7.2.4 Findings

There are significant improvements achieved for the Sofulu dump site by the experiment. In addition, many important experiences/data were obtained through it. Those are presented below.

a. Urgent Needs of Soil Cover

Although there are many important issues for the sanitary landfill as stipulated in the Turkish Solid Waste Control Regulation, the most critical matter is soil covering operation. As everybody notice the major adverse impact of the Sofulu dump site is the fire and smoke and it could not extinguish without cover soil on the waste disposed. In this experiment a part of the Sofulu dump site has been covered by soil and it stopped the fire and smoke from that part. However, the other parts of the landfill are still uncovered and create fire/smoke. Although it costs a lot, the Adana GM understood importance and urgent needs of soil cover through the experiment.

b. Unloading Operation

Although the MoE (Ministry of Environment) is strongly requesting municipalities in the country to adopt a sanitary landfill which should not cause fire and smoke. However, most of the municipalities in the country are suffering from the smoke of the landfill including the capital Ankara. As far as the team observed the fire/smoke are occurred at steep slopes on which soil cover could not be done. These steep slopes are created because waste unloading operation is done at the upper part of the landfill. Through the experiment the Adana GM experienced the principal waste unloading operation should be done from the bottom of the landfill which requires access road to the working face.

c. Leachate Circulation System

One of the most important issue of the experiment is to find out the applicability of a leachate circulation system as a leachate treatment method for the rehabilitation of the dump site. Since the leachate circulation system constructed in the experiment is a temporary one, it can prevent leachate from discharging into public water courses in dry season, i.e., from April to October. For the prevention of leachate in rainy season it requires expansion of the regulation pond volume and pumping capability. The system works very well in dry season and the construction cost of the system is very cheap, about a little bit over US$ 100,000. The team considers it might be an applicable and cheap method for the rehabilitation of open dump sites. Because the final soil cover and storm water drains to be done by the rehabilitation can reduce the amount of leachate generation.

7.3 Experiment of the Separate Collection and Compost Quality Improvement

7.3.1 Background

The MoE intends to achieve 90% of MSW recycling. In order to realise this target it is indispensable to recover the organic waste especially kitchen waste which shares more 60% of the MSW in the target cities, Adana and Mersin.

The MoE states in the Environmental Manual for Municipalities that composting is the most suitable method of the organic waste recycling for the MSW. In Turkey two composting plants have been constructed and being operated in Izmir and Mersin Greater Municipalities. However, the performance of the two plants could not be sufficient. It might be main cause of bad performance that both municipalities do not apply separate collection system for composting.

As concluded from the results of the interviews with the farmers in the first study work in Turkey, the quality of composts produced at the present Mersin composting plant is very poor, which is mainly why farmers stop to use the product. Therefore, the improvement of compost quality by the experimental separate collection, etc. has been carried out as pilot project in the second and third study works in Turkey.

7.3.2 Plan of the Experiment

The results of the pilot project will determine whether it is possible to improve the compost quality currently produced at the existing plant. Compost quality improvement will be carried out the selection of an area and the separate collection of compostable (kitchen waste, garden waste, etc.) and non-compostable (glass, plastic, metal, etc.) waste items, and using the former waste type for compost production. A separate collection campaign will be held in the selected area to raise public awareness and consequently encourage public co-operation.

Using the compost produced through this pilot project, a study planned to be carried out to determine the marketability of the product in Adana and Mersin, and to ascertain product demand and the appropriate price. Taking the above into account, in January 1999 the study team drafted a plan of the experiment of which main works and the roles of the study team and Mersin GM are summarised in the table below. The plan was approved by JICA and the budget for the work items to be done by the team was allocated by JICA.

Table 7-6: Outline of Experiment on Separate Collection & Composting Quality Improvement and Division of Work

Items	Outline	Equipment & Materials	Responsible Body
Separate Collection	Gain residents' co-operation	Installation of a notice requesting for co-operation Preparation of pamphlets Holding assemblies and meetings	JICA JICA Mersin GM
	Implement separate collection	Distribution of plastic bags Installation of containers for separate collections Collection of segregated waste	JICA JICA Mersin GM
Compost Quality Improvement	Improvement of existing facility	Installation of recovery lines for non-compostable waste	JICA
	Recovery of non-compostable waste	Allocation of several workers	Mersin GM
	Facilitation of fermentation	Mixing and moistening of compost	Mersin GM
	Improvement of the management of the compost plant	Preparation of operation manual	JICA
	Pilot project assessment	Survey on compost market and the appropriate price of compost	JICA

7.3.3 Implementation of the Experiment of the Separate Collection

a. Implementation Schedule

The pilot project of separate collection has been conducted in the third study works in Turkey (May 10 to June 9, 1999).

The experiment of the separate collection have been conducted according the following schedule:

Table 7-7: Implementation Schedule for Separate Collection in Mersin GM

Activities	May																June							
Separate Collection (May 10 – May 9)	Week 1				Week 2				Week 3				Week 4				Week 1				Week 2			
1. Gain Resident's Co-operation																								
a. Installation of notice/signboard		■																						
b. Distribution of leaflets No.1 & No.2		■																						
2. Implementation of Separate Collection																								
a. Distribution of plastic bags				■								■												
b. Installation of waste bins				■																				
c. Installation of containers				■																				
d. Waste separation at source					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				
e. Collection of C & NC wastes						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
f. Monitoring of separate collection activities						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
3. Assemblies and Meetings with the Residents																								
1. Meeting with president of the GSHC	■		■																					
2. Meeting with the residents of the GSHC				■			■											■						

b. Public Education to Gain Resident's Co-operation

b.1 Objectives

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

With the exception of isolated demonstrative experiences, e.g., waste separation at household level, which is done informally by the "eskici", such activities are not frequently found to have considered to sensitive participants through inductive talks and education on appropriate solid waste management and segregation.

Incentives toward waste minimisation and recycling are the basic requisites of improving solid waste management accompanied with participation in waste collection, transportation, disposal and stabilisation costs as well as increasing public awareness in these issues. However, the functional dissociation of those actors active in solid waste production and haulage is the main reason of modest public awareness in Mersin GM.

Therefore, the main objective of the public education and co-operation programs is to raise public awareness on SWM issues through the proper waste handling practices

(reuse, reduction and recycling), to promote common responsibility for sustainable development and particularly the city environment in co-operation with the citizens.

In order to achieve the objectives, the followings are proposed:

- Raise public awareness on SWM issues.
- Introduce public co-operation and participation as a mean of keeping the city environmentally clean.

b.2 Experiment to Promote Separate Collection System for Composting

The main objective of the pilot project "Compost Quality Improvement and Separate Collection" is to investigate a possibility of the introduction of a separate refuse collection system and gain public co-operation.

Public education and co-operation on SWM is meant to let the public know all about the production and management of refuse. This is achieved by providing information about the origins, linkages and consequences of the problem on solid waste, with the objective of enlightening the minds of the public and eventually, gaining their co-operation and support.

With this in mind a separate collection was introduced at a selected housing complex (Guven Sitesi) with a population of 5,140. In the separate collection experiment residents were asked to separate compostable wastes (kitchen waste and garden waste) and non-compostable wastes (glass, plastic, metal, etc.), and place them into separated containers installed at the housing complex. Then the district municipality (YDM) will collect the waste separately from other municipal wastes and bringing them to the existing composting plant for the production of improved compost.

The category kitchen wastes was placed into plastic bags differentiated with by green colour and logo "Only Kitchen Waste" (for compostable waste) provided by JICA for the experiment. Other wastes (non-compostable) were placed in available plastic bags at source such as shopping bags. These waste bags were placed into two containers, differentiated by colour and material (for compostable wastes: plastic containers with logo "Only Kitchen Waste and Garden Waste" provided for the experiment; and for non- compostable: existing silver/metal containers) installed at the housing complex.

As being the beginning of any separate collection implementation in Mersin GM, the result of the experiment was very effective, and the participation and co-operation of both residents and collection workers were successfully achieved.

b.3 Main Campaign Tools Used in the Experiment to Promote Separate Collection

To achieve the main objectives of the pilot project various campaign tools were used. Table 7-8 tabulates the campaign tools used in the pilot project "Compost Quality Improvement and Separate Collection" to promote public awareness and co-operation:

Table 7-8 : Campaign Tools for MGM

Campaign Tools	Purpose
Signboard	A 3.00m x 5.00m size signboard was installed in GSHC announcing the implementation of the pilot project for separate collection and encouraging public co-operation as shown in the sample below.
Leaflets	2,000 leaflets were distributed among the residents of GSHC to inform and request their co-operation for the separation collection experiment. Two types of leaflets were produced: 1000 regarding general information on separate collection and requesting co-operation, and other 1,000 informing the residents how to separate and dispose the waste appropriately and requesting their co-operation. Both types of leaflets are shown in the next pages.
Plastic bags for kitchen waste	45,000 green plastic bags especially designed (with logo: “Only Kitchen Waste”) to collect food waste from the households were distributed in GSHC. The distribution was made according the following plan: 25 buildings x 10 floors x 4 apartments = 1,000 apartments 1,000 apart. x 30 days = 30,000 + 50% = 45,000 bags The doorkeepers made the distribution of the plastic bags every 3 days under the supervision of the building representatives.
Container for kitchen waste and garden waste	Green plastic containers (cap. 750 lit.) with logo “Only Kitchen and Garden waste” were provided and installed in the streets of the housing complex, one container every 2 buildings (see Section 7.3) . The existing containers (for other wastes) were reinstalled together with the new containers for kitchen and garden wastes.
Plastic waste bins for kitchen waste	250 plastic bins (approx. 50 lit. each) were installed at the staircase landing area of every apartment building (10 buckets x 25 buildings = 250) which was used by the householders to discharge the kitchen waste into them.
Education book	As part of the experiment and complementary material to promote the separate collection, 2,000 education books has been prepared and distributed among the residents of GSHC (1,000), MGM (500), AGM (400), MoE and JICA Ankara Office (50), others (50).

Signboard

THE COMMUNITY OF GÜVEN SITESI

IS CONTRIBUTING WITH OUR CITY ENVIRONMENT

Pilot project for waste separation at generation source and waste recovery

From May 10 to June 9, 1999

YOUR CO-OPERATION IS NECESSARY TO BEAUTIFY MERSIN CITY!

Promoted by:
MERSIN GREATER MUNICIPALITY & YENISEHIR DISTRICT MUNICIPALITY

Supported by:
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

Leaflet (1)

THE COMMUNITY OF GÜVEN SITESI IS CONTRIBUTING WITH OUR CITY ENVIRONMENT

"Separate Waste Collection for Waste Recovery"

A separate waste collection program is to be conducted in your housing complex for waste recovery and contribution to your city environment. Therefore, you are requested to separate your garbage into two categories at home:

• **Kitchen waste**	In the **green plastic bag** promoted by MGM & YDM and provided by JICA
• **Other waste**	**In a separate bag** (paper, textile, plastic, leather & rubber, metal, bottle & glass, ceramic & stone and miscellaneous)

For this purpose plastic bags will be distributed and provided you to dispose your kitchen waste. Also, containers for kitchen waste will be installed in your housing complex to dispose the garbage separately into them.
Your active participation and co-operation in source separation is very important for the welfare and life quality of your community and city environment.
For more information, please ask to your housing complex management office.

