

Lao People's Democratic Republic

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

FINAL REPORT

VOLUME IV. SUPPORTING REPORT (3):
FEASIBILITY STUDY

AUGUST 1982

Japan International Cooperation Agency (JICA)

6 5 15
02-086

Lao People's Democratic Republic

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

JICA LIBRARY



1100802161

24261

FINAL REPORT

VOLUME IV SUPPORTING REPORT (3);
FEASIBILITY STUDY

AUGUST, 1992

Japan International Cooperation Agency (JICA)



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

LIST OF VOLUMES

EXECUTIVE SUMMARY

VOLUME I. MAIN REPORT

VOLUME II. SUPPORTING REPORT (1); PRESENT SOLID WASTE MANAGEMENT

- Appendix A. Profile of the Study Area
- Appendix B. Waste Amount and Composition Survey
- Appendix C. Community Consciousness Survey
- Appendix D. Investigation of Km 18-DS, DCDS and NCDS
- Appendix E. Other Field Survey
- Appendix F. Present Solid Waste Management
- Appendix G. Evaluation of Present Solid Waste Management

VOLUME III. SUPPORTING REPORT (2); BASIC PLAN

- Appendix H. Planning Frameworks for a Basic Plan
- Appendix I. Selection of an Optimum Alternative
for Technical System
- Appendix J. Outline of the Basic Plan

VOLUME IV SUPPORTING REPORT (3); FEASIBILITY STUDY

- Appendix K. Immediate Improvement Needs and Plan
- Appendix L. Collection Experiment
- Appendix M. Experiment on Sanitary Landfill Operation
- Appendix N. Feasibility Study of the First Priority Project

This is VOLUME IV. SUPPORTING REPORT (3)

CONTENTS OF SUPPORTING REPORT (3)

	Page
Contents of Supporting Report (3)	
Abbreviations	
List of Tables	
List of Figures	

APPENDIX K IMMEDIATE IMPROVEMENT NEEDS AND PLAN

K.1	Immediate Improvement Needs.....	K-1
K.1.1	Technical System.....	K-2
K.1.2	Institutional System.....	K-2
K.2	Immediate Improvement Plan.....	K-4
K.2.1	Technical System.....	K-4
K.2.2	Institution System.....	K-15
K.3	Result.....	K-22
K.3.1	Technical System.....	K-22
K.3.2	Institutional System.....	K-27

APPENDIX L COLLECTION EXPERIMENT

L.1	Objectives.....	L-1
L.1.1	Purpose of Pilot Project.....	L-1
L.1.2	Objectives of the Collection Experiment.....	L-1
L.2	Plan.....	L-2

L.2.1	Outline of Experiment.....	L-2
L.2.2	Plan of Experiment.....	L-4
L.3	Execution.....	L-26
L.3.1	Preparation Work.....	L-26
L.3.2	Implementation.....	L-41
L.4	Findings.....	L-83

APPENDIX M EXPERIMENT ON SANITARY LANDFILL OPERATION

M.1	Objectives.....	M-1
M.1.1	Purpose of Pilot Project.....	M-1
M.1.2	Objectives of the Experiment.....	M-2
M.2	Proposed Plan.....	M-3
M.2.1	Site Development Plan.....	M-3
M.2.2	Operational Plan.....	M-8
M.3	Results.....	M-9
M.3.1	Execution.....	M-9
M.3.2	Findings.....	M-10

APPENDIX N FEASIBILITY STUDY OF THE FIRST PRIORITY PROJECT

N.1	Preliminary Design of Technical System.....	N-1
N.1.1	Design Conditions.....	N-1
N.1.2	Collection and Haulage.....	N-4
N.1.3	Road Sweeping, Drain Cleansing and Grass Cutting.....	N-32
N.1.4	Final Disposal.....	N-40

N.1.5	Operation and Maintenance of Equipment.....	N-95
N.2	Institutional Plan.....	N-108
N.2.1	Organization.....	N-108
N.2.2	Finance.....	N-115
N.2.3	Laws and Enforcement.....	N-123
N.2.4	Public Education.....	N-124
N.3	Estimation of Project Cost.....	N-152
N.3.1	Investment Cost.....	N-152
N.3.2	Operation Cost.....	N-159
N.3.3	Project Cost.....	N-167
N.4	Project Evaluation.....	N-170
N.4.1	Technical Evaluation.....	N-170
N.4.2	Environmental Evaluation.....	N-172
N.4.3	Social Evaluation.....	N-177
N.4.4	Economic and Financial Evaluation.....	N-181
N.5	Implementation Plan.....	N-212
N.5.1	Operation Manual for SWM.....	N-212
N.5.2	Project Implementation Body and Schedule.....	N-238
N.5.3	Financial Plan.....	N-241
N.5.4	Establishment of Monitoring System.....	N-246

ABBREVIATION

ORGANIZATIONS

- DCTC, VM : Department of Communication, Transport and Construction,
Vientiane Municipality
- DPH, VM : Department of Public Health, Vientiane Municipality
- DEPF, VM : Department of Economic 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	: Apparent 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)
USD	: Urban Services Department
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
Cl ⁻	: Chlorine Ion
COD	: Chemical Oxygen Demand
DO	: Dissolved Oxygen
Hg	: Mercury
Pb	: Lead
T-N	: Total Nitrogen

UNIT

m m	: millimeter	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	: kilowatt
res.	: residence	per.	: person
hou.	: household	emp.	: employees

LIST OF TABLES

		Page
Table K.2-1	Working Day Table.....	K-1
Table K.2-2	Weekly Schedule of Collection Vehicle.....	K-7
Table K.2-3	Data for Amount of Waste Hauled to KM 18-DS and Number of Incoming Vehicles.....	K-9
Table K.2-4	Schedule of Cleaning-up through Public Cooperation.....	K-11
Table K.2-5	Accounting Sheet.....	K-18
Table K.2-6	Ledger for Management of Collection Fee.....	K-20
Table K.3-1	Cost Analysis Sheet.....	K-30
Table L.2-1	Area Condition.....	L-8
Table L.2-2	Number of Contractors and Range of Present Collection Fee.....	L-17
Table L.2-3	Ldger for Management Collection Fee.....	L-20
Table L.2-4	Accounting Sheet.....	L-21
Table L.2-5	List of Persons Assigned from DCTC to Join in the Experimental Project.....	L-25
Table L.3-1	Number of Families Wishing to enter into a Contract and the Participation Ratio.....	L-28
Table L.3-2	Basic Data for the Collection Experiment Plan....	L-29
Table L.3-3	Schedule of Waste Collection.....	L-30
Table L.3-4	Cleaning-up Schedule through Public Cooperation..	L-31
Table L.3-5	Collection Time, Distance and Loading Weight of Waste Observed in the Present Collection System..	L-43
Table L.3-6	Collection Time, Distance and Loading Weight of Waste Observed in the Collection Experiment.....	L-44
Table L.3-7	Comparison of Collection Efficiency.....	L-50
Table L.4-1	Revenue and Expenditure of Collection Experiment.....	L-84
Table L.5-2	Balance of Revenue and Expenditure.....	L-87
Table N.1-1	Population Density and Ratio of Participation in the Candidate Bans.....	N-5
Table N.1-2	Outline of Proposed Discharged and Storage System in 1995.....	N-9

Table N.1-3	Outline of Proposed Collection and Haulage System in 1995.....	N-10
Table N.1-4	Population and Population Density.....	N-12
Table N.1-5	Extension of Service Coverage.....	N-11
Table N.1-6	Amount of Domestic and Commercial Waste Collected by Each Sector.....	N-16
Table N.1-7	Operation Plan for Collection Vehicle (CDT).....	N-19
Table N.1-8	Number of Collection Vehicles (DCT) Required for Domestic and Commercial Wastes.....	N-21
Table N.1-9	Survey on Large Waste Producers.....	N-25
Table N.1-10	Amount and Volume of Waste Discharged from Each Institutional Facility, Collected from Road Sweeping and Grass Cutting Activities.....	N-28
Table N.1-11	Operation Plan for Collection Vehicle (DCT).....	N-29
Table N.1-12	Number of Containers Required.....	N-30
Table N.1-13	Outline of Proposed Road Sweeping, Drain Cleansing and Grass Cutting System in 1995.....	N-33
Table N.1-14	Designed Landfill Volume.....	N-42
Table N.1-15	Characteristics of Clayey Soil.....	N-43
Table N.1-16	Discharge Design.....	N-54
Table N.1-17	Content of the Work for Landfill Equipment.....	N-78
Table N.1-18	Comparison of Landfill Equipment Performance.....	N-79
Table N.1-19	Function of Maintenance Shop.....	N-100
Table N.2-1	Proposed Number of Personnel According to Section (1995).....	N-110
Table N.2-2	Amount of Waste, Service Cost and Necessary Burden in 1995.....	N-118
Table N.2-3	Necessary Cost Share According to Services Recipient.....	N-119
Table N.2-4	Tariff for SWM.....	N-119
Table N.3-1	Investment Cost for Collection and Haulage.....	N-153
Table N.3-2	Investment Cost for Cleansing.....	N-153
Table N.3-3	Investment for Disposal Site.....	N-154
Table N.3-4	Investment Cost for Maintenance Shop.....	N-155
Table N.3-5	Investment Cost for Fee Collection.....	N-156
Table N.3-6	Total Investment Cost.....	N-157
Table N.3-7	Number of Personnel for the USD.....	N-160

Table N.3-8	Annual Operation Cost of Collection and Haulage..	N-161
Table N.3-9	Annual Operation Cost of Cleansing.....	N-162
Table N.3-10	Operation Cost of Disposal Site.....	N-163
Table N.3-11	Operation Cost of Maintenance Shop.....	N-164
Table N.3-12	Administrative Cost.....	N-165
Table N.3-13	Total Operation Cost in 1995.....	N-166
Table N.3-14	Collection and Cleansing Services Project Cost in 1995.....	N-168
Table N.3-15	Disposal site Project Cost.....	N-169
Table N.4-1	Mortality of Lao P.D.R. Compre to Neighboring Countries.....	N-178
Table N.4-2	Comparison of Transportation Cost of Institutional Waste.....	N-185
Table N.4-3	Comparison of the Collection Services with a Maintenance Shop and without a Maintenance Shop..	N-189
Table N.4-4	Balance of Collection Service in 1995.....	N-191
Table N.4-5	Balance of Collection Service Considering Other Operational Shares in 1995.....	N-192
Table N.4-6	Number of Vehicle by Size in 1995.....	N-193
Table N.4-7	Revenue from Tipping Fee in 1995.....	N-193
Table N.4-8	Balance of Final Disposal Service.....	N-194
Table N.4-9	Investment Plan for SWM of VM.....	N-196
Table N.4-10	Annual Cost Estimates.....	N-197
Table N.4-11	Calculation of Balance, Debt and Depreciation....	N-198
Table N.4-12	The Budget Allocation to SWM in VM Budget (Foreign Loan).....	N-199
Table N.5-1	Weekly Schedule of Collection Vehicle.....	N-215
Table N.5-2	Daily Check List.....	N-217
Table N.5-3	Cycle Time.....	N-218
Table N.5-4	Repair Specification.....	N-219
Table N.5-5	Working Day Table.....	N-223
Table N.5-6	Incoming Vehicle Data and Daily Record.....	N-225
Table N.5-7	Contract Sheet.....	N-227
Table N.5-8	Receipt for Collection Fee.....	N-228
Table N.5-9	Ledger for Management of Collection Fee.....	N-229
Table N.5-10	Accounting Sheet.....	N-231
Table N.5-11	Monthly Report on Revenue and Expenditure.....	N-232

Table N.5-12	Cost Analysis Sheet.....	N-233
Table N.5-13	Data for Amount of Waste Hauled to KM 18-DS and Number of Incoming Vehicles.....	N-235
Table N.5-14	Financial Resources for Investment.....	N-242
Table N.5-15	Composition of Revenue.....	N-243
Table N.5-16	Allocation of VM Budget for SWM (in case of Grant).....	N-244
Table N.5-17	Balance Sheet and Cash Flow.....	N-245
Table N.5-18	Personnel to be Involved in Monitoring Operations.....	N-246
Table N.5-19	Principal and Supporting Indicators.....	N-247

LIST OF FIGURES

		Page
Fig. K.2-1	Amount of Waste Hauled to KM 18-DS (January, 1992).....	K-10
Fig. K.2-2	Amount of Waste Hauled by DCTC, Private and Directly (January, 1992).....	K-10
Fig. K.2-3	Collection Routes for Cleaning-up of Roads, Drains and Public Areas.....	K-12
Fig. K.2-4	Receipt for Collection Fee.....	K-21
Fig. K.3-1	Sticker of "Clean Vientiane" Prepared for Collection Experiment.....	K-32
Fig. L.2-1	Outline of Experiment.....	L-3
Fig. L.2-2	Candidate Sites for Collection Experiment (1)....	L-6
Fig. L.2-3	Candidate Sites for Collection Experiment (2)....	L-7
Fig. L.2-4	Area Condition (Ban Sisavath Tay).....	L-10
Fig. L.2-5	Area Condition (Ban Sisavath Kang).....	L-11
Fig. L.2-6	Area Condition (Ban Sisavath Neua).....	L-12
Fig. L.2-7	Area Condition (Ban Dong Mieng).....	L-13
Fig. L.2-8	Area Condition (Ban Thong Sang Nang).....	L-14
Fig. L.2-9	Contract Sheet.....	L-18
Fig. L.2-10	Receipt for Collection.....	L-19
Fig. L.2-11	Organization Chart of Executing Committee for Collection Experiment.....	L-24
Fig. L.3-1	Location Map of Contractors in Ban Dong Mieng....	L-32
Fig. L.3-2	Location Map of Contractors in Ban Sisavath Tay.....	L-33
Fig. L.3-3	Location Map of Contractors in Ban Sisavath Kang.....	L-34
Fig. L.3-4	Collection Routes and Points of Ban Dong Mieng...	L-35
Fig. L.3-5	Collection Routes and Points of Ban Sisavath Tay.....	L-36
Fig. L.3-6	Collection Routes and Points of Ban Sisavath Kang.....	L-37
Fig. L.3-7	Collection Routes for Cleaning-up of Road, Drain and Public Areas in Ban Dong Mieng.....	L-38

Fig. L.3-8	Collection Routes for Cleaning-up of in Ban Sisavath Tay.....	L-39
Fig. L.3-9	Collection Routes for Cleaning-up of in Ban Sisavath Kang.....	L-40
Fig. L.3-10	Time for Collection Service Works.....	L-45
Fig. L.3-11	Comparison of Working Time for One Trip.....	L-48
Fig. L.3-12	Comparison of Transportation Distance for One Trip.....	L-48
Fig. M.2-1	Site Development Plan for the Experiment of Sanitary Landfill.....	M-4
Fig. M.2-2	Plans of Enclosing Bund and Fence.....	M-6
Fig. M.2-3	Plans of Embankment, Entrance Gate and Plantation.....	M-7
Fig. N.1-1	Future Waste Stream in the Study Area (1995).....	N-3
Fig. N.1-2	The area with a population density of more than 70 persons/ha in 1995.....	N-7
Fig. N.1-3	Proposed Containers Location Map for Large Waste Producers and Roads.....	N-26
Fig. N.1-4	Conception Drawing for Close Dump Truck and Small Dump Truck.....	N-37
Fig. N.1-5	Conception Drawing for Water Truck and Detachable Container Truck.....	N-38
Fig. N.1-6	Conception Drawing for Wheel Loader.....	N-39
Fig. N.1-7	Geological Profile of KM 18-DS.....	N-44
Fig. N.1-8	Layout of Main Facilities.....	N-47
Fig. N.1-9	Typical Cross Section of Enclosing Bund.....	N-50
Fig. N.1-10	Typical Cross Section of Divider Drainage System.....	N-52
Fig. N.1-11	Proposed Drainage System at KM 18-DS.....	N-55
Fig. N.1-12	Profile of Pipe Culvert.....	N-56
Fig. N.1-13	Drains for Reclaimed Area.....	N-57
Fig. N.1-14	Typical Cross-Sections of Access.....	N-59
Fig. N.1-15	Types of Gas Removal Facilities.....	N-63
Fig. N.1-16	Gas Removal Facilities.....	N-64
Fig. N.1-17	Plan of Site Office.....	N-67
Fig. N.1-18	Booster House for Water Supply.....	N-69
Fig. N.1-19	Pipe Construction for Water Supply.....	N-70

Fig. N.1-20	Comparison of Landfill Method.....	N-75
Fig. N.1-21	Cover by Cell Method.....	N-76
Fig. N.1-22	Organization Structure.....	N-86
Fig. N.1-23	Location of Water Monitoring System.....	N-89
Fig. N.1-24	Site Development and Layout of Maintenance Shop..	N-96
Fig. N.1-25	Plan of Building for Maintenance Shop.....	N-98
Fig. N.1-26	Elevation of Building for Maintenance Shop.....	N-99
Fig. N.1-27	Proposed Vehicle Depot.....	N-107
Fig. N.2-1	Proposed Organization of the USD.....	N-109
Fig. N.2-2	Organization Scheme of USD.....	N-111
Fig. N.4-1	Number of Patients by Kind of Diseases.....	N-179
Fig. N.4-2	Cash Flow of Project in Case of Loan.....	N-201
Fig. N.4-3	Cash Flow of Project in Case of Grant Aid.....	N-201
Fig. N.4-4	Sensitivity Analysis Case 1.....	N-203
Fig. N.4-5	Sensitivity Analysis Case 2.....	N-203
Fig. N.4-6	Sensitivity Analysis Case 3.....	N-203
Fig. N.4-7	Sensitivity Analysis Case 4.....	N-204
Fig. N.4-8	Sensitivity Analysis Case 5.....	N-206
Fig. N.4-9	Sensitivity Analysis Case 6.....	N-206
Fig. N.4-10	Sensitivity Analysis Case 7.....	N-208
Fig. N.4-11	Sensitivity Analysis Case 8.....	N-209
Fig. N.4-12	Sensitivity Analysis Case 9.....	N-210
Fig. N.4-13	Sensitivity Analysis Case 10.....	N-210
Fig. N.5-1	Outline of Operation for SWM.....	N-213
Fig. N.5-2	Monthly Report on Revenue and Expenditure.....	N-232
Fig. N.5-3	Amount of Waste Hauled to KM 18-DS (January, 1992).....	N-236
Fig. N.5-4	Amount of Waste Hauled by DCTC, Private and Directly (January, 1992).....	N-237
Fig. N.5-5	Implementation Schedule.....	N-239

APPENDIX K

IMMEDIATE IMPROVEMENT NEEDS AND PLAN

APPENDIX K IMMEDIATE IMPROVEMENT NEEDS AND PLAN

K.1 Immediate Improvement Needs

Immediate improvement needs have been identified with due consideration of the following criteria;

- a. Possibility of immediate improvement.
- b. Efficient use of existing resources without large investment.
- c. Achievement of tangible improvement effects in a short time.
- d. Possibility to become a model for future improvement.

