JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE MINISTRY OF ENVIRONMENT AND NATURAL RESOURCES
THE PLANNING OFFICE FOR SAN SALVADOR METROPOLITAN AREA
THE REPUBLIC OF EL SALVADOR

THE STUDY ON REGIONAL SOLID WASTE MANAGEMENT FOR SAN SALVADOR METROPOLITAN AREA IN THE REPUBLIC OF EL SALVADOR

FINAL REPORT
VOLUME I

EXECUTIVE SUMMARY

NOVEMBER 2000

KOKUSAI KOGYO CO., LTD.

PREFACE

In response to a request from the Government of the Republic of El Salvador, the Government of Japan decided to conduct a development study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador and entrusted the study to the Japan International Cooperation Agency (JICA).

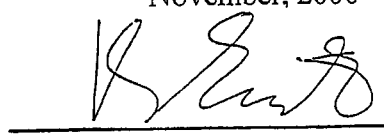
JICA selected and dispatched a study team headed by Mr. Hiroshi Kato, KOKUSAI KOGYO CO., LTD. to El Salvador two times between December 1999 and November 2000. In addition, JICA set up an advisory committee headed by Dr. Hidetoshi Kitawaki, a professor of Toyo University between December 1999 and November 2000, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of El Salvador and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of El Salvador for their close cooperation extended to the Team.

November, 2000



Kunihiko Saito
President
Japan International Cooperation Agency

November, 2000

Mr. Kunihiko Saito
President
Japan International Cooperation Agency

Letter of Transmittal

Dear Mr. Saito,

We are pleased to submit the report on the Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador.

This report consists of two main components: a study on the present situation of municipal waste management in San Salvador Metropolitan Area; and the formulation of the municipal solid waste management master plan until the year 2010.

In the study on the present situation of municipal waste management, five types of field investigations were carried out and existing data and information of various sources were collected and examined. By doing so, present situation of municipal waste management of San Salvador Metropolitan Area was assessed and the issues to be considered were identified.

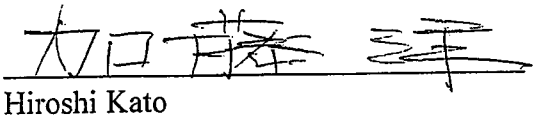
The master plan was formulated setting up its ultimate goals as promotion of public health and welfare, implementation of sustainable municipal solid waste management, and the contribution to environmental conservation. In the master plan, a planning framework with phased goals, targets, and strategies, technical system, financial system, and the organizational and institutional system were proposed. Furthermore, a regional management system that would allow all 14 municipalities of San Salvador Metropolitan Area to enjoy the merits of regional management was proposed since these municipalities have different dimensions, e.g. population, municipal budget.

During the study, three pilot projects were carried out. Two of these, the "Sanitary Education/Public Awareness Promotion Campaign" and the "Collection Service Experiment", promoted the active participation of the counterparts and residents, provoking a strong positive response.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Health and Welfare of Japan. We also wish to extend our sincere gratitude to the Government of the Republic of El Salvador, the Ministry of Environment and Natural Resources (MARN), Mayors Council for San Salvador Metropolitan Area (COAMSS), Planning Office for San Salvador Metropolitan Area (OPAMSS), the Embassy of Japan and the JICA office in the Republic of El Salvador for their cooperation during the implementation of our study in the Republic of El Salvador.

Finally, we hope that this report will help improve solid waste management and urban environment sanitation in San Salvador Metropolitan Area in El Salvador.

Respectfully,



Hiroshi Kato
Team Leader
The Study on Regional Solid Waste Management
for San Salvador Metropolitan Area in the Republic
of El Salvador

Abstract

1 Objectives of the Study

The study covers 14 municipalities in the San Salvador Metropolitan area, and aims to:

- Formulate a Master Plan on Regional SWM targeting the year 2010.
- Pursue technology transfer regarding SWM study and planning methods for the counterpart personnel.

