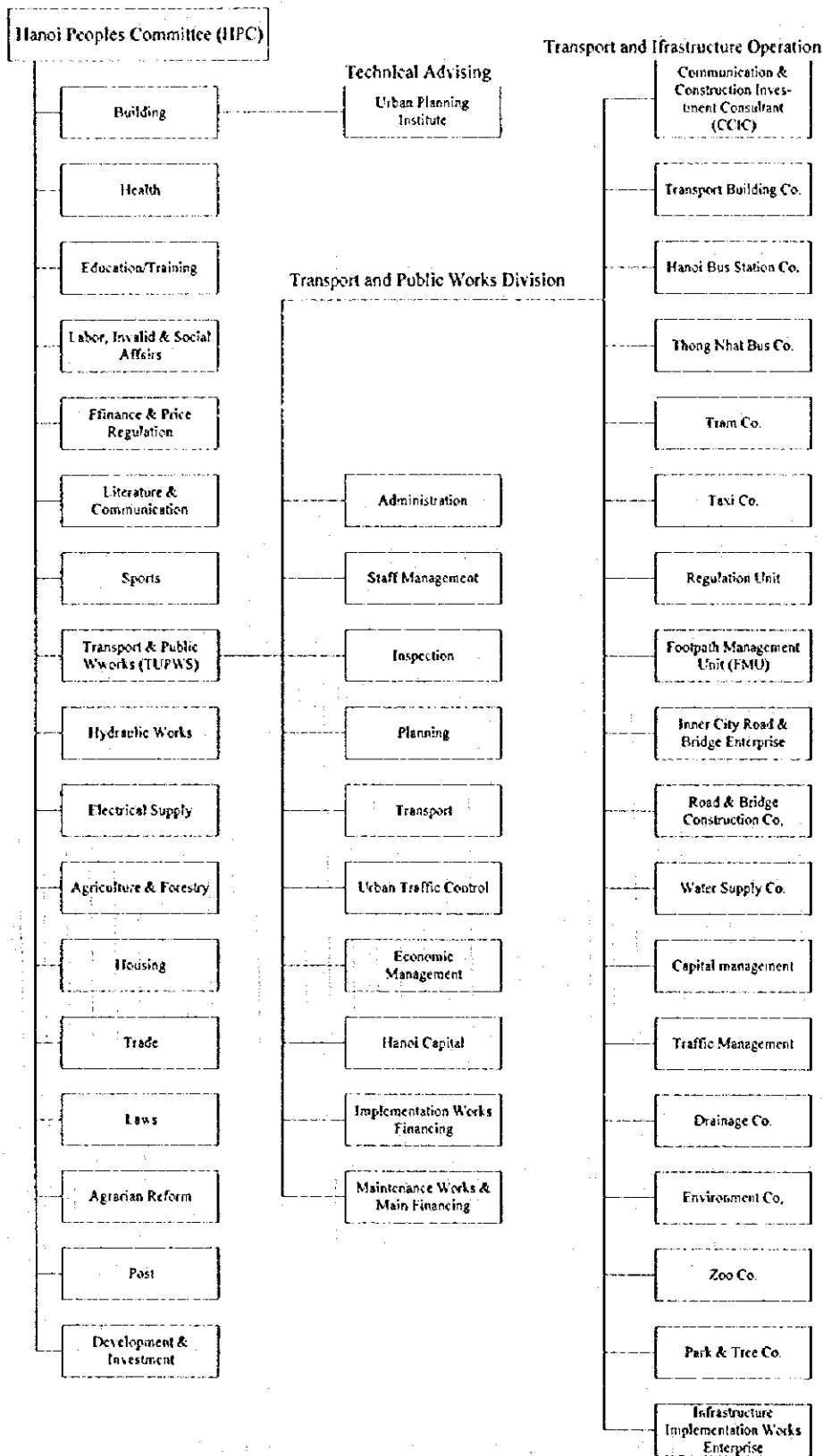


Fig. 2-7-2 HPC and TUPWS Organization Chart

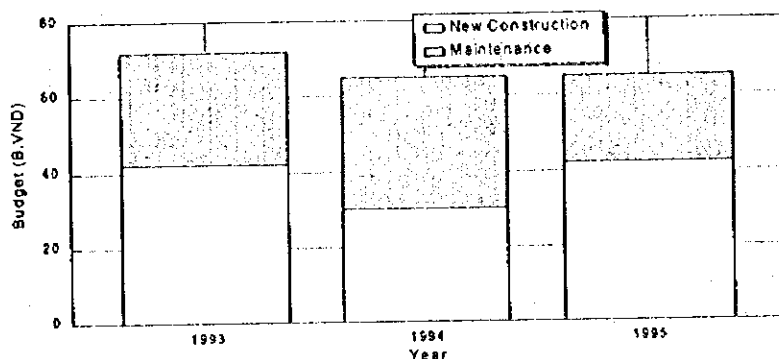


Fig. 2-7-3 TUPWS Road Budget

Table 2-7-2 shows the performance and budget, for each of the five districts in rural Hanoi, which was used for the maintenance, rehabilitation and upgrading of district and village roads between 1990 and 1995, as obtained from the planning department of TUPWS. The increase in the budget allocated for the different improvement projects of roads in all the districts show the importance given to the transport infrastructure in the last few years. The increase in the length of the district road network was limited to a section of about 1.5 Km in Thanh Tri district while other maintained a constant length.

Table 2-7-2 District Budget for Road Improvement

District	1990	1991	1992	1993	1994	1995*
<b>Thanh Tri</b>						
District Roads (km)	46.29	46.29	46.29	46.29	46.29	47.80
Village Road (km)	245.00	245.00	254.00	254.00	254.00	254.00
State Budget (m d)	190	420	1,500	1,500	4,500	7,500
Local Budget (m d)	250	200	600	1,500	5,500	7,500
Manpower (man day)	6,000	6,000	5,000	30,000	20,000	20,000
<b>Gia Lam</b>						
District Roads (km)	49.30	49.30	49.30	49.30	49.30	49.30
Village Road (km)	449.00	449.00	449.00	449.00	449.00	449.00
State Budget (m d)	0	675	1,100	2,250	2,600	7,300