There are two types of immediate improvement needs as shown below;

- a. Improvement needs in crucial areas with specific problems.
- b. Improvement needs to demonstrate the feasibility of introducing a future system. (e.g. Pilot project for collection experiment and experiment on sanitary landfill operation).

The implementation of these immediate improvement projects is very important in view of the fact that the Basic Plan targets will be achieved only through step-wise improvement. The former is described in this Appendix K, while the latter is mentioned in the Appendix L and M.

Immediate improvement needs in Vientiane urban area have been identified as follows;

K.1.1 Technical System

1) Discharge and Storage

The immediate improvement need on the discharge system in the Study area is;

- execution of a separate discharge for infectious waste in hospitals.

2) Collection and Haulage

The needs identified regarding collection and haulage system are;

- preparation of weekly and monthly working schedule; and
- collection of data regarding amount of waste collected.

3) Road Sweeping, Drain Cleansing and Grass Cutting

The need required for road sweeping, drain cleansing and grass cutting system is;

- stimulation of community cooperation for cleaning up its surroundings.

4) Final Disposal

The immediate improvement needs on the final disposal system are;

- securing land for the KM 18-DS;
- authorization of the KM 18-DS as a disposal site;
- control of the scavenging activities;
- provision of a record of incoming vehicles; and
- improvement of tipping fee collection system.

5) Equipment Operation and Maintenance

The needs for the equipment operation and maintenance system are;

- improvement of the basic knowledge of the DCTC operators and mechanics on equipment operation and maintenance; and
- execution of regular maintenance.

K.1.2 Institutional System

1) Organization and Management

The needs identified regarding organization and management are;

- clarification of the roles of each organization; and
- assignment of the person (s) in charge of planning and management.

2) Legislation and Enforcement

The immediate improvement need for the present legislation and enforcement is;

- strengthening of enforcement capability.

3) Finance

The immediate improvement needs on the present financial system are;

- improvement of accounting system;
- improvement of fee collection system; and
- collection of data for operational expenditure.

4) Public Cooperation and Education

The needs for the present public cooperation and education are;

- strengthening present public cooperation for the Cleansing Day designated on Saturdays; and
- preparation of an education program for primary schools.

K.2 Immediate Improvement Plan

K.2.1 Technical System

1) Discharge and Storage

As for the discharge and storage of waste, the matter that should be immediately improved is the complete segregation and proper disposal of an infectious waste in hospitals.

Even though infectious waste is segregated at the generation source, it is discharged into open heaps, a trailer or a container together with non-infectious waste. The Study Team and DCTC executed WACS (Waste Amount and Composition Survey) in the rainy season (October, 1991) and dry season (February, 1992). During this period, the hospitals were requested to segregate the discharge of infectious waste by using plastic bags to guarantee the safety of the workers. After the WACS, the Study Team and DCTC asked the hospitals to continuously segregate and discharge infectious waste.

2) Collection and Haulage

a. Preparation of weekly and monthly working schedule

The working schedules for collection workers and collection vehicles are prepared for systematic management and for the basic organization of SWM.

i. working schedule for collection workers

Working Day Table is prepared to manage collection workers and drivers. Working Day Table is shown in Table K.2-1. Every morning before work, the workers are gathered by the supervisor to brief them on the day's collection areas, routes and on matters to be attended at the court of DCTC. At that time daily allowances for labours are paid to workers and drivers according to the signature on the table. This table is used both as a check sheet of the work days and receipt for daily allowances.

ii. weekly schedule for collection vehicles

Weekly schedule for collection vehicles is prepared in order to manage collection vehicles and to give regular services to the residences, shops, offices and institutional facilities under contract with DCTC. Weekly schedule of collection vehicle is tabulated in Table K.2-2.

Each collection vehicle gets their own collection routes beforehand. Present condition of collection vehicles, however, are very poor. Present operation ratio of the existing vehicles is only 20 percent and the schedule for the repair of vehicles and collection routes are often changed according to the condition of the vehicles.

The collection vehicle supplied by JICA is occupied from Monday to Wednesday morning for collection experiment, it is possible in order to use vehicle as stand-by vehicles in other days of the week. Then, the supervisor has to check which of the vehicles need repair and the collection routes not covered last week. He should also make a weekly schedule for the collection vehicles.

Table K. 2-1 Working Day Table

Name	Duty	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.	Fee
Mr. Vanly	Driver							1,000
Mr. Sichanh	Driver							1,000
Mr. Tui	Worker							800
Mr. Lai	Worker							800
Mr. Mang	Worker							800
Mr. Tikham	Worker							800
Mr. Siphon	Worker							800
Mr. Somphet	Worker							800
Mr. Sengphoon	Worker							800
Mr. Phong	Worker							800

Table K. 2-2 Weekly Schedule of Collection Vehicle

Week	Vehicle No.	Collection Areas(Plan)	Collection Areas(Execution)	Departure	Arrival
() Mon.	383	Ban Dong Mieng		:	:
	116			:	:
	160	Ban Hai Sok, Samsenthai Road		:	:
	238	Embassy of USA and Road		:	:
	248	Beer Company		:	:
() Tue.	383	Ban Sisavath Tay		:	:
	116			:	:
	160	Ban Sikhay		:	:
	238	Mahosot Hospital		:	:
	248	Beer Company		:	:
() Wed.	383	Ban Sisavath Kang		:	:
	116			:	:
	160	Soviet Culture Center		:	:
	238	Ban Hai Sok		:	:
	248	Sisattanak District		:	:
() Thu.	383			:	:
	116			:	:
	160	Embassy of USA		:	:
	238	Nong Douang Market		:	:
	248	150 Hospital		:	:
() Fri.	383			:	:
	116			:	:
	160	Naxai Restourant		:	:
	238	Embassy of France and UNO		:	:
	248	Ban Hai Sok		:	:
() Sat.	383			:	:
	116			:	:
	160			:	:
	238			:	:
	248	Beer Company		:	:

b. Collection of data regarding amount of waste collected

The actual amount of waste collected, amount of waste hauled to KM18-DS and hauling ratio of DCTC, private companies, and waste directly hauled were not almost understood until the waste hauled to KM 18-DS measured using weighbridge. The measured data is compiled daily by the operators in the site. The daily record is processed in the computer twice a week in the DCTC office.

These data constructs the monthly records. The daily fluctuation of amount of waste hauled to KM18-DS and hauling ratio by DCTC, private and directly are graphed and will be managed as a basic data on collection and haulage plan.

The monthly record is tabulated in Table K.2-3 and the daily fluctuation of amount of waste hauled to KM 18-DS and hauling ratio are shown in Fig. K.2-1 and K.2-2 respectively.

3) Road Sweeping, Drain Cleansing and Grass Cutting

a. Stimulation of community cooperation for cleaning up its surrounding

Public cooperation for cleaning-up roads, drains and public areas was established in the collection experiment. Cleaning-up of public areas is done by the residents and collection and haulage is carried out by DCTC.

The schedule for the cleaning-up of roads, drains and public areas through public cooperation is tabulated in Table K.2-4 and the routes for public waste collection is shown in Fig. K.2-3.

Table K. 2-3 Data for Amount of Waste Hauled to KM18-DS and Number of Incoming Vehicle

DATE	Amount of Waste Hauled to KM18-DS (ton)				Number of Incoming Vehicles							
	DCTC	Private-CRC	Private-ISC	Private-SWM	Directly	Total	DCTC	Private-CRC	Private-ISC	Private-SWM	Directly	Total
Jan. 1 Wed	-	-	-	-	-	0	-	-	-	-	-	0
2 Thu	9.12	2.25	3.9	0	1.29	16.56	4	1	1	0	1	7
3 Fri	8.25	0	2.34	0	10.14	20.73	3	0	1	0	3	7
4 Sat	16.66	3.83	2.38	0	1.23	24.1	5	2	1	0	2	10
5 Sun	-	-	-	-	-	0	-	-	-	-	-	0
6 Mon	4.34	1.71	6.55	0	1.02	13.62	2	1	1	0	1	5
7 Tue	5.21	2.44	3.8	0	3.41	14.86	4	1	1	0	3	9
8 Wed	5.58	2.82	3.46	0	8.87	20.73	2	1	1	0	4	8
9 Thu	1.38	3.52	3.18	0	5.45	13.53	1	1	1	0	5	8
10 Fri	8.02	2.6	3.52	0	5.72	19.86	3	1	1	0	4	9
11 Sat	3.25	2.6	0	0	5.64	11.49	1	1	0	0	4	6
12 Sun	3.14	0	3.98	0	0	7.12	1	0	1	0	0	2
13 Mon	5.21	5.58	2.09	0	5.45	18.33	2	2	1	0	4	9
14 Tue	6.46	2.48	3.91	4.11	10.68	27.64	3	2	1	1	4	11
15 Wed	5.87	2.52	2.87	0	0	11.26	3	1	1	0	0	5
16 Thu	10.81	5.03	4.72	3.19	2.63	26.38	4	2	1	1	2	10
17 Fri	9.4	2.7	2.32	0	9.09	23.51	4	1	1	0	2	8
18 Sat	4.48	4.1	3.54	0	4.32	16.44	3	2	1	0	2	8
19 Sun	-	-	-	-	-	0	-	-	-	-	-	0
20 Mon	6.21	1.14	2.38	0	2.7	12.43	2	1	1	0	2	6
21 Tue	5.23	2.38	4.03	0.05	2.5	14.19	3	2	1	1	3	10
22 Wed	8.35	5.89	0	0	10.78	25.02	4	2	0	0	5	11
23 Thu	5.52	5.33	4.09	3.49	6.8	25.23	3	2	1	1	3	10
24 Fri	6	4.26	2.99	0	17.6	30.85	3	2	1	0	6	12
25 Sat	7.93	4.32	0	0	4.5	16.75	3	2	0	0	4	9
26 Sun	0	3.35	0	0	6.43	9.78	0	1	0	0	2	3
27 Mon	4.16	5.46	4.69	0	10.28	24.59	2	2	1	0	7	12
28 Tue	1.47	4.81	3.41	3.88	5.38	18.95	1	2	1	1	2	7
29 Wed	10.69	5.8	4.39	3.87	5.71	30.46	4	2	1	1	6	14
30 Thu	11.07	5.61	3.1	0	3.37	23.15	4	4	1	0	4	11
31 Fri	6.82	3.45	0	0	2.33	12.6	3	1	0	0	2	6
Total	180.63	95.98	81.64	18.59	153.32	530.16	77	40	23	6	87	233
Average (per day)	6.45	3.43	2.92	0.66	5.48	18.93	2.75	1.43	0.82	0.21	3.11	8.32
Average (per working day)	6.69	3.69	3.55	3.10	5.90		2.85	1.54	1.00	1.00	3.35	

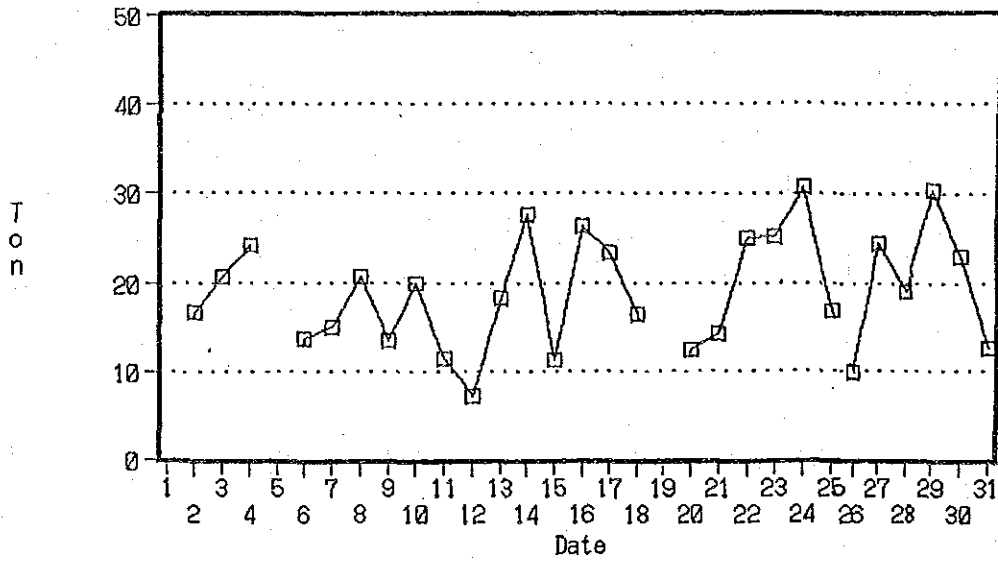


Fig. K.2-1 Amount of Waste Hauled to KM18-DS(January, 1992)

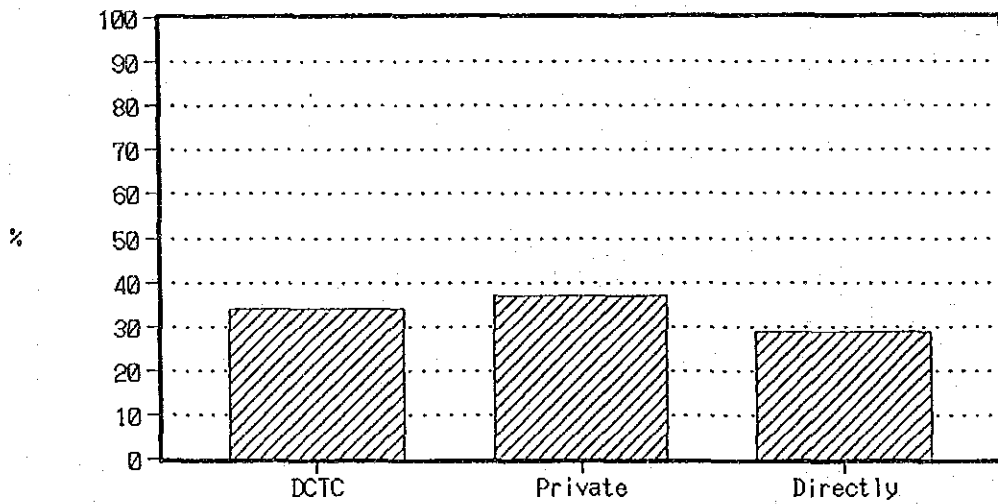


Fig. K.2-2 Amount of Waste Hauled by DCTC, Private and Directly (January, 1992)

Table K.2-4 Schedule of cleaning-up through public cooperation

Date of cleaning-up		Cleaning-up Areas
Residents	DCTC	
22 Feb.	24 ~ 29 Feb.	Ban Sisavath Tay
29 Feb.	2 ~ 7 Mar.	Ban Sisavath Kang
7 Feb.	9 ~ 14 Mar.	Ban Dong Mieng

4) Final Disposal

The immediate improvement plan for the final disposal system, which can be achieved through the efficient use of the existing personnel and equipment and cooperation of the citizens without incurring large investments, has been discussed with the related organizations. In addition, the experiment on sanitary landfill operation has been conducted by the DCTC and the Study Team from February 13 to March 21 1992, and the details of the experiment are described in Appendix E. The details of the immediate improvement plan proposed for the final disposal system are as follows.

a. Securing land for the KM 18-DS

Although the present KM 18-DS has been used as the final disposal site of the Vientiane urban area for more than 20 years, the boundary of the site is not clearly secured. It is identified that the part of the land which should belong to the Vientiane Municipality has been used not only for cultivation but also as residences of the private farmers. It is, therefore, urgent to secure the land of the Vientiane Municipality for the KM 18-DS by the installation of boundary fences or pegs in order to avoid further invasion which will only make the future operation of the KM 18-DS more difficult.

