J.3.3 Project Cost of AMUAM

a. Investment Cost

aa. Equipment and Facilities Schedule

Table J.3.3a Equipment and Facilities Schedule for AMUAM

Item	unit	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Collection Work											
Compactor truck 15.3m3	units	53	53	53	53	53	53	53	53	108	108
Dump truck 10m3	units	17	17	17	17	17	17	17	17	20	32
2. Street Sweeping Work											
Container 1m3	nos.	8	8	8	8	8	8	8	8	16	16
3. Workshop	nos	1	1	1	1	1	1	1	1	1	1
4. Transfer and transport											
Closed trailer 50 m3	units	9	9	9	9	9	9	9	10	10	10
Open trailer 70m3	units	2	2	2	2	2	2	2	2	2	2
Civil Works	set	1	1	1	1	1	1	1	1	1	1
5. Final Disposal											
5.1 Chaco-I site											
Bulldozer 21 ton	units	6	6	6	6	6	7	7	7	7	8
Backhoe 0.7m3	units	1	1	1	1	1	1	1	1	1	1
Dump truck 10 ton	units	2	2	2	2	2	2	2	2	2	2
Water tanker	units	1	1	1	1	1	1	1	1	1	1
Excavator (UU)	units	1	1	1	1	1	1	1	1	1	1
Pickup	units	1	1	1	1	1	1	1	1	1	1
5.2 Unidentified Site	nos										
Bulldozer 21 ton	units	3	3	4	4	5	5	6	6	6	7
Backhoe 0.7m3	units	1	1	1	1	1	1	1	1	1	1
Dump truck 10 ton	units	1	1	1	1	2	2	2	2	2	2
Water tanker	units	1	1	1	1	1	1	1	1	1	1
Excavator (UU)	units	1	1	1	1	1	1	1	1	1	1
Pickup	units	1	1	1	1	1	1	1	1	1	1

ab. Procurement Schedule

Table J.3.3b Procurement Schedule of Equipment for AMUAM

Item	unit	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Collection Work												
Compactor truck 15.3m3	units	53							53	55		
Dump truck 10m3	units	17							20	12		
2. Street Sweeping Work												
Container 1m3	nos.	5							8	8		
3. Workshop												
Machineries	set	1										
4. Transfer and transport												
Closed trailer 50 m3	units	9							10			
Open trailer 70m3	units	2							2			
Machineries	set	1										
5. Final Disposal												
5.1 Chaco-I site												
Bulldozer 21 ton	units	6					1		6		1	
Backhoe 0.7m3	units	1							1			
Dump truck 10 ton	units	2							2			
Water tanker	units	1							1			
Excavator (UU)	units	1							1			
Pickup	units	1							1			
Machineries	set	1										
5.2 Unidentified site												
Bulldozer 21 ton	units	4				1		1	4		1	
Backhoe 0.7m3	units	1							1			
Dump truck 10 ton	units	1				1			1			
Water tanker	units	1							1			
Excavator (UU)	units	1							1			
Pickup	units	1							1			
Machineries	set	1										

ac. Estimation of Investment Schedule

Table J.3.3c Investment Cost Schedule of AMUAM unit:mill.Gs

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
1.	Collection Work	0	9,909	0	0	0	0	0	0	10,194	9,747	0	0	29,850
1.1	Equipment	0	9,909	0	0	0	0	0	0	10,194	9,747	0	0	29,850
	Compactor truck 15.3m		8,288							8,288	8,603			25,179
	Dump truck 10m3		1,621							1,906	1,144			4,671
2	Street Sweeping Work	0	9	0	0	0	0	0	0	9	10	0	0	28
2.1	Container 1m3		9							9	10			28
3	Workshop	200	1,284	0	0	0	0	0	0	0	0	0	0	1,484
3.1	Civil works		70											70
3.2	Building works		650											650
3.3	Machineries		564											564
3.4	Land acquisition	200												200
4	Transfer and transport	0	8,187	0	0	0	0	0	0	4,738	0	0	0	12,925
4.1	Equipment	0	4,343	0	0	0	0	0	0	4,738	0	0	0	9,081
	Closed trailer 50 m3		3,553							3,948				7,501
	Open trailer 70m3		790							790				1,580
4.2	Civil Works		1,014											1,014
4.3	Building Works		2,370											2,370
4.4	Machineries		460											460
5	Final Disposal	2,137	12,301	0	0	610	6,041	314	714	9,114	4,500	628	0	36,409
5.1	Chaco-i site	1,237	7,321	0	0	350	3,125	314	400	6,519	0	314	0	19,580
5.1.1	Equipment	0	2,947	0	0	0	0	314	0	2,947	0	314	0	6,522
	Bulldozer 21 ton		1,256					314		1,836		314		4,400
	Backhoe 0.7m3		244							244				488
	Dump truck 10 ton		444							444				888
	Water tanker		188							188				376
	Excavator (UU)		147							147				294
	Pickup		38							38				76
5.1.2	Civil Works	437	3,607			350	3,125		400	3,572				11,491
5.1.3	Building Works		587											587
5.1.4	Machineries		180											180
5.1.5	Land acquisition	800												800
5.2	Unidentified site	950	4,980	0	0	260	2,916	0	314	2,595	4,500	314	0	16,829
5.2.1	Equipment	0	2,095	0	0	0	536	0	314	2,095	0	314	0	5,354
	Bulldozer 21 ton		1,256				314		314	1,256		314		3,454
	Backhoe 0.7m3		244							244				488
	Dump truck 10 ton		222				222			222				666
	Water tanker		188							188				376
	Excavator (UU)		147							147				294
	Pickup		38							38				76
5.2.2	Civil Works	250	2,315	0	0	260	2,380	0	0	500	4,500	0	0	10,205
5.2.3	Building Works		480											480
5.2.4	Machineries		90											90
5.2.5	Land acquisition	700												700
Total		2,337	31,690	0	0	610	6,041	314	714	24,055	14,257	628	0	80,696
Physical contingency (10%)		239	3,169	0	0	61	604	31	71	2,406	1,426	63	0	8,070
Price contingency (10%)		239	3,169	0	0	61	604	31	71	2,406	1,426	63	0	8,070
Grand Total		2,864	38,028	0	0	732	7,249	377	857	28,866	17,108	754	0	96,835

b. O & M Cost

Table J.3.3d Summary of O & M Cost for AMUAM unit: mill.Gs

	Category	Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
1.	Administration												
	Labor		141	141	141	141	141	141	141	141	169	169	1,466
		General Manager	37	37	37	37	37	37	37	37	37	37	370
		Engineer	60	60	60	60	60	60	60	60	60	60	600
		Accountant	20	20	20	20	20	20	20	20	40	40	240
		Clerk	24	24	24	24	24	24	24	24	32	32	256
	Miscellaneous		6	6	6	6	6	6	6	6	6	6	60
4	Workshop		301	301	301	301	301	301	301	301	404	404	3,216
	Labor		295	295	295	295	295	295	295	295	398	398	3,156
		Manager	30	30	30	30	30	30	30	30	30	30	300
		Assistant Manager	20	20	20	20	20	20	20	20	20	20	200
		Mechanic, Foreman	105	105	105	105	105	105	105	105	150	150	1,140
		Driver, Operator	30	30	30	30	30	30	30	30	50	50	340
		Worker	90	90	90	90	90	90	90	90	120	120	960
		Clerk	20	20	20	20	20	20	20	20	28	28	216
	Maintenance		6	6	6	6	6	6	6	6	6	6	60
5	Transfer & Transport		440	440	440	440	440	440	440	466	482	482	4,510
	Labor		237	237	237	237	237	237	237	237	253	253	2,402
		Manager	30	30	30	30	30	30	30	30	30	30	300
		Assistant Manager	20	20	20	20	20	20	20	20	20	20	200
		Mechanic, Foreman	15	15	15	15	15	15	15	15	15	15	150
		Driver, Operator	130	130	130	130	130	130	130	130	140	140	1,320
		Worker	30	30	30	30	30	30	30	30	36	36	312
		Clerk	12	12	12	12	12	12	12	12	12	12	120
	Maintenance		60	60	60	60	60	60	60	60	60	60	600
	Fuel	Trailer	143	143	143	143	143	143	143	169	169	169	1,508
6	Final Disposal		3,165	3,177	3,225	3,241	5,204	4,103	4,175	6,887	5,597	5,725	44,502
6.1	Chaco-I Site		1,885	1,894	1,903	1,911	3,244	2,137	2,142	3,662	2,360	2,423	23,561
	Maintenance		83	83	83	83	83	92	92	92	92	102	885
	Labor		259	259	259	259	265	275	275	275	281	293	2,698
		Manager	30	30	30	30	30	30	30	30	30	30	300
		Foreman	30	30	30	30	30	30	30	30	30	30	300
		Trackscale operator	30	30	30	30	30	30	30	30	30	30	300
		Machine operator	110	110	110	110	110	120	120	120	120	130	1,160
		Mechanic	15	15	15	15	15	15	15	15	15	15	150
		Worker	30	30	30	30	36	36	36	36	42	42	343
		Clerk	8	8	8	8	8	8	8	8	8	8	80
		Watchman	6	6	6	6	6	6	6	6	6	6	60

	Category	Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
	Material		336	340	346	349	353	393	395	399	401	441	3,753
		Fuel & lubricant	301	303	305	306	306	344	344	346	346	385	3,286
		Insecticide	11	11	13	13	15	15	15	17	17	17	144
		Miscellaneous	24	26	28	30	32	34	36	36	38	39	323
	Utilities		57	62	65	70	74	77	80	82	86	89	742
		Water	23	25	26	28	30	31	32	33	35	36	299
		Electricity	34	37	39	42	44	46	48	49	51	53	443
	Subletting work for disposal site		1,150	1,150	1,150	1,150	2,469	1,300	1,300	2,814	1,500	1,500	15,483
6.2	Unidentified Site		1,280	1,283	1,325	1,330	1,960	1,966	2,033	3,225	3,237	3,302	20,941
	Maintenance		60	60	60	60	74	74	83	83	83	92	729
	Labor		214	214	214	214	230	230	240	246	246	256	2,304
		Manager	30	30	30	30	30	30	30	30	30	30	300
		Foreman	15	15	15	15	15	15	15	15	15	15	150
		Trecksrale operator	30	30	30	30	30	30	30	30	30	30	300
		Machine operator	90	90	90	90	100	100	110	110	110	120	1,010
		Mechanic	15	15	15	15	15	15	15	15	15	15	150
		Worker	24	24	24	24	30	30	30	36	36	36	294
		Clerk	4	4	4	4	4	4	4	4	4	4	40
		Watchman	6	6	6	6	6	6	6	6	6	6	60
	Material		132	185	227	232	290	296	344	350	356	402	2,864
		Fuel & lubricant	165	166	205	207	261	263	305	305	305	346	2,528
		Insecticide	6	6	7	8	9	9	11	13	15	17	101
		Miscellaneous	11	13	15	17	20	24	28	32	36	39	235
	Utilities		40	40	40	40	46	46	46	46	52	52	448
		Water	10	10	10	10	10	10	10	10	10	10	100
		Electricity	30	30	30	30	36	36	36	36	42	42	348
	Subleasing work for disposal site		784	784	784	784	1,320	1,320	1,320	2,500	2,500	2,500	14,596
	Total		3,906	3,918	3,969	3,932	5,945	4,844	4,916	7,654	6,483	6,611	52,228

J.3.4 Estimation of Rental Fees and Tipping Fees

a. Principle to Determine Rental Fees and Tipping Fees

The rental fees and the tipping fees were determined on the basis of "Beneficiaries-Pay-Principle". However, the administration and workshop costs were evenly distributed and added as overhead to the rental fees and tipping fees.

The concept to determine fees is shown in Figure J.3.4a.

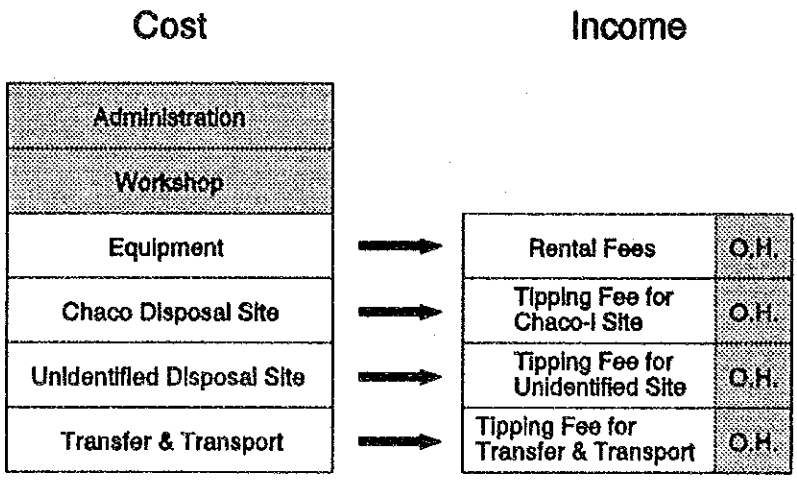

Figure J.3.4a Concept of Rental Fees and Tipping Fees

b. Overhead

Overhead for AMUAM shall not include a profit because AMUAM is a nonprofitable organization. Overhead was, therefore, set up as follows to equilibrate income and expenditure until 2006.

Overhead Cost	7,947 mill Gs
Direct Cost	141,116 mill.Gs
Total Estimated Cost for AMUAM until 2006	149,063 mill.Gs
Investment	96,835 mill Gs
O & M	52,228 mill.Gs

$$Overhead\ Rate = \frac{Overhead\ Cost}{Direct\ Cost} = \frac{7,947}{141,116} = 5.6\ \%\quad Say\ \ 6.0\ \%$$

c. Rental Fees (Annual Equivalent Costs)

This study report proposed that all municipalities except Asuncion municipality would carry out waste collection and transportation work by using equipment rented from AMUAM. The rental fees of those equipment were, thereby, calculated for cost estimation.

Rental fees, i.e. annual equivalent costs, include the cost described below.

- depreciation of equipment
- overhead: 6 % of equipment price with contingency, for AMUAM
- interest: 10%, 3% and 0%

Rental fees were calculated by the following equation.

$$Capital\ Recovery\ Factor = \frac{i\ (1+i)^n}{(i+1)^n\ -\ 1}$$

i = interest
n = year

$$Annual\ Equivalent\ Cost = Price\ with\ Contingency \times Capital\ Recover$$

Hence, the annual equivalent cost calculations were presented in Table J.3.4a to J.3.4c.

Table J.3.4a Rental Fee Calculation of Compactor Truck 15.3 m^3

Item	Calculation	Unit	10 % Interest	3 % Interest	No Interest
Basic Price	a	Gs	156,457,600	156,457,600	156,457,600
Price with contingency	b=ax1.2	Gs	187,749,120	187,749,120	187,749,120
Useful life year	c	years	7	7	7
Interest	d	%	10	3	0
Annual equivalent cost	e=@pmt(b,d,c)	Gs/year	38,564,702	30,134,927	26,821,303
Overhead for AMUAM 6%	f=(b/c)x0.06	Gs/year	1,609,278	1,609,278	1,609,278
Total	g=e+f	Gs/year	40,173,980	31,744,205	28,430,581

Table J.3.4b Rental Fee Calculation of Dump Truck 10 tons

Item	Calculation	unit	10 % Interest	3 % Interest	No Interest
Basic Price	a	Gs	95,341,350	95,341,350	95,341,350
Price with contingency	b=ax1.2	Gs	114,409,620	114,409,620	114,409,620
Useful life year	c	years	7	7	7
Interest	d	%	10	3	0
Annual equivalent cost	e=@pmt(b,d,c)	Gs/year	23,500,365	18,363,471	16,344,231
Overhead for AMUAM 6%	f=(b/c)x0.06	Gs/year	980,654	980,654	980,654
Total	g=e+f	Gs/year	24,481,019	19,344,125	17,324,885

Table J.3.4c Rental Fee Calculation of Container 1 m^3

Item	Calculation	unit	10 % Interest	3 % Interest	No Interest
Basic Price	a	Gs	1,165,910	1,165,910	1,165,910
Price with contingency	b=ax1.2	Gs	1,399,092	1,399,092	1,399,092
Useful life year	c	years	5	5	5
Interest	d	%	10	3	0
Annual equivalent cost	e=@pmt(b,d,c)	Gs/year	369,077	305,498	279,818
Overhead for AMUAM 6%	f=(b/c)x0.06	Gs/year	16,789	16,789	16,789
Total	g=e+f	Gs/year	385,866	322,287	296,608

d. Tipping Fees

This study report proposed that AMUAM would operate waste final disposal work for 15 municipalities, and operate transfer and transportation work for Asuncion and F.Mora. Tipping fees to be charged to municipalities by AMUAM were, thereby, estimated for cost estimation.

da. Tipping Fee of Waste Disposal for Chaco-i Site

Table J.3.4d Estimation of Tipping Fee with 10 % Interest of Waste Disposal for Chaco-i Site unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Base	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	3,194	3,833	7	10 %	-	788	-	788
Machinery	180	216	15	10 %	-	28	-	28
Civil Work	11,491	13,789	10	10 %	-	2,244	-	2,244
Building	587	704	30	10 %	-	75	-	75
Land	800	960	-	-	5 %	-	48	48
O&M (average 1997-2006)	-	-	-	-	-	2,356	-	2,356
sub-total	-	-	-	-	-	5,490	48	5,539
Overhead	-	-	-	-	-	329	3	332
Total	-	-	-	-	-	5,820	51	5,871

Tipping Fee = Yearly Cost ÷ Average Yearly Waste Disposal Amount
= 5,871,000,000 Gs ÷ 288,131 ton = 20,376 Gs/ton

Table J.3.4e Estimation of Tipping Fee with 3 % Interest of Waste Disposal for Chaco-i Site

unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Base	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	3,194	3,833	7	3 %	-	615	-	615
Machinery	180	216	15	3 %	-	18	-	18
Civil Work	11,491	13,789	10	3 %	-	1,617	-	1,617
Building	587	704	30	3 %	-	36	-	36
Land	800	960	-	-	5 %	-	48	48
O&M (average 1997-2006)	-	-	-	-	-	2,356	-	2,356
sub-total	-	-	-	-	-	4,642	48	4,690
Overhead	-	-	-	-	-	278	3	281
Total	-	-	-	-	-	4,290	51	4,971

Tipping Fee = 4,971,000,000 Gs ÷ 288,131 ton = 17,253 Gs/ton

Table J.3.4f Estimation of Tipping Fee without Interest of Waste Disposal for Chaco-i Site

unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Base	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	3,194	3,833	7	0	-	548	-	548
Machinery	180	216	15	0	-	14	-	14
Civil Work	11,491	13,789	10	0	-	1,379	-	1,379
Building	587	704	30	0	-	23	-	23
Land	800	960	-	-	0.05	-	48	48
O&M (average 1997-2006)	-	-	-	-	-	2,356	-	2,356
sub-total	-	-	-	-	-	4,320	48	4,368
Overhead	-	-	-	-	-	259	3	262
Total	-	-	-	-	-	4,579	51	4,630

