Lao People's Democratic Republic

THE STUDY
ON
THE SOLID WASTE MANAGEMENT
SYSTEM IMPROVEMENT PROJECT
IN VIENTIANE

FINAL REPORT

VOLUME II SUPPORTING REPORT (1):
PRESENT SOLID WASTE MANAGEMENT

AUGUST, 1992

Japan International Cooperation Agency (JICA)

Lao People's Democratic Republic

THE STUDY ON THE SOLID WASTE MANAGEMENT SYSTEM IMPROVEMENT PROJECT IN VIENTIANE

FINAL REPORT

VOLUME II SUPPORTING REPORT (1) :
PRESENT SOLID WASTE MANAGEMENT

AUGUST, 1992

Japan International Cooperation Agency (JICA)

CONTENTS OF SUPPORTING REPORT (1)

THE STUDY ON THE SOLID WASTE MANAGEMENT
SYSTEM IMPROVEMENT PROJECT IN VIENTIANE

LIST OF VOLUMES

This is VOLUME II. SUPPORTING REPORT (1)

CONTENTS OF SUPPORTING REPORT (1)

APPENDIX E OTHER FIELD SYRVEYS

APPENDIX F PRESENT SOLID WASTE MANAGEMENT

ABBREVIATION

ORGANIZATIONS

DCTC, VM	: Department of Communication, Transport and Construction, Vientiane Municipality
DPH, VM	: Department of Public Health, Vientiane Municipality
DPF, VM	: Department of Planning and Finance, Vientiane Municipality
ITSTP, MCTPC	: Institute of Technical Studies and Town Planning, Ministry of Communication, Transport, Post and Construction
JICA	: Japan International Cooperation Agency
JIS	: Japan Industrial Standard
JSCE	: Japan Society of Civil Engineers
Lao P.D.R.	: Lao People's Democratic Republic
MCTPC	: Ministry of Communication, Transport, Post and Construction
MOH	: Ministry of Health
NGD	: National Geographic Department
PRIVATE-CRC	: Construction and Renovation Company No.1
PRIVATE-ISC	: Inter-Construction and Sanitation Company
PRIVATE-SWM	: Solid Waste Management Company
SSC,MEPE	: State Statistical Center, Ministry of Economy,Planning and Finance
SSC,VM	: State Sanitary Company, Vientiane Municipality
UNDP	: United Nations Development Program
US	: United States
USAID	: United States Agency for International Development
USSR	: Union of Soviet Socialist Republics
WHO	: World Health Organization

REPORT & STUDY

ASG	: Apparant Specific Gravity
CCS	: Community Consciousness Survey
CV	: Calorific Value
DCDS	: Dongphosi Candidate Disposal Site
DF/R	: Draft Final Report
DRAINAGE F/S	: Feasibility Study on Improvement of Drainage System in Vientiane, March 1990
DS	: Disposal Site
F/R	: Final Report
IC/R	: Inception Report
IT/R	: Interim Report
KM 18-DS	: Kilometer 18 of Route 13 Disposal Site
M/M	: Minutes of Meetings
N.A.	: Not Available
NCDS	: Noensaard Candidate Disposal Site
PR/R	: Progress Report
S/W	: Scope or Work for the Study
SWM	: Solid Waste Management
UNDP M/P	: Master Plan for Urban Development in Vientiane conducted by UNDP (Vientiane, Schema Directeur ETD Amenagement Urbain Rapport Final Mai 1989)
WACS	: Waste Amount and Composition Survey

SOCIO-ECONOMY

EIRR	: Economic Internal Rate of Return
GDP	: Gross Domestic Product
GRDP	: Gross Regional Domestic Product
GVA	: Gross Value Added
NRMP	: Net Regional Material Products
O&M	: Operation and Maintenance

TECHNICAL

EL (el)	: Elevation
Dai.	: Diameter
GL	: Ground Level
RC	: Reinforced Concrete
BOD	: Biochemical Oxygen Demand
CI^-	: Chlorine Ion
COD	: Chemical Oxygen Demand
DO	: Dissolved Oxygen
Hg	: Mercury
Pb	: Lead
T-N	: Total Nitrogen

UNIT

m m	: milimeter	cm	: centimeter
m	: meter	km	: kilometer
m^2	: square meter	ha	: hectare
m^3	: cubic meter	mg	: milligram
lit.	: litre	km^2	: square kilometer
sq	: square	cu.	: cubic
kg	: kilogram	t	: ton
s(sec)	: second	min.	: minutes
hr	: hour	d	: day
%	: percent	p.a	: per annum
o/oo	: per mille (1/1.000)	no.	: number
nos.	: numbers	k w	: kilowaltt
res.	: residence	per.	: person
hou.	: household	emp.	: employees

LIST OF TABLES

LIST OF FIGURES

APPENDIX A

PROFILE OF THE STUDY AREA

APPENDIX A PROFILE OF THE STUDY AREA

A.1 Natural Conditions

A.1.1 Location and Area

1) National Geography

Lao P.D.R. is a landlocked country which shares over 1,000 kilometers of borders with Thailand, Cambodia, Vietnam, China and Myanmar. To the south, it is bordered by Cambodia for about 200 km, to the north-west, by Myanmar for about 150 km, and to the north, by China for about 200 km long. Lao P.D.R. has an area of 236,800 square kilometers, and is within the tropic zone, between 14^{o} and 23^{o} latitudes and 100^{o} and 108^{o} longitudes . Rivers and mountains mainly dominate the topography, and mountains and plateaus cover well over 70% of the country.

2) Vientiane Municipality

Vientiane Municipality, the capital of Lao P.D.R., plays the most important role in the political and economic activities of the country. The central part thereof is located at $19^{o}87'$ of north latitude and $102^{o}48'$ of east longitude. It faces the left bank of the Mekong which flows at the southern end of the Vientiane Plane. The other side of the Mekong is Thailand.

The area of Vientiane Municipality is 3,920 km^2 comprising 8 administrative districts. As of 1991, the population of the municipality is 425,000, that is, 10% of the national population. The topography of the municipality is generally flat and the elevation varies from 164 m to 175 m.

3) Study Area

The Study area covers the Vientiane Urban Area in the year 2000, and is located in the southern part of the municipality. It comprises 4 districts, namely Chanthabouly, Sisattanak, Sikhottabong and Saisettha. The Study area is 29.35 km^2, which is 0.75% of the total area of the Vientiane Municipality, and is shown in Fig. A.1-1.

According to the UNDP M/P ("Master Plan for Urban Development in Vientiane conducted by UNDP"), the Study Area is divided into the nine homogeneous zones shown in Fig. A.1-2; i.e. Namphou, Hal Mahosot, Pasak, Phone Xai, That Luang, Dong Palane, Sokpaluang, Souane Mone and Wattay.

For population projection and the estimation of future solid waste generation of the Study, the above-mentioned 9 zones used in the UNDP M/P are also applied to the Study instead of the administrative districts due to the following reasons;

a. A city or urban development plan such as the UNDP M/P takes precedence of a solid waste management plan ;

b. The populations and areas of the nine zones in the Study area (the urban area) are clearly prepared in the UNDP M/P.

c. The Study area only partly covers the above-mentioned 4 districts.

A.1.2 Climate

1) General

The annual Asian monsoon cycles that affect mainland South-East Asia produce two general seasons in Lao P.D.R.: the wet season from May to October and the dry seasib from November to April. Average precipitation varies considerably accounting to latitude and altitude, with southern Lao P.D.R. getting the most rain overall.

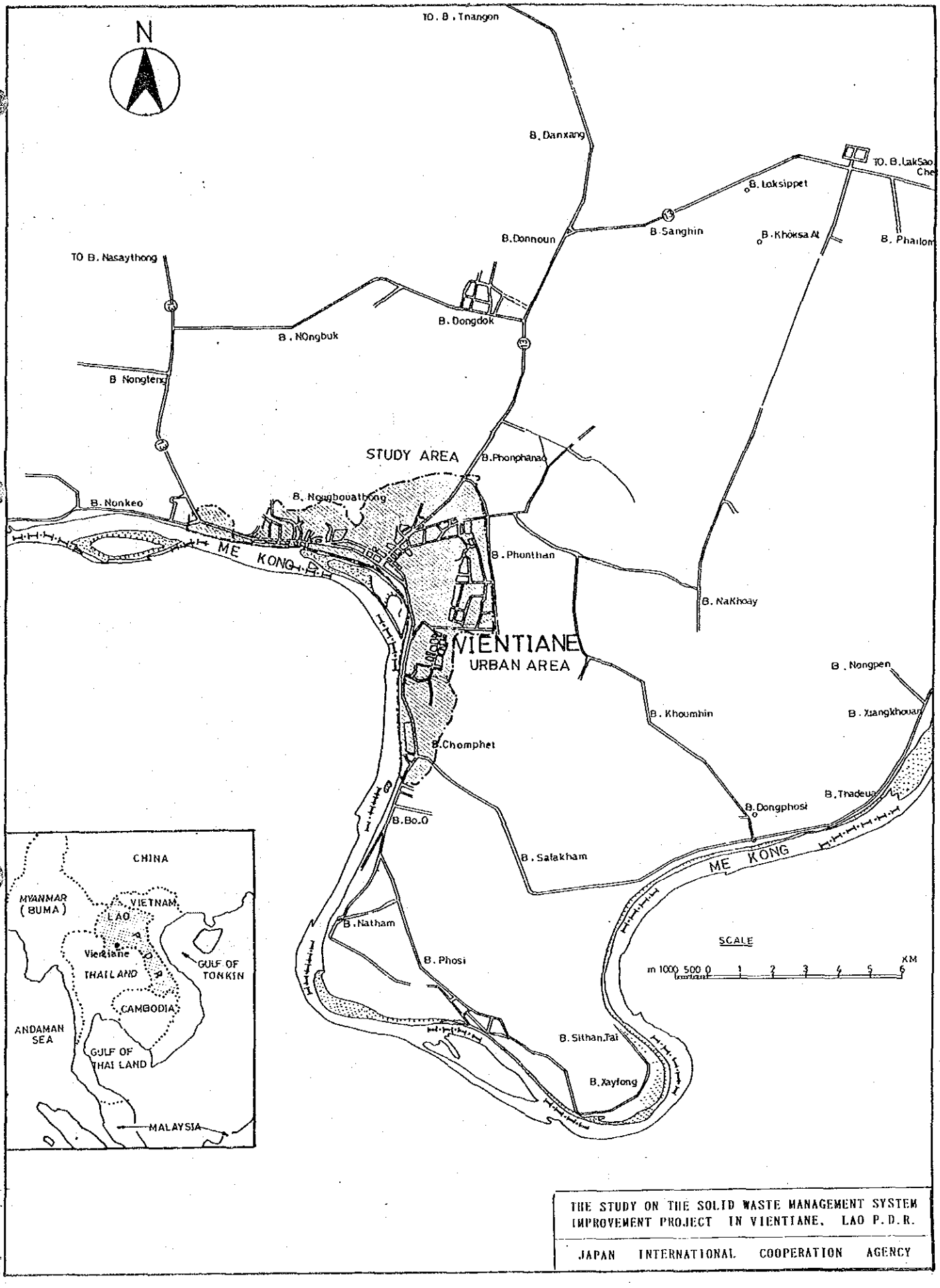


Fig. A.1-1 Study Area

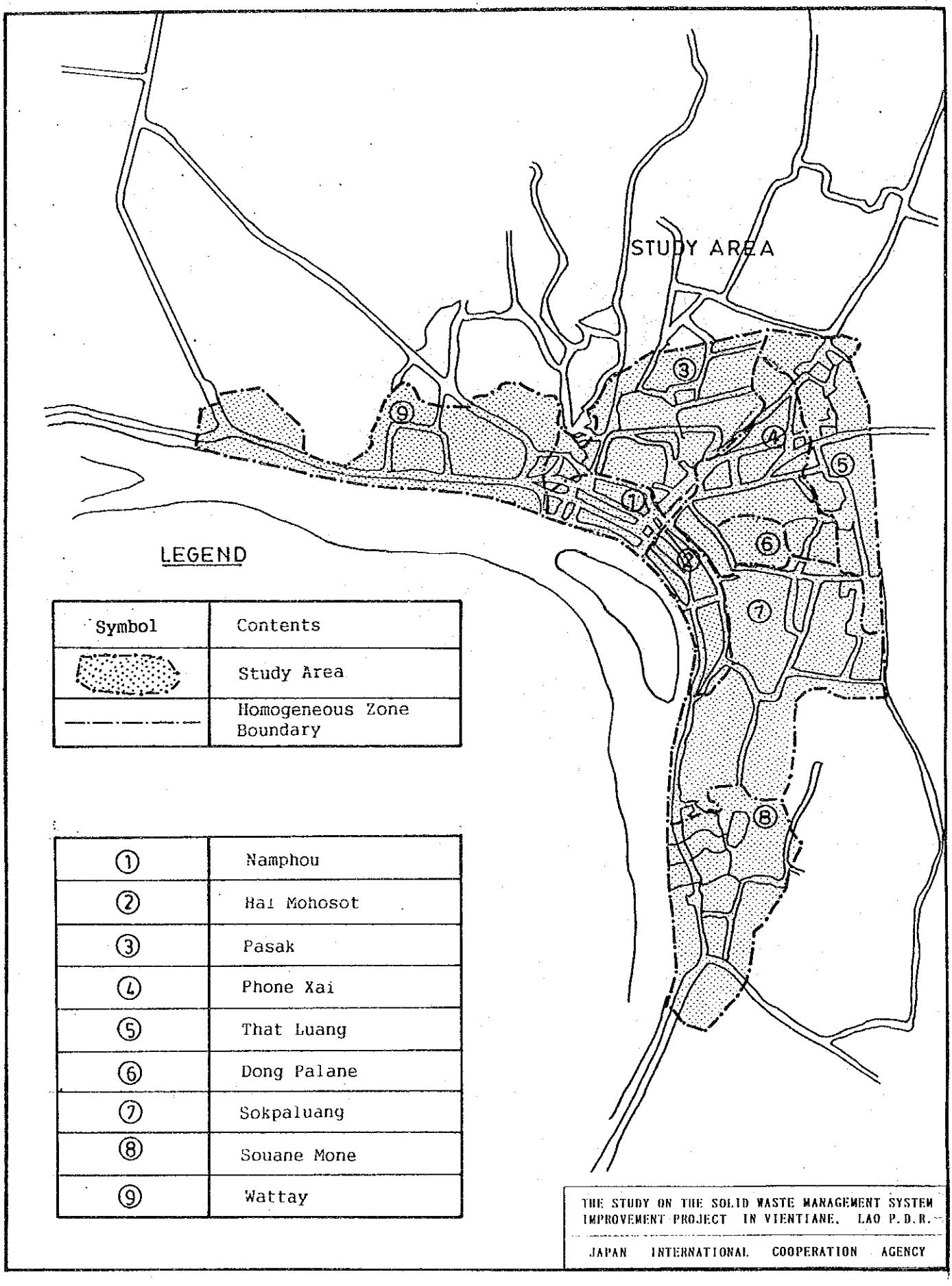


Fig. A.1-2 Homogeneous Zones in the Study Area

The temperature also varies according to altitude. In the Mekong River Valley from Bokeo Province to Champasak Province, as in most of Thailand and Myanmar, the highest temperature occurs in March and April (with a temperature approaching 38^{o}C), and the lowest in December and January (dropping as low as 15^{o}C).

Temperature in Vientiane ranges from a low of about 12^{o}C during the coolest months of December and January to a high of 38^{o}C during the hottest months of March through May. The relative humidity is in general 75 to 80 per centduring the rainy season and 65 to 70 in other periods. The average annual rainfall is around 1,600 mm in Vientiane, of which about 86 per cent occurs during May through September. Monthly temperature and rainhall in Vientiane observed at the Vientiane Meteorological Station are tabulated in Tables A.1-1 and A.1-2.

2) Storm Rainfall Intensities

According to the Drainage F/S ("Feasibility Study on Improvement of Drainage System in Vientiane, March 1990") conducted by JICA, the probable rainfall for the one-day storm rainfall is as follows ;

2 year	:	104.0 mm/day
5 year	:	132.1 mm/day
10 year	:	150.6 mm/day
20 year	:	168.4 mm/day
100 year	:	208.7 mm/day

And the probable rainfalls for the short duration is as follows ;

Table A.1-1 Monthly Temperature in Vientiane

Month		Jan.	Feb.	Mar.	Apr.	May.	June
Tempe-	Max.	33.7	33.6	36.7	38.4	35.8	34.8
rature	Min.	14.5	15.1	18.8	20.0	21.2	23.4
°C	Average	23.5	24.2	28.2	29.0	28.5	28.7

Month		JULY	Aug.	Sept.	Oct.	Nov.	Dec.
Tempe-	Max.	34.3	33.4	33.6	33.6	32.2	31.8
rature	Min.	22.8	23.0	22.7	15.3	15.9	11.8
°C	Average	27.4	27.8	27.3	27.0	25.3	23.1

Source; Vientiane Meteorological Station (1967 - 1986)

Table A.1-2 Monthly Rainfall in Vientiane

Month		Jan.	Feb.	Mar.	Apr.	May.	June
Rain-	Max.	53.1	64.7	111.9	167.6	383.6	611.0
fall	Min.	0.0	0.3	0.1	10.8	97.6	95.4
mm	Average	15.7	15.0	34.7	78.4	235.8	238.2

Month		JULY	Aug.	Sept.	Oct.	Nov.	Dec.
Rain-	Max.	635.0	624.9	488.9	142.1	29.7	22.8
fall	Min.	150.1	117.8	163.4	19.2	0.0	0.0
mm	Average	295.2	302.6	289.2	82.5	14.8	5.9

Source; Vientiane Meteorological Station (1967 - 1986)

Probable Rainfall for Short Duration

Unit : mm

Duration	Return Period in Years				
in minutes	2	5	10	20	50
15	19.2	25.8	30.1	34.3	39.7
30	30.8	43.9	52.5	60.8	71.6
60	44.9	70.4	87.2	103.4	124.4
120	58.5	88.6	108.6	127.7	152.5
180	65.9	95.9	115.8	134.9	159.5

A.2 Urban Structure

A.2.1 Administration

1) National Level

The Council of the Lao P.D.R. government consists of twelve ministries. In addition to the Council of the Government, there are the Office of the Prime Minister, the National Bank, the National Planning Committee and the National Front Committee.

