Chapter 7

Conclusions and Recommendations

7. Conclusions and Recommendations

7.1 Conclusions

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

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

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

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

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

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

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

7) The amount of waste, generated by the hurricane Mitch, that is to be disposed of at the existing disposal site is approximately 300,000 m^3. This is double the waste collection amount in 1999.

b. Technical System

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

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

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

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

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

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

7) The present disposal site is 31.7 hectares, of which only 12 hectares are currently used for landfilling. The construction of a new final disposal site has become an urgent need as the life span of the existing site has become shorter (until 2004) as a result of the disposal from 1998 until 1999 of waste (approximately 300,000m^3) resulting from the hurricane. The present disposal site has a favorable natural condition in terms of environmental protection and haulage of waste. The sanitary condition can easily be enhanced by improving some facilities, training staff in operation techniques, and raising awareness among the municipalities' staff and citizens. Therefore, the best option is considered to be the utilization of the existing disposal site, for as long as possible, providing the landfill operation level is improved.

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

c. Institutional System

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

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

waste fee bills are issued with the electricity statement, should be introduced, as electricity charges have a high collection rate and have more registered users.

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

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

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

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

7) Although the AMDC got huge financial damage by the hurricane Mitch, there are no visible affects in solid waste management works. This is due to that the AMDC put the priority of budget allocation to solid waste management because it is one of basic human needs. Therefore it is expected that the present well operation of solid waste works sacrifices other sectors.

d. Cost Summary of the Revised Priority Projects

The cost for the revised priority projects covers the investment from 1999 to 2002 and the O & M costs from 1999 to 2010.

Table 45: Project Cost Summary of the Revised Priority Projects

uinit: 10^3 Lps

Category	Items	1999	2000	2001	2002	2003	2004-2010
Collection & Haulage	Investment	0	40,876	0	0	0	40,876
	O & M	11,029	11,497	12,721	12,721	14,593	102,151
	Contract out	13,834	13,834	21,900	21,900	21,900	153,300
Street Sweeping	Investment	0	818	0	0	0	1,227
	O & M	2,840	2,840	3,316	3,500	3,500	28,371
	Contract out	6,730	6,730	6,730	7,104	7,104	57,579
Disposal Site	Investment	3,703	42,408	0	3,689	720	30,466
	O & M	4,982	5,222	5,605	5,685	5,693	39,852
General Expense	O & M	2,828	2,934	3,896	3,943	4,282	30,667
Total	Investment	3,703	84,102	0	3,689	720	72,570
	O & M	21,679	22,493	25,538	25,850	28,068	201,042
	Contract out	20,564	20,564	28,630	29,004	29,004	210,879
	Total	**45,946**	**127,158**	**54,168**	**58,543**	**57,792**	**484,490**

e. Project Evaluation

e.1 The SWM Revised Master Plan

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

If the waste fee system A is introduced in 2001, the FIRR will be 15.4%. Even though the waste fee rates gradually rise as in the system B, the revised master plan will be financially feasible because the FIRR will be 12.1%.

e.2 Revised Priority Projects

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

If the waste fee system A is introduced in 2001, the FIRR will be 28.3%. Even though the waste fee rates gradually rise as in the system B, the revised priority projects will be financially feasible because the FIRR will be 13.8%.

7.2 Recommendations

a. Implementation of the Revised Master Plan

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

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

b. The Improvement of the Institutional System

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

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

2) The SWM Executing Unit will efficiently carry out solid waste management works in preparation for: the establishment of the municipal cleansing corporation (MCC); the introduction of the new waste fee collection system; and the expansion of contracting out services and training staff.

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

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

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

Waste Collection Fee	Descriptions
Residential Waste Collection Fee	Three different rates according to the resident's income bracket
Business Waste Collection Fee	Ten different rates according to the sales income bracket
Large Discharger Waste Collection Fee	Based on the weight of waste discharged
Direct Haulage Fee	Based on the weight of waste received at the disposal sites

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

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

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

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

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

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

c. Improvement of Technical System

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

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

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

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

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

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

i) City center.

ii) High and middle income residential areas.

iii) Low income residential areas in the city.