Tipping Fee = 4,630,000,000 Gs ÷ 288,131 ton = 16,071 Gs/ton

db. Tipping Fee of Waste Disposal for Unidentified Disposal Site

Table J.3.4g Estimation of Tipping Fee with 10 % Interest of Waste Disposal for Unidentified Site unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Basic	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	2797	3356.4	7	0.1	-	689	-	689
Machinery	90	108	15	0.1	-	14	-	14
Civil Work	10205	12246	10	0.1	-	1,993	-	1,993
Building	480	576	30	0.1	-	61	-	61
Land	700	840	-	-	0.05	-	42	42
O&M (average 1997-2006)	-	-	-	-	-	2,094	-	2,094
sub-total	-	-	-	-	-	4,851	42	4,894
Overhead	-	-	-	-	-	291	3	294
Total	-	-	-	-	-	5,142	45	5,187

Tipping Fee = Yearly Cost ÷ Average Yearly Waste Disposal Amount
= 5,187,000,000 Gs ÷ 194,618 ton = 26,654 Gs/ton

Table J.3.4h Estimation of Tipping Fee of Waste Disposal with 3 % Interest for Unidentified Site unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Basic	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	2797	3356.4	7	0.03	-	539	-	539
Machinery	90	108	15	0.03	-	9	-	9
Civil Work	10205	12246	10	0.03	-	1,436	-	1,436
Building	480	576	30	0.03	-	29	-	29
Land	700	840	-	-	0.05	-	42	42
O&M (average 1997-2006)	-	-	-	-	-	2,094	-	2,094
sub-total	-	-	-	-	-	4,107	42	4,149
Overhead	-	-	-	-	-	246	3	249
Total	-	-	-	-	-	4,353	45	4,398

Tipping Fee = 4,398,000,000 Gs ÷ 194,618 ton = 22,597 Gs/ton

Table J.3.4i Estimation of Tipping Fee without Interest of Waste Disposal for Unidentified Site unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Basic	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	2797	3356.4	7	0	-	479	-	479
Machinery	90	108	15	0	-	7	-	7
Civil Work	10205	12246	10	0	-	1,225	-	1,225
Building	480	576	30	0	-	19	-	19
Land	700	840	-	-	0.05	-	42	42
O&M (average 1997-2006)	-	-	-	-	-	2,094	-	2,094
sub-total	-	-	-	-	-	3,824	42	3,866
Overhead	-	-	-	-	-	229	3	232
Total	-	-	-	-	-	4,053	45	4,098

Tipping Fee = 4,098,000,000 Gs ÷ 194,618 ton = 21,059 Gs/ton

dc. Tipping Fee of Waste Transfer and Transportation

Table J.3.4j Estimation of Tipping Fee with 10 % Interest of Transfer and Transportation unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Price	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	4462	5354.4	7	0.1	-	1,100	-	1,100
Machinery	460	552	7	0.1	-	113	-	113
Civil Work	1014	1216.8	30	0.1	-	129	-	129
Building	2370	2844	30	0.1	-	302	-	302
Land	0	0	-	-	0.05	-	0	0
O&M (average 1997-2006)	-	-	-	-	-	451	-	451
sub-total	-	-	-	-	-	2,095	0	2,095
Overhead	-	-	-	-	-	126	0	126
Total	-	-	-	-	-	2221	0	2,221

Tipping Fee = Yearly Cost ÷ Average Yearly Waste Disposal Amount
= 2,221,000,000 Gs ÷ 256,997 ton = 8,641 Gs/ton

Table J.3.4k Estimation of Tipping Fee with 3 % Interest of Transfer and Transportation unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Price	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	4462	5354.4	7	0.03	-	859	-	859
Machinery	460	552	7	0.03	-	89	-	89
Civil Work	1014	1216.8	30	0.03	-	62	-	62
Building	2370	2844	30	0.03	-	145	-	145
Land	0	0	-	-	0.05	-	0	0
O&M (average 1997-2006)	-	-	-	-	-	451	-	451
sub-total	-	-	-	-	-	1606	0	1,606
Overhead	-	-	-	-	-	96	0	96
Total	-	-	-	-	-	1703	0	1,703

Tipping Fee = Yearly Cost ÷ Average Yearly Waste Disposal Amount
= 1,703,000,000 Gs ÷ 256,997 ton = 6,625 Gs/ton

Table J.3.4l Estimation of Tipping Fee without Interest of Transfer and Transportation unit: mill.Gs

	Price		Useful Life Year	Interest	Rental Rate	Cost		
	Price	with contingency				Annual Equivalent	Rental Cost	Total Yearly Cost
Equipment	4462	5354.4	7	0	-	765	-	765
Machinery	460	552	7	0	-	79	-	79
Civil Work	1014	1216.8	30	0	-	41	-	41
Building	2370	2844	30	0	-	95	-	95
Land	0	0	-	-	0.05	-	0	0
O&M (average 1997-2006)	-		-	-	-	451	-	451
sub-total	-	-	-	-	-	1430	0	1,430
Overhead	-	-	-	-	-	81	0	86
Total	-	-	-	-	-	1,516	0	1,516

Tipping Fee = Yearly Cost ÷ Average Yearly Waste Disposal Amount
= 1,516,000,000 Gs ÷ 256,997 ton = 5,899 Gs/ton

J.3.5 Cost of Each Municipalities

The estimated MSWM costs for 15 municipalities are included in Data Book.

The summary of estimated MSWM costs for all municipalities are presented in Table J.3.5a.

Table J.3.5a Summary of Estimated MSWM Cost unit: mill.Gs

Municipality	Waste Disposal Amount 1997-2006	Interest=10%		Interest=3%		Interest=0%	
		Total Cost mill.Gs	Unit Cost Gs/ton	Total Cost mill.Gs	Unit Cost Gs/ton	Total Cost mill.Gs	Unit Cost Gs/ton
Asuncion	2,213,725	143,698	64,912	132,321	59,773	128,098	57,865
F.Mora	356,240	24,185	67,890	21,427	60,148	20,391	57,240
Lambare	415,370	23,261	56,001	20,658	49,734	19,662	47,336
San Lorenzo	462,820	24,220	52,331	23,302	50,348	22,234	48,040
Capiata	310,615	17,442	56,153	15,569	50,123	14,854	47,821
Luque	405,880	24,772	61,033	23,309	57,428	21,368	52,646
M.R.Alonso	181,405	9,878	54,453	8,903	49,078	8,531	47,027
Villa Elisa	162,425	9,264	57,036	8,300	51,101	7,931	48,829
Nemby	118,625	8,376	70,609	7,583	63,924	7,280	61,370
J.A.Saldivar	6,205	814	131,185	777	125,222	762	122,804
Ita	52,560	4,649	88,451	4,269	81,221	4,124	78,463
Aregua	14,600	2,123	145,411	2,002	137,123	1,955	133,904
Limpio	80,665	6,160	76,365	5,658	70,142	5,467	67,774
Villa Hayes	35,770	3,325	92,955	3,088	86,329	2,998	83,813
B.Aceval	15,330	1,874	122,244	1,764	115,068	1,722	112,329
Total	0	160,343		146,609		139,279	

J.3.6 Project Cost

The project cost is summarized in Table J.3.6a.

Table J.3.6a Cost of the First Priority Project for AMUAM unit:mill.Gs

Project	Executing Bodies	Description	Total Amount mill.Gs	Local Portion mill.Gs	Foreign Portion 1,000 USD
Collection Improvement	Municipality of Asuncion	Project Amount Contents - Procurement of waste collection trucks, containers and machineries for the existing workshop	8,585	303	4,565
	AMUAM	Total Project Amount	20,798	2,997	9,466
		[Collection Improvement] Project Amount Contents - Procurement of waste collection trucks, containers	11,901	5	6,325
		[Workshop] Project Amount Contents - Land acquisition: 1 ha - Construction of a workshop building . Floor area: 800 m^2 . Procurement of equipment for the workshop	1,781	813	515
		[Un-identified Disposal Site] Project Amount Contents - Land acquisition: 100 ha - Construction of a final disposal site . Capacity: 800,000 m^3 . Design life year for Phase 1: 4 years . Area of landfill: approximately 25 ha . Target operation level: Level 2 . Facilities: Office, warehouse, truckhouse, fence, gate, parking, etc. - Procurement of equipment for landfill operation	7,116	2,179	2,626
Transfer and Transport	AMUAM	Project Amount Contents - Costruction of a transfer station . RC structure, two-storied building . Capacity and transfer system Direct re-loading system: 15 ton/hour Indirect re-loading system: 110 ton/hour - Procurement of open and closed trailers	9,824	2,411	3,942
Chaco-i Disposal Site	AMUAM	Project Amount Contents - Land acquisition: 200 ha - Construction of a final disposal site . Capacity: 1,600,000 m^3 . Design life year for Phase 1: 4 years . Area of site development: approximately 100 ha . Target operation level: Level 3 . Facilities: Office, warehouse, truckhouse, fence, gate, parking, etc. - Procurement of equipment for landfill operation	10,270	2,931	3,902
Total Project Amount			49,477	8,642	21,872

J.4 Project Evaluation

J.4.1 Evaluation Method

a. Social Evaluation

The social evaluation of each project was conducted on the basis of the following factors:

- creation of jobs
- improvement of the public health in the study area
- appropriateness of technology
- improvement of technical level
- impacts on cleansing service workers
- recovery of degraded areas
- conformity with the city structure
- equality of service level

b. Environmental Evaluation

The environmental evaluation of each project was carried out regarding the assessment items set up by adopting "Matrix for Scoping" by JICA.

c. Economic and Financial Evaluation

ca. Method of economic and financial evaluation

The method of economic and financial evaluation applied in this study are shown in Table J.4.1a

Table J.4.1a Economic and Financial Evaluation Methods

Project	Collection improvement	AML Transfer and Transport	Chaco-i Disposal Site
Economic Evaluation	- Least cost method - Qualitative analysis	- Cost-benefit analysis - Quantitative analysis	- Least cost method - Qualitative analysis
Financial Evaluation	- Income and expenditure analysis	- Income and expenditure analysis	- Income and expenditure analysis

The methods presented in the table were adopted for the following reasons:

- Economic evaluation on an environmental project is usually carried out based on a least cost method because quantitative benefits are too difficult to estimate.

- Since the reduction of transportation cost is expected, a cost-benefit analysis is used for the project that proposes the AML transfer station in order to analyze its economic value on a national scale.

- Qualitative analysis is adopted for the Chaco-i sanitary landfill project. Because it is an indispensable facility for MSWM, although the quantitative benefits are not expected.

- Financial evaluation is carried out on the income and expenditure analysis of the AMUAM and 15 municipalities.

cb. Methods of economic evaluation

The economic evaluation method in this study are shown Table J.4.1b.

Table J.4.1b Benefits, Costs and Criteria

	Collection Improvement	AML Transfer & Transport	Chaco-i Disposal Site
Benefit	Environmental improvement - Improvement of public health - Development of sightseeing resource - Land price increase - Reduction of sanitary cost Employment generation Reduction of collection cost Reduction of drain blockage	Reduction of Transportation Cost* Others - Environmental improvement - Promotion of regional development	Environmental improvement - Improvement of public health - Preservation of ground water - Protection from scattering waste - Land price increase - Reduction of sanitary cost Ultimate use of reclaimed land
Cost	Investment O&M	Investment O&M	Investment O&M
Criteria	None	IRR > 12%**	None
Evaluation Period	1996 - 2025	1996- 2025	1996-2025

Note. * This was estimated quantitatively.
** From STP.

cc. Methods of Financial Evaluation

The income and expenditure taken into account for evaluation are tabulated in Table J.4.1c.

Table J.4.1c Income, Expenditure and Evaluation

Items / Organizations	Revenue	Expenditure
1. AMUAM		
Collection	Rental Fee (Gs/unit)	Depreciation and Maintenance of Vehicles
Street Sweeping	Rental Fee (Gs/unit)	Depreciation and Maintenance of Vehicles
Transfer Operation	Tipping Fee (Gs/ton)	Depreciation and O&M of Facilities, Vehicles and Equipment
Final Disposal	Tipping Fee (Gs/ton)	Depreciation and O&M of Facilities, Vehicles and Equipment
2. Asuncion		
Collection	Collection Fee (Gs/month)	Depreciation and O&M of Vehicles
Street Sweeping	Collection Fee (Gs/month)	Depreciation and O&M of Vehicles
Transfer Operation	Collection Fee (Gs/month)	Tipping Fee
Final Disposal	Collection Fee (Gs/month)	Tipping Fee
3. Other 14 Municipalities		
Collection	Collection Fee (Gs/month)	Rental Fee of Vehicles and O&M
Street Sweeping	Collection Fee (Gs/month)	Rental Fee of Vehicles and O&M
Transfer Operation	Collection Fee (Gs/month)	Tipping Fee
Final Disposal	Collection Fee (Gs/month)	Tipping Fee

The assumptions which were set up for estimation of income and expenditure are as follows:

- The municipality of Asuncion bear the following cost:
  - Purchase of required equipment such as a compactor truck and a container, for waste collection work and street sweeping work;
  - Investment and O & M for a workshop; and
  - Tipping fees for transfer and transportation and final disposal.

- Tipping fees for final disposal are determined for the Chaco-i disposal site and for the unidentified disposal site respectively, taking their conditions into account.

Since MSWM is an indispensable public utility and the executing bodies are AMUAM and Asuncion Municipality, the standard of the financial evaluation was set as follows:

- As for AMUAM, the evaluation standard was set as "the Project should be viable", i.e. the FIRR is more than 3%, even in the case of minimum rental and tipping fees (CRF=0%), with either 10% decrease in total revenues or 10% increase in total expenses.

- As for Asuncion Municipality, since collection vehicles and equipment are planned to be procured by a loan, the evaluation standard was set as "the Project should be viable", i.e. the FIRR is more than 3%, even in the case of maximum rental and tipping fees (CRF=10%), with either 10% decrease in total revenues or 10% increase in total expenses.

J.4.2 Evaluation of Collection System Improvement Project for 15 Municipalities

a. Social Evaluation

aa. Contents of the project

The improvement of collection system for 15 municipalities consists of the following projects:

- Extension of collection service area for 12 municipalities
- Commencement of collection service for J.A. Saldivar, Aregua and B. Acevai municipalities
- Extension of street sweeping service length for 8 municipalities
- Commencement of street sweeping service for 7 municipalities
- Establishment of proper operation and maintenance system
- Provision of landfill equipment for unidentified inter-municipal disposal sites

ab. Social evaluation

The ultimate objective of the Improvement of Collection System for the 15 Municipalities is to create a clean living environment in the Asuncion Metropolitan Area, for the healthy life of it's residents.

This objective will be reached basically through:

- the improvement of the solid wastes collection services
- the improvement of the street sweeping activities and

- the improvement of the refuse disposal operations

From a social standpoint, however, the project yields other assets beyond it's main objective.

These assets are mainly the following:

- Creation of jobs, technical as well as unskilled ones (primarily these the least)

- Improvement of the Public Health in the area, since it is recognized that there is a linkage between the health status of the population and the cleanliness of the public spaces which includes the effectiveness of the refuse collection services.

- Improvement of the technical level of Paraguayan professionals, mostly engineers, but also technicians.

- Improvement of working conditions for the unskilled laborers, primarily on matters related to safety and hygiene.

- Recovery of degraded areas making them viable to be used by the community, specially as in the case of the existing municipal landfills in the municipalities.

- General improvement in the landscape, be it in the urbanized areas as well as in the open green spaces.

The evaluation of most of these outcomes quantitatively is rather difficult, since many of them have a strong psychological component and it's measurement is sometimes impossible to be made. Qualitatively, the improvement of collection system for 15 municipalities is feasible from a social view point because the big contribution of the above-mentioned assets will be expected. In addition. the proposed plan is appropriate in terms of technology because the system is widely practiced in the Study area and causes little problem. Furthermore, the implementation of the project will contribute to equality of cleansing service level in the area since it aims at the extension and commencement of services.

However, a quantitative evaluation shall be made on the social outcomes of the project based on:

i. accountability of the new jobs that will be created with the correspond-

ing incomes;

ii. employee survey, seeking the opinion of the municipalities' laborers and technicians on the improvements of the services;

iii. public opinion survey, similar to the one made at the beginning of the project; and

iv. evaluation of public health status by specific indicators.

b. Environmental Assessment

ba. Outline of the Project

The outline of the improvement of collection system is summarized as follows;

- Area of collection service will be expanded
- Street length of street sweeping service will be extended

bb. Environmental impact by the execution of the project

bba. Environmental impact by the expansion of the collection service area

The following impacts will be considered as results of the expansion of the collection service area;

- Scattered waste and dust which are caused by inappropriate waste treatment, like illegal disposal of waste, will be reduced.
- Water pollution caused by inappropriate waste treatment, like illegal disposal of waste, will be reduced.
- Blockade of water way which is likely to be caused by inappropriate waste treatment, like illegal disposal of waste, will be reduced.
- Soil pollution caused by inappropriate waste treatment like, illegal disposal of waste, will be reduced.
- Offensive odor caused by inappropriate waste treatment like, illegal disposal of waste, will be reduced.
- Insanitary areas will be reduced.
- Air pollution, noise and vibration may occur due to new traffic of collection vehicles.

bbb. Environmental impact by the extension of street sweeping service

The following impact will be considered as results of the expansion of street sweeping service:

- Dust from streets will be reduced
- Water polluting materials on streets will be reduced.
- Generation of offensive odor caused by kitchen waste on streets will be reduced.
- Noxious insects will be reduced.
- Traffic obstacles will be decreased, as cars skidding on street waste are reduced.
- The appearance of streets will be improved.

bc. Impact assessment

bca. Setting goals for environmental preservation

Collection service is for the improvement and preservation of the environment. The impact assessment on the environment regarding the collection service system can not be measured like the one of water quality, where preservation target can be quantified. Therefore, the goal for environmental preservation is set as " A project to improve the present environment, and a project with no excessive adverse impact on the present environment"

bcb. Impact assessment

Most of the results from the prediction about the impact caused by the expansion of collection service area are in favor of the improvement of the present environmental situations, and therefore, are satisfying the goal of environmental preservation as well. On the other hand it is true that the inevitable traffic increase due to collection vehicles would have mal effects on the living environment, e.g. air pollution, etc.. However, the number of additional traffic created by collection vehicles for each municipality are not more than 10 per day. This number is about the same figure which can be created by general traffic. This means the increase in the traffic due to additional collection vehicles would not cause adverse effects on the present environment. Therefore, the results of the prediction satisfy the goal of environmental preservation.

All of the prediction results of the impact caused by the extension of street sweeping length were in favor of the improvement of the environmental preservation. Therefore, the prediction results satisfy goal of the environmental preservation.

c. Economic and financial evaluation

The improvement of the solid wastes collection systems of 15 municipalities was evaluated from the economic and financial viewpoints. The proposed plan for improving the solid wastes collection systems in the 15 municipalities consists of the lowest cost method among the several alternatives that were carefully considered. This evaluation procedure is known as the "least cost method".

ca. Economic evaluation

Qualitative evaluation was used for assessing the benefits from the improved collection systems of solid wastes in the 15 municipalities of the Asunción Metropolitan Area (AMA). Benefits evaluated qualitatively as generated by this Project component were the following.

caa. Environmental improvement

i. Improved public health

Better solid wastes collection systems imply less scattered trash in public areas and less illegal dump sites. The society at large reaps the benefits in the form of reduced number of focus of pathogenic germs and disease vectors, which ultimately lead to better public health. The economic significance is to be found in less absenteeism and longer productive life of workers.

