

PART *IV*

Conclusions and Recommendations

Chapter 13

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13 Conclusions and Recommendations

As the title of the project suggests, the study began by formulating a regional solid waste management plan for the provinces of Adana and Icel. As a result of discussions on the IC/R by the JICA study team and the concerned agencies of Turkey, however, the target areas were restricted to the greater municipalities of Adana (Adana GM) and Mersin (Mersin GM), and the formulation of a solid waste management master plan (M/P) for each greater municipality were stipulated. Conclusions and recommendations, therefore, are made separately for each greater municipality.

13.1 Adana GM

13.1.1 Present Solid Waste Management Issues and Improvement Measures

a. Urban Solid Waste Generation Amount and Waste Flow

Based on the field investigations (WACS, POS, recycling survey) the 1999 MSW generation amount in Adana GM is about 834 ton/day, or 300 thousand ton/year. Because of unsatisfactory collection services, 1.7% (14 ton/day) of the generation amount are inappropriately handled at the generation source. The majority, however, is dumped in Sofulu (92.4%; 771 ton/day) or recycled by the Eskici and the waste pickers (5.9%; 49 ton/day).

In 2020, the M/P target year, MSW generation amount in Adana GM is predicted to be 2.8 times the present, that is 2,355 ton/day or 860 thousand ton/year. To continue the present waste management system until 2020, a sanitary landfill site with a capacity of 18.3 million cubic meters – 3.5 times the size of Sofulu (5.3 million cubic meters) as stated in the F/S – is needed for the 12.2 million ton of waste, the estimated total disposal amount by 2020. The solid waste management issues that need to be urgently addressed for Adana GM, therefore, are not only restricted to the acquisition of a future disposal site, but also include waste generation control and waste volume reduction.

b. Technical Issues and Improvement Measures

Collection and street sweeping services are firmly established in the study area with the aim to eliminate MSW from the living environment – the most important concern of urban solid waste management. Nonetheless, to preserve the environment and for a sustainable solid waste management, numerous issues, including open dumping, have to be addressed. Below are the main issues presented according to priority.

b.1 Conversion of Open Dumpsite into Sanitary Landfill

Sofulu, the only disposal site of Adana GM, is a typical dumpsite where fires break out and the untreated leachate flow into public waters, the other adverse factors, seriously affect the surrounding environment. Strong opposition from neighbours regarding the use of the disposal site makes the construction of a new disposal site an immediate concern.

The assessment of the 6 candidate disposal sites proposed by Adana GM concluded that the continued use of Sofulu would be most favourable, but this requires the rehabilitation and conversion of the site into a sanitary landfill. The municipality should, therefore, expedite whatever means to realise this by, making effective use of the results of the pilot project, executed by the municipality with the study team.

b.2 Recycling by Public Institutions

The waste composition survey results show that the waste in Adana GM predominantly constitutes kitchen waste (64.4%). The compost market survey done in May 1999 shows an extremely high demand for compost derived from waste (3.7 million ton/year).

Recycling systems are established and are very active in the private sector that are mainly run by informal entities. In total, 5.9% of the generated MSW is recycled at present. The recycling activities of public institutions are considerably limited especially since the government does not promote separate collection, which is essential for waste minimisation and for resource-recovery.

Considering recycling as an issue of priority in solid waste management, the Ministry of Environment aims to have 90% of the MSW generation amount recycled. The current private sector recycling system hardly covers kitchen waste. But to further promote the activity, the inclusion of food wastes is necessary, and to realise this the government institutions in Adana GM should actively introduce separate collection and promote composting of kitchen waste.

b.3 Improvement of Collection Service Efficiency

Collection and haulage expenses make up the bulk of the SWM expenses (the study team estimates the expenses to be over 78% in the DMs in Adana GM). The improvement of the collection and haulage system is therefore extremely important.

Based on the 1997 and the 1998 waste management expenditure records provided by each district municipality in both greater municipalities, the study team, based on a number of assumptions, estimated the collection and haulage unit cost shown in the table below.

unit: US\$/ton

DM Year	Seyhan DM	Yuregir DM	Adana Average	Yenisehir DM	Toroslar DM	Akdeniz DM	Mersin Average
1997	17.0	26.6	20.1	15.5	5.4	14.8	11.5
1998	27.3	36.0	29.8	10.6	4.5	13.0	9.4
Average	22.2	31.3	25.0	13.1	5.0	13.0	10.5

As can be seen from the table, the unit cost for collection and haulage in the two DMs of Adana GM are higher than the DMs of Mersin GM. This is attributed to the following problems in Adana, although incomparable elements such as the conditions in service areas and the roads covered by the collection route also play a part.

- Over 40% of the 122 collection vehicles in use are tractor trailers (6m³), which are considered inefficient for collection. In particular, tractor trailers make up 46 (75%) of the 61 collection vehicles in Yuregir DM.

- Compactor trucks are generally considered efficient tools for collection. However, those used have a storage capacity lower than those used in Mersin GM: only 9.7m³ as opposed to Mersin's 13.6m³.
- Wheeled containers facilitate the efficient loading of discharged waste onto compactor trucks. In contrast with Mersin, Adana GM only has a few wheeled containers. In addition, the collection system is not uniform, varying from curbside collection, communal container collection, and door to door collection.
- Waste collection in every district municipality in Mersin GM is contracted out to private firms. Conversely, the services in Adana GM are carried out directly by the respective district municipalities.

