

**cbc. Sensitivity Analysis**

Sensitivity analysis was conducted for both Asunción and AMUAM under specified conditions of decreased revenues and/or increased expenses. Results of the sensitivity analysis are shown in Table 8.4.2m and 8.4.2n.

**Table 8.4.2m Results of the Sensitivity Analysis for Asuncion**

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

**Table 8.4.2n Results of the Sensitivity Analysis for AMUAM**

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

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

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

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

#### **d. Overall Evaluation**

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

Socially, there will be many benefits to be gained, which signify the appropriateness of the Project.

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

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

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

### **8.4.3 Evaluation of Construction Project of AML Transfer Station**

#### **a. Social Evaluation**

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

From a social standpoint, however, the project yields other benefits beyond its main objective. These benefits are mainly the following:

- Creation of jobs, technical as well as unskilled ones.

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

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

## **b. Environmental Evaluation**

### **ba. Outline of the project**

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

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

### **bb. Present Environmental Condition**

The survey points for the present environmental condition are shown in Figure 8.4.3a. The survey results and the appraisal of the present environmental condition

for Avenida Madam Lynch site are tabulated in Table 8.4.3a.

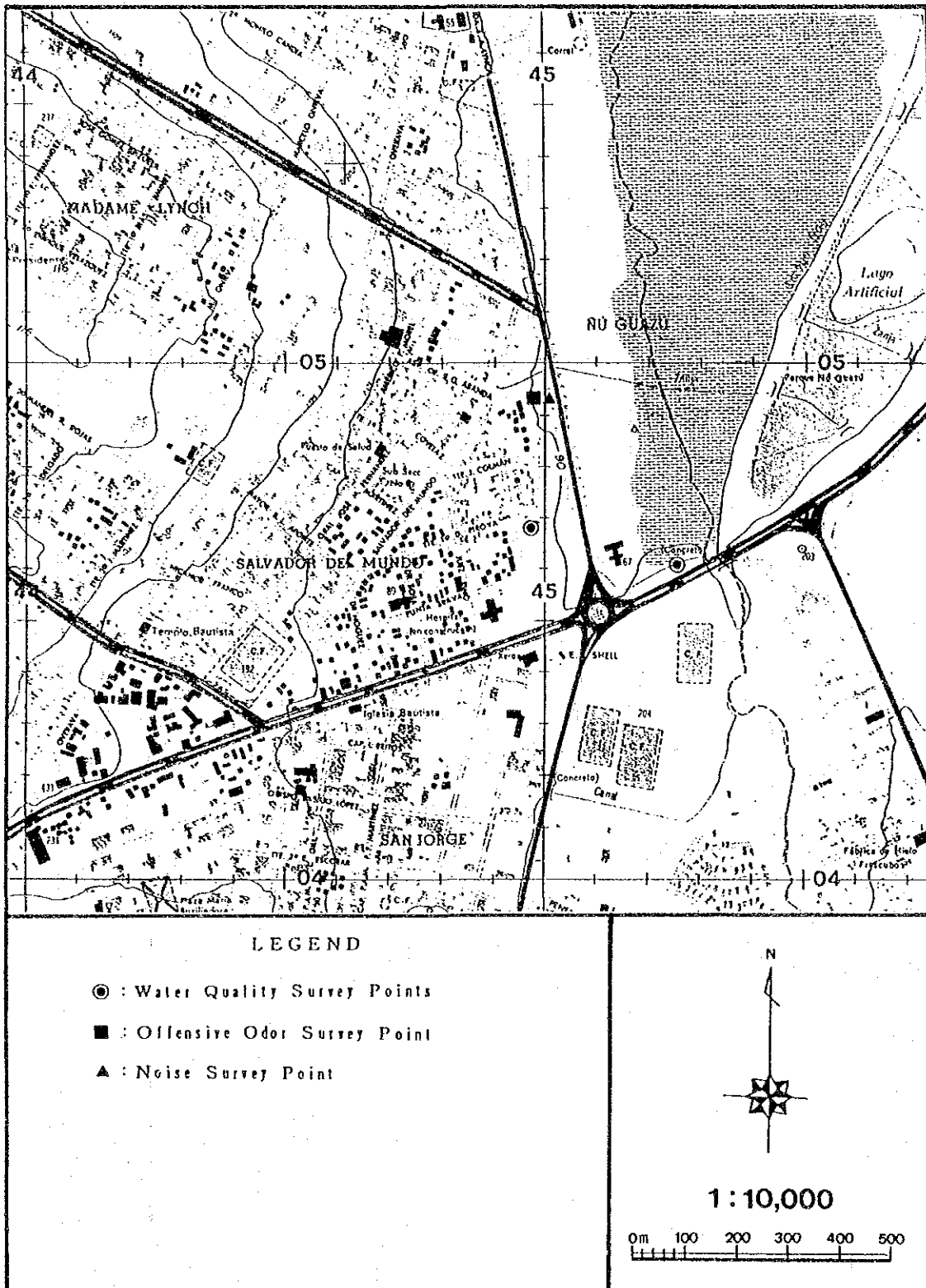


Figure 8.4.3a Location Map of Environmental Survey Points for Avenida Madam Lynch Site

Table 8.4.3a Appraisal of Present Environmental Condition for Avenida Madam Lynch Site

Survey Item		Survey Result	Appraisal of Present Conditions
Water Quality	Items related to Human Health	Pb	Not detected
		As	Not detected
		Cd	Not detected
		Cr <sup>6+</sup>	Not detected
		Hg	Not detected
		pH	between 6.8 and 7.4
	Other Items	COD	between 11 and 50 mg/l
		BOD	between 5.2 and 14.4 mg/l
		T-N	between 9.7 and 24.4 mg/l
		SO <sub>4</sub> <sup>2-</sup>	between 54 and 73.5 mg/l
	Cl <sup>-</sup>	between 45.7 and 62.4 mg/l	
		Regarding the concentration of river water and ground water, ground water is more concentrated than river water in BOD and COD and river water is more concentrated than ground water for T-N. There was no significant difference in pH.	
Offensive Odor	Ammonia	Not detected	Although the environmental standard does not specify these limits, the present condition was judged to be satisfactory because these were not detected and also satisfied the limit (5 ppm) specified by the Japanese environmental standard.
Noise	Noise level (L <sub>90</sub> )	<ul style="list-style-type: none"> <li>- Noise level was between 44dB(A) and 63 dB(A).</li> <li>- Noise level was less than 50 dB(A) between 1 am and 4 am.</li> <li>- Noise level was around 60 dB(A) and less than 65 dB(A).</li> </ul>	Present noise level satisfy the Japanese environmental specification, i.e. 65 dB(A) for daytime and 60 dB(A) for night time in the commercial area.

bc. Environmental Evaluation

Table 8.4.3b Environmental Evaluation of AML Transfer Station

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

**c. Economic and financial evaluation**

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

**ca. Economic evaluation**

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

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

**caa. Standard Conversion Factor (SCF)**

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

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

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

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

$$SCF = 0.96$$

**cab. Correction for unskilled labor**

The following data were used.

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

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

Table 8.4.3b shows that the EIRR resulting from the transfer station is 18.0% if the useful life of the project is assumed to be 30 years.

Table 8.4.3c Economic Evaluation for Transfer and Transport System

unit: mill.Gs

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

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

**cb. Financial evaluation**

**cba. FIRR**

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

Expenditures, on the other hand, consisted of those for investment as well as for operation and maintenance. Investments included contingency allowances, and one-third of investments on the centralized workshop. Operation and maintenance costs of the Transfer Station also included one-third of operation and maintenance costs of the workshop and AMUAM's administration cost.

Table 8.4.3d, 8.4.3e and 8.4.3f show details on the expenditures and revenues of the Transfer Station. The resulting FIRR were 12.14% (CRF-10%), 7.09% (CRF-3%) and 5.10% (CRF-0%).



Table 8.4.3d Financial Evaluation for Transfer and Transport System with 10% Interest unit: mill.Gs

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

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

Table 8.4.3e Financial Evaluation for Transfer and Transport System with 3% Interest unit: mill.Gs

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

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

Table 8.4.3f Financial Evaluation for Transfer and Transport System at 0% Interest unit: mill.Gs

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

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

**cbb. Sensitivity Analysis**

Results of the sensitivity analysis, conducted under specified conditions of decreased revenues and/or increased expenses, are shown in Table 8.4.3g.