Local Budget (m d)	4,520	8,930	9,040	9,600	8,000	8,000
Manpower (man day)	N/A	N/A	N/A	N/A	N/A	N/A
<b>Dong Anh</b>						
District Roads (km)	113.00	113.00	113.00	120.00	120.00	120.00
Village Road (km)	400.00	400.00	400.00	393.00	393.00	393.00
State Budget (m d)	150	280	580	3,400	5,190	5,500
Local Budget (m d)	900	1,264	2,600	2,950	8,850	9,000
Manpower (man day)	50,000	60,000	75,000	87,000	172,000	150,000
<b>Tu Lien</b>						
District Roads (km)	28.90	28.90	28.90	28.90	28.90	28.90
Village Road (km)	410.00	410.00	410.00	410.00	410.00	410.00
State Budget (m d)	N/A	265	1,384	2,749	2,755	2,000
Local Budget (m d)	N/A	177	2,182	947	468	1,000
Manpower (man day)	N/A	N/A	N/A	N/A	N/A	N/A
<b>Soc Son</b>						
District Roads (km)	189.60	189.60	89.60	189.60	189.60	189.60
Village Road (km)	323.50	323.50	23.50	323.50	323.50	323.50
State Budget (m d)	57	105	2,050	1,070	1,070	4,730
Local Budget (m d)	23	41	0	0	0	500
Manpower (man day)	7,700	6,000	24,000	45,000	45,000	165,000

\* Anticipated



## CHAPTER 3 PRESENT TRAFFIC CONDITIONS

### 3.1 Cordon Line Survey

Table 3-1-1 shows the summary of the cordon line survey carried out in October, 1995. The survey points were 15 stations on the highways, 1 Noi Bai International airport, 3 railway stations of Giap Bat, Hanoi and Yen Vien, and 1 river port of Chuong Duong. The locations are shown in Fig. 3-1-1.

