13.4 Financial Evaluation

13.4.1 Financial Evaluation for The SWM Master Plan

a. Conditions for Financial Evaluation

Table 13-3 shows the conditions for the master plan's financial evaluation.

Table 13-3: Condition for the Master Plan's Financial Evaluation

Evaluation Period	12 years, from 1999 until 2010
Executing Body	a) The AMDC's SWEU will be the executing unit starting from 1999. After 2001, the Municipal Cleansing Corporation (MCC) will be the executing body. b) The MCC will commission private contractors to execute some of the work.
Investment Plan	**a) Collection and Haulage** New equipment will be acquired in 2001, 2004 and 2008, and the investment necessary for the purchase of these equipment is included in the expenses calculated for the previous fiscal years. **b) Street Sweeping** One 4 ton truck, for transporting MCC street sweepers, will be operated in 2001; more trucks will be operated in 2009. **c) Final Disposal** In 1999, the final disposal site will be improved, so it can be used until 2006. In 2004, the land for the new disposal site will be acquired and construction work will be completed in 2006. **d) Recycling** In 2004, one 4 ton truck, used to carry recycled waste to middle men, will be operated; more trucks will be purchased in 2008. In 2004, recycling of some wastes will begin by putting containers at public areas and supermarkets (high-income areas). In 2008, recycling of some wastes will begin by putting containers at elementary schools (middle-income areas). In 2007, the semi-mechanical sorting plant for the recovery of valuable items will be constructed near the new disposal site.
Salvage Value	The salvage value of equipment for collection, haulage, landfilling, street sweeping and recycling equipment, and a disposal site in 2011 were taken into account.
Cut-off Rate	Based on the interest rate of IDB for loans, the cut-off rate was established at 12% per annum.
Interest Rate	**a) Long Term Loan** • It is assumed that a long term loan will cover 80% of the investment required in 2000. • The assumed interest rate is 8.5% per annum. • The repayment period is 10 years, of which the grace period is 2 years. **b) Short Term Loan** • The assumption is that a short term loan will cover the finance required temporarily. • The assumed interest rate is 12.5% per annum.
Inflation	The present value (1998) is used for the financial evaluation

For the financial evaluation, the various cases of the waste fee collection system, the waste fee collection rates, the waste collection fee system, and basic socio-economic parameters were assumed and four cases were formulated.

Table 13-4: Cases to be Examined for the Master Plan's Financial Evaluation

Case	Main Systems	Description
1	• Present waste fee collection system • Present waste fee tariff	**1) Waste fee collection system** • Residential waste: Joint billing with fixed property tax • Business waste: Joint billing with business income tax **2) Waste fee collection rate** • Residential waste: from 48.7% in 1998 to 90% in 2010 • Business waste: from 73.8% in 1998 to 90% in 2010 **3) Revenue Potential** a) Residential waste: • The number of household is proportional to the population. • Fixed property values is reviewed every 5 years. b) Business waste: • The revenue is proportional to changes in GRDP.
2	• Joint billing of waste collection fees and electricity charges from 2001 • Present waste fee tariff	**1) Waste fee collection system** Joint billing of waste collection fees and electricity charges will begin from 2001. **2) Waste fee collection rate** The collection rate for residential waste and business waste collection fees will increase to 90%. **3) Revenue Potential** The conditions are same as in Case 1.
3	• Joint billing of waste collection fee and electricity charges from 2001 • New waste fee system A	**1) Waste fee collection system** Joint billing of waste collection fees and electricity charges will begin from 2001. **2) Waste fee collection rate** The collection rate for residential waste and business waste collection fees will increase to 90%. **3) Waste collection fee system** From 2001, the system will be changed as follows: a) Residential waste: High-income G.: Lps. 70/month/house (175% of WTP) Middle-income G.: Lps. 33/month/house (110% of WTP) Low-income G.: Lps. 18/month/house (90% of WTP) b) Business waste collection fee will be charged according to their annual turnover. c) Large scale dischargers will be charged according to the discharge amount. Collection service: Lps. 480/ton d) Direct haulers will be charged according to the haulage amount. Direct haulage: Lps. 50/ton **4) Revenue Potential** The conditions are same as in Case 1.
4	• Joint billing of waste collection fee and electricity charges from 2001 • New waste fee system B	**1) The difference between Case 3 and Case 4 is the proposed waste collection fee.** In Case 4, the waste collection fee is raised in a few stages. **2) Waste collection fee system** a) Residential waste (unit:Lps/month/house) 2001 / 2003 / 2008 high-income group: Lps. 63 / Lps. 70 / Lps. 80 middle-income group: Lps. 22 / Lps. 33 / Lps. 36 low-income group: Lps. 11 / Lps. 18 / Lps. 20 b) Large scale dischargers: Lps. 480/ton / Lps. 480/ton / Lps. 530/ton c) Direct haulage: Lps. 50/ton / Lps. 50/ton / Lps. 55/ton

c. SWM Unit Cost in the Master Plan

Table 13-5 summarizes the SWM costs required until 2010.

Table 13-5: Estimated SWM Cost for the Master Plan

unit: 1,000 Lps

Item	1997*	1999 to 2000 average**	2001 to 2007 average	2008 to 2010 average
Collection & Haulage	9,429 (0)	21,815 (0)	52,405 (5,038)	80,460 (5,038)
Street Sweeping	4,510 (0)	9,570 (0)	11,097 (94)	13,520 (56)
Final Disposal	747 (0)	5,118 (452)	9,810 (3,394)	12,419 (3,896)
Recycling	0	0	390 (103)	2,007 (210)
Others	3,013	2,756	3,910	4,918
Total SWM Works	17,699 (0)	39,259 (452)	77,612 (8,629)	113,324 (9,200)

Note:
*: Excludes depreciation.
**: Includes the cost for contracting out.
Figures in parentheses indicate depreciation values.

Table 13-6 summarizes the waste collection and the waste disposal amounts until 2010.

Table 13-6: Waste Collection and Disposal Amounts

ton/year

Item	1997	1999 to 2000 average	2001 to 2007 average	2008 to 2010 average
Collection & Haulage*	112,816	124,371	199,187	301,677
Street Sweeping*	N.A.	10,400	11,391	13,867
Final Disposal	135,923	134,994	214,377	323,161
Recycling	0	0	1,490	6,917
Others	N.A.	N.A.	N.A.	N.A.
Total SWM Works	135,923	134,994	214,377	323,161

Note:
*: Includes the cost for contracting out.

Table 13-7 summarizes the estimated unit costs for SWM until 2010.

Table 13-7: Estimated SWM Unit Costs

unit: Lps/ton

Item	1997*	1999 to 2000 average**	2001 to 2007 average	2008 to 2010 average
Collection & Haulage***	83.6	175.4	263.1	266.7
Street Sweeping	N.A.	920.2	974.2	975.0
Final Disposal	5.5	37.9	45.8	38.4
Recycling	0	0	261.7	290.2
Others	N.A.	N.A.	N.A.	N.A.
Total SWM Works	130.2	290.8	362.0	350.7

Note:
*: Excludes depreciation.
**: Includes depreciation of investment in disposal site improvements.
***: Includes the cost for contracting out.

d. Revenue Plan

d.1 Revenue Plan Under the Present Waste Collection Fee System

As residential waste fees are billed with the fixed property tax, the amount of waste fees that can be collected is assumed to increase in proportion to the population growth. In addition, the review of fixed property values to be conducted in 2000, 2005 and 2010 is taken into account. The collection amount for both the business income tax and the business waste fee is assumed to increase in relation to the increase in GRDP.

Table 13-8: Estimated Revenue Plan Under the Present Waste Fee System

Items			1997	2000	2005	2010
Residential waste	Population		816,665	917,104	1,112,695	1,350,000
	No. of households*		148,485	166,746	202,308	245,455
	Collection potential	(10^3 Lps)	14,440	36,555	51,107	64,470
	Collection rate	(%)	48.7	55.9	68.0	80.0
	Revenue plan	(10^3 Lps)	7,032	20,434	34,753	51,576
Business waste	GRDP	(10^3 Lps)	13,609	16,516	21,893	27,942
	Collection potential**	(10^3 Lps)	17,383	22,764	30,176	38,513
	Collection rate	(%)	73.8	77.5	83.8	90.0
	Revenue plan	(10^3 Lps)	12,829	17,642	25,287	34,662

Note: *One household is assumed to have an average of 5.5 family members.
**The collection potential was forecast based on the estimated revenue in 1998 (Lps. 20,070).

d.2 Revenue Plan Under the New Waste Collection Fee System

The POS revealed that residents' willingness to pay (WTP) is as follows: high-income group – Lps 40/month/household; middle-income group – Lps 30/month/household; and low-income group – Lps 20/month/household. A survey in 1997 on household accounts, conducted by the Statistics Bureau, shows that the average salary of the head of a family in Tegucigalpa is Lps. 6,870/month/household for the high-income group, Lps. 3,247/month/household for the middle-income group, and Lps. 1,990/month/household for the low-income group.

The WTP cited by the high income group is only 0.6%, whereas the WTP for the low income group is over 1% of their respective monthly incomes. Taking these figures into account, a waste collection fee that amounts to around 1% of the salaries of each income group was established. From 2003, the proposed collection fee rates (for both Case 3 and Case 4) will be equivalent to: 175% of the WTP cited by high income households; 110% of the WTP cited by middle income households; and 90% of the WTP cited by low income households (Table 13-9).

Table 13-9: Comparison between Willingness to Pay and Proposed Waste Collection Fee Rates in Waste Collection Fee System B

(unit: Lps/month/household, %)

Income Group Bracket	Willingness to Pay	1% of Average Income	Proposed Waste Collection Fee Rates		
			2001-2002	2003-2007	2008-2010
High-income Group	40	68.7	63	70	80
Middle-income Group	30	32.5	22	33	36
Low-income Group	20	19.9	11	18	20

Table 13-10 shows revenue estimates for the proposed waste fee system A.

Table 13-10: Revenue Estimation in the Proposed Waste Collection Fee System A

Items			2000*	2001	2005	2010
Total No. of Households			166,746	173,320	202,308	245,455
High-income bracket	Population rate	(%)		18.5	16.5	14.0
	No. of Household	(person)		32,064	33,381	34,364
	Collection Service Rate	(%)		100	100	100
	Collection Fee	(Lps)		70	70	70
	Collection Rate	(%)		90	90	90
	Revenue Plan	(10^3 Lps)		21,547	22,432	23,093
Middle-income bracket	Population rate	(%)		34.5	40.5	48.0
	No. of Household	(person)		59,795	81,935	117,818
	Collection Service Rate	(%)		80	90	93
	Collection Fee	(Lps)		33	33	33
	Collection Rate	(%)		90	90	90
	Revenue Plan	(10^3 Lps)		15,154	26,281	39,051
Low-income bracket	Population rate	(%)		47.0	43.0	38.0
	No. of Household	(person)		81,461	86,992	93,273
	Collection Service Rate	(%)		55	60	70
	Collection Fee	(Lps)		18	18	18
	Collection Rate	(%)		90	90	90
	Revenue Plan	(10^3 Lps)		8,710	10,147	12,603
Revenue Plan		(Lps1,000)	9,065	49,999	61,664	77,633

Note: *The present waste fee system will remain until 2000.

Table 13-11 shows revenue estimates for the proposed waste fee system B.

Table 13-11: Revenue Estimation in the Proposed Waste Collection Fee System B

Items			2000*	2001	2005	2010
Total No. of Households			166,746	173,320	202,308	245,455
High-income bracket	Population rate	(%)		18.5	16.5	14.0
	No. of Household	(person)		32,064	33,381	34,364
	Collection Service Rate	(%)		100	100	100
	Collection Fee	(Lps)		63	70	80
	Collection Rate	(%)		90	90	90
	Revenue Plan	(10^3 Lps)		21,816	25,236	26,690
Middle-income bracket	Population rate	(%)		34.5	40.5	48.0
	No. of Household	(person)		59,795	81,935	117,818
	Collection Service Rate	(%)		80	90	93
	Collection Fee	(Lps)		22	33	36
	Collection Rate	(%)		90	90	90
	Revenue Plan	(10^3 Lps)		11,366	26,281	42,601
Low-income bracket	Population rate	(%)		47.0	43.0	38.0
	No. of Household	(person)		81,461	86,992	93,273
	Collection Service Rate	(%)		55	60	70
	Collection Fee	(Lps)		11	18	20
	Collection Rate	(%)		90	90	90
	Revenue Plan	(10^3 Lps)		5,323	10,147	14,103
Revenue Plan		(Lps1,000)	9,065	38,505	61,664	86,394

Note: *The present waste fee system will remain until 2000.

Table 13-11 shows revenue estimates for non-residential waste (i.e., business waste, large waste volumes, and directly hauled waste) in the proposed waste fee system A and system B.