Table 8.4.3g Results of the Sensitivity Analysis for Transfer and Transport System

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

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

#### **d. Overall Evaluation**

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

Socially, there will be various benefits to be acquired, which show the appropriateness of the Project.

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

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

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

#### **8.4.4 Evaluation of Construction Project of Chaco-i Inter-municipal Final Disposal Site**

##### **a. Social Evaluation**

From the social standpoint, the project has the following benefits:

- Creation of jobs, technical as well as unskilled ones (primarily these the least)
- Improvement of the Public Health in the surrounding areas of the present landfills, since it is recognized that there is a linkage between the health status of the population and the cleanliness of the public spaces.
- Improvement of the technical level of Paraguayan professionals, engineers mostly, but also technicians.
- Improvement of working conditions of the unskilled personnel, basically on matters related to safety and hygiene.

- Recovery of degraded areas making them viable to be used by the community, specially as in the case of the Cateura landfill.
- General improvement in the landscape sight, be it in the urbanized areas as well as in the open green spaces.

The evaluation of most of these outcomes quantitatively is rather difficult, since many of them have a strong psychological component and it's measurement is sometimes impossible to be made. Quantitatively, the construction of Chaco-i inter-municipal landfill is feasible socially, because the large contribution of the above-mentioned benefits will be expected.

## **b. Environmental Evaluation**

### **ba. Outline of the plan**

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

- The final disposal site shall be surrounded by banks approximately 5m high. Dumping of waste should start after construction of the banks.
- Trees are to be planted around the site to shut out the site and to prevent dust and waste scattering.
- In case of strong winds, water will be sprayed to prevent dust scattering at the construction and operation phase.
- The permeability coefficient of surface soil is very low; i.e.  $10^{-6}$  to  $10^{-9}$ cm/s. This indicates that the possibility of ground water contamination by leachate is very little even without lining material on the bottom. Therefore, installation of a liner is not considered to be feasible.
- Leachate is discharged into the regulation pond ( $2,500m^2 \times 2m$ ) and usually pumped back up to the disposal area by the leachate circulation facility.
- Gas is to be released via perforated pipes from inside the site to create an aerobic condition.
- Waste is to be covered using soil everyday, to prevent the production of offensive odors and scattering of waste.
- Since the discharge of the Rio Negro (Negro River) is not enough for dilution of leachate and in the downstream of the river there are some colonies of farmers, it is planned to construct a diversion canal which will flow directly into the Paraguay River and be about 5 km long.

bb. Present environmental condition

The locations of survey points are shown in Figure 8.4.4a. The survey results and the appraisal of the present environmental condition for the Chaco-i site are tabulated in Table 8.4.4a.

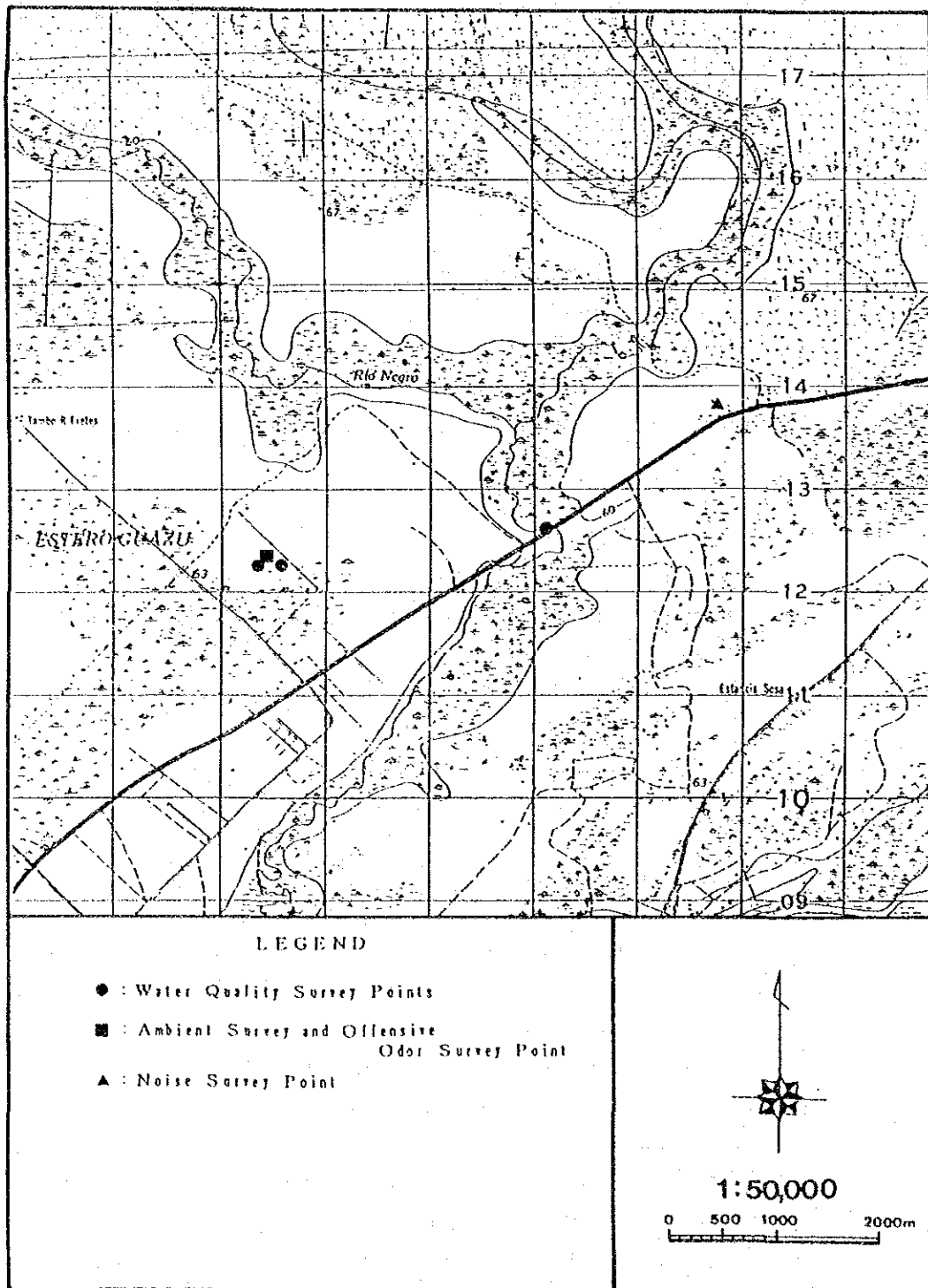


Figure 8.4.4a Location Map of Environmental Survey Points for Chaco-i Site

Table 8.4.4a Appraisal of present Environmental Condition for Chaco-i Site

Survey Item		Survey Result		Appraisal of Present Conditions
Water Quality	Items related to Human Health	Pb	Not detected	Although the environmental standard does not specify these limits, the present condition is deemed to be satisfactory because these were not detected.
		As	Not detected	
		Cd	Not detected	
		Cr <sup>6+</sup>	Not detected	
		Hg	Not detected	
		pH	between 6.3 and 6.7	
		COD	between 3.5 and 68.5 mg/l	
		BOD	between 0.75 and 9.9 mg/l	
		T-N	between 1.3 and 4.9 mg/l	
		SO <sub>4</sub> <sup>2-</sup>	between 23 and 100 mg/l	
		Cl <sup>-</sup>	between 10.6 and 14.2 mg/l	
		Regarding the concentration of river water and ground water, ground water is more concentrated than river water in all items.		
Ambient	Suspended Particular Matters	Not detected		Although the environmental standard does not specify this limit, the present condition is deemed to be satisfactory because this was not detected. The results of SPM were within the Japanese environmental standard of 0.1 mg/l per day.
	Dust	Not detected		
Offensive Odor	Ammonia	Not detected		Although the environmental standard does not specify this limit, the present condition is deemed to be satisfactory because this was not detected. The results of SPM were within the Japanese environmental standard of 5ppm.
Noise	Noise level (L <sub>eq</sub> )	<ul style="list-style-type: none"> <li>- Noise level was between 24dB(A) and 61 dB(A).</li> <li>- Noise level was less than 40 dB(A) between 1 am and 4 am.</li> <li>- Noise level was around 60 dB(A).</li> </ul>		Present noise level satisfy the Japanese environmental specification, i.e. 65 dB(A) for daytime and 60 dB(A) for night time in the commercial area.