The future of our city environment depends on our effort. Our co-operation in waste separation will offer better clean environment to future generation
Thank you very much for you cooperation
Promoted by
Mersin Greater Municipality & Yenisehir District Municipality
Supported by
Japan International Cooperation Agency (JICA)

Leaflet (2)

THE COMMUNITY OF GÜVEN SITESI IS CONTRIBUTING WITH OUR CITY ENVIRONMENT

"Separate Waste Collection for Waste Recovery"

From May 10 to June 9, 1999

IMPORTANT

1) Please separate your wastes into two categories:

• **Kitchen waste**	In the **green plastic bag** promoted by MGM & YDM and provided by JICA
• **Other waste**	**In a separate bag** (paper, textile, plastic, leather & rubber, metal, bottle & glass, ceramic & stone and miscellaneous)

1) Kitchen wastes must be disposed in a plastic bag separately from other wastes.
2) **Do not mix kitchen wastes with plastic, aluminium sheet or other miscellaneous items** because they are collected as compostable materials.
3) Before disposing of leftover food, drain the liquid out of it as much as possible.
4) If no doorkeeper (kapici) collect your garbage, please dispose your plastic bag containing kitchen waste into the plastic container "Only for Kitchen Waste". Other wastes will be disposed in the existing container.
5) Garden waste should be disposed in the green colour container "Only for Kitchen Waste and Garden Waste" installed at your housing complex.
6) For the safe disposal of wastes that cannot be recycled in an environmentally friendly manner, please consult your building manager or MGM.
7) Co-operate for the proper way of garbage disposal.

The future of our city environment depends on our effort. Our co-operation in waste separation will offer better clean environment to future generation
Thank you very much for you co-operation
Promoted by
Mersin Greater Municipality & Yenisehir District Municipality
Supported by
Japan International Cooperation Agency (JICA)

Figure 7-10: Signboard and Leaflets for Campaign Tools for Promotion of Public Awareness and Co-operation

b.4 Public Education through Meetings and Assemblies

To effectively promote measures for separate waste collection experiment and in order to deepen understanding of the necessity to separate wastes among the residents, several meetings and assemblies were carried out during the second and third study works in Turkey with the building representatives, householders and doorkeepers of Guven Sitesi Housing Complex (GSHC).

Training and instructions were carried out by the team and counterpart, and reinforced through complementary materials, e.g., pamphlets, presentation using visual materials and projector, education books, and separate collection demonstration in situ.

Among the series of meetings, the relevant one's were carried out before the implementation (May 6th) and during the implementation (May 10th-commencement day, May 12th and June 2nd) of the experiment.

The meetings were consisted on the followings:

- Explanation why is necessary to separate wastes.
- Instruction for proper discharge of compostable and non-compostable wastes.
- Appropriate use of plastic bags, dustbins, waste bins, and containers for compostable and non-compostable wastes.

The most effective meeting was held on May 12th on the job training, because the residents understood on the practice what should and should not discharge into the separate waste bins and containers for compostable and non-compostable wastes, and how to participate properly.

On June 2nd a final meeting with the representatives was held providing information on the progress results of the residents participation and waste separation levels, destination and final product of their compostable wastes, and how well they are co-operating to encourage a continuous promotion of separate collection in GSHC, and influence other areas.

During the meetings the representatives of the complex demonstrated high interest on the separation activities and appreciation for selecting GSHC as the site to carry out the experimental project.

For the sustainability of the pilot project, it is expected that the active participation and efforts made by the residents of GSHC should influence and promote positively other areas as well as all over the city and take initiatives for a real source separation in Mersin.

b.5 Education Book

As part of the experiment and complementary material to promote separate collection system, a education book has been prepared and distributed in GSHC to enlightens the minds of not only residents of the complex but children of both Adana GM and Mersin GM, and gain their co-operation and support.

The education book has been published to draw the attention of close linkage between the living environment and the waste. It emphasises the benefits to be obtained if care is devoted to achieve the followings three simple targets:

1. Minimising the waste quantity.
2. Recycling the waste.
3. Landfilling the unrecyclable waste in a way that not harms the environment.

This education book outlines many practical steps to achieve those targets and was prepared taking into account the followings aspects:

- Simple and colourful, and made of good quality paper to encourage people's for reading and keeping.
- Format with little text and many illustrations and photographs to attract the attention of the residents, especially children of the complex.
- Text with general vocabulary not limited to defined group: age, gender, social status, etc.

It is expected that the messages described are valuable information and will direct important steps and develops attitudes, and practices for the contribution of an appropriate SWM and better environment in the near future.

b.6 Outline of the Experiment on Public Education

Public education is not an absolute: it is highly dependent on various intrinsic features of a given society, and therefore was planned and implemented taking into account the characteristics of GSHC. The following are rough guidelines of the public education on separate collection implemented in GSHC, bearing in mind that specific and details of long-term education programs will be devised and undertaken by the counterpart of Mersin.

Table 7-9 : Outline of the Experiment on Public Education in MGM

Programs in the Community	
1. Implementation period :	During the implementation of the public education
2. Targets :	Building representatives, "kapicis" (doorkeepers) and residents
3. Methods :	Work meetings, workshops, lectures, leaflets, pamphlets, educational books, site visits
4. Sponsor :	MoE, MGM , DM, municipalities, community organisations

b.7 Promotion of Public Interest in Future SWM for Mersin

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

b.8 Institutional, Administrative, and Legislative Changes

National and regional laws and legislation in place, that help maintain regional sanitation and mitigate environmental pollution, should be made know to the general public. Also for future reference, the public should be encouraged to contribute any ideas that could be used to enforce and enact new regulations for environmental protection.

c. Implementation of the Experiment of the Separate Collection

c.1 Selection of the Experiment Site

Guven Sitesi Housing Complex (GSHC), located in Guvenevler "mahalle" (ward) at the south-east sector of Yenisehir district was selected as an experimental site for the separate collection by the team and counterpart due to the following reasons:

1) As an experiment certain scale of population is necessary. The GSHC has 25 buildings of ten stories in an area of approximately 4.6ha. as shown in Figure 7-11. In total 1,000 households and 5,140 residents (about 1% of whole population of Mersin GM) living the complex.

2) There is enough space for the installation of containers for separately discharged compostable waste without disturbing current refuse collection system.

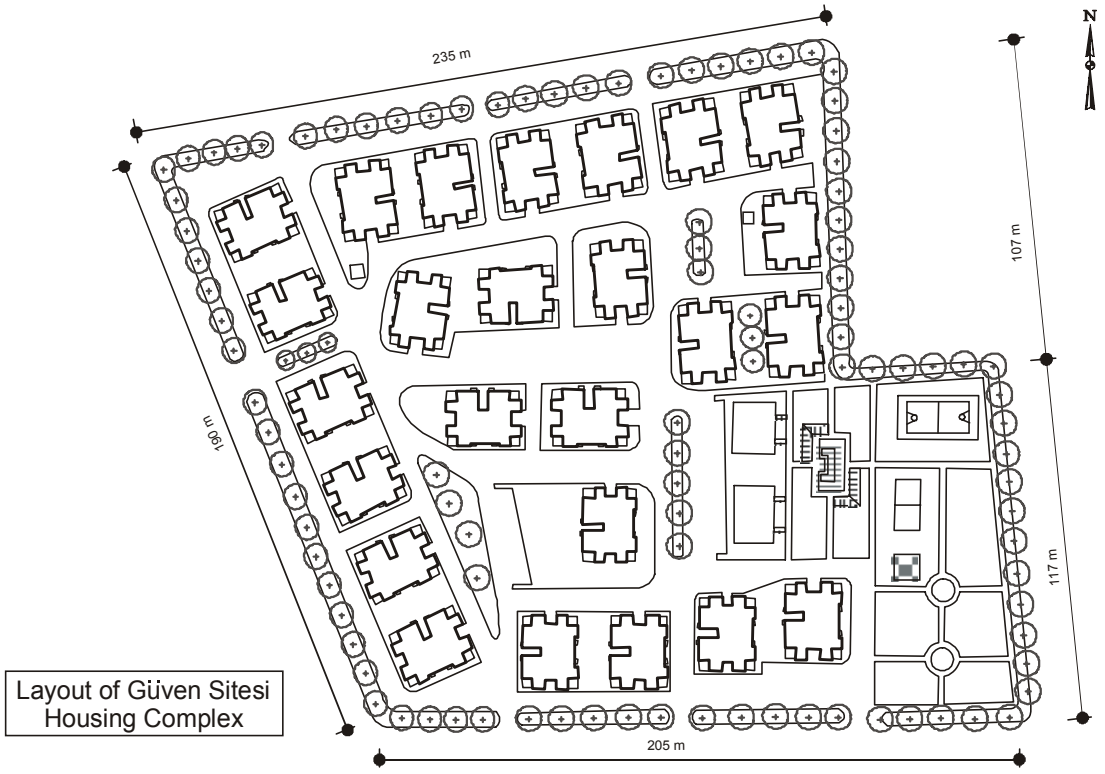


Figure 7-11: Layout of Guven Sitesi Housing Complex in MGM

c.2 Gain Resident's Co-operation

In order to obtain resident's co-operation for separate discharge of compostable and non-compostable wastes the team and counterpart conducted the following works:

1) Installation of a notice board to ask co-operation of the residents of the Guven Sitesi Housing Complex and inform general public in Mersin Greater Municipality about the separate collection experiment.

2) Delivery of pamphlets and education books to instruct the residents of the GSHC to conduct a proper separate discharge of their waste.

3) Holding assemblies and meetings with the residents and their representatives.

c.3 Implementation of Separate Collection

The separate collection was implemented for one month (from May 10 to June 9, 1999). Prior to the commencement of the separate collection experiment the team and counterpart conducted the following activities:

1) Distribution of green plastic bags which shall be used by households for the separate discharge of compostable waste.

2) Distribution of waste bins which shall be used by "kapicis" (doorkeepers: who take care of waste collection from households of each building) for compostable waste collection.

3) Installation of new colours green containers for compostable waste for collection service. Current containers are used for the collection of non-compostable waste.

The survey was conducted according the following schedule:

Table 7-10: Implementation Schedule by Activities in Mersin GM

Activity	Schedule	Result (from May 10th to June 9th)
Separate waste at source by residents of GSHC	From May 10 to June 9, 1999	Satisfactory
Separate collection by private contractors of YDM	From May 11 to June 10, 1999	Well carried out according the planned schedule

Figure 7-12 shows the outline for the implementation of experiment on separate collection. The experimental project is essentially divided into three stages; namely, (1) preparation and planning stage, (2) implementation and verification stage, and (3) evaluation.