Table 13-12: Revenue Estimation for Non-Residential Waste in the Proposed Waste Collection Fee Systems A and B

Items			2000	2001	2005	2010
GRDP (million Lps)			16,516	17,507	21,893	27,942
Collection potential by business income (10^3 Lps)				26,540	33,190	42,360
Large discharge	Volume (ton/day)			29.8	45.7	71.1
	Fee (Lps/ton)	System A		480	480	480
		System B		480	480	530
	Revenue (10^3 Lps)	System A		5,221	8,007	12,457
		System B		5,221	8,007	13,754
Direct haulage	Volume (ton/day)			45.5	59.7	81.9
	Fee (Lps/ton)	System A		50	50	50
		System B		50	50	55
	Revenue (10^3 Lps)	System A		830	1,090	1,495
		System B		830	1,090	1,644
Collection potential (10^3 Lps)		System A	22,764	32,591	42,287	56,312
		System B	22,764	32,591	42,287	57,758
Collection rate (%)			77.5	90.0	90.0	90.0
Estimated Revenue (10^3 Lps)		System A	17,642	29,332	38,058	50,681
		System B	17,642	29,332	38,058	51,982

c. Financial Internal Rate of Return (FIRR) and Financial Balance

Table 13-13 shows the FIRRs and the net present values (NPVs) at a 12% discount rate for the four hypothetical revenue cases.

Table 13-13: Result of FIRRs for 4 Cases

Case	Description	FIRR (%)	Discount rate = 12.0%	
			Revenue over Expenditure	NPV* (R - E) (1000Lps)
Case 1	• Present waste fee collection system • Present waste fee rates	N.A.	0.7191	-128,683
Case 2	• Joint billing of waste collection fees and electricity charges from 2001 • Present waste fee rates	N.A.	0.8188	-85,965
Case 3	• Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system A	22.8	1.0413	19,826
Case 4	• Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system B	17.2	1.0264	12,679

Note: *NPV stands for Net Present Value.

For Case 1 and Case 2, the net present values calculated based on a discount rate of 12.0% (opportunity costs) are negative and therefore indicate that the master plan will be financially unfeasible. The inference is that the waste collection fee system must be changed.

For Case 3 and Case 4, the FIRRs imply that the master plan will be financially feasible, because they exceed the cut off rate of 12.0%.

Figure 13-1 and Table 13-14 show that although the profit and loss between 1999 and 2001 will be negative, it will be positive after 2002 and the internal reserves will reach Lps. 61 million in 2010, which will be enough for the required investment. Therefore, it implies that Case 4 will make the master plan financially sustainable.

The conclusion is that Case 4 will be more acceptable to the citizens than Case 3.

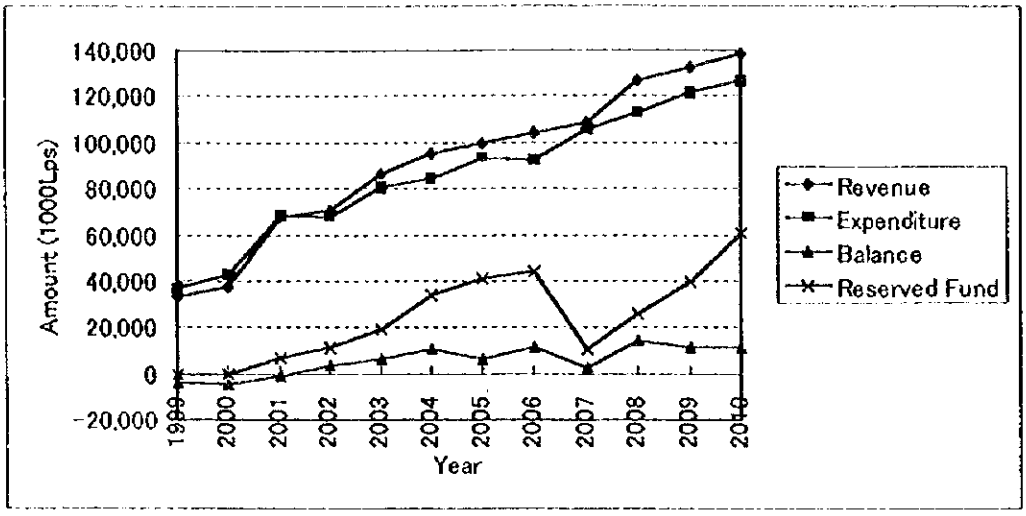


Figure 13-1:Cash Flow Diagram for Case 4

Table 13-14: Cash Flow and Profit and Loss Statement for Case 4

Cash Flow

unit: 10^3 Lps.

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
a.	Cash-in													
a.1	Finance													
	Loan	10,004	51,662	0	0	0	0	0	0	0	0	0	0	61,666
	Long Term	0	38,470	0	0	0	0	0	0	0	0	0	0	38,470
	Short Term	10,004	13,192	0	0	0	0	0	0	0	0	0	0	23,196
	Finance Total	10,004	51,662	0	0	0	0	0	0	0	0	0	0	61,666
a.2	Revenue													
	Basic service	33,558	38,058	62,391	65,125	80,643	87,800	91,535	95,431	99,495	114,730	119,522	124,518	1,012,806
	Residents	17,174	20,407	38,505	39,806	53,804	59,352	61,664	64,067	66,563	80,151	83,214	86,394	671,100
	Commercial etc	16,384	17,651	23,886	25,319	26,838	28,449	29,871	31,365	32,933	34,579	36,308	38,124	341,707
	Large amount	0	0	4,702	5,034	5,389	6,731	7,206	7,678	8,160	10,997	11,717	12,483	80,117
	Direct haulage	0	0	747	800	856	917	980	1,044	1,113	1,304	1,389	1,480	10,630
	Revenue Total	33,558	38,058	67,840	70,958	86,888	95,448	99,722	104,153	108,788	127,031	132,628	138,481	1,103,553
	Cash-in Total	43,562	89,719	67,840	70,958	86,888	95,448	99,722	104,153	108,788	127,031	132,628	138,481	1,165,219
b.	Cash-out													
b.1	Investment	6,332	48,087	0	2,961	1,838	0	2,961	12,844	40,413	3,815	2,961	578	122,790
b.2	Expenditure													
	O&M Cost	19,550	22,702	23,594	23,485	25,052	28,751	26,322	24,757	27,476	32,641	29,767	34,305	318,403
	Contract out	17,680	17,680	28,630	29,004	39,954	39,954	51,278	51,652	62,976	63,349	74,673	75,047	551,877
	Commission to BSC			3,392	3,548	4,344	4,772	4,966	5,208	5,439	6,352	6,631	6,924	51,597
	Interest	0	1,251	4,919	3,270	2,861	2,452	2,044	1,635	1,226	817	409	-0	20,884
	Expenditure Total	37,230	41,632	60,536	59,306	72,212	75,930	84,630	83,251	97,117	103,160	111,481	116,276	942,761
b.3	Repayment	0	0	0	4,809	4,809	4,809	4,809	4,809	4,809	4,809	4,809	0	38,470
	Cash-out Total	43,562	89,719	60,536	67,076	78,858	80,739	92,400	100,904	142,339	111,783	119,251	116,854	1,104,020
c.	Reserved Fund (a.-b.)	0	0	7,304	11,186	19,216	33,926	41,247	44,497	10,946	26,194	39,572	61,199	61,199

Profit and Loss Statement

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
a.	Revenue	33,558	38,058	67,840	70,958	86,888	95,448	99,722	104,153	108,788	127,031	132,628	138,481	1,103,553
b.	Cost													
b.1	Expenditure	37,230	41,632	60,535	59,306	72,212	75,930	84,630	83,251	97,117	103,160	111,481	116,276	942,761
b.2	Depreciation	0	905	8,064	8,064	8,557	8,834	8,834	9,327	8,721	9,724	10,033	10,431	91,494
	Cost Total (b.1+b.2)	37,230	42,537	68,599	67,370	80,769	84,764	93,464	92,579	105,839	112,884	121,514	126,707	1,034,254
c.	Profit and Loss (a.-b.)	-3,672	-4,479	-759	3,588	6,119	10,685	6,258	11,575	2,949	14,148	11,114	11,774	69,299

f. Sensitivity Analysis

A sensitivity analysis was conducted on fluctuation in revenue and expenditure under the Case 4 scenario. The results are shown below.

		Expenditure				
		-10%	-5%	0%	+5%	+10%
Revenue	-10%	17.2	7.0	-2.8	N.A.	N.A.
	-5%	27.7	17.2	7.5	-1.8	N.A.
	0%	38.5	27.1	17.2	8.0	-0.9
	+5%	50.4	37.4	26.6	17.2	8.4
	+10%	64.0	48.4	36.3	26.2	17.2

The results of the sensitivity analysis reiterate the importance of revenue control, as the decrease in revenue by more than 5% will shift the cut off rate to a negative value.

g. Conclusion of the Financial Evaluation

The financial evaluation concluded that theoretically both Case 3 and Case 4 will make the master plan financially feasible. The financial evaluation of the two cases revealed the following requirements:

a) The waste fee collection rate must be increased to 90% by introducing the joint billing of waste fees and electricity charges.

b) The new waste collection fee system, proposed in the master plan, must be introduced.

If the above requirements are satisfied, even though the waste fee rates gradually rise as in Case 4, the master plan will be financially feasible because the FIRR will be 17.2%.

13.4.2 Financial Evaluation for the Priority Projects

a. Conditions for Financial Evaluation

The conditions for the priority projects' financial evaluation are as shown in Table 13-15.

Table 13-15: Condition for the Priority Projects' Financial Evaluation

Evaluation Period	The performance of projects to be invested from 1999 to 2002 is evaluated for 12 years, from 1999 until 2010.
Executing Body	a) The AMDC's SWEU will be the executing unit starting from 1999. After 2001, the Municipal Cleansing Corporation (MCC) will be the executing body. b) The MCC will commission private contractors to execute some of the work.
Investment Plan	a) **Collection and Haulage** The operation of new equipment will start between 2001 and 2003, and the investment necessary for the purchase of these equipment is included in the expenses calculated for the fiscal year before these years. The investment for replacement are included after seven years. b) **Street Sweeping** In 2001, one 4 ton truck, for transporting MCC street sweepers, will be purchased; it will be replaced in 2008. c) **Final Disposal** In 1999, the final disposal site will be improved, so it can be used until 2006. In 2004, the land for the new disposal site will be acquired and construction work will be completed in 2006. In 2000 and 2002, new landfill equipment will be purchased and they will be replaced after six years. d) **Recycling** is not included in the priority projects.
Salvage Value	The salvage value of equipment for collection, haulage, landfilling, street sweeping and recycling equipment, and a disposal site in 2011 were taken into account.
Cut-off Rate	Based on the interest rate of IDB for loans, the cut-off rate was established at 12% per annum.
Interest Rate	**a) Long Term Loan** • It is assumed that a long term loan will cover 80% of the investment required in 2000. • The assumed interest rate is 8.5% per annum. • The repayment period is 10 years, of which the grace period is 2 years. **b) Short Term Loan** • The assumption is that a short term loan will cover the finance required temporarily. • The assumed interest rate is 12.5% per annum.
Inflation	The present value (1998) is used for the financial evaluation.

b. Cases for Financial Evaluation

The financial evaluation for the master plan found that the introduction of the joint billing of waste collection fees and electricity charges will be essential to ensure a sustainable SWM. Therefore, for the priority projects' financial evaluation, the various cases shown for the waste fee collection rates, the waste collection fee system, and basic socio-economic parameters were assumed; three cases were formulated.

Table 13-16: Cases to be Examined for the Priority Projects' Financial Evaluation

Case	Main Systems	Description
1	• Joint billing of waste collection fees and electricity charges from 2001 • Present waste fee tariff	**1)Waste fee collection system** Joint billing of waste collection fees and electricity charges will begin from 2001. **2)Waste fee collection rate** The collection rates for residential and business waste collection fees will increase to 90%. **3)Revenue Potential** a) Residential waste: • The number of household is proportional to the population. • Fixed property values is reviewed every 5 years. b) Business waste: • The revenue is proportional to changes in GRDP.
2	• Joint billing of waste collection fee and electricity charges from 2001 • New waste fee system A	**1)Waste fee collection system** Joint billing of waste collection fees and electricity charges will begin from 2001. **2)Waste fee collection rate** The collection rates for residential and business waste collection fees will increase to 90%. **3)Waste collection fee system** It will be changed to the following system from 2001. a) Residential waste: High-income G.: Lps. 70/month/house (175% of WTP) Middle-income G.: Lps. 33/month/house (110% of WTP) Low-income G.: Lps. 18/month/house (90% of WTP) b)Business waste collection fee will be charged according to their annual turnover. c)Large scale dischargers will be charged according to the discharge amount. Collection service: Lps. 480/ton d)Direct haulers will be charged according to the haulage amount. Direct haulage: Lps. 50/ton **4)Revenue Potential** The conditions are same as in Case 1.
3	• Joint billing of waste collection fee and electricity charges from 2001 • New waste fee system B	**1)The difference between Case 2 and Case 3 is the proposed waste collection fee.** In Case 3, the waste collection fee is raised in a few stages. **2)Waste collection fee system** a) Residential waste (unit:Lps/month/house) 2001 / 2003 / 2008 high-income group: Lps. 63 / Lps. 70 / Lps. 80 middle-income group: Lps. 22 / Lps. 33 / Lps. 36 low-income group: Lps. 11 / Lps. 18 / Lps. 20 b) Large scale dischargers: Lps. 480/ton / Lps. 480/ton / Lps. 530/ton c) Direct haulage: Lps. 50/ton / Lps. 50/ton / Lps. 55/ton

c. SWM Unit Cost in the Priority Projects

Table 13-17 summarizes the costs required for the priority projects until 2003.