2 Study Area

This Study will cover the following 14 municipalities under the jurisdiction of COAMSS:

San Salvador, Mejicanos, Ciudad Delgado, Cuscatancingo, Ayutuxtepeque, San Marcos, Nueva San Salvador, Antiguo Cuscatlan, Soyapango, Ilopango, San Martin, Apopa, Nejapa and Tonacatepeque.

3 Wastes Targeted

This Study will cover household waste, commercial waste, institutional waste, street sweeping waste and medical waste. Industrial waste will not be covered.

4 Target Year

The target year of the Master Plan is 2010.

5 The Master Plan

5.1 Goals

The principal goal of the Master Plan is to establish a sound Solid Waste Management System by the target year 2010 in AMSS, where the major population and economic activities of the country are centered.

The Master Plan aims to:

- **promote the citizens' well-being and public health;**
- **implement sustainable SWM; and**
- **contribute to environmental conservation.**

5.2 Outline of Master Plan

The M/P aims to establish plans for sustainable municipal SWM with primary target of 100% service coverage, and attempting to solve present problems of cleansing services that are observed through this Study.

Merits of regional management of municipal SW consist of the following:

- Large SWM facilities (e.g., a landfill) that one municipality can hardly have or manage due to problems of such as large financial burden, difficulty in recruiting technical human resources, administration complexity, can be controllable under a regional management scheme. Because, a burden on each member municipality is proportionally small in respective aspects.
- As for regional use facilities, economy of scale will be attained in facilities' size and such productivity will be in an optimum range compared with the individual municipal facilities. Consequently, its cost shared by member municipalities would by cheaper than the costs that an individual project requires.

On the other hand, it is sometimes very difficult for several municipalities that are politically financially autonomous to share the same scheme and to collaborate for an unanimous benefit. Viewing the present municipal SWM system in AMSS, the M/P proposes plans that merits of regional SWM can as much as possible be enjoyed by 14 respective municipalities of AMSS. The proposed municipal SWM system is presented in Figure 1 below.

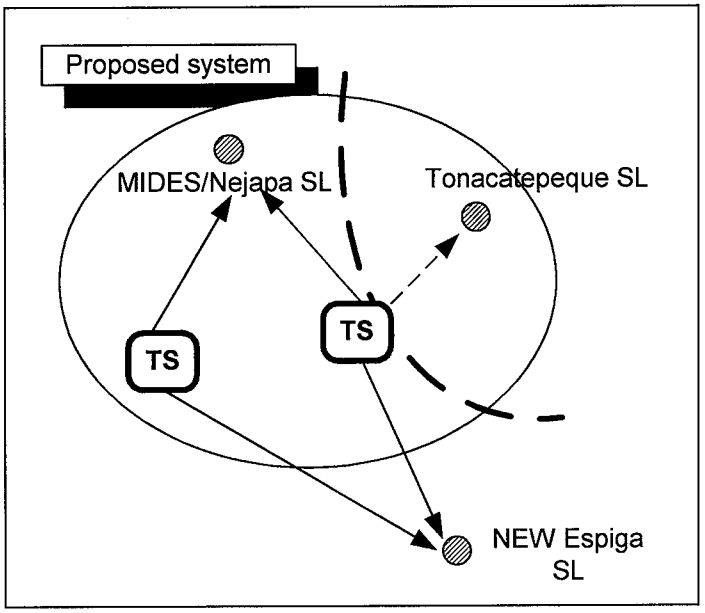


Figure 1: Proposed MSWM System

On the other hand, the M/P will also formulate individual municipal SWM plans that are correlated with the regional SWM system. Table 1 shows principal components of the M/P. Table 2 shows stepwise implementation of the M/P.