The improvement of these conditions should be gradually carried out by the district municipalities of Adana GM.

c. Institutional Issues and Improvement Measures

c.1 Unit Cost of Solid Waste Management

The waste management accounts (revenue and expenditure) of Adana GM and its 2 DMs are not handled separately from other municipal accounts, hence the following costs are not individually determined: collection and haulage, road sweeping, public area cleansing, final disposal, administrative costs. This condition hinders any possibility of determining the unit cost of every waste management process and assessing their efficiency.

Adana GM and the two DMs need to establish separate accounts for their SWM costs and revenues to provide justification for charges. They also need to demonstrate that they are recovering the full costs involved, operating cost effectively, and that any capital spending proposals involving external financing are affordable.

c.2 Performance Assessment

The performance of each cleansing service activity is hardly ever assessed because basic data is not collected (not only the unit costs but also data on service quality, collection and cleansing frequency by area, and collection and disposal amount). In particular, the absence of data on final disposal hinders any understanding that may be derived regarding the type and amount of waste being disposed of.

Performance assessment involves establishing indicators used to evaluate how effective and efficient a service is. The use of comparative data and other performance assessment results is vital to good management and decision making.

For performance assessment, every basic data relevant to the cleansing services should be collected and subject to comparative analysis. A database system should be constructed for the management of these data. Data from the WACS, the POS, the time and motion survey, the recycling system survey, compost market survey, and the medical institution survey should be used as a first step towards the construction of a database. By using the weighbridge installed in Sofulu under this study, Adana GM should classify the disposal amount by DM and waste type (industrial and medical). It is also necessary to determine whether the waste is from the GM, the DM, directly hauled or disposed of by private collection firms. These data are extremely

useful not only in determining the unit cost of the services, but also in understanding the efficiency of each system, e.g., collection and haulage.

c.3 Cleansing Tax

The cleansing tax was introduced to fund the investment and recurrent expenditure for SWM. The cleansing tax collected by the municipalities, however, is insufficient for the full provision of SWM services as shown in the table below.

unit: million TL

Items	Municipality	Seyhan DM	Yuregir DM	Adana GM	Whole Adana GM
Revenues from Cleansing Tax (A)		176,259	95,698	15,991	287,948
Expenditure (B)		1,731,384	946,747	871,027	3,549,158
Cost Covering Rate (A/B)		10.2	10.1	1.8	8.1

Note: The expenditures in the table are actual figures. Based on the revenues of the two DMs, 70 % of the collected tax is assumed to be allocated for the SWM expenses. The Adana GM revenue in the table is as provided by the GM itself.

Although separate accounting should be done for the solid waste management service expenses to accurately ascertain the costs involved, the cleansing tax should be reconsidered to cover the service expenses.

c.4 Administration and Organisation

At present the administration and organisational systems of Adana GM and its 2 DMs are neither qualitatively nor quantitatively suited to promote a sound solid waste management service. Although these three parties provide SWM services, their actions are poorly co-ordinated. Consequently, the absence of a solid waste management plan officially approved by these parties, and a common objective, make matters worse.

Adana GM and its DMs should systematically promote the services and establish a system for proper monitoring, management, and guidance. This would require not only the recruitment of capable personnel, but also the development and improvement of the capabilities of the present SWM staff (by holding training programs) as a means to acquire the required manpower. The municipalities should therefore devise a human resource training plan, with the MoE indirectly providing support in the preparation of the program and offering various opportunities, etc. Using the master plan as a basis, a rational solid waste management plan will be made for Adana GM, including the formation of a co-ordinating committee to control the functions of the institutions responsible for solid waste management services in the GM and the 2 DMs.

c.5 Privatisation and Contracting System

The Turkish government encourages the involvement of private companies in solid waste management services. This, however, is not fully promoted in the district municipalities of Seyhan and Yuregir, a factor assumed to have contributed to why the unit cost for collection and haulage in these district municipalities is higher than that of the DMs of Mersin GM. Also, legislation regarding tendering and the contracting out of private companies is not clearly devised to allow the participation of the private sector in solid waste management services.

SWM is an essential public service that must be made available to all to ensure public health and environmental preservation. This, however, requires work efficiency and regular services, and the formulation of an appropriate performance contract for private sector involvement through inter-municipal co-operation. In addition, relevant legislation should be revised, for they give priority to the lowest bidder in tendering and restrict the contract term to one year.

c.6 Public Co-operation

The residents are not aware of the various SWM problems as the current system only entails a discharge and collection method using communal containers without any form of segregation.

As promoted by the MoE, waste volume reduction and resource-recovery are issues that have to be raised to improve the current SWM system. Aside from formulating relevant legislation and constructing the required facilities, solving of these issues would require the co-operation of the public the most. The type of public co-operation required, however, is one that is long-lived and steady. Consequently, much is expected from the resident education and information programs. The pilot project done in Mersin was the first step toward gaining public co-operation, and experiences gained should be used to promote education programs for the public to realise waste volume reduction and resource-recovery.

d. Present Medical Solid Waste Management Issues and Improvement Measures

The survey on medical institutions showed that the amount of medical waste (refers only to infectious waste) generated in Adana GM in 1999 is 4.4 ton/day, or 1,600 ton/year.

Although separation at source is carried out in general, some medical wastes from medical institutions were mixed with general wastes at the discharge point. Although Yuregir DM has no vehicles especially designated for medical waste collection, such waste type is separately collected from general wastes in Adana GM. During workshop 3 conducted in Ankara, it was reported that Yuregir DM also has own and started the operation of a medical waste collection vehicle. The most significant problem, however, is that medical waste is disposed of along with general wastes in the open dumpsite.