Table 13-17: Estimated SWM Cost for the Priority Projects

unit: 1,000 Lps

Item	1999-2000 average*	2001- 2003 average	1999-2003 average
Collection & Haulage**	21,815 (0)	41,044 (3,214)	33,352 (1,928)
Street Sweeping**	9,570 (0)	10,512 (94)	10,135 (56)
Final Disposal	5,118 (452)	8,846 (3,097)	7,354 (2,039)
Administration etc.	2,756	4,521	3,815
Total SWM Works	39,259 (452)	64,923 (6,405)	54,656 (4,023)

Note:
*: Excludes depreciation.
**: Includes the cost for contracting out.
Figures in parentheses indicate depreciation values.

Table 13-18 summarizes the waste collection and the waste disposal amounts until 2003.

Table 13-18: Waste Collection and Disposal Amounts

ton/year

Items	1999-2000 average	2001- 2003 average	1999-2003 average
Collection & Haulage*	124,371	164,589	148,502
Street Sweeping*	10,400	10,786	10,631
Final Disposal	134,994	177,130	160,275
Administration etc.	N.A.	N.A.	N.A.
Total SWM Works	134,994	177,130	160,275

Note:
*: Includes the cost for contracting out.

Table 13-19 summarizes the estimated unit costs for SWM until 2003.

Table 13-19: Estimated SWM Unit Costs

unit: Lps/ton

Items	1999-2000 average	2001- 2003 average	1999-2003 average
Collection & Haulage*	175.4	249.4	224.6
Street Sweeping*	920.2	974.6	953.3
Final Disposal	37.9	49.9	45.9
Administration etc.	N.A.	N.A.	N.A.
Total SWM Works	290.8	366.5	341.0

Note:
*: Includes the cost for contracting out.

d. Revenue Plan

d.1 Revenue Plan Under the Present Waste Collection Fee System

As residential waste fees are billed with the fixed property tax, the amount of waste fees that can be collected is assumed to increase in proportion to the population growth. In addition, the review of fixed property values to be conducted in 2000, 2005 and 2010 is taken into account. The collection amount for both the busi ss income tax and the business waste fee is assumed to increase in relation to the increase in GRDP. Table 13-20 shows the revenue estimated based on the assumptions stated above.

Table 13-20: Estimated Revenue Plan Under the Present Waste Collection Fee System

Items		1999	2000	2001	2002	2003	Total
Residential waste	Population	882,322	917,104	953,257	990,835	1,029,895	
	No. of households*	160,422	166,746	173,319	180,152	187,254	
	No. of properties	130,717	135,705	157,372	163,419	169,698	
	Collection potential**(10^3 Lps)	32,107	36,506	42,086	43,399	44,746	193,282
	Collection rate (%)	53.5	55.9	90.0	90.0	90.0	
	Revenue plan (10^3 Lps)	17,177	20,407	37,877	39,059	40,271	149,761
Business waste	GRDP (million Lps)	15,581	16,516	17,507	18,557	19,671	
	Collection potential (10^3 Lps)	21,476	22,764	24,130	25,578	27,112	121,060
	Collection rate (%)	76.3	77.5	90.0	90.0	90.0	
	Revenue plan (10^3 Lps)	16,388	17,642	21,717	23,020	24,401	103,168
Total Revenue Plan (10^3 Lps)		33,565	38,049	59,594	62,079	64,672	252,929

Note: *One household is assumed to have an average of 5.5 family members.
**The collection potential was forecast based on the estimated revenue in 1998 (Lps. 20,070).

d.2 Revenue Plan Under the New Waste Collection Fee System

The revenue plan was prepared for the following two cases.

unit: Lps./house/month

Case	Category	2001 to 2002	after 2003
System A	High Income Residents	70	70
	Middle Income Residents	33	33
	Low Income Residents	18	18
System B	High Income Residents	63	70
	Middle Income Residents	22	33
	Low Income Residents	11	18

Table 13-21 shows revenue estimates for the proposed waste fee systems.

Table 13-21: Revenue Estimation in the Proposed Waste Collection Fee System A and System B

Items				2000	2001	2002	2003
Total No. of Household				166,746	173,319	180,152	187,254
High-Income bracket	Population rate (%)			19.0	18.5	18.0	17.5
	No. of households			31,682	32,064	32,427	32,770
	Collection Service Rate (%)			90	100	100	100
	Collection Fee (Lps/month)		Case A		70	70	70
			Case B		63	63	70
	Fee Collection Rate (%)				90	90	90
	Revenue Plan (10^3 Lps)		Case A		24,240	24,515	24,774
			Case B		21,816	22,063	24,774
Middle-Income bracket	Population rate (%)			33.0	34.5	36.0	37.5
	No. of households			55,026	59,795	64,855	70,220
	Collection Service Rate (%)			70	80	80	80
	Collection Fee (Lps/month)		Case A		33	33	33
			Case B		22	22	33
	Fee Collection Rate (%)				90	90	90
	Revenue Plan (10^3 Lps)		Case A		17,049	18,491	20,021
			Case B		11,366	12,328	20,021
Low-Income bracket	Population rate (%)			48.0	47.0	46.0	45.0
	No. of households			80,038	81,460	82,870	84,264
	Collection Service Rate (%)			50	55	55	55
	Collection Fee (Lps/month)		Case A		18	18	18
			Case B		11	11	18
	Fee Collection Rate (%)				90	90	90
	Revenue Plan (10^3 Lps)		Case A		8,710	8,860	9,010
			Case B		5,323	5,415	9,010
Total Revenue bracket	Case A	High-income level			24,240	24,515	24,774
		Middle-income level			17,049	18,491	20,021
		Low-income level			8,710	8,860	9,010
		Total		20,407	49,999	51,866	53,805
	Case B	High-income level			21,816	22,063	24,774
		Middle-income level			11,366	12,328	20,021
		Low-income level			5,323	5,415	9,010
		Total		20,407	39,806	39,806	53,805

Table 13-22 shows revenue estimates for non-residential waste (i.e., business waste, large waste volumes, and directly hauled waste) in the proposed waste fee system A and system B.

Table 13-22: Revenue Estimation for Non-Residential Waste in the Proposed Waste Collection Fee Systems A and B

Items			2000	2001	2002	2003
GRDP		(million Lps)	16,516	17,507	18,557	19,671
Collection potential by business income		(10^3 Lps)		26,540	28,132	29,820
Large	volume	(ton/day)		29.8	31.9	34.2
discharge	Fee	(Lps/ton)		480	480	480
	Revenue	(10^3 Lps)		5,221	5,589	5,992
Direct	volume	(ton/day)		45.5	48.7	52.1
haulage	Fee	(Lps/ton)		50	50	50
	Revenue	(10^3 Lps)		830	889	951
Collection potential		(10^3 Lps)	22,764	32,591	34,610	36,763
Collection rate		(%)	77.5	90.0	90.0	90.0
Revenue plan		(10^3 Lps)	17,642	29,332	31,149	33,087

e. Financial Internal Rate of Return (FIRR) and Financial Balance

Table 13-23 shows the FIRRs and the NPVs calculated based on a 12% discount rate for the three hypothetical revenue cases.

Table 13-23: Result of FIRRs for 3 Cases

Case	Description	FIRR (%)	Discount rate = 12.0%	
			Revenue over Expenditure	NPV* (R - E) (1000Lps)
Case 1	• Joint billing of waste collection fees and electricity charges from 2001 • Present waste fee rates	-0.1	0.9240	-30.240
Case 2	• Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system A	32.2	1.1047	42.069
Case 3	• Joint billing of waste collection fees and electricity charges from 2001 • New waste fee system B	23.0	1.0674	27.016

Note: *NPV stands for Net Present Value.

For Case 1, the net present values, calculated based on a discount rate of 12.0% (opportunity costs), are negative and therefore indicates that priority projects will be financially unfeasible. The inference is that the waste collection fee system must be changed.

For Case 2, the FIRR implies that the priority projects will be financially feasible, because it will reach 32.2%, widely exceeding the cut off rate of 12.0%.

For Case 3 that will introduce the transitional raise of waste collection fee system, the FIRR also implies that the priority projects will be financially feasible, because it will reach 23.0%, still exceeding the cut off rate of 12.0%.

Figure 13-2 shows that although the profit and loss between 1999 and 2001 will be negative, it will be positive after 2002 and more than Lps. 12 million will be gained annually after 2003. Case 3 will make the priority projects financially sustainable because internal reserves will reach Lps. 18 million in 2003.

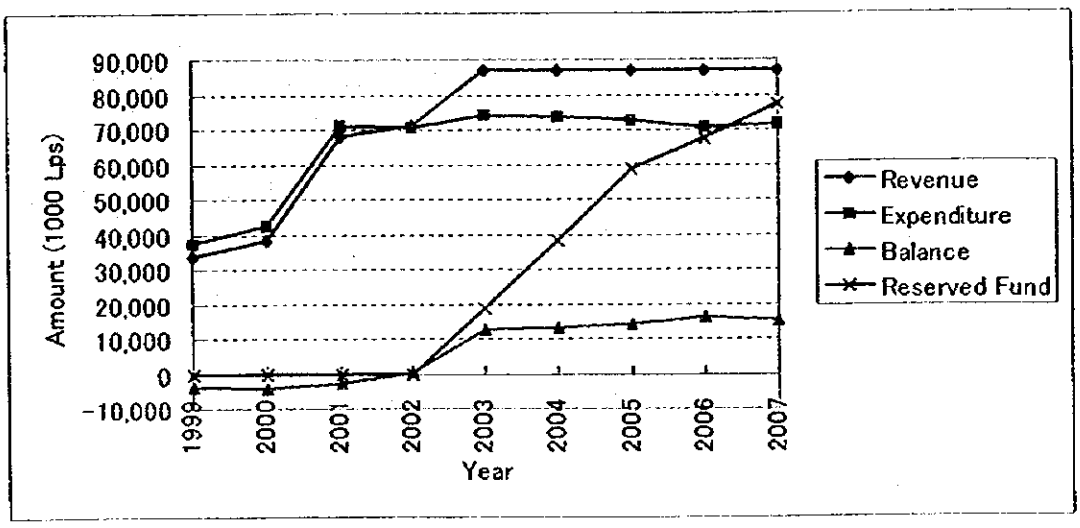


Figure 13-2: Cash Flow Diagram for Case 3

Table 13-24: Cash Flow and Profit and Loss Statement for Case 3

Cash Flow

unit: 10^3 Lps

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
a. Cash-in													
a.1 Finance													
Loan	10,004	26,898	9,658	12,212	0	0	0	0	0	0	0	0	58,772
Long Term	0	18,659	0	0	0	0	0	0	0	0	0	0	18,659
Short Term	10,004	8,239	9,658	12,212	0	0	0	0	0	0	0	0	40,113
Finance Total	10,004	26,898	9,658	12,212	0	0	0	0	0	0	0	0	58,772
a.2 Revenue													
Collection & Disposal	33,558	38,058	62,391	65,125	80,643	80,643	80,643	80,643	80,643	80,643	80,643	80,643	844,272
Residents	17,174	20,407	38,505	39,806	53,804	53,804	53,804	53,804	53,804	53,804	53,804	53,804	546,326
Commercial etc	16,384	17,651	23,886	25,319	26,838	26,838	26,838	26,838	26,838	26,838	26,838	26,838	297,946
Largr amount	0	0	4,702	5,034	5,389	5,389	5,389	5,389	5,389	5,389	5,389	5,389	52,848
Direct haulage	0	0	747	800	856	856	856	856	856	856	856	856	8,397
Revenue Total	33,558	38,058	67,840	70,958	86,888	86,888	86,888	86,888	86,888	86,888	86,888	86,888	905,517
Cash-in Total	43,562	64,956	77,497	83,170	86,888	86,888	86,888	86,888	86,888	86,888	86,888	86,888	964,289
b. Cash-out													
b.1 Investment	6,332	23,323	11,216	16,509	0	0	0	14,009	11,159	14,178	13,547	0	110,273
b.2 Expenditure													
O&M Cost	19,550	22,702	31,069	28,381	29,470	30,715	29,725	27,814	29,719	29,657	29,735	29,722	338,258
Contract out	17,680	17,680	28,630	29,004	29,004	29,004	29,004	29,004	29,004	29,004	29,004	29,004	325,025
Commission to BSC			3,967	4,151	4,344	4,344	4,344	4,344	4,344	4,344	4,344	4,344	42,873
Interest	0	1,251	2,616	2,793	2,914	1,189	991	793	595	396	198	-0	13,737
Expenditure Total	37,230	41,632	66,281	64,329	65,733	65,253	64,065	61,955	63,662	63,402	63,281	63,070	719,893
b.3 Repayment	0	0	0	2,332	2,332	2,332	2,332	2,332	2,332	2,332	2,332	0	18,659
Cash-out Total	43,562	64,956	77,497	83,170	68,065	67,585	66,397	78,296	77,153	79,912	79,161	63,070	848,824
c. Reserved Fund (a.-b.)	0	0	0	0	18,823	38,126	58,617	67,208	76,943	83,920	91,647	115,465	115,465

Profit and Loss Statement

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
a. Revenue	33,558	38,058	67,840	70,958	86,888	86,888	86,888	86,888	86,888	86,888	86,888	86,888	905,517
b. Cost													
b.1 Expenditure	37,230	41,632	66,281	64,329	65,733	65,253	64,065	61,955	63,662	63,402	63,281	63,070	719,893
b.2 Depreciation	0	905	4,526	6,128	8,557	8,557	8,557	8,557	8,123	8,123	8,123	8,123	78,279
Cost Total (b.1+b.2)	37,230	42,537	70,807	70,458	74,290	73,810	72,622	70,513	71,784	71,524	71,404	71,193	798,171
c. Profit and Loss (a.-b.)	-3,672	-4,479	-2,968	501	12,598	13,078	14,266	16,375	15,104	15,364	15,484	15,695	107,346

f. Sensitivity Analysis

A sensitivity analysis was conducted on fluctuation in revenue and expenditure under the Case 3 scenario. The results are shown below.