The Supreme People's Assembly (SPA) serves as the government's legislative body. Since the revolution, total members in the SPA has varied between 40 and 45. About two-thirds of the members are drawn from the LPRP (Lao People's Revolutionary Party), the Lao Front for National Construction and the Alliance of Lao Patriotic Neutralist Forces. The SPA's main function thus far has been to meet

once a year to approve declarations of the prime minister.
For 15 years following the revolution, the Lao.P.D.R. had no constitution. The first official Constitution was drafted mid-1990 by the Party for the approval of the Supreme People's Assembly.

The Lao P.D.R.'s first legal code was not enacted until 1988, the same year that Vientiane began looking abroad for foreign capital. The new canon established a court system, prosecutor's office, criminal trial rules and one of the most liberal foreign investment codes in Asia.

Lao P.D.R. is divided into 16 provinces (khwang): Vientiane, Sayabuli, Luang Phabang, Luang Nam Tha, Xieng Khwang, Houa Phan, Phong Sali, Bokeo, Oudomxai, Bolikhamsai, Khammouane, Savannakhet, Saravan, Sekong, Attapeu and Champasak. In addition, Vientiane Municipality independent prefecture on an administrative parity with the provinces.

Below the province is the mouang or district, which is comprised of two or more tasseng(sub-district or cantons), which are in turn divided into ban, or villages.

2) Vientiane Municipality

The Vientiane Municipality consists of eight districts; Chanthabouly, Sisattanak; Sikhottabong; Saisettha; Hatsayfong; Saithani; Nasaythong and Phialath district. An administrative map of Vientiane Municipality is prepared and is shown in Fig. A.2-1. The urban area, which is the Study area, covers part of 4 districts, Chanthabouly, Sisattanak, Sikhottabong and Saisettha district, and the Study area includes 96 villages (Bans).

In each district, there is a district administrative committee under the control of the Vientiane Municipality administrative committee. In Vientiane Municipality, however, there is no sub-district (tasseng). The district is divided into villages (Ban), which are the lower level administrative unit called "village committee". A village in Lao P.D.R. signifies a unit administrative

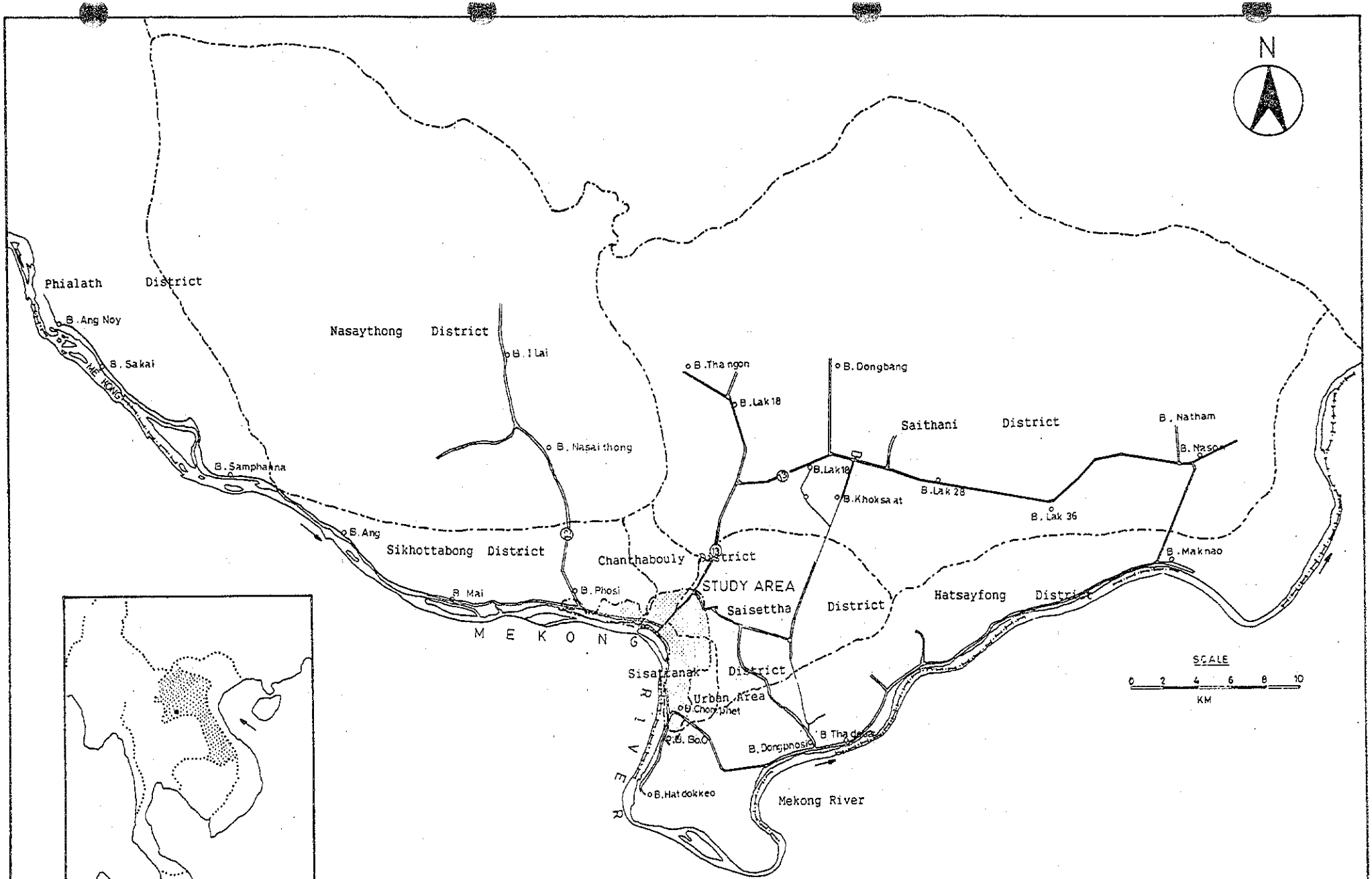


Fig. A.2-1 Administration Map of Vientiane Municipality

THE STUDY ON THE SOLID WASTE MANAGEMENT SYSTEM IMPROVEMENT PROJECT IN VIENTIANE, LAO P.D.R.

JAPAN INTERNATIONAL COOPERATION AGENCY

area.

The head of Vientiane Municipality is called a governor who is appointed by the prime minister. Under the governor, there are three vice-governors who are appointed also by the prime minister.

The Vientiane Municipality has 12 departments, 4 mass organizations and 8 districts as of 1991. The organization chart is shown in Fig. A.2-2.

The highest decision making body in Vientiane Municipality is an administrative committee which is composed of the governor, three vice-governors and 3 directors from 12 departments.

3) Numbers of Government Employee

According to the DEPF, VM (Department of Economic Planning and Finance, Vientiane Municipality), the number of government employees working in Vientiane Municipality is as follows ;

a. National level

i. state government employee	10,297	persons
ii. state enterprise employee (under the jurisdiction of ministries)	5,436	persons
Total	15,733	persons

b. Municipality level

i. municipal government employee	7,724	persons
- administration 1,992 persons		
- Others 5,732 persons		
ii. state enterprise employee (under the jurisdiction of municipality)	6,516	persons
Total	14,240	persons

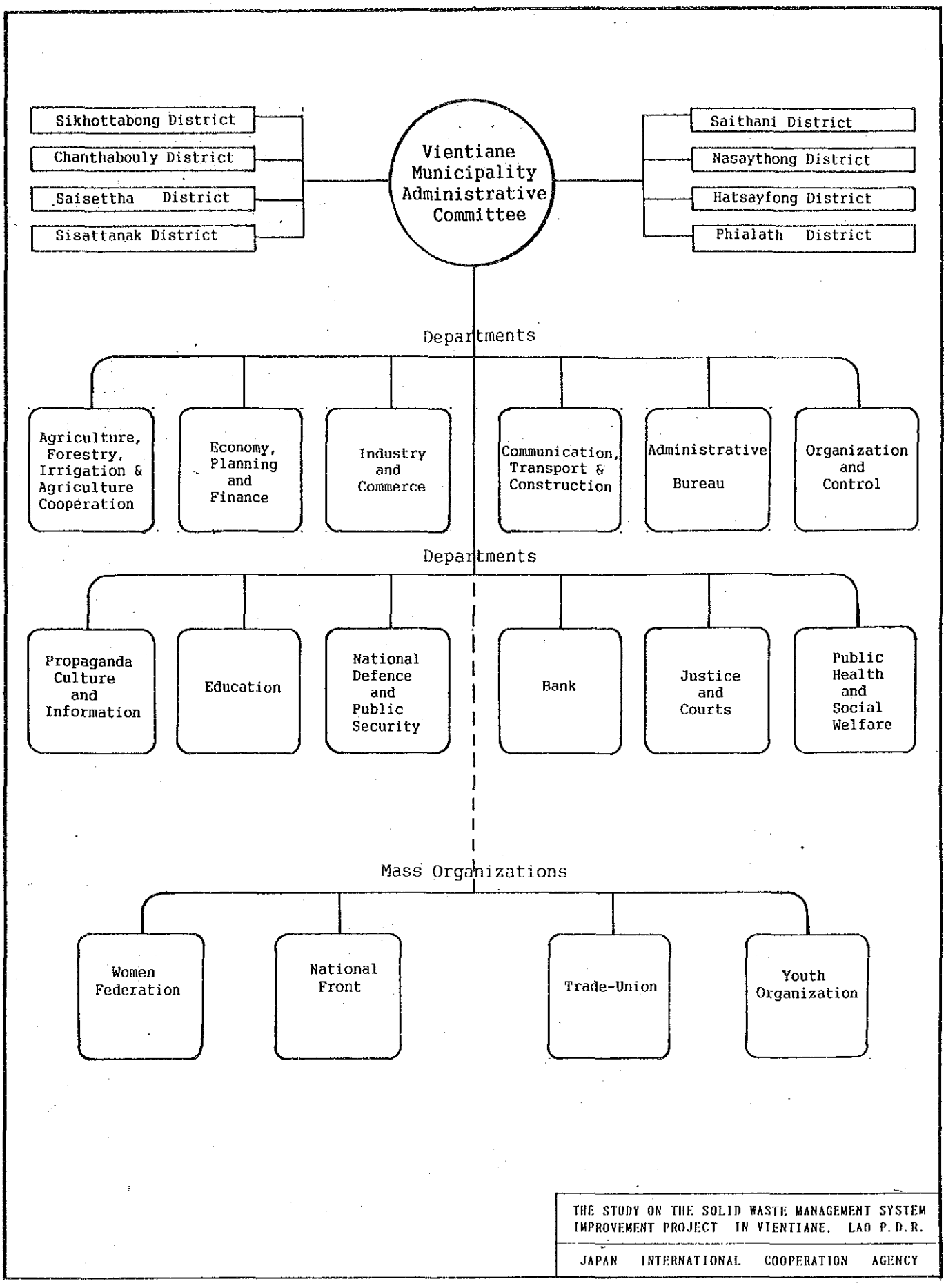


Fig. A.2-2 Organization Chart of Vientiane Municipality

However, the mumber of employees working in the urban area is not exactly confirmed. It is roughly estimated that 77% of the above-mentioned employees are working in the urban area.

A.2.2 Land Use

The urban area of Vientiane Municipality occupies 29.35 km^2 or 0.9 percent of the municipality area. This urban area was developed as the core of Vientiane Municipality in the rather elevated areas extending along the Mekong.

The structure of the city is formed by the existing urbanized area and three highways which link the city with Luang Phabang, Savannakhet and Phonngan Thadeua.

The present land use in the Study area (2,935 ha) is summarized as follows ;

Residential area	1,240 ha	42.3 %
Public commercial area	820 ha	27.9 %
Industrial area	25 ha	0.9 %
Water area	65 ha	2.2 %
Green area	697 ha	23.7 %
Others	88 ha	3.0 %

Source; ITSTP, MCTPC

The residential area and the green area occupy 66 % of the total area, and in most of the green areas are cultivated lands.

Since the present population density is not high, services such as commerce and business will be more concentrated in the city in the future. Meanwhile, residential and industrial areas may be extended in the outskirt of the city.

The urban plan of Vientiane was once formulated in 1961. The population envisaged in this plan was 120,000. Thereafter, several plans were studied and the most updated plan was formulated in 1989 as "the Master Plan for Urban Development in Vientiane" conducted by UNDP (Vientiane, Schema Directeur ETD Amenagement Urbain Rapport Final Mai 1989).

For this planning, the present and future populations and land uses were studied. Topographic condition and transportation were comprehensively studied as well. On the basis of these study, zoning by land use categories was conducted effectively.

The plan divided the area into urbanized and reserved blocks. It specified and programmed the land use and the method of development in the urbanized block. Table A.2-1 and Fig. A.2-3 present the land use envisaged by the plan.

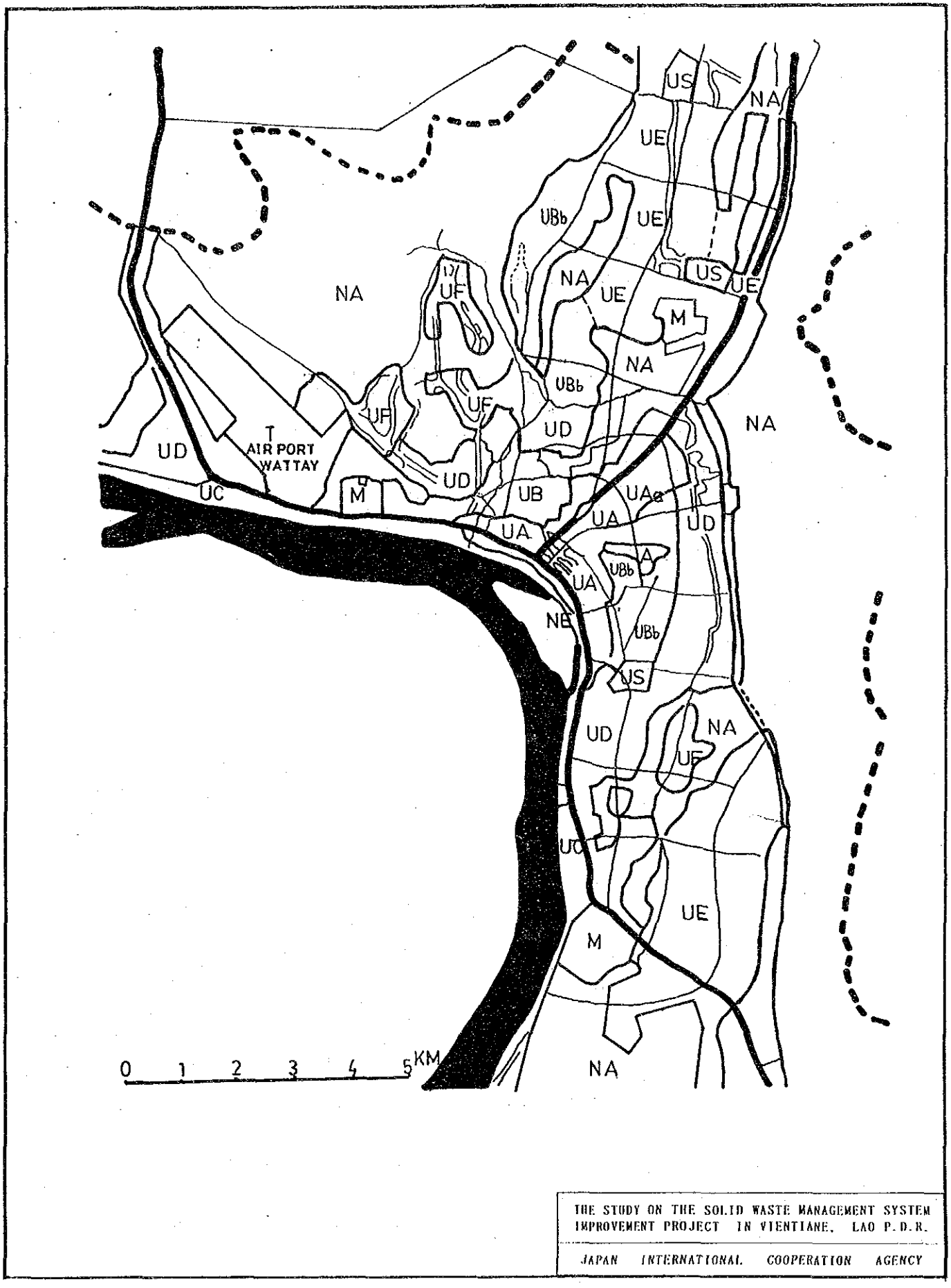
The plan presents an appropriate land use in the Study area up to the year 2000 as follows;

Residential	1,703 ha
Public and business	594 ha
Industrial	36 ha
Water	89 ha
Green	272 ha
Others	241 ha
Total	2,935 ha

Source; ITSTP, MCTPC

Table A.2-1 Vientiane Urban Plan

Mark	Area	Use	Development Method
UA	Center	Administration/Business	Conservation
UAa	Center (sub zone)	Administration/Business	Conservation
UB	Peripheral of Center	Resident/Industry	Construction
UBb	Peripheral of Center (sub zone)	Resident/Industry	Construction
UC	Riverline	Resident	Construction
UD	Suburb	Resident	Construction
UE	Expansion Area	Resident	Construction
UF	Rice Field	Resident	Conservation
US	University	Education	Conservation
M	Military	Military	Conservation
NA	Agricullture Land	Agriculture	Conservation
NE	Reserved Area	Public Park	Conservation
T	Transportation	Transportation	Not specified



THE STUDY ON THE SOLID WASTE MANAGEMENT SYSTEM IMPROVEMENT PROJECT IN VIENTIANE, LAO P.D.R.

