

Table 3.3c Population Forecast of Urban Area (1992–2006)

No	Urban Area	Population			Average Annual Growth Rate % (1992–2002)
		1992	2002	2006	
1	Highly Urbanized M.				
	Asuncion	502,426	544,098	561,720	0.80
2	F.Mora	95,349	116,230	125,811	2.00
	Sub-total	597,775	660,328	687,531	1.00
	Urbanized M.				
3	Lambaré	99,990	148,010	173,150	4.00
4	San Lorenzo	133,405	217,303	264,133	5.00
5	Capiatá	83,898	150,249	189,685	6.00
6	Luque	84,885	183,260	239,801	8.00
7	M.R.Alonso	39,422	85,109	115,790	8.00
8	Villa Elisa	29,918	64,591	87,875	8.00
	Subtotal	471,518	848,521	1,070,434	6.05
	Less Urbanized M.				
9	Nemby	27,234	48,772	61,573	6.00
10	J.A. Saldivar	2,016	3,610	4,558	6.00
11	Itá	14,275	21,230	24,720	4.00
12	Areguá	6,335	7,722	8,359	2.00
13	Limpio	26,396	42,996	52,262	5.00
14	Villa Hayes	11,843	17,531	20,508	4.00
15	Benjamín Aceval	6,203	9,182	10,742	4.00
	Subtotal	94,302	150,944	182,722	4.82
	Total :	1,163,595	1,659,793	1,940,687	3.62

Source : Projection was done by the JICA Study Team. Projections for the period 2002–2006 were made using the 1992–2002 rates.

ac. Forecast on Waste Amount and Composition

aca. Forecast on Future Waste Amount

i. Methodology

Waste generation will be projected based on the increase in population, however creating a margin for the increase in generation ratio attributed to increase in GDP. However, the ratio of garden waste will not increase because a future land area of a house will not increase.

The most direct influence on waste generation is the change in population and estimated annual population growths of 15 municipalities for the planning period are shown in Table 3.3c.

ii. Forecast on Waste Amount

Based on the WACS results and the above-mentioned assumption, the forecast on MSW generation ratio is presented in Table 3.3d.

Table 3.3d Forecast on Waste Generation Ratio

	Unit	1994	2000	2006
1. MSW				
Household	g/person/d	961	1,020	1,083
Shop	g/shop/d	3,186	3,382	3,590
Restaurant	g/shop/d	31,958	33,924	36,011
Market	g/shop/d	5,961	6,328	6,717
Institutional	g/employee/d	78	83	88
Street Sweeping				
for the 14 municipalities	g/km/d	39,950	39,950	39,950
for Asuncion	g/km/d	(254,700)	(254,700)	(254,700)
Hospital	g/bed/d	4,000	4,246	4,507
Bulky	g/person/d	0.6	0.6	0.7
2. Other Wastes	g/pers/d	30	32	34

Note : * The generation ratio for Asuncion shown in parentheses is calculated by the actual disposal amount observed by the truck scale at the Cateura landfill while the ratio for the other 14 municipalities is the one obtained by the WACS conducted by the JICA Study Team.

acb. Forecast on Waste Composition

In Table 3.3e results for household waste and MSW (excluding street sweeping and bulky wastes) composition from WACS are compared with the data of Rio de Janeiro in Brazil provided by the Applied Research Center of COMLURB (Rio de Janeiro Municipal Public Cleansing Company), Pinang in Malaysia for 1987 and Tokyo in Japan for 1972.

Table 3.3e Comparison of Waste Composition Data for MSW unit:%

	Household Waste from WACS	MSW * from WACS	Pinang ** Malaysia 1987	Tokyo Japan 1972	Rio de Janeiro 1991
1. Combustibles	71.1	72.8	88.1	89.0	79.1
Kitchen waste	36.6	37.4	32.8	25.9	33.9
Paper	6.4	10.2	25.5	35.6	27.1
Textile	1.3	1.2	3.4	3.2	2.7
Plastic	3.9	4.2	11.2	6.9	12.7
Grass and Wood	22.2	19.2	14.4	-	2.0
Leather and Rubber	0.7	0.6	0.8	0.8	0.7
Others	-	-	-	16.6	-
2. Non-Combustibles	28.9	27.2	12.0	11.0	20.4
Metal	1.3	1.3	2.6	3.7	3.1
Glass	3.1	3.5	1.4	7.3	2.2
Ceramic and Stone	2.5	2.5	0.2	-	0.4
Others (soils, etc.)	22.0	19.9	7.8	-	14.7
Total	100	100	100	100	99.5
Unit Weight (kg/m ³)	220	215	190	N.A.	209

Note: WACS : Waste Amount and Composition Survey
 * : The figure shows the composition of MSW other than street sweeping and bulky waste.
 ** Source : "Solid Waste Management Study for Pulau Pinang and Seberang Perai Municipalities, August 1989, JICA"

Referring to Table 3.3e, the frame of the waste composition in 2006 is set as follows:

- Paper and plastic ratios will increase up to 24% and 7% respectively as seen in Malaysia and Brazil.
- Ratio of grass and wood will decrease down to 10% due to the reduction of vegetation in the urban area.
- Soils (others) ratio will decrease down to 11% due to the increase of the paved road rate.
- Only minor changes will be observed for the other items.

Based on the above, the forecast for composition of MSW is done and tabulated in Table 3.3f.

Table 3.3f Forecast on Composition of MSW unit: %

Composition	1994	2000	2006
1. Combustibles	72.8	75	79
Kitchen Waste	37.4	36	34
Paper	10.2	18	24
Textile	1.2	2	3
Plastic	4.2	5	7
Grass and Wood	19.2	13	10
Leather and Rubber	0.6	1	1
2. Non-Combustibles	27.2	25	21
Metal	1.3	2	3
Glass	3.5	5	5
Ceramic and Stone	2.5	2	2
Others (Soils, etc.)	19.9	16	11
Total	100.0	100.0	100.0

Note: MSW here excludes street sweeping and bulky waste.

acc. Forecast on Calorific Value

In case a separate collection system will not be introduced, the LCV of mixed waste is estimated in Table 3.3g.

Table 3.3g Forecast on Lower Calorific Value

Year	Lower Calorific Value (kcal/kg)
	Mixed
1993	1,192
2000	1,425
2006	1,697

Note: MSW excludes street sweeping and bulky waste.

ad. Future Waste Stream

The future waste streams in 2006 of 15 municipalities are prepared and presented in Tables 3.3h, 3.3i and 3.3j.

Table 3.3h Waste Stream in 2006 (1)

Unit: ton/day

Municipality	Asuncion	F.Mora	Lambare	San Lorenzo	Capiata
Waste Generation	824	158	203	325	225
Recycling at Generation	30	7	9	14	10
Self-disposal at Generation	119	22	29	99	67
Collection Amount	675	129	165	212	148
Recycling from Discharge to Disposal	24	5	7	11	8
Other Wastes(ISW)	19	4	6	9	6
Disposal Amount	670	128	164	210	146

Table 3.3i Waste Stream in 2006 (2)

Unit: ton/day

Municipality	Luque	M.R. Alonso	Villa Elisa	Nemby	J.A. Saldivar
Waste Generation	294	139	104	80	6
Recycling at Generation	13	6	5	3	0
Self-disposal at Generation	84	43	24	22	3
Collection Amount	197	90	75	55	3
Recycling from Discharge to Disposal	10	5	4	3	0
Other Wastes(ISW)	8	4	3	2	0
Disposal Amount	195	89	74	54	3

Table 3.3j Waste Stream in 2006 (3)

Unit: ton/day

Municipality	Ita	Aregua	Limpio	Villa Hayes	B. Aceval
Waste Generation	33	11	70	25	14
Recycling at Generation	1	0	3	1	1
Self-disposal at Generation	9	5	29	8	6
Collection Amount	23	6	38	16	7
Recycling from Discharge to Disposal	1	0	2	1	0
Other Wastes(ISW)	1	0	2	1	0
Disposal Amount	23	6	38	16	7

d. MSWM Master Plan for 15 Municipalities

The technical system as well as institutional systems proposed in the MSWM Master Plan for 15 municipalities are presented in Tables 3.3ka to 3.3yb.

Table 3.3ka Asuncion MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		510,497	535,496	561,720
Collection Ratio		83 % (73%)	100 %	100 %
Number of Users		94,431 (83,000)	119,344	125,188
Serviced Population (*)		423,713 (372,422)	535,496	561,720
Non-serviced Population		86,784 (138,075)	0	0
Collection System		Curb collection with waste stands.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Compaction trucks without public containers	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Transfer system with trailers	Transfer system with trailers
Number of Personnel		140 persons	217 persons	245 persons
Unit Cost		11,959 Gs/ton	23,558 Gs/ton	23,866 Gs/ton
Main Equipment (Unit)		Compactor 30 units	Compactor 59 units	Compactor 68 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		264 km	300 km	300 km
Number of Personnel		160 persons	370 persons	370 persons
Unit Cost		10,772 Gs/km	11,132 Gs/km	11,132 Gs/km
Main Equipment (Unit)			Container 969 sets.	Container 1016 sets.
3. INTERMEDIATE TREATMENT				
		No processing facilities except for the incinerator for infectious hospital waste.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Mainly by the private sector and less involvement of the Municipality.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Sanitary landfill level 1: controlled tipping	Sanitary landfill level 3	Sanitary landfill level 3
Disposal Site		Cateura	Chaco-i (AMUAM)	Chaco-i (AMUAM)
Distance from Main Generation Source		5.4 km	31.9 km	31.9 km
Unit Cost		685 Gs/ton	Tipping Fee: 20,376 Gs/ton	Tipping Fee: 20,376 Gs/ton
Number of Personnel		7 persons	-	-
Main Equipment (Unit)		5	-	-
6. EQUIPMENT OPERATION & MAINTENANCE				
Place		Parque Caballero	Parque Caballero	Parque Caballero
Number of personnel		77 persons	44 persons	66 persons

Table 3.3kb Asuncion MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Environmental Bureau	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		523 persons	454 persons	512 persons
Type of Management		Municipality & partly private contractor	Municipality	Municipality
2. FINANCE				
Budget				
-- for the whole municipality		50,700 million Gs.	? million Gs.	? million Gs.
-- for MSWM		7,000 million Gs.	14,218 million Gs.	13,182 million Gs.
State of Cadastre Registration		Under completion	Completed	Completed
Fee charging or Collection System		The Municipality charges an annual fee for all the services together with other municipal fees. The amount depends on the size of the property, the floor area of the building and the pavementation of the adjacent road.	The Municipality charges an annual fee for all the services together with other municipal fees. The amount depends on the size of the property, the floor area of the building and the pavementation of the adjacent road.	The Municipality charges an annual fee for all the services together with other municipal fees. The amount depends on the size of the property, the floor area of the building and the pavementation of the adjacent road.
Fee Tariff				
-- for collection from residential areas		7,500 Gs/month	9,300 Gs/month	11,500 Gs/month
-- for collection from commercial areas		22,700 Gs/month	28,000 Gs/month	34,400 Gs/month
Number of Users		94,431(83,000)	119,344	125,188
3. PRIVATIZATION				
Privatization Method		Contract	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE			A sanitation guideline shall be enforced with the cooperation of the AMUAM/SENASA	A sanitation guideline shall be enforced with the cooperation of the AMUAM/SENASA
5. PUBLIC COOPERATION			Should be carried out seeking the cooperation of the AMUAM.	Should be carried out seeking the cooperation of the AMUAM.