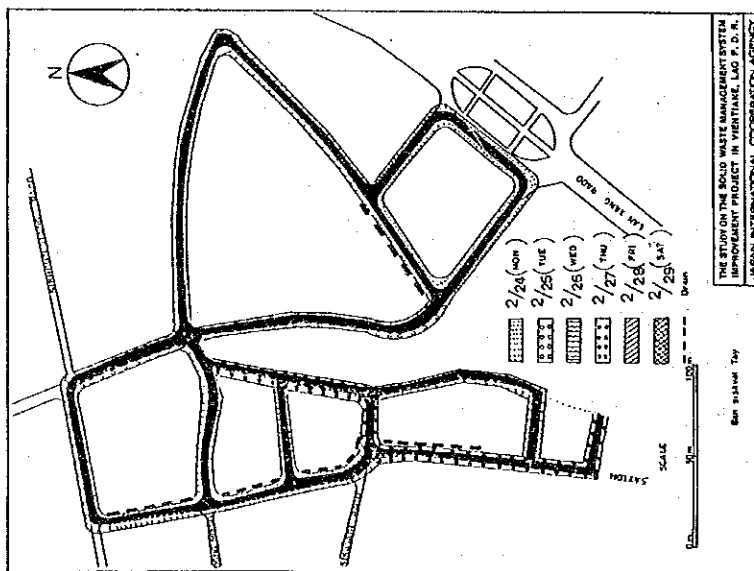
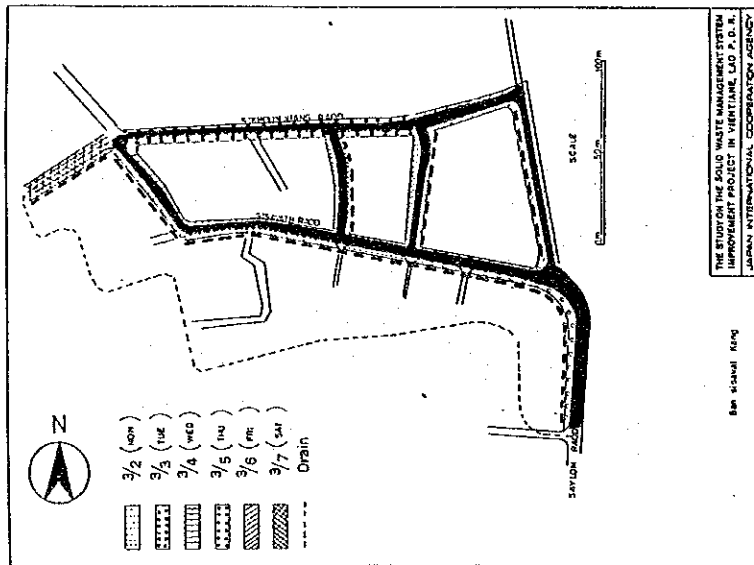
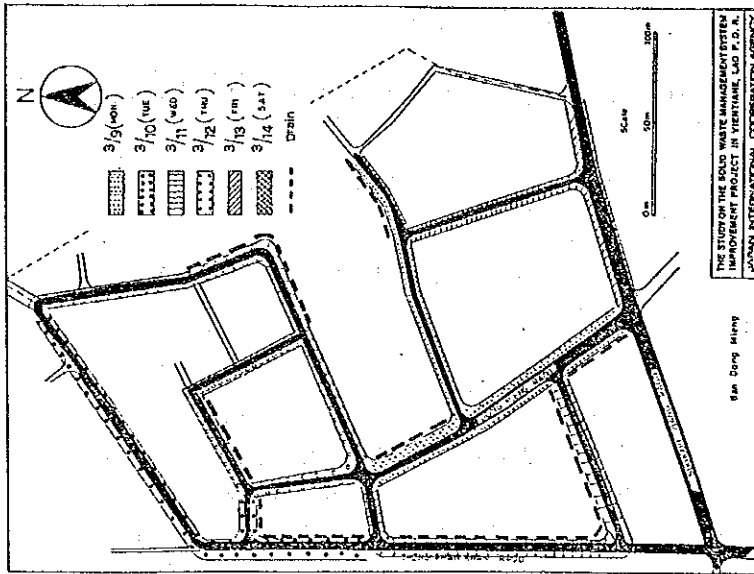


Fig. K.2-3 Collection Routes for Cleaning-up of Roads, Drains and Public Areas

b. Authorization of the KM 18-DS as a disposal site

For solid waste management, a final disposal site is absolutely necessary. Even if a processing facility such as an incinerator would be introduced, a disposal site is still necessary for SWM. Many countries are facing serious problems regarding the final disposal system due to the lack of a final disposal site. It is quite fortunate that the Vientiane Municipality has sufficient land for final disposal at KM 18 which can be utilized for another 30 years.

It is, therefore, necessary that the Vientiane Municipality shall authorize the KM 18-DS as the final disposal site of the Vientiane urban area and restrict not only cultivation in the site but also the use of the surrounding area to avoid future problems.

c. Control of scavenging activities

The scavenging activities contribute to the recycling and recovery of reusable materials in the Study area. In addition, scavenging is the major source of income of the farmers living in the surrounding area. Scavenging by children, however, shall be prohibited and scavengers shall be sufficiently cautioned against infectious hospital waste.

In order to avoid the spread of communicable diseases, animal scavenging at the site shall also be restricted.

d. Provision of the record of incoming vehicles

For a sound SWM, the provision of the record of incoming vehicles is indispensable. When recording incoming vehicles, the inspection of incoming waste, especially dangerous wastes such as industrial and hospital wastes is also required. When an inspector identifies the existence of hazardous wastes, he must caution the scavengers and instruct the vehicles to dump its waste at a designated area.

e. Improvement of tipping fee collection system

A temporary overseer is employed by DCTC under a verbal contract. His main assignment is the collection of tipping fees from incoming vehicles and he is paid from the tipping fees. Present tipping fees are;

- 400 kips for a small vehicle;
- 600 kips for a medium-sized vehicle;
- 800 kips for a large vehicle.

The present tipping fee collection system shall be improved as follows:

- i. The temporary overseer shall be employed by DCTC and his assignment shall be clearly outlined to him.
- ii. The receipt of the tipping fee shall be issued at the time of inspection.
- iii. The tipping fee is proposed to be increased in the following manner:

- a small vehicle ; 600 kips/unit
- a medium vehicle ; 900 kips/unit
- a large vehicle ; 1,200 kips/unit

5) Equipment Operation and Maintenance

(1) Improvement of Basic Knowledge

In order to improve the basic knowledge of the DCTC operators and mechanics regarding equipment operation and maintenance, the Study Team has arranged a 2-week training course from the 2nd to the 14th, of March. Totally 8 operators and mechanics were selected by DCTC to be trained in the course. Technical training was held at the DCTC office and the demonstration training was done at the KM 8 on Route 13 North with the supply of a bulldozer.

Content of training programs were as follows:

- a. Basic information on vehicles and construction equipment;
- b. Outline of main parts of engine and power train;
- c. Instruction for operation of a truck and a bulldozer;
- d. Instruction of " HOW TO MAINTAIN EQUIPMENT ";
 - Inspection record,
 - Daily report to workshop,
 - Daily, three months, six months and one year check list,
 - How to make a check list.
- e. Outline of hydraulics for power steering;
- f. Safety regulations; and
- g. Tire and under carriage;

(2) Execution of Regular Maintenance

The Study Team also provided the operators and mechanics a training course on "Regular Maintenance System".

The training includes the following:

- a. Regular maintenance which consists of daily, weekly, monthly and one yearly check-up; and
- b. How to use and make a weekly, monthly check sheet.

K.2.2 Institutional System

1) Organization and Management

The immediate improvement plan on organization and management is as proposed below.

a. Clearing roles for each organization

There are various organizations concerned in the solid waste management. However, the responsibilities and roles of these agencies are not clearly defined. It means that institutional structure is not well established ; many problems can be eliminated by a well established institutional structure. Further, the unclarities in the role of each organization also greatly impedes the establishment of cooperation among the agencies concerned. In addition, responsible persons are often changed, too, without apparent reason. This situation is the same even in the various organizations of the Vientiane Municipality. The Study Team, therefore, proposes the major importance of clearly defining the role of the Cleansing Section of the DCTC, VM, especially in respect to the successful conduct of the collection experiment.

b. Assignment of the person (s) in charge of planning and management

Good planning is one of the key factors behind the conduct of smooth and effective works. Unfortunately, neither a long term nor a short term plan regarding solid waste management have been set up by the responsible agencies. Moreover, nobody is directly assigned to take charge of the planning and management in the Cleansing Section of DCTC. The Study Team recommended to DCTC the assignment of person(s) to take charge of planning and management in the Cleansing Section.

2) Legislation and Enforcement

a. Strengthening enforcement capability

Vientiane Municipality has few regulations related to solid waste management, and they seem to be insufficient and out of date. A basic law and an enforcement system on solid waste management is also non-existent in Lao P.D.R.. All of the existing regulations issued by Vientiane Municipality should be revised, therefore, in accordance to the present situation and to strengthen effective enforcement.

3) Finance

The immediate improvement plan of the financial system is as proposed below;

a. Improvement of accounting system

The major improvement point is to introduce a separate accounting system for SWM, to clarify cash flow.

An accounting sheet shown in Table K.2-5 was proposed and has been used in the collection experiment.

As for revenues, the fee collector should inform the accountant of the date, code, item and amount of money collected. The accountant shall, then, record these and file the stubs of receipts given to the contractors when fees are collected.

As for expenditures, the receipts when money is paid for goods or services are numbered and filed. The section number and the vehicle number shall be informed of the receipt, if possible, to easily check and control the operation. After that, the date, receipt number, code, item and amount of money are recorded in the sheet.

Table K. 2-5 Accounting Sheet

No. 1

Month	Date	Receipt No.	Code	Item	Revenue	Expenditure	Balance
Feb.	17		R-1	Collection Fee	21,000		21,000
Feb.	17	1	E-7	Stationary		1,200	19,800
Feb.	18		R-1	Collection Fee	52,000		71,800
Feb.	18		R-1	Collection Fee	63,000		134,800
Feb.	20	2	E-7	Opening Bank Account		1,000	133,800
Feb.	22		R-1	Collection Fee	1,000		134,800
Feb.	22		R-1	Collection Fee	177,000		311,800
Feb.	24		R-3	Unclear	100		305,600
Feb.	24	4	E-2	Labour Fee		6,200	306,000
Feb.	24		R-2	Tipping Fee	1,810		306,600
Feb.	24	001	R-2	Tipping Fee	400		308,410
Feb.	24	002	R-2	Tipping Fee	600		308,510
Feb.	24	003	R-2	Tipping Fee	800		309,310
Feb.	24	004	R-2	Tipping Fee	800		310,110
Feb.	25	3	E-7	Stationary		2,350	310,610
Feb.	25	4	E-2	Labour Fee		6,200	304,410
Feb.	25	005	R-2	Tipping Fee	500		304,910
Feb.	25	006	R-2	Tipping Fee	500		305,510
Feb.	25	007	R-2	Tipping Fee	600		306,010
Feb.	25	008	R-2	Tipping Fee	500		306,810
Feb.	25	009	R-2	Tipping Fee	800		307,610
Feb.	25	010	R-2	Tipping Fee	800		308,410
Feb.	25	011	R-2	Tipping Fee	800		309,210
Feb.	25	012	R-2	Tipping Fee	800		306,860
Feb.	26	013	R-2	Tipping Fee	800		307,660
Feb.	26	014	R-2	Tipping Fee	500		308,160
Feb.	26	015	R-2	Tipping Fee	800		308,960
Feb.	26	016	R-2	Tipping Fee	400		309,360
Feb.	26	018	R-2	Tipping Fee	800		310,160
Feb.	26	019	R-2	Tipping Fee	800		310,960
Feb.	26	4	E-2	Labour Fee		5,600	305,360
Feb.	27	020	R-2	Tipping Fee	500		305,860
Feb.	27	021	R-2	Tipping Fee	800		306,660
Feb.	27	022	R-2	Tipping Fee	800		307,460
Feb.	28	023	R-2	Tipping Fee	500		307,960
Feb.	28	024	R-2	Tipping Fee	800		308,760
Feb.	28	025	R-2	Tipping Fee	800		309,560
Feb.	28	026	R-2	Tipping Fee	400		309,960
Feb.	28	027	R-2	Tipping Fee	500		310,460
Feb.	28	028	R-2	Tipping Fee	400		310,860
Feb.	28	029	R-2	Tipping Fee	500		311,360
Feb.	28	030	R-2	Tipping Fee	800		312,160
Feb.	28	031	R-2	Tipping Fee	500		312,660
Feb.	29	032	R-2	Tipping Fee	500		313,160
Feb.	29	033	R-2	Tipping Fee	800		313,960
Feb.	29	035	R-2	Tipping Fee	500		314,460
Feb.	29	036	R-2	Tipping Fee	800		315,260

At the end of the working day, the cash and the balance recorded in the sheet are to be checked.

b. Improvement of fee collection system

A ledger for the management of collection fee is prepared as shown in Table K.2-6. The major improvement to be made in this system is the formulation of the ledger and the development of a method which shall allow easy access to the ledger whenever a contract is made or fee is collected.

The second one is the numbering of every page of the receipt book before it is used (see Fig. K.2-4). A rule of not tearing any page regardless of errors made is established in order to avoid trouble or doubt.

c. Collection of data for operational expenditure

From the account sheet, the sum by each item-code is arranged in the cost analysis sheet every month. The same goes with the volume of solid waste transferred based on the data of weighbridge.

From the above data, the balance and unit cost of each work on SWM can be attained. Careful analysis of the change of unit cost will point out the problem or possible ways to improve SWM.

4) Public Cooperation and Education

The immediate improvement plan for public cooperation and education are:

a. Strengthening present public cooperation for the Cleansing Day designated on Saturdays

ໃບຮັບເງິນ

ເລກທີ 500

ຊື່ແລະນາມສະກຸນ.....
 ເດືອນເລກທີ.....ເລກທີໜ່ວຍ.....ຊື່ບ້ານ.....
 ຈຳນວນເງິນ.....
 ໄດ້ຮັບຈຳນວນເງິນທີ່ແຈ້ງຢູ່ຂ້າງເທິງນີ້ເປັນຄ່າເກັບຂີ້ເຫຍື້ອ
 ສຳລັບເດືອນ.....

ວັນທີ.....ເດືອນ..... 1992

ກອງອານາໄມເທດສະບານ. ຄະນະສຳຫລວດຂີ້ເຫຍື້ອຂອງໃຈກາ



ໃບຮັບເງິນ

ເລກທີ 500

ຊື່ແລະນາມສະກຸນ.....
 ເດືອນເລກທີ.....ເລກທີໜ່ວຍ.....ຊື່ບ້ານ.....
 ຈຳນວນເງິນ.....
 ໄດ້ຮັບຈຳນວນເງິນທີ່ແຈ້ງຢູ່ຂ້າງເທິງນີ້ເປັນຄ່າເກັບຂີ້ເຫຍື້ອ
 ສຳລັບເດືອນ.....

ວັນທີ.....ເດືອນ..... 1992

ກອງອານາໄມເທດສະບານ. ຄະນະສຳຫລວດຂີ້ເຫຍື້ອຂອງໃຈກາ

Fig. K. 2-4 Receipt for Collection Fee

It can be surely said that most solid waste management problems would be solved quickly and efficiently, if the public cooperation is strengthened. Citizen's cooperation does not only refer to the number of people participating in the Cleansing Day activities, but also refers to how they keep the city clean by proper storage and discharge manner, non-littering at public places, etc.

DCTC is proposed by the Study Team to strengthen public cooperation by means of public education and public campaign.

b. Preparation of an education program for the primary school

The objective of public education is to strengthen citizen's cooperation. It is recommended that waste education should be established in primary schools. The solid waste education should include the following;

- i. waste and public health
- ii. necessity for proper discharge and storage
- iii. importance of keeping public places clean
- iv. waste flow from generation to final disposal
- v. waste amount and cost
- vi. waste disposal and environment
- vii. importance of recovery (recycling)

K.3 Results

K.3.1 Technical System

1) Discharge and Storage

During the WACS, the hospitals were requested to segregate and discharge infectious waste.

However, a lot of the infectious waste was found to be included in the non-infectious waste in the rainy season, in spite of the request made by the study Team to the hospitals on segregation. As such, the composition of waste segregated at the hospital was about 1.3%.

On the other hand, amount of the infectious waste segregated in the dry season was 14.7%. Waste composition was analyzed in this season, because infectious waste was not included in non-infectious wastes. The average of discharge amount of infectious waste is considered as about 15% of all waste discharged from hospitals.

As infectious waste was segregated at the generation source, it is concluded that segregation and discharge of infectious waste will easily become a habit if the equipment necessary for segregation, i.e., plastic bags or containers for infectious waste, is provided.

2) Collection and Haulage

a. Preparation of weekly and monthly working schedule

i. working schedule for collection workers

The Working Day Table prepared for the management of workers and drivers produced the following effects.

- Collection service was done at a regular time. As morning meeting was held at a fixed time (8:00 A.M.), the collection crew was able to start at a regular time (8:30 A.M.).
- The daily allowances for labours were managed systematically and clearly. By signing on the Working Day Table, workers and drivers get their pay every working day. Because the allowances were placed in the computer according to the Table.
- Collection crew became conscious of the collection work, and behaviour became efficient due to regular working time.

A Weekly Schedule of the collection vehicles produced the following effects;

- The collection areas allotted to each vehicle became clear to every staff.
- The regular collection service was conducted in residences, shops, markets and offices.
- Administration system of collection vehicles was established.
- Planning of repair, maintenance and back up service for the vehicles was established even though the present maintenance system is not satisfactory.

b. Collection of data regarding amount of waste collected

The actual amount of waste hauled to KM18-DS was observed from November 15, 1991 to the end of January 1992, with the use of the weighbridge installed by the Study Team. According to the results, the maximum amount of hauled waste was 39.36 tons and the minimum was zero.

The great difference between the maximum and minimum amounts showed an average of 17.4 tons per day. The average number of incoming vehicles was about 8.5 units per day.

Average amount of waste hauled by DCTC, those privately and directly hauled are 6.1 tons, 7.8 tons and 3.5 tons, and shared 35.3 %, 44.7 % and 20 % respectively.

3) Road Sweeping, Drain Cleansing and Grass Cutting

As for the cleaning-up of roads, drains and public areas through public cooperation, a cleansing day was proposed and implemented in each Ban.

The Study Team informed the chiefs of the 3 Bans the designated day, method and type of waste for the cleansing day and asked them to explain the details to and solicit the participation of their residents. In addition, the announcement by the loudspeaker was done at previous and designated days. However, the result of the cleansing work by the residents was not sufficient.

It was requested, therefore, that DCTC as well as the chiefs of the Bans should further conduct public and educational campaigns in order to achieve public cooperation regarding cleansing services.