Table 1: Principal Components of M/P

Regional system	Individual system
• Transfer transport • Intermediate treatment (separate collection + material recovery facility) • Final disposal (MIDES, Tonacatepeque, Espiga) • Medical waste management (incinerator) • Establishment and operation of Execution Unit of SWM in OPAMSS (UE-OPAMSS) • Establishment and operation of San Salvador Municipal Public Company of Urban Cleansing (EMAUSS) • Encouragement of private sector's participation in SWM, and supervision and control of them	• Introduction of container collection system into areas where do not have collection service. • Renewal of collection vehicles. • Street sweeping • Institutional capacity building of 13 municipalities other than San Salvador (through consultation with UE-OPAMSS) • Encouragement of private sector's participation in SWM, and supervision and control of them

Table 2: Outline of Master Plan

Municipality	Present(1999)	Phase I 2003	Phase II 2006	Phase III 2010
Population				
San Salvador	473,374	497,844	510,367	512,873
Mejicanos	185,204	200,917	209,708	217,248
Ciudad Delgado	149,394	164,069	172,570	180,727
Cuscatancingo	90,079	104,640	114,077	125,618
Ayutuxtepeque	28,000	34,056	38,014	43,005
San Marcos	69,660	73,452	75,326	76,106
Nueva San Salvador	138,723	160,588	176,944	197,690
Antiguo Cuscatlan	42,773	52,790	61,090	72,950
Soyapango	283,598	290,412	297,183	309,772
Ilopango	127,434	144,985	155,957	168,554
San Martin	73,000	94,175	108,991	129,365
Apopa	163,974	192,728	211,715	235,614
Nejapa	15,000	16,831	17,737	18,350
Tonacatepeque	29,000	33,607	36,399	39,509
Total	**1,869,213**	**2,061,094**	**2,186,078**	**2,327,381**
Municipal Solid Waste Management				
Waste generation amount (ton/year)				
San Salvador	206,391	231,945	244,801	259,510
Mejicanos	28,119	31,550	33,303	35,310
Ciudad Delgado	12,101	13,577	14,331	15,195
Cuscatancingo	10,292	11,547	12,189	12,924
Ayutuxtepeque	4,040	4,533	4,785	5,074
San Marcos	12,376	13,885	14,657	15,541
Nueva San Salvador	34,011	38,158	40,278	42,706
Antiguo Cuscatlan	18,300	20,550	21,694	23,013

Municipality	Present(1999)	Phase I 2003	Phase II 2006	Phase III 2010
Soyapango	58,627	65,850	69,517	73,750
Ilopango	17,368	19,485	20,569	21,810
San Martin	9,605	10,776	11,375	12,061
Apopa	18,145	20,357	21,488	22,784
Nejapa	1,903	2,136	2,254	2,390
Tonacatepeque	8,352	9,370	9,891	10,488
Total	**439,630**	**493,719**	**521,132**	**552,556**
Collection service coverage ratio (%)				
San Salvador	81.1	88.0	93.1	100
Mejicanos	84.9	90.4	94.5	100
Ciudad Delgado	75.0	84.1	90.9	100
Cuscatancingo	71.5	81.9	89.6	100
Ayutuxtepeque	66.7	78.8	87.9	100
San Marcos	64.8	77.6	87.2	100
Nueva San Salvador	93.5	95.9	97.6	100
Antiguo Cuscatlan	92.1	95.0	97.1	100
Soyapango	94.7	96.6	98.1	100
Ilopango	50.0	68.2	81.8	100
San Martin	65.4	78.0	87.4	100
Apopa	72.7	82.6	90.1	100
Nejapa	52.7	69.9	82.8	100
Tonacatepeque	52.7	69.9	82.8	100
Average	**73.8**	**82.6**	**90.1**	**100**
Collection				
Separate collection ratio				
San Salvador	-	-	10.0%	30.0%
Mejicanos	-	5.0%	20.0%	40.0%
Ciudad Delgado	-	-	5.0%	25.0%
Cuscatancingo	-	-	-	20.0%
Ayutuxtepeque	-	-	-	20.0%
San Marcos	-	-	-	20.0%
Nueva San Salvador	-	10.0%	25.0%	45.0%
Antiguo Cuscatlan	-	10.0%	25.0%	45.0%
Soyapango	-	10.0%	25.0%	45.0%
Ilopango	-	-	-	15.0%
San Martin	-	-	-	20.0%
Apopa	-	-	5.0%	25.0%
Nejapa	-	-	-	15.0%
Tonacatepeque	-	-	-	15.0%
Average	**-**	**2.9%**	**11.3%**	**30.7%**
Transfer station				
T/S 1 (350 ton/day)	-	F/S, EIA, B/D, D/D and construction	Operation	Operation