Unlike general wastes, the inappropriate handling of medical waste would reap extremely devastating represents. It is, therefore, imperative that those responsible for medical waste handling urgently deal with this issue, particularly that which concerns final disposal. As temporary measures, a separate place should be designated for the disposal of medical waste and soil covering should be carried out on the same day. The construction of a disposal site exclusively for medical waste should be promoted simultaneously as well.

The adoption of such improvement measures would incur additional service expenses. Legally, medical institutions should shoulder all expenses for the handling of medical waste, that is from collection to disposal. A study should be carried out therefore as to the manner in which medical institutions should cover the increase in the expenses.

e. **Hazardous Waste Management Issues and Improvement Measures**

Legally, the operation of the treatment and disposal facilities for hazardous waste is the responsibility of the GM. There is, however, not even one such facility in Adana GM, and nationally there are only 2 hazardous waste disposal sites and 1 incineration facility.

Facilities for the exclusive treatment and disposal of hazardous wastes should be urgently constructed not for Adana GM alone but for the region of Cukurova. Until such facilities are operated, it is recommended that the authorities practice the following measures in the management of hazardous wastes.

- Oblige industries to minimise hazardous waste generation and to handle and store waste within their premises. Oblige transport and disposal of waste to Izmit or Izmir.
- Investigate the use of existing facilities for treatment of hazardous wastes (incineration in kilns of cement factories, etc.). Oblige industries to treat such waste type prior to discharge, and to store or their premises those that cannot be treated in the existing facilities.
- Establish a strict monitoring system for incoming haulage vehicles to prevent the disposal of hazardous waste along with general waste at the municipal disposal site. For industries categorised as highly potential hazardous industrial waste generators, only when the industries prove that their waste is not hazardous will they be entitled to dispose waste at the municipal disposal site.

13.1.2 SWM Master Plan

a. **Master Plan**

The principal goal of the SWM master plan is “to create a *closed loop society* on solid waste in Adana Greater Municipality by the target year 2020” through the following:

- Control waste generation as much as possible (waste minimisation)
- Recycle generated waste as much as possible (recycling)
- Safely dispose wastes that cannot be recycled in an environmentally friendly manner (waste stabilisation)

To attain these, the master plan specifically aims to:

- Promote recycling at source by the establishment of a separate collection system
- Treat all (100%) compostable and non-compostable waste that will be collected separately by taking the former to the compost plant and the latter to the sorting plant for recycling.
- Dispose of waste residue from the composting and sorting plant in the sanitary landfill site.

If the goals of the M/P are realised, the waste flow in 2020 is estimated as follows.

unit: ton/day (% = ratio to generation amount)

Items Year	Generation	Discharge	Improper Disposal at Generation	Compost Plant	Sorting Plant	Final Disposal	Recycling
1999	834 (100)	803(96)	14 (2)	0 (0)	0 (0)	771 (92)	49 (6)
2020	2,355 (100)	2,308(98)	0 (0)	1,039 (44)	1,269 (54)	1,006 (43)	549 (23)

As shown in the table, the forecast generation amount in 2020 is 2.8 times the present amount. Even if 100% of the discharge amount is treated, the final disposal amount will be only 1.3 times the present disposal amount. As in industrialised nations, therefore, the following measures should be adopted if the acquisition of a disposal site proves difficult.

- Increase the efficiency of composting and sorting plants, and reduce the amount of residue by eliminating impurities, e.g., plastics, in compostable wastes and further breaking down non-compostable wastes.
- Construct an RDF plant for the recycling of waste residue from the sorting plant.
- Promote generation control measures and recycling at source. Establish an administration system that promotes the production of recyclable goods/products from the manufacturing stage in order to minimise waste generation as much as possible.

b. M/P Implementation

The M/P is feasible by increasing the current handling cost by 3.7 times the 1998 SWM expenditure. Adana GM and the district municipalities of Seyhan and Yuregir should, therefore, adopt the strategies pointed out in this report, and request the co-operation of the central government to successfully implement the M/P.

The implementation of the M/P would inevitably require the planned acquisition of a site for the solid waste treatment and disposal facilities. However, site acquisition becomes increasingly difficult as more and more residents identify with the NIMBY syndrome. The table below shows the plans in the M/P for site acquisition.

Final disposal site	Acquire approval (approval of EIA) for the continued use of Sofulu by June 2000. For the new disposal site after the closure of Sofulu, site selection, F/S implementation, and EIA approval should all be finalised by June 2008.
Transfer station	In case of a distant new disposal site (over 250km from city centre), the site for the transfer station, the F/S, and EIA approval should all be finalised by June 2008.
Intermediate treatment facility	Since this will be located next to the final disposal site, site acquisition should be carried out in together with the acquisition of the disposal site.
Medical waste disposal site	Since this will be constructed within the final disposal site, site acquisition should be carried out in together with the acquisition of the disposal site.

Gaining the consensus of the residents in the surrounding area is the most vital factor regarding the acquisition of a site for the SWM treatment and disposal facilities. It is, therefore, important to conduct the site selection process in a manner transparent to the public. Changing the impression of the residents with regard to the present

disposal site in Sofulu is also important, making the conversion of the disposal site into a sanitary landfill site a matter of considerable urgency.

13.1.3 Feasibility Study (F/S) for Priority Projects

a. Selection and Planning of Priority Projects

Using the M/P as a basis, and based on discussions with the counterparts, the following were selected as priority projects and a feasibility study was carried out. The outline is as follows.