4) Final Disposal

Considering the present situation of final disposal in the Study area, the proposed immediate improvement plan has been modified and executed by the Vientiane Municipality as follows;

a. Securing land for the KM 18-DS

The DCTC received the approval of the staking out of the site the construction of the surrounding fence. The boundary stakes were installed and the fence is now being constructed after the budget allocation.

b. Authorization of the KM 18-DS as a disposal site.

After the approval of the Governor, the Vientiane Municipality took the necessary measures for authorization. Finally, the Department of Land, Ministry of Economy Planning and Finance has issued a title deed for the use of the site to the Municipality.

c. Control of scavenging activities

The DCTC has assigned an inspector for the control of scavenging activities. He took necessary measures for the restriction of children scavenging and gave cautions to the scavengers when hazardous waste was found in incoming vehicles.

d. Provision of a record of incoming vehicles

A record of incoming vehicles to the KM 18-DS was provided after the installation of the weighbridge in November 15, 1991. Then incoming vehicles were classified into the following three categories;

- DCTC's vehicles;
- Private companies' vehicles; and
- Others (directly hauled).

The inspector assigned at the KM 18-DS inspects the wastes of others which may contain some industrial wastes, and also pay necessary attentions to the infectious hospital wastes hauled by DCTC.

e. Improvement of tipping fee collection system

In response to the improvement plans, DCTC employed an overseer and gave him a clear assignment at the disposal site.

The receipt of the tipping fee was prepared by the Study Team in February 1992. Subsequently, DCTC issued the receipt and the overseer inspected the incoming vehicles when he issued the receipt.

However, the increment of the tipping fee is being discussed in the Administrative Committee of Vientiane Municipality.

5) Equipment operation and maintenance

The operators and mechanics trained have improved in their vehicles and heavy equipment operation and maintenance capabilities. The result may contribute in the improvement of the DCTC present equipment operation and maintenance system.

K.3.2 Institutional System

1) Organization and Management

a. Clearing roles for each organization

In response to the proposal made by the Study Team, DCTC has assigned the persons required for execution of the collection experiment. The assigned staffs, totally 18 persons, consist of a project manager, a supervisor, an accountant, fee collectors, weighbridge operators, a mechanic, drivers and labours. Each person was clearly assigned his duty and responsibility. The result of the collection experiment shows that the personnel of the Cleansing Section is being well organized. The clarification of duties and responsibilities resulted in efficient work.

b. Assignment of the person (s) in charge of planning and management

DCTC has assigned a person in charge of planning and finance of the Cleansing Section upon the recommendation of the Study Team. This person also joined the collection experiment as a fee collector. Moreover, during the collection experiment, some of the immediate improvement plans regarding planning and management have been executed.

They are;

- i. daily and weekly working plan of workers;
- ii. daily and weekly working plan of vehicles;
- iii. planning of fee collection and waste collection.

After the collection experiment, DCTC has set a plan to extend the collection service contract with the residents up to the end of 1992 and also plans to extend the service coverage to other areas in Vientiane Municipality.

2) Legislation and Enforcement

a. Strengthening enforcement capability

In order to strengthen enforcement capability as proposed by the Study Team, DCTC has requested the Study Team to provide laws and regulations regarding solid waste management in the neighbouring countries of Lao P.D.R.. These laws and regulations will be used as example for revising the existing regulations and for issuing new ones. The Study Team agreed and it would be delivered to DCTC when the draft final report is to be submitted. And after careful consideration, the Study Team shall ask DCTC to adopt the existing laws and regulations of Thailand because of the similarities in language and way of living, social conditions, traditions and customs, between Thai and Lao.

3) Finance

Some of the immediate improvement plans have been executed in the collection experiment. The experience shows that the Laotian side could continue and improve the proposed plan in the future.

a. Improvement of accounting system

In the collection experiment, a personal computer of the JICA Study Team was used to make the above-mentioned sheets. This is expected to affect the improvement of the SWM account system, because the accountant who was the counterpart of the project mastered its operation.

b. Improvement of fee collection system

With regard to fee collection, the potential possibilities for the establishment of self-finance was proven when punctual services were given. Moreover, a new extra charge concept was induced from the experiment. Residents sometimes want to discharge more waste than what was agreed in the contract, and this prompted the introduction of the ticket system for extra charge.

c. Collection of data for operational expenditure

Cost analysis is also expected to improve SWM through the checking of the operational cost according to the monthly data. Data for operational expenditure of the experiment was collected and analyzed. The cost analysis sheet of the experiment is tabulated in Table K.3-1.

4) Public Cooperation and Education

a. Strengthening present public cooperation for the Cleansing Day designated on Saturdays

In the collection experiment, the Study Team has strengthened public cooperation for the Cleansing Day designated on Saturdays by recommending the conduct of public education and campaign to DCTC. For public education, the Study Team conducted an education program on solid waste management to the Lao Women's Union. The solid waste education includes the following;

- i. proper storage and discharge manner;
- ii. reducing litter in public places;
- iii. eliminating illegal dumping of waste; and
- iv. resource recovery and recycling.

Table K. 3-1 Cost Analysis Sheet

Total	Collection			Disposal		Others	
	R-1	E-2, E-2-1	314,000	R-2	R-3	E-1, E-1-1	100
Revenue	328,200			14,100			
Expenditure							
Personnel	275,384	E-2, E-2-1	145,500	E-3, E-3-1			103,084
Fuel & Lubrica	54,550	E-4	50,000	E-6			4,550
Maintenance	0	E-5	0				
Rental	840,000		0	E-8			
Depreciation	360,429	E-9	360,429				
Sub-total	1,530,363		555,929	866,800			107,634
Administration			42,058				
Disposal fee			39,663				
Total	1,530,363		637,650	932,376			
Balance	*****		-323,650	-918,276			
excluding Depr	-841,734		36,779	-918,276			
Volume treated			19.38	455.57			
Unit cost			32,902	2,047			

Code for Revenue

R-1: Collection Fee for Collection Service

R-2: Tipping Fee at KM18-DS

R-3: Others

Code for Expenditure

E-1: Personnel Expenditure for Administration

E-1-1: Personnel Expenditure for Administration (Over Time)

E-2: Personnel Expenditure for Cleansing Service

E-2-1: Personnel Expenditure for Cleansing Service (Over Time)

E-3: Personnel Expenditure for KM18-DS

E-3-1: Personnel Expenditure for KM18-DS (Over Time)

E-4: Fuel & Lubricant for Vehicle

E-5: Maintenance for Vehicle

E-6: Utility for Inspection Building

E-7: Others (Administrative Expenditure etc.)c

E-8: Rental for Bulldozer

E-9: Depreciation of Collection Vehicles

About public campaign, the Study Team, with cooperation from the village committees, encouraged the residents in the 3 selected villages for the collection experiment to carry out drain cleansing on Saturday. Although the number of people joining in the cleansing day is not satisfactory, DCTC and the village committees should continuously conduct public campaigns.

Furthermore, the Study Team and DCTC also campaigned in Vientiane Municipality through the mass-media (television and newspaper) to promote the collection experiment using the slogan "Clean Vientiane".

The Study Team also prepared a uniform (see Plate 5) for all persons concerned in the collection experiment and stickers of "Clean Vientiane" as shown in Fig. K.3-1, to promote the project and encourage greater public awareness regarding the importance of proper solid waste management.

b. Preparation of an educational program for the primary school

The Study Team, with the cooperation of DCTC, conducted a solid waste education program in the 3 primary schools of each selected village in the collection experiment. During the solid waste education, the teachers were observed to pay little attention, but, the pupils were quite interested in the details and the drawing boards prepared by the Study Team. The content of the program covers all the necessary information regarding solid waste management for the pupils in the primary school.

The brochure prepared by the Study Team both in English and Lao is shown in Appendix N, N.2.4, the Supporting Report (3).



Fig. K.3-1 Sticker of "Clean Vientiane" Prepared for Collection Experiment

APPENDIX L

COLLECTION EXPERIMENT

APPENDIX L COLLECTION EXPERIMENT

L.1 Objective

L.1.1 Purpose of Pilot Project

There are many improvement measures stated in the Basic Plan. In terms of the technical system for the Basic Plan, the following two are the main objectives;

- a. Extension of collection service to the whole population of the Vientiane urban area; and
- b. Execution of sanitary landfill for disposal of solid waste collected.

In order to examine the workability of the proposed Basic Plan and to make the Plan more practical, a pilot project consisting of collection experiment and experiment on sanitary landfill operation was carried out for one month from the middle of February.

After the preparation of a draft plan, various meetings with the organization and persons concerned in the project have been held in February 1992 in order to concretize and strengthen the draft plan. After the modification of the draft plan, both collection and sanitary landfill operation experiments have been carried out from the end of February.

L.1.2 Objectives of the Collection Experiment

As clearly described in the previous section L.1.1, the objective of the collection experiment is to examine the workability of the proposed collection plan in the Basic Plan. The main objectives of the proposed collection plan in the Basic Plan are described as follows:

- a. Extension of collection service to the whole population of the Vientiane urban area;
- b. Establishment of a self-sustainable collection system by the Beneficiary-Pay-Principle under which service recipients pay waste collection fees;
- c. Establishment of an efficient and reliable collection system under which regular services can be provided. In concrete terms, the curb and bell collection for the residential and commercial area is proposed; and
- d. Establishment of public cooperation for cleaning-up roads, drains and public areas.

In order to examine the proposed collection plan, the following items were studied in the collection experiment,

- strategy and tactics for the extension of collection service;
- strengthening of the present cleansing section;
- discharge method;
- collection method;
- determination of collection fee and its payment method;
- administration system of collection vehicle;
- administration system of labourers; and
- progress of community consciousness on environmental and sanitary hygiene.

L.2 Plan

L.2.1 Outline of Experiment

Outline of collection experiment is shown in Fig. L.2-1

The experiment consists of three major stages.

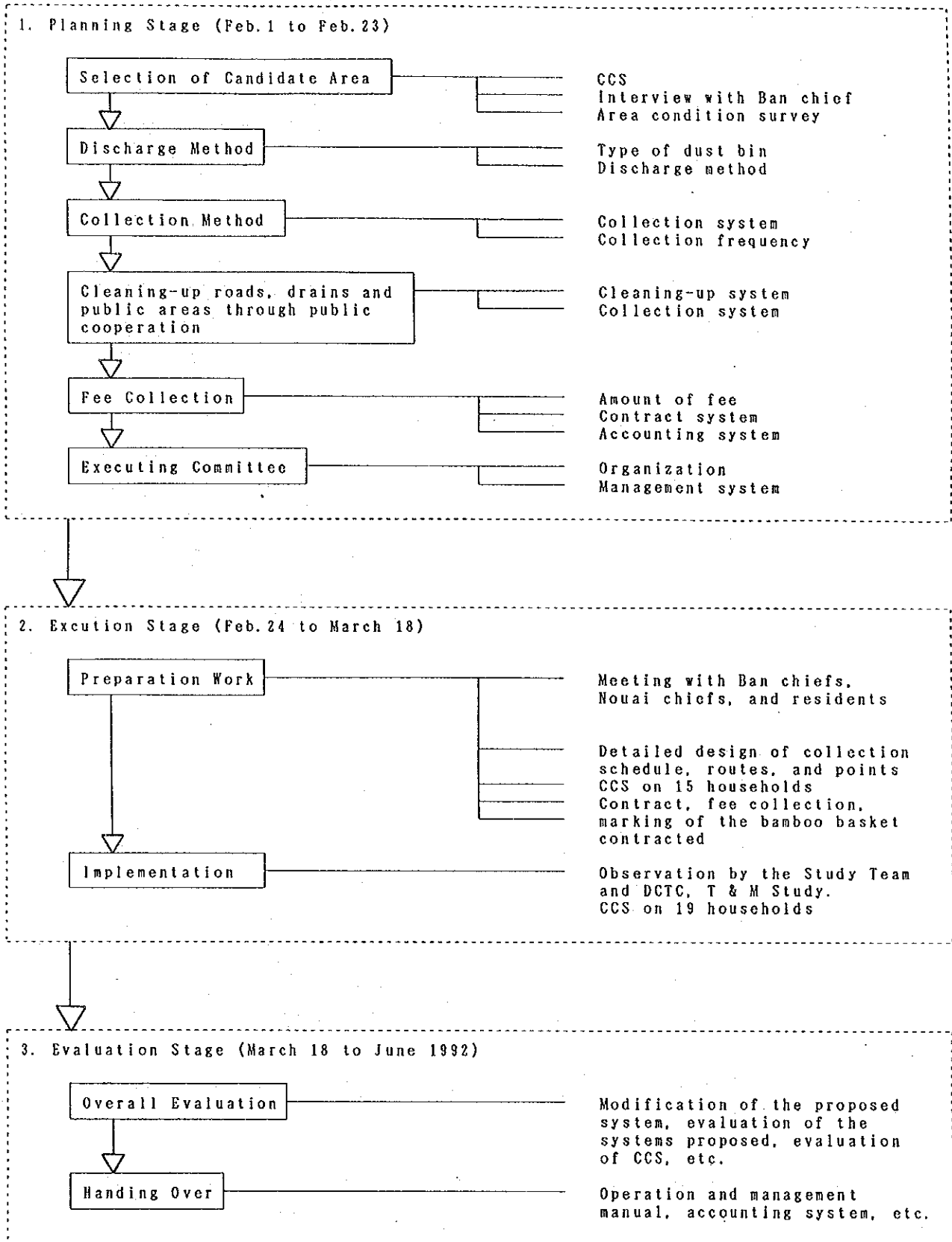


Fig. L. 2-1 Outline of Experiment

- a. Planning stage Planning for storage, discharge, collection and haulage methods based on the Basic Plan
- b. Execution stage
 - i. Preparation work ... To hold a meeting with the residents to explain the details of the project, contract, fee collection, marking, CCS (Community Consciousness Survey) and detail design of collection method, etc.
 - ii. Implementation Observation, T&M study, and CCS.
- c. Evaluation stage Evaluation of proposed collection system and handing over of the collection experiment to DCTC.

L.2.2 Plan of Experiment

1) Selection of Experimental Areas

Five candidate areas for the experiment were selected according to the following procedure:

- a. Among the 96 Bans in the Study area, 33 Bans, where the community consciousness survey (CCS) had been carried out, were chosen as candidate experimental sites.
- b. Among the foregoing 33 Bans, 23 Bans were selected as candidates because they are not covered by collection services.
- c. Based on the area condition survey conducted by the Study Team, 23 Bans were reduced to 14 Bans.
- d. Among the 14 Bans, 5 Bans were selected according to the interviews with the Ban Chief which showed their strong demands for collection services.

Candidate sites for the experiment are shown in Fig. L.2-2 and L.2-3.

2) Area Condition

Area conditions are shown in Table L.2-1 and shown in Fig. L.2-4~8.

3) Discharge Method

a. Dust bins for waste discharge

The use of a bamboo basket for discharge shall be adopted because of its general use and cheapness. And any kind of lid shall be used to prevent the scattering of waste.

Contracted bamboo baskets shall be sprayed in green to distinguish them from others.

b. Discharge place

Contractors shall be responsible for putting their dust bins in the main roads and fixed collection points according to collection routes.