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3la F. Mora MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		99,201	111,717	125,811
Collection Ratio		64 %	85 %	100 %
Number of Users		13,822	20,797	27,554
Serviced Population		63,111	94,959	125,811
Non-serviced Population		36,090	16,758	0
Collection System		Curb collection with and without waste stands.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Compaction trucks without public containers	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Compactor type transfer system with 70 m ³ container truck	Compactor type transfer system with 70 m ³ container truck
Number of Personnel		37 persons	40 persons	79 persons
Unit Cost		21,135 Gs/ton	37,208 Gs/ton	47,762 Gs/ton
Main Equipment (Unit)			Compactor 9 units	Compactor 18 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		2 km	20 km	40 km
Number of Personnel		32 persons (part-time)	23 persons	46 persons
Unit Cost		18,000 Gs/km	23,151 Gs/km	22,466 Gs/km
Main Equipment (Unit)			Container 8 sets.	Container 16 sets.
3. INTERMEDIATE TREATMENT				
		No processing facilities except for the incinerator for infectious hospital waste in some hospitals. The others dispose by themselves or through the collection system.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Carried out by the private sector in the Cateura Landfill Site.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Sanitary landfill level 1: controlled tipping	Sanitary landfill level 3	Sanitary landfill level 3
Disposal Site		Cateura, Asuncion	Chaco-i (AMUAM)	Chaco-i (AMUAM)
Distance from Main Generation Source		7 km	30.9 km	31.2 km
Unit Cost		939 Gs/ton	Tipping Fee: 20,376 Gs/ton	Tipping Fee: 20,376 Gs/ton
Number of Personnel		7 persons (Municipality of Asuncion)	N.A.	N.A.
Main Equipment (Unit)		Municipality of Asuncion	N.A.	N.A.
6. EQUIPMENT O & M				
Place		El Carmen, F.Mora	AMUAM workshop	AMUAM workshop
Number of personnel		3 persons	N.A.	N.A.

Table 3.31b F. Mora MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Sanitation Bureau	Integrated municipal dpt.	Integrated municipal dpt.
Number of Personnel		34 persons Municipality 37 persons Private	67 persons	131 persons
Type of Management		Municipality for street sweeping and private contractor for collection.	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		2,126 million Gs.	? million Gs.	? million Gs.
- for MSWM		20 million Gs.	2,097 million Gs.	3,620 million Gs.
State of Cadastre Registration		Completed	Completed	Completed
Fee charging or Collection System		Street sweeping is charged by the Municipality only to around 2,700 shops in the commercial area every six months with other fees such as patent fees. Collection is charged by the private contractor directly to the users through fee collectors, then the Private contractor submits the invoices to the Municipality which stamps them and returns to the Contractor 95% of the value, keeping 5% for administrative costs.	Use cadastre information to improve accuracy and coverage. Billing and collection system based on a detailed study of costs, showing clearly the convenience of early payment.	Use cadastre information to improve accuracy and coverage. Billing and collection system based on a detailed study of costs, showing clearly the convenience of early payment.
- for collection from residential areas		2,500-3,600 Gs/month	9,300 Gs/month	11,500 Gs/month
- for collection from commercial areas		3,060-3,800 Gs/month 8,200 Gs/month bank 17,760 Gs/month big	28,000 Gs/month	34,400 Gs/month
Number of Users		13,822	20,797	27,554
3. PRIVATIZATION				
Privatization Method		Concession	Only medical wastes shall be collected by the private contractor through a concession contract.	Only medical wastes shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE			A municipal sanitation regulation shall be enforced with assistance from AMUAM/SENASA	A municipal sanitation regulation shall be enforced with assistance from AMUAM/SENASA
5. PUBLIC COOPERATION		Through pamphlets and stickers with the cooperation of private companies such as Coca-Cola.	Through pamphlets and stickers with the cooperation of private companies such as Coca-Cola, in coordination with AMUAM	Through pamphlets and stickers with the cooperation of private companies such as Coca-Cola, in coordination with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3ma Lambare MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAUL-AGE				
Urban Area Population		108,149	136,843	173,150
Collection Ratio		61%	80%	100%
Number of Users		13,860	23,018	36,407
Inhabitants per Household		4,756	4,756	4,756
Serviced Population		65,918	109,474	173,150
Non-serviced Population		42,231	27,369	0
Collection System		Curve collection	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump trucks	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		24 persons	40 persons	79 persons
Unit Cost		26,644 Gs/ton	24,157 Gs/ton	26,999 Gs/ton
Main Equipment (Unit)			Compactor 9 units	Compactor 18 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		6 km	17 km	25 km
Number of Personnel		8 persons	20 persons	31 persons
Unit Cost		18,721 Gs/km	23,851 Gs/km	25,424 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Mainly by the private sector and less involvement of the Municipality.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Sanitary landfill level 1	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site		Puerto Pabla	AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source		6.5 km	15 km	15 km
Unit Cost		? Gs/ton	Tipping fee: 26,654 Gs/ton	Tipping fee: 26,654 Gs/ton
Number of Personnel		0 persons	N.A.	N.A.
Main Equipment (Unit)			N.A.	N.A.
6. EQUIPMENT O & M				
Place		Ecuador and Guaira St.	AMUAM workshop	AMUAM workshop
Number of personnel		3 persons	N.A.	N.A.

Table 3.3mb Lambare MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Environmental Bureau	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		10 persons municipality 24 persons private	64 persons	116 persons
Type of Management		Municipality & private contractor	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		4,100 million Gs.	? million Gs.	? million Gs.
- for MSWM		367 million Gs.	1,629 million Gs.	3,000 million Gs.
State of Cadastre Registration		Completed	Completed	Completed
Fee charging or Collection System		The Municipality charges an annual fee for all the services together with other municipal fees. The user can pay in installments of up to four months.	Cadastre information to improve accuracy and coverage. System to clearly show the fine for late payment, so as to induce early payment.	Cadastre information to improve accuracy and coverage. System to clearly show the fine for late payment, so as to induce early payment.
- for collection from residential areas		2,500-4,000 Gs/month	5,200 Gs/month	6,300 Gs/month
- for collection from commercial areas		10,000-30,000 Gs/month	15,100 Gs/month	18,600 Gs/month
Number of Users		13,860	23,018	36,407
3. PRIVATIZATION				
Privatization Method		Contract	Only medical wastes collected by the private contractor through a concession contract	Only medical wastes collected by the private contractor through a concession contract
4. REGULATION & GUIDELINE				
			A municipal sanitation regulation shall be enforced with the assistance of AMUAM/SENASA	A municipal sanitation regulation shall be enforced with the assistance of AMUAM/SENASA
5. PUBLIC COOPERATION				
			Municipality, in coordination with AMUAM.	Municipality, in coordination with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3na San Lorenzo MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAUL-AGE				
Urban Area Population		147,079	197,100	264,133
Collection Ratio		16 %	45 %	70 %
Number of Users		5,200	19,252	40,133
Serviced Population		23,956	88,695	184,893
Non-serviced Population		123,123	108,405	79,240
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Compaction trucks without public containers and dump trucks.	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Direct transportation by vehicles	Direct transportation by vehicles
Number of Personnel		36 persons	40 persons	? persons
Unit Cost		18,836 Gs/ton	26,484 Gs/ton	23,805 Gs/ton
Main Equipment (Unit)			Compactor 9 units	Compactor 18 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		6 km	21 km	32 km
Number of Personnel		8 persons	24 persons	38 persons
Unit Cost		13,698 Gs/km	22,440 Gs/km	23,459 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities except for the incinerator for infectious hospital waste.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Mainly by the private sector and less involvement of the Municipality.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Open Dump	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site		Anahi-i 1	AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source		8 km	15 m	15 m
Unit Cost		1,360 Gs/ton	Tipping fee: 26,654 Gs/ton	Tipping fee: 26,654 Gs/ton
Number of Personnel		1 person	N.A.	N.A.
Main Equipment (Unit)				
6. EQUIPMENT O & M				
Place		Municipality	AMUAM workshop	AMUAM workshop
Number of personnel		7 persons	N.A.	N.A.

Table 3.3nb San Lorenzo MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Sanitation Bureau	Integrated municipal Dept.	Integrated municipal Dept.
Number of Personnel		58 persons	68 persons	123 persons
Type of Management		Municipality	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		3,200 million Gs.	? million Gs.	? million Gs.
- for MSWM		150 million Gs.	1,943 million Gs.	3,942 million Gs.
State of Cadastre Registration		Completed	Completed	Completed
Fee charging or Collection System		Through collectors who receive 10% of the fees	Cadastre information to improve accuracy and coverage. System to promote interrelated payment of fees for municipal services.	Cadastre information to improve accuracy and coverage. System to promote interrelated payment of fees for municipal services.
- for collection from residential areas		2,500 Gs/month	5,200 Gs/month	6,300 Gs/month
- for collection from commercial areas		3,500 Gs/month shops 8,000 Gs/month supermarkets 16,000 Gs/month hotel, etc	15,100 Gs/month	18,600 Gs/month
Number of Users		5,200	19,252	40,133
3. PRIVATIZATION				
Privatization Method		None	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
			A sanitary regulation shall be enforced with the assistance of AMU-AM/SENASA	A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA
5. PUBLIC COOPERATION				
		None	Municipality in cooperation with AMUAM	Municipality in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3oa Capiata MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAUL-AGE				
Urban Area Population		94,268	133,721	189,685
Collection Ratio		15 %	45 %	70 %
Number of Users		3,000	12,852	28,360
Serviced Population		14,046	60,174	132,780
Non-serviced Population		80,222	73,547	56,906
Collection System		Curb collection	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump truck	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		5 persons	28 persons	54 persons
Unit Cost		14,694 Gs/ton	27,662 Gs/ton	22,732 Gs/ton
Main Equipment (Unit)			Compactor 6 units	Compactor 12 units
2. STREET SWEEPING				
Sweeping System		No sweeping service provided.	Manual sweeping	Manual sweeping
Length of Road Swept			6 km	12 km
Number of Personnel			9 persons	18 persons
Unit Cost			37,443 Gs/km	35,160 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Mainly by the private sector and less involvement of the municipality.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Open dumping	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site		Compania Sexta	AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source		12 km	15 km	15 km
Unit Cost		2,597 Gs/ton	Tipping fee: 26,654 Gs/ton	26,654 Gs/ton
Number of Personnel		1 person	N.A.	N.A.
6. EQUIPMENT O & M				
Place		All maintenance done outside.	AMUAM workshop	AMUAM workshop
Number of personnel			N.A.	N.A.