Unit: US\$ 1,000

Category	Contents of Projects	Investment (2000 - 2001)	Investment (2002 - 2005)
Municipal SWM	Introduction of Separate Collection System	1,796	1,488
	Construction of a Sorting Plant (55,000 ton/year)	3,693	0
	Construction of a Compost Plant (75,000 ton/year)	6,778	0
	Construction of a Municipal SW Disposal Site	12,481	13,676
	Sub-total	24,748	15,614
Medical SWM	Construction of a Medical SW Disposal Site	1,313	0
Detailed Design and Supervision		1,619	191
Total		27,680	15,355

b. Priority Project Evaluation

The priority projects were evaluated from a technical, social, environmental, financial, and economic view.

As a result of the financial evaluation if the following requirements are satisfied, the implementation of the priority projects will be financially feasible because the FIRR is slightly over the cut-off rate at 8.1 %.

- The tax collection rate will be increased to 90 % in 2002.
- Number of cleansing tax payers for waste generated by households will increase in proportion to the population and for enterprises to the GRDP.
- Raise the cleansing tax fee to 1.8 times the 1998 rate in real terms in 2003.
- Double the cleansing tax rate in 2005 (i.e., 3.6 times the 1998 rate in total), aiming to provide 50% of the SWM cost (inclusive of depreciation cost).
- Raise the SWM budget allocation rate from the general financial sources (exclusive of cleansing tax) 1.15 times the 1998 rate in 2003.
- Acquire a central government subsidy equivalent to 20 % of the investment for 2000 and 2001.

The economic evaluation concludes if the benefits from resource recovery (which contributes to the global environmental conservation) are evaluated at 1.2 times the market price, the EIRR would be calculated as 10 %, which over the cut-off rate 8 %. In addition to the qualitative benefits, there are considerable qualitative benefits.

The results of the overall priority project evaluation conclude the projects as feasible from a technical, social, environmental, financial, and economical stand.

c. Environmental Impact Assessment (EIA) Conclusions

Based on the results of discussions held with the MoE the EIA for Sofulu Site Development Plan was carried out, i.e., the construction of the final disposal site, compost plant, and sorting plant, to determine the impacts of the project on the following:

economic activities, public health, hazards/risks, topographic and geological conditions, groundwater resource conditions, hydrological conditions, fauna and flora, landscape/aesthetics, air pollution, water pollution, soil contamination, noise and vibration, offensive odour.

The EIA concluded that the plan will bring about various positive and negative impacts. The adverse impacts may be reduced through the various countermeasures that are taken at the time of the implementation. Accordingly, it has been concluded that a permissible limit can be maintained by preparing suitable countermeasures based on the results of the EIA.

d. Priority Project Implementation

As the first step toward the realisation of the M/P, the study team recommends the implementation of a priority project to the Turkish side with due consideration of the following:

- To gain approval on the EIA report, the nature and objectives of the project should be immediately explained to the residents to obtain resident consensus. In order to gain resident consensus the Sofulu dumpsite should immediately be converted to a sanitary landfill.
- The modification of the cleansing tax system and introduction of a disposal fee should be considered to secure independent funds. Nonetheless, a considerable amount of external funding is required to cover the capital required. For external funding, studies on the use of facility construction subsidies (environmental fund) and domestic and foreign soft loans should be given priority.
- The success of the separate collection system which will be simultaneously introduced with composting and sorting, will significantly influence the success of the composting and sorting plants. The success of the separate collection system relies on the degree of public co-operation, making the implementation of relevant, long term public education programs extremely important. Effectively using the experiences gained from the pilot project in Mersin, educational methods suited to the conditions in Adana GM should be developed and considerable efforts invested to gain the co-operation of the residents.
- The medical waste generation amount is comparatively less than MSW, and the medical waste haulage expenses only make up a small portion of the expenses for the adequate treatment of medical wastes. The construction of a medical waste disposal site in accordance with the MoE standards would require a huge amount of capital. Therefore, an inter-municipal disposal system should be

established whereby other municipalities (e.g., Karatas, Seyhan, etc.) in Adana Province are allowed to dispose of their medical wastes into the medical waste disposal site to be constructed in Sofulu.

e. Outline of the Alternative Plan

During the meeting on the draft final report, (DR/R) the Turkish counterpart requested the examination of an alternative plan to reduce the project costs of the priority projects. Although the laws concerning disposal sites do not acknowledge the contents of the alternative plan, the following alternative plans will reduce project costs; from a view of environmental protection the problems will be negligible, and therefore the team recommends them.

Municipal Solid Waste Disposal Site:

Sofulu disposal site has operated for 10 years without an impermeable bottom structure. On the bottom surface of the disposal area, there is an impermeable stratum 2 to 6m from the top soil. Therefore, instead of constructing an impermeable bottom structure, sheet piles shall be inserted into the bottom of the valley up to the natural, impermeable strata so that they act as a leachate preventing structure to obstruct the flow of leachate downstream.

The adoption of this measure would reduce the construction costs of the municipal waste landfill site by 42.6%.

Medical Waste Disposal Site:

There is over 3m of impermeable strata that lies 2 to 3 m from the surface of the disposal area's top soil. The base of the landfill shall be furnished with an impermeable structure without an HDPE liner. If the impermeable structure of the slope is constructed according to the law, i.e., "clay layer + HDPE", the slope's gradient would have to be reduced, thus increasing the area of the impermeable structure. The impermeable layer of the slope shall be change from the legally stipulated "clay layer + HDPE" to "mortar + HDPE".

