Chapter 7

The SWM Master Plan for Adana

7 The SWM Master Plan for Adana

7.1 Outline of the Master Plan

7.1.1 Goals

The principal goal of the SWM master plan is:

"To create *a closed-loop society* on solid waste[1] in Adana Greater Municipality by the target year 2020"

The master plan aims to:

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

The proposed measures to be taken, in order to attain the goals, are summarised below.

Technical System

T1. Elimination of improper disposal at generation, illegal dumping and improper self-disposal.

T2. Establishment of a separate collection system.

T3. Establishment of a transfer system if the final disposal site is far from the city centre.

T4. Improvement of the public area cleansing system.

T5. Establishment of a government related recycling system.

T6. Establishment of an intermediate treatment system by the construction of compost and sorting plants.

T7. Establishment of a sanitary landfill, strictly complying with the SW Control Regulation.

T8. Establishment of a proper medical waste disposal system from generation to final disposal.

[1] A closed-loop society means a society fully aware of the relationship between waste and the environment.

Institutional System

I1. Improvement and strengthening of management/control capability of public organisations concerned with SWM.

I2. Integration of current laws and regulations for successful implementation of the master plan.

I3. Establishment of a financially sustainable system.

I4. Establishment of private sector involvement in SWM by reducing the municipalities' involvement in operation of the technical system.

I5. Establishment of a proper monitoring and information management system.

I6. Full utilisation of available human resources through the establishment of proper human resources development programs.

I7. Establishment of public co-operation system for SWM through implementation of public education programs and raising awareness on SW.

I8. Establishment of a proper medical waste control/management system.

7.1.2 Targets

The M/P will be implemented by phases, as shown below, to achieve the above-mentioned objective.

Phase 1: 2000 - 2005 (F/S target year)

Phase 2: 2006 - 2012

Phase 3: 2013 - 2020

In order to achieve the principle goal of the master plan, the targets for the establishment of major technical system components are proposed as shown in the table below.

Table 7-1: Targets of SWM M/P for Adana

Items	Present (1999)	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
Refuse Collection Rate	97 %*[1]	100 %	100 %	100 %
Ratio of Improper Disposal to Generation Amount	1.7 %*[1]	0 %	0 %	0 %
Ratio of Separate Collection to Discharge Amount	0 %	30 %	60 %	100 %
Ratio of Intermediate Treatment to Discharge Amount	0 %	30 %	60 %	100 %
Share of sorting plant	0 %	43 %	51 %	55 %
Share of compost plant	0 %	57 %	49 %	45 %
Final Disposal Method of MSW	Open Dumping	Sanitary Landfill at MSW Landfill		
Final Disposal Method of Medical Waste	Open Dumping	Sanitary Landfill at a Medical Waste Landfill		

Note: *1 The figure is estimated based on the results of the POS

7.1.3 Strategy

The strategies to be adopted in the three planning stages are summarised below.

Phase 1 (2000 - 2005): Short Term Improvement by F/S Projects

Technical Aspects

- Improper disposal at generation, such as illegal dumping and inappropriate self-disposal, shall be eliminated by 2005 through an intensive public education campaign, and enforcement with the provision of sufficient collection service.
- A public container system shall be unified by the use of wheeled containers by 2002, and cover the whole population of the city. The separate discharge of compostable and non-compostable wastes will begin at the latest from 2002.
- The use of tractor-trailers in Yuregir DM will be gradually replaced with compactor trucks. A separate collection will begin and cover 30 % of population in the city from 2002.
- The current public cleansing system, a combination of mechanical and manual sweeping system based on road type, will be maintained. Prevention of littering in the city will be achieved through intensive public education campaign and enforcement.
- A government related recycling system shall be established to encourage waste minimisation, and begin source separation for reuse, recycling, and recovery of MSW.
- After the required funds are secured, a detailed design of separate collection and sorting/compost plants (F/S projects of this study) shall be conducted. Then a sorting plant (57,000 ton/year) and compost plant (75,000 ton/year) shall be constructed and vehicles/equipment procured by 2002. The plants shall be operated from January 2002. The rate of recycling to generation amount will increase from 5.9 % in 1999 to 9.7 % in 2005.
- The rehabilitation of the current Sofulu dump site will be completed and scavenging at the dump site shall be eliminated by 2001. Then after the required funds are secured, a detailed design of the new Sofulu disposal site (F/S project of this study) shall be conducted. The site shall be developed and vehicles/equipment procured by 2002. The final disposal site is estimated to be operated from January 2002 to December 2009. While the new Sofulu disposal site will be used, Adana GM shall conduct site selection and F/S works for the next disposal site after Sofulu has been completed(filled) by 2008.
- The source segregation and the separate discharge/collection of medical waste (infectious/hazardous medical waste) shall be conducted strictly, and improper disposal at the Sofulu dump site eliminated by 2000. Along with the new Sofulu disposal site development a medical waste disposal site, which complies with the Regulation of the Medical Waste Control, will be constructed by 2002. From January 2002 all medical wastes shall be disposed of at the medical waste disposal site, but until the new medical waste disposal site is completed, all medical waste will be disposed of at the Sofulu dumpsite using the trenching

method. Irrecoverable hazardous chemicals that are corrosive, flammable, explosive, and reactive shall be treated prior to discharge. Recoverable hazardous chemicals shall be separated and collected separately for recycling. All medical waste entering the landfill site shall be recorded at the weighbridge, so that the DMs and the GM can keep a record on medical waste disposal amounts.

Institutional Aspects

- The current administrative system of the GM and the DMs will be improved through review of the system, and redefinition of the tasks/assignments, in order to meet with the proposed technical systems, i.e., separate collection, government related recycling system, and sanitary landfill. The establishment of a regional waste authority responsible for hazardous and medical waste treatment/disposal will be examined.

- Present organisations responsible for SWM shall be strengthened both in quantity and quality to properly administer and control the proposed technical systems, i.e., separate collection, sorting/compost plants, etc.

- Carefully taking the capability of the private sector into consideration, the involvement of the private sector shall be encouraged not only for conventional cleansing services but also proposed new technical system. An appropriate performance contract for private sector involvement shall be elaborated through inter-municipal co-operation, etc.

- A systematic monitoring and information management system regarding SWM shall be established in the GM and in the DMs. At first unit costs of operations shall be identified to evaluate cost/benefit, cost/efficiency and cost/effectiveness. Along with this, a database on all SWM activities will be developed and maintained to continuously check the quality and costs of the cleansing services by both public and private sectors.

- A human resources development program shall be created in order to train professionals involved with SWM. The program shall cover a broad spectrum of professionals and employees, from management to operational levels, including those responsible for supporting activities.

- For proper operation of the proposed material recovery and recycling facilities, a public co-operation system shall be set up through an intensive public education and campaign. For the purpose various experiences and tools obtained by the experiment on the separate collection of this study shall be fully utilised including modification of the education book prepared by the team.

- Seminars and conferences supported with animations and pamphlets shall be arranged targeting the primary schools and the local TVs.

- The current scattered legal provisions in diverse laws and regulations shall be into an integrated and transparent package, especially to properly operate proposed new technical systems.

- The separate accounts of the SWM costs and revenues shall be established in Adana GM and Seyhan and Yuregir DMs in order to provide justification for

the increase of charges, etc. The current coverage rate (about 8.1 %) of cleansing tax to the SWM costs shall be raised to 40 % by 2005. Through the development of a database the tax collection management system will be improved. A tipping-fee system for the Sofulu disposal site shall be introduced by 2002.

- A code of practice on medical waste disposal shall be formulated. In order to establish a proper medical waste control/management system current organisations of the GM as well as the provincial government will be strengthened. As a measure of strengthening the establishment of a regional medical waste authority will be examined. The costs of medical waste disposal (from collection to final disposal) will be gradually covered by the fee from the generators. Possibilities and benefits as well as applicability of inter-municipalities co-operation shall be reviewed.

Phase 2 (2006 - 2012): Medium Term Improvement

Technical Aspects

- The separate discharge and collection system shall be expanded to cover 60 % of the city's in population by 2012. Taking the requests may arise from the operation of sorting/compost plants into consideration, the categories of separate discharge wastes shall be reviewed.
- The ratio of the mechanical sweeping operation will be raised if the labour cost will be increased and the road conditions improved. If these labour and road conditions allow, a whole system for major roads will be exchanged to a fully mechanical system.
- The government related recycling system shall be strengthened to encourage further waste minimisation and enhance source separation rate for reuse, recycling and recovery of MSW.
- In addition to the sorting/compost plants in Sofulu site, a sorting plant (135,000 ton/year) and composting plant (108,000 ton/year) shall be constructed at future landfill site by 2010. The new plants shall be operated from January 2010. The rate of recycling to generation amount will be raised from 9.7 % in 2005 to 15.2 % in 2012.
- The Sofulu disposal site will be used until December 2009. After a detailed design of the future disposal site the site shall be developed and vehicles/equipment procured by 2010. The future final disposal site shall be large enough to receive the wastes from the city for more than 11 years.
- Infectious waste will be treated at generation by autoclaves in steam resistant bags, and lacerating materials crushed at the site of generation. The medical waste disposal site at Sofulu will be closed by December 2009. From January 2010 all medical wastes shall be disposed of at a medical waste disposal site to be constructed at the future landfill site.

Institutional Aspects

- The administrative system, including the roles of the GM and the DMs in SWM, will be reviewed and improved in order to meet with the change of SWM, i.e., the increase in the NIMBY (Not In My Back Yard) syndrome, etc.
- The organisations responsible for SWM shall be further strengthened in terms of administrative and control capabilities not only for municipal SW but also hazardous and industrial SW.
- The involvement of the private sector will be further encouraged in order to achieve more efficient but lower cost SWM. The government shall also encourage the participation of the private sector in the provision of facilities such as sorting/composting plants through the modification of the laws on privatisation to allow for this.
- The database on SWM activities will be maintained. The comparative cost data and other performance data obtained by the database will be used to measure the efficiency of the services, and to good management and decision making.
- All staff concerned with SWM including private employee shall undergo a programme of proper training and professional development. Vocational qualifications shall be set up to act as a means of assessing the competence of persons responsible for SWM facilities and operations.
- In order to expand separate collection as well as material recovery and recycling the intensive public education and campaign shall be continued to raise public co-operation.
- The coverage rate of cleansing tax to the SWM costs shall be raised to 70 % by 2012. The tipping-fee system will be extended to the sorting and compost plants to cover the excess cost which comes from actual operation and maintenance cost minus benefits such as sales revenue of recovered materials and saving cost of landfill.
- All costs of medical waste disposal (from collection to final disposal) shall be covered by the fee from the generators.

Phase 3 (2013 - 2020): Long Term Improvement

Technical Aspects

- The separate discharge and collection system shall be expanded and cover 100 % of the city in population by 2020. In order to achieve the goal of the M/P the separate discharge and collection system shall be improved in accordance with the change of the socio-economic situation, i.e., the increase of separate items, a improvement of discharge method by use of decomposable container for compostable wastes.
- The most appropriate rate of the mechanical and manual sweeping operation shall be elaborated and applied, considering the labour and road conditions.
- A government related recycling system shall be fully established to realise the goal of the M/P.

- The sorting/compost plants in Sofulu site will be closed by December 2016. With the additional construction of 330,000 ton/year for the sorting plant and 273,000 ton/year for the compost plant the capacities of the plants at the future landfill site shall be raised up to 465,000 ton/year and 381,000 ton/year respectively by 2017. The expanded plants shall be operated from January 2017. The rate of recycling to generation amount will be raised from 15.2 % in 2012 to 23.3 % in 2020.
- The future final disposal site will be continuously used.
- All medical wastes shall be continuously disposed of at a medical waste disposal area of the future landfill site.

Institutional Aspects

- The administration and organisation accountable for a closed loop society on solid waste will be fully established.
- The maximum involvement of the private sector not only in operation of cleansing services, but also in the provision of facilities such as sorting/composting plants and hazardous wastes treatment/disposal facilities will be achieved. The government will be able to properly control and monitor all the activities of the private sector.
- The database on all SWM activities will fully function to provide all data necessary for administration, policy decision, control/monitoring, public relation and financial management.
- The public shall be encouraged to co-operate in order to realise a closed loop society through continuous public education and campaign.
- The coverage rate of cleansing tax to the SWM costs shall be raised to 100 % by 2020. The tipping-fee for waste treatment/disposal will be raise to 100 % of the necessary cost. Export to Middle East countries of compost (perhaps some enriched with additives) shall be considered.

7.1.4 Future Waste Stream

a. Influential Factors

In accordance with the realisation of the above targets the waste streams in future shall change. The main factors that will affect the changes in the waste stream in Adana GM are:

- Changes in waste generation amount.
- Elimination of improper disposal at generation.
- Changes in conventional waste recycling amount by private sector, i.e., recycling rate at generation and by street and landfill waste pickers.
- Changes in treatment rate.
- Changes in waste composition, i.e., rate of compostable and non-compostable wastes.

b. Changes of the Influential Factors

The changes of the above-mentioned factors are assumed in the master plan as follows:

- The changes in waste generation amount are as presented in Chapter 5.
- The improper disposal at generation such as improper self-disposal and illegal dumping shall be eliminated by 2005.
- Regarding the changes in conventional waste recycling done by mainly informal private sector, since the public sector will promote the source recycling activities done by the citizen and "eskici", the recycling rate at generation, (2.88 % of generation amount) is assumed to be maintained by 2020. On the contrary, the recycling of street waste pickers and scavengers at landfill will be gradually disappeared by 2020 and 2002 respectively.
- The treatment at sorting and compost plants is done in accordance with the above targets.
- The changes in waste composition are as presented in Chapter 5. Based on the composition, the rates of non-compostable waste for sorting plant and compostable waste for compost plant are determined.

Based on the above assumption the changes of the influential factors are assumed and summarised in the table below.

Table 7-2: Changes of the Influential Factors in Adana GM

Factors \ Year	1999	2005	2012	2020
Waste Generation (ton/day)	834	1,200	1,739	2,355
Improper Disposal (ton/day)				
Self-disposal	6	0	0	0
Illegal dumping	8	0	0	0
Conventional Recycling (ton/day)				
At generation	25	31	38	47
By street waste pickers	15	11	6	0
By scavengers at landfill	9	None by 2002	0	0
Waste Composition (%)				
Non-Compostable	33	43	51	55
Compostable	67	57	49	45
Treatment (ton/day)				
At sorting plant	0	149	519	1,269
At compost plant	0	198	498	1,039

c. Future Waste Stream

In addition to the above assumption and establishment of the influential factors, the following rates are set up by the design of sorting and compost plants:

Sorting Plant

Material recovery rate: 24 %

Residue rate: 76 %

Compost Plant

Compost production rate:	18 %
Material recovery rate:	1 %
Vaporisation rate:	77 %
Residue rate:	4 %

Finally waste streams from 1999 to 2020 are presented in the table below. Based on the table the waste streams in year 1999, 2005, 2012, and 2020 are illustrated in the following figures.

Table 7-3: Future Waste Stream (Adana GM)

ADANA									Sorting Plant			Compost Plant								
Year	Waste Generation	Self Disposed Waste	Recycling at Generation Sources	Waste Discharge	Recycling by Street Waste Picker	Illegal Dumpe Waste	Collection	Without Treatment Waste	Non-Composta ble Waste	Recycling 24%	Residue 76%	Composta ble Waste	Recycling 1%	Compost 18%	CO2,H2O 77%	Residue 4%	Recycling at Disposal Site	Final Disposal of MSW	Other Waste	Total Final Disposal
	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)
1998	284,700	2,048	8,760	273,892	5,121	2,731	266,040	266,040	0	0	0	0	0	0	0	0	3,285	262,755	8,760	271,515
1999	304,410	2,190	9,125	293,095	5,475	2,920	284,700	284,700	0	0	0	0	0	0	0	0	3,285	281,415	9,125	290,540
2000	323,755	1,825	9,490	312,440	5,214	2,433	304,793	304,793	0	0	0	0	0	0	0	0	2,190	302,603	9,855	312,458
2001	344,925	1,460	9,855	333,610	4,954	1,947	326,709	326,709	0	0	0	0	0	0	0	0	1,095	325,614	10,585	336,199
2002	366,460	1,095	10,220	355,145	4,693	1,460	348,992	244,295	39,785	9,548	30,237	64,912	649	11,684	49,982	2,597	0	277,129	9,855	286,984
2003	388,725	730	10,585	377,410	4,432	973	372,005	260,403	44,641	10,714	33,927	66,961	670	12,053	51,560	2,678	0	297,008	10,585	307,593
2004	412,450	365	10,950	401,135	4,171	487	396,477	277,534	48,766	11,704	37,062	70,176	702	12,632	54,036	2,806	0	317,402	11,315	328,717
2005	438,000	0	11,315	426,685	3,911	0	422,774	295,942	54,538	13,089	41,449	72,294	723	13,013	55,666	2,892	0	340,283	12,410	352,693
2006	462,820	0	11,680	451,140	3,650	0	447,490	313,243	59,069	13,200	45,869	75,178	750	13,500	57,750	3,178	0	366,537	13,505	380,042
2007	487,640	0	12,045	475,595	3,389	0	472,206	330,544	63,748	13,200	50,548	77,914	750	13,500	57,750	5,914	0	398,668	14,235	412,903
2008	515,380	0	12,410	502,970	3,129	0	499,841	349,889	70,478	13,200	57,278	79,475	750	13,500	57,750	7,475	0	434,595	15,330	449,925
2009	543,120	0	12,775	530,345	2,868	0	527,477	369,234	75,957	13,200	62,757	82,286	750	13,500	57,750	10,286	0	470,520	16,425	486,945
2010	572,320	0	13,140	559,180	2,607	0	556,573	222,629	163,632	39,272	124,360	170,311	1,703	30,656	131,139	6,813	0	353,802	17,520	371,322
2011	603,710	0	13,505	590,205	2,346	0	587,859	235,143	176,358	42,326	134,032	176,358	1,764	31,744	135,796	7,054	0	376,229	18,980	395,209
2012	634,735	0	13,870	620,865	2,086	0	618,779	247,512	189,346	45,443	143,903	181,921	1,819	32,746	140,079	7,277	0	398,692	20,075	418,767
2013	661,015	0	14,235	646,780	1,825	0	644,955	257,982	201,226	46,200	155,026	185,747	1,825	32,850	140,525	10,547	0	435,528	20,805	456,333
2014	686,930	0	14,600	672,330	1,564	0	670,766	268,306	209,279	46,200	163,079	193,181	1,825	32,850	140,525	17,981	0	476,826	21,900	498,726
2015	714,305	0	15,330	698,975	1,304	0	697,671	279,069	221,859	46,200	175,659	196,743	1,825	32,850	140,525	21,543	0	519,873	22,630	542,503
2016	741,680	0	15,695	725,985	1,043	0	724,942	289,977	230,532	46,200	184,332	204,434	1,825	32,850	140,525	29,234	0	563,509	23,360	586,869
2017	769,420	0	16,060	753,360	782	0	752,578	0	406,392	97,534	308,858	346,186	3,462	62,313	266,563	13,848	0	322,706	24,455	347,161
2018	798,255	0	16,425	781,830	521	0	781,309	0	421,907	101,258	320,649	359,402	3,594	64,692	276,740	14,376	0	335,025	25,185	360,210
2019	828,550	0	16,790	811,760	261	0	811,499	0	446,325	107,118	339,207	365,175	3,652	65,732	281,185	14,606	0	353,813	26,280	380,093
2020	859,575	0	17,155	842,420	0	0	842,420	0	463,331	111,199	352,132	379,089	3,791	68,236	291,899	15,163	0	367,295	27,375	394,670

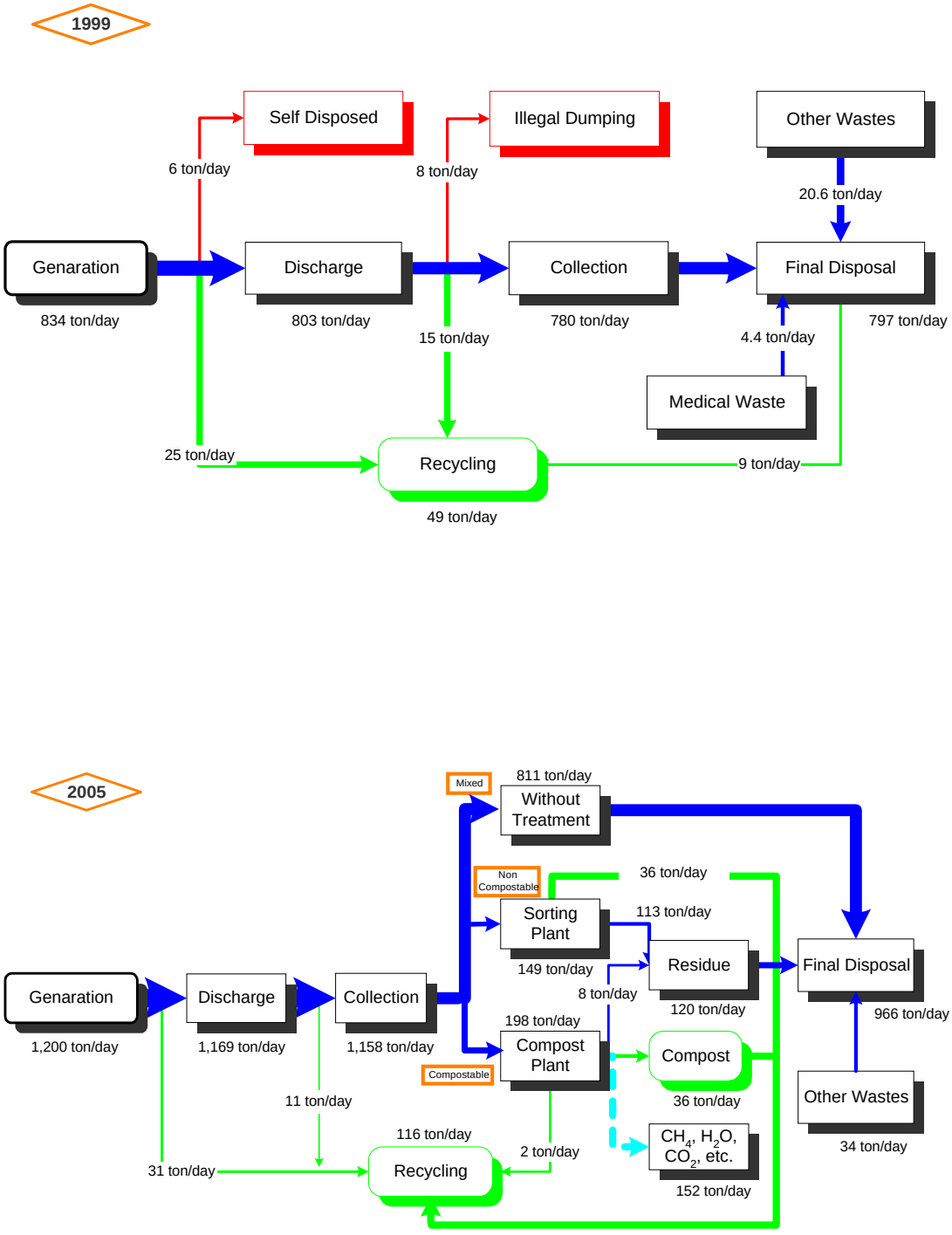

Figure 7-1: Waste Stream in Year 1999 and 2005 (Adana GM)

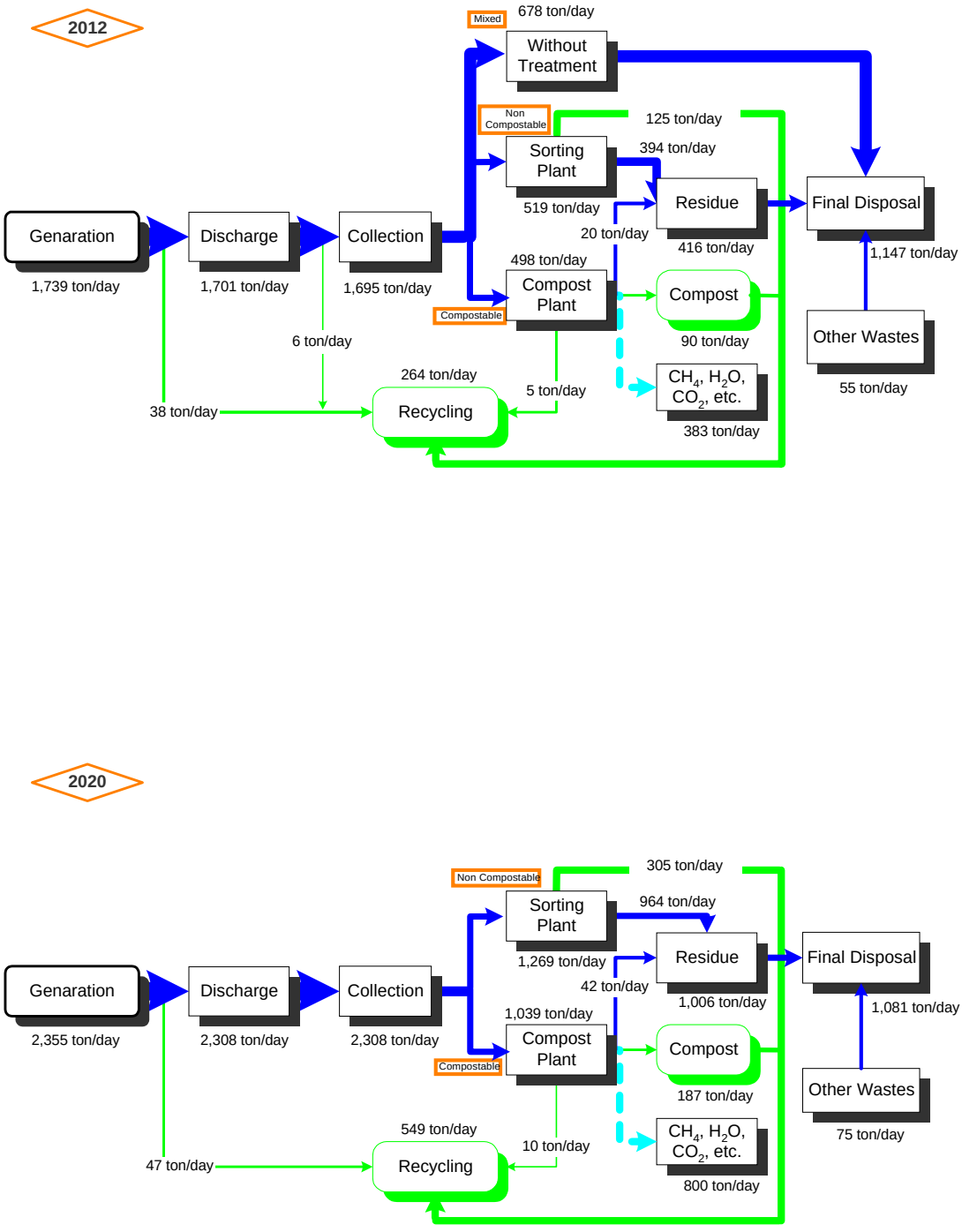

Figure 7-2: Waste Stream in Year 2012 and 2020 (Adana GM)

7.2 Technical System

7.2.1 Planning Conditions

In order to plan the technical system for the SWM M/P for Adana, various frameworks are set in Chapter 5. The important issues for the planning are summarised in the table below.

