PART I

PERSONNEL SOLID WASTE MANAGEMENT

CHAPTER 1
INTRODUCTION

PART 1 PRESENT SOLID WASTE MANAGEMENT

CHAPTER 1 INTRODUCTION

1.1 Background

Vientiane is the capital and primary city of Lao P.D.R. and is politically, economically and commercially the key center of the nation.

The urban area of Vientiane covers 2,935 ha comprising the 4 districts; Chanthabouly, Sikhottabong, Sisattanak and Saisettha. The total population in this urban area in 1991 was estimated to be 142,723.

Public health has been one of the areas of primary concern in Lao P.D.R.. The life expectancy at birth in Laos was estimated at 50 years, one of the lowest in Asia. In 1990, the infant mortality rate still stood at a high figure of 118 per 1,000. Laotian death rate which is still 16.1 per thousand was also one of the highest in Asia.

The present regime stresses the improvement of the sanitary conditions of the nation under the slogan "Three Clean's", namely clean water, clean food and clean houses.

The management of solid waste in the area has become a critical problem due to the following factors:

- Large portion of the waste is not routinely collected;
- A considerable amount of waste is illegally dumped into Mekong River and the existing drainage channels;
- Enforcement of regulations on solid waste is inadequate;
- Collection routine is inefficient;

- Collection vehicle fleet is old and subject to frequent breakdowns;

- Environmental conditions of the disposal system contribute to health problems;

- The institutional and administrative structure is not well established and not suitable for the required cleansing services;

- Finance and auditing procedures are in need of revision; and

- Public education system and participation programs are not established.

To overcome the above-mentioned problems and to improve the situation in a systematic manner, the preparation and implementation of a Basic Plan on the Solid Waste Management System Improvement Project in Vientiane is a very effective approach technically as well as financially. However, so far this approach has not been practiced in the area leaving the existing solid waste management at a very low level.

It is with the above mentioned objective and consideration that the Government of Lao has requested the Japanese Government to carry out "The Study on the Solid Waste Management System Improvement Project in Vientiane".

Successful implementation of the Basic Plan is crucial for the well-being of the people living in Vientiane because it will not only reduce the health problems associated with poor solid waste management such as the outbreaks of dengue fever, but also improve the function of urban drainage systems.

1.2 Objectives of the Study

The general objective of the Study is to contribute to the development of solid waste management system in Vientiane with the aim to improve and safeguard public health and protect environmental quality.

The principal objective of the Study is to formulate a basic plan on the solid waste management system improvement project, identify the first priority project, and conduct a feasibility study on the first priority project.

Furthermore, the Study Team pursued technology transfer to the Laotian counterparts during the Study, especially through the collection experiment and experiment on sanitary landfill operation.

1.3 Policy of the Study

1) Characteristics of a SWM Study

The eminent characteristics of a SWM study are;

a. The study has to be carried out during the time when the existing SWM system is operating.

b. The essence of SWM is the prompt removal and appropriate disposal of generated waste. Among the processes involved, waste collection particularly presents a point of contact between the public and the administration. An appropriate collection system cannot be established without the mutual cooperation of these two sides. In this context, a proper understanding of the social and cultural background of the Study area is essential in the preparation of a SWM plan.

c. The SWM is directly related to the daily life of the people. The proposed plan would not become workable only with the careful consideration of the intention of the administrators and officers concerned in SWM. It should also take the opinion of the citizen into consideration.

d. In order to formulate a workable and appropriate SWM master plan, it is indispensable to understand the educational background of the people in the area, their ways of thinking, customs and their daily lives in addition to the present SWM technical and institutional system, and the natural and socio-economic conditions of the Study area.

e. There is, therefore, no typical or definite SWM plan. A different plan should be made for each study area in accordance with its own condition and peoples. As such, pilot projects, such as collection experiment and experiment on sanitary landfill, are very important for the verification of the proposed plan.

In addition to the above-mentioned aspects, due to the rapid change in the socio-economic and political situation in Lao P.D.R., it would be very important to identify the present situation of the institutional system on SWM and to make an appropriate institutional development plan. This task, however, shall not be easy for foreign professionals without the appropriate support of the Laotian side.

2) Joint Study

With the above-mentioned reasons, the Study Team proposed the joint implementation of the Study and asked the cooperation and active participation of the Laotian side, specially on the following works;

a. Community consciousness survey;

b. Survey on private contractor of waste collection;

c. Study on waste amount and composition;

d. Survey on scavengers;

e. Survey on recycling system and market for reusable materials;

f. Construction of an inspection building and weighbridge foundation at the present km 18 disposal site;

g. Execution of pilot project; i.e. collection experiment and experiment on sanitary landfill operation;

h. Intensive education campaign for the people in conjunction with the pilot project;

i. Organization and institution planning;

j. Financial planning;

k. Prompt decision making regarding the selection of the sites for major facilities, level of collection fees and other important matters which require the decision of the Laotian side.

3) Stepwise Approach

Considering the financial limitation and difficulty of obtaining public cooperation, a stepwise approach is necessary to achieve the targets of the Basic Plan.

Phased development plan was proposed as follows.

- Immediate Improvement Phase 1992-1994

- Phase I 1995-1997

- Phase II 1998-2000

While the Study shall examine the desirable solid waste management system to be established by 2000, it shall also examine the Phase I improvement project to be implemented between 1995 and 1997 and immediate improvement measures to be done prior to the commencement of the Phase I project in view of the necessity for a stepwise improvement approach which should be within the financial capacity of the Municipality. Small-scale pilot projects have been implemented to respond to such requirements as the implementation of urgent improvement measures in line with the targets of the Basic Plan and the verification of the feasibility of the Basic Plan. With regard to collection and disposal, the phased improvement will be conducted in accordance with the following steps.

a. Curb collection and bell collection system which were examined in the collection experiment shall be established by 1995.

b. Collection service ratios of residential and commercial areas shall be expanded up to 50% and 60% by 1995, respectively, and up to 100% by 2000.

c. Public cooperation for cleaning up roads and drains shall be established by 1995, and the cleaned-up wastes shall be collected and disposed by the USD (Urban Service Department) which will be newly established in Vientiane Municipality and take whole responsibility on SWM.

d. Level 2 sanitary landfill site should be constructed at the KM 18-DS in 1994. It is proposed that level 3 sanitary landfill system should be realized in Phase II.

1.4 Scope of the Study

1) Study Area

The Study area for the Basic Plan covers the Vientiane urban area in the year 2000. It is approximately 30 km^2 and is shown in Fig. 2.1-1. The project area for the feasibility study was selected based on the results of the basic plan study.

However, the future landfill site is included in the Study area together with its environs even though it is located outside the area shown in Fig. 2.1-1.

2) Study Wastes

The Study wastes for the Basic Plan cover domestic wastes, commercial wastes, street sweeping wastes and institutional wastes (schools, hospitals and markets).

1.5 Key Assumptions

Key assumptions used in this Study are as follows:

1) Socio-economic Conditions

		1995	2000
- projected population (persons)		163,000	193,000
- annual growth rate of population		3.4%	
- annual increase rate of GRDP in real term	1991-1995	7%	
	1996-2000	5%	

- future budget scale of the Municipality — to increase in proportion to GRDP based on the budget of 1992

- currency exchange rate — US$ 1.00 = ¥ 129 = 729 Kips

- inflation rate — 17.7% in 1990
10.4% in 1991
3% from 1992 to 2000

2) Waste Amount and Composition

- generation ratio of domestic waste per capita per day in 1991 — 0.75 Kg

- annual increase of waste generation rate — 3.4%

- waste composition — paper and plastic will increase, while wood/ bamboo and others will decrease in future. It will not, however, change much by the year 2000.

	1991	1995	2000
- Collection Amount (ton/day)	13.9	68.3	148.2
Vientiane Municipality	(6.1)	(58.3)	(138.2)
Private Contractors	(7.8)	(10)	(10)

3) Life Span of Equipment and Facilities

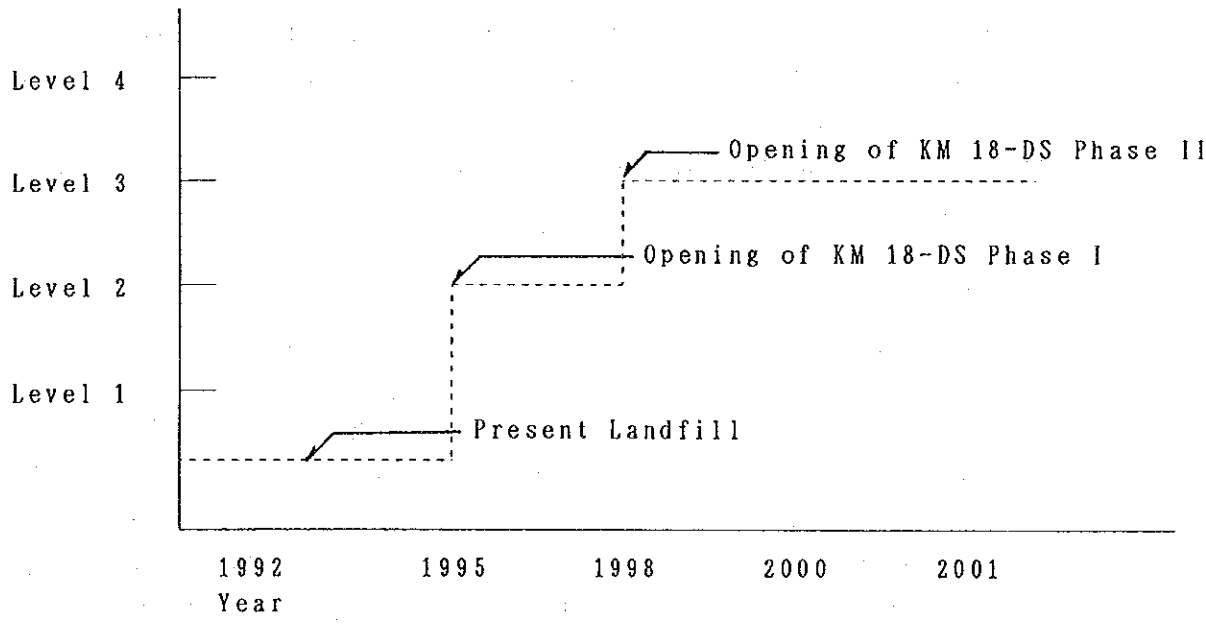
	Life Span (years)	Salvage value (%)
- container, grass cutter and maintenance equipment	5	0
- vehicle and heavy equipment	7	10
- machinery	18	0
- building and civil works	30	0

Note: The Life span of other facilities for the disposal site depends on the period of its operation.

4) Sanitary Landfill Development by Stage

Sanitary landfill will be developed in step by step manner as shown below.