Table 3-1-1 Cordon Line Survey

STATION	LOCATION	TRIP	SAMPLE	SAMPLE RATE	REMARKS
101	NH3	22,093	1,934	8.8	24Hr
102	PH16	2,926	568	19.4	
103	DH	1,439	215	14.9	
104	NH1	43,910	4,608	10.5	
105	PH181	6,587	995	15.1	
106	NH5	52,252	4,188	8.0	24Hr
107	PH	4,677	688	14.7	
108	DH	8,298	1,424	17.2	
109	NH1	75,306	3,976	5.3	24Hr
110	NH6	72,207	5,691	7.9	24Hr
111	PH72	13,345	1,636	12.3	
112	NH32	44,879	4,256	9.5	
113	PH23	4,603	716	15.6	
114	DH	5,879	608	10.3	
115	DH	18,920	1,608	8.5	
116	HANOI R/S	7,717	1,532	19.9	
117	GIAP BAT R/S	159	86	54.1	
118	YEN VIEN R/S	81	45	55.6	
119	NOI BAI A/P	3,031	616	20.3	
120	CHUONG DUONG R/P	363	120	33.1	
	Total	388,672	35,510	9.1	

NOTE: NH: NATIONAL HIGHWAY R/S: RAILWAY STATION  
 PH: PROVINCIAL HIGHWAY A/P: AIR PORT  
 DH: DISTRICT HIGHWAY R/P: RIVER PORT

Table 3-1-2 shows the vehicle occupancies from the passenger interviews at the cordon line stations of 101 to 115.

Table 3-1-2 Vehicle Occupancies

Mode	Sample	Passengers	Occupancy	Remarks
Walk	387	387	1.00	
Bicycle	9,285	9,755	1.05	
Cyclo	69	103	1.49	include. driver
Motorcycle	13,635	19,023	1.40	
Passenger Car	1,172	4,570	3.90	include. driver
Mini Bus/Van	1,859	13,499	8.66	include. driver
Bus	3,009	95,560	25.09	include. driver
Truck	3,808	8,285	2.18	include. driver
Others	175	365	2.09	

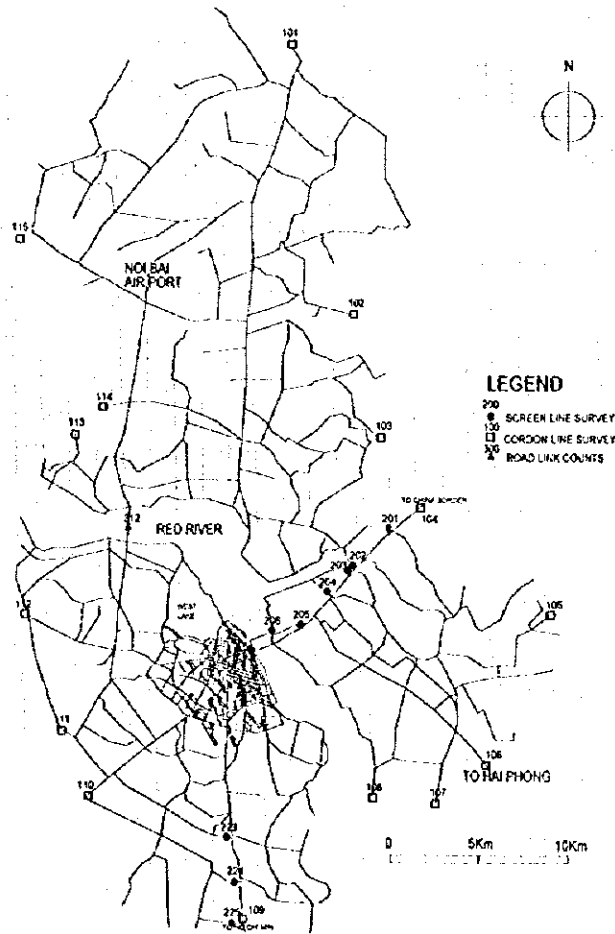
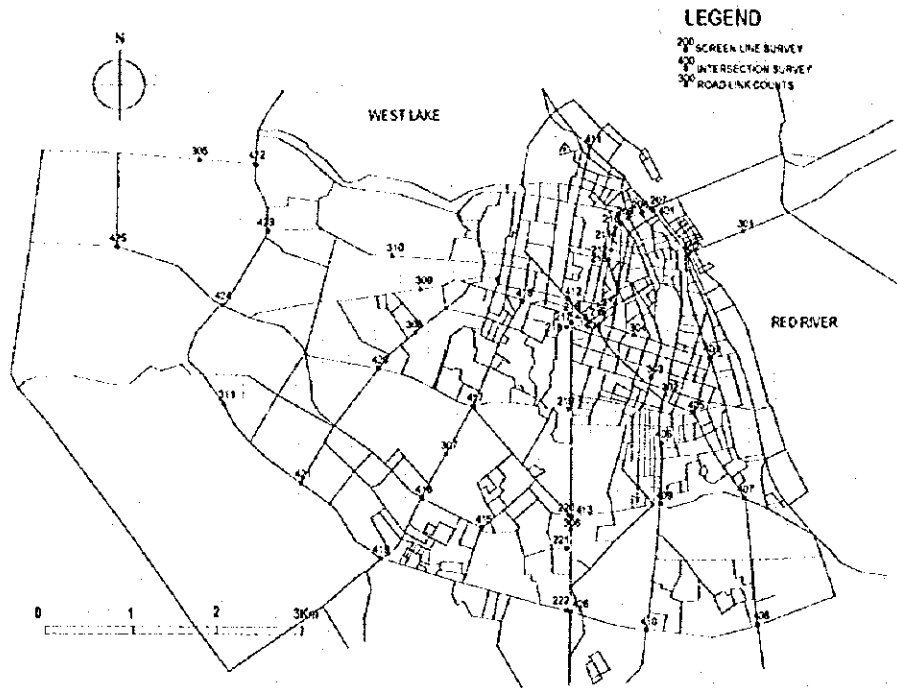