Table 7-4: Planning Conditions for SWM M/P for Adana

Items	Unit	Present (1999)	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
Population in Adana GM	Persons	**1,196,620**	**1,479,477**	**1,831,770**	**2,268,174**
Population of Seyhan DM	Persons	859,170	1,099,454	1,395,243	1,756,713
Population of Yuregir DM	Persons	337,450	380,023	436,527	511,461
MSW Amount					
Generation	ton/day	834	1,200	1,739	2,355
Discharge	ton/day	803	1,169	1,701	2,308
Collection	ton/day	780	1,158	1,695	2,308
MSW Composition					
Non-compostable	%	33	43	51	55
Compostable	%	67	57	49	49
Intermediate Treatment Facility					
Site		Sofulu	Sofulu	Unidentified future disposal site	
Distance from city centre	km	10	10	20	
Final Disposal Site					
Site		Sofulu	Sofulu	Unidentified future disposal site	
Distance from city centre	km	10	10	20	

7.2.2 Discharge and Storage System

For the improvement of the discharge and storage system the following main policies will be applied to the M/P of the target area.

- The type of containers used will be regulated; a standard 800 lit., wheeled container system will be extended.
- A source separation system will be initiated for discharging the non-compostable (recyclable wastes) and compostable wastes (organic and green wastes) in a controlled manner, to provide for a composting/recycling scheme.
- The separate collection system will be initiated in the high income mahalles. then expanded to middle and low income mahalle.
- For compostable waste the use of plastic containers is recommended to prevent them from rusting, while current metal container can be used for non-compostable wastes.

7.2.3 Collection and Haulage System

For the improvement of the collection and haulage system the following main issues will be applied to the M/P of Adana.

- The use of compactor trucks (12 m^3 - 16 m^3) will be extended and gradually unified.

- Communal container collection system will be applied in order to increase the collection efficiency.
- It is assumed that the existing collection equipment will be used in the beginning of Phase 1, and gradually replaced with the new vehicles, after they exceed the life span of 7 years.
- Collection frequency will be daily, 6 days a week for residential and commercial and market waste for compostable (organic and putrescible) waste.
- Collection frequency for source separated non-compostable waste (recyclable materials) will be once or twice a week.
- Direct hauling of collected waste will be continued in Phase 1, and after the new landfill site (which is assumed to be located 20 km from the city centre) will be in operation in Phase 2, there may be a need of transfer station(s).
- When a new disposal site is identified, the need of transfer station(s) shall be examined.

7.2.4 Public Area Cleansing System

For the improvement of the public area cleansing system the following main ideas will be applied to the M/P of the target area.

- The present street sweeping work, mainly conducted manually, is deemed to be an appropriate method due to cheap labour costs and inferior road conditions that would hamper mechanical street sweeping equipment. However, the ratio of manual/mechanical sweeping work shall be examined and changed according to the labour cost increase and the improvement of road conditions.
- The existing mechanical street sweepers will be used for the cleaning of main roads and boulevards in Phase 1, renewing them when necessary. In Phase 2, the ratio of the mechanical sweeping operation will be increased if the labour cost will be increased, and a road conditions improved. If these labour and road condition allows whole system for major road will be exchanged to a fully mechanical system.
- The street waste, which is collected manually, will be stored in wheeled containers that are allocated only for this purpose, and will be collected by the existing collection vehicles.
- In order to shorten the haulage distance of the collected waste, communal containers will be used as collection points, which will be placed in close proximity. The haulage distance will be controlled, which will be less than one km.
- More litter boxes will be installed to reduce the workload for street sweepers and preventing waste from scattering.
- A new type of cart with a larger haulage capacity will be introduced to improve the efficiency of the haulage work.
- The supervision system of labourers will be improved.

7.2.5 Recycling and Intermediate Treatment System

a. Recycling

The following government related recycling systems will be established.

- An administration system that promotes production of recyclable goods/products from the manufacturing stage, with government assistance, in order to minimise waste generation (generation control) as much as possible.
- A system that enables recycling at source, in particular, separate discharge at source and promote the recycling of segregated waste materials.
- Recycling by the intermediate treatment facilities.

b. Intermediate Treatment System

In order to facilitate recycling by the intermediate treatment facilities, sorting and compost plants will be constructed in accordance with the schedule as shown in the table below. The detailed design of the plants in Phase 1 is presented in Chapter 10.

Table 7-5: Outline of Intermediate Treatment System for Adana

Facilities	Outlines
1. Sofulu Sorting Plant	
Capacity	190 ton/day
Construction year	2001
Operation year	2002 - 2016
2. Sorting Plant No 1 at Future Landfill	
Capacity	450 ton/day
Construction year	2009
Operation year	2010 - 2024
3. Sorting Plant No 2 at Future Landfill	
Capacity	1,100 ton/day
Construction year	2016
Operation year	2017 - 2031
4. Sofulu Compost Plant	
Capacity	250 ton/day
Construction year	2001
Operation year	2002 - 2016
5. Compost Plant No 1 at Future Landfill	
Capacity	360 ton/day
Construction year	2009
Operation year	2010 - 2024
6. Compost Plant No 2 at Future Landfill	
Capacity	910 ton/day
Construction year	2016
Operation year	2017 - 2031

7.2.6 Final Disposal System

The JICA study team and the counterparts of Adana GM have conducted site selection works and both sides have agreed the current Sofulu landfill to be the final disposal site for the F/S.

It is recommended that the following sites be investigated if a new landfill site is to be selected:

- Adana Cimento Quarry

When a new site is required, it may be possible that some of the quarry is no longer operated by the factory.

- Quarries and Valleys at Karahan

The new Sofulu landfill was designed in accordance with the design standard prepared by the MoE as presented in Chapter 10.

Based on the above, the outline of final disposal system for Adana up to 2020 is summarised as presented in the table below.

Table 7-6: Outline of Final Disposal System for Adana

Facilities	Outlines
1. Sofulu Disposal Site	
New landfill area	30 ha
MSW landfill amount	3,006,000 ton
Construction year	2001
Operation year	2002 - 2009
2. Unidentified Future Disposal Site	
Area	N/A
MSW landfill amount	4,752,000 ton
Construction year	2009
Operation year	2010 - 2020

7.2.7 Operation and Maintenance System

SWM works change on a day to day basis; to maintain the efficiency of operations, making a prompt decision and taking swift action are essential. Employing a large number of people is risky and is also difficult to maintain the level of management required, so it is recommended that the private sector participation in SWM works will be extended in order to reduce the burden and work load on the authority responsible for SWM, and minimise the costs.

a. Maintenance of Equipment

At present, the workshop owned by the municipalities only provides preventive maintenance service for equipment, and the major repairs are executed by the private workshops. The M/P proposes to continue this application till the end of Phase 2. Preventive maintenance will be executed by the existing municipal facilities and major repairs be conducted at private garages. The reason for this is as follows:

- It takes time for the municipal workshop to purchase spare parts. So spare parts used only frequently will be purchased and kept in storage.
- Complex repair works will be consigned to the private sector although the cost is higher than if directly conducted at the municipal workshop because private garages are able to purchase spare parts much more readily.

In Phase 3, it is recommended that the whole repair and maintenance works will be privatised.

b. Operation of Collection Services

To limit the burden and workload currently experienced by the Cleansing Departments, involvement of the private sector will be encouraged. The proposed measures are as follows:

- In Phase 1 the municipalities will begin to contract out some of their collection service to the private sector. Majority of collection vehicles will be owned by

the municipalities and the rest will be hired out or supplied by the private sector. The contract would include drivers, collection workers, fuel, and maintenance.

- In Phase 2 the municipalities can contract out majority of the operation work to the private sector. The private collection company will be entrusted a small percentage of collection vehicles owned by the municipalities. Through the gradual expansion of this system, the authority responsible for SWM can nurture the potential of the private sector, in preparation for the future hand-over of all collection work.

- In Phase 3 all the collection services will be operated by the private contractors. The municipalities shall monitor, supervise, and control the works conducted by the contractors.

c. Operation of Public Cleansing Services

Street sweeping workers will be employed in a contract base as at present, because it is very difficult for the municipalities to manage many street sweepers and employee cost will be high. However, mechanical street sweepers and washers are owned by the Adana GM and entrusted to a contractor.

In Phase 2 all the public cleansing services will be operated by the private contractors including ownership of the necessary equipment. The municipalities shall monitor, supervise and control the works to be conducted by the contractors.

7.2.8 Medical SWM

The present medical waste management system in Adana has shown the failures of both the municipal authorities (regulating authority) and the hospitals to ensure that their handling/management of medical waste do not cause harm to both public health and to the environment. The following measures shall be taken by the medical institutions and the regulating authorities in order to eliminate the risks, posed by infectious and hazardous waste, and to comply with the Medical Waste Control Regulations.

- Infectious waste and hazardous waste (medical waste) shall be separated strictly at generation and at the central collection point. Medical waste will be collected separately from general waste in a specially assigned vehicle. The specially assigned vehicle shall not transport general waste, nor any other waste, without prior decontamination by disinfecting agents.

- Medical institutions shall ensure that no unauthorised persons can gain access to medical waste storage areas. All infectious waste storage areas must be locked.

- Recoverable hazardous waste shall be separated for recycling. Irrecoverable hazardous waste that is corrosive, reactive, flammable, or explosive shall be treated prior to discharge, in order to prevent damage to the landfill structures, e.g., geomembranes and drainage pipes.

- Infectious waste shall be autoclaved in steam resistant bags, and lacerating/piercing materials crushed before discharge, according to the medical waste regulations.

- Medical waste shall be disposed of in a special trench at Sofulu dumpsite until December 2001, and from 2002 at a special medical waste disposal site at the new sanitary landfill. Entry of the special medical waste collection vehicles will be monitored, and their weight recorded at the weighbridge, in order to supervise the entry of infectious substances and to accumulate data on medical waste disposal.

- Infectious waste shall not be kept in medical institutions for more than 48 hours, as stipulated by law. Smaller generators of medical wastes shall have their infectious waste removed and taken to the nearest hospital with a proper interim storage facility. Incineration will not be introduced in the short term, but incineration at a cement factory shall be examined for a long term solution.

- Medical institutions shall strictly monitor their inventory under strict accounting practises to reduce wastages, especially of pharmaceuticals and of hazardous chemicals. Medical institutions shall introduce a comprehensive recycling plan to introduce the recycling of general waste and recoverable hazardous waste.

- Medical institutions shall develop an education system for all those involved in the handling of infectious waste and hazardous waste. Waste management persons shall be instructed frequently on proper medical waste handling procedures. Medical institutions shall also prepare an emergency procedure guideline in case of accidental contamination, or release of dangerous chemicals.

7.3 Institutional System

7.3.1 Administration and Organisation

For practical measures and applications related to the administration and organisation, a methodology can be pursued, with which each cleansing and/or solid waste management department and/or section can undertake a self-criticism to identify the gaps and requirements. This approach is also closely connected with the concept ‘redefinition’ of the tasks and assignments for and in each individual solid waste management unit.

At top managerial post, the assigned person for Head or Director position should possess specific qualifications and capabilities. Managerial qualifications comprise two relevant assets; namely, administrative capabilities and operational skills. While the former asset relates to administrative management qualifications, the latter refers to operational management qualifications. The synthesis of these assets can avail an excellent background for the top responsible person to set up a decision making process supported by relevant feedback from monitoring and evaluation records.

Under administrative management functions, the solid waste management unit should deal with (i) legislative and regulatory issues; (ii) personnel recruitment; manpower requirements and allocation, contractual employment; (iii) financial requirements, accounting, comparative costs and cash-flow analyses, fiscal management, budgeting; and (iv) public relations. The operational management functions, on the other hand, embrace (i) manpower mobilisation and logistical organisation; (ii) supervision of service implementations; (iii) proceeding achievement records; and (iv) instructions

and manuals oriented training. These functions have to be carried out by mid-career personnel, while support staff in the field is engaged in implementation phases as practitioners. Once this pre-conditional framework is achieved by each solid waste management unit, the functions could be bound to self-sustainability and self-reliance principle, where rational and independent administration and organisation models are applied by respective municipalities.

In the development of adequate administrative and organisational models, each municipality should be free to make own choices in line of their political and optional preferences. The pre-conditions mentioned above are the building blocks, on which flexible models can be structured. The philosophical approach towards the identification of a suitable administrative model should be associated with self-experiencing principle. The observations show ,that there are roughly three political preferences for solid waste services; (i) privatisation, (ii) semi-privatisation, and (iii) non-privatisation. Whichever option the municipalities take, one issue stays however essential; namely, the aforementioned 'pre-conditional framework'. Once this issue gains a clarification, the rest of the work to be undertaken is the determination of personnel size.

Following determinants have to be taken into account regarding the personnel size:

- service types - collection, separation, transportation, disposal, recovery, processing, public relations, etc.
- service size in quantified terms - service area, target groups, volume, capacity, distance, costs, efficiency, etc.
- service modes - privatisation, semi-privatisation, non-privatisation; contracting, subcontracting, etc.
- service requirements - planning, programming, budgeting, financing, organising, implementing, supervising, monitoring, evaluating, operating, strategy formulation, decision making, etc.

Based on these determinants, an appropriate model can be found under optional preferences of individual municipalities in compliance with their political viewpoints and instrumental availabilities in financial, personnel, and material terms.

7.3.2 Legislation and Enforcement

The legislative constraints and weaknesses at national level require betterment actions oriented primarily towards municipalities to commercialise and to involve the private sector more effectively in delivery of their solid waste management services. Furthermore, limited power of municipalities to obtain necessary sites for solid waste management facilities as well as their limited rights to access to use those facilities located outside their boundaries should also be re-regulated. Marginal contributions provided through public participation need to be converted to fruitful contributions and consultative character of NGO involvement must be transferred into compulsory references in decision making processes. On the other hand, it is an undeniable fact that there is no 'umbrella law' for solid waste management. Legislation for the collection, transport, disposal, and financing of solid wastes is currently dispersed over a number of laws and regulations, many of which require substantial review.

The current legislative instruments are, however, partially sufficient for the enforcement of any service mode as desired by the respective municipality. Although they provide a basis for municipalities to make choices between privatised, semi-privatised and non-privatised service options in solid waste management with contracting and subcontracting possibilities in this respect, the laws are, however, considered as anti-competitive, which hinder private sector involvement. Generally, two methods are currently used in Turkey for promoting private sector participation in carrying out operational functions in municipal services. The first method involves the contracting of private companies, while the second involves the commissioning of municipal owned companies to perform envisaged services.

Application of the first method runs under the enforcement of the provisions of the State Bidding Law No. 2886, which require the obligatory selection of the lowest tender. This clause makes it impossible to rule out unrealistic or technically deficient tenders. Although the municipalities are complaining to suffer under this tendering legislation, there are possibilities, however, to overcome the bottleneck. The first possibility is to prepare consistent tender documents including meaningful specifications of standards and scope of works, which makes comparative tender analysis easy. This requirement is also valid for the preparation of the municipality contract documents to be mutually signed by the private companies. The second possibility is to confine on the technical pre-qualification criteria prior to subjecting the financial offer to final evaluation. This is the only way to associate high quality performances with low cost requirements in compliance with the provisions of the current tendering legislation.

Both of the steps indicated above necessitate a certain level of expertise. The lack of qualified, skilled and experienced personnel dealing with these issues result in undesired and unintended outcomes, with which the municipalities themselves are not satisfied and begin to complain. Therefore, acquisition of external support through know-how transfer by training programs and consultancy services, which might be delivered by an experienced municipality or union of municipalities as well as a private company, seems to be essential and indispensable. Inter-municipal co-operation and collaboration within an exchange program collectively developed by respective municipalities in Adana would be extremely beneficial.

Contracting out solid waste management services to municipal owned companies is the other method for promoting private sector participation in operational functions of the municipalities. In this case, the municipalities enjoy the exemption from the State Bidding Law and have the advantage to commission the service to an own Municipal Economic Enterprise. The main obstacle of this model is the politicisation of the management staff as well as deterioration of principles and mechanisms set for functional operation of an independent and free enterprise, which ought to be active within the competitive system of business market. If this method of contracting is preferred, it requires an extreme caution for securing and ensuring the autonomy, which is jurisdictionally recognised to such legal entities.

Another outstanding source of complaint from the municipality side is associated with the procedures required by the General Accounting Law No.1050, which limit the contract period to one year, only. In effect, the respective clause removes any incentive for contractors to invest in new plant and equipment for the sake of quality betterment in service performances. The extension of the contract period over one

year reaching to a 3-5 year duration could be an encouraging factor for the contractors. Nevertheless, this issue must be arranged by legislating organs of the nation.

7.3.3 Financial System

a. Basic Concept

Enough cleansing tax should be charged to cover the whole SWM costs which include operation and maintenance cost, and depreciation cost. The following measures should be taken to secure a financial source.

- Review and raise the cleansing tax amount to cover sufficiently the SWM costs including depreciation.
- Establish a tax collection management system and increase collection rate up to more than 90%.
- A tipping-fee shall be collected from direct waste hauliers in proportion to the waste amount brought into a composting plant and a disposal site.

Moreover, when setting a waste tax amount, the most appropriate combination of the following principles shall be considered.

- Polluter-pays-principle (waste dischargers pay the SWM cost)
- Cross-subsidy mechanism (the affluent pays for the less well off)
- Different service levels in accordance with the amount of collection fee paid.

b. Problems in the Present Waste Fee Collection System

At present the cleansing tax amount is per type of building by each provincial tax collection committee based on tax table per group and rank, which was decided by the Undersecretariat of Treasury of Prime Minister's Office. The increase rate of the tariff in 1999 is only between 1.386 and 1.391 times of that of 1998. The amount of tax reviewed by the Undersecretariat of Treasury is not sufficient to cover the SWM costs increase caused by inflation.

Although collection rate of the cleansing tax is said to be between 70 to 90 percent, the actual collection amount of tax are between 45 and 93 percent against the planned budget in 1998. The gap attributes to insufficient data management of taxable buildings.

Adding to the above problems, the cleansing tax has other problems;

- Same tariffs are adopted in the same province, therefore it is difficult to modify the differences of SWM costs by DMs.
- It is not efficient to motivate the minimisation of waste discharge or segregate collection for recycling.

Considering that the tax has a compelling force and the present collection rate is more than 70 percent, the present cleansing tax will be continuously charged for the base of SWM revenues with reviewing the SWM costs and setting rational tariff.

c. Calculation of Cleansing Tax Revenue

Total SWM expense in Adana in 1998 was 3,549 billion TL(depreciation cost is not fully included.)

Based on this assumption, the necessary SWM costs exceed present expenditure.

- Collection and haulage US$ 30/ton
- Public area cleansing US$ 186/ton
- Final disposal US$ 10/ton

Table 7-7: SWM Costs (Adana) in 1998

		Amount (ton/year)	Unit price (US$/ton)	Cost in US$	Cost in TL (million)
Seyhan DM	Collection/haulage	176,426	30	5,292,780	1,505,690
	Public area cleansing	10,186	186	1,894,596	538,975
	Sub-total	186,612	(38.5)	7,187,376	2,044,665
Yuregir DM	Collection/haulage	71,432	30	2,142,960	609,629
	Public area cleansing	2,088	186	388,368	110,483
	Sub-total	73,533	(34.4)	2,531,328	720,112
Adana GM	Public area cleansing	5,908	186	1,098,888	312,612
	Final Disposal	271,515	10	2,715,150	772,406
	Sub-total	-	-	3,814,038	1,085,018
Total		266,040*	(50.9)	13,532,742	3,849,795

Notes: Exchange rate US$ 1 =284,480 TL
* Sum of the collection/haulage amount and public area cleansing amount.
( ) means figures of calculation result of costs in US$/amount of waste.

On the other hand, the revenue of cleansing tax are shown in Table 7-8 that the collection rate increase to 90%.

Table 7-8: Revenue from Waste Fee Collection (Adana)

unit: million TL

	Tax collected in 1998	Collection rate (%)	Potential of tax charged	Amount of tax collected (90% collection rate)
Seyhan DM	251,798	80	314,748	283,273
Yuregir DM	136,711	85	160,836	144,752
Total	388,509	-	475,584	428,025

As a result, it can be concluded that cleansing tax need to be raised 9 times of that in 1998 in order to entirely cover SWM costs.

Considering current Turkish economy, it is very difficult to increase the cleansing tax at once to cover the SWM costs fully. Therefore in the master plan, the cleansing tax will be proposed to increase step by step to cover the SWM costs in continuation of present system. The target will be as follows;

Phase 1 (2005) Cleansing tax will cover 50% of overall SWM costs

Phase 2 (2012) Cleansing tax will cover 75% of overall SWM costs

Phase 3 (2020) Cleansing tax will cover 100% of overall SWM costs

d. Financial Control

Financial control by SWM services is not done by the cleansing department in both the GMs and DMs. But in order to provide efficient SWM services, it is very important to establish the separate accounting system by SWM services, and a budget planning system in the cleansing department. That does not mean to contract to private enterprises or to pay directly by the cleansing department, but that makes it necessary to feed back the information of actual revenue and actual expenditure periodically.

Actual revenue should consist of the cleansing tax, tipping fee and selling of usable materials. Actual expenditure should consist of current expenditure, including direct personnel expenses, indirect personnel expenses, contracting out expenses and other operation and maintenance expenses, and capital expenditure. It is necessary to feed back every quarter at least, while it is desirable to feed back every month between the financial department and the cleansing department.

The cleansing department should keep documents on the working records of staff and workers by SWM services and amount of fuel consumed by vehicles (including heavy equipment) by SWM services as well as maintenance report by vehicle every day. And the cleansing department reports the separate accounting expenses by SWM services to the general manager of the municipality and the director of the financial department. (It is necessary to be reported every half year, though it is desirable to be reported every quarter.)

Stocking and analysing these separate accounting data, the director of cleansing department requires the budget of next year with the issues to be improved.

7.3.4 Privatisation and Contracting System

Privatisation is not a means for overwhelming financial bottlenecks, as well as getting rid of personnel and maintenance costs as expressed by many of the municipal administrators. Every service has a cost in return; however, the essential principle centres around the maximisation of efficiency and cost minimisation. The main objective of private sector involvement is to reduce costs of service delivery, whilst maintaining and improving the level of supplied services. In order to judge the advantages and disadvantages of privatisation and of contracting out solid waste management services, each of the municipalities in Adana should assess their current unit costs and must implement a separate cost accounting system for themselves, detached from the general accounting system of the municipality.

Solid waste management is a significant public service which must be available for all citizens in order to maintain public health, and to protect the environment. Involvement of the private sector in solid waste management should increase competition, investment, competent management, and operation. Appropriate models to be used are contracting out for collection services and concession contracts for building, operating and transferring of waste treatment, processing and disposal facilities. In both cases, the responsibility for raising revenues to pay for these services will, however, remain with the municipalities. The objectives of the Build, Operate and Transfer (BOT) Law No. 3996 allow the provision of solid waste management related investments and services. The concession contracts based on BOT-models would gain a means to encourage private sector involvement, if regional

associations and unions are promoted and mobilised for collective treatment and disposal of solid wastes along with clinical and hazardous wastes. This is at least a preposition in regard of 'economies of scale' to operate manageable facilities.

In contracting out solid waste management services, the municipalities should introduce appropriate performance contracts for private sector involvement. This could be well achieved by inter-municipal co-operation, in which exchange of ideas and experience may take place. This co-operation can be carried to further stages for preparing draft tender documents with a typical draft contract clauses, which are developed on a systematic base. Identification of tasks in precise connections with terms of reference falls appropriate for the management of performance contracts and smooth monitoring of accomplishments. However, necessary legislating actions have to be undertaken, in order to authorise municipalities to enter into contractual commitments for certain periods exceeding one year.