		Expenditure				
		-10%	-5%	0%	+5%	+10%
Revenue	-10%	23.0	14.2	6.6	0.0	N.A.
	-5%	33.4	23.0	14.6	7.4	1.01
	0%	45.6	32.9	23.0	16.1	8.02
	+5%	60.7	44.2	32.3	23.0	15.3
	+10%	81.4	58.1	43.0	31.9	23.0

The results of the sensitivity analysis implies that even though the expenditure increase 5% or the revenue decreases 5% the FIRR will increase the cut off rate.

g. Conclusion of the Financial Evaluation

The financial evaluation concluded that theoretically both Case 2 and Case 3 will make the priority projects financially feasible. The financial evaluation of the two cases revealed the following requirements:

a) The waste fee collection rate must be increased to 90% by introducing the joint billing of waste fees and electricity charges.

b) The new waste collection fee system, proposed in the master plan, must be introduced.

If the above requirements are satisfied, even though the waste fee rates gradually increase as in Case 3, the priority projects will be financially feasible because the FIRR will be 23%.

13.5 Economic Evaluation

13.5.1 The Economic Evaluation Method

The economic evaluation aims to examine the viability of the project in macroeconomic terms. As it is difficult to quantify the benefits obtained through the implementation of SWM projects (although various approaches have been tried), some of the benefits are only quantified in general. For the purpose of this economic evaluation the WTP data, obtained through the public opinion survey, is the economic benefit of this project.

Generally, the WTP amount increases with income growth and the promotion of environmental education and awareness. Looking at the present situation, however, there is a tendency that the WTP amount is inversely proportional to the income level. As the potential benefits associated with disposal site improvement affect only the immediate neighbors, the general WTP of residents are less likely to increase.

Taking these factors into account, the economic internal return (EIRR) was calculated based on the following conditions.

a) For 1999, only investment was included.

b) It was assumed that the WTP will increase in proportion to the GRDP per capita and reach to the level of willingness to pay obtained by the survey.

c) As the study did not survey the WTP for non-residential waste, expenses for waste services paid out by non-residential sources in 1997 was used. In other words, it was assumed that non-residential sources will expend Lps. 263/ton until 2010.

d) The conversion factors shown in Table 13-25 were used to calculate the economic costs. This is in order to take factors, such as internal transfer of taxes, unemployment rate, etc., into account.

e) The book values of equipment for 2011, to be procured by the MCC, were included.

Table 13-25: Conversion Factor into Economic Costs

	Items	Conversion Factor
Investment	Collection, haulage & landfill equipment	0.83
	Manual carts, containers, etc.	0.93
	Civil work	0.88
	Land acquisition	0.50
O & M costs	Skilled labor	1.00
	Unskilled labor	0.60
	Diesel etc.	0.88
	Maintenance (including spares)	0.88
	Street sweeping	0.60
	Administration etc.	0.80

Note: A general sales tax of 12% is included in the cost estimate.

13.5.2 Economic Evaluation on the Master Plan

a. Benefits and Costs

Table 13-26 shows the economic benefits and costs from 1999 to 2010.

b. EIRR

The EIRR of the master plan, calculated based on the above benefits and costs, was 16.1%, which is over the cut off rate.

c. Sensitivity Analysis

The sensitivity analysis revealed that the implementation of both environmental education and awareness campaign largely affect the sensitivity of the WTP.

	Costs					
Benefits		-10%	-5%	0%	+5%	+10%
	-10%	16.1	2.5	N.A.	N.A.	N.A.
	-5%	30.0	16.1	3.1	N.A.	N.A.
	0%	43.6	29.3	16.1	3.8	N.A.
	+5%	57.3	42.2	28.7	16.1	4.3
	+10%	71.6	55.1	40.9	28.1	16.1

d. Qualitative Evaluation

One of the most important objectives of the SWM works is to maintain the city in a sanitary condition and an aesthetic condition; this means that waste must be removed from human contact immediately and hauled out of the city. Final disposal operations, however, would pose a negative impact on the environment.

The master plan projects will improve the sanitary and working conditions in the existing disposal site, leading to the improvement of the surrounding environment and social acceptability of the disposal site.

Expanding waste collection services into marginal areas will reduce the number of disease-carrying vermin, especially mosquitoes that transmit the virus which causes dengue fever.

The secondary effects will be the increase in job opportunities and the introduction of sanitary landfilling technologies to other Honduran cities.

Recycling will contribute to resource recovery and natural conservation, and also to reduction of illegal dumping as side effect.

These effects, which are too difficult to be quantified, would far outweigh the quantifiable benefits.

13.5.3 Economic Evaluation on the Priority Projects

Table 13-27 shows the predicted benefits and costs for the priority projects in economic terms until 2010.

The EIRR is 18.6%, which is greater than the EIRR calculated for the master plan.

The sensitivity analysis revealed that the implementation of both environmental education and awareness campaign largely affect the sensitivity of the WTP.

	Costs					
		-10%	-5%	0%	+5%	+10%
Benefits	-10%	18.6	5.7	N.A.	N.A.	N.A.
	-5%	34.3	18.6	6.3	-3.2	N.A.
	0%	52.7	33.4	18.6	6.8	-2.5
	+5%	74.2	50.6	32.6	18.6	7.3
	+10%	99.3	70.6	48.8	31.9	18.6

Table 13-26: Benefits and Costs (Parameters) for the Economic Evaluation on the Master Plan

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	residual	Total
Benefit															
Residential	High income residents		12,905	14,799	15,263	15,729	16,197	16,664	16,966	17,258	17,536	17,800	18,045		179,162
	Middle income residents		13,075	16,559	18,316	20,223	25,081	27,608	30,063	32,693	36,695	39,814	43,153		303,280
	Low income residents		9,056	10,339	10,726	11,123	12,576	13,028	13,361	13,695	16,367	16,756	17,143		144,171
Businesses			7,427	9,541	10,215	10,936	13,660	14,624	15,581	16,600	20,212	21,534	22,942		163,272
Total Benefit (B)		0	42,462	51,238	54,520	58,012	67,514	71,924	75,971	80,246	90,811	95,904	101,284		789,885
Cost															
collection	Investment	0	29,271	0	0	0	0	0	0	29,271	0	0	0	-16,726	41,816
	O&M		9,174	9,117	9,117	9,117	10,261	9,117	9,117	9,117	11,786	9,117	11,786		106,826
	Contract out		8,760	17,520	17,520	26,280	26,280	35,040	35,040	43,800	43,800	52,560	52,560		359,160
street sweeping	Investment	0	545	0	0	0	0	0	0	545	272	0	0	-506	856
	O&M		1,739	2,128	2,248	2,248	2,248	2,368	2,488	2,608	2,728	2,833	2,953		26,590
	Contract out		5,384	5,384	5,683	5,683	5,683	5,982	6,281	6,580	6,880	7,179	7,478		68,197
recycling	Investment	0	0	0	0	1,099	0	0	0	1,936	488	0	0	-349	3,174
	O&M		0	0	0	0	413	413	413	413	825	825	825		4,127
disposal	Investment	5,572	10,096	0	2,458	479	0	2,458	10,771	1,764	2,458	2,458	479	-9,349	29,645
	O&M		4,517	4,666	4,431	5,551	6,551	5,880	4,709	6,405	6,753	7,316	7,624		64,404
indirect	O&M		2,369	2,879	2,866	3,057	3,509	3,212	3,021	3,353	3,983	3,633	4,186		36,069
Total Cost (C)		5,572	71,855	41,695	44,323	53,515	54,945	64,470	71,840	105,792	79,975	85,921	87,892	-26,930	740,865
B - C		-5,572	-29,393	9,544	10,197	4,497	12,569	7,454	4,130	-25,546	10,836	9,983	13,391	26,930	49,020

Table 13-27: Benefits and Costs (Parameters) for the Economic Evaluation on the Priority Projects

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	residual	Total
Benefit															
Residential	High income residents		12,905	14,799	15,263	15,729	15,729	15,729	15,729	15,729	15,729	15,729	15,729		168,801
	Middle income residents		13,075	16,559	18,316	20,223	20,223	20,223	20,223	20,223	20,223	20,223	20,223		209,736
	Low income residents		9,056	10,339	10,726	11,123	11,123	11,123	11,123	11,123	11,123	11,123	11,123		119,105
			7,427	9,541	10,215	10,936	10,936	10,936	10,936	10,936	10,936	10,936	10,936		114,672
Businesses															
Total Benefit (B)		0	42,462	51,238	54,520	58,012	58,012	58,012	58,012	58,012	58,012	58,012	58,012		612,314
Cost															
collection	Investment	0	8,717	9,310	11,244	0	0	0	0	8,717	9,310	11,244	0	-21,269	37,273
	O&M		9,174	13,954	12,328	12,168	12,168	12,168	12,168	12,168	12,168	12,168	12,168		132,799
	Contract out		8,760	17,520	17,520	17,520	17,520	17,520	17,520	17,520	17,520	17,520	17,520		183,960
street sweeping	Investment	0	545	0	0	0	0	0	0	545	0	0	0	-311	778
	O&M		1,739	2,128	2,248	2,248	2,248	2,248	2,248	2,248	2,248	2,248	2,248		24,102
	Contract out		5,384	5,384	5,683	5,683	5,683	5,683	5,683	5,683	5,683	5,683	5,683		61,916
recycling	Investment	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	O&M		0	0	0	0	0	0	0	0	0	0	0		0
disposal	Investment	5,572	10,096	0	2,458	0	0	0	11,719	0	2,458	0	0	-6,083	26,221
	O&M		4,517	4,666	4,431	5,551	6,395	5,724	4,428	5,720	5,678	5,731	5,722		58,564
indirect	O&M		2,369	3,791	3,463	3,596	3,748	3,628	3,394	3,627	3,619	3,629	3,627		38,492
Total Cost (C)		5,572	51,301	56,754	59,377	46,767	47,763	46,971	57,161	56,228	58,684	58,223	46,968	-27,663	564,105
B - C		-5,572	-8,839	-5,515	-4,857	11,245	10,249	11,041	850	1,784	-672	-211	11,044	27,663	48,209

Part 4

Recommendations

Chapter 14

Conclusions and Recommendations

14 Conclusions and Recommendations

14.1 Conclusions

a. Amount of municipal solid waste generated and the waste stream

1) As of 1998, approximately 481 ton of municipal solid waste is generated each day in the Central District. This figure includes the overall municipal waste generation rate of 566 g/cap/day and residential waste generation rate of 375 g/cap/day.

2) Based on the assumption that the collection rate is 64%, 289 ton is collected per day if waste is collected everyday. In reality, however, Saturday is a half-day and there are no collection services on Sunday, so the actual daily collection amount is 368 ton/day. Further, dischargers haul 23 ton of waste to the disposal site, most of which is commercial waste.

3) The final disposal amount is approximately 343 ton/day: 333 ton/day of municipal waste, and 10 ton/day of industrial waste and medical waste.

4) The on-site disposal amount is approximately 20 ton/day and the amount recycled at generation sources is approximately 4 ton/day.

5) The uncollected waste amount is approximately 114 ton/day.

6) The present waste generation amount is estimated to double (1,053 ton/day) in relation to the forecast population increase, that is from 0.85 million in 1998 to 1.35 million in 2010. These waste problems are predicted to worsen by 2010 if no countermeasures are taken. Therefore, an appropriate municipal solid waste management system must be established urgently.

b. Technical System

1) At present, the most common SWM technical system in the Central District is rudimentary, composed only of collection and haulage of waste and final disposal systems. This system is basically appropriate for the Central District as long as the acquisition of land for the disposal site is financially and socially unproblematic.

2) As nature conservation is a global issue, such concept should be gradually incorporated into the solid waste management. As a long term plan, the Central District should gradually introduce both a recycling system and a waste minimization system; however, long term solutions must not affect the financial sustainability of the cleansing work.

3) The present collection and haulage system, i.e., the compactor collection system and the container collection system, functions adequately, but the efficiency of the dump truck collection system was poorer in comparison. Therefore, the use of dump trucks for waste collection should be avoided.

4) The introduction of a waste transfer system will not be necessary until 2006, when the reserve capacity of the present disposal site expires, because the current disposal site is located only 6.5km from the center of the city.

5) Areas that do not receive collection services are frequently low income residential areas where lack of a frequent service has left unhygienic conditions, that are often blamed for outbreaks of dengue fever. The expansion of a regular waste collection service, therefore, should be a continuous endeavor.

6) In areas where collection vehicles are inaccessible due to the poor road conditions and topographical features, the point collection system with communal containers, that obliges beneficiaries to bring their waste to points accessible to collection vehicles, should be adopted. One of the pilot projects conducted during the study found that residents' are willing to cooperate with primary collection (i.e. taking their wastes to the collection points) as long as environmental education and public motivation is promoted sufficiently.

7) The present disposal site is 31.7 hectares, of which only 12 hectares are currently used for landfilling. Even though the final waste disposal amount is predicted to increase in future, the site has the capacity to receive waste generated in the Central District until 2006. The present disposal site has a favorable natural condition in terms of environmental protection and haulage of waste. The sanitary condition can easily be enhanced by improving some facilities, training staff in operation techniques, and raising awareness among the municipalities' staff and citizens. Therefore, the best option is considered to be the utilization of the existing disposal site, for as long as possible, providing the landfill operation level is improved.