Level of Landfill



Landfill Level and Target Year

5) Estimation of Fee Collection

- type of fee
  - basic fee
  - extra fee
  - special fee
  - tipping fee

- fee collection rate

  100% of collected waste

  (No services are provided without contract and pay by 1995. Afterwards, a cross-subsidy system shall be introduced.)

- amount of solid waste according to type of fee (ton/day)

	1995	2000
basic	40.3	103.1
extra	10.1	25.8
special (for container)	7.1	8.4
tipping	14.0	14.7

- number of households, shops and containers

basic fee (No. of household and shop)	13,400	32,700
special fee (No. of container)	29	29

- number of vehicles for tipping fee collection (vehicle/day)

small	1.2	1.3
medium	1.5	1.5
large	3.9	4.0

- fee tariff

	1995-	1998-
. basic fee	1,000 kips/basket/month	1,200
. extra fee	250 kips/basket	
. special fee	30,000 kips/container/month	50,000

. tipping fee	small	600	900
(kips/vehicle)	medium	800	1,200
	large	1,000	1,500

6) Loan Conditions

repayment schedule and interest rate in real term (nominal interest rate)

- long term loans repayment over 20 years with a 3 years grace period 3.0% (6.0%)

- short term loans repayment in the following year 8.5% (11.5%)

1.6 Work Processes of the Study

The Study commenced in October of 1991 based on the Scope of Work (Appendix I) signed between the Laotian Government and JICA in October 1990, and ended in September of 1992. The Study consists of the following two phases:

Phase 1 : Formulation of a Basic Plan

Phase 2 : Execution of the Feasibility Study on the First Priority Project

The work processes of the Study are described below.

1) Phase 1 : Formulation of a Basic Plan (October 1991-January 1992)

(1) 1st Stage Work in Lao P.D.R. (October-December, 1991)

a. Submission and discussion of the Inception Report

b. Data collection and analysis

c. Field survey

- study on present SWM
- community consciousness survey
- investigation of the present and future disposal sites
- study of waste amount and composition (rainy season)

d. Review of existing plans

e. Analysis of present SWM and identification of problems

f. Confirmation of the planning frameworks

- estimation of future waste amount and composition
- confirmation of planning criteria and pre-condition

g. Comparative analysis of alternatives on SWM

h. Selection of optimum SWM system

i. Preparation and discussion of progress report

(2) 1st Stage Work in Japan (December 1991-January 1992)

a. Analysis of 1st stage work done in Lao P.D.R.

b. Formulation of a Basic Plan

- collection and haulage plan
- processing and disposal plan
- operation and maintenance plan
- stepwise improvement plan
- organization and institution plan
- financial plan

c. Selection of the first priority project

d. Preparation of the Interim Report

2) Phase 2 : Execution of the Feasibility Study on the First Priority Project (February-September, 1992)

(1) 2 nd Stage Work in Lao P.D.R. (February-March, 1992)

a. Submission and discussion on the Interim Report

b. Confirmation of the first priority project

c. Collection of additional data

d. Additional field survey

e. Execution of pilot project

- collection experiment
- experiment on sanitary landfill operation

(2) 2nd Stage Work in Japan (April-June, 1992)

a. Analysis of 2nd stage work in Lao P.D.R.

b. Preliminary design of major facilities

c. Study on required equipment

d. Operation and maintenance plan

e. Estimation of project cost

f. Organization, institution and financial plan

g. Project evaluation

h. Implementation plan

i. Preparation of the Draft Final Report

(3) Submission and Discussion of the Draft Final Report (June 1992)

(4) Submission of the Final Report (September 1992)

a. Preparation of the Final Report

b. Submission of the Final Report

1.7 Study Organization

The Study organization and list of members are attached as Appendix 2. The Study was supervised by the Project Executive Committee of Lao and the Advisory Committee of JICA.

1.8 Final Report

The Draft Final Report was submitted to the Lao P.D.R. in June 1992 by JICA. The proposed plan and strategy of the realization of the project in the report were discussed in the joint meeting among Vientiane Municipality, the Advisory Committee and the Study team. The contents of the report were generally accepted by the meeting. This Final Report was prepared on the basis of the Draft Final Report reflecting the conclusions of the meeting mentioned above.

The report comprises five volumes as follows;

Executive Summary
Volume 1 : Main Report
Volume 2, 3 and 4 : Supporting Report (1), (2) and (3)

Main report covers all aspects of the Study. It describes the features of the proposed plan and the assessment thereof. Meanwhile Supporting Reports describe specific topics in detail. Readers of Main Report are invited to refer to the relevant volume of the Supporting Report, if he or she feels it necessary to trace the logic and the reason for a description.

1.9 Acknowledgment

The Study Team would like to acknowledge the Vientiane Municipality and other authorities concerned for their sincere cooperation during the whole Study period. There is no doubt that such progress as this could not have been achieved without their cooperation. The data and information furnished to the team have been utilized as the basic materials for the Study. Meeting and discussion were held in a very effective and constructive setting. The activities of counterpart officers complied sufficiently with the requirements. The facilities provided for the Study were satisfactory. Availing this opportunity, JICA Study Team would like to express hearty gratitude to all the people of Lao P.D.R. concerned.

The Study Team also would like to acknowledge the support received from the Government of Japan in various aspects of the Study. Among others special acknowledgment is due to the Embassy of Japan to Lao P.D.R. and the Advisory Committee of JICA for their valuable suggestions and guidance given in the course of the Study. Their comments and recommendations have been given our sincerest considerations.

It is our great pleasure to report that, with this cooperation and support, the Study Team was able to make successful study.

CHAPTER 2

PROFILE OF THE STUDY AREA

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2.1 Natural Conditions

1) Location and Area

Lao P.D.R. has an area of 236,800 square kilometers, and is within the tropical zone.

Vientiane Municipality, the capital of Lao P.D.R., plays the most important role in the political and economic activities of the country.

Vientiane Municipality covers 3,920 km^2 and comprises 8 administrative districts. As of 1991, the population of the Municipality is 425,000, that is, 10% of the national population.

The Study area shall cover the Vientiane Urban Area in the year 2000, and is located in the southern part of the Municipality. 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. 2.1-1.

According to the UNDP M/P, the Study Area is divided into nine homogeneous zones, namely Namphou, Hal Mahosot, Pasak, Phone Xai, That Luang, Dong Palane, Sokpaluang, Souane Mone and Wattay.

2) Climate

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 season from November to April.

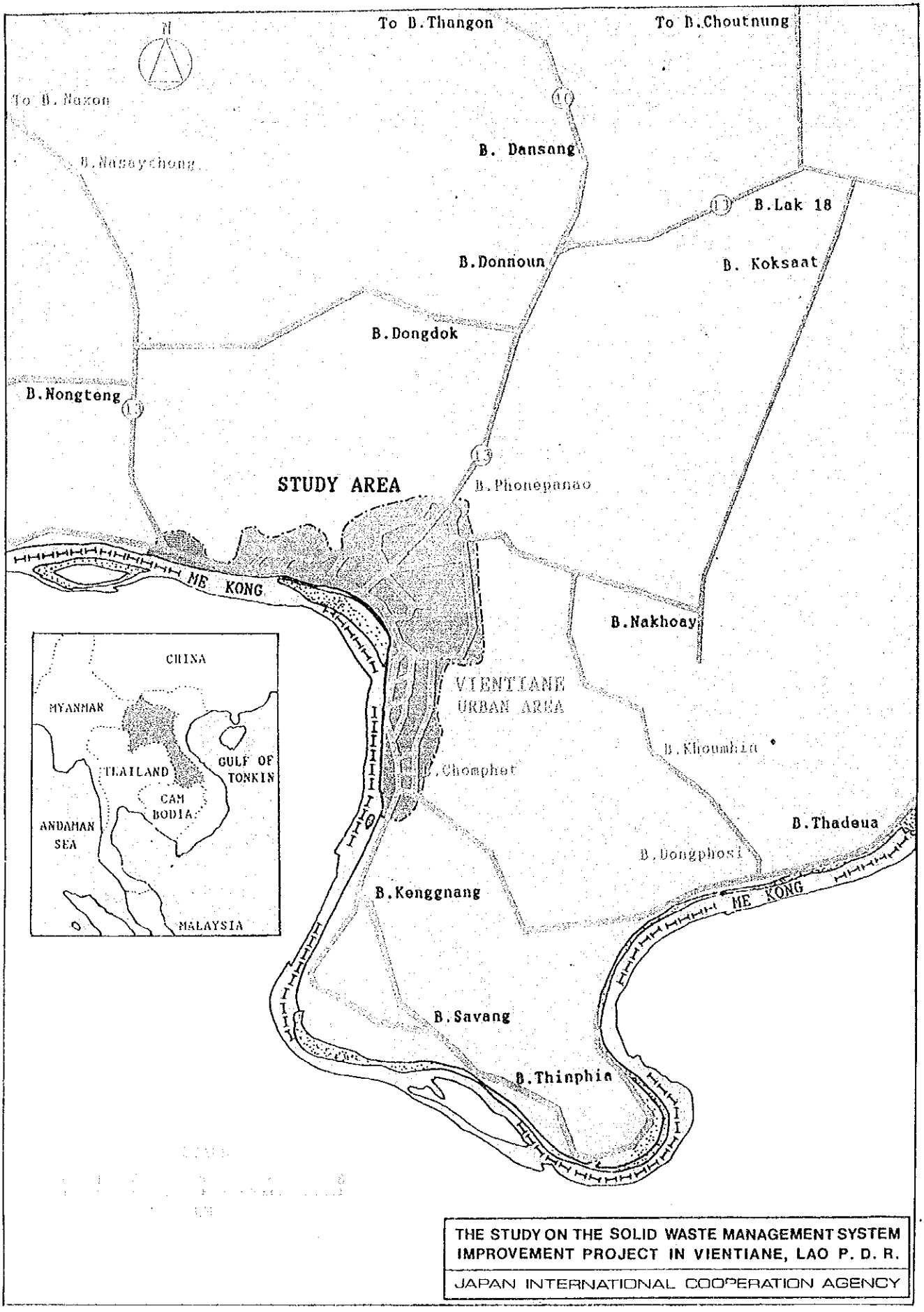

Fig. 2.1-1 Study Area

Temperature in Vientiane ranges from about 12°C during the coolest months of December and January to 38°C during the hottest months of March through May. The relative humidity is generally 75 to 80 percent during 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 percent occurs during May through September.

2.2 Urban Structure

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.

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 is an independent prefecture on an administrative parity with the provinces.

(2) Vientiane Municipality

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. 2.2-1. The urban area, which is the Study area, covers a part of the Chanthabouly, Sisattanak, Sikhottabong and Saisettha districts, and the Study area includes 96 villages (Bans).

