4 Pilot Projects

This chapter presents objectives of pilot projects and how they were conducted in the latter half of the First Work in El Salvador. The pilot projects that were conducted are:

- Inspection of collection route improvement,
- Sanitary education and public awareness promotion campaign, and
- Collection Service Experiment.

4.1 Sanitary Education and Public Awareness Promotion Campaign

4.1.1 Outline of Pilot Project

The pilot project of sanitary education and public awareness promotion campaign aims to:

- Raise awareness of the residents regarding SWM,
- Inform residents of the necessity of proper disposal and management of SW,
- Share the responsibilities between the municipalities and the citizens, and
- Promote public participation.

In order to achieve the goals above, sanitary education and public awareness promotion campaign activities have been implemented throughout AMSS, concentrating in three municipalities: Cuscatancingo, San Marcos and San Martin (one community each in first two municipalities and one school each in all three municipalities). Profile is shown in the following table:

Table 4-1: Profile of Sanitary Education and Public Awareness Promotion Campaign Programs

Programs in the Community		
1.	Period of implementation	• May-June 2000, Maria Auxiliadora (Municipality of Cuscatancingo) • June 2000, 10 de Octubre (Municipality of San Marcos)
2.	Target group	• Leaders and residents of the two aforementioned communities
3.	Methods and campaign tools	• Meetings, workshops and clean-up activities. • Educational booklet, panels, video, banners, leaflets, signboards, canvassing
4.	Organization	• Municipalities of Cuscatancingo and San Marcos, • Community Associations, • OPAMSS, with the support of JICA Study Team
5.	Cooperation	Health Center (MSPAS) Communal Clinic (ISSS)
Programs in Schools		
1.	Period of implementation	• May 2000, Liceo Cristiano (Cuscatancingo) • June 2000, 10 de Octubre School (San Marcos) and Jorge Larde School (San Martin)
2.	Target group	Teachers, students and parents of the three schools.
3.	Methods and educational tools	Teacher training course and trial lessons, educational booklet and panels, practical examples, video, etc.
4.	Organization	Municipality of Cuscatancingo, Municipality of San Marcos, Municipality of San Martin, OPAMSS, with the support of JICA Study Team
5.	Cooperation	Schools of Cuscatancingo, San Marcos and San Martin
Public Awareness Promotion Campaign		
1.	Period of implementation	May-June 2000 • Maria Auxiliadora (Cuscatancingo) • 10 de Octubre (San Marcos) • In AMSS (during or after the implementation of the campaign: any time and in any other community by the Counterpart initiative)
2.	Target group	All AMSS citizens
3.	Methods	Public participation through public logo/mascot design contest. Campaign tools: stickers, educational booklet and panels, banners, leaflets, video, broadcast canvassing, etc.
4.	Organization	OPAMSS, All municipalities in AMSS, Other relevant organizations, with the support of JICA Study Team (during pilot project implementation period)

4.1.2 Results of the Pilot Project

Results of the pilot project are as follows:

- Although methods and tools are important for the sanitation environment education, it was confirmed through the pilot project that nothing is more crucial than active participation and cooperation of citizens who receive the education. Also it was found that sanitary conditions of areas, which were subject to the pilot project, were improved.

- Many residents participated in the program held in Maria Auxiliadora and 10 de Octubre. Major participants were women. They had a great concern about garbage problems, and they recognized that those problems were caused not only by municipal improper collection service but also by their inappropriate manner. On the other hand, education tools such as panels and a video used in the program attracted the residents and fully worked to convey messages.
- A questionnaire survey of teachers who received the training course was carried out after the course. They evaluated that methods and tools used in the course were appropriate as those were fit for the actual circumstances of El Salvador. Moreover, it was recognized that the teachers training course is very effective for diffusing knowledge about sanitation environment because the knowledge is conveyed not only to students but also to the whole residents through the students.
- It was found that a video is an effective tool to attract students and convey messages to them. Teachers participated not only in their own classes but also in other schools' classes, therefore, the classes got better one after another.

4.2 Collection Service Experiment

4.2.1 Outline of the Project

Objectives of this pilot project are as follows:

- examining suitability of container collection system in areas where collection service is insufficiently or not at all provided,
- applying findings acquired through this pilot project to a M/P, and
- Technology Transfer.

Areas, where the waste collection service is insufficiently or not at all provided, are generally inaccessible for collection vehicles. The main objective of this pilot project is to examine the suitability of the container collection system to such areas.

Two pilot project sites were selected, one is Maria Auxiliadora in Cuscatancingo, the other is 10 de Octubre in San Marcos. Profiles of the sites are described hereinafter.

4.2.2 Results of the Project

Results of the pilot project were as follows:

- The container adapted in the pilot project was the same as containers widely used in the Study Area and can be turned over by the 18yd3 compactor truck that many municipalities have. Then, there is no need to buy a new truck for the container. There is no problem about sustainability, as the container can be manufactured and obtained in the Study Area.
- Number of containers was calculated based on knowledge acquired through WACS, and it was confirmed that the number calculated was proper.
- Data obtained from this pilot project showed that the container collection systems' efficiency was 22-37% higher than the conventional system (curbside collection).

- Discharge manner for the container collection system was conveyed to residents through municipal personnel in Maria Auxiliadora, on the other hand, it was done through hygiene committee members in 10 de Octubre. Results of the questionnaire carried out after the pilot project showed that both communication ways well functioned.
- Almost all the residents in both areas showed their willingness to cooperate the collection system by means of keeping the discharge manner. Moreover, many residents showed their willingness to cooperate the system by means of not only keeping the manner but also cleaning surroundings of containers.
- In Maria Auxliadora, containers had to be placed out of the area, as there is no space for the placement. As a result, some residents around the container complained against the placement. When this container collection system is employed, an area subject to the system should have enough space to place the containers.