8) Planning and construction of a new final disposal site should proceed deliberately while the existing disposal site has a reserve.

9) At present, recycling activities rely mainly on scavengers operating at the disposal site and in towns and on the collection workers' sorting work. Although both activities contribute to recycling, they are informal and thus impose negative impacts on the present solid waste management system. These negative impacts will grow if no proper countermeasures are taken. It is, therefore, necessary for the governmental organizations – as a long term objective – to be gradually involved in recycling to shift the trends from an informal activity to a formal activity.

c. Institutional System

1) At present, the AMDC spends Lps. 130 per ton for the management of municipal solid waste. The minimum SWM unit cost to materialize the appropriate level of SWM in the Central District is approximately Lps. 360 per ton. Therefore it is essential to establish a sufficient revenue source to cover both the costs and the improvements in the present technical system.

2) The collection rates of the present waste fees, charged jointly with the fixed property tax for residential waste and with the business income tax for business waste, are low. Its improvement cannot be expected to be done immediately, nor can an increase in revenue from waste collection fees be expected. The financial evaluation concluded that the present waste fee collection system will be unable to financially sustain the SWM works. Therefore, a new joint billing system, where waste fee bills are issued with the electricity statement, should be introduced, as electricity charges have a high collection rate and have more registered users.

3) Since the present waste collection fee system is related to the fixed property tax, residents who are tenants do not have to pay waste collection fees. This situation also restricts the number of service recipients issued a statement; those who feel that the present system is unfair are unwilling to pay their waste fee. Therefore, the present system should be improved so that it is fair to the majority of service recipients.

4) The position of the AMDC's Cleansing Department, an executing body responsible for SWM, is under the Public Service Division in the Urban Development Bureau. The very limited authority held by the Cleansing Department restricts its ability to quickly make important decisions. Therefore, the organization responsible for SWM works needs to have a higher profile.

5) With every political transition, experienced staff at the AMDC are replaced by new officials; this has left the current Cleansing Department officials with very little experience in technological and administrative processes. There has been two drastic changes in the organization system in the five year period between 1993 and 1998, thus undermining the Cleansing Department's capacity to provide effective waste services. It is imperative that the authority responsible for SWM is made stable in order to improve its administrative capabilities.

6) With the continuous urban expansion, the amount of SWM works is becoming more intricate and overwhelming; it has reached a point where it is both physically and financially difficult for the AMDC to effectively manage on their own. Therefore the private sector's financial and technical capabilities must be introduced into the SWM system. In addition, the AMDC should encourage the public to become involved in SWM works through environmental education, public campaigns, etc.; the public should be made aware of their responsibility in supporting SWM. In order to achieve the goal in the master plan, the AMDC should effectively promote and coordinate the participation of both the private sector and citizens.

d. Cost Summary of the Priority Projects

Table 14-1 shows the project cost summary. The cost for the priority projects covers the investment from 1999 to 2002 and the O & M costs from 1999 to 2010.

Table 14-1: Project Cost Summary of the Priority Projects

Unit: 10^3 Lempiras

		1999	2000	2001	2002	2003	2003-2010
Collection & Haulage	Investment	0	10,503	11,216	13,547	-	35,266
	O & M	10,163	11,567	17,522	15,338	14,932	104,524
	Contract out	10,950	10,950	21,900	21,900	21,900	153,300
Street Sweeping	Investment	0	656	0	0	-	656
	O & M	2,840	2,840	3,316	3,500	3,500	24,503
	Contract out	6,730	6,730	6,730	7,104	7,104	49,727
Disposal Site	Investment	6,332	12,164	0	2,961	-	17,005
	O & M	3,997	5,334	5,491	5,214	6,542	46,470
General Expense	O & M	2,550	2,961	4,739	4,329	4,495	31,589
Total	Investment	6,332	23,323	11,216	16,509	-	52,927
	O & M	19,550	22,702	31,069	28,381	29,470	207,086
	Contract out	17,680	17,680	28,630	29,004	29,004	203,027
	Total	**43,562**	**63,705**	**70,915**	**73,894**	**58,474**	**463,041**

c. Project Evaluation

c.1 The SWM Master Plan

The financial evaluation concluded that the master plan will be financially feasible if, from 2001,the waste collection fees and electricity charges are jointly billed and if the new waste fee system is introduced.

If the waste fee system A is introduced in 2001, the FIRR will be 22.8%. Even though the waste fee rates gradually rise as in the system B, the master plan will be financially feasible because the FIRR will be 17.2%.

c.2 Priority Projects

The financial evaluation concluded that the priority projects will be financially feasible if, from 2001,the waste collection fees and electricity charges are jointly billed and if the new waste fee system is introduced.

If the waste fee system A is introduced in 2001, the FIRR will be 32.2%. Even though the waste fee rates gradually rise as in the system B, the priority projects will be financially feasible because the FIRR will be 23.0%.

14.2 Recommendations

a. Implementation of the Master Plan

The master plan is assessed to be feasible from technical, social, environmental, financial, and economic viewpoints. Therefore, the AMDC should implement this master plan based on the strategies proposed in this study.

In the master plan, the improvement of the institutional system is given priority, followed by technical improvements in general.

b. The Improvement of the Institutional System

The master plan proposes basic strategies to achieve the goals for 2010 based on future projections, made by taking the current actual situation of the Central District into account. There will, however, be unforeseen matters when the master plan is executed, often caused by socioeconomic changes, among others. To achieve the goal, in the event of such uncertainties, it is essential for a sound institutional system, which can tackle these matters, to be in place. In addition, most problems, at present, are attributed to the inadequate institutional system. Therefore, the improvement of institutional system is given a priority.

1) An SWM Executing Unit, a temporary organization directly linked to the Mayor's office, will be established in early 1999. The SWM Executing Unit will have the same functions as the present Cleansing Department, however, its hierarchy level will be raised to much a higher level than the present Cleansing Department so that it can immediately take appropriate actions. This measure will strengthen the Cleansing Department effectively with the minimum organizational change.

2) The SWM Executing Unit will efficiently carry out solid waste management works in preparation for: the establishment of the municipal cleansing corporation

(MCC); the introduction of the new waste fee collection system; and the expansion of contracting out services and training staff.

3) The fully autonomous MCC will be established by 2001, and will be responsible for municipal solid waste management in the Central District.

4) In 2001, the new waste fee collection system will be introduced to collect waste fees together with the electricity charges.

5) The waste collection fee system, to be introduced in 2001, are shown below.

Waste Collection Fee	Descriptions
Residential Waste Collection Fee	Three different rates according to the residents' income bracket
Business Waste Collection Fee	Ten different rates according to the business income bracket
Large Scale Dischargers' Waste Collection Fee	Based on the weight of waste discharged
Direct Haulage Fee	Based on the weight of waste received at the disposal sites

6) The private sector's involvement in collection and haulage works will be gradually expanded after the establishment of the MCC, the introduction of the new joint billing system, and the introduction of the new waste fee rates. In order to minimize the cost for contracting out, while creating a climate for fair competition, the following measures should be taken when selecting the competitors. Other works, such as final disposal, will be gradually commissioned to private sectors following the contracting out of collection and haulage works.

   i) The MCC holds an open bid so that the process is transparent to the general public.

   ii) The MCC limits the amount to be collected in one contract area to less than 50 ton/day.

   iii) The MCC directly operates at least 25% of the entire collection and haulage works.

7) The MCC, in collaboration with the AMDC, should actively carry out a campaign to raise public awareness and initiate a hygiene education program to promote cooperation with SWM; the sensitivity analysis in the financial evaluation revealed the importance of such education programs for the master plan to succeed. Solid waste education materials, such as books and videos, and other campaign goods, such as posters, stickers, and 'Limpin' (the campaign mascot), all proved to be a success during the study. In the future, these and other similar materials should be effectively used by the waste management authorities to promote public awareness.

8) The MCC should provide training for those engaged in solid waste management and create a human resource development plan to improve their employees' basic skills.

c. Improvement of the Technical System

1) The waste management authorities should implement the following measures to prepare for the expansion of contracting out SWM operations.

i) Produce a collection area map, where each collection area has a discharge amount of approximately 50 ton/day.

ii) Improve its finances, its capacity to plan both SWM and contract forms, and its monitoring and supervision capabilities.

iii) Provide facilities and tools, such as a weighbridge, required to monitor and supervise contractors.

2) Where collection vehicles can access the discharge points, compactors will be used, and where collection vehicles cannot access discharge points the containers will be used to provide waste collection services.

3) The areas given priority for waste collection services are as follows.

i) City center.

ii) High and middle income residential areas.

iii) Low income residential areas in the city.

iv) Low income residential areas on the outskirts of the city.

4) The construction and operation of recycling facilities by public waste authorities usually require additional funding. Therefore, the master plan does not propose the construction and operation of both recycling facilities and processing facilities, but the following measures may be carried out after the institutional system undergoes complete reform.

i) Promotion of on-site composting.

ii) Separate collection at collection points for recycling waste.

iii) Provide funding for a sorting company, which will provide scavengers with job opportunities, before entry restrictions are enforced at the disposal site.

5) Taking into account the high unemployment rate, narrow and steep roads, and road congestion, street sweeping shall be manually carried out in the Central District except for some sections of the trunk roads.

6) The study provided various basic data, such as the waste generation amount and the waste composition, for proper solid waste management. The AMDC and the MCC should effectively utilize these data to manage solid wastes. The SW authorities should continue to accumulate basic data, such as differences in daily and seasonal waste amount, so that this plan may be re-examined in the future.

7) The responsible authorities for solid waste collect residential waste, business waste and large scale dischargers' waste but not construction waste and liquid waste.

8) The public final disposal site receives residential waste, business waste, non-hazardous waste, treated medical waste and non-hazardous construction waste but not liquid waste.

Part 5

Proposed Medical and Industrial Waste Management Policies

Chapter 15

Proposed
Medical and Industrial
Waste Management Policies

15 Proposed Medical and Industrial Waste Management Policies

15.1 Current Situation

15.1.1 Current Medical Waste Management Conditions

The information described in this section refers generally to the study on medical waste conducted in 1996.

a. Institutional System

In Honduras, there are no specific laws or regulations for the handling of medical wastes.

b. Waste Generation

Table 15-1 shows the medical waste generation amount estimated during the 1996 study.

Table 15-1: Medical Waste Generation Amount in the Central District

Medical Institution	Type	Number of beds	Number of patients	Amount of waste generated	Waste Generation Factor	
					kg/bed/day	kg/patient/day
Hosp. Escuela	Hospital	1,115		1,364.5	1.22	
Torax	Hospital	292		225.7	0.77	
San Felipe	Hospital	397		285.7	0.72	
San Miguel	Health center		225	15.5		0.069
Las Torres	Health center		25	2.0		0.080
Monte Redondo	Health center		20	0.5		0.025
Total				1,893.9		

c. Storage

1) The containers commonly used in health establishments are plastic waste baskets and 200 liter metallic drums. Observations show that more than 90% of the existing containers in hospitals and health care centers do not have lids and 93% are made of plastic.

2) The present number of containers is not enough to adequately store all the wastes generated. The study found that 43% of the surveyed hospitals and 53% of the health care centers lack containers for waste storage. The lack of containers affects cleansing activities because people tend to throw trash directly to the floor, thereby increasing the cleansing tasks.

3) Almost all of the health establishments lack secondary containers to be placed within or near the health service areas. This situation also adversely affects the cleansing level because the primary containers cannot be emptied more frequently.

4) None of the health establishments segregate medical wastes according to type.

5) Due to highly contagious diseases such as AIDS, hepatitis B, and cholera, the assisting personnel (medical and paramedical) are trained in the proper use of plastic containers or glass bottles, and how to store syringes, needles, etc. However, the desired results have not been achieved due to the lack of follow-ups and containers.

6) Very few health establishments insert plastic bags in their containers, probably due to economic reasons.

7) In the Escuela and San Felipe hospitals, cleansing is done by private companies. Although the use of plastic bags and supply of containers are stipulated in the contract, the private companies do not always comply with their obligations, due, in a way, to the lack of continuous supervision.

8) In the health care centers, cleansing is generally limited to sweeping and mopping. Compared with the hospitals, fumigation and disinfecting are not frequently carried out. Normally, only one person takes care of the cleansing activities, and this person also assists the nurse or doctor in rendering health services. Most of the time, there is a limited supply of cleansing materials, e.g., detergents, disinfectants, soap, broom, mops, and water containers.

d. Collection

The collection of medical wastes is carried out in two stages. The first stage is internal collection which hauls waste from their place of origin to the general gathering cabin or treatment unit. The second stage is external collection which directly transports waste from the health establishment to a treatment plant or final disposal site.

While the Escuela and San Felipe hospitals use wheeled carts, other hospitals have no collection equipment. Therefore, solid wastes have to be collected manually. Manual collection, however, has to be ceased because it exposes the personnel to health hazards.

External collection is generally carried out in three different ways: through the personnel and the use of the vehicles of the Ministry of Health; with the support of the municipalities; and by contracting private collection companies.