The economically active population in the Asunción Metropolitan Area in 1992 was estimated at 552,521, of which 523,221 were fully occupied (Source: Cuentas Nacionales 1982/1992, BCP, 1993). Assuming initially that the prevailing minimum monthly salary of Gs345,000 reflects the marginal productivity of labor, and that there are 23 working days in a month, then the marginal productivity of labor is Gs15,000 per day. This means that a one-day absenteeism of the 523,221 fully occupied economically active population amounts to a production loss of Gs7,848,315,000, which is equivalent to US$4,130,692 at the exchange rate of Gs1,900 per one US$. These are the financial values of production loss for one-day absenteeism. On the other hand, the labor force data for the Asunción Metropolitan Area (Indicadores de la Fuerza de Trabajo, Area Metropolitana 1983-1991, STP, 1992) indicate that 40% of the occupied economically active population can be categorized as unskilled workers. If the assumed correction factor for unskilled workers (0.5) is applied to 40% of fully occupied economically active population, the economic value of production loss for one-day absenteeism would be US$3,304,554.

ii. Avoidance of tourism loss

Foreign tourists get a bad impression of the city they are visiting if public places are littered with rubbish. This was evidenced in the 1994 Rio de Janeiro carnival in which around one-fourth of a sample of tourists complained about trash. A better garbage collection system reduces the chance of losing repeat tourism due to inadequate solid wastes collection.

In 1991, Paraguay was visited by 296,813 foreign tourists, and their estimated spending amounted to US$144,600,000. Then, potential losses (one-fourth) would be US$36,150,000, since it can be safely assumed that most foreign tourists come to the Asunción Metropolitan Area (Source: Anuario Estadístico del Paraguay 1991, STP, 1993).

iii. Land value appreciation

Studies conducted in the United States documented cases where the land value increased as a result of the improved quality of the adjoining water body, or due to less polluted air quality. For instance, land value surrounding a water body increased between 8% and 25% in the U.S., depending on the distance from the shore, when the water quality improved (Source: Benefit of Water Pollution Control on Property Values, by D.M.Dornbush and S.M.Barrager, EPA-600/5-73-005, Washington, D.C., 1973) . Under the same reasoning, the land value can be expected to increase as a result of the environmental improvement consisting of better solid wastes collection, that is, less trash scattered in public sites.

iv. Extra costs avoidance

Inadequate solid wastes collection will create focus for breeding of pests, and for emission of foul odors and contamination of air and water. In order to neutralize these unwanted effects, households may have to incur extra costs such as pest control treatment, use of air freshener, and water treatment.

cab. Employment generation

During the collection process of solid wastes, the method selected for street sweeping makes a big difference in employment. Sweeping machines are available, but if manual sweeping is selected, the social benefits from employment generation are undeniable. Needless to say, the said social benefits should be weighed against the efficiency criterion of the operating entity.

The street sweeping crew of Asunción Municipality in 1992 was composed of 232

persons, whose yearly earnings assuming the minimum monthly salary of Gs345,000 would amount to Gs960,480,000, without social benefits. At the assumed exchange rate of Gs1,900 per US$, and the 0.5 correction factor for unskilled labor, the economic value of yearly earnings of the Asunción street sweeping crew would amount to nearly US$253,000.

cac. Lower collection cost

Haphazard dumping and scattering of solid wastes in public places imply the need for extra works at additional collection costs. The World Bank estimates 3 to 10 times higher collection costs for wastes scattered along roads. In other words, an improved solid wastes collection system can be implemented at one-third to one-tenth of the costs needed for the collection of garbage scattered in public sites.

cad. Reduced flood damage

Inadequate solid wastes collection implies scattered garbage which ends up in storm drainages and canals during rain. The resulting clogging of storm drainages causes flood damages, and reducing these flood damages requires added costs for unclogging storm drainages. Therefore, an improved solid wastes collection should reduce the costs for unclogging storm drainages, leading ultimately to reduced flood damage.

cb. Financial evaluation

Financial evaluation was conducted taking as basis the whole MSWM operation (collection, transfer station, final disposal) under two main implementing agencies: Asunción Municipality and AMUAM. The other 14 municipalities would be implementing the Project as operating entities of MSWM.

Asunción was assumed to be in charge of its MSWM, except operation and maintenance of the transfer station and the final disposal site. AMUAM was assumed to be responsible for the investment and replacement needed for the MSWM in the remaining 14 municipalities, operation and maintenance of the centralized workshop for the machinery and equipments that would be rented out to the 14 municipalities, operation and maintenance of the transfer station and the final disposal sites.

cba. Revenues and Expenses

i. Municipal Revenues and Expenses

Revenues from solid wastes disposal services by municipality were estimated on the basis of the willingness to pay survey conducted during the first stage field work. The assumed monthly payments (weighted average with income groups distribution as weight) by user groups and by type of municipalities were as follows.

Table J.4.2a Assumed Monthly Payments unit: Gs

User Groups	Type of Municipalities		
	HUM	UM	LUM
Household	7,322	4,053	3,538
Food Shops	11,250	5,689	5,299
Other Shops	25,430	12,859	11,978
Market Shops	5,625	2,845	2,650

An 80% bill collection rate was assumed.

Municipal expenses differed for Asunción on one hand, and the remaining 14 municipalities on the other. Asunción municipality had the following expense items: investment and replacement, operation and maintenance of machinery and equipments, tipping fees for the transfer station and the final disposal site, and administrative expenses. The remaining 14 municipalities, on the other hand, had the following expense items: rental fees for machinery and equipments, tipping fees for the transfer station (F. Mora) and the final disposal sites (all municipalities), operation of the rented machinery and equipments, and administrative expenses.

ii. Revenues and Expenses of AMUAM

Revenues of AMUAM consisted of payments made by member municipalities as rental and tipping fees. Tipping fees for sanitary landfills were paid by all of the 15 municipalities, tipping fees for transfer station by two municipalities (Asunción and F. Mora), and rental fees for machinery and equipments by 14 municipalities except Asunción.

Rental and tipping fees were calculated as "annual equivalent costs", that is, by applying the "capital recovery factor" to the price of component items, under specified assumptions on interest rates and useful life of the said items. The useful

life of different items were estimated from the engineering viewpoint.

Three levels of rental and tipping fees were estimated by assuming three different interest rates for the capital recovery factor. These interest rates were 10% (IDB ordinary funds at 7.0 to 8.75% plus 0.75% commitment commission), 3% (OECF), and 0% (donation). Results of these calculations were presented elsewhere, in J.3.4 Estimation of Rental Fees and Tipping Fees.

Expenses of AMUAM consisted of investment and replacement needed for the MSWM in 14 municipalities except Asunción, as well as the operation and maintenance of the facilities and machinery that would be used by more than one municipality, and administrative expenses. These expenses included acquisition and replacement of machinery and equipments, land acquisition, in addition to construction,operation and maintenance of the transfer station and sanitary landfills.

cbb. Financial Internal Rate of Return (FIRR)

The cash flow analysis conducted on the basis of the assumed revenues and expenses are shown in Table J.4.2c, J.4.2d and J.4.2e for Asunción Municipality, and in Table J.4.2f, J.4.2g and J.4.2h for AMUAM. Resulting financial internal rates of return (FIRR) are summarized in Table J.4.2b.

Table J.4.2b Results of FIRR

Implementing Agency	Financial Internal Rate of Return		
	CRF 10%	CRF 3%	CRF 0%
Asuncion	38.27%	51.97%	56.95%
AMUAM	17.72%	12.73%	10.67%

Note: CRF stands for Capital Recovery Factor.

The FIRR for Asunción increased when the assumed interest rate for the capital recovery factor decreased, because the lower interest rate resulted in lower tipping fees and a more favorable cash flow. The opposite was true in the case of FIRR for AMUAM. Lower interest rates resulted in lower rental and tipping fees, which implied lower revenues or less favorable cash flow for AMUAM.

Table J.4.2c Cash Flow for Asuncion with 10 % Interest unit: mill.Gs

Year	House-holds	Revenue Types				Expense Types				Cash Flow
		Food Shops	Other Shops	Market Shops	Total	Invest-ment	O & M	Tipping Fee	Total	
1996	0	0	0	0	0	8585	0	0	8585	-8585
1997	8191	58	6266	300	14815	797	4524	5402	10723	4092
1998	8256	60	6485	310	15112	706	4582	5719	11007	4105
1999	8322	62	6712	321	15418	377	4807	6037	11221	4197
2000	8389	65	6947	332	15733	2998	4865	6355	14218	1515
2001	8456	67	7191	344	16057	4396	5092	6482	15970	87
2002	8523	69	7442	356	16391	655	5150	6598	12403	3988
2003	8592	72	7703	369	16735	8179	5179	6725	20083	-3348
2004	8660	74	7972	382	17088	567	5293	6853	12713	4375
2005	8730	77	8251	395	17453	380	5462	6969	12811	4642
2006	8799	79	8540	409	17828	566	5520	7096	13182	4646

Hence, FIRR is 38.27% with 10% interest for 30 years project life.

Table J.4.2d Cash Flow for Asuncion with 3 % Interest unit: mill.Gs

Year	House-holds	Revenue Types				Expense Types				Cash Flow
		Food Shops	Other Shops	Market Shops	Total	Invest-ment	O & M	Tipping Fee	Total	
1996	0	0	0	0	0	8585	0	0	8585	-8585
1997	8191	58	6266	300	14815	797	4524	4445	9766	5049
1998	8256	60	6485	310	15112	706	4582	4706	9994	5118
1999	8322	62	6712	321	15418	377	4807	4968	10152	5266
2000	8389	65	6947	332	15733	2998	4865	5229	13092	2641
2001	8456	67	7191	344	16057	4396	5092	5334	14822	1235
2002	8523	69	7442	356	16391	655	5150	5430	11235	5156
2003	8592	72	7703	369	16735	8179	5179	5534	18892	-2157
2004	8660	74	7972	382	17088	567	5293	5639	11499	5589
2005	8730	77	8251	395	17453	380	5462	5735	11577	5876
2006	8799	79	8540	409	17828	566	5520	5839	11925	5903

Hence, FIRR is 51.97% with 3% interest for 30 years project life.

Table J.4.2e Cash Flow for Asuncion with No Interest unit: mill.Gs

Year	Revenue Types					Expense Types				Cash Flow
	House-holds	Food Shops	Other Shops	Market Shops	Total	Invest-ment	O & M	Tipping Fee	Total	
1996	0	0	0	0	0	8585	0	0	8585	-8585
1997	8191	58	6266	300	14815	797	4524	4090	9411	5404
1998	8256	60	6485	310	15112	706	4582	4330	9618	5494
1999	8322	62	6712	321	15418	377	4807	4571	9755	5663
2000	8389	65	6947	332	15733	2998	4865	4811	12674	3059
2001	8456	67	7191	344	16057	4396	5092	4908	14396	1661
2002	8523	69	7442	356	16391	655	5150	4996	10801	5590
2003	8592	72	7703	369	16735	8179	5179	5092	18450	-1715
2004	8660	74	7972	382	17088	567	5293	5188	11048	6040
2005	8730	77	8251	395	17453	380	5462	5277	11119	6334
2006	8799	79	8540	409	17828	566	5520	5373	11459	6369

Hence, FIRR is 56.95% with no interest for 30 years project life.

Table J.4.2f Cash Flow for AMUAM with 10% Interest unit: mill.Gs

Year	Revenue Types			Expense Types			Cash Flow
	Machinery Rental	Tipping Fee	Total	Investment	O & M	Total	
1995	0	0	0	2864	0	2864	-2864
1996	0	0	0	38028	0	38028	-38028
1997	2333	8871	11204	0	3906	3906	7298
1998	2333	9732	12065	0	3918	3918	8147
1999	2333	10642	12975	732	3969	4701	8274
2000	2333	11521	13854	7249	3982	11231	2623
2001	2333	12628	14961	377	5945	6322	8639
2002	2333	13703	16036	857	4844	5701	10335
2003	2333	14827	17160	28866	4916	33782	-16622
2004	2333	15902	18235	17108	7654	24762	-6527
2005	4611	17000	21611	754	6483	7237	14374
2006	4611	18080	22691	0	6611	6611	16080

Hence, FIRR is 18.06% with 10% interest for 30 years project life.

Table J.4.2g Cash Flow for AMUAM with 3% Interest unit: mill.Gs

Year	Revenue Types			Expense Types			Cash Flow
	Machinery Rental	Tipping Fee	Total	Investment	O & M	Total	
1995	0	0	0	2864	0	2864	-2864
1996	0	0	0	38028	0	38028	-38028
1997	1835	7368	9203	0	3906	3906	5297
1998	1835	8087	9922	0	3918	3918	6004
1999	1835	8850	10685	732	3969	4701	5984
2000	1835	9588	11423	7249	3982	11231	192
2001	1835	10518	12353	377	5945	6322	6031
2002	1835	11425	13260	857	4844	5701	7559
2003	1835	12374	14209	28866	4916	33782	-19573
2004	1835	13277	15112	17108	7654	24762	-9650
2005	3633	14205	17838	754	6483	7237	10601
2006	3633	15115	18748	0	6611	6611	12137

Hence, FIRR is 12.73% with 3% interest for 3 years project life.

Table J.4.2h Cash Flow for AMUAM with No Interest unit: mill.Gs

Year	Revenue Types			Expense Types			Cash Flow
	Machinery Rental	Tipping Fee	Total Revenues	Invest-ment	Operat.& Mainten.	Total Expenses	
1995	0	0	0	2864	0	2864	-2864
1996	0	0	0	38028	0	38028	-38028
1997	1646	6808	8454	0	3906	3906	4548
1998	1646	7476	9122	0	3918	3918	5204
1999	1646	8182	9828	732	3969	4701	5127
2000	1646	8863	10509	7249	3982	11231	-722
2001	1646	9731	11377	377	5945	6322	5055
2002	1646	10572	12218	857	4844	5701	6517
2003	1646	11453	13099	28866	4916	33782	-20683
2004	1646	12292	13938	17108	7654	24762	-10824
2005	3256	13156	16412	754	6483	7237	9175
2006	3256	14005	17261	0	6611	6611	10650

Hence, FIRR is 10.67% with no interest for 30 years project life.

Table J.4.2i Cash Flow for Each Municipality with 10% Interest

unit: mill.Gs

Year	Asuncion	F.Mora	Lambare	San Lorenzo	Capiata	Luque	M.R. Alonso	Villa Elisa	Nemby	J.A. Saldivar	Ita	Aregua	Limpio	Villa Hayes	B. Aceval	Fifteen Municip.
1996	-8585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8585
1997	4092	144	-796	-843	-591	-1028	-409	-350	-381	-64	-284	-155	-343	-168	-131	-1306
1998	4105	120	-806	-931	-639	-1084	-419	-358	-400	-64	-291	-155	-361	-164	-130	-1575
1999	4197	86	-805	-1015	-696	-1146	-429	-355	-429	-63	-306	-164	-371	-168	-135	-1799
2000	1515	446	-534	-550	-399	-798	-255	-252	-327	-54	-258	-137	-263	-110	-99	-2076
2001	87	435	-596	-664	-481	-913	-292	-286	-359	-54	-271	-146	-282	-118	-105	-4047
2002	3988	436	-657	-785	-571	-1022	-320	-317	-390	-62	-285	-145	-293	-118	-103	-644
2003	-3348	428	-725	-892	-648	-1124	-353	-356	-419	-61	-297	-153	-311	-126	-106	-8490
2004	4375	423	-781	-995	-721	-1210	-374	-382	-447	-60	-311	-152	-329	-126	-112	-1201
2005	4642	-670	-1751	-2146	-1501	-2276	-856	-818	-929	-89	-429	-228	-631	-291	-167	-8139
2006	4646	-672	-1802	-2241	-1567	-2355	-870	-837	-954	-87	-443	-227	-647	-290	-171	-8517

Table J.4.2j Cash Flow for Each Municipality with 3% Interest

unit: mill.Gs

Year	Asuncion	F.Mora	Lambare	San Lorenzo	Capiata	Luque	Alonso	Villa Elisa	Nemby	J.A. Saldivar	Ita	Aregua	Limpio	Villa Hayes	B. Aceval	Fifteen Municip.
1996	-8585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8585
1997	5049	346	-605	-685	-488	-895	-352	-290	-334	-61	-258	-146	-313	-152	-123	694
1998	5118	335	-607	-753	-525	-936	-358	-293	-349	-61	-263	-146	-327	-148	-122	567
1999	5266	316	-600	-818	-568	-982	-363	-288	-372	-60	-275	-154	-335	-151	-126	490
2000	2641	689	-323	-334	-259	-618	-185	-180	-266	-51	-226	-127	-224	-92	-90	354
2001	1235	691	-367	-420	-320	-703	-210	-203	-290	-51	-236	-134	-238	-98	-94	-1440
2002	5156	704	-410	-511	-388	-782	-228	-224	-313	-58	-247	-133	-246	-97	-92	2131
2003	-2157	709	-459	-590	-445	-855	-250	-251	-336	-57	-256	-139	-259	-103	-94	-5541
2004	5589	717	-497	-664	-497	-912	-261	-267	-356	-56	-267	-138	-272	-101	-99	1920
2005	5876	-289	-1373	-1710	-1204	-1880	-697	-668	-804	-83	-377	-209	-550	-252	-150	-4369
2006	5903	-278	-1406	-1777	-1249	-1930	-700	-676	-822	-81	-388	-208	-561	-251	-153	-4577

Table J.4.2k Cash Flow for Each Municipality with 0% Interest unit: mill.Gs

Year	Asuncion	F.Mora	Lambare	San Lorenzo	Capiata	Luque	M.R. Alonso	Villa Elisa	Nemby	J.A. Saldivar	Ita	Aregua	Limpio	Villa Hayes	B. Aceval	Fifteen Municip.
1996	-8585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8585
1997	5404	421	-533	-625	-448	-843	-330	-267	-317	-60	-248	-143	-302	-146	-120	1444
1998	5494	415	-532	-686	-481	-879	-335	-269	-330	-60	-252	-143	-315	-142	-119	1368
1999	5663	401	-523	-744	-519	-919	-338	-262	-350	-59	-264	-150	-321	-144	-123	1348
2000	3059	779	-242	-253	-205	-548	-158	-152	-242	-50	-214	-123	-209	-85	-87	1269
2001	1661	786	-280	-328	-259	-622	-179	-172	-264	-50	-223	-130	-221	-90	-90	-463
2002	5590	803	-316	-407	-318	-690	-193	-189	-284	-56	-232	-129	-228	-89	-88	3174
2003	-1715	813	-358	-475	-367	-751	-211	-211	-304	-55	-241	-134	-239	-93	-90	-4430
2004	6040	826	-389	-539	-411	-798	-218	-223	-321	-54	-250	-133	-251	-91	-94	3095
2005	6334	-144	-1227	-1543	-1091	-1729	-635	-610	-757	-80	-357	-202	-519	-238	-143	-2940
2006	6369	-128	-1254	-1599	-1128	-1768	-635	-615	-772	-78	-367	-201	-529	-236	-146	-3087

cbc. Sensitivity Analysis

Sensitivity analysis was conducted for both Asunción and AMUAM under specified conditions of decreased revenues and/or increased expenses. Results of the sensitivity analysis are shown in Table J.4.2l and J.4.2m.