4.3 Collection Route Improvement

4.3.1 Objectives

The objectives of this pilot project were as follows:

- Technology transfer,
- The creation of a manual that shows how to improve the collection route, and
- Data gathering to apply them to the M/P.

Since the main objective was technology transfer and the adapting of a methodology, it was imperative to explain some concepts that the users of such methodology had to know, given the heterogeneity of the group. Such elements were measure conversions and this objective was achieved through expositions, tutorship and field practices.

On the other hand, with the information and experience obtained through the pilot project a Collection Route Improvement Manual was formulated, which will systematize the methodology applied throughout the project in order to provide a tool for the users to apply such methodology by themselves.

Also, the efficiency and effectiveness of the collection route improvement through the data obtained during the pilot project were assessed.

4.3.2 Selection of Target Route

14 collection routes were selected for this pilot project. The requirements for a target route to be accepted were the following:

- The municipalities should appoint a person for this pilot project who knew the waste collection and haulage tasks from his corresponding municipality.
- The proposal of 2 routes per municipality.
- Besides, it was preferable to have the data on the collection amount from a weighbridge, in order to evaluate the pilot project.

The participating municipalities, counterpart members and routes were as follows:

Municipality	Representative	Route
San Salvador (SS)	Manuel de Jesús Olivares Geronimo Macario Pérez	Participation without routes
Mejicanos (MJ)	José Gonzalo Castillo	12 and 13
Ciudad Delgado (CD)	Luis Alonso Ramírez	01 and 02
Cuscatancingo (CT)	Mario Edgardo Aguilar José Manuel Ramírez	Participation without routes
San Marcos (SM)	Mauricio Antonio Balcaceres	07 and 08
Nueva San Salvador (ST)	Miguel Ángel Gutiérrez Víctor Manuel Mejia	02 and 04
Soyapango (Sy)	Héctor Nahun Martines Jorge Schafik Handal Vega	05 and 11
Ilopango (IL)	Francisco Cruz Sorto	Participation without routes
San Martín (SMT)	Pedro Arnulfo Casco David Fernando Cruz	03 and 05
Apopa (AP)	Luis Alberto Romero	04 and 05
Nejapa (NJ)	Eduardo Alfredo Cruz	Participation without routes

11 municipalities participated, which sent 16 participants and a total of 14 routes were analyzed.

4.3.3 Results of the Project

Results of the pilot project were as follows:

- Time required for collection work was reduced (6.5 hours in all, 11%) due to the improvement.
- It is impossible to absolutely avoid overlapped collection routes, where collection activity is not carried out. Therefore, it is important to reduce such routes and increase a portion of routes where collection activity is carried out. The portion increased from 0.58 to 0.60 (2%) by the improvement.
- Distance covered by vehicles in the collection areas was enormously decreased from 169.82km to 99.74km.

5 Framework of Master Plan

5.1 Goals, Targets and Strategies

5.1.1 Goals and Target year

a. 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.**

b. Target Year

In accordance with the "scope of work" of the Study, the target year for the master plan is set up as follows

Master Plan: Year 2010

5.2 Forecast of Future Waste Composition and Amount

5.2.1 Municipal Solid Waste

a. Waste Composition

Table 5-1 shows composition of residential waste and Table 5-2 shows of restaurant, other commercial, institutional, market and road sweeping wastes in the future. Waste composition generally changes with economic growth, e.g., amount of plastics increase. GNP of El Salvador is about 2,000US$/capita and GRDP of AMSS has reached to about 2,500US$/capita, i.e., the country has not been one of developing countries. Therefore, it was assumed that the composition would not change in the next decade because of such economic condition.

Table 5-1: Composition of Residential Waste

Unit: %

Composition	High income	Middle income	Low income
Combustible	95.5	94.4	93.4
Food waste	59.5	57.6	66.0
Papers	18.5	13.0	13.1
Textiles	1.2	1.1	2.5
Grass, wood, bamboo	2.7	16.8	4.0
Plastics	12.1	5.8	7.8
Rubber, leather	1.5	0.1	0.0
Incombustible	4.5	5.6	6.6
Metals	1.3	1.1	1.2
Bottles, glass	1.3	2.6	3.7
Ceramics and soil	0.2	0.7	0.6
Others	1.7	1.2	1.1
Total	100.0	100.0	100.0

Table 5-2: Composition of Commercial, Institutional, Market and Road Sweeping Wastes

Unit: %

Composition	Commercial		Institutional	Market	Road sweeping
	restaurant	Other			
Combustible	95.1	97.5	89.3	96.8	88.3
Food waste	62.2	6.4	19.0	78.1	2.6
Papers	22.1	63.1	35.0	9.5	6.4
Textiles	0.0	5.2	1.1	0.3	0.4
Grass, wood, bamboo	0.3	11.8	12.3	1.4	75.3
Plastics	10.2	10.6	20.5	7.2	3.6
Rubber, leather	0.3	0.4	1.4	0.3	0.0
Incombustible	4.9	2.5	10.7	3.2	11.7
Metals	0.7	1.3	0.5	0.4	0.1
Bottles, glass	2.4	0.3	4.6	0.8	0.3
Ceramics and soil	0.0	0.0	1.6	0.7	9.8
Others	1.8	0.9	4.0	1.3	1.5
Total	100.0	100.0	100.0	100.0	100.0

Table 5-3: Moisture Content

Category		Moisture content (%)
Residential	High income	51.45
	Middle income	46.97
	Low income	46.61
Commercial	Restaurant	58.83
	Other	12.79
Institutional		19.19
Market		64.85
Road sweeping		16.60

Table 5-4: Carbon and Nitrogen Content

Category	Content (%)		C/N ratio
	Carbon	Nitrogen	
Residential *	42.74	2.81	15.2
Restaurant	45.16	3.52	12.8
Market	44.55	3.28	13.6

Note: * middle income

b. Waste Amount

Future waste generation amount is calculated based on the assumptions above.

Waste generation ratio is show in Table 5-5.