In the urban area in the Central District, the AMDC is in charge of collecting the waste of health care centers and hospitals. Some of the hospitals contract out waste collection to private companies.

e. Treatment

There is no incineration plant in the Central District or hospitals with incinerators for medical waste.

f. Final Disposal

There are no marked differences in the management of medical wastes and municipal wastes. They are disposed of at the same disposal site.

g. On-going Projects

There is an on-going project for the construction of an incineration plant for medical waste supported by PAHO. The capacity of this incinerator is only a few tons of waste

per day. The building and facilities have been constructed near the final disposal site of the Central District, however, the incinerator which was supposed to be imported from Switzerland has not arrived yet. In addition, the organization responsible for the operation of this plant has not been determined yet. Quite a few problems also need to be overcome first prior to the commencement of the operation of the incineration plant.

15.1.2 Current Industrial Waste Management Conditions

a. General

The 106 industries in the Central District are classified in Table 15-2.

Table 15-2: Industrial Activities in the Central District according to Code ISIC

	ISIC[1]	INDUSTRIAL ACTIVITIES IN TEGUCIGALPA	No.
1	1110	Agricultural production	1
2	3111	Slaughtering of cattle, preparation and preservation of meat	5
3	3113	Canning of fruits and vegetables	1
4	3115	Manufacture of oil, vegetable and animal fat	1
5	3116	Milling products	2
6	3117	Bakery	4
7	3118	Sugar refinery	1
8	3119	Manufacture of cacao, chocolate, confectionery goods	2
9	3121	Food processing factory	2
10	3134	Industry of non-alcoholic beverages, e.g., soft drinks	1
11	3211	Spinning, textiles and its finishing	2
12	3220	Clothes Factory	3
13	3233	Manufacture of leather goods and by-products of leather (except shoes and clothes)	1
14	3240	Manufacture of shoes (except vulcanized or molded rubber, or plastic)	3
15	3311	Wood mills, carpentry and other woodcutting work	8
16	3320	Manufacture of furniture and accessories except those made of metal	4
17	3410	Manufacture of paper and paper products	3
18	3420	Printing, editorials and related industries	8
19	3522	Manufacture of pharmaceutical products and medicines	4
20	3523	Manufacture of soaps and goods for cleansing, perfumes, cosmetics and other dressing table goods	3
21	3529	Manufacture of chemical products	6
22	3540	Manufacture of several products derived from petroleum and coal	1
23	3559	Manufacture of hard rubber products	1
24	3560	Manufacture of plastic products	3
25	3610	Manufacture of objects of clay and porcelain	2
26	3692	Manufacture of cement, lime and gypsum	3
27	3710	Basic industry of iron and steel	2
28	3812	Manufacture of metallic furniture and accessories	1
29	3819	Manufacture of metallic products	1
30	3825	Construction of office machinery	2
31	3839	Construction of electrical supplies	3
32	3843	Manufacture of vehicles and parts	4
33	3852	Manufacture of photographic apparatus and optic instruments	1
34	3909	Manufacturing Industries (not classified before)	2
35	5000	Construction	1
36	6100	Wholesale commerce	2
37	6320	Hotels, guest houses and other lodgings	1
38	7121	Transport by sea or coastal trade	1
39	7200	Communications	4
40	8201	Financial institutions	1
41	8322	Accounting services, auditing and bookkeeping	4
42	9331	Medical and dentistry services and other sanitary services	1
		TOTAL:	106

Source: National Association of Industries (ANDI), 1998

[1] International Standard Industrial Classification

b. Legal Aspects

Table 15-3 enumerates the industrial activities considered as infractions and offenses with respect to the environmental law, and the corresponding penalties imposed.

Table 15-3: Regulations and Penalties Related to Industrial Waste in the Central District

(General By-laws of the Environmental Law, 1993)

(a) INFRACTIONS		
Light	Medium	Serious
Article 110: - Pile up sawdust, coffee pulp, rice shells or other industrial waste in sites that may lead to soil and water resource contamination - Establish industries without the approval of the SERNA* - Discharge untreated industrial waste (non-toxic) into the ground, rivers, streams, etc. - Discharge human excreta into streets, vacant lots, green areas, public buildings, rivers, roadsides, roads and other prohibited areas.	**Article 111:** Repeat a light infraction	**Article 112:** - Unauthorized discharge of contaminating substances (liquids, solids or gases) into streams, tanks or the sewer system, without complying with the purification process - Discharge industrial waste into streets, vacant lots, green areas, public buildings, rivers, seas, etc. - Three penalties due to medium infractions
Fine (Lps.)		
Article 122: 1,000--5,000	Article 123: 5,000--100,000	Article 124: 100,000--1,000,000
(b) ENVIRONMENTAL OFFENSES (Article 104)		
- Produce, store, import, trade, transport, use or dispose toxic products or pollutants that are very harmful to public health and the ecosystem, without consideration of the environmental regulations - Allow the contamination of food and drinking water	- Atmospheric discharge of active pollutants or potentially dangerous products that are untreated or prohibited due to their serious effects on public health or the ecosystem. - Discharge of untreated or prohibited harmful pollutants into water systems (including water supply systems) or the ground thereby affecting groundwater resources, soil or subsoil, and consequently seriously affect public health and the ecosystem	
Sanction		
Article 107: - imprisonment of 1 to 5 years - permanent closure - temporary suspension - confiscation - canceling or revocation - compensation - replacement	**Article 106:** - imprisonment of 3 to 10 years - permanent closure - confiscation - canceling or revocation - compensation - replacement	

* SERNA: Secretariat of Natural Resources and Environment.

c. Responsible Institutions

The institutions in charge of enforcing the environmental regulations regarding the discharge of industrial solid or liquid waste are:

c.1 DECA (General Directorate of Environmental Evaluation and Control)

DECA is under the jurisdiction of the Ministry of Natural Resources and Environment. It investigates reports received on environmental infractions and offenses, and evaluates actual conditions to make the appropriate recommendations. Due to limitations in personnel, actions are based on the reports received.

c.2 CESCCO (Center of Study and Control of Pollutants)

CESCCO has been placed under the Secretariat of Natural Resources and Environment in June 1997 (formerly under the Secretariat of Public Health since August 1986). It was established through an agreement between the Swiss Federal Council (COSUDE), the PHO/WHO, and the Government of Honduras.

CESCCO performs the following: a) laboratory analysis (including analysis of chemical pollutants, e.g., pesticides, heavy metals, hydrocarbons, parameters for water and air quality analysis, etc., b) training, and c) environmental assessments.

Up till 1997, CESCCO had performed 33 environmental assessments nationwide, eight of them in the Central District, and five are still ongoing or pending. It is equipped with a modern laboratory and has biologists, micro-biologists, industrial engineers, sanitary engineers, etc., in its employ.

c.3 Environmental Attorney's Office:

The Environmental Attorney's Office is in charge of taking to court all those accused of environmental offenses, especially serious offenses that could lead to imprisonment or compensation. To effectively carry out its responsibilities, the office works in cooperation with DECA.

c.4 Environmental Department of the AMDC:

This department has been created according to Article 13 of the By-laws of the National Environmental Impact Evaluation System (SINEIA), to support the DECA on the preparation of the terms of reference, revision of EIA documents, following up and control of environmental reports.

The department accompanies other inspectors called to follow up the SINEIA and conducts environmental inspections of shops and industries applying for a license to operate. The section also executes necessary field inspections and prepares and submits technical reports and recommendations to mitigate adverse environmental impacts.

d. National Program on Waste

This is a component of the Environmental Sanitation Program within the Environmental Sanitation Department of the General Directorate of Health, under the Sub-secretariat of Population Hazards of the Secretariat of Health. This program started in December 1997, mainly in the metropolitan area, and is planned to be extended to several regions nationwide within a four year period.

d.1 Objectives:

- To establish at the national level, the proper treatment and final disposal of waste produced by households, hospitals, industries, including the special handling and disposal of toxic and hazardous wastes, to protect public health and the environment.
- To establish coordination among the municipalities, the Secretariat of Health and the Secretariat of Natural Resources and Environment for the development of an efficient waste management system.
- To contribute to the control of epidemics due to the inadequate management of waste.
- Promotion of financing to allow the efficient implementation of the selected waste management system.

d.2 Budget:

The budget of the National Program on Waste for the coming four years is as follows:

Table 15-4: Budget of the National Program on Waste

Year	1998	1999	2000	2001	TOTAL
Budget (Lps.)	5,315,300	6,717,300	8,127,933	10,243,882	30,404,415

Source: Proposal for the National Program on Waste, Secretariat of Health. Sept. 1997.

e. Discharge of Industrial Waste

In 1992 some students of the Faculty of Chemical Science and Pharmacy of the UNAH prepared a thesis on industrial waste in the Central District as a degree requirement. The students conducted a survey on the 34 main industries in Tegucigalpa, extracting samples from 1/3 of the existing industries. The survey was the only survey carried out that had a wide coverage.

The results of this survey are shown in Table 15-5. Although 6 years have passed since the survey was carried out, the results are considered useful as conditions have hardly changed. The industries have not improved their treatment and discharge systems as the Environmental Law has only been enacted for a short period, and the effluent standards have only been established for about 8 months.

Table 15-5: Survey on Industrial Waste in the Central District

No	Industrial Category	Liquid Waste	Solid Waste				Gaseous Emissions
			Remains of Products, etc.		Remains of Packing, etc.		
		Final Disposal	Treat-ment	Final Disposal	Treat-ment	Final Disposal	Final Disposal
1	Sausage Factory	AP	I	Ab	I	Ab	At
2	Sausage Factory	AP	N	B	N	B, Ab	
3	Sausage Factory	LC	I, others	R, Ab	N	BP	At
4	Sausage Factory	LC	N	R	I	Ab	At
5	Cereal Processing Factory	AP	N	R, At, Ab	I , N	Ab	At
6	Cereal Processing Factory	AP	N	B, Ab	N	B	-
7	Flour Mill	AP	N	R, A, B	N	B	-
8	Herbs & Spices Factory	AP	N	B	N	B	-
9	Bread & Cookies Factory	AP	N, R	R, Ab	N	B	At
10	Bread & Cookies Factory	AP	N	R, Ab	N	B	At
11	Bread & Cookies Factory	AP	N	R	N	R, B	At
12	Water Purification Factory	AP	-	-	N	B	At
13	Water Purification Factory	AP, C	N	B	N, R	B, R	At
14	Ice Factory	AP	-	-	N, R	B, R	At
15	Pastry Factory	AP	N	R	N	B	At
16	Pastry Factory	AP	I	Ab	I	Ab	At
17	Esp. Food Factory	AP	I, R	R	I	Ab	At
18	Food Processing	AP	N	B	N	B	At
19	Patisserie/Chewing Gum Factory	AP	R	-	N	B	At
20	Patisserie/Chewing Gum Factory	AP	R	-	I	B	At
21	Manufacturing Industry	AP	N	B	N	B	At
22	Milk Products	AP	-	-	R, N	B	At
23	Milk Products	AP	N	AP	I	-	At
24	Milk Products	AP	N	B	N	B	At
25	Milk Products	AP	-	-	N	B	At
26	Milk Products	AP	N	R	N	B	-
27	Distillery	LC	LO	Stream	N	B.a.I	At
28	Slaughterhouse	River	Firing, etc.	BP, R	I	Ab	At
29	Beer/Soft Drinks Factory	River	N	B, R	N	B	At
30	Beer/Soft Drinks Factory	Stream	-	-	N	B	At
31	Coffee Mill	AP	N	B	N	B	At
32	Coffee Mill	Stream	N	B.a.I.	N	B.a.I.	At
33	Poultry Farm	River	N	B, R	Ab	I	At
34	Poultry Farm	River	N	B	B	I	At

Note:
AP: Sewer system Ab: Abandoned in site At: Atmosphere B: Disposal site of the AMDC,
B.a.I: Open disposal site C: Road ditch BP: Own disposal site
I: Incineration LC: Collecting lagoon LO: Oxidation lagoon N: None
R: Recycling, either in the factory or by selling recoverable materials
Source: Study of Industrial Waste in Tegucigalpa, Thesis of Chemical Science and Pharmacy, Carol I. Ordoñez B., Eunice Barahona F., Jorge A. Ordoñez A. UNAH, Tegucigalpa, 1992.

The above table shows that 71% of the industries during the survey were discharging effluents directly to the sewer system, 18% to the rivers, and only 9% had collecting lagoons (Table 15-6). It is worth noting that the effluents discharged to the sewer system finally reach the Choluteca River. This is the reason why in a study made on 1994 by a Swiss student (a degree requirement at the Ecole Polytechnique Federale of Lausane, Switzerland) on the contamination of the Choluteca River, the study refers to the river and its tributaries as a "sewer network in the open". This study and others on Tahal (1993), recommended the construction of a treatment plant in order to facilitate river water purification.

The table below shows that 62% to 74% of the wastes are not treated, 12% to 24% are incinerated, and 9% to 12% are recycled. For final disposal, 35 to 65% of the industries hires the services of the AMDC to haul their waste to the final disposal site. Around 18% to 21% of the waste are abandoned in the factories or in the open; 9% to 38% are recycled by the users, sold as recoverable materials or returned to the original

manufacturer. The table also shows that all of the 34 surveyed industries emit gases (88%).