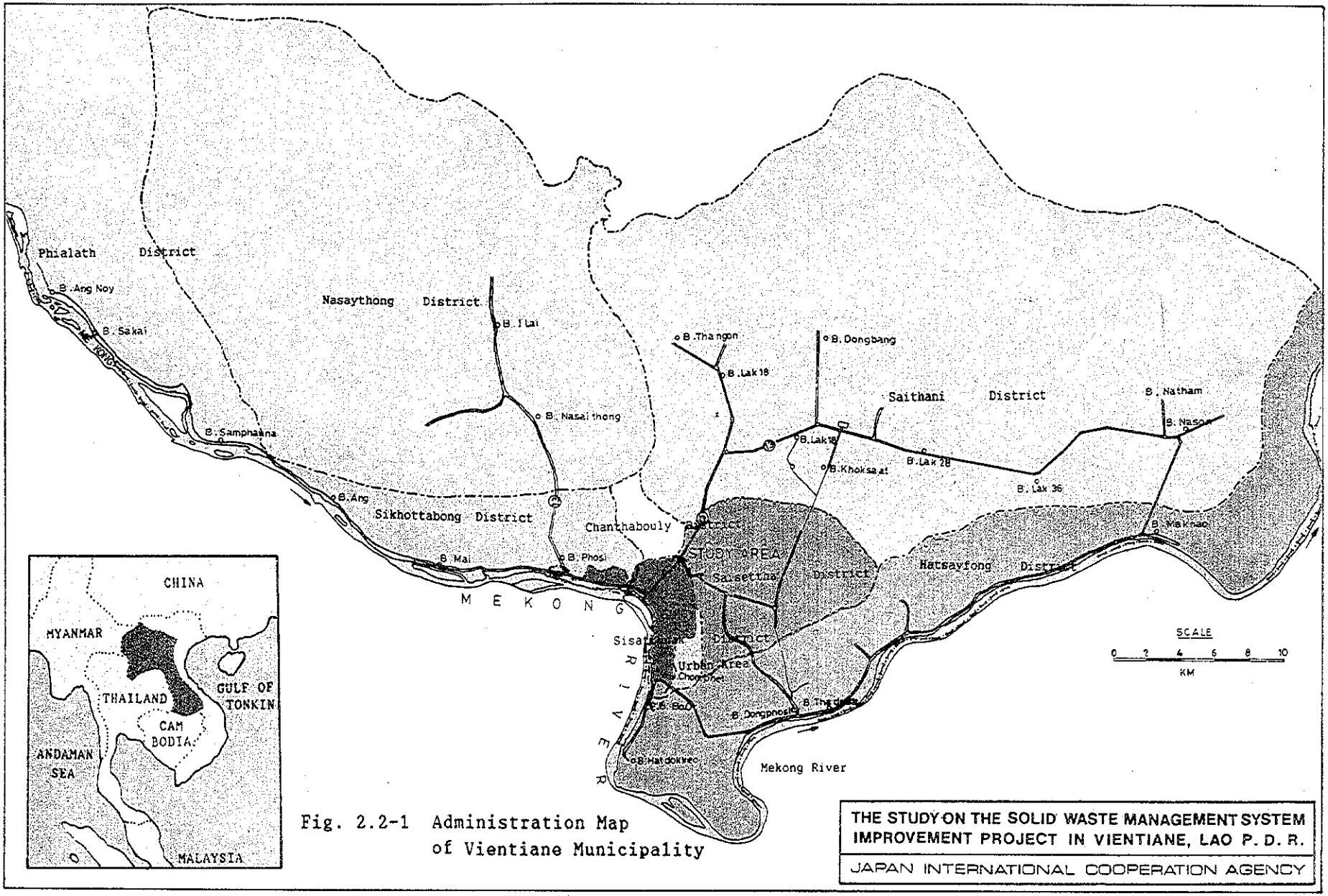

Fig. 2.2-1 Administration Map of Vientiane Municipality

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

JAPAN INTERNATIONAL COOPERATION AGENCY

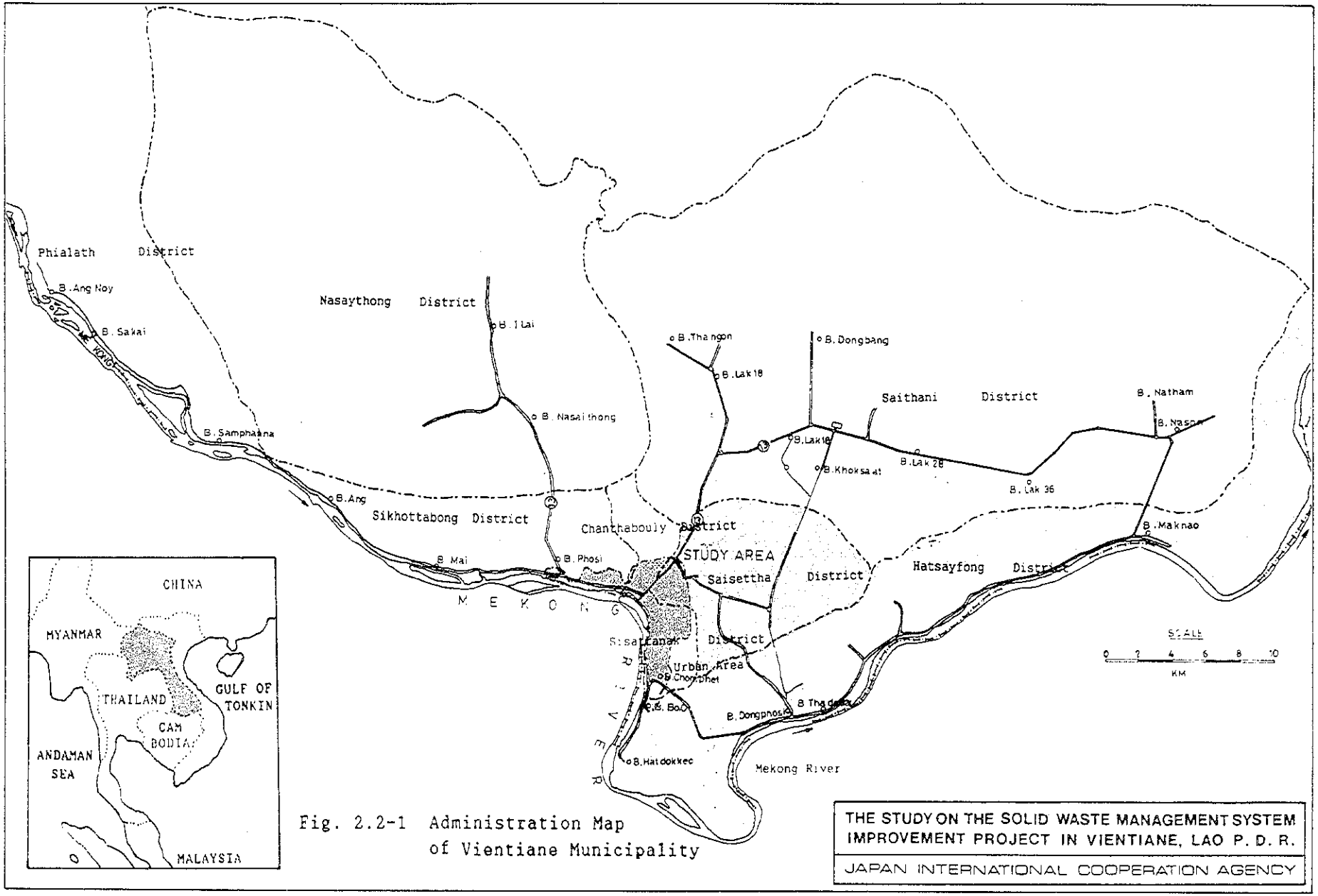

Fig. 2.2-1 Administration Map of Vientiane Municipality

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

JAPAN INTERNATIONAL COOPERATION AGENCY

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 lowere level administrative unit called "village committee"

Vientiane Municipality is headed by a governor who is appointed by the prime minister. Under the governor 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 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.

2) Land Use

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

Residential area	1,240 ha	43.3 %
Public and 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 Master Plan for Urban Development in Vientiane" conducted by UNDP (Vientiane, Schema Directeur ETD Amenagement Urbain Rapport Final Mai 1989) was formulated in 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 studies, zoning by land use categories was conducted effectively.

The plan divided the area into urbanized blocks and reserved blocks, and specified and programmed land use.

The plan presents the following appropriate land uses in the Study area up to the year 2000;

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

Source; ITSTP, MCTPC

3) Infrastructure

(1) Transport

Roads in the Municipality have a total length of 1,254 km, of which 302 km are paved with asphalt, 478 km are lateritic metalling and 474 km unpaved. The total length of roads in the Study area is about 228.1 km, of which 61.8 km or 27% are paved.

The Wattay Airport is located in the western part of Vientiane urban area and is utilized for international and domestic air flights.

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

Water and electricity systems are well developed and supplies are stable in the area. Drainage systems utilize either natural water courses or ditches along the roads. Sewerage is virtually non-existent in Vientiane.

4) Master Plan for Urban Development in Vientiane

The most updated urban plan of Vientiane is the "Vientiane, Schema Directeur et d'Amenagement Urbain, Programme de Developpement 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 Developpement Urbain de la Prefecture de Vientiane" (Urban Development Program of the Vientiane Municipality) 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 priority projects in Vientiane;

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

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

e. the establishment of an urban data collection system 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). The Master Plan would be followed by further detailed studies.

5) Drainage F/S in Vientiane

Another specific project related to the Study is the "Feasibility Study on Improvement of Drainage System in Vientiane" (Drainage F/S in Vientiane conducted by JICA).

One of the recommendations in the Drainage F/S identified the poor quality of drainage water due to the influx of domestic sewerage. The pollutant loads may increase along with the growth in population and economic activities in the study area. In order to secure the amenities for the local residents and to improve sanitary conditions, water quality should be improved. In this connection, the introduction of sewerage systems and garbage collection and disposal system should be considered. Amongst these, garbage collection and disposal is considered to be one of the most urgent need.

2.3 Social Conditions

1) Customs and Religion

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.

The Cleansing day, which is called "Red 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 .

95% of the population of Lao P.D.R. is Buddhist.

2) Public Health

a. Mortality 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 zero to four years of age, under 5 years mortality rate (U5MR), is 193 per 1,000 live birth due to the poor health condition in the rural area.

Comparing the above figures with neighboring countries as shown in Table 2.3-1, the IMR and U5MR of Lao P.D.R. is ranked in the worst position.

Table 2.3-1 Comparison of Mortality Rate and Life Expectancy

Country	IMR	U5MR	Life Expectancy (Year)
Lao P.D.R.	118	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.

b. Communicable disease

The most serious communicable disease in the country is malaria. Typical children diseases such as diarrhea and respiratory infections have high incidence rates.