Table 5-5: Waste Generation Ratio

Source		unit	Generation ratio
Household waste	High income	g/person/day	600
	Middle income		540
	Low income		420
Commercial waste	Restaurant	g/seat/day	466
	Others	g/employee/day	482
Institutional waste		g/employee/day	196
Market waste		g/stall/day	1,674
Street sweeping waste		g/m/day	198

Parameters necessary for future waste amount forecast, except for street sweeping length, are set up assuming that they are on a proportional increase to the population growth. Forecast parameters in 2010 are listed in Table 5-6.

Table 5-6: Forecast Parameters in 2010

	Population				Commercial		Institutional waste	Market waste	Street sweeping waste
	Total	High income	Middle income	Low income	Restaurant	Others			
					Nos. of seat	Nos. of employee	Nos. of employee	Nos. of stall	km
San Salvador	512,873	155,606	117,858	239,409	20,253	51,173	93,374	23,429	324,769
Mejicanos	217,248	6,713	71,670	138,865	10,389	22,644	43,366	1,698	29,060
Delgado	180,727	5,837	23,314	151,576	8,960	21,989	23,509	532	15,036
Cuscatancingo	125,618	0	14,773	110,845	8,693	12,466	15,195	0	8,970
Ayutuxtepeque	43,005	4,270	19,369	19,366	1,287	3,811	10,473	317	2,660
San Marcos	76,106	0	20,488	55,618	3,782	5,548	6,569	515	7,010
Nueva San Salvador	197,690	48,039	126,304	23,347	7,143	17,029	41,170	3,288	43,080
Antiguo Cuscatlan	72,950	41,107	26,065	5,778	2,455	7,469	23,301	704	51,630
Soyapango	309,772	0	51,949	257,823	24,097	27,772	45,385	3,693	12,618
Ilopango	168,554	0	38,312	130,242	8,363	12,137	17,206	553	1,760
San Martin	129,365	0	26,636	102,729	12,794	13,915	14,681	4,644	1,700
Apopa	235,614	0	11,616	223,998	19,895	18,481	16,371	6,771	5,615
Nejapa	18,350	0	9,175	9,175	1,598	2,637	1,872	108	668
Tonacatepeque	39,509	0	19,755	19,754	1,815	5,525	17,234	197	3,225
Total	2,327,381	261,572	577,284	1,488,525	131,524	222,596	369,706	46,449	507,801

Table 5-7 summarizes waste generation amount in 2010 calculated by incorporating the figures in Table 5-5 and Table 5-6.

Table 5-7: Waste Generation Amount in 2010

Unit : ton/day

	Household	Restaurant	Other than restaurant	Institutional	Market	Road sweeping	Total
San Salvador	257.6	9.4	24.7	18.3	39.2	64.4	413.6
Mejicanos	101.0	4.8	10.9	8.5	2.8	5.8	133.8
Delgado	79.8	4.2	10.6	4.6	0.9	3.0	103.1
Cuscatancingo	54.6	4.1	6.0	3.0	0.0	1.8	69.5
Ayutuxtepeque	21.2	0.6	1.8	2.1	0.5	0.5	26.7
San Marcos	34.5	1.8	2.7	1.3	0.9	1.4	42.6
Nueva San Salvador	106.8	3.3	8.2	8.1	5.5	8.5	140.4
Antiguo Cuscatlan	41.2	1.1	3.6	4.6	1.2	10.2	61.9
Soyapango	136.4	11.2	13.4	8.9	6.2	2.5	178.6
Ilopango	75.4	3.9	5.9	3.4	0.9	0.3	89.8
San Martin	57.5	6.0	6.7	2.9	7.8	0.3	81.2
Apopa	100.4	9.3	8.9	3.2	11.3	1.1	134.2
Nejapa	8.9	0.7	1.3	0.4	0.2	0.1	11.6
Tonacatepeque	19.0	0.8	2.7	3.4	0.3	0.6	26.8
Total	1,094.3	61.2	107.4	72.7	77.7	100.5	1,513.8

5.2.2 Medical Waste

For the forecast of future medical waste generation, it is assumed that the total number of beds in AMSS increases in proportion to the increase rate of the urban population in AMSS, and that the medical waste generation as well increases in proportion to the number of beds.

Accordingly, medical waste generation amount from 2001 to 2010 is forecast based on the assumptions above (see the table below).

Table 5-8: Forecast of Future Medical Waste Generation Amount

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Increase Rate	1.000	1.027	1.053	1.078	1.103	1.126	1.148	1.170	1.189	1.208	1.227	1.245
Amount (ton/day)	3.20	3.29	3.37	3.45	3.53	3.60	3.67	3.74	3.80	3.87	3.93	3.98

5.3 Other Pre-Conditions

5.3.1 Financial Conditions

5.3.1.1 Economic Growth Rate

Past 5 years national economic growth records (about 5.0%) and the recent global lower growth rate on average, the economic growth rate in this country is assumed to be 5.0% until year 2005 and 4.0% after that time for the analyses and examinations given by this study. Meanwhile, the growth rates of GRDP, municipal budget and household income in AMSS are estimated to be 0.5% above the GDP growth rate

considering that the AMSS continues to receive localization of more weighted central functions of most production and consumption activities than other areas.

Table 5-9: GRDP in San Salvador Metropolitan Area

	Unit	1999	2000	2001 to 2005	2006 to 2010
GDP growth rate	%	2.1%	3.5%	5.0%	4.0%
GRDP growth rate	%	2.6%	4.0%	5.5%	4.5%

Table 5-10: GRDP in San Salvador Metropolitan Area

	Unit	1999	2000	2005	2010
GRDP	million colon in 1998 price	42,057	43,739	57,166	71,239
GRDP/capita *	US$	2,466	2,500	2,927	3,369

Note: * divided by total population of 14 municipalities

5.3.1.2 Financial Conditions

a. Financial Scale of Municipalities

Estimations on 14 municipal budgets are shown in the table below assuming that will be increased proportion to the GRDP growth rates estimated.