The executive municipal personnel engaged in solid waste management and cleansing assignments have to be in a position to evaluate the benefits of contracting out selected services and concessions recognised for waste treatment and disposal facilities.

The municipalities in Adana that practise privatisation models have more or less the necessary expertise; (i) to prepare sound bidding documents with clear performance specifications, and (ii) to carry out competitive and transparent tender procedures. However, if those municipalities at the outset have a further breakdown of services along with a rough indication about unit costs, a more unique contracting system could be attained. This would further avail a clear performance monitoring. It should not be forgotten, on the other hand, that not only the municipalities, but also the candidate contractors are not sufficiently familiar with and experienced in the assessment of unit costs of contracted services. Therefore a certain period of time is required for both sides to be mutually more experienced in client and contractor relations in this sector for professional and institutional reasons.

For the time being, neither the private companies possess the required expertise, nor the conditions are favourable in street cleansing and waste removal business. As long as the municipalities regard privatisation as an escape from bureaucratic, administrative, and legislative handicaps as well as a cheaper way of manpower hiring, neither the quality of services get better, nor the required professionalisation in this sector could be achieved. The experiences mention that, given suitable guidance from proficient consultants or joint venture with internationally renowned contractors, some business opportunities may arise and waste collection, recycling, treatment and disposal contracts would be more attractive; particularly, if the disposal route is landfill rather than incineration or other process technologies. However, those companies will be looking for clear indications that the municipalities are looking for the best utilisation of money, not the cheapest price, and offering a reasonable contract duration.

7.3.5 Monitoring and Information Management System

Without any exception, all of the municipalities in Adana lack properly prepared, precisely organised guidance documents. Extensive dissemination of formalised and formatted information is rare, whereas verbal communications and transmission of

instructions are predominantly preferred in coarse of an hierarchically respected 'order and obey' principles among public and private personnel.

The essential handicap of the municipalities lies in the identification of unit costs of operations, which allow no monitoring action based on cost-benefit, cost-efficiency, and cost-effectiveness type of evaluation instruments. This deficiency hinders the development of an adequate decision making process related to managerial and operational issues, aided by accurate and quantitative assessments.

The absence of a set of technical and financial performance criteria prevents the executive personnel of the cleansing and solid waste management units to accurately determine requirements related to operations and projects. Developing and maintaining a database on solid waste management activities is therefore essential primarily for:

- Registering solid waste generators.
- Inspecting waste removal and disposal activities and facilities.
- Undertaking appraisals on potential public and private sector operations influencing the currently applied solid waste service.
- Auditing financial and operational performance as well as levels of cost recovery.
- Providing guidance for operations as well as proof of evidence for enforcement.

The data about costs, quality, and accountability is indispensable to judge the efficiency of services, effectiveness of performances, and affordabilities of cleansing and solid waste management units. A set of indicators could be used on a comparative basis, which is important for good management and decision making. Under current conditions in each of municipalities, no judgements can be made concerning the following throughout the fulfilment of the requirements of a successful solid waste management:

- The appropriateness of the mode of service applied.
- The performance of the involved public and private personnel and the service quality.
- Budgetary and financial affordability.

The respective solid waste management units of individual municipalities in Adana should be competent in: (i) preparation of contracts in compliance with legislation and regulations as well as professional and managerial requirements; (ii) inspection, supervision and control of operations as well as monitoring of implementations and enforcement; and (iii) assessment of service and financial performances.

Although the municipalities highly rely on public observations for performance records, technical instruments need also be developed and practised to identify goals and achievement rates throughout in-house and field services.

The monitoring and information management related recommendations for system improvement purposes are primarily oriented towards municipalities, such as Adana Greater Municipality, that apply full-privatisation and contracting out solid waste services. However, the Seyhan District Municipality that applies a semi-privatised model should clearly identify whether this option is preferred as a consequence of system deficiency in monitoring. The Yuregir District Municipality that applies a

non-privatised model on the other hand, should undertake a thorough comparative analysis, and be able to justify and to substantiate quantitatively why a non-privatised service mode is pursued in stead of a privatised one. A critical question should be posed here whether privatisation would have been preferred if the Yuregir District Municipality have had an effective monitoring and evaluation system.

For both Seyhan and Yuregir District Municipalities it should be made transparent that 'monitoring' and 'controlling' are two different concepts, that are, however, interchangeably applied. The public agencies usually try to compensate monitoring deficiencies by amplifying control mechanisms. Once the control mechanisms are set at a desirable level, then one can think about practising monitoring instruments. This is generally valid for all municipalities in Turkey.

In this regard, the Seyhan District Municipality may wish to carry the experiences made within a semi-privatisation framework to a full-privatised action field. The successfully applied control mechanism, as verbalised by the responsible personnel of the Seyhan District Municipality, could perpetuate respectively throughout a full-privatised model. When this transition takes place, more efforts must be mobilised for developing effective monitoring instruments.

The situation in the Yuregir Municipality on the other hand, is relatively critical, since a shift from a non-privatised model to a privatised one would require radical decisions. It would further mean an internal and institutional restructuring, which deserves a cautious transition period comprising step by step privatising and contracting approaches. This period has to be adequately commensurated with gradual introduction and implementation of identified monitoring instruments. In order to come up with such a radical decision, the responsible personnel of the Yuregir District Municipality needs first to convince themselves that control mechanisms on indoors and outdoors employees are effectively applied. Depending on such a secure basis, the Yuregir District Municipality could then be mentally in a position to tackle with monitoring instruments.

If the requirements of effective monitoring are not fulfilled, no efficiency maximisation effort could be taken up on a comparative basis. Implementation of improvement measures should rely on operational and quantitative data. Therefore, empirical analyses should be applied as technical instruments in identification of performance targets, and in assessment of success levels.

In this regard, the core staff of the solid waste management units pursuing a full-privatised service mode, has to be well equipped with necessary monitoring instruments. In such models, central monitoring and evaluation are essential for contracted services; which is the case for Adana Greater Municipalities.

For partial privatisation approaches, as experienced by the Seyhan District Municipality, the activities and performances of both municipal and hired personnel have to be monitored and evaluated.

In non-privatisation model, which is currently applied by the Yuregir District Municipality, effective monitoring and evaluation of activities and performances of the municipal personnel require a fair management mentality suitable for auto-criticism. Therefore, top-managerial posts should be occupied by open-minded employees, who are open to new approaches and innovations, rather than 'order and

obey' relations. In other words, they have to possess the willingness to implement monitoring instruments rather than insisting on control mechanisms.

Departing from the relevance of the reliable data for the following, an appropriate information management system has to be developed by each municipality pertaining basically to service provision and financial performance.

- Service related inputs (level, quality, and costs of services provided)
- Mobilisation of available resources (cost-effectiveness of services)
- Performance review (information base for policy making and managerial decisions).

A service provision oriented database has to precisely provide details on operation including number of premises; size of population served; type and volume of wastes collected; size of vehicle pool; distances travelled for collection, haulage and disposal; vehicles operating duration; service routes followed as well as means of collection. By attaching special attention to apportioned services provided and facilities shared by public and private parties, indicators based calculations have to be carried out for both total expenditures and individual costs. Accordingly, operating costs, employee costs, fuel costs, total capital costs and vehicle costs have to be associated with specific service characteristics to identify unit costs, such as costs per 1,000 of population served, cost per households served, cost per bin or container handled, and cost per ton of waste collected.

In order to identify financial performance in an accurate manner, beside fixed and variable costs, tax and revenues collected need to be identified. Adequate financial information required in this respect can be more easily obtained if a separate accounting system is applied for solid waste management. Otherwise, within the overall current and capital expenditures, and transfer payments flow of the municipality, it is not possible to differentiate between the costs attributable to diverse solid waste service categories.

Conclusively, a systematic information management is required for all municipalities in Adana to provide more accurate, relevant, comparable, and up-to-date assessments necessary for effective monitoring, which is in fact the functional building block of appropriate evaluation and decision making. In this regard, the fundamentals of the information system should comprise three main components, namely: (i) service provision; (ii) operational aspects; and (iii) financial records.

Information related to overall service provision should include:

- Service area, population and households size.
- Volume, weight and composition of wastes collected.
- Service mode and frequency.
- Characteristics of service fleet, equipment and means.
- Personnel size engaged in office and field services.
- Public complaints.

Operational information component, on the other hand, has to be structured on:

- Size of vehicle pool and duration of operations.
- Vehicle operation records.
- Vehicle operation costs.

- Personnel size and employment period.

Financial information component, lastly, should cover records related to:

- Vehicle operation costs.
- Labour costs.
- Office management costs.
- Unit costs of apportioned services per ton, person, household, employee, etc.
- Collected tax and revenues.

The document needs to be designed by taking into account further specific details not only for monitoring, but also for reporting purposes on daily, weekly, monthly, quarterly, or yearly basis. By this way, instrumental aid for an adequate monitoring would be provided leading to objective evaluations and strategic decisions connected with necessary planning, programming, scheduling, and budgeting aspects of implementation oriented actions.

7.3.6 Human Resources Development

The heads of the responsible departments in the greater municipalities or the directors of the related directorates in district municipalities engaged in solid waste management services have to be in a position to tackle with managerial issues encompassing both administrative and operational engagements. Administrative engagements include defining performance standards, accounting, financial management, contracting, regulation, and control functions related to maintaining standards, enforcement of licence conditions for waste removal, storage, treatment and disposal facilities and registering waste generators.

The decision making approach associated with the Head or the Director post has to rely on effectively applied diagnosis and prognosis techniques availing an appropriate basis for monitoring and evaluation, followed by implementation oriented preparations and actions. Accordingly the service area, size of target groups and their socio-economic and cultural status, volume of work, and the organisation of operations should be well determined by the person in charge.

Since the required qualification for such a post is relatively high under current conditions, the municipalities have to be very keen on appointing the most suitable persons, who might be already available in their own personnel, but have been neglected due to political or any other reason. Since a particular training program in compliance with the acquisition of above mentioned skills is not presently available, the solid waste managers should be eager to undertake investigations and researches to intensify their knowledge on own initiatives. Therefore, every occasion for self-training has to be provided to the employees bearing such an eagerness.
A rough distinction can be made between the Deputy Heads or the Deputy Directors; normally two, each supervise internal (in-house / indoors) management and external (field / outdoors) operations. Internal activities should focus on following subjects, which could be dealt with by respective division or section chiefs. These subjects of concern are related to: (i) administrative and personnel recruitment issues, (ii) legislative and regulatory issues; (iii) accounting, financial, and budgetary issues. Similarly, the following external activities could also be dealt by a respective division or section chief. These subjects of concern are: (i) operational organisation,

supervision, inspection and performance assessment; (ii) logistics, support services, repair and maintenance; and (iii) manual development and personnel training.

This prototype model on division of labour in a certain solid waste management unit could be subjected to further diversification in accordance with the professional and the qualifications needed by respective municipalities, versus available human resources.

Although the size of in-house management staff has to vary due to volume of work, determined by the size of service area, target group and service mode, this staff constitutes a permanent core unit, which has to exist with respective experts no matter full-privatisation, semi-privatisation, or non-privatisation model is applied in service delivery.

The size of outdoor operations staff, on the other hand, is determined by the service mode, size of service area, and target group. This staff possesses a flexible character and is subject to variations according to full-privatisation, semi-privatisation, or non-privatisation model applied in service delivery. The size of municipal personnel engaged in outdoor operations will diminish in case of full-privatisation, proportionally correspond in case of semi-privatisation, and increase in case of non-privatisation. This affirmation is conversely valid for the size of hired personnel of the private contractor.

The normative personnel standards correspondingly developed for managerial and operational personnel size, would give indications on manpower requirements of each individual municipality by taking into account the needed qualification and specialisation as well as applied service mode.

The background and further training of the mid-career staff is extremely important, because they have to provide upwards and downwards support within the functional and vertical stream of activities. Unfortunately, training possibilities for mid-career staff engaged in solid waste management assignments are enormously limited or almost absent in Turkey. Therefore, top level municipal administrators have to devote a specific regard to training issues and intend to find pragmatic solutions. A strong recommendation in this respect is to get in touch with more experienced greater municipalities and municipal unions and ask for their assistance. Such contacts and requests should also be extended to internationally organised public institutions and associations and NGOs, e.g., Municipal Association of Turkey (TBD-Turkiye Belediyecilik Dernegi), and IULA (International Union of Local Administrations), interested in providing training programs to local administrations and communal agencies.

Another recommendation could be the strengthening of experience and idea exchange engagements or inter-municipal coordination between greater and district municipalities in Adana. This would naturally provide a platform to discuss and evaluate the experiences made by individual municipalities in diverse solid waste management issues. Especially the debates on privatisation practices, transmission of experiences and ex-post-facto evaluations would be extremely valuable and beneficial. It would, for instance, be very interesting to hear the confers of the Adana Greater Municipality, Seyhan District Municipality and Yuregir District Municipality, which implement full-privatised, semi-privatised, and non-privatised service models, respectively.

Beside the above mentioned efforts oriented towards the training of top-level and mid-career management staff of the solid waste management units of individual municipalities in Adana and Mersin, systematically developed training programs have to be offered to the municipal and/or private personnel engaged in operational services of solid waste management. Although such personnel is subjected to short-term training programs applied by certain municipalities at modest levels, their qualificational up-grading is unavoidable. It would be a rational approach, if these training courses are designed on manual basis, where the practices are amply described and illustrated.

The training programs should be designed and tailored for the development of formal basis of managerial and operational activities. Implementations in line with manuals, guidelines, instructions should be introduced and demonstrated on basis of formalised procedures, formatted transmissions, schematic organisations supplemented by phasing and scheduling techniques, bar-charts and checklists. These should be the training tools used by trainers and multiplicators for dissemination of knowledge and experience.

In order to rationalise the training related endeavours and to meet the urgent requirements in this respect, the municipalities have to possess the intention for collective organisations. This is the way, in which the burdens are tremendously minimised and multiplicator effects, in contrary, are effectively maximised. Training concerned collective approaches in the Cukurova Region could be more easily promoted to advance levels, if inter-municipal co-operation is realised in specific joint operations; e.g., facility management, recyclables marketing, hazardous waste disposal, etc. A certain degree of experience gained in a couple of concrete partnerships would open new and diverse lanes for further co-operation opportunities. Therefore, the relevance of municipal unions should be reconsidered by the municipalities in Adana with respective task attributions, where high priority is placed to training activities.

7.3.7 Public Education and Co-operation

a. Basic Concept

Public education and co-operation are important components of any integrated SWM program. In view of limited resident participation in SWM and low public awareness of waste problems in Adana, there is a need to inform the public of the SWM problems, e.g., increasing waste volume, environmental deterioration, and inappropriate handling procedures, etc.

With the exception of isolated cases, e.g., waste separation at household level, which is done informally by the “eskici”, such activities are frequently do not consider sensitive participants through inductive talks, and education on appropriate solid waste management and segregation.

Another reason for the importance of public education is the need to introduce to the public the idea that it is the responsibility of each individual to engage in activities that would not only improve the environment, but also their standard of living. The public also need to initiate waste minimisation through a separate collection system and community based recycling programs, and change their consumption patterns, so

that eventually they can pass on their knowledge and experiences to the future generation.

In this sense, education programs for the public would pave the way for achieving the ultimate goals of this study:

- To reduce the amount of waste being produced (waste minimisation)
- To recycle waste as much as possible (recycling)
- To dispose wastes, that cannot be recycled, in an environmentally-friendly manner (waste stabilisation)

b. Specific Issues

b.1 Importance of Aesthetics and Environmental Issues

There is a need to raise public awareness on regional environmental issues and the benefits that result from a cleaner environment. The need to conserve non-renewable natural resources should also be emphasised.

b.2 Importance of Proper Waste Handling Practices

Most of the wastes are discharged and collected using communal containers without any form of segregation, except the items separated to be sold to *eskici*; the residents are hardly aware of the SWM problems. Therefore, it is important to promote the use of appropriate containers and storage methods for waste prior to collection. Separate collection is indispensable to waste volume reduction, resource recovery, and in particular, for the improvement of the environment and quality of life.

b.3 Responsibilities of Individuals, Various Groups and Authorities Regarding SWM

The municipalities in the target area are lack of properly prepared and precisely organised guidance to inform the public on waste minimisation and on the importance of recycling. On the other hand the public need to cooperate with the authorities that manage waste collection, haulage, treatment, and disposal

b.4 How the Public Can Make a Change. What They Could do to Assist Future SWM

The public, as consumers, have the power to change consumption pattern as well as the quality of manufactured goods and packaging, through selective purchasing, e.g., refraining from buying virgin materials, non-biodegradable plastics. Conversely, the use of goods made from recycled materials should be encouraged. As producers of waste, the different methods of waste minimisation, recycling, and conscientious discharge manners can be discussed.

b.5 Promotion of Public Interest in Future SWM

The authorities can encourage public motivation to participate and devise a SWM system, suitable for to the local culture and common practices.

c. Main Players in SWM for Public Education and Co-operation

Since the MoE (Ministry of Environment) aims to recycle 90 % of MSW in the country by enforcing municipalities to apply separate collection system, the public

co-operation for the separation of their waste is the most critical issue. Public co-operation for proper MSW management could be only achieved through a long, continuous public education by the relevant agencies. The relevant parties that aim to devise an MSWM public education program, and solicit co-operation is listed below:

Public Players: Administrative entities generally concerned with SWM

- MoE: Ministry of Environment
- MoD: Ministry of Education
- Greater Municipalities of Adana (departmental office related to social promotion activities)
- District Municipalities in Adana GMs
- Schools

Community Players: Power potential entities for the source separation and recycling.

- Community residents (potential communal actors: housewives, "kapicis" (doorkeepers), "eskici" (recycling material pickers), children, etc.).

Moderate Players: Both public and private entities covering niches of SWM services.

- NGO's organisations
- Voluntary workers, etc.

d. Experiment on the Separate Collection

In order to examine the needs and the method of obtaining public co-operation to separate collection, the JICA team, in collaboration with the C/P, conducted the experiment on separate collection in Mersin. Many valuable experiences were gained, from the experiment, for future expansion of separate collection. Among them an education book produced by the team is considered an important tool for public education, and it could be a base for an SWM education book for the country.

7.3.8 Guidelines

a. General

Political Guidelines:

- Placing top priority to collaborative, co-operative, and co-ordinative actions as well as participatory and contributory initiatives.
- Promoting inter-municipal support, and collective and joint actions, in coping with solid waste management problems.
- Creating organisations for information exchange, transmission of experiences, and exchange of new ideas.
- Strengthening regional and local links in common issues of concern.
- Providing inter-municipal support for new projects, investments, implementations, and measures.
- Promoting regulatory, managerial, operational, functional, and technological developments.

- Providing professional incentives and encouraging training for human resources development.
- Devoting particular attention to public awareness as a socio-cultural factor necessary for prospective actions, especially in separate collection, recycling and resource recovery practices.
- Promoting rehabilitation, restoration, up-grading and aftercare projects for diverse facilities.
- Intensifying co-operation possibilities with other local actors; governmental agencies, private business and industrial enterprises, public service entities, non-governmental organisations, academic institutions, mass media and publicity.

Legislative Guidelines:

- Gathering and compiling relevant laws and regulations on solid waste management in a concise manner.
- Identifying legal instruments to ensure and to preserve competitiveness in contracting out services within the mechanisms of free business market to encourage appropriate private sector involvement.
- Allowing auditing for intra-municipal as well as contracted out services.
- Mobilising and enforcing provisions resulting in higher service performances.

Administrative Guidelines:

- Warranting the best utilisation and mobilisation of available human resources and expertise.
- Accrediting qualification in appointments for specific posts.
- Developing an adequate administrative organisation scheme by taking into account type, size, scope,and content of works to be accomplished.
- Distinguishing between management and operations oriented structuring models.
- Preparing personnel standardisation concepts and precise job descriptions.
- Formalising and formatting internal and external information flow.
- Establishing a database, and promoting quantification of expressions.
- Human resources development and staff training requirements.

Managerial Guidelines:

- Distinguishing between administrative management and operations management responsibilities.
- Establishing system fundamentals for comparative analyses.
- Setting the building blocks for problem identification; problem solving oriented preparations and decision making; financing, budgeting and programming;

action organisation; implementation; monitoring, performance assessment, evaluation and reporting.

- Identifying the most advantageous service mode on comparative basis.
- Preparing thorough tender documents and following transparent contracting procedures.
- Undertaking necessary steps for identifying unit costs by implementing a separate accounting and budgeting system particular for solid waste management services.
- Assessing financial terms and costs on unit and item basis.
- Promoting operationalisation and quantification of decisions and actions.
- Relying on empirical assessments and expressions in strategic evaluations and formulations.
- Keeping statistical records and preserving updating habits in information management.

Operational Guidelines:

- Developing standards for operations as well as working principles for field services.
- Setting and scheduling target dates for efficiency improvement.
- Describing precisely the apportionment of solid waste management services and preparing a set of instructions and directives for the particular tasks to be carried out.
- Meeting organisational and logistical requirements of operations management.
- Providing effective maintenance for vehicles and equipment.
- Developing systematic tools for field monitoring, inspection and performance measurement.
- Evaluating and reporting the service achievements and operational deficiencies.
- Preparing recommendations and proposals for the elimination of operational gaps in the delivery of services.
- Elaborating on rationalisation measures by investigating each portion of service particularly with regard to manpower, equipment, vehicular, material and financial allocations.

Technical Guidelines:

- Preparing guidance documents, manuals and handbooks, which indicate and illustrate the techniques of operations and handling of equipment.
- Promoting technical training of logistical and operational staff and conducting workshops and course programs.

- Preparing auditing checklists for municipal and private company performances covering financing and cost aspects.
- Developing project appraisal as well as project based accounting and budgeting skills.
- Elaborating issues on self-sufficiency and affordability at municipal, departmental and sectional levels.
- Introducing 'cost recovery' and 'service charge' concepts in dealing with financial aspects of provided services.
- Preparing specimen contracts and related performance documents.
- Identifying technical assistance and expert service requirements.

These guidelines formulated above depend on a logical and systematic frame, in which:

- Policy guidelines refer to overall orientation and optional preferences in delivery of solid waste management services.
- Legislative guidelines relate to intangible tools describing field of activities associated with respective authorisations and responsibilities.
- Administrative guidelines comprise the structural and organisational setting in accordance with political preferences and legislative obligations.
- Managerial guidelines give indications pertaining to decision preparation and rational decision making.
- Operational guidelines are pertinent for purposeful actions and implementations.
- Technical guidelines constitute tangible tools for efficiency enhancement.

When considered as individual aspects of an integrative package, all these guidelines determine the institutional structure of the greater and district municipalities in Adana with due references to their service styles in solid waste management assignments.

b. Guidelines for Seyhan and Yuregir DMs

Guidelines for the Cleansing Directorates of the Seyhan and Yuregir District Municipalities can be categorised in two sections. The primary guidelines are those, which are valid for all respective directorates and district municipalities in general. The supplementary guidelines, on the other hand, are those which are more particular in character and require specific reference.

Primary Guidelines:

- The cleansing directorates of both district municipalities in Adana have to be aware of the fact that, they must ultimately be motivated towards improvement of their managerial capabilities.
- In this connection, with available personnel employed in the office for administrative services, more achievements in field operations must be attained.

This issue however has to be more seriously considered by the Cleansing Directorate of the Yuregir District Municipality.

- System betterment approaches ought to be undertaken in administrative, managerial and operational activities based on better mobilisation and organisation of personnel, vehicular and instrumental means as well as monetary resources. Efficiency criteria must be primarily referred by the Cleansing Directorates for internal evaluation and self-criticism, particularly by the Yuregir District Municipality.

- Technical up-gradings and capacity enhancements must be attained for more rationality in SWM services. More practical and efficient means; such as, wheeled containers, must be injected into the system, particularly in Yuregir without any further delay.

- The requirement for establishing a systematic base for unit costs calculations must be acknowledged as indispensable for transparency and rationality in decisions and actions.

- Prior to any policy decisions related to privatisation and contracting, cost-effectiveness principle must be appropriately applied, especially by the Cleansing Department of the Yuregir District Municipality.

- Managerial capabilities and service performances have to be alternatively and comparatively analysed by cleansing directorates on basis of service segments, before identifying political preferences towards privatisation.

Supplementary Guidelines:

- For more efficiency in SWM, both district municipalities in Seyhan and Yuregir should look after further intensification of inter-directorial collaboration and horizontal co-operation.

- Inter-directorial linkages should be particularly intensified in personnel recruitment, accounting and financial management for more effective administration of services, if reorganisational approaches within the municipality are not preferred.

- Organisation of logistic services encompassing maintenance and repair must be reviewed by both district municipalities, in order to identify whether some steps towards more rationality could be undertaken by alternative managerial and / or political approaches.

- Internal decentralisation of authority and / or redistribution of assignments without any change in personnel size, has to be seriously and critically reconsidered by the Yuregir District Municipality for a more effective management of solid waste services.

- Current level of external collaboration, especially of the Seyhan District Municipality with industrial plants operated under private entrepreneurial management, should be substantially improved.

- The support need of the Cleansing Directorate of the Seyhan District Municipality for supervision and control should be internally re-evaluated.