Table 3.3ob Capiata MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Sanitation dept.	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		8 persons	28 persons	54 persons
Type of Management		Municipality	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		1,016 million Gs.	? million Gs.	? million Gs.
- for MSWM		5 million Gs.	1,360 million Gs.	2,897 million Gs.
State of Cadastre Registration		Completed	Completed	Completed
Fee charging or Collection System		The collection fee is charged directly to the users through fee collectors who get 15%.	Cadastre information to improve accuracy and coverage of billing and collection. System to promote inter-related payment of fees for municipal services.	Cadastre information to improve accuracy and coverage of billing and collection. System to promote inter-related payment of fees for municipal services.
- for collection from residential areas		2,500 Gs/month	5,200 Gs/month	6,300 Gs/month
- for collection from commercial areas		4,000-15,000 Gs/month 500,000 Gs/month industry	15,100 Gs/month	18,600 Gs/month
Number of Users		3,000	12,852	28,360
3. PRIVATIZATION				
		none	only medical waste shall be collected by the private contractor through a concession contract.	only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
			A sanitary regulation shall be enforced with assistance from AMUAM/SENASA	A sanitary regulation shall be enforced with assistance from AMUAM/SENASA
5. PUBLIC COOPERATION				
			Municipality, with assistance from AMUAM	Municipality, with assistance from AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3pa Luque MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAUL-AGE				
Urban Area Population		99,010	157,116	239,801
Collection Ratio		23 %	45 %	70 %
Number of Users		4,800	14,785	35,103
Serviced Population		22,954	70,702	167,861
Non-serviced Population		76,056	86,414	71,940
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump trucks	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		18 persons	36 persons	70 persons
Unit Cost		36,571 Gs/ton	33,873 Gs/ton	25,449 Gs/ton
Main Equipment (Unit)			Compactor 8 units	Compactor 16 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		28 km	40 km	60 km
Number of Personnel		33 persons	44 persons	67 persons
Unit Cost		15,656 Gs/km	20,616 Gs/km	20,868 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Mainly by the private sector and less involvement of the Municipality.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Sanitary landfill level 1: controlled tipping	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site		Cateura	AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source		20 km	15 km	15 km
Unit Cost		Unknown	Tipping fee: 20,376 Gs/ton	Tipping fee: 20,376 Gs/ton
Number of Personnel		7 persons (Asuncion)	N.A.	N.A.
Main Equipment (Unit)		Municipality of Asuncion	N.A.	N.A.
6. EQUIPMENT O & M				
Place		Done outside	AMUAM workshop	AMUAM workshop
Number of personnel			N.A.	N.A.

Table 3.3pb Luque MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Treasury Dept.	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		municipality 35 private 18	84 persons	143 persons
Type of Management		Municipality & partly private contractor	Municipality	Municipality
2. FINANCE				
Budget				
– for the whole municipality		1,423 million Gs.	? million Gs.	? million Gs.
– for MSWM		15 million Gs.	694 million Gs.	1,476 million Gs.
State of Cadastre Registration		Completed	Completed	Completed
Fee charging or Collection System		The private contractor charges the fee directly to the users monthly. The street sweeping is charged by the Municipality which must be paid when any transaction is conducted at the Municipality. The user pays according to linear meters bordering the street and type of pavementation.	Use cadastre information to improve accuracy and coverage. Control strict compliance with the term and conditions of the concession by the private contractor. System to promote inter-related payment of fees for municipal services.	Use cadastre information to improve accuracy and coverage. Control strict compliance with the term and conditions of the concession by the private contractor. System to promote inter-related payment of fees for municipal services.
– for collection from residential areas		5,700 Gs/month	5,200 Gs/month	6,300 Gs/month
– for collection from commercial areas		10,000 Gs/shops/month 15,000 Gs/Workshop/month 18,000 Gs/Hospital & School/month	15,100 Gs/month	18,600 Gs/month
Number of Users		4,800	14,785	35,103
3. PRIVATIZATION				
Privatization Method		Concession	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
			Sanitary regulation shall be enforced with assistance from AMU-AM/SENASA	Sanitary regulation shall be enforced with assistance from AMUAM/SENASA
5. PUBLIC COOPERATION				
		Sanitation Dept.	Municipality, in coordination with AMUAM	Municipality, in coordination with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3qa M.R.Alonso MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAUL-AGE				
Urban Area Population		45,982	72,967	115,790
Collection Ratio		16 %	45 %	70 %
Number of Users		1,500	6,885	16,996
Serviced Population		7,154	32,835	81,053
Non-serviced Population		38,829	40,132	34,737
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump truck	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		6 persons	18 persons	37 persons
Unit Cost		22,356 Gs/ton	33,873 Gs/ton	25,449 Gs/ton
Main Equipment (Unit)			Compactor 4 units	Compactor 8 units
2. STREET SWEEPING				
Sweeping System		No service	Manual sweeping	Manual sweeping
Length of Road Swept			6 km	10 km
Number of Personnel			8 persons	12 persons
Unit Cost			23,744 Gs/km	20,822 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Mainly by the private sector and less involvement of the Municipality.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Open dumping	Sanitary landfill level 3	Sanitary landfill level 3
Disposal Site		Barrio Central	Chaco-i (AMUAM)	Chaco-i (AMUAM)
Distance from Main Generation Source		2 km	17 km	17 km
Unit Cost		18,630 Gs/ton	Tipping fee: 20,376 Gs/ton	Tipping fee: 20,376 Gs/ton
Number of Personnel		1 person	N.A.	N.A.
Main Equipment (Unit)			N.A.	N.A.
6. EQUIPMENT O & M				
Place		None	AMUAM workshop	AMUAM workshop
Number of personnel		None	N.A.	N.A.

Table 3.3qb M.R.Alonso MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Sanitation dept.	Integrated dept.	Integrated dept.
Number of Personnel		7 persons	30 persons	54 persons
Type of Management		Municipality	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		919 million Gs.	? million Gs.	? million Gs.
- for MSWM		50 million Gs.	694 million Gs.	1,476 million Gs.
State of Cadastre Registration		Completed	Completed	Completed
Fee charging or Collection System		One fee collector goes to the users every month.	Cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.	Cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.
- for collection from residential areas		3,000 Gs/month	5,200 Gs/month	6,300 Gs/month
- for collection from commercial areas		13,000 Gs/month	15,100 Gs/month	18,600 Gs/month
Number of Users		1,500	6,885	16,996
3. PRIVATIZATION				
Privatization Method		None	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE			A municipal sanitary regulation shall be enforced with assistance from AMUAM/SENASA	A municipal sanitary regulation shall be enforced with assistance from AMUAM/SENASA
5. PUBLIC COOPERATION			Municipality, in cooperation with AMUAM	Municipality, in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3ra Villa Elisa MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		34,896	55,376	87,875
Collection Ratio		46 %	65 %	85 %
Number of Users		3,500	7,783	16,150
Serviced Population		16,188	35,994	74,694
Non-serviced Population		18,709	19,382	13,181
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump truck	Compaction trucks without public containers	Compaction trucks without public containers
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		5 persons	14 persons	28 persons
Unit Cost		14,384 Gs/ton	27,486 Gs/ton	22,685 Gs/ton
Main Equipment (Unit)			Compactor 3 units	Compactor 6 units
2. STREET SWEEPING				
Sweeping System		No street sweeping	Manual sweeping	Manual sweeping
Length of Road Swept			9 km	20 km
Number of Personnel			11 persons	22 persons
Unit Cost			21,309 Gs/km	18,630 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		Mainly by the private sector and less involvement of the Municipality.	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Open dump	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site		The final disposal site is not set, the municipality is looking for trenches and pits to fill up.	AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source		5 km	15 km	15 km
Unit Cost		1,644 Gs/ton	Tipping fee: 26,654 Gs/ton	Tipping fee: 26,654 Gs/ton
Number of Personnel		1 person (part time)	N.A.	N.A.
6. EQUIPMENT O & M				
Place		None	AMUAM workshop	AMUAM workshop
Number of personnel		0 persons	N.A.	N.A.

Table 3.3rb Villa Elisa MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Sanitation dept.	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		2 persons municipality 6 persons private	28 persons	54 persons
Type of Management		Private contractor & partly municipality	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		283 million Gs.	? million Gs.	? million Gs.
- for MSWM		14 million Gs.	712 million Gs.	1,545 million Gs.
State of Cadastre Registration		Under completion	Completed	Completed
Fee charging or Collection System		The private contractor charges the fees directly to the users through fee collectors, then they give the municipality 10%.	Use cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.	Use cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.
- for collection from residential areas		3,800 Gs/month	5,200 Gs/month	6,300 Gs/month
- for collection from commercial areas		8,500 to 15,000 Gs/shop/month	15,100 Gs/shop/month	18,600 Gs/shop/month
Number of Users		3,500	7,783	16,150
3. PRIVATIZATION				
Privatization Method		Concession	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
			A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA	A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA
5. PUBLIC COOPERATION				
			Municipality, in coordination with AMUAM	Municipality, in coordination with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3sa Nemby MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		30,600	43,407	61,573
Collection Ratio		7 %	45 %	70 %
Number of Users		450	4,161	9,182
Serviced Population		2,112	19,533	43,101
Non-serviced Population		28,488	23,874	18,472
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump truck	Dump trucks	Dump trucks
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		4 persons	22 persons	43 persons
Unit Cost		17,808 Gs/ton	41,895 Gs/ton	36,314 Gs/ton
Main Equipment (Unit)			Dump truck 5 units	Dump truck 10 units
2. STREET SWEEPING				
Sweeping System		None	Manual sweeping	Manual sweeping
Length of Road Swept			3 km	12 km
Number of Personnel			4 persons	14 persons
Unit Cost			20,091 Gs/km	20,091 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		None	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Open dump	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site		Mbocayaty	AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source		3 km	15 km	15 km
Unit Cost		0 Gs/ton	Tipping fee: 26,654 Gs/ton	Tipping fee: 26,654 Gs/ton
Number of Personnel		1 (a resident)	N.A.	N.A.
6. EQUIPMENT O & M				
Place		None	AMUAM workshop	AMUAM workshop
Number of personnel			N.A.	N.A.

Table 3.3sb Nemby MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Private contractor	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		5 persons private	29 persons	61 persons
Type of Management		Private contractor	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		304 million Gs.	? million Gs.	? million Gs.
- for MSWM		3 million Gs.	664 million Gs.	1,410 million Gs.
State of Cadastre Registration		Under completion	To be completed	Completed
Fee charging or Collection System		The private contractor charges a fee directly to the users. If the fee is not paid the service is discontinued.	Use cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.	Use cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.
- for collection from residential areas		2,500 Gs/month	4,500 Gs/month	5,500 Gs/month
- for collection from commercial areas		2,500 Gs/month	14,400 Gs/month	17,600 Gs/month
Number of Users		450	4,161	9,182
3. PRIVATIZATION				
Privatization Method		Concession	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
		Exists	A municipal sanitation regulation shall be enforced with assistance from AMUAM/SENASA	A municipal sanitation regulation shall be enforced with assistance from AMUAM/SENASA
5. PUBLIC COOPERATION				
		None	Municipality, in cooperation with AMUAM	Municipality, in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3ta J.A.Saldivar MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		2,265	3,213	4,558
Collection Ratio		0 %	25 %	50 %
Number of Users		0	174	495
Serviced Population		0	803	2,279
Non-serviced Population		2,265	2,410	2,279
Collection System		No service	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles			Dump trucks	Dump trucks
Haulage System			Integrated municipal dept.	Integrated municipal dept.
Number of Personnel			2 persons	3 persons
Unit Cost			79,452 Gs/ton	39,269 Gs/ton
Main Equipment (Unit)				
2. STREET SWEEPING				
Sweeping System		None	Manual sweeping	Manual sweeping
Length of Road Swept			1 km	2 km
Number of Personnel			2 persons	2 persons
Unit Cost			19,178 Gs/km	17,808 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		None	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		There is no disposal site.	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site			AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source			15 km	15 km
Unit Cost			Tipping fee: 26,654 Gs/ton	Tipping fee: 26,654 Gs/ton
Number of Personnel			N.A.	N.A.
Main Equipment (Unit)			N.A.	N.A.
6. EQUIPMENT O & M				
Place			AMUAM workshop	AMUAM workshop
Number of personnel			N.A.	N.A.