Table J.4.2l Results of the Sensitivity Analysis for Asuncion

No.	Case	FIRR		
		CRF-10%	CRF-3%	CRF-0%
1	Base Case	38.27%	51.97%	56.95%
2	10% Decrease in Total Revenues	19.02%	31.99%	37.03%
3	10% Increase in Total Expenses	20.64%	33.78%	38.84%
4	10% Decrease in Total Revenue and 10% Increase in Total Expenses	5.72%	16.89%	21.37%

Table J.4.2m Results of the Sensitivity Analysis for AMUAM

No.	Case	FIRR		
		CRF-10%	CRF-3%	CRF-0%
1	Base Case	18.06%	12.73%	10.67%
2	10% Decrease in Total Revenues	15.03%	10.13%	8.20%
3	10% Increase in Total Expenses	15.31%	10.37%	8.43%
4	10% Decrease in Total Revenue and 10% Increase in Total Expenses	12.50%	7.91%	6.07%

Asunción was a lot more sensitive than AMUAM to both decreased revenues and increased expenses. Both AMUAM and Asunción were slightly more sensitive to decreased revenues than to increased expenses.

A 10% decrease in revenues or a 10% increase in expenses affected the FIRR of Asunción and AMUAM quite differently. As a matter of fact, while in the case of Asunción the FIRR declined by around 20% from the base case, in the case of AMUAM the FIRR declined only by around 3%. The high sensitivity of Asunción to fluctuations in revenues or expenses justifies the seemingly high values of FIRR obtained as base cases.

Under the simultaneous 10% decrease in revenues and 10% increase in expenses, AMUAM remained with a FIRR of 12.5% when the interest rate assumed for the capital recovery factor was 10%. Asunción, on the other hand, remained feasible under the same conditions only if the interest rates for the capital recovery factor were 3% (FIRR=16.89%) or 0% (FIRR=21.37%).

d. Overall Evaluation

The Project, Improvement of Collection System for 15 Municipalities, is concluded to be feasible from social, environmental, economical and financial viewpoints.

Socially, there will be many benefits to be gained, which signify the appropriate-ness of the Project.

Environmentally most of the results of impact assessment are in favor of the improvement of the present environmental situations.

Economically, qualitative evaluation of the solid wastes collection street sweeping system improvement clarified the benefits to be obtained, which indicate the goodness of the Project.

Financially, the most important conclusion is that the two implementing agencies, Asuncion Municipality and AMUAM, show viable results. However, analyses of the 14 municipalities other than Asuncion show that there are serious cash flow problems at municipal levels. This will put to hard test the political will of each individual municipality and AMUAM to really push ahead with the MSWM project.

J.4.3 Evaluation of Construction Project of AML Transfer Station

a. Social Evaluation

The main objective of the construction of the AML transfer station is to reduce waste transportation cost of Asuncion and F.Mora municipalities.

From a social standpoint, however, the project yields other benefits beyond its main objective.

These benefits are mainly the following:

- Creation of jobs, technical as well as unskilled ones.
- Improvement of the public health in Asuncion and F.Mora as the project will contribute to the haulage systems of the two municipalities.
- Reduction of the traffic volume.
- Improvement of the technical level of Paraguayan professional engineers mostly, but also technicians.
- Improvement of working condition of the unskilled personnel basically of matter related to safety and hygiene.

The evaluation of most of these outcomes quantitatively is rather difficult, since many of them have a strong psychological component and its measurement is sometimes impossible to be made. Qualitatively, the constriction of AML transfer station is feasible socially because the big contribution of the above mentioned benefits will be expected.

However, a quantitative evaluation shall be made on the social outcomes of the project based on:

i. accountability of the new jobs that will be created with the corresponding incomes; and

ii. employee survey, seeking the opinion of the municipalities' laborers and technicians on the improvements of the services.

b. Environmental Evaluation

ba. Outline of the project

The outline of the transfer station project can be summarized as follows;

- The transfer station is to be a two story structure. Transfer of collected waste will be done by dropping the waste from the second floor to a large compactor trailer track on the first floor.
- A pit for storing waste is not provided.
- The number of vehicles coming in and out in a day is planned 124 per day and 25 per day respectively.
- For the purpose of smooth transfer operation, extra trailer trucks for carrying out waste are always stationed.
- The transfer of waste is conducted inside a building in order to prevent noise and offensive odor.
- The floor of the transfer station is washed by water every day in order to prevent offensive odor and to maintain sanitary work environment.
- The waste water from washing the floor is stored in specially prepared highly water tight containers, which is periodically transported by a tank lorry to the newly planned final disposal site. Therefore, the sewer is not disposed of into a nearby drainage.
- The cleaning of vehicles is not done in this transfer station.

bb. Selection of assessment items

The assessment items are set up as follows, adopting "Matrix for Scoping" by JICA.

i. Relocation of residents

There are no residents inside the project area. Accordingly there are no citizens being affected by the presences of the T/S. Therefore, relocation of residents is not considered as an assessment item.

ii. Traffic and public facilities

The project area faces to Madame Lynch Avenue which is one of the trunk roads of Asuncion. Therefore, concentration of collection vehicles will have some impact on the traffic and public facilities. Accordingly it will be considered as an assessment item.

iii. Health and sanitation

Because of carrying in and out vehicles, there will be an little impact on health and sanitary. Therefore, it will be selected as an assessment item.

iv. Waste

There will be no large scale earth work for the construction of the transfer station. Waste generated by the construction works will be assumed to be little. Therefore, waste is not selected as an assessment item.

v. Ground water

The transfer operation will be conducted inside the building. Therefore, there is no chance that waste brought in is exposed to rain, which means leachate will not be generated. Accordingly, the impact on ground water will be close to zero. Ground water is not considered as an assessment item.

vi. Condition of proximal water bodies

The impact on condition of lakes and rivers is not considered because the construction of the transfer station will involve a large scale earth works which causes changes in the flowing of river water. Therefore, condition of lakes and rivers is not selected as an assessment item.

vii. Flora and fauna

At present the project site is under the military management and it is used as a grazing land where cattle are put out to pasture. There is no primary forest within the project site. Therefore, almost no impact on flora and fauna is considered. It is not selected as an assessment item.

viii. Landscape

As mentioned, the project site is under the military management and is used as a grazing land for cattle. There will be some impact on landscape, if a building is constructed there. Therefore, landscape is selected as an assessment item.

ix. Air pollution

There will be some impact on air by exhaust gas emitted by construction equipments during the construction and by the operation of collection vehicles.

Therefore, air pollution is selected as an assessment item.

x. Water pollution

Some impact on water pollution is considered owing to floor washing and vehicles washing. Therefore, water pollution is selected as an assessment item.

xi. Soil pollution

As the transfer operation will be conducted inside the building, spreading of pollutants is not forecasted. There will be almost no impact on soil. Therefore, soil pollution is not selected as an assessment item.

xii. Noise and vibration

There will be some impact on noise and vibration due to the concentration of collection vehicles. Therefore, noise and vibration are selected as an assessment item.

xiii. Offensive odor

Offensive odor due to vehicles carrying waste in and out is estimated to cause a small amount of impact. Therefore, offensive odor is selected as an assessment item.

As a result, seven items of traffic and public facilities, health and sanitary, landscape, air pollution, water pollution, noise and vibration, and offensive odor are selected as assessment items.

bc. Environmental impact

i. Traffic and public facilities

As a result of field study, traffic volume of Madame Lynch Avenue, where the project site is located, is approximately 16,000 vehicles per day. On the other hand the number of vehicles of carrying waste to and from is scheduled to be 124/day and 25/day respectively. The ratio of traffic volume by vehicles carrying waste to and from is predicted small as to compared to the total volume of traffic on Madame Lynch street, though future total traffic volume on the street stays same as it is at present. However, it is presumed that the vehicles carrying waste in and out will have impact on the traffic on Madame Lynch street at the time of in and out of the transfer station. There is no public facilities like schools and etc. in the

proximity of the project site. Therefore, there will be no impact on those public facilities.

ii. Health and sanitary

The transfer operation will be conducted by dropping waste from the second floor level to the first floor level. Therefore, the time during which the waste is exposed to the air is short. And also the floor will be confided to be kept clean by washing with water repeatedly. Therefore, there will only be a few flies and rats which is likely to gather on kitchen waste. It is predicted that the impact on health and sanitation can be little.

iii. Landscape

In the vicinities of the project site there is no facilities which are particularly concerned with landscape. Therefore, there is no impact on the resources of landscape.
The topography of the project site is flat. There will be almost no change in topography by the earth work of the construction. There are no buildings behind the site. Therefore, the building of the transfer station will be considered to have an impact on the landscape in this area.

iv. Air pollution

Numbers of vehicles of carrying waste to and from the transfer station are scheduled to be 124/day and 25/day respectively. This is small in comparison to the present traffic volume on the street. Therefore, the impact on the air by the exhaust from the waste transportation vehicles is considered little. Since the transfer operation will be conducted inside a building, spreading of dust and waste around the transfer station can be minimized. Therefore, the impact on the air is predicted to be little.

v. Water pollution

The waste water from washing the floor will be stored in a specially prepared highly water tight pit, then transported periodically by a tank lorry to a newly planned final disposal site, where it will be sprayed. Therefore, it is planned not to be discarded to a nearby sewerage or drainage. Besides washing vehicles will not be conducted in this transfer station. Therefore, the impact on the water quality is predicted to be little.

vi. Noise and vibration

Numbers of vehicles of carrying waste to and from the transfer station are scheduled to be 124/day and 25/day respectively. This amount is small in comparison to the present traffic volume on the street. Therefore, the impact from the noise and vibration by the waste transportation vehicles is considered little.

vii. Offensive odor

The offensive odor generated from the waste can be reduces and kept at a minimum because all of the transfer operation of waste will be conducted inside the building, the operation will be done by dumping waste from the second floor level to the first floor level, which makes time of the exposure of waste to the air short, and the floor shall be kept clean by washing the floor repeatedly by water. Besides, the waste water generated from washing floor will be stored in a specially prepared highly water tight pit. Therefore, the offensive odor generated from the leachate can be reduced as well.
Consequently, the impact by the offensive odor is predicted to be little.

bd. Impact assessment

bda. Setting goals for environmental preservation

i. Traffic and public facilities

It is not possible to set quantitative target figures to control traffic and public facilities. Accordingly, the goal for environmental preservation regarding traffic and public facilities is set as " Not to have too much impact on surrounding traffic and on utilization of surrounding public facilities".

ii. Sanitary and health

As in the case of traffic and public facilities, the goal for environmental preservation regarding sanitary and health is set as "Not to have too much impact on sanitation and health in the surrounding area".

iii. Landscape

It is also not possible to set a quantitative target for landscape. Accordingly, the goal for environmental preservation regarding landscape is set as " Not to have too much impact on landscape resources, and should be a facility to be harmonized with the surrounding landscape.

iv. Air pollution

In the Republic of Paraguay environmental standard and exhaust emission standard regarding air pollution have not yet been established. Therefore, the goal for environmental preservation regarding air pollution is set as " Not to pollute the existing air extremely".

v. Water pollution

The environmental preservation goal regarding water pollution is set as the environmental standard for water quality set by the Republic of Paraguay.

vi. Noise and vibration

In the Republic of Paraguay the environmental standard and restriction regarding noise and vibration have not yet been established, as in the case of air pollution. Therefore, the goal for environmental preservation regarding noise and vibration is set as "Not to worsen the present situation of noise exceedingly".

vii. Offensive odor

In the Republic of Paraguay the environmental standard and restriction regarding offensive odor have not yet been established, as in the cases of air pollution and noise and vibration. Therefore, the goal for environmental preservation is set as "Not to worsen the present situation exceedingly".

bdb. Impact assessment

i. Traffic and public facilities

Since there are no public facilities in the proximity of the project site, the impact on public facilities is predicted to be zero. Accordingly, the goal for environmental preservation regarding public facilities is achieved. However, some impact on the environment caused by traffic in Madame Lynch Avenue is anticipated as vehicles carrying waste to and from the transfer station increases. This does not clear the goal. Therefore, it is necessary to take measures against foreseeable situations.

ii. Health and sanitation

Occurrence of noxious insects is little. The impact on health and sanitation is predicted to be little. The result of the prediction indicates the achievement of the goal for environmental preservation.

iii. Landscape

In the vicinities of the project site there are no facilities which are particularly concerned with landscape erosion, Therefore, no impact on the resources of landscape is predicted. At the same time it is predicted that the construction of the transfer station will have impact on the surrounding landscape. According to the prediction results, the impact on the resources of landscape achieves the goal, but the impact by the building of the transfer station does not accomplish the goal for environmental preservation.

iv. Air pollution

The exhaust from vehicles carrying waste to and from is little in comparison to the one from the present traffic. Spreading of waste and dust will be prevented by the transfer station. Accordingly, the impact on air pollution is predicted to be little. The result of the prediction achieves the goal for environmental preservation.

v. Water pollution

The sewage from washing floor is planned not to be discharged to nearby bodies of water. Vehicle washing will not be conducted in the transfer station. Accordingly, the impact on water quality is predicted to be little. The result of the prediction achieves the goal for environmental preservation.

vi. Noise and vibration

The impact on noise and vibration is predicted to be little, since the number of vehicles carrying waste to and from the transfer station is comparatively small. Therefore, the result of the prediction achieves the goal for environmental preservation.

vii. Offensive odor

All of the transfer operation of waste will be conducted inside the building. The sewage generated from washing the floor will be stored in a highly water tight pit. Accordingly offensive odor generated from waste and sewage can be reduced. It is predicted that the impact of offensive odor is little. Therefore, the result of the prediction achieves the goal for environmental preservation.

be. Proposal for preservation measures

The items which require preservation measures are traffic, impact from vehicles

carrying waste to and from the facilities, and landscape, impact from the construction of the building of the transfer station itself.
The following are preservation measures for traffic affected by vehicles carrying waste in and out of the facilities;

- To provide an exclusive lane by improving the present Madame Lynch Avenue
- To provide traffic signal at the entrance in order to guide vehicles carrying waste to and from the facilities
- To station a guard at the entrance of the facilities to regulate traffic in order to guide vehicles carrying waste to and from the facilities

From the above options it appears more practical to station a traffic control man.
Preservation measures for landscape affected by the construction of the building are as follows;

- To make the building height as low as possible.
- To adopt a color scheme which makes outside wall of the building well camouflaged.
- To plant trees around the site as a buffer.
- To apply two of above mentioned measures at a time.

From the above options it appears most practical to plant trees around the site as a buffer.

bf. Monitoring

The most important items for environmental preservation in this transfer station are the construction of the building and floor washing. By conducting transfer operations inside the building, impact on health and sanitation, dust noise and offensive odor can be reduced. The monitoring should be conducted based on these view points regarding the following items. These items are in common with the maintenance of general facilities.

- To monitor the building to prevent it from becoming too old for use and being damaged.
- To monitor the execution of floor washing.
- To monitor the sewer pit to prevent it from becoming to old for use and being damaged.

c. Economic and financial evaluation

The transfer station for improving transportation of solid wastes in the Asunción Metropolitan Area was evaluated from the economic and financial viewpoints.

ca. Economic evaluation

Benefits were defined as the reduction in operation and maintenance costs resulting from the transfer station. Costs, on the other hand, were defined as the added investment required to achieve the reduction in operation and maintenance costs.

For the economic evaluation, market prices were adjusted using the following correction factors.

caa. Standard Conversion Factor (SCF)

The SCF was calculated from foreign trade data published by the Central Bank of Paraguay (Boletín Estadístico No.403, BCP, Mayo 1993), using the following formula.

$$SCF = (M+X) / (M+Tm) + (X-Tx)$$

Item	1990	1991	1992	1993
Import (M)	1,352,018	1,460,312	1,421,601	4,233,931
Import tax (Tm)	85,443	111,530	105,046	302,019
Export (X)	958,681	737,096	156,555	2,352,332
Export tax (Tx)	30,859	13,037	97	43,993

SCF=(4,233,931+2,352,332)/(4,233,931+302,019)+(2,352,332-43,993)

SCF = 0.96

cab. Correction for unskilled labor

The following data were used.

- Correction factor for unskilled labor: 0.5
  (World Bank: Guidelines for Calculating Financial and Economic Rates of Return for DFC Projects)
- Unskilled labor: 40% of labor force
  (STP, Indicadores de la Fuerza de Trabajo, Area Metropolitana 1983-1991)

- Labor costs: 30% of O&M costs
  (Assumption for the EIRR calculation)

Table J.4.3a shows that the EIRR resulting from the transfer station is 18.0% if the useful life of the project is assumed to be 30 years.

Table J.4.3a Economic Evaluation for Transfer and Transport System

unit: mill.Gs

Year	Investment			O & M			Cash Flow
	With T.S.	Without T.S.	"Cost" (Change in Inv.)	With T.S.	Without T.S.	"Benefit" (Savings in O&M)	
1996	14036	10367	3669	0	0	0	-3669
1997	636	601	35	3611	3917	306	271
1998	563	1052	-489	3664	4059	395	884
1999	300	752	-452	3869	4423	554	1006
2000	2396	2704	-308	3922	4601	679	987
2001	3365	300	3065	3948	4708	760	-2305
2002	519	451	68	4001	4779	778	710
2003	11087	10517	570	4027	4886	859	289
2004	449	1202	-753	4137	4954	817	1570
2005	300	1502	-1202	4827	5178	351	1553
2006	300	1202	-902	4880	5285	405	1307

Hence, EIRR is 18.00% with 10% interest for 30 years project life.

cb. Financial evaluation

cba. FIRR

Revenues consisted of the Tipping Fee from the municipalities of Asunción and Fernando de la Mora. Three levels of tipping fee were estimated using three interest rates 10%, 3% and 0%.

Expenditures, on the other hand, consisted of those for investment as well as for operation and maintenance. Investments included contingency allowances, and one-third of investments on the centralized workshop (one-third of the workshop investment included in the final disposal, and one-third in the solid wastes collection system). Operation and maintenance costs of the Transfer Station also included one-third of AMUAM's operation and maintenance costs.

Table J.4.3b, J.4.3c and J.4.3d show details on the expenditures and revenues of the Transfer Station. The resulting FIRR were 12.14% (CRF-10%), 7.09% (CRF-3%) and 5.10% (CRF-0%).

Table J.4.3b Financial Evaluation for Transfer and Transport System with 10% Interest unit: mill.Gs

Year	Expenses			Revenues	Cash Flow
	Investment	O & M	Total	Tipping Fee	
1995	80	0	80	0	-80
1996	10338	0	10338	0	-10338
1997	0	590	590	1817	1227
1998	0	590	590	1933	1343
1999	0	590	590	2053	1463
2000	0	590	590	2170	1580
2001	0	590	590	2230	1640
2002	0	590	590	2284	1694
2003	5686	590	6276	2344	-3932
2004	0	616	616	2404	1788
2005	0	675	675	2457	1782
2006	0	675	675	2517	1842

Hence, FIRR is 12.14% with 10% interest for 30 years project life.