The adoption of this measure would reduce the construction costs of the medical waste landfill site by 49.4%.

Further, the C/P's comments on the DF/R included a regional medical waste incineration plant; the following is an outline from the main report.

- Because no land has been secured for the incineration plant, the transregional medical waste incineration plant for Adana and Icel will be located part way between the two provinces.
- Specifically, a rough estimate of the costs for construction, operation, and management costs, and the advantages and disadvantages of the plant are presented.

13.2 Mersin GM

13.2.1 Present Solid Waste Management Issues and Waste Flow

a. Urban Solid Waste Generation Amount and Waste Flow

The 1998 MSW generation amount in Mersin GM is about 446 ton/day, or 16.3 million ton/year. Because of unsatisfactory collection services, 3.1% (14 ton/day) are inappropriately handled at the generation source, while the majority is taken to the compost plant disposal site for disposal (84.1%: 75 ton/day) or treatment (9.0%: 40 ton/day). The amount of waste recycled including those recycled at the compost plant, is 10.6% (47.4 ton/day).

In 2020, the M/P target year, the MSW generation amount in Mersin GM is predicted to triple the present amount, that is 1,350 ton/day or 493 thousand ton/year. To continue the present waste management system until 2020, a sanitary landfill site with a capacity of 10.02 million cubic meters – 9 times the size of the disposal site to be constructed in Cimsa (1.16 million cubic meters), as stated in the FS – is needed for the 6.68 million ton of waste, the estimated total disposal amount from 1999 to 2020. The solid waste management issues that need to be urgently addressed for Mersin GM, therefore, are not only restricted to the acquisition of a future disposal site, but also include waste generation control and waste volume reduction.

b. Technical Issues and Improvement Measures

Collection and street sweeping services are firmly established in the study area with the aim to eliminate MSW from the living environment – the most important concern of urban solid waste management. Nonetheless, to preserve the environment and for a sustainable solid waste management, numerous issues, including inappropriate final disposal, have to be addressed. Below are the main issues presented according to priority.

b.1 Conversion of Dumpsite into Sanitary Landfill

The compost plant dumpsite is the only disposal site in Mersin GM. Urban sprawl area has extended to several hundreds meters from the plant thereby affecting the dumpsite. Because of infrequent covering of waste and insufficient environmental countermeasures, fires break out, and the untreated leachate flow into public waters; the other adverse impacts seriously affect the surrounding environment. Neighbours frequently complain about these unfavourable conditions, and therefore strongly oppose the use of the site. A new site should be constructed immediately to close the present disposal site, which is nearly full.

Based on the assessment of the 5 candidate disposal sites proposed by Mersin GM, the study team recommends the construction of a sanitary landfill in the CIMSA site. This recommendation was approved in October 1998 by the Turkish steering committee of this study. With official approval, the JICA Study Team carried out an F/S on the CIMSA site from February 1999. Based on the results of the F/S stipulated in this report, therefore, Mersin GM should construct a sanitary landfill in the CIMSA site in order to rehabilitate the area, and to close the compost plant disposal site immediately.

b.2 Recycling of Organic Waste

The waste composition survey shows that the waste in Mersin GM mainly contains kitchen waste (63.0%). The compost market survey in May 1999 revealed an extremely high demand for compost derived from waste (1.26 million ton/year) in the province of Icel.

The compost plant in Mersin GM opened in 1985 and uses organic waste for composting. The compost produced by the plant does not meet the quality demanded by the farmers, as it contains a lot of impurities, e.g., plastic, glass, etc. Therefore, the demand is seen to decrease annually. In terms of volume, the plant only treated 40 ton/day in 1998, as opposed to the nominal capacity of 128 ton/day. These problems are due to antiquated facilities and the absence of a separate collection system.

Recycling systems are established and are very active in the private sector that are mainly run by informal entities. In total, 10.6% of the generated MSW are recycled at present in addition to the recycling rate (4.6%) at the compost plant.

Considering recycling as an issue of priority, the Ministry of Environment aims to have 90% of the MSW generation amount recycled. Recycling is not satisfactorily carried out in the current system, with only 10.6% (47.4 ton/day) of the collected waste recycled. To further promote recycling activities, the government institutions in Mersin GM should actively introduce separate collection and promote composting of kitchen waste.

b.3 Improvement of Collection Service Efficiency

In general, collection and haulage expenses make up the bulk of the SWM expenses (over 70%). Based on the 1998 waste management expenditure records provided by each district municipality, the study team, based on various assumptions, estimated the collection and haulage unit cost as extremely low, averaging 43%. This is probably because the depreciation cost of the municipal collection vehicles lent to the private company are excluded, and the inclusion of collection and haulage expenses in the public area cleansing expenses.

The district municipalities in Mersin GM should determine the collection and haulage unit cost as soon as possible to improve collection and haulage service efficiency, which extremely important. Although wheeled containers are more popular in Mersin GM than in Adana GM, they should be used all over the city to improve collection efficiency.

As the counterpart did not propose any site for the transfer station, an F/S on the introduction of a transfer station system was not carried out. A transfer station is deemed necessary, however, if the final disposal site (CIMSA) is developed 20km from the city centre. Accordingly, Mersin GM should immediately select a site for the transfer station in co-operation with its 3 district municipalities, and should carry out the F/S on the implementation of the system.

c. Institutional Issues and Improvement Measures

c.1 Unit Cost of Solid Waste Management

The waste management accounts (revenue and expenditure) of Mersin GM and its district municipalities are not handled separately from other municipal accounts,

hence the following are not individually determined: collection and haulage, road sweeping, public area cleansing, final disposal, administrative costs. This condition hinders any possibility of determining the unit cost of every waste process and assessing their efficiency.