Table 3.31b J.A.Saldivar MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		None	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel			5.8 persons	7.6 persons
Type of Management			Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		42 million Gs.	? million Gs.	? million Gs.
- for MSWM		0.2 million Gs.	71 million Gs.	110 million Gs.
State of Cadastre Registration		Incomplete	To be completed	To be completed
Fee charging or Collection System			Cadastre information to introduce and improve collection systems for municipal taxes and fees. System to promote inter-related payment of fees for municipal services.	Cadastre information to introduce and improve collection systems for municipal taxes and fees. System to promote inter-related payment of fees for municipal services.
- for collection from residential areas			4,500 Gs/month	5,500 Gs/month
- for collection from commercial areas			14,400 Gs/month	17,600 Gs/month
Number of Users		0	174	495
3. PRIVATIZATION				
Privatization Method		None	None	None
4. REGULATION & GUIDELINE				
			A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA.	A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA
5. PUBLIC COOPERATION				
		None	Municipality in cooperation with AMUAM	Municipality in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3ua Ita MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		15,440	19,536	24,720
Collection Ratio		18 %	45 %	70 %
Number of Users		600	1,858	3,658
Serviced Population		2,839	8,791	17,304
Non-serviced Population		12,601	10,745	7,416
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump truck	Dump trucks	Dump trucks
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		6 persons	14 persons	18 persons
Unit Cost		12,362 Gs/ton	56,787 Gs/ton	35,378 Gs/ton
Main Equipment (Unit)			Dump truck 3 units	Dump truck 4 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		6 km	10 km	15 km
Number of Personnel		9 persons	7 persons	7 persons
Unit Cost		20,245 Gs/km	12,603 Gs/km	8,402 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		None	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		Open dump	Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site		Compania Potrero Poi	AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source		3 km	15 km	15 km
Unit Cost		3,288 Gs/ton	26,654 Gs/km	26,654 Gs/km
Number of Personnel		1 person (part-time)	N.A.	N.A.
Main Equipment (Unit)			N.A.	N.A.
6. EQUIPMENT O & M				
Place		None	AMUAM workshop	AMUAM workshop
Number of personnel			N.A.	N.A.

Table 3.3ub Ita MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Secretariat	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		17 persons	24 persons	29 persons
Type of Management		Municipality	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		483 million Gs.	? million Gs.	? million Gs.
- for MSWM		12 million Gs.	411 million Gs.	634 million Gs.
State of Cadastre Registration		Under completion	To be completed	Completed
Fee charging or Collection System		The Municipality charges a monthly fee for the collection service through fee collectors. If the user doesn't pay, the service is discontinued. Street sweeping is charged to shops in the commercial and market areas.	Cadastre information to improve accuracy and coverage. System whereby collection of municipal taxes and fees would be inter-related.	Cadastre information to improve accuracy and coverage. System whereby collection of municipal taxes and fees would be inter-related.
- for collection from residential areas		3,000 Gs/month	4,500 Gs/month	5,500 Gs/month
- for collection from commercial areas		3,000 Gs/month	14,400 Gs/month	17,600 Gs/month
Number of Users		600	1,858	3,658
3. PRIVATIZATION				
Privatization Method			Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE			A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA	A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA
5. PUBLIC COOPERATION		Culture Dept.	Municipality in cooperation with AMUAM	Municipality in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3va Aregua MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		6,591	7,422	8,359
Collection Ratio		0	25 %	50 %
Number of Users		0	384	865
Serviced Population		0	1,856	4,180
Non-serviced Population		6,591	5,567	4,180
Collection System		No service	Curb collection with waste stands.	Curb collection with waste stands..
Collection Vehicles			Dump trucks	Dump trucks
Haulage System			Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel			6 persons	10 persons
Unit Cost			81,279 Gs/ton	72,146 Gs/ton
Main Equipment (Unit)			Dump truck 1 unit	Dump truck 2 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		2 km	5 km	5 km
Responsible Organization		Municipality	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		7 persons	6 persons	6 persons
Unit Cost		19,178 Gs/km	24,658 Gs/km	24,658 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be enforced.
4. RECYCLING				
			Recycling at generation sources shall be promoted.	Recycling at generation sources shall be promoted.
5. FINAL DISPOSAL.				
		There is no disposal site. Street sweeping waste is burned on site and the rest dumped beside the road.		
Landfill Method			Sanitary landfill level 2	Sanitary landfill level 3
Disposal Site			AMUAM inter-municipal landfill	AMUAM inter-municipal landfill
Distance from Main Generation Source			15 km	15 km
Unit Cost			26,654 Gs/ton	26,654 Gs/ton
Number of Personnel			N.A.	N.A.
6. EQUIPMENT O & M				
Place			AMUAM workshop	AMUAM workshop
Number of personnel			N.A.	N.A.

Table 3.3vb Aregua MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization			Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		7 persons	14 persons	18 persons
Type of Management		Municipality	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		266 million Gs.	? million Gs.	? million Gs.
- for MSWM		0.1 million Gs.	189 million Gs.	287 million Gs.
State of Cadastre Registration		Under completion	To be completed	Completed
Fee charging or Collection System		A sweeping fee is charged annually with the property tax. However, this fee is symbolic since it doesn't represent real cost or service provided.	Cadastre information to improve accuracy and coverage. System for the collection of municipal fees on the basis of estimated costs.	Cadastre information to improve accuracy and coverage. System for the collection of municipal fees on the basis of estimated costs.
- for collection from residential areas			4,500 Gs/month	5,500 Gs/month
- for collection from commercial areas			14,400 Gs/month	17,600 Gs/month
Number of Users			1,856	4,180
3. PRIVATIZATION				
Privatization Method		None	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
			A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA	A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA
5. PUBLIC COOPERATION				
		None	Municipality, in cooperation with AMUAM	Municipality, in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3wa Limpio MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		29,102	38,999	52,262
Collection Ratio		1 %	25 %	50 %
Number of Users		70	2,145	5,749
Serviced Population		318	9,750	26,131
Non-serviced Population		28,784	29,249	26,131
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump trucks	Dump trucks	Dump trucks
Haulage System		Direct transportation by collection vehicles	Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel		2 persons	18 persons	35 persons
Unit Cost		17,123 Gs/ton	47,260 Gs/ton	39,510 Gs/ton
Main Equipment (Unit)			Dump truck 4 units	Dump truck 8 units
2. STREET SWEEPING				
Sweeping System		Manual sweeping	Manual sweeping	Manual sweeping
Length of Road Swept		1 km	3 km	3 km
Number of Personnel		3 persons	4 persons	4 persons
Unit Cost		19,178 Gs/km	30,137 Gs/km	30,137 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be enforced.
4. RECYCLING				
		None	Recycling at generation sources shall be promoted.	Recycling at generation sources shall be promoted.
5. FINAL DISPOSAL				
Landfill Method		Open dump	Sanitary landfill level 3	Sanitary landfill level 3
Disposal Site		Private property	Chaco-i (AMUAM)	Chaco-i (AMUAM)
Distance from Main Generation Source		4 km	22.1 km	22.1 km
Unit Cost		0 Gs/ton	20,376 Gs/ton	20,376 Gs/ton
Number of Personnel		0 persons	N.A.	N.A.
Main Equipment (Unit)			N.A.	N.A.
6. EQUIPMENT O & M				
Place		None	AMUAM workshop	AMUAM workshop
Number of personnel		0 persons	N.A.	N.A.

Table 3.3wb Limpio MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Municipality and Private contractor	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		2 persons private 3 persons municipality	25 persons	38 persons
Type of Management		Private contractor	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		408 million Gs.	? million Gs.	? million Gs.
- for MSWM		1 million Gs.	458 million Gs.	851 million Gs.
State of Cadastre Registration		Under completion	To be completed	To be completed
Fee charging or Collection System		The collection fee is charged directly to the users by the private contractor. The sweeping fee is charged by the municipality with other taxes and fees.	Cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.	Cadastre information to improve accuracy and coverage. System to promote inter-related payment of fees for municipal services.
- for collection from residential areas		2,500 Gs/month	4,500 Gs/month	5,500 Gs/month
- for collection from commercial areas		2,500 Gs/month	14,400 Gs/month	17,600 Gs/month
Number of Users		70	2,145	5,749
3. PRIVATIZATION				
Privatization Method		None	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
			A municipal sanitary regulation shall be enforced with assistance from AMUAM/SENASA	A municipal sanitary regulation shall be enforced with assistance from AMUAM/SENASA
5. PUBLIC COOPERATION				
		None	Municipality, in cooperation with AMUAM	Municipality, in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3xa Villa Hayes MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		12,809	16,208	20,508
Collection Ratio		10 %	45 %	70 %
Number of Users		250	1,495	2,942
Serviced Population		1,220	7,294	14,356
Non-serviced Population		11,589	8,914	6,152
Collection System		Curb collection.	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles		Dump trucks	Dump trucks	Dump trucks
Haulage System		Direct transportation by collection vehicle	Direct transportation by collection vehicle	Direct transportation by collection vehicle
Number of Personnel		5 persons	10 persons	19 persons
Unit Cost		19,178 Gs/ton	61,840 1Gs/ton	53,425 Gs/ton
Main Equipment (Unit)				
2. STREET SWEEPING				
Sweeping System		No sweeping system	Manual sweeping	Manual sweeping
Length of Road Swept			5 km	5 km
Number of Personnel			6 persons	6 persons
Unit Cost			24,658 Gs/km	24,658 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be enforced.
4. RECYCLING				
		None	Recycling at generation sources shall be promoted.	Recycling at generation sources shall be promoted.
5. FINAL DISPOSAL				
Landfill Method		Open dump	Sanitary landfill level 3	Sanitary landfill level 3
Disposal Site		Puente Lata	Chaco-i (AMUAM)	Chaco-i (AMUAM)
Distance from Main Generation Source		3.5 km	20.3 km	20.3 km
Unit Cost		0 Gs/ton	20,376 Gs/ton	20,376 Gs/ton
Number of Personnel		0 persons	N.A.	N.A.
Main Equipment (Unit)				
6. EQUIPMENT O & M				
Place		None	AMUAM workshop	AMUAM workshop
Number of personnel		0 persons	N.A.	N.A.