The health condition in the Vientiane Municipality is the same as that of the nation. The number of patients according to disease is shown in Table 2.3-2. Due to poor sanitary and drainage conditions, people in the Study area suffer from malaria and dengue, diseases that result from such conditions.

Table 2.3-2 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

c. Solid waste management and public health

The two prevalent communicable diseases in Vientiane, i.e., diarrhea and dysentery 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 leads to the evolution of some communicable diseases. In this sense, sanitary storage, collection, haulage and disposal of solid waste is important.

d. 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.

i. lack of political will

The social service sectors, including health, water, solid waste management and environmental sanitation, are not the country's political priorities.

ii. poor health infrastructure

The present health system has to contend with the problems of a very weak infrastructure.

iii. manpower

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

iv. 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.

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.

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 the village mostly on Saturday mornings. These activities are carried out by the villagers.

4) Employment

The working force 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.

2.4 Population

1) Population Trend

According to the National Population Census in 1985, there were 3.618 million Laotians. 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.

2) Population Projection

a. 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

b. 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 2.4-1).

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

c. Study area

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 2.4-1. 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:

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

Table 2.4-1 Present Population and Number of Families in Vientian Municipality

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.

2.5 Economic Conditions

1) National Economy

a. 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 the reforming of Lao economy from a control economy to a market oriented economy and has been developed as a strategy for improving the productivity and efficiency of the Lao economy. The main features of the NEM are as follows:

i. market orientation and pricing

ii. exchange rate flexibility

iii. improvement of the financial system

iv. increased autonomy for state enterprises

b. 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 was more than 8%, though the average rate between 1984 and 1988 was 3.0%. The industry sector induced the growth of Lao economy. The Third Five Year Plan projected that the share of industry and that of services will increase relatively, while the share of agriculture will decrease.

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

2) Regional Economy

GRDP (gross regional domestic product) of Vientiane Municipality was estimated at about 30 billion kips in 1990. This is about 10% of the GDP. The growth rate of GRDP is more than that of the GDP, though that of the service sector has decreased since 1989.

3) Income Level

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

According to the Master Plan for Urban Development in Vientiane, the food expenses of the lower class is a lot more in proportion to their income. The middle class gets 25,445 kips per month and spends 71% for food.

4) Industry

The industrial structure of Vientiane Municipality shows that industrial products covers only a small ratio of the GRDP, although the locally managed industrial enterprises in Vientiane Municipality is half of that of the whole country.

Table 2.5-1 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; DPF, VM

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

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

The unemployment ratios is 15%. There are many government workers in Vientiane Municipality due to the stagnancy of the market economy (see Table 2.5-2).

Table 2.5-2 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

5) Local Finance

The budget of Vientiane Municipality was 3,553 million kips in 1990. The revenue of Vientiane Municipality is 9.7% of GRDP in 1989. Non taxable revenues has increased rapidly.

Districts have autonomous budget systems. The 1990 budget of the four districts located in the urban area of Vientiane Municipality were 188 million kips for Chanthabouly, 131 million kips for Saisettha, 172 million kips for Sikhottabong and 136 million kips for Sisattanak.

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 2.5-3.

Table 2.5-3 Tax and User Charge

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

CHAPTER 3

FIELD SURVEY

CHAPTER 3 FIELD SURVEY

3.1 Waste Amount and Composition Survey

1) Objectives of the Survey

Basic information such as the quantity of solid waste generated in the Study area, the population covered by the collection services, maps showing the collection area, etc., is the principal and the key factor for a successful and workable solid waste management plan.

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

2) Definitions of Wastes

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 institutional wastes, the following were 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 services;
- drain cleansing services; and
- grass cutting services.

e. Hauled waste (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.

3) Selection of Sampling Points

a. 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

b. Selection of sampling points

The selection of sampling points was carried out in cooperation with DCTC. AS a result, 31 Bans (villages) equivalent to 1/3 of total number of Bans in the Study area, which is 96 Bans, were selected as sampling points.

4) Survey Period

The survey was conducted in the following periods:

Table 3.1-1 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 (8 days)	From 6 to 13 February 1992 (8 days)
WACS for Wastes Hauled to KM 18-DS	From 12 to 13 November 1991 From 17 November 1991 to 31 January 1992	
WACS for Wastes Directly Hauled to KM 18-DS	From 17 November 1991 to 31 January 1992	

5) Method of the Survey

Method of the survey is tabulated in Table 3.1-2. Upon consideration of the daily fluctuations of discharged wastes, the survey was conducted continuously for 8 days.

Before the execution of the WACS, required numbers of plastic bags were distributed to the residences, shops and offices selected as sampling points.

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

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

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

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

Table 3.1-2 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 Rubber.Leather Metal, Grass Ceramic, Others)
Shop	by plastic bag	by platform scale	
Market	by collection vehicle	by weighbridge	
Office	by plastic bag	by platform scale	
Hospital	by trailer of hospital	by weighbridge	
Road Sweeping	by colletion vehicle	by weighbridge	

6) Results of the Survey

a. Waste amount

The result of the waste amount survey is tabulated in Table 3.1-3, 3.1-4.

Based on the result of the survey, the discharge ratio of each generation source is considered as follows;

- residence : 653 g/d/per.
- shop : 8,958 g/d/shop
- market : 1,301 g/d/shop (The figure includes daily stalls which do not have permanent spaces in the market)
- office : 31 g/d/emp.
- hospital : 957 g/d/bed
- road sweeping : 58,000 g/d/km

b. Waste composition

The result the of waste composition survey is tabulated in Table 3.1-5.

The characteristic of the composition of each waste is described as follows:

i. domestic waste

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

- The amount of garbage 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.

Table 3.1-3 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 3.1-4 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

Table 3.1-5 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	2.5	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

- By comparing the waste composition with that of other countries, the (Apparent Specific Gravity) in the Study area was found to be 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.

ii. commercial waste

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

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

iii. other wastes

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

- The majority of office wastes is composed of 36% wood/bamboo. Paper ranks second as it covers about 27%.

- As for hospital wastes, a lot of the infectious waste was included in the non-infectious waste in the 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, 14.7% of infectious waste was segregated in the dry season. Waste composition was analyzed in this season because infectious waste was segregated from non-infectious waste.

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

- 90% of the road sweeping wastes are made up of wood/bamboo and others (soil and sand) accumulated from gardening.

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

Based on the physical composition of waste survey in wet base and various figures achieved in Japan, the three contents, low calorific value and C/N ratio were estimated. The figures required for the estimation were taken from the "Guideline for Construction of Refuse Treatment Facilities in Japan". The result of the estimation is tabulated in Table 3.1-6.

3.2 Community Consciousness Survey

1) Objectives of the Survey

A CCS (Community Consciousness Survey) has been conducted to obtain the basic data for the formulation of a basic plan. The main objectives of the survey are described as follows:

a. Collection of the basic information for the formulation of the SWM basic plan such as population covered by collection service, public opinion on the present SWM, the public's willingness to pay the collection fee, etc.;

b. Identification of present discharge and storage system, ratio of waste generation, ratio of waste discharge and self-disposal, amount of recycling at generation sources; and

c. Finally, to examine the present waste stream especially from the generation point to the discharge point.

Table 3.1-6 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

2) Selection of Survey Area

In order to get the representative public opinion and basic data of the Study area, sample residences and shops were selected according to the following;

a. The Study area was divided into the residential area and 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 each 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. 20 residences or shops were selected as sampling points from each homogeneous zone. Totally, 120 residences were selected and 60 shops were selected from C zone.

The selection of sampling points was carried out in cooperation with the DCTC. The total number of sample residences and shops was 180.

3) Survey Period

The survey was conducted for 5 days from October 28 to November 1, 1991.

4) Method of Survey

Upon consideration of the present conditions of SWM and the Study area, a draft questionnaire written in English was prepared by the Study Team. With the close cooperation of the DCTC, the draft questionnaire was reviewed and modified, then translated into Lao for better understanding.

Before the execution of the survey, the objectives and the contents were carefully explained to the interviewer for several days, and pre-interview survey was also conducted for the reviewal and modification of the contents of the questionnaire.

The CCS was conducted by interviewing each resident and shop owner. The interviewer visited each interviewee and the answers obtained were put into the computer and processed.

5) Result of Survey

The answers processed are described in C.5, Appendix C of the Supporting Report (1).

6) Findings

Major findings by the CCS are summarized as follows:

a. Discharge and storage

i. source separation, recycling and self-disposal

- The residents who breed domestic animals totals 70% in the collection area, and 77% in the non-collection area. Most of the food waste generated from the residences is fed to domestic animals.

- the food waste generated from the commercial area is collected by collectors and/or farmers free of charge. 47% of the shops receive food waste collection services.

- As for the treatment of garden waste, 96% of the residents in the non-collection area carry out open burning at the premises and/or road-side, while only 44% in the collection area do so.

- 88% of the residents in the non-collection area answered that they would burn garden waste even if collection services would be provided in the future.

- The ratio of residents who utilize their food waste and garden waste as fertilizer is 13% in the collection service area, 15% in the non-collection service area, and 3% in the shops.

- The ratio of residents who want to have guidance on methods of producing fertilizer from food waste and garden waste is 61, 69 and 30% respectively.

- The ratio of residences and the shops from where unused or recyclable materials are collected by the collectors is 48% and 43%, respectively.

- Most of residents and shops who receive collection services answered that a collector would mainly using a handcart come around one a week or once a month. Major recyclable materials are bottles and ferrous metal.

ii. type of refuse bins

- Bamboo baskets are commonly used as dustbins. Each residence has one or two baskets and the capacity of a basket is 30~50 liters. Most of the baskets have no lids. The baskets are usually placed in front of the houses or at the backyard for collection.

- Most of the shops use bamboo baskets as dustbins. Each shop usually owns one or two baskets. The capacity of the basket is more than 50 liters and the basket has no lid. The baskets are placed in front of the shops for collection.

iii. storage and discharge points

- In the non-collection area, the ratio of residents who discharge waste around their premises without dustbins is 77%. On the other hand, 70% of the residents in the collection area discharge waste in dustbins to be collected by the collection workers.

- More than 20% of the residences both in the collection and non-collection area discharge their waste at open spaces which spontaneously become clandestine disposal sites in the area.

- The waste discharged around the premises is self-disposed mainly by means of open burning and partly by landfilling.

- Self-disposal, however, is a method considered to be unsatisfactory as many waste are seen to be scattered on the road within the premises.

b. Collection service

i. collection area

- The ratio of the residents who receive collection service is 19% in the residential area. 20% of the 19%, that is 4% of the total number of residents, seems to receive services temporarily.

- In the commercial area, 87% of the shops receive collection services.

- More than 90% of the residences and shops not receiving collection services wish for services.

ii. collection system

- 39% of the residents are aware of the collection system. Almost half of the residents who are aware of the collection system replied that waste has been collected, under the curb collection system, along the roads. Another half of the residents said that waste has been collected, under the door to door collection system, by collection workers. About 5% of the residents receive bell collection system services.