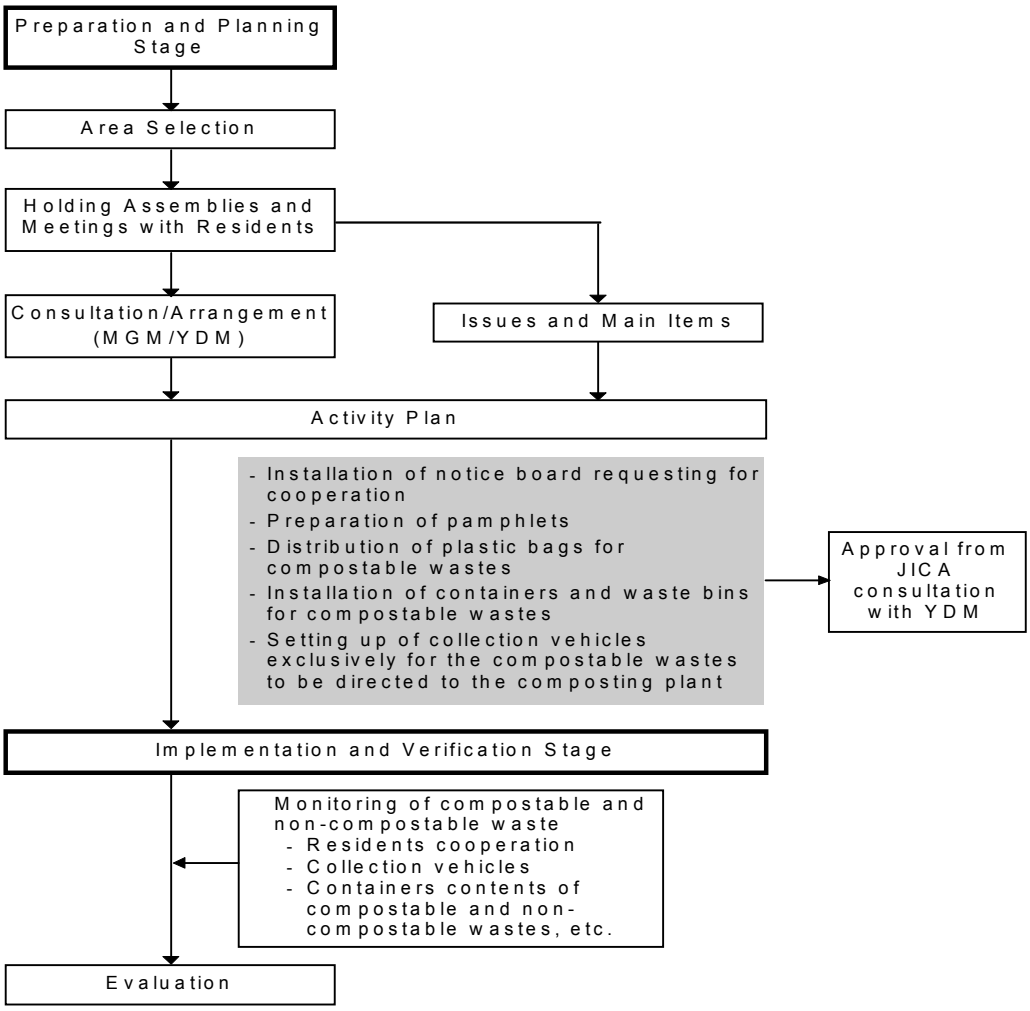


Figure : Implementation Procedure of Separate Collection

Figure 7-12: Implementation Procedure of Separate Collection in Mersin

Before and during the implementation of separate collection several meetings with the president, building representatives, doorkeepers and residents of the complex were conducted in order to apply an approach in community base separation experiment.

During the implementation stage, monitoring and verification of the separation collection activities were conducted to make clear problems, issues and main items.

The monitoring for separate collection was conducted daily from May 11, 1999, during the implementation of the pilot project in order to know the followings:

1) Waste separate amount

2) Separation level of compostable and non-compostable wastes

3) Observation of residents participation and co-operation, and level of waste separation

Figure 7-13 shows the location of green plastic containers (for compostable wastes) besides the existing metal containers (for non-compostable wastes). Every two buildings (80 householders) as illustrated in the figure use both containers (green plastic and silver metallic). Also, waste bins (for compostable) provided for the experiment are placed at every stair landing area together with the existing ones for non-compostable wastes, which are used by 4 householders. The wastes discharged by the householders into the separated waste bins are collected by the doorkeepers and disposed into the corresponding containers installed outdoor in the complex. Later the compostable wastes and non-compostable wastes are collected separately by the private contractors and bringing them to the existing composting plant and landfill respectively.

Figure 7-13: Location of Containers

c.4 Monitoring

At the beginning, the implementation of the plans proposed in the M/P was carried out with some difficulties, due to the national and municipal elections and change of the municipal government. However, the performance was satisfactorily achieved after the commencement and during the implementation of the experiment.

A monitoring survey of the separate collection were conducted from May 11th to June 10th (except some weekends) in GSHC to verify the proposed system and identify the issues and main items with following objectives:

- Control of the components of wastes brought by residents and/or doorkeepers,
- Controlling the capacity of containers arranged,
- Controlling the truck drivers and workers who discharge the separated waste components into defined truck, and

- Determining the faults and improving the experiment for sustainable implementation of the pilot project.

The following check sheet was utilised for the verification of the separate collection.

Table 7-11: Check Sheet for Separate Waste Collection

Compostable Waste								**Non Compostable Waste**					
Date								Date					
Truck number								Truck number					
Driver name								Driver name					
Supervisor								Supervisor					
Workers								Workers					
Arrival time (Guven Sitesi)								Arrival time (Guven Sitesi)					
Time for collection GS								Time for collection GS					
Transportation time								Transportation time					
Arrival time (Compost Plant)								Arrival time (Compost Plant)					
Weight								Weight					
Compostable Waste								**Non Compostable Waste**					
Cont	**No. of bags**		**Qty.**	**Separation Grade**			**Remarks**	**Cont.**	**Qty.**	**Separation Grade**			**Remarks**
Green	Green	Other	(%)	Poor	Aver.	Good		Exist.	(%)	Poor	Aver.	Good	
C1								E1					
C2								E2					
C3								E3					
…								…					
…								…					
…								…					
…								…					

Note: C: Compostable, GW: garden waste, NC: Non-Compostable, M: mixed waste, NA: Not available

Using the check sheet above a monitoring survey was carried out by one month. Taking into account the numbers of green plastic bags (compostable) and other bags (non-compostable) in both containers for compostable and non-compostable wastes a survey on the separation level was done categorising as poor, average and good.

The results of the monitoring survey of the container content of both compostable and non-compostable wastes are shown in the following figures:

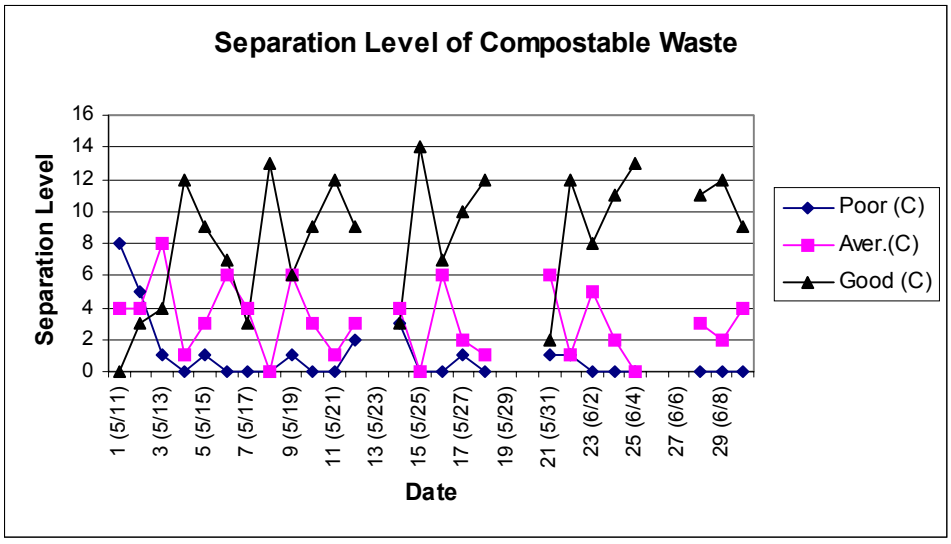


Figure 7-14: Separation Level of Compostable Wastes in MGM

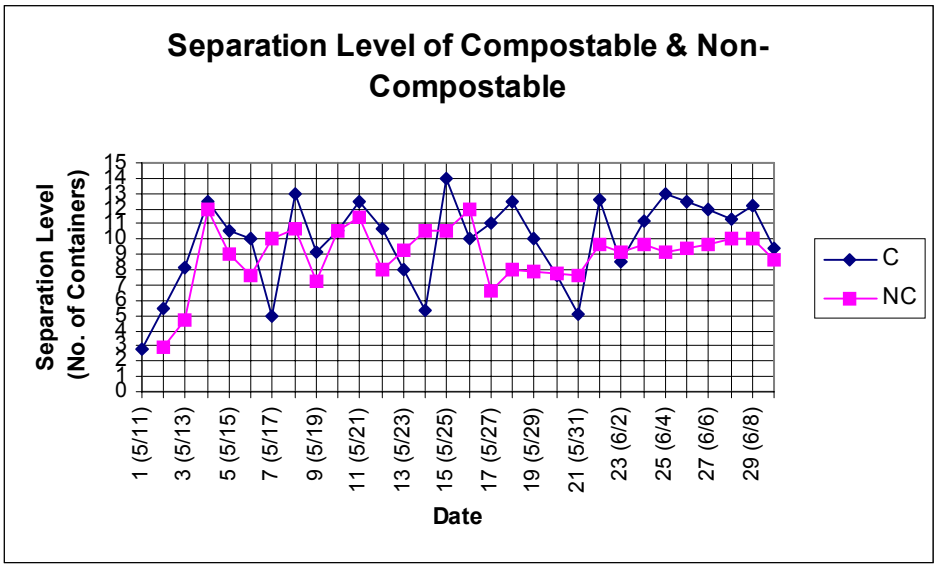


Figure 7-15: Separation Level of Non-Compostable Wastes in MGM

As it is observed in the above figures, generally the waste separation activities are well carried out during the weekdays. However, the performance is declining during the weekends due to the leave of residents at the weekend and the resting date of the doorkeepers. Apparently, the green plastic bag for kitchen waste provided, contains food waste. However, some of them contain many other plastic bags and non-compostable wastes as it were observed during the waste separation activities in the compost plant.

Other issues observed during the implementation of the experiment are as follows:

- The participation of the residents and building administers of the GSHC and the private collection workers in the collection activity were satisfactory obtained.
- Generally the waste separation of compostable waste from other waste (non-compostable waste) at source were well carried out by the residents using

green plastic bags provided by the team. However, some non-compostable waste has been encountered in the green plastic bags, needing to pay more attention for the separation at source.

- The collection of the collective waste bins (one for compostable waste and other one for non-compostable waste placed at every stair landing area) by the doorkeepers were well carried out.
- Generally there is only one dustbin at the kitchen source to dispose general waste, because most of the residents do not practice a separate collection of household wastes. During the implementation of the separate collection, some of the residents used shopping plastic bags for non-compostable wastes placed into the existing dustbin, and the provided green plastic bags for kitchen waste without receptacle. This situation made the residents to mistakenly throw kitchen wastes into the existing dustbin with non-compostable wastes.
- The collection activity by the private contractor of Yenisehir District Municipality (YDM) was proceeding in smooth way according the planned schedule. The collection workers were highly co-operative and courteous.

Figure 7-16 shows summarised both separation levels (compostable and non-compostable wastes). Monitoring survey on some weekends (May 23, 29, 30 and June 5, 6) were not performed. However, in order to make continuous lines an interpolation between Friday and Monday level values was made as shown in the mentioned figure. The separation levels were improved after the final meeting of June 2nd with the GSHC representatives, obtaining an average level for both compostable and non-compostable wastes, achieving a satisfactory experiment result.