**bc. Environmental evaluation**

**Table 8.4.4b Environmental Evaluation of Chaco-i Inter-municipal Landfill**

Phase Evaluation Items	Construction Phase	Operation Phase
1. Water Pollution	- The heavy rain may produce muddy water. Its impact will be negligible due to the flat topography.	- Since the permeability of surface soil ranges from $10^{-6}$ to $10^{-9}$ cm/sec., the impact on the ground water by the generation of leachate will be permissible. In addition, there are no inhabitants in the vicinity of the site. - The leachate will be usually pumped up back to the landfill by a leachate circulation facility in order not to discharge it into a diversion canal. - The leachate will be discharged to a the diversion canal only during heavy rain. The impact will be permissible because it will be diluted by the rain water and there are no inhabitants along the diversion canal up to the Paraguay River where leachate will be diluted enough.
2. Air Pollution	- Adverse impact from dust will be mitigated by sprinkling water by a water tanker.	- The generation of dust can be controlled by water sprinkling.
3. Noise	- The impact by the operation of construction equipment will be negligible because there are no inhabitants in the vicinity of the site.	- The impact by the operation of landfill equipment will be negligible because there are no inhabitants in the vicinity of the site.
4. Offensive Odor	- There is no generation of odor at the construction phase.	Daily covering can minimize the generation of odor.

**c. Economic and financial evaluation**

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

**ca. Economic evaluation**

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

**i. Improved public health**

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

**ii. Prevention of groundwater pollution**

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

**iii. Prevention of scattering solid wastes**

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

**iv. Land value appreciation**

Studies conducted in the United States documented cases where the land value increased as a result of the improved quality of the adjoining water body, or due to less polluted air quality. For instance, land value surrounding a water body increased between 8% and 25% in the U.S., depending on the distance from the shore, when the water quality improved (Source: Benefit of Water Pollution Control on Property Values, by D.M.Dornbush and S.M.Barrager, EPA-600/5-73-005, Washington, D.C., 1973). Under the same reasoning, the value of the land surrounding the Cateura landfill can increase in the future, if the final disposal site is moved to Chaco-1, because of the potential for re-utilization of the Cateura site as a park or sports ground.

**v. Extra costs avoidance**

Inadequate final disposal of solid wastes creates focus for breeding of pests, and for emission of foul odors and contamination of air and water. In order to



neutralize these unwanted effects, households near the present landfills may have to incur extra costs such as pest control treatment, use of air freshener, and water treatment.

**cb. Financial evaluation**

**cba. FIRR**

Revenues consisted of the Tipping Fee from the 6 municipalities, i.e. Asunción, F.Mora, M.R.Alonso, Limpio, Villa Hayes and B.Aceval. Three levels of tipping fee were estimated using three interest rates 10%, 3% and 0%.

Expenditures, on the other hand, consisted of those for investment as well as for operation and maintenance. Investments included contingency allowances, and one-third of investments on the centralized workshop. Operation and maintenance costs of the final disposal sites also included one-third of operation and maintenance costs of the workshop and AMUAM's administration cost.

Tables 8.4.4c, 8.4.4d and 8.4.4e show details on the expenditures and revenues of the final disposal system of solid wastes. The resulting FIRR were 22.92% (CRF-10%), 16.65% (CRF-3%) and 14.23% (CRF-0%).

Table 8.4.4c Financial Evaluation for Final Disposal with 10% Interest  
unit: mill.Gs

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

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

Table 8.4.4d Financial Evaluation for Final Disposal with 3% Interest  
unit: mill.Gs

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

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

Table 8.4.4c Financial Evaluation for Final Disposal with 0% Interest  
unit: mill.Gs

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

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

#### cbb. Sensitivity Analysis

Results of the sensitivity analysis, conducted under specified conditions of decreased revenues and/or increased expenses, are shown in Table 8.4.4e.

Table 8.4.4f Results of the Sensitivity Analysis for Chaco-i Inter-municipal Landfill

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

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

#### d. Overall Evaluation

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

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

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

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

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

## 8.5 Implementation Plan

### 8.5.1 Project Implementation Bodies and Schedule

#### a. Project Implementation Bodies

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

- i. **Collection Improvement:** AMUAM for 14 municipalities and Asuncion
- ii. **Transfer and Transport:** AMUAM
- iii. **Chaco-i Final Disposal Site:** AMUAM

#### b. Implementation Schedule

The proposed implementation schedule of the 3 projects are tabulated in Table 8.5.1a.

Table 8.5.1a Implementation Schedule

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

## 8.5.2 Financial Plan

Financial Plans were prepared for AMUAM, for municipalities, and for the Project as a whole. These three categories of plans were prepared for each of the three interest rates at which rental and tipping fees were calculated.

The cash flow analysis indicated that Asunción, with a well established MSWM, could undertake investments/replacements as well as operation and maintenance on the basis of loans and internally generated funds. However, revenues of AMUAM for MSWM depend on payments of rental and tipping fees by member municipalities, which is possible only when the MSWM is in operation. In addition, the level of the rental and tipping fees would have opposite effects on the finances of AMUAM and the member municipalities. If these fees were high, AMUAM would improve its finances at the expense of financial burden for member municipalities. Conversely, if these fees were low, member municipalities would bear less financial burden but AMUAM would run the risk of becoming an unviable implementing agency. Furthermore, the revenues from user charges were not enough to cover the costs of MSWM, except in Asuncion during most of the years of the Project, and F.Mora during the first phase of the Project (up to 2004). These financial analyses implies that AMUAM requires donations to finance initial investments during the take-off period of the MSWM, but subsequently can replace facilities and equipments with internally generated funds, thereby ensuring continuity of the MSWM.

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

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

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

Financial Plans are shown in Table 8.5.2a, 8.5.2b, 8.5.2c, 8.5.2d, 8.5.2e, 8.5.2f, 8.5.2g, 8.5.2h and 8.5.2i. Financial plans by municipality are included in Data Book for the cases of rental and tipping fees calculated with capital recovery factor at 10%, 3% and 0% interest rates.

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

Table 8.5.2a Financial Plan of AMUAM with 10% Interest unit: mill.Gs

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

Table 8.5.2b Financial Plan of AMUAM with 3% Interest unit: mill.Gs

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

Table 8.5.2c Financial Plan of AMUAM with 0% Interest unit: mill.Gs

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



Table 8.5.2d Financial Plan of Asuncion Municipality with 10% Interest  
unit: mill.Gs

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

Table 8.5.2c Financial Plan of Asuncion Municipality with 3% Interest

unit: mill.Gs

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

Table 8.5.2f Financial Plan of Asuncion Municipality with 0% Interest  
unit: mill.Gs

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

Table 8.5.2g Financial Plan of the Project with 10% Interest unit: mill.Gs

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

Table 8.5.2h Financial Plan of the Project with 3% Interest unit: mill.Gs

Year	Expenditures							Income			
	Initial Cost	O & M	Interest	Am-orti-zation	Rental Fee	Tipping Fee	Total	Foreign Grant	Foreign Loan	User Charges	Property Tax
1995	2864	0	0	0	0	0	2864	2864	0	0	0
1996	46613	0	0	0	0	0	46613	38028	6868	0	1202
1997	797	14103	206	0	1835	12770	29711	0	638	20891	5727
1998	706	14173	225	0	1835	13806	30745	0	565	21450	6111
1999	1109	14448	242	0	1835	14887	32521	0	302	22031	7132
2000	10247	14519	251	0	1835	15943	42795	0	2398	25312	10559
2001	4773	16710	323	0	1835	17000	40641	0	3517	26074	7735
2002	1512	15667	429	0	1835	18023	37466	0	524	26869	7951
2003	37045	15768	444	0	1835	19099	74191	0	6543	27699	27964
2004	17675	18621	641	0	1835	20130	58902	0	454	28566	20917
2005	1134	22106	668	0	3633	21174	48715	0	304	29472	13257
2006	566	22292	643	1128	3633	22211	50473	0	453	30418	13722
2007	0	22292	623	1128	3633	22211	49887	0	0	30420	13627
2008	0	22292	589	1128	3633	22211	49853	0	0	30420	13603
2009	0	22292	555	1129	3633	22211	49820	0	0	30420	13580
2010	0	22292	521	1128	3633	22211	49785	0	0	30420	13556
2011	0	22292	488	1128	3633	22211	49752	0	0	30420	13532
2012	0	22292	454	1128	3633	22211	49718	0	0	30420	13509
2013	0	22292	420	1129	3633	22211	49685	0	0	30420	13486
2014	0	22292	386	1128	3633	22211	49650	0	0	30420	13461
2015	0	22292	352	1128	3633	22211	49616	0	0	30420	13437
2016	0	22292	318	1128	3633	22211	49582	0	0	30420	13413
2017	0	22292	284	1129	3633	22211	49549	0	0	30420	13390
2018	0	22292	251	1128	3633	22211	49515	0	0	30420	13367
2019	0	22292	217	1128	3633	22211	49481	0	0	30420	13343
2020	0	22292	183	1128	3633	22211	49447	0	0	30420	13319
2021	0	22292	149	1129	3633	22211	49414	0	0	30420	13296
2022	0	22292	115	1128	3633	22211	49379	0	0	30420	13271
2023	0	22292	81	1128	3633	22211	49345	0	0	30420	13248
2024	0	22292	48	1128	3633	22211	49312	0	0	30420	13224
2025	0	22292	0	1129	3633	22211	49265	0	0	30420	13192
Total	125041	591955	10106	22565	90973	597052	1437692	40892	22565	836765	376230