Table J.4.3c Financial Evaluation for Transfer and Transport System with 3% Interest unit: mill.Gs

Year	Expenses			Revenues	Cash Flow
	Investment	O & M	Total	Tipping Fee	
1995	80	0	80	0	-80
1996	10338	0	10338	0	-10338
1997	0	590	590	1393	803
1998	0	590	590	1483	893
1999	0	590	590	1574	984
2000	0	590	590	1664	1074
2001	0	590	590	1710	1120
2002	0	590	590	1750	1160
2003	5686	590	6276	1797	-4479
2004	0	616	616	1843	1227
2005	0	675	675	1884	1209
2006	0	675	675	1930	1255

Hence, FIRR is 7.09% with 3% interest for 30 years project life.

Table J.4.3d Financial Evaluation for Transfer and Transport System at 0% Interest unit: mill.Gs

Year	Expenses			Revenues	Cash Flow
	Investment	O & M	Total	Tipping Fee	
1995	80	0	80	0	-80
1996	10338	0	10338	0	-10338
1997	0	590	590	1240	650
1998	0	590	590	1320	730
1999	0	590	590	1401	811
2000	0	590	590	1481	891
2001	0	590	590	1523	933
2002	0	590	590	1558	968
2003	5686	590	6276	1600	-4676
2004	0	616	616	1641	1025
2005	0	675	675	1678	1003
2006	0	675	675	1719	1044

Hence FIRR is 5.10% with 0% interest for 30 years project life.

cbb. Sensitivity Analysis

Results of the sensitivity analysis, conducted under specified conditions of decreased revenues and/or increased expenses, are shown in Table J.4.3c.

Table J.4.3c Results of the Sensitivity Analysis for Transfer and Transport System

No.	Case	FIRR		
		CRF-10%	CRF-3%	CRF-0%
1	Base Case	12.14%	7.09%	5.10%
2	10% Decrease in Total Revenues	10.03%	5.28%	3.36%
3	10% Increase in Total Expenses	10.23%	5.45%	3.53%
4	10% Decrease in Total Revenue and 10% Increase in Total Expenses	8.25%	3.70%	1.81%

The sensitivity analysis shows that the Transfer Station is slightly more sensitive to decreased revenues than to increased expenses. The financial evaluation suggests that the Transfer Station is barely justifiable from the financial viewpoint, even at the highest of the three levels of tipping fees under consideration.

d. Overall Evaluation

The Project, Construction of AML Transfer Station, is concluded to be feasible from social, environmental, economical and financial viewpoints.

Socially, there will be various benefits to be acquired, which show the appropriate-ness of the Project.

Environmentally, there will be some impacts on the surrounding environment. These impacts will be permissible by means of several mitigation measure to be done.

Economically, the quantified evaluation shows EIRR of the project is 18% and is more than the standard set by the STP in Paraguay, which indicate the goodness of the Project.

Even in the case of the minimum tipping fee (CRF=0%), with either 10% decrease in total revenues or 10% increase in total expenses, the FIRR is more than 3.0%, which shows the Project by AMUAM is viable.

J.4.4 Evaluation of Construction Project of Chaco-i Inter-municipal Final Disposal Site

a. Social Evaluation

The main objective of the Construction of the Inter-municipal Final Disposal Site at Chaco-i is to implement sanitary landfill operation, which is more environmentally sound than present landfill, and to create a clean living environment in the Asuncion Metropolitan Area, for the healthy enjoyment of it's residents.

This objective will be reached basically through the improvement of the refuse disposal operations.

From the social standpoint, however, the project yields other benefits beyond it's main objective.

These benefits are mainly the following:

- Creation of jobs, technical as well as unskilled ones (primarily these the least)
- Improvement of the Public Health in the surrounding areas of the present landfills, since it is recognized that there is a linkage between the health status of the population and the cleanliness of the public spaces.
- Improvement of the technical level of Paraguayan professionals, engineers mostly, but also technicians.
- Improvement of working conditions of the unskilled personnel, basically on matters related to safety and hygiene.
- Recovery of degraded areas making them viable to be used by the community, specially as in the case of the Cateura landfill.
- General improvement in the landscape sight, be it in the urbanized areas as well as in the open green spaces.

The evaluation of most of these outcomes quanititatively is rather difficult, since many of them have a strong psychological component and it's measurement is sometimes impossible to be made. Quanitiatively, the construction of Chaco-i

inter-municipal landfill is feasible socially, because the large contributon of the above-mentioned benefits will be expected.

It shall be made however an evaluation of the social outcomes of the project based on:

i. accountability of the new jobs that will be created with the corresponding incomes;

ii. employee survey, seeking the opinion of the municipalities' laborers and technicians on the improvements of the landfill operation;

iii. public opinion survey, similar to the one made at the beginning of the project; and

iv. evaluation of public health status by specific indicators

b. Environmental Evaluation at the Inter-municipal Disposal Site at Chaco-i

ba. Outline of the plan

The outline of environmental preservation plan in this master plan is shown bellow.

- The final disposal site shall be surrounded by banks approximately 5m high. Dumping of waste should start after construction of the banks.
- Trees are to be planted around the site to shut out the site and to prevent dust and waste scattering.
- In case of strong winds, water will be sprayed to prevent dust scattering at the construction and operation phase.
- The permeability coefficient of surface soil is very low; i.e. 10^{-6} to 10^{-9}cm/s. This indicates that the possibility of ground water contamination by leachate is very little even without lining material on the bottom. Therefore, installation of a liner is not considered to be feasible.
- Leachate is discharged into the regulation pond (2,500m^2 x 2m) and usually pumped back up to the disposal area by the leachate circulation facility.
- Gas is to be released via perforated pipes from inside the site to create an aerobic condition.
- Waste is to be covered using soil everyday, to prevent the production of offensive odors and scattering of waste.

- Since the discharge of the Rio Negro (Negro River) is not enough for dilution of leachate and in the downstream of the river there are some colonies of farmers, it is planned to construct a diversion canal which will flow directly into the Paraguay River and be about 5 km long.

bb. Selection of environmental evaluation items

As stated in the M/M on the Scope of Work of the study, the environmental evaluation of the proposed landfill should cover the technical aspects of water pollution.
In this study 4 items were investigated; water quality, air pollution, noise pollution and offensive odor.

bc. Present environmental condition

Analysis method, dates of investigation and analysis items are shown in Annex D.

bca. Water quality

- Heavy metals were not detected in both ground water and river water.
- Concentration of each item in ground water are higher than in river water.
- The environmental water quality standards for pH, COD, SO_4^{-2}, Cr^{+6} and Hg are established. The concentration of COD and SO_4^{-2} were higher than the environmental water quality standard value. Concentration of the other items were lower than the environmental water quality standard value.

bcb. Air pollution

- The items investigated, dust fall, suspended particular matter and methane gas, were not detected.

bcc. Noise

- There are no institutions near the proposed final disposal site which may be the producer of noise pollution. The present noise level changes in proportion to traffic volume change.

bcd. Offensive odor

- Ammonia was not detected.

bd. Environmental impact

- The target phase of the environmental impact assessment were both during the construction and operation phase.
- Items of the environmental impact assessment are water quality, air pollution, noise and offensive odor.
- Environmental impact assessment was done quantitatively as much as possible relative to the site development plan and the present condition of the environment.
- The area under assessment for environmental impact is the proposed site and its surrounding.

bda. Water quality

i. Construction phase

There is a possibility that during heavy rain, run-off water could flow out of the site polluting the nearest bodies of water, at the construction phase, as the land has been stripped of its vegetation. However as the proposed site is relatively flat, impact on the surrounding water quality during the construction phase is deemed to be little.

ii. Operation phase

There is a possibility that leachate from the site may contaminate ground water and river water near the proposed site. But, in the site development plan, leachate is to be pumped back up to the disposal area by the leachate circulation facility. It is also judged that the permeability coefficient of surface soil is too low to require a liner. Therefore, it is deemed that the possibility of ground water contamination by leachate is little. However, during heavy rain, leachate diluted in the regulating pond is released into the Paraguay river via a stream. The impact on water quality is calculated using the water quality index from the COD. The formula is shown below.

$$C = \frac{Q1 \times C1 + Q2 \times C2}{Q1 + Q2}$$

C: water quality (mg/l)
Q1: water quantity discharged from the regulation pond(m^3/sec)
Precipitation(P): 20 mm/hour
Area of regulation pond plus disposal area(S):
Coefficient of runoff(r): 1.0
Q1 = P x 1/1000 x S x r / 3600

= 20 x 1/1000 x 40000 x 1/3600
= 0.222 m^3/sec

C1: water quality from the regulation pond (mg/l)
401 mg/l
(Average COD of leachate measured at Cateura)

Q2: water quantity of Paraguay river (m^3/sec)
3,000 m^3/sec
(source : Environmental Profile of Paraguay, p105)

C2: water quality of Paraguay river (mg/l)
22.7 mg/l
(source : SENASA)

$$C = \frac{0.222 \times 401 + 3{,}000 \times 22.7}{0.222 + 3{,}000} = 22.7 \ mg/l$$

The calculated water quality is the same as the value of the present water quality in Paraguay river. Therefore, it is judged that the possibility of river water contamination by the leachate from the regulation pond is little.

bdb. Air pollution

i. Construction Phase

There is a possibility that dust may rise from land which is stripped of its vegetation for construction. In the plan, in case of strong winds, water is to be scattered. The scattering of water can decrease the effects of the wind and prevent dust from rising. Therefore, it is judged that the possibility of air pollution from dust is little.

ii. Operation phase

In case of dust scattering from the surface of dried cover soil, impact on air pollution is deemed to be the same as the construction phase. Methane gas produced at the site is decreased by the aerobic condition maintained by means of natural ventilation through leachate collection pipes. Therefore, it is judged that the possibility of air pollution by dust and methane is little.

bdc. Noise

i. Construction phase

During the construction phase, the main source of noise is the operation of construction machinery. However, as there are no residents residing in the vicinity, it is judged that the impact on the surroundings from the noise pollution by construction machines is little.

ii. Operation phase

During the operation phase, the main sources of noise are waste haulage vehicles carrying waste to the site and heavy machinery for landfill works. The number of vehicles carrying waste to the site is approximately 20 to 50 units/day. Therefore, it is deemed that the possibility of noise pollution from vehicles carrying waste to the site is little. The number of heavy machinery for landfilling works is approximately 6 units/day and there are no residents in the surroundings. Therefore, it is judged that the possibility of noise pollution from heavy machinery for landfilling works is little.

bdd. Offensive odor

i. Construction phase

During the construction phase, there are no factors which may produce offensive odors. Therefore, there are no possibilities of offensive odors being produced by construction works.

ii. Operation phase

During the operation phase, the main sources of offensive odor are from uncovered waste and outflow gas from pipes. Ammonia was not detected at the Cateura disposal site where there are various sources of offensive odors. Furthermore there are no residents in the surroundings. Therefore, it is judged that the impact on the surrounding from the offensive odor from operation is little.

be. Impact assessment

bea. Setting goals for environmental preservation

i. Water quality

The goal for environmental preservation on water quality is set as the environmental standard for water quality set by the Republic of Paraguay.

ii. Air pollution

There are no ambient air quality standards and gas discharge regulation in Paraguay. Therefore, the air pollution is set as "Not to make remarkable adverse impacts on the present air quality".

iii. Noise

There are no environmental quality standards for noise in Paraguay. Therefore, the goal for environmental preservation regarding noise is set as "Not to worsen the present situation of noise exceedingly".

iv. Offensive odor

There are no environmental quality standards for offensive odor in Paraguay. Therefore, the goal for environmental preservation is set as "Not to worsen present situation of odor exceedingly".

beb. Environmental evaluation

i. Water Quality

Leachate is discharged into the regulation pond and pumped back to the disposal area by the leachate circulation facility and the permeability coefficient of surface soil is very low. Therefore, it is deemed that the possibility of ground water contamination by leachate will be little. In the case of heavy rain, the calculated COD value of the leachate is the same value as the present COD value in Paraguay river; i.e. 22.7 mg/l. Therefore in case of leachate infiltration of the river this value indicated that the present water quality will not deteriorate.
The leachate will be discharged to a diversion Canal, to be constructed, only during heavy rain. The impact will be permissible because the leachate will be diluted by rain water and there are no inhabitants along the canal up to Paraguay River where the leachate will be sufficiently diluted. Therefore it is deemed that the environ-

mental impact on water quality is low.

ii. Air Pollution

It is deemed that the possibility of air pollution by dust is little as water is to be scattered and trees planted around the site. Methane gas produced from inside the site is reduced by the aerobic condition maintained inside the site by means of natural ventilation through leachate collection pipes. Therefore, it is deemed that environmental impact by air pollution satisfies the goal for environmental preservation.

iii. Noise

It is deemed that the possibility of noise pollution by construction machinery, heavy machinery for landfill works and waste haulage vehicles at the site is little. Furthermore, there are no inhabitants in the area. Therefore, it is deemed that environmental impact by noise pollution satisfies the goal for environmental preservation.

iv. Offensive odor

The offensive odor will be produced mainly by anaerobic decomposition of wastes. This will be improved by natural ventilation through leachate collection pipes and gas removal pipes to be installed. In addition, daily covering of waste will prevent offensive odors from dispersion. Therefore, the impact by offensive odor satisfies the goal for environmental preservation.

bf. Suggestion of measures against environmental impact

The environmental impact for each item satisfies the goals for environmental preservation. However, it is important to carry out the mitigation plans against environmental impact, especially the treatment of leachate. The following are suggestions for leachate treatment and measures against environmental impact on water quality.

- To carry out the circulation of leachate.
- All leachate in the regulation pond shall be pumped back to the disposal site before heavy rain.
- To carry out soil cover to prevent rainwater from infiltrating the waste.

bg. Monitoring

It is important to understand that the new site will have an influence on the surrounding environment after commencing operation. Especially, understanding the impact on water quality of ground water and river water is important, as Paraguay is situated upstream of Paraguay River, any pollution caused by the Paraguayan section of the river would have an effect in other countries situated down stream, such as Argentina. Therefore, regular monitoring of water quality is necessary, such as:

- Ground water quality monitoring in the observation well.
- River water quality monitoring.
- Water quality monitoring of leachate discharged into the regulation pond.

c. Economic and financial evaluation

The improvement of the final disposal of solid wastes (sanitary landfill) in the Asunción Metropolitan Area was evaluated from the economic and financial viewpoints. The proposed plan for the inter-municipal final disposal consists of the lowest cost method among the several alternatives that were carefully considered. This evaluation procedure is known as the "least cost method".

ca. Economic evaluation

Qualitative evaluation was used for assessing the benefits from the improved final disposal of solid wastes (sanitary landfill) in the Asunción Metropolitan Area (AMA). Benefits evaluated qualitatively were those generated as environmental improvements by this Project component and were the following.

i. Improved public health

Better final disposal of solid wastes implies less illegal dump sites. The society at large reaps the benefits in the form of reduced number of focus of pathogenic germs and disease vectors, which ultimately lead to better public health. The economic significance is to be found in less absenteeism and longer productive life of workers.

The economically active population in the Asunción Metropolitan Area in 1992 was estimated at 552,521, of which 523,221 were fully occupied (Source: Cuentas Nacionales 1982/1992, BCP, 1993). Assuming initially that the prevailing minimum monthly salary of Gs345,000 reflects the marginal productivity of labor, and that there are 23 working days in a month, then the marginal productivity of labor is

Gs15,000 per day. This means that a one-day absenteeism of the 523,221 fully occupied economically active population amounts to a production loss of Gs7,848,315,000, which is equivalent to US$4,130,692 at the exchange rate of Gs1,900 per one US$. These are the financial values of production loss for one-day absenteeism. On the other hand, the labor force data for the Asunción Metropolitan Area (Indicadores de la Fuerza de Trabajo, Area Metropolitana 1983-1991, STP, 1992) indicate that 40% of the occupied economically active population can be categorized as unskilled workers. If the assumed correction factor for unskilled workers (0.5) is applied to the 40% of unskilled workers, the economic value of production loss for one-day absenteeism would be US$3,304,554.

ii. Prevention of groundwater pollution

In the final disposal of solid wastes, a major source of pollution is the leachate. A true sanitary landfill has an impervious barrier which prevents the leachate from reaching and contaminating the groundwater, i.e. 3 meters of impermeable soils at the site will prevent the leachate from contaminating the groundwater.

iii. Prevention of scattering solid wastes

Even if the collection system is improved and solid wastes are brought into the final disposal site, the management of solid wastes is not satisfactory if the trash is scattered in and around the final disposal site. A true sanitary landfill implies that solid wastes are covered by earth, thereby preventing scattering and stench. Planting of trees around the final disposal site helps prevent the scattering of solid wastes, in addition to the aesthetic effect of improving the scenery by blocking the direct view of trash.

iv. Land value appreciation

Studies conducted in the United States documented cases where the land value increased as a result of the improved quality of the adjoining water body, or due to less polluted air quality. For instance, land value surrounding a water body increased between 8% and 25% in the U.S., depending on the distance from the shore, when the water quality improved (Source: Benefit of Water Pollution Control on Property Values, by D.M.Dornbush and S.M.Barrager, EPA-600/5-73-005, Washington, D.C., 1973). Under the same reasoning, the value of the land surrounding the Cateura landfill can increase in the future, if the final disposal site is moved to Chaco-i, because of the potential for re-utilization of the Cateura site as a park or sports ground.

v. Extra costs avoidance

Inadequate final disposal of solid wastes creates focus for breeding of pests, and for emission of foul odors and contamination of air and water. In order to neutralize these unwanted effects, households near the present landfills may have to incur extra costs such as pest control treatment, use of air freshener, and water treatment.

cb. Financial evaluation

cba. FIRR

Revenues consisted of the Tipping Fee from the 15 municipalities of Asunción Metropolitan Area. Three levels of tipping fee were estimated using three interest rates 10%, 3% and 0%.

Expenditures, on the other hand, consisted of those for investment as well as for operation and maintenance. Investments included contingency allowances, and one-third of investments on the centralized workshop (one-third of the workshop investment included in the transfer station, and one-third in the solid wastes collection system). Operation and maintenance costs of the final disposal sites also included one-third of AMUAM's operation and maintenance costs.

Tables J.4.4a, J.4.4b and J.4.4c show details on the expenditures and revenues of the final disposal system of solid wastes. The resulting FIRR were 22.92% (CRF-10%), 16.65% (CRF-3%) and 14.23% (CRF-0%).

Table J.4.4a Financial Evaluation for Final Disposal with 10% Interest

unit: mill.Gs

Year	Expenses			Revenues	Cash Flow
	Investment	O & M	Total	Tipping	
1995	2705	0	2705	0	-2705
1996	15275	0	15275	0	-15275
1997	0	3315	3315	6973	3658
1998	0	3327	3327	7698	4371
1999	732	3378	4110	8468	4358
2000	7250	3391	10641	9211	-1430
2001	377	5354	5731	10232	4501
2002	857	4253	5110	11222	6112
2003	10937	4325	15262	12259	-3003
2004	5400	7037	12437	13244	807
2005	754	5790	6544	14260	7716
2006	0	5918	5918	15252	9334

Hence FIRR is 22.92% with 10% interest for 30 years project life.