Mersin GM and its three DMs need to establish separate accounts for their SWM costs and revenues to provide justification for charges. They also need to demonstrate that they are recovering the full costs involved, operating cost effectively, and that any capital spending proposals involving external financing are affordable.

c.2 Performance Assessment

The performance of each cleansing service activity is hardly ever assessed because basic data is not collected (not only the unit costs but also data on service quality collection and cleansing frequency by area, etc. and collection and disposal amount). In particular, the absence of data hinders any understanding that may be derived regarding the type and amount of waste being disposed of.

Performance assessment involves establishing indicators used to evaluate how effective and efficient a service is. The use of comparative data and other performance assessment results is vital to good management and decision making.

For performance assessment, every basic data relevant to the cleansing services should be collected and subject to comparative analysis. A database system should be constructed for the management of these data. Data from the WACS, the POS, the time and motion survey, the recycling system survey, the compost market survey, and the medical institution surveys, should be used as a first step toward the construction of a database. By using the weighbridge at the compost plant disposal site, Mersin GM should classify the disposal amount by DM and by waste type (industrial and medical). It is also necessary to determine whether the waste is from the GM, the DM, directly hauled or disposed of by private collection firms. These data are extremely useful not only in determining the unit cost of the services, but also in understanding the efficiency of each system, e.g., collection and haulage.

c.3 Cleansing Tax

The cleansing tax was introduced to fund the investment and recurrent expenditure for SWM. The cleansing tax collected by the municipalities, however, is insufficient for the full provision of SWM services as shown in the following table.

unit: million TL

Items	Municipality	Yenisehir DM	Toroslar DM	Akdeniz DM	Mersin GM	Whole Mersin GM
Revenues from Cleansing Tax (A)		62,458	53,691	117,107	54,273	287,529
Expenditure (B)		178,175	177,816	497,289	367,278	379,278
Cost Covering Rate (A/B)		35.1	30.2	23.5	15.9	14.3

Note: The expenditure in the table is actual figure but the revenues of the three DMs are assumed that 70 % of the collected tax is allocated to SWM for each DM. The revenue of Mersin GM is the actual figure provided by the GM.

Although separate accounting should be done for the solid waste management service expenses to accurately ascertain the costs involved, the cleansing tax should be reconsidered to cover the service expenses.

c.4 Administration and Organisation

At present the administration and organisational systems of Mersin GM and its 3 DMs are neither qualitatively, nor quantitatively, suited to promote a sound solid waste management service. Although these four parties provide services, their actions are poorly co-ordinated. Consequently, the absence of a solid waste management plan officially approved by these parties, and a common objective make matters worse.

Mersin GM and its DMs should systematically promote the services and establish a system for proper monitoring, management, and guidance. This would require not only the recruitment of capable personnel, but also the development and improvement of the capabilities of the present SWM staff (by holding training programs) as a means to acquire the required manpower. The municipalities should therefore devise a human resource training plan, with the MoE indirectly providing support in the preparation of the program and offering various opportunities, etc. Using the master plan as a basis, a rational solid waste management plan should be made for Mersin GM, including the formation of a waste co-ordinating committee to control the functions of the institutions responsible for solid waste management services in the GM and the 3 DMs.

c.5 Privatisation and Contracting System

Some of the cleansing services in Mersin GM and its 3 DMs are contracted out to private companies. The Turkish government encourages the involvement of private companies in solid waste management services. However, legislation regarding tendering and the contracting out of private companies is not clearly devised to allow the participation of the private sector in solid waste management services.

SWM is an essential public service that must be made available to all to ensure public health and environmental preservation. This, however, requires work efficiency and regular services, and the formulation of an appropriate performance contract for private sector involvement through inter-municipal co-operation. In addition, relevant legislation should be revised, for they give priority to the lowest bidder in tendering and restrict the contract term to one year.

c.6 Public Co-operation

The residents are not aware of the various SWM problems as the current system only has a discharge and collection system using communal containers without any form of segregation.

As promoted by the MoE, waste volume reduction and resource-recovery are issues that have to be raised to improve the current SWM system. Aside from formulating relevant legislation and constructing the required facilities, solving of these issues would require the co-operation of the public the most. The type of public co-operation required, however, is one that is long-lived and steady. Consequently, much is expected from the resident education and information programs. The pilot project done in Mersin was the first step toward gaining public co-operation, and experiences gained should be used to promote education programs for the public to realise waste volume reduction and resource-recovery.

d. Present Medical Solid Waste Management Issues and Improvement Measures

The survey on medical institutions showed that the amount of medical waste (only refers to infectious waste) generated in Mersin GM in 1999 is about 1.6 ton/day, or 584 ton/year.

Medical waste, from segregation at source to disposal in the compost plant disposal site, is separated from general waste. However, since waste is deposited in trenches dug in a section of the compost plant windrow area, contamination from leachate from the medical waste is feared, although daily soil cover is applied after disposal. The adoption of such method may be inevitable considering the absence of a medical disposal site. On the other hand, this condition only stress the importance of the immediate construction of a medical waste disposal site.