Table 5-11: Financial Scale of Municipalities

Unit: 1,000 colones in 1999 price

Year / City	1999	2005	2010
San Salvador	322,537	438,409	546,335
Mejicanos	15,227	20,697	25,793
Delgado	18,175	24,704	30,786
Cuscatancingo	13,016	17,692	22,047
Ayutuxtepeque	8,652	11,760	14,655
San Marcos	10,662	14,492	18,060
Nueva San Salvador	56,785	77,185	96,186
Antiguo Cuscatlan	21,265	28,904	36,020
Soyapango	40,332	54,821	68,317
Ilopango	12,970	17,629	21,969
San Martin	6,743	9,165	11,422
Apopa	13,994	19,021	23,704
Nejapa	8,554	11,627	14,489
Tonacatepeque	5,985	8,136	10,139

b. Prediction of Average Household Income

Household income in AMSS is predicted to grow in proportion to the growth rate of GRDP/capita (see the table below).

Table 5-12: Prediction of Average Household Income

Unit: colones/year in 1999 price

Year / City	1999	2005	2010
San Salvador	76,110	96,464	116,518
Mejicanos	60,340	73,326	87,132
Delgado	46,901	56,018	65,671
Cuscatancingo	46,355	51,127	56,305
Ayutuxtepeque	57,500	59,629	63,414
San Marcos	50,212	63,506	77,849
Nueva San Salvador	81,776	89,867	97,201
Antiguo Cuscatlan *	149,969	149,625	148,945
Soyapango	56,757	74,265	88,016
Ilopango	47,871	54,386	61,306
San Martin	37,264	35,569	35,618
Apopa	40,705	44,151	47,985
Nejapa	32,089	37,459	44,432
Tonacatepeque	31,718	35,216	39,435

Note: * The increase rate of population is higher than that of GRDP.

c. Current Financial System of Municipalities

The status quo of municipal financial system is assessed as shown in the table below, based on the information received by the Team through inquiries and on the data forwarded by C/P.

Table 5-13: Current Financial System of Municipality

	Separate accounting	Fee collection through CAESS/ DELSUR	Computerized DB for fee collection	Financial Analysis
San Salvador	Sufficient	Cleansing fee & S/L	Exist	Sufficient
Mejicanos	Not sufficient	S/L	Not sufficient	Not sufficient
Delgado	Sufficient	S/L	Not sufficient	Not sufficient
Cuscatancingo	Not sufficient	Cleansing fee	No	Not sufficient
Ayutuxtepeque	Not sufficient	S/L	Not sufficient	Not sufficient
San Marcos	Not sufficient	S/L	Not sufficient	Not sufficient
Nueva San Salvador	Sufficient	Cleansing fee & S/L	Not sufficient	Not sufficient
Antiguo Cuscatlan	Not sufficient	No	Not sufficient	Not sufficient
Soyapango	Sufficient	S/L	Exist	Sufficient
Ilopango	Sufficient	S/L	Not sufficient	Sufficient
San Martin	Not sufficient	No	Exist	Not sufficient
Apopa	Not sufficient	S/L	Not sufficient	Not sufficient
Nejapa	Sufficient	No	No	Not sufficient
Tonacatepeque	Not sufficient	No	No	Not sufficient

d. Current Financial Dimensions of OPAMSS

OPAMSS's budget in 2000 is reduced approximately to 70% of that in 1997. Personal cost accounts for about 80% in both years.

Table 5-14: Budget of OPAMSS

Unit: 1000 colones

	2000	1999	2000/1999(%)
Personnel Cost	5,041	7,597	66.4
Goods & Services	776	1,047	74.1
Financial Cost	363	353	102.8
Current Transfer	0	10	0.0
Investment	155	176	88.1
Amortization	200	200	100
Total	6,535	9,383	69.6

Source: Financial Department of OPAMSS

Revenue/expenditure balance of OPAMSS in years 1997, 1998, and 1999 are summarized in the table below.

Table 5-15: Balance of OPAMSS

Unit: 1,000 colones

Item		1999	1998	1997
Revenue	Sales of goods and services *	6,082	8,598	10,261
	Current transfer	476	950	0
	Financial revenue	173	471	356
	Adjustment	70	1	24
	Total	6,801	10,020	10,641
Expenditure		9,368	10,720	7,457
Surplus/Deficit		-2,567	-700	3,184

Note : * including permission services
Source : Financial Department of OPAMSS

5.4 Comparative Examination of Technical Alternatives

5.4.1 Storage and Discharge System

As the POS shows that the use of the plastic sack is widely accepted in the Study Area, this is favorable in view of sanitation and handling. The problem is that it is vulnerable to animal infestation. Therefore, the best recommendable storage method is combination use of the plastic bag and the plastic dustbin.

5.4.2 Collection and Transport System

5.4.2.1 Collection

Almost of the municipalities in the Study Area still need to raise collection coverage. Therefore, mixed collection is recommendable over the Study Area in principal. There are, however, some municipalities that have achieved high collection coverage such as San Salvador, Nueva San Salvador and Antiguo Cuscatlan. In high-income areas of such municipalities, introduction of separate collection in the near future is recommendable.

In the Study Area many communities that is inaccessible for the collection vehicle exist. For such communities, point collection (container collection or station collection) or house to house collection by community-based collection or micro-enterprises depending on conditions of a target community would be applicable. For the accessible area to collection vehicle, continuation of the present collection method, i.e., curbside collection with ringing bell, is recommendable.

The 18 yd^3 compactor truck would be the best suitable for the Study Area especially in view of its efficiency, i.e., fewer collection cost per ton of waste. The 11 yd^3 compactor truck and the dump truck would also be used depending on town structure, road condition, type of waste, etc. It should be kept in mind, however, the collection costs of those vehicles are high. Especially, one of the dump truck is enormous.