Municipality			Present(1999)	Phase I 2003	Phase II 2006	Phase III 2010
T/S 2 (900 ton/day)			-	F/S, EIA, B/D, D/D	Construction and operation	Operation
Intermediate treatment						
MRF			-	-	F/S, EIA, B/D, D/D	Construction and operation
Incinerator			-	-	-	Begin examine
Landfill						
MIDES/ Nejapa S/L			Operation	Operation	Operation	Operation
Tonactepeque S/L			-	F/S, EIA, B/D, D/D	Construction and operation	Operation
New Espiga S/L			-	Construction and operation	Operation	Operation
Cost (million colon, inc. economic costs)						
Regional system		Inv.	-	67.1	49.2	16.2
		O&M	-	2.1	29.1	54.1
		Total	-	**69.2**	**78.3**	**70.3**
Individual system		Inv.	-	104.9	10.5	116.2
		O&M	-	508.9	525.8	742.0
		Total	-	**613.8**	**536.3**	**858.2**
Total			-	**683.0**	**614.6**	**928.5**
Medical Waste Management						
Waste generation amount (ton/year)			**1,168**	**1,285**	**1,361**	**1,449**
Intermediate treatment						
Nejapa autoclave			Operation	Operation	Operation	Operation
Incinerator			-	F/S, EIA, B/D, D/D and construction	Operation	Operation
Cost (million colon, exc. economic costs)						
Incinerator		Inv.	-	24.5	-	0.7
		O&M	-	-	5.3	7.1
		Total	-	**24.5**	**5.3**	**7.8**

6 Recommendations

6.1 Compilation and Utilization of Data

It is recommended that data and information regarding such as "waste stream" should be systematically be measured, compiled and utilized every year in order to follow and verify what are assumed and planned in the M/P. Such compiled data and information will be extremely important to review and modify the M/P when in future it becomes necessary. At the same time, annual trends in respective SWM particulars can then be actually understood. Such data will possibly suggest a key for upgrading the SWM system of the AMSS.

6.2 Collection Route Improvement

Collection routes in most municipalities are decided based on the empirical judgement of collection vehicle drivers or they are not reviewed carefully. Therefore, under-capacity or over-capacity waste loading is usual and chronic in AMSS. It consequently introduces lowered collection efficiency and service life shortened by unnecessary breakdowns of collection vehicles (mainly by overload).

The Study's pilot project of collection route improvement verified that the efficiency of collection works can be improved by appropriate vehicle allocation that should be brought out by collection route improvement practices. Since the Study produced the Manual for Collection Route Improvement, this should like to be utilized fully for such improvement practices by respective municipal officers by themselves.

6.3 Transfer Stations and Trailer Transport

All 14 municipalities currently carry out the direct transport by collection vehicle that is for a fairly long distance for many municipalities. It is recommended to have T/S and trailer transport system in order to realize efficient collection and transport activities and to prolong the service life of collection vehicles. Transfer stations should be localized at optimum locations to attain the cost-effective SWM activities and environmental benefits.

6.4 Administration of SWM Services

The Study recommends institutional improvement measures for the administration of SWM service. It recommends for the San Salvador municipality to create the San Salvador Municipal Public Company of Urban Cleansing (EMAUSS), in order to provide SWM services that are more competitive and efficient.

The Study also proposes that Execution Unit of SWM of OPAMSS (UE-OPAMMS) in order to support other 13 municipalities in technical and administrative improvement of respective SWM services.

