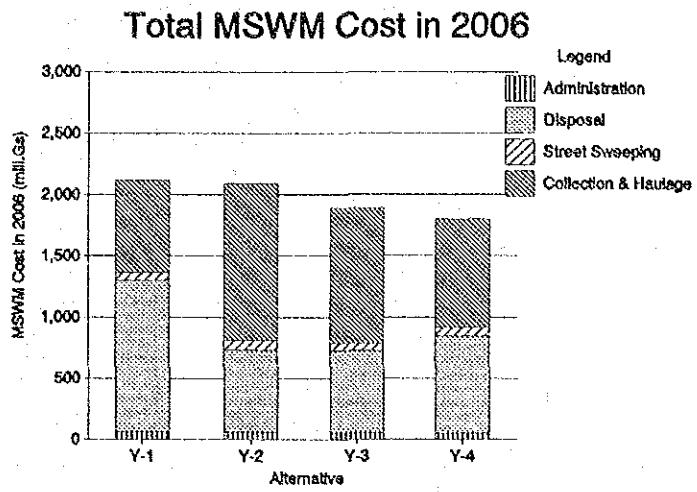
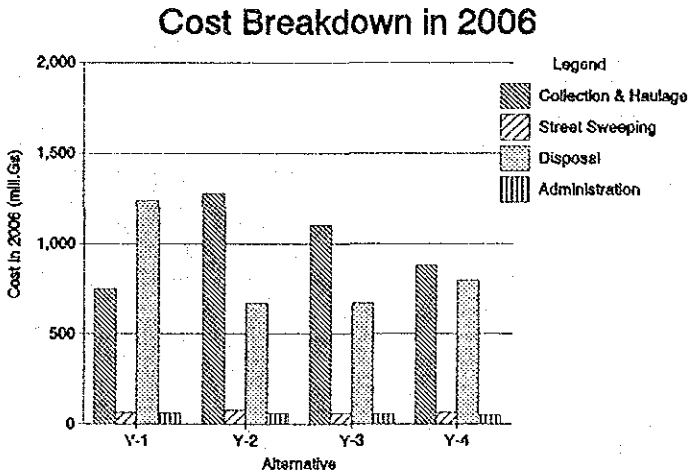




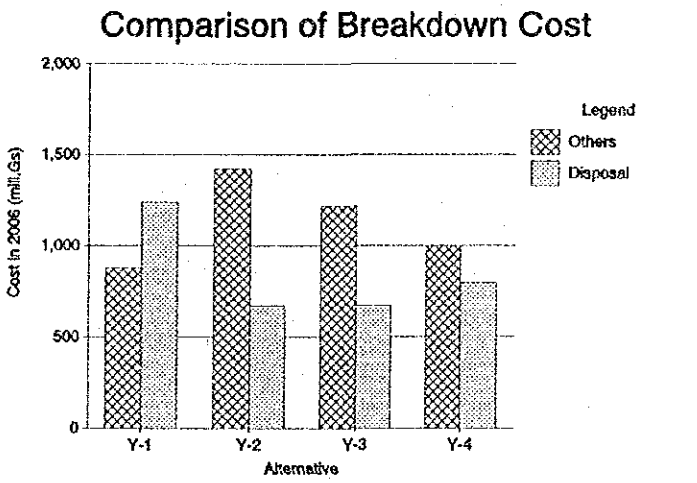


Figure 6.5.2c Illustration of Annual MSWM Expenses in 2006 for Capiata

Table 6.5.2d Annual MSWM Expense in 2006 for Luque

Luque	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	1,036	1,547	1,439	1,179
	Unit (Gs/ton)	20,428	30,500	28,079	23,229
1.1 Collection & Haulage	Total (mill.Gs)	1,036	1,547	937	1,179
	Unit (Gs/ton)	20,428	30,500	18,465	23,229
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	502	0
	Unit (Gs/ton)	0	0	9,614	0
2. Street Sweeping	Total (mill.Gs)	93	107	90	97
	Unit (mill.Gs/km/year)	5.14	5.96	4.99	5.37
Sub-total	Total (mill.Gs)	1,129	1,654	1,722	1,276
	Unit (Gs/ton)	21,630	31,689	32,992	24,447
3. Final Disposal	Total (mill.Gs)	1,407	897	897	1,066
	Unit (Gs/ton)	26,948	17,191	17,191	20,414
4. Administration	L.S.	76	77	73	70
Total Cost in 2006	(mill.Gs)	2,612	2,628	2,499	2,412
Cost per Collection Amount	(Gs/ton)	50,045	50,346	47,880	46,207

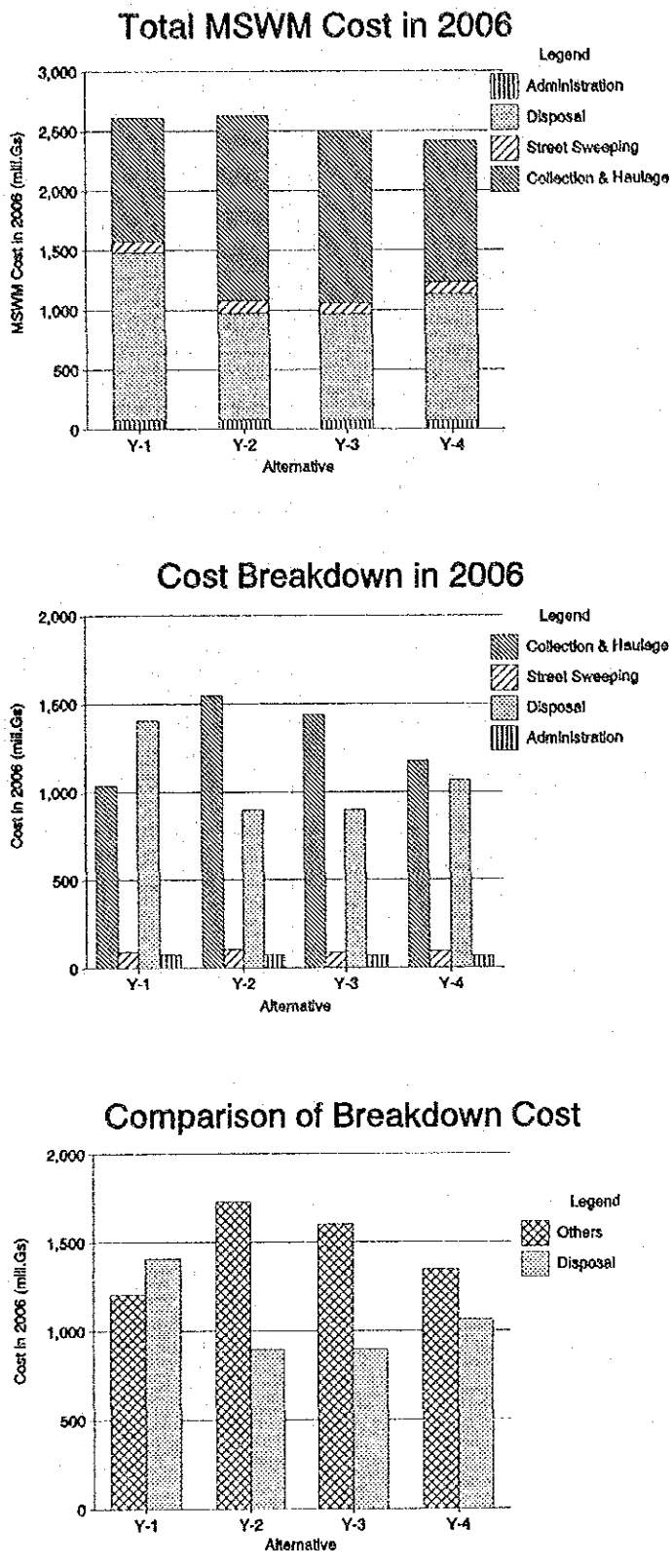
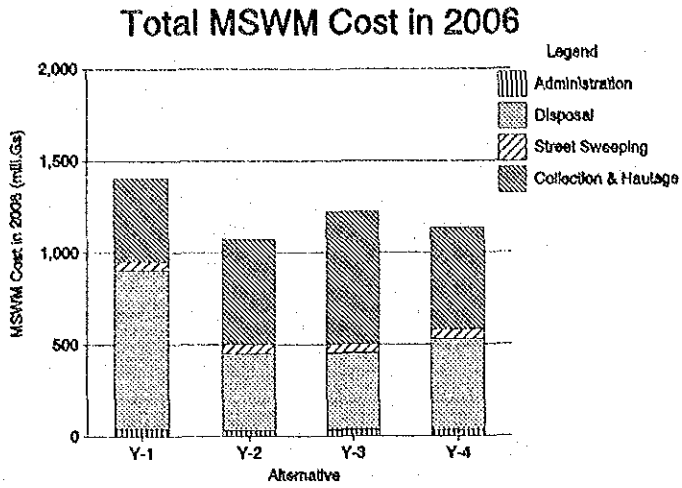
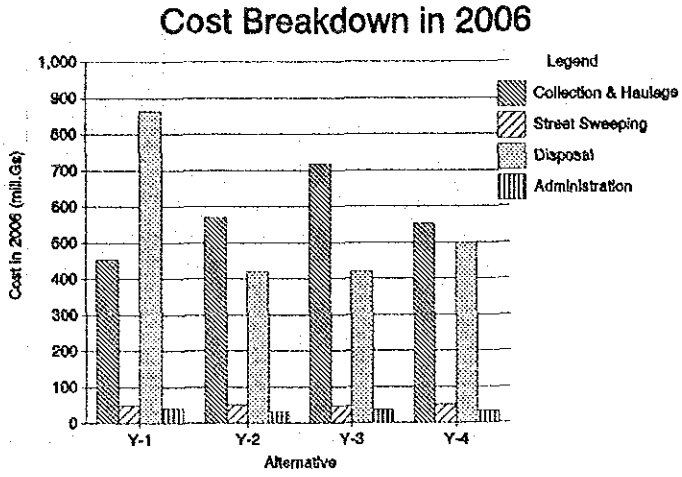


Figure 6.5.2d Illustration of Annual MSWM Expenses in 2006 for Luque

Table 6.5.2e Annual MSWM Expense in 2006 for M.R.Alonso

M.R.Alonso	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	454	570	718	551
	Unit (Gs/ton)	19,131	24,037	29,899	23,229
1.1 Collection & Haulage	Total (mill.Gs)	454	570	438	551
	Unit (Gs/ton)	19,131	24,037	18,465	23,229
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	280	0
	Unit (Gs/ton)	0	0	11,434	0
2. Street Sweeping	Total (mill.Gs)	49	52	48	52
	Unit (mill.Gs/km/year)	4.88	5.24	4.84	5.18
Sub-total	Total (mill.Gs)	503	622	868	603
	Unit (Gs/ton)	20,568	25,434	35,494	24,658
3. Final Disposal	Total (mill.Gs)	864	420	420	499
	Unit (Gs/ton)	35,314	17,191	17,191	20,414
4. Administration	L.S.	41	31	36	33
Total Cost in 2006	(mill.Gs)	1,408	1,074	1,222	1,135
Cost per Collection Amount	(Gs/ton)	57,559	43,904	49,969	46,424





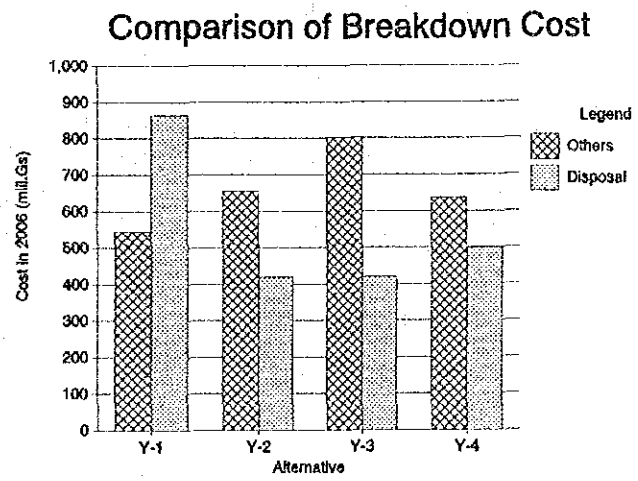


Figure 6.5.2c Illustration of Annual MSWM Expenses in 2006 for M.R.Alonso

Table 6.5.2f Annual MSWM Expense in 2006 for Villa Elisa

Villa Elisa	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	412	709	679	500
	Unit (Gs/ton)	19,131	32,924	30,502	23,229
1.1 Collection & Haulage	Total (mill.Gs)	412	709	398	500
	Unit (Gs/ton)	19,131	32,924	18,465	23,229
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	281	0
	Unit (Gs/ton)	0	0	12,037	0
2. Street Sweeping	Total (mill.Gs)	105	130	103	112
	Unit (mill.Gs/km/year)	5.23	6.49	5.17	5.61
Sub-total	Total (mill.Gs)	517	839	889	612
	Unit (Gs/ton)	22,132	35,916	38,057	26,199
3. Final Disposal	Total (mill.Gs)	816	402	402	477
	Unit (Gs/ton)	34,937	17,191	17,191	20,414
4. Administration	L.S.	40	37	36	33
Total Cost in 2006	(mill.Gs)	1,373	1,278	1,219	1,122
Cost per Collection Amount	(Gs/ton)	58,781	54,700	52,187	48,011

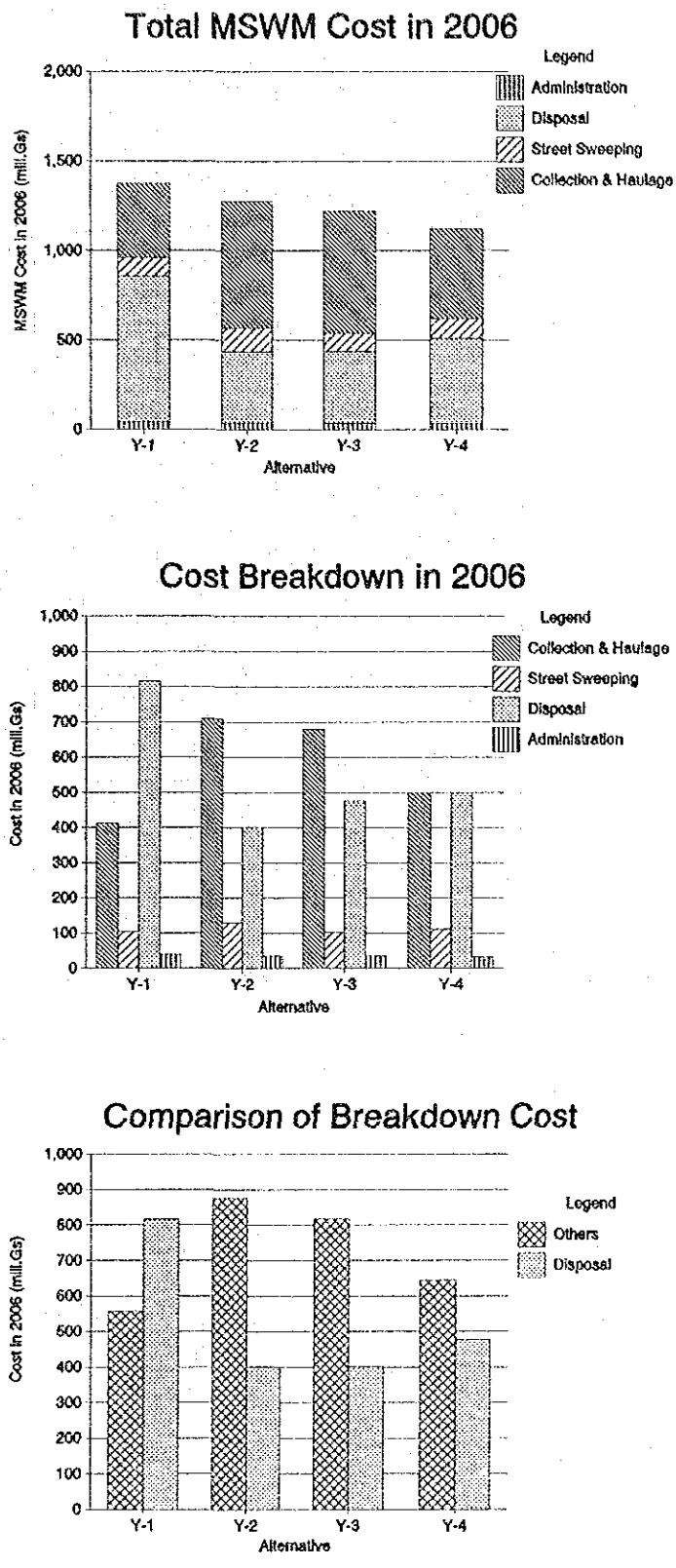
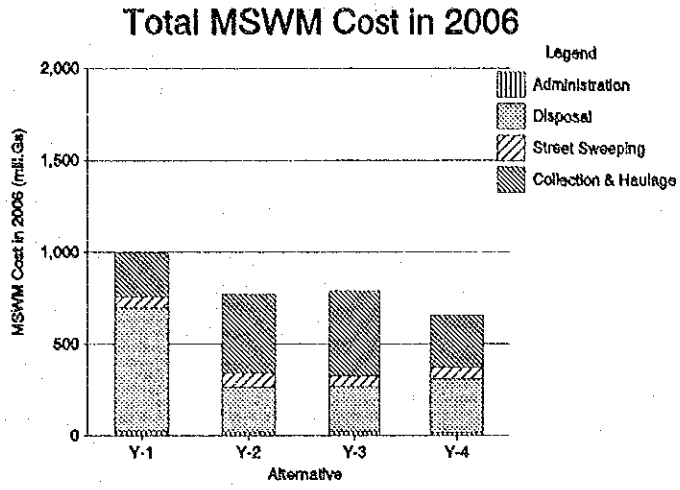
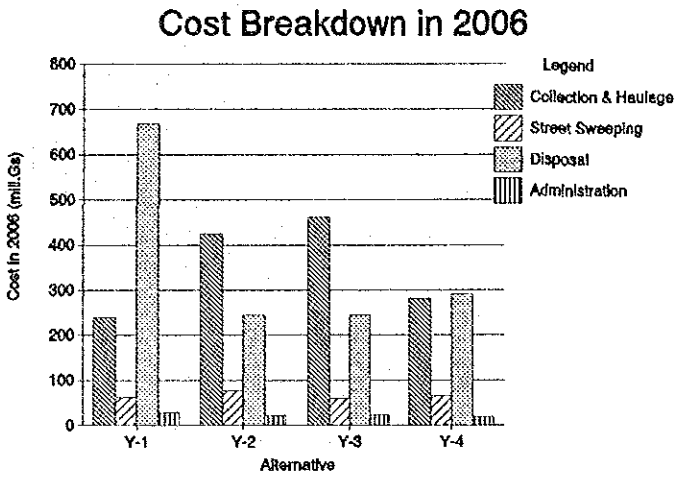