Table 3.3xb Villa Hayes MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		Sanitation dept.	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		7 persons	18 persons	28 persons
Type of Management		Municipality	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		402 million Gs.	? million Gs.	? million Gs.
- for MSWM		6 million Gs.	280 million Gs.	505 million Gs.
State of Cadastre Registration		Under completion.	To be completed	Completed
Fee charging or Collection System		The Municipality charges the users through a fee collector.	Cadastre information to improve accuracy and coverage. System whereby collection of different municipal taxes and fees would be inter-related.	Cadastre information to improve accuracy and coverage. System whereby collection of different municipal taxes and fees would be inter-related.
- for collection from residential areas		4,000 Gs/month	4,500 Gs/month	5,500 Gs/month
- for collection from commercial areas		4,000 Gs/month	14,400 Gs/month	17,600 Gs/month
Number of Users		250	1,495	2,942
3. PRIVATIZATION				
Privatization Method		None	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE			A municipal sanitary regulation shall be enforced with assistance from AMUAM/SENASA	A municipal sanitary regulation shall be enforced with assistance from AMUAM/SENASA
5. PUBLIC COOPERATION		Sanitation dept.	Municipality, in cooperation with AMUAM	Municipality, in cooperation with AMUAM

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

Table 3.3ya Benjamin Aceval MSWM Master Plan on Technical System

Item	Year	1994	2000	2006
1. COLLECTION & HAULAGE				
Urban Area Population		6,709	8,489	10,742
Collection Ratio		0	25 %	50 %
Number of Users		0	427	1,082
Serviced Population		0	2,122	5,371
Non-serviced Population		6,709	6,367	5,371
Collection System		No collection service	Curb collection with waste stands.	Curb collection with waste stands.
Collection Vehicles			Dump trucks	Dump trucks
Haulage System			Direct transportation by collection vehicles	Direct transportation by collection vehicles
Number of Personnel			4 persons	9 persons
Unit Cost			57,534 Gs/ton	47,358 Gs/ton
Main Equipment (Unit)			Dump truck 1 unit	Dump truck 2 units
2. STREET SWEEPING				
Sweeping System		No service	Manual sweeping	Manual sweeping
Length of Road Swept			6 km	6 km
Number of Personnel			7 persons	7 persons
Unit Cost			25,570 Gs/km	25,570 Gs/km
3. INTERMEDIATE TREATMENT				
		No processing facilities.	Proper treatment of hazardous waste shall be enforced.	Proper treatment of hazardous waste shall be completely established.
4. RECYCLING				
		None	Recycling at generation sources shall be promoted.	Recycling at generation sources and by the private sector shall be promoted
5. FINAL DISPOSAL				
Landfill Method		There is no landfill.	Sanitary landfill level 3	Sanitary landfill level 3
Disposal Site			Chaco-i (AMUAM)	Chaco-i (AMUAM)
Distance from Main Generation Source			30.5 km	30.5 km
Unit Cost			20,376 Gs/ton	20,376 Gs/ton
Number of Personnel			N.A.	N.A.
Main Equipment (Unit)				
6. EQUIPMENT OPERATION & MAINTENANCE				
Place			AMUAM workshop	AMUAM workshop
Number of personnel			N.A.	N.A.

Table 3.3yb Benjamin Aceval MSWM Master Plan on Institutional System

Items	Year	1994	2000	2006
1. ADMINISTRATION AND ORGANIZATION				
Responsible Organization		None	Integrated municipal dept.	Integrated municipal dept.
Number of Personnel		0 persons	13 persons	18 persons
Type of Management		No service	Municipality	Municipality
2. FINANCE				
Budget				
- for the whole municipality		119 million Gs	? million Gs.	? million Gs.
- for MSWM		0.15 million Gs	167 million Gs.	255 million Gs.
State of Cadastre Registration		Under completion	To be completed	Completed
Fee charging or Collection System		None	Cadastre information to plan coverage of municipal services. System for the collection of fees for municipal services on the basis of estimated costs. System to promote inter-related payment of fees for municipal services.	Cadastre information to plan coverage of municipal services. System for the collection of fees for municipal services on the basis of estimated costs. System to promote inter-related payment of fees for municipal services.
- for collection from residential areas			4,500 Gs/month	5,500 Gs/month
- for collection from commercial areas			14,400 Gs/month	17,600 Gs/month
Number of Users		0	451	1,142
3. PRIVATIZATION				
Privatization Method		None	Only medical waste shall be collected by the private contractor through a concession contract.	Only medical waste shall be collected by the private contractor through a concession contract.
4. REGULATION & GUIDELINE				
			A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA	A sanitary regulation shall be enforced with the assistance of AMUAM/SENASA
5. PUBLIC COOPERATION				
		Mayor	Municipality, in cooperation with AMUAM.	Municipality, in cooperation with AMUAM.

Note: Since the property tax transferred to the municipal governments from the Central Government by the 1992 Constitution, the revenue of the Municipality is expected to be increased drastically. Therefore, it could not be forecasted.

c. Institutional Development at Regional and National Level

ca. Administration and Organization

The institutional system encompassing all the municipalities shall be developed and supported by AMUAM at the regional level and by SENASA at the National Level.

These entities (mainly AMUAM) may help the municipalities to improve the administration and organization of their MSWM bodies, providing services that can be shared by several municipalities such as:

- transfer and disposal;
- vehicles and equipment maintenance; and
- human resources improvement.

Also, they can promote the coordination of action on matters such as:

- finance, specially policy on tariffs;
- production of ordinances and law enforcement; and
- public environmental education.

cb. Financial Support

The implementation of the proposed Master Plans will impose added responsibilities on AMUAM and SENASA, which will be unable to face these additional requirements without further institutional development. This, in turn, requires the necessary financial support.

cc. Laws and Enforcement

Besides the Regulations of the National Sanitary Code, the municipalities shall be guided to produce their own legislation, which shall take into account the National legislation as well as the local conditions and peculiarities.

cd. Inter-municipal cooperation

One of the most effective ways to improve MSWM institutional build up is through inter-municipal cooperation and it shall be promoted.

4. FEASIBILITY STUDY

4.1 Feasibility Study of the First Priority Project

a. Contents of the First Priority project

At the meeting of IT/R held in December 1993, the Paraguayan Supervisory Committee decided the contents of the first priority project for feasibility study as follows:

- i. Improvement of collection systems for 15 municipalities.
- ii. Construction of transfer station(s) for Asuncion and F.Mora; and
- iii. Construction of Chaco-i inter-municipal disposal site

b. Technical System

In response to the decision made by the Paraguayan Supervisory Committee, the preliminary design of the above-mentioned 3 projects were conducted. The results of designs are summarized in Tables 4.1a, 4.1b and 4.1c. The illustrations are in Plates 1 and 2.

Table 4.1a Improvement of Collection Systems for 15 Municipalities

Item	Item	
Equipment	Compactor 15.3 m ³	
	Asuncion	59 units
	F.Mora	9 units
	Lambare	9 units
	San Lorenzo	9 units
	Capiata	6 units
	Luque	8 units
	M.R.Alonso	4 units
	Villa Elisa	3 units
	Spare	5 units
	Total	112 units
Equipment	Dump Truck 10 m ³	
	Nemby	5 units
	J.A.Saldivar	0.2 units
	Ita	3 units
	Aregua	1 units
	Limpio	4 units
	Villa Hayes	2 units
	Benjamin Aceval	1 units
	Spare	0.8 units
	Total	17 units
Equipment	Container 1 m ³	
	Asuncion (Collection)	969 nos.
	Asuncion (Street Sweeping)	140 nos.
	F.Mora	8 nos.
	Total	1,117 nos.
Maintenance	Establishment of a workshop	800 m ²
Final Disposal	Inter-municipal landfill site	100 ha
	Bulldozer 21 ton	4 units
	Backhoe 0.7 m ³	1 unit
	Dump Truck 10 ton	1 unit
	Water Tanker	1 unit
	Wheel Excavator	1 unit
	Pickup	1 unit

Table 4.1b Outline of AML Transfer and Transport

Items	Plan
a. Target Year	2000
b. Service Population	630,000 (Asuncion and F.Mora)
c. Proposed Site	Madame Lynch Avenue, Asuncion
d. Received Waste	694 ton/day in 2000 - Household Waste - Commercial Waste - Market Waste - Institutional Waste - Bulky Waste - Road Sweeping Waste - Other Waste
e. Method of Transfer	Street Sweeping Waste: Direct re-loading to an open trailer Other wastes: Indirect re-loading to a closed trailer
f. Capacity	Transfer capacity: Direct re-loading: 15 tons/hour In-direct re-loading: 110 tons/hour Transport capacity: Open trailer: 15 tons/hour Closed trailer: 110 tons/hour
g. Required Area	10,000 m ²
h. Transfer Station Outline	Truck scale Access ramp Platform Push-pits Transfer packers Office
i. Transportation Equipment Outline	70 m ³ open trailer: 2 units 50 m ³ closed trailer: 9 units
j. Personnel	24 persons
k. Construction Period	1 year 1994 Land acquisition 1995 Detailed Design 1995 Tender 1996 Construction

Table 4.1c Outline of Chaco-i Inter-municipal Disposal Site

Items	Contents	Remarks
a. Target Year	2000	
b. Service population	821,000	Users are: Asuncion, F.Mora, M.R.Alonso, Limpio, Villa Hayes and B.Aceval
c. Proposed Site	Villa Hayes, Chaco	Site area 196 ha
d. Waste to be disposed	<ul style="list-style-type: none"> - Household Waste - Commercial Waste - Market Waste - Institutional Waste - Bulky Waste - Road Sweeping Waste - Other Waste 	
e. Capacity	1,600,000 m ³	
f. Life Year of Site	4 years	From 1997 to 2000
g. Landfill Method	Sanitary landfill	Leachate is circulated.
h. Landfill Area	40 ha	From 1997 to 2000
i. Facilities Outline		
- Main Facilities	Enclosing structure, drainage system, access road	
- Environmental Protection Facilities	Buffer zone, gas removal, leachate circulation and monitoring	
- Building and Accessories	Office, warehouse, truck scale, fence, well, parking	
j. Equipment	<ul style="list-style-type: none"> Bulldozer 6 Backhoe 1 Dump Truck 2 Water Tanker 1 Wheel Excavator 1 Pickup 1 	
k. Personnel	25 persons	
l. Construction Period	2 years	Design in 1995 Construction in 1996

c. Project Cost

ca. Investment Cost

The investment costs of the 3 projects are estimated and shown in Table 4.1d.

Table 4.1d Investment Cost unit: mill.Gs

Project	Investment
Collection Improvement	29,383
Asuncion	8,585
AMUAM	20,798
AML Transfer and Transport	9,824
Chaco-i Final Disposal Site	10,270
Total	49,477

- Note:
1. Investment was estimated based on the price in 1994.
 2. Investment for collection improvement is a total of 2 years from 1995 to 1996.
 3. Investment for transfer and transport is a total of 2 years from 1995 to 1996.
 4. Investment for Chaco-i final disposal site is a total of 2 years from 1995 to 1996.
 5. Total cost includes engineering fees and physical contingency.

cb. Operation and Maintenance Cost

Operation cost consists of the depreciation cost and operation/maintenance cost, which covers costs for fuel, personnel and management, etc..