In conclusion, it can say that the performance of separation grade is risen after meetings and declining on weekends except during June, suggesting that continuous meeting and information releases are necessary to encourage the promotion of sustainable separate collection.

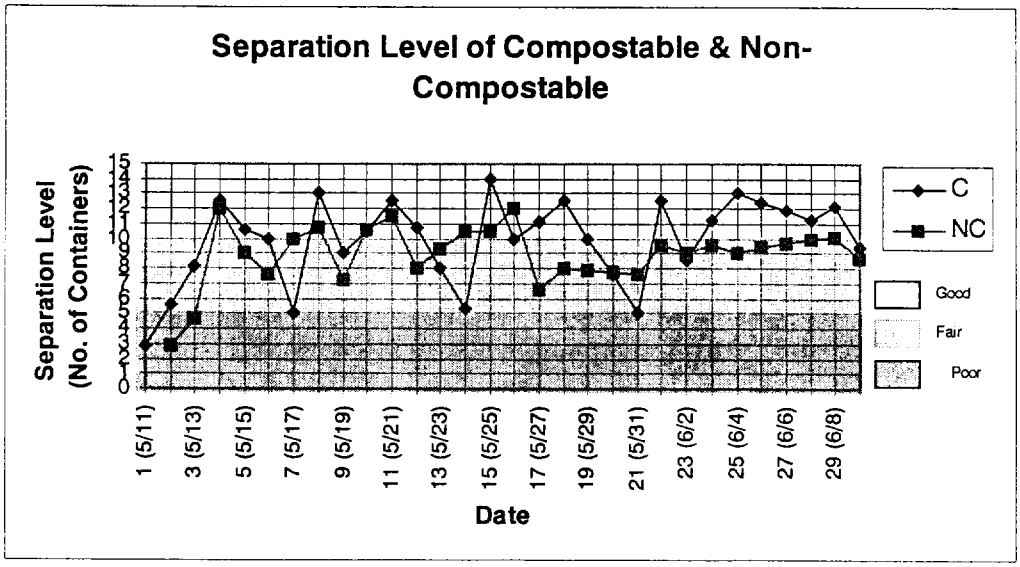


Figure 7-16: Separation Level of Compostable & Non-Compostable Wastes in MGM

Details of the daily monitoring survey performed during May 11 to June 10 are shown in the Annex.

c.5 Separated Waste Amount

The average daily amount was about 1,030 Kg (49.3%) and 1,060 Kg (50.7%) for compostable and non-compostable wastes respectively. Figure 7-17 shows the daily separated waste amount from May 11 to June 10, 1999 (except weekends).

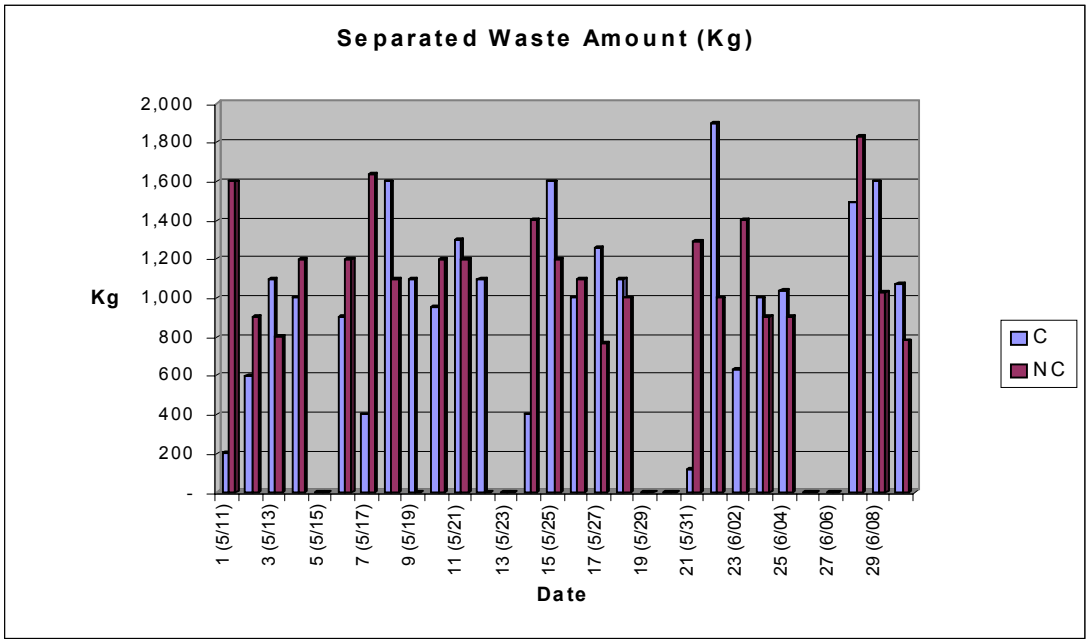


Figure 7-17: Separated Waste Amount in MGM

As it is observed in the figure, non-compostable wastes surpass considerably the compostable wastes, especially on Monday, pointing out that the householder's discharge several non-compostable items during the weekends. Generally, however, during the weekdays the compostable wastes surpass the non-compostable wastes.

c.6 Findings

The following main findings were obtained by the experiment from May 10th to June 10th:

1) According to the visual observation of compostable waste discharged into the green containers (see Figure 7-16), the level of separation, how it includes non-compostable wastes, is coming worse in the weekend.

2) The compostable waste brought into the windrow yard still includes some non-compostable, such as plastics, etc. The rate of non-compostables in the compostable wastes collected is 7.1%. According to the results of the measurement of non-compostables eliminated by composting plant workers.

3) According to the physical composition analysis of non-compostable waste conducted for 4 days on May 22nd, 23rd, June 9th and 10th, the rate of kitchen waste in the non-compostable waste is **33.43%** in average.

Table 7-12: Results of Non-compostable Waste Composition Survey (Wet Base) in Mersin (Discharge Source : Household Waste at Guven Sitesi Housing Complex)

Unit : g

Date	Item	Physical Composition											Apparent Specific Gravity
		Kitchen Waste	Paper	Textile	Grass Wood	Plastic	Leather Rubber	Metal	Bottle Glass	Ceramic Stone	Miscella-neous	Total	
22 May.	g	3,400.00	3,400.00	1,200.00	200.00	1,800.00	400.00	200.00	1,200.00	1,200.00	1,200.00	14,200.00	0.08
Sat.	%	23.94	23.94	8.45	1.41	12.68	2.82	1.41	8.45	8.45	8.45	100.00	
23 May.	g	4,000.00	1,800.00	600.00	200.00	1,000.00	50.00	100.00	600.00	600.00	200.00	9,150.00	0.08
Sun.	%	43.72	19.67	6.56	2.19	10.93	0.55	1.09	6.56	6.56	2.19	100.00	
9 June.	g	2,950.00	3,000.00	600.00	100.00	1,000.00	100.00	200.00	400.00	-	-	8,350.00	0.09
Wed.	%	35.33	35.93	7.19	1.20	11.98	1.20	2.40	4.79	-	-	100.00	
10 June.	g	4,000.00	2,950.00	1,900.00	230.00	1,000.00	400.00	100.00	50.00	600.00	-	11,230.00	0.09
Thu.	%	35.62	26.27	16.92	2.05	8.90	3.56	0.89	0.45	5.34	-	100.00	
Total	g	14,350.00	11,150.00	4,300.00	730.00	4,800.00	950.00	600.00	2,250.00	2,400.00	1,400.00	42,930.00	0.09
Week	%	33.43	25.97	10.02	1.70	11.18	2.21	1.40	5.24	5.59	3.26	100.00	

7.3.4 Implementation of the Experiment of the Compost Quality Improvement

a. Implementation Schedule

The experiment of the compost quality improvement was conducted for 5 months from April to August 1999

Most of experiment work were conducted in the third study works in Turkey (11 May to 10 June 1999) in accordance with the schedule shown in the Figure below.

Figure7-16: Implementation Schedule for Compost Quality Improvement in MGM

Outline	Second Study Work in Turkey						Third Study Work in Turkey						Second Study work in Japan																	
	April						May						June						July						August					
1. Improvement of Existing Facility																														
a. Installation of recovery line for non-compostable waste							■	■																						
2. Recovery of non-compostable waste																														
a Allocation of 2-3 workers for non-compostable waste									■	■	■																			
b. Allocation of 1 worker to pick up harmful waste to he plant												■	■	■																
3. Facilitation and Fermentation																														
a. Arrangement of equipment for turning and watering									■	■	■	■	■	■	■	■	■	■	■	■										
4. Improvement of the management of the compost plant																														
a. preparation of operation manual	■	■	■	■	■	■	■	■																						
5. Monitoring compost Quality																														
a. Installation of small laboratory							■	■																						
b. Implementation of laboratory test									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
6. Pilot Project Assessment																														
a. Compost Market Survey																														
b. Chemical Analysis of compost in a formal laboratory																											■	■	■	■

b. Improvement of Existing Facility for Recovery of Non-compostable Waste

The composting plant has two production lines with a feeding conveyor belt respectively where manual picking of recyclable materials is carried out. The feeding conveyor belts were not originally intended for the purpose of picking. No safety measure is provided. Therefore JICA study team installed some facilities as follows :

- 6 safety bars along the feeding conveyor belt
- 2 platforms along the feeding conveyor belt
- 2 staircase for transport of materials

c. Recovery of Non-compostable Waste and Formulation of Windrow

In order to clarify the volume of non-compostable waste mixed with compostable waste, non-compostable waste were eliminated as much as possible at a feeding conveyor belt by 2-3 workers for best quality compost(fine compost) production from 11th May to 26th May 1999. Target rejects were 8 types wastes, namely, Metal, Ceramic, Plastic bag except green bag for compostable waste, plastics(pet bottles, etc.,) green plastic bag for compostable waste, rubber, glass and textile.
On the other hand, for secondary quality compost(coarse compost) production from May 27th to June 10th 1999, textile which is harmful waste for plant operation was eliminated by one worker at a feeding conveyor belt.

d. Major Works for Compost Windrow Conducted by JICA Study Team

JICA Study Team carried out the following:

1) At Truck Scale, Waste receiving point

- weighing the compostable waste (raw and pretreated)
- weighing the non-compostable waste

2) At Compost Plant

- Elimination of non-compostable waste an much as possible at a conveyor belt (from May 11th to May 26th ,1999) by 2-3 workers
- Elimination of harmful waste to as much as possible at a conveyor belt (from May 27th to June 10th, 1999) by 1 worker
- Weighing of rejects by waste type

3) At Compost Plant Office

- Installation of a small laboratory in the office
- Implementation of Simple Laboratory Test
- Confirmation of harmful waste to the composting plant

4) At Windrow

- Formation of 8 compost windrows(fine compost)
- Formation of 11 compost windrow(coarse compost)
- Measurement of windrow temperature
- Turning and Watering of windrow

5) At Small Laboratory in the Compost Plant Office

- Implementation of Laboratory tests(Apparent Specific Gravity(ASG), pH, Moisture Content

6) At a Formal Laboratory

- Physical and chemical analysis of compost

e. Preparation of a Material for Improvement of Management of the Compost Plant

JICA Study Team prepared a material, the "Operation Manual for the Experiment on Compost Quality Improvement", for compost quality improvement in English and Turkish version respectively.