Figure 6.5.2f Illustration of Annual MSWM Expenses in 2006 for Villa Elisa

Table 6.5.2g Annual MSWM Expense in 2006 for Nemby

Nemby	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	240	425	462	282
	Unit (Gs/ton)	18,294	32,316	33,655	21,482
1.1 Collection & Haulage	Total (mill.Gs)	240	425	217	282
	Unit (Gs/ton)	18,294	32,316	16,477	21,482
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	245	0
	Unit (Gs/ton)	0	0	17,178	0
2. Street Sweeping	Total (mill.Gs)	62	77	60	65
	Unit (mill.Gs/km/year)	5.16	6.44	4.99	5.45
Sub-total	Total (mill.Gs)	302	502	652	347
	Unit (Gs/ton)	21,215	35,265	45,803	24,377
3. Final Disposal	Total (mill.Gs)	669	245	245	291
	Unit (Gs/ton)	46,972	17,191	17,191	20,414
4. Administration	L.S.	29	22	23	19
Total Cost in 2006	(mill.Gs)	1,000	769	790	657
Cost per Collection Amount	(Gs/ton)	70,233	54,030	55,477	46,134





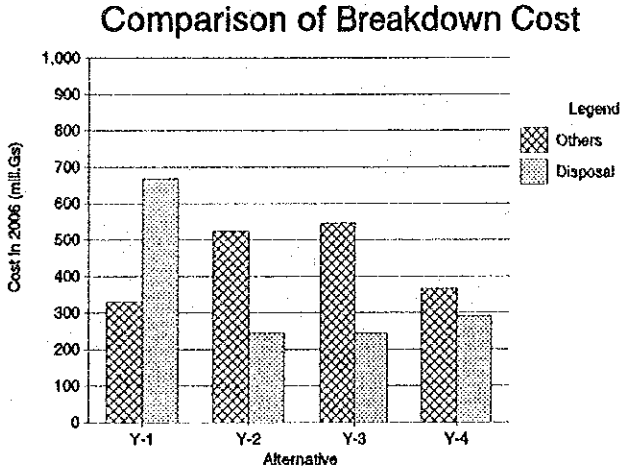


Figure 6.5.2g Illustration of Annual MSWM Expenses in 2006 for Nemby

Table 6.5.2h Annual MSWM Expense in 2006 for Saldivar

Saldivar	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	6	12	120	8
	Unit (Gs/ton)	17,094	33,437	173,208	21,482
1.1 Collection & Haulage	Total (mill.Gs)	6	12	6	8
	Unit (Gs/ton)	17,094	33,437	16,477	21,482
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	114	0
	Unit (Gs/ton)	0	0	156,731	0
2. Street Sweeping	Total (mill.Gs)	13	19	13	15
	Unit (mill.Gs/km/year)	6.61	9.59	6.49	7.41
Sub-total	Total (mill.Gs)	19	31	140	23
	Unit (Gs/ton)	26,027	42,466	191,781	31,507
3. Final Disposal	Total (mill.Gs)	240	13	13	15
	Unit (Gs/ton)	328,704	17,191	17,191	20,414
4. Administration	L.S.	8	1	4	1
Total Cost in 2006	(mill.Gs)	267	45	150	39
Cost per Collection Amount	(Gs/ton)	365,438	61,446	205,364	53,478

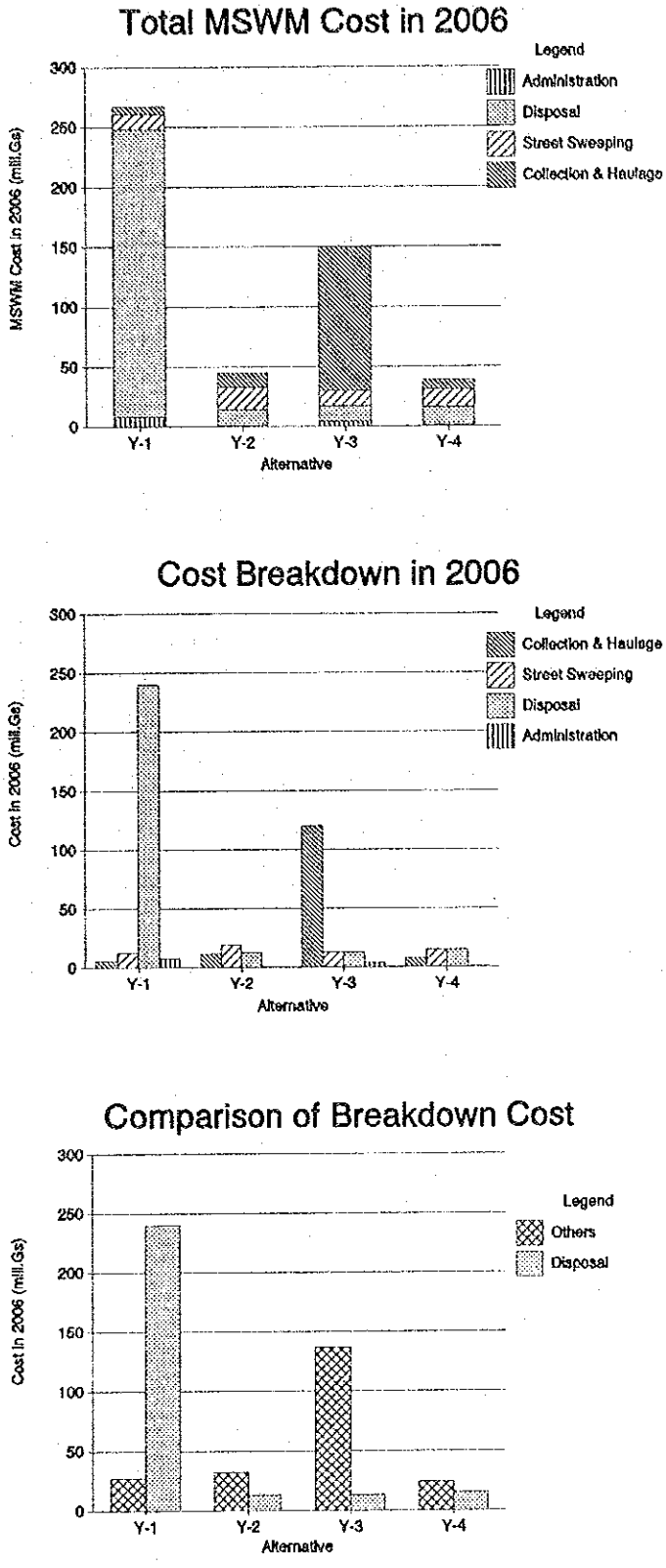
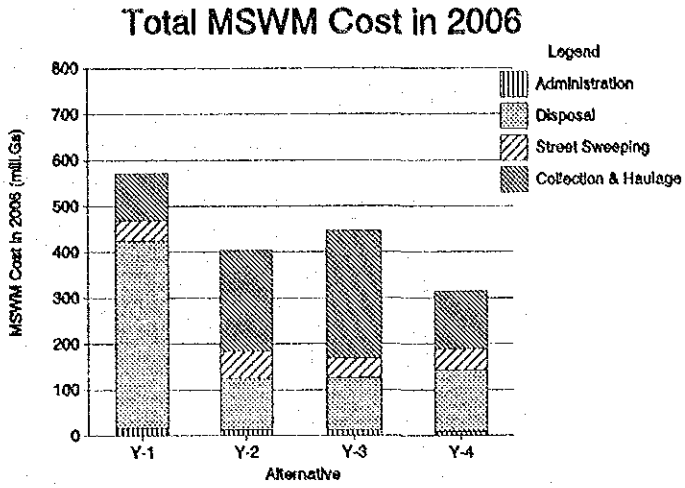
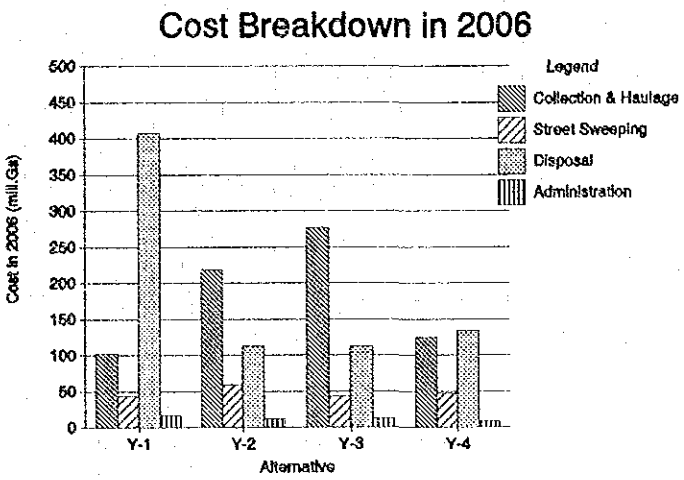


Figure 6.5.2h Illustration of Annual MSWM Expenses in 2006 for Saldivar

Table 6.5.2i Annual MSWM Expense in 2006 for Ita

Ita	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	103	219	277	125
	Unit (Gs/ton)	17,694	37,547	47,491	21,482
1.1 Collection & Haulage	Total (mill.Gs)	103	219	96	125
	Unit (Gs/ton)	17,694	37,547	16,477	21,482
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	181	0
	Unit (Gs/ton)	0	0	27,525	0
2. Street Sweeping	Total (mill.Gs)	44	59	43	47
	Unit (mill.Gs/km/year)	4.92	6.53	4.82	5.23
Sub-total	Total (mill.Gs)	147	278	380	172
	Unit (Gs/ton)	22,374	42,314	57,839	26,180
3. Final Disposal	Total (mill.Gs)	408	113	113	134
	Unit (Gs/ton)	62,138	17,191	17,191	20,414
4. Administration	L.S.	17	12	13	9
Total Cost in 2006	(mill.Gs)	572	403	446	315
Cost per Collection Amount	(Gs/ton)	87,048	61,290	67,874	47,991





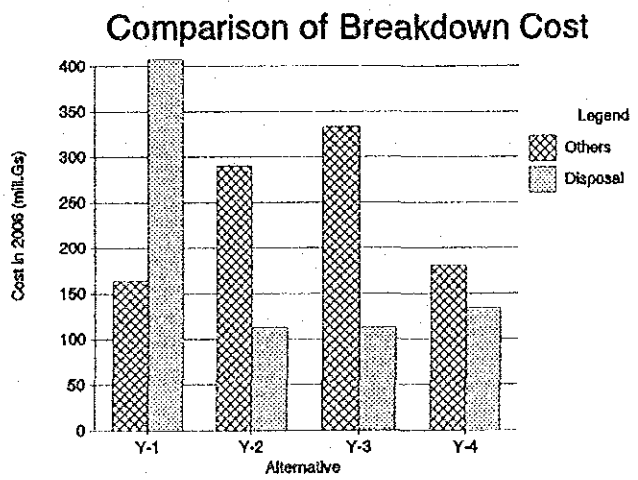


Figure 6.5.2i Illustration of Annual MSWM Expenses in 2006 for Ita

Table 6.5.2j Annual MSWM Expense in 2006 for Aregua

Aregua	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	20	36	133	24
	Unit (Gs/ton)	18,294	32,690	79,686	21,482
1.1 Collection & Haulage	Total (mill.Gs)	20	36	18	24
	Unit (Gs/ton)	18,294	32,690	16,477	21,482
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	115	0
	Unit (Gs/ton)	0	0	63,209	0
2. Street Sweeping	Total (mill.Gs)	38	48	36	40
	Unit (mill.Gs/km/year)	5.40	6.90	5.21	5.73
Sub-total	Total (mill.Gs)	58	84	186	64
	Unit (Gs/ton)	31,781	46,027	101,918	35,068
3. Final Disposal	Total (mill.Gs)	302	31	31	37
	Unit (Gs/ton)	165,282	17,191	17,191	20,414
4. Administration	L.S.	11	3	6	3
Total Cost in 2006	(mill.Gs)	371	119	206	104
Cost per Collection Amount	(Gs/ton)	203,178	65,115	113,088	57,147

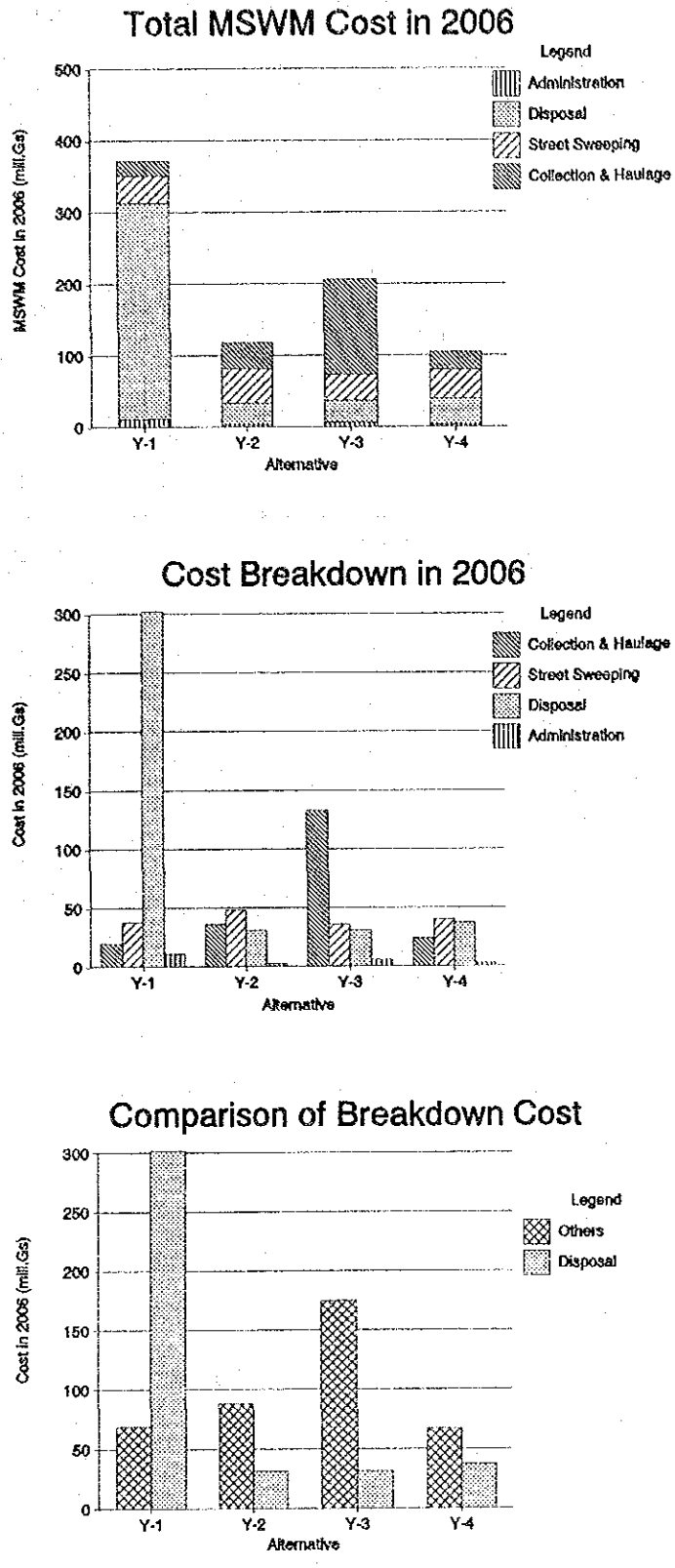
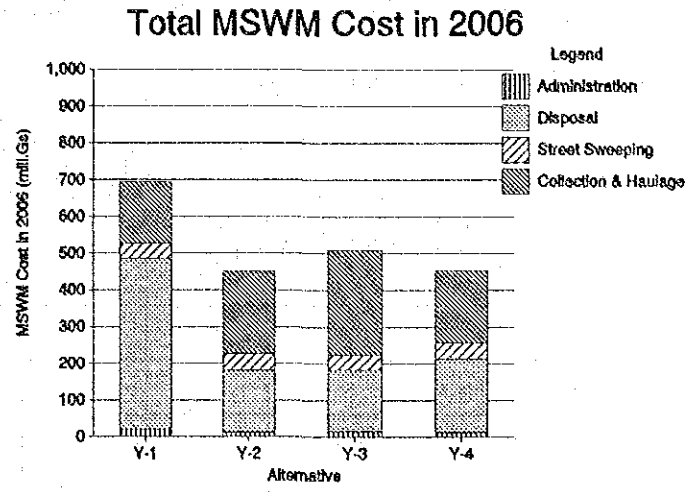
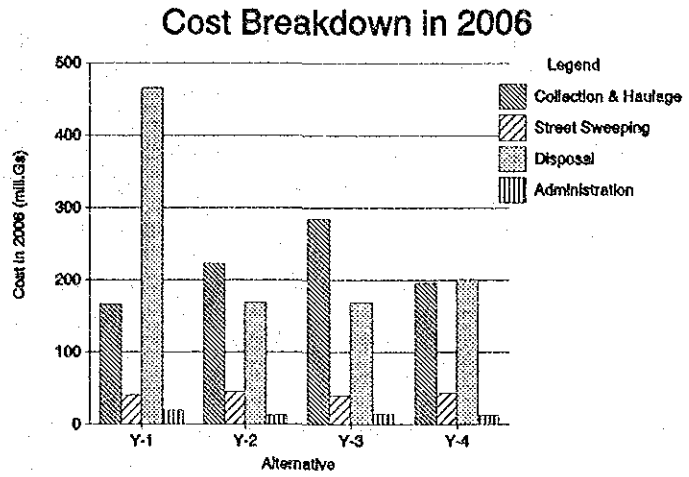