Table J.4.4b Financial Evaluation for Final Disposal with 3% Interest

unit: mill.Gs

Year	Expenses			Revenues	Cash Flow
	Investment	O & M	Total	Tipping	
1995	2705	0	2705	0	-2705
1996	15275	0	15275	0	-15275
1997	0	3315	3315	5976	2661
1998	0	3327	3327	6606	3279
1999	732	3378	4110	7275	3165
2000	7250	3391	10641	7924	-2717
2001	377	5354	5731	8808	3077
2002	857	4253	5110	9674	4564
2003	10937	4325	15262	10578	-4684
2004	5400	7037	12437	11434	-1003
2005	754	5790	6544	12321	5777
2006	0	5918	5918	13185	7267

Hence, FIRR is 16.65% with 3% interest for 30 years project life.

Table J.4.4c Financial Evaluation for Final Disposal with 0% Interest

unit: mill.Gs

Year	Expenses			Revenues	Cash Flow
	Investment	O & M	Total	Tipping Fee	
1995	2705	0	2705	0	-2705
1996	15275	0	15275	0	-15275
1997	0	3315	3315	5568	2253
1998	0	3327	3327	6157	2830
1999	732	3378	4110	6780	2670
2000	7250	3391	10641	7382	-3259
2001	377	5354	5731	8208	2477
2002	857	4253	5110	9012	3902
2003	10937	4325	15262	9854	-5408
2004	5400	7037	12437	10652	-1785
2005	754	5790	6544	11479	4935
2006	0	5918	5918	12287	6369

Hence, FIRR is 14.23% with 0% interest for 30 years project life.

cbb. Sensitivity Analysis

Results of the sensitivity analysis, conducted under specified conditions of decreased revenues and/or increased expenses, are shown in Table J.4.4d.

Table J.4.4d Results of the Sensitivity Analysis for Chaco-i Inter-municipal Landfill

No.	Case	FIRR		
		CRF-10%	CRF-3%	CRF-0%
1	Base Case	22.92%	16.65%	14.23%
2	10% Decrease in Total Revenues	18.83%	13.09%	10.84%
3	10% Increase in Total Expenses	19.20%	13.41%	11.15%
4	10% Decrease in Total Revenue and 10% Increase in Total Expenses	15.44%	10.08%	7.93%

The sensitivity analysis shows that the final disposal system is slightly more sensitive to decreased revenues than to increased expenses. The financial evaluation indicates that the final disposal system is easily justifiable from the financial viewpoint.

d. Overall Evaluation

It is concluded that the Project, Construction of Inter-municipal Final Disposal Site at Chaco-i, is feasible from social, environmental, economic and financial viewpoints.

Socially, there will be various benefits to be obtained which indicate the goodness of the Project.

Environmentally although there will be several adverse impacts, these impacts will be permissible by the several mitigation measures. In addition, in comparison with the present disposal operations conducted in the area, the Project will contribute to the improvement of the final disposal system greatly.

Economically, qualitative evaluation of the Project clearly showed the benefits to be acquired, which indicate the appropriateness of the Project.

Even in the case of the minimum tipping fee (CRF=0%), with either 10% decrease in total revenues or 10% increase in total expenses, the FIRR is more than 10%, which shows the Project by AMUAM is viable.

J.5 Implementation Plan

J.5.1 Project Implementation Bodies and Schedule

a. Project Implementation Bodies

The implementation bodies of the 3 projects will be as follows:

i. **Collection Improvement:** AMUAM for 14 municipalities and Asuncion

ii. **Transfer and Transport:** AMUAM

iii. **Chaco-i Final Disposal Site:** AMUAM

b. Implementation Schedule

The proposed implementation schedule of the 3 projects are tabulated in Table J.5.1a.

Table J.5.1a Implementation Schedule

Item	Collection Improvement	Transfer & Transport	Chaco-i Disposal Site
Design Target Year	2000	2000	2000
Service Commencement Year	1997	1997	1997
Preparatory Period			
Establishment of MSWM Department in AMUAM	1994	1994	1994
Land Acquisition	1994	1994	1994
Detailed Design	1995	1995	1995
Tender	1995	1995	1995
Implementation	1996	1996	1996
Commencement of operation	1997	1997	1997

J.5.2 Financial Plan

a. Municipalities

aa. User Charges for Solid Wastes Collection

aaa. Willingness to Pay (WTP)

It was postulated early in the Study that a truly viable MSWM should be financially self-sufficient, and operated with the participation and support of the service users. Accordingly, a survey was conducted on the willingness to pay (WTP) for solid wastes disposal services, on the basis of which the revenues for each municipality were estimated. The WTP was estimated for four user categories (households, food shops, other shops, market shops), and three categories of municipalities (HUM,UM,LUM).

Tables J.4.2i, J.4.2j and J.4.2k show that the revenues estimated from user charges, assuming an 80% collection rate, were not enough to cover the costs of MSWM, except in Asunción during most of the years of the Project, and in F. de la Mora during the first phase of the Project (up to 2004). All other municipalities had negative cash flows during the whole Project period.

aab. User Charges of HUM

In an attempt to increase revenues, the user charges of Highly Urbanized Municipalities (HUM) were applied in the re-estimation of revenues in Urbanized Municipalities (UM) and Less Urbanized Municipalities (LUM). Results shown in Table J.5.2a, J.5.2b and J.5.2c indicate the following.

- The cash flows of J.A.Saldivar, Ita, Aregua and Benjamin Aceval remain negative during every year of the Project even under the optimal combination of HUM user charges with rental and tipping fees estimated at 0% interest rate.

- HUM user charges affect most favorably the cash flows of Lambaré, San Lorenzo, and M.R.Alonso, especially in combination with rental and tipping fees estimated at 3% and 0% interest rates.

- The cash flows in the remaining municipalities become positive during the five-year period 2000-2004, that is, before the second phase of the Project.

Table J.5.2a Municipal Cash Flow using HUM User Charger with 10% Interest unit: mill.Gs

Year	Asuncion	F.Mora	Lambare	San Lorenzo	Capiata	Luque	M.R. Alonso	Villa Elisa	Nemby	J.A. Saldivar	Ita	Aregua	Limpio	Villa Hayes	B. Aceval	Fifteen Municip.
1996	-8585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8585
1997	4092	144	36	-33	-148	-519	-185	-112	-178	-56	-188	-129	-223	-63	-100	2338
1998	4105	120	58	-67	-172	-541	-179	-103	-187	-55	-191	-128	-236	-55	-97	2271
1999	4197	86	92	-97	-204	-566	-172	-81	-205	-55	-203	-136	-241	-55	-101	2258
2000	1515	446	631	887	408	166	172	131	39	-37	-91	-81	9	73	-31	4237
2001	87	435	614	860	369	116	165	125	26	-35	-97	-88	1	72	-35	2616
2002	3988	436	600	832	326	78	170	123	15	-42	-105	-85	3	80	-29	6389
2003	-3348	428	581	818	298	52	172	117	7	-40	-111	-92	-2	80	-30	-1068
2004	4375	423	576	812	277	48	188	126	0	-38	-117	-89	-6	88	-33	6631
2005	4642	-670	-341	-238	-448	-930	-254	-273	-458	-65	-228	-163	-294	-69	-85	125
2006	4646	-672	-338	-230	-456	-915	-225	-252	-459	-63	-443	-227	-296	-59	-85	-74

Table J.5.2b Municipal Cash Flow using HUM User Charger with 3% Interest unit: mill.Gs

Year	Asuncion	F.Mora	Lambare	San Lorenzo	Capiata	Luque	M.R. Alonso	Villa Elisa	Nemby	J.A. Saldivar	Ita	Aregua	Limpio	Villa Hayes	B. Aceval	Fifteen Municip.
1996	-8585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8585
1997	5049	346	227	44	-45	-386	-128	-52	-131	-53	-162	-120	-193	-47	-92	4257
1998	5118	335	257	10	-58	-393	-118	-38	-136	-52	-163	-119	-202	-39	-89	4312
1999	5266	316	297	-20	-76	-402	-106	-14	-148	-52	-172	-126	-205	-38	-92	4427
2000	2641	689	842	964	548	346	242	203	100	-34	-59	-71	48	91	-22	6528
2001	1235	691	843	937	530	326	247	208	95	-32	-62	-76	45	92	-24	5056
2002	5156	704	847	909	509	318	262	216	92	-38	-67	-73	50	101	-18	8967
2003	-2157	709	847	895	501	321	275	222	90	-36	-70	-78	50	103	-18	1656
2004	5589	717	860	889	501	346	301	241	91	-34	-73	-75	51	113	-20	9498
2005	5876	-289	37	-85	-151	-534	-95	-123	-333	-59	-176	-144	-213	-30	-68	3612
2006	5903	-278	58	-77	-138	-490	-55	-91	-327	-57	-388	-208	-210	-20	-67	3555

Table J.5.2c Municipal Cash Flow using HUM User Charger with 0% Interest unit: mill.Gs

Year	Asuncion	F.Mora	Lambare	San Lorenzo	Capiata	Luque	M.R. Alonso	Villa Elisa	Nemby	J.A. Saldivar	Ita	Aregua	Limpio	Villa Hayes	B. Aceval	Fifteen Municip.
1996	-8585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8585
1997	5404	421	299	104	-5	-334	-106	-29	-114	-52	-152	-117	-182	-41	-89	5007
1998	5494	415	332	77	-14	-336	-95	-14	-117	-51	-152	-116	-190	-33	-86	5113
1999	5663	401	374	54	-27	-339	-81	12	-126	-51	-161	-122	-191	-31	-89	5285
2000	3059	779	923	1045	602	416	269	231	124	-33	-47	-67	63	98	-19	7443
2001	1661	786	930	1029	591	407	278	239	121	-31	-49	-72	62	100	-20	6033
2002	5590	803	941	1013	579	410	297	251	121	-36	-52	-69	68	109	-14	10010
2003	-1715	813	948	1010	579	425	314	262	122	-34	-55	-73	70	113	-14	2767
2004	6040	826	968	1014	587	460	344	285	126	-32	-56	-70	72	123	-15	10673
2005	6334	-144	183	82	-38	-383	-33	-65	-286	-56	-156	-137	-182	-16	-61	5041
2006	6369	-128	210	101	-17	-328	10	-30	-277	-54	-367	-201	-178	-5	-60	5045

aac. Conclusions on User Charges

- User charges should be increased to HUM rates definitely in Lambaré, and if possible in San Lorenzo, M.R.Alonso and Luque.

- The second phase of the Project may be too heavy a financial burden on most municipalities.

ab. Additional Financial Resources

To offset the revenue deficits occurring at the assumed user charges, other possible financing alternatives were examined, as a result of which municipalities decided to use part of the property tax for MSWM. At the same time, AMUAM decided to apply part of the tax on the tickets of the mass transit system as a subsidy for MSWM. Consequently, revenue shortfalls for MSWM were covered with property tax (70%) and AMUAM subsidy from bus ticket tax (30%).

b. AMUAM

i. Municipal Contribution

The original revenue source of AMUAM was the contribution of member municipalities amounting to 1% of current income, or as determined by its Deliberative Council. This revenue permitted AMUAM to carry out some inter-municipal activities such as road maintenance with its own machinery.

ii. Rental and Tipping Fees

When the decision was made for AMUAM to be one of the two main implementing agencies of the MSWM Project, the required additional revenue source was defined as the rental and tipping fees to be paid by member municipalities. This implied that the level of the rental and tipping fees would have opposite effects on the finances of AMUAM and the member municipalities. If these fees were high, AMUAM would improve its finances at the expense of financial burden for member municipalities. Conversely, if these fees were low, member municipalities would bear less financial burden but AMUAM would run the risk of becoming an unviable implementing agency.

iii. Tax on Bus Tickets

The tax on tickets of the mass transit system was a revenue source under the

jurisdiction of each municipality. Recently, the municipalities of the Asunción metropolitan area decided to transfer to AMUAM the right to tax the tickets of the mass transit system. This is a revenue source with great potential which can permit AMUAM to expand its activities. Fortunately, AMUAM administrators are fully conscious of the high priority of MSWM, and decided to use part of the proceeds from the tax on bus tickets as a subsidy to each municipality with deficit revenues for MSWM.

c. Financial Plans

The above considerations were taken into account in the preparation of the Financial Plans for AMUAM, for municipalities, and for the Project as a whole. These three categories of plans were prepared for each of the three interest rates at which rental and tipping fees were calculated.

The cash flow analysis indicated that Asunción, with a well established MSWM, could undertake investments/replacements as well as operation and maintenance on the basis of loans and internally generated funds. However, revenues of AMUAM for MSWM depend on payments of rental and tipping fees by member municipalities, which is possible only when the MSWM is in operation. This implies that AMUAM requires donations to finance initial investments during the take-off period of the MSWM, but subsequently can replace facilities and equipments with internally generated funds, thereby ensuring continuity of the MSWM.

Accordingly, Foreign Grant was assumed to finance the first two years of the initial investments needed for the MSWM in 14 Municipalities, and the facilities to be managed by AMUAM. The subsequent investments were assumed to be financed by reserve funds set up from the surplus of rental and tipping fees.

Conversely, Foreign Loan was assumed to finance 80% of the investments needed for the MSWM in Asuncion. The loan was assumed to have a grace period of 10 years, followed by an amortization period of 20 years.

The income shortfall was assumed to be covered by property tax (70%) and bus ticket tax (30%).

Financial Plans are shown in Table J.5.2d, J.5.2e, J.5.2f, J.5.2g, J.5.2h, J.5.2i, J.5.2j, J.5.2k and J.5.2l. Financial plans by municipality are included in Data Book for the cases of rental and tipping fees calculated with capital recovery factor at 10%, 3% and 0% interest rates.

These Tables show that lower interest rates imply lower expenditures on rental/tipping fees and interest payments, thereby lowering the amount needed to be covered by property tax and bus ticket tax. All expenses including payments to AMUAM for rental and tipping fees were duly taken into account. This made AMUAM a viable implementing agency for MSWM. As long as Asuncion and AMUAM are viable over the long-run, the implementing agencies will be able to replace machinery and equipment, and keep the solid wastes disposal services in operation.

Table J.5.2d Financial Plan of AMUAM with 10% Interest unit: mill.Gs

Year	Revenue			Expenses		
	Machinery Rental	Tipping Fee	Total	Investment	O & M	Total
1995	0	0	0	2864	0	2864
1996	0	0	0	38028	0	38028
1997	2333	8790	11123	0	3906	3906
1998	2333	9631	11964	0	3918	3918
1999	2333	10522	12855	732	3969	4701
2000	2333	11382	13715	7249	3982	11231
2001	2333	12461	14794	377	5945	6322
2002	2333	13506	15839	857	4844	5701
2003	2333	14602	16935	28866	4916	33782
2004	2333	15648	17981	17108	7654	24762
2005	4611	16717	21328	754	6483	7237
2006	4611	17769	22380	0	6611	6611
2007	4611	17769	22380	0	6611	6611
2008	4611	17769	22380	0	6611	6611
2009	4611	17769	22380	0	6611	6611
2010	4611	17769	22380	0	6611	6611
2011	4611	17769	22380	0	6611	6611
2012	4611	17769	22380	0	6611	6611
2013	4611	17769	22380	0	6611	6611
2014	4611	17769	22380	0	6611	6611
2015	4611	17769	22380	0	6611	6611
2016	4611	17769	22380	0	6611	6611
2017	4611	17769	22380	0	6611	6611
2018	4611	17769	22380	0	6611	6611
2019	4611	17769	22380	0	6611	6611
2020	4611	17769	22380	0	6611	6611
2021	4611	17769	22380	0	6611	6611
2022	4611	17769	22380	0	6611	6611
2023	4611	17769	22380	0	6611	6611
2024	4611	17769	22380	0	6611	6611
2025	4611	17769	22380	0	6611	6611
Total	115495	468639	584134	96835	177837	274672

Table J.5.2c Financial Plan of AMUAM with 3% Interest unit: mill.Gs

Year	Revenue			Expenses		
	Machinery Rental	Tipping Fee	Total	Investment	O & M	Total
1995	0	0	0	2864	0	2864
1996	0	0	0	38028	0	38028
1997	1835	7368	9203	0	3906	3906
1998	1835	8087	9922	0	3918	3918
1999	1835	8850	10685	732	3969	4701
2000	1835	9588	11423	7249	3982	11231
2001	1835	10518	12353	377	5945	6322
2002	1835	11425	13260	857	4844	5701
2003	1835	12374	14209	28866	4916	33782
2004	1835	13277	15112	17108	7654	24762
2005	3633	14205	17838	754	6483	7237
2006	3633	15115	18748	0	6611	6611
2007	3633	15115	18748	0	6611	6611
2008	3633	15115	18748	0	6611	6611
2009	3633	15115	18748	0	6611	6611
2010	3633	15115	18748	0	6611	6611
2011	3633	15115	18748	0	6611	6611
2012	3633	15115	18748	0	6611	6611
2013	3633	15115	18748	0	6611	6611
2014	3633	15115	18748	0	6611	6611
2015	3633	15115	18748	0	6611	6611
2016	3633	15115	18748	0	6611	6611
2017	3633	15115	18748	0	6611	6611
2018	3633	15115	18748	0	6611	6611
2019	3633	15115	18748	0	6611	6611
2020	3633	15115	18748	0	6611	6611
2021	3633	15115	18748	0	6611	6611
2022	3633	15115	18748	0	6611	6611
2023	3633	15115	18748	0	6611	6611
2024	3633	15115	18748	0	6611	6611
2025	3633	15115	18748	0	6611	6611
Total	90973	397992	488965	96835	177837	274672

Table J.5.2f Financial Plan of AMUAM with 0% Interest unit: mill.Gs

Year	Revenue			Expenses		
	Machinery Rental	Tipping Fee	Total	Investment	O & M	Total
1995	0	0	0	2864	0	2864
1996	0	0	0	38028	0	38028
1997	1646	6808	8454	0	3906	3906
1998	1646	7476	9122	0	3918	3918
1999	1646	8182	9828	732	3969	4701
2000	1646	8863	10509	7249	3982	11231
2001	1646	9731	11377	377	5945	6322
2002	1646	10572	12218	857	4844	5701
2003	1646	11453	13099	28866	4916	33782
2004	1646	12292	13938	17108	7654	24762
2005	3256	13156	16412	754	6483	7237
2006	3256	14005	17261	0	6611	6611
2007	3256	14005	17261	0	6611	6611
2008	3256	14005	17261	0	6611	6611
2009	3256	14005	17261	0	6611	6611
2010	3256	14005	17261	0	6611	6611
2011	3256	14005	17261	0	6611	6611
2012	3256	14005	17261	0	6611	6611
2013	3256	14005	17261	0	6611	6611
2014	3256	14005	17261	0	6611	6611
2015	3256	14005	17261	0	6611	6611
2016	3256	14005	17261	0	6611	6611
2017	3256	14005	17261	0	6611	6611
2018	3256	14005	17261	0	6611	6611
2019	3256	14005	17261	0	6611	6611
2020	3256	14005	17261	0	6611	6611
2021	3256	14005	17261	0	6611	6611
2022	3256	14005	17261	0	6611	6611
2023	3256	14005	17261	0	6611	6611
2024	3256	14005	17261	0	6611	6611
2025	3256	14005	17261	0	6611	6611
Total	81544	368633	450177	96835	177837	274672