- 30% of the shops are aware of the collection system. Almost half of the shops aware of the collection system said that waste has been collected, under the curb collection system, along the roads. Another half of the shops replied that waste has been collected, under the door to door collection system, by collection workers. About 5% of the shops receive bell collection system services.

iii. collection time

- 78% of the residences who receive collection services make it a rule to discharge waste at the designated time.

- On the other hand, they are not satisfied with the collection time because of its irregularity. Only 48% of the residences replied that they receive collection services at a fixed time. Moreover, 61% of the residences have experienced discharging waste after the collection vehicle has left.

- 76% of the shops who receive collection services discharge their waste at the designated time.

- On the contrary, with regard to receiving time, only 42% of the shops reported that they received service at a fixed time. Conclusively, the shops as well as the residents receive collection services irregularly.

iv. collection fee

- 48% of the residences who receive collection services pay a collection fee of 100 to 499 kips/month and 26% of the residences pay 500 to 999 kips/month. 22% of the residents temporarily pay about 200 kips per bamboo basket.

- 33% of the shops receiving collection services pay a collection of 1,000 to 1,499 kips/month and 31% of the shops pay 500 to 999 kips/month.

- Both 78% of the residences and 85% of the shops receiving regular collection services directly pay their collection fees to contractors.

- Assuming that collection service is conducted, most of the residences and the shops reported that they would pay the collection fee directly to contractors.

- 50% of the residences and the shops said that the current budget of the Vientiane Municipality for waste management (18 kips/month/capita) is reasonable while the other 50% said that it was too small.

- With respect to the extra fee for cleansing services, 35% of the residences in the collection area reported that they were able to afford 100 kips to 500 kips/month, and 43% replied that they were only able to pay less than 100 kips/month.

- On the other hand, 50% of the residences and the shops in the non-collection area would pay 100 to 500 kips/month, while 40% would pay less than 100 kips/month.

v. others

- More than 80% of the residences and shops are satisfied with the collection service. However, there are some residences and shops who are dissatisfied with the services due to the their low collection frequency and uncertainty in the collection time.

Total expenditure per month per family of about half of the residences and shops is more than 85,000 kips per month. About 80% of the households and shops exceed 55,000 kips/month/family.

3.3 Investigation of Present and Candidate Disposal Sites

1) Proposed Sites

As stated in the S/W and M/M agreed between Vientiane Municipality and the Preliminary Survey Team, the final disposal plan to be studied was limited to the following scenarios:

a. Continued use and improvement of the existing site (KM 18-DS);

b. Opening of a new sanitary landfill site according to the proposal made by the UNDP Report on Disposal of Solid Waste in Urban Vientiane. When the life of the proposed site is over, an alternative site will be opened based on the recommendations of the said report.

However, the two proposed disposal sites (Site A at Ban Khamsawat and Site B at Ban Nongvang) were found to be already occupied by some residents. Therefore, the Vientiane Municipality requested that instead of the two candidate disposal sites proposed by UNDP, the following two candidate sites shown in Fig. 3.3-1 should be studied in the Study. The request was accepted by the Study Team.

a. DCDS (Dongphosi Candidate Disposal Site)

b. NCDS (Noensaard Candidate Disposal Site)

2) Contents of the Investigation

In accordance with the IC/R (Inception Report), a topographic, geological, water quality and landuse survey has been carried out for the present disposal site(KM 18-DS) and two candidate sites (DCDS and NCDS) as follows;

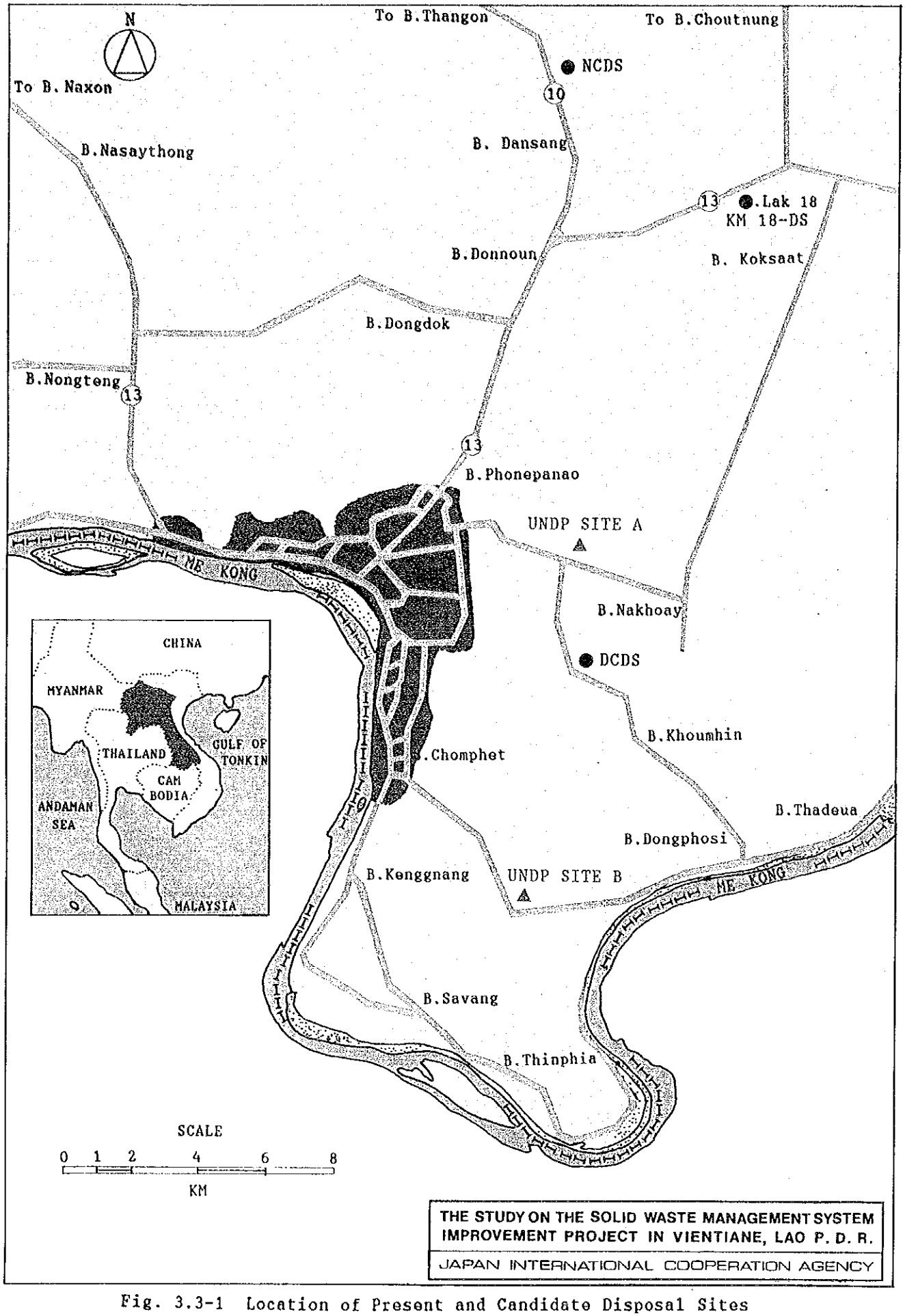

Fig. 3.3-1 Location of Present and Candidate Disposal Sites

a. Topographic survey, a scale of 1/1,000, in three sites (approximately 150 ha in total);

b. Two boring tests for soil analysis in a disposal site (six boring tests, approximately 60 m deep in total: 10 m for each);

c. Water quality survey on the 6 samples from the 6 above-mentioned boring holes and 3 samples from the leachate of the present KM 18 disposal site and surface water of two candidate sites. (Analysis items were PH, COD, BOD, T-N, Cl^-, Pb and Hg); and

d. Land use survey of the surrounding area of the three disposal sites by field reconnaissance.

3) Result of the Investigation

In addition to the above-mentioned survey on the surrounding environment, the latest aerial photographs of the three candidate sites were obtained. Using the aerial photos, several field reconnaissances have been done. The results of the investigation are tabulated in Table 3.3-1.

Table 3.3-1 Results of the Investigation (1)

Items	KM18-DS	NCDS	DCDS
1) Possibility of Land Acquisition			
a. Land use restrictions	Nil	National Reserved Forest	National Reserved Forest
b. Land ownership	Vientiane Municipality	Ministry of Agriculture & Forestry	Office of Cabinet Council
c. Necessity of compensation	Nil	Nil	Necessary
d. Other considerations	Existing disposal site	Nil	Nil
2) Possibility of Acquiring Neighboring Consensus			
a. Necessity of neighboring consensus	A little	A little	A little
b. Necessity of "out of sight" measures	Necessary	Necessary	Necessary
c. Necessity of isolation from noise, dust and odor measures	Necessary	Necessary	Necessary
d. Other consideerations	Existing Disposal site	At present, it is a national	Road pavement is necessary
3) Compatibility with Regional Development Plans		reserved forest.	for about 7 km
a. Competitive development Plans	Nil	Nil	Green Peace Lanxang Plan
b. Conformity with the Master Plan and use land use plan	Good	Fair	Poor
c. Direction of urbanization towards sites	within year 2,000, direction of urbanization towards the site is less probability.	within year 2,000, direction of urbanization towards the site is less probility.	within year 2,000, direction of urbanization towards the site is probable.
d. Other considerations	There is a new airport construction plan within 4 to 6 km from the site.	There is a new airport construction plan within 4 to 6 km from the site	Nil

Table 3.3-1 Results of the Investigation (2)

Items	KM18-DS	NCDS	DCDS
4) Economic Feasibility			
a. Location of site (distance from main waste generation area)(Km)	18 km	18 km	11 km(7.0km is unpaved)
b. Area of site (ha)	More than 60 ha	More than 30 ha	30 ha
c. Life expectancy (years)	More than 30 years	More than 15 years	More than 15 years
d. Availability of cover soil	Available	Available	Available
e. Accessibility of public services	Very good	Very good	Pair
f. Estimated cost of compensation	Nil	Nil	18 milion US $
g. Availability of public services	Electricity	Electricity	Nil
h. Present conditions of site (Land use, type of surface soil, depth of ground water)	Disposal site but party is forest and rice field.	Reserved forest but partly cultivated	Reserved forest but partly cultivated
i. Technical considerations	Construction of surrounding bund	Construction of surrounding bund	Construction of surrounding bund
j. Benefits of site upon completion	Nil	Nil	Nil
5) Environmental Acceptability			
a. Possibility of drinking water pollution	Possible	Possible	Possible
b. Impact by surface water pollution	Possible	Possible	Possible
c. Impact of flooding	Nil	Nil	Nil
d. Impact by groundwater pollution	Possible	Possible	Possible
e. Distance from airport and other public facilities	A primary school is located within 800m. Plan to construct a new airport in adjacent area	A primary school is located within 800 m. Plan to construct a new airport in near area	Primary school is located within 100 meters.
f. Distance form densely populated area	12 km	12 km	4.2 km
g. Dust, noise and odor hazards	Possible	Possible	Possible