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

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

i) Promotion of on-site composting.

ii) Separate collection at collection points for recycling waste.

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

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

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

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

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

Chapter 8

Proposed Medical and Industrial Waste Management Policies

8. Proposed Medical and Industrial Waste Management Policies

8.1 Medical Solid Waste Management Policies

a. Improvement of Institutional System and Formulation of Guidelines

a.1 Improvement of Institutional System

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

a.2 Formulation of Guidelines

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

b. Formulation of the Medical SWM Master Plan

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

c. Educational Programs

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

8.2 Industrial Solid Waste Management (ISWM) Policies

a. Improvement of Institutional and Administrative Systems

a.1 Improvement of Institutional System

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

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

a.2 Inventory System

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

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

a.3 Introduction of Economic Incentives

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

b. Technical Assistance

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

c. Waste Producers

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

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

Appendix

Record of Pilot Projects Implementation

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

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

1. Campaign for Raising Awareness on Solid Waste Issues

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

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

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

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

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

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

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

(1) Logo Contest to Select the Campaign Logo

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

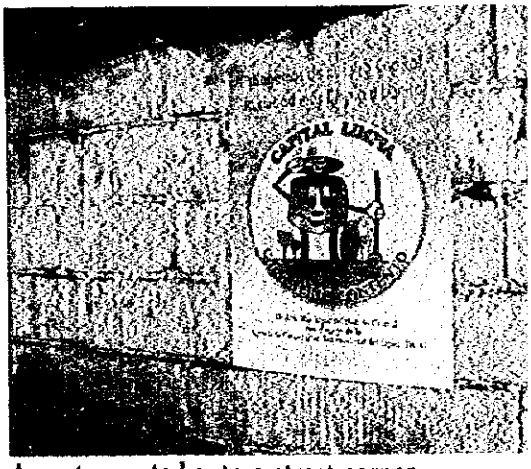
(2) Stickers bearing the campaign logo (large: 5,000, small: 10,000)

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

Students explaining the campaign to drivers a sticking the campaign stickers onto the vehicl after the driver has given them permission to

(3) Posters(3,000)

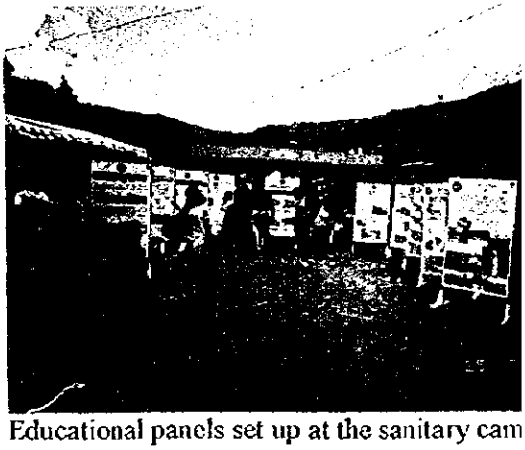
To stimulate the interest of the residents in the clean-up campaign, 3,000 posters were displayed on public facilities where they can be seen by many.



A poster pasted onto a street corner

(4) Educational Panels (10)

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



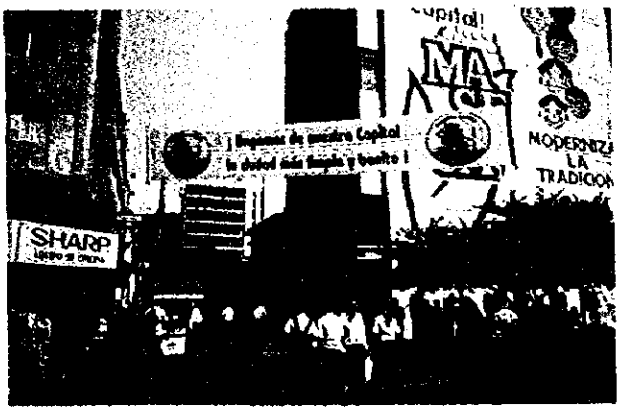
Educational panels set up at the sanitary cam site