Table J.5.2g Financial Plan of Asuncion Municipality with 10% Interest

unit: mill.Gs

Year	Expenditures						Income				
	Initial Cost	O & M	Tipping Fee	Interest	Amortization	Total	Foreign Loan	User Charges	Property Tax	Bus Ticket Tax	Total
1996	8585	0	0	0	0	8585	6868	0	1202	515	8585
1997	797	4524	5402	687	0	11410	638	14815	0	0	15452
1998	706	4582	5719	750	0	11757	565	15112	0	0	15677
1999	377	4807	6037	807	0	12028	302	15418	0	0	15720
2000	2998	4865	6355	837	0	15055	2398	15733	0	0	18132
2001	4396	5092	6482	1077	0	17047	3517	16057	0	0	19574
2002	655	5150	6598	1429	0	13832	524	16391	0	0	16915
2003	8179	5179	6725	1481	0	21564	6543	16735	0	0	23278
2004	567	5293	6853	2135	0	14848	454	17088	0	0	17542
2005	380	5462	6969	2181	0	14992	304	17453	0	0	17757
2006	566	5520	7096	2098	1128	16408	453	17828	0	0	18281
2007	0	5520	7096	2031	1128	15775	0	17828	0	0	17828
2008	0	5520	7096	1918	1128	15662	0	17828	0	0	17828
2009	0	5520	7096	1805	1129	15550	0	17828	0	0	17828
2010	0	5520	7096	1692	1128	15436	0	17828	0	0	17828
2011	0	5520	7096	1580	1128	15324	0	17828	0	0	17828
2012	0	5520	7096	1467	1128	15211	0	17828	0	0	17828
2013	0	5520	7096	1354	1129	15099	0	17828	0	0	17828
2014	0	5520	7096	1241	1128	14985	0	17828	0	0	17828
2015	0	5520	7096	1128	1128	14872	0	17828	0	0	17828
2016	0	5520	7096	1015	1128	14759	0	17828	0	0	17828
2017	0	5520	7096	903	1129	14648	0	17828	0	0	17828
2018	0	5520	7096	790	1128	14534	0	17828	0	0	17828
2019	0	5520	7096	677	1128	14421	0	17828	0	0	17828
2020	0	5520	7096	564	1128	14308	0	17828	0	0	17828
2021	0	5520	7096	451	1129	14196	0	17828	0	0	17828
2022	0	5520	7096	339	1128	14083	0	17828	0	0	17828
2023	0	5520	7096	226	1128	13970	0	17828	0	0	17828
2024	0	5520	7096	113	1128	13857	0	17828	0	0	17828
2025	0	5520	7096	0	1129	13745	0	17828	0	0	17828
Total	28206	155354	199060	32776	22565	437961	22565	501361	1202	515	525643

Table J.5.2h Financial Plan of Asuncion Municipality with 3% Interest

unit: mill.Gs

Year	Expenditures						Income				
	Initial Cost	O & M	Tipping Fee	Interest	Amortization	Total	Foreign Loan	User Charges	Property Tax	Bus Ticket Tax	Total
1996	8585	0	0	0	0	8585	6868	0	1202	515	8585
1997	797	4524	5402	206	0	10929	638	14815	0	0	15452
1998	706	4582	5719	225	0	11232	565	15112	0	0	15677
1999	377	4807	6037	242	0	11463	302	15418	0	0	15720
2000	2998	4865	6355	251	0	14469	2398	15733	0	0	18132
2001	4396	5092	6482	323	0	16293	3517	16057	0	0	19574
2002	655	5150	6598	429	0	12832	524	16391	0	0	16915
2003	8179	5179	6725	444	0	20527	6543	16735	0	0	23278
2004	567	5293	6853	641	0	13354	454	17088	0	0	17542
2005	380	5462	6969	668	0	13479	304	17453	0	0	17757
2006	566	5520	7096	643	1128	14953	453	17828	0	0	18281
2007	0	5520	7096	623	1128	14367	0	17828	0	0	17828
2008	0	5520	7096	589	1128	14333	0	17828	0	0	17828
2009	0	5520	7096	555	1129	14300	0	17828	0	0	17828
2010	0	5520	7096	521	1128	14265	0	17828	0	0	17828
2011	0	5520	7096	488	1128	14232	0	17828	0	0	17828
2012	0	5520	7096	454	1128	14198	0	17828	0	0	17828
2013	0	5520	7096	420	1129	14165	0	17828	0	0	17828
2014	0	5520	7096	386	1128	14130	0	17828	0	0	17828
2015	0	5520	7096	352	1128	14096	0	17828	0	0	17828
2016	0	5520	7096	318	1128	14062	0	17828	0	0	17828
2017	0	5520	7096	284	1129	14029	0	17828	0	0	17828
2018	0	5520	7096	251	1128	13995	0	17828	0	0	17828
2019	0	5520	7096	217	1128	13961	0	17828	0	0	17828
2020	0	5520	7096	183	1128	13927	0	17828	0	0	17828
2021	0	5520	7096	149	1129	13894	0	17828	0	0	17828
2022	0	5520	7096	115	1128	13859	0	17828	0	0	17828
2023	0	5520	7096	81	1128	13825	0	17828	0	0	17828
2024	0	5520	7096	48	1128	13792	0	17828	0	0	17828
2025	0	5520	7096	0	1129	13745	0	17828	0	0	17828
Total	28206	155354	199060	10106	22565	415291	22565	501361	1202	515	525643

Table J.5.2i Financial Plan of Asuncion Municipality with 0% Interest

unit: mill.Gs

Year	Expenditures						Income				
	Initial Cost	O & M	Tipping Fee	Inter-est	Amor-tization	Total	Foreign Financ.	User Charges	Prop-erty Tax	Bus Ticket Tax	Total
1996	8585	0	0	0	0	8585	6868	0	1202	515	8585
1997	797	4524	5402	0	0	10723	638	14815	0	0	15452
1998	706	4582	5719	0	0	11007	565	15112	0	0	15677
1999	377	4807	6037	0	0	11221	302	15418	0	0	15720
2000	2998	4865	6355	0	0	14218	2398	15733	0	0	18132
2001	4396	5092	6482	0	0	15970	3517	16057	0	0	19574
2002	655	5150	6598	0	0	12403	524	16391	0	0	16915
2003	8179	5179	6725	0	0	20083	6543	16735	0	0	23278
2004	567	5293	6853	0	0	12713	454	17088	0	0	17542
2005	380	5462	6969	0	0	12811	304	17453	0	0	17757
2006	566	5520	7096	0	1128	14310	453	17828	0	0	18281
2007	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2008	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2009	0	5520	7096	0	1129	13745	0	17828	0	0	17828
2010	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2011	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2012	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2013	0	5520	7096	0	1129	13745	0	17828	0	0	17828
2014	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2015	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2016	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2017	0	5520	7096	0	1129	13745	0	17828	0	0	17828
2018	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2019	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2020	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2021	0	5520	7096	0	1129	13745	0	17828	0	0	17828
2022	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2023	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2024	0	5520	7096	0	1128	13744	0	17828	0	0	17828
2025	0	5520	7096	0	1129	13745	0	17828	0	0	17828
Total	28206	155354	199060	0	22565	405185	22565	501361	1202	515	525643

Table J.5.2j Financial Plan of the Project with 10% Interest unit: mill.Gs

Year	Expenditures							Income			
	Initial	O & M	Interest	Amor-tization	Rental Fee	Tipping Fee	Total	Foreign Grant	Foreign Loan	User Charges	Prop-erty Tax
1995	2864	0	0	0	0	0	2864	2864	0	0	0
1996	46613	0	0	0	0	0	46613	38028	6868	0	1202
1997	797	14102	687	0	2333	14192	32111	0	638	20891	7407
1998	706	14172	750	0	2333	15350	33311	0	565	21450	7907
1999	1109	14447	807	0	2333	16559	35255	0	302	22031	9045
2000	10247	14518	837	0	2333	17737	45672	0	2398	25312	12573
2001	4773	16709	1077	0	2333	18943	43835	0	3517	26074	9971
2002	1512	15666	1429	0	2333	20104	41044	0	524	26869	9556
2003	37045	15766	1481	0	2333	21327	77952	0	6543	27699	30596
2004	17675	18619	2135	0	2333	22501	63263	0	454	28566	23970
2005	1134	22103	2181	0	4611	23686	53715	0	304	29472	16757
2006	566	22289	2098	1128	4611	24865	55557	0	453	30418	17281
2007	0	22289	2031	1128	4611	24865	54924	0	0	30420	17153
2008	0	22289	1918	1128	4611	24865	54811	0	0	30420	17074
2009	0	22289	1805	1129	4611	24865	54699	0	0	30420	16995
2010	0	22289	1692	1128	4611	24865	54585	0	0	30420	16916
2011	0	22289	1580	1128	4611	24865	54473	0	0	30420	16837
2012	0	22289	1467	1128	4611	24865	54360	0	0	30420	16758
2013	0	22289	1354	1129	4611	24865	54248	0	0	30420	16680
2014	0	22289	1241	1128	4611	24865	54134	0	0	30420	16600
2015	0	22289	1128	1128	4611	24865	54021	0	0	30420	16521
2016	0	22289	1015	1128	4611	24865	53908	0	0	30420	16442
2017	0	22289	903	1129	4611	24865	53797	0	0	30420	16364
2018	0	22289	790	1128	4611	24865	53683	0	0	30420	16284
2019	0	22289	677	1128	4611	24865	53570	0	0	30420	16205
2020	0	22289	564	1128	4611	24865	53457	0	0	30420	16126
2021	0	22289	451	1129	4611	24865	53345	0	0	30420	16048
2022	0	22289	339	1128	4611	24865	53232	0	0	30420	15968
2023	0	22289	226	1128	4611	24865	53119	0	0	30420	15889
2024	0	22289	113	1128	4611	24865	53006	0	0	30420	15810
2025	0	22289	0	1129	4611	24865	52894	0	0	30420	15732
Total	125041	591882	32776	22565	115495	667699	1555458	40892	22565	836765	458666

Table J.5.2k Financial Plan of the Project with 3% Interest unit: mill.Gs

Year	Expenditures							Income			
	Initial Cost	O & M	Interest	Amortization	Rental Fee	Tipping Fee	Total	Foreign Grant	Foreign Loan	User Charges	Property Tax
1995	2864	0	0	0	0	0	2864	2864	0	0	0
1996	46613	0	0	0	0	0	46613	38028	6868	0	1202
1997	797	14103	206	0	1835	12770	29711	0	638	20891	5727
1998	706	14173	225	0	1835	13806	30745	0	565	21450	6111
1999	1109	14448	242	0	1835	14887	32521	0	302	22031	7132
2000	10247	14519	251	0	1835	15943	42795	0	2398	25312	10559
2001	4773	16710	323	0	1835	17000	40641	0	3517	26074	7735
2002	1512	15667	429	0	1835	18023	37466	0	524	26869	7051
2003	37045	15768	444	0	1835	19099	74191	0	6543	27699	27964
2004	17675	18621	641	0	1835	20130	58902	0	454	28566	20917
2005	1134	22106	668	0	3633	21174	48715	0	304	29472	13257
2006	566	22292	643	1128	3633	22211	50473	0	453	30418	13722
2007	0	22292	623	1128	3633	22211	49887	0	0	30420	13627
2008	0	22292	589	1128	3633	22211	49853	0	0	30420	13603
2009	0	22292	555	1129	3633	22211	49820	0	0	30420	13580
2010	0	22292	521	1128	3633	22211	49785	0	0	30420	13556
2011	0	22292	488	1128	3633	22211	49752	0	0	30420	13532
2012	0	22292	454	1128	3633	22211	49718	0	0	30420	13509
2013	0	22292	420	1129	3633	22211	49685	0	0	30420	13486
2014	0	22292	386	1128	3633	22211	49650	0	0	30420	13461
2015	0	22292	352	1128	3633	22211	49616	0	0	30420	13437
2016	0	22292	318	1128	3633	22211	49582	0	0	30420	13413
2017	0	22292	284	1129	3633	22211	49549	0	0	30420	13390
2018	0	22292	251	1128	3633	22211	49515	0	0	30420	13367
2019	0	22292	217	1128	3633	22211	49481	0	0	30420	13343
2020	0	22292	183	1128	3633	22211	49447	0	0	30420	13319
2021	0	22292	149	1129	3633	22211	49414	0	0	30420	13296
2022	0	22292	115	1128	3633	22211	49379	0	0	30420	13271
2023	0	22292	81	1128	3633	22211	49345	0	0	30420	13248
2024	0	22292	48	1128	3633	22211	49312	0	0	30420	13224
2025	0	22292	0	1129	3633	22211	49265	0	0	30420	13192
Total	125041	591955	10106	22565	90973	597052	1437692	40892	22565	836765	376230

Table J.5.21 Financial Plan of the Project with 0% Interest unit: mill.Gs

Year	Expenditures							Income			
	Initial Cost	O & M	Inter-est	Amorti-zation	Rental Fee	Tipping Fee	Total	Foreign Grant	Foreign Loan	User Charges	Property Tax
1995	2864	0	0	0	0	0	2864	2864	0	0	0
1996	46613	0	0	0	0	0	46613	38028	6868	0	1202
1997	797	14102	0	0	1646	12210	28755	0	638	20891	5058
1998	706	14172	0	0	1646	13195	29719	0	565	21450	5393
1999	1109	14447	0	0	1646	14219	31421	0	302	22031	6362
2000	10247	14518	0	0	1646	15218	41629	0	2398	25312	9743
2001	4773	16709	0	0	1646	16213	39341	0	3517	26074	6825
2002	1512	15666	0	0	1646	17170	35994	0	524	26869	6021
2003	37045	15767	0	0	1646	18178	72636	0	6543	27699	26876
2004	17675	18620	0	0	1646	19145	57086	0	454	28566	19646
2005	1134	22103	0	0	3256	20125	46618	0	304	29472	11789
2006	566	22289	0	1128	3256	21101	48340	0	453	30418	12228
2007	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2008	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2009	0	22289	0	1129	3256	21101	47775	0	0	30420	12149
2010	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2011	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2012	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2013	0	22289	0	1129	3256	21101	47775	0	0	30420	12149
2014	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2015	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2016	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2017	0	22289	0	1129	3256	21101	47775	0	0	30420	12149
2018	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2019	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2020	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2021	0	22289	0	1129	3256	21101	47775	0	0	30420	12149
2022	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2023	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2024	0	22289	0	1128	3256	21101	47774	0	0	30420	12148
2025	0	22289	0	1129	3256	21101	47775	0	0	30420	12149
Total	125041	591884	0	22565	81544	567693	1388727	40892	22566	836765	341955

J.5.3 Establishment of a Monitoring System

a. Necessity for the Establishment of a Monitoring System

Once a Municipality and/or AMUAM, an executing body of MSWM, decides to commit itself to achieving Master Plan target, it will be important to establish a system within the Municipality to monitor closely the progress of improvements. Data will be obtained through such monitoring for self-evaluation of the Municipality's performance, without which the Municipality will be unable to assess progress.

b. Personnel Responsible for Monitoring

In the Operation Planning and Control Section of the Sanitation Department in each Municipality or AMUAM, the following personnel should be involved in monitoring operations.

Table J.5.3a Personnel to be involved in monitoring operations

Action Required	Personnel Responsible
Identification of useful indicators	Technician
Data collection and compilation	Technician
Data analysis, evaluation of performance and formulation of action plans	Manager
Review of Master Plan targets based upon the performance evaluation	Manager, Deputy Director and Director

c. Indicators to be Used

ca. Selection of indicators

Selection of indicators are related to the Master Plan targets. Useful indicators include the following items as shown in Table J.5.3b.

Table J.5.3b Principal and Supporting Indicators

Master Plan Target	Principal Indicators	Supporting Indicators
a. Expansion of collection services	. Collection service coverage in terms of population . Amount of waste collected . Number of fee payers	. Percentage in terms of area . Waste measured by the weigh bridges . Ledger for management of collection fee
b. Expansion of street sweeping service	. Length of streets swept . Amount of waste collected	. Percentage in terms of area . Waste measured by the weigh bridges
c. Upgrading of the Standard	. Standard of sanitary landfill	. Amount of waste scattering . Number of complaint by residents
d. Strengthening of the Organization	. Collection and street sweeping services' efficiency	. Number of personnel in the Sanitation Dept. . Unit cost of services per ton
e. Securing financial resources for MSWM	. Collection fee . Rental fee . Tipping fee . Revenue and expenditure	. Ledger for management of collection fee . Accounting sheet

The above table shows some useful indicators. There may be other indicators. It is important to distinguish principal indicators from supporting indicators, as shown in the above table. Whether a particular indicator should be treated as principal or supporting indicator depends on the purpose of the evaluation.

cb. Definitions of indicators

One of the most serious problems with respect to performance indicators arises when considering ways to measure performance, i.e. the definition of indicators. For example, the unit collection cost differs greatly depending on whether or not to include certain indirect costs such as administration costs, assumed office rent, cost of stand-by vehicles and insurance premium to be paid, etc..

In view of the above it is important for the municipalities to establish the precise definitions of the indicators, and use indicators of the same definitions over a long period. This will enable the municipalities to compare past performances with the present using the same criteria.

It will be also very useful for the Central Government, ie. SENASA, to develop definitions of indicators to be used by all Local Governments. The development of such definitions will enable inter-municipal comparisons on the basis of similar criteria.

ANNEX K

EXPERIMENT ON SANITARY LANDFILL OPERATION AND SCHOOL LECTURE ON SOLID WASTE

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K.1 Experiment on Sanitary Landfill Operation

K.1.1 Objective of the Experiment

The objective of this experiment is to demonstrate the impact of the environmental improvement in the present disposal site by the execution of sanitary landfill operation and to obtain basic data for the design of sanitary landfill and construction and operation cost. The experiment will lead to greater understanding of the Paraguayan solid waste engineers on environmental protection measures concerning waste disposal. Moreover, it will help to change peoples' bad prejudice towards the disposal site and it will promote cooperation on the solid waste management activities.

K.1.2 Method of the Experiment

a. Site and Period of the Experiment

The experiment was planned to be executed in the Cateura landfill site, because it had the largest number of neighbors and it was also creating serious impact on its surrounding area as it receives the biggest amount of wastes in the Study area.