Table 8.5.2i Financial Plan of the Project with 0% Interest unit: mill.Gs

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

### 8.5.3 Establishment of a Monitoring System

#### a. Necessity for the Establishment of a Monitoring System

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

#### b. Personnel Responsible for Monitoring

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

Table 8.5.3a Personnel to be Involved in Monitoring Operations

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

**c. Indicators to be Used**

**ca. Selection of indicators**

Selection of indicators are related to the Master Plan targets. Useful indicators include the following items as shown in Table 8.5.3b.

**Table 8.5.3b Principal and Supporting Indicators**

Master Plan Target	Principal Indicators	Supporting Indicators
a. Expansion of collection services	<ul style="list-style-type: none"> <li>. Collection service coverage in terms of population</li> <li>. Amount of waste collected</li> <li>. Number of fee payers</li> </ul>	<ul style="list-style-type: none"> <li>. Percentage in terms of area</li> <li>. Waste measured by the weigh bridges</li> <li>. Ledger for management of collection fee</li> </ul>
b. Expansion of street sweeping service	<ul style="list-style-type: none"> <li>. Length of streets swept</li> <li>. Amount of waste collected</li> </ul>	<ul style="list-style-type: none"> <li>. Percentage in terms of area</li> <li>. Waste measured by the weigh bridges</li> </ul>
c. Upgrading of the Standard	<ul style="list-style-type: none"> <li>. Standard of sanitary land-fill</li> </ul>	<ul style="list-style-type: none"> <li>. Amount of waste scattering</li> <li>. Number of complaint by residents</li> </ul>
d. Strengthening of the Organization	<ul style="list-style-type: none"> <li>. Collection and street sweeping services' efficiency</li> </ul>	<ul style="list-style-type: none"> <li>. Number of personnel in the Sanitation Dept.</li> <li>. Unit cost of services per ton</li> </ul>
e. Securing financial resources for MSWM	<ul style="list-style-type: none"> <li>. Collection fee</li> <li>. Rental fee</li> <li>. Tipping fee</li> <li>. Revenue and expenditure</li> </ul>	<ul style="list-style-type: none"> <li>. Ledger for management of collection fee</li> <li>. Accounting sheet</li> </ul>

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

**cb. Definitions of indicators**

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



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

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

# **CHAPTER 9**

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**EXPERIMENT ON  
SANITARY LANDFILL OPERATION  
AND SCHOOL LECTURE  
ON SOLID WASTE**



## **CHAPTER 9 EXPERIMENT ON SANITARY LANDFILL OPERATION AND SCHOOL LECTURE**

*This chapter describes the experiment of sanitary landfill operation conducted in the Cateura landfill in Asuncion and the lecture on solid waste management conducted at 4 primary schools in Asuncion, San Lorenzo and Capiata.*

### **9.1 Experiment on Sanitary Landfill Operation**

#### **9.1.1 Proposed Plan**

##### **a. Objective of the Experiment**

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

##### **b. Site and Period of the Experiment**

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

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

##### **c. Contents of the Experiment**

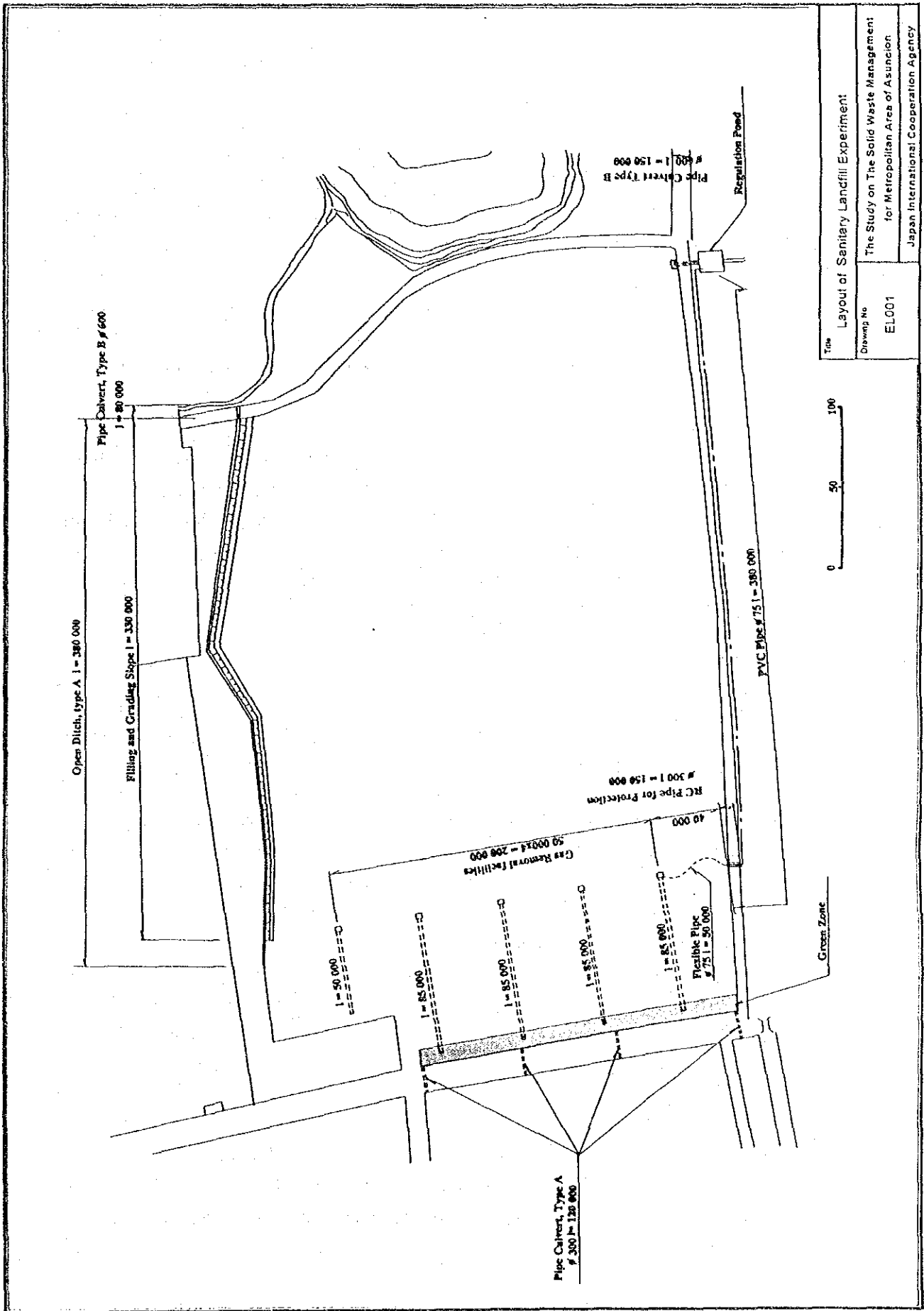
The sanitary landfill Level 3 with a leachate circulation system is proposed in the master plan, while the present Cateura landfill is considered as Level 1 with occasional soil cover. Although it is difficult to completely improve the present landfill up to Level 3 due to the huge amount of waste disposed of at present and

a limited budget, the contents of the experiment are planned so as to meet with Level 3 of sanitary landfill as much as possible. Consequently, the contents and aim of the experiment are as follows:

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

**d. Proposed Plan**

The proposed plans of the sanitary landfill experiment is shown in Figure 9.1.1a. The detailed drawings, No.ES01 to ES06, concerning the sanitary landfill experiment are included in the Data Book. These proposed plans were confirmed at the meeting of the Interim Report. The implementation of the sanitary landfill experiment, as shown in Plate 4, was executed in collaboration with Paraguayan and Japanese sides.