Fig. 3-1-1 Survey Locations

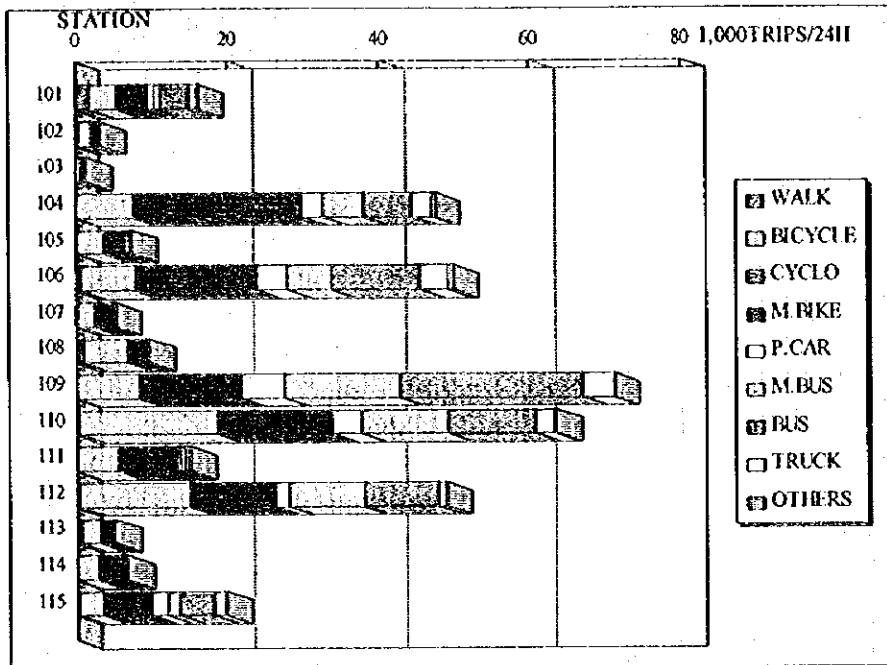


Fig. 3-1-2 24hr. trips by mode and by station.