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. A.2-3 Future Land Use Map

A.2.3 Infrastructure

1) Transport

The existing transportation network in Vientiane Municipality is illustrated in Fig. A.2-4.

a. Road

The road system in Lao P.D.R. remains very much underveloped. However, the roads around the periphery of Vientiane Municipality streching as far as the Nam Ngum Dam are surfaced and developed for just about any type of vehicle. Otherwise unsurfaced roads predominate elsewhere in the country.

Roads in the municipality have a total length of 1,254 km, of which 302 km are paved with asphalt, 478 km are lateritic and 474 km unpaved. There trunk roads connect the municipality with principal cities such as Luang Phabang, Savannakhet, etc..

The total length of roads in the Study area is about 228.1 km, of which 61.8 km or 27% are paved.

b. Air

The Wattay Airport is located in the western part of Vientiane urban area and is utilized for international and domestic air flights. Lao Aviation handles all domestic flights in Lao P.D.R., and with Vientiane as the hub, all flights originate and terminate at Wattay Airport.

c. Boat

Rivers are the true highways and byways of Lao P.D.R.. The Mekong is the longest and most important water route and is navigable year-round between Luang Phabang in the north and

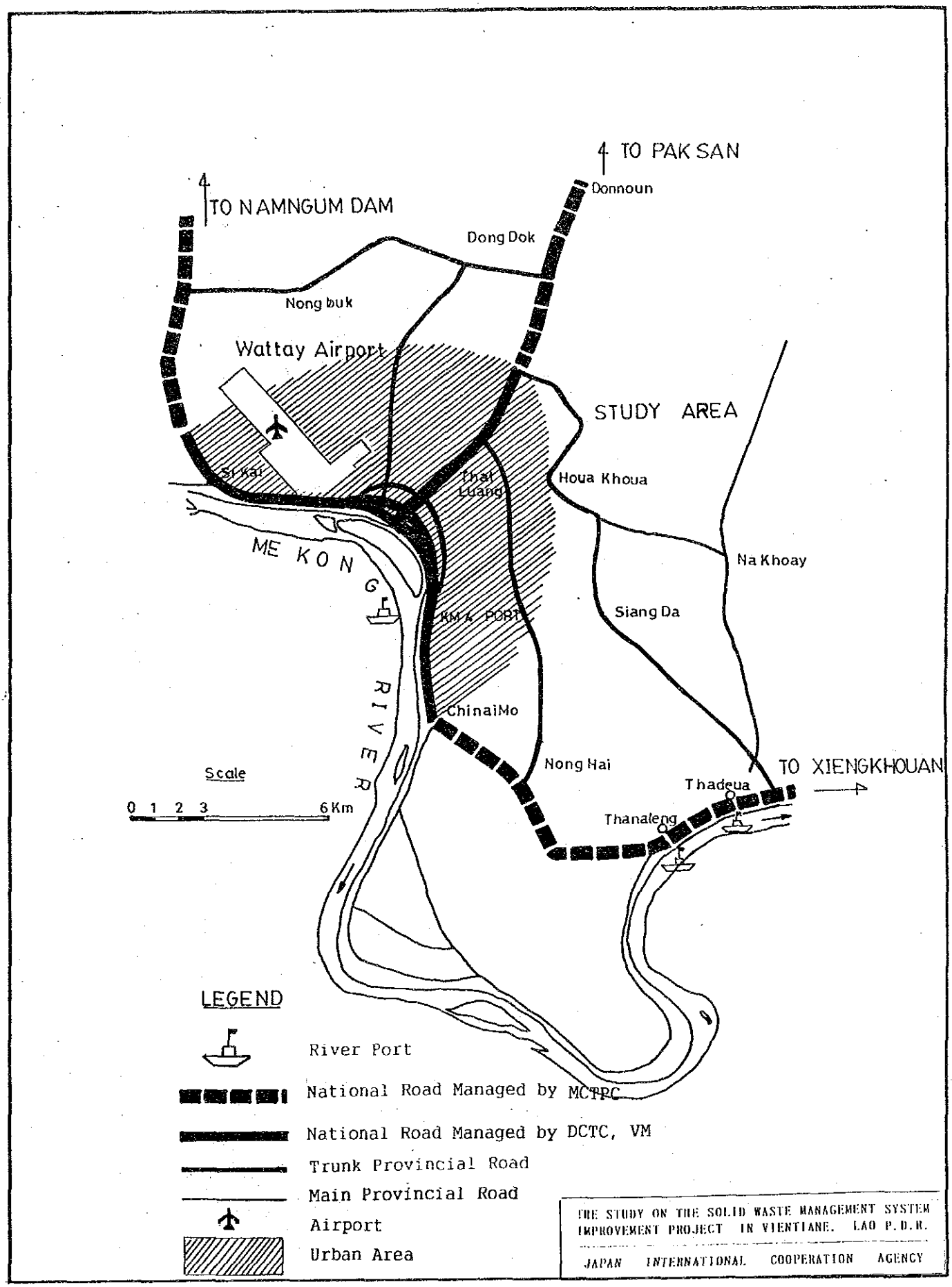


Fig. A.2-4 Existing Transportation Network in Vientiane Municipality

Savannakhet in the south.

There are three major river ports in Vientiane Municipality. Thanaleng, which is the biggest, is used for international trading between Thailand; Thadeua, for international passenger transport between Thailand; and Km 4 port, for domestic transport.

2) Others

About 60,000 m^3/day of domestic water is supplied from the Chinaimo and Kaoliao treatment plants, both of which intake water from the Mekong.

Electricity is supplied from the Nam Ngum power station constructed in 1971 with an installed capacity of 150,000 kw. Electrical connection in Vientiane has not been fully completed yet. Sewerage is virtually non-existent in Vientiane.

Water and electricity supply are well developed and stable in the area. Drainage systems utilize either natural water courses or ditches along the roads.

A.2.4 Master Plan for Urban Development in Vientiane

The urban planning of Vientiane was once formulated in 1961. Thereafter several plans were studied and the most updated plan is the " Vientiane, Schema Directeur et d'Amenagement Urbian, Programme de Development Urbain de la Prefecture de Vientiane Lao/85/003, Rapport Final Mai 1989 " (hereinafter referred as the Master Plan for Urban Development in Vientiane).

The main purpose of the Lao/85/003 "Programme de Development Urbain de la Prefecture de Vientiane" (Urban Development Program of the Vientiane Muncipality) project is to reinforce the present research institution, which carries out a study on the city master plan at a national level, in order to realize and manage the plan prepared.

In the project, the following topics were studied;

a. policy making methods regarding the options of the urban development for the next decade (1990-2000);

b. the execution of feasibility studies for the priority projects in Vientiane;

c. the feasibility study on the use of local construction materials in order to avoid the increase in imports;

d. the training of local staff for the application of the urban development program ; and

e. the establisment of an urban data collection system in order to meet future needs.

The Master Plan was formulated in cooperation with the Institute of Technical Studies and Town Planning of the Ministry of Communication, Transport, Post and Construction. It gives the first diagnosis of the Vientiane Urban Area and presents preliminary recommendations for its urbanization over the next decade (1990~2000). It intends to promptly inform the cooncerned authorities and to allow them to express their opinion regarding the orientation of the Study. The Master Plan would be followed by further detailed studies.

In response to the recommendation made in the Master Plan, "the Slum Development and Rehabilitation Project" is being executed in the Sihom village under the auspices of the UNDP. The project cost is estimated at 5 million US dollars.

A.2.5 Drainage F/S in Vientiane

Te other specific projects related to the Study, is the "Feasibility Study on Improvement of Drainage System in Vientiane", (Drainage F/S in Vientiane).

a. The objectives of the Study

The objectives of the study are as follows ;

- To formulate a basic plan for the storm water drainage system improvement in the study area of 56.2 km^2 in the urbanized part of Vientiane Municipality, and to identify the priority project;

- To conduct a feasibility study on the indentified priority project; and

- To carry out technology transfer to the Laotian staff through the implementation of the study.

b. Recommendations

The recommendations in the Drainage F/S are as follows ;

i. The Hong Ke system is attested to be economically viable and technically sound. With the urbanization and intensification of the land use in the area, inundation damages will increase remarkably. In view of this, the implementation of the proposed Hong Ke system should be undertaken urgently.

ii. In order to make improvement of the main drainage system effective, the improvement of lateral canals is one of the most important works to be carried out by the Government of Lao P.D.R.. The Municipality should accelerate the progress of this improvement work.

iii. Other related urban plans should be consistent with the proposed drainage improvement plans so that safety against inundation and enhancement of amenity contemplated in the study can be secured.

iv. In order to realise the drainage master plan smoothly and effectively, the reiforcement of the executive agency and budgetary arrandgement will be indispensable. The channels of communication with concerned agencies should be enhanced to achieve better coordination with other related plans.

v. The water quality of the drainage water is poor due to the influx of domestic sewerage. The pollutant loads may increase with the growth in population and economic activities in the study area. In order to secure the amenity for the local residents and to improve the sanitary condition, the water quality should be improved. In this connection, the introduction of sewerage systems and garbage collection and treatment system shoud be considered. Amongst these, garbage treatment is considered to be of the most urgent need.

vi. The continuous maintenance and cleansing of the proposed drainage canals will contribute to the improvement of the water quality. The siltings of the suspended solid should be trapped and removed periodically. The dilution of polluted water by introducing fresh water from the Mekong and/or groundwater will be effective during the dry season. The artifical agitation of water by means of pumping will increase DO and be effective in improving water quality is recommended, as well as the coontinuous data collection on storm rainfall and water levels by the intruments installed by the study team.

vii. The drainage plan should be consistent with the development plan of the Houei Makhiao river basin, since the plan proposes the discharge of storm water to the Houei Makhiao.

This river has large retarding spaces enough to accommodate the water without causing any significant adverse effect thereto. In this connection, data collection and recording should be commended as soon as possible for hydrogy, topography and socio-economy including water quality and environment.

viii. At present, the management of rivers is not integrated and no regulation have been enacted on the water right with regard to quality and quantity. The situation may cause institutional difficulty in the drainage management. It is recommended that the Government establishes an integrated institution and regulations for the improvement and OMR (operation, maintenance and repair) of drainage systems.

A.3 Social Conditions

A.3.1 Customs and Religion

1) Calendar

The government follows the western (Gregorian) calendar for government and business purposes, but many traditional Lao villagers still follow the lunar calendar where the New Year begins in December. However, the Lao New Year (Pimai) is celebrated in April when the auspices are more favourable. Reference is sometimes also made to the Buddhist Era-the current year is

2533 beginning at " Pimai" (April) 1990.
2534 beginning at " Pimai" (April) 1991.
2535 beginning at " Pimai" (April) 1992.

2) Cleansing Day

The Cleansing day, which is called "Real Saturday", has been established in 1975 in order to ask people to engage in cleansing

works such as drain cleansing, grass-cutting, house sweeping, collection, haulage and disposal wastes every saturday morning. The cleansing day is also set before Lao New Year (Pimai) in the middle of April and national day (2 December) for house cleaning works.

3) Religion

The population of Lao P.D.R. is divided among the following religious seats;

- Buddhist 95%
- Bahai 2.9%
- Evangelists 2%
- Roman Catholist 1%
- Islam (Muslim) 0.1%

A.3.2 Public Health

1) Rate and Life Expectancy

In 1990, the infant mortality rate (IMR) up to one year of age was estimated by the Central Health Statistic Unit, at 118 per 1,000 live births. The estimated mortality rate of children from one to four years of age, under 5 years mortality rate (U5MR), is 193 per 1,000 live births due to the poor health condition in the rural area.

Commparing the above figures with neighbouring countries as shown in Table A.3-1, the IMR and U5MR of Lao P.D.R. is located in the worst position.

Table A.3-1 Comparison of mortality Rate and Life Expectancy

Country	IMR	U5MR	Life Expectancy (Year)
Lao P.D.R.	188	193	50
Thailand	45	60	62
Vietnam	75	100	57
Myanmar	70	95	56
Indonesia	80	130	52

Source : Statistics on children in UNICEF assisted countries, 1986.

Thus, the birth rate and the death rate were both high while the average life expectancy was low as shown below ;

	1985	1988	1990
Crude Birth Rate (per 1,000)	46.1	45.8	45.8+
Crude Death Rate (per 1,000)	17.1	16.1	16.1+
Life Expectancy in 1990	49 years of age for male		
	52 years of age for female		

2) Communicable Disease

The serious problem diseases are malaria. Typical chidren diseases, diarrhea and respiratory infections, have high incidence rates. Many of these diseases are preventable through immunization and proper

sanitation. However, in 1991 only 32.7% are immunized against tuberculosis, 17.41% have been immunized for DPT and polilomyelitis and 30.8% for measles. In addition, only 42% of the population has access to safe water.

Table A.3-2 Main Cause of Mortality in Eight Provincial and Two Central Hospital, 1990, LAO P.D.R.

Causes	Number of Deaths
1. Malaria	315
2. Pneumonia	125
3. Meningitis	60
4. Diarrhea	51
5. Tuberculosis	31
6. Road accidents	21
7. Anemia	20
8. Dysentery	19
9. Hepatitis	17
10. Hepatic Cirrhosis	13
11. Tetanus	11
12. Hypertension	11

Source : Central Health Statistic Unit, MOH

Table A.3.-3 Main Causes of Morbidity in Eight Provincial and Two Cental Hospitals, 1990, LAO P.D.R.

Causes	Number of Cases
1. Malaria	43,257
2. Diarrhea	42,347
3. Influenza	37,443
4. Pneumonia	20,604
5. Gastro-duodena Ulcer	13,889
6. Tonsillitis	11,221
7. Skin Diseases	8,913
8. Parasitosis	5,494
9. Malnutrition	2,910
10. Measles	2,168

Source : Central Health Statistic Unit, MOH

Table A.3-4 Nationwide Immunization Coverage of Children of Less than 1 Year of Age based on Provincial Reports of Provincial Health Services, Lao P.D.R. 1985-90

Year	Children Immunized	DPT3	TOPV3	BCG	Measles	TT 2 (only pregnant)
1985	Total Nos.	5,561	5,493	11,838	6,639	3,739
	%	4	4	8	6	2
1986	Total Nos.	7,983	8,006	14,170	11,681	5,418
	%	5	5	10	10	4
1987	Total Nos.	15,373	15,292	23,148	17,408	9,019
	%	10	10	15	11	6
1988	Total Nos.	25,840	25,840	41,467	36,416	9,294
	%	17	17	27	19	5
1989	Total Nos.	32,778	34,877	46,621	40,191	7,210
	%	21	22	29	20	4
1990	Total Nos.	28,402	40,575	41,558	51,638	17,956
	%	21	30	31	29	11
1991 9 month	Total Nos.	22,247	27,543	51,419	57,308	20,888
	%	17.33	17.5	32.7	30.8	11.22

Remarks :

DPTC 3 = Diphteria, Pertussis (3 doses, 1 month interval)
OPV 3 = Oral Polio (3 doses, 1 month interval)
BCG = Tuberculosis (1 doses, Birth(6-8y.booster)
TT 2 = Tetanos (1 doses, 1 month interval)

The health condition in the Vientiane Municipality is same as that of the nation described above. The number of patients according to disease was obtained from the Department of Health, Vientiane Municipality, and is shown in Table A.3-5. The typical diseases due to poor sanitary and drainage conditions were malaria and dengue, and people in the Study area suffered from these diseases.

Table A.3-5 Number of Patients by Kind of Disease

Unit : person

	1985	1986	1987	1988	1989	1990
Malaria	8,678	8,255	8,846	7,184	3,277	4,521
Influenza	15,339	25,765	18,566	22,359	15,802	11,822
Pneumonia	14,162	9,289	11,826	7,222	6,995	3,677
Dysentery	2,746	5,827	8,262	10,295	4,543	2,058
Diarrhea	8,161	15,708	14,140	13,555	9,823	6,519
Conjunctivitis	3,941	1,568	714	2,343	1,308	298
Dengue	712	155	6,728	136	1	76

Source : Department of Health, Vientiane Municipality, 1991

3) Control of Communicable Disease

The Department of Public Health in Vientiane Municipality controls and supervises the distribution of food by food dealers. However, there are still many small dealers operating without a license. Controlling such illegal action is necessary to control the prevalence of communicable diseases ; i.e., diarrhea, dysenteria.

Strengthening anti-mosquito measure is essential to control the occurrence of dengue fever which is caused by virus carried by Aedes-aegypti (a type of mosquito) that exists in Vientiane Municipality.