Title	Layout of Sanitary Landfill Experiment
Drawing No.	EL001
The Study on The Solid Waste Management for Metropolitan Area of Asuncion	
Japan International Cooperation Agency	

Figure 9.1.1a Proposed Plan of the Sanitary Landfill Experiment

## 9.1.2 Findings

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

- The buffer zone which was constructed at the northern side of the disposal site was proved to be very effective to shut residents' sights off. Plantations are deemed to improve the living environment of the neighborhood when they grow.
- The open drainage was excavated along the foot of the hill on the southern side of the disposal site in order to divert sewage and storm water from the hills to avoid it infiltrating the disposal site and to distinguish the landfill site from the residential areas. This aim was achieved. In addition, this drainage gave the impression that the neighborhood was some distance away from the disposal site. The neighbors thereby appreciate the new open drainage. This effect was not anticipated.
- After the commencement of the leachate circulation facility, the leachate collected in the regulation pond usually did not overflow except for days with heavy rainfall, although the capacity of the regulation pond is small, approximately 70 m<sup>3</sup>. This fact proves that the leachate circulation method is effective in controlling leachate quality and quantity in Paraguay. This could be foreseen because evaporation is more than precipitation in Paraguay. The experiment of the leachate circulation system should be continued in order to be applied for the large disposal site in future.
- The horizontal gas removal facility, which is made up with gravel and perforated pipes 50 cm below the ground, collected ground water and made the earth soft because the ground water table was rather shallow. In such case, vertical gas removal may be more suitable than horizontal gas removal facilities.

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

## **9.2 Experiment of School Lecture on Solid Waste**

### **9.2.1 Method of the Experiment**

#### **a. Objective of the Experiment**

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

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

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

#### **b. Method of the Public Educational Campaign**

##### **ba. Educational Material Used**

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

##### **bb. Educational Video**

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

The scenario of this video tape made by the Study Team is presented in Spanish and Guarani.

##### **bc. Teaching manual and material**

The teaching manual and materials which were prepared for this school lecture are presented in Spanish.



#### **bd. Lecture**

An hour lecture was given at 4 primary schools in Asuncion, San Lorenzo and Capiata.

#### **9.2.2 Findings**

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

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

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

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

# ***CHAPTER 10***

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## ***RECOMMENDATIONS***



## CHAPTER 10 RECOMMENDATIONS

*This chapter describes inferences and recommendations for the 15 municipalities from both a technical and institutional standpoint.*

### 10.1 Conclusions

#### a. Technical System

##### aa. Present MSWM

##### i. Present technical system

In every aspect the present technical systems of the 14 municipalities other than Asuncion, are very weak and there are some municipalities which do not have any cleansing service. It appears to be difficult for 14 municipalities to establish a self-sustainable MSWM, especially in operating individually, as they intended, without equipment to start the operation of MSWM.

##### ii. Improvement needs

In order to maintain a beautiful and clean living environment in the Asuncion Metropolitan Area, the following technical systems are in urgent need of improvement:

- Procurement of vehicles and equipment necessary for executing the minimum level of cleansing service; and
- Establishment of an inter-municipal landfill which guarantees the disposal of MSW discharged in HUM (Asuncion and F. Mora).

##### ab. MSWM Master Plan

##### i. Goal of the MSWM Master Plan

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

## **ii. Selection of optimum technical system alternatives**

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

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

## **iii. Phased improvement**

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

### **ac. Feasibility Study**

#### **i. Site for the Proposed Transfer Station**

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

#### **ii. Project costs**

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

Table 10.1a Estimated Project Costs

unit: mill.Gs

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

### iii. Economic and financial evaluation

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

Table 10.1b Summary of EIRR and FIRR

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

### b. Institutional System

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

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

## **10.2 Recommendations**

### **a. Technical system**

#### **aa. Obtainment of basic data and its utilization**

- Basic data on the waste stream diagrams and composition of waste were obtained from the Study. It is, however, essential to execute a periodical waste amount and composition survey (WACS) and to compile basic data on daily and seasonal fluctuation of wastes in order to prepare future reviewal of the proposed Master Plan.
- An operation program was developed for the truck scale installed at the Cateura landfill in order to analyze the actual status of collection and final disposal. It is very important to acquire and analyze data on them to accomplish a more efficient collection system and a more desirable final disposal system. The experiences to be gained from the truck scale shall be effectively utilized throughout the country.

#### **ab. Collection**

- The collection service by means of curb collection with waste stands shall be extended, or commenced in some municipalities to maintain a beautiful and clean environment.
- As for collection from large producers of waste in HUM, i.e. markets, hospitals, etc., a container (about 1.0 m<sup>3</sup>) collection system by compactor trucks shall be introduced.
- For the extension and commencement of collection service, collection vehicles and equipment shall be acquired and installation of the waste stand shall be promoted especially in the residential area for the improvement of collection efficiency and maintaining environmental sanitation.

#### **ac. Transfer operation**

- Asuncion and F. Mora municipalities, which will dispose of their MSW at the Chaco-i inter-municipal landfill, shall introduce a transfer operation system to reduce waste haulage cost.
- Since the results of the Feasibility Study prove the proposed AML site is



suitable as a transfer station for MSW of the two municipalities, the Paraguayan side is requested to make every effort to acquire the land.

**ad. Street Sweeping**

- The manual sweeping system is recommended to be continued under the condition of high unemployment and poor roads. The street sweeping service shall be extended or implemented in order to cover the main street in the urban area of each municipality.

**ae. Recycling**

- For the reduction of waste generation amount and conservation of natural resources, recycling is expected to play a very important role in future MSWM. The municipal governments, therefore, shall make an effort to promote recycling activities in cooperation with the central government.
- Recycling activities by the public sector are not profitable as experienced in neighboring countries. The introduction of a recycling facility shall be carefully examined to avoid financial deadlock and conflict with the present private recycling business including a large number of scavengers.

**af. Operation and Maintenance of Equipment**

- Upon consideration of financial and technical capabilities of each municipality and transactional aspects, the proposed operation and maintenance system of vehicles and equipment for MSWM are shown below.

Use of Equipment	Work Items	Operation	Maintenance & Repair
1. Collection		Each Municipality	Asuncion for their Equipment AMUAM for the other 14 Municipalities
2. Street Sweeping		Each Municipality	Asuncion for their Equipment AMUAM for the other 14 Municipalities
3. Transfer Operation	Transfer Station Transfer Vehicles	AMUAM AMUAM	AMUAM AMUAM
4. Final Disposal	Chaco-i Unidentified Inter-municipal	AMUAM AMUAM	AMUAM AMUAM

Consequently, we recommend that the AMUAM should establish a new workshop and the Asuncion Municipality should improve and strengthen the present one.

**ag. Final disposal**

- Since it is very difficult to have a future disposal site in HUM (Asuncion and F. Mora), the immediate construction of the Chaco-i inter-municipal landfill is most desirable.
- The results of the Feasibility Study show the proposed Chaco-i location is suitable as an inter-municipal disposal site of MSW for 6 municipalities including the HUMs. The Paraguayan side is requested to make every effort to acquire the land and to establish regulations through parliament, including restrictions on the use of the surrounding land.
- As for the 9 municipalities whose optimum technical systems for MSWM master plans are "**Inter-municipal disposal at a sanitary landfill(s) 15 km away from their urban center**", they should make an effort to establish an inter-municipal cooperation system and to identify candidates sites for the inter-municipal sanitary landfill as soon as possible.
- The present open and/or controlled tipping landfill operation should be terminated and the sanitary landfill operation shall be applied to the new landfill.