The Operation Manual in Turkish version contributed to understand the improvement of compost quality for the counterpart staffs.

f. Separate Windrow Area for Maturation of Compost

An appropriate area (more than 300 m^2) for windrow of the compost was reserved for the pilot project near the composting plant.

4 rows of windrow were lined up for maturation. One row with 8 windrows is for fine compost production and the other 3 rows with 11 windrows are for coarse compost production. The space of each windrow was maintained more than 3.0 meters for easy turning operation by a wheel loader.

After about 1 month maturation, 8 windrows for fine compost were collected into 2 and 11 windrows for coarse compost were collected into 3. These are conducted for easy control and equalisation of the quality of the compost produced.

h. Facilitation and Fermentation

To produce good quality compost, turning and watering of windrow is indispensable. The time for these works is determined based on the moisture content, temperature of windrow and etc. On site turning and watering of the windrow, etc. were conducted by using the following equipment :

- a wheel loader (bucket capacity about 1 m^3) with an operator
- a water tanker (tank capacity about 8 m^3) with a driver

i. Monitoring the Pilot Project Implementation

i.1 Co-operation of Turkish Side to the Experiment

Municipal waste collection service in Guven Sistesi Housing Complex(GSHC) has been conducted by the private company based on the contract with the Yenisehir Distrcit Municipality(YDM). A collection vehicle for compostable waste is scheduled to get to the GSHC at 7:00 am. The punctuality performance of vehicle's arrival time was very good. The time error was within only 5 minutes during experiment period.

The performance of co-operation to the experiment extended by composting plant workers of MGM and collection workers of a private firm was satisfactory.

i.2 Monitoring the Compost Quality Improvement

i.2.1 Discharge of Wastes of the GSHC

Yenisehir District Municipality(YDM) has been extending public waste collection service to GSHC seven days/week even national holidays. Since the disposal site is under the control of MDM, the hauled weight is measured for five days/week from Monday to Friday. It is not measured on Saturday and Sunday, because these days are off duty for disposal site workers employed by MGM.

The doormen of GSHC, who collect the waste discharged by residents at a stair landing area and discharge it into the container for public collection service are off duty on Sunday. Thus, compostable waste discharge amount is naturally smaller on Monday. Data of the first day data was omitted because of residents' unfamiliarity to the separate collection. Therefore, total 23 days data was used to analyse the experiment.

(1) Waste Discharge Ratio of GSHC

GSHC is regarded as middle income residential area. The waste discharge ratio of GSHC is 420 grams/person/day taking into account the population 5,140. This value is considered reasonable, because the value is between middle (477gram/person/day) and low income(391gram/person/day) residential area which was clarified in WACS in 1998.

(2) Difference of Discharge Ratio between Compostable and Non-compostable Waste

According to Table 7-13, compostable waste occupies 49.1 % and non-compostable waste 50.1 %. On the other hand, the value was 71.8 % in the WACS carried out in 1998. The difference of about 20 % is considered mainly due to incomplete separation of compostable waste and non-compostable waste.

Table 7-13: Composition of Compostable Waste and Non-compostable Waste in MGM

Date		Compostable waste (A) (kg)	Non-compostable waste (B) (kg)	Total (A)+(B) (kg)	Ratio (A)/((A)+(B)) (%)
May 12	Wed	600	900	1,500	40.0
13	Thu	1,100	800	1,900	57.9
14	Fri	1,000	1,200	2,200	45.5
17	Mon	400	1,640	2,040	19.6
18	Tue	1,600	1,100	2,700	59.3
20	Thu	950	1,200	2,150	44.2
21	Fri	1,300	1,200	2,500	52.0
22	Sat	1,100	700	1,800	61.1
23	Sun	900	800	1,700	52.9
24	Mon	400	1,400	1,800	22.2
25	Tue	1,600	1,200	2,800	57.1
26	Wed	1,000	1,100	2,100	47.6
27	Thu	1,260	770	2,030	62.1
28	Fri	1,100	1,000	2,100	52.4
31	Mon	120	1,290	1,410	8.5

Date	Compostable waste (A) (kg)	Non-compostable waste (B) (kg)	Total (A)+(B) (kg)	Ratio (A)/((A)+(B)) (%)
June 1 Tue	1,900	1,000	2,900	65.5
2 Wed	630	1,400	2,030	31.0
3 Thu	1,000	900	1,900	52.6
4 Fri	1,040	900	1,940	53.6
7 Mon	1,490	1,830	3,320	44.9
8 Tue	1,600	1,030	2,630	60.8
9 Wed	1,070	780	1,850	57.8
10 Thu	1,180	1,050	2,230	52.9
Total	24,340	25,190	49,530	49.1

(3) Moisture Content of Compostable Waste at Collection Point of GSHC

Water content of compostable waste was measured by using the sample of waste on the conveyor belt discharged from feed hopper. However, by visual observation, considerable amount of water flows out not only from the pre-treated compost production line but also while compostable waste is dumped to the feed hopper from collection vehicle at the compost plant. Therefore, modification is made on the moisture content value at the time the collection vehicle arrives at weigh-bridge of final disposal site as shown in Table 7-14.

As shown in Table 7-14, the Moisture content after pre-treatment is 56% on average.

Table 7-14: Estimate of Moisture Content of Compostable Waste on Collection Vehicle's Arrival at the Weighbridge of Disposal Site in MGM

Date	Compostable waste (kg)		Moisture Content (%)	
	Compostable Waste	Pretreated material	Pretreated material	Compostable Waste
May 18 Tue	1,600	820	65	82
26 Wed	1,000	370	65	87
27 Thu	1,260	700	53	74
28 Fri	1,100	820	59	70
June 1 Tue	1,900	1,490	59	68
2 Wed	630	600	53	55
3 Thu	1,000	760	44	57
4 Fri	1,040	860	44	54
8 Tue	1,600	1,190	58	69
9 Wed	1,070	840	55	65
Average	---	---	56	68

(4) Ratio of Rejected Non-compostable Material in Compostable Waste

As shown in Table 7-15. the weight ratio of non-compostable material mixed with compostable waste is 7.5%. The value is approximately half of WACS value conducted by Study Team in 1998.

Table 7-15: Weight Ratio of Rejected Non-compostable Material from Compostable Waste in MGM

Date			Compostable waste (A)	Reject material (kg) (B)								
				Metal	Ceramic	Plastic bag	Plastics	Green Plastic Bags	Rubber	Glass	Textile	Total
May	12	Wed	600	0.0	0.0	---	7.5	4.8	0.0	1.2	1.3	14.8
	13	Thu	1,100	0.3	0.0	---	41.1	26.3	0.0	2.2	5.6	75.5
	14	Fri	1,000	1.2	0.0	---	42.1	26.9	0.0	8.0	7.8	86.0
	17	Mon	400	3.8	1.7	---	39.4	25.2	1.9	1.6	15.3	88.9
	18	Tue	1,600	3.6	0.0	---	25.4	36.0	1.4	10.2	7.4	84.0
	20	Thu	950	1.4	0.0	---	6.8	43.8	0.0	11.4	13.0	76.4
	21	Fri	1,300	2.2	1.0	35.6	5.2	26.5	3.2	10.0	7.8	91.5
	26	Wed	1,000	2.0	0.0	30.0	6.8	21.0	0.8	8.0	10.9	79.5
Total			7,950	14.5	2.7	65.6	174.3	210.5	7.3	52.6	69.1	596.6
Ratio (B)/(A)(%)			100.0	0.2	0.0	0.8	2.2	2.6	0.1	0.7	0.9	7.5
Ratio by WACS (%)			100.0	0.7	1.0	6.4			0.2	2.6	3.4	14.2

(5) Mix Ratio of Compostable Waste in Non-compostable Material Collected Separately by Regular Collection Service

The result of physical composition analysis of non-compostable material mixed with compostable waste is shown in Table 7-14. The mixed ratio of compostable waste, namely, kitchen waste, grass/wood contained in non-compostable waste is 33.4 %

Table 7-16: Physical Composition Analysis of Non-compostable Material Mixed with Compostable Waste in MGM

date		Physical Composition											Apparent Specific Gravity (kg/m^3)
		Kitchen Waste	Paper	Textile	Grass Wood	Plastic	Leather Rubber	Metal	Bottle Glass	Ceramic Stone	Miscella-neous	Total	
22 May	g	3,400	3,400	1,200	200	1,800	400	200	1,200	1,200	1,200	14,200	80
Sat	%	23.9	23.9	8.5	1.4	12.7	2.8	1.3	8.5	8.5	8.5	100.0	
23 May	g	4,000	1,800	600	200	1,000	50	100	600	600	200	9,150	80
Sun	%	43.7	19.7	6.6	2.2	10.9	0.4	1.1	6.6	6.6	2.2	100.0	
9 June	g	2,950	3,000	600	100	1,000	100	200	400	---	---	8,350	90
Wed	%	35.3	35.9	7.2	1.2	12.0	1.2	2.4	4.8	---	---	100.0	
10 June	g	4,000	2,950	1,900	230	1,000	400	100	50	600	---	11,230	90
Thu.	%	35.6	26.3	16.9	2.0	8.9	3.6	0.9	0.4	5.4	---	100.0	
Total	g	14,350	11,150	4,300	730	4,800	950	600	2,250	2,400	1,400	42,930	90
Week	%	33.4	26.0	10.0	1.7	11.2	2.2	1.4	5.2	5.6	3.3	100.0	

(6) Moisture Content of Compostable Waste

Moisture content by Pilot Project and WACS

There are two data on the value of moisture content of compostable waste. One is 68% (2.1kg-water/kg-dry solid) as shown in Table 7-17 by pilot project, and the other is 75.6 %(3.1kg-water/kg-dry solid) by WACS, which is 1.0 kg-water/kg-dry solid larger than pilot project value.

Moisture Content of Compostable Waste for the Compost Production Planning

Moisture Content of compostable waste calculated from the result of WACS, is obtained using the mix ratio of compostable waste and non-compostable materials in weight(92.5% and 7.5%) by the pilot project as shown in the table below.

Table 7-17 shows moisture content of compostable waste estimated by the WACS. The moisture content is estimated as 75.6 %(3.1 kg-water/dry solid), which is higher than 68% measured in the pilot project. The difference of moisture content value between pilot project and WACS is considered due to water leakage somewhere from collection point to weigh-bridge.

However, according to WACS, moisture content of garden waste(grass and wood) is about 70 % by WACS, which is almost same as 75.6 %. Therefore, garden waste is not considered it does not affect the moisture content of the compostable waste.

Table 7-17: Moisture Content of Compostable Waste by the result of WACS in 1998

Compostable Waste 100 kg	Compostable	92.5 kg	Dry Solid	22.5 kg	(24.4 %)
			Water	70.0 kg	(75.6 %)
	Non-compostable	7.5 kg	Dry Solid	4.1 kg	(55.2 %)

(7) Material Balance of Compostable Waste

Material Balance of Separate Collection is shown in Figure 7-18 from generation to raw material.