6.5 Independent Accounting

All municipalities other than San Salvador municipality do not make clear distinction between SWM accounting and other accountings of municipality. Therefore, the revenue/expenditure balance of SWM services remains unclear and its feedback to operational activity improvement does not take place. In order to execute sustainable and competitive SWM services, it is recommended that accounting of SWM services should make independent of the municipal general accounting.

6.6 SWM Fees Collection

It is appreciable that the current joint billing of SWM fees with electricity charge for households is an effective collection system, however, it is anticipated that reasonable fee rates are not charged for large commercial/institutions dischargers.

In order to realize the sustainable SWM services, it is necessary to establish and facilitate such a fee structure and collection system that fee fairly corresponding as a consideration of the service provided is to be charged and collected.

Therefore, it is recommended to improve the fee collection efficiency for household users and to apply the specific duty system (fee in proportion to waste quantity) for large-scale dischargers.

6.7 Implementation of the Master Plan

This development study (The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador), under the JICA's technical cooperation program, will be finalized and ended when the Final Report of the Study is submitted to the Salvadoran side around November 2000. The solid waste management M/P is to be implemented by the Salvadoran side. If the M/P is not implemented, it means that all time and resources devoted to the study result in vain. Furthermore, benefits such as "promotions of citizens' well-being and public health", "implementation of sustainable SWM" and "contribution to environmental conservation" expected in the M/P will not be attained. Therefore, the study team strongly recommends that the M/P and its plans and projects should be implemented.

From now, it is necessary for the Salvadoran side to procure technical and financial resources etc. in order to implement the M/P. The M/P is formulated in due consideration of the Salvadoran's technical capability and financial affordability for the SWM, therefore, they can be considered to be ready for implementation.

In order to avoid this study suffering from an unproductive ending of non-implementation of the M/P, efforts should be made by the Salvadoran side to create such circumstances that the plans and projects recommended in the M/P can be continuously followed and promoted. In practice, it is recommended that the Salvadoran side should make a request of technical cooperation to JICA and/or other international cooperation agency for the follow-up and implementation of M/P projects.

The Study on Regional Solid Waste Management for San Salvador Metropolitan Area in the Republic of El Salvador

List of Volumes

Volume I	Executive Summary
Volume I(S)	Executive Summary (Spanish Version)
Volume II	Main Report
Volume II(S)	Main Report (Spanish Version)
Volume III	Annex
Volume III(S)	Annex (Spanish Version)
Volume IV	Data Book
Volume IV(S)	Data Book (Spanish Version)

This is the Executive Summary.

In this report, the project cost is estimated by using the April 2000 price and an exchange rate of 1.00 US$ = 105.00 Japanese Yen = 8.75 Colones.

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List of Abbreviations

AECI	Spanish International Cooperation Agency
AIDIS	Inter-American Sanitary Engineering and Environmental Association
AMSS	San Salvador Metropolitan Area
ANDA	National Aqueduct and Sewerage Administration
ATP	Availability to pay
AU	Urbanized/urbanizable Area
B/D	Basic Design
BCI	Burden on citizens' income
BCR	Central Reserve Bank
BHN	Basic Human Needs
BOD	Biological demand of oxygen
BOOT	Build Own Operate and Transfer
BOT	Build Operate and Transfer
BYRP	Bond Yield Risk Premium Approach
C/P	Counterpart
C/P	Compost Plant
CAESS	Electric Lighting Company of San Salvador
CAPM	Capital Asset Pricing Model
CD	Controlled Dumping
CDA	Department Council of Mayors
CEPRHI	Executive Committee for the Protection of Hydraulic Resources
CESTA	Appropriate Technology Center
CIDA	Canadian International Development Agency
COAMSS	Mayors Council for San Salvador Metropolitan Area
COD	Chemical oxygen demand
COMURES	Association of Municipalities in the Republic of El Salvador
CPI	Consumer Price Index
CRC	Zone Coverage
CS	Cleansing service
CTR	Cost per ton collected
CTT	Cost per ton transported
D/D	Detailed Design
D/S	Disposal Site
DA	Agricultural Development Zone
DB	Data Base
DELSUR	Electricity Distribution Company of the South
DIGESTYC	General Directorate of Statistics and Census
DR	Restricted Development Zone
DTE	Ecologically-sustainable Tourism Development Zone
DUA	Directorate of Urbanism and Architecture
ECC	Efficiency on Use of Truck Capacity
EDE	Electricity Distribution Companies
EIA	Environment Impact Assessment
EMAUSS	San Salvador Municipal Public Company of Urban Cleansing
ERZ	Route Efficiency Use in Zone
FDS	Final Disposal Site
FIRR	Financial Internal Rate of Return
FISDL	Social Investment Fund for Local Development
FMLN	Farabundo Marti National Liberation Party
FODES	Economic and Social Development Fund