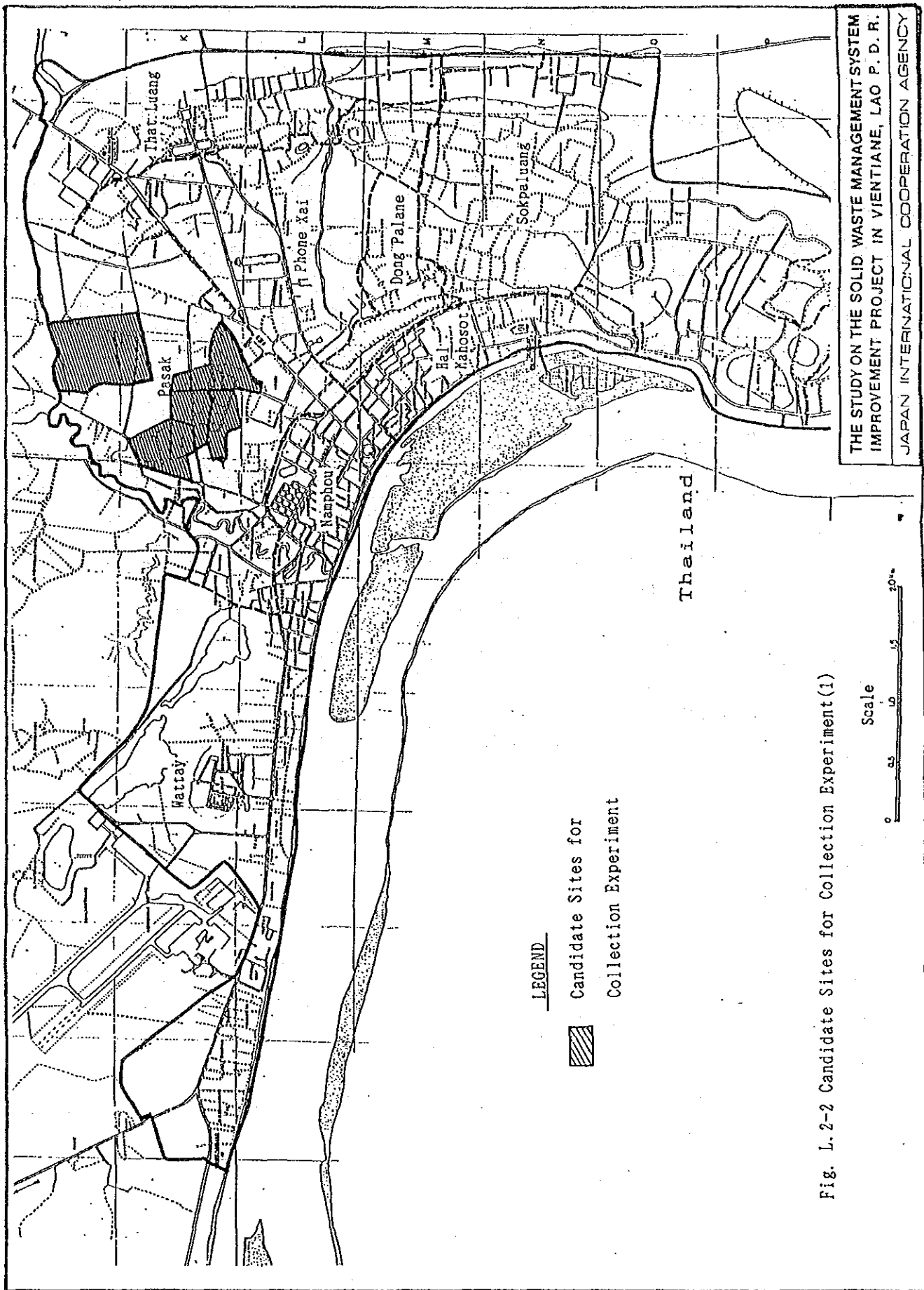
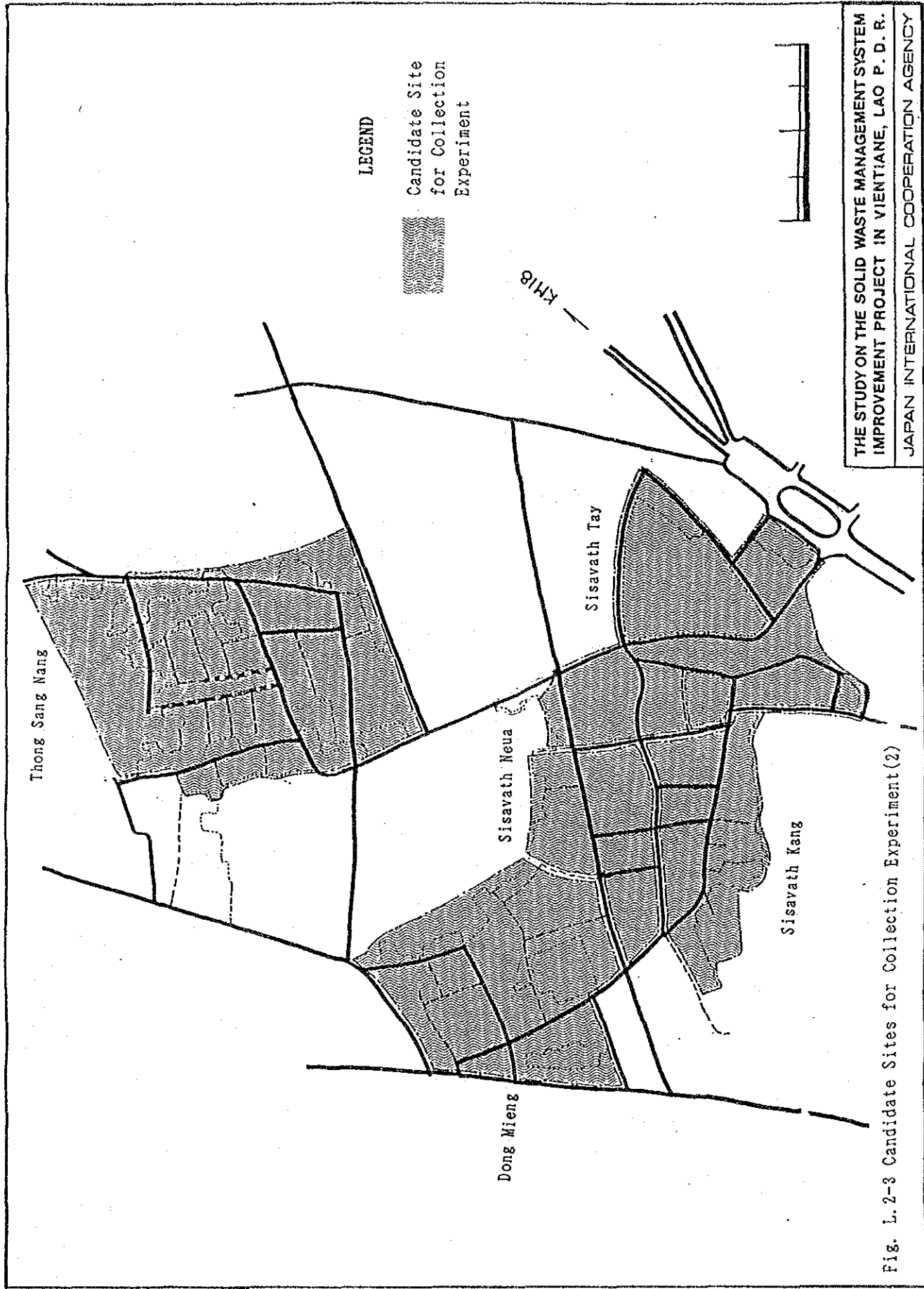


Fig. L.2-2 Candidate Sites for Collection Experiment (1)

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



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

Fig. L.2-3 Candidate Sites for Collection Experiment (2)

Table L.2-1 Area Condition

Items	Bans	Sisavath Tay	Sisavath Kang	Sisavath Neua	Dong Mieng	Thong Sang Nang
1. Population (Person)		1,922	1,387	1,006	2,191	2,028
Number of Families(family)		358	276	174	382	333
Area(ha)			42		30	48
Population density (person)			102.7		73.3	42.3
2. Characteristic of Ban						
Number of residences		292	253	142	330	294
		(79.5%)	(90.3%)	(80.2%)	(34.8%)	(86.4%)
Number of shops		66	23	32	52	39
		(18%)	(8.2%)	(18.0%)	(13.3%)	(11.4%)
Number of public institutions (offices, markets, temples schools)		6	4	0	5	3
		(1.6%)	(1.4%)	(0.0%)	(1.2%)	(0.8%)
Number of companies and factories		3	0	3	2	4
		(0.7%)	(0.0%)	(1.6%)	(0.4%)	(1.0%)
Total		367	280	177	389	340
		100%	100%	100%	100%	100%
3. Race						
Laotian		1,829	1,305	960	2,081	2,022
		(95.1%)	(94%)	(95.4%)	(95%)	(99.7%)
Vietnamese		53	20	12	20	-
		(2.7%)	(1.4%)	(1.2%)	(0.9%)	-
Thai		2	3	2	1	2
		(0.1%)	(0.2%)	(0.2%)	(0.04%)	(0.09%)
Chinese		38	55	25	90	-
		(2.1%)	(4%)	(2.4%)	(4.1%)	-
European		-	-	-	-	3
		-	-	-	-	(0.14%)

Items	Bans	Sisavath Tay	Sisavath Kang	Sisavath Neua	Dong Mieng	Thong Sa Nang
Cambodian		-	1 (0.07%)	-	-	-
Indian		-	3 (0.2%)	7 (0.6%)	-	-
4. Religion						
Buddhism		99%	98%	100%	98%	98.5%
Catholic, Bahaism & Muslim		1%	2%	0%	2%	1.5%
5. Road Condition						
Total Length		3,015m	2,671m	1,451m	2,830m	4,895m
Length and %		3,015m	2,671m	1,451m	2,560m	4,645m
Road width 4 m		100%	100%	100%	90.4%	94.8%
Length and % of Paved road		2,575m 85%	2,451m 91.7%	1,031m 71%	980m 34.7%	1,600m 32.7%
6. Kind and % of drain						
Soil		362m 100%	634m 100%	144m 100%	1,125m 100%	3,664m 100%
Concrete		0	0	0	0	0
7. Percentage of water supply						
		98.8%	99.6%	98.2%	76.7%	100%
8. Electricity						
		100%	100%	100%	100%	100%
9. Contract with Private Contractor						
		86 Residents 24%	11 3.9%	12 6.8%	4 (1.0%)	0 (0.0%)

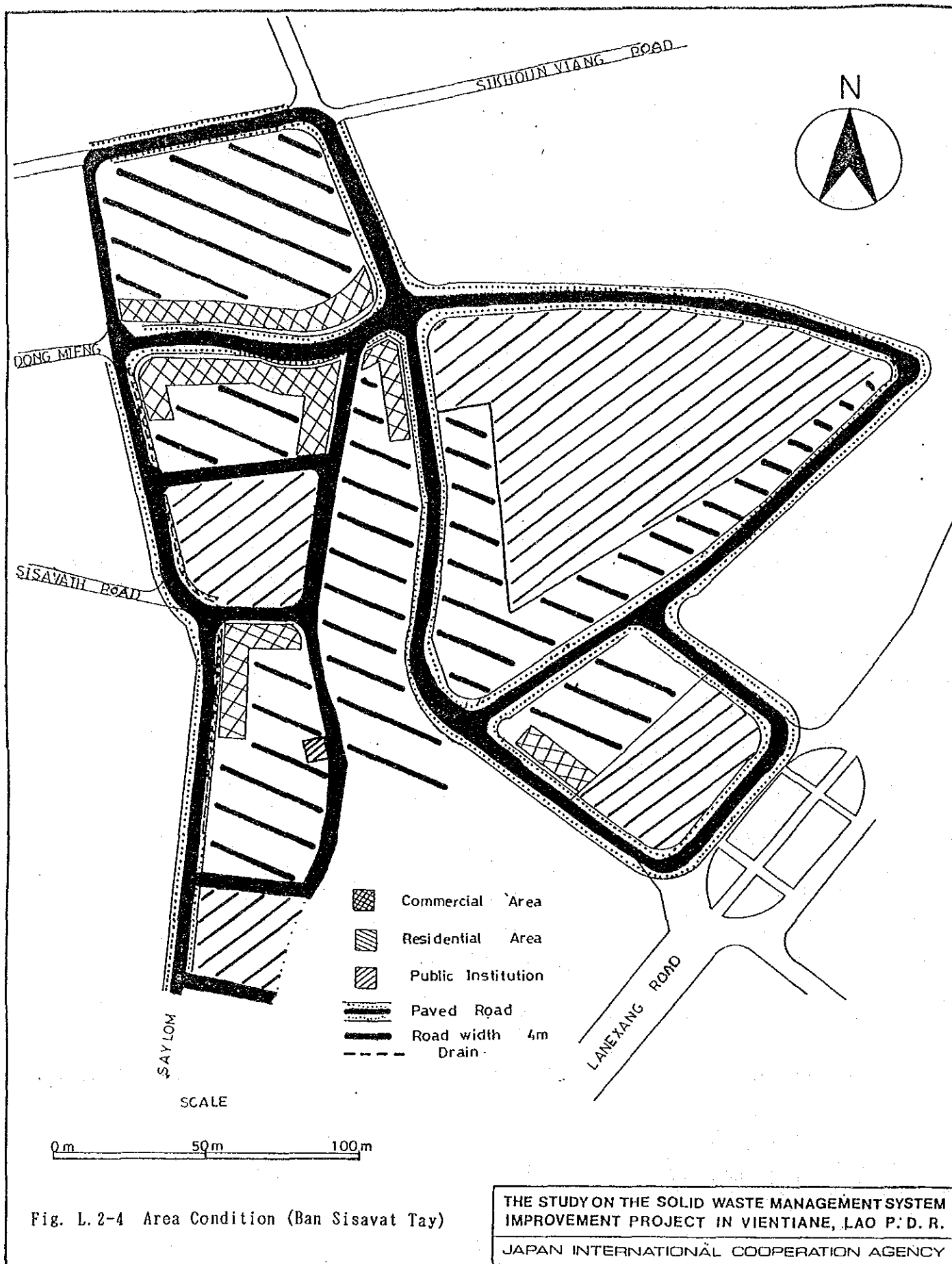
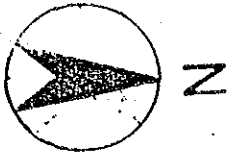








Fig. L.2-4 Area Condition (Ban Sisavat Tay)

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



-  Commercial Area
-  Residential Area
-  Public Institution
-  Paved Road
-  Road width > 4m
-  Drain

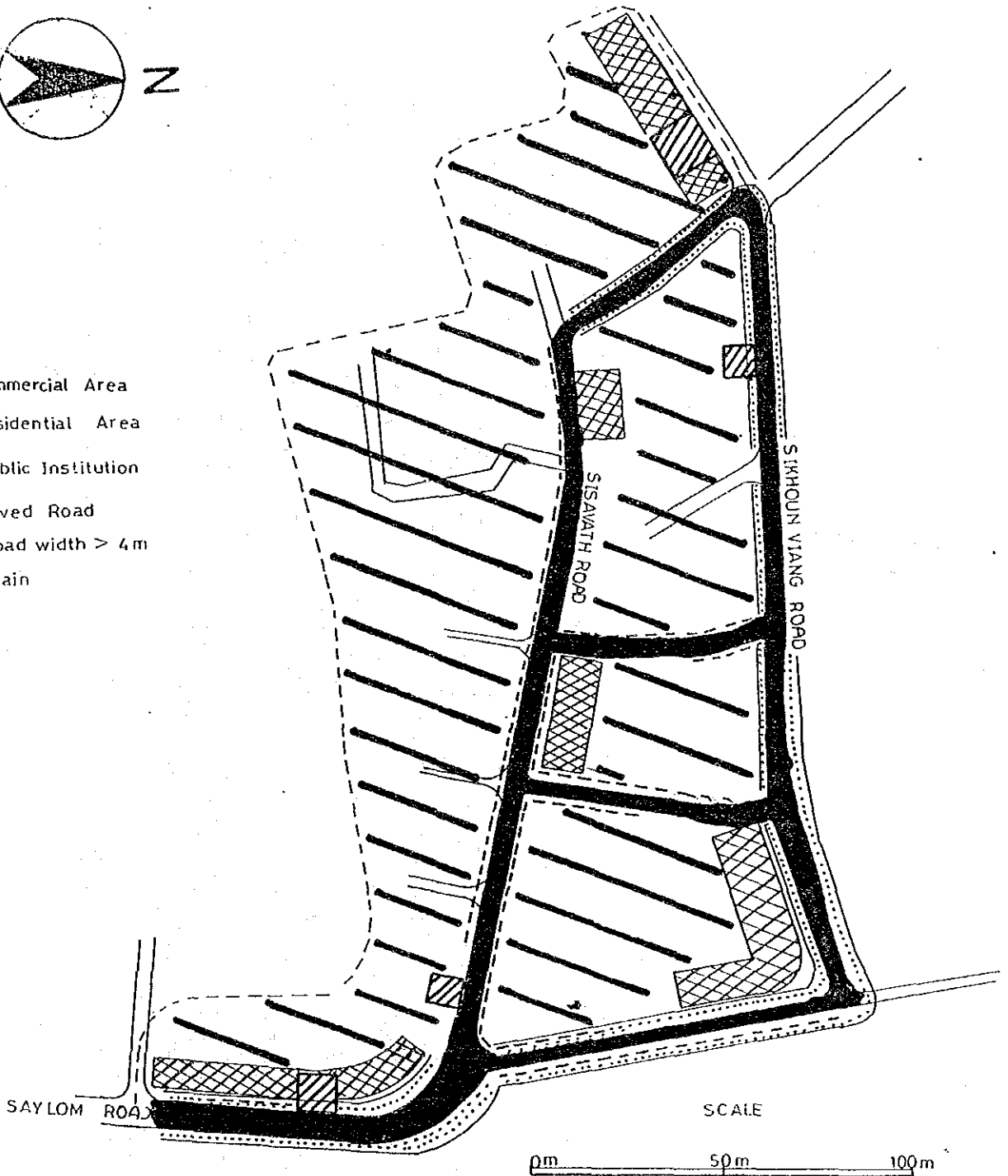


Fig. L. 2-5 Area Condition (Ban Sisavat Kang)

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

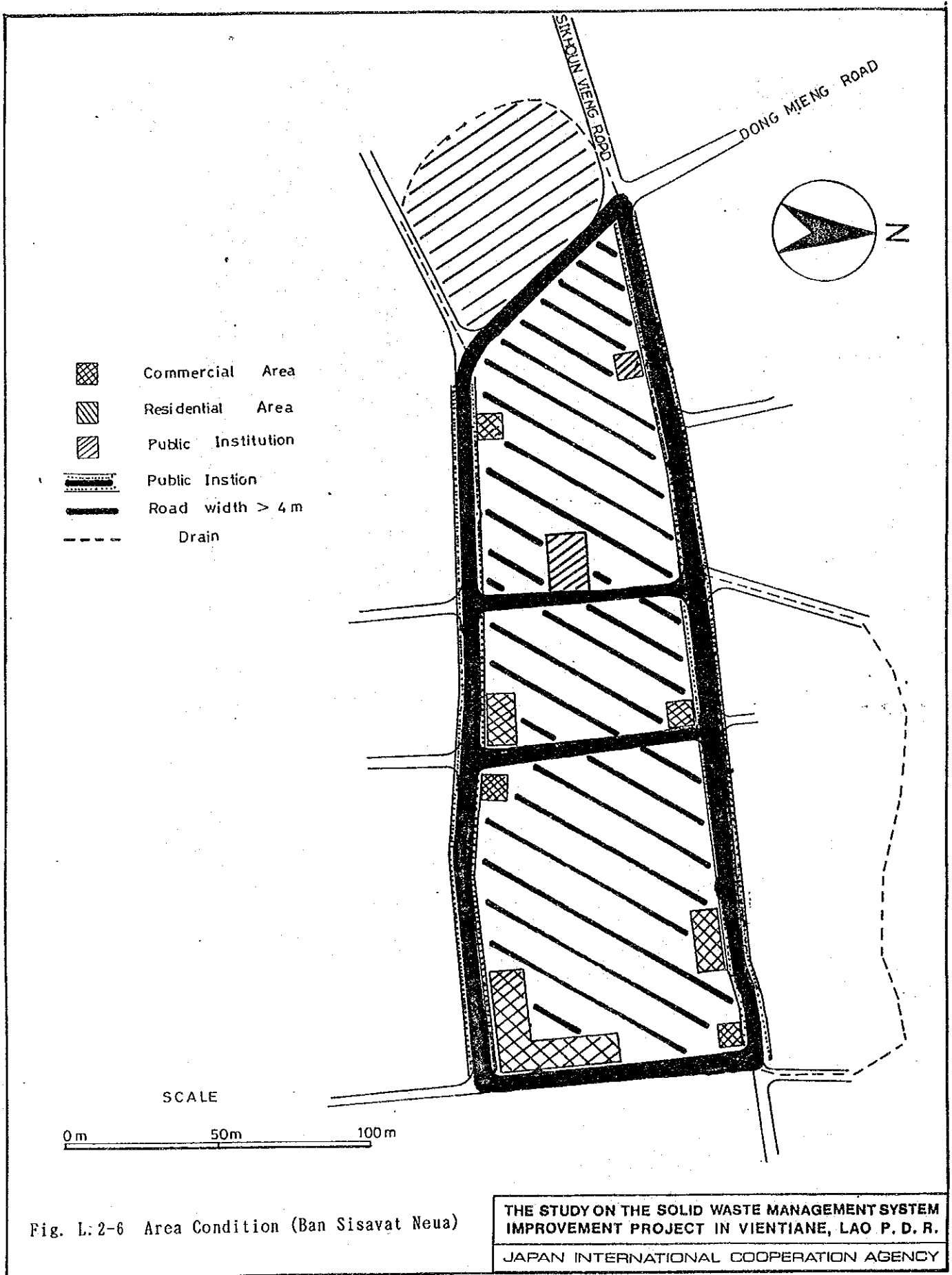


Fig. L:2-6 Area Condition (Ban Sisavat Neua)