Based on the above assumption, the operation cost in 2000 is calculated and shown below in Table 4.1e.

Table 4.1e Operation and Maintenance Cost unit: mill.Gs

Project	Investment
Collection Improvement	6,637
Asuncion	4,865
AMUAM	1,772
AML Transfer and Transport	440
Chaco-i Final Disposal Site	1,911
Total	8,988

- Note. 1. The collection cost for AMUAM does not include labor cost, maintenance cost, fuel cost, etc., concerning collection work, because they are born by municipalities.

d. Institutional System

da. Administration and Organization

i. Administration

The administration of the Institutional System supporting the First Priority Projects will be based on three main assumptions:

- The institutional model of MSWM in each municipality will be based on the *municipal provision of the services*, which means that services will be rendered by the municipal staff and by municipally owned vehicles and equipments.
- The AMUAM, the Association of Municipalities of the Metropolitan Area, will be responsible for the waste disposal and transfer operations, as well as for the vehicles and equipment maintenance of all the municipalities other than Asuncion.
- The municipalities will bear the costs of the services provided, be it directly in the case of the collection and street sweeping services, or be it indirectly, when the services are provided by AMUAM.

ii. Organization

In order to cope with its new responsibilities on MSWM, a new organizational structure of the AMUAM is proposed as shown in Figure 4.1a.

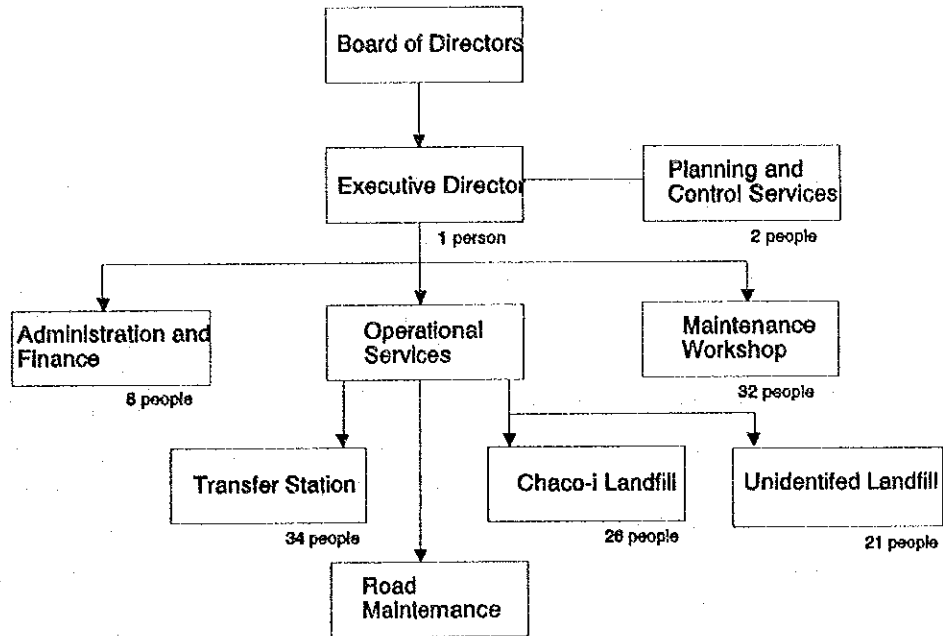


Figure 4.1a Proposed Organization of AMUAM

The number of personnel required to run the proposed structure is estimated at 124 people in total.

The new organization structures for 15 municipalities are proposed in accordance with the categories of municipalities, i.e. HUM, UM and LUM, as shown in Figures 8.2.1a, 8.2.1b and 8.2.1c in the Main Report.

db. Finance

i. Organizations

The organization directly involved in the implementation of the Project are AMUAM and the 15 municipal governments, according to their roles described in Section 1.4d, Executing Bodies for Technical Systems of MSWM.

The Central Government should be involved through SENASA, which is expected to provide strong technical support to AMUAM and member municipalities. However, it would be difficult to expect financial support from the Central Government in the area of MSWM due to tight financial situation and the lack of a subsidiary system.

The Departmental Governments were established by virtue of the 1992 Constitution, and are still being organized. Financial support from the Departmental Government should not be expected.

ii. AMUAM

According to the role of AMUAM in the MSWM, revenue sources considered viable were the following:

- Rental and Tipping Fees (for Transfer Station and Final Disposal Sites)

Revenues of AMUAM for MSWM were assumed to be rental and tipping fees, as indicated in Section 1.4c, Revenue and Expenditure for Financial Analysis. These fees were estimated as annual equivalent costs, on the basis of prices of investment items and the capital recovery factor under three assumed interest rates: 10%, 3% and 0%. The 10% interest rate was based on the IDB (Inter-American Development Bank) ordinary funds consisting of 7.0 to 8.75% interest rate plus 0.75% commitment commission. The 3% interest rate was based on the OECF loan, and the 0% was based on donations. The rental and tipping fees by the assumed interest rate are summarized in Table 4.1f.

Table 4.1f Rental and Tipping Fees by Interest Rate

Type	Items	Unit	Amount of Fee		
			Interest 10%	Interest 3 %	Interest 0 %
Rental Fee	Compactor 15.3 m ³	Gs/year	40,173,980	31,744,205	28,430,581
	Dump truck 10 m ³	Gs/year	24,481,019	19,344,125	17,324,885
	Container 1 m ³	Gs/year	385,866	322,287	296,608
Tipping Fee	Final disposal in Chaco-i	Gs/ton	20,376	17,253	16,071
	Final disposal in Unidentified site	Gs/ton	26,654	22,597	21,059
	Transfer and Transport	Gs/ton	8,641	6,625	5,899

- Tax on Bus Tickets

The tax on bus tickets was under the jurisdiction of each municipality, but member

municipalities recently decided to transfer this revenue source to AMUAM. This is a revenue source of great potential. AMUAM decided to use part of the revenues from the tax on bus tickets to cover the revenue shortfall from MSWM user charges.

iii. Municipalities

– User Charges for Waste Collection

Municipal revenues for MSWM were estimated on the basis of a willingness to pay (WTP) survey conducted in the first stage of the study. Results of the survey (weighted average with income groups distribution as weight) were as follows.

Table 4.1g User Charges for Collection unit: Gs/month

User Groups	Types of Municipalities		
	HUM	UM	LUM
Households	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.

– Property tax

The property tax used to be collected by the Central Government, but the 1992 Constitution transferred this tax to municipal governments. Collected property tax is distributed as follows: 70% for the municipal government, 15% for the Departmental government, and 15% to financially weaker municipalities. The property tax rate is set by the Central Government, but it is revised at the end of each year so as to keep up with inflation.

de. Privatization

The First Priority Projects will rely basically on governmental agencies, i.e, the municipal governments and AMUAM, and not on provision of services by private contractors.

The main reason for this procedure is the need to build up an institutional capacity in each one of the municipalities of the study area, since in some of them the

services are very poorly provided and in others there is non at all.

After accumulating experience on municipal solid waste management, these municipalities may, in the future, decide to contract the collection and street sweeping services (as well as disposal and transfer operations) to the private sector.

4.2 Project Evaluation

a. Evaluation Method

aa. Social Evaluation

The social evaluation of each project was conducted on the creation of jobs, improvement of the public health in the study area, appropriateness of technology, etc..

ab. Environmental Evaluation

The environmental evaluation of each project was carried out regarding the assessment items set up by adopting "Matrix for Scoping" presented in "Environmental Guidelines for Infrastructure Projects, IV Solid Waste Management, September 1992, JICA".

ac. Economic and Financial Evaluation

i. Scheme of economic and financial evaluation

The scheme of economic and financial evaluation applied in this study is shown in Table 4.2a.

Table 4.2a Scheme of Economic and Financial Evaluation

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 in view of national economy.
- 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.

ii. Methods of economic evaluation

The economic evaluation method in this study are shown Table 4.2b.

Table 4.2b Benefits, Costs and Evaluation Criteria in Economic Evaluation

	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	EIRR > 12%**	None
Evaluation Period	1996 - 2025	1996 - 2025	1996-2025

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

iii. Methods of Financial Evaluation

The income and expenditure taken into account for evaluation are tabulated in Table 4.2c.

Table 4.2c Income, Expenditure and Evaluation in Financial Evaluation

Organizations	Items	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 the maximum rental and tipping fees (CRF=10%), with either 10% decrease in total revenues or 10% increase in total expenses.

b. Evaluation of Collection System Improvement Project for 15 Municipalities

ba. Social Evaluation

Qualitatively, the improvement of collection system for 15 municipalities is feasible from a social view point because many benefits, such as recovery of degraded areas, general improvement in the landscape, etc., will be expected.

bb. Environmental Evaluation

Environmental evaluation of the Collection System Improvement Project is presented in Table 4.2d.

Table 4.2d Environmental Evaluation of Collection System Improvement

Items	Environmental Impact	Evaluation and Mitigation Measures
Favorable Impacts	<ul style="list-style-type: none"> - Reduction of scattered waste and dust - Reduction of offensive odor, water pollution and blockade of water way caused by illegal dumping - Reduction of insanitary area - Improvement of environmental sanitation and view of each municipality 	Most of the results of the prediction about the impact by the implementation of the project are in favor of the improvement of the present environmental situation.
Adverse Impacts	<ul style="list-style-type: none"> - Increase of air pollution, noise and vibration caused by collection vehicles 	Due to the few additional traffic, the adverse impact caused by the increase of the traffic would be negligible.

bc. Economic and financial evaluation

i. 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.

- Environmental improvement
 - . Improved public health
 - . Avoidance of tourism loss
 - . Land value appreciation
 - . Extra costs avoidance
- Employment generation
- Lower collection cost
- Reduced flood damage

ii. Financial evaluation

- Revenues and Expenses

Revenues of each municipality were estimated by assuming 80% of the user charges for collection service, which is presented in Table 4.1f, were collected. As for the expenses, as shown in Table 4.2c, those were estimated differently for Asuncion municipality and other 14 municipalities.

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.

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.

- Financial Internal Rate of Return (FIRR)

The cash flow analysis were conducted on the basis of the assumed revenues and expenses, and resulting financial internal rates of return (FIRR) are summarized in Table 4.2e.

Table 4.2e 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 for setting rental and tipping fees.

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.

- 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 4.2f and 4.2g.

Table 4.2f 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 4.2g 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%

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.

bd. 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 appropriateness 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. The resolution of this problem is described in Section 4.3b Financial Plan.

c. Evaluation of Construction Project of AML Transfer Station

ca. Social Evaluation

Qualitatively, the construction of AML transfer station is feasible socially because many benefits, such as creation of jobs, improvement of technical level, etc., will be expected.

cb. Environmental Evaluation

Environmental evaluation of the Construction of AML Transfer Station is presented in Table 4.2h.