When expansion of collection service is required, making plural shifts is recommendable rather than purchasing other vehicles. This results in fewer collection cost per ton of waste. Also it would be a way to rent collection vehicles to the private sector for the second or third shift.

5.4.2.2 Transport System

In order to seek optimum location of T/Ss and their sizes, three cases were set.

- Case 1 is to use one large size of T/S, 1200 ton/day, in the central part of SS,
- Case 2 is to use two small size of T/Ss, 300 ton/day, in the west and in the east of the Study Area and one medium size of T/S, 600 ton/day, in the central part of SS, and
- Case 3 is to use one small size of T/S, 300 ton/day in the west and one large T/S, 900 ton/day in the east.

Case 3 would be the most practical as the both T/Ss are out of the densely populated area of the Study Area.

The examination included 11 municipalities except AP, NJ and TN. Any case could not find the justifiable reasons for employing transfer transport for CD, CT and AY.

As for type of T/S, direct-load type is recommendable due to its fewer cost and smaller environmental impacts on and around the site.

The examination carried out here were based on several assumptions. More concrete investigation such as feasibility study must be necessary to decide the employment of an optimum transfer transport for AMSS.

5.4.3 Intermediate Processing System

Objectives and methods of the intermediate processing system in municipal SWM are summarized in the table below. As it could be judged from the table below, the primary objective in the intermediate processing is the volume reduction in general. Subsequent objectives could be in the order of: improvement of waste handling; waste stabilization (e.g., prevention of waste decay); resource recovery; and energy recovery.

Table 5-16: Objectives and Methods of Intermediate Processing System

	Improvement of waste handling	Volume reduction	Waste stabilization	Resources recovery	Energy recovery
Separation		X		X	
Baling	X	X			
Composting	X	X	X	X	(X)
Incineration	X	X	X		X

What method of intermediate processing to be selected in municipal SWM will largely depend on the intrinsic local conditions (e.g., geographical, social, economical conditions).

Therefore, it is essential to introduce an optimum intermediate processing at an optimum time, i.e., the introduction should be when it is really needed.

5.4.4 Final Disposal System

10 municipalities out of 14 municipalities use MIDES Nejapa sanitary landfill (S/L), 2 municipalities use ESPIGA controlled dumping (C/D) site, and 2 municipalities dispose their waste at an open dumping (O/D) site that is within the respective jurisdiction (see Figure 5-1).

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 5-2 below.

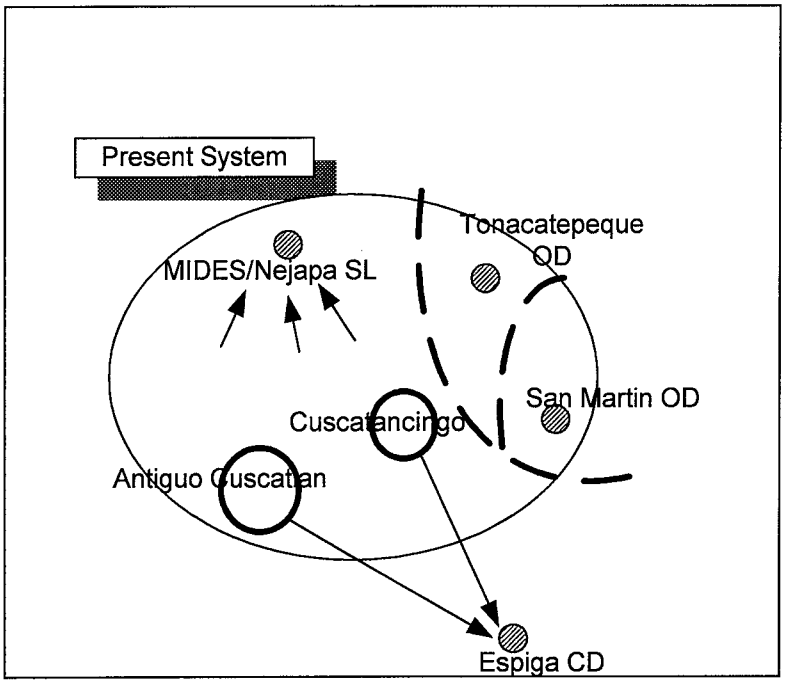

Figure 5-1: Present Municipal SWM System

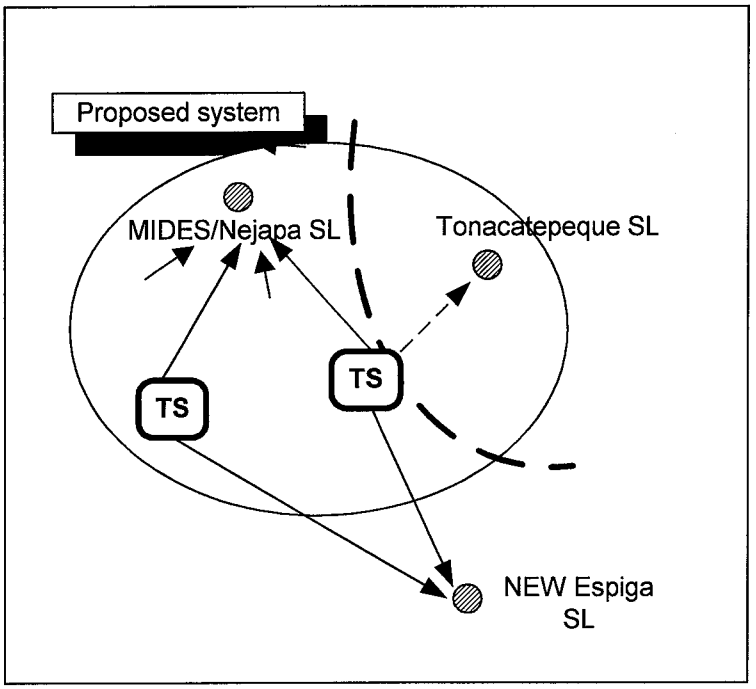

Figure 5-2: Proposed Municipal SWM System

5.4.5 Medical Waste Management System

The Study Team in conducting the medical waste survey (MWS) investigated the status quo of medical waste management in AMSS. It consequently revealed that many medical institutions are practicing appropriate handling of medical waste following the recently published manual[9]. However, some large public hospitals and small private hospitals with small number of beds have not yet established appropriate handling of medical waste, since medical waste mixed with common waste are discharged by such institutions.