Table 3-1-3 24Hr/14Hr Factor

MODE	14Hr Trips	24Hr Trips	24/14Hr
WALK	2,857	3,215	1.13
BICYCLE	29,934	34,934	1.17
CYCLO	314	339	1.08
M.Cycle	29,709	34,744	1.17
P.CAR	4,326	5,057	1.17
M.BUS	3,748	4,316	1.15
BUS	1,909	2,145	1.12
TRUCK	6,830	9,295	1.36
OTHERS	683	783	1.15

Fig. 3-1-2 shows the summary of the cordon line survey results, adjusted to 24Hr trips applying the average 24/14 hours factors derived from four 24Hr. survey stations (see Table 3-1-3), and occupancies. The highest flow was observed at the station 109 on the National Highway No.1 to Ho Chi Min City, followed by the station 110 on the National Highway No.6 to Ha Dong Town.

The average mode shares of 15 highway stations show the highest share of 29.5% for motorcycle, followed by 23.2% for bicycle, 19.9% for bus and 13.6% for mini bus. The passenger car and truck comprise of low shares of 5.9% and 4.7% respectively. The highest share of motorcycle (47.0%) is seen on the station 104, National Highway No.1 to north, and the highest share of bicycle (60.2%) is seen on the station 108, a district highway in Gia Lam to south. The high bicycle flow of about 18,000 trips/day is seen at the station 110, National Highway No.6 to Ha Don.

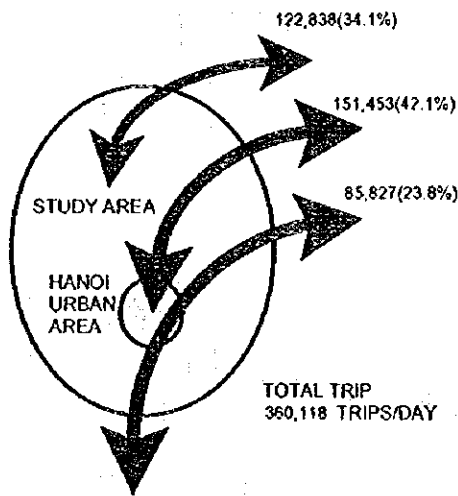


Fig. 3-1-3 Cordon Trip Flow

Fig. 3-1-3 shows the cordon trip flows among outside of the Study area, Hanoi rural area and Hanoi urban area, after the expansion of sample OD to the counts by hour and mode, excluding walk trips, drivers and trips at the stations 116 - 120. The final total cordon trips are 220 thousands/day and about 1/3 of the cordon trips are through trips of the Study area.

The passengers from the 3 railway stations in the Study area were about 8,000 trips/day, which equivalents to 3.6% of the total cordon trips, the passenger from the airport comprises of 3,031 trips or 1.4% excluding welcomers and well-wishers, and the passengers from the river port comprises of 363 trips or 0.2%.



### 3.2 Screen Line Survey

The screen line was selected along the existing railway running from the south, crossing Red River by Long Bien Bridge to north. The traffic were counted at totally 25 survey stations where the streets cross the railway line, for 14 hours and for 24 hours at 4 major stations of 203, 207, 216 and 222.

Table 3-2-1 Screen Line Trips

Station	Counts (TRIP)	PHF(%)	Remarks	Station	Counts (TRIP)	PHF(%)	Remarks
201	6,793	15.4		214	59,872	11.8	
202	7,100	11.5		215	187,780	11.4	
203	54,675	10.3	24Hr	216	95,566	9.8	24Hr
204	21,403	11.7		217	70,177	10.5	
205	8,154	11.0		218	131,751	10.7	
206	34,927	13.4		219	213,353	12.3	
207	153,936	10.3	24Hr	220	193,433	15.0	
208	12,856	9.5		221	65,031	12.6	
209	40,879	12.6		222	206,898	10.0	24Hr
210	126,159	12.4		223	42,853	18.7	
211	27,813	10.4		224	20,608	10.1	
212	4,600	13.5		225	51,575	13.7	
213	31,675	12.6		Total	1,869,867		