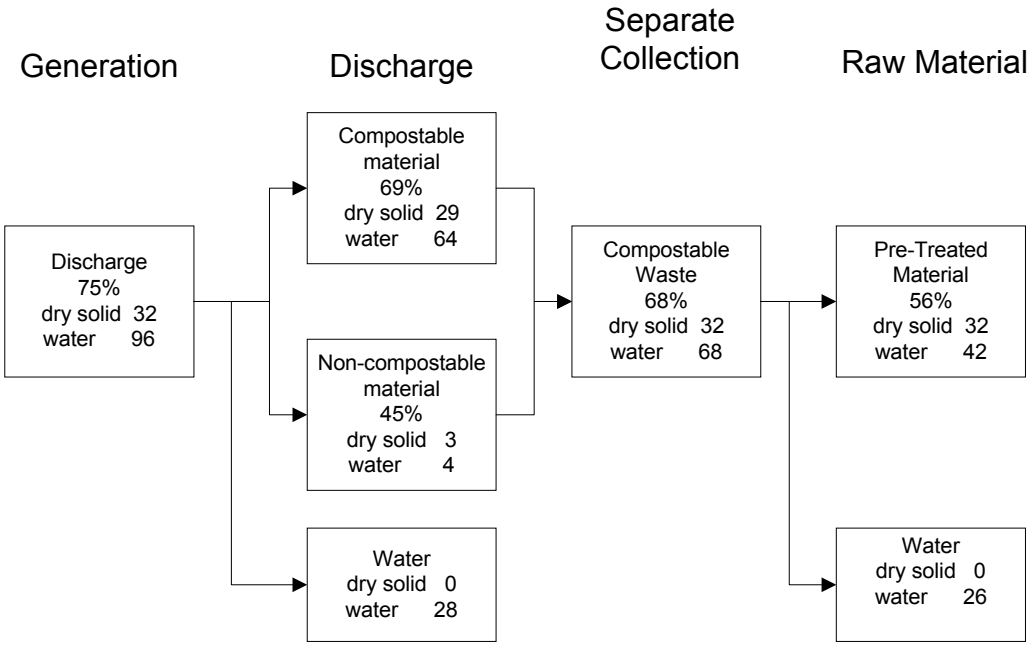


Figure 7-18: Material Balance of Separate Collection

(8) Characteristics of Compostable Waste

- **Approximate Relationship between Apparent Specific Gravity(ASG) and Moisture Content**

Figure 7-19 shows relationship between ASG and Moisture Content. ASG distributes in the range of 400 to 800 kg/m^3 , mainly 600 to 800 kg/m^3 . Moisture content varies 40 to 82 %, mainly 40 to 65 %.

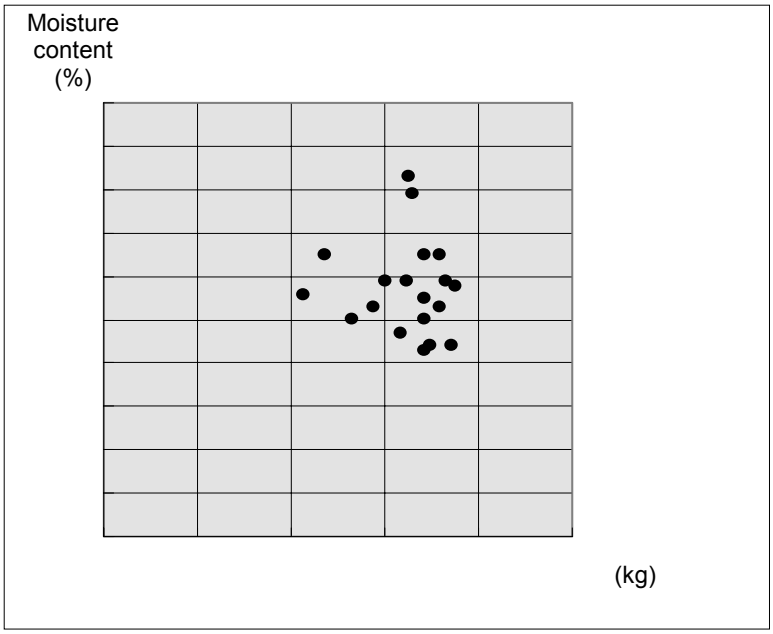


Figure 7-19: Approximate Relationship between Apparent Specific Gravity(ASG) and Moisture Content

- **Variation of Temperature During the Composting Process**

The compost windrow temperature rises at the beginning due to the heat release from the biological activity. When the readily biodegradable organic material is depleted, bacteria activity is reduced, the temperature of the composting material begins to drop, and the first stage of the composting process is complete.

The composted material is usually cured for an additional 2 to 8 weeks in open windrows to ensure complete stabilisation. After the temperature drops rapidly to around 40^{o}C, windrow temperature decreases gradually.

Figure 7-20 shows time(day)-temperature during the compost process relationship of the experiment. Field investigation period was not long enough to confirm the gradual temperature decrease. However, it is considered the temperature have decreased gradually like other examples[1].

1 George Tchobanoglous, Hilary Theisen, Samuel Vigil, *Integrated solid waste management Engineering principles and management issues* Figure 9-38, 305 page

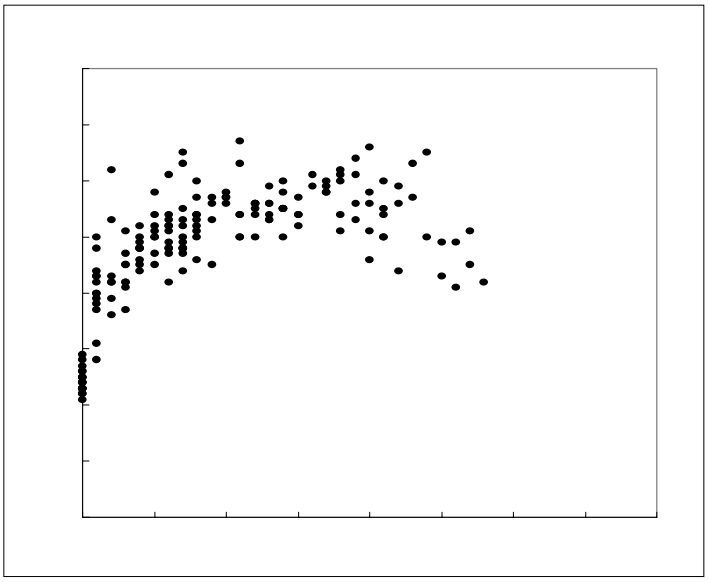


Figure 7-20: Variation of Temperature During the Composting Process

- **Variation of pH During Compost Process**

  pH of windrow composting ranges 7.5 to 9.0 after 1 week usually. Figure 7-21 shows the pH variation of compost process conducted in the experiment. It shows 2 lines of pH. One line ranges between 6.0 and 7.0, which is slightly lower than other examples[2]. Other line ranges between 8.0 and 9.0, which varies within the range shown in the other examples.

  Since the value of pH varies depending on the measurement method, it is difficult to comment on the data.

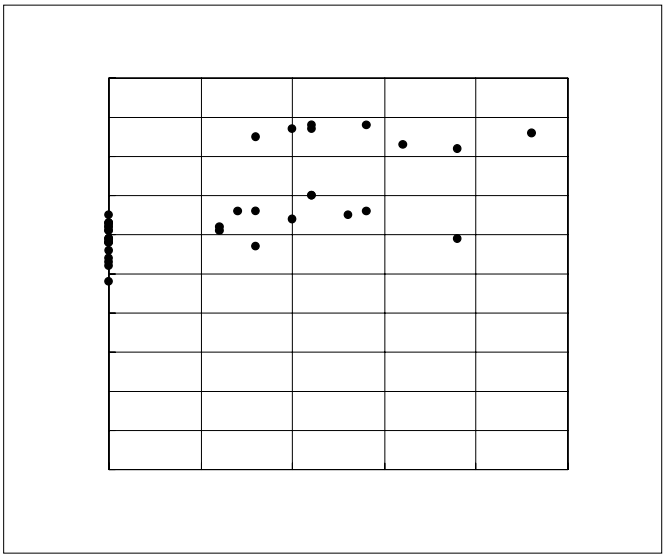


Figure 7-21: Variation of pH During Compost Process

[2] George Tchobanoglous, Hilary Theisen, Samuel Vigil, - Integrated solid waste management Engineering principles and management issues Figure 14-5, 692 page

h. Findings

1) **Leakage of Water at Section between Feed Hopper and Pre-treatment**

According to visual observation, much water leaks in the section between feed hopper and pre-treatment. This should be taking into consideration for the compost production planning.

1) Mechanical Troubles

- **Compost Plant**

  Compost production experiment was conducted by using one of two lines exclusively due to small amount of compostable waste. The line got out of order 2 times during one month. First time, it was repaired by using spare parts. Second time, 2 lines got of gear at the same time. The line for compost production experiment line took about two weeks to be repaired. Therefore, JICA Study Team was obliged to use another line, which was repaired by exchanging of spare parts in 3 days.

- **Wheel Loader for Turning of Compost Windrow**

The wheel loader got mechanical trouble one time within one month. It took 4 days to be repaired regarding hydraulic system trouble.

It implies mechanical condition of compost windrow affects the schedule of turning of compost windrow.

- **Result of Sieve Analysis of the Compost produced by the Current Compost Plant**

  The existing plant produces compost using raw materials without separate collection. The result of the sieve analysis of the raw materials which has been cured for about 6 months is shown in Table 7-18.

Table 7-18: Result of Sieve Analysis of the Compost produced by the Present Compost Plant Using Raw Material Without Separate Collection

sieve size(mm)	more than 30	30-8	8-2	less than 2	Total
weight(kg)	6.5	6.4	4.9	14.9	32.7
weight ratio(%)	19.9	19.6	15.0	45.6	100.0

Note : surveyed by study team in May 1999

7.3.4 Compost Market Survey

If the organic materials are separated from municipal solid wastes and are subjected to bacterial decomposition, the end product remaining after composting process is a dark-brown substance referred to as humus or compost.

In general, the beneficial use of compost is the soil improving, while its value as fertiliser is of minor importance. By adding compost, the capability of the soil to keep the moisture and nutrients will be improved.

As fertiliser regarded, compost contents micro nutrients which is not available in chemical fertiliser. Thus, the risk of failure of crops due to lack of nutrients will be reduced.

The municipal solid waste generated in target area is suitable for composting due to its high content of organic matters. Furthermore, the soil condition in the target area are characterised by shortage of fertile soil, which make the compost salable and in great demand. However, unlike recyclable items such as aluminum, paper and glass, no national markets for compost product are available.

a. Objectives of the Survey

Once the solid waste have been converted to a humus, they are ready for the final step of composting operation, marketing. The study team, therefore, investigates end-uses for the compost product and price to find the feasibility of new compost plant. As for the compost market survey, a questionnaire to the farmers in Adana and Icel Provinces was planned to be conducted by showing them the improved compost samples to be produced by the above-mentioned experiment in order to:

- identify potential users and their location, and
- find out a seasonal variation of the compost demand, total estimated demand in the area, and an expected price of the compost.

b. Method of the Survey

b.1 Preparation of Samples

Due to the strike of the workers of the compost plant commencement of the experiment was delayed. Therefore the study team could not produce improved compost while they stayed in Turkey, by the mid-June 1999. In stead the team obtained the following types of sample compost for the questionnaire survey by sieving the fine compost produced by the existing compost plant in Mersin:

- Very fine compost (VFC) sieved by a 8 m/m screen, and
- Extremely very fine compost (EVFC) sieved by a 2.5 m/m screen

The former includes some foreign materials especially plastic while the latter few. As for the product rate against the fine compost in weight, the former is 60.6% and the latter 45.6%.

b.2 Selection of Villages

Originally, the study team plans to select 25 villages from each province as random for a questionnaire survey. From these villages, they can be divided further to 20 villages from hilly area and 5 from flat area. In total 50 villages were selected for the survey.