In reviewing current medical waste management system in AMSS, the Study will recommend an optimum system for medical waste treatment as a part of the M/P for the regional SWM in AMSS in order that all medical institutions in AMSS could practice appropriate medical waste management. In this context, reviews on current system and examination for the optimum system to be proposed are detailed as follows.

- As for medical institutions that are going to introduce "separation collection" from now on, the autoclave facility with small capacity could be appropriate for in-hospital treatment only for infectious medical waste. Treatment for medical wastes other than infectious wastes should be entrusted to a specialized agent.
- Because autoclave treatment does not visually enable to confirm its disinfection performance, the autoclave can not be an absolute and sure treatment method. Therefore, it is suggested that at least some of medical waste should be subject to incineration treatment. On the other hand as the current medical waste management in AMSS, there are no in-hospital autoclave facilities in AMSS and most medical institutions entrust the medical waste treatment for MIDES to disinfect by the autoclave at Nejapa disposal site where waste after treatment is landfilled. Therefore, the disadvantage of visual confirmation inability is not eminent due to the single major flow of medical waste treatment at current AMSS. In this context, this autoclave treatment at a disposal site is effective in medical waste management. However, to rely on the only one treatment system (i.e., autoclave) is not recommended because there are several problems such as follows:
  - □ Medical waste consists of what suited for autoclave treatment and what not suited for that.
  - □ In case that the only one autoclave facility has a breakdown or an accident, there is no other choice to alter the treatment of standby infectious waste.
- An optimum system for medical waste treatment should therefore consider a system consisting of plural treatment measures.
- In order to aim to treat all medical waste from all medical institutions in AMSS, the optimum system should be examined from the overall viewpoint consisting of such as collection, transport, treatment and disposal aspects. In practice, if an intermediate treatment facility is localized at more appropriate position such as at a wide premise of a metropolitan large hospital (than at the final disposal site),

[9] Manual para Personal Médico y de Enfermería, Gestión y Manejo de Desechos Sólidos Hospitalarios ALA91/33

transportation costs will be significantly reduced. And as that consequence, a beneficial impact to lower overall costs for medical waste management could be brought about.

- In this case, in order safely to dispose treated medical waste at final disposal site, the treatment method should be such that enables visual confirmation on disinfection performance by way of clear identification of waste appearance changes (e.g., through incineration process). Medical waste incineration treatment could be feasible in AMSS with a satisfactory treatment performance where appropriate operation management and exhaust emission control on hazardous substances are implemented.

As explained above, it is suggested that, in parallel with the currently operated autoclave treatment, medical waste incineration should be introduced to secure the appropriate and safe medical waste management.

In addition to that, if an incineration plant is designed and operated not exclusively for medical waste but also for incinerating high calorific industrial waste, it will enable co-incineration of medical waste and high calorific industrial waste. Such facilities have merits in attaining cost-effectiveness both in the context of investment costs and O&M costs. Therefore, due attentions should be paid for present and future trends in industrial waste management in AMSS, in order to aim at establishing the optimum medical waste management system.

6 Particulars for Master Plan Formulation

6.1 Policy for Selection of an Optimum System

14 municipalities are members of COAMSS/OPAMSS that has metropolitan approaches and collective collaboration among all members. However, each municipality has an independent autonomy in its administration and respective dimensions (such as population scale and financial dimensions) are diverse. Therefore, in order to select an optimum system for realizing a sustainable municipal SWM, ample and prudent consideration should be made over intrinsic characteristics of respective 14 municipalities.

Regional management of municipal SW could attain series of benefit when collective use SWM facilities are installed and operated, because such facilities could have merits of economy of scale than the cases that each municipality installs and operates respective facilities for individual use. On the other hand, it should be reminded that said regional management could have some problems and demerits. For example, since an organization in charge of regional management of municipal SW is a conglomerate of several autonomous municipalities, a decision making may require considerable time to attain consensus among all members, or sometimes it can not be reached to a decision.

Currently, 10 out of 14 municipalities in AMSS dispose their municipal waste at MIDES Nejapa landfill. As for remaining 4 municipalities, 2 municipalities use ESPIGA controlled dumping site and the other 2 municipalities dispose of at open dumping site within their jurisdiction.

It should be a matter of course that the selection of a final disposal alternative lies on discretion of respective autonomous municipalities. Meanwhile, "Special Regulation on Integral Solid Waste Management (Reglamento Especial sobre el Manejo Integral de los Desechos Sólidos) was published on 1st June 2000. Out of present final disposal sites that 14 municipalities use, a final disposal site that complies with this requirement is only MIDES Nejapa sanitary landfill that 10 municipalities use. Therefore, other 4 municipalities will be required to implement satisfactory final disposal of their municipal waste in order to comply with such environmental legislative requirements.

Meanwhile, the "environmental conservation" in municipal SWM is a very important mission as recently required from the national legislative proposition. And it can not be neglected.

Therefore, M/P should comprehend solutions for problems of such as:

- problems of costly tipping fee (namely MIDES Nejapa fee, etc.)
- environmental pollution problems by ESPIGA controlled dumping and open dumping by 2 municipalities.
- problems in performing tasks of resource conservation (e.g., separate discharge/collection).