Table 3.3-1 Results of the Investigation (3)

Items	KM18-DS	NCDS	DCDS
h. Land use of adjacent areas	Rice field and residential area	Mainy reserved forest, partly rice field	Rice field and residential area
i. Slope stability	Flat	Flat	Flat
j. Inshore or river fishery	Nil	Nil	Nil
k. Terrestrial vegetation and wildlife	Nil	Nil	Nil
l. Aquatic / Marine flora and fauna	Nil	Nil	Nil
m. Impact on Natural landscape	Nil	Fair	Fair
n. Histric places or stuructures	Nil	Nil	Nil
o. Religious places or structures	Nil	Nil	Nil

3.4 Others

3.4.1 Survey on Private Contractors

1) Private Contractors

The present collection service in the study area was carried out by the DCTC and private contractors. There were three private companies engaged in the collection, haulage and disposal of the solid waste in the Study area. These companies were newly established under the government policy, the New Economic Mechanism, which promotes privatization. For instance, before October 1989 the CRC (Codnstruction and Renovation Company No.1) was under the Chanthabouly district administrative committee. In October 1989, it became an independent private company by the procurement of the vehicles and equipment from the district. The three private contractors are as follows:

- Private - CRC (Construction and Renovation Company No. 1 in Chanthabouly District);
- Private - ISC (Inter-Construction and Sanitation Company in Sisattanak District); and
- Private - SWM (Solid Waste Management Company in Saisettha District).

2) Status of Private Contractors

An interview survey was conducted by the Study Team in October 1991 to know the status of the three private companies. The results of the interview survey are tabulated in Table 3.4-1.

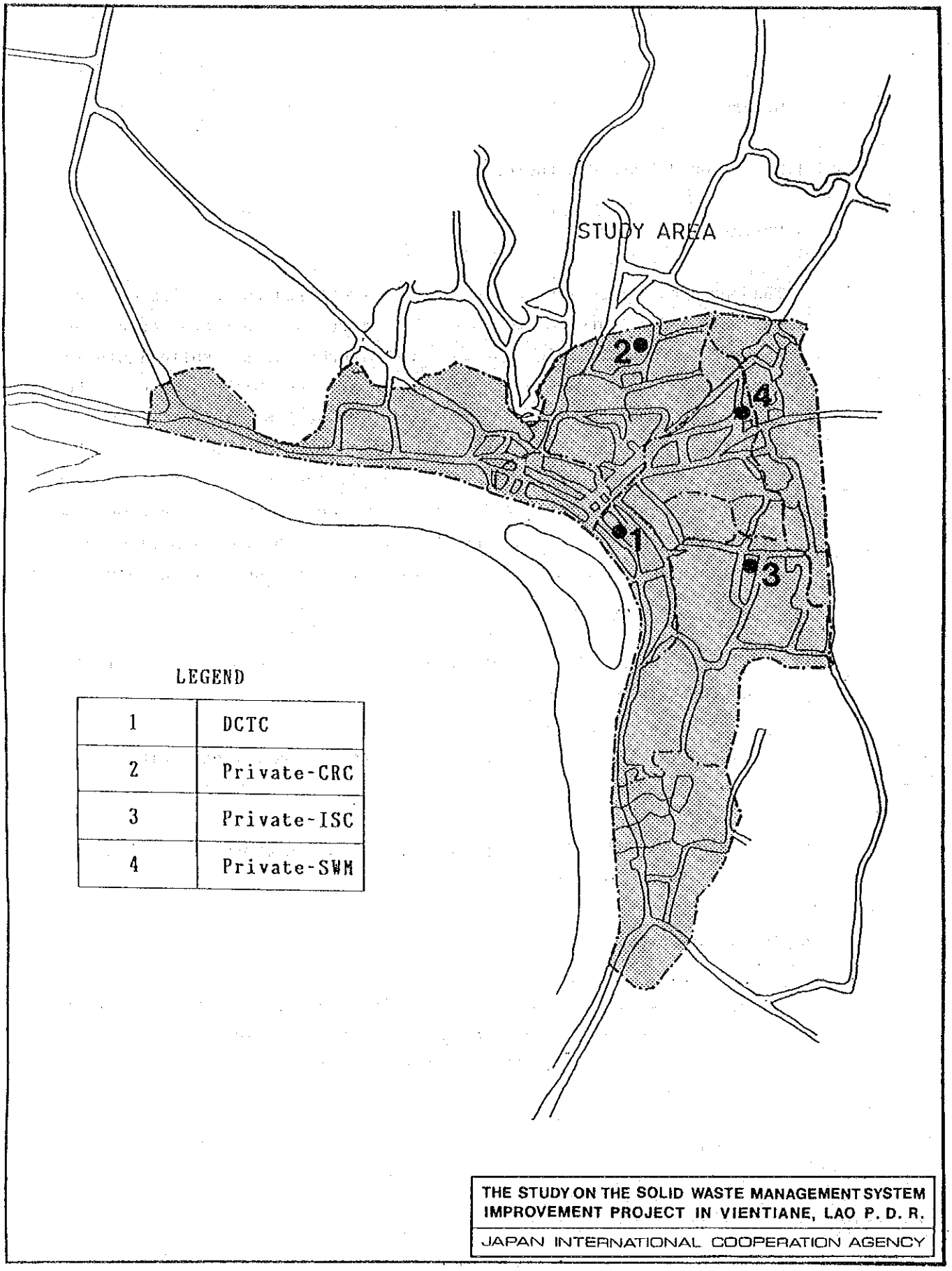

Fig. 3.4-1 Location of DCTC and Private Contractor

Table 3.4-1 Status of Private Contractors

October, 1991

Name of Company	Construction and Renovation Co. No.1	Inter-construction and Sanitation Co.	Solid Waste Management Co.
Located District	Chanthabouly District	Sisattanak District	Saisettha District
Year of Establishment	10/1989	1989	1/1991
Capital	22 millions kips	8 millions kips	N.A.
Materials & Tools	- 2 bamboo basket/ vehicle - 2 rakes each - 2 shovels each	same as the left same as the left same as the left	N.A.
Refuse Collection System . team . frequency	- One truck is composed of a drive and three collectors - Twice a week per family	same as the left	- once a week per family
Working Hours and Trips . working hours . lunch break . trips	8 am to 6 pm 2 hours 2 to 3 trips per day	7 am to 5 pm 2 hours 1 up to 2 trips per day	8 am to 6 pm

Name of Company	Construction and Renovation Co. No.1	Inter-Construction and Sanitation Co.	Solid Waste Management Co.
Maintenance System of Vehicle			
. small maintenance	by driver	by driver	
. heavy maintenance	private workshop	private workshop	
Collection Area			
. Nos. of family	1,084 families	56 families	239 families
. Nos. of offices	37 offices	10 offices	2 markets
and markets	1 market	5 markers	
Income	987,260	1,360,000	250,000
Expenditure	854,518	528,000	247,000
Balance	132,742	832,000	3,000
(kip/month)			
Salary of Employee			
. manager	30,000 k	-	20,000 k
. 1st vice manager	28,000 k		-
. 2nd vice manager	25,000 k		-
. clerk	18,000 k	25,000 k	13,000 k
. driver	40,000 k	43,800 k	13,000 k
. collector	26,000 k	22,000 k	13,000 k
. others	lunch	lunch	-

Name of Company	Construction and Renovation Co. No.1	Inter-Construction and Sanitation Co.	Solid Waste Management Co.
Collection fee/month			
- For Residences			
. maximum	1,000 k/family	5,000 k/family	2,000 k/family
. minimum	200 k/family	2,000 k/family	600 k/family
- For Offices			
. maximum	5,000 k/month	35,000 k/month	
. minimum		5,000 k/month	
. foreign residents	5,000 k/month	11,200 k/month	
- For Markets			
. maximum	300,000 k/month	300,000 k/month	12,000 k/month
. minimum		150,000 k/month	7,000 k/month
- Base of Collection Fee Decision	1/ Quantity of waste 2/ Nos. of people 3/ Location 4/ Profession		

3.4.2 Survey on Scavengers

1) Time and Method of the Survey

The survey on scavengers was done by the Study Team in 2 periods during the Study. The first survey was conducted for a week in the middle of October 1991. At that time the scavengers were free from rice field work which was their other main source of income. The survey was carried out again for a week in the middle of November 1991, during rice harvesting time when almost all scavengers were engaged in harvesting work.

The Study Team members mainly conducted interviews with the scavengers. Total number of scavengers interviewed, including full time and part time scavengers, were about 20.

2) Result of the Survey

a. Residence of scavengers

Almost all of the scavengers come from Phokham village which is located only 300 m from the disposal site.

b. Number of scavengers

The average number of scavengers per day is 30 and the maximum is around 70. The scavengers range from children to elderly persons and their presence at the site fluctuates seasonally.

The number of scavengers during the recent years has nearly stabilized. There seems to be little relationship between the number of scavengers and the economic situation.

c. Mode of operation and activities of scavengers

All of scavengers have their own means of transportation for transporting goods, especially metal and rubber shoe, to local dealers in town who offer better prices than those at the disposal site.

The type of goods normally collected and sold by the scavengers are as shown in Table 3.4-2.

Based on the survey, the amount of recyclable waste collected and recovered by the scavengers at the dump site per month is estimated to be 9 tons per month.

The scavenged goods are mainly sold to foreign countries (Thailand and Vietnam), and almost all of the scavenged goods are exported to Thailand.

d. Remuneration of scavengers

Most of the scavengers interviewed told that they scavenged because they had no other better jobs and that the income from the disposal site was good and enabled them to sustain their livelihood. The average income of each scavenger is estimated at 20,000 kips (28 US$) per month. Although it is less than the manual worker's pay, almost all scavengers are satisfied with their income and do not wish to find other major sources of income. The survey has clearly supported the fact by showing that nearly 20 scavengers have been scavenging for more than 20 years.