However, after a couple day of the survey, the study team realised that the potential users of compost are depended on type of crop, not area condition. Criteria for selection of the village, therefore, has been changed and given priority to type of crop. The list of villages had been surveyed is tabulated in the Tables below. All the figures in the tables were obtained by the questionnaire survey to the farmer. The location

map of selected village in Adana Province and Icel Province is shown in the Figures below.

Table 7-19: List of Surveyed Village in Adana Province

No.	Village Name	Municipality	Type of Crop	Total No. of Farmer	Total Farm Area (ha)	Average Farm Area (ha/Farmer)
Adana Province						
1	Kabasakal	Seyhan	Wheat	150	150	1.0
2	Sambayat	Seyhan	Wheat, Corn	240	800	3.3
3	Gokceler (Gerdan)	Seyhan	Wheat, Corn	100	2,000	20.0
4	Kayisli	Seyhan	Wheat, Corn	120	900	7.5
5	Buruk	Yuregir	Wheat, Grape Watermelon	350	1,800	5.1
6	Yunusoglu	Yuregir	Orange, Vegetables, Wheat, Corn, Cotton	60	1,200	20.0
7	Imakbasi	Yuregir	Vegetables, Watermelon Wheat, Corn, Cotton	30	800	26.7
8	Yolgegen	Seyhan Merkez	Wheat, Corn, Orange	90	6,000	66.7
9	Mustafalar	Yuregir Merkez	Wheat, Cotton	150	500	3.3
10	Akkuyu	Yuregir Merkez	Wheat	100	2,000	20.0
11	Turunslu	Yuregir Merkez	Wheat, Corn	100	1,000	10.0
12	Karaomerli	Yuregir Merkez	Wheat, Corn, Peanut	30	300	10.0
13	Baklali	Yuregir Merkez	Wheat, Cotton, Tobacco	300	5,000	16.7
14	Kiligli	Yuregir Merkez	Wheat, Cotton	500	1,800	3.6
15	Solakli Beldesi	Yuregir Merkez	Wheat, Corn, Cotton,	200	7,500	37.5
16	Yarbass (Havutlu)	Yuregir Merkez	Wheat, Corn, Cotton, Orange, Watermelon	100	1,000	10.0
17	Fadil	Karaisali	Wheat, Cotton	15	250	16.7
18	Salbas	Karaisali	Grape, Watermelon, Onion, Cotton	350	500	1.4
19	Kasoba	Karaisali	Pepper, Watermelon, Wheat, Corn, Cotton	70	600	8.6
20	Soysali	Ceyhan Merkez	Wheat, Corn, Cotton, Watermelon	350	4,000	11.4
21	Zeytin Beli Kasabasi	Yumurtalik Merkez	Watermelon, Cotton, Vegetables	350	2,000	5.7
22	Ayualik	Yumurtalik	Watermelon, Orange, Vegetables	100	500	5.0
23	Deveciusagi	Yumurtalik	Watermelon, Wheat, Cotton	200	1,500	7.5
24	Gukurkamis	Karatas Merkez	Corn, Wheat, Cotton	30	1,200	40.0
25	Yuzbasi Kuyu	Karatas Merkez	Cotton, Corn, Wheat, Watermelon	150	3,000	20.0
Total				4,235	46,300	10.9

Table 7-20: List of Surveyed Village in Icel Province

No.	Village Name	Municipality	Type of Crop	No. of Farmer	Farm Area (ha)	Average Farm Area (ha/Farmer)
Icel Province						
1	Hebili	Mersin Merkez	Grape, Orange, Wheat	200	100	0.5
2	Pug-Karacadag	Mersin Merkez	Grape, Orange, Wheat	200	500	2.5
3	Burhankoy	Mersin Merkez	Grape, Orange	400	5,000	12.5
4	Yampar (Gokkusagi)	Mersin Merkez	Grape, Orange, Wheat	300	1,000	3.3
5	Dikilitas Beldesi	Mersin Merkez	Orange, Wheat, Corn	500	1,500	3.0
6	Tekke	Mersin Merkez	Grape, Wheat, Corn, Orange	120	500	4.2
7	Adanalioglu	Mersin Merkez	Vegetables, Orange	700	4,500	6.4
8	Kazanli Kasabasi	Mersin Merkez	Wheat, Corn, Pepper, Orange	350	1,800	5.1
9	Demihisar	Mersin Merkez	Orange	150	200	1.3
10	Karaisali	Mersin Merkez	Orange	150	200	1.3
11	Gukcebelen	Mersin Merkez	Orange, Vegetables	150	400	2.7
12	Kalekoy	Mersin Merkez	Lemon, Corn, Tomato	400	500	1.3
13	Doruklu	Mersin Merkez	Grape	400	1,000	2.5
14	Musali	Mersin Merkez	Grape	450	450	1.0
15	Resul	Mersin Merkez	Grape	200	300	1.5
16	Camili	Mersin Merkez	Grape, Orange	200	250	1.3
17	Igdir	Mersin Merkez	Orange, Wheat	300	900	3.0
18	Kalibercu	Tarsus Merkez	Grape, Wheat	200	1,000	5.0
19	Atalar (Deliminnet)	Tarsus Merkez	Vegetables, Wheat, Corn, Orange	400	1,400	3.5
20	Bahsis Beldesi	Tarsus Merkez	Vegetables, Wheat, Corn	1,400	1,600	1.1
21	Dedeler	Tarsus Merkez	Grape	300	600	2.0
22	Evci	Tarsus Merkez	Grape, Orange	200	400	2.0
23	Kerimler	Tarsus Merkez	Grape	60	200	3.3
24	Nacarli	Tarsus Merkez	Grape, Orange, Wheat	250	500	2.0
25	Buluklu	Dorukkent	Grape, Orange, Wheat	200	550	2.8
			Total	8,180	25,350	3.1

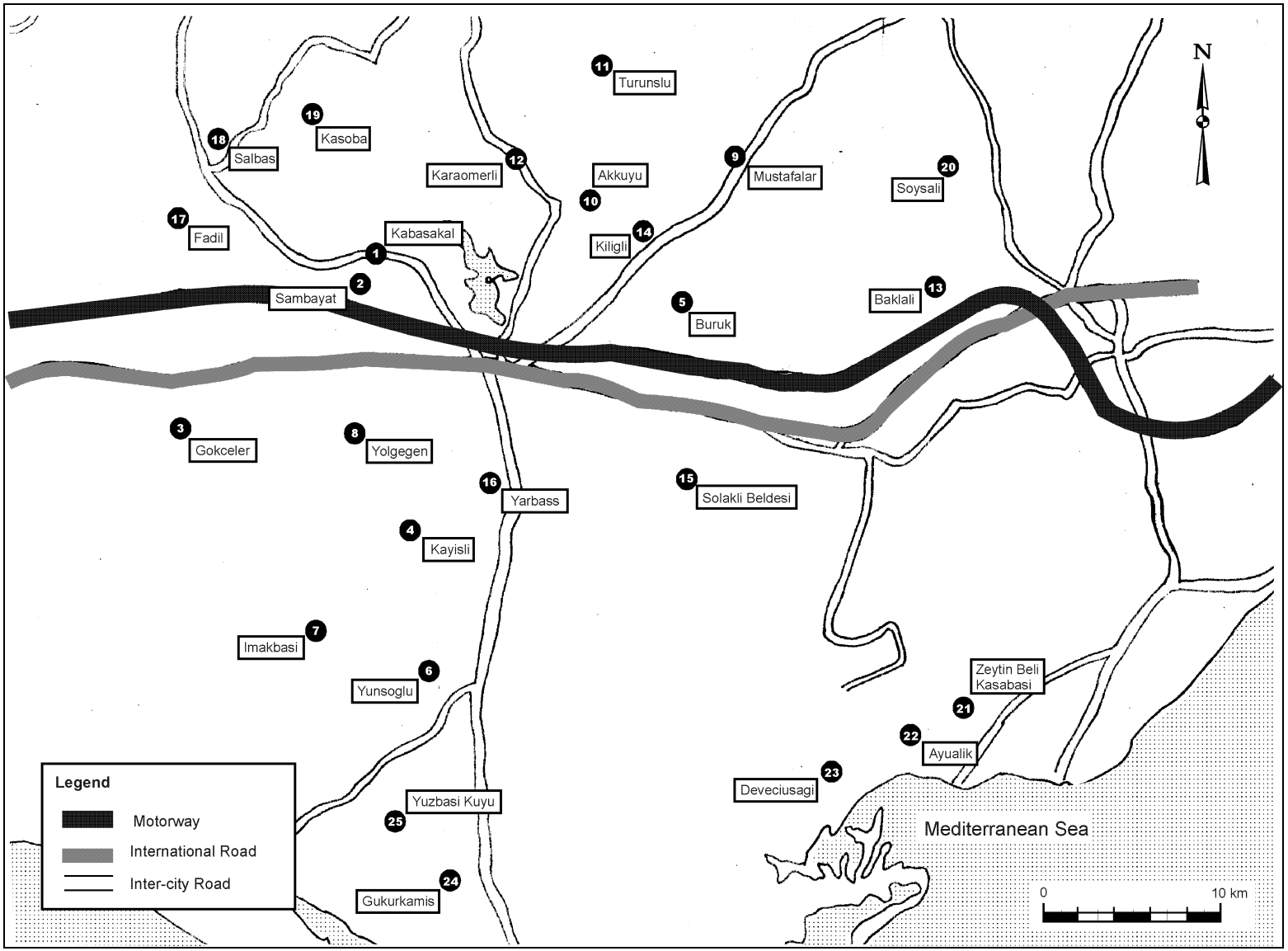


Figure 7-22: Location Map of Selected Village for Compost Market Survey in Adana Province