- Elaborations should be undertaken to meet 25 additional personnel demand of the Cleansing Directorate of the Seyhan District Municipality and 200 additional skilled personnel demand of the Cleansing Directorate of the Yuregir District Municipality.
- Limited experience of the Cleansing Directorate of the Seyhan District Municipality should be enriched by more information exchange and transfer of experiences from other municipalities.
- In order to avoid conflicts with the contractor, more attention should be paid by the Cleansing Directorate of the Seyhan District Municipality to due payments.
- Both directorates of the district municipalities in Adana should try to be more documentary and formal in informative and instructive transmissions.
- The contract should not be the only source of reference for monitoring of SWM services. A manual has to be immediately developed for private and municipal personnel in this respect.
- The Cleansing Directorates, but particularly of the Yuregir District Municipality, should be more actively involved in and informed about financial matters in SWM services.
- More effort should be given by both district municipalities for preparation and offer of human resources development and personnel training programs, not only for operations of field staff but for administrative and managerial duties of office staff, as well.

7.3.9 Medical SWM

a. Legislation

The legal tool currently available is meticulous in style, but it is without deficiencies; in order for the regulations to be an effective tool for medical institutions to control of medical waste, there is a need for the MoE, in consultation with medical professionals, academics, political analysts, etc., to revise the regulation in the near future.

The survey on medical institutions in Adana revealed that the regulation's good intentions are not conveyed to the users – the hospitals and the waste collection staff. Communication is of vital importance in any management task, and medical waste management is no exception. A solid, comprehensive transcription of the hospital's and the district municipality's obligations under the regulation, or a code of practise, would be a powerful implement to tackle the current problems in medical waste management.

The first step in preparing a code of practise is to identify who the code is for and what their obligation is under the medical waste regulation. The next step is to gather the opinions of all the main parties involved, so that real problems can be identified, and agendas brought to the open. The good intentions of any guideline that does not integrate the problems faced by those involved would be redundant, for the code would merely be another bureaucratic handout with no real value. Only in developing a code of practise for all of those responsible for the safe management of medical

waste would the authorities provide the means to achieve what the regulation set out to do as an objective.

b. Education & Human Resource Development

In the current world of information technology, knowledge has become a determining factor of development. And the lack of knowledge has hindered, in many parts of the world, the efforts of law makers and academia to improve the knowledge base of its people. Another problem that causes the knowledge gap is that education programs are sometimes introduced in a way that is not informative, thought provoking, and motivating, but is dictating, uninformative, and, most of all, uninteresting. The only results of this type of education program are wasted tax money, wasted resources, and a disgruntled public that sees only the failures of the program.

In the case of Adana it is evident that the hospitals frequently hold training programs for their waste management staff, but there is no way to determine whether the knowledge is being passed on, and that the staff involved are given the opportunity to reflect upon what they have been taught. Also the study revealed that the workers who handle medical waste outside the hospital, i.e., waste collection staff and landfill operators receive no training. The indifference to sanitation outside the medical institutions, as seen by the poor waste management practises at the hospitals and at the landfill site, is an indication, perhaps, of a failure in the training of staff by both the hospitals and the authorities.

The first step in developing an effective education program is to assign a think-tank with representatives from the following:

i. Ministry of Environment
ii. Ministry of Health
iii. Ministry of Education
iv. Greater Municipalities of Adana and Mersin
v. District Municipalities of Adana and Mersin
vi. Academic institutions
vii. Healthcare professionals
viii. Representatives of waste collection workers and private waste collection companies

c. Enforcement and Monitoring

An effective monitoring system is one of the most efficient means for the authorities to manage not only medical waste, but also municipal waste, industrial waste, hazardous waste, and municipal finances. It is also an effective means for the authorities to administer the healthcare expenditures in both private and public hospitals, so that the information can be used to plan fiscal matters.

The provincial governments of Adana and Mersin have records on the amount of medical waste generated each month, but the study revealed that none of the hospitals have their medical waste weighed. In addition, the disposal sites did not have a weighbridge at the time that the data was collected, questioning the validity of the

information kept by the provincial governments. This questionable data, collected by the provincial government, is a clear symptom of an inadequate monitoring system.

It is nearly impossible for the authorities to collect the correct amount of dues for waste collection, to enforce the law in an efficient and democratic manner, to impose penalties on those who violate the system, and to make concrete future plans using inaccurate information. Therefore, the authorities must strive to collect reliable data at all times so that there is less outlay over the long term.

One of the ways in which the authorities can gather information that is reliable is to introduce a relational database system for all the administrative tasks.

There is a need to truly identify the problems faced by hospitals before the authorities introduce any new legislation, or new changes, for there may be a deeper, underlying problem – totally unrelated to medical waste – as to why hospitals are indifferent, or have an unrealistic perception of the true situation.

7.4 The SWM Master Plan

7.4.1 The SWM Master Plan

The SWM master plan for Adana GM is summarised in the table below.

Table 7-9: The SWM Master Plan for Adana

Phase / Components	Present (1999)	Phase 1 (2000 - 2005)	Phase 2 (2006 - 2012)	Phase 3 (2013 - 2020)
1. MSW Generation				
Population in Adana GM	**1,196,620**	**1,479,477**	**1,831,770**	**2,268,174**
Seyhan DM	859,170	1,099,454	1,395,243	1,756,713
Yuregir DM	337,450	380,023	436,527	511,461
MSW Amount (ton/day)				
Generation	834	1,200	1,739	2,355
Discharge	803	1,169	1,701	2,308
Collection	780	1,158	1,695	2,308
MSW Composition (%)				
Non-compostable	33	43	51	55
Compostable	67	57	49	49
2. Refuse Collection & Transportation				
Collection rate	100 (97% by POS)	100 %	100 %	100 %
Ratio of improper disposal to generation	1.7 %	0 %	0 %	0 %
Separate collection rate to refuse collection	0 %	30 %	60 %	100 %
Collection system	Communal container, curb side and door to door collection	Communal container collection (point collection)	Communal container collection (point collection)	Communal container collection (point collection)
Types of communal container	Mixed and various kinds of container	800 lit. wheeled container	800 lit. wheeled container	800 lit. wheeled container
Major type of vehicles (units)	Compactor trucks (16 m^3): 71 Tractor trailer (6 m^3):50 Lorry: 1 Collection truck for medical waste: 2	Compactor trucks (16 m^3): 77 Collection truck for medical waste: 2	Compactor trucks (16 m^3): 141 Collection truck for medical waste: 2	Compactor trucks (16 m^3): 256 Collection truck for medical waste: 3
Transportation system	Direct haulage	Direct haulage	Transfer system if a future disposal site locates more than 20 km from city centre	Transfer system if a future disposal site locates more than 20 km from city centre
Executing organisation	Seyhan and Yuregir DMs	DMs and Private contractors employed by DMs	Majority of the work done by private contractors employed by DMs	Private contractors employed by DMs

Phase / Components	Present (1999)	Phase 1 (2000 - 2005)	Phase 2 (2006 - 2012)	Phase 3 (2013 - 2020)
Unit cost (US$/ton)	24.8	25.3	24.6	22.7
3. Public Area Cleansing				
Method of sweeping	Machinery and manual labour	Machinery and manual labour	Machinery and manual labour	Mainly machinery
Length of served road (km)	718	888	1,100	1,363
Operation by	Private contractor and Yuregir DM	Private contractor	Private contractor	Private contractor
Unit cost (US$/ton)	186	186	186	186
4. Recycling Intermediate Treatment				
Sorting plant Site Treated amount (ton/year)	 None 0	 Sofulu 54,538	 Sofulu and new landfill 189,346	 New landfill 463,331
Unit cost (US$/ton)	None	13.4	13.0	13.0
Compost plant Site Treated amount (ton/year)	 None 0	 Sofulu 72,294	 Sofulu and new landfill 181,921	 New landfill 379,089
Unit cost (US$/ton)	None	15.0	14.6	14.9
Recycling at generation	25 (ton/day)	31 (ton/day)	38 (ton/day)	47 (ton/day)
Overall recycling rate	5.9 %	9.7 %	15.2 %	23.3 %
Recycling system	No organised recycling and mainly done by private sector	Government related recycling system be established.	Government related recycling system be expanded.	A closed loop society will be created.
5. Final Disposal				
Method of operation	Open dumping	Sanitary landfill	Sanitary landfill	Sanitary landfill
Final disposal site	Sofulu site	Sofulu site	New landfill	New landfill
Distance from city (km)	10	10	20	20
Operation by	Private contractor	Private contractor	Private contractor	Private contractor
Nos. of workers	11	11	34	85
Tipping fee (US$/ton)	None	13.1	13.1	13.1
Unit cost (US$/ton)	0.8	9.4	9.5	9.6
Main equipment	Bulldozer: 2 Tractor with trailer: 3 Wheel loader: 1	Bulldozer: 3 Excavator: 1 Dump truck: 3 Water tanker: 1	Bulldozer: 4 Excavator: 1 Dump truck: 3 Water tanker: 1	Bulldozer: 4 Excavator: 1 Dump truck: 3 Water tanker: 1
6. Maintenance & Repair				
Preventive Maintenance	Municipal and private workshop	Municipal and private workshop	Municipal and private workshop	Private workshop
Major repair	Municipal and private workshop	Private workshop	Private workshop	Private workshop
Operation by	DMs and private	DMs and private	DMs and private	Private company
7. Public Organisations Responsible on SWM	Adana GM for treatment, transfer operation, final disposal and part of public area cleansing. Seyhan and Yuregir DMs for collection and part of public area cleansing.			
8. Financial Matters				
Unit SWM Cost (US$/ton)	39.2	49.3	49.8	50.9
Revenue Source	• Cleansing tax • Budget allocation from general finance	• Cleansing tax • Budget allocation from general finance • Sale of recyclables and compost • Tipping fee	• Cleansing tax • Budget allocation from general finance • Sale of recyclables and compost • Tipping fee	• Cleansing tax • Sale of recyclables and compost • Tipping fee
Collection rate of cleansing tax (%)	N/A	90	90	90
Coverage rate of cleansing tax to SWM	8.1 %	58 %	77 %	107 %
Total revenue (US$ 1,000)	12,778	28,730	33,428	45,016
Cleansing tax (%)	10.7	38.4	58.2	71.6
Budget allocation from general finance (%)	89.3	55.0	25.2	None
Sale of recyclables and compost (%) Tipping fee (%)	None None	5.2 1.4	14.8 1.8	26.5 1.9
Total revenue per capita (US$)	11.1	19.4	18.2	19.8
Municipal Budget (thousand US$)	102,104	133,663	170,585	222,577

Components \ Phase	Present (1999)	Phase 1 (2000 - 2005)	Phase 2 (2006 - 2012)	Phase 3 (2013 - 2020)
Adana GM	60,052	82.372	108,567	145,777
Seyhan DM	26,609	32,364	39,048	48,246
Yuregir DM	15,443	18,923	22,970	28,555
Share of SWM budget	11.2%	11.8%	4.9%	0 %
9. Privatisation	Landfill operation and cleansing works other than Yuregir DM are contracted	Majority of the work will be contracted to private companies.	Most of the work will be contracted to private companies.	All of the work will be contracted to private companies.
10. Public Co-operation	There are very little public education programs and co-operation	Conduct of active public education and co-operation campaigns	Conduct of active public education and co-operation campaigns	Promotion of waste minimisation and recycling campaigns
11. Medical SWM				
Generation (ton/day)	4.4	6.2	8.9	12.7
Treatment at generation	Very limited	Majority	All institutions	All institutions
Final disposal	Open dumping	Sanitary landfill at Sofulu medical waste disposal site	Sanitary landfill at new landfill site medical waste disposal site	Sanitary landfill at new landfill site medical waste disposal site
Final disposal operation	Adana GM	Adana GM	Inter-municipal operation	Inter-municipal operation
12. Industrial SWM				
Generation of HW (hazardous waste) (ton/day)	55,000	N/A	N/A	N/A
HW treatment	None	Treat at generation or kilns of cement factories or plant at Izmit	Treat at generation or kilns of cement factories or plant at Izmit	Treat at generation or an treatment plant to be constructed for Cukurova region
Final disposal	Few control and possibility of HW dumping at Sofulu disposal site	Prohibit and control HW disposal at Sofulu and oblige disposal at Izmit or Izmir	Prohibit and control HW disposal at new landfill and oblige disposal at Izmit or Izmir	Dispose of at a HW landfill to be constructed for Cukurova region

7.4.2 Preliminary Project Cost Estimation

a. Cost Estimation Items

A Cost estimation of the GM in 2020 is required for the followings.

- Refuse Collection and Transportation Costs
- Public Area Cleansing Costs
- Intermediate Treatment and Recycling Costs
  - Sorting Plant
  - Compost Plant
- Final Disposal Costs

b. Unit Cost for Cost Estimation

The US dollar is used for the calculation, as the Turkish Lira is unstable. The calculation uses the May 1999 prices at an exchange rate of US$ 1 = 407,000 Turkish Lira. The depreciation period for facilities, heavy machinery, equipment, and the residual value are shown in the table below.

Table 7-10: Depreciation Period of Facility and Equipment

Items	Depreciation Period (Year)	Residual Value (%)
Vehicle and heavy machinery	7	10
Machinery	15	0
Building	30	0

Note: The life span of civil works and facilities other than buildings depends on the period of its operation.

The unit cost of each item is shown in the table below.

Table 7-11: Unit Cost

Item		Unit Cost (US$/ton)
Refuse Collection & Transportation		22.7
Public Area Cleansing		186.0
Intermediate Treatment and Recycling	Sorting Plant	13.0
	Compost Plant	14.9
Final Disposal		9.6

c. Waste Amount for Each Items

c.1 Refuse Collection & Transportation and Public Area Cleansing Amount

Refuse collection and public area cleansing amount are shown in the table below.

Table 7-12: Refuse Collection & Transportation and Public Area Cleansing Amount

Item	Unit	AGM	SDM	YDM	Sub Total	Total
Refuse Collection & Transportation	ton/year	0	573,213	232,085	805,298	842,420
Public Area Cleansing	ton/year	12,062	20,797	4,263	37,122	

c.2 Recycling Intermediate Treatment Amount

Intermediate treatment amount is shown below.

- Sorting plant: 463,331 ton/year
- Compost plant: 379,089 ton/year

d. Landfill Disposal Amount

Landfill disposal amount is 394,670 ton /year.

7.4.3 Implementation Plan

a. Implementation Plan

Taking the targets and strategies into consideration, the SWM master plan shall be implemented in steps. A proposed implementation plan is presented in the table below.

b. Project Costs

Based on the above implementation plan the M/P project costs are summarised in the table below.

Table 7-13: Implementation Plan of the Master Plan for Mersin GM

Implementation Plan of SWM M/P for Adana

	Activities	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
TECHNICAL SYSTEM																							
T1	**Discharge and Storage System**																						
1.1	Elimination of improper self-disposal																						
1.2	Improvement of a public container system																						
	a. Procurement of wheeled containers																						
1.3	Establishment of a separate discharge system																						
	a. Procurement of public containers for compostable wastes																						
T2	**Collection and Haulage System**																						
2.1	Improvement of collection/haulage system																						
	a. Procurement of compactor trucks																						
	b. Operation & maintenance of collection vehicles																						
2.2	Establishment of a separate collection system																						
	a. Detailed design of a separate collection system																						
	b. Procurement of collection trucks for non-compostable wastes																						
	c. Operation & maintenance of collection vehicles																						
2.3	Establishment of a transfer system (if landfill locates far)																						
T3	**Public Area Cleansing System**																						
3.1	Improvement of the public area cleansing system																						
	a. Procurement of mechanical street sweepers																						
	b. Operation of public area cleansing system																						
T4	**Establishment of Recycling and Treatment System**																						
4.1	Establishment of a government related recycling system																						
4.2	Construction of a sorting plant at Sofulu																						
	a. Detailed design of the sorting plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation			○																			
	d. Operation & maintenance of the plant																						
4.3	Construction of a compost plant at Sofulu																						
	a. Detailed design of the compost plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation			○																			
	d. Operation & maintenance of the plant																						
4.4	Construction of a sorting plant at future landfill (Phase 2)																						
	a. Detailed design of the sorting plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation											○											
	d. Operation & maintenance of the plant																						
4.5	Construction of a compost plant at future landfill (Phase 2)																						
	a. Detailed design of the compost plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation											○											
	d. Operation & maintenance of the plant																						
4.6	Construction of sorting plants at future landfill (Phase 3)																						
	a. Detailed design of the sorting plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation																		○				
	d. Operation & maintenance of the plant																						
4.7	Construction of a compost plant at future landfill (Phase 3)																						
	a. Detailed design of the compost plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation																		○				
	d. Operation & maintenance of the plant																						
T5	**Establishment of a Sanitary Landfill**																						
5.1	Rehabilitation of the present landfill																						
	a. Rehabilitation of the present landfill																						
5.2	Construction of Sofulu sanitary landfill																						
	a. Detailed design of the disposal site																						
	b. Construction of the disposal site																						
	c. Procurement of equipment for the site operation			○					○		○												
	d. Operation & maintenance of the site																						
5.3	Selection of a future landfill site																						
	a. Site selection and F/S including EIA																						
5.4	Construction of a future landfill																						
	a. Detailed design of the disposal site																						
	b. Construction of the disposal site																						
	c. Procurement of equipment for the site operation											○				○		○					○
	d. Operation & maintenance of the site																						
T6	**Establishment of a Proper Medical Waste Disposal System**																						
6.1	Establishment of treatment system at generation																						
6.2	Urgent improvement of collection haulage system																						
	a. Procurement of collection vehicles		○																				
	b. Final disposal of medical waste at designated area of Sofulu site																						
6.3	Establishment of final disposal system at Sofulu disposal site																						
	a. Detailed design of the disposal site																						
	b. Construction of the disposal site																						
	c. Procurement of equipment for the site operation			○							○												
	d. Operation & maintenance of the site																						
6.4	Establishment of final disposal system at future disposal site																						
	a. Detailed design of the disposal site																						
	b. Construction of the disposal site																						
	c. Procurement of equipment for the site operation																	○					
	d. Operation & maintenance of the site																						

Table 7-14: Cost Schedule of the Master Plan Projects for Mersin GM

Unit: US$ 1,000

ADANA			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Separate Collection System	Container	Invest		33	4	4	4	4	4	33	37	9	13	7	9	9	37	42	14	18	12	14	0
	Compactor	Invest		1,664	320	384	384	384	320	384	2,112	3,136	1,024	1,088	960	896	960	2,752	3,712	1,664	1,792	1,600	0
		O&M for Compactor			1,066	1,271	1,517	1,763	2,009	2,214	2,460	2,747	4,551	4,961	5,412	5,781	6,150	6,519	6,929	7,298	7,708	8,159	8,569
Plant	Sorting Plant	Design & Supervision	199								471							1,152					
		Invest. for civil work		661								1,567							3,827				
		Invest. for machine		2,597								6,155							15,037				
		Invest. for V&E		435							435	1,031						435	3,550				
		O&M			446	446	446	446	446	446	446	446	1,503	1,503	1,503	1,503	1,503	1,503	1,503	3,639	3,639	3,639	3,639
	Compost Plant	Design & Supervision	365								526							1,329					
		Invest. for civil work		1,208								1,740							4,397				
		Invest. for machine		4,570								6,581							16,635				
		Invest. for V&E		1,000							1,000	1,440						1,000	5,080				
		O&M			549	549	549	549	549	549	549	549	1,340	1,340	1,340	1,340	1,340	1,340	1,340	2,789	2,789	2,789	2,789
Final Disposal	Municipal Waste	Design & Supervision	1,007				191				1,488				217				125				
		Invest. for civil work		10,790				13,676				12,911				15,535				8,926			
		Invest. for V&E		1,691					434		1,691					434		1,914					
		O&M			331	331	331	331	360	378	378	378	370	370	370	370	396	396	396	396	330	330	330
	Medical Waste	Design & Supervision	48								107												
		Invest. for civil work		972								2,182											
		Invest. for V&E		341							341							341					
		O&M			23	23	23	23	23	23	23	23	35	35	35	35	35	35	35	35	35	35	35

(Note): V&E: Vehicles and equipment

7.5 Financial Analysis

7.5.1 Overall SWM Costs

a. Investment Plan

The required investment for each phase of the M/P is outlined in the following table.

Table 7-15: Investment Costs of Master Plan for Adana

unit: US$ 1,000

	Phase 1 (1999-2005)	Phase 2 (2006-2012)	Phase 3 (2013-2020)	Total
Separate Collection	3,185	9,136	13,522	25,843
Sorting Plant	3,892	9,659	24,001	37,552
Compost Plant	7,143	11,287	28,441	46,871
Final Disposal	27,355	16,741	27,368	71,464
Medical Waste Disposal	1,361	2,630	341	4,332
Total	**42,936**	**49,453**	**93,673**	**186,062**

b. Overall SWM Costs

The overall SWM costs, including depreciation and O&M costs, for the principal years covered by the M/P are as shown in the following table.

Table 7-16: SWM Costs for Adana

unit: US$ 1,000

	Present*	2005	2012	2020
Collection & Haulage	6,293	10,080	14,469	18,265
Public Area Cleansing	3,455	4,449	5,508	6,820
Sorting Plant	0	732	2,468	6,031
Compost Plant	0	1,088	2,654	5,652
Final Disposal	224	3,321	3,969	3,805
Medical Disposal	0	195	287	287
Administration	698	993	1,468	2,043
Overall SWM Costs	**10,670**	**20,858**	**30,823**	**42,903**

Note: * Average SWM expense in 1997 and 1998

c. Unit Costs

The following table shows the unit cost in the last year of each phase of the M/P.

Table 7-17: Unit Costs of Master Plan for Adana

unit: US$/ton

	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
Collection & Haulage	25.3	24.6	22.7
Public Area Cleansing	186.0	186.0	186.0
Sorting Plant	13.4	13.0	13.0
Compost Plant	15.0	14.6	14.9
Final Disposal	9.4	9.5	9.6
Medical Disposal	86.2	88.3	61.9
Overall SWM Costs	49.3	49.8	50.9

7.5.2 Revenue Plan

The revenue plan outlined in the M/P is as detailed in the following section.

a. Cleansing Tax

The ultimate goal of the M/P is to use the cleansing tax revenues to cover (100%) the overall SWM costs. In accordance with this goal, the following phases were set to raise the cleansing tax rate.

Table 7-18: Stepwise Increase Plan of Cleansing Tax for Adana

		Collection Rate	Increase in Real Terms	net SWM Costs* Covered (%)	Overall Increase (from the 1998 rate)
Phase 1	～2001	?%->90%	0%	14%	1.8 times
Phase 2	2003	90%	1.8 times	25%	3.7 times
Phase 3	2005	90%	double	58%	8.1 times
Phase 4	2010	90%	1.4 times	77%	13.3 times
Phase 5	2015	90%	1.3 times	107%**	23.6 times

Note: * overall SWM costs - (sale of recoverable and compost + tipping fee)
** Including some parts of financial costs.

The effects on the residents' share in SWM costs, in real terms, in the cleansing tax rate in each M/P phase are as shown in the table below.

Table 7-19: Changes in Residents' Share in SWM Costs for Adana

	Present (1998)	2005	2012	2020
Average annual household income (US$/year)	8,280	9,150	9,960	11,010
Cleansing tax per household (US$/year)	8.3*	30.2	43.1	57.7
Ratio of cleansing tax (%) to income	0.1	0.33	0.43	0.52

Note: * POS Willingness to Pay

As far as the ratio of the cleansing tax to the annual income is concerned, the gradual increase in tax rate is not seen to incur any significant impact.

b. Allocation from Municipal Tax Revenues

Although the allocation in 2003 from municipal tax revenues will increase by 1.1 times the present rate, the gradual increase in tax rate will decrease the rate allocated by the municipality for SWM. The following allocation should therefore be realised .

Table 7-20: General Budget and Allocation for SWM in Adana

unit: US$ 1,000

	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
General Budget	133,663	170,585	222,577
Allocation for SWM	15,814	8,434	0
Allocation Rate (%)*	11.8	4.9	0

Note: *: Average of rate allocated to Adana GM and the two DMs.

c. SWM Financial Source

The financial source for the SWM costs in the final year of each phase will change as shown in the following table.

Table 7-21: SWM Financial Source for Adana

unit: US$ 1,000

	Present	2005	2012	2020
Cleansing Tax	1,365	11,023	19,430	32,247
Budget Allocation from Municipal Tax	11,413	15,814	8,434	0
Sale of Recoverables and Compost	0	1,495	4,963	11,928
Tipping Fee	0	398	601	841
Total	12,778	28,730	33,428	45,016

7.5.3 FIRR and Cash Flow

a. Cash Flow

Using the calculated revenue and expenditure, the FIRR is 1%. As shown in the diagram, the accounts after 2002 are also estimated to be in the black, thereby making the accumulation of US$ 31 million in reserve possible by 2020.

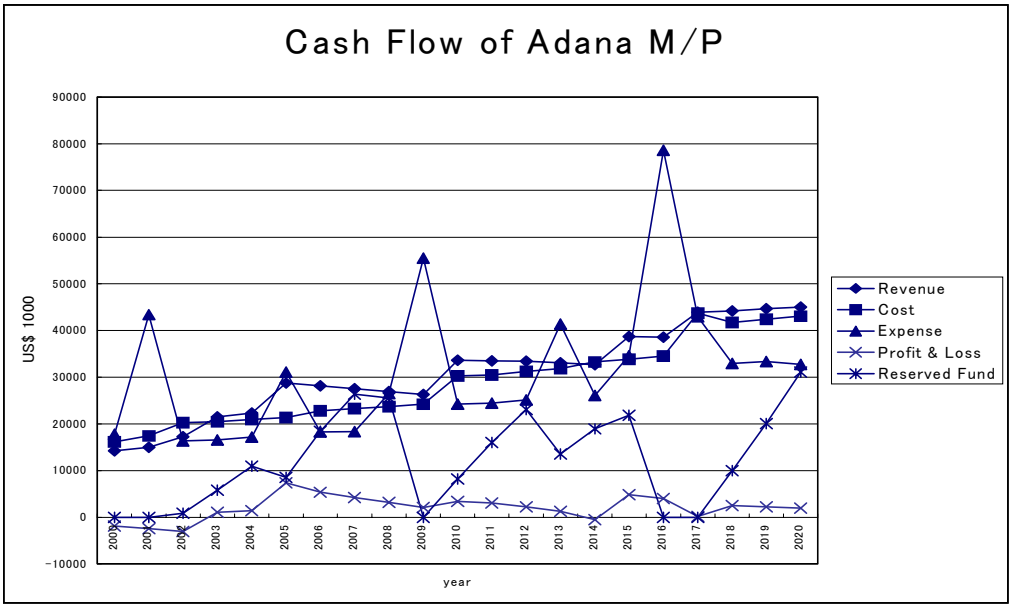

Figure 7-3: Cash Flow of Adana GM M/P

b. Conclusion

Based on the above assessment, the master plan for Adana is deemed financially feasible.