Table 3-2-2 24/14 Hours Factor by Mode

Mode	14Hr Trips	24Hr Trips	24/14Hr
Walk	5,795	7,261	1.25
Bicycle	100,020	108,580	1.09
Cyclo	6,707	7,367	1.10
M.Bike	146,784	164,620	1.12
P.Car	10,140	11,989	1.18
M.bus	6,913	7,795	1.13
Bus	1,687	1,797	1.07
Truck	9,187	12,825	1.40
Others	1,028	1,350	1.31

The total daily passengers cross the screen line are about 1.9 million trips as shown in Table 3-2-1. The peak hour factors (PHF) are calculated at 9.5% at the station 208 on the Red River Dike road under Long Bien Bridge, and 18.7% at the station 223, where a road from the National Highway No.1 branches.

The mode shares after adjusted to 24hrs. trips applying 24/14 hrs. factors by mode shown in Table 3-2-2 are given in Fig. 3-2-1. The highest flow is seen at the station 219 on Kham Thien St., followed by the station 220 on Kim Lien St. and 215 on Nguyen Thai Hoc St. at the city center. The highest motorcycle flow of about 155 thousands or 59.1% of the total trips is seen at the station 219. The highest bicycle flows about 64 thousands are seen at the stations 219 and 220.

The total mode share of all the screen line survey stations shows the highest share of 50.4% for motorcycle, followed by 23.1% for bicycle, 7.2% for mini bus and 6.7% for passenger car.