The experiment was carried out from February to March in 1994.

b. Contents of the Experiment

As described in the objective of the experiment, the purpose of the experiment is to demonstrate how the environmental improvement measures work to the present landfill and to obtain basic data for design, construction and operation of the sanitary landfill proposed in the master plan. The sanitary landfill Level 3 with a leachate circulation system is proposed in the master plan, while the present Cateura landfill is considered as Level 1 with occasional soil cover. Although it is difficult to completely improve the present landfill up to Level 3 due to the huge amount of waste disposed of at present and a limited budget, the contents of the experiment are planned so as to meet with Level 3 of sanitary landfill as much as possible. Consequently, the contents of the experiment are proposed to construct the facilities:

- To establish the disposal site boundary.
- To reduce the total leachate amount.
- To improve the leachate quality.
- To release gas generated from wastes.
- To screen the landfill site from the residents' sights.

c. Proposed Facilities

ca. To reduce the total leachate amount and establish the site boundary

In order to reduce the total leachate amount, water supply to the waste layer by infiltration must be reduced. The open ditch provided around the landfill site intercept water coming from outside and also to drain out surface water immediately. Water from the open ditch is diverted out with the drain pipe culverts provided under the road. This drain can also work to intercept domestic sewage water consistently discharged from the small houses standing on the slope to the east of the site. In addition, the construction of the surrounding drain distinguishes the landfill clearly from the neighboring squatter houses, so that the site boundary is established.

cb. To improve the leachate quality

The regulation pond equipped with water pump is provided at the outlet of the drain for leachate. Leachate is caught at the regulation pond and then returned to the landfill with a water pump and a conduit. It is returned to the inside layer of the landfill through the gas removal pipe provided in the site.

cc. To release gas generated from wastes

Although gas removal facilities should be provided before landfill operations start, there are no sufficient gas removal facilities provided at the Cateura landfill site. Without sufficient gas removal facilities earth has been filled on the top of waste to cover waste where the landfill operation has been completed. It is, at present, observed that the gas is coming up at many spots at the site. This gas removal facility will work to improve such present dangerous conditions. Moreover, it can eliminate the adverse impacts on trees, which will also be planted in the experiment, by gas and leachate.

cd. To screen the landfill site from the residents' sights

A buffer zone, which is made up with plants, is provided at the northern side of the

landfill site to shut it off. The buffer zone will improve the living conditions of the surrounding residential area by reducing the impact by the landfill operation.

K.1.3 Proposed Plan of Sanitary Landfill Experiment

The proposed plans of the sanitary landfill experiment is shown in Figure K.1.3a. The detailed drawings, No.ES01 to ES06, concerning the sanitary landfill experiment are included in Data Book. These proposed plans were confirmed at the meeting of the Interim Report. The implementation of the sanitary landfill experiment was executed in collaboration with Paraguayan and Japanese sides.

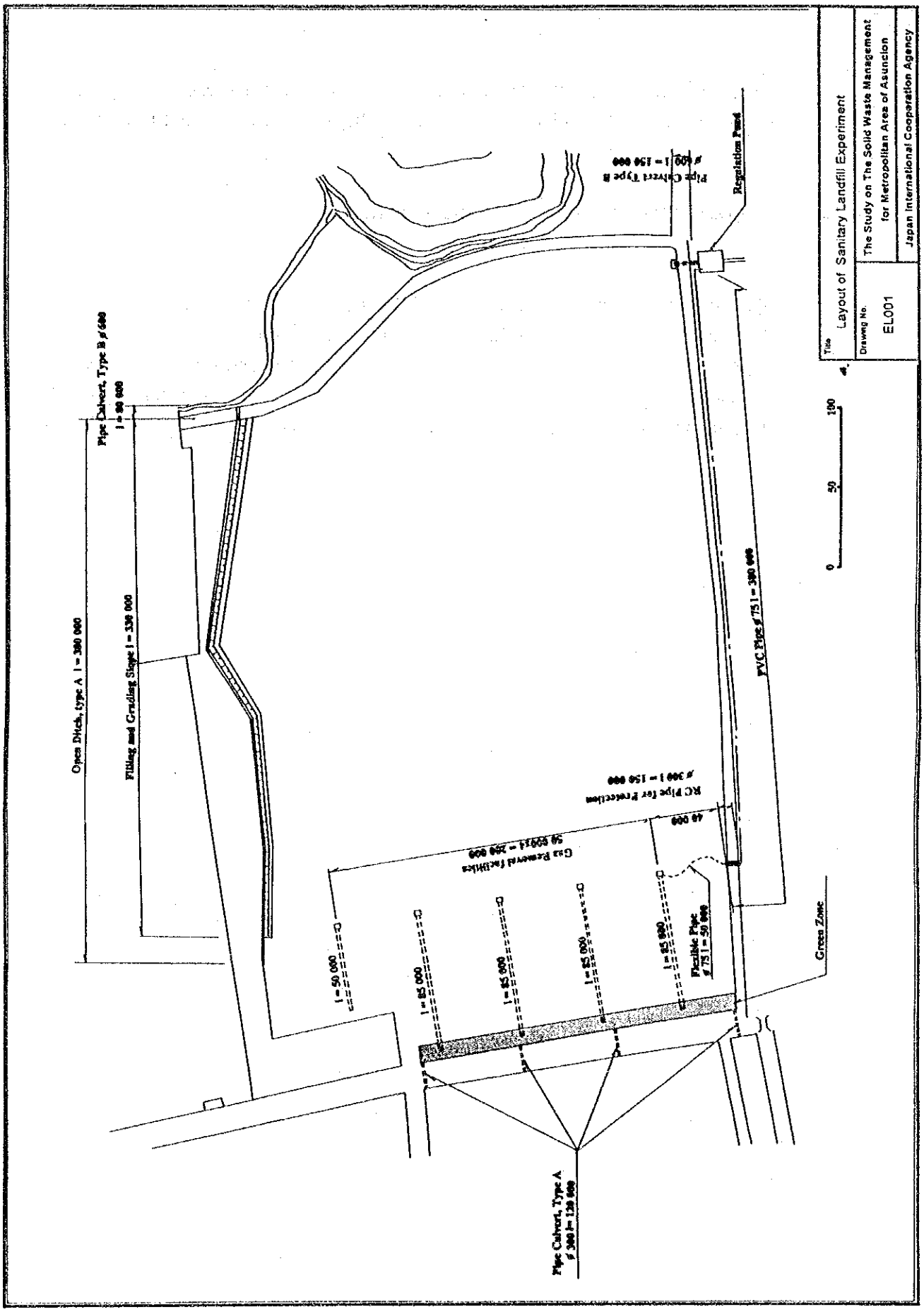

Figure K.1.3a Proposed Plan of the Sanitary Landfill Experiment

K.1.4 Findings

Operation of leachate circulation was started in April 1994 after the construction for the sanitary landfill experiment was completed. The findings recognized through the experiment are as follows.

- The buffer zone which was constructed at the northern side of the disposal site was proved to be very effective to shut residents' sights off. Even the embankment which was filled with soil 1 meter high for the buffer zone was found to shut residents' sight off because the existing landfill site is very low. Plantations are estimated to improve the living environment of the neighborhood after they grow.

- The open drainage was excavated along the foot of the hill in the southern side of the disposal site in order to divert sewage and storm water run from on the hill to avoid it infiltrating the disposal site and to distinguish the landfill from the neighborhood. This aim was achieved. In addition, this drainage help to made neighborhood to appear some distance away from the disposal site. The neighbors thereby appreciates the new open drainage. This effect was not anticipated.

- After leachate circulation started, the leachate collected in the regulation pond usually did not overflow except for rainy days, although the capacity of regulation pond is small, approximately 70 m^3. This fact proves that leachate circulation method is effective to control leachate quality and quantity in Paraguay. This could be foreseen because evaporation is more than precipitation in Paraguay. The experiment of the leachate circulation system should be continued in order to be applied for the large disposal site in future.

- The horizontal gas removal, which is made up with gravel and perforated pipe 50 cm below the ground, collected ground water and made the ground soft because the ground water table was rather shallow. In such case, vertical gas removal may be more suitable than horizontal gas removal facilities.

The sanitary landfill experiment was concluded to be almost successful except horizontal gas removal facilities, because the leachate circulation system is functioning and the neighbors appreciate the buffer zone and new open drain.

K.2 Experiment of School Lecture on Solid Waste

K.2.1 Objective of the Experiment

The objective of the school lecture experiment on solid waste are as follows.

- to teach the problems caused by solid waste to students
- to teach the appropriate discharge measures of solid waste to students
- to introduce teaching methods on solid waste problems to teachers

In addition, it can be expected that the effects of the school lecture will spread to other citizens through students and their parents.

K.2.2 Method of the Public Educational Campaign

a. Educational Material Used

The following materials were prepared and used for the solid waste lecture.

- Educational video
- Teaching manual and material

b. Educational Video

The educational video on the solid waste aspect was made by the production company by the finance of the JICA Study Team in consultation with the counterparts.

The scenario of this video tape is presented from the next page.

EDUCACIÓN ESCOLAR DE LA BASURA.
"LAS BASURAS AL BASURERO..."

LOCUCIONES.

VOZ DE LA NIÑA:

Mi casa puede tener este color o este otro.
Puedo agregarle una ventana, un árbol, también puedo ponerle otros detalles que la distingan.

De mí también depende que esté limpia...

Yo soy Leti..

Ésta es mi casa..y hoy comprendí que las basuras deben ir al basurero.

ESCENA 4

LETI : Mientras nosotros dormimos, existen muchas personas que están limpiando todo lo que hemos ensuciado. Éste es el caso de mi amigo Queney mucho más alto que yo y trabaja bastante.
Queney es barrendero...

ESCENA 5

LETI : Queney sale todas las mañanas muy temprano. Va hasta su ligar de trabajo. Donde se reúne con sus demás compañeros.

QUENEY : Dividimos los servicios en recolección de basuras barrido de calles y limpieza de mercados. En Asunción somos más de 400 personas las que salimos a limpiar a la ciudad, distribuidas en más de 50 camiones, además de tantas otras personas y vehículos en los demás municipios. Algunos limpian a la mañana como yo, pero otros lo hacen por las tardes y por las noches.

Yo limpio la zona del mercado 4 de Asunción, que es una de las más difíciles, por la cantidad de basura que se junta y por la cantidad de gante que transita la zona. Por esas razones, las zonas de mayor producción de basuras se limpian dos o tres veces al día.

En las calles donde circulan muchos autos y gente, como ocurre en el centro de las ciudades, la limpieza se hace por las noches. Primero temprano por la mañana. Los camiones recorren las calles despacito, recogiendo todo lo que puede afear nuestras ciudades.

Cuando se trata de recolectar las basuras depositadas a los costados de los negocios y residencias. La cosa también es bastante complicada, ya que los camiones recolectores, deben pasar entre autos estacionados, y mis compañeros tienen que recoger las bolsas corriendo entre los otros vehículos que circulan por esos sectores.

ESCENA 7

LETI : Queney me cuenta que limpian las calles y recogen basuras en la mayoría de las viviendas, comercios y vías públicos.

QUENEY : Las basuras están en todas partes!!!, en los patios baldíos, en las calles, en las veredas, en los ríos..arroyos.
Uno encuentra de todo: ropas, zapatos viejos, restos de comidas, envoltorio de caramelos, helados y dulces, latas, y hasta desechos industriales y de los comercios..

Y por supuesto con tantos manjares..¿cómo las plagas no la van a pasar bien?. Cuando las basuras no se manejan correctamente, pueden producir más de 40 enfermedades, que son trasmitidas a través de moscas, mosquitos, ratas y animales domésticos que juegan con nuestros hijos.
Además, cuando los desechos alimenticios se pudren, se origina un gas muy peligroso que es conocido como gas metano.
Por eso las enfermedades están al orden del día. Cual-

quiera se puede contagiar..especialmente los niños y los más viejos...

La gente arroja los desechos sin pensar en las consecuencias: produciendo malos olores y contaminando las plantas, el agua y por ende a nuestro ganado...así como las capas freáticas, o sea, los pozos de los vecinos. Cuando se acumula demasiada basura en los ríos o los arroyos, la anchura de estos ríos se reducen, lo que puede causar inundaciones.

ESCENA 10

LETI : Queney siempre nos recomienda que separemos las basuras en paquetes, ya que muchos de los desechos son re-utilizables, y muchos objetos como los vidrios, son muy peligrosos para los recolectores.

ESCENA 11

QUENEY : Conviene siempre separar los residuos en dos bolsas, en uno tratando de poner todos los elementos inorgánicos, como plásticos, vidrios, papeles y metales, y en la otra los orgánicos: como restos de comida y desechos de jardín, ya que todo esto facilita el proceso de reciclaje. Es mejor que las basuras se saquen a la vereda en bolsas de plástico, el mismo día en que va a pasar el recolector, y antes de la hora de recolección.

Después de recoger las basuras de las casas y comercios, éstas son transportadas hasta puntos de vertido designados por las municipalidades. Allí hay personas que separan productos comercializables como vidrios, papeles, plásticos y metales, para venderlos a los fabricantes.
Muchas familias viven de ese recurso.
Las basuras que no pueden ser recicladas se dejan en el vertedero. Para hacer un vertedero higiénico y sanitario, éstas deben ser compactadas y cubiertas por tierra con topadoras. Desgraciadamente, muchas municipalidades no cuentan con los recursos necesarios.

El reciclaje consiste en la re-utilización de la basura convirtiéndola en otros elementos, así: los restos de papeles que se convierten en papeles nuevos o las botellas, vidrios y plásticos rotos que son utilizados como materia prima en la fabricación de nuevas botellas y plásticos.

ESCENA 13

LETI : Queney me cuenta, que aún cuando para él termina su jornada laboral, otros siguen trabajando. Los técnicos e ingenieros que planifican los servicios de limpieza se reúnen y analizan como ampliar las zonas de recolección, como mejorar la seguridad en la recolección de basuras, como hacer que nuestra ciudad se vea más linda...entre otras cosas.

ESCENA 14

LETI : Hoy comprendí que mi ciudad es mi casa, mi barrio, mi vecindario, por eso mi esfuerzo por mantenerla limpia es importante.
Por de pronto, voy a terminar de pintar esto.
Es un regalo para Queney..como agradecimiento por conservar mi ciudad tan limpia...y por ser mi amigo!!!

c. Teaching manual and material

The teaching manual and material which was prepared for this school lecture is presented below.

1. RESUMEN DE LA EDUCACIÓN

La clase no va a ser explicado netamente por el instructor, se va realizar con la participación constante de los alumnos con preguntas sencillas, y despertando en los alumnos el interés sobre el tema.

Ej. i. ¿Qué es la basura?
ii. ¿Qué perjuicio nos causa la basura?
iii. ¿Cómo son tratadas las basuras?
iv. ¿Cómo colaborar en el tratamiento de la basura?

2. EJECUCIÓN DE LA CLASE

Al comienzo de la clase, para que los alumnos tomen interés, el Sr.Yoshida va a dar una breve explicación del objeto de la clase. Luego, el contraparte como instructor seguirá la clase.

3. GUIÓN

El instructor como(A.) va a dar una breve explicación del tema, y el alumno como(B.) puede responder de esta forma.

i. ¿Qué es la basura?

A. La basura, son todas las cosas que ya no se necesitan en la casa, comercios, restaurantes, industrias.
Por ejemplo, en la casa son las bolsas de plásticos y papel que sobran después de las compras y restos de comida.

A. ¿En sus casas que otro tipo de basura existen?
B. Las cosas que no se utilizan preparar la comida (vísceras de los pescados, semillas y cáscaras de frutas).
Restos de telas prendas viejas, calzados rotos o los que quedaron chicos.
Periódicos y revistas viejos, cuadernos usados, restos de latas y botellas

que contenían alimentos, utensilios rotos.
Hojas y ramas de los árboles del patio, las tierras y piedras que se juntan cuando se limpia el patio.
Restos de cigarrillos, restos de yerba y café.
Juguetes y pelotas descompuestos.

A. ¿Qué tipo de cosas existen en los comercios y restaurantes?.

B. En los comercios
-Grandes cajas de madera y cartón que contenían mercaderías.
-Mercaderías descompuestas y sucias que ya no se pueden vender.
-Repuestos descompuestos al reparar una mercadería.

B. En los restaurantes.
-Restos de ingredientes que sobran al preparar la comida.
-Restos de latas de los ingredientes. Restos de botellas de vinos y gaseosas.
-Restos de comida de los clientes.
-Servilletas utilizadas por los clientes.

A. ¿Qué hay en las industrias?

B. Restos de hierros, restos de cortes de gomas y cueros, restos de telas e hilos, restos de vidrios, restos de plásticos, aceites y algunos productos farmacéuticos.

A. Agregar a los ejemplos de arriba, que salen basuras de mercados, oficinas y hospitales.
-Pensar en que existen varios tipos de basura, y que el proceso normal de vida del hombre implica generación de basura.
-(En Asunción se genera al día casi 150 camionadas de basura)
-(En San Lorenzo se genera al día casi 75 camionadas de basura)
-(En Capiata se genera al día casi 55 camionadas de basura)
-Pensar en que existen basuras que son biodegradables y otros que no lo son.

ii. ¿Qué tipo de daño nos causa la basuras?

A. Dentro de la basura [los restos de comidas] y [las partes que no se pueden usar para cocinar] si se deja abandonado, por ejemplo se convierte en comida de ratas, cucarachas y moscas que atraen el cólera, disentería y peste bubónica, éstos se multiplican son causa de enfermedades. Las basuras descompuestas, contienen muchos microbios que dañan al cuerpo humano.

A. Qué tipo de daños causan por ejemplo las basuras que se arrojan en los arroyos, parques y calles.

B. Si se arrojan las basuras en los arroyos, no corre bien el agua y cuando llueve se desbordan. Se ensucia el agua y se llena de larvas mosquitos, y despide malos olores.

B. Si se arroja en las calles y plazas, los papeles y plásticos vuelan con el viento y se dispersan por toda la ciudad. En las casas próximas a los lugares donde se arrojan basuras llegan los malos olores. Mientras jugaba en el parque o calles, tuve una herida don restos de vidrio o hierros.

A. En el caso de que se juegue en los lugares donde hay basura, se tienen que lavar bien las manos y los pies porque están llenos de microbios.

A. La basura es fuente de diversas enfermedades, despide malos olores, obstruye el cauce, y deteriora la bella imagen de la ciudad, razón por la cual debemos darle una disposición correcta.

A. Pero, aunque parezca que la basura es la representación del mal, también es un tesoro.
¿Cuáles son las cosas que son tesoro dentro de la basura.?

B. Papel, latas y botellas vacías, resto de hierro, resto de vidrios, plásticos, se pueden vender.

A. Estas cosas son utilizadas como material para fabricar latas, botellas, papeles nuevos, hierros, plásticos. Por eso para fabricar la misma cosa, no se necesita tanto de materia prima, de esta forma preservamos la naturaleza. (dar una explicación de reciclaje)

A. Pero, si se saca con los restos de comida se convierte en una simple basura, por eso existe la necesidad de sacar en forma separada.

A. Estas cosas, no se deben sacar junto con la basura, se deben dejar dentro de la casa y cuando se juntan mucho, se pueden vender.

iii. ¿Cómo son manejadas las basuras?

A. ¿Sabes como son tratados las basuras sacadas de la casa?

B. Viene el recolector de basura y lleva al vertedero.
Son arrojados en las calles, parque y arroyos.
Son quemados en los patios y calles.
Son depositados en pozos del patio.

A. En el caso de que las basuras sacadas de las casas son recolectadas y arrojadas en el vertedero:
(En Asunción es casi 70%)
(En San Lorenzo es casi 50%)