Table 4.2h Environmental Evaluation of AML Transfer Station

Items	Environmental Impact	Impact Assessment	Mitigation Measures
1. Traffic and Public Facilities	<ul style="list-style-type: none"> - The number of incoming and outgoing vehicles to T/S is scheduled to be 124/day and 25/day. 	<ul style="list-style-type: none"> - A mitigation measure is necessary for oncoming vehicles. - There will be no impact on public facilities because there is no facility in the vicinity. 	<ul style="list-style-type: none"> - To station a person at the entrance of the T/S to regulate traffic in order to guide incoming and outgoing vehicles.
2. Health and Sanitary	<ul style="list-style-type: none"> - Rats and flies infestation due to food waste. 	<ul style="list-style-type: none"> - By the frequent washing of the floor and reception pit, the infestation of rats and flies will be eliminated, so that the impact on health and sanitary aspects can be permissible. 	<ul style="list-style-type: none"> - To wash the floor and reception pit frequently - To spray insecticide periodically
3. Landscape	<ul style="list-style-type: none"> - The building of the T/S will have an impact on the surrounding landscape. 	<ul style="list-style-type: none"> - A mitigation measure is necessary for the preservation of surrounding landscape. 	<ul style="list-style-type: none"> - To plant trees around the T/S as a buffer zone
4. Air pollution	<ul style="list-style-type: none"> - The impact on the air by exhaust gas from incoming and outgoing vehicles will be predicted. 	<ul style="list-style-type: none"> - Since the number of in and outgoing vehicles is very small in comparison to the present traffic, the impact by the exhaust gas is negligible. 	<ul style="list-style-type: none"> - None
5. Water Pollution	<ul style="list-style-type: none"> - The waste water from washing the floor, pit and vehicles may have an impact on a nearby stream if it will be discharged. 	<ul style="list-style-type: none"> - The waste water will be stored in a sealed tank and transported to the Chaco-i landfill for spraying back at the landfill. The impact caused by the waste water will be negligible. 	<ul style="list-style-type: none"> - None
6. Noise and Vibration	<ul style="list-style-type: none"> - Noise and vibration caused by in and outgoing vehicles will be little compared to the present traffic. 	<ul style="list-style-type: none"> - The impact caused by in and outgoing vehicles will be negligible. 	<ul style="list-style-type: none"> - None
7. Offensive Odor	<ul style="list-style-type: none"> - The offensive odor from putrefactive wastes may be expected. 	<ul style="list-style-type: none"> - By the frequent washing of the floor and reception pit and operation inside the building, the impact by offensive odor can be mitigated. 	<ul style="list-style-type: none"> - To wash the floor and reception pit frequently - To spray insecticide periodically

cc. **Economic and financial evaluation**

i. **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.

- **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

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

$$SCF = 0.96$$

- **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 4.2i 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 4.2i 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.

ii. Financial evaluation

- 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. Operation and maintenance costs of the Transfer Station also included one-third of operation and maintenance costs of the workshop and AMUAM's administration cost.

The resulting FIRR were 12.14% (CRF-10%), 7.09% (CRF-3%) and 5.10% (CRF-0%).

– Sensitivity Analysis

Results of the sensitivity analysis, conducted under specified conditions of decreased revenues and/or increased expenses, are shown in Table 4.2j.

Table 4.2j 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.

cd. 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 appropriateness 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 indicated the goodness of the Project.

Even in the worst case that is 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.

d. Evaluation of Construction Project of Chaco-i Inter-municipal Disposal Site

da. Social Evaluation

Qualitatively, the construction of Chaco-i inter-municipal landfill is feasible socially, because many benefits, such as improvement of working conditions of municipal landfill, recovery of surrounding areas of present landfill, etc. will be expected.

db. Environmental Evaluation

The environmental evaluation of the Construction of Inter-municipal Final Disposal Site at Chaco-i is presented in Table 4.2k.

Table 4.2k Environmental Evaluation of Chaco-i Inter-municipal Landfill

Phase Evaluation Items	Construction Phase	Operation Phase
1. Water Pollution	<ul style="list-style-type: none"> - The heavy rain may produce muddy water. Its impact will be negligible due to the flat topography. 	<ul style="list-style-type: none"> - Since the permeability of surface soil ranges from 10^{-6} to 10^{-9} cm/sec., the impact on the ground water by the generation of leachate will be permissible. In addition, there are no inhabitants in the vicinity of the site. - The leachate will be usually pumped up back to the landfill by a leachate circulation facility in order not to discharge it into a diversion canal. - The leachate will be discharged to a the diversion canal only during heavy rain. The impact will be permissible because it will be diluted by the rain water and there are no inhabitants along the diversion canal up to the Paraguay River where leachate will be diluted enough.
2. Air Pollution	<ul style="list-style-type: none"> - Adverse impact from dust will be mitigated by sprinkling water by a water tanker. 	<ul style="list-style-type: none"> - The generation of dust can be controlled by water sprinkling.
3. Noise	<ul style="list-style-type: none"> - The impact by the operation of construction equipment will be negligible because there are no inhabitants in the vicinity of the site. 	<ul style="list-style-type: none"> - The impact by the operation of landfill equipment will be negligible because there are no inhabitants in the vicinity of the site.
4. Offensive Odor	<ul style="list-style-type: none"> - There is no generation of odor at the construction phase. 	<ul style="list-style-type: none"> Daily covering can minimize the generation of odor.

dc. Economic and financial evaluation

i. 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.

- Improved public health
- Prevention of groundwater pollution
- Prevention of scattering solid wastes
- Land value appreciation near the present landfill
- Extra costs avoidance near the present landfills

ii. Financial evaluation

- FIRR

Revenues consisted of the Tipping Fee from the 6 municipalities, i.e. Asunción, F.Mora, M.R.Alonso, Limpio, Villa Hayes and B.Aceval. 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. Operation and maintenance costs of the final disposal sites also included one-third of operation and maintenance costs of the workshop and AMUAM's administration cost.

The resulting FIRR were 22.92% (CRF-10%), 16.65% (CRF-3%) and 14.23% (CRF-0%).

– Sensitivity Analysis

Results of the sensitivity analysis, conducted under specified conditions of decreased revenues and/or increased expenses, are shown in Table 4.21.

Table 4.21 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.

dd. 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 worst case that is 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.

4.3 Implementation Plan

a. Project Implementation Bodies and Schedule

aa. 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 4.3a.

Table 4.3a 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

b. Financial Plan

Financial Plans were prepared 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. In addition, 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 inviable implementing agency. Furthermore, the revenues from user charges were not enough to cover the costs of MSWM, except in Asuncion during most of the years of the Project, and F.Mora during the first phase of the Project (up to 2004). These financial analyses 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 be 10% and 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%) from each municipality and bus ticket tax (30%) from AMUAM.

Financial Plans for AMUAM and Asuncion are shown in Table 4.3b and 4.3c. Financial plans for 14 municipalities other than Asuncion 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.

Table 4.3b 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 4.3c 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

5. OTHER STUDIES

5.1 Experiment on Sanitary Landfill Operation and School Lecture

a. Experiment on sanitary landfill operation

aa. Proposed Plan

In order to demonstrate the impact of the environmental improvement plan 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 was carried out at the Cateura landfill in Asuncion from February to March in 1994.

The contents and aim of the experiment are as follows:

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

The proposed plans of the sanitary landfill experiment is shown in Figure 9.1.1a. in the Main Report. The implementation of the sanitary landfill experiment, as shown in Plate 4, was executed in collaboration with Paraguayan and Japanese sides.

ab. Findings

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. Plantations are deemed to improve the living environment of the neighborhood when they grow.
- The open drainage was excavated along the foot of the hill on the southern side of the disposal site in order to divert sewage and storm water from the hills to avoid it infiltrating the disposal site and to distinguish the landfill site from the residential areas. This aim was achieved.

- After the commencement of the leachate circulation facility, the leachate collected in the regulation pond usually did not overflow except for days where rainfall was heavy, although the capacity of regulation pond is small, approximately 70 m³. This could be foreseen because evaporation is more than precipitation in Paraguay.

The sanitary landfill experiment was concluded to be successful because the leachate circulation system is functioning as planned and the neighbors appreciate the buffer zone and new open drain, etc..

b. Experiment of School Lecture on Solid Waste

ba. Method of the Experiment

The objective of the primary school lecture experiment on solid waste were as follows:

- to teach the problems caused by solid waste to pupils;
- to teach the appropriate discharge measures of solid waste to pupils; and
- to introduce teaching methods on solid waste problems to teachers.

The educational video and teaching manual and materials were prepared and used for the solid waste lecture.

An hour lecture was given at 4 primary schools in the study area.

bb. Findings

The execution of the experiment of primary school lecture on solid waste motivated pupils on solid waste problems. The majority of pupils listened to the lectures and made discussions and questions full of interest. Many teachers expected to carry out the education on solid waste themselves by using the educational video and materials prepared by the Study Team, provided that the audio-visual system was available.

This experiment made not only the pupils but also teachers to understand how dirty their towns were at present and how important appropriate discharge manner of solid wastes was. Their motivation will be expanded to consider how they should go about making their towns clean and beautiful through the continuous sanitary education programs.

Many people related to the solid waste management understand that the problems can not be solved only by improvement of waste collection and disposal systems and that the sanitary education will be very effective in solving these problems. Therefore, this experiment of school education was much appreciated by them.

The method of school education on solid waste which was used for the experiment was found to be very effective and applicable to most cities in Paraguay with small revision depending on the conditions of the towns.

5.2 General Recommendation for The Improvement of ISW and Medical SWM

a. Study on Present ISWM (Industrial Solid Waste Management)

aa. Method of the Study

In this study, general recommendations for the improvement of the ISWM (Industrial Solid Waste Management) in the study area are prepared based on a rapid diagnosis study, using the existing data and information.

In order to make a rapid diagnosis on the present ISWM, the following surveys were conducted:

- data collection from responsible agencies on the present ISWM, i.e. SENASA and Asuncion Municipality;
- questionnaire survey to the producers of ISW; and
- field survey such as observations of the incoming ISW at the present landfills and field reconnaissance on illegal dumping sites.

ab. General Recommendations

i. Necessity of Further survey

Although there are approximately 3,000 factories in the Metropolitan Area of Asuncion, the questionnaire survey could only be conducted on limited factories, due to time shortages and lack of a reliable list of factories.

Since there are many sorts of factories and wastes generated, the survey should be conducted again after the list of existing factories have been prepared.

ii. Laws and Regulations

A legislation which ensure economic incentive shall be produced to support efforts in order to minimize the production of industrial wastes and to promote the use of pollution control equipments.

The Environmental Impact Assessment legislation shall be in order to define the precise role of the different government agencies dealing with this matter.

Coordination shall be sought between the National Government and the Municipal governments, when producing laws, regulations and guidelines regarding industrial waste, bearing in mind the hierarchy of the laws, ordinances and guidelines, so to avoid conflicts on environmental legislation.

The control and enforcement system to eliminate illegal dumping of ISW shall also be established urgently in cooperation with various agencies concerned.

iii. Administrative structure

The administrative structure which ensures a proper ISWM shall be established by clearly defining the roles of each organization concerned.

Coordination shall also be sought between the different levels of government and the different governmental agencies, in the law enforcement activities related to industrial waste management.