(5) Educational Texts (10,000)

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

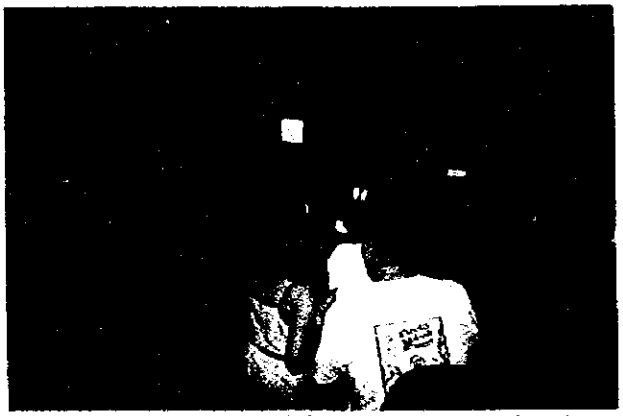
(6) Campaign Banners (30)

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



(7) Educational Video

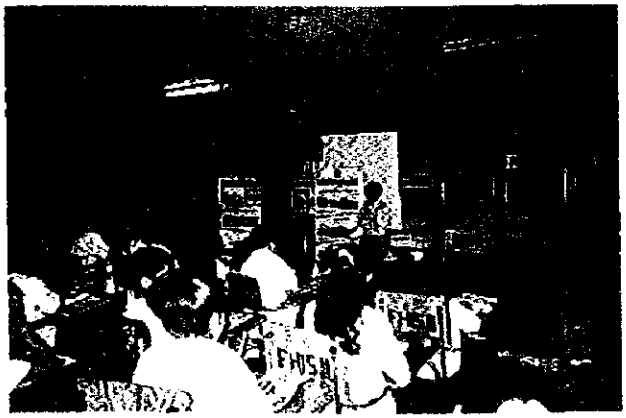
An educational video was produced; the counterpart managed the whole work, e.g., script writing, acting, shooting, etc., using JICA's video camera. Through this project, the municipal staff proved that they are capable of independently producing educational videos.



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

(8) Educational Programs on SWM

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



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

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

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

Final disposal site (Before)

Final disposal site (After)

San Martin/Ayestas area (Before)

San Martin/Ayestas area (After)

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

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

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

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

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

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

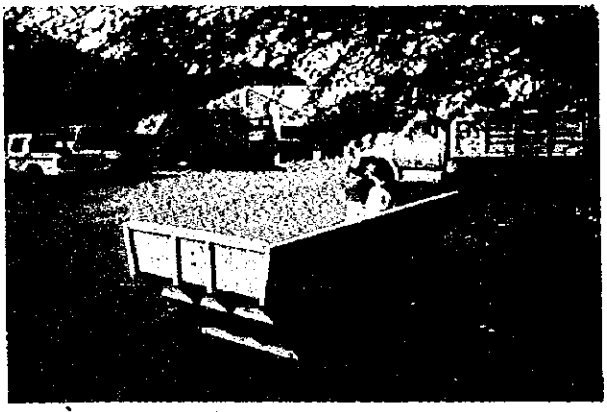
In this pilot project, public containers were installed in illegal dumpsites of the pilot project areas to urge the residents to discharge their wastes into the containers. To do so, however, it is imperative to first clear the illegal dumpsites of wastes. Nonetheless, if the removal of these wastes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

The following activities were carried out in this pilot project.