The prevalence of malaria is very serious as it affects large numbers of children as well as adults. This disease usually prevails in the rural area. However, because of limited manpower and funds, malaria detection and control measures are very limited.

4) Solid Waste Management and Public Health

The two prevalent communicable diseases in Vientiane, i.e., diarrhea and dypenteria are reportedly caused by defective solid waste management. It is most likely, however, that improper storage and disposal of solid waste helps the quick breeding of rodents and flies, which would leads to the evolution of some communicable diseases. In this sense, sanitary storage, collection, haulage and disposal of solid waste is important. Treatment and disposal should be carefully planned in such a manner that will prevent the future occurrence of air, water, and soil pollution.

5) Activities Related to Public Health Control

The activities of the Department of Public Health related to public health are as follows ;

a. Inspection of the sanitary conditions of premises and the inspection of infectious diseases ;
b. Mosquito and rodent control ;
c. Food and drug control ; and
d. Market control.

6) Problem in the Field of Public Health

According to the Department of Public Health, Vientiane Municipality, the public health sector of Vientiane Municipality is faced with the following serious problems.

a. Lack of Political Will

The social service sectors, including health, water, solid waste management and environmental sanitation, are not the country's political priorities, rather, agriculture, industry, transportation and communication are the key sectors which occupy great government attention at this stage of the country's development.

b. Poor Health Infrastructure

The present health system has to contend with the problems of a very weak infrastructure. Despite efforts made, the conditions of the health facilities of central and provincial hospitals, and district and sub-districts dispensaries are all extremely poor. They are supplied with only limited medical equipment and few medicines.

c. Manpower

The weakness of the health infrastructure is also attributed to the lack of manpower.

d. Lack of Coordination

Another problem with the health system is the notable lack of coordination among the different departments and also between the different ministries.

Urban areas in the country has undergone serious environmental

degradation in the past decade, due to continuing population growth and lack of urban infrastructure development to protect public health. Sewage disposal, storm water drainage and solid waste management are among the most severe problems found in urban areas of the country.

In 1975, a primary health care strategy was adopted to provide health care to the vast majority of the population and a community participation campaign was launched. Although much progress has been made in the past 16 years, the health situation and the development of the health system remains unsatisfactory. The absence of well qualified personnel, the lack of drugs, equipment, recurrent cost funding and the poor physical state of health facilities are major causes of this poor health condition.

According to the Department of Public Health, Vientiane Municipality, there are serious problems in the health sector of Vientiane. The lack of hospitals, equipments, drugs, medicines and personnels are serious constraints to improve health conditions, while the low level of sanitary condition of both urban and rural areas is the major cause of diseases.

The list of hospitals in the Vientiane Municipality is summarized in Table A.3-6.

Table A.3-6 List of Hospitals in Vientiane Municipality

Hospital Classification	No. of hospitals in Vientiane	No. of beds* (bed)	No. of doctors (person)	No. of hospitals in Study area
Municipality Hospital	1	200	57	1
District level hospital	8	30	39	4
Sub-district level hospital	38	5	2	11
Village level hospital	18	0	0	3
Mahosot Hospital	1	450*	132	1
Military Hospital 103	1	450*	51	1
Police Hospital	1	60*	10	1
Lao-Soviet Hospital	1	150	74	1
Hospital No I	1	30	14	1
Total	70	1,375	379	24

Source : Department of Public Health, Vientiane Municipality, 1991

Note : *Figures are obtained by interview survey conducted by the Study Team in October 1991.

A.3.3 Community Structure

At the village level, the administrative committee usually consists of the village chief, the local Party secretary and members of the public security, local representatives of the Lao Front for National Construction, the Union of Lao Women, and the Lao People's Revolutionary Youth and also co-opted influential villagers. The committee concerns itself with village affairs, including the

regulation of disputes and dispensation of justice. In addition, it

acts as the intermediary between the village and higher authority, the district or provincial level. The village committee is responsible for communicating government decrees, for example on rates of taxation, and for implementing policies, and other implementation of the government's programme. The committee is also responsible for organizing village political meetings or seminars to discuss the Party line, and for explaining the importance of political events. How government directives are received depends greatly on the enthusiasm, or inertia, of the village committee, and on the dedication and influence of members of the LPRP(Lao People's Revolutionary Party) serving on it.

As for community activities related to solid waste management, the village administrative committee organizes the collection of waste, sweeping of public places or roads and drain cleansing in village mostly on Saturday mornings. These activities are carried out by the villagers.

A.3.4 Employment

The working populace of Lao P.D.R. in 1986 was estimated to be 1.55 million, 42% of the total population according to the World Bank. The figure appears to exclude economically inactive Buddhist monks, secondary school students and military personnels. The World Bank also estimated the sectorial shares of employment in 1986, that is, 80% for agriculture, 2% for industry, and 18% for service.

The World Bank projected the future structure of employment up to the year 2000 and the results are shown in the following table.

Table A.3-7 Future Structure of Employment in Lao P.D.R. up to Year 2000

	1986		1995		2000	
	Total (in '000)	%	Total (in '000)	%	Total (in '000)	%
Agriculture	1,364	80.0	1,762	78.0	2,009	77.0
Industry	27	1.6	52	2.3	73	2.7
Construction	10	0.6	23	1.0	31	1.2
Transport,commerce and services	304	17.8	422	18.7	499	19.1
Total	1,706	100.0	2,251	100.0	2,612	100.0

A.4 Population

A.4.1 Population Trend

The national population was based on the 1985 National Population Census. According to this census, there were 3.618 million Laotians, comprising 1.773 million males and 1.845 million females. Based on the census, the State Statistical Center, MEPF (Ministry of Economy, Planning and Finance) has announced the population in 1990 (see Table A.4-1). According to the table, the average population density was estimated to be 17.1 persons per km^2 on the basis of a territory of 236,800 km^2. As for the regional distribution of population in 1990, more than 10% of the population is concentrated in Vientiane Municipality.

According to the DPF,VM (Department of Planning and Finance, Vientiane Municipality), the annual growth rate of the population of the State and Vientiane Municipality by the year 2000 is 2.9% and 3.4% respectively. This figure is also applied to the "Draft of the Third Five Year Plan of the Lao P.D.R., (1991-1995) March 1991".

A.4.2 Population Projection

1) State

Based on the annual growth rate (2.9%) given by the DPF, VM, the state population in thousands by the year 2000 is simply extrapolated as follows ;

Year	1985	1990	1995	2000
Population (1,000)	3,618	4,170	4,811	5,550

Table A.4-1 Population Area and Density of Provinces in 1990

Unit: 1,000 persons

Name of Province	Area (km^2)	Total Population	Males	Females	Density Person/km^2
1 Vientiane Municipality	3,920	442	225.4	196.6	113
2 Phong Saly	16,270	142	69.6	72.4	9
3 Luang Namtha	9,325	114	55.9	58.1	12
4 Oudomxai	21,190	291	142.6	148.4	14
5 Bokeo	4,970	64	31.4	32.6	13
6 Luang Phabang	16,875	339	166.1	172.9	20
7 Houa Phan	16,500	243	119.1	123.9	15
8 Sayaboury	11,795	182	89.2	92.8	15
9 Xieng Khwang	17,315	189	92.6	96.4	11
10 Vientiane	19,990	312	159.1	152.9	16
11 Bolikhamsai	16,470	145	71.1	73.9	9
12 Khammouane	16,315	249	122.0	127.0	15
13 Savannakhet	22,080	640	313.6	326.4	29
14 Saravane	10,385	211	103.4	107.6	20
15 Sekong	7,665	58	28.4	29.6	8
16 Champasak	15,415	469	229.8	239.2	30
17 Attapeu	10,320	80	39.2	40.8	8
Total	2,368,000	4,170	2,043	2,126	17.1

Source: State Statistical Center, Ministry of Economy, Planning and Finance

2) Vientiane Municipality

The population figures of Vientiane Municipality in 1985 and 1991 given by the DNDPS, VM (Department of National Defence and Public Security of Vientiane Municipality), which are 327,676 and 424,717, respectively, differ from the figures of the State Statistic Center (381,000 in 1985 and 442,000 in 1990). However, the figures given by the DNDPS, VM are adopted in the Study due to the lack of breakdown in the Center (refer to Table A.4-2).

Based on the annual growth rate (3.4%) given by the DPF, VM, the population of the Vientiane Municipality in thousands by the year 2000 is simply projected as follows ;

Year	1985	1991	1995	2000
Population (1,000)	327	425	485	574

3) Study Area

As mentioned in A.1.1, the Study area consists of 9 homogenous zones which are divided into 81 Bans (villages), according to the UNDP Master Plan. However, a survey has been carried out in October 1991 by the Study Team in cooperation with DCTC in order to find out the actual number of villages in the Study area and their respective population. The result of the survey, in which the population and the number of families of each village were identified at each village office, are tabulated in Table A.4-2. The population and number of families in the Study area in 1991 are 142,723 persons and 24,156 families, respectively.

Based on the annual growth rate (3.4%) given by the DPF, VM, the population of the Study area in thousands by the year 2000 is simply projected as follows ;

Table A.4-2 Present Population and Number of Families in Vientiane Municpality

Name of District	1985				
	No. of Village	Population			No. of Families
		①Total	②Urban Area	②/① (%)	
Total	409	327,676	130,246	39.7	61,545
Sub Total	153	* 155,256	* 130,246	83.9	33,456
Sisattanak	36	* 43,763	* 41,961	95.9	7,495
Saisettha	47	* 30,649	* 25,877	84.4	8,351
Chanthabouly	27	* 46,921	* 36,182	77.1	8,523
Sikhottabong	43	* 33,923	* 26,226	77.3	9,087
Sub Total	256	172,420	N.A.	N.A.	28,089
Saithani	107	72,799	N.A.	N.A.	11,614
Nasaythong	77	41,534	N.A.	N.A.	7,068
Hatsayfong	72	58,087	N.A.	N.A.	9,407
*** Phialath	-	-	-	-	-
Name of District	1991				
	No. of Village	Population			No. of Families
		①Total	②Urban Area	②/① (%)	
Total	477	424,717	142,723	33.6	69,129
Sub Total	191	216,977	** 142,723	65.3	38,105
Sisattanak	40	49,955	** 49,322	98.7	8,562
Saisettha	54	59,919	** 27,602	46.1	10,134
Chanthabouly	38	49,157	** 39,083	79.5	9,161
Sikhottabong	59	57,946	** 26,716	46.1	10,248
Sub Total	286	207,740	N.A.	N.A.	31,024
Saithani	123	83,655	N.A.	N.A.	12,203
Nasaythong	55	35,687	N.A.	N.A.	5,707
Hatsayfong	74	75,618	N.A.	N.A.	10,754
Phialath	34	12,780	N.A.	N.A.	2,360
1991/1985	1.17	1.30	1.09	0.84	1.12

Source: Bureau of the Population Census under the Department of National Defence and Public Security, Vientiane Municipality.

*: UNDP Master Plan for Urban Development in Vientiane.

**: Data obtained by JICA Study Team.

***: Phialath District was established in 1988, divided from Nasaythong District.

Year	1985	1991	1995	2000
Rate (%)	-	1.5	3.4	3.4
Population	130	143	163	193

A.5 Economic Conditions

A.5.1 National Economy

1) New Economic Mechanism

The principles of NEM (New Economic Mechanism) were first announced in 1985. The NEM was approved by the 4th Congress of the LPRP (Lao People's Revolutionary Party). The NEM aims at a market-oriented economy from a control economy and has been developed as a strategy for improving the productivity and efficiency of the Lao economy. The main features of the NEM is as follows ;

a. Market orientation and pricing

The principles of an effective market-oriented economy must be clearly understood. Several elements are necessary for it to be successful ;

i. The heart of the market system is the encouragement of competition, that is, to have more than one seller and more than one buyer for any given good or service, in fact, a great number of both buyers and sellers.

ii. Any buyer or any seller should be able to participate in a given market, and the need for prior permission should be avoided. Government rules and regulations should be kept to the absolute minimum.

iii. The treatment of all buyers and all sellers in any given market should be even and fair: no person should have an unfair advantage in the form of preferred access to credit, or preferential treatment in the form of taxes.

iv. Efforts should be made to keep both buyers and sellers promptly informed of current market prices, especially with respect to agricultural commodities.

In the development of a market-oriented economic system, the private sector --- especially the small farmers, artisans, and tradesmen --- should be encouraged to engage in business under conditions of fair competition.

Means of improving access to credit where appropriate will be considered.

b. Exchange rate flexibility

The exchange rate will continue to be maintained and managed on a unified and market-responsive basis. Only in this manner can the most efficient users of foreign exchange maintain their access to foreign exchange.

c. Improvement of the financial system

The financial system is being restructured, to better assist in promoting greater productivity and efficiency. The commercial banking system is being separated from the central bank. New regional commercial banks are being set up to provide banking services within the major northern, capital, central, and southern regions. Market-responsive interest rates for both deposits and loans are being encouraged, so that the savings habits of the people will be fostered, and so that borrowers can better appreciate the true business costs of money to run their enterprises.

Provisions are made for furthering competitive market development in the banking sector, to be matched with the development and installation of the appropriate supervision and monitoring framework.

d. Increased autonomy for state enterprises

There are two main thrusts of government policy for state enterprises. On the one hand, those state enterprises which do not fall into a strategic area classification, and which can not survive on their own will have to be disposed of or divested by the government. The government will not be directly involved in business operations.

On the other hand, those state enterprises which are being retained by the government must learn to operate efficiently, economically, and effectively. The government must be paid a fair share of the profits of any state enterprise which for any reason enjoys a monopoly position by virtue of government policy and by virtue of the nature of their activities. Such retained state enterprises will be strengthened, especially with respect to their managerial capabilities. The overall principle is that state enterprises must be able to survive on their own resources. They will enjoy operational autonomy and make their own business decisions, but they can no longer depend upon the central government to support them financially, such as through subsidies.

In keeping with this approach, the government will determine which state enterprises are to be disposed of, and which are to be retained, early in the Plan period. Further to this decision, the government will establish the appropriate machinery for the disposition of unnecessary state enterprises.

The importance of early action and decision on the possible divestment of the remaining state enterprises can not be underestimated. The management and staff of the state

enterprises will want to retain as many benefits under the old system as they can, and the sooner the management is tested on its ability to compete successfully under the new market system the better. If the management is found wanting, appropriate corrective measures can then be taken.

2) National Economy

Lao economy is in a reforming process and grew at a relatively high pace in 1989 and 1990.

The growth rate of GDP in 1989 is more than 8% though the average rate between 1984 and 1988 was 3.0% as shown in Table A.5-1. The industry sector induced the growth of Lao economy. The projection of the Third Five Year Plan projected that the share of industry and that of services will increase relatively though the share of agriculture will decrease, as shown in Fig. A.5-1.

Table A.5-1 Gross Domestic Product by Industrial Origin, at 1989 prices in million of Kip

	1984 (act'l)	1985 (act'l)	1986 (act'l)	1987 (act'l)	1988 (act'l)	1989 (act'l)	1990 (est'd)	1991 (proj)	1992 (proj)	1993 (proj)	1994 (proj)	1995 (proj)
1. Agriculture	185,665	189,321	219,093	202,971	205,956	209,561	223,289	243,426	260,807	272,823	283,931	294,867
Paddy	95,442	100,789	104,763	87,820	72,481	101,439	107,761	117,507	124,993	128,958	131,907	134,563
Other crops	34,169	36,504	27,933	37,787	50,035	49,426	52,506	57,255	61,613	64,157	66,819	69,606
Livestock and fishery	23,377	24,598	26,124	24,485	25,273	27,773	29,006	29,908	30,708	31,475	32,232	32,986
Forestry	32,677	27,430	60,273	52,879	57,967	30,923	34,016	38,755	43,494	48,233	52,973	57,712
2. Industry	41,152	42,474	49,490	40,959	40,109	53,001	61,418	68,727	75,193	81,424	87,906	97,213
Mining and quarrying	935	1,027	1,247	969	760	1,048	1,066	1,084	1,102	1,121	1,140	1,160
Manufacturing	21,008	23,857	27,297	26,008	24,331	32,937	38,113	42,441	46,721	51,038	55,568	61,200
Construction	10,915	9,296	13,012	8,698	10,083	12,499	14,066	15,722	17,415	19,162	21,095	23,800
Electric, gas and water	8,294	8,294	7,934	5,284	4,935	6,517	8,173	9,480	9,954	10,104	10.104	11,053
3. Services	56,764	63,667	62,263	67,864	72,018	83,117	89,722	97,007	105,264	113,095	121,229	130,569
Transportation	8,189	8,581	11,343	13,020	13,947	14,683	17,422	19,598	22,548	24,805	26,980	29,484
Wholesale and retail trade	23,752	25,840	28,338	30,054	26,749	34,344	35,352	37,629	39,880	42,151	44,534	47,497
Banking, insurance, real estate	175	181	346	1,314	773	798	886	960	1,041	1,128	1,222	1,324
Ownership of dwellings	9,618	326	3,838	3,952	4,070	4,188	4,646	4,905	5,179	5,468	5,773	6,095
Public administration and defence	10,773	10,212	10,610	11,445	11,941	11,250	11,753	12,257	12,769	13,263	13,766	14,270
Other services	10,263	15,127	7,788	8,479	14,538	17,854	19,663	21,657	23,856	26,280	28,953	31,899
4. Import duties	391	619	1,205	607	1,823	2,574	3,063	3,231	3,545	3,899	4,157	4,455
5. GDP in 1989 constant kip	289,972	296,081	332,051	312,401	319,906	348,253	377,492	412,391	444,809	471,241	497,223	527,103
Growth Rate (%)		4.3	12.1	5.9	2.4	8.9	8.4	9.2	7.9	5.9	5.8	6.0
Population (,ooo persons)	3,513	3,618	3,122	3,828	3,940	4,053	4,170	4,291	4,415	4,543	4,675	4,811
Exchange Rate (Kip/USD)	253	424	400	385	477	719	710	748	774	800	836	875
GDP per capita (1989 const US$)	112	114	124	114	113	120	126	134	140	141	143	152

Source of historical data: Data for the period from 1984 to 1989 was obtained from the National Accounts Office of MEPF, as adjusted for paddy rice and import duties by the Office of Economic and Social Strategy and Planning.