Figure 6.5.2j Illustration of Annual MSWM Expenses in 2006 for Aregua

Table 6.5.2k Annual MSWM Expense in 2006 for Limpio

Limpio	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	167	223	285	196
	Unit (Gs/ton)	18,294	24,471	30,151	21,482
1.1 Collection & Haulage	Total (mill.Gs)	167	223	150	196
	Unit (Gs/ton)	18,294	24,471	16,477	21,482
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	135	0
	Unit (Gs/ton)	0	0	13,674	0
2. Street Sweeping	Total (mill.Gs)	41	46	40	44
	Unit (mill.Gs/km/year)	5.16	5.72	4.99	5.45
Sub-total	Total (mill.Gs)	208	269	415	240
	Unit (Gs/ton)	21,106	27,296	42,111	24,353
3. Final Disposal	Total (mill.Gs)	466	169	169	201
	Unit (Gs/ton)	47,247	17,191	17,191	20,414
4. Administration	L.S.	20	13	15	13
Total Cost in 2006	(mill.Gs)	694	452	509	454
Cost per Collection Amount	(Gs/ton)	70,404	45,821	51,674	46,110





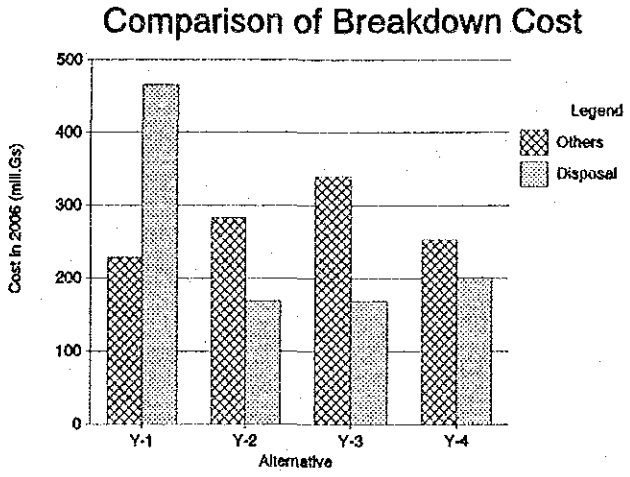


Figure 6.5.2k Illustration of Annual MSWM Expenses in 2006 for Limpio

Table 6.5.21 Annual MSWM Expense in 2006 for Villa Hayes

Villa Hayes	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	76	95	184	86
	Unit (Gs/ton)	18,894	23,724	41,352	21,482
1.1 Collection & Haulage	Total (mill.Gs)	76	95	66	86
	Unit (Gs/ton)	18,894	23,724	16,477	21,482
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	118	0
	Unit (Gs/ton)	0	0	24,875	0
2. Street Sweeping	Total (mill.Gs)	45	49	43	47
	Unit (mill.Gs/km/year)	5.02	5.41	4.82	5.23
Sub-total	Total (mill.Gs)	121	144	270	133
	Unit (Gs/ton)	25,501	30,348	56,902	28,030
3. Final Disposal	Total (mill.Gs)	373	82	82	97
	Unit (Gs/ton)	78,534	17,191	17,191	20,414
4. Administration	L.S.	15	7	8	7
Total Cost in 2006	(mill.Gs)	508	232	262	237
Cost per Collection Amount	(Gs/ton)	107,156	48,965	55,297	49,897

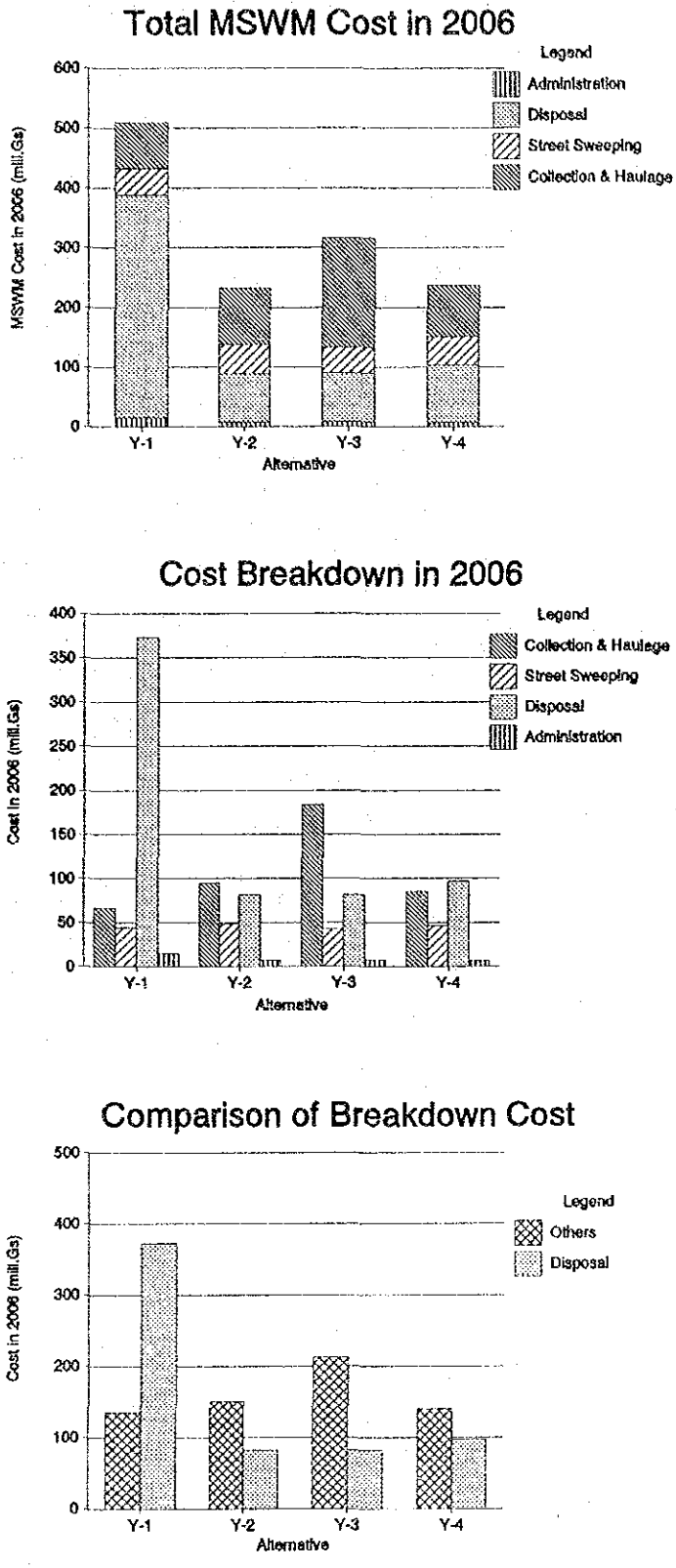


Figure 6.5.21 Illustration of Annual MSWM Expenses in 2006 for Villa Hayes

Table 6.5.2m Annual MSWM Expense in 2006 for Benjamin Aceval

Benjamin Aceval	Unit	Y-1	Y-2	Y-3	Y-4
1. Total Collection & Haulage	Total (mill.Gs)	34	50	175	39
	Unit (Gs/ton)	18,894	27,460	66,206	21,482
1.1 Collection & Haulage	Total (mill.Gs)	34	50	30	39
	Unit (Gs/ton)	18,894	27,460	16,477	21,482
1.2 Transfer Operation & Haulage	Total (mill.Gs)	0	0	119	0
	Unit (Gs/ton)	0	0	40,593	0
2. Street Sweeping	Total (mill.Gs)	59	68	56	62
	Unit (mill.Gs/km/year)	5.37	6.22	5.13	5.63
Sub-total	Total (mill.Gs)	93	118	231	101
	Unit (Gs/ton)	31,849	40,411	79,110	34,589
3. Final Disposal	Total (mill.Gs)	384	50	50	60
	Unit (Gs/ton)	131,426	17,191	17,191	20,414
4. Administration	L.S.	14	5	8	5
Total Cost in 2006	(mill.Gs)	491	173	290	165
Cost per Collection Amount	(Gs/ton)	168,174	59,330	99,190	56,653

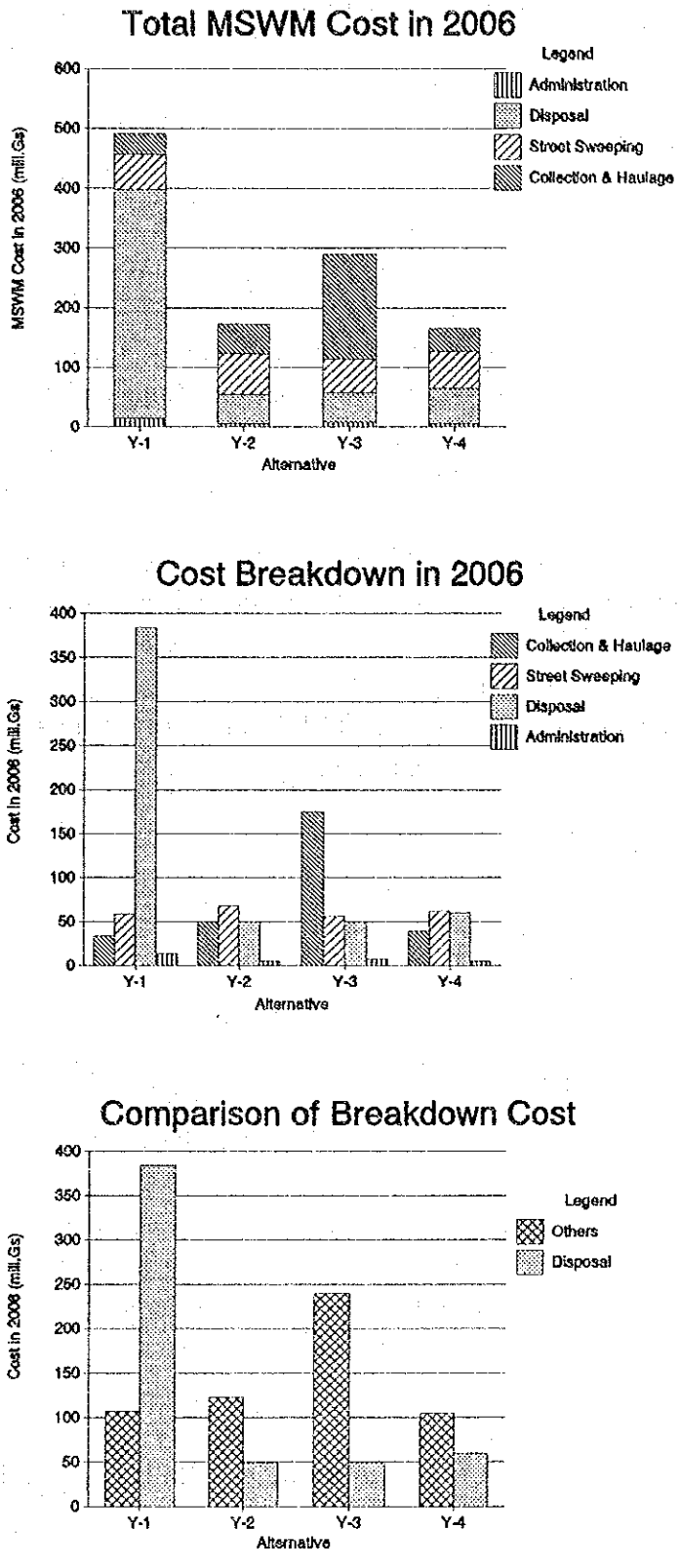


Figure 6.5.2m Illustration of Annual MSWM Expenses in 2006 for Benjamin Aceval

6.5.3 Evaluation of Alternatives for UM and LUM

a. Method

The evaluation method is described in Section 6.4.3.

b. Evaluation for Lambare, San Lorenzo, Capiata, Luque, Villa Elisa, Nemby, J.A.Saldivar, Ita and Aregua Municipalities

ba. Conclusion by the Study Team

As for the optimum technical system for the above-mentioned 9 municipalities, the Team proposed them to select the Alternative Y-4; that is

Inter-municipal disposal
An inter-municipal sanitary landfill 15 km away from the center of the urban area of each municipality.

bb. Evaluation

The summary of evaluation is as follows:

- Least cost among the 4 alternatives.
- There is no technical difficulty observed in comparison with the other alternatives.
- Socially, there will be some difficulties such as setting-up the inter-municipal disposal site 15 km away from the center of the urban area of each municipality. However, the resolution of these matters was discussed with the Paraguayan side at the IT/R meeting.
- Compared with the present technical system, the proposed system is more environmentally acceptable.

c. Evaluation for M.R.Alonso, Limpio, Villa Hayes and B. Aceval Municipalities

ca. Conclusion by the Study Team

As for the optimum technical system for the above-mentioned 4 Municipalities, the Team proposed them to select the Alternative Y-2; that is

Inter-municipal disposal
An inter-municipal sanitary landfill at A-5 without a transfer system.

cb. Evaluation

The summary of evaluation is as follows:

- Least cost among the 4 alternatives for Limpio, Villa Hayes and M.R. Alonso Municipalities.
- As for B.Aceval although Y-2 is the second least cost alternative, Alternative Y-4 is not possible because the Municipality of Villa Hayes shall take Alternative Y-2.
- There is no technical difficulty observed in comparison with the other alternatives.
- Socially, there will be some difficulties such as setting-up the inter-municipal disposal site in Chaco; i.e. outside of the jurisdiction of M.R.Alonso, Limpio and B.Aceval and within the jurisdiction of Villa Hayes Municipality. However, the resolution of these matters was discussed with the Paraguayan side at the IT/R meeting.
- Compared with the present technical system, the proposed system is more environmentally acceptable.

d. Financial Evaluation

Financial evaluation consists of the least cost method to be selected among different alternatives for each city estimated in Section 6.5.2. Further, a comparative analysis was conducted between the least cost alternative and the estimated revenues.

For revenue estimation, the number of households in 1992 was projected to 2006 using the assumed population growth rates. The number of shops was also projected using the assumed GDP growth rate. The fees to be paid by beneficiaries were mainly those obtained from the "Willingness to Pay" survey. The collection rate of fees was assumed to be 80%.

Results for Urbanized and Less Urbanized Municipalities are as follows.

Table 6.5.3a Result of Evaluation Revenue

Municipality	Least Cost Alternative (Millon Gs)	Estimated Revenue (Millon Gs)
Urbanized		
Lambare	2,371	1,783
San Lorenzo	2,740	2,053
Capiata	1,799	1,356
Luque	2,412	1,757
M.R.Alonso	1,074	793
Villa Elisa	1,122	725
Less Urbanized		
Nemby	657	486
J.A.Saldivar	39	24
Ita	572	204
Aregua	104	64
Limpio	452	341
Villa Hayes	232	234
B.Aceval	165	88

It can be seen that among Urbanized and Less Urbanized Municipalities, only in Villa Hayes revenues exceed the least cost alternative. For the rest of the municipalities, revenues do not cover the least cost alternative even under the unlikely scenario of 100% collection rate of fees from the beneficiaries.

6.6 Institutional Requirements

6.6.1 Private Versus Public Participation in MSWM

Municipal Solid Waste Management is a public service, and as such it should always be managed by the government, usually represented by the municipalities or by any other local level of authority.

This is an almost universal occurrence, varying only in the degree of involvement of the public sector which ranges from operating the whole system with its own means to exercising only its regulatory and controlling power.

In the Study Area, there are many different situations, including, in some of the less urbanized municipalities, cases of no government involvement at all.

Concerning the largest and most common part of the operation of the service, i.e. collection (and sometimes the street cleaning) activities, basically three situations can usually occur:

a. The operation is conducted fully by the municipality, with it's own personnel and equipment, with the services being provided by an independent authority (such as a municipal company) or by the municipal administrative structure

itself, usually through a department or section.

b. Operation is contracted with a private firm, working under municipal control and receiving payment from the municipality itself, according to the amount of services rendered, embodied in a contract service.

c. The operation is made by a private firm working as a concessionaire, where the municipality exercises a light control and the private firm collects the fees directly from the serviced households and other solid waste producers, under a franchise system.

All these situations occur in the Study Area, where only the operational and cost recovery practices vary from municipality to municipality.

The reasons for the selection of each of these alternatives may vary, but the selection is usually made according to tradition, the will of public authorities to reduce the operating costs, or their inability to face operating or capital costs of the system.
Regardless of all the above considerations, the comparison between the public versus private operation in Latin America shows, on average, a better and more efficient service being provided by the private enterprises, usually at a lower cost than the public sector. The reason for this situation is that, generally, governmental agencies don't have incentives to increase productivity and efficiency, but rather their management is very much influenced by political and other non managerial issues.