Chapter 8

The SWM Master Plan for Mersin

8 The SWM Master Plan for Mersin

8.1 Outline of the Master Plan

8.1.1 Goals

The principal goal of the SWM master plan is:

"To create *a closed loop society* on solid waste[1] in Mersin Greater Municipality by the target year 2020"

The master plan aims to:

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

The proposed measures to be taken, in order to attain the goals, are summarised below.

For Technical System

T1. Elimination of improper disposal at generation, illegal dumping, and improper self-disposal.

T2. Establishment of a separate collection system.

T3. Establishment of a transfer system if the final disposal site is far from the city centre.

T4. Improvement of the public area cleansing system.

T5. Establishment of a government related recycling system.

T6. Establishment of an intermediate treatment system by the construction of compost and sorting plants.

T7. Establishment of a sanitary landfill, strictly complying with the SW Control Regulation.

T8. Establishment of a proper medical waste disposal system from generation to final disposal.

[1] A closed loop society means a society fully aware of the relationship between waste and the environment.

For Institutional System

I1. Improvement and strengthening of management/control capability of public organisations concerned with SWM.

I2. Integration of current laws and regulations for successful implementation of the master plan.

I3. Establishment of a financially sustainable system.

I4. Establishment of private sector involvement in SWM by reducing the municipalities' involvement in operation of the technical system.

I5. Establishment of a proper monitoring and information management system.

I6. Full utilisation of available human resources through the establishment of proper human resources development programs.

I7. Establishment of public co-operation system for SWM through implementation of public education programs and raising awareness on SW.

I8. Establishment of a proper medical waste control/management system.

8.1.2 Targets

The M/P will be implemented by phases, as shown below, to achieve the above-mentioned objective.

Phase 1: 2000 - 2005 (F/S target year)

Phase 2: 2006 - 2012

Phase 3: 2013 - 2020

In order to achieve the principle goal of the master plan, the targets for the establishment of major technical system components are proposed as shown in the table below.

Table 8-1: Targets of SWM M/P for Mersin

unit: %

Items	Present (1998)	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
Refuse Collection Rate	91*[1]	100	100	100
Ratio of Improper Disposal to Generation Amount	3.1*[1]	0	0	0
Ratio of Separate Collection to Discharge Amount	0	30	60	100
Ratio of Intermediate Treatment to Discharge Amount	0	30	60	100
Share of sorting plant	0	46	54	58
Share of compost plant	0	54	46	42
Final Disposal Method of MSW	Improper Dumping	Sanitary Landfill at MSW Landfill		
Final Disposal Method of Medical Waste	Trench Method	Sanitary Landfill at Medical Waste Landfill		

Note *1: The figure is estimated based on the results of the POS

8.1.3 Strategy

The strategies to be adopted in the three planning stages are summarised below.

Phase 1 (2000 - 2005): Short Term Improvement by F/S Projects

Technical Aspects

- Improper disposal at generation, such as illegal dumping and inappropriate self-disposal, shall be eliminated by 2005 through an intensive public education campaign, and enforcement with the provision of sufficient collection service.
- A public container system shall be unified by the use of wheeled containers by 2002 and cover the whole population of the city. The separate discharge of compostable and non-compostable wastes will begin from 2002.
- A site for the transfer station shall be selected and the F/S on the implementation of transfer system shall be carried out. A separate collection will commence to 30 % of population in the city from 2002.
- The current public cleansing system, a combination of mechanical and manual sweeping system based on road type, will be maintained. Prevention of littering in the city will be achieved through intensive public education campaign and enforcement.
- A government related recycling system shall be established to encourage waste minimisation, and begin source separation for reuse, recycling, and recovery of MSW.
- After the required funds are secured, a detailed design of separate collection and sorting/compost plants (F/S projects of this study) shall be conducted. Then a sorting plant (35,000 ton/year) and compost plant (38,500 ton/year) shall be constructed and vehicles/equipment procured by 2002. The plants shall operate from January 2002.
- The rehabilitation of current disposal site (Compost Plant dumpsite) will be completed and scavenging at the dump site shall be eliminated by 2002. Then after the required funds are secured, a detailed design of the Cimsa disposal site (F/S project of this study) shall be conducted. The site shall be developed and vehicles/equipment procured by 2002. The final disposal site is estimated to be operated from January 2002 to December 2005. While the Cimsa disposal site will be used, Mersin GM shall conduct site selection and F/S works for the next disposal site after the Cimsa by 2004. After a detailed design of the future disposal site the site shall be developed and vehicles/equipment procured by 2006.
- The source segregation and the separate discharge/collection of medical waste (infectious/hazardous medical waste) shall be conducted strictly. Along with the Cimsa disposal site development a medical waste disposal site, which complies with the Regulation of the Medical Waste Control, will be constructed by 2002 inside of the Cimsa site. From January 2002 all medical wastes shall be disposed of at the medical waste disposal site, but until the new medical waste disposal site is completed, all medical waste will be disposed of at the Compost

Plant dumpsite using the trenching method. Irrecoverable hazardous chemicals that are corrosive, flammable, explosive, and reactive shall be treated prior to discharge. Recoverable hazardous chemicals shall be separated and collected separately for recycling. All medical waste entering the landfill site shall be recorded at the weighbridge, so that the DMs and the GM can keep a record on medical waste disposal amounts.

Institutional Aspects

- The current administrative system of the GM and the DMs will be improved through review of the system, and redefinition of the tasks/assignments, in order to meet with the proposed technical systems, i.e., separate collection, government related recycling system, and sanitary landfill. The establishment of a regional waste authority responsible for hazardous and medical waste treatment/disposal will be examined.

- Present organisations responsible for SWM shall be strengthened both in quantity and quality to properly administer and control the proposed technical systems, i.e., separate collection, sorting/compost plants, etc.

- Carefully taking the capability of the private sector into consideration, the involvement of the private sector shall be encouraged not only for conventional cleansing services but also proposed new technical system. An appropriate performance contract for private sector involvement shall be elaborated through inter-municipal co-operation, etc.

- A systematic monitoring and information management system regarding SWM shall be established in the GM and in the DMs. At first unit costs of operations shall be identified to evaluate cost/benefit, cost/efficiency and cost/effectiveness. Along with this, a database on all SWM activities will be developed and maintained to continuously check the quality and costs of the cleansing services by both public and private sectors.

- A human resources development program shall be created in order to train professionals involved with SWM. The program shall cover a broad spectrum of professionals and employees, from management to operational levels, including those responsible for supporting activities.

- For proper operation of the proposed material recovery and recycling facilities, a public co-operation system shall be set up through an intensive public education and campaign. For the purpose various experiences and tools obtained by the experiment on the separate collection of this study shall be fully utilised including modification of the education book prepared by the team.

- The current scattered legal provisions in diverse laws and regulations shall be into an integrated and transparent package, especially to properly operate proposed new technical systems.

- The separate accounts of the SWM costs and revenues shall be established in all municipalities in Mersin GM in order to provide justification for the increase of charges, etc. The current coverage rate (about 23.6 %) of cleansing tax to the SWM costs shall be raised to 40 % by 2005. Through the development of a

database, the tax collection management system will be improved. A tipping-fee system for the Cimsa disposal site shall be introduced by 2002.

- A code of practice on medical waste disposal shall be formulated. In order to establish a proper medical waste control/management system current organisations of the GM as well as the provincial government will be strengthened. As a measure of strengthening the establishment of a regional medical waste authority will be examined. The costs of medical waste disposal (from collection to final disposal) will be gradually covered by the fee from the generators.

Phase 2 (2006 - 2012): Medium Term Improvement

Technical Aspects

- The separate discharge and collection system shall be expanded to cover 60 % of the city in population by 2012. Taking the requests may arise from the operation of sorting/compost plants into consideration, the categories of separate discharge wastes shall be reviewed.

- The ratio of the mechanical sweeping operation will be raised if the labour cost will be increased and the road conditions improved. If these labour and road conditions allow, a whole system for major roads will be exchanged to a fully mechanical system.

- The government related recycling system shall be strengthened to encourage further waste minimisation and enhance source separation rate for reuse, recycling and recovery of MSW.

- The capacity of the sorting plant and composting plant shall be enlarged to 112,000 ton/year (77,000 ton/year be added) and 98,000 ton/year (59,500 ton/year be added) by 2010 respectively. The new plants shall operate from January 2010. The rate of recycling to generation amount will be raised from 10.1 % in 2005 to 15.5 % in 2012.

- The future final disposal site will be used and it shall be large enough to receive the wastes from the city for more than 16 years.

- Infectious waste will be treated at generation by autoclaves in steam resistant bags, and lacerating materials crushed at the site of generation. All medical wastes shall be disposed of at the medical waste disposal site at Cimsa.

Institutional Aspects

- The administrative system, including the roles of the GM and the DMs in SWM, will be reviewed and improved in order to meet with the change of SWM, i.e., the increase in the NIMBY (Not In My Back Yard) syndrome, etc.

- The organisations responsible for SWM shall be further strengthened in terms of administrative and control capabilities not only for municipal SW but also hazardous and industrial SW.

- The involvement of the private sector will be further encouraged in order to achieve more efficient but lower cost SWM. The government shall also

encourage the participation of the private sector in the provision of facilities such as sorting/composting plants through the modification of the laws on privatisation to allow for this.

- The database on SWM activities will be maintained. The comparative cost data and other performance data obtained by the database will be used to measure the efficiency of the services, and to good management and decision making.
- All staff concerned with SWM including private employees shall undergo a programme of proper training and professional development. Vocational qualifications shall be set up to act as a means of assessing the competence of persons responsible for SWM facilities and operations.
- In order to expand separate collection as well as material recovery and recycling the intensive public education and campaign shall be continued to raise public co-operation.
- The coverage rate of cleansing tax to the SWM costs shall be raised to 70 % by 2012. The tipping-fee system will be extended to the sorting and compost plants to cover the excess cost which comes from actual operation and maintenance cost minus benefits such as sales revenue of recovered materials and saving cost of landfill.
- All costs of medical waste disposal (from collection to final disposal) shall be covered by the fee from the generators.

Phase 3 (2013 - 2020): Long Term Improvement

Technical Aspects

- The separate discharge and collection system shall be expanded and cover 100 % of the city in population by 2020. In order to achieve the goal of the M/P the separate discharge and collection system shall be improved in accordance with the change of the socio-economic situation, i.e., the increase of separate items, and improvement of discharge method by use of decomposable container for compostable wastes.
- The most appropriate rate of the mechanical and manual sweeping operation shall be elaborated and applied, considering the labour and road conditions.
- A government related recycling system shall be fully established to realise the goal of the M/P.
- With the additional construction of 203,000 ton/year for the sorting plant and 143,500 ton/year for the compost plant in the future landfill site total capacities of the plants shall be raised up to 280,000 ton/year and 203,000 ton/year respectively by 2017. The expanded plants shall be operated from January 2017. The rate of recycling to generation amount will be raised from 15.2 % in 2012 to 23.3 % in 2020.
- The future final disposal site will be continuously used.
- All medical wastes shall be continuously disposed of at the medical waste disposal area of the Cimsa site.

Institutional Aspects

- The administration and organisation accountable for a closed loop society on solid waste will be fully established.
- The maximum involvement of the private sector not only in operation of cleansing services, but also in the provision of facilities such as sorting/composting plants and hazardous wastes treatment/disposal facilities will be achieved. The government will be able to properly control and monitor all the activities of the private sector.
- The database on all SWM activities will fully function to provide all data necessary for administration, policy decision, control/monitoring, public relation, and financial managemen.
- The public shall be encouraged to co-operate in order to realise a closed loop society through continuous public education and campaign.
- The coverage rate of cleansing tax to the SWM costs shall be raised to 100 % by 2020. The tipping-fee for waste treatment/disposal will be raise to 100 % of the necessary cost.

8.1.4 Future Waste Stream

a. Influential Factors

In accordance with the realisation of the above targets the waste streams in future shall change. The main factors that will affect the changes in the waste stream in Mersin GM are:

- Changes in waste generation amount.
- Elimination of improper disposal at generation.
- Changes in conventional waste recycling amount by private sector, i.e., recycling rate at generation and by street and landfill waste pickers.
- Changes in treatment rate.
- Changes in waste composition, i.e., rate of compostable and non-compostable wastes.

b. Changes of the Influential Factors

The changes of the above-mentioned factors are assumed in the master plan as follows:

- The changes in waste generation amount are as presented in Chapter 5.
- The improper disposal at generation such as improper self-disposal and illegal dumping shall be eliminated by 2005.
- Regarding the changes in conventional waste recycling done by mainly informal private sector, since the public sector will promote the source recycling activities done by the citizen and “Eskici”, the recycling rate at generation, (2.88 % of generation amount) is assumed to be maintained by 2020. On the contrary, the recycling of street waste pickers and scavengers at landfill will be gradually disappeared by 2020 and 2002 respectively.
- The treatment at sorting and compost plants is done in accordance with the above targets.

- The changes in waste composition are as presented in Chapter 5. Based on the composition, the rates of non-compostable waste for sorting plant and compostable waste for compost plant are determined.

Based on the above assumption the changes of the influential factors are assumed and summarised in the table below.

Table 8-2: Changes of the Influential Factors in Mersin GM

Year / Factors	1998	2005	2012	2020
Waste Generation (ton/day)	446	663	969	1,350
Improper Disposal (ton/day)				
Self-disposal	6	0	0	0
Illegal dumping	8	0	0	0
Conventional Recycling (ton/day)				
At generation	15	19	23	29
By street waste pickers	10	7	4	0
By scavengers at landfill	2	None by 2002	0	0
Waste Composition (%)				
Non-Compostable	35	46	54	58
Compostable	65	54	46	42
Treatment (ton/day)				
At sorting plant	0	88	305	766
At compost plant	40	103	260	555

c. Future Waste Stream

In addition to the above assumption and establishment of the influential factors, the following rates are set up by the design of sorting and compost plants:

Sorting Plant

Material recovery rate:	24 %
Residue rate:	76 %

Compost Plant

Compost production rate:	18 %
Material recovery rate:	1 %
Vaporisation rate:	77 %
Residue rate:	4 %

Finally waste streams from 1999 to 2020 are presented in the table below. Based on the table the waste streams in year 1999, 2005, 2012, and 2020 are illustrated in the following figures.

Table 8-3: Future Waste Stream (1998-2020) in Mersin GM

CIMSA									Sorting Plant			New Compost Plant					Existing Compost Plant					
Year	Waste Generation	Self Disposed Waste	Recycling at Generation Sources	Waste Discharge	Recycling by Street Waste Picker	Illegal Dumpe Waste	Collection	Without Treatment Waste	Non-Composta ble Waste	Recycling 24%	Residue 76%	Composta ble Waste	Recycling 1%	Compost 18%	CO2,H2O 77%	Residue 4%	Inject Waste to Existing Compost Plant	Reject Waste from Eisting Compost Plant	Recycling at Disposal Site	Final Disposal of MSW	Other Waste	Total Final Disposal
	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)	(ton/year)
1998	162,790	2,190	5,475	155,125	3,650	2,920	148,555	148,555	0	0	0	0	0	0	0	0	14,600	3,650	548	137,057	6,205	143,262
1999	171,915	1,877	5,475	164,563	3,484	2,503	158,576	158,576	0	0	0	0	0	0	0	0	14,600	3,650	411	147,215	6,205	153,420
2000	182,500	1,564	5,840	175,096	3,318	2,086	169,692	169,692	0	0	0	0	0	0	0	0	14,600	3,650	276	158,466	6,570	165,036
2001	192,355	1,251	5,840	185,264	3,152	1,669	180,443	180,443	0	0	0	0	0	0	0	0	14,600	3,650	139	169,354	6,935	176,289
2002	204,035	938	6,205	196,892	2,986	1,252	192,654	134,858	23,696	5,687	18,009	34,100	341	6,138	26,257	1,364	0	0	2	154,229	6,570	160,799
2003	216,080	625	6,205	209,250	2,820	835	205,595	143,917	26,522	6,365	20,157	35,156	352	6,328	27,070	1,406	0	0	0	165,480	7,300	172,780
2004	228,125	312	6,570	221,243	2,654	418	218,171	152,720	28,798	6,912	21,886	36,653	367	6,598	28,223	1,465	0	0	0	176,071	7,665	183,736
2005	241,995	0	6,935	235,060	2,488	0	232,572	162,800	32,095	7,703	24,392	37,677	377	6,782	29,011	1,507	0	0	0	188,699	8,030	196,729
2006	255,500	0	6,935	248,565	2,322	0	246,243	172,370	34,720	7,800	26,920	39,153	392	7,048	30,148	1,565	0	0	0	203,075	8,395	211,470
2007	269,735	0	7,300	262,435	2,156	0	260,279	182,195	37,480	7,800	29,680	40,604	400	7,200	30,800	2,204	0	0	0	219,663	9,125	228,788
2008	285,065	0	7,300	277,765	1,990	0	275,775	193,043	41,366	7,800	33,566	41,366	400	7,200	30,800	2,966	0	0	0	239,807	9,490	249,297
2009	300,760	0	7,665	293,095	1,824	0	291,271	203,890	44,564	7,800	36,764	42,817	400	7,200	30,800	4,417	0	0	0	259,952	10,220	270,172
2010	317,915	0	8,030	309,885	1,658	0	308,227	123,291	96,167	23,080	73,087	88,769	888	15,978	68,352	3,551	0	0	0	199,929	10,585	210,514
2011	335,435	0	8,030	327,405	1,492	0	325,913	130,365	103,640	24,874	78,766	91,908	919	16,543	70,769	3,677	0	0	0	212,808	11,315	224,123
2012	353,685	0	8,395	345,290	1,326	0	343,964	137,586	111,444	26,747	84,697	94,934	949	17,088	73,099	3,798	0	0	0	226,081	12,045	238,126
2013	369,745	0	8,760	360,985	1,160	0	359,825	143,930	118,742	27,000	91,742	97,153	950	17,100	73,150	5,953	0	0	0	250,020	12,410	262,430
2014	385,440	0	9,125	376,315	994	0	375,321	150,128	123,856	27,000	96,856	101,337	950	17,100	73,150	10,137	0	0	0	274,814	13,140	287,954
2015	401,135	0	9,125	392,010	828	0	391,182	156,473	131,437	27,000	104,437	103,272	950	17,100	73,150	12,072	0	0	0	300,191	13,505	313,696
2016	417,925	0	9,490	408,435	662	0	407,773	163,109	137,012	27,000	110,012	107,652	950	17,100	73,150	16,452	0	0	0	326,737	14,235	340,972
2017	435,810	0	9,855	425,955	496	0	425,459	0	242,512	58,203	184,309	182,947	1,829	32,930	140,869	7,319	0	0	0	191,628	14,600	206,228
2018	454,060	0	10,220	443,840	330	0	443,510	0	252,801	60,672	192,129	190,709	1,907	34,328	146,846	7,628	0	0	0	199,757	15,330	215,087
2019	472,675	0	10,585	462,090	164	0	461,926	0	267,917	64,300	203,617	194,009	1,940	34,922	149,387	7,760	0	0	0	211,377	16,060	227,437
2020	492,750	0	10,585	482,165	0	0	482,165	0	279,656	67,117	212,539	202,509	2,025	36,450	155,925	8,109	0	0	0	220,657	16,790	237,447

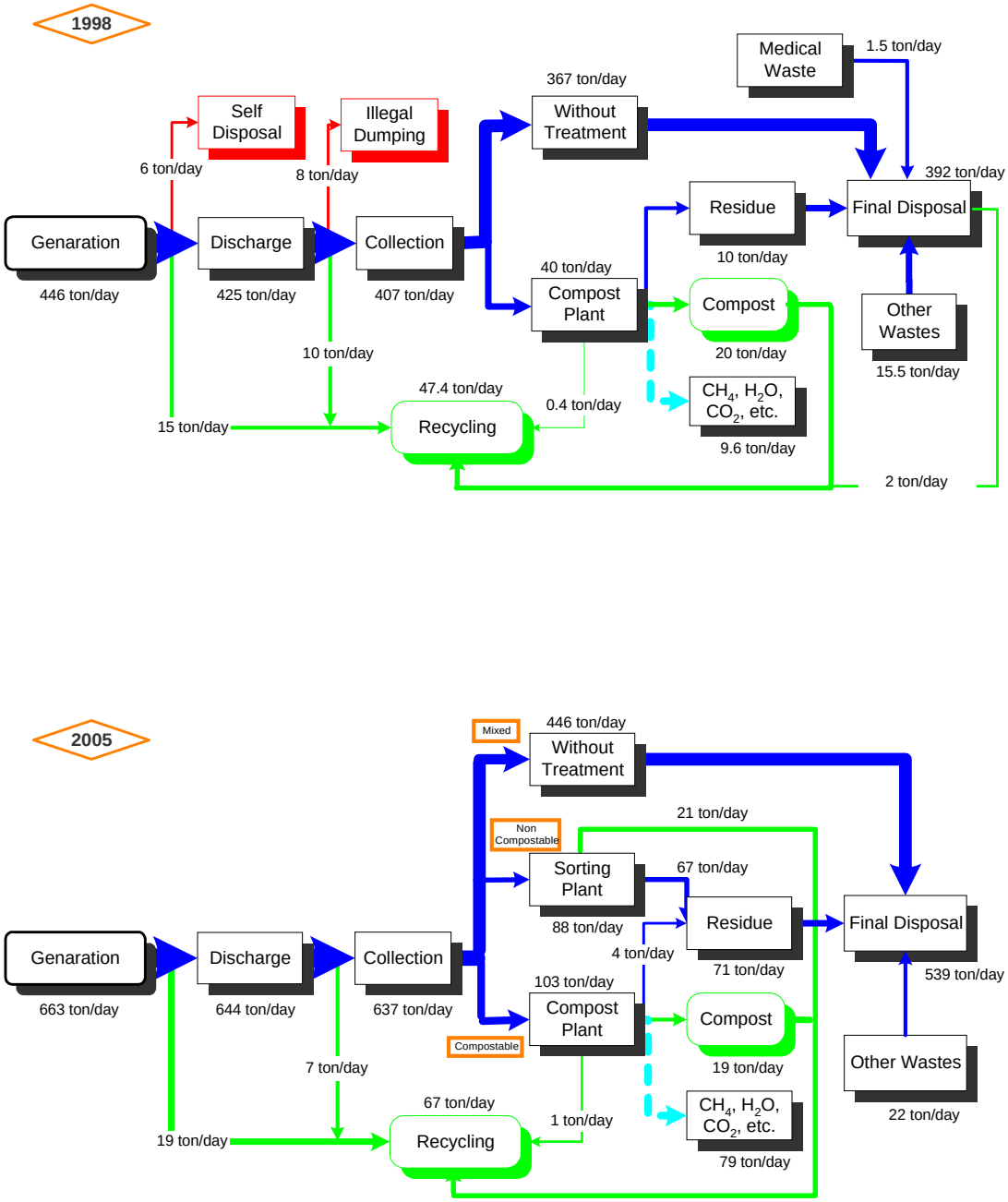

Figure 8-1: Waste Stream in Year 1998 and 2005 (Mersin GM)

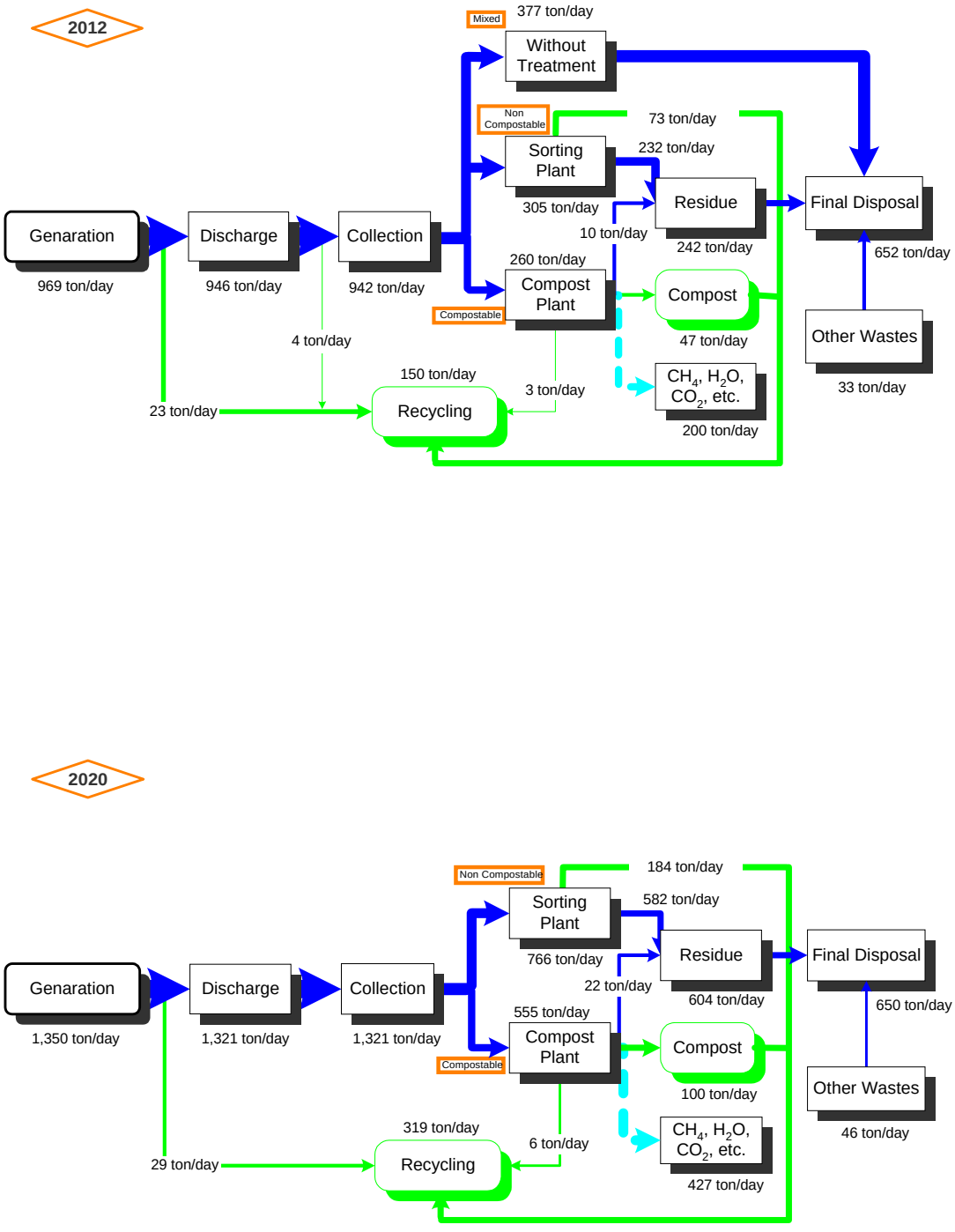

Figure 8-2: Waste Stream in Year 2012 and 2020 (Mersin GM)

8.2 Technical System

8.2.1 Planning Conditions

In order to plan the technical system for the SWM M/P for Mersin, various frameworks are set in Chapter 5. The important issues for the planning are summarised in the table below.