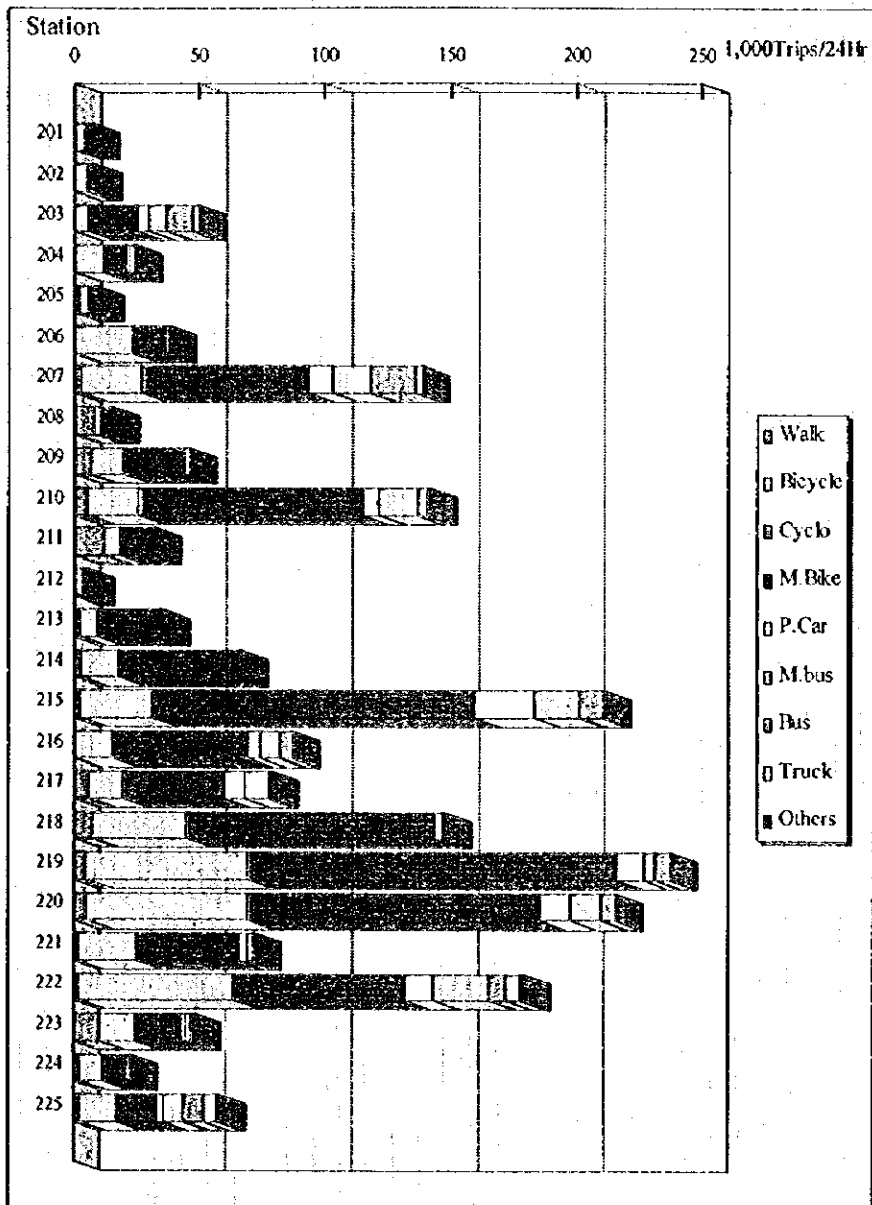


Fig. 3-2-1 Screen Line Trips

### 3.3 Traffic Flows on Road Links

Traffic counts were carried out at 12 stations on the streets within the urban area. Table 3-3-1 summarizes the survey results, converted to trips applying the occupancies from the Cordon line survey. The peak hour factors range between 8.9% at Thang Long bridge to Noi Bai Airport and 13.9% on Ba Trieu St. The D-values at the peak hour range between 0.51 at the station 308 and 0.80 at the station 312 on Thang Long bridge.

Table 3-3-1 Road Link Flow

Station	Location	Trip	PHF	D-Value	Remarks
301	Chong Duong Br.	194,280	11.1	0.69	24Hr
302	Hue St.	106,064	10.3		One-Way
303	Ba Trieu St.	150,742	13.9		One-Way
304	Trang Thi St.	49,643	11.8		One-Way
305	Duong Nghia Do St.	112,797	13.6		One-Way
306	Duong Giai Phong St.	265,289	10.8	0.63	24Hr
307	Nguyen Luong Bang St.	235,555	11.5	0.54	
308	Giang Vo St.	208,041	11.4	0.51	
309	Kim Ma St.	158,933	10.6	0.59	
310	Doi Can St.	68,925	10.8	0.56	
311	Duong Lang St.	135,222	10.5	0.54	
312	Thang Long Br.	59,243	8.9	0.80	24Hr

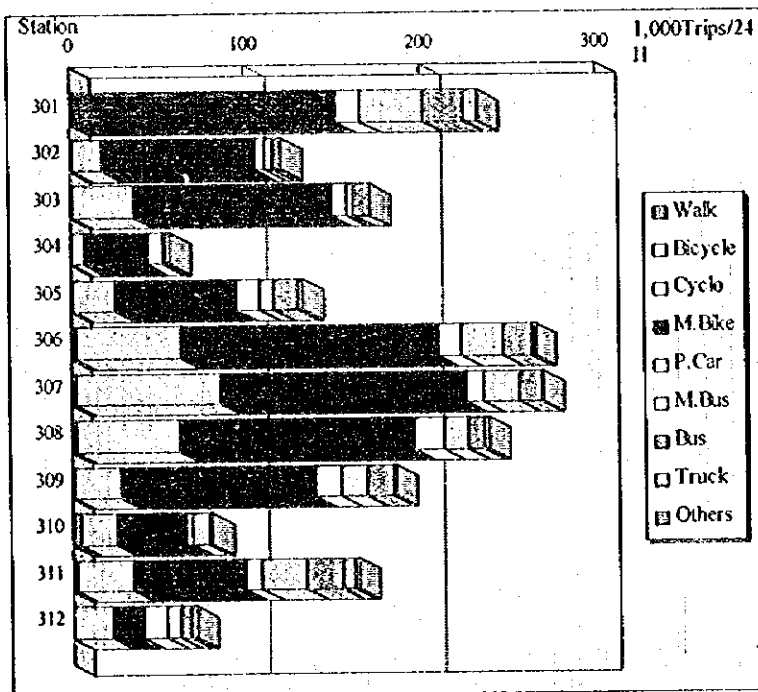


Fig. 3-3-1 Traffic Flow on Road Links

The traffic flows adjusted to 24hrs. trip applying the average 24/14 hrs factor at the stations 306 are shown in Fig. 3-3-1. The highest flow of about 269 thousands trips/24hrs. is seen at the station 307 on the extension of the National Highway No.6, followed by the station 306 (265 thousands trips/24hrs.) on the extension of the National Highway No.1. The highest motorcycle share of 73.0% is seen at the station 302, followed by the station 301 (65.0%) where non motorized trips are not allowed. The