Table 15-6: Treatment and Disposal of Industrial Waste in the DC (1992)

Action /Source of Discharge	Liquid Effluents		Solid Waste								Gaseous Emissions	
			Remains of Products, etc.				Remains of Packing, etc.					
	Final Disposal		Treatment		Final Disposal		Treatment		Final Disposal		Final Disposal	
1. EFFLUENTS:	Case	%	Case	%	Case	%	Case	%	Case	%	Case	%
Sewer System	24	71										
Streams	6	18										
Collecting Lagoon												
2. TREATMENT:												
None			21	62			25	74				
Incinerated			4	12			8	24				
Recycled			4	12			3	9				
3. FINAL DISPOSAL:												
AMDC's Disposal Site					12	35			22	65		
Abandoned					7	21			6	18		
Recycled					13	38			3	9		
4. GASEOUS EMISSIONS:												
Atmosphere											30	88

15.2 Proposed Policies

15.2.1 Medical Solid Waste Management Policies

a. Improvement of Institutional System and Formulation of Guidelines

a.1 Improvement of Institutional System

The AMDC proposes the need to review the roles, tasks, responsibilities, and powers of the Central Government, the municipalities, and the institutions discharging medical waste in order to establish an agreeable institutional system.

a.2 Formulation of Guidelines

In order to enable the government to devise a medical SWM plan, a medical SWM guideline in line with the Sanitary Code will be prepared as soon as possible.

b. Formulation of the Medical SWM Master Plan

A medical SWM master plan that covers a financial plan, institutional plan, training plan, and technical plan will be formulated.

c. Educational Programs

When the medical SW guidelines are enforced, an educational program will be held for the staff of medical institutions, to promote source segregation and proper storage of infectious and non-infectious wastes.

15.2.2 Industrial Solid Waste Management (ISWM) Policies

a. Improvement of Institutional and Administrative Systems

a.1 Improvement of Institutional System

The AMDC proposes the need to review the roles, tasks, responsibilities, and powers of the Central Government, the municipalities, and the institutions discharging industrial waste in order to establish an agreeable institutional system. An administrative structure that will ensure the formulation of an institutional system will be established.

The number of staff in charge of ISWM will be increased by reforming the existing administrative structure. Technical training will be given to these staff.

a.2 Inventory System

A classification system for industrial solid wastes will be established to distinguish hazardous wastes from non-hazardous wastes.

The responsible organizations for ISWM will produce an inventory system that incorporates data on the characteristics, amount, treatment and discharge methods of industrial waste generated. These data will be periodically updated.

a.3 Introduction of Economic Incentives

Waste discharge legislation that provides economic incentives to dischargers should be introduced, to assist in minimizing ISW discharge and to control pollution.

b. Technical Assistance

Through technical assistance, administrative officers will gain technical knowledge (in discharge, treatment, recycling, and disposal methods, etc.), correct information, and will work towards the development of appropriate technologies. The administration will transfer technical information and know-how to dischargers through various transfer schemes.

c. Waste Producers

Waste producers should find the most appropriate technical measures in line with the principle that the treatment and disposal of waste they produce is their responsibility.

The administrative organization will assist waste producers in the construction and operation of a sanitary landfill and treatment system.

Appendix

Record of Pilot Projects Implementation

During the second study work in Honduras, the following four pilot projects were carried out to verify the feasibility of the technical system proposed in the M/P, introduce SWM techniques, and collect necessary data and information. The aim and the activities of the each pilot project are introduced with pictures in the following pages.

1) Campaign for Raising Awareness on Solid Waste Issues
2) Experimental Implementation of the Best Collection System for Marginal Areas
3) Experimental Improvement of the Existing Final Disposal Site
4) Improvement of the Managerial Capabilities of the Cleansing Department

1. Campaign for Raising Awareness on Solid Waste Issues

This pilot project was intended to reinforce the waste education program within the "Mobile Municipality" campaign being carried out by the municipality to promote sanitary improvement.

This mobile municipality campaign commenced in February 1998 and was carried out twice a month in poor areas, i.e., marginal areas surrounding the city where sanitary facilities are of poor standards.

The campaign started with clean-up operations involving resident participation followed by health care activities carried out in a tent, especially set up for the campaign. The health care activities were performed with the cooperation and participation of the residents, and included: vaccinations and medical check ups for children, vaccinations of pets against rabies, distribution of family planning materials and sanitary education pamphlets, and haircutting. Cultural shows (musical shows and plays), games, and soccer competitions were also held.

These activities were held with the close cooperation and the voluntary participation of the residents. The medical staff of local health centers assisted the health care activities, while cultural shows were held with the cooperation and participation of primary school students.

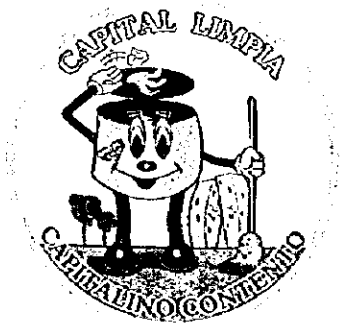
The pilot project focused on informing the public of the potential hazards of solid waste, the necessity of proper solid waste management, responsibilities of the residents and the municipalities, and the required manner of public participation.

In addition, the following were especially carried out to reinforce the waste education program:

1. Logo contest to select the campaign logo
2. Production of stickers (large: 5,000, small: 10,000) bearing the selected campaign logo
3. Production of posters (3,000)
4. Production of waste education panels (10)
5. Production of waste education texts (10,000 copies)
6. Production and set up of campaign banners (30)
7. Production of waste education videos
8. Implementation of educational programs on SWM
9. Site visits to the pilot project areas before and after execution of pilot projects

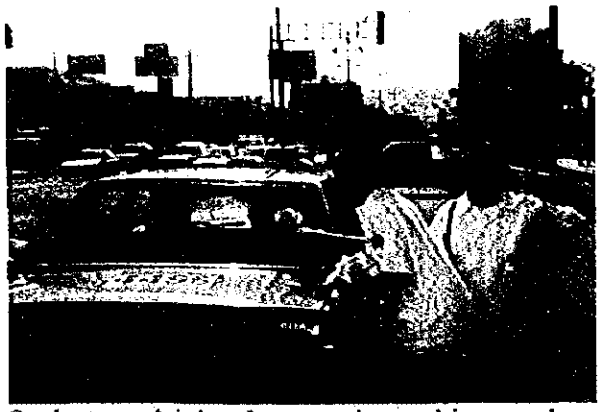
(1) Logo Contest to Select the Campaign Logo

To ensure a sustainable clean-up campaign, the planning and implementation were not left entirely to the municipality alone. The voluntary participation of the residents was considered of great importance. With this in mind, an advertisement was placed in a local newspaper to invite participants. The winning logo is shown to the right.



(2) Stickers bearing the campaign logo (large: 5,000, small: 10,000)

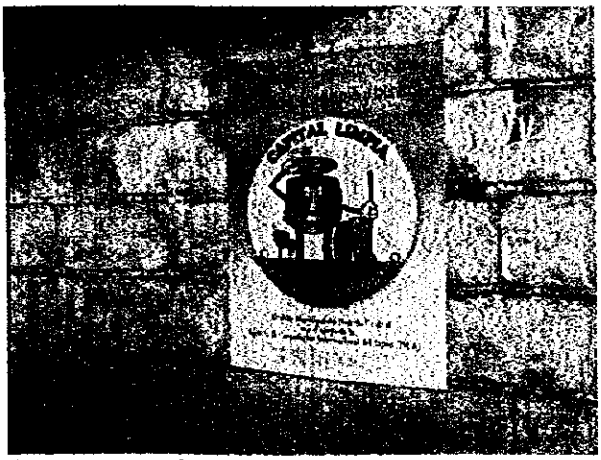
The stickers were pasted onto the municipal vehicles, and to make the campaign more effective and to enhance the students' awareness of solid waste problems, the students were asked to distribute the stickers to vehicles at the intersection.



Students explaining the campaign to drivers and sticking the campaign stickers onto the vehicles, after the driver has given them permission to do so.

(3) Posters(3,000)

To stimulate the interest of the residents in the clean-up campaign, 3,000 posters were displayed on public facilities where they can be seen by many.



A poster pasted onto a street corner

(4) Educational Panels (10)

Educational panels were designed according to the following concepts: a) the problems wastes incur, b) the present solid waste management conditions, c) the things the public can do to help. Pictures and photos were used to attract the attention of children and adults alike, and to facilitate understanding.

Educational panels set up at the sanitary campaign site

(5) Educational Texts (10,000)

Comic books briefly illustrating the adverse impacts of improper waste disposal on the public and the environment were produced. These were used in the trial lesson on SWM in primary schools, and distributed to the residents by governmental agencies.

(6) Campaign Banners (30)

Banners (30) bearing the campaign logo were set up in 30 designated places. The picture to the right shows the campaign banner set up at the central park of Tegucigalpa which is usually full of passers-by.

(7) Educational Video

An educational video was produced; the counterpart managed the whole work, e.g., script writing, acting, shooting, etc., using JICA's video camera. Through this project, the municipal staff proved that they are capable of independently producing educational videos.

Counterparts editing and dubbing the educational video they produced for the campaign

(8) Educational Programs on SWM

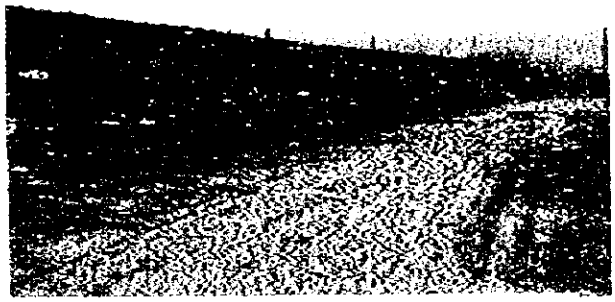
A trial lesson was conducted for 110 students from three primary schools in the marginal areas of Tegucigalpa. The educational texts produced by the counterpart and the study team were used. Discussions were held on prevailing waste problems to raise awareness, as well as on what the students can do to help solve these problems themselves.

Study team member Masaharu Kina giving a lecture in Spanish on waste problems using the educational panels

(9) Site Visits to the Pilot Project Areas Before and After Execution of Pilot Project

A total of about 30 people representing the counterpart agency, steering committee, agencies related to waste management, Ministry of International Cooperation (SETCO), the residents, the press, etc., visited the sites prior to and after the implementation of the pilot project. The visit made the representatives realize the seriousness of the problems incurred by improper waste handling and the great improvement achieved as a result of the pilot projects.

Final disposal site (Before)



Final disposal site (After)

San Martin/Ayestas area (Before)

San Martin/Ayestas area (After)

Site visit to the final disposal site
(Prior to the pilot project)

Site visit to the San Martin/Ayestas area
(After the pilot project)

2. Experiment on the Implementation of the Best Collction System for Marginal Areas

This pilot project was intended to determine the applicability of the container collection system in marginal areas where collection services are unsatisfactory or not provided at all.

For this pilot project, 5.5m^3 and 10m^3 public containers were manufactured and installed in the project area. Municipal container trucks were used to periodically collect the waste. Educational programs and clean-up operations were also simultaneously carried out to motivate the residents to further participate in the implementation of the container collection system.

This pilot project was implemented in San Martin/Ayestas and Tres de Mayo. Although both *colonias* are located comparatively close to the city center, they have poor infrastructure and consist of low-income residential areas. Due to unsatisfactory waste collection services in these *colonias*, wastes are illegally dumped resulting in the creation of an unsanitary living environment. In contrast with other marginal areas, the number of residents suffering with dengue fever was also observed to be high in these two *colonias*.

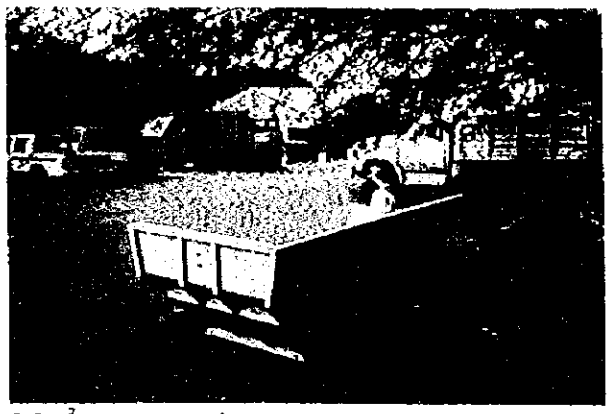
In this pilot project, public containers were installed in illegal dumpsites of the pilot project areas to urge the residents to discharge their wastes into the containers. To do so, however, it is imperative to first clear the illegal dumpsites of wastes. Nonetheless, if the removal of these wastes is to be carried out by the municipality alone, illegal dumping activities are highly likely to recur. Municipalities can only do so much to prevent such activities from becoming widespread. To successfully eliminate such activities, therefore, residents should be made to feel attached to their area, be proud of it and have a strong sense of duty to keep it clean by monitoring the waste disposal activities of those who feel otherwise. With this as a premise, the illegal dumpsites were cleared of wastes mainly with the help of the residents, assuming of course that having them clean the area themselves would make them refrain from illegally dumping wastes at the area again. The municipalities and the study team carried out public educational programs that would educate the residents on the importance of sanitation and raise awareness on waste issues, and provided the residents with the tools and vehicles for the clean-up operations.

The following activities were carried out in this pilot project.