6.6.2 Basic Principles

The basic principle that shall govern the institutional system of a municipal solid waste management project is the one that states that solid waste being a problem closely related to public health, it's ultimate responsibility shall remain, always, with the public sector, i.e. the government.
Based on this principle, we can also state that the municipalities shall strengthen their institutional and technical capabilities in all cases, including when the operational responsibility is transferred to a private enterprise.

Other principles that shall be followed for the development of an efficient and sustainable municipal solid waste system are:

i. The services provided by the system shall be fully paid by the costumers.

ii. The system has to be designed to be cost affordable to the costumers, using appropriate technologies and systems.

iii. A cross subsidy, where an overprice is charged to the largest producers of waste shall be practiced to offset the underpayment of those not able to pay fully for the service.

iv. Being an activity heavily dependent on non-skilled labor, technical solutions for countries with high unemployment rates, like Paraguay, shall emphasize the use of manpower instead of machinery.

6.6.3 Legislation and Enforcement

As previously stated, legislation concerning MSWM in the municipalities of the Study Area is almost non-existent. As a matter of fact, there is not a single code related to solid waste management, only sparse ordinances in some of the cities of the Study Area, usually concerning cleaning of vacant lots and disposal operations. On the same line, enforcement of the existing legislation is very rare, since the municipalities rely only on their capacity and strategic position to charge fines together with other municipal taxes, including the annual automobile registration.

6.6.4 Administration, Organization and Management

The extent and depth of the administration, organization and management requirements of the SWM system will depend upon the institutional model adopted in each or all the municipalities of the Study Area. This means that if a model that keeps all the operational activities with the municipality is adopted, the administrative structure and the corresponding managerial and organizational systems will have more resources than if the role of the municipality is only controlling and monitoring private operations.

In any case, the municipality is to have full knowledge of the services being rendered and to carry out a planned control system to evaluate efficiency and effectiveness.

6.6.5 Revenue Sources

Fees to be paid by beneficiaries of solid waste disposal services are the sole revenue source under consideration. To be realistic, government subsidies may also

need to be considered in such instances as when a given project is deemed to bring large benefits to the society at large, without directly contributing to the revenues of institutions implementing improvements in solid wastes disposal services.

Solid wastes disposal services are usually operated under the "Beneficiary Pays Principle (BPP)". These fees should be low enough to be within the "Ability to Pay" of beneficiaries, but high enough to cover the operation costs and also the investment and replacement costs (depreciation costs). The "Ability to Pay" was assumed to be taken into account by beneficiaries in their answers to the "Willingness to Pay" survey.

An interview survey was conducted in order to find out the Willingness to Pay for solid wastes disposal services by the beneficiaries, UNDER THE ASSUMPTION that the solid wastes disposal services were SATISFACTORY. The average Willingness to Pay by category of Municipalities showed that households are willing to pay significantly more than the fees actually being paid, provided that the service is satisfactory.

6.6.6 Public Cooperation

Cooperation from the producers of solid waste is fundamental to the success of any MSWM system. As a matter of fact, without this type of cooperation, no system can be successful, since it is almost impossible to perform all the collection and cleaning activities without support from the citizens. This means that efforts shall be made to produce a public awareness campaign on MSWM issues, so as to gain the cooperation of people in general, even on difficult issues such as selection of disposal sites and imposing municipal waste taxes or fees.

6.6.7 Summary of General Institutional Requirements

As previously stated, the institutional system is composed of four sub-systems. A summary of the requirements applicable to the problems of the Study Area for each sub-system is given below:

i. Organization and Management

It will be dependent upon the decision on the extent of privatization of the services.

ii. Legislation and Enforcement

Creation and establishment of legislation on solid waste management and systems to enforce it.

iii. Finance (Revenue Sources)

Also dependent upon the extent of privatization, the local legislation and the population's capability to pay.

iv. Public Cooperation

Creation and establishment of mass education campaigns, mainly at the primary school level.

6.6.8 Institutional Requirements for Master Plan Alternatives

a. Method of institutional study

The institutional system shall be regarded in two levels: one for the entire Metropolitan Area (the Metropolitan System) and another for each one of the Municipalities considered autonomously (the Municipal Systems).

The decision on which institutional system for each level should be select, will be dependent on the following aspects:

aa. Technical aspects

Technical alternatives will depend on the technical system that best fits the study.

ab. Economical and financial aspects

The main requirement is to provide a self sustainable system, affordable to the consumers and covering the majority of the solid waste producers.

ac. Customs and other cultural aspects

Being an activity heavily dependent on the behavior of the public, it is very important that the selected institutional system take into account the way in which people deal with the production, storage and discharge of solid waste.

b. Alternatives to be selected

For each level of the institutional system (metropolitan or municipal), there are basically the following decisions to be made:

- Metropolitan System:
  Existence or not of a Metropolitan Agency to deal with solid wastes management.

- Municipal System:
  Nature and type of the public entity in charge of Solid Waste Management.

These decisions will be made according to the following requirements:

ba. Concerning organization and management

Each one of the municipalities shall have its own MSWM unit, the size and organizational scheme of each being dependent upon the extent of the private sector participation and the size of the municipality.

In any case, the MSWM unit needs to have full managerial capacity and technical knowledge so to handle proficiently it's tasks, be it as operator or as supervisor and controller.

bb. Concerning legislation and enforcement

The cities of the Study area should manage to enact common ordinances in respect to MSWM, specially in the case of refuse disposal.

Enforcement of the legislation, in it's turn, shall be made by each city through their own enforcement agents.

bc. Concerning finance

The financing of the MSWM is the most important step to insure sustainability to the system, and at the same time, the most critical decision to be made.

A more rational tariff structure should be provided after a study taking into account the different types of wastes produced, their quantity and the affordability to pay of each economic segment of the population.

bd. Concerning public cooperation

Audiovisual materials shall be produced and shared by all the municipalities as well as booklets and other printed materials, the teaching and distribution teams however shall belong to each municipality.

c. Preliminary Proposals

The selection of the most appropriate Master Plan alternative should not be determined from the institutional aspects. Since institutional demands generally result from prevailing technological conditions, attention should be given instead, to the selection of the optimum technical system.

Some proposals however, are given as follows:

ca. Concerning the metropolitan system

Establishment of a Metropolitan Entity to deal with solid waste in the Asuncion Metropolitan Area.

cb. Concerning the municipal systems

The models more prone to be selected are be the following:

- Municipal Department operating their own equipment and employing their own personnel.
- Municipal Department contracting the services (or part of them) with private companies.
- Municipal Company operating their own equipment and their own personnel.
- Municipal Company contracting the services (or part of them) with private companies.
- Concession of the collection and disposal services, remaining the street sweeping services with the municipality.

6.7 Selection of the Optimum Alternatives

6.7.1 Overall Evaluation

As clearly described in the previous sections, the evaluation of technical system alternatives for selection was done by the least cost method. Based on the data obtained from the "Willingness to Pay" survey, the revenue was estimated in the financial evaluation assuming 80% of fees will be collected. The Table 6.7.1a and 6.7.1b presents the summary of these evaluations.

Table 6.7.1a Summary of Evaluation for HUM

Municipality	Waste Disposal from 1997 to 2006 (ton)	Waste Disposal in 2006 (ton)	Cost of Each Alternative in 2006 Upper(annual expenses):mill.Gs Lower(unit cost):Gs					Average Willingness to Pay (Gs/household/month)	Estimated Revenues (mill.Gs/year)	Required Fee by Household (Gs/household/month)
			X-1	X-2	X-3	X-4	X-5			
Asuncion	2,023,901 (1,167,717)	221,190 (85,575)	14,542 70,019	11,930 57,441	10,836 52,174	11,284 54,332	10,797 51,986	8,227	18,915	Same as Willingness to Pay
F.Mora	315,464 (246,016)	41,245 (15,914)	3,039 73,681	2,308 55,955	2,089 50,660	2,180 52,843	2,023 49,047	8,227	3,188	Same as Willingness to Pay

Note: Shadow shows the least cost alternative.
Double line shows the second least cost alterative.
( ) shows the amount only for X-1.

Table 6.7.1b Summary of Evaluation for UM and LUM

Municipality	Waste Disposal 1997–2006 (ton)	Waste Disposal in 2006 (ton)	Total Cost of Each Alternative in 2006 Upper(annual expenses):mill.Gs Lower(unit cost):Gs				Average Willingness to pay (Gs/household/month)	Estimated Revenues (mill.Gs/year)	Required Fee by Household (Gs/household/month)
			Y-1	Y-2	Y-3	Y-4			
Lambare	363,983	50,735	2,380 46,910	2,687 52,971	2,467 48,625	2,371 46,728	4,160	1,783	5,824
San Lorenzo	364,035	58,400	3,036 51,994	3,032 51,922	2,801 47,954	2,740 46,918	4,160	2,053	5,824
Capiata	231,149	39,055	2,116 54,170	2,091 53,548	1,890 48,405	1,799 46,034	4,160	1,357	5,824
Luque	302,741	52,195	2,612 50,045	2,628 50,346	2,499 47,880	2,412 46,207	4,160	1,757	5,824
M.R.Alonso	140,734	24,455	1,408 57,559	1,074 43,904	1,222 49,969	1,135 46,424	4,160	793	5,824
Villa Elisa	142,950	23,360	1,373 58,781	1,278 54,700	1,219 52,187	1,122 48,011	4,160	725	6,656
Nemby	84,654	14,235	1,000 70,233	769 54,030	790 55,477	657 46,134	3,875	486	5,425
J.A Saldivar	4,667	730	267 365,438	45 61,446	150 205,364	39 53,478	3,875	24	6,588
Ita	40,671	6,570	572 87,048	403 61,290	446 67,874	315 47,921	3,875	204	6,200
Aregua	12,723	1,825	371 203,178	119 65,115	206 113,088	104 57,147	3,875	64	6,588
Limpio	57,983	9,855	694 70,404	452 45,821	509 51,674	454 46,110	3,875	341	5,425
Villa Hayes	27,949	4,745	508 107,156	232 48,965	262 89,666	237 49,897	3,875	234	Same as Willingness to Pay
Benjamin Aceval*	14,444	2,920	491 168,174	173 59,330	290 99,190	165 56,653	3,875	88	7,367

Note: Shadow shows the least cost alternative.
Double line shows the second least cost alterative.

* Although Y-2 is the second least cost alternative, Y-2 shall be the optimum alternative due to the unrealistic nature of Alternative Y-4.

6.7.2 Selection of the Optimum Technical System

a. Recommendations

At the Supervisory Committee meeting for the discussion of the Interim Report, based on the above-mentioned evaluation, the Study Team recommended the following aspects:

- Optimum technical systems for 15 municipalities.
- Basis for the establishment of an inter-municipal sanitary landfill 15 km away from the center of the urban area of each municipality without a transfer system.
- Required payments by beneficiaries.

The details of recommendation are described below.

aa. Optimum technical systems

The optimum technical systems recommended by the Team for MSWM in 15 municipalities are summarized in Table 6.7.2a.

Table 6.7.2a *Recommendations on Optimum Technical System*

Municipalities	Optimum Alternative	Remarks
1. HUM		
1-1. Asuncion	Inter-municipal landfill at A-5 site with a transfer system	If the acquisition of transfer station site(s) will be difficult, a direct transportation system shall be examined.
1-2. F.Mora	Inter-municipal landfill at A-5 site with a transfer system	If the acquisition of transfer station site(s) will be difficult, a direct transportation system shall be examined.
2. UM		
2-1. Lambare	Inter-municipal landfill 15 km away from the center	If the acquisition of a landfill site for both inter-municipal and independent disposal will be difficult, participation in landfill operation at A-5 may be examined.
2-2. San Lorenzo	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
2-3. Capiata	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
2-4. Luque	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
2-5. M.R.Alonso	Inter-municipal landfill at A-5 site without a transfer system	The municipality shall make an effort to join the inter-municipal landfill operation at A-5 site
2-6. Villa Elisa	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
3. LUM		
3-1. Nemby	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
3-2. J.A.Saldivar	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
3-3. Ita	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
3-4. Aregua	Inter-municipal landfill 15 km away from the center	In order to realize the least cost technical system, the municipality should make every effort to obtain an inter-municipal landfill site.
3-5. Limpio	Inter-municipal landfill at A-5 site without a transfer system	The municipality shall make an effort to join the inter-municipal landfill operation at A-5 site
3-6. Villa Hayes	Inter-municipal landfill at A-5 site without a transfer system	The municipality shall make an effort to join the inter-municipal landfill operation at A-5 site
3-7. Benjamin Aceval	Inter-municipal landfill at A-5 site without a transfer system	The municipality shall make an effort to join the inter-municipal landfill operation at A-5 site

ab. Basis for the establishment of an inter-municipal landfill 15 km away from the center

As clearly described in section H.5.2.5 in Annex H, an inter-municipal sanitary landfill operation is cheaper as it more economical to obtain a larger area for landfilling. This is a major element to make the Alternative Y-4 a least cost alternative among the alternatives, especially in comparison to Y-1 independent disposal with a haulage distance shorter than Y-4. It should be noted that the following assumptions were taken in the estimation of disposal cost in the Alternative Y-4:

i. To achieve an economy of scale, total landfill amount from 1997 to 2006 was assumed as one millon tons for a inter-municipal landfill 15 km away from the center.
ii. One millon tons of waste for 10 years (1997-2006) is discharged by a population of 300 thousand in 1992 and 500 thousand in 2006 which is equivalent to the total urban population of San Lorenzo, Capiata and Luque.

Therefore, we recommend the municipalities where the optimum technical system is Y-4 that they should make their effort to:

- establish an inter-municipal cooperation system among the municipalities;
- identify candidate sites for the inter-municipal landfill operation as soon as possible; and
- set up cooperation among the municipalities with a total population of more than 300 thousand in 1992 (for the group).

ac. Required payment by beneficiaries

The comparative analysis between the least cost alternative and the estimated revenue for each city showed that only in three out of 15 cities (Asuncion, Fernando de la Mora and Villa Hayes) could the payment from beneficiaries cover the corresponding least cost alternative. Subsequently, a limited sensitivity analysis was conducted to investigate the payment increase required by each city to cover the least cost alternative.

Fees to be paid by beneficiaries were assumed to increase by 30%, 40%, 50%, 60%, and 70% over the Base Case for each category of beneficiary. A 90% increase was assumed only for Benjamin Aceval.

Estimated total revenues exceed the least cost alternatives when the monthly fees to be paid by the beneficiaries are as follows.

Table 6.7.2b Required Fee by Beneficiaries

Case	Municipality	Required Fee (Gs/month)			
		Household	Food Shops	Other Shops	Market Shops
Base	Asuncion	8,227	11,250	25,430	5,625
	F.Mora	8,227	11,250	25,430	5,625
	Villa Hayes	3,825	5,299	11,978	2,650
Base + 40%	Lambare	5,824	7,965	18,003	3,983
	San Lorenzo	5,824	7,965	18,003	3,983
	Capiata	5,824	7,965	18,003	3,983
	Luque	5,824	7,965	18,003	3,983
	M.R.Alonso	5,824	7,965	18,003	3,983
	Nemby	5,425	7,419	16,769	3,710
	Limpio	5,425	7,419	16,769	3,710
Base + 60%	Villa Elisa	6,656	9,102	20,574	4,552
	Ita	6,200	8,478	19,165	4,240
Base + 70%	J.A.Saldivar	6,558	9,008	20,363	4,505
	Aregua	6,558	9,008	20,363	4,505
Base + 90%	B.Aceval	7,363	10,068	22,758	5,035

In summary, the least cost alternative for each city is estimated to become viable under the following circumstances:

- Fees the beneficiaries are willing to pay in Asuncion, Fernando de la Mora and Villa Hayes;
- Required fee increases in the remaining 12 cities;
- Cross subsidies among the 15 cities;
- Government subsidies for 12 cities; and
- Lower service levels in 12 cities, such as:--

  . to decrease the sweeping length of road.
  . to introduce a manual landfill operation for municipalities of which waste collection amount is small.

b. Selection of the Optimum Technical System

In total 62 alternatives were analyzed and evaluated for the selection of the optimum MSWM technical systems for 15 municipalities at the meeting of IT/R which was submitted to the Paraguayan side in December, 1993.

As mentioned in the previous section (6.7.2), at the Supervisory Committee

meeting for the discussion of the IT/R, the Study Team proposed optimum MSWM technical systems for the 15 municipalities as shown in Table 6.7.2a. The Team requested the Paraguayan side that each municipality should examine the recommendation presented by the Team and commented on them by the end of December, 1993.

The Supervisory Committee decided that if any municipalities did not send their comment to the Team by the 21st of January 1994, the commencement date of the phase 2 study, the recommendations made by the Team would be considered as approved by such municipalities. This decision was confirmed by both the Paraguayan side and Japanese side in the M/M for the Interim Report on December 17, 1993.

There was no comment on the recommendations by that time. Consequently the technical systems recommended by the Team, as shown in Table 6.7.2a, was approved by the Paraguayan side as the optimum technical system of MSWM Master Plan for 15 municipalities in the Study area.

6.7.3 Optimum MSWM Institutional Systems

As for the optimum institutional system of MSWM Master Plans for 15 municipalities corresponding to the above-mentioned technical systems, the following decisions were confirmed by both the Paraguayan side and Japanese side in the M/M for the Interim Report on December 17, 1993:

> "Regarding the metropolitan system on MSWM, the Supervisory Committee decided that the AMUAM will act as the overall coordinating body on MSWM in the Metropolitan Area in collaboration with SENASA.
>
> As for the municipal systems on MSWM, the Study Team requested the Paraguayan side that each municipality should inform the Team about their plans and decisions on the municipal system by the end of January 1994. The models more prone to be selected being the following:
>
> **i. Full Municipal Operation**
>
> Municipal department operating their own equipment and employing their own personnel.

ii. **Municipal Operation with Private Companies**

Municipal department contracting the services (or part of them) with private companies.

iii. **Full Municipal Company's Operation**

Municipal company operating their own equipment and their own personnel.

iv. **Municipal Company with Private Companies**

Municipal company contracting the services (or part of them) with private companies.

v. **Concession**

Concession of the collection and disposal services, retaining the street sweeping services with the municipality.