**b. Institutional System**

**ba. Recommendation for each municipality**

- The 14 municipalities other than Asuncion shall establish a Department or Section, managed by a selected professional with clear duties, powers and responsibilities over the management of solid wastes in each city.
- Strong emphasis should be made on public participation in MSWM in order to make up the insufficient physical and financial resources of both the service supplier (each municipality) and service user (citizens). Each municipality is, therefore, requested to conduct public awareness programs and school educational campaigns to achieve cooperation. For this purpose, tools prepared by the Study Team, i.e. a video tape and educational pamphlets, shall be efficiently used.

**bb. Recommendation for AMUAM**

Competence and function of the AMUAM on MSWM in the Metropolitan area shall be developed. It is recommended that the AMUAM shall provide the following services for sound MSWM as the inter-municipal institution of the Metropolitan area.

- provision of the transfer and disposal operation services for the municipalities of the study area;
- provision of the maintenance services for the vehicles and equipments of the 14 municipalities other than Asuncion; and
- establishment of a training program for the officials of all the municipalities in the study area, in collaboration with SENASA, so that it can benefit other Paraguayan municipalities.

Consequently, AMUAM is requested to employ qualified managers and engineers who have a thorough knowledge of MSWM.

**bc. Legislation**

An appropriate legislation dealing with Solid Waste Management shall be prepared and issued, although the first step required presently is the approval of the Sanitary Code.

**bd. Executing bodies**

Upon consideration of the very weak financial and technical capabilities of the 14 municipalities other than Asuncion, AMUAM, as shown in Section 1.4 Key Assumptions, shall be the executing body of the First Priority Project and take the responsibility of fund raising, repayment, construction of facilities, procurement of equipment and operation of AML transfer station and inter-municipal landfills, excluding the collection and street sweeping improvement projects in Asuncion. The funds shall be repaid by the rental fee raised from leasing the vehicles for 14 municipalities other than Asuncion and tipping fees of the AML transfer station and inter-municipal landfills.

Although AMUAM is recommended to be the primary executing body for the First Priority Projects, the present capability of AMUAM appears to be insufficient. Therefore, Asuncion Municipality, which has enough experience in MSWM and is the leader of AMUAM, shall strongly support AMUAM for the execution of the

First Priority Project.

**be. Financial source**

The 14 municipalities other than Asuncion will find it difficult to pay the rental and tipping fees, which recover the whole cost of the First Priority Projects, with the revenues from collection fee. Consequently, the investment cost of the projects by AMUAM shall be subsidized by the Central Government or financed by the donation of both bilateral and multilateral aid agencies. As such, AMUAM, in cooperation with SENASA and 15 municipalities, shall make every effort to acquire such assistance in order to successfully implement the projects.

As for the replacement of equipment and expansion of facilities, the procurement and construction costs shall be covered by the internal reserves of Asuncion (collection fee) and AMUAM (rental and tipping fees).

The cost of MSWM in each municipality shall be recovered through the user fee in principal for establishing self-sustainable MSWM. Since utilities are not in the jurisdiction of municipalities in Paraguay, this situation leaves only user fees and property taxes as possible financial sources for MSWM in the hands of municipalities.

To avoid additional overhead cost and to facilitate bill collection, the user fee for solid wastes may be attached to the yearly property tax billing. In municipalities where user fees cannot be increased to cover the MSWM costs, proceeds from property taxes will have to be resorted to, at least until user charges can be increased or until the population growth permits higher revenues. AMUAM shall subsidize these municipalities with the tax on bus tickets. Regardless of the financing system, two things will be essential. First, accurate cost accounting is needed to establish and maintain a cost-effective operation. Second, the funds collected should be earmarked for capital replacement and operating expenses for MSWM.

# **CHAPTER 11**

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## **GENERAL RECOMMENDATION FOR THE IMPROVEMENT OF ISWM AND MEDICAL SWM**

## **CHAPTER 11 GENERAL RECOMMENDATION FOR THE IMPROVEMENT OF ISWM AND MEDICAL SWM**

*The chapter describes the results of the study on present industrial and medical solid waste management and general recommendations for the improvement of ISWM and medical SWM.*

### **11.1 Study on Present ISWM (Industrial Solid Waste Management)**

#### **11.1.1 Method of the Study**

##### **a. Scope of the Study**

The scope of the study is to prepare general recommendations for the improvement of the ISWM (Industrial Solid Waste Management) in the study area based on a rapid diagnosis study.

##### **b. Method of the Study**

Due to the time limitation of the study a rapid diagnosis study was carried out for one month. Therefore, one should bear in mind that there are certain limitations on the utilization of the results of the study; i.e. reliability and accuracy of the data obtained. In order to make a rapid diagnosis on the present ISWM, the following surveys were conducted:

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

## **11.1.2 Findings**

### **a. Laws and Regulations**

Environmental control on industrial waste in particular, in Paraguay, are scattered within several laws and regulations and shall be followed by guidelines and ordinances, to make it's enforcement effective .

Also, so far, there has not been any coordination defined among the different laws and regulations, at national government level or at local level (municipalities).

Since a hierarchy of laws, regulations, ordinances and guidelines regarding the environmental aspects is not established and each municipality is being made to regulate their own laws concerning industrial pollution, a coordination among the different national and municipal agencies will become more difficult in the future.

### **b. Administration and Organization**

Environmental control in Paraguay is in it's initial stage, showing a disorganized system. The laws, ordinances and guidelines concerning solid waste management, as well as environmental control on the whole are not already consolidated in a coherent body of legislation. This situation poses difficulties on the coordination of actions among the different government agencies, at various levels, to abate waste discharges into the environment.

For the new industries an approval system has already been designed. This system however may be disrupted by the new Environmental Assessment Law, which gives the Ministry of Agriculture, through the Direction of the Environmental Control, the powers to make decisions on the Impact Assessment necessary to approve each industry.

It seems, however, that SENASA will keep working on pollution and contaminants and the Direction of Environmental Control will be in charge of the natural resources, i.e. the fauna and flora.

Control for the wastes discharged by the existing industries, are made today only following complaints from neighbors to the municipality or to SENASA. These complaints are usually related to air pollution (smell or smoke), flies and other nuisances to the population.

Regular and routine controls are made by SENASA only on the selected industries known to be the heavier polluters. These are the olive oil producers, tanneries, alcohol distilleries and slaughterhouses.

The role of the provincial governors, recently elected for the first time, has not been defined so far, but they will probably also play a role concerning pollution control.

**c. Generation**

**ca. Characteristics of factories**

In Paraguay 62 % of the factories are located in the Metropolitan Area of Asuncion. In the Metropolitan Area of Asuncion 80 % of the factories are light industries and heavy industry accounts for only 20 %. Quite a large percentage of factories are using agricultural products as raw materials.

**cb. Generation**

The generation of ISWs is considered to be minimal compared with MSWs due to underdevelopment of not only heavy industries but also light ones. In addition, at present, the wastes generated in small industries are managed (collected and disposed) by municipalities. According to the incoming ISW survey at present landfill, the amount of ISW disposed of at municipal landfills are very limited except those deposited at the Cateura landfill.

**d. Collection and Haulage**

Generally in the study area, wastes from small scale factories are collected and transported to the municipal landfills by the Municipalities as MSW while wastes from large scale factories are collected and transported by private contractors or the factories by themselves.

**e. Processing and Recycling**

No processing facilities for ISW exist in the Study area while recyclable ISW is reused according to the questionnaire survey conducted by the Study Team. Construction wastes are well recycled as aggregates or materials for reclaiming low lands.



**f. Final disposal**

**fa. HUM (Asuncion and Fernando de la Mora)**

**faa. Companies approved for disposal by Asuncion Municipality.**

Only 4 companies have been granted permission for disposing of their wastes into the Cateura landfill site by the Municipality of Asuncion by paying 500,000 Gs/month, at the time of July 1993.

In addition, approximately 30 companies have been allowed to pay for disposal of wastes with their products, not money, to the Municipality of Asuncion.

**fab. Companies without approval**

**i. Small scale factories**

Wastes discharged by small scale factories are generally collected by the municipal collection service because their quantities are little.

**ii. Large scale factories**

The following measures are expected to be taken:

- Final disposal in their premises;
- Illegal dumping in public areas; and
- Illegal dumping in landfills.

**fb. UM and LUM.**

Factories in this area are expected to dispose of wastes in their own premises and illegally dump them; the former measure is deemed to be more common than the latter because most factories have large compounds.

**g. Data obtained by the Truck Scale**

**ga. Salient feature**

According to the data obtained by the truck scale at the Cateura landfill for five months from October 1, 1993 to February 28, 1994, the following salient features of ISW disposal are observed.