Table 8-4: Planning Conditions for SWM M/P for Mersin

Items	Unit	Present (1998)	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
Population in Mersin GM	Persons	**634,850**	**788,999**	**982,499**	**1,249,940**
Population of Akdeniz DM	Persons	255,516	293,508	337,148	395,024
Population of Troslar DM	Persons	234,024	297,744	378,813	498,823
Population of Yenisehir DM	Persons	145,310	197,747	266,538	356,091
MSW Amount					
Generation	ton/day	446	663	969	1,350
Discharge	ton/day	425	644	946	1,321
Collection	ton/day	407	637	942	1,321
MSW Composition					
Non-compostable	%	35	46	54	58
Compostable	%	65	54	46	42
Intermediate Treatment Facility					
Site		Cimsa	Cimsa	Cimsa	Unidentified
Distance from city centre	km	20	20	20	future site 20
Final Disposal Site					
Site		Compost plant	Cimsa	Unidentified future disposal site	
Distance from city centre	km	10	20	20	

8.2.2 Discharge and Storage System

For the improvement of the discharge and storage system the following main policies will be applied to the M/P of the target area.

- The type of containers used will be regulated; a standard 800 lit., wheeled container system will be extended.
- A source separation system will be initiated for discharging the non-compostable (recyclable wastes) and compostable wastes (organic and green wastes) in a controlled manner, provide for a composting/recycling scheme.
- The separate collection system will be initiated in the high income mahalles. then expanded to middle and low income mahalle.
- For compostable waste the use of plastic containers is recommended to prevent them from rusting, while current metal container can be used for non-compostable wastes.

8.2.3 Collection and Haulage System

For the improvement of the collection and haulage system the following main issues will be applied to the M/P of Adana.

- The use of compactor trucks (12 m^3 - 16 m^3) will be extended and gradually unified.
- Communal container collection system will be applied in order to increase the collection efficiency.
- It is assumed that the existing collection equipment will be used in the beginning of Phase 1, and gradually replaced with the new vehicles, after they exceed the life span of 7 years.
- Collection frequency will be daily, 6 days a week for residential and commercial and market waste for compostable (organic and putrescible) waste.
- Collection frequency for source separated non-compostable waste (recyclable materials) will be once or twice a week.
- Direct hauling of collected waste will be continued in the Phase 1, and after the new landfill site (which is assumed to be located 20 km from the city centre) will be in operation in Phase 2, there may be a need of transfer stations.
- When a new disposal site is identified, the need of transfer stations shall be examined.

8.2.4 Public Area Cleansing System

For the improvement of the public area cleansing system the following main ideas will be applied to the M/P of the target area.

- The present street sweeping work, mainly conducted manually, is deemed to be an appropriate method due to cheap labour costs and inferior road conditions that would hamper mechanical street sweeping equipment. However, the ratio of manual/mechanical sweeping work shall be examined and changed according to the labour cost increase and the improvement of road conditions.
- The existing mechanical street sweepers will be used for the cleaning of main roads and boulevards in Phase 1, renewing them when necessary. In Phase 2, the ratio of the mechanical sweeping operation will be increased if the labour cost will be increased, and the road conditions improved. If these labour and road condition allows it, whole system for major road will be exchanged to a fully mechanical system.
- The street waste, which is collected manually, will be stored in wheeled containers that are allocated only for this purpose, and will be collected by the existing collection vehicles.
- In order to shorten the haulage distance of the collected waste, communal containers will be used as collection points, which will be placed in close proximity. The haulage distance will be controlled, which will be less than one km.
- More litter boxes will be installed to reduce the workload for street sweepers and preventing waste from scattering.
- A new type of cart with a larger haulage capacity will be introduced to improve the efficiency of the haulage work.
- The supervision system of labourers will be improved.

8.2.5 Recycling and Intermediate Treatment System

a. Recycling

The following government related recycling systems will be established.

- An administration system that promote production of recyclable goods/products from the manufacturing stage, with government assistance, in order to minimise waste generation (generation control) to as much as possible.
- A system that enables recycling at source, in particular, separate discharge at source and promote the recycling of segregated waste materials.
- Recycling by the intermediate treatment facilities.

b. Intermediate Treatment System

In order to facilitate recycling by the intermediate treatment facilities sorting and compost plants will be constructed in accordance with the schedule as shown in the table below. The detailed design of the plants in Phase 1 is presented in Chapter 11.

Table 8-5: Outline of Intermediate Treatment System for Mersin (2001-2020)

Facilities	Outlines
1. Cimsa Sorting Plant No.1	
Capacity	100 ton/day
Construction year	2001
Operation year	2002 - 2016
2. Cimsa Sorting Plant No.2	
Capacity	220 ton/day
Construction year	2009
Operation year	2010 - 2024
3. Sorting Plant at Future Landfill	
Capacity	580 ton/day
Construction year	2016
Operation year	2017 - 2031
4. Cimsa Compost Plant	
Capacity	110 ton/day
Construction year	2001
Operation year	2002 - 2016
5. Cimsa Compost Plant	
Capacity	170 ton/day
Construction year	2001
Operation year	2010 - 2016
6. Compost Plant at Future Landfill	
Capacity	410 ton/day
Construction year	2016
Operation year	2017 - 2020

8.2.6 Final Disposal System

The JICA study team and the counterparts of Mersin GM have conducted site selection works and both sides have agreed the Cimsa candidate site to be the final disposal site for the F/S. The new disposal site after the closure of the disposal site at Cimsa site, will be constructed by December 2005.

The proposed Cimsa landfill was designed in accordance with the design standards prepared by the MoE, as presented in Chapter 11.

Based on the above, the outline of final disposal system for Mersin up to 2020 is summarised as presented in the table below.

Table 8-6: Outline of Final Disposal System for Mersin (2001-2020)

Facilities	Outlines
1. Cimsa Disposal Site	
New landfill area	12 ha
MSW landfill amount	714,000 ton
Construction year	2001
Operation year	2002 - 2005
2. Unidentified Future Disposal Site	
Area	N/A
MSW landfill amount	3,724,000 ton
Construction year	2005
Operation year	2006 - 2020

8.2.7 Operation and Maintenance System

SWM works change on a day to day basis; to maintain the efficiency of operations, making a prompt decision and taking swift action are essential. Employing a large number of people is risky and is also difficult to maintain the level of management required, so it is recommended that the private sector participation in SWM works will be extended in order to reduce the burden and work load on the authority responsible for SWM, and minimise the costs.

a. Maintenance of Equipment

At present, the workshop owned by the municipalities only provides preventive maintenance service for equipment, and the major repairs are executed by the private workshops. The M/P proposes to continue this application till the end of Phase 2. Preventive maintenance will be executed by the existing municipal facilities and major repairs be conducted at private garages. The reason for this is as follows:

- It takes time for the municipal workshop to purchase spare parts. So spare parts used only frequently will be purchased and kept in storage.
- Complex repair works will be consigned to the private sector although the cost is higher than if directly conducted at the municipal workshop because private garages are able to purchase spare parts much more readily.

In Phase 3, it is recommended that the whole repair and maintenance works will be privatised.

b. Operation of Collection Services

To limit the burden and workload, currently experienced by the Cleansing Departments, involvement of the private sector will be encouraged. The proposed measures are as follows:

- In Phase 1 the private collection company will be entrusted a small percentage of collection vehicles owned by the municipalities. Through the gradual expansion of this system, the municipality responsible for SWM can nurture the potential of the private section, in preparation for the future hand-over of all collection work.

- In Phase 2 whole collection services will be operated by the private contractors. The municipalities shall monitor, supervise and control the works to be conducted by the contractors.

c. Operation of Public Cleansing Services

Street sweeping workers will be employed in a contract base as at present, because it is very difficult for the municipalities to manage many street sweepers and employee cost will be high.

In Phase 1 all the public cleansing services will be operated by the private contractors including ownership of the necessary equipment. The municipalities shall monitor, supervise and control the works to be conducted by the contractors.

8.2.8 Medical SWM

The present medical waste management system in Mersin has shown the failures of both the municipal authorities (regulating authority) and the hospitals to ensure that their handling/management of medical waste do not cause harm to both public health and to the environment. The following measures shall be taken by the medical institutions and the regulating authorities in order to eliminate the risks, posed by infectious and hazardous waste, and to comply with the Medical Waste Control Regulations.

- Infectious waste and hazardous waste (medical waste) shall be separated strictly at generation and at the central collection point. Medical waste will be collected separately from general waste in a specially assigned vehicle. The specially assigned vehicle shall not transport general waste, nor any other waste, without prior decontamination by disinfecting agents.
- Medical institutions shall ensure that no unauthorised persons can gain access to medical waste storage areas. All infectious waste storage areas must be locked.
- Recoverable hazardous waste shall be separated for recycling. Irrecoverable hazardous waste that is corrosive, reactive, flammable, or explosive shall be treated prior to discharge, in order to prevent damage to the landfill structures, e.g., geomembranes and drainage pipes.
- Infectious waste shall be autoclaved in steam resistant bags, and lacerating/piercing materials crushed before discharge, according to the medical waste regulations.
- Medical waste shall continue to be disposed of in a special trench at Cimsa dumpsite until December 2005, and from 2006 at a special medical waste disposal site at the new sanitary landfill. Entry of the special medical waste collection vehicles will be monitored, and their weight recorded at the weighbridge, in order to supervise the entry of infectious substances and to accumulate data on medical waste disposal.
- Infectious waste shall not be kept in medical institutions for more than 48 hours, as stipulated by law. Smaller generators of medical wastes shall have their infectious waste removed and taken to the nearest hospital with a proper

interim storage facility. Incineration will not be introduced in the short term, but incineration at a cement factory shall be examined for a long term solution.

- Medical institutions shall strictly monitor their inventory under strict accounting practises, to reduce wastages especially of pharmaceuticals and of hazardous chemicals. Medical institutions shall introduce a comprehensive recycling plan to introduce the recycling of general waste and recoverable hazardous waste.
- Medical institutions shall develop an education system for all those involved in the handling of infectious waste and hazardous waste. Waste management persons shall be instructed frequently on proper medical waste handling procedures. Medical institutions shall also prepare an emergency procedure guideline in case of accidental contamination, or release of dangerous chemicals.

8.3 Institutional System

8.3.1 Administration and Organisation

For practical measures and applications related to the administration and organisation, a methodology can be pursued, with which each cleansing and/or solid waste management department and/or section can undertake a self-criticism to identify the gaps and requirements. This approach is also closely connected with the concept 'redefinition' of the tasks and assignments for and in each individual solid waste management unit.

At top managerial post, the assigned person for Head or Director position should possess specific qualifications and capabilities. Managerial qualifications comprise two relevant assets; namely, administrative capabilities and operational skills. While the former asset relates to administrative management qualifications, the latter refers to operational management qualifications. The synthesis of these assets can avail an excellent background for the top responsible person to set up a decision making process supported by relevant feedback from monitoring and evaluation records.

Under administrative management functions, the solid waste management unit should deal with: (i) legislative and regulatory issues; (ii) personnel recruitment, manpower requirements and allocation, contractual employment; (iii) financial requirements; accounting, comparative costs and cash-flow analyses, fiscal management, budgeting, and (iv) public relations. The operational management functions, on the other hand, embrace; (i) manpower mobilisation and logistical organisation, (ii) supervision of service implementations, (iii) proceeding achievement records, (iv) instructions and manuals oriented training. These functions have to be carried out by mid-career personnel, while support staff in the field is engaged in implementation phases as practitioners. Once this pre-conditional framework is achieved by each solid waste management unit, the functions could be bound to self-sustainability and self-reliance principle, where rational and independent administration and organisation models are applied by respective municipalities.

In the development of adequate administrative and organisational models, each municipality should be free to make own choices in line of their political and optional preferences. The pre-conditions mentioned above are the building blocks, on which

flexible models can be structured. The philosophical approach towards the identification of a suitable administrative model should be associated with self-experiencing principle. The observations show ,that there are roughly three political preferences for solid waste services; (i) privatisation, (ii) semi-privatisation, and (iii) non-privatisation. Whichever option the municipalities take, one issue stays however essential; namely, the aforementioned 'pre-conditional framework'. Once this issue gains a clarification, the rest of the work to be undertaken is the determination of personnel size.

Following determinants have to be taken into account regarding the personnel size:

- service types - collection, separation, transportation, disposal, recovery, processing, public relations, etc.
- service size in quantified terms - service area, target groups, volume, capacity, distance, costs, efficiency, etc.
- service modes - privatisation, semi-privatisation, non-privatisation; contracting, subcontracting, etc.
- service requirements - planning, programming, budgeting, financing, organising, implementing, supervising, monitoring, evaluating, operating, strategy formulation, decision making, etc.

Based on these determinants, an appropriate model can be found under optional preferences of individual municipalities in compliance with their political viewpoints and instrumental availability in financial, personnel, and material terms.

8.3.2 Legislation and Enforcement

The legislative constraints and weaknesses at national level require betterment actions oriented primarily towards municipalities to commercialise and to involve the private sector more effectively in delivery of their solid waste management services. Furthermore, limited power of municipalities to obtain necessary sites for solid waste management facilities as well as their limited rights to access to use those facilities located outside their boundaries should also be re-regulated. Marginal contributions provided through public participation need to be converted to fruitful contributions and consultative character of NGO involvement must be transferred into compulsory references in decision making processes. On the other hand, it is an undeniable fact that there is no 'umbrella law' for solid waste management. Legislation for the collection, transport, disposal, and financing of solid wastes is currently dispersed over a number of laws and regulations, many of which require substantial review.

The current legislative instruments are, however, partially sufficient for the enforcement of any service mode as desired by the respective municipality. Although they provide a basis for municipalities to make choices between privatised, semi-privatised and non-privatised service options in solid waste management with contracting and subcontracting possibilities in this respect, the laws are, however, considered as anti-competitive, which hinder private sector involvement. Generally, two methods are currently used in Turkey for promoting private sector participation in carrying out operational functions in municipal services. The first method involves the contracting of private companies, while the second involves the commissioning of municipal owned companies to perform envisaged services.

Application of the first method runs under the enforcement of the provisions of the State Bidding Law No. 2886, which require the obligatory selection of the lowest tender. This clause makes it impossible to rule out unrealistic or technically deficient tenders. Although the municipalities are complaining to suffer under this tendering legislation, there are possibilities, however, to overcome the bottleneck. The first possibility is to prepare consistent tender documents including meaningful specifications of standards and scope of works, which makes comparative tender analysis easy. This requirement is also valid for the preparation of the municipality contract documents to be mutually signed by the private companies. The second possibility is to confine on the technical pre-qualification criteria prior to subjecting the financial offer to final evaluation. This is the only way to associate high quality performances with low cost requirements in compliance with the provisions of the current tendering legislation.

Both of the steps indicated above necessitate a certain level of expertise. The lack of qualified, skilled and experienced personnel dealing with these issues result in undesired and unintended outcomes, with which the municipalities themselves are not satisfied and begin to complain. Therefore, acquisition of external support through know-how transfer by training programs and consultancy services, which might be delivered by an experienced municipality or union of municipalities as well as a private company, seems to be essential and indispensable. Inter-municipal co-operation and collaboration within an exchange program collectively developed by respective municipalities in Mersin would be extremely beneficial.

Contracting out solid waste management services to municipal owned companies is the other method for promoting private sector participation in operational functions of the municipalities. In this case, the municipalities enjoy the exemption from the State Bidding Law and have the advantage to commission the service to an own Municipal Economic Enterprise. The main obstacle of this model is the politisation of the management staff as well as deterioration of principles and mechanisms set for functional operation of an independent and free enterprise, which ought to be active within the competitive system of business market. If this method of contracting is preferred, it requires an extreme caution for securing and ensuring the autonomy, which is jurisdictionally recognised to such legal entities.

Another outstanding source of complaint from the municipality side is associated with the procedures required by the General Accounting Law No.1050, which limit the contract period to one year, only. In effect, the respective clause removes any incentive for contractors to invest in new plant and equipment for the sake of quality betterment in service performances. The extension of the contract period over one year reaching to a 3-5 year duration could be an encouraging factor for the contractors. Nevertheless, this issue must be arranged by legislating organs of the nation.

8.3.3 Financial System

a. Basic Concept

Enough cleansing tax should be charged to cover the whole SWM costs which include operation and maintenance cost, and depreciation cost. The following measures should be taken to secure a financial source.

- Review and raise the cleansing tax amount to cover sufficiently the SWM costs including depreciation.
- Establish tax collection management system and increase collection rate up to more than 90%.
- A tipping-fee shall be collected from direct waste haulers in proportion to the waste amount brought into a composting plant and a disposal site.

Moreover, when setting a waste tax amount, the most appropriate combination of the following principles shall be considered.

- Polluter-pays-principle (waste dischargers pay the SWM cost)
- Cross-subsidy mechanism (the affluent pays for the less well off)
- Different service levels in accordance with the amount of collection fee paid.

b. Problems in the Present Waste Fee Collection System

At present the cleansing tax amount is set per type of building by each provincial tax collection committee based on tax table per group and rank, which was decided by the Undersecretariat of Treasury of Prime Minister's Office. The increase rate of the tariff in 1999 is only between 1.386 and 1.391 times of that of 1998. The amount of tax reviewed by the Undersecretariat of Treasury is not sufficient to cover the SWM costs increase caused by inflation.

Although collection rate of the cleansing tax is said to be between 70 to 90 percent, the actual collection amount of tax are between 45 and 93 percent against the planned budget in 1998. The gap attributes to insufficient data management of taxable buildings.

Adding to the above problems, the cleansing tax has other problems.

- Same tariffs are adopted in same province, therefore it is difficult to modify the differences of SWM costs by DMs.
- It is not efficient to motivate the minimisation of waste discharge or segregate collection for recycling.

Considering that the tax has a compelling force and the present collection rate is more than 70 percent, the present cleansing tax will be continuously charged for the base of SWM revenues with reviewing the SWM costs and setting rational tariff.

c. Calculation of Cleansing Tax Revenue

Total SWM expense in Mersin in 1998 was 903 billion TL(depreciation cost is not fully included.)

Based on this assumption, the necessary SWM costs exceed present expenditure as shown in the Table below.

- Collection and haulage US$ 25/ton
- Public area cleansing US$ 221/ton
- Final disposal US$ 10/ton

Table 8-7: SWM Costs in 1998 (Mersin GM)

		Amount (ton/year)*	Unit price (US$/ton)	Cost in US$	Cost in TL (million)
Yenisehir DM	Collection/haulage	31,303	25	782,575	222,627
	Public area cleansing	1,866	221	412,386	117,316
	Sub-total	33,169	(36.0)	1,194,961	339,943
Toroslar DM	Collection/haulage	50,925	25	1,273,125	362,179
	Public area cleansing	3,012	221	665,652	189,365
	Sub-total	53,937	(35.9)	1,938,777	551,544
Akdeniz DM	Collection/haulage	56,473	25	1,411,825	401,636
	Public area cleansing	3,284	221	725,764	206,465
	Sub-total	59,757	(35.8)	2,137,589	608,101
Mersin GM	Public area cleansing	1,692	221	373,932	106,376
	Composting plant	7,300	(19.1)	139,750	39,756
	Final Disposal	143,262	10	1,432,620	407,552
	Sub-total	-	-	1,946,302	553,684
Total		148,555*	(48.6)	7,217,629	2,053,272

Notes: Exchange rate US$ 1 =284,480 TL
* Sum of the collection/haulage amount and public area cleansing amount.
( ) means figures of calculation result of Costs in US$/amount of waste.

On the other hand, the revenue of cleansing tax in case the collection rate is increased to 90% is shown in the following Table.

Table 8-8: Revenue from Waste Fee Collection (Mersin GM)

unit: million TL

	Tax collected in 1998	Collection rate (%)	Potential of tax charged	Amount of tax collected (90% collection rate)
Yenisehir DM	89,225	80	111,531	100,378
Toroslar DM	76,701	70	109,573	98,616
Akdeniz DM	167,296	90	185,884	167,296
Total	333,222	-	406,988	366,290

As a result, it can be concluded that cleansing tax needs to be raised 6 times of that in 1998 in order to entirely cover SWM costs.

Considering current Turkish economy, it is very difficult to increase the cleansing tax at once to cover the SWM costs fully. Therefore in the master plan, the cleansing tax will be proposed to increase step by step to cover the SWM costs in continuation of present system. The target will be as follows;

Phase 1 (2005) Cleansing tax will cover 50 % of overall SWM costs

Phase 2 (2012) Cleansing tax will cover 75 % of overall SWM costs

Phase 3 (2020) Cleansing tax will cover 100 % of overall SWM costs

d. Financial Control

Financial control by SWM services is not done by the cleansing department in both GMs and the DMs, though Mersin GM tried to formulate budget by groups of SWM in 1995. But in order to provide efficient SWM services, it is very important to establish a separate accounting system by SWM services, and by budget planning system in the cleansing department. That does not mean to contract to private enterprises or to pay directly by the cleansing department, but that makes it necessary to feed back the information of actual revenue and actual expenditure periodically.

Actual revenue should consist of the cleansing tax, tipping fee and selling of usable materials. Actual expenditure should consist of current expenditure, including direct personnel expenses, indirect personnel expenses, contracting out expenses and other operation and maintenance expenses, and capital expenditure. It is necessary to feed back every quarter at least, while it is desirable to feed back every month between the financial department and the cleansing department.

The cleansing department should keep documents on the working records of staff and workers by SWM services and amount of fuel consumpted by vehicles (including heavy equipment) by SWM services as well as maintenance report by vehicles every day. And the cleansing department reports the separate accounting expenses by SWM services to the general manager of the municipality and the director of the financial department. (It is necessary to be reported every half year, though it is desirable to be reported every quarter.)

Stocking and analysing these separate accounting data, the director of cleansing department requires the budget of next year with the issues to be improved.

8.3.4 Privatisation and Contracting System

Privatisation is not a means for overwhelming financial bottlenecks, as well as getting rid of personnel and maintenance costs as expressed by many of the municipal administrators. Every service has a cost in return; however, the essential principle centres around the maximisation of efficiency and cost minimisation. The main objective of private sector involvement is to reduce costs of service delivery, whilst maintaining and improving the level of supplied services. In order to be able to judge the advantages and disadvantages of privatisation and of contracting out solid waste management services, each of the municipalities in Mersin should assess their current unit costs and must implement a separate cost accounting system for themselves, detached from the general accounting system of the municipality.

Solid waste management is a significant public service which must be available for all citizens in order to maintain public health, and to protect the environment. Involvement of the private sector in solid waste management should increase competition, investment, competent management, and operation. Appropriate models to be used are contracting out for collection services and concession contracts for building, operating, and transferring of waste treatment, processing and disposal facilities. In both cases, the responsibility for raising revenues to pay for these services will, however, remain with the municipalities. The objectives of the Build, Operate and Transfer (BOT) Law No. 3996 allow the provision of solid waste management related investments and services. The concession contracts based on BOT-models would gain a means to encourage private sector involvement, if regional

associations and unions are promoted and mobilised for collective treatment and disposal of solid wastes along with clinical and hazardous wastes. This is at least a preposition in regard of 'economies of scale' to operate manageable facilities.