The Supervisory Committee decided that if any municipalities do not present their decision to the Team by the end of January 1994, the present municipal system employed in such municipalities will be considered to be their future system."

In response to the decision made by the committee, all 15 municipalities expressed their intentions to conduct their MSWM by themselves, provided the capital for procurement of equipment and final disposal sites were ensured. These intentions were confirmed at the Supervisory Committee meeting for the discussion of the PR/R (2) held in March 1994.

CHAPTER 7

THE MASTER PLAN

CHAPTER 7 THE MASTER PLAN

This chapter describes the goals, strategies and targets of the Master Plan for the 15 municipalities which make up the Study Area. It also gives an account of the technical and institutional systems for these municipalities up tho the target year of 2006.

7.1 Planning Framework

7.1.1 Goal, Strategy and Targets

a. Goal

In order to formulate a draft master plan for the municipal solid waste management for the Study area, the goal of the Master Plan is proposed as follows:

DEVELOPMENT AND REALIZATION OF A BEAUTIFUL AND CLEAN LIVING ENVIRONMENT IN THE ASUNCION METROPOLITAN AREA TOWARDS THE 21st CENTURY.

The goal of the Solid Waste Management Master Plan is achieved through:

- **Citizens' Participation and**
- **Establishment of Self-sustainable Solid Waste Management**

b. Targets

In order to realize the goal, targets for 15 municipalities are set up and tabulated in Table 7.1.1a.

Table 7.1.1a Targets of Collection, Street Sweeping and Final Disposal Services

Services / Municipality	Collection Coverage Ratio(%)			Street Sweeping Distance(km)			Sanitary Landfill Level		
	1994	2000	2006	1994	2000	2006	1994	2000	2006
1.Highly Urbanized Muni.									
1-1 Asuncion	83(73)	100	100	264	300	300	Level 1	Level 3	Level 3
1-2 F.Mora	64	85	100	2	20	40	Level 1	Level 3	Level 3
2.Urbanized Muni.									
2-1 M.R.Alonso	16	45	70	0	6	10	Open	Level 2	Level 3
2-2 *Luque*	23	45	70	28	40	60	Level 1	Level 2	Level 3
2-3 Capiata	15	45	70	0	6	12	Open	Level 2	Level 3
2-4 San Lorenzo	16	45	70	6	21	32	Level 1	Level 2	Level 3
2-5 Lambare	61	80	100	6	17	25	Level 1	Level 2	Level 3
2-6 Villa Elisa	46	65	85	0	9	20	Open	Level 2	Level 3
3.Less Urbanized Muni.									
3-1 Nemby	7	45	70	0	3	12	Open	Level 1	Level 2
3-2 J.A.Saldivar	0	25	50	0	1	2	None	Level 1	Level 2
3-3 Ita	18	45	70	6	10	15	Open	Level 1	Level 2
3-4 Aregua	0	25	50	2	5	10	None	Level 1	Level 2
3-5 Limpio	1	25	50	1	3	8	None	Level 1	Level 2
3-6 Villa Hayes	10	45	70	0	5	9	Open	Level 1	Level 2
3-7 Aceval	0	25	50	0	6	11	None	Level 1	Level 2

Note: Collection coverage was estimated based on the number of users in February 1994. However, the ratio for Asuncion is based on "Servicio Derecoleccion Diferenciada, Dirrecion de Medio Ambiente" while the figure based on number of users is 73 %.

c. Strategies for the Attainment of the Goal

The proposed strategies for the attainment of the Goal is detailed in the six paragraphs as follows:

ca. Provision of facilities and equipment to apply to the basic objective for the execution of Municipal SWM:

- Municipal SWM must be able to control or mitigate the adverse impacts of waste on the environment and human health.
- Solid waste is a resource to be utilized through appropriate means.

cb. Provision of solid waste services and facilities to comply with the following priority:

- Minimization of solid waste production
- Minimization of the need for landfill
- Development of Sanitary Landfills

cc. Provision of appropriate and scheduled services to the citizens for proper storage, collection and reception of solid waste. Illegal dumping must be eliminated.

- The offered solid waste services must comply with the generation of waste.
- The offered solid waste services should make it relatively easy for the citizens to get rid of their waste.
- The offered solid waste collection services must follow a strict and regular schedule on a routine basis, so that citizens may develop good habits concerning waste discharge manner.

cd. Self-financed solid waste management through the increase of citizens' burden.

- The "polluter pays principle" will be advocated, but where appropriate (to minimize administration), general principles for financing will be employed, and if necessary (to eliminate non-collection areas), "cross subsidies" will be established.
- All costs (also capital costs) must be covered by fees and charges being admitted so that a capital seed is provided for take off.

ce. Increase in public involvement in environmental protection and attention on environmental matters.

- The citizens must be made responsible for/aware of his own role in the production of pollutants and the proper handling of waste (however, everybody should have the right to receive solid waste services, provided they pay).
- The citizens must participate actively in the solid waste services (eg. proper discharge and source separation of recyclables).

cf. Full control over activities related to Municipal SWM and the cleanliness of the Asuncion Metropolitan Area.

- Involvement of private enterprises will be encouraged when appropriate and feasible.
- Private enterprises will be invited to participate through competitive bidding.
- Private cooperation will be supervised and controlled by the municipality.

The municipality will maintain full contact with the citizens on matters related to payment, complaints and exemption.

d. Strategy Elements

In concrete terms, the Goal is to be obtained through:

i. Establishment of a self-sustainable solid waste management system;

ii. Provision of collection services in the urban area of the Asuncion Metropolitan area and establishment of a reliable collection system under which regular services can be provided;

iii. Construction of sanitary disposal sites which employs sufficient measures for protection of the environment and human health;

iv. Establishment of efficient street sweeping and public area cleansing systems;

v. Establishment of the Beneficiary-Pay-Principle under which service recipients pay waste collection fee (tax) and tipping fee according to the capability of each household owner;

vi. Establishment of proper legislation and regulations through modification and revision of the existing ones;

vii. Establishment of proper roles of the organizations involved in solid waste management;

viii. Strengthening of the management and administration system;

ix. Development of public participation and education programs;

x. Development of the human resources involved in solid waste management; and

xi. Securing funds for capital investment for the equipment and facilities necessary for the realization of the goal, specially during the time of take off.

7.1.2 Target Year and Population

a. Target Year

The master plan shall cover a long period from 1994 to 2006. Upon consideration of the limited resources for MSWM in the Asuncion Metropolitan Area, the goal of the master plan shall be achieved in a stepwise manner. The period of the plan is divided into the following three stages.

Table 7.1.2a Target Year

Category of Plan	Target Year
Master Plan	1994 – 2006
Medium Term Improvement Plan	2001 – 2006
Short Term Improvement Plan for F/S	1997 – 2000
Immediate Improvement Plan	Present – 1996

b. Population Forecast for the Urban Area

Since there is neither an urban area development master plan nor an official population forecast for the Study area, the population forecast, was carried out by the Study Team.

Growth rates to project the future population in the Study Area were estimated considering the population census data of 1962, 1972, 1982 and 1992. Also, growth trends, urban development potential such as the areas proximate to Asuncion city, land availability (open spaces), cost of land, employment opportunities, etc., were examined for the estimation of the population growth rates as shown in Table 7.1.2b.

Based on the past population growth rates (refer to Table 7.1.2c Urban Area Population and Growth Rate of the Study Area), the future population is projected and tabulated in Table 7.1.2d.

Table 7.1.2b Classification of Growth Rates

Municipality	Growth Rate, according to the last Census: Increase /Decrease	Proximity to Asuncion	Land Availability (%)	Cost of Land	Employment Opportunity	Future Housing Develop (%)	Current Growth Rate (%)	Adopted Growth Rate (%)
Highly Urbanized Mu.								
Asuncion	Decrease	—	—	high	high	—	1.00	0.80
F.Mora	Decrease	contiguous	—	high	high	—	3.62	2.00
Urbanized Mu.								
Lambare	Decrease	contiguous	10	average	average	—	4.06	4.00
San Lorenzo	Decrease	near	20	average	high	10	5.99	5.00
Capiata	Increase	near	50	average	average	30	6.26	6.00
Luque	Increase	contiguous	50	average	average	30	13.04	8.00
M.R.Alonso	Increase	contiguous	10	average	average	10	10.42	8.00
Villa Elisa	Decrease	near	30	average	low	10	9.53	8.00
Less Urbanized Mu.								
Nemby	Decrease	near	50	below ave.**	low	20	8.55	6.00
J.A.Saldivar *	—	far	70	below ave.	low	20	N.A.	6.00
Ita	Increase	far	70	below ave.	low	10	4.37	4.00
Aregua	Decrease	near	50	below ave.	low	30	2.04	2.00
Limpio	Decrease	near	50	low	low	10	5.11	5.00
Villa Hayes	Increase	far	90	low	low	—	4.79	4.00
Benjamin Aceval	Increase	far	90	low	low	—	4.66	4.00

Source: JICA Study Team

* Same rate as Capiata is adopted

** below average

Table 7.1.2c Urban Area Population and Growth Rate of the Study Area

Municipality/ Urban Area	Population				Average Annual Growth Rate (%)		
	1962	1972	1982	1992	1962–1972	1972–1982	1982 – 1992
Highly Urbanized M.							
1.Asuncion	288,882	388,958	454,881	502,426	3.02	1.58	1.00
2.F.Mora	14,519	36,892	66,810	95,349	9.77	6.12	3.62
Subtotal	303,401	425,850	521,691	597,775	3.45	2.05	1.37
Urbanized M.							
3.Lambare	20,778	31,732	67,168	99,990	4.33	7.79	4.06
4.San Lorenzo	18,573	36,811	74,552	133,405	7.08	7.31	5.99
5.Capiata	20,892	26,417	45,716	83,898	2.37	5.64	6.26
6.Luque	11,008	13,921	24,917	84,885	2.38	5.99	13.04
7.M.R.Alonso	5,686	7,388	14,636	39,422	2.65	7.08	10.42
8.Villa Elisa	3,214	4,774	12,038	29,918	3.97	9.76	9.53
Subtotal	80,151	121,013	239,027	471,518	4.21	7.04	7.03
Less Urbanized M.							
9.Nemby	796	861	11,994	27,234	0.79	30.14	8.55
10.J.A. Saldivar	–	–	–	2,016	–	–	–
11.Ita	6,265	7,069	9,311	14,275	1.21	2.79	4.37
12.Aregua	3,699	3,916	5,177	6,335	0.57	2.83	2.04
13.Limpio	1,438	2,232	16,036	26,396	4.49	21.80	5.11
14.Villa Hayes	4,712	4,795	7,420	11,843	0.17	4.46	4.79
15.Benjamin Aceval	3,463	2,881	3,935	6,203	–1.82	3.17	4.66
Subtotal	20,373	21,754	53,873	94,302	0.66	9.49	5.76
Total :	403,925	568,617	814,591	1,163,595	3.48	3.66	3.63

Source: Dirección General de Estadistica, Encuestas y Censos. Secretaria Tecnica de Planificación

* The following Municipalities were considered populated districts:
1962: (F.Mora, Lambare, San Lorenzo, Capiata, M.R. Alonso and Villa Elisa)
1972: (Capiata, M.R. Alonso, and Villa Elisa);
1982: (Capiata and M. R. Alonso)

** Estimated urban population (Nemby and Limpio)

Table 7.1.2d Urban Area Population Projections for Selected Years Within the Study Area (1992-2006)

No	Urban Area	Population			Average Annual Growth Rate % (1992-2002)
		1992	2002	2006	
	Highly Urbanized M.				
1	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	Lambare	99,990	148,010	173,150	4.00
4	San Lorenzo	133,405	217,303	264,133	5.00
5	Capiata	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	Ita	14,275	21,230	24,720	4.00
12	Aregua	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	Benjamin 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.

ba. Highly Urbanized Municipalities

According to the Statistic, Survey and Census Bureau, the population growth rates of Asuncion and Fernando de la Mora has decreased from 3.02 % (1962-1972) to 1.00 % (1982-1992) and 9.77 % (1962-1972) to 3.62 % (1982-1992) respectively (refer to Table 7.1.2c). According to this trend, and due to its small area (117 km^2 for Asuncion and only 20 km^2 for Fernando de la Mora), high cost and shortage of land, the future growth rate will be expected to reduce to 0.80 % (Asuncion) and about 2.00 % (Fernando de la Mora), for the next ten years (1992-2002).

The population projections for 2006 were prepared using the same growth rates as for the period between 1992-2002. Accordingly, the population for 2002 and 2006 is expected to reach 544,098 and 561,720 (Asuncion) and 116,230 and 125,811 (Fernando de la Mora) respectively.

The Population of the Highly Urbanized Municipalities will occupy 35.43 % of the total population in the Study area by 2006.

bb. Urbanized Municipalities

The population growth of these municipalities are very much influenced by the increase in the number of migrants from rural areas. Among the Urbanized Municipalities, Luque (13.04 %), Mariano Roque Alonso (10.42 %) and Villa Elisa (9.53 %) show high growth rates during the period 1982–1992 (refer to Table 7.1.2c). However, by 2002, it is projected to decline to about 8.00 % for these municipalities, which is still significantly high, because the population growth rates are expected to gradually stabilize.

For the same period (1982–1992), Lambare, San Lorenzo and Capiata show 4.06 %, 5.99 % and 6.26 % in growth rates respectively (refer to Table 7.1.2b). By 2002, these municipalities will only have minor changes, declining to 4.0 % (Lambare), 5.0 % (San Lorenzo) and 6.0 % (Capiata) retaining almost the same growth levels as the 1982–1992 period.

In 1992, the population of the Urbanized Municipalities accounted for 40.52 % of the total population of the Study area, less than the 51.37 % reflected in the Highly Urbanized Municipalities. However, by 2006, the situation is projected to reverse with 55.16 % of the total population of the Study Area for the Urbanized Municipalities and 35.43 % for the Highly Urbanized Municipalities (refer to Table 7.1.2d).

Some of the reasons behind such rapid population growth in the Urbanized Municipalities are the increase in number of migrants from rural areas, cheaper land cost compared to Asuncion, availability of lands, locations of new housing settlements by the National Housing Council (CONAVI), etc.

bc. Less Urbanized Municipalities

Among the Less Urbanized Municipalities, the highest growth rates are found in Nemby (30.14 %) and Limpio (21.80 %) during 1972–1982, declining to 8.55 % and 5.11 % in 1982–1992 respectively (Table 7.1.2c). By 2006, these figures are expected to decline to 6.00 % (Nemby) and 5.00 % (Limpio) (refer to Table 7.1.2d).

Ita, Aregua, Villa Hayes and Benjamin Aceval show slight increase in growth rates reaching 4.37 %, 2.04 %, 4.79 % and 4.66 % respectively (refer to Table 7.1.2c). However, the growth rates are estimated to stabilize at just 4 %, 2 %, 4 % and 4 % respectively for the same municipalities by 1992–2006 (refer to Table 7.1.2d).

Recently, the municipality of J.A. Saldivar was separated from Capiata, therefore

the population growth rate is taken as 6 %, the same as Capiata to estimate the future population for the next 14 years.

The population growth of the Less Urbanized Municipalities is expected to decline slightly, however the number of persons is on the increase. The total population of these municipalities is projected to reach 182,722 people by the year 2006, accounting for 9.41 % of the total population of the Study area.

The projected urban area population growths are shown in Figures 7.1.2a, 7.1.2b, 7.1.2c and 7.1.2d.