Table 11.1.2a ISW Disposal at Cateura Landfill (1/10/1993–28/2/1994)

Items	Units	Quantity	Remarks
Maximum Daily Disposal	ton/day	58.3	4/10/93
Average Daily Disposal	ton/day	17.8	_____
Total Disposal in 5 Months	ton	2,666	_____
Share of ISW in Total Disposal	%	3.7	Total disposal 71,213 ton
Monthly Disposal (Max.)	ton/month	785	Feb.,1994
Monthly Disposal (Min.)	ton/month	358	Dec.,1993
Biggest Amount by a Company for 5 months	ton	1,108	Curtiembre San Lorenzo S.A. (Tannery)
Number of Companies Registered	company	85	_____
Number of Vehicles Registered	units	102	_____
Total Disposal from Tannery	ton	2,172	_____
Share of Disposal from Tannery in ISW	%	81.4	_____

From Table 11.1.2a it is concluded as follows:

- Disposal amount of ISW is not very large. It accounts for only 3.7% of the total disposal.
- Main ISW was the wastes from tanneries and it is equivalent to 81.4% of the total ISW disposed of.

**gb. Survey on direct haul wastes**

According to the data obtained by the scale, the daily disposal amount of ISW seems to be very small. As the classification of ISW and MSW is not clear in the Study area, some of the ISW might be registered in the category of direct haul waste (Code No. 80). A one month survey on the contents of Code No. 80 was conducted, dividing Code No. 80 into 7 codes. The followings are findings of the survey:

- Other wastes, which is considered as municipal wastes, shares about half (46.9%). This is because normal municipal collection has limits on the amount which can be collected.
- Garden wastes came second (33.6%).
- The amount of construction waste is very small (18.3% and 4.68 ton/day) compared to other countries.
- Bulky waste disposal is almost negligible (1.3% and 0.32 ton/day).

This proves that bulky items such as TVs, cars, tables, etc., are well recycled in the Study area and that ISW is not included in the direct haul wastes except for some construction wastes.

#### **h. Illegal Dumping of ISW**

Arroyo Mburicao and Banco de San Miguel are two major illegal dumping sites and various industrial solid wastes have been dumped there.

The other illegal dumping sites are small and difficult to identify their numbers and locations.

### **11.1.3 General Recommendations**

#### **a. Necessity of Further survey**

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

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

#### **b. Laws and Regulations**

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

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

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

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

**c. Administration and Organization**

**ca. Administrative structure**

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

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

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

**cb. Plans and technology**

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

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

Furthermore the administration is required to have technical knowledge (in discharge, treatment, recycling, disposal methods, etc.), collect information and develop new techniques. The administration has to transfer technical information to enterprises and provide them with technical aid through subsidies and other schemes.

**d. Reduction at generation source and recycling**

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

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

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

**e. Generation of Waste**

**ea. Inventory system**

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

**eb. Segregation of hazardous wastes**

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

**f. Treatment and Disposal**

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

In many cases the most convenient treatment and final disposal method is secured landfill, because its cost is relatively low. The central government may be requested to construct such facilities for the sake of environmental protection if it is very difficult for the private sector to acquire land and funds for such construction.

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

**g. Supervision and advise**

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

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

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

**11.2 Study on Present Medical SWM**

**11.2.1 Method of the Study**

**a. Definition of Terms**

In this study, "Medical Solid Wastes" is defined as wastes produced in conjunction with the activities in the medical institutions.

Since non-infectious wastes are collected and disposed of at municipal landfills, the study on these wastes is done as part of MSWM. The term medical waste in this chapter refers to infectious wastes.

**b. Scope of the study**

The scope of the study is to prepare general recommendations for the improvement of Medical SWM (Infectious Wastes) in the Study area based on a rapid diagnosis study.

**c. Method of the Study**

Due to time limitations, a rapid diagnosis study was carried out for one month in August, 1993. In order to make a rapid diagnosis on present medical SWM, the following surveys were conducted:

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

## **11.2.2 Findings**

### **a. Difficulty in obtaining the medical institutions list**

It was very difficult to obtain the medical institutions list in the Study Area, because it did not exist and also there were many medical institutions discharging infectious wastes.

### **b. National policy on infectious waste management**

The basic policy, improvement of the infectious waste management expanding from Asuncion to the whole country step by step, is considered to be reasonable.

The project in accordance with this policy has started in Asuncion and Fernando de la Mora, and this project should be expanded to cover the whole Metropolitan Area.

### **c. Separate Collection**

Separate collection for infectious waste is observed to be carried out improperly due to the financial reasons of medical institutions and also lack of basic knowledge on infectious wastes even among persons working in the institutions.

### **d. Education of infectious solid waste to all medical staff.**

Education on how to deal with infectious solid waste should be given to all medical staff, including doctors, nurses, cleaners, etc., because all of them potentially handle infectious waste.

- e. **Illegal dumping of infectious waste at sites other than municipal landfill sites**

This case is not seen at present and this condition should be maintained.

### **11.2.3 General Recommendations**

- a. **Laws and Regulations**

- aa. **Guideline**

The guideline on MSWM prepared in accordance with the Sanitary Code which contains a section on medical solid waste shall be put into effect as soon as possible so to empower the government authorities to carry on their plans related to Medical Waste Management.

- ab. **Public education on segregation**

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

- ac. **Hierarchy of legislation**

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

- ad. **Coordination**

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

- ae. **Role of municipalities**

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



**af. Enforcement**

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

**b. Others**

**ba. Smooth implementation of entrustment plan**

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

**bb. Strengthening SENASA**

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

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

**bc. Review of collection fee**

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

# ***Appendix***

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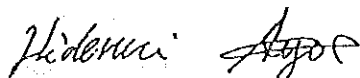
**Appendix 1: Scope of Work**

SCOPE OF WORK  
FOR  
THE STUDY  
ON  
THE SOLID WASTE MANAGEMENT  
FOR  
METROPOLITAN AREA OF ASUNCION  
IN  
THE REPUBLIC OF PARAGUAY

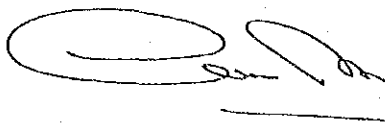
AGREED UPON BETWEEN

THE MINISTRY OF PUBLIC HEALTH AND SOCIAL WELFARE  
AND  
JAPAN INTERNATIONAL COOPERATION AGENCY

ASUNCION, 27th., JAN. 1993



DR. HIDENORI AYA  
LEADER  
PREPARATORY STUDY TEAM  
JAPAN INTERNATIONAL  
COOPERATION AGENCY



DRA. CYNTHIA PRIETO CONTI  
MINISTRA  
MINISTERIO DE SALUD PUBLICA  
Y BIENESTAR SOCIAL

## I .INTRODUCTION

In response to the request of the Government of the Republic of Paraguay (hereinafter referred to as the Government of Paraguay), the Government of Japan has decided to conduct the Study on the Solid Waste Management for Metropolitan Area of Asuncion in the Republic of Paraguay (hereinafter referred to as the "Study") in accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of Paraguay.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study, in close cooperation with the authorities concerned of the Government of Paraguay.

The present document sets forth the scope of work with regard to the Study.

## II .OBJECTIVE OF THE STUDY

The objectives of the Study are:

1. to formulate a master plan for the improvement of the Solid Waste Management (hereinafter referred to as "SWM") of the Asuncion Metropolitan Area up to the target year of 2006.
2. to conduct a feasibility study for the first priority project based on the master plan.

## III .STUDY AREA

The Study will cover the whole area under the jurisdiction of Association of Municipalities of the Asuncion Metropolitan Area.