6.2 Technical System

6.2.1 Technical Particulars to be Considered

6.2.1.1 Collection System

Under the status quo, the primary target of collection system in AMSS should be to raise collection service coverage to 100%. The subsequent target after achieving 100% collection service coverage should be introduction of separate collection system that will aims at resource conservation and reduction of final disposal amount. In practice, followings are recommended for realizing the separate collection system:

- Municipalities that achieve the more than 85% coverage should then prepare for introducing the separate collection (e.g., examination and implementation of pilot projects for separate collection).
- When the service coverage exceeds 90%, the separate collection system should be gradually applied zone-by-zone (e.g., the separate collection coverage should be increased annually about 5% of municipal total.).

The success in shifting the generators' behavior from mixed waste discharge to source separation largely depends on morals and devotion of themselves. Namely, **the fewer** the separation **items** are, **the higher** possibility of **success** they may have in the source separation.

Therefore, it is recommended the separation items of the initial separate collection system should be two (2) items: "recyclable" and "non-recyclable".

6.2.1.2 Haulage System

As examined in the previous section, it is judged that to locate two (2) transfer stations (T/Ss): one in the eastern part of AMSS; and another in the western part of AMSS.

Accordingly, this M/P formulates a plan of haulage system that attempts to improve efficiency in collection and haulage works, by introducing a T/S system.

6.2.1.3 Intermediate Processing System

Under the circumstances, it is judged that the necessity for introducing intermediate processing system in AMSS for municipal SWM is fairly small. Team's observation is summarized as follows.

- As for compost, its market size is currently small and a market demand for compost products only exists in relatively short periods. Therefore, it is anticipated that if compost is produced substantially more than what is produced today, its limited marketability may result in price drop and surplus of compost product and further financial burdens for municipalities.
- There might be a justifiable reason to introduce a MIDES S/P for creating job opportunities for waste pickers. However, material recovery from mixed discharged waste has large limitation for resource conservation purposes. It is

also doubtful whether S/P that recovers materials from mixed discharged waste has financial feasibility in maintaining the operation. Whereas if a S/P is fed with source separated recyclable materials, its efficiency will be much higher. Therefore, S/P that recovers materials from mixed discharged waste is not recommended.

- Incineration facilities are very expensive and also require technical capability for their operation and maintenance. It is judged that introduction of such intermediate processing system for present AMSS should be too early, in view of economical dimensions that municipalities has.

Reminding the above, this M/P will attempt to examine appropriate plans for introducing intermediate processing systems for AMSS.

6.2.1.4 Final Disposal System

Currently, 10 out of 14 municipalities in AMSS dispose their municipal waste at MIDES Nejapa landfill. As for remaining 4 municipalities, 2 municipalities use ESPIGA controlled dumping site and the other 2 municipalities dispose of at open dumping site within their jurisdiction.

It should be a matter of course that the selection of a final disposal alternative lies on discretion of respective autonomous municipalities. Meanwhile, "Special Regulation on Integral Solid Waste Management (Reglamento Especial sobre el Manejo Integral de los Desechos Sólidos) was published on 1st June 2000. Out of present final disposal sites that 14 municipalities use, a final disposal site that complies with this requirement is only MIDES Nejapa sanitary landfill that 10 municipalities use. Therefore, other 4 municipalities will be required to implement satisfactory final disposal of their municipal waste in order to comply with such environmental legislative requirements.

However, viewing financial capabilities of respective municipalities, the US$18/ton tipping fee of MIDES should be very expensive. Which consequently would impose a significant financial burden on municipal finances that may possibly lead to municipal financial crisis. This implies serious questions that whether or not a "sustainable SWM" that being the goal of the Master Plan could be realized by respective 14 municipalities, from municipal financial aspects.

Accordingly, in order to attempt solutions for the above-mentioned problem, this M/P examines a sanitary landfill construction that complies with the national legislative requirement published on 1st June 2000[10].

6.3 Institutional and Organizational System

Table 6-1 outlines the approach for the management of the different elements involved in SWM of AMSS.

[10] "Special Regulation on Integral Solid Waste Management (Reglamento Especial sobre el Manejo Integral de los Desechos Sólidos) was published on 1st June 2000.

Table 6-1: Institutional Approach of SWM Elements within AMSS

Approach	Elements	Bodies in charge
Metropolitan	□ Final disposal (S/L) □ Transfer stations □ Haulage from T/S to final disposal □ Separation plant □ Transportation of rejected material from S/P to S/L □ Compost plant □ Sanitary/environmental education program □ Promotion to separate recyclable materials at the generation source □ Optimization of collection (Manual of Route Improvement).	COAMSS/OPAMSS
Municipal (in each municipality)	□ Collection of domestic SW. □ Collection of commercial SW. □ Collection of institutional SW. □ Collection of separate recyclable materials. □ Collection of organic composting SW. □ Public road cleansing. □ Sanitary/environmental education. □ Promote separation at the source. □ SWM Supervision and control within its municipality.	14 respective municipalities
National (applicable in AMSS)	□ Management of hazardous medical SW generated in health establishments of MSPAS, ISSS and the private sector of AMSS: - Separation at the source. - Separate collection. - Treatment. - Final disposal.	MSPAS

Table 6-2 outlines the optimal operation methods suggested for SWM in AMSS, during the implementation process of the Master Plan.