FS	Feasibility Study
FUSADES	Salvadoran Fund for Development
FUSAL	Salvadoran Fund for Health and Development
GC	Gathering Center
GCK	Fuel Expense per Kilometer
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GTZ	German Technical Cooperation
GVW	Gross Vehicle Weight
HDPE	High Density Polyethylene
HHI	Herfindahl-Hirschman Index
ICI	Institutions, Commercials and Industries
IDB	Inter-American Development Bank
IRDB	International Reconstruction and Development Bank
ISDEM	Salvadoran Institute for Municipal Development
ISSS	Salvadoran Institute of Social Security
IUDOP	University Institution of Public Opinion
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KXG	Kilometer per Fuel Gallon
M/P	Master Plan
MARN	Ministry of Environment and Natural Resources
MIDES	Integral Solid Waste Management (company)
MINED	Ministry of Education
MOH	Ministry of Finance
MP	Maximum Protection Zone
MRF	Material Recovery Facility
MSPAS	Ministry of Public Health and Social Assistance
MSW	Municipal Solid Waste
MUS	Minimum Urban Salary
MWI	Medical Waste Incineration
MWS	Medical Waste Survey
NGOs	Non-Governmental Organizations
O&M	Operation and Maintenance
O/D	Open Dumping
OPAMSS	Planning Office For San Salvador Metropolitan Area
PAHO	Pan-American Health Organization
PET	Polyethylene Terephthalate
PLAMADUR	Urban Development Master Plan
PNC	Civil National Police
POS	Public opinion survey
PROCOMES	Association of Communal Projects of El Salvador
PSP, PPS	Private Sector Participation
RCXE	Collection per Employee
RCXEH	Collection Efficiency per Employee
RCXK	Waste Production per Kilometer
REDES	Salvadoran Foundation for Reconstruction and Development
S/L	Sanitary landfill
S/P	Selection Plant
SACDEL	Consulting and Training System for Local Development
SAE	Environment Service Specialists
SEMA	Executive Secretariat for Environment
SIGET	Superintendent's Office of Electricity and Telecommunications

SINAMA	National Environment Arrangement System
SW	Solid wastes
SWEU	Solid Waste Management Executing Unit
SWM	Solid Waste Management
SW-SRE	Solid Waste Service-Rendering Enterprises
T&M	Time and Motion
T/S	Transfer Station
TDS	Total Dissolved Solids
UCA	José Simeón Cañas Central American Univercity
UE-OPAMSS	Execution Unit of SWM of OPAMSS
UNES	Salvadoran Ecological Unity
USAID	United States Agency for International Development
UTLA	Latin-American Technology University
VAT	Value Added Tax
VRC	On-route Velocity
VT	Haulage Velocity
WACS	Waste Amount and Composition Survey
WHO	World Health Organization
WTP	Willingness to pay
ZP	Protection Zone

Abbreviations for the 14 Municipalities

SS	San Salvador
MJ	Mejicanos
CD	Delgado
CT	Cuscatancingo
AY	Ayutuxtepeque
SM	San Marcos
ST	Nueva San Salvador
AC	Antiguo Cuscatlan
SY	Soyapango
IL	Ilopango
SMT	San Martin
AP	Apopa
NJ	Nejapa
TN	Tonacatepeque