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

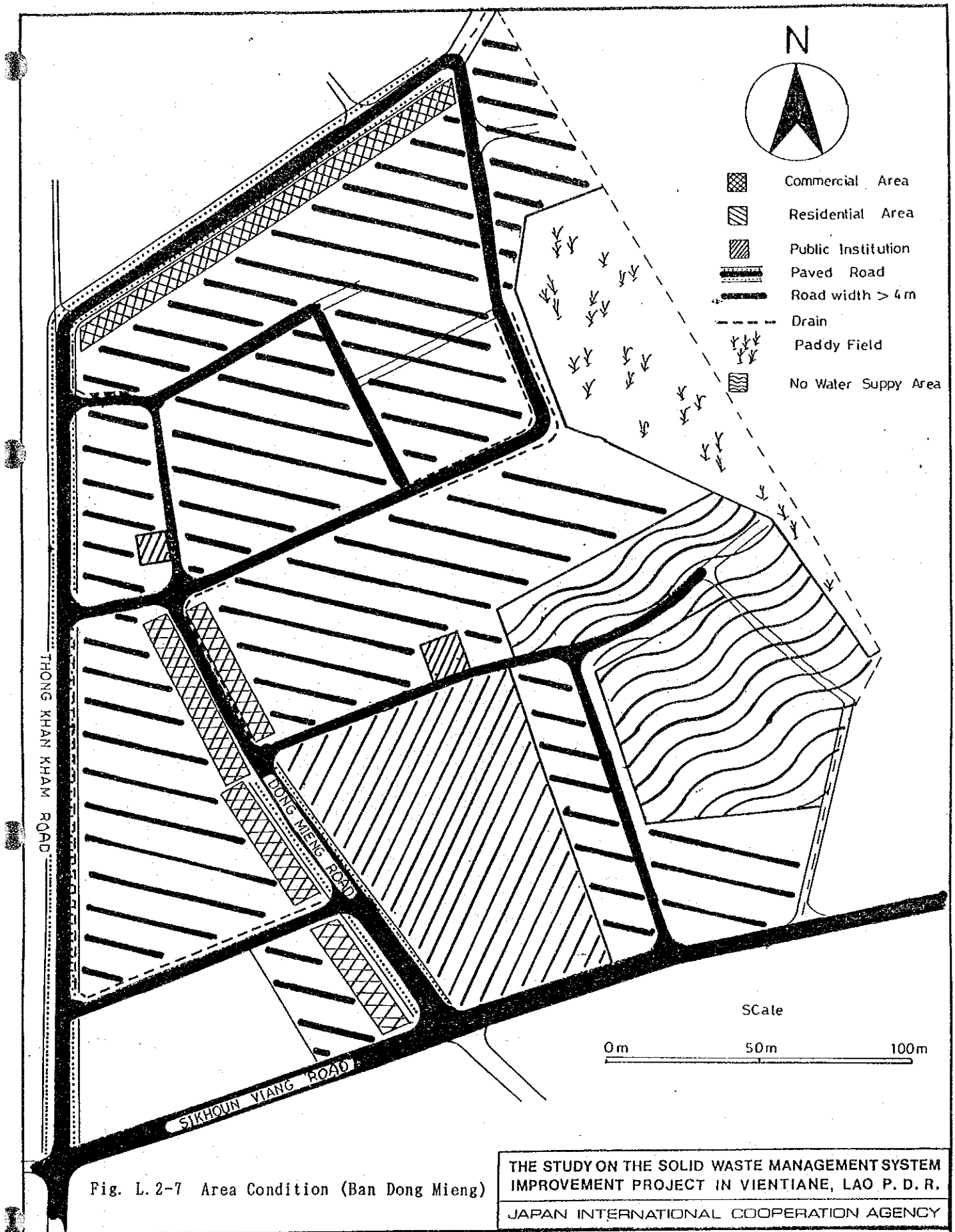
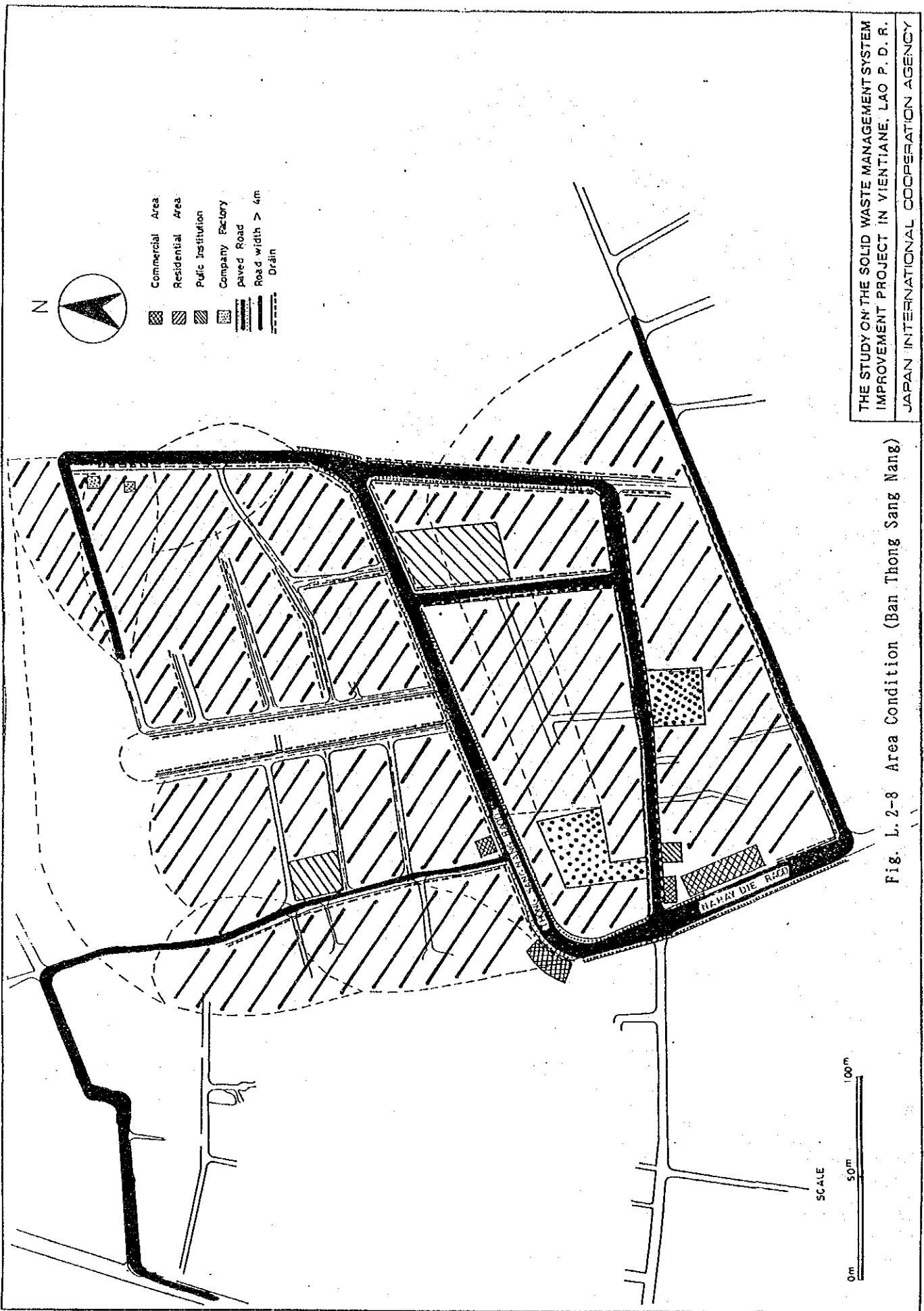


Fig. L.2-7 Area Condition (Ban Dong Mieng)

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



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

Fig. L. 2-8 Area Condition (Ban Thong Sang Nang)

c. Discharge time

Contractors are solely responsible for placing their dust bins at the designated places and during the fixed days and times of the collection schedule.

4) Collection Method

a. Collection system

Bell and curb collection system shall be adopted in this experiment. Where bell collection system is used, a collection worker signals to the residents the arrival of the collection vehicle at the fixed collection point through a loudspeaker. Residents around the collection point then will bring out their baskets and empty them on the vehicles.

Where curb collection is applied, the residents are responsible for placing the baskets to be emptied at the main road on the collection day and for returning the empty baskets in their storage location until the next collection.

b. Collection point

Collection point shall be decided according to the terms of the contract for collection.

c. Collection schedule

Collection schedule shall be established according to the terms of the contract for collection.

d. Collection frequency

In principle, collection frequency shall be once a week in order to unify the collection fee.

e. Collection fee

The collection fee was decided according to the present fee of DCTC and private companies. The present collection fee is tabulated in Table L.2-2.

The residents pay about 500 ~ 5,000 kips for collection fees, and the majority pay 1,000 kips.

Consequently, the collection fee will be 1,000 kips a month per bamboo basket of medium size (about 70 ~ 80 liters).

5) Contract System

The fee collectors are not only involved in fee collection but are also responsible for making contract negotiations with residents and shops for collection services. The list of contractors, contract period and receipt of collection fees are placed in the computer. Contract Sheet, Receipt for Collection Fee and Ledger for Management of Collection Fee are shown in Fig.L.2-9, L.2-10 and Table L.2-3, respectively.

In addition, contracted bamboo baskets are marked with the color green to distinguish them from not contracted ones.

6) Accounting System

Cash received from fee collectors and operator of disposal sites should be checked, the receipts filed and the details noted down in the accounting sheet, which is independent from that of DCTC, within the same day. The accounting sheet is tabulated in Table L.2-4.

The remainder in the accounting sheet and cash in the cash box must be checked everynight, and the difference should be noted down in the accounting sheet. The concept of the accounting system is illustrated below.

Table L.2-2 Number of Contractors and Range of Present Collection Fee

Items	DCTC	Private-SWM	Private-CRC
1. Number of Contractors			
- Residence	32	25	
- Shop	15	12	
- Office, Market Hotel, Hospital etc.	70	6	41
- International Institution (e.g., embassy etc.)	14	28	
- Village	2		5
- Total	131	71	(about 900 residences) 46
2. Range of Fee			
500 ~ 1,000	13%	(Residence) 30%	(Residence) 100%
1,100 ~ 2,000	25%	52%	
2,100 ~ 5,000	24%	18%	
5,000 ~ 10,000	16%		
11,000 ~ 100,000	18%		
110,000 ~ 400,000	4%		
Remarks	The average fee for residences is 1,000 Kips	Shop: 1,000~28,000 Office etc.1,000~ 150,000kips International Institution: 4,000~11,200kips	Office etc.: 1,000~28,000



ສັນຍາຜູກພັນ ແກ້ບມັດນຳຂີ້ເຫຍື້ອ

ລະຫວ່າງ : ຜູ້ຮັບເຕມົາ (ຄະນະສຳຫລວດຂີ້ເຫຍື້ອຂອງ ໃຈກາ ແລະ ກອງອານາໄມ ເຫດສະບານ) ກັບເຈົ້າຂອງຂີ້ເຫຍື້ອ (ຜູ້ສັນຍາຈ້າງ)

ຊື່.....
 ທັງສອງຝ່າຍ ໄດ້ຕົກລົງກັນເປັນເອກະພາບກັນ ຕາມກຳນົດ ດັ່ງລຸ່ມນີ້:

- ກ. ເນື້ອ ໃນແກ້ບຂີ້ເຫຍື້ອ ປະຈຳວັນ
- ຂ. ໄລຍະສັນຍາ.....ເດືອນຫນຶ່ງ
 ຈາກວັນທີເດືອນປີ 1992
 ຫາວັນທີ.....ເດືອນ.....ປີ 1992
- ຄ. ຈຳນວນມື້ທີ່ ໄປແກ້ບຂີ້ເຫຍື້ອອາທິດນຶ່ງເທື່ອນຶ່ງຄືວັນ
- ງ. ລາຄາ.....1.000 ກີບ ຕໍ່ ນຶ່ງເດືອນຕໍ່ນຶ່ງເຮັງ
- ຈ. ວິທີແກ້ບເງິນ.....ຈ່າຍລ່ວງຫນ້າທັງຫມົດນຶ່ງເດືອນ
- ສ. ພາຫານໃສ່ຂີ້ເຫຍື້ອ.....ເຮັງ ໄມ້ ໄຜ່ຂະໜາດກາງ ຈຳນວນ.....ຫນ່ວຍ.

ວັນທີເດືອນປີ 1992

ຊື່ແລະລາຍເຊັນເຈົ້າຂອງຂີ້ເຫຍື້ອ

.....

ຊື່ແລະລາຍເຊັນຜູ້ຮັບເຕມົາ



ກອງອານາໄມເຫດສະບານ

ລາຍເຊັນ.....

ຄະນະສຳຫລວດຂີ້ເຫຍື້ອຂອງ ໃຈກາ

Fig. L.2-9 Contract Sheet

ໃບຮັບເງິນ

ເລກທີ 500

ຊື່ແລະນາມສະກຸນ.....

ເລື່ອນເລກທີ.....ເລກທີໜ່ວຍ.....ຊື່ບ້ານ.....

ຈຳນວນເງິນ.....

ໄດ້ຮັບຈຳນວນເງິນທີ່ແຈ້ງຢູ່ຂ້າງເທິງນີ້ເປັນຄ່າເກັບຂີ້ເຫຍື້ອ

ສຳລັບເດືອນ.....

ວັນທີ.....ເດືອນ..... 1992

ກອງອານາໄມເທດສະບານ. ຄະນະສຳພາລວດຂີ້ເຫຍື້ອຂອງໃຈກາ



ໃບຮັບເງິນ

ເລກທີ 500

ຊື່ແລະນາມສະກຸນ.....

ເລື່ອນເລກທີ.....ເລກທີໜ່ວຍ.....ຊື່ບ້ານ.....

ຈຳນວນເງິນ.....

ໄດ້ຮັບຈຳນວນເງິນທີ່ແຈ້ງຢູ່ຂ້າງເທິງນີ້ເປັນຄ່າເກັບຂີ້ເຫຍື້ອ

ສຳລັບເດືອນ.....