Sources: Draft of the Third Five Year Plan of the Lao People's Democratic Republic, Ministry of Economy, Planning and Finance.

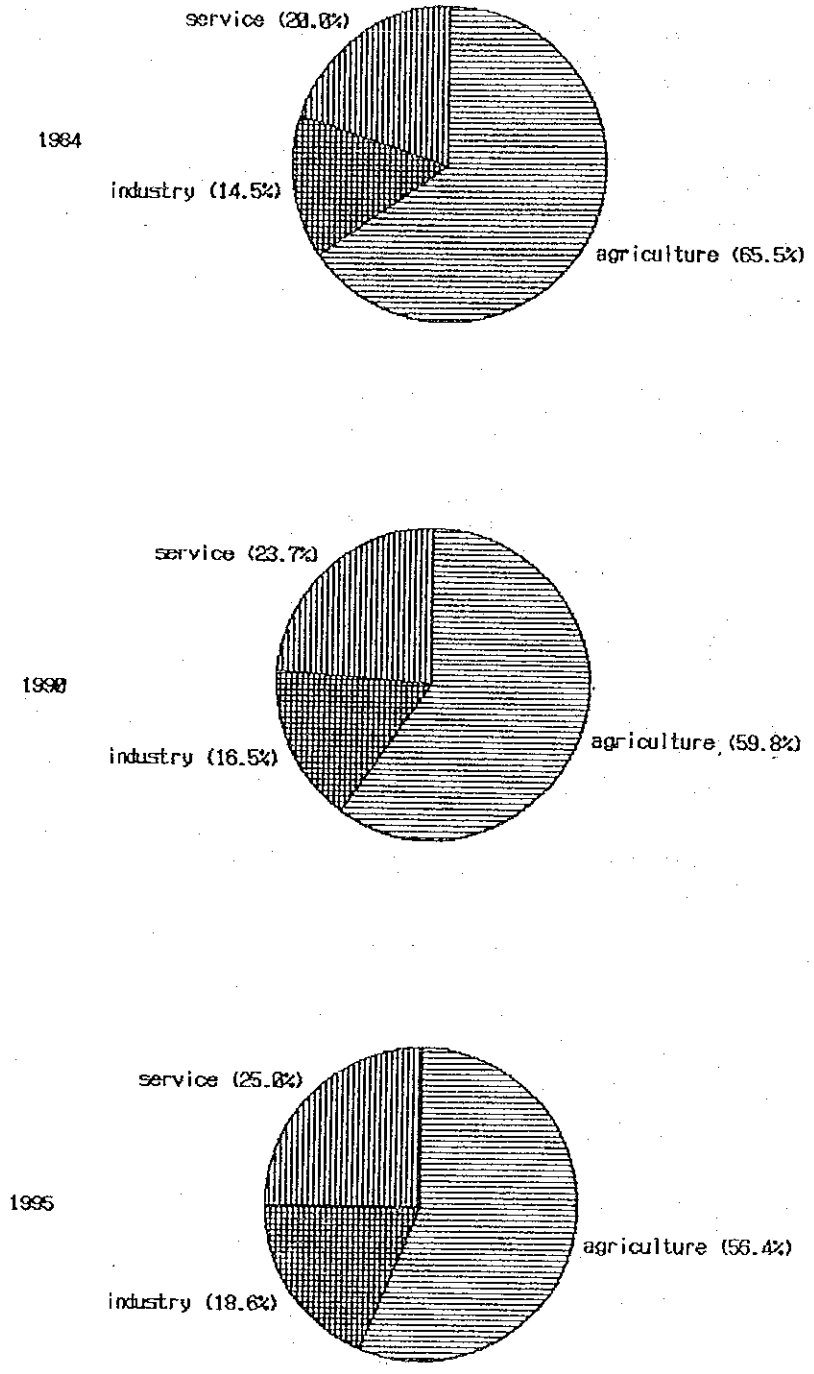


Fig. A.5-1 Change of GDP Composition

GNP per capita is estimated at US $ 126 in 1990. Although this is one of the lowest figures in the world, the figure does not give a true picture of the living standards of Lao people because monetization of the economy is still on the way.

A.5.2 Regional Economy

GRDP (gross regional domestic product) of Vientiane Municipality is estimated at about 30 billion kips in 1990.

This is about 10% of the GDP as shown in Table A.5-2. The growth rate of GRDP is more than that of the GDP, though that of the service sector has decreased since 1989.

A.5.3 Income Level

GRDP per capita is estimated at US $ 87 in 1990, which is lower than the average of the whole country. (The number of population of Vientiane Municipality is assumed at 406,800 in 1990.)

The income and expense per household is shown in Table A.5-3. The lower income class has more proportion of food expense. The middle class gets 25,445 kips per month and spends 71% for food.

The area by average income is shown in Fig. A.5-2.

Table A.5-2 Trend of GRDP

Unit ; million kips

Constant Price in 1988

	1980	1985	1986	1987	1988	1989	1990
Total (A)	7,129.6	18,052.8	18,641.8	19,932.1	23,466.1	27,699.3	30,198.3
Growth Rate			3.3	6.9	17.7	18.0	9.0
Sectors							
1.Agriculture and Forestry	6,606.8	13,428.1	12,008.7	13,151.9	14,223.9	15,078	18,546.0
2.Industry	313.3	1,057.4	1,030.0	771.6	793.5	624.7	1,178.0
3.Service	149.3	3,567.3	5,603.0	6,008.5	8,448.9	11,978.6	10,458.8
Reference							
GDP (B)		221,000	244,000	223,000	228,000	265,000	
A/B x 100(%)		8.2	7.6	8.9	10.3	10.5	

Source ; DPH, VM

Table A.5-3 Income and Expenses per Household

Class / Items	10-20%		20-30%		40-50%		60-70%		70-80%	
	Kip	%	Kip	%	Kip	%	Kip	%	Kip	%
Rice	4,170	28	4,370	24	6,380	25	7,365	22	8,750	22
Meat&fish	4,605	31	5,385	29	7,460	29	9,455	26	11,370	28
Other food	2,700	18	3,330	18	4,245	17	5,370	16	6,350	16
Clothes	865	6	1,075	6	1,225	5	1,520	5	2,170	5
Education	145	1	190	1	270	1	500	1	495	1
Transport	110	1	230	1	500	2	630	2	910	2
Medical	390	3	495	3	390	2	900	3	690	2
Fuel	630	4	690	4	930	4	1,320	4	1,030	3
Electric	940	6	1,080	6	1,575	6	1,575	5	2,055	5
Dwelling	25	0	150	1	280	1	125	0	220	1
Tax	55	0	100	1	80	0	145	0	100	0
Others	470	3	960	5	1,350	5	1,995	6	2,225	5
Total	15,105	102	18,055	98	24,685	97	30,900	92	36,365	90
Saving	290	2	395	2	760	3	2,600	8	4,165	10
Average Income	14,815	100	18,450	100	25,445	100	33,500	100	40,530	100

Source: Questionnaire Survey Done by UNDP M/P (Programme de Developpememt Urbain de la Prefecture de Vientiane)in March 1988

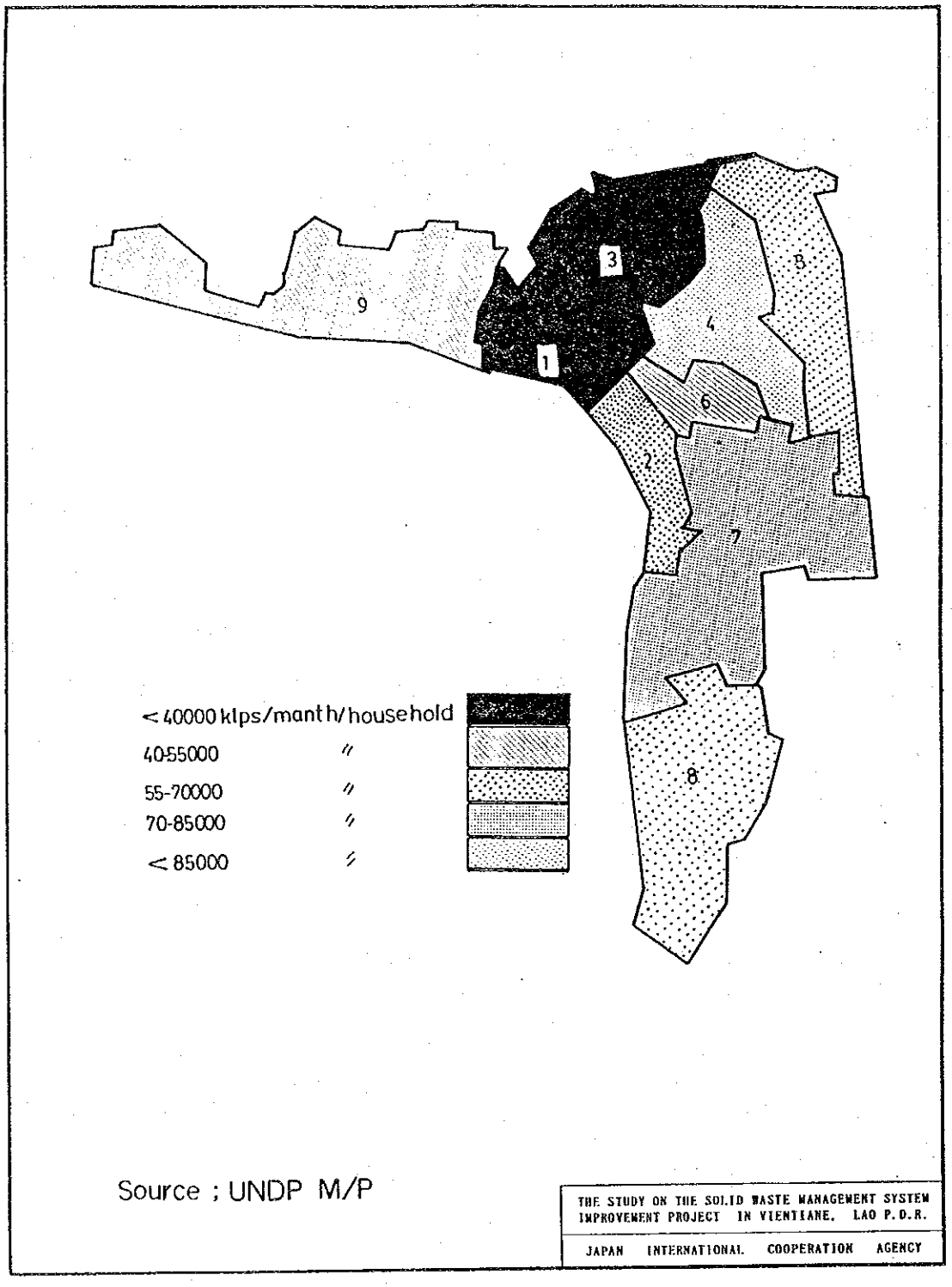


Fig.A.5-2 Average Income by the Area

A.5.4 Industry

The industrial structure of Vientiane Municipality shows that the weight of industry in GRDP is small, although number of the industrial enterprises by local management in Vientiane Municipality shares half of the whole country.

Table A.5-4 Proportion of GRDP and GDP (%)

	GRDP	GDP
Agriculture	61.4	59.6
Industry	3.9	16.4
Service	34.7	24.0
Total	100.0	100.0

Source ; DPH,VM

The proportion of the service sector points out the characteristics of urban economy, though that of agriculture keeps playing a major role in Vientiane Municipality as shown in Table A.5-5

The labour force of Vientiane Municipality, which is between 16 and 60 years old, is 37% of the population.

The unemployment ratio is 15%. There are many government workers in Vientiane Municipality because the market economy has not grown in this country shown in Table A.5-6.

Table A.5-5 Characteristics of Vientiane Municipality (1990)

		VM (A)	Whole Country (B)	Share A/B x 100
A. Agriculture				
Harvested Area of Total Rice Production	ha	42,247	656,654	6.4
Production of Rice	tons	136,862	1,508,402	9.1
Production of Vegetables	"	8,159	60,681	13.4
Number of Buffalos	head	61,661	1,059,600	5.8
Number of Cattle	"	49,270	850,840	5.8
B. Industry				
Number of the Industrial Enterprises by Local Management		193	365	52.9
Capital Investment by Local Management	mill.kips	750.0	10,055.7	7.5
C. Services				
Commodity Transport by Provinces (1989)	thou.tons	51	351	14.5

Source ; SSC, MEPE

Table A.5-6 Composition of Labour Force in Vientiane Municipality

Primary Industry	5%
Secondary Industry excluding Government Workers	15%
Tertiary Industry excluding Government Workers	19%
Government Workers	61%

Source ; UNDP M/P

A.5.5 Local Finance

The trend of budget in Vientiane Municipality is shown in Table A.5-7. The revenue of Vientiane Municipality is 9.7% of GRDP in 1989. Non tax revenue has increased rapidly.

Districts have autonomous budget systems. The trend of budget in the districts, which are located in the urban area of Vientiane Municipality, is shown in Tables A.5-8, A.5-9, A.5-10 and A.5-11.

A.5.6 Tax System and Utility Charging System

In Lao P.D.R., a tax reform policy was introduced in 1988 and is being promoted now.

The major taxes and their collecting body are shown in Table A.5-12.

Table A.5-7 Budget of Vientiane Municipality

Unit: Thousand Kips

Years	1985	1986	1987	1988	1989	1990	1991 (10 month)
A. Revenue							
1. Turnover Tax of State Enterprise and State Cooperative	591,174	629,790	950,096	1,019,096	1,466,000	-	-
2. Tax on Industrial, Commercial Profits and Agricultural tax	551,594	768,712	669,016	904,521	939,000	1,538,300	1,919,200
3. Non-Tax Revenue	45,183	186,809	178,400	220,200	295,000	2,007,600	1,075,700
4. Exchange Foreign Currency	-	-	68,425	-	-	-	-
5. Foreign aids	-	6,179	20,541	6,281	-	-	-
6. Others	83,872	-	-	24,830	-	-	-
Total Revenue(A)	1,271,823	1,591,490	1,886,478	2,175,802	2,700,000	3,553,900	2,994,900
B. Expenditure							
1. Investment Expenditure	616,303	445,496	665,389	606,403	647,000	1,053,700	900,000
2. Personal Expenditure	325,050	678,678	822,085	1,081,909	1,890,600	1,781,300	1,887,500
3. General Account	240,820	286,197	292,364	448,573	496,700	718,900	1,467,000
4. Other	16,390	11,347	44,915	32,871	61,600	-	-
5. Subsidy to Central Level	-	-	35,000	-	-	-	-
Total Expenditure	1,198,563	1,421,700	1,859,700	2,169,700	2,599,200	3,553,900	4,254,500
Balance	73,260	169,790	26,778	6,074	161,700	-	-1,259,600

Reference

Revenue of National Budget (B)	10,299,000	18,503,000	20,108,000	28,210,000	34,313,000
(A)/(B) x 100(%)	12.3	8.6	9.4	7.7	7.9

Table A.5-8 Budget of Chanthabouly District

Unit: Thousand Kips

Years	1985	1986	1987	1988	1989	1990	1991 (10 month)
A. Revenue							
1. Turnover Tax of State Enterprise	4,812	14,048	7,647	3,502	3,744	2,653	2,846
2. Turnover Tax of State Cooperative	3,894	150	1,724	5,755	3,360	-	-
3. Tax on Industrial, Commercial Profits and Agricultural Tax	95,667	110,297	106,700	85,106	100,204	154,384	179,699
4. Non-Tax Revenue	28	9,439	8,156	6,901	24,239	28,406	9,730
5. Balance Past Years	1,200	135	-	2,425	265	3,410	-
Total Revenue	105,601	134,070	124,230	103,690	131,813	188,853	192,275
B. Expenditure							
1. Investment Expenditure	5,152	15,320	31,551	31,901	21,401	14,738	-
2. Personal Expenditure	12,446	28,638	27,805	40,263	58,686	67,333	14,638
3. General Account	14,941	18,572	23,560	30,260	47,807	64,869	67,109
4. Other	-	-	-	-	-	1,400	347
5. Subsidy to Vientiane Municipality	37,431	68,277	40,315	1,000	500	-	-
Total Expenditure	69,971	130,806	123,231	103,425	128,440	148,340	82,092
Balance	35,630	3,264	999	265	3,413	40,513	110,193