In contracting out solid waste management services, the municipalities should introduce appropriate performance contracts for private sector involvement. This could be well achieved by inter-municipal co-operation, in which exchange of ideas and experience may take place. This co-operation can be carried to further stages for preparing draft tender documents with a typical draft contract clauses, which are developed on a systematic base. Identification of tasks in precise connections with terms of reference falls appropriate for the management of performance contracts and smooth monitoring of accomplishments. However, necessary legislating actions have to be undertaken, in order to authorise municipalities to enter into contractual commitments for certain periods exceeding one year.

The executive municipal personnel engaged in solid waste management and cleansing assignments have to be in a position to evaluate the benefits of contracting out selected services and concessions recognised for waste treatment and disposal facilities.

The municipalities in Mersin that practise privatisation models have more or less the necessary expertise; (i) to prepare sound bidding documents with clear performance specifications, and (ii) to carry out competitive and transparent tender procedures. However, if those municipalities at the outset have a further breakdown of services along with a rough indication about unit costs, a more unique contracting system could be attained. This would further avail a clear performance monitoring. It should not be forgotten, on the other hand, that not only the municipalities, but also the candidate contractors are not sufficiently familiar with and experienced in the assessment of unit costs of contracted services. Therefore a certain period of time is required for both sides to be mutually more experienced in client and contractor relations in this sector for professional and institutional reasons.

For the time being, neither the private companies possess the required expertise, nor the conditions are favourable in street cleansing and waste removal business. As long as the municipalities regard privatisation as an escape from bureaucratic, administrative, and legislative handicaps as well as a cheaper way of manpower hiring, neither the quality of services get better, nor the required professionalisation in this sector could be achieved. The experiences mention that, given suitable guidance from proficient consultants or joint venture with internationally renowned contractors, some business opportunities may arise and waste collection, recycling, treatment and disposal contracts would be more attractive; particularly, if the disposal route is landfill rather than incineration or other process technologies. However, those companies will be looking for clear indications that the municipalities are looking for the best utilisation of money, not the cheapest price, and offering a reasonable contract duration.

8.3.5 Monitoring and Information Management System

Without any exception, all of the municipalities in Mersin lack properly prepared and precisely organised guidance documents. Extensive dissemination of formalised and formatted information is rare, whereas verbal communications and transmission of

instructions are predominantly preferred in coarse of an hierarchically respected 'order and obey' principles among public and private personnel.

The essential handicap of the municipalities lies in the identification of unit costs of operations, which allow no monitoring action based on cost-benefit, cost-efficiency, and cost-effectiveness type of evaluation instruments. This deficiency hinders the development of an adequate decision making process related to managerial and operational issues, aided by accurate and quantitative assessments.

The absence of a set of technical and financial performance criteria prevent for the executive personnel of the cleansing and solid waste management units to accurately determine requirements related to operations and projects. Developing and maintaining a database on solid waste management activities is therefore essential primarily for:

- Registering solid waste generators.
- Inspecting waste removal and disposal activities and facilities.
- Undertaking appraisals on potential public and private sector operations influencing the currently applied solid waste service.
- Auditing financial and operational performance as well as levels of cost recovery.
- Providing guidance for operations as well as proof of evidence for enforcement.

The data about costs, quality and accountability is indispensable to judge the efficiency of services, effectiveness of performances and affordability of cleansing and solid waste management units. A set of indicators could be used on a comparative basis, which is important for good management and decision making. Under current conditions in each of municipalities, no judgements can be made concerning the following throughout the fulfilment of the requirements of a successful solid waste management:

- The appropriateness of the mode of service applied.
- The performance of the involved public and private personnel and the service quality.
- Budgetary and financial affordability.

The respective solid waste management units of individual municipalities in Mersin should be competent in: (i) preparation of contracts in compliance with legislation and regulations as well as professional and managerial requirements; (ii) inspection, supervision and control of operations as well as monitoring of implementations and enforcement; and (iii) assessment of service and financial performances.

Although the municipalities highly rely on public observations for performance records, technical instruments need also be developed and practised to identify goals and achievement rates throughout in-house and field services.

The monitoring and information management related recommendations for system improvement purposes are primarily oriented towards those municipalities; such as Mersin Greater Municipality, Yenisehir, Akdeniz, and Toroslar District Municipalities, that apply full-privatisation and contract out solid waste services.

If the requirements of effective monitoring are not fulfilled, no efficiency maximisation effort could be taken up on a comparative basis. Implementation of improvement measures should rely on operational and quantitative data. Therefore, empirical analyses should be applied as technical instruments in identification of performance targets, and in assessment of success levels.

In this regard, the core staff of the solid waste management units pursuing a full-privatised service mode, has to be well equipped with necessary monitoring instruments. In such models, central monitoring and evaluation are essential for contracted services, which is the case for Mersin Greater Municipality, Yenisehir, Akdeniz, and Toroslar District Municipalities.

Departing from the relevance of the reliable data for the following, an appropriate information management system has to be developed by each municipality pertaining basically to service provision and financial performance.

- Service related inputs (level, quality, and costs of services provided)
- Mobilisation of available resources (cost-effectiveness of services)
- Performance review (information base for policy making and managerial decisions).

A service provision oriented database has to precisely provide details on operation including number of premises; size of population served; type and volume of wastes collected; size of vehicle pool; distances travelled for collection, haulage and disposal; vehicles operating duration; service routes followed as well as means of collection. By attaching special attention to apportioned services provided and facilities shared by public and private parties, indicators based calculations have to be carried out for both total expenditures and individual cost. Accordingly operating costs, employee costs, fuel costs, total capital costs and vehicle costs have to be associated with specific service characteristics to identify unit costs; such as costs per 1,000 of population served, cost per households served, cost per bin or container handled, and cost per ton of waste collected.

In order to identify financial performance in an accurate manner beside fixed and variable costs, tax and revenues collected need to be identified. Adequate financial information required in this respect can be more easily obtained if a separate accounting system is applied for solid waste management. Otherwise, within the overall current and capital expenditures, and transfer payments flow of the municipality, it is not possible to differentiate between the costs attributable to diverse solid waste service categories.

Conclusively, a systematic information management is required for all municipalities in Mersin to provide more accurate, relevant, comparable, and up-to-date assessments necessary for effective monitoring, which is in fact the functional building block of appropriate evaluation and decision making. In this regard, the fundamentals of the information system should comprise three main components, namely: (i) service provision, (ii) operational aspects, and (iii) financial records.

Information related to overall service provision should include:

- Service area, population and households size.
- Volume, weight and composition of wastes collected.
- Service mode and frequency.

- Characteristics of service fleet, equipment and means.
- Personnel size engaged in office and field services.
- Public complaints.

Operational information component, on the other hand, has to be structured on:

- Size of vehicle pool and duration of operations.
- Vehicle operations records.
- Vehicle operation costs.
- Personnel size and employment period.

Financial information component, lastly, should cover records related to:

- Vehicle operation costs.
- Labour costs.
- Office management costs.
- Unit costs of apportioned services per ton, person, household, employee, etc.
- Collected tax and revenues.

The document needs to be designed by taking into account further specific details not only for monitoring, but also for reporting purposes on daily, weekly, monthly, quarterly or yearly basis. By this way, instrumental aid for an adequate monitoring would be provided leading to objective evaluations and strategic decisions connected with necessary planning, programming, scheduling, and budgeting aspects of implementation oriented actions.

8.3.6 Human Resources Development

The heads of the responsible departments in the greater municipalities or the directors of the related directorates in district municipalities engaged in solid waste management services have to be in a position to tackle with managerial issues encompassing both administrative and operational engagements. Administrative engagements include defining performance standards, accounting, financial management, contracting, regulation, and control functions related to maintaining standards, enforcement of licence conditions for waste removal, storage, treatment and disposal facilities and registering waste generators.

The decision making approach associated with the Head or the Director post has to rely on effectively applied diagnosis and prognosis techniques availing an appropriate basis for monitoring and evaluation, followed by implementation oriented preparations and actions. Accordingly the service area, size of target groups and their socio-economic and cultural status, volume of work, and the organisation of operations should be well determined by the person in charge.

Since the required qualification for such a post is relatively high under current conditions, the municipalities have to be very keen on appointing the most suitable persons, who might be already available in their own personnel, but have been neglected due to political or any other reason. Since a particular training program in compliance with the acquisition of above mentioned skills is not presently available, the solid waste managers should be eager to undertake investigations and researches to intensify their knowledge on own initiatives. Therefore, every occasion for self-training has to be provided to the employees bearing such an eagerness.

A rough distinction can be made between the Deputy Heads or the Deputy Directors; normally two, each supervise internal (in-house / indoors) management and external (field / outdoors) operations. Internal activities should focus on the following subjects, which could be dealt with by respective division or section chiefs. These subjects of concern are related to: (i) administrative and personnel recruitment issues; (ii) legislative and regulatory issues; and (iii) accounting, financial and budgetary issues. Similarly, the following external activities could also be dealt by a respective division or section chief. These subjects of concern are: (i) operational organisation; supervision, inspection and performance assessment; (ii) logistics, support services, repair and maintenance; and (iii) manual development and personnel training.

This prototype model on division of labour in a certain solid waste management unit could be subjected to further diversification in accordance with the professional and the qualifications needed by respective municipalities, versus available human resources.

Although the size of in-house management staff has to vary due to volume of work determined by the size of service area and target group as well as service mode, this staff constitutes a permanent core unit, which has to exist with respective experts no matter full-privatisation, semi-privatisation or non-privatisation model is applied in service delivery.

The size of outdoor operations staff, on the other hand, is determined by the service mode, size of service area, and target group. This staff possesses a flexible character and is subject to variations according to full-privatisation, semi-privatisation, or non-privatisation model applied in service delivery. The size of municipal personnel engaged in outdoor operations will diminish in case of full-privatisation, proportionally correspond in case of semi-privatisation, and increase in case of non-privatisation. This affirmation is conversely valid for the size of hired personnel of the private contractor.

The normative personnel standards correspondingly developed for managerial and operational personnel size, would give indications on manpower requirements of each individual municipality by taking into account the needed qualification and specialisation as well as applied service mode.

The background and further training of the mid-career staff is extremely important, because they have to provide upwards and downwards support within the functional and vertical stream of activities. Unfortunately, training possibilities for mid-career staff engaged in solid waste management assignments are enormously limited or almost absent in Turkey. Therefore, top level municipal administrators have to devote a specific regard to training issues and intend to find pragmatic solutions. A strong recommendation in this respect is to get in touch with more experienced greater municipalities and municipal unions and ask for their assistance. Such contacts and requests should also be extended to internationally organised public institutions and associations and NGOs, e.g., Municipal Association of Turkey (TBD-Turkiye Belediyecilik Dernegi), and IULA (International Union of Local Administrations), interested in providing training programs to local administrations and communal agencies.

Another recommendation could be the strengthening of experience and idea exchange engagements or inter-municipal coordination between greater and district

municipalities in Adana. This would naturally provide a platform to discuss and evaluate the experiences made by individual municipalities in diverse solid waste management issues. Especially the debates on privatisation practices, transmission of experiences and ex-post-facto evaluations would be extremely valuable and beneficial. It would, for instance, be very interesting to hear the confers of the Adana Greater Municipality, Seyhan District Municipality and Yuregir District Municipality, which implement full-privatised, semi-privatised and none-privatised service models, respectively.

Beside the above mentioned efforts oriented towards the training of top-level and mid-career management staff of the solid waste management units of individual municipalities in Adana and Mersin, systematically developed training programs have to be offered to the municipal and/or private personnel engaged in operational services of solid waste management. Although such personnel is subjected to short-term training programs applied by certain municipalities at modest levels, their qualificational up-grading is unavoidable. It would be a rational approach, if these training courses are designed on manual basis, where the practices are amply described and illustrated.

The training programs should be designed and tailored for the development of formal basis of managerial and operational activities. Implementations in line with manuals, guidelines, instructions should be introduced and demonstrated on basis of formalised procedures, formatted transmissions, schematic organisations supplemented by phasing and scheduling techniques, bar-charts and checklists. These should be the training tools used by trainers and multiplicators for dissemination of knowledge and experience.

In order to rationalise the training related endeavours and to meet the urgent requirements in this respect, the municipalities have to possess the intention for collective organisations. This is the way, in which the burdens are tremendously minimised and multiplicator effects, in contrary, are effectively maximised. Training concerned collective approaches in the Cukurova Region could be more easily promoted to advance levels, if inter-municipal co-operation is realised in specific joint operations; e.g., facility management, recyclables marketing, hazardous waste disposal, etc. A certain degree of experience gained in a couple of concrete partnerships would open new and diverse lanes for further co-operation opportunities. Therefore, the relevance of municipal unions should be reconsidered by the municipalities in Mersin with respective task attributions, where high priority is placed to training activities.

8.3.7 Public Education and Co-operation

a. Basic Concept

Public education and co-operation are important components of any integrated SWM program. In view of limited resident participation in SWM and low public awareness of waste problems in Mersin, there is a need to inform the public of the SWM problems, e.g., increasing waste volume, environmental deterioration, and inappropriate handling procedures, etc.

With the exception of isolated cases, e.g., waste separation at household level, which is done informally by the “eskici”, such activities are frequently do not consider

sensitive participants through inductive talks, and education on appropriate solid waste management and segregation.

Another reason for the importance of public education is the need to introduce to the public the idea that it is the responsibility of each individual to engage in activities that would not only improve the environment, but also their standard of living. The public also need to initiate waste minimisation through a separate collection system and community based recycling programs, and change their consumption patterns, so that eventually they can pass on their knowledge and experiences to the future generation.

In this sense, education programs for the public would pave the way for achieving the ultimate goals of this study:

- To reduce the amount of waste being produced (waste minimisation)
- To recycle waste as much as possible (recycling)
- To dispose wastes, that cannot be recycled, in an environmentally-friendly manner (waste stabilisation)

b. Specific Issues

b.1 Importance of Aesthetics and Environmental Issues

There is a need to raise public awareness on regional environmental issues and the benefits that result from a cleaner environment. The need to conserve non-renewable natural resources should also be emphasised.

b.2 Importance of Proper Waste Handling Practices

Most of the wastes are discharged and collected using communal containers without any form of segregation except the items separated to be sold to *eskici*; the residents are hardly aware of the SWM problems. Therefore, it is important to promote the use of appropriate containers and storage methods for waste prior to collection. Separate collection is indispensable to waste volume reduction, resource recovery, and in particular, for the improvement of the environment and quality of life.

b.3 Responsibilities of Individuals, Various Groups and Authorities Regarding SWM

The municipalities in the target area are lack of properly prepared and precisely organised guidance to inform the public on waste minimisation and on the importance of recycling. On the other hand the public need to cooperate with the authorities that manage waste collection, haulage, treatment, and disposal

b.4 How the Public Can Make a Change. What They Could do to Assist Future SWM

The public, as consumers, have the power to change the consumption pattern, as well as the quality of manufactured goods and packaging, through selective purchasing, e.g., refraining from buying virgin materials, non-biodegradable plastics. Conversely, the use of goods made from recycled materials should be encouraged. As producers of waste, the different methods of waste minimisation, recycling and conscientious discharge manners can be discussed.

b.5 Promotion of Public Interest in Future SWM

The authorities can encourage public motivation to participate and devise a SWM system, suitable for to the local culture and common practices.

c. Main Players in SWM for Public Education and Co-operation

Since the MoE (Ministry of Environment) aims to recycle 90 % of MSW in the country by enforcing municipalities to apply separate collection system, the public co-operation for the separation of their waste is the most critical issue. Public co-operation for proper MSW management could be only achieved through a long, continuous public education by the relevant agencies. The relevant parties that aim to devise an MSWM public education program, and solicit co-operation is listed below:

Public Players: Administrative entities generally concerned with SWM

- MoE: Ministry of Environment
- MoD: Ministry of Education
- Greater Municipalities of Mersin(departmental office related to social promotion activities)
- District Municipalities in Mersin GM
- Schools

Community Players: Power potential entities for the source separation and recycling.

- Community residents (potential communal actors: housewives, “kapicis” (doorkeepers), “eskici” (recycling material pickers), children, etc.).

Moderate Players: Both public and private entities covering niches of SWM services.

- NGO’s organisations
- Voluntary workers, etc.

d. Experiment on the Separate Collection

In order to examine the needs and the method of obtaining public co-operation to separate collection, the JICA team, in collaboration with the C/P, conducted the experiment on separate collection in Mersin. Many valuable experiences were gained, from the experiment, for future expansion of separate collection. Among them an education book produced by the team is considered an important tool for public education, and it could be a base for an SWM education book for the country.

8.3.8 Guidelines

a. General

Political Guidelines:

- Placing top priority to collaborative, co-operative, and co-ordinative actions as well as participatory and contributory initiatives.

- Promoting inter-municipal support, and collective and joint actions in coping with solid waste management problems.

- Creating organisations for information exchange, transmission of experiences and exchange of new ideas.
- Strengthening regional and local linkages in common issues of concern.
- Providing inter-municipal support for new projects, investments, implementations, and measures.
- Promoting regulatory, managerial, operational, functional and technological developments.
- Providing professional incentives and encouraging training for human resources development.
- Devoting particular attention to public awareness as a socio-cultural factor necessary for prospective actions, especially in separate collection, recycling and resource recovery practices.
- Promoting rehabilitation, restoration, up-grading and aftercare projects for diverse facilities.
- Intensifying co-operation possibilities with other local actors; governmental agencies, private business and industrial enterprises, public service entities, non-governmental organisations, academic institutions, mass media and publicity.

Legislative Guidelines:

- Gathering and compiling relevant laws and regulations on solid waste management in a concise manner.
- Identifying legal instruments to ensure and to preserve competitiveness in contracting out services within the mechanisms of free business market to encourage appropriate private sector involvement.
- Allowing auditing for intra-municipal as well as contracted out services.
- Mobilising and enforcing provisions resulting in higher service performances.

Administrative Guidelines:

- Warranting the best utilisation and mobilisation of available human resources and expertise.
- Accrediting qualification in appointments for specific posts.
- Developing an adequate administrative organisation scheme by taking into account type, size, scope, and content of works to be accomplished.
- Distinguishing between management and operations oriented structuring models.
- Preparing personnel standardisation concepts and precise job descriptions.
- Formalising and formatting internal and external information flow.
- Establishing a database, and promoting quantification of expressions.

- Human resources development and staff training requirements.

Managerial Guidelines:

- Distinguishing between administrative management and operations management responsibilities.
- Establishing system fundamentals for comparative analyses.
- Setting the building blocks for problem identification; problem solving oriented preparations and decision making; financing, budgeting and programming; action organisation; implementation; monitoring, performance assessment, evaluation and reporting.
- Identifying the most advantageous service mode on comparative basis.
- Preparing thorough tender documents and following transparent contracting procedures.
- Undertaking necessary steps for identifying unit costs by implementing a separate accounting and budgeting system particular for solid waste management services.
- Assessing financial terms and costs on unit and item basis.
- Promoting operationalisation and quantification of decisions and actions.
- Relying on empirical assessments and expressions in strategic evaluations and formulations.
- Keeping statistical records and preserving updating habits in information management.

Operational Guidelines:

- Developing standards for operations as well as working principles for field services.
- Setting and scheduling target dates for efficiency improvement.
- Describing precisely the apportionment of solid waste management services and preparing a set of instructions and directives for the particular tasks to be carried out.
- Meeting organisational and logistical requirements of operations management.
- Providing effective maintenance for vehicles and equipment.
- Developing systematic tools for field monitoring, inspection and performance measurement.
- Evaluating and reporting the service achievements and operational deficiencies.
- Preparing recommendations and proposals for the elimination of operational gaps in the delivery of services.

- Elaborating on rationalisation measures by investigating each portion of service particularly with regard to manpower, equipment, vehicular, material and financial allocations.

Technical Guidelines:

- Preparing guidance documents, manuals and handbooks, which indicate and illustrate the techniques of operations and handling of equipment.
- Promoting technical training of logistical and operational staff and conducting workshops and course programs.
- Preparing auditing checklists for municipal and private company performances covering financing and cost aspects.
- Developing project appraisal as well as project based accounting and budgeting skills.
- Elaborating issues on self-sufficiency and affordability at municipal, departmental and sectional levels.
- Introducing 'cost recovery' and 'service charge' concepts in dealing with financial aspects of provided services.
- Preparing specimen contracts and related performance documents.
- Identifying technical assistance and expert service requirements.

These guidelines formulated above depend on a logical and systematic frame, in which:

- Policy guidelines refer to overall orientation and optional preferences in delivery of solid waste management services.
- Legislative guidelines relate to intangible tools describing field of activities associated with respective authorisations and responsibilities.
- Administrative guidelines comprise the structural and organisational setting in accordance with political preferences and legislative obligations.
- Managerial guidelines give indications pertaining to decision preparation and rational decision making.
- Operational guidelines are pertinent for purposeful actions and implementations.
- Technical guidelines constitute tangible tools for efficiency enhancement.

When considered as individual aspects of an integrative package, all these guidelines determine the institutional structure of the greater and district municipalities in Mersin with due references to their service styles in solid waste management assignments.

b. Guidelines for Yenisehir, Akdeniz and Toroslar DMs

Guidelines for the Cleansing Directorates of the Yenisehir, Akdeniz and Toroslar District Municipalities can be categorised in two sections. The primary guidelines are those, which are valid for all respective directorates and district municipalities in general. The supplementary guidelines, on the other hand, are those which are more particular in character and require specific reference.

Primary Guidelines:

- The cleansing directorates of the district municipalities in Mersin have to be aware of the fact that, based on considerable experience gained in privatisation, they must now be motivated towards improvement of their capabilities.
- In this connection, with available personnel employed in the office for administrative services, more achievements in field operations must be attained.
- Within the framework of ''lessons to be learned'' principle, the comparatively successful consequences of the joint-contracting action implemented by the Environmental Health Department of the Mersin Greater Municipality and the Cleansing Directorate of the Akdeniz District Municipality, must be carefully analysed by other cleansing directorates on own behalf.
- System betterment approaches ought to be undertaken in administrative, managerial and operational activities based on more purposefully mobilisation and organisation of personnel, vehicular and instrumental means as well as monetary resources. In this respect, efficiency criteria must be primarily referred by the cleansing directorates for internal evaluation and self-criticism.
- Unit costs of contracted services should be more precisely assessed, particularly by the Cleansing Directorates of the Akdeniz and Toroslar District Municipalities, for undertaking more refined and detailed calculations on costs and benefits of privatisation and contracting.
- A joint symposium of the municipalities in Mersin must be organised in order to assess the positive and negative aspects of privatisation of SWM services as well as to prepare policy recommendations and guidelines for practitioners.
- Since comparatively advance level of privatisation has reached to a certain maturity in Mersin, critical discussions at serious and pluralistic platforms should be initiated in following subjects within context of a ''quest for paradigm'' mentality:
    - Social security of the labour force employed in contracted SWM services,
    - Accomplishment of SWM services under Municipal Economic Enterprise status,
    - Requirements for integrated contracting of SWM services,
    - Requirements for BOT based approaches in SWM.

Supplementary Guidelines:

- For more efficiency in SWM, all three district municipalities in Mersin, but particularly Akdeniz and Toroslar, should look after further intensification of inter-directorial collaboration and horizontal co-operation.

- Inter-directorial linkages should be particularly intensified in personnel recruitment, accounting and financial management for more effective administration of services, since reorganisational approaches within the municipalities are not preferred.

- The Cleansing Directorates of the district municipalities should be more actively involved in and informed about financial matters of SWM services.

- For the fulfilment of financial monitoring requirements, a transparent accounting system should be developed, which is based on the computer networks of the district municipalities, however with first priority in Toroslar.

- Organisation of logistic services encompassing maintenance and repair must be comparatively reviewed by privately served Yenisehir District Municipalities and municipally served Akdeniz and Toroslar District Municipalities, in order to identify, whether some steps towards more rationality could be undertaken by alternative managerial and / or political approaches.

- Beside promoting current inter-municipal collaboration running at modest level, more effort should be devoted for establishing fruitful external collaborations with other local governmental, non-governmental, private and semi-private agencies, which are currently very elementary for consensus building at some vital and strategical decisions concerning SWM in Mersin. .

- Serious discussions and elaborations should be internally held by individual cleansing directorates oriented towards assessment of long range needs and identification of strategical aims for SWM in respective municipal district of Mersin.

- Endeavours supported by legal consultations should be confined on development of formal procedures in form of supplementary circulars and instructions accepted and implemented by all district municipalities in Mersin, in order to eliminate the legislative gaps in waste collection and transport activities.

- The appropriateness of the municipal economic (municipally owned) enterprise status as an alternative for the current status of cleansing directorates for the management of solid waste services in Mersin should be discussed in depth with identification of protective instruments for political corruption.

- Due attention should be paid for prevention of potential conflicts with privately employed manpower in contracted solid waste management services pertaining to the fulfilment of the requirements of the judicial provisions of Labour Law on social security.

- All cleansing directorates of the district municipalities in Mersin should try to be more documentary and formal in informative and instructive transmissions.

- The contract should not be the only source of reference for monitoring of SWM services. A manual has to be immediately developed for private and municipal personnel in this respect.

- More effort should be given by district municipalities for preparation and offer of human resources development and personnel training programs, not

only for operations of field staff but for administrative and managerial duties of office staff, as well.