## IV .SCOPE OF THE STUDY

In order to achieve the above objectives, the Study will cover the followings:

### 1. Basic Study

(1) Collection and review of existing data and information on:

- a. Physical conditions such as climate, topography, geology, etc.
- b. National policies and development plans related to SWM
- c. Social and economic conditions and statistics
- d. Urban development plan and land use
- e. Road traffic system

*Ague*

- f. Legislation and institutional aspects on SWM
- g. Financial condition of the Municipalities
- h. Present condition of SWM
  - Discharge
  - Collection
  - Transfer
  - Transportation
  - Treatment
  - Disposal
  - Street sweeping
  - Composting
  - Resource recovery
  - Administration
  - Institution
  - Legal aspects
  - Finance
- i. Review of on-going projects related to SWM
- j. Social and environmental impact of the solid waste problem

(2) Field survey

- a. Amount of solid waste and its composition
- b. Geology, water quality, land use in existing dumping area and future landfill sites
- c. Public consciousness on SWM
- d. Environmental survey

2. Analysis of collected data

3. Identification and analysis of the problems

4. Forecast of future amount and characteristics of solid waste

5. Formulation of the master plan on SWM

(1) Confirmation of planning framework for the formulation of the master plan

- a. Target year
- b. Planning area
- c. Service level
- d. System components

(2) Preparation of alternatives for future system components

(3) Evaluation of alternatives from the viewpoint of public health, technology, economy, society, institution and finance

(4) Conduct of initial environmental examination

(5) Selection of the best alternative and formulation of the master plan

(6) Implementation schedule of the master plan

*S*

*Age*

- (7) Identification of the priority project
6. Feasibility study on the priority project
  - (1) Confirmation of the planning framework
    - a. Target year
    - b. Planning area
    - c. Service level
    - d. System components
  - (2) Supplemental basic study
  - (3) Technical examination of system components
  - (4) Preliminary design of facilities
  - (5) Identification of necessary equipments
  - (6) Planning of operation and maintenance
  - (7) Consideration of institutional and organizational development
  - (8) Cost estimation
  - (9) Environmental impact assessment, if necessary
  - (10) Project evaluation
    - a. socio-economic aspects
    - b. financial aspects
    - c. environmental aspects
  - (11) Project implementation plan

*S*

*HPR*

## V .SCHEDULE OF THE STUDY

The Study, will be carried out in accordance with the tentative schedule attached in the ANNEX.

## VI .REPORTS

JICA will prepare and submit the following reports in ENGLISH to the Government of Paraguay.

- 1.Inception Report;  
Twenty (20) copies at the beginning of the first work in Paraguay.
- 2.Progress Report (I) ;  
Twenty (20) copies at the end of the first work in Paraguay.
- 3.Interim Report;  
Twenty (20) copies at the beginning of the second work in Paraguay.
- 4.Progress Report (II) ;  
Twenty (20) copies at the end of the second work in Paraguay.
- 5.Draft Final Report;  
Twenty (20) copies at the beginning of the third work in Paraguay.  
The Government of Paraguay will submit its comments within one (1) month after the reception of the Draft Final Report.
- 6.Final Report;  
Forty (40) copies within two (2) months after the reception of the comments on the Draft Final Report.

## VII .UNDERTAKINGS OF THE GOVERNMENT OF PARAGUAY

The Government of Paraguay shall accord privileges, immunities and other benefits to the Japanese Study Team (hereinafter referred to as "the Team") in accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of Paraguay.

1.To facilitate the smooth conduct of the Study, the Government of Paraguay shall take necessary measures:

- (1) to secure the safety of the Japanese Study Team
- (2) to permit the members of the Team to enter, leave and sojourn in Paraguay for the duration of their assignment

*J*

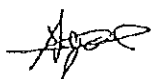
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therein, and exempt them from foreign registration requirements and consular fees;

- (3) to exempt the members of the Team from taxes, duties and other charges on equipment, machinery and other materials brought into Paraguay for the conduct of the Study;
  - (4) to exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study;
  - (5) to provide necessary facilities to the Team or remittance as well as utilization of the funds introduced into Paraguay from Japan in connection with the implementation of the Study;
  - (6) to secure permission for entry into private properties or restricted area for the conduct of the Study;
  - (7) to secure permission for the Team to take all data and documents (including photographs) related to the Study out of Paraguay to Japan;
  - (8) to provide medical services as needed. Their expenses will be chargeable on members of the Team.
2. The Government of Paraguay shall bear claims, if any arises, against the members of the Team resulting from, occurring in the course of or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.
3. The Ministry of Public Health and Social Welfare, National Service of Environmental Sanitation (hereinafter referred to as "SENASA") shall act as counterpart agency to the Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth and appropriate implementation of the Study.
4. SENASA shall, at their own expense, provide the Team with the following items, in cooperation with relevant organizations, if necessary.
- (1) available data and information related to the Study
  - (2) counterpart personnel
  - (3) suitable office space with necessary equipments and furnitures

S



(4) credential or identification cards

(5) appropriate number of vehicles with drivers


#### VI .UNDERTAKING OF JICA

For the implementation of the Study, JICA will take the following measures:

- 1.To dispatch, at its own expense, the Team to Paraguay;
- 2.To pursue technology transfer to the Paraguay counterpart personnel in the course of the Study.

#### K .CONSULTATION

JICA and SENASA shall consult each other in respect of any matter that may arise from or in connection with the Study.



TENTATIVE STUDY SCHEDULE

ANNEX

DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
WORK IN PARAGUAY																
WORK IN JAPAN																
REPORT PRESENTATION	▲ IC/R			▲ P/R (1)	▲ IT/R			▲ P/R (2)	▲ DF/R					▲ E/R		
Report	IC/R: Inception Report      IT/R: Interim Report      F/R: Final P/R : Progress Report      DF/R: Draft Final Report															

## Appendix 2: Study Organization and Persons Involved

### 2.1 Study Organization

The SENASA (Ministry of Public Health and Social Welfare, National Service of Environmental Sanitation) was the Team's counterpart agency and act as an overall coordinating body with regards to the implementation of the Study and as a direct communication body of JICA regarding general affairs. SENASA took necessary steps regarding the assignment of the Paraguayan counterpart personnel for respective fields in the Study.

The Advisory Committee, which was organized by JICA, gave necessary advice to JICA.

The Supervision Committee, which was organized by the Paraguayan side, was convened at the time of submission of Inception Report, Interim Report and Draft Final Report to make the strategic decisions related to the Study.

The study organization is shown below.

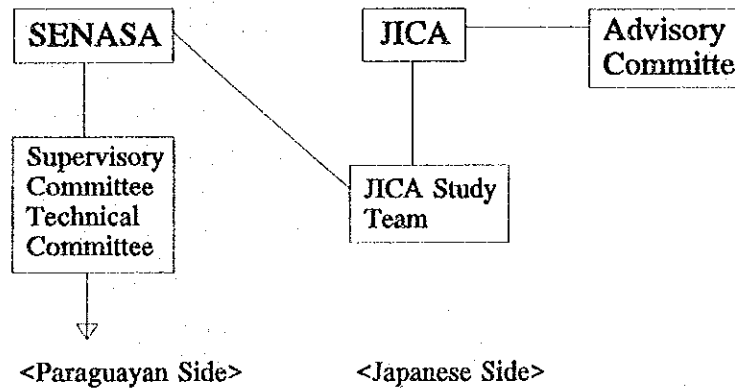


Figure: Study Organization

## 2.2

### Persons Involved

#### a. Member of Paraguayan Supervisory Committee

Dr. Andrés Vidodich	Minister, Ministry of Public Health and Social Welfare
Ing. Genaro Cristaldo Ibarra	General Director, SENASA
Ing. Sebastian G. Jara Resquín	Environmental Protection Director
Econ. Miguel Angel Aguilar	Technical Secretary, Economic Planning Agency
Ing. Vicente Capello	Engineer, IDM
Ing. Luis Ugarte	Engineer, IDM
Ing. Enrique Hugo del Valle	Chairman of AMUAM, Mayor of Nemby
Dr. Andrés Vicente Cáceres	Mayor of Luque
Lic. Benita Jara	Mayor of Capiata
Sr. Celso Cabral	Mayor of Lambare
Sr. Francisco Centurión	Mayor of Ita
Sr. Esuardo Cano Guitierrez	Mayor of Mariano Roque Alonso
Prof. Juan Alberto Rojas M.	Mayor of Villa Hayes
Ing. Optaciano Claudio Gomez	Mayor of Limpio
Dr. Manuel María Páez Monges	Mayor of Aregua
Sr. Alfredo Gill	Mayor of Benjamin Aceval
Sr. Eusebio Bareiro Benitez	Mayor of Jose Augusto Saldivar
Prof. Pedro A. Fretes C.	Mayor of Villa Elisa
Ing. Juan Alberto Migliore	Chief General Urban Bureau, Asuncion Municipality
Ing. Carlos Galarza J.	Director of Environmental Protection Dept., Asuncion Municipality
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