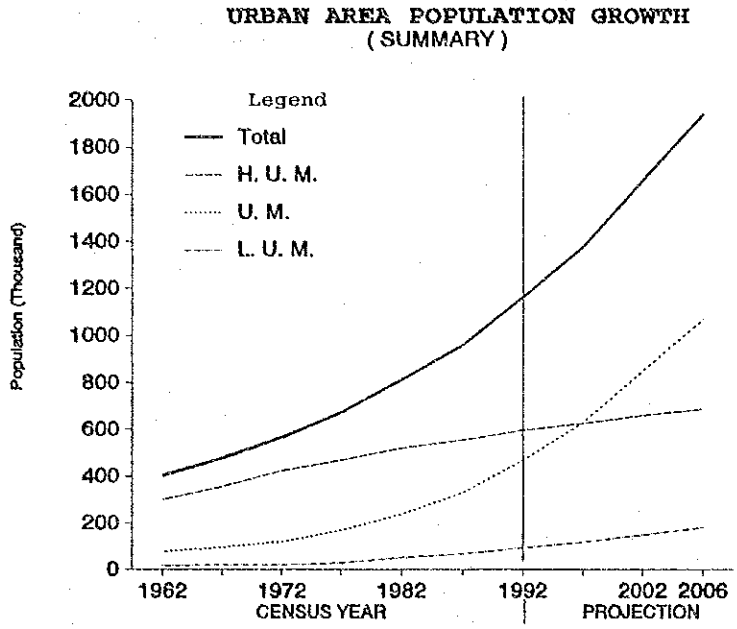


Figure 7.1.2a Urban Area Population Growth (Summary)

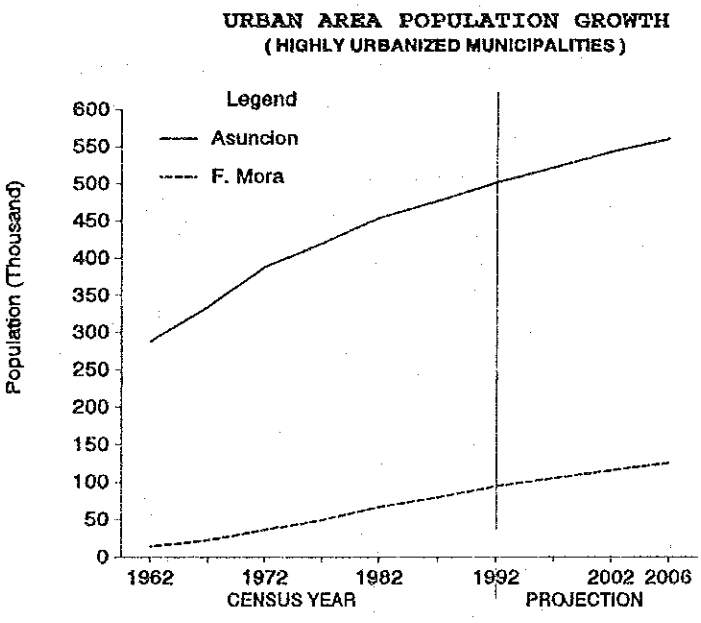


Figure 7.1.2b Urban Area Population Growth (Highly Urbanized Municipalities)

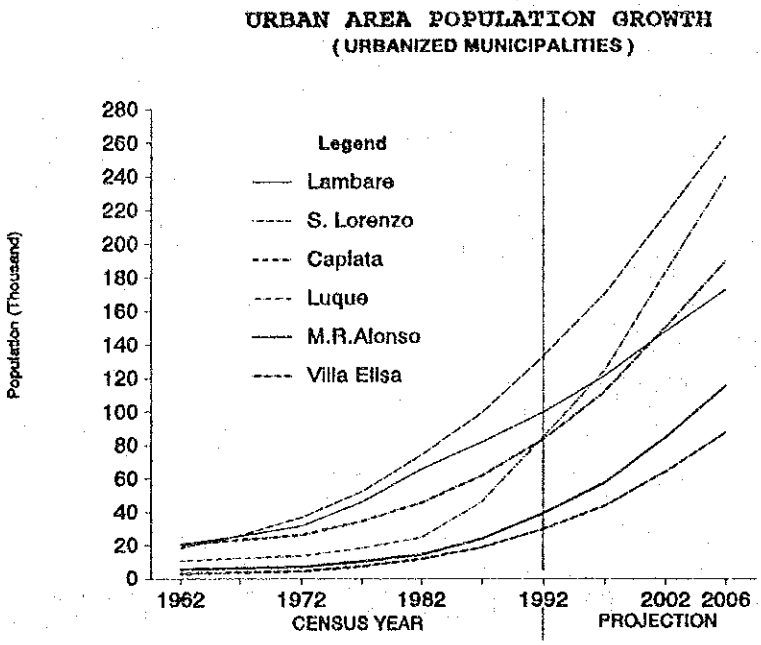


Figure 7.1.2c Urban Area Population Growth (Urbanized Municipalities)

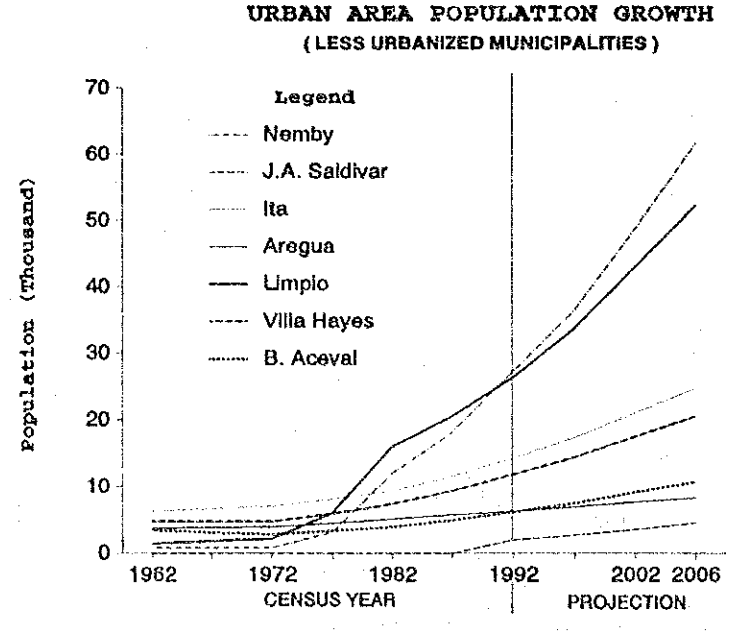


Figure 7.1.2d Urban Area Population Growth (Less Urbanized Municipalities)

7.1.3 Forecast on Waste Amount and Composition

a. *Forecast on Future Waste Amount*

aa. Forecast Model

The Waste Amount and Composition Survey (WACS) carried out by the JICA Study Team was used as a reference in the elaboration of the MSW amount estimate of the Study area.

The forecast model will include interim estimates for the years 1994, 1998 and 2006 of the planning period. The types of waste to be forecasted are:

i. MSW

- Household waste
- Commercial waste
- Market waste
- Institutional waste
- Street sweeping waste
- Hospital waste (non-infectious waste)
- Bulky waste

ii. Other wastes (ISW)

ab. Factors affecting waste increase and composition

The following factors will have an influence on the future generation of waste and its composition:

- The social welfare and the financial capacity of the single consumers/families.
- Industrial technology.
- Import of goods.

Forecasts are difficult to conduct in Paraguay due to the lack of previous data regarding waste amount and composition. From a financial viewpoint (e.g., the GDP), the wastes generated in Paraguay should identify with the developing state of the country.

ac. Methodology for the Forecast-Model

The forecast-model covers two (2) items. The first item is the forecast of the total waste amount and its composition. The forecast of the total waste amount will require a study on the relation between GDP and the generation of waste.

For the type of wastes to be forecasted, the following assumptions were made:

aca. Household waste

The weighed result from the residential areas will be used. Waste generation will be projected based on the number of inhabitants, with a margin for the increase in generation ratio as a result of a rise in GDP. However, the ratio of garden waste (grass and wood, and others) will not increase because the future land area of houses is not expected to increase.

acb. Commercial waste

Waste generation will be forecasted based on the number of shops which will increase in accordance with the increase in population, with a margin for the increase in generation ratio as a result of a rise in GDP.

acc. Market waste

Waste generation will be forecasted based on the number of shops in the market which will also increase with the population, with a margin for the effects from a rise in GDP.

acd. Institutional waste

Waste generation will be forecasted based on the number of employees which will also increase with the population, with a margin for the effects from a rise in GDP.

ace. Street sweeping

Waste generation ratio will not change and it will be projected based on the length of the street for sweeping services.

acf. Hospital waste (non-infectious waste)

Waste generation will be projected based on the number of beds, with a margin for the increase in generation ratio as a result of a rise in GDP.

acg. Bulky waste

Waste generation will be projected based on the number to inhabitants with a margin for the increase in generation ratio as a result of a rise in GDP.

ach. Other wastes (ISW)

Waste generation will be forecasted based on the population, with a margin for the effects from a GDP increase.

ad. Increase in Population

The most direct influence on waste generation is the change in population. The estimated annual population growths in the Study area for the planning period are tabulated in Table 7.1.2d.

ae. Relation between GDP and Waste Generation

To determine the relationship between GDP and the generation of waste , the increased amount of welfare was taken into account. A strict relation is not expected in advance, but some indications for further analysis is recognized.

An increase in the GDP is expected to have a large impact on the generation of waste per capita of developing countries than of developed countries. Also, at a certain welfare level, increase in GDP will remarkably change the composition of waste.

Japan has fine statistics allowing for the analysis of the relationship between GDP and waste generation in a developing economy (1963 - 1970) and a developed economy (1975 - 1988). The years 1970 - 1975 are excluded due to fluctuations in data resulting from a new waste disposal and public cleansing law and economic recession and instability caused by the oil crisis.

Based on the data of Japan for the period between 1963-1970, a developing economy can be characterized as follows:

- Average increase in waste generation per capita: 5.789 %/year
- Average increase in GNP *: 10.438 %/year

* GNP was used due to the unavailability of GDP figures.

Based on this figure, we assume that the change in GDP will affect waste generation as follows:

- Flexibility for a developing economy: 0.55 of GDP-change in %

The GDP of Paraguay (taken from the 1993 constant) is supposed to develop as follows:

- 1994 - 1998 + 3.5 %
- 1999 - 2006 + 3.5 %

The annual increase in GDP would result in a rise in waste generation due to improved welfare. The increase in waste generation per capita per year is, therefore, estimated as:

- 1994 - 1998 3.5 x 0.55 = 1.925 %/year →Say 1.9 %/year
- 1999 - 2006 3.5 x 0.55 = 1.925 %/year →Say 1.9 %/year

Accordingly, a 1.9 % increase in waste generation per capita per year can be constantly observed during the planning period 1994-2006.

On the other hand, garden wastes such as grass, wood, and soil share about 44% of MSW due to the housing style with large gardens, unpaved roads, etc.. Garden wastes should not increase in future because of urbanization and improvement of roads. We concluded, therefore, the increase in waste generation per capita per year in the planning period is **1.1 %** (1.9 % x 0.56 = 1.06 % →say 1.1 %).

af. Forecast on Waste Amount

Based on the above-mentioned assumption, the forecast on MSW and other wastes shall be presented. A temporary forecast on waste generation ratio in the Study area is done based on the generation ratio in 1994 and tabulated in Table 7.1.3a. In addition, a temporary forecast on the increase in the number of generation sources in the Study area is also carried out based on that in 1993 and tabulated in Table 7.1.3b. The results of the forecast are shown in Tables 7.1.3c to 7.1.3q.

Table 7.1.3a 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*	g/km/d	39,950	39,950	39,950
		(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 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.

b. Forecast on Waste Composition

ba. Forecast on Waste Composition

A change in the composition of waste is expected due to manufacturing of new products and a different consumption pattern.

In Table 7.1.3b, 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 7.1.3b 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
Apparent 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"

There is no existing data available in the Study area. The analysis was, therefore, focused on the comparison of the data provided by the WACS and Brazil assuming that changes in waste composition would result in waste characteristic of a developed economy.

Brazil was chosen for its reliable waste data and its geographical and demographic features which is similar to Paraguay.

The ratios of papers, plastics, grass and wood, and others (soils, etc.) indicate the necessity of considerations to be made when carrying out the forecast. Development on the other hand will only be considered as a minor change.

Referring to Table 7.1.3a, 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.

Table 7.1.3c shows the forecast on waste composition of MSW excluding street sweeping and bulky wastes in the Study area.

Table 7.1.3c 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.

bb. Forecast on Calorific Value

bba. LCV of each physical composition item

The following calorific values were measured in the WACS:

- for mixed combustibles from 7 generation sources, i.e. residential areas (high, middle and low income), markets, commercial areas (restaurants and others) and institutions; and
- for each combustible item from the middle income residential area.

The calorific value of waste differs according to physical composition and three contents; moisture content, combustible waste and ash. The ratio of combustible waste and ash depends on the change in physical composition. Table 7.1.3d shows our survey data on mixed combustibles and the data of Japan for 1972.

Table 7.1.3d Comparison of the Three Contents and LCV

		1993 JICA Study		Japan in 1972
		Household	MSW	
Moisture content	(%)	39.8	40.3	54.1
Combustible	(%)	25.2	26.6	31.4
Ash	(%)	35.0	33.1	14.5
Lower calorific value Measured	(kcal/kg)	1,120	1,179	1,165

Note: MSW excludes street sweeping and bulky waste.

The above 1993 data obtained by the JICA Study Team are weighing average figures of mixed wastes, taking the waste generation ratio by each category into account. The moisture content of each data ranges between 25% and 60 %. The lower calorific value was determined only taking into account the possibility that the physical composition may vary, because the moisture content is forecasted to remain constant.

The higher calorific values (HCVs) in dry base of each combustible components of the middle income residential area were also measured. Based on the higher calorific values, the lower calorific values (LCVs) were calculated. The results are tabulated in Table 7.1.3e.

Table 7.1.3e HCVs in Dry Base and LCVs in Wet Base of Each Combustible Waste

	Higher Calorific Value in Dry Base (kcal/kg)	Lower Caloritic Value in Wet Base (kcal/kg)
Kitchen Waste	4,830	1,100
Paper	4,371	2,600
Textile	3,917	2,300
Plastic	9,617	6,500
Grass & Wood	3,445	1,400
Leather & Rubber	5,056	3,500

Based on Table 7.1.3e, the LCVs of wastes can be calculated by the following formula.

$$LCV = (RGa^{*1} * 1,100 + RPa^{*2} * 2,600 + RT^{*3} * 2,300 + RPl^{*4} * 6,500 + RGr^{*5} * 1,400 + RL^{*6} * 3,500) / 100$$

RGa[*1]; Ratio of kitchen waste in wet weight (%)
RPa[*2]; Ratio of paper in wet weight (%)
RT[*3]; Ratio of textile in wet weight (%)
RPl[*4]; Ratio of plastic in wet weight (%)
RGr[*5]; Ratio of grass and wood in wet weight (%)
RL[*6]; Ratio of leather and rubber in wet weight (%)

bbb Lower calorific value forecast

With the above mentioned formula the future LCV of MSW is estimated by multiplying the LCV in Table 7.1.3e by the ratio of the future physical composition shown in Table 7.1.3c.

In case a separate collection system will not be introduced, the LCV of mixed waste is estimated and tabulated in Table 7.1.3f.

Table 7.1.3f 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.

7.1.4 Future Waste Stream

The waste streams for the 15 municipalities in the year 2006 were forecasted.

a. Conditions of the Forecast

aa Source recycling

The food waste recycling rate (54g/person/day) at generation sources will be maintained until 2006.

ab. Self-disposal (collection service area)

Since the most common housing style (detached houses) is not expected to change in future, the self-disposal rate (245g/person/day) will be kept by 2006. Consequently, the self-disposal amount is calculated by the formula below.

$SA = 245(g/person/day) \times NP \times CCR/100 \times 10^{-6}$

SA	: Self-disposal amount (ton/day)
NP	: Population (persons)
CCR	: Collection coverage ratio (%)

ac. Self-disposal (non-collection service area)

Self-disposal amount in non-collection service area is derived from the following formula:

$SA\ (non) = HWA \times (1 - CCR/100) \times 10^{-6}$

SA (non)	: Self-disposal amount in non-collection service area (ton/day)
HWA	: Household waste amount (ton/day)

ad. Discharge

The waste discharge amount is obtained by the following formula:

$DA = WGA - SRA - SA - SA\ (non)$

DA	: Discharge amount (ton/day)

WGA : Waste generation amount (ton/day)
SRA : Source recycling amount (ton/day)

ae. Recycling other than at sources

The amount of recycling other than at sources (42 g/person/day) will be maintained till 2006.

af. Other waste

The amount of the other wastes, which is 30 g/person/day in 1994 and only disposed of at the Cateura landfill, will change to 34 g/person/day by 2006.

ag. Landfill

The landfill amount is calculated by the formula below.

LA = DA − RA + OWA

LA : Landfill amount (ton/day)
RA : Amount of recycling other than at sources (ton/day)
OWA : Other wastes amount (ton/day)

ai. Apparent specific gravity

Apparent specific gravity of waste after compaction at the final disposal site is:

- Residue of incineration: 1.1
- Others: 0.8

b. Future Waste Stream

The future waste streams in 2006 for 15 municipalities are prepared and presented in Figures 7.1.4a to 7.1.4o.