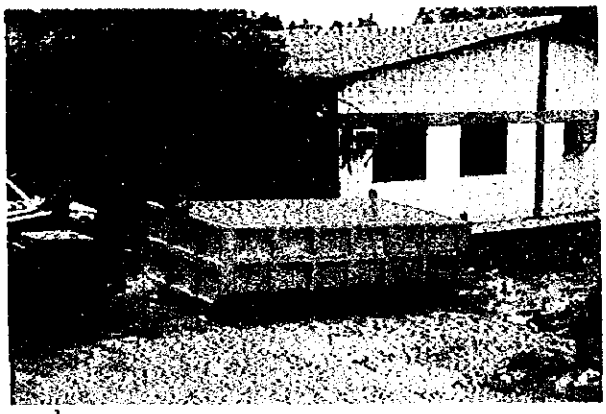
1. Manufacture of containers (three 5.5m^3 and two 10m^3)
2. Public education activities
3. Production of leaflets (to encourage public participation in clean-up operations)

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

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



5.5m^3 waste container



10m^3 waste container

(2) Public education activities

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

(3) Production of leaflets

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

(4) Clean-up Operations

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

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

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

(5) Container Collection System

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

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

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

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

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

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

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

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

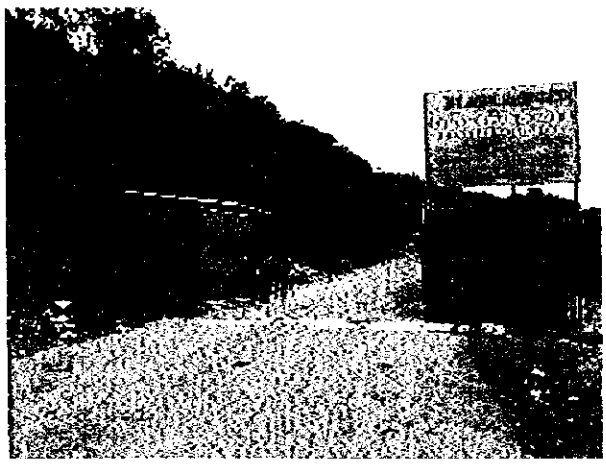
1. Facility Improvement
   a) Erection of gates, fences and construction of a guardhouse (security improvements)
   b) Pavement of approach road (improve the landscape by reducing dust and litter, and reduce the vehicle breakdowns)
   c) Installation of a net fence to prevent waste from scattering
 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

(1) Facility Improvement

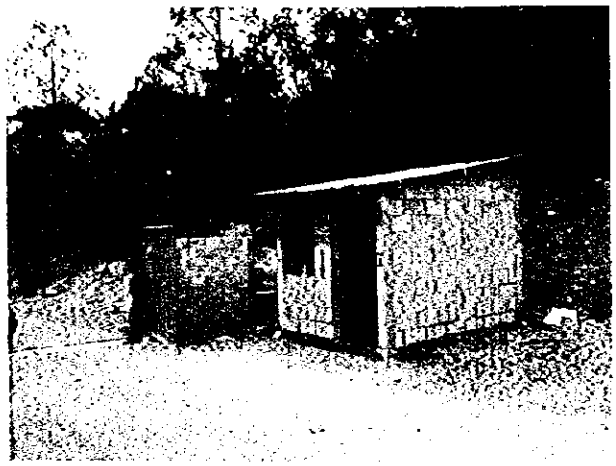
a) Erection of gates, fences, and construction of a guardhouse (improvement of security facilities)

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

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



The gate constructed at the entrance to the final disposal site



Guardhouse constructed at the site entrance

b) Pavement of Approach Road

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

Paving of the approach road

Final disposal site (Before improvement)