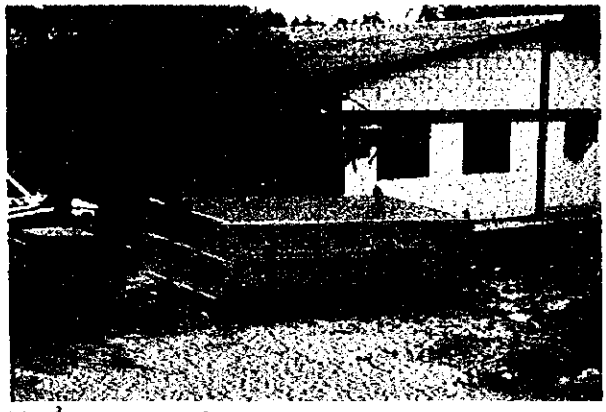
1. Manufacture of containers (three 5.5m^3 and two 10m^3)
2. Public education activities
3. Production of leaflets (to encourage public participation in clean-up operations)

(1) Manufacture of containers (three 5.5m^3 and two 10m^3)

Although light, containers are quite spacious and are therefore expensive to ship, as shipment costs are calculated by space covered. To avoid such exorbitant expenses, the containers for the pilot project were manufactured locally. The existence of a factory with the proper technology to produce containers of good quality in the central district of Tegucigalpa was confirmed



5.5m^3 waste container



10m^3 waste container

(2) Public education activities

The municipal staff and the study team held talks with the residents in a community hall and a health center within the project areas as a means of enhancing public awareness on waste problems. The talks focused on the seriousness of sanitary problems generated by wastes and the present illegal dumping conditions, and encouraged the residents to determine ways to solve these issues.

(3) Production of leaflets

In order to encourage public participation in clean-up operations, leaflets with the campaign logo were produced and distributed.

(4) Clean-up Operations

Illegally dumped wastes at the designated collection station were cleared with the voluntary participation of the residents. Cleaning the area themselves is assumed to cultivate within the residents a feeling of attachment to their environment, and encourage the discharge of wastes into the containers to be installed. The number of residents who voluntarily participated in the clean-up operations of illegal dumpsites totaled over 100 for each clean-up operation. Including participants in the street-sweeping activities, each clean-up operation had a total of over 500 participants.

San Martin/Ayestas (Before the clean-up operation) The foul smell and the flies were a constant nuisance to surrounding residents.

San Martin/Ayestas (After the clean-up operation) With the participation of the residents, the area was cleared of wastes.

(5) Container Collection System

The roads leading to the areas designated for the containers are unpaved, narrow and sloped. Although the use of a container truck was considered quite dangerous, a 5.5m^3 container truck built for such bad roads was proven to make container collection and haulage possible. With residents from other areas coming all the way to discharge their wastes, the installed containers were immediately filled up. The non-recurrence of illegal dumping activities in areas surrounding the container collection points was attributed to the effective implementation of public education activities.

Billboards bearing the following messages were set up: No illegal dumping! Let us throw our waste into the containers!

The residents abided by the regulations and made sure they disposed their wastes into the containers.

3. Experiment on the Improvement of the Existing Final Disposal Site

By demonstrating landfill techniques, conducting hands-on-training on sanitary landfill methods, improving sanitary conditions through scavenger participation, and partially improving the disposal site, this pilot project aimed to:

1. Partially improve the sanitary level of the final disposal site
2. Confirm the suitability of the technical system of the final disposal proposed in the master plan
3. Motivate the residents and the municipal staff

The present final disposal site has sufficient supply of cover soil, and is equipped with the necessary landfilling equipment provided by the Japanese government. Realistically, therefore, there should be no difficulty in speedily covering the wastes and keeping the disposal site sanitary to a certain degree. The fact that this is not carried out is attributed to problems in the technical aspects, i.e., technical ineptness, lack of knowledge and interest in sanitary landfill techniques, as well as the financial aspects of running the disposal site. Another impediment is the existence of scavengers in the disposal site.

To solve these technical problems, this pilot project covered the following:

1. Facility Improvement
   a) Erection of gates, fences and construction of a guardhouse (security improvements)
   b) Pavement of approach road (improve the landscape by reducing dust and litter, and reduce the vehicle breakdowns)
   c) Installation of a net fence to prevent waste from scattering
   d) Construction of a slope in the section completely landfilled, and turfing or planting of shrubbery (landscape improvement)
   e) Manufacture and use of movable net fence to prevent waste from scattering
   f) Installation of gas removal facilities
2. Demonstration of landfill techniques & hands-on-training of Cleansing Department staff on proper sanitary landfill methods.
3. Improving sanitary conditions through scavenger participation
   a) Formulation of final disposal site operation regulations with scavenger participation
   b) Issuing entry permits to the site for scavengers
   c) Vaccinations for tetanus and hepatitis B

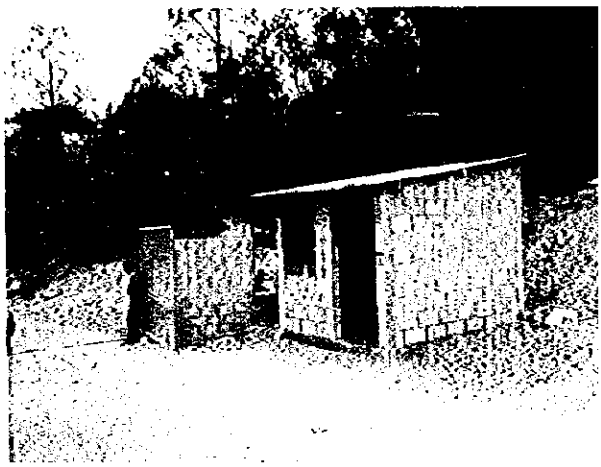
(1) Facility Improvement

a) Erection of gates, fences, and construction of a guardhouse (improvement of security facilities)

The absence of security facilities made it possible for just about anybody to enter the site. Controlling entry to the site would be the first step toward sanitary landfilling. Although fencing the entire site is desirable, only the area close to the entrance was fenced in the pilot project. Other improvements carried out to control entry to the site included the erection of a gate, construction of a guardhouse, and the installation of *"Unauthorized Persons Keep Out!"* sign.

Entrance to the final disposal site (Before the pilot project)

The gate constructed at the entrance to the final disposal site



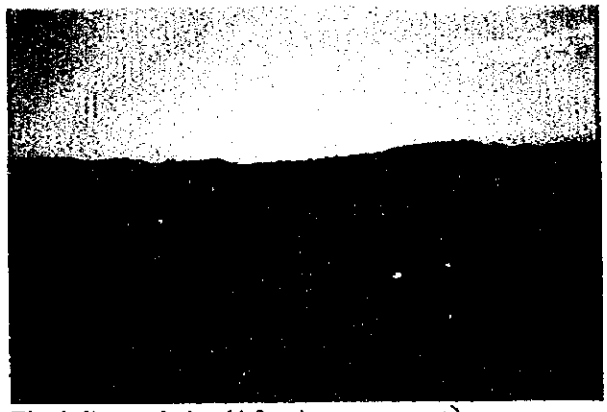
Guardhouse constructed at the site entrance

b) Pavement of Approach Road

The unpaved condition of the approach road generates dust, and the road is also littered with a lot of wastes. Since the road is visible from the public highway, such unsanitary condition does not render a good view of the site. Hence 300m of this approach road was paved to improve the landscape, eliminate dusty conditions, and to a certain degree indirectly reduce vehicular breakdowns.

Paving of the approach road

Final disposal site (Before improvement)



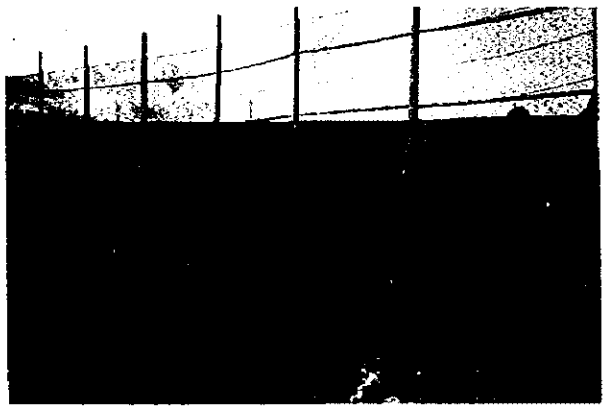
Final disposal site (After improvement)

c) Installation of a net fence to prevent waste scattering

Since the disposal site is located on high grounds, strong winds scatter the wastes. The deteriorating condition of the landscape due to waste scattering is a serious environmental problem in the disposal site. To improve the landscape, a net fence was installed at one section of the shoulder of the slope of the landfill site.

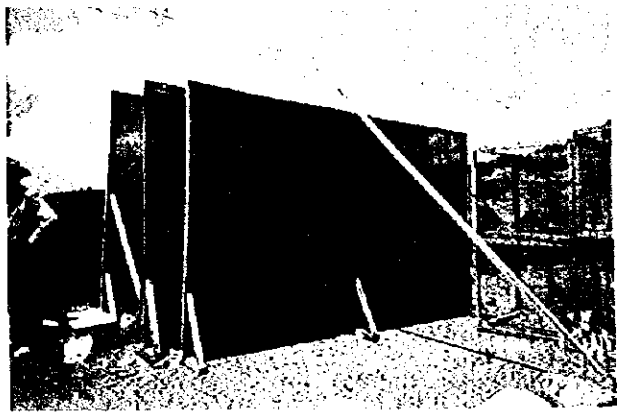
d) Construction of a slope in the section completely landfilled, and turfing or planting of shrubbery

Because the finishing touches to the slope of the landfilled section were not carried out, wastes scattered and the slope eroded, resulting in unsightly conditions. To improve these conditions, slope protection works, i.e., finishing touches on one section of the slope, turfing, and planting of shrubbery, were carried out.



e) Manufacture and use of a movable net fence to prevent waste scattering

To minimize waste scattering at the landfill section, net fences that can be moved from one landfill section to another, depending on which section is being used, were made and installed.



(f) Installation of gas removal facilities

To speedily remove, dissolve and stabilize gases generated by the covered wastes, and to prevent explosions in the site, gas removal facilities were installed.

(2) Demonstration of landfill techniques & hands-on-training on sanitary landfill methods

Guidance on proper landfill methods was extended on site using municipal vehicles.

Sanitary landfill training yard

54 trucks of waste were hauled to the sanitary landfill training yard.

Immediately after discharge, waste was leveled off with a bulldozer.

Waste was immediately covered.

First sanitary landfill layer was completed.

After the sanitary landfill operation was completed, there were no visible signs of waste buried below.

(3) Improving Sanitary Conditions through Scavenger Participation

The existence of many scavengers in the site incurs various problems. They hamper the speedy covering of wastes and create fires that spreads over the site when they burn copper wires for the recovery of copper. The unsanitary state of the disposal site also endangers their health. Driving the scavengers off the disposal site would be an ideal solution to these problems. This, however, is easier said than done. The recovery of valuable materials is the only source of income for many of the scavengers, most of who, for various reasons, are unable to enter the traditional labor market.

Given such conditions, long-term and short-term improvement plans were proposed in the M/P. The long-term plan entailed the creation of job opportunities outside of the disposal site for the scavengers to facilitate their removal from the final disposal site. The short-term plan entails the improvement of the disposal site on the premise that scavengers are working at the disposal site, and its feasibility was analyzed in the pilot project.

(a) Formulation of final disposal site operation regulations with scavenger participation

Through Project Cycle Management (PCM) workshop, it was confirmed that the scavengers themselves are strongly aware of the problems in the disposal site environment. Although their cooperation is essential to the improvement of sanitary conditions, it is common knowledge that most scavengers hate adhering to rules. Regulations were, therefore, formulated with their active participation to ensure effective enforcement.

(b) Issuing entry permits to the final disposal site for scavengers

One of the regulations agreed upon by the scavengers is the restriction of site entry to entry permit holders. To execute this regulation, the Social Development Department of the municipality issued permits to the scavengers. The permits bear the picture of the permit holder.

(c) Vaccinations for tetanus and hepatitis B

To reduce the risk of scavengers catching serious diseases, they were vaccinated against tetanus and hepatitis B. These series of considerations are expected to improve the relationship between the scavengers and the municipality into one that is based on trust and cooperation.

4. Improvement of the Managerial Capability of the Cleansing Department

This pilot project was intended to introduce methods of effectively using the various data that have been collected, teach the importance of proper management, and assist the staff in being able to analyze potential problems.

Operation and maintenance are extremely essential in solid waste management services. To highly ensure the sustainability of the SWM services, it is very important to shift the management mentality to a level that would at least take the following items into consideration:

a) The amount of waste collected by each collection vehicle the previous month

b) The costs incurred the previous month in the collection of each ton of waste

c) Cost breakdowns

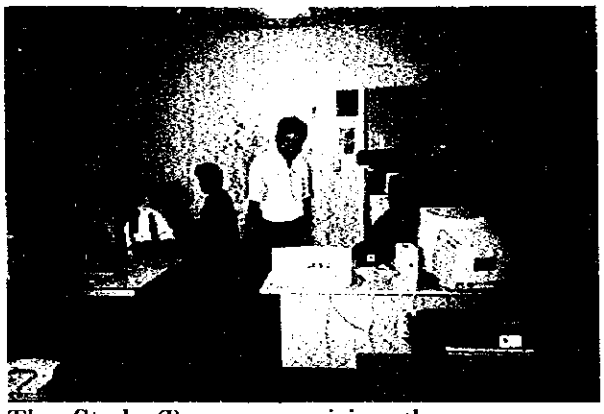
The following were implemented under this pilot project:

a) Establishment of a final disposal amount database

b) Establishment of waste collection amount database per collection vehicle

c) Establishment of a database on fuel, lubricants and spare parts expenses per collection vehicle

d) Introduction of the use of computers for solid waste data management.



The Study Team supervising the management program operation methods.

Cleansing Department staff entering data into the computer.