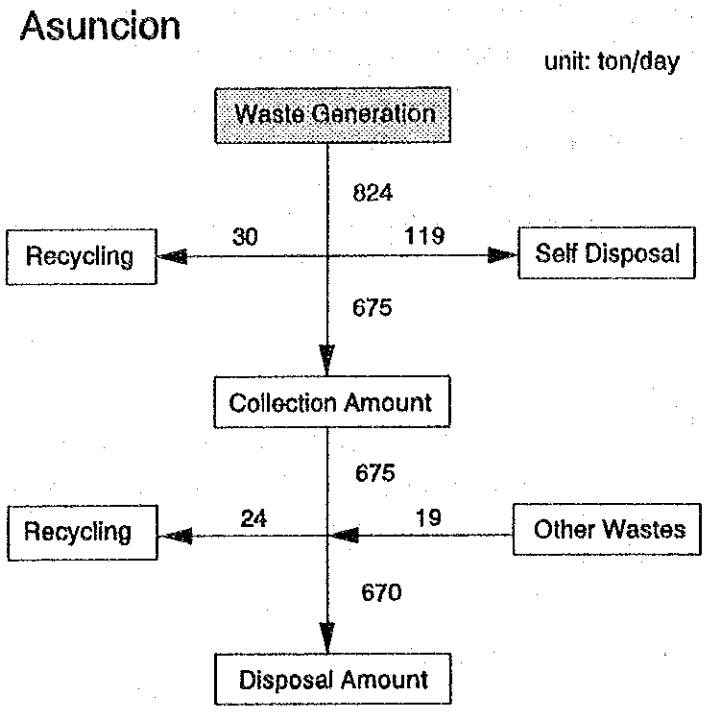


Figure 7.1.4a Waste Stream Diagram of Asuncion in 2006

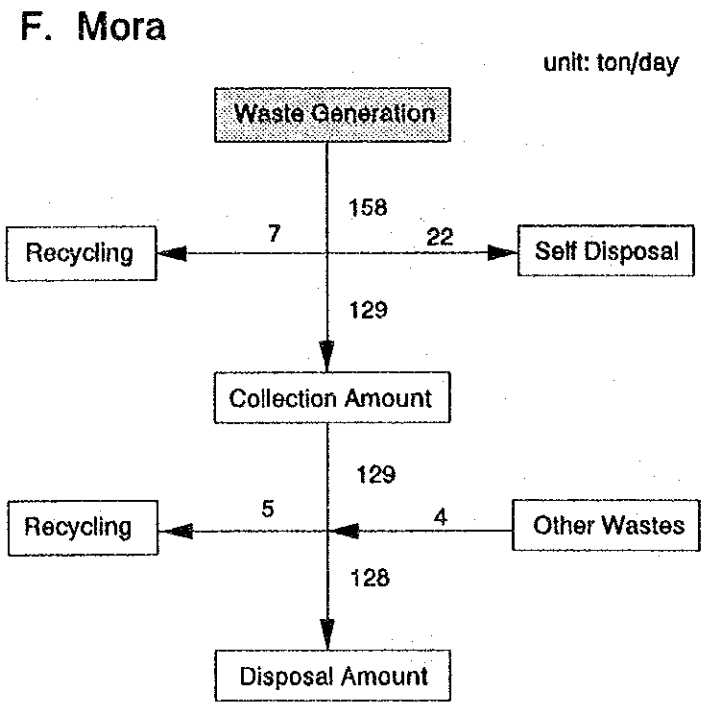


Figure 7.1.4b Waste Stream Diagram of F. Mora in 2006

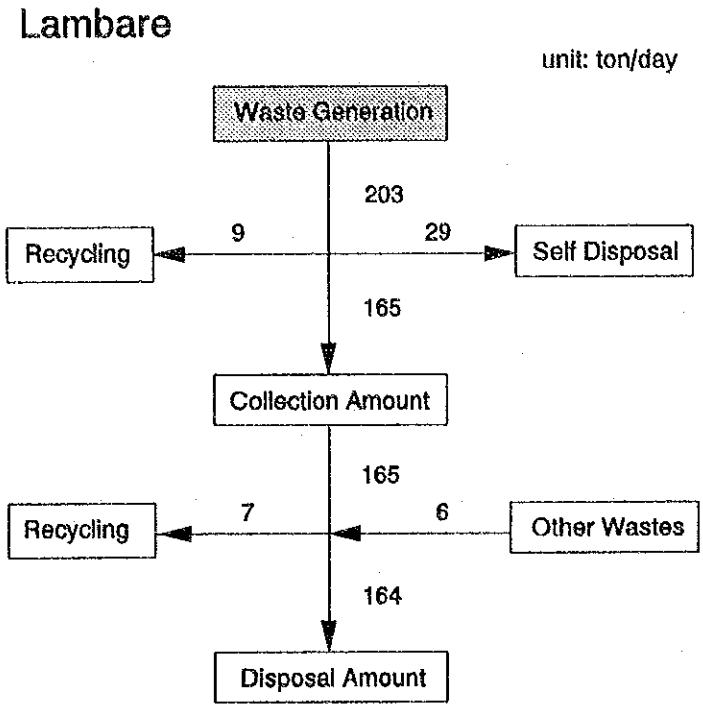


Figure 7.1.4c Waste Stream Diagram of Lambare in 2006

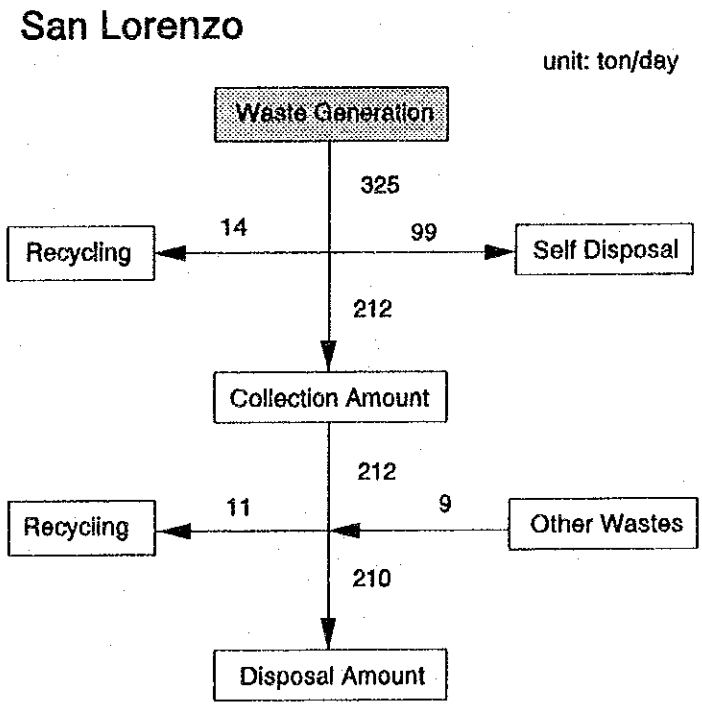


Figure 7.1.4d Waste Stream Diagram of San Lorenzo in 2006

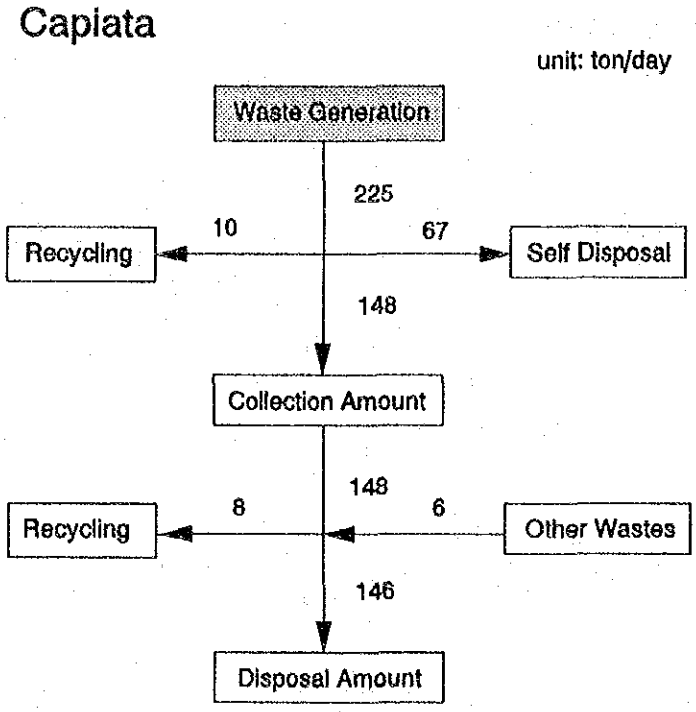


Figure 7.1.4e Waste Stream Diagram of Capiata in 2006

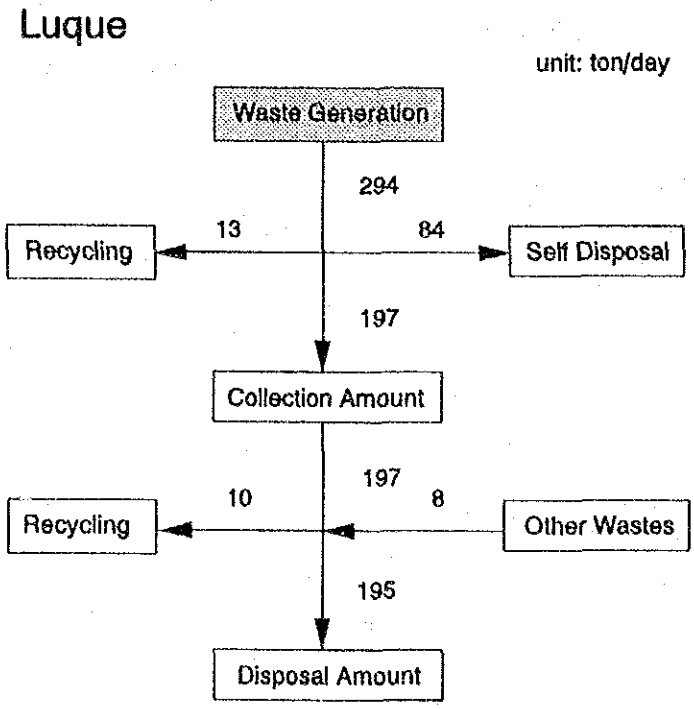


Figure 7.1.4f Waste Stream Diagram of Luque in 2006

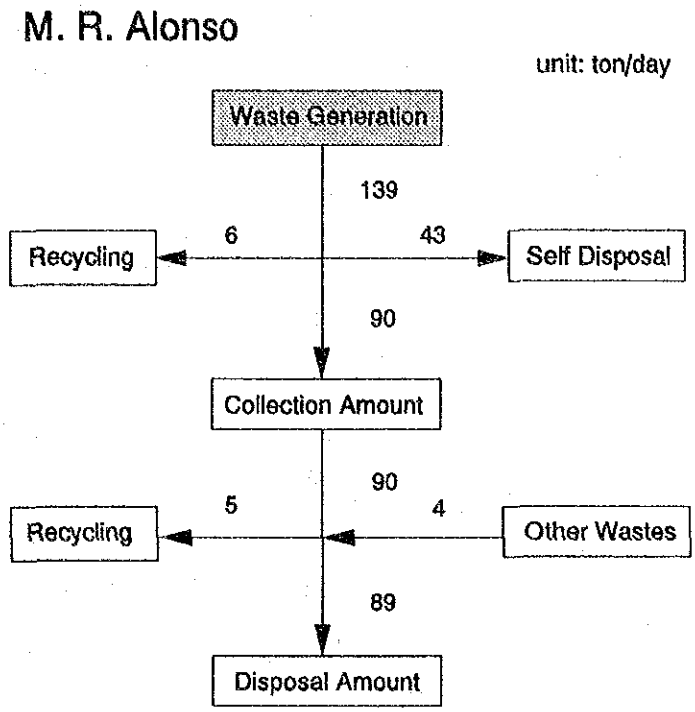


Figure 7.1.4g Waste Stream Diagram of M.R.Alonso in 2006

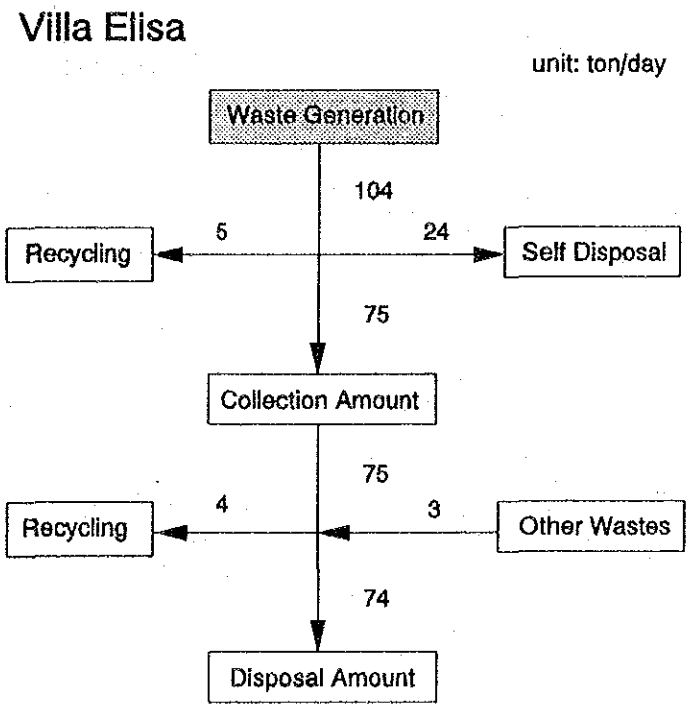


Figure 7.1.4h Waste Stream Diagram of Villa Elisa in 2006

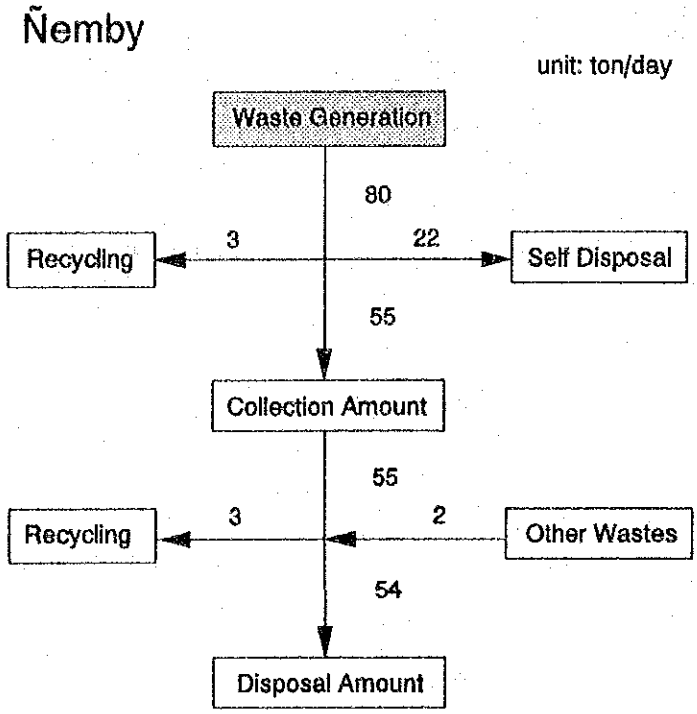


Figure 7.1.4i Waste Stream Diagram of Nemby in 2006

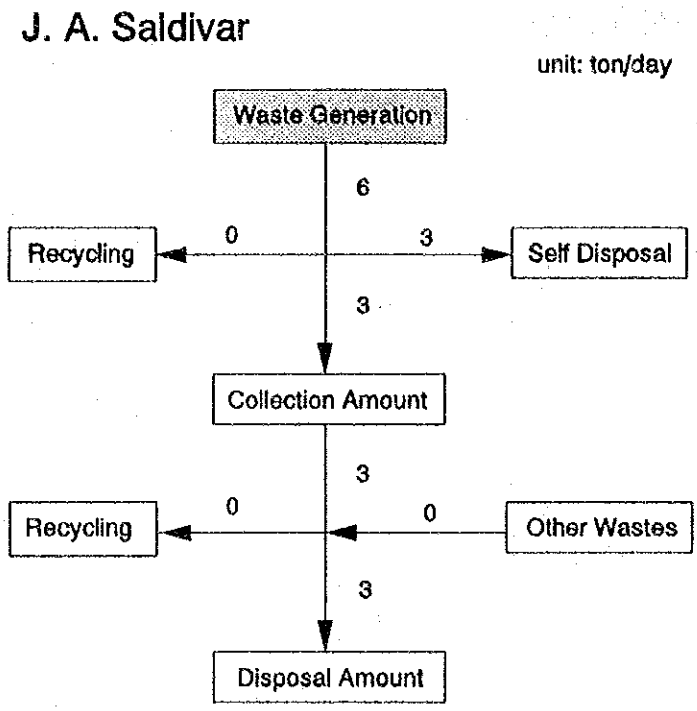


Figure 7.1.4j Waste Stream Diagram of J.A.Saldivar in 2006

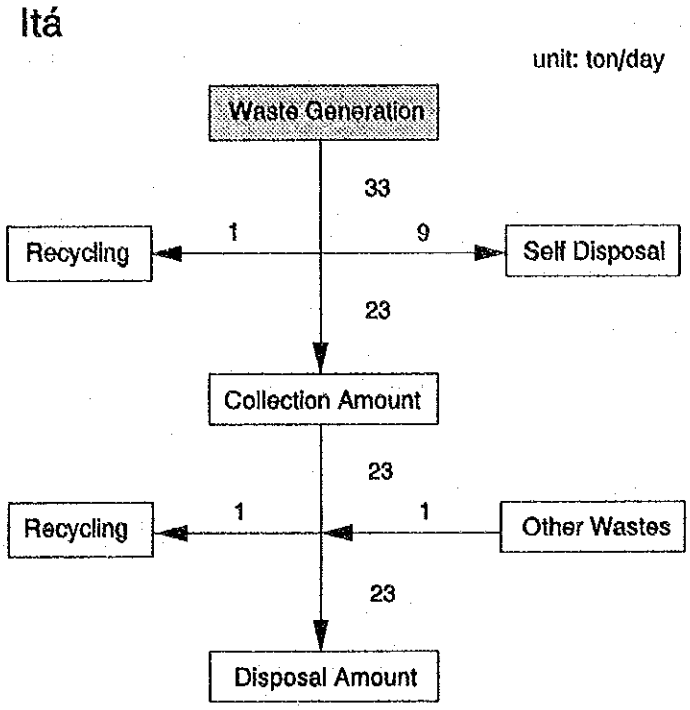


Figure 7.1.4k Waste Stream Diagram of Ita in 2006

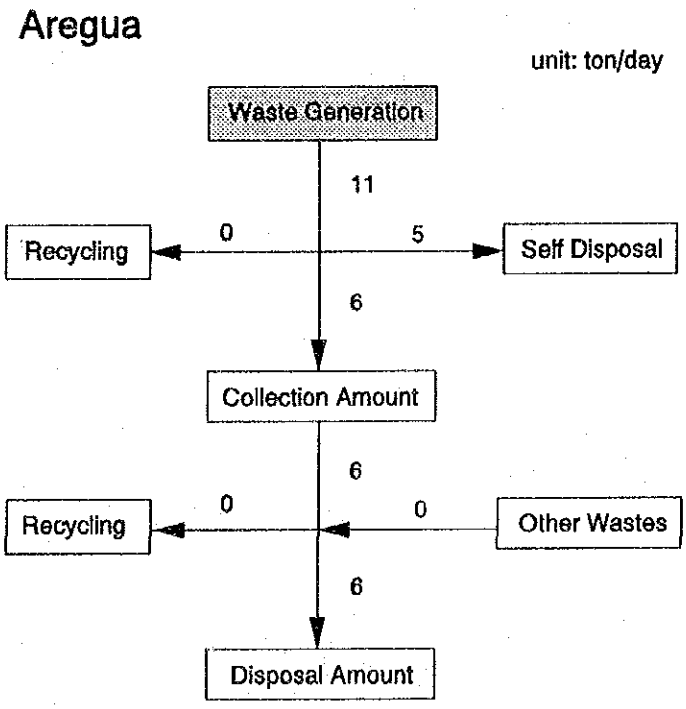


Figure 7.1.4l Waste Stream Diagram of Aregua in 2006

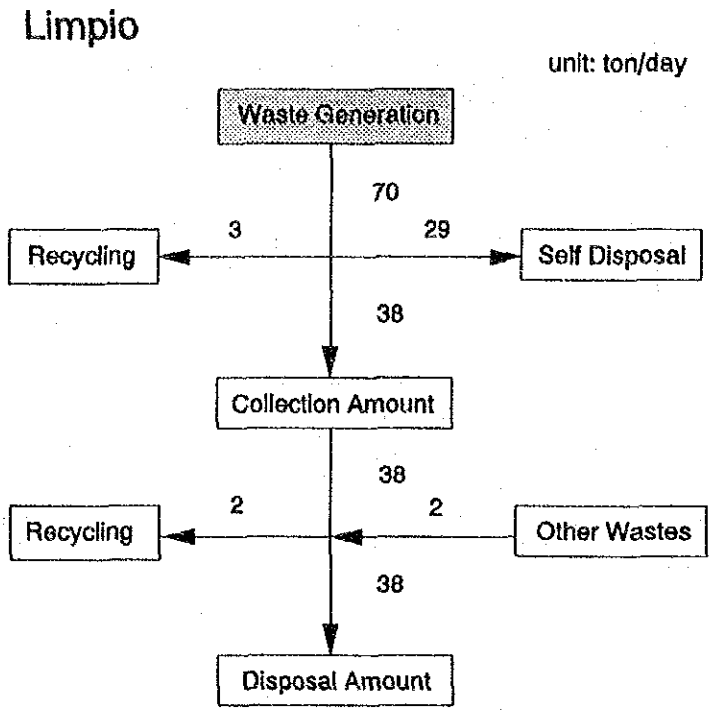


Figure 7.1.4m Waste Stream Diagram of Limpio in 2006

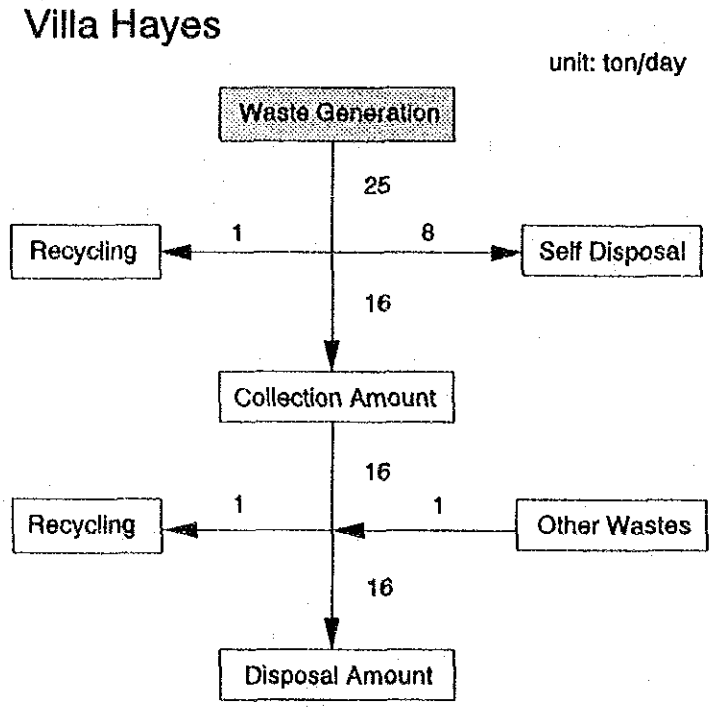


Figure 7.1.4n Waste Stream Diagram of Villa Hayes in 2006

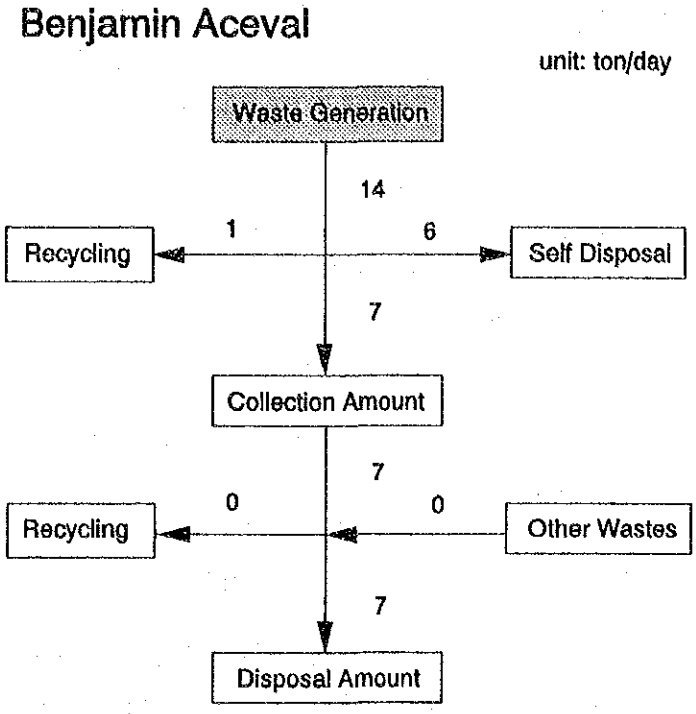


Figure 7.1.4o Waste Stream Diagram of Benjamin Aceval in 2006

7.1.5 Economic and Financial Conditions

According to preliminary results from the 1992 population census, the population growth rate of the Central Department was much higher (5.7%) than the national average (3.1%), but Asuncion grew at only 1%. Within the Central Department, the population growth rates exceeded 10% in M.R. Alonso and Nemby, and ranged between 5% and 10% in Aregua, Capiata, Limpio, Luque, San Lorenzo and Villa Elisa.

The focus of the Project is on the urban population in the Study Area, which grew at a rate of 3.63% per year between 1982 and 1992. The urban population projection for the Project is based on an overall 3.62% annual growth rate in the Study Area, up to the target year.

On the other hand, the real growth rate of GDP is estimated at 3.5% for 1994 by the new Paraguayan administration inaugurated in August 1993. Since this is the only available official figure, in the absence of medium or long-term national development plans, the initial goal of 3.5% real growth rate in GDP should be the basis for estimating the future economic conditions. Therefore, the initial target is

assumed as the GDP growth rate for the term of this administration and beyond.

In reality, if the proposed measures are successful to reactivate the economy and make it less vulnerable to fluctuations in international prices of a few export commodities, then, higher growth rates can be expected in some of the future years. Likewise, unexpected factors can bring about lower GDP growth rates. However, for the sake of facilitating projections, the GDP growth rate is assumed to average out at the initial target of 3.5%.

The 3.5% real growth rate of GDP may appear to be low in relation to the assumed overall population growth rate of 3.62% in the Study Area. However, the GDP growth rate refers to the whole economy, while the population growth rate refers to the urban population in the Study Area, where the concentration of economic activities is observed to be quite high.

Financially, the basic condition for a solid wastes management system is that the service should be self-supporting. As public a utility, the service is legislated to be provided at real costs plus administrative expenses. This does not imply the right to run the service inefficiently. On the contrary, there is an obligation to render the service efficiently and to the satisfaction of the beneficiaries.

An interview survey was conducted to investigate the willingness to pay for solid wastes disposal services. Respondents were requested to answer the questions UNDER THE ASSUMPTION that solid wastes disposal services were SATISFAC-TORY. A comparison between the fee actually paid for solid wastes disposal services and the willingness to pay indicated that households were willing to pay significantly more than the fee actually paid, provided that the service is rendered at the satisfaction of beneficiaries.

Important conclusions from the interview survey are not only the determination of fees the beneficiaries are willing to pay, but also the indication on the good will and cooperative attitude of recipients towards improved levels of solid wastes disposal services. It is therefore estimated that improvements in solid wastes disposal services can be implemented with reasonable certainty concerning the cooperation of beneficiaries in paying the necessary fees to finance such improvements.

7.1.6 Conditions for Cost Estimation

All cost estimates are conducted based on the following conditions:

- The prices and exchange rate are based on the figures of February 1994. The mean exchange rates in February 1994 is shown below.
  1 US$ = 1,880.50 Gs = 106.41 Japanese Yen

- Labor costs and investments for constructions and equipment available in Paraguay reflects Paraguayan price level. These prices are presented in Guarani(Gs). Table 7.1.6a presents information on the unit prices in February 1994 in Paraguay.

- Prices for equipment not available in Paraguay reflects prices in South America. These will be presented in CIF prices in US Dollar.

- All salaries are net salaries, including 9.5% income tax and 41.47 % social security charge.

- The inflation rate is not taken into account.

The information on typical unit prices for earthworks, concrete works, buildings, etc., were obtained from the Paraguayan Chamber of Construction Industry and Ministry of Public Works and Communication.

Table 7.1.6a presents information on unit prices available in Paraguay in February 1994.