highest bicycle share of 31.8% is seen at the station 312, followed by the station 307 (30.8%). The average shares of 12 survey stations are 55.7% for motorcycle, 19.4% for bicycle, 7.0% for mini bus and 6.4% for passenger car. The hourly fluctuation patterns (Fig.3-3-2) show the typical two peaks patterns having a morning peak hour at 6:00 - 7:00 and an evening peak hour at 16:00 - 17:00.

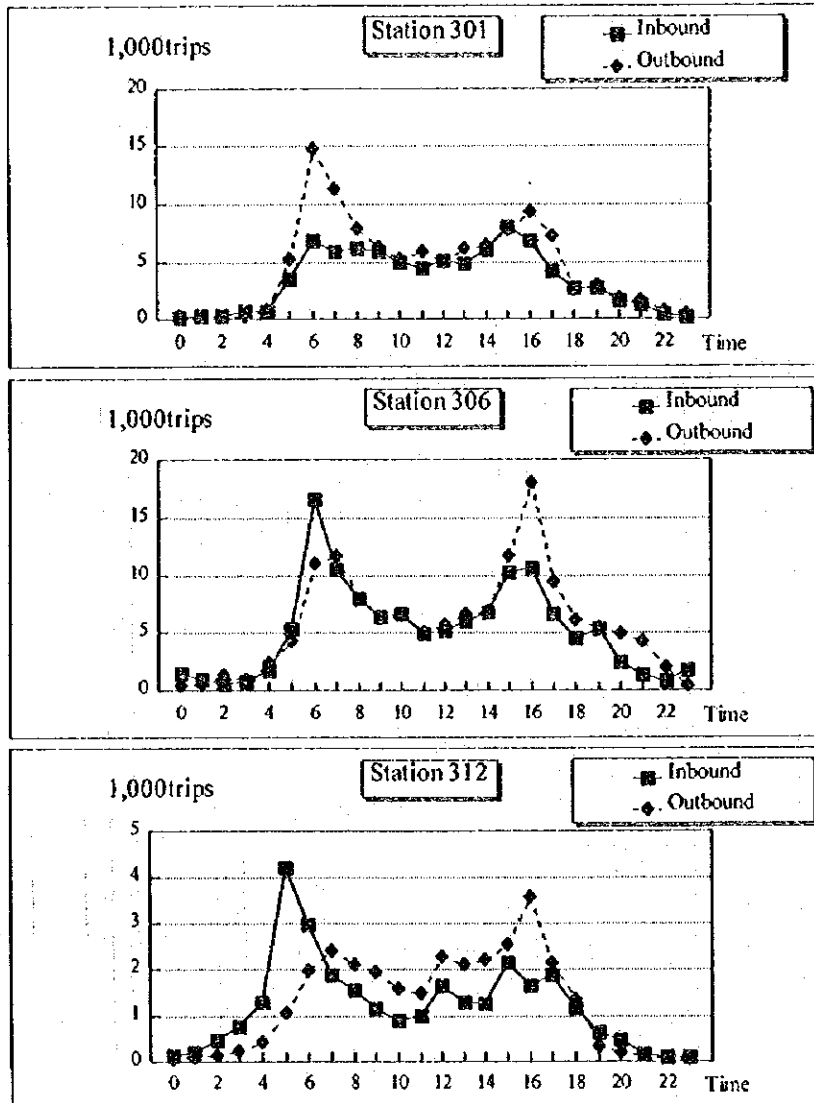


Fig. 3-3-2 Hourly Fluctuation