Table A.5-9 Budget of Saisettha District

Unit: Thousand Kips

Years	1985	1986	1987	1988	1989	1990	1991 (10 month)
A. Revenue							
1. Turnover Tax of State Enterprise	1,680	4,650	5,766	5,125	6,707	4,249	-
2. Turnover Tax of State Cooperative	-	-	-	-	-	-	-
3. Tax on Industrial, Commercial Profits and Agricultural Tax	19,100	24,600	27,410	33,238	38,300	57,279	58,352
4. Non-Tax Revenue	2,420	8,390	4,604	11,600	18,141	51,426	17,914
5. Subsidy from Vientiane Municipality	13,300	18,610	19,345	17,500	41,522	18,900	-
Total Revenue	36,500	56,250	57,125	67,463	104,670	131,854	76,266
B. Expenditure							
1. Investment Expenditure	-	5,850	4,000	2,500	-	-	-
2. Personal Expenditure	17,600	29,960	32,540	37,445	84,635	105,042	28,846
3. General Account	18,900	19,440	20,585	27,518	20,035	26,812	20,569
4. Special	-	1,000	-	-	-	-	-
Total Expenditure	36,500	56,250	57,125	67,463	104,670	131,854	49,415
Balance	-	-	-	-	-	-	26,851

Table A.5-10 Budget of Sikhottabong District

Unit: Thousand Kips

Years	1985	1986	1987	1988	1989	1990	1991 (10 month)
A. Revenue							
1. Turnover Tax of State Enterprise	-	11,847	13,625	6,215	12,194	16,470	-
2. Turnover Tax of State Cooperative	-	185	49	5,956	233	1,375	-
3. Tax on Industrial, Commercial Profits and Agricultural Tax	-	34,587	39,776	28,568	48,137	73,060	48,492
4. Non-Tax Revenue	-	10,141	11,663	7,978	20,175	22,420	16,993
5. Others	-	-	-	-	670	-	-
6. Subsidy from Vientiane Municipality	-	4,244	5,042	32,056	30,430	54,522	16,319
Total Revenue	32,872	61,004	70,155	80,773	111,839	172,847	81,804
B. Expenditure							
1. Investment Expenditure	-	10,843	12,469	235	860	-	-
2. Personal Expenditure	-	28,031	32,236	56,286	64,074	116,617	27,320
3. General Account	-	21,937	25,223	23,581	46,663	56,230	24,494
Total Expenditure	25,156	60,811	69,933	80,102	111,597	172,847	51,814
Balance	7,626	193	222	671	242	-	29,988

Table A.5-11 Budget of Sisattanak District

Unit: Thousand Kips

Years	1985	1986	1987	1988	1989	1990	1991 (10 month)
A. Revenue							
1. Turnover Tax of State Enterprise	2,728	8,201	8,761	9,932	11,056	8,202	1,527
2. Turnover Tax of State Cooperative	-	1,799	2,806	3,485	5,311	-	-
3. Tax on Industrial, Commercial Profits and Agricultural Tax	25,879	35,750	37,632	44,243	59,365	79,591	74,250
4. Non-Tax Revenue	1,550	7,430	9,045	10,652	12,769	48,741	25,804
5. Subsidy from Vientiane Municipality	1,860	-	-	-	-	-	-
Total Revenue	32,024	53,180	58,244	68,312	88,501	136,534	101,581
B. Expenditure							
1. Investment Expenditure	3,870	8,005	13,544	15,632	9,789	13,436	-
2. Personal Expenditure	8,916	9,500	10,639	11,009	36,420	48,584	25,985
3. General Account	16,679	35,011	34,061	41,347	42,056	72,020	27,071
Total Expenditure	29,466	52,516	58,244	67,988	88,265	134,040	53,056
Balance	2,550	664	-	324	236	2,494	48,525

Table A.5-12 Tax and Users Charge

Items	Payers	Collecting Body
Tax		
-Corporate Income Tax	enterprises	Central Government
-Personal Income Taxes	individuals except farmers	"
-Business Licenses	enterprises	"
-Turnover Tax	enterprises	"
-Land Tax	owners of non-agriculture land	Local Government
-Tax on Natural Resources	enterprises using natural resources	Central Government
-Agriculture Tax	farmers	Local Government
Users Charge		
-Education	students	School
-Health	patients	Health care facilities
-Electricity	consumers	EDC
-Water Supply	"	Nampapa
-Irrigation	farmers using irrigation system	Ministry of Agriculture
-Roads	users	DCTC
-Post Telephone and Telex	users	MCTPC

Present tax system and utility charging system are described as follows;

a) Corporate income tax is assessed on the companies net profit. The rate is a single rate, standing now at 45%.

b) Pesonal income tax depend on progressive rates as shown below ;

Salaries		Industrial and Trade Profits	
Monthly Incomes	Rates	Annual Incomes	Rates
Less than 20 KK	2%	Less than 200 KK	10%
25 to 60 KK	5%	200 to 500 KK	15%
60 to 120 KK	10%	500 to 1000 KK	20%
120 to 200 KK	15%	1000 to 2000 KK	25%
200 to 300 KK	20%	2000 to 3000 KK	30%
over 300 kk	30%	3000 to 4000 KK	35%
		over 4000 KK	40%

Note; KK : Thousand Kips.

c) Business licenses depend on the amount of capital engaged in business or annual turnover achieved in the previous year as shown below;

i. For Import-Export activities

Class	Amount of Capital	Amount of Patents	Categories of Authorized Products
1	More than 200 KK	50 KK	1 to 14
2	150 to 200 KK	40 KK	1 to 12
3	100 to 140 KK	40 KK	1 to 10
4	50 to 100 KK	20 KK	1 to 7
5	10 to 50 KK	10	1 to 4

ii. For Other Business Activities

Class	Annual Turnover	Transports and Manufacturing	Trade
1	More than 100 KK	15 KK	20 KK
2	50 to 100 KK	10 KK	15 KK
3	20 to 50 KK	70 KK	10 KK
4	10 to 20 KK	50 KK	70 KK
5	5 to 10 KK	35 KK	50 KK
6	2 to 50 KK	20 KK	30 KK
7	below 20 KK	15 KK	25 KK

KK : Thousand kips

d) Turnover tax means a comprehensive tax on consumption, and has five tax rates : 3, 6, 10, 15 and 20 percent.

e) Custom tariffs are part of larger import-export taxes. Tax rates range from exemption for certain machineries to 70% percent for luxury goods and are shown in Table A.5-13.

Table A.5-13 Example of Custom Tariffs

most finished products	around 20%
machinery	" 5%
intermediate goods	" 5%
cement	" 3%
yarn	" 6%
bicycle	" 5%
garments	10 ~ 30%
furniture	10 ~ 30%
gasoline	" 15%
diesel	" 3%
other fuel	5 ~ 10%
cars	50%
cigarettes	" 70%
tobacco	" 40%
soft drinks	" 40%
alcoholic beverage	" 70%

f) Land taxes are determined according to the location of the property, i.e. non-agricultural land and area of land.

The tariffs on electricity and water supply is shown in Table A.5-14. Irrigation charges were not confirmed.

Table A.5-14 Tariff on Electricity and Water

Electricity Tariff (as of November 1991)

	Rate (kips)
1) Domestic Use	
For the first 200 kw	7 kips/kw
For the next 201 kw	14 kips/kw
2) Office (Ministries etc..)	18 kips/kw
3) Commercial Use	
For the first 200 kw	14 kips/kw
For the next 201 kw	20 kips/kw
4) Industrial Use	
For all units	7 kips/kw
5) Irrigation Use	
For all units	7 kips/kw
6) Embassy and International Organization	
For all units	56 kips/kw

Water Tariff

1) Domestic Use		
For the first	0.5 ~ 5 cubic meter	30 kips
	6 ~ 10	35 kips
	10 ~ 30	40 kips
	31 +	50 kips
2) Trade use		
For the first	0 ~100 cubic meter	110 kips
	101 +	100 kips

APPENDIX B

WASTE AMOUNT AND COMPOSITION SURVEY

APPENDIX B WASTE AMOUNT AND COMPOSITION SURVEY

B.1 Objectives of the Survey

1) Objectives

Basic information such as the quantity of solid waste generated in the Study area, the population covered by the collection services, maps showing collection area, etc. is the principal and the key factor for a successful and workable solid waste management plan. Neither study, however, nor data regarding basic information which is reliable is not available other than the " Report on Disposal of Solid Waste in Urban Vientiane" by the UNDP. This, however, does not include waste composition study, etc..

A WACS (Waste Amount and Composition Survey) was carried out in order to obtain the above-mentioned basic information waste generation ratio, discharge amount, amount of self-disposal and collection, and to finally clarify the waste stream in the Study area.

The waste stream is the Study area was completed after the completion of WACS both in rainy season and dry season.

2) Definitions

In order to make the contents of the WACS and the waste stream clearly understood, the words used in the study are defined as follows ;

a. Domestic wastes

Wastes generated in or discharged from each household including wastes in shops. Those generated through commercial activities are excluded.

b. Commercial wastes

Wastes generated in or discharged from shops, excluding domestic wastes of shops. Shops include restaurants, hotels, drug stores, grocery shops, printing shops, etc..

c. Institutional wastes

As for the institutional wastes, the following wastes are examined in the Study ;

- market wastes ;
- government office wastes including wastes of schools ; and
- hospital wastes.

d. Road sweeping wastes

Road sweeping wastes include all wastes generated by the following cleansing services ;

- road sweeping wastes ;
- drain cleansing wastes ; and
- grass cutting wastes.

e. Hauled wastes (to KM 18-DS)

Aside from DCTC, there are three private companies authorized for waste collection in November 1991. Hauled wastes mean wastes hauled by the DCTC and the three contractors.

f. Directly hauled wastes (to KM 18-DS)

Directly hauled wastes mean wastes hauled by someone other than the above-mentioned four organizations to the KM 18-DS.

B.2 Selection of Sampling Points

1) Number of Sampling Points

Number of sampling points other than the hauled wastes and direct hauled wastes is shown below ;

- domestic wastes	30 points
- commercial wastes	5 points
- market wastes	2 points
- government office wastes	4 points
- hospital wastes	1 points
- road sweeping wastes	1 points
Total	43 points

2) Selection of Sampling Points

In order to get the average amount and composition of waste in the Study area, the sampling points of domestic wastes and commercial wastes were selected according to the following ;

a. The Study area was divided into a residential area and a commercial area called as C zone.

b. The residential area was divided into the following two zones ;

i. A zone is the area where the average monthly income of each household is not less than 55,000 kips in accordance with the Vientiane City Master Plan prepared by UNDP.

ii. B zone is the area where the average monthly income of each household is less than 55,000 kips in accordance with the Master Plan.

c. Three homogeneous zones, of which name was applied in the UNDP M/P, were selected for A and B zones respectively, and a homogeneous zone was selected for C zone.

d. Five residences or shops were selected as sampling points from each homogeneous zones.

The selection of sampling points was carried out in cooperation with the DCTC. AS a result, 31 Bans (villages), equivalent to 1/3 of total number of Bans in the Study area ; i.e. 96 Bans, were selected as sampling points. The sampling points for domestic and commercial wastes are tabulated in Table B.2-1 and shown in Fig. B.2-1. In addition, the sampling points for market, office, hospital and road sweeping wastes are tabulated in Table B.2-2 and shown in Fig. B.2-1. The number of samples for the WACS is tabulated in Table B.2-3.

Table B.2-1 Sampling Points for Domestic Wastes and Commercial Wastes

Type of Area	Zone	Name of Homogeneous zone	Name of Sampling Village	No. of Res. (Shop)	
Residential Area	A Income: not less than 55,000 kip/ month	Phone Xai	Fai	1	
			Phone Xai	1	
			Naxay	1	5
			Nong Bone Tay	1	
			Phonsa At	1	
		Sokpaluang	Saphane Thong Neua	1	
			Thong Saphane Thong	1	5
			Phone Papao Thong	1	
			Wat Nak	2	
		Hal Mahosot	Phia Wat	1	
			Simuong	1	
			Pha Pho	1	5
			Bung Khangong Tay	1	
			Bung Khangong Neua	1	
	B Income: less than 55,000 kip/ month	Wattay	Na Kham	1	
			Nong Panay	1	
			Wattay Noy	1	5
			Sikhay Tha	1	
			Sikhay Thong	1	
		Pasak	Thon Khan Kham Neua	1	
			Sisavath Neua	1	
			Dong Mieng	1	5
			Thong Sangnang	1	
			Khoua Luang Tay	1	
		Dong Palane	Nong Chanh	1	
			Dong Palane Tha	1	5
			Dong Palane Thong	1	
			Phonsinpuane	2	
	Total			30	
Commercial Area	C	Namphou	Xieng Nhune Thong	1	
			Xieng Nhune Tha	2	5
			Hay Sok	2	

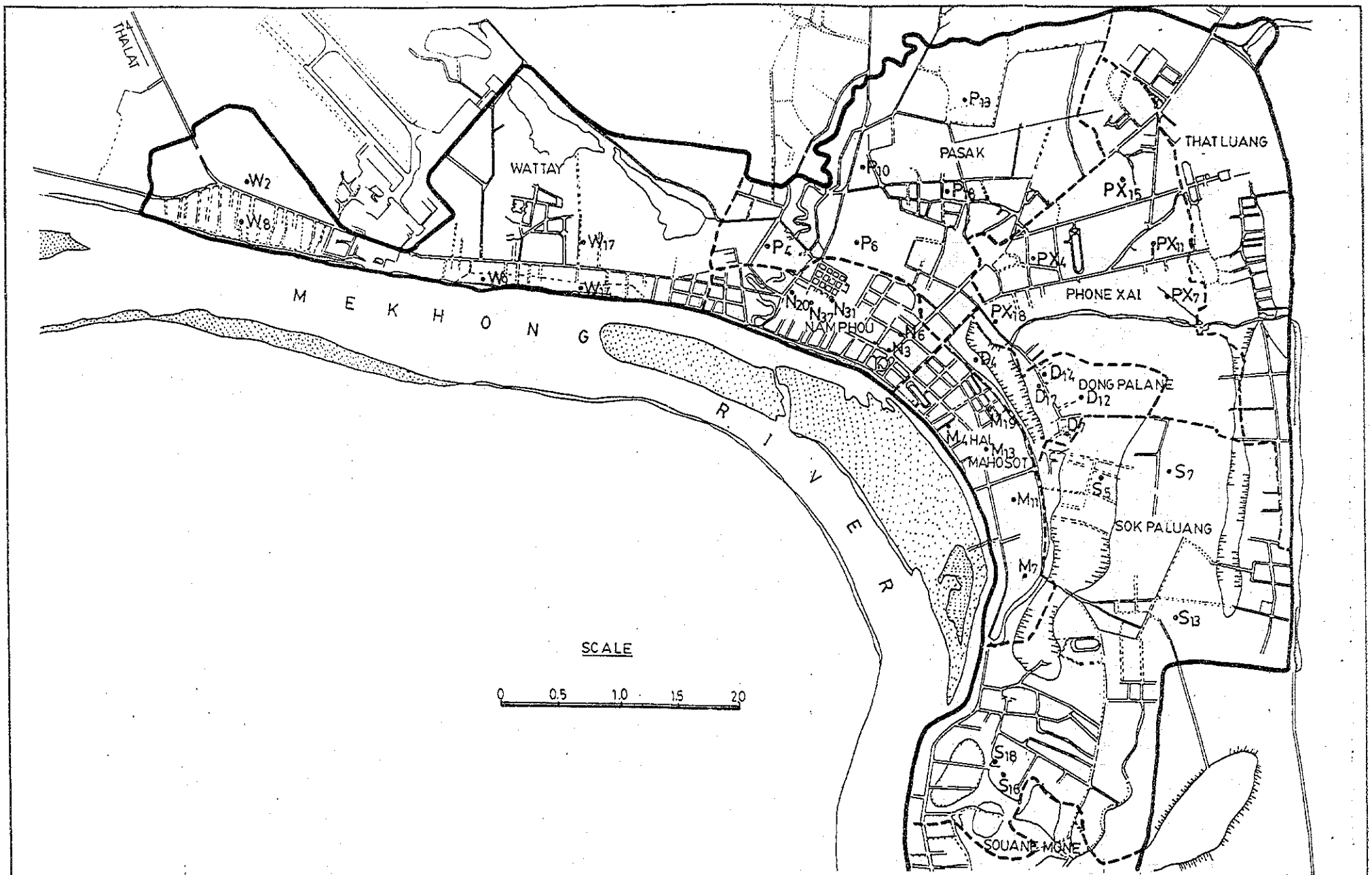


Fig. B.2-1 Sampling Points of Waste Amount and Composition Survey

THE STUDY ON THE SOLID WASTE MANAGEMENT SYSTEM IMPROVEMENT PROJECT IN VIENTIANE, LAO P.D.R.

JAPAN INTERNATIONAL COOPERATION AGENCY

Table B.2-2 Sampling Points for Institutional Wastes and Road Sweeping Wastes

Classification		Name of Sampling Point
Institution	Market	Nong Chanh
		That Luang
	Government Office	MOFA
		MOH
		VM
		MOE
	Hospital	Mahosot Hospital
Road Sweeping		Lane Xang Avenue

Note ; MOFA : Ministry of Foreign Affair
MOH : Ministry of Health
VM : Vientiane Municipality
MOE : Ministry of Education

Table B.2-3 Number of Sample for WACS

Discharge Sources	Hogeneous Zone Name	Nummber of Survey Point	Frequency time/week	Season	No. of Samples
Residential Areas	-	30	7	2	420
Zone A	. Phone Xai . Sokpaluang . Hal Mohoso	5 5 5	7	2	210
Zone B	. Wattay . Pasak . Dong Palan	5 5 5	7	2	210
Commercial Area (Zone C)	. Namphou	5	7	2	70
Institutional Facilities	-	7	7	2	98
Markets	-	2	7	2	28
Government Offices	-	4	7	2	56
Hospitals	-	1	7	2	14
Road Sweeping	-	1	7	2	14
Total	-	43	7	2	602

B.3 Survey Period

The survey was conducted in the following periods ;

Table B.3-1 Survey Period

Classification of WACS	Survey Period	
	Rainy Season	Dry Season
WACS for Domestic and Commercial Wastes	From 15 to 22 October, 1991 (8 days)	From 6 to 13 February, 1992 (8 days)
WACS for Institutional and Road Sweeping Wastes	From 17 to 24 November 1991 (8 days)	From 6 to 13 February, 1992 (8 days)
WACS for Hauled Wastes to KM 18-DS	From 12 to 13 November, 1991 From 17 November 1991 to 31 January 1992	
WACS for Directly Hauled Wastes to KM 18-DS	From 17 November 1991 to 31 January 1992	

B.4 Method of the Survey

Method of the survey is tabulated in Table B.4-1. Upon consideration of the daily fluctuations of discharged wastes, the survey was conducted continuously for 8 days. The amount of waste discharged a day was measured from 7 AM morning to 7 AM the following day.