ວັນທີ.....ເດືອນ..... 1992

ກອງອານາໄມເທດສະບານ. ຄະນະສຳພາລວດຂີ້ເຫຍື້ອຂອງໃຈກາ

Fig. L. 2-10 Receipt for Collection

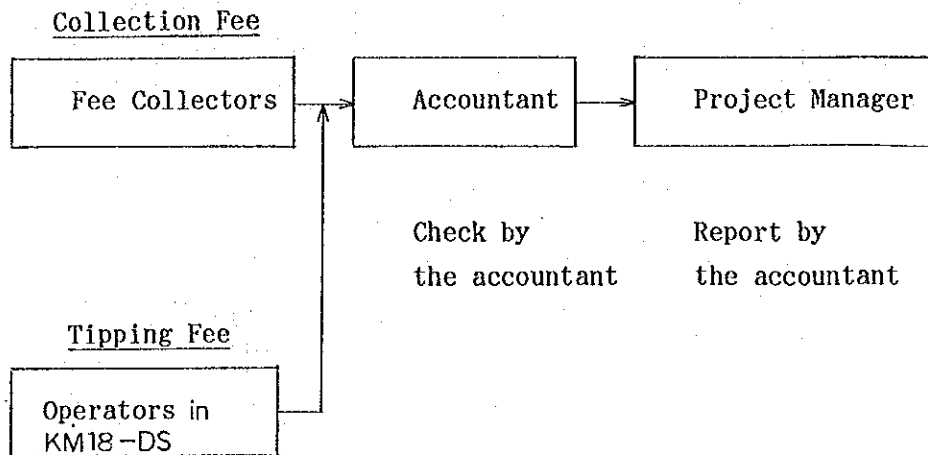
Table L. 2-3 Ledger for Management of Collection Fee

No.	Code No.	Family Name	House No.	Nouai	Ban	District	Contract Date	Contract Month & No. of Baskets																																							
								Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec																												
①	②	③	④	⑤	⑥	⑦	⑧	⑨	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32																
134	SK-1-01	Mrs. Phoy	N.A.	14	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0														
135	SK-1-02	Mr. Rounmy	N.A.	15	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0												
136	SK-1-03	Mrs. Keo	N.A.	15	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
137	SK-1-04	Mr. Nouphtat	N.A.	15	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
138	SK-1-05	Mr. Noupphanh	N.A.	15	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									
139	SK-1-06	Mr. Khanfong	N.A.	15	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
140	SK-1-07	Mr. Khanmanh	N.A.	15	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
141	SK-1-08	Mr. Phansamay	N.A.	16	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
142	SK-1-09	Mr. Ven	N.A.	16	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
143	SK-1-10	Mr. Vichit	N.A.	16	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
144	SK-1-11	Mrs. Khonkham	N.A.	16	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
145	SK-1-12	Mr. Viengxay	N.A.	16	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
146	SK-1-13	Mr. Khasene	N.A.	16	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
147	SK-1-14	Mr. Bounhome	N.A.	16	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
148	SK-1-15	Mrs. Pong	N.A.	17	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
149	SK-1-16	Mrs. Xicu	N.A.	17	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
150	SK-1-17	Mr. Khampane	N.A.	17	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
151	SK-1-18	Mr. Viangkham	N.A.	17	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
152	SK-1-19	Mrs. Naly	N.A.	17	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
153	SK-1-20	Mr. Khamphay	N.A.	17	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
154	SK-1-21	Mrs. Khamtanh	N.A.	17	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
155	SK-1-22	Mrs. Somphane	N.A.	15	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
156	SK-2-01	Mrs. Vongdeuane	N.A.	12	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
157	SK-2-02	Mr. Somphavanh	N.A.	12	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
158	SK-2-03	Mr. Boutdy	N.A.	12	Sisavatkang	Chanthabouly	Feb. 26 1992	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table L. 2-4 Accounting Sheet

No. 1

Month	Date	Receipt No.	Code	Item	Revenue	Expenditure	Balance
Feb.	17		R-1	Collection Fee	21,000		21,000
Feb.	17	1	E-7	Stationary		1,200	19,800
Feb.	18		R-1	Collection Fee	52,000		71,800
Feb.	18		R-1	Collection Fee	63,000		134,800
Feb.	20	2	E-7	Opening Bank Account		1,000	133,800
Feb.	22		R-1	Collection Fee	1,000		134,800
Feb.	22		R-1	Collection Fee	177,000		311,800
Feb.	24		R-3	Unclear	100		305,600
Feb.	24	4	E-2	Labour Fee		6,200	306,000
Feb.	24		R-2	Tipping Fee	1,810		306,600
Feb.	24	001	R-2	Tipping Fee	400		308,410
Feb.	24	002	R-2	Tipping Fee	600		308,510
Feb.	24	003	R-2	Tipping Fee	800		309,310
Feb.	24	004	R-2	Tipping Fee	800		310,110
Feb.	25	3	E-7	Stationary		2,350	310,610
Feb.	25	4	E-2	Labour Fee		6,200	304,410
Feb.	25	005	R-2	Tipping Fee	500		304,910
Feb.	25	006	R-2	Tipping Fee	500		305,510
Feb.	25	007	R-2	Tipping Fee	600		306,010
Feb.	25	008	R-2	Tipping Fee	500		306,810
Feb.	25	009	R-2	Tipping Fee	800		307,610
Feb.	25	010	R-2	Tipping Fee	800		308,410
Feb.	25	011	R-2	Tipping Fee	800		309,210
Feb.	25	012	R-2	Tipping Fee	800		306,860
Feb.	26	013	R-2	Tipping Fee	800		307,660
Feb.	26	014	R-2	Tipping Fee	500		308,160
Feb.	26	015	R-2	Tipping Fee	800		308,960
Feb.	26	016	R-2	Tipping Fee	400		309,360
Feb.	26	018	R-2	Tipping Fee	800		310,160
Feb.	26	019	R-2	Tipping Fee	800		310,960
Feb.	26	4	E-2	Labour Fee		5,600	305,360
Feb.	27	020	R-2	Tipping Fee	500		305,860
Feb.	27	021	R-2	Tipping Fee	800		306,660
Feb.	27	022	R-2	Tipping Fee	800		307,460
Feb.	28	023	R-2	Tipping Fee	500		307,960
Feb.	28	024	R-2	Tipping Fee	800		308,760
Feb.	28	025	R-2	Tipping Fee	800		309,560
Feb.	28	026	R-2	Tipping Fee	400		309,960
Feb.	28	027	R-2	Tipping Fee	500		310,460
Feb.	28	028	R-2	Tipping Fee	400		310,860
Feb.	28	029	R-2	Tipping Fee	500		311,360
Feb.	28	030	R-2	Tipping Fee	800		312,160
Feb.	28	031	R-2	Tipping Fee	500		312,660
Feb.	29	032	R-2	Tipping Fee	500		313,160
Feb.	29	033	R-2	Tipping Fee	800		313,960
Feb.	29	035	R-2	Tipping Fee	500		314,460
Feb.	29	036	R-2	Tipping Fee	800		315,260



The collection and tipping fees should be deposited in a bank, therefore, an account shall be opened under the project manager's name.

Money shall be withdrawn from the bank by the project manager if there is only less than 50,000 kips left in the cash box.

If there is more than 100,000 kips, a deposit should be made in the bank. At the end of the month, the total of the revenue and expenditure and their sub-totals should be summed up.

6) Executing Committee for Collection Experiment

The most important objective in this experiment is the expansion of collection areas. Therefore, this experiment shall not only be temporarily executed, but shall be continually modified in future.

Because of the above-mentioned reason, it is necessary to execute the experiment originally. Executing committee for collection experiment shall be established in the DCTC in Vientiane Municipality and it shall consist of 3 units.

The organization chart is shown in Fig. L.2.11. The list of persons assigned from DCTC to join in the experimental project is in Table L.2-5. The duties of each unit are as follows;

a. Administration unit

- general affairs
- personnel management
- accounting
- research and development
- campaign and enforcement

b. Cleansing unit

- refuse collection
- cleansing works
- operation of weighbridge
- management of disposal site

c. Maintenance unit

- maintenance of the collection vehicle

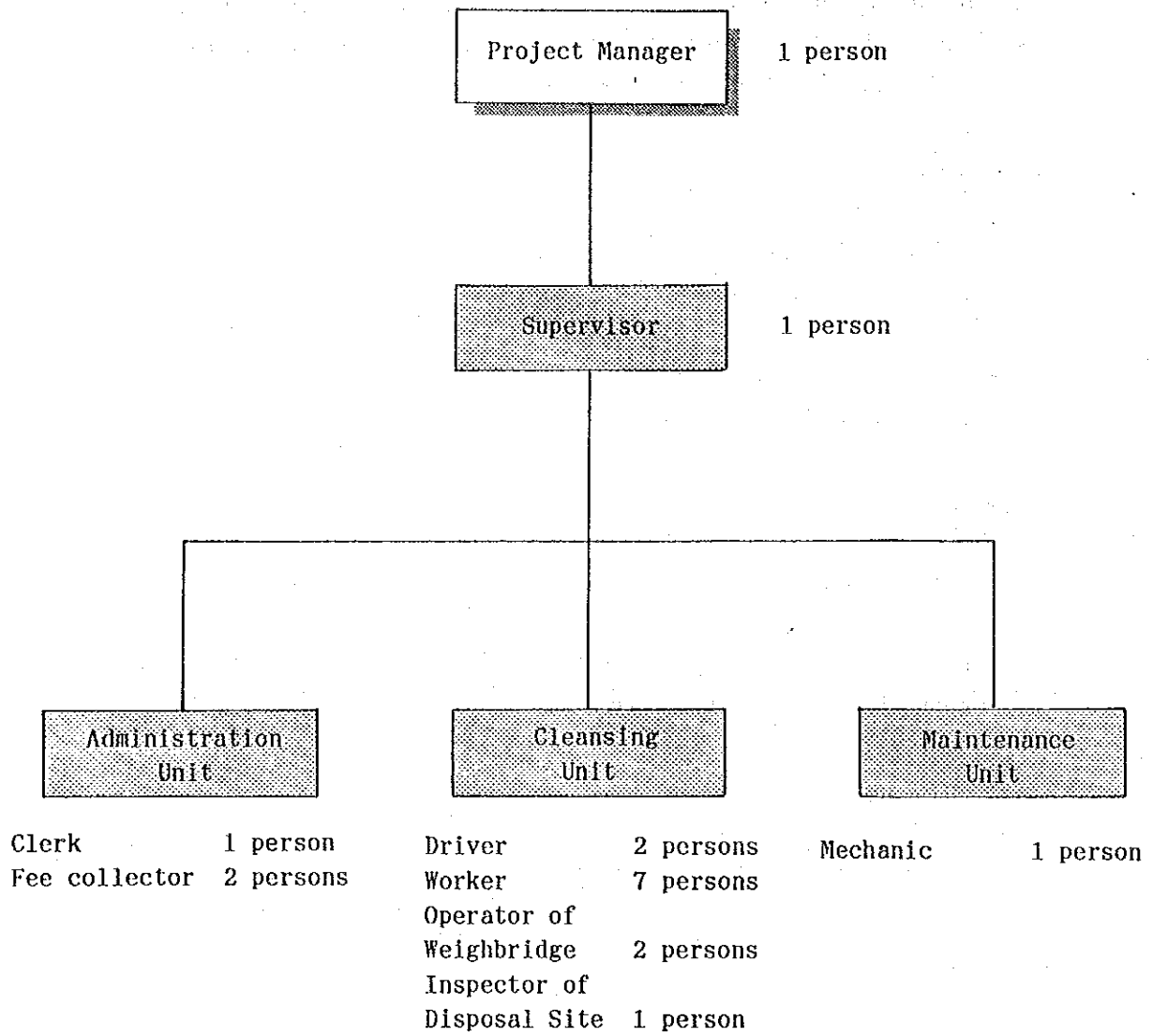


Fig. L.2-11 Organization Chart of Excecuting Committee for Collection Experiment.

Table L.2-5 List of Persons Assigned from DCTC to join in the
Experimental Project

1. Project Manager	:	Mr. Dapkeo DOUANGPRACHANH
2. Supervisor	:	Mr. Oudom PHONGPASEUT
3. Fee Collector	:	Mr. Pradthana Mr. Khampan
4. Mechanic	:	Mr. Boonsi
5. Weighbridge Operator	:	Mr. Boonyou Mr. Boonsang
6. Accountant	:	Mr. Boonta
7. Driver	:	Mr. Vanly Mr. Sichanh
8. Labour	:	Mr. Tui Mr. Lai Mr. Tiddam Mr. Siphon Mr. Somphet Mr. Phong Mr. Siphon
9. Inspector of Disposal Site	:	Mr. Mued

L.3 Execution

L.3.1 Preparation Work

1) Preparation Schedule for the Experiment

The following preparation works were executed prior to the commencement of the experiment.

a. Feb. 3 to 5

- explanation of purpose and detailed plan of collection experiment to Ban (village) and Nouai (the smallest unit of community in a village) chiefs;
- inducement of residents and shops through the Nouai chiefs to participate in the collection experiment.

b. Feb. 6 to 9

- explanation to residents and solicitation of volunteers by chiefs of 5 Bans and Nouais.

c. Feb. 10 to 13

- explanation meetings with residents in the 5 Bans concerning the limited number of participants in the experiment by the Study Team, DCTC and chiefs of the 5 Bans.

d. Feb. 14 to 16

- final selection of the 3 Bans (Dong Mieng, Sisavath Tay and Sisavath Kang)
- detailed design of the experiment (collection routes, schedule etc.)
- Training of fee collectors

e. Feb. 17 to 22

- contract, collection of fee, marking of bamboo baskets, etc.
- training of collection crew

f. Feb. 23

- opening ceremony of collection experiment at Sisavath Tay

2) Final Selection of Experimental Areas

As described in the previous chapter, the objective of the collection experiment is to examine the workability of the proposed collection plan in the Basic Plan. In addition, due to the very limited financial capability of the Municipality and the difficulty of obtaining public cooperation, a stepwise approach is proposed to achieve the targets of the Basic Plan. In view of these basic policy of the Study and the limited experimental period (only one month), the Study Team set up the following criteria on final selection of the experimental areas;

- i. Upon consideration of the experiment (to examine 1. extension of collection service, 2. establishment of the Beneficiary-Pay-Principle, 3. establishment of an efficient and reliable collection system and 4. establishment of public cooperation.), the experiment should be succeeded by DCTC after the experiment by the Study Team. As such the experiment should achieve favourable results to some extent.
- ii. In terms of the favourable results to some extent, the experiment should prove that at least the operation and maintenance cost (personnel expenditure, fuel and lubricant cost, etc.) of the experiment should be covered by the fee collection in the experimental areas. In addition, the experiment should be successfully done in order to extend the collection services in these areas.

iii. Consequently, the ratio of participation in the experiment should be more than 25% and an efficient collection work should be done in the areas.

iv. Afterwards, new strategies and tactics should be formulated to proceed with the expansion of the collection services in other areas.

Based on the above-mentioned criteria, Ban Dong Mieng, Ban Sisavath Kang and Tay were selected as experimental areas. Ban Sisavath Neua and Ban Tong Sang Nang were excluded due to low participation ratio. In addition, there are impassable roads in Ban Tong Sang Nang.

Number of families wishing to enter into a contract and the participation ratio are shown in Table L.3-1.

Table L.3-1 Number of Families Wishing to enter into a Contract and the Participation Ratio

Name of Ban	No. of Families	Contract Families	Ratio (%)	Final Selection
Dong Mieng	382	133	35	Yes
Thong Sang Nang	333	59	17.7	No
Sisavath Kang	276	75	27	Yes
Sisavath Tay	358	98	27	Yes
Sisavath Neua	174	19	10.9	No

3) Detailed Design

Detailed design was done according to the terms of the contract for collection services and the location of families who were willing to enter into a contract.

a. Basic data for planning

The following basic data was prepared to plan the collection schedule, collection routes and collection points.

Table L.3-2 Basic Data for the Collection Experiment Plan

Name of Ban	Waste Amount (ton/week)	Waste Volume (m ³ /week)	No. of Trips Required
Dong Mieng	3.4	19.6	2.0
Sisavath Kang	1.9	11.0	1.1
Sisavath Tay	2.5	14.5	1.5

Note:

- * Waste Amount : $626 \times 5.9 \times (\text{Contracted Families}) \times 7$
- * Waste Volume : $(\text{Waste Amount})/0.173$
- * No of Trips : $(\text{Waste Volume})/10$
- ** 626 : Amount of Discharged Waste (g/person/day)
- ** 5.9 : Average of Family Member in Vientiane Urban Area (persons/family)
- ** 7 : Days/Week
- ** 0.173 : Apparent Specific Gravity (ton/m³)
- ** 10 : Loading Capacity of the Collection Vehicle (m³) Used in the experiment

b. Collection schedule

i. shedule of waste collection

As an experiment, the collection vehicle was operated from Monday to Wednesday mornings. It was used as a stand by vehicle in other days of the week.

Table L.3-3 Schedule of Waste Collection

	Morning(8:30)	Afternoon(14:00)
Mon.	Ban Dong Mieng	Ban Dong Mieng
Tue.	Ban Sisavath Tay	Ban Sisavath Tay
Wed.	Ban Sisavath Kang	for stand by
Thu.	for stand by	for stand by
Fri.	for stand by	for stand by
Sat.	for stand by	for stand by

- ii. Schedule of cleaning-up roads, drains and public areas was formulated by the residents themselves. Collection and haulage of the waste cleaned up was carried out by the project Team. The schedule for the cleaning-up of these public areas through public cooperation is in Table L.3-4.

Table L.3-4 Cleaning-up Schedule through public cooperation

Data of Cleaning-up		Cleaning-up Areas
Residents	P.P. Team	
22 Feb.	24-29 Feb.	Ban Sisavath Tay
29 Feb.	2- 7 Mar.	Ban Sisavath Kang
7 Mar.	9-14 Mar.	Ban Dong Mieng

Note;

* P.P. Team : Collection Experiment Pilot Project Team

c. Collection routes and points

Collection routes and bell collection points were drawn according to the previous basic data, collection schedule and location map of contractors shown in Fig. L.3-1~3. Collection routes and points are shown in Fig.L.3-3~6 and collection routes for cleaning-up of roads, drains and public areas are shown in Fig L.3-6~9.