Table 6-2: Optimal Operation Methods Proposed for SWM in AMSS

Elements	Operation Methods
A.- Municipal Solid Waste	
1. Separation at the source	• By the SW generators themselves in houses, commercial and institutional establishments, markets and others.
2. Public road cleansing	• Direct operation by each of the 14 municipalities using their human and physical resources. • Contracting out by the municipalities of micro-enterprises and individual enterprises for the cleansing of specific areas.
3. Collection	• Direct operation by each of the 14 municipalities using their human and physical resources. • Contracting out by the municipalities of micro-enterprises and individual enterprises for the cleansing of specific areas. • Concession by the corresponding municipalities to micro-enterprises and/or cooperatives for the collection of specific areas
4. Collection of separate recyclable materials	• Direct operation by each one of the municipalities. This collection should be preferably granted to recyclers, micro-enterprises or cooperatives integrated by scavengers.
5. Transfer station(s) (T/S)	Contract-out (previous public tender) by the municipalities to private sectors for the construction, operation, maintenance and financing of the transfer station(s). Payment could be set per ton transferred and the duration of the contract would depend on the amount invested.
6. Transportation between T/S and sanitary landfill (S/L)	□ Contract-out (previous public tender) by the municipalities for the transportation of SW from T/S to S/L. Payment could be set per ton carried.
7. Selection plant (S/P)	□ An exception only for social support to the scavengers displaced from the former Mariona dumping site; the municipalities will construct a SW selection plant with a maximum capacity of 200 Ton/day. Operation and maintenance of the S/P will be responsibility of the scavengers, who will be regulated and supervised by OPAMSS. □ Any new S/P will be constructed, operated, given maintenance and financed by those interested in this SW recovery process.
8. Compost plant (C/P)	□ Promote the construction, operation and maintenance of the C/P by the private sector, and commercialization of the compost produced, providing municipal incentives and/or insuring a partial purchase of the compost processed.
9. Sanitary landfills (S/L)	□ Contract-out (previous public tender) by the municipalities to private sectors for the construction, operation and maintenance of the S/L. Payment would be per ton disposed of.
10. Sanitary–environmental education	□ To be executed by each of the 14 municipalities within their own jurisdiction. However, the policies, programs, guides and activities will have a metropolitan approach supervised by COAMSS/OPAMSS.
B.- Hazardous Medical Solid Waste	
1. Separation at the source	□ By the Medical SW generators themselves in health establishments of MSPAS, ISSS and by the private sector of AMSS, with a previous training to the staff in charge of the separation.
2. Separate collection	□ Preferably by contract-out to private specialized and authorized enterprises to conduct this type of collection. □ Direct operation by MSPAS by using human resources (specially trained) and physical resources of their own.
3. Treatment	□ Contract-out and direct operation by the hospitals using authorized technology.
4. Final disposal	□ Contract-out to S/L for disposal in special cells.

6.4 Financial System

It is a basic principle of SWM that all expenditure (i.e., direct and indirect costs) of cleansing services should be covered by the cleansing fee income. However, in year 1999 9 municipalities out of 14 municipalities could not even cover the direct costs of cleansing services by the cleansing fees collected.

As for 4 municipalities out of 9 municipalities that use CAESS/DELSUR for MIDES landfill fee collection, the final disposal expenditure (i.e., MIDES tipping fee payment and CAESS/DELSUR commission payment) in 8 months in 1999 exceeded the income (landfill fee income collected at the same period from users by CAESS/DELSUR).

This implies the following 3 problems:

- Problems of SWM fee collection system;
- Problems of high tipping fee of MIDES landfill; and
- Problems of administration and control.

The above problems imply large difficulties in pursuing sustainable municipal SWM. Among other, collection vehicles donated by the Japanese government in 1989 and 1996 become old and their remaining service life is short. It accordingly is necessary to replace those collection vehicles in the near future which could impose notable financial burden on respective municipalities' finance.

In this context, impacts of municipal finance till the year 2010 (M/P target year) are preliminarily examined on the assumption stated below:

The table blow shows financial improvement of total balance until year 2010, when series of improvement scenarios are carried out such as, "fee collection rate increase (up to 90%)" and "specific duty (US$/ton) application on large dischargers", "MIDES landfill tipping fee reduction" and "use of T/Ss and transport".

Table 6-3: Improvement of Total Balance until Year 2010 by Adopting Respective Measures

Unit: 1000 colones

Municipality	Original balance estimated on vehicle replacement	Balance improvement after "Fee collection rate increase"	Further balance improvement after "specific duty on large dischargers"	Further balance improvement after "MIDES tipping fee reduction to US$9/ton"	Further balance improvement in case of "Case A T/Ss use"	Further balance improvement in case of "Case B T/Ss use"
San Salvador	392,459	454,008	same as before*	645,594	671,543	668,267
Mejicanos	485	27,310	- ditto -*	53,419	57,484	55,589
Delgado	8,652	19,132	23,174	33,411	34,603	35,443
Cuscatancingo	-4,571	-2,061	1,007	1,007	3,496	1,890
Ayutuxtepeque	-279	2,196	3,767	7,213	8,652	7,869
San Marcos	-9,094	2,938	5,076	15,798	11,274	6,024
Nueva San Salvador	57,500	73,543	84,053	113,557	140,995	139,631
Antiguo Cuscatlan	-62,936	-54,864	-49,195	-49,195	-17,199	-22,347
Soyapango	-17,366	15,277	31,826	85,208	97,143	99,071
Ilopango	15,361	24,702	28,889	44,169	50,607	51,848
San Martin	1,995	9,071	10,798	10,798	12,360	12,315
Apopa	4,578	42,108	46,275	61,853	-	-
Nejapa	-5,938	-4,443	-3,677	-2,081	-	-
Tonacatepeque	-24,183	-22,788	-20,120	-20,120	-	-

Note: * The tariff of non-domestic waste has already changed to reflect the waste weight.

Attention should be paid to that even series of the income improvement assumed above take place, Nejapa and Tonacatepeque municipalities will have a negative balance in total till 2010. Drastic measures to improve the income and/or reduce the SWM costs should be carefully considered.

The above financial improvement scenarios assumed should be taken into consideration for formulating the Master Plan (M/P).

Meanwhile, although the total financial balance until 2010 would be improved to follow the scenarios above, in 2003 when several collection vehicles should be replaced to new ones 6 municipalities may need to transfer some municipal budget to SWM budget as shown in the table below.

Table 6-4: Municipal Burden Transfer to replace vehicles in 2001 and in 2003

	2001	2003
Cuscatancingo	0%	8.8%
Ayutuxtepeque	0.8%	0%
San Marcos	3.5%	0%
Antiguo Cuscatlan	0%	14.8%
Nejapa	0%	7.0%
Tonacatepeque	48.8%	31.9%