1) Collection of Sample

Before the execution of the WACS, required numbers of plastic bags distributed to residences, shops and offices which were selected as sampling points. Then, when a sample was collected by the Study Team, the name of survey point was written on each plastic bag in order to classify the sample.

Samples discharged from markets, road sweeping were collected by using collection vehicle supplied by JICA for the Study.

Sample discharged from hospital was collected by the trailer which was installed at the Mahosot Hospital and hauled by the collection truck of DCTC.

2) Waste Amount Survey

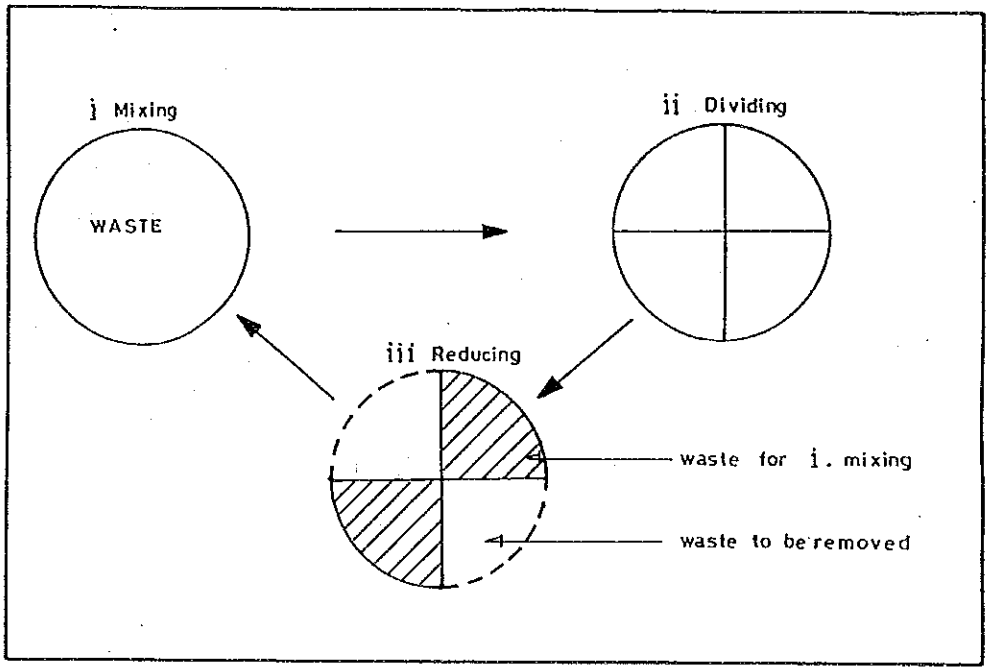
Amount of waste was measured by each sampling point. Samples used plastic bags were measured by a platform scale. Samples used collection vehicle and trailer were measured at the weighbridge installed by the Study Team.

3) Waste Composition Survey

The composition of waste was measured in wet base in accordance with the following categories.

- residential area A zone
- residential area B zone
- commercial area
- markets
- offices
- hospital

Each category of waste was gathered and mixed together. Then, waste mixed together was reduced in volume by applying the reducing method shown below many times until the volume became 30 t0 50 liters.



i. Mixing

In case that, large size wastes e.g. cardboard, textile etc. were contained in the waste, those big size wastes were made small and mixed again.

ii. Dividing

Waste mixed well was divided into four blocks which should be almost same volume.

iii. Reducing

The diagonal two blocks of waste divided into four was removed.

Above i~iii method was continued untill remaining waste volume became the designated amount for waste composition analysis (30 to 50 liters). Then, the waste was put into a plastic bucket.

The plastic bucket containing waste was tapped on the ground several times and the waste volume in it was measured by eye and the weight was measured by the platform scale. ASG (Apparent Specific Gravity) was calculated by following formula.

ASG = Weight of Waste (kg)/Volume of Waste (l)

Waste after measured ASG was applied to the composition survey. Items of waste composition survey were shown in Table B.4-1

Table B.4-1 Method of Survey

Discharge Source	Collection Method of Sample	Method of Waste Amount Survey	Items of Waste Composition Survey
Residence	by plastic bag	by platform scale	Analysis Items .ASG (Apparent Specific Gravity) .Physical Composition..Wet Base (Garbage, Paper, Textile, Plastic, Wood.Bamboo, Metal, Grass. Ceramic, Others)
Shop	by plastic bag	by platform scale	
Market	by collelction vehicle	by weighbridge	
Office	by plastic bag	by platform scale	
Hospital	by trailer of hospital	by weighbridge	
Road Sweeping	by collection vehicle	by weighbridge	

B.5 Results of the Survey

1) Waste Amount

The result of waste amount survey is tabulated in Table B.5-1, B.5-2 and shown in Fig. B.5-1 ~ B.5-4

Amount of waste discharged from residences and shops per unit per day was almost same both in rainy season and in dry season.

Discharged amount of waste from residences was 638 g/day/person in rainy season and 668 g/day/person in dry season. Average discharged amount of waste was 653 g/day/person.

Discharged amount of waste from shops was 8,769 g/day/shop in rainy season and 9,147 g/day/shop in dry season. Average discharge amount of waste is 8,958 g/day/shop.

On the other hand, amount of waste discharged from institutions except for offices was different between in rainy season and in dry season.

Discharged amount of waste from markets was 969 g/day/shop in rainy season and 1,633 g/day/shop in dry season. Average discharge amount of waste was 1,301 g/day/shop. The difference was because of fruit waste contain due to the season of fruit.

Discharged amount of waste from hospitals was 1,449 g/day/bed in rainy season and 465 g/day/bed in dry season. Average discharge amount of waste was 957 g/day/bed.

Discharged amount of waste from road sweeping is 27 kg/day/km in rainy season and 89 kg/day/km in dry season. Average discharge amount of waste is 58 kg/day/km. The difference was because of fallen leaves in dry season.

Based on the result of the survey, the discharge ratio of each

generation source is considered as follows,

a. Residence	: 653 g/d/per.
b. Shop	: 8,958 g/d/shop
c. Market	: 1,301 g/d/shop (The figure includes daily shops which do not have permanent spaces in the market)
d. Office	: 31 g/d/emp.
e. Hospital	: 957 g/d/bed
f. Road Sweeping	: 58,000 g/d/km

Table B.5-1 Waste Amount in Residences and Shops

Season	Zone	Number of Residences	Total Number of Family Members	Average Number of a Family Members	Average Discharge Amount(g/d/hou.)	Average Discharge Amount (g/d/per.)		
						Minimum	Maximum	Average
Rainy	A	13	122	9.4	5,706	219	961	607
	B	13	92	7.1	4,775	223	1,227	669
	Residential Area	26	214	8.3	5,241	219	1,227	**638**
	Commercial Area(C)	5	-	-	**8,769**	-	-	-
Dry	A	15	143	9.5	6,308	360	1,554	664
	B	14	92	6.6	4,439	332	1,399	672
	Residential Area	29	235	8.1	5,374	332	1,554	**668**
	Commercial Area(C)	5	-	-	**9,147**	-	-	-
Average	A	14	133	9.5	6,007	-	-	635
	B	14	92	6.9	4,607	-	-	670
	Residential Area	28	225	8.2	5,307	-	-	**653**
	Commercial Area(C)	5	-	-	**8,958**	-	-	-

Table B.5-2 Amount of Institutional and Road Sweeping Wastes

(UNIT:Kg)

Season	Survey Area	Number of Generation Sources Surveyed	Average Discharge Amount/Day			Average/ Day/ Unit
			Minimum	Maximum	Average	
Rainy	Nong Chanh	780 shops	600	970	831.00	1.066
	That Luang	1050 shops	240	1,410	941.00	0.897
	Market Total	1,830 shops	-	-	1772.00	0.969
	MOFA	270 employee	1.00	2.80	1.79	0.007
	MOH	80 employee	0.10	1.70	0.87	0.011
	VM	40 employee	1.60	26.75	12.36	0.309
	MOE	160 employee	0.90	2.40	1.49	0.009
	Office Total	550 employee	-	-	16.52	0.030
	Mahosot	450 bed	0.00	2,520.00	652.21	1.449
	Lane Xang Av.	2 Km	11	130	53.00	27.000
Dry	Nong Chanh	780 shops	1,260	1,610	1420.00	1.821
	That Luang	1050 shops	990	2,090	1570.00	1.494
	Market Total	1,830 shops	-	-	2989.00	1.633
	MOFA	270 employee	2.80	10.10	4.10	0.015
	MOH	80 employee	0.50	8.80	3.07	0.038
	VM	40 employee	2.60	18.90	7.21	0.180
	MOE	160 employee	2.40	4.30	2.78	0.017
	Office Total	550 employee	10.20	30.10	17.08	0.031
	Mahosot	450 bed	76.00	280.00	209.43	0.465
	Lane Xang Av.	2 Km	110	280	178.57	89.000
Average	Nong Chanh	780 shops	-	-	1125.50	1.444
	That Luang	1050 shops	-	-	1255.50	1.196
	Market Total	1,830 shops	-	-	2380.50	1.301
	MOFA	270 employee	-	-	2.95	0.011
	MOH	80 employee	-	-	1.97	0.025
	VM	40 employee	-	-	9.79	0.245
	MOE	160 employee	-	-	2.14	0.013
	Office Total	550 employee	-	-	16.80	0.031
	Mahosot	450 bed	-	-	430.82	0.957
	Lane Xang Av.	2 Km	-	-	115.79	58.000

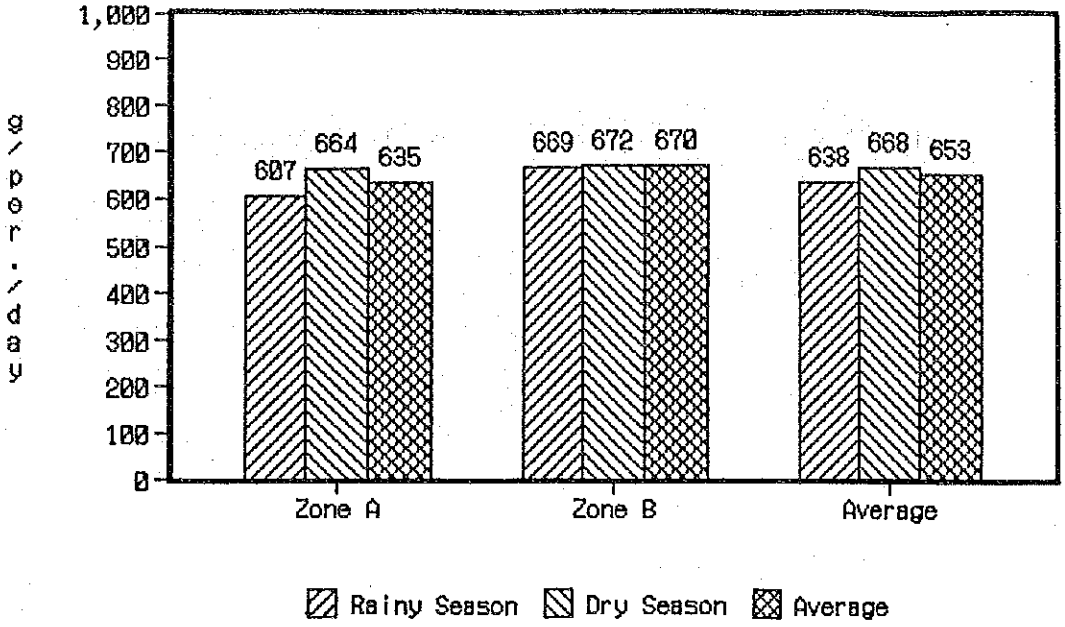


Fig.B.5-1 Amount of Waste Discharged
from Residences per Person per Day

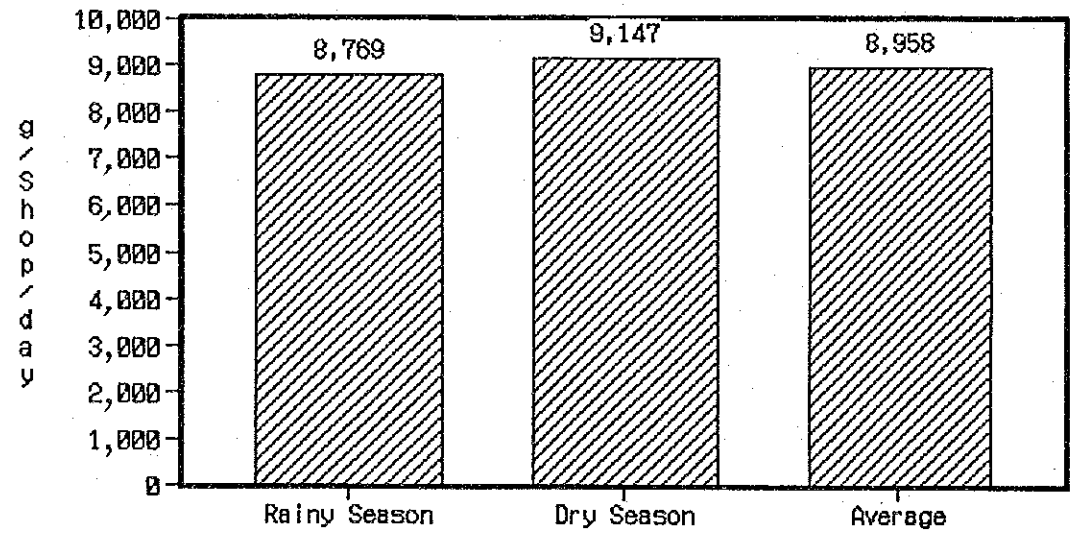


Fig.B.5-2 Amount of Waste Discharged
from a Shops per Day

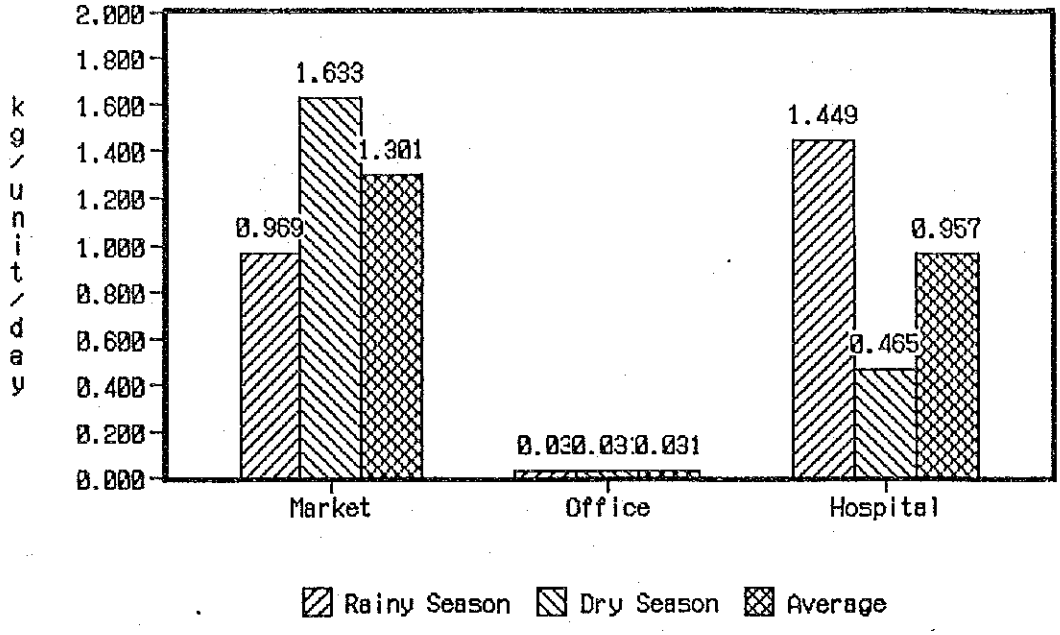


Fig.B.5-3 Amount of Waste Discharged
from each Institution per Unit per Day

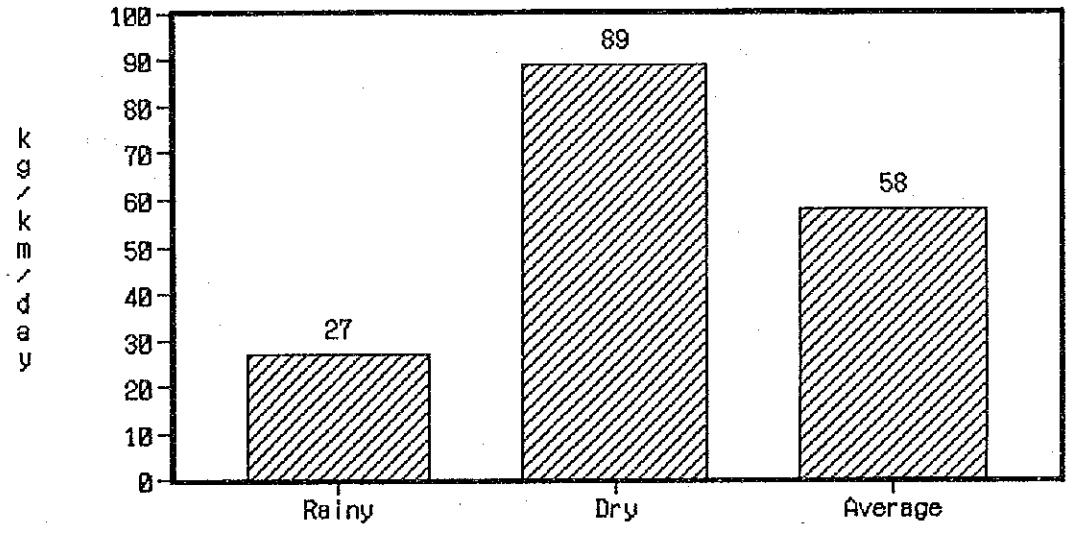


Fig.B.5-4 Amount of Waste Discharged
from Road Sweeping per Km per Day

2) Waste Composition

The result of the waste composition survey is tabulated in Tables B.5-3~ and B.5-4, and shown in Fig. B.5-5.