The construction of a medical waste disposal site would incur additional expenses. Legally, medical institutions should shoulder all expenses for the handling of medical wastes, that is from collection to disposal. A study should be carried out, therefore, as to the manner in which medical institutions should cover the increase in the expenses.

e. Hazardous Waste Management Issues and Improvement Measures

Legally, the operation of the treatment and disposal facilities for hazardous waste is the responsibility of the GM. There is, however, not even one such facility in Mersin GM, and nationally there are only 2 hazardous waste disposal sites and 1 incineration facility.

Facilities for the exclusive treatment and disposal of hazardous wastes should be urgently constructed not for Mersin GM alone but for the region of Cukurova. Until such facilities are operated, it is recommended that the authorities should practice the following measures in the management of hazardous wastes.

- Oblige industries to minimise hazardous waste generation and to handle and store waste within their premises. Oblige transport and disposal of waste to Izmir or Izmit.
- Investigate the use of existing facilities for treatment of hazardous wastes (incineration in kilns of cement factories, etc.). Oblige industries to treat such waste type prior to discharge, and to store on their premises those that cannot be treated in the existing facilities.
- Establish a strict monitoring system for incoming haulage vehicles to prevent the disposal of hazardous waste along with general waste at the municipal disposal site. For industries categorised as highly potential hazardous industrial waste generators, only when the industries prove their waste is not hazardous will they be entitled to dispose waste at the municipal disposal site.

13.2.2 SWM Master Plan

a. Master Plan

The principal goal of the SWM master plan is “to create a *closed loop society* on solid waste in Mersin Greater Municipality by the target year 2020” through the following:

- Control waste generation as much as possible (waste minimisation)
- Recycle generated waste as much as possible (recycling)
- Safely dispose wastes that cannot be recycled in an environmentally friendly manner (waste stabilisation)

To attain these, the master plan specifically aims to:

- Promote recycling at source by the establishment of a separate collection system
- Treat all (100%) compostable and non-compostable waste that will be collected separately by taking the former to the compost plant and the latter to the sorting plant for recycling.
- Dispose of waste residue from the composting and sorting plant in the sanitary landfill site.

If the goals of the M/P are realised, the waste flow in 2020 is estimated as follows.

Unit: ton/day, (% = ratio to generation amount)

Items Year	Generation	Discharge	Improper Disposal at Generation	Compost Plant	Sorting Plant	Final Disposal	Recycling
1998	446 (100)	425 (95)	14 (3)	40 (9)	0 (0)	375 (84)	47 (11)
2020	1,350 (100)	1,321(98)	0 (0)	550 (41)	766 (57)	604 (45)	319 (24)

As shown in the table, the forecast generation amount in 2020 is triple the present amount. Even if 100% of the discharge amount is treated the final disposal amount will be only 1.6 times the present disposal amount. As in industrialised nations, therefore, the following measures should be adopted if the acquisition of a disposal site proves difficult.

- Increase the efficiency of composting and sorting plants and reduce the amount of residue by eliminating impurities, e.g., plastics, in compostable wastes and further breaking down non-compostable waste.
- Construct an RDF plant for the recycling of waste residue from the sorting plant.
- Promote generation control measures and recycling at source. Establish an administration system that promotes the production of recyclable goods/products from the manufacturing stage in order to as much as possible minimise waste generation.

b. M/P Implementation

The M/P is feasible by increasing the current handling cost by 7.3 times the 1998 SWM expenditure. Mersin GM and the district municipalities of Yenisehir, Toroslar, and Akdeniz should, therefore, adopt the strategies pointed out in this report, and request the co-operation of the central government to successfully implement the M/P.

The implementation of the M/P would inevitably require the planned acquisition of a site for the solid waste treatment and disposal facilities. However, site acquisition becomes increasingly difficult as more and more residents identify with the NIMBY syndrome. The table below shows the plans in the M/P for site acquisition.

Final disposal site	Acquire approval (approval of EIA) for the construction of a disposal site at CIMSA site by June 2000. For the new disposal site after the closure of the disposal site at CIMSA site, site selection, F/S implementation, and EIA approval should all be finalised by June 2004.
Transfer station	Select the site for the transfer station and conduct the F/S by June 2000. If the construction of the transfer station is proven feasible, EIA approval should be obtained and the station should be constructed in time for the scheduled opening in January 2002.
Intermediate treatment facility	Since this will be located next to the final disposal site, site acquisition should be carried out together with the acquisition of the disposal site. The facilities will be constructed at the new disposal site in 2016.
Medical waste disposal site	Since this will be constructed within the final disposal site, site acquisition should be carried out together with the acquisition of the disposal site. The facility will be constructed at the new disposal site in 2020.

Gaining the consensus of the residents in the surrounding area is the most vital factor regarding the acquisition of a site for the SWM treatment and disposal facilities. It is, therefore, important to conduct the site selection process in a manner transparent to the public. Changing the impression of the residents with regard to the present compost plant disposal site is also important, making the conversion of the disposal site into a sanitary landfill site a matter of considerably urgency.

13.2.3 Feasibility Study (F/S) for Priority Projects

a. Selection and Planning of Priority Projects

Using the M/P as a basis and based on discussions with the counterparts, the following were selected as priority projects and a feasibility study was carried out. The outline is as follows.

Unit: US\$ 1,000			
Category	Contents of Projects	Investment (2000 - 2001)	Investment (2002 - 2005)
Municipal SWM	Introduction of Separate Collection System	1,349	1,028
	Construction of a Sorting Plant (32,500 ton/day)	2,629	0
	Construction of a Compost Plant (40,000 ton/day)	4,877	0
	Construction of a Municipal SW Disposal Site	6,442	9,353
	Sub-total		15,297
Medical SWM	Construction of a Medical SW Disposal Site	2,210	0
Detailed Design and Supervision		813	130
Total		18,320	10,511

b. Priority Project Evaluation

The priority projects were evaluated from a technical, social, environmental, financial, and economic view.