Table 3.4-2 Types and Prices of Reusable Materials Recoverd

Items	Selling Price of Scavenger	From Primary Dealers		From Final Dealers		Buying Price of End Users	Place of Recycling
		Buy	Sell	Buy	Sell		
Metals							Thailand
- Iron	20 kip/kg	20- 30 kip/kg	28- 40 kip/kg	28-42 kip/kg	60 kip/kg	60 kip/kg	
- Aluminum	200 kip/kg	150- 300 kip/kg	170- 476 kip/kg		450- 600 kip/kg	450- 600 kip/kg	
- Copper	800 kip/kg	700-1000 kip/kg	840-1100 kip/kg		980-1120 kip/kg	980-1120 kip/kg	
- Brass	600 kip/kg	500- 700 kip/kg	560- 950 kip/kg		1090-1120 kip/kg	1090-1120 kip/kg	
Paper							Lao P.D.R.
- Newspaper	no supply	15 kip/kg	25 kip/kg		35-75 kip/kg	35-75 kip/kg	Vietnam
- Cardboard	10 kip/kg	10 kip/kg	20 kip/kg		88 kip/kg	88 kip/kg	Thailand
Rubber Shoe	150 kip/kg	140-200 kip/kg	160-210 kip/kg			252 kip/kg	Thailand
Glass							
- Bottle	10-20 kip/bottle	10-20 kip/bottle	15-30 kip/bottle			20-30 kip/kg	Lao P.D.R.
Plastic							
- Plastic bin	30-40 kip/kg	not available	not available	140 kip/kg		not available	Vietnam
- Plastic bag	20 kip/kg	not available	not available			not available	
Animal's bone	20 kip/kg					47-117 kip/kg	Thailand

e. Social and health aspects of scavengers

The work environment and occupational hazards of the scavengers are clearly seen at the disposal site. Firstly, the work environment i.e. the condition of the KM 18-DS where crude dumping is practiced, may construct many occupational hazards, such as high possibilities of infections, diseases and accidents. Undefined movements of the scavengers and vehicles on the site may subject the scavengers to possible accident. The lack of inspection on incoming waste disposed of at the site by private collectors may result to the inclusion of prohibited or dangerous waste, which could endanger the scavengers.

However, it is surprising to know that despite of the unfavorable condition of the dump site, all of the scavengers working at the dump site are in good health. There are also no reports stating that scavengers are infected with communicable diseases, including minor diseases and bodily pains. There seems to be no relationship, therefore, between the health of the scavengers and the condition of the dump site.

3.4.3 Survey of Private Recyclers

1) Time and Method of the Survey

The survey on private recyclers of reusable materials has been carried out not only in Lao P.D.R. but also in Thailand, which is the biggest market for reusable materials from Vientiane. Persons concerned were interviewed and data were collected from all related government and private agencies. All recycling dealers in Vicntiane, including a recycling factory and some recycling dealers in Nongkhai and Khonkaen provinces, Thailand, were visited by the Study Team during the 3 week survey, from the end of October to the middle of November.

2) Result of the Survey

a. Amount of recycled materials

The Study Team carried out the recycling system survey by interviewing all of the 8 recycling dealers in Vientiane which collected their goods from scavengers and door-to-door recyclers including those from residences and factories. From the results of the above survey, it is estimated that the total amount of recycled materials in Vientiane is 60 tons/month based on the following information obtained in the interview survey.

This figure (60 tons/month) is also confirmed by the result of the interview with a Thai dealer living in Nongkhai who is the only Thai dealer of recycled materials from Lao P.D.R..

b. Recycling system and market for reusable materials

The present situation of the recycling system and market for reusable materials is described below according to materials. The distribution channel of reusable materials is illustrated and shown in Fig. 3.4-2..

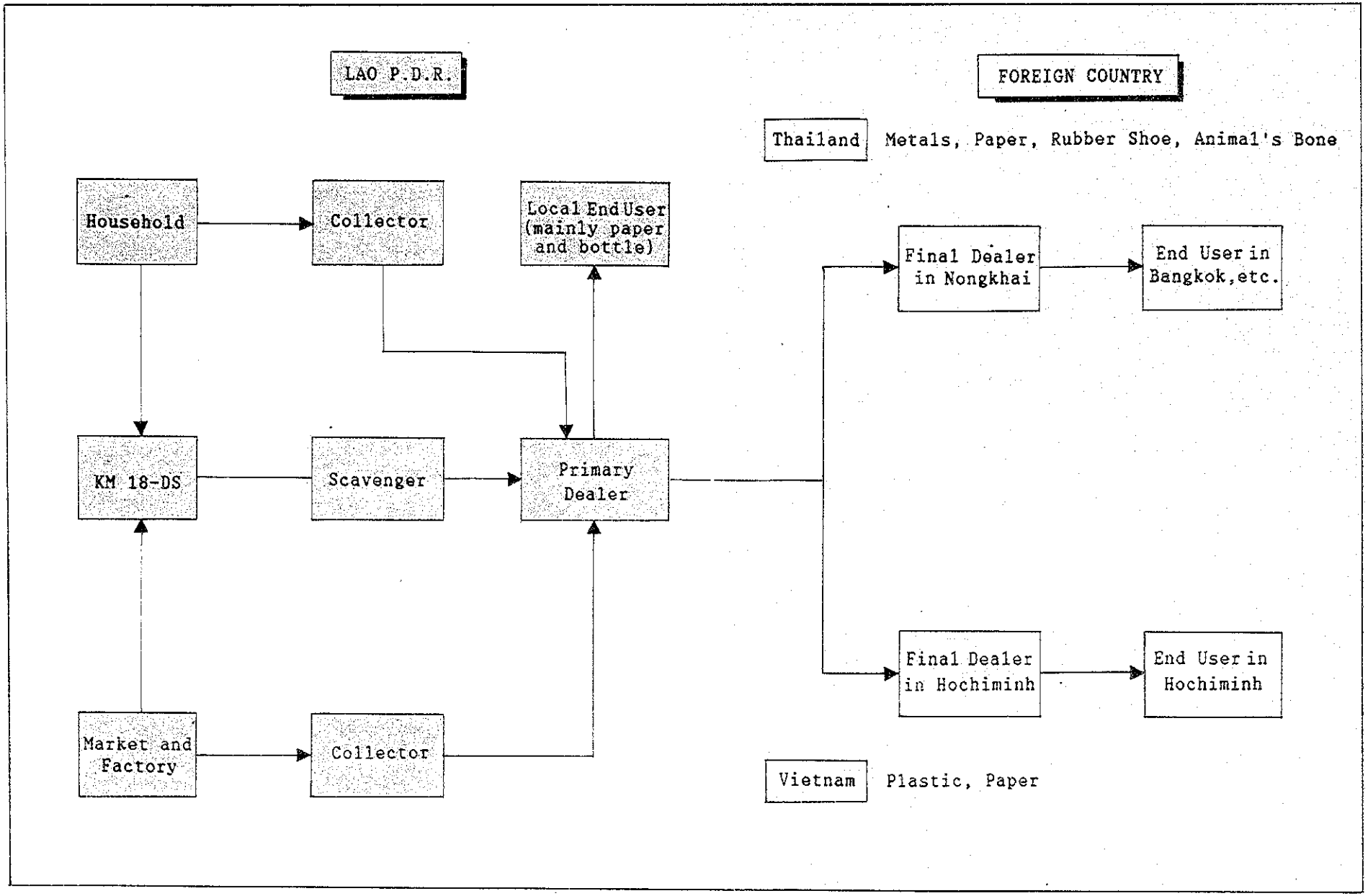

Fig. 3.4-2 Distribution Channel of Reusable Materials in the Study Area

i. metals

The recovered scrap metals are normally sold to the primary dealers stationed in the city by the scavengers, residents and shops that produce recyclable waste.

All of dealers collect their goods and normally store large quantities to sell for a period of 2-3 months. When enough quantity, is obtained they would sell their merchandise to a Thai dealer from Nongkhai province. From the shop in Nongkhai, the recycled materials are sold mostly to the end users in Bangkok.

The results of the survey conducted by the Study Team on the biggest recycling dealer in Nongkhai showed that the price of all scrap metals is determined by the end users in Bangkok based on the market situation.

ii. paper

Paper that are normally recycled includes newspapers, books, cardboards and high quality papers. Price of waste paper highly depends on their grade. The paper recycling work in Vientiane is being conducted by a paper mill in Lao P.D.R. at KM 10 Thadeua Road.

Another channel involved in recycling paper is a printing shop in Vientiane. This shop sends its waste paper and paper collected from other sources for recycling to Vietnam by its own truck. About 5 tons/month of waste paper is transported to Hochiminh city, which is more than 1,200 km away from Vientiane, for recycling due to cheaper recycling charges than Thailand.

iii. bottle

Bottle are recovered according to type and size through factories in Vientiane, such as Lao Beer Company, local whiskey factories, fish sauce factories, including many small factories and businesses which need bottles to contain their goods.

iv. plastic and rubber shoe

Due to the high tariff imposed on plastic by Thailand, the recycling channel for plastic in Vientiane is only through Vietnamese dealers. Vietnamese dealers transport goods from Vietnam, sells them in Vientiane and then buy plastic wastes from scavengers at the KM 18-DS for recycling in Vietnam.

v. animal's bone

The bones of buffaloes and cows are bought from scavengers by a Laotian primary dealer who transports them to Nongkhai Province, Thailand.

Animal bones from the disposal site are sold to 2 animal bone factories in Khonkaen Province in Thailand. Then animal's feed and fertilizer are produced from these bones. Nearly all products are sent to the factory's head office in Samut Sakorn Province, and then delivered to the Bangkok port to be exported to Japan.

3.4.4 Construction of an Inspection Building and Installation of a Weighbridge

The construction of an inspection building and installation of a weighbridge at the present KM 18 disposal site was carried out by DCTC and the Study Team.

The building and foundation of the weighbridge were completed by the middle of November 1991. Then, a weighbridge was installed in order to collect the data of the actual disposal amount at the KM 18-DS.

3.4.5 Time and Motion Study

1) Objectives of the Study

The objectives of the study are:

- to observe the present collection and haulage system; and
- to clear the problems and assess the present practices of the present collection and haulage system.

2) Method of the Study

The vehicles belonging to DCTC and Private-SWM were traced for time and motion study.

Study team consisted of 4 members including a driver. The duties and responsibilities of each member were assigned in preparation stage.

3) Results

The results of the T & M study are summarized as follows:

a. Working efficiency

Working efficiency per worker, including the driver is shown below.

	Amounted of Collected Waste (ton/day/worker)	(kg/hour/worker)
Private - SWM	0.38	58
DCTC	0.38	188

Working efficiency of the DCTC crew is three times better than Private-SWM due to the following;

i. The collection area of the DCTC crew was a densely populated commercial area, while that of the Private-SWM was a residential area;

ii. The bell collection system was adopted in some parts of the DCTC collection area;

iii. The private-SWM crew had a punctured tire which took one hour to repair; and

iv. The private-SWM moved up to a total of 110 km, while DCTC ran for only 53 km. For a better comparison, the mileage required for one ton of waste collection and transport is 58 km/ton for Private-SWM and only 35 km/ton for DCTC.

b. Level of user's cooperation with collection work

The residents were cooperative with the collection services. Especially, in the area where a bell collection service is adopted, residents brought the waste to the collection vehicle upon hearing the sound of truck tapping.

c. Maintenance of the collection vehicles

The maintenance of the collection vehicles is very poor as can be seen from the lack of a spare tire when the Private-SWM had a punctured tire. Repair works took an hour resulting in poor collection efficiency.