Table 7.1.6a Information on Unit Prices Available in Paraguay

DESCRIPTION	UNIT	PRICE
1. Salary, including 42% Social Securities Charge		
- manager	Gs/month	> 3,045,000
- engineer & mechanic	Gs/month	1,645,000
- driver & operator	Gs/month	845,000
- worker	Gs/month	495,000
- clerk	Gs/month	345,000
2. Earthworks		
- Excavation and compaction; haulage distance = 0 to 50 m	Gs/m^3	5,200
- Excavation, Hauling and compaction		
0 - 1 km	Gs/m^3	7,200
1 - 5 km	Gs/m^3	9,000
5 -10 km	Gs/m^3	11,300
10 -15 km	Gs/m^3	14,100
3. Drainage Works		
- Under ground drain including excavation, supply & placing of gravel	Gs/m	9,000
- Under ground drain with perforated pipes, including excavation, supply & placing of perforated pipe (D=diameter) and filter material		
D=100 mm	Gs/m	12,700
D=150 mm	Gs/m	15,800
D=300 mm	Gs/m	43,700
- Open Ditch w=3.0 m, including excavation and shaping	Gs/m	2,600
- Open Ditch w=1.5 m, including excavation, supply and facing of stones	Gs/m	60,000
- Concrete pipe D=600 mm, including excavation, foundation, supply & placing concrete pipe and refilling	Gs/m	125,000
- Concrete pipe culvert D=1,200 mm, including excavation, foundation, supply and placing concrete pipe and refilling	Gs/m	270,000
4. Pavement works		
- Surface Course, Dense-graded Asphalt Concrete	Gs/m^3	216,000
- Base Course, Mechanical Stabilized Gravel	Gs/m^3	58,000
- Sub-base Course, Gravel	Gs/m^3	36,100
5. Concrete works, including material and works concerning framework, reinforcement work, concrete work		
- wall	Gs/m^3	244,000
- slab	Gs/m^3	255,000
- column	Gs/m^3	268,000
- continuous footing foundation	Gs/m^3	272,000
6. Building works		
- Garage from a steel structure with steel cladding, including foundation and concrete floor	Gs/m^2	71,100
- Office building of brickwork, including all works	Gs/m^2	591,000
7. Miscellaneous works		
- Fence, consisting of 2 m high galvanized wire mesh erected on galvanized steel posts each 2.5 m	Gs/m	37,000
- Gate, 8 m wide	Gs/set	930,000
- Turfing, consist of supply of turf and soil and all works to be necessary	Gs/m^2	7,600
8. Materials		
- Diesel Oil	Gs/l	550
- Gravel	Gs/m^3	18,900
- Sand	Gs/m^3	11,000
- Cement	Gs/50kg	11,690
- Ready Mixed-Concrete		
150 kg/cm2	Gs/m^3	123,600
180 kg/cm2	Gs/m^3	128,600
210 kg/cm2	Gs/m^3	133,600
240 kg/cm2	Gs/m^3	139,600
- Steel beam	Gs/kg	935
- Electric power	Gs/kwh	22.36

7.2 MSWM Master Plan for 15 Municipalities

a. Location of MSWM Facilities

The location of MSWM facilities proposed in the Master Plan are presented in Figure 7.2a.

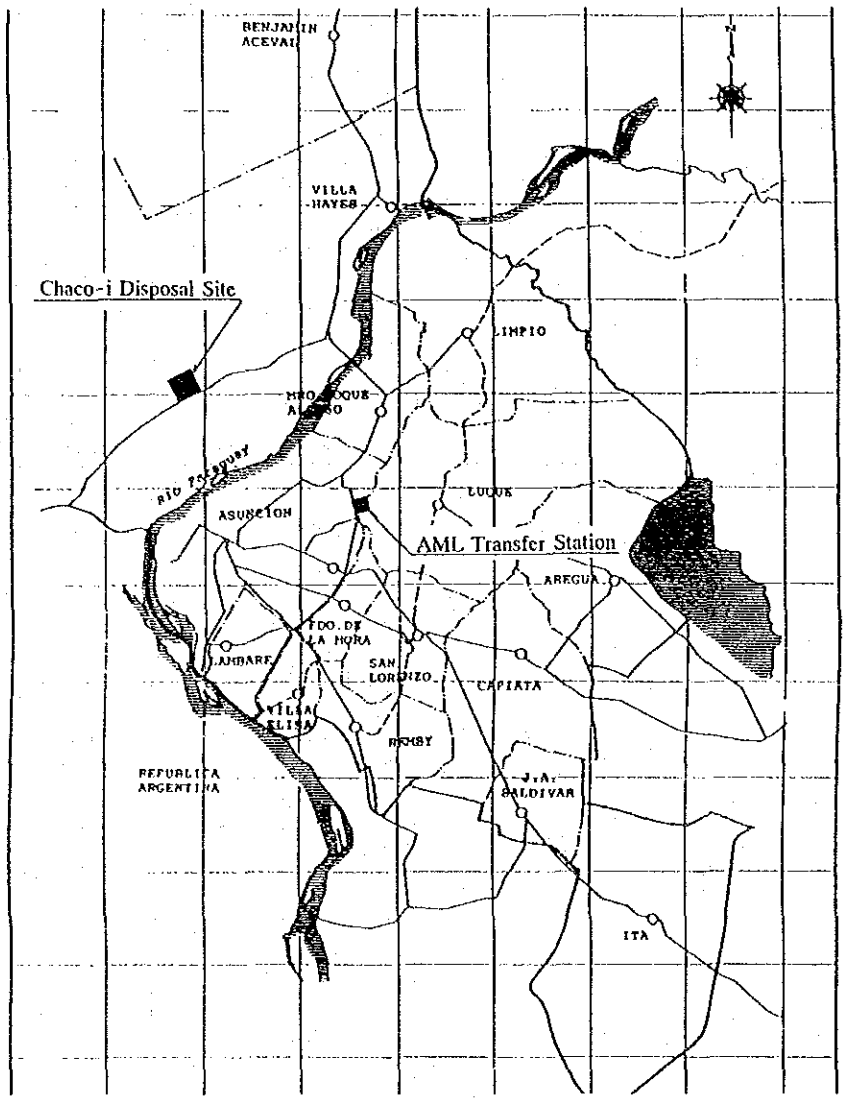


Figure 7.2a Location of MSWM Facilities

b. 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 7.2.1a to 7.2.15b.

7.2.1 MSWM Master Plan for Asuncion

Table 7.2.1a 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 7.2.1b 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.

7.2.2 MSWM Master Plan for F.Mora

Table 7.2.2a 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 7.2.2b 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 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, 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.

7.2.3 MSWM Master Plan for Lambare

Table 7.2.3a Lambare MSWM Master Plan on Technical System

Item \ Year	1994	2000	2006
1. COLLECTION & HAULAGE			
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 7.2.3b 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.

7.2.4 MSWM Master Plan for San Lorenzo

Table 7.2.4a San Lorenzo MSWM Master Plan on Technical System

Item \ Year	1994	2000	2006
1. COLLECTION & HAULAGE			
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 7.2.4b 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 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.

7.2.5 MSWM Master Plan for Capiata

Table 7.2.5a Capiata MSWM Master Plan on Technical System

Item \ Year	1994	2000	2006
1. COLLECTION & HAULAGE			
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 7.2.5b 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.

7.2.6 MSWM Master Plan for Luque

Table 7.2.6a Luque MSWM Master Plan on Technical System

Item \ Year	1994	2000	2006
1. COLLECTION & HAULAGE			
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 7.2.6b 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 AMUAM/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.

7.2.7 MSWM Master Plan for M.R.Alonso

Table 7.2.7a M.R.Alonso MSWM Master Plan on Technical System

Item \ Year	1994	2000	2006
1. COLLECTION & HAULAGE			
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 7.2.7b 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 form AMUAM/SENASA	A municipal sanitary regulation shall be enforced with assistance form 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.

7.2.8 MSWM Master Plan for Villa Elisa

Table 7.2.8a 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 7.2.8b 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.

7.2.9 MSWM Master Plan for Nemby

Table 7.2.9a 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 7.2.9b 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 interrelated payment of fees for municipal services.	Use 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	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.

7.2.10 MSWM Master Plan for J.A.Saldivar

Table 7.2.10a 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	There is no disposal site.		
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		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 7.2.10b J.A.Saldivar MSWM Master Plan on Institutional System

Year / Items	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.

7.2.11 MSWM Master Plan for Ita

Table 7.2.11a 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 7.2.11b 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.

7.2.12 MSWM Master Plan for Aregua

Table 7.2.12a 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 7.2.12b Arequa 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.

7.2.13 MSWM Master Plan for Limpio

Table 7.2.13a 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.