As a result of the financial evaluation if the following requirements are satisfied, the implementation of the priority projects will be financially feasible because the FIRR is slightly over the cut-off rate at 8.3 %.

- The tax collection rate will be increased to 90 % in 2002.
- Number of cleansing tax payers for waste generated by households will increase in proportion to the population and for enterprises to the GRDP.
- Raise the cleansing tax fee 1.8 times the 1998 rate in real terms in 2002.
- Double the cleansing tax rate in 2005 (i.e., 3.6 times the 1998 rate in total), aiming to provide 67 % of the SWM cost (inclusive of depreciation cost).
- Raise the SWM budget allocation rate from the general financial sources (exclusive of cleansing tax) 1.6 times the 1998 rate in 2003.
- Acquire a central government subsidy equivalent to 50 % of the investment for 2000 and 2001.

The economic evaluation concludes if the benefits from resource recovery (which contributes to the global environmental conservation) are evaluated at 7 times the market price, the EIRR would be calculated as 15 %, which over the cut-off rate 8 %. In addition to the qualitative benefits, there are considerable qualitative benefits.

The results of the overall priority project evaluation conclude the projects as feasible from the technical, social, environmental, financial, and economical stand.

c. Environmental Impact Assessment (EIA) Conclusions

Based on the results of discussions held with the MoE, the EIA for Cimsa Site Development Plan, was carried out, i.e., the construction of a final disposal site, compost plant, and sorting plant, to determine the impacts of the project on the following:

economic activities, traffic and public facilities, public health, hazards/risks, groundwater resource conditions, hydrological conditions, fauna and flora, landscape/aesthetics, air pollution, water pollution, soil contamination, noise and vibration, offensive odour.

The EIA concluded that the plan will bring about various positive and negative impacts. The adverse impacts may be reduced through the various countermeasures that are taken at the time of the implementation. Accordingly, it has been concluded that a permissible limit can be maintained by preparing suitable countermeasures based on the results of the EIA.

d. Priority Project Implementation

As the first step toward the realisation of the M/P, the study team recommends the implementation of a priority project to the Turkish side with due consideration of the following:

- To gain approval on the EIA Report, the nature and objectives of the project should be immediately explained to the residents to obtain resident consensus. In order to gain resident consensus the compost plant dumpsite should immediately be converted to a sanitary landfill.
- The modification of the cleansing tax system and introduction of a disposal fee should be considered to secure independent funds. Nonetheless, a considerable amount of external funding is required to cover the capital required. For external funding, studies on the use of facility construction subsidies (environmental fund) and domestic and foreign soft loans should be given priority.
- The success of the separate collection system which will be simultaneously introduced with composting and sorting, will significantly influence the success of the compost and sorting plants. The success of the separate collection system relies on the degree of public co-operation, making the implementation of relevant, long term public education programs extremely important. Effectively using the experiences gained from the pilot project in Mersin, educational methods suited to the conditions in Mersin GM should be developed and considerable efforts invested to gain the co-operation of the residents.
- The medical waste generation amount is significantly less than MSW generation, and the medical waste haulage expenses only make up a small portion of the expenses for the adequate treatment of medical wastes. The construction of a medical waste disposal site in accordance with the MoE standards would require a huge amount of capital. Therefore, an inter-municipal disposal system should be established where other municipalities (e.g., Tarsus, Silifke, etc.) in Icel Province are allowed to dispose of their medical wastes into the medical waste disposal site to be constructed at Cimsa site.

e. Outline of the Alternative Plan

During the meeting on the draft final report, (DR/R) the Turkish counterpart requested the examination of an alternative plan to reduce the project costs of the priority projects. Although the laws concerning disposal sites do not acknowledge the contents of the alternative plan, the following alternative plans will reduce project costs, and from a view of environmental protection the problems will be negligible, and therefore the team recommends them.

Municipal Solid Waste Disposal Site:

If the impermeable structure of the slope is constructed according to the law i.e., “clay layer + HDPE” the slope’s gradient would have to be reduced, thus increasing the area of the impermeable structure. The impermeable layer of the

slope shall be changed from the legally stipulated “clay layer + HDPE” to “mortar + HDPE”.

The adoption of this measure would reduce the construction costs of the medical waste landfill site by 26.2%.

Medical Waste Disposal Site:

There is over 3m of impermeable strata that lies 2 to 8 m from the surface of the landfill’s top soil. The bottom of the landfill shall be an impermeable structure without an HDPE liner. If the impermeable structure of the slope is constructed according to the law i.e., “clay layer + HDPE” the slope’s gradient would have to be reduced, thus increasing the area of the impermeable structure. The impermeable layer of the slope shall be changed from the legally stipulated “clay layer + HDPE” to “mortar + HDPE”.

The adoption of this measure would reduce the construction costs of the medical waste landfill site by 51.7%.

Further, the C/P’s comments on the DF/R included a regional medical waste incineration plant; the following is an outline from the main report.

- Because no land has been secured for the incineration plant, the transregional medical waste incineration plant for Adana and Icel will be located part way between the two provinces.
- Specifically, a rough estimate of the costs for construction, operation, and management costs, and the advantages and disadvantages of the plant are presented.