a. Domestic Waste

The characteristics of the composition of the domestic waste are described as follows ;

i. The garden waste, which consists of wood/bamboo and others, shares about 60% of the composition. The major contents of the "others" were soil and sand accumulated from gardening works.

ii. The amount of garbage in the domestic waste is very small as it covers only about 17%. This is because 75% of the households breed domestic animals to whom they feed their food waste.

iii. By comparing the waste composition with that of other countries, the ASG (Apparent Specific Gravity) is low at 0.169 kg/lit. and the CV (Calorific Value) is high at 1,707 kcal/kg. This indicates that waste in the Study area is of low moisture content and very combustible due to less garbage content.

b. Commercial Waste

The characteristics of the composition of the commercial waste are mentioned as follows ;

i. Although garbage shares about 43% of the composition, the ratio is not high in consideration of high ratio of the restaurant in the commercial area. This is because food waste generated in restaurants is collected by waste collectors or farmers and fed to the livestock.

ii. The ASG and CV are 0.170 kg/lit. and 1,423 kcal/kg respectively.

c. Other Wastes

The characteristics of the composition of the other wastes are summarized as follows ;

i. As for market wastes, the garbage covers more than 60% of the composition.

ii. Regarding the composition of office wastes, the majority is wood/bamboo and it shares about 36%. Paper ranks second as it covers about 27%.

iii. As for hospital wastes, a lot of the infectious waste was included in the non-infectious waste in rainy season, regardless of the Study Team's request for the segregation of the infectious waste. As such the waste composition analysis was cancelled.

On the other hand, the infectious waste was segregated in dry season and the amount of it was 14.7%. Waste composition was analyzed in this season because infectious waste was not included in non-infectious waste.

The amount of infectious waste is considered as about 15%.

iv. In terms of road sweeping wastes, wood/bamboo and others (soil and sand) accumulated from gardening shares about 90%.

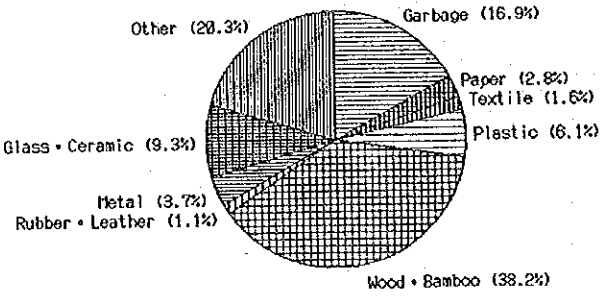
Table B.5-3 Physical Composition of Waste

Season	Type of Waste	Apparent Specific Gravity (Kg/l)	Classification									
			Garbage (%)	Paper (%)	Textile (%)	Plastic (%)	Wood Bamboo (%)	Rubber Leather (%)	Metal (%)	Glass Ceramic (%)	Other (%)	TOTAL (%)
Rainy	Domestic Wastes(A)	0.193	12.7	2.6	2.5	6.1	38.6	0.2	5.1	3.8	28.5	100.0
	Domestic Wastes(B)	0.181	9.4	2.7	1.6	6.6	45.9	2.1	2.8	10.4	18.5	100.0
	Domestic Wastes(Av.)	0.187	11.1	2.6	2.0	6.3	42.2	1.1	4.0	7.0	23.6	100.0
	Commercial Wastes(C)	0.153	29.2	24.7	0.3	8.3	14.3	0.0	7.8	6.5	8.9	100.0
	Market Wastes	0.213	61.1	6.6	0.5	4.2	12.8	0.1	1.1	1.6	12.0	100.0
	Office Wastes	0.088	3.8	29.5	0.0	8.9	38.7	0.0	0.0	4.0	15.1	100.0
	Hospital Wastes	-	-	-	-	-	-	-	-	-	-	-
	Road Sweeping Wastes	0.062	0.0	6.5	0.0	6.5	51.6	0.0	0.0	0.0	35.5	100.0
Dry	Domestic Wastes(A)	0.141	16.7	3.1	1.6	5.9	33.9	1.6	5.9	11.0	20.3	100.0
	Domestic Wastes(B)	0.158	28.7	2.6	0.7	5.6	34.7	0.5	0.9	12.4	13.9	100.0
	Domestic Wastes(Av.)	0.150	22.7	2.9	1.2	5.8	34.3	1.1	3.4	11.7	16.9	100.0
	Commercial Wastes(C)	0.187	57.4	15.2	0.2	7.4	3.2	0.5	3.9	6.8	5.4	100.0
	Market Wastes	0.240	62.3	7.9	0.4	4.4	13.6	0.5	2.6	2.1	6.2	100.0
	Office Wastes	0.065	7.9	34.8	0.0	9.9	33.2	2.4	5.1	5.9	0.8	100.0
	Hospital Wastes	0.139	47.1	13.3	6.2	11.7	8.3	2.1	1.7	4.3	5.3	100.0
	Road Sweeping Wastes	0.050	0.0	0.8	0.0	10.1	60.1	0.0	1.5	0.0	27.5	100.0
Average	Domestic Wastes(A)	0.167	14.7	2.9	2.1	6.0	36.3	0.9	5.5	7.4	24.4	100.0
	Domestic Wastes(B)	0.170	19.1	2.7	1.2	6.1	40.3	1.3	1.9	11.4	16.2	100.0
	Domestic Wastes(Av.)	0.168	16.9	2.8	1.6	6.1	38.2	1.1	3.7	9.3	20.3	100.0
	Commercial Wastes(C)	0.170	43.3	20.0	0.3	7.9	8.8	0.3	5.9	6.7	7.2	100.0
	Market Wastes	0.227	61.7	7.3	0.5	4.3	13.2	0.3	1.9	1.9	9.1	100.0
	Office Wastes	0.077	5.9	32.2	0.0	9.4	36.0	1.2	2.6	5.0	7.9	100.0
	Hospital Wastes	0.139	47.1	13.3	6.2	11.7	8.3	2.1	1.7	4.3	5.3	100.0
	Road Sweeping Wastes	0.056	0.0	3.7	0.0	8.3	55.9	0.0	0.8	0.0	31.5	100.0

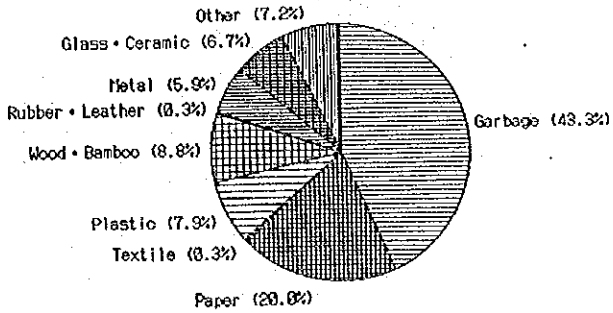
Table B.5-4 Composition of Hospital Waste

Rainy Season	Date	19 Nov. 1991 (Tue)	20 Nov. 1991 (Wed)	21 Nov. 1991 (Thu)	22 Nov. 1991 (Fri)	23 Nov. 1991 (Sat)	24 Nov. 1991 (Sun)	25 Nov. 1991 (Mon)	Total Amount	Average/ Day
	Total Amount of Waste (Kg)	0	2520	760	520	290	15.5	460	4565.5	652.2
	* Amount of Infectious Waste (Kg)	0	N.A.	(25)	(11.7)	(3.3)	(15.5)	(5.2)	(60.7)	(8.7)
	Percentage of Infectious Waste(%)	-	N.A.	3.3	2.3	1.1	100.0	1.1	1.3	1.3
Dry Season	Date	07 Jan. 1992 (Fri)	08 Jan. 1992 (Sat)	09 Jan. 1992 (Sun)	10 Jan. 1992 (Mon)	11 Jan. 1992 (Tue)	12 Jan. 1992 (Wed)	13 Jan. 1992 (Thu)	Total Amount	Average/ Day
	Total Amount of Waste (Kg)	180	76	250	280	260	270	150	1466.0	209.4
	Amount of Infectious Waste (Kg)	14.8	15.7	36.3	32.7	30.5	51.5	33.5	215.0	30.7
	Percentage of Infectious Waste(%)	8.2	20.7	14.5	11.7	11.7	19.1	22.3	14.7	14.7

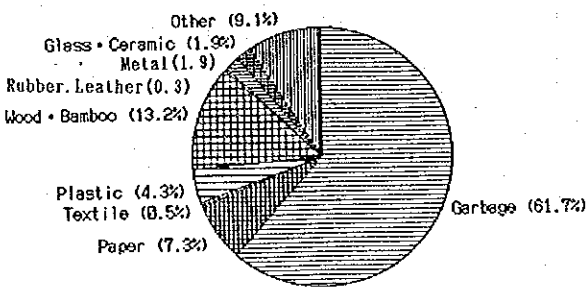
* Due to the inclusion of the infectious waste into the non-infectious, these figures are used only for reference.



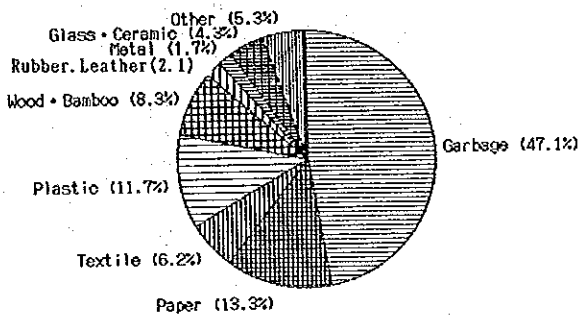
Domestic Wastes



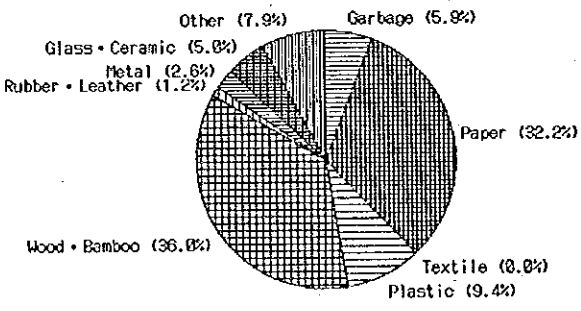
Commercial Wastes



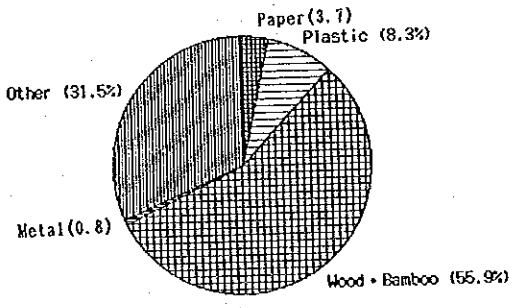
Market Wastes



Hospital Wastes



Office Wastes



Road Sweeping Wastes

* Physical composition is shown as a average of both of rainy and dry season.

Fig. B.5-5 Physical Composition of Waste

3) Three Contents, Low Calorific Value and C/N Ratio

Based on the physical composition of waste surveyed in wet base, ratios of three contents and low calorific value, and C/N ratio were estimated by the following calculation;

a. Ratio of three contents;

Ratio of three contents was calculated as shown below, based on the figure given in Table B.5-5;

Combustible (%) = {content of garbage (%)} x 0.278 + {content of paper (%) x 0.584.....+ {content of others (%)} x 0.227

Moisture (%) = {content of garbage (%) x 0.636 + {content of paper (%) x 0.533.....+ {content of others (%)} x 0.415

Ash (%) = {content of garbage (%)} x 0.086 + {content of paper (%) x 0.061.....+ {content of others (%) x 0.358

Table B.5-5 Three Contents of Municipal Solid Waste (Wet Base)

(Unit;Weight%)

	Combustible(B)	Moisture (W)	Ash (A)
Garbage	27.8	63.6	8.6
Paper	58.4	35.5	6.1
Textile	66.9	28.3	4.8
Plastic	74.3	16.8	8.9
Wood・Bamboo	65.9	30.1	4.0
Rubber・Leather	72.2	14.4	13.4
Metal	0.0	7.8	92.2
Glass・Ceramic	0.0	2.1	97.9
Others	22.7	41.5	35.8

* Source; "Guideline for Construction of Refuse Treatment Facilities in Japan"

Table B.5-6 Percentage of Elements in Each Type of Waste

(Unit: %)

	Garbage	Paper	Textile	Plastic	Wood/ Bamboo	Others
Combustibles	84.96	92.58	96.84	94.43	97.21	78.87
Carbon(C)	42.72	43.27	49.13	72.88	48.18	40.85
Hydrogen(H)	5.78	6.23	6.49	12.64	6.29	5.30
Nitrogen(N)	2.49	0.33	2.03	0.65	2.03	2.59
Sulfur(S)	0.10	0.04	0.10	0.09	0.18	0.07
Chlorine(Cl)	0.30	0.46	0.46	3.50	0.44	0.52
Oxygen(O)	33.57	42.25	38.63	4.67	40.09	29.54
Ash	15.04	7.42	3.16	5.57	2.79	21.13

* Source; "Guideline for Construction of Refuse Treatment Facilities in Japan"
* Others include rubbers, leathers, metals, glasses and ceramics.

b. Low calorific value (Hu);

Low calorific value was calculated as shown below, based on the figure given in Table B.5-7.

Hu (Kcal/Kg) = 45 x (Value of Combustibles) x 6 x (Value of Moisture)

c. C/N ratio;

C/N ratio is calculated as shown below, based on the figure given in Table B.5-6.

Carbon (C) = {content of garbage (%)} x 0.8496 x 0.4272 +
{content of paper (%)} x 0.9258 x 0.4327 +.....+
{content of others (%)} x 0.7887 x 0.4085

Hydrogen (C) = {content of garbage (%)} x 0.8496 x 0.0578 +
{content of paper (%)} x 0.9258 x 0.0623 +.....+
{content of others (%)} x 0.7887 x 0.0530

d. Three contents, low calorific value and C/N ratio

As a result of the above-mentioned calculation, Three contents, low calorific value and C/N ratio were estimated and tabulated in Table B.5-7.

Table B.5-7 Three Contents, Low Calorific Value and C/N Ratio of Waste

Season	Type of Waste	Contents (%)				Calorific Value (Kcal/Kg)	Ratio of C/N
		Combustibles	Moisture	Ash	Total		
Rainy	Domestic Wastes(A)	43.3	34.7	22.0	100.0	1,741	22.4
	Domestic Wastes(B)	46.1	30.7	23.1	100.0	1,891	23.6
	Domestic Wastes(Av.)	44.6	32.8	22.6	100.0	1,813	23.0
	Commercial Wastes(C)	40.4	37.6	22.1	100.0	1,591	29.6
	Market Wastes	35.8	50.7	13.5	100.0	1,309	20.7
	Office Wastes	54.1	30.3	15.6	100.0	2,241	31.2
	Hospital Wastes	-	-	-	-	-	-
	Road Sweeping Wastes	50.7	33.7	15.6	100.0	2,079	23.6
Dry	Domestic Wastes(A)	40.0	32.7	27.3	100.0	1,603	22.7
	Domestic Wastes(B)	40.5	36.9	22.6	100.0	1,601	22.3
	Domestic Wastes(Av.)	40.3	34.8	25.0	100.0	1,602	22.5
	Commercial Wastes(C)	34.1	46.9	19.0	100.0	1,255	23.8
	Market Wastes	36.2	50.3	13.5	100.0	1,327	21.0
	Office Wastes	53.7	30.2	16.1	100.0	2,234	38.1
	Hospital Wastes	42.0	44.0	14.0	100.0	1,623	25.7
	Road Sweeping Wastes	54.2	30.3	15.5	100.0	2,257	22.5
Average	Domestic Wastes(A)	41.7	33.7	24.7	100.0	1671.8	22.6
	Domestic Wastes(B)	43.3	33.8	22.9	100.0	1746.2	23.0
	Domestic Wastes(Av.)	42.4	33.8	23.8	100.0	1707.3	22.7
	Commercial Wastes(C)	37.2	42.2	20.5	100.0	1422.8	26.7
	Market Wastes	36.0	50.5	13.5	100.0	1318.0	20.9
	Office Wastes	53.9	30.3	15.8	100.0	2237.5	34.7
	Hospital Wastes	42.0	44.0	14.0	100.0	1,623	25.7
	Road Sweeping Wastes	52.5	32.0	15.6	100.0	2168.0	23.1