8.3.9 Medical SWM

a. Legislation

The legal tool currently available is meticulous in style, but it is without deficiencies; in order for the regulations to be an effective tool for medical institutions to control of medical waste, there is a need for the MoE, in consultation with medical professionals, academics, political analysts, etc., to revise the regulation in the near future.

The survey on medical institutions in Mersin revealed that the regulation's good intentions are not conveyed to the users – the hospitals and the waste collection staff. Communication is of vital importance in any management task, and medical waste management is no exception. A solid, comprehensive transcription of the hospital's and the district municipality's obligations under the regulation, or a code of practise, would be a powerful implement to tackle the current problems in medical waste management.

The first step in preparing a code of practise is to identify who the code is for and what their obligation is under the medical waste regulation. The next step is to gather the opinions of all the main parties involved, so that real problems can be identified, and agendas brought to the open. The good intentions of any guideline that does not integrate the problems faced by those involved would be redundant, for the code would merely be another bureaucratic handout with no real value. Only in developing a code of practise for all of those responsible for the safe management of medical waste would the authorities provide the means to achieve what the regulation set out to do as an objective.

b. Education & Human Resource Development

In the current world of information technology, knowledge has become a determining factor of development. And the lack of knowledge has hindered, in many parts of the world, the efforts of law makers and academia to improve the knowledge base of its people. Another problem that causes the knowledge gap is that education programs are sometimes introduced in a way that is not informative, thought provoking, and motivating, but is dictating, uninformative, and, most of all, uninteresting. The only results of this type of education program are wasted tax money, wasted resources, and a disgruntled public that sees only the failures of the program.

In the case of Mersin it is evident that the hospitals frequently hold training programs for their waste management staff, but there is no way to determine whether the knowledge is being passed on, and that the staff involved are given the opportunity to reflect upon what they have been taught. Also the study revealed that the workers who handle medical waste outside the hospital, i.e., waste collection staff and landfill operators receive no training. The indifference to sanitation outside the medical institutions, as seen by the poor waste management practises at the hospitals and at the landfill site, is an indication, perhaps, of a failure in the training of staff by both the hospitals and the authorities.

The first step in developing an effective education program is to assign a think-tank with representatives from the following:

i. Ministry of Environment
ii. Ministry of Health
iii. Ministry of Education
iv. Greater Municipalities of Adana and Mersin
v. District Municipalities of Adana and Mersin
vi. Academic institutions
vii. Healthcare professionals
viii. Representatives of waste collection workers and private waste collection companies

c. Enforcement and Monitoring

An effective monitoring system is one of the most efficient means for the authorities to manage not only medical waste, but also municipal waste, industrial waste, hazardous waste, and municipal finances. It is also an effective means for the authorities to administer the healthcare expenditures in both private and public hospitals, so that the information can be used to plan fiscal matters.

The provincial governments of Adana and Mersin have records on the amount of medical waste generated each month, but the study revealed that none of the hospitals have their medical waste weighed. In addition, the disposal sites did not have a weighbridge at the time that the data was collected, questioning the validity of the information kept by the provincial governments. This questionable data, collected by the provincial government, is a clear symptom of an inadequate monitoring system.

It is nearly impossible for the authorities to collect the correct amount of dues for waste collection, to enforce the law in an efficient and democratic manner, to impose penalties on those who violate the system, and to make concrete future plans using inaccurate information. Therefore, the authorities must strive to collect reliable data at all times so that there is less outlay over the long term.

One of the ways in which the authorities can gather information that is reliable is to introduce a relational database system for all the administrative tasks.

There is a need to truly identify the problems faced by hospitals before the authorities introduce any new legislation, or new changes, for there may be a deeper, underlying problem – totally unrelated to medical waste – as to why hospitals are indifferent, or have an unrealistic perception of the true situation.

8.4 The SWM Master Plan

8.4.1 The SWM Master Plan

The SWM master plan for Mersin GM is summarised in the table below.

Table 8-9: The SWM Master Plan for Mersin

Components \ Phase	Present (1998)	Phase 1 (2000 - 2005)	Phase 2 (2006 - 2012)	Phase 3 (2013 - 2020)
1. MSW Generation				
Population in Mersin GM	**634,850**	**788,999**	**982,499**	**1,249,940**
Akdeniz DM	255,516	293,508	337,148	395,024
Troslar DM	234,024	297,744	378,813	498,823
Yenisehir DM	145,310	197,747	266,538	356,091
MSW Amount (ton/day)				
Generation	446	663	969	1,350
Discharge	425	644	946	1,321
Collection	407	637	942	1,321
MSW Composition (%)				
Non-compostable	35	46	54	58
Compostable	65	54	46	42
2. Refuse Collection & Transportation				
Collection rate	100 (92% by POS)	100 %	100 %	100 %
Ratio of improper disposal to generation	3.1 %	0 %	0 %	0 %
Separate collection rate to refuse collection	0 %	30 %	60 %	100 %
Collection system	Communal container, curb side and door to door collection	Communal container collection (point collection)	Communal container collection (point collection)	Communal container collection (point collection)
Types of communal container	Mixed and various kinds of container	800 lit. wheeled container	800 lit. wheeled container	800 lit. wheeled container
Major type of vehicles (units)	Compactor trucks ($16\ m^3$): 41 Lorry: 1 Collection truck for medical waste: 1	Compactor trucks ($16\ m^3$): 63 Collection truck for medical waste: 1	Compactor trucks ($16\ m^3$): 88 Collection truck for medical waste: 1	Compactor trucks ($16\ m^3$): 125 Collection truck for medical waste: 2
Transportation system	Direct haulage	Transfer system may be necessary for the transportation to Cimsa site.	Transfer system if a future disposal site locates more than 20 km from city centre	Transfer system if a future disposal site locates more than 20 km from city centre
Executing organisation	Private contractors employed by DMs	Private contractors employed by DMs	Private contractors employed by DMs	Private contractors employed by DMs
Unit cost (US$/ton)	10.5	23.3	20.7	19.3
3. Public Area Cleansing				
Method of sweeping	Machinery and manual labour	Machinery and manual labour	Machinery and manual labour	Mainly machinery
Length of served road (km)	624	776	967	1,230
Operation by	Mainly private contractor and partly municipalities	Private contractor	Private contractor	Private contractor
Unit cost (US$/ton)	316	221	221	221
4. Recycling Intermediate treatment				
Sorting plant				
Site	None	Cimsa	Cimsa	Cimsa & New landfill
Treated amount (ton/year)	0	32,095	111,444	279,656
Unit cost (US$/ton)	None	18.3	16.8	16.9
Compost plant				
Site	Compost plant landfill	Cimsa	Cimsa	New landfill
Treated amount (ton/year)	14,600	37,677	94,934	202,509
Unit cost (US$/ton)	21.7	22.2	22.5	22.4
Recycling at generation	15 (ton/day)	19 (ton/day)	23 (ton/day)	29 (ton/day)
Overall recycling rate	10.6 %	10.1 %	15.5 %	23.6 %
Recycling system	Few government related recycling but mainly done by private sector	Government related recycling system be established.	Government related recycling system be expanded.	A closed loop society will be created.
5. Final Disposal				
Method of operation	Improper landfill	Sanitary landfill	Sanitary landfill	Sanitary landfill
Final disposal site	Compost plant site	Cimsa site	New landfill	New landfill
Distance from city (km)	8.5	20	20	20
Operation by	Mersin GM	Mersin GM	Private contractor	Private contractor

Phase / Components	Present (1998)	Phase 1 (2000 - 2005)	Phase 2 (2006 - 2012)	Phase 3 (2013 - 2020)
Tipping fee (US$/ton)	None	13.9	13.9	13.9
Unit cost (US$/ton)	1.1	12.9	10.8	10.6
Main equipment	Bulldozer: 1 Excavator: 1	Bulldozer: 2 Excavator: 1 Dump truck: 3 Water tanker: 1	Bulldozer: 3 Excavator: 1 Dump truck: 3 Water tanker: 1	Bulldozer: 3 Excavator: 1 Dump truck: 3 Water tanker: 1
6. Maintenance & Repair				
Preventive Maintenance	Municipal and private workshop	Municipal and private workshop	Private workshop	Private workshop
Major repair	Municipal and private workshop	Private workshop	Private workshop	Private workshop
Operation by	GM and private	GM and private	Private company	Private company
7. Public Organisations Responsible on SWM	Mersin GM for treatment, transfer operation, final disposal and part of public area cleansing. Akdeniz, Troslar and Yenisehir DMs for collection and part of public area cleansing.			
8. Financial Matters				
Unit SWM Cost (US$/ton)	37.6	52.1	50.0	53.3
Revenue Source	• Cleansing tax • Budget allocation from general finance	• Cleansing tax • Budget allocation from general finance • Sale of recyclables and compost • Tipping fee	• Cleansing tax • Budget allocation from general finance • Sale of recyclables and compost • Tipping fee	• Cleansing tax • Sale of recyclables and compost • Tipping fee
Collection rate of cleansing tax (%)	N/A	90	90	90
Coverage rate of cleansing tax to SWM	23.6 %	79 %	99 %	119 %
Total revenue (US$ 1,000)	4,458	16,669	20,229	27,725
Cleansing tax (%)	26.3	57.2	66.9	70.0
Budget allocation from general finance (%)	73.2	35.3	15.5	0
Sale of recyclables and compost (%)	0.3	5.5	15.2	27.4
Tipping fee (%)	0.2	2.0	2.4	2.6
Total revenue per capita (US$)	7.0	21.1	20.6	22.2
Municipal Budget (US$ 1,000)	48,127	63,655	81,987	107,846
Mersin GM	28,960	39,913	52,918	71,394
Akdeniz DM	4,961	6,318	7,902	10,117
Troslar DM	6,083	7,617	9,406	11,894
Yenisehir DM	8,123	9,807	11,761	14,441
Share of SWM budget	6.8%	9.3 %	3.8 %	0 %
9. Privatisation	All collection works and most of cleansing works are contracted	Most of the work will be contracted to private companies.	All of the work will be contracted to private companies.	All of the work will be contracted to private companies.
10. Public Co-operation	There are very little public education programs and co-operation	Conduct of active public education and co-operation campaigns	Conduct of active public education and co-operation campaigns	Promotion of waste minimisation and recycling campaigns
11. Medical SWM				
Generation (ton/day)	1.5	2.2	3.2	4.9
Treatment at generation	Very limited	Majority	All institutions	All institutions
Final disposal	Trench method disposal operation without liner	Sanitary landfill at Cimsa medical waste disposal site	Sanitary landfill at Cimsa medical waste disposal site	Sanitary landfill at Cimsa medical waste disposal site
Final disposal operation	Mersin GM	Mersin GM	Inter-municipal operation	Inter-municipal operation
12. Industrial SWM				
Generation of HW (hazardous waste) (ton/day)	490,000	N/A	N/A	N/A
HW treatment	None	Treat at generation or kilns of cement factories or plant at Izmit	Treat at generation or kilns of cement factories or plant at Izmit	Treat at generation or an treatment plant to be constructed for Cukurova region
Final disposal	Few control and possibility of HW dumping at Compost Plant disposal site	Prohibit and control HW disposal at Cimsa and oblige disposal at Izmit or Izmir	Prohibit and control HW disposal at new landfill and oblige disposal at Izmit or Izmir	Dispose of at a HW landfill to be constructed for Cukurova region

8.4.2 Preliminary Project Cost Estimation

a. Cost Estimation Items

A cost estimation of the GM in 2020 is required for the following;

- Refuse Collection & Transportation Costs
- Public Area Cleansing Costs
- Intermediate Treatment and Recycling Costs
  - Sorting Plan
  - Compost Plant
- Final Disposal Costs

b. Unit Cost for Cost Estimation

The US dollar is used for the calculation, as the Turkish Lira is unstable. The calculation uses the May 1999 prices at an exchange rate of US$ 1 = 407,000 Turkish Lira. The depreciation period for facilities, heavy machinery, and equipment, and the residual value are shown in the table below.

Table 8-10: Depreciation Period of Facility and Equipment

Items	Depreciation Period (Year)	Residual Value (%)
Vehicle and heavy machinery	7	10
Machinery	15	0
Building	30	0

Note: The life span of civil works and facilities other than building depends on the period of its operation.

The unit cost of each item is shown in the table below.

Table 8-11: Unit Cost

Item		Unit Cost (US$/ton)
Refuse Collection & Transportation		19.3
Public Area Cleansing		221
Intermediate Treatment and Recycling	Sorting Plant	16.9
	Compost Plant	22.4
Landfill Gas Collection Facility		0.2
Final Disposal		10.6

c. Waste Amount for Each Items

c.1 Refuse Collection & Transportation and Public Area Cleansing Amount

Refuse collection and public area cleansing amount are shown in the table below.

Table 8-12: Refuse Collection & Transportation and Public Area Cleansing Amount

Item	Unit	MGM	YDM	TDM	ADM	Sub Total	Total
Refuse Collection & Transportation	ton/year	0	105,224	171,184	189,833	466,241	482,165
Public Area Cleansing	ton/year	2,734	3,015	4,868	5,307	15,924	

c.2 Recycling Intermediate Treatment Amount

Intermediate treatment amount is shown below.

- Sorting plant: 279,656 ton/year
- Compost plant: 202,509 ton/year

d. Landfill Disposal Amount

Landfill disposal amount is 237,447 ton/year.

8.4.3 Implementation Plan

a. Implementation Plan

Taking the targets and strategies into consideration, the SWM master plan shall be implemented in steps. A proposed implementation plan is presented in the table below.

b. Project Costs

Based on the above implementation plan the M/P project costs are summarised in the table below.

Table 8-13: Implementation Plan of the Master Plan for Mersin GM

Implementation Plan of SWM M/P for Mersin

	Activities	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
TECHNICAL SYSTEM																							
T1	**Discharge and Storage System**																						
1.1	Elimination of improper self-disposal																						
1.2	Improvement of a public container system																						
	a. Procurement of wheeled containers																						
1.3	Establishment of a separate discharge system																						
	a. Procurement of public containers for compostable wastes																						
T2	**Collection and Haulage System**																						
2.1	Improvement of collection/haulage system																						
	a. Procurement of compactor trucks																						
	b. Operation & maintenance of collection vehicles																						
2.2	Establishment of a separate collection system																						
	a. Detailed design of a separate collection system																						
	b. Procurement of collection trucks for non-compostable wastes																						
	c. Operation & maintenance of collection vehicles																						
2.3	Establishment of a transfer system (if necessary)																						
	a. Site selection and F/S including EIA for transfer station(s)																						
	b. Detailed design of the transfer system																						
	c. Construction of the transfer system																						
	d. Procurement of equipment for the transfer system operation			△																			
	e. Operation & maintenance of the transfer system																						
T3	**Public Area Cleansing System**																						
3.1	Improvement of the public area cleansing system																						
	a. Procurement of mechanical street sweepers																						
	b. Operation of public area cleansing system																						
T4	**Establishment of Recycling and Treatment System**																						
4.1	Establishment of a government related recycling system																						
4.2	Construction of a sorting plant at Cimsa																						
	a. Detailed design of the sorting plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation			○																			
	d. Operation & maintenance of the plant																						
4.3	Construction of a compost plant at Cimsa																						
	a. Detailed design of the compost plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation			○																			
	d. Operation & maintenance of the plant																						
4.4	Construction of a sorting plant at Cimsa (Phase 2)																						
	a. Detailed design of the sorting plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation											○											
	d. Operation & maintenance of the plant																						
4.5	Expansion of the compost plant capacity at Cimasa (Phase 2)																						
	a. Procurement of equipment for the plant operation											○											
	b. Operation & maintenance of the plant																						
4.6	Construction of sorting plants at future landfill (Phase 3)																						
	a. Detailed design of the sorting plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation																		○				
	d. Operation & maintenance of the plant																						
4.7	Construction of a compost plant at future landfill (Phase 3)																						
	a. Detailed design of the compost plant																						
	b. Construction of the plant																						
	c. Procurement of equipment for the plant operation																		○				
	d. Operation & maintenance of the plant																						
T5	**Establishment of a Sanitary Landfill**																						
5.1	Rehabilitation of the present landfill																						
	a. Rehabilitation of the present landfill																						
5.2	Construction of Cimsa sanitary landfill																						
	a. Detailed design of the disposal site																						
	b. Construction of the disposal site																						
	c. Procurement of equipment for the site operation			○																			
	d. Operation & maintenance of the site																						
5.3	Selection of a future landfill site																						
	a. Site selection and F/S including EIA																						
5.4	Construction of a future landfill																						
	a. Detailed design of the disposal site																						
	b. Construction of the disposal site																						
	c. Procurement of equipment for the site operation										○							○					
	d. Operation & maintenance of the site																						
T6	**Establishment of a Proper Medical Waste Disposal System**																						
6.1	Establishment of treatment system at generation																						
6.2	Urgent improvement of collection haulage system																						
	a. Procurement of collection vehicles		○																				
	b. Final disposal of medical waste at designated area of Sofulu site																						
6.3	Establishment of final disposal system at Cimsa disposal site																						
	a. Detailed design of the disposal site																						
	b. Construction of the disposal site																						
	c. Procurement of equipment for the site operation			○							○							○					
	d. Operation & maintenance of the site																						

Table 8-14: Cost Schedule of the Master Plan Projects for Mersin GM

Unit: US$ 1,000

			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Separate Collection System	Container	Invest.		5	1	1	1	1	1	6	6	18	2	3	2	2	7	8	49	6	6	6	0
	Compactor	Invest.		1,344	256	192	320	256	256	256	1,664	576	512	640	576	576	512	1,984	960	832	960	960	0
		O&M for Compactor			924	1,100	1,232	1,452	1,628	1,804	1,980	2,200	2,420	2,640	2,860	3,080	3,300	3,476	3,696	3,960	4,180	4,400	4,664
Plant	Sorting Plant	Design & Supervision	142								312							824					
		Invest. for Civil Work		567								1,247							3,289				
		Invest. for Machine		1,685								3,707							9,773				
		Invest. for V&E		377							377	829						377	3,016				
		O&M			378	378	378	378	378	378	378	378	1,210	1,210	1,210	1,210	1,210	1,210	1,210	3,024	3,024	3,024	3,024
	Compost Plant	Design & Supervision	263								408							981					
		Invest. for Civil Work		872								1,352							3,253				
		Invest. for Machine		3,138								4,864							11,705				
		Invest. for V&E		867							867	1,344						867	4,578				
		O&M			440	440	440	440	440	440	440	440	1,122	1,122	1,122	1,122	1,122	1,122	1,122	2,323	2,323	2,323	2,323
Final Disposal	Municipal Waste		317			25	105				102				126				75				
				5,185			1,805	7,548				7,355				9,035				5,348			
				1,257							1,691							1,691					
					375	375	375	341	398	398	398	426	425	425	425	425	441	441	441	441	404	404	404
	Medical Waste	Design & Supervision	91																				
		Invest. for Civil Work		1,869																			
		Invest. for V&E		341							341							341					
		O&M			34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34

Note: V&E: Vehicles and equipment

8.5 Financial Analysis

8.5.1 Overall SWM Costs

a. Investment Plan

The required investment for each phase of the M/P is outlined in the following table.

Table 8-15: Investment Costs of Master Plan for Mersin

unit: US$ 1,000

	Phase 1 (1999-2005)	Phase 2 (2006-2012)	Phase 3 (2013-2020)	Total
Separate Collection	2,377	4,518	6,868	13,763
Sorting Plant	2,771	6,472	17,279	26,522
Compost Plant	5,140	8,835	21,384	35,359
Final Disposal	16,242	9,274	16,149	41,665
Medical Waste Disposal	2,301	341	341	2,983
Total	**39,031**	**29,440**	**62,021**	**120,292**

b. Overall SWM Costs

The overall SWM costs, including depreciation and O&M costs, for the principal years covered by the M/P are as shown in the following table.

Table 8-16: SWM Costs for Mersin

unit: US$1,000

	Present*	2005	2012	2020
Collection & Haulage	1,278	5,193	6,868	9,015
Public Area Cleansing	2,681	2,206	2,746	3,494
Sorting Plant	0	586	1,876	4,737
Compost Plant	158	836	2,133	4,528
Final Disposal	130	2,542	2,583	2,506
Medical Disposal	0	181	181	181
Administration	598	577	819	1,223
Overall SWM Costs	4,845	12,121	17,201	25,684

Note: * Average SWM expense in 1997 and 1998

c. Unit Costs

The following table shows the unit cost in the last year of each phase of the M/P.

Table 8-17: Unit Costs of Master Plan for Mersin

unit: US$/ton

	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
Collection & Haulage	23.3	20.7	19.3
Public Area Cleansing	221.0	221.0	221.0
Sorting Plant	18.3	16.8	16.9
Compost Plant	22.2	22.5	22.4
Final Disposal	12.9	10.8	10.6
Medical Disposal	225.4	155.0	101.2
Overall SWM Costs	52.1	50.0	53.3

8.5.2 Revenue Plan

The revenue plan outlined in the M/P is as detailed in the following sections.

a. Cleansing Tax

The ultimate goal of the M/P is to use the cleansing tax revenues to fully cover (100%) the overall SWM costs. In accordance with this goal, the following phases were set to raise the cleansing tax rate.

Table 8-18: Stepwise Increase Plan of Cleansing Tax for Mersin

		Collection Rate	Increase in Real Terms	Net SWM Costs* Covered (%)	Overall Increase (from the 1998 rate)
Phase 1	～2001	?%->90%	0%	23%	1.8 times
Phase 2	2003	90%	1.8 times	43%	3.8 times
Phase 3	2005	90%	2 times	88%	8.1 times
Phase 4	2010	90%	1.1 times	99%	10.8 times
Phase 5	2015	90%	1.1 times	112%**	14.1 times

Note: * overall SWM costs - (sale of recoverable and compost + tipping fee)
** Including some parts of financial costs.

The effects on the residents' share in SWM costs in real terms, in the cleansing tax rate in each M/P phase are as shown in the table below.

Table 8-19: Changes in Residents' Share in SWM Costs for Mersin

	Present (1998)	2005	2012	2020
Average annual household income (US$/year)	5,530	6,320	6,840	7,360
Cleansing tax per household (US$/year)	12.7*	46.5	53.0	59.8
Ratio of cleansing tax (%) to income	0.2	0.74	0.77	0.81

Note: * POS Willingness to Pay

As far as the ratio of the cleansing tax to the annual income is concerned, the gradual increase in tax rate is not seen to incur any significant impact.

b. Allocation from Municipal Tax Revenues

Although the allocation from municipal tax revenues in 2002 will increase by 1.4 times the present rate, the gradual increase in tax rate will decrease the rate allocated by the municipality for SWM. The following allocation should therefore be realised.

Table 8-20: General Budget and Allocation for SWM in Mersin

unit: US$ 1,000

	Phase 1 (2005)	Phase 2 (2012)	Phase 3 (2020)
General Budget	63,655	81,987	107,846
Allocation for SWM	5,893	3,143	0
Allocation Rate (%)*	9.3	3.8	0

Note: * Average of rate allocated to Mersin GM and the three DMs.

c. SWM Financial Source

The financial source for the SWM costs in the final year of each phase will change as shown in the following table.

Table 8-21: SWM Financial Source for Mersin

Unit: US$1,000

	Present	2005	2012	2020
Cleansing Tax	1,171	9,529	13,532	19,417
Budget Allocation from Municipal Tax	3,266	5,893	3,143	0
Sale of Recoverables and Compost	13	921	3,075	7,597
Tipping Fee	8	326	479	711
Total	4,458	16,669	20,229	27,725

8.5.3 FIRR and Cash Flow

a. Cash Flow

Using the calculated revenue and expenditure, the FIRR is 3%. As shown in the diagram, the accounts after 2005 are also estimated to be in the black, thereby making the accumulation of US$ 21 million in reserve possible by 2020.

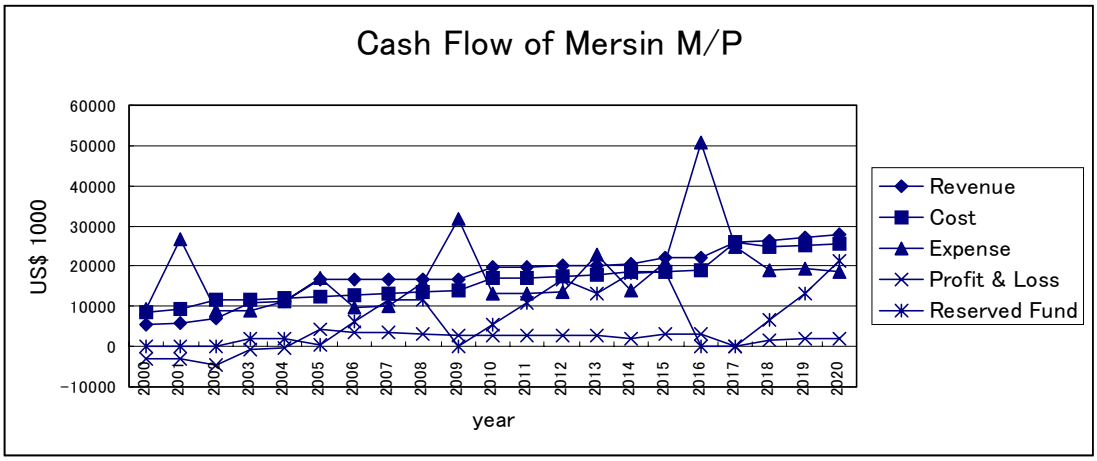

Figure 8-3: Cash Flow of Mersin GM M/P

b. Conclusion

Based on the above assessment, the master plan for Mersin is deemed financially feasible with the implementation of a gradual increase in cleansing tax rate.