CHAPTER 4

PRESENT SOLID WASTE MANAGEMENT

CHAPTER 4 PRESENT SOLID WASTE MANAGEMENT

4.1 Existing Plans and Studies

With regard to the existing plans and studies regarding the solid waste management in Vientiane, the following plans and studies were identified by the Study Team:

a. Report on Solid Waste in Urban Vientiane, S. Sandanam, April 1989, Project UNDP-UNHCR LAO/85/003;

b. Report on the Pilot Project on the Collection and Disposal of Solid Waste, S. Sandanam, October 1989;

c. Report on the Field Visit to Vientiane Lao People's Democratic Republic 14-21 March 1989, Dr.Hisashi Ogawa;

d. Mission Report on Workshop and Field Visit on Solid Waste Management, Dr.H. Ogawa, WHO staff, Mr.D.J.V. Campbell, WHO Consultant, Environmental Safety Center, Harwell Laboratory, United Kingdom; and

e. The Study of Compost in Vientiane, Ministry of Agriculture and Forestry, Lao P.D.R..

The plans and studies shall be reviewed in order to adjust the Basic Plan to the above. The review has been carried out and described in G. 1, Appendix G, Supporting Report (1).

4.2 Waste Stream

1) Concept of Waste Stream

The waste stream in the Study area is drawn up based on the following two surveys. WACS was conducted both in the rainy season and in the dry season in Vientiane, Lao P.D.R.:

- WACS (Waste Amount and Composition Survey); and
- CCS (Community Consciousness Survey)

A weighbridge was installed in the middle of November 1991 in order to collect the data of the actual amount of waste hauled to the KM 18-DS. As a result, the actual amount of waste hauled to the KM 18-DS was observed from November 15, 1991 to end of January 1992 and analyzed.

The waste stream concept is illustrated and shown in Fig. 4.2-1. Solid waste from each generation source is classified into three categories; i.e. recycled, discharged and self-disposed waste. Discharged waste is divided into waste collected by each collection service and waste dumped by clandestine methods; i.e. illegal dumping or littering.

2) Waste Generation and Discharge

a. Generation sources

The generation sources in the Study area are classified in the Study as follows:

- Residence (Domestic Wastes)
- Shop (Commercial Wastes)
- Market (Market Wastes...Institutional Wastes)
- Office (Office Wastes...Institutional Wastes)
- Hospital (Hospital Wastes...Institutional Wastes)
- Road, drain and parks (Road Sweeping, Drain Cleansing and Grass-Cutting Wastes...Road Sweeping Wastes)

b. Domestic waste

The generation and discharge of domestic wastes in the collection area is estimated by the WACS and CCS, and is shown in Fig. 4.2-2. The bases of the estimation are explained in F. 1 of Appendix F, Supporting Report (1).

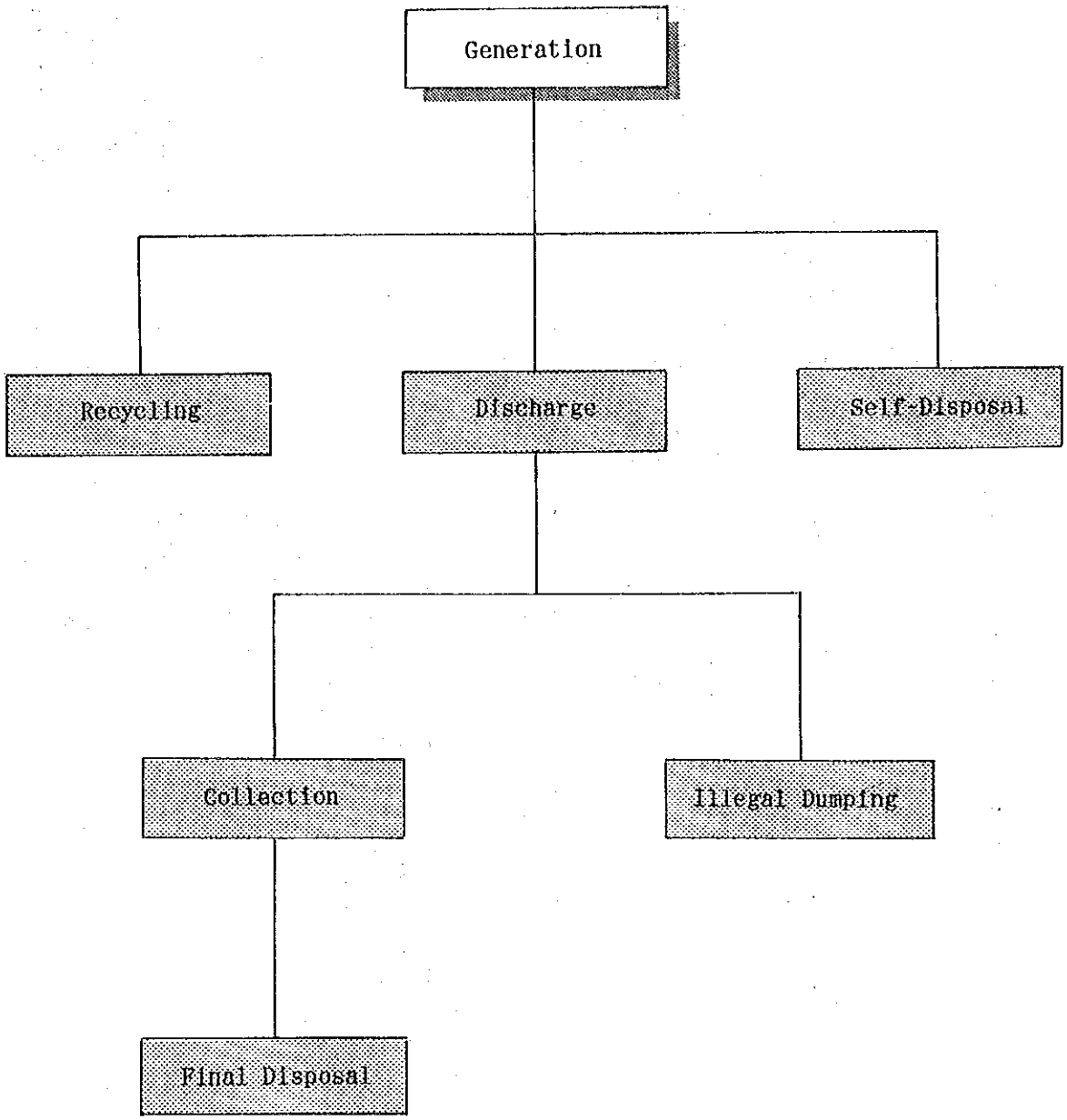

Fig. 4.2-1 Concept of Waste Stream

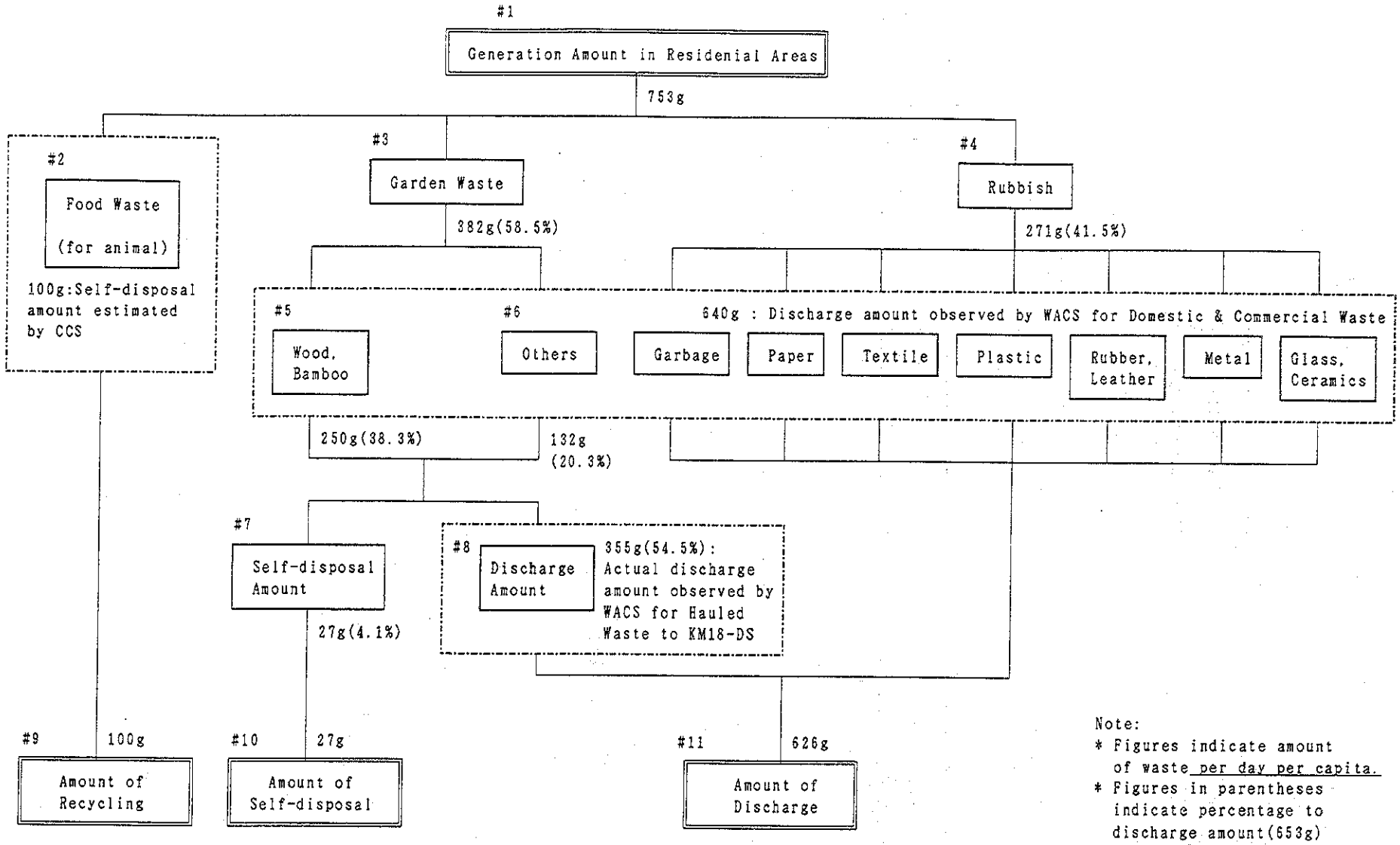

Fig.4.2-2 Generation and Discharge of Dommestic Waste in the Collection Area