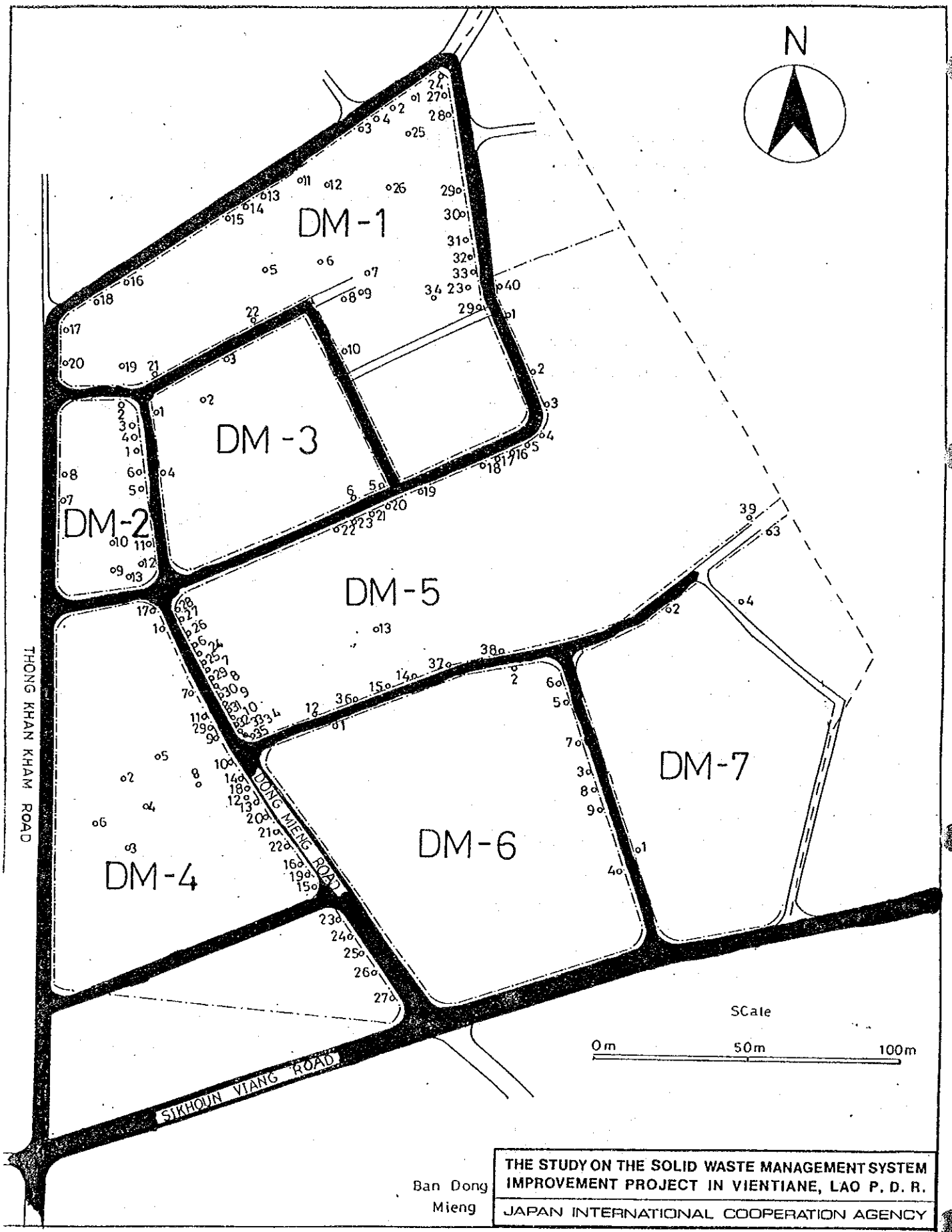


Fig. L.3-1 Location Map of Contractors in Ban Don Mieng

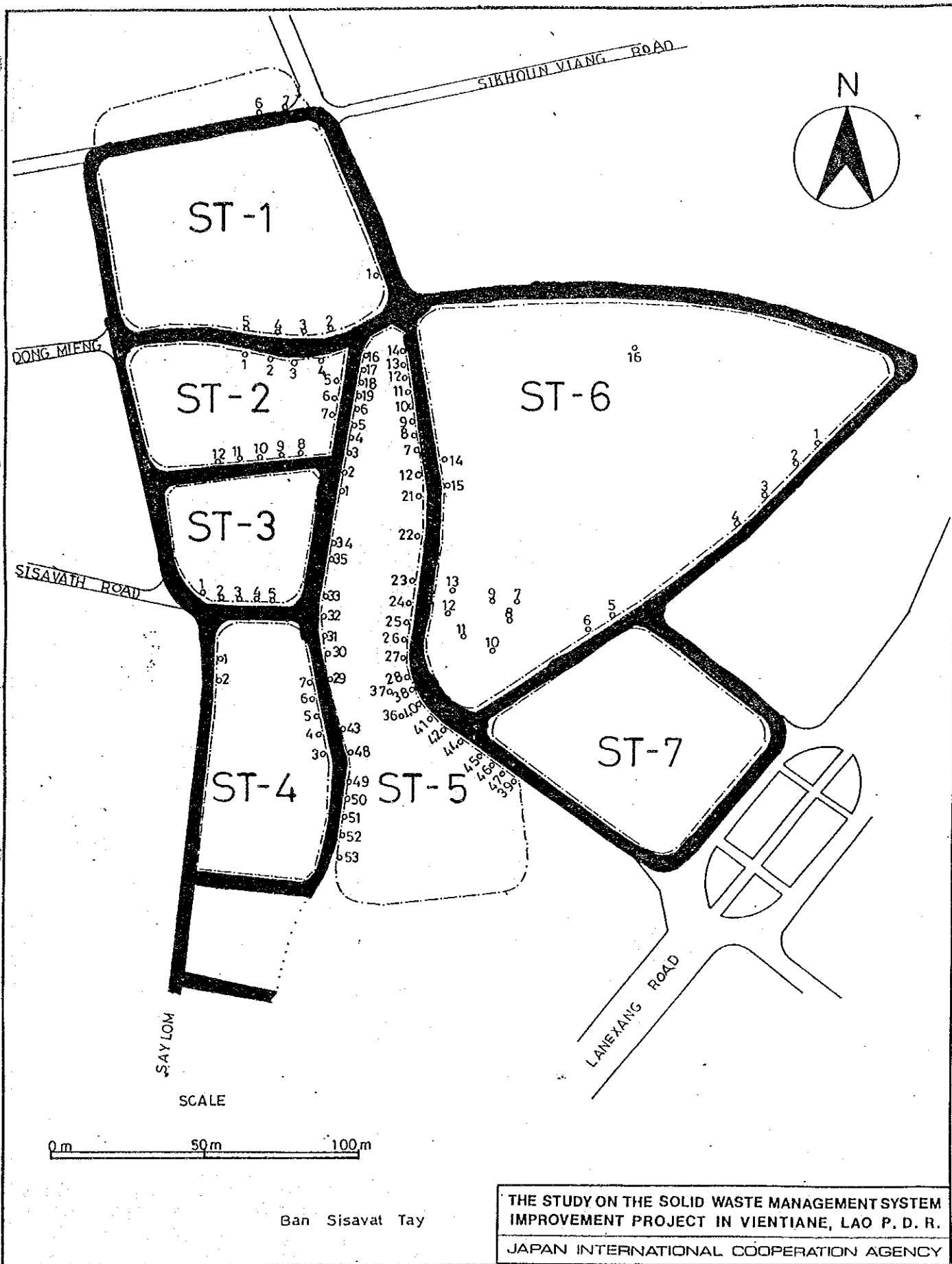
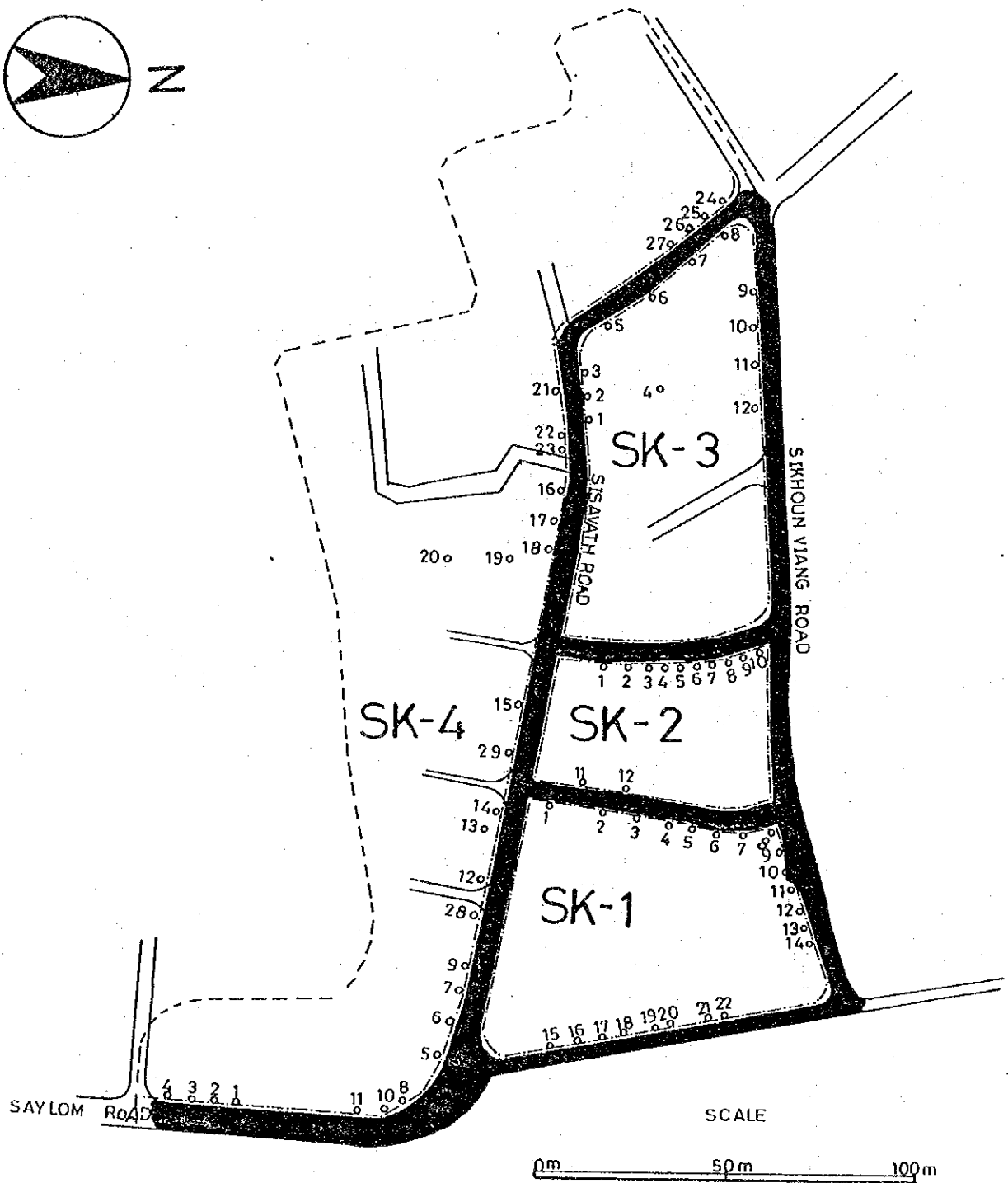
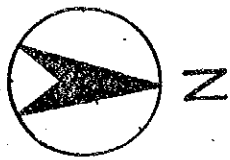


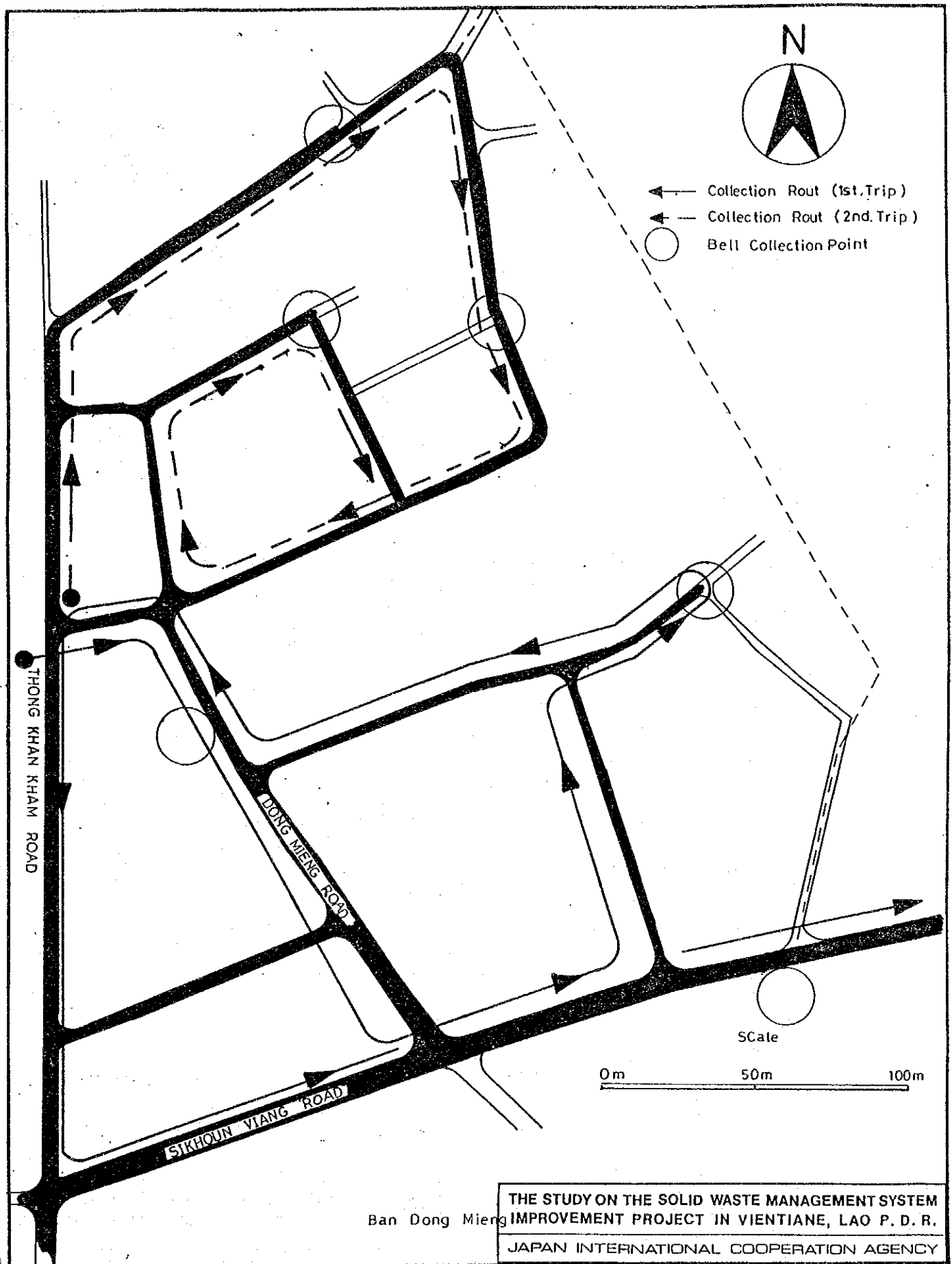
Fig. L.3-2 Location Map of Contractors in Ban Sisavat Tay



Ban Sisavat
Kang

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

Fig. L.3-3 Location Map of Contractors in Ban Sisavat Kang



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

Fig. L.3-4 Collection Routes and Points of Ban Don Mieng

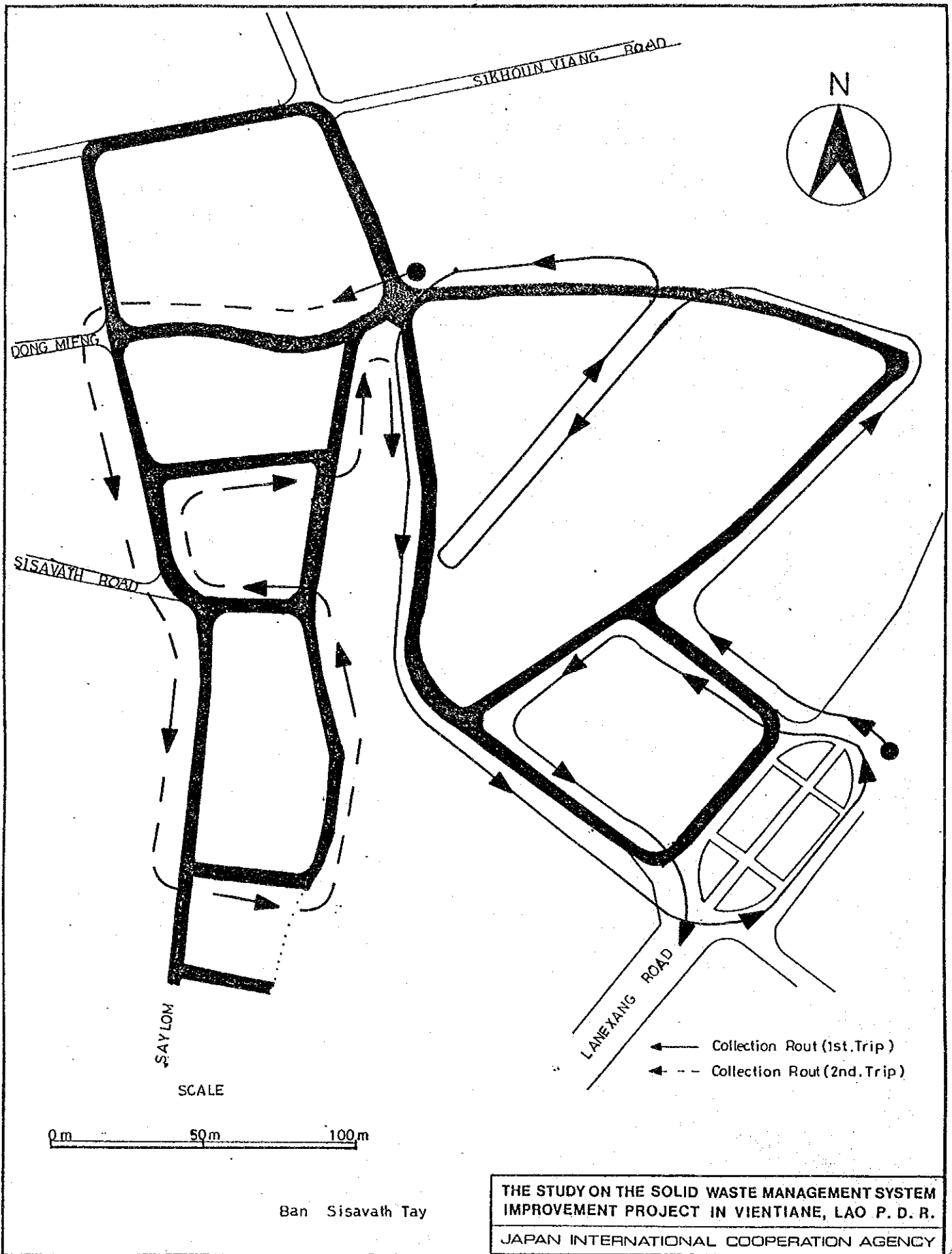


Fig. L.3-5 Collection Routes and Points of Ban Sisavath Tay