The municipalities shall cooperate with the National Government authorities mainly on matters related to nuisances and hazards to the people produced by mismanagement of the industrial wastes.

iv. Plans and technology

Guidelines and plans should be made with regards to industrial waste management to serve as a standard the enterprises have to comply with.

It will be essential to review personnel disposition within the administration and organization and increase the staff responsible for industrial waste management, and then conduct necessary training courses.

Furthermore the administration is required to have technical knowledge (in discharge, treatment, recycling, disposal methods, etc.), collect information and develop new techniques. The administration has to transfer technical information

to enterprises and provide them with technical aid through subsidies and other schemes.

v. Reduction at generation source and recycling

Although the generation of ISW is not large at present, it is necessary to control the generation and discharge of waste, and further to reduce the amount through recycling.

Enterprises shall develop processes which would enable the treatment of industrial waste at generation source. It is necessary that enterprises examine the raw materials they use and take necessary steps that would mitigate environmental pollution caused by their waste.

In addition, all enterprises are required to plan the utilization of these recyclable materials and to increase the means for their use.

vi. Inventory system

Each factory shall submit to the SENASA information on the characteristics and amount of industrial waste they generate. The information can be used for the management of industrial waste. Inventory system is effective for supervising ISWM. Therefore, precise registration and continuous updating of inventories shall be implemented.

vii. Segregation of hazardous wastes

Dischargers should try to separate hazardous wastes from non-hazardous ones in order to reduce the amount of harmful industrial solid wastes to be disposed of and facilitate waste reuse and recycling.

viii. Treatment and Disposal

Basic treatment and final disposal methods needed for industrial wastes are chemical treatment such as neutralization and oxidation, reduction, thermal treatment such as incineration, and secured landfill. The characteristics of industrial solid waste are so variable that it is necessary to find out the best treatment and final disposal alternatives from a technical and economic point of view.

In many cases the most convenient treatment and final disposal method is secured landfill, because its cost is relatively low. The central government may be

requested to construct such facilities for the sake of environmental protection if it is very difficult for the private sector to acquire land and funds for such construction.

An environmental impact assessment is necessary prior to the construction of an industrial waste disposal site.

ix. Supervision and advise

Appropriate supervision and sound advises from the central government are most important to steadily implement industrial solid waste management.

It is, therefore, important to primarily analyze and improve administrative capacity, then conduct inspection and give advises on the operation of the storage, transportation and final disposal of industrial solid wastes.

In addition, the ISW shall be clearly defined by the Central government (SENASA).

b. Study on Present Medical SWM

ba. Method of the Study

In this study, general recommendations for the improvement of Medical SWM (Infectious Wastes) in the Study area are proposed based on a rapid diagnosis study using the existing data and information.

In order to make a rapid diagnosis on present medical SWM, the following surveys were conducted:

- data collection from responsible agencies on present medical SWM, i.e., SENASA and Asuncion Municipality.
- questionnaire survey to the producer of medical solid waste.
- field survey

bb. General Recommendations

i. Guideline

The guideline on MSWM prepared in accordance with the Sanitary Code which contains a section on medical solid waste shall be put into effect as soon as

possible so to empower the government authorities to carry on their plans related to Medical Waste Management.

ii. Public education on segregation

The enforcement of the above mentioned guidelines shall be preceded by a public education program at hospitals and sanatoria, promoting source separation and storage of the infectious and non-infectious wastes.

iii. Hierarchy of legislation

Coordination between the National Government and the Municipal governments shall be sought, when producing laws, regulations and guidelines on medical waste, bearing in mind the hierarchy of the laws, ordinances and guidelines, so to avoid legislative conflicts.

iv. Coordination

Coordination between the different levels of government and the different governmental agencies shall also be sought, in the law enforcement activities related to the medical waste management.

v. Role of municipalities

The role of the Municipalities shall be to cooperate with the National Government authorities mainly on matters related to nuisances and hazards to the people in general produced by mismanagement of the medical waste.

vi. Enforcement

The source segregation of infectious waste shall be strictly controlled. According to the regulation, penalties for hospitals which will not segregate wastes shall be fined.

vii. Smooth implementation of entrustment plan

Based on the tender results (held in August 1993), Asuncion Municipality shall facilitate the entrustment plan of infectious solid waste collection and disposal service to the private company.

viii. Strengthening SENASA

In order to realize sound medical waste disposal by the private company, the SENASA shall strengthen its capability of inspection and control to both medical institutions and the private contractor. The inspection and control work shall cover the following aspects:

- to medical institutions;
 - . segregation of infectious waste.
 - . elimination of infectious waste discharge as MSW which is collected by municipalities.
 - . payment of disposal fee to the private company.
- to the private company for infectious waste disposal;
 - . strict execution of the regular collection service.
 - . proper treatment and disposal.

ix. Review of collection fee

The extra collection fee for infectious waste collection, i.e. 7,000Gs/kg if exceeding 75kg/month, shall be revised in order to avoid the inclusion of infectious waste into the MSW. Because the extra fee of 7,000Gs/kg is about 7 times more expensive than the normal fee of 1,068Gs/kg ($80,000 \text{ Gs/month} \div 75 \text{ kg/month} = 1,068 \text{ Gs/kg}$) this may cause integration of infectious waste into the MSW by hospitals. Generally, the extra fee should be cheaper than the normal fee to give an incentive to hospitals for discharging infectious waste.

6. RECOMMENDATIONS

6.1 Conclusions

a. Technical System

aa. Present MSWM and Priority of the Improvement Projects

Based on the study on the present MSWM in 15 municipalities, the following conclusions were made regarding the priority of improvement on MSWM:

- In every aspect, the present MSWM of the 14 municipalities other than Asuncion, are very weak and there are some municipalities which do not have any cleansing service. Therefore, the first priority of the improvement of MSWM should be on the establishment of the basic MSWM technical system which consists of collection, street sweeping and final disposal services.
- The second priority should be in the acquisition of a future landfill for Asuncion and F.Mora municipalities in their jurisdiction, which is very difficult to secure, except for the river channel area of the Paraguay River, an international river.
- Since the introduction of a recycling and/or resource recovery plant will require a financial burden on the local governments, reduction and resource recovery of solid wastes shall be done after the establishment of the above-mentioned basic MSWM technical system.

ab. MSWM Master Plan

i. Goal of the MSWM Master Plan

The goal of MSWM Master Plan is "**Development and Realization of a Beautiful and Clean Living Environment in the Asuncion Metropolitan Area towards the 21st Century**". This will be achieved through **Citizens' Participation and Establishment of Self-sustainable Solid Waste Management**.

ii. Selection of optimum technical system alternatives

In total, 62 technical system alternatives for MSWM in 15 municipalities were carefully examined. In order to achieve the goal established, the following alternatives were concluded to be the optimum technical systems and approved by the Paraguayan Supervisory Committee.

- For Asuncion and F.Mora Municipalities:
Inter-municipal disposal at the Chaco-i sanitary landfill with a transfer station.
- For M.R. Alonso, Limpio, Villa Hayes and B. Aceval Municipalities:
Inter-municipal disposal at the Chaco-i sanitary landfill without a transfer station.
- For Lambare, San Lorenzo, Capiata, Luque, Villa Elisa, Nemby, J.A. Saldivar, Ita and Aregua Municipalities:
Inter-municipal disposal at a sanitary landfill (unidentified) 15 km away from the center of the urban area of each municipality.

iii. Phased improvement

The procurement of equipment and construction of MSWM facilities proposed in the Master Plan shall be implemented step by step, i.e. short term (1996 - 2000) and middle term (2001 - 2006).

iv. Selection of the First Priority Projects

With the discussion of the Paraguayan side regarding the proposed Master Plan, the following projects were concluded as the first priority projects to be implemented by 2000.

- Improvement of collection systems for 15 municipalities;
- Construction of the Chaco-i inter-municipal disposal site; and
- Construction of AML (Madame Lynch Avenue) transfer station.

ac. Feasibility Study

i. Site for the Proposed Transfer Station

A comparison study was conducted on the investment and O&M costs and environmental aspects regarding the two candidate sites selected by the Paraguayan side. The study concluded that the Madame Lynch Avenue site is more suitable than the Vinas Cue site.

ii. Project costs

The proposed project costs were estimated based on the equipment and construction prices in February 1994.

Table 6.1a Estimated Project Costs unit: mill.Gs

Project	Items	Main Contents of the Projects	Project Cost
1. Collection Improvement			
For Asuncion		Compactor truck: 44 units Container: 1,109 units	8,585
For the other 14 municipalities		Compactor truck: 53 units Dump truck: 17 units Workshop building: 800 m ² Landfill equipment & vehicles: 9 units	20,798
2. AML Transfer Station			
		Building: 1,060 m ² Trailer: 11 units	9,824
3. Chaco-i Inter-municipal Disposal Site			
		Landfill equipment: 8 units Vehicles: 4 units	10,270

iii. Economic and financial evaluation

As for the standards of economic/financial evaluation, the EIRR was set more than 12 % of that standard set by the STP in Paraguay. Since MSWM is an indispensable public utility and the level of the rental and tipping fees would have opposite effects on the finances of AMUAM and 15 municipalities (revenues for AMUAM and expenses for 15 municipalities), the FIRR was set more than 3 %. The results of the economic/financial evaluation on the 3 projects, the EIRR/FIRR are shown below, which concluded that the three projects are feasible from a broader perspective.

Table 6.1b Summary of EIRR and FIRR

Projects	Executing Agency	EIRR	FIRR
Improvement of Collection System for 15 Municipalities	AMUAM	-	10.67%
	Asuncion Municipality	-	56.95%
Construction of AML Transfer Station	AMUAM	18.00%	5.10%
Inter-municipal Disposal Site at Chaco-i	AMUAM	-	14.23%

b. Institutional System

Based on the discussions made during the study, the following conclusions can be drawn regarding the institutional system of the study area:

- Lack of legislation and a very weak managerial capacity hinder the provision of MSWM services greatly.
- Although MSWM is a municipal responsibility, the increasing complexity of MSWM within the fast growing urban areas and the chronic lack of financial resources in the local governments places a heavier responsibility on regional organizations and National Government concerning MSWM institutional build up.
- Citizen's participation in MSWM activities is almost non-existent in the area, although the public opinion survey carried out at the beginning of the study shows that there is a potential for involvement, including willingness to pay for the services, provided that they are rendered properly.
- There is a great need for professional training in the solid waste management services, since they are today run in an unprofessional manner, usually by untrained municipal employees, working on a tight schedule, resulting in low productivity and inability to render the services efficiently.
- It is essential that an inter-municipal institution takes care of the operational and managerial aspects of Solid Waste Management which are common in several municipalities, mainly on transfer & disposal operations and legislation & enforcement of laws.
- This inter-municipal institution shall also be responsible for vehicle and equipment maintenance, since some of the municipalities are very small, thus not achieving the minimum size required to justify the development of its own workshop.
- The sustainable development of a sound MSWM system depends upon the development of the human resources through a training program.
- While privatization shall be recognized as an important alternative mainly for the provision of collection and street cleansing services, it shall not be considered until the managers of the MSWM services at each municipality gain enough knowledge and experience to have full control to grant this type of service efficiently.