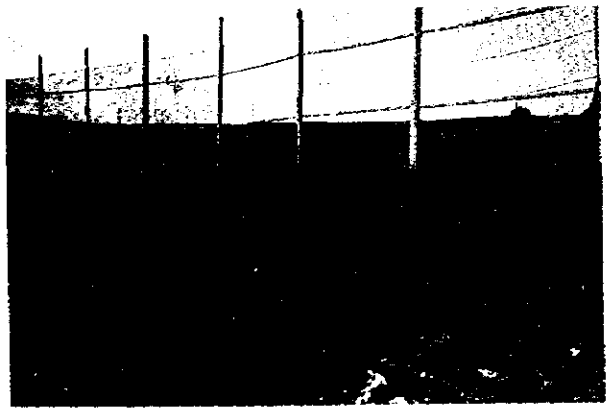
Final disposal site (After improvement)

c) Installation of a net fence to prevent waste scattering

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

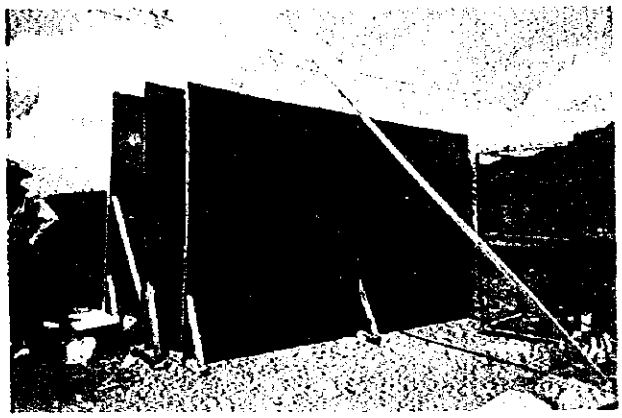
d) Construction of a slope in the section completely landfilled, and turfing or planting of shrubbery

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



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

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



(f) Installation of gas removal facilities

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

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

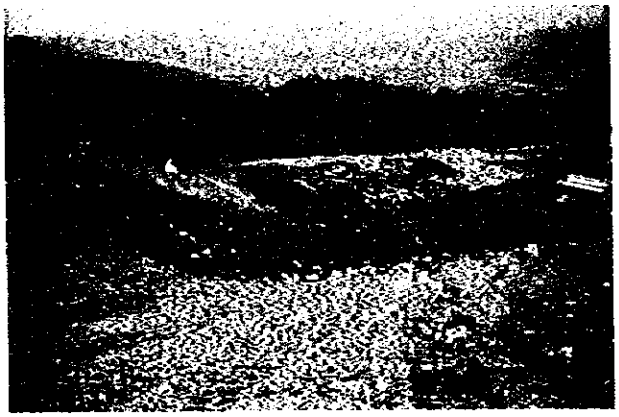
Guidance on proper landfill methods was extended on site using municipal vehicles.

Sanitary landfill training yard

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

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

Waste was immediately covered.



First sanitary landfill layer was completed.

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

(3) Improving Sanitary Conditions through Scavenger Participation

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

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

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

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

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

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

(c) Vaccinations for tetanus and hepatitis B

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

4. Improvement of the Managerial Capability of the Cleansing Department

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

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

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

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

c) Cost breakdowns

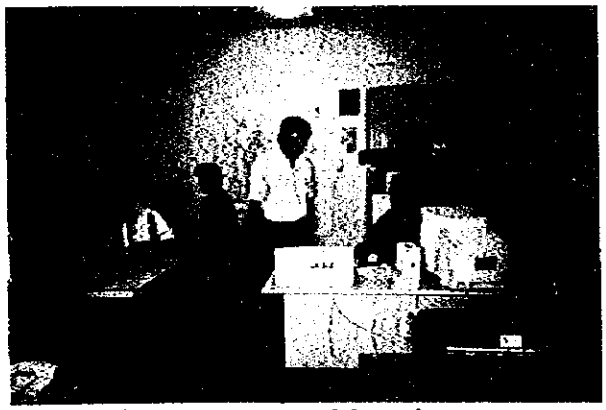
The following were implemented under this pilot project:

a) Establishment of a final disposal amount database

b) Establishment of waste collection amount database per collection vehicle

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

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



The Study Team supervising the management program operation methods.

Cleansing Department staff entering data into the computer.