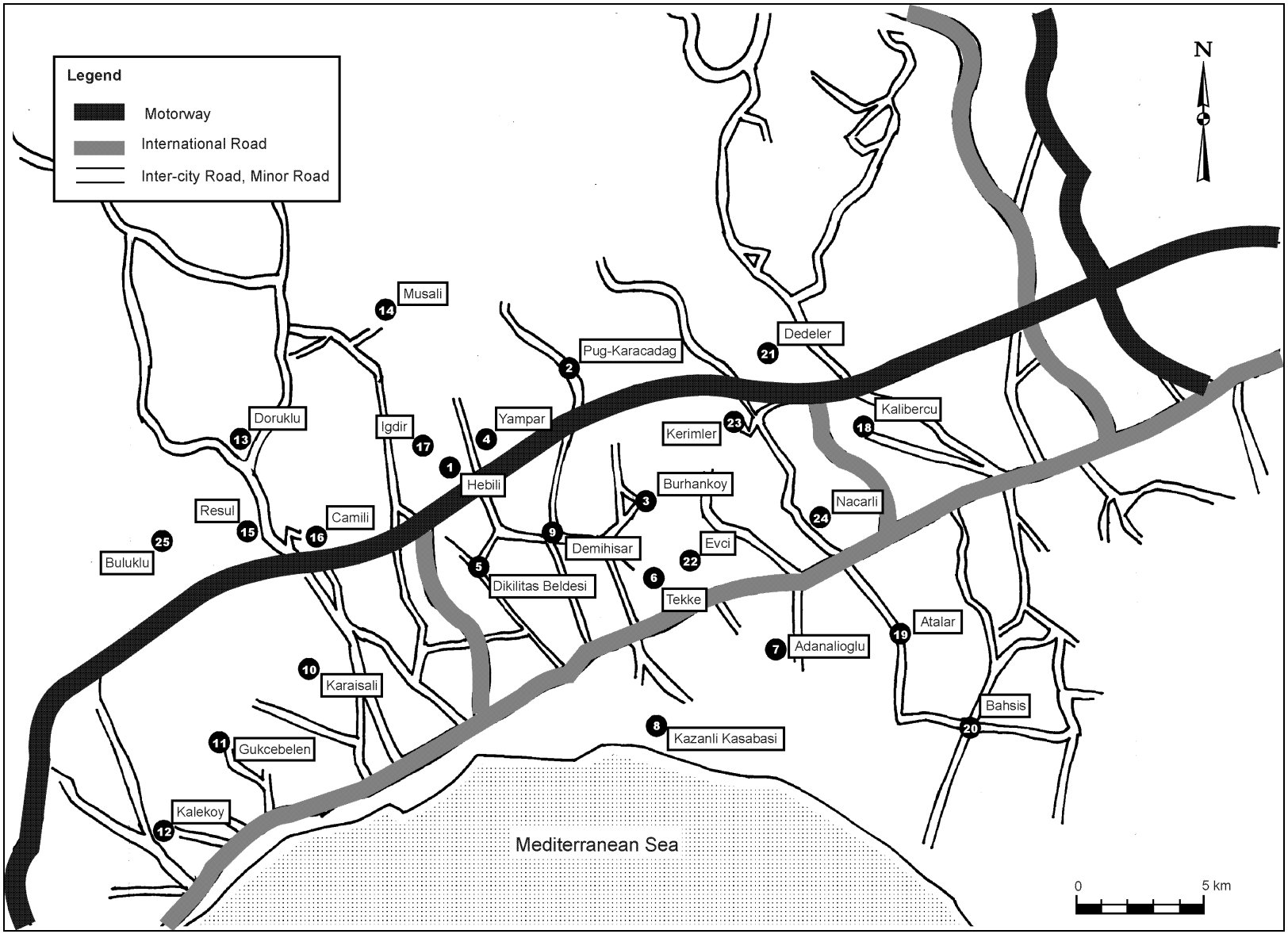


Figure 7-23: Location Map of Selected Village for Compost Market Survey in Icel Province

b.3 Questionnaire Survey

A questionnaire sheet for the survey was prepared by the team as shown below. The survey was conducted from May 20th to June 3rd, 1999 by visiting groups of farmers in local pubs (kahave hane) in the villages. The questionnaire survey in each village was proceeded to the whole group of farmers gathered in a pub. Number of farmers listening, discussing and giving their opinion in each village was somewhere around 10-20 persons.

Survey Date..... No. of farmers meet.....

Village No. ..... Name of Village.....

Name of Municipality..... Province Adana ☐ Icel ☐

Questionnaire for Compost Market Survey

A. Question on farm land

1. How many farmers are there in your village?

   .....

2. How many average hectare of farm land for each farmer is in your village?

   .....

3. What type of crop do you plant? How many ha are there in your village?

Type of Crop	Farm Area (ha)
Trees of citrus or orange	
Vegetables like onions, etc.	
Fruits like grape, watermelon, etc.	
Cereals like corn, wheat, etc.	
Cotton	
Others.....	

4. What month is your farm cultivation and harvesting and price of crop?

Type of Crop	Cultivation Period	Harvesting Period	Price (Kg/TL)
Trees of citrus or orange			
Vegetables like onions, etc.			
Fruits like grape, etc.			
Cereals like corn, wheat, etc.			
Cotton			
Others.....			

5. How many kilometer is from your village to city?

.....

6. Do you have your own transportation for example....tractor, pick-up?

.....

B. Question on fertiliser

7. What fertiliser do you use for your farm? What is the price?

Type of fertiliser	Price (TL/ton)
Matured goat manure	
Matured cow manure	
Matured chicken manure	
Fresh manure	
Chemical fertiliser	
Fertile soil	
Compost	
Others.....	

8. Does the price include transportation?

.....

9. How much do you use fertiliser per ha? How many times per year?

.....

10. What month do you fill fertiliser to your farm?

.....

11. Where do you buy fertiliser?

.....

12. Why do you use this fertiliser?

.....

13. Is this fertiliser available whenever you want?

.....

14. Do you also use other fertiliser for your farm? What is the price?

.....

C. Question on Compost Market

15. Have you ever used "compost" for your farm land?

.....if Yes, When? .....

16. Do you know qualification of compost?

.....

17. If compost is good quality and available, will you use it?

.....

If not, please proceed to Q. 22

18. Do you know the proper ratio amount to apply compost to your farm land?

.....

19. How much of compost will you use per ha/year?

.....

20. How often and when do you use compost for your farm land? (What month?)

.....

21. How much are you willing to pay at most for compost?

Price of Compost/Ton	Fine Compost	Coarse Compost
0-1 Mil. TL		
1,000,001-2 Mil. TL		
2,000.001-3 Mil. TL		
3,000,001-4 Mil. TL		
4,000,001-5 Mil. TL		
5,000,001-6 Mil. TL		
6,000,001-7 Mil. TL		
7,000,001-8 Mil. TL		
8,000,001-9 Mil. TL		
9,000,001-10 Mil. TL		

22. Why do you not use compost?

.....

c. Results of Survey

Cukurova Region, an important agricultural area in Turkey, is located east part of the Mediterranean Zone. The region comprises of 3 provinces namely; Adana, Icel and Hatay. Due to the large agricultural area, preferable climate to the crop and enough water supply of the region, there is possibility to raise the various crops in this area. Furthermore, since the Seyhan dam constructed on the Seyhan river in 1956, irrigated agricultural land has been increased. At the time being, 312,000 ha or 24% of total agricultural land (1.3 million ha) of Cukurova Region is being irrigated. While the ratio of irrigated area for the Turkey is 14%.

Total area of the Cukurova Region is about 3.9 million ha. From this, 34% is formed of agricultural land which Adana Province occupies the largest agricultural area (674,509 ha), followed by Icel Province (388,779 ha) and Hatay Province (266,804 ha). The land use distribution in Cukurova Region and breakdown by province is tabulated in the table below.

Table 7-21: Land Use of Cukurova Region and Breakdown by Province

Land Use	Adana		Icel		Hatay		Cukurova Retion	
	Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)	Area (Ha)	Ratio (%)
Agricultural Land	674,509	39.10	388,779	24.52	266,804	49.38	1,330,092	34.54
Pasture	84,508	4.90	219,821	13.87	49,673	9.19	354,002	9.19
Forest and Swamp	856,721	49.66	886,045	55.89	207,931	38.49	1,950,697	50.66
Settlement Area	14,239	0.83	9,327	0.59	6,239	1.15	29,805	0.77
Others	95,290	5.52	81,287	5.13	9,614	1.78	186,191	4.84
TOTAL	1,725,267	100.00	1,585,259	100.00	540,261	100.00	3,850,787	100.00

Source : 1st Cukurova Agriculture Congress in Adana, 9-11 January 1991.

From the final report of the project "The Effect of Different Plant Residues on Nitrogen Mineralisation, Immobilisation and Dentrification in Soils" by Cukurova University in co-operation with Justus-Liebig University in 1994 described that Cukurova Region has a typical Mediterranean climate (very hot in summer) and stored on subtropics zone. Organic matter content of the soils in Cukurova is 1-2%. Although the soil organic matter is very poor in Cukurova Region, plant residues in soils had been fired by farmers due to the problem of sowing following harvest. Because of burning the plant residues in soil, soils physical, chemical; and biological properties and its productivity are getting worse. Besides, since intensive agricultural system have been using in Cukurova Region, high amounts of chemical fertilisers are applied to the soils.

According to Agricultural Credit Cooperative (ACC), the total amount use of chemical fertiliser in Turkey that only ACC sold was 2,000,000 ton/year. This figure does not include sale amount from another sellers like big fertiliser companies or markets. From total sale amount of ACC, Cukurova Region occupied about 7.5% or 150,000 ton/year which can be classified into further detail for Adana, Icel and Hatay about 70,000 ton/year, 50,000 ton/year and 30,000 ton/year respectively.

The element of fertiliser (N:P:K) using by farmers in Cukurova Region is depended on type of crop. For example, chemical fertiliser element 20:20:20 is being used for

wheat and cotton fields, 0:0:46 for wheat and corn, 15:15:15 for citrus plantation, etc. The price of chemical fertiliser is also depended on its element which almost varies from 30 million TL/ton to 70 million TL/ton.

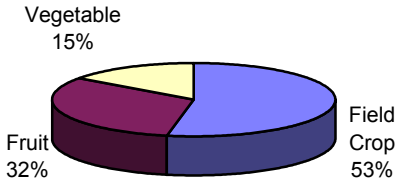
However, from the outcome of questionnaire survey, almost farmers in the selected village acknowledged the bad effects of chemical fertiliser to their fields. Because soil is getting harder, more salinity and decreasing in groundwater level but they mainly do not have other choice.

In view point of economic, farmers in target area are mainly considered as middle income. They have their own farm land and transportation like tractor for working in farm. There is no official statistical data on average size of farm land for each farmer in the target area. However, size of farm land can be roughly imagined by type of crop. For fruit orchard like vine yard, citrus garden (lemon, mandarin, sour orange, grape fruit) the average farm land of each farmer is normally smaller than farm for field crops like wheat, corn, cotton, etc.

c.1 Adana Province

c.1.1 Agricultural Situation

According to the data from Administration of Agriculture and Village Affairs of Adana Province in 1997, 39% (675,000 ha) from total area (1.7 million ha) of Adana Province is agricultural land. In further detail, agricultural land has been divided into 3 categories according to main type of crops which shown in the figure below.



Type of Crop	Farm Area (ha)	Percent
Field Crop	357,750	53
Fruit	216,000	32
Vegetable	101,250	15
Total	675,000	100

Figure 7-24: Agricultural Land by Type of Crop in Adana Province

There are many types of agricultural products in Adana from field crop like wheat, corn, cotton, fruit like citrus (lemon, mandarin, sour orange, grape fruit), vegetable like tomato, pepper, egg plant, etc. Field crop farm mainly located in mountainous area in the northern part of Adana. While fruit orchard and vegetable garden are cultivated in the flat area which slope down from the north of Adana toward to the Mediterranean Sea in the south.

For field crop, season of cultivation is divided into 2 times/year. The first crop can be cultivated in summer or winter that depends on farmer's decision. The annual cycle of field crop cultivation is shown in the figure below. The price of main crops and estimated income of farmer by type of crop in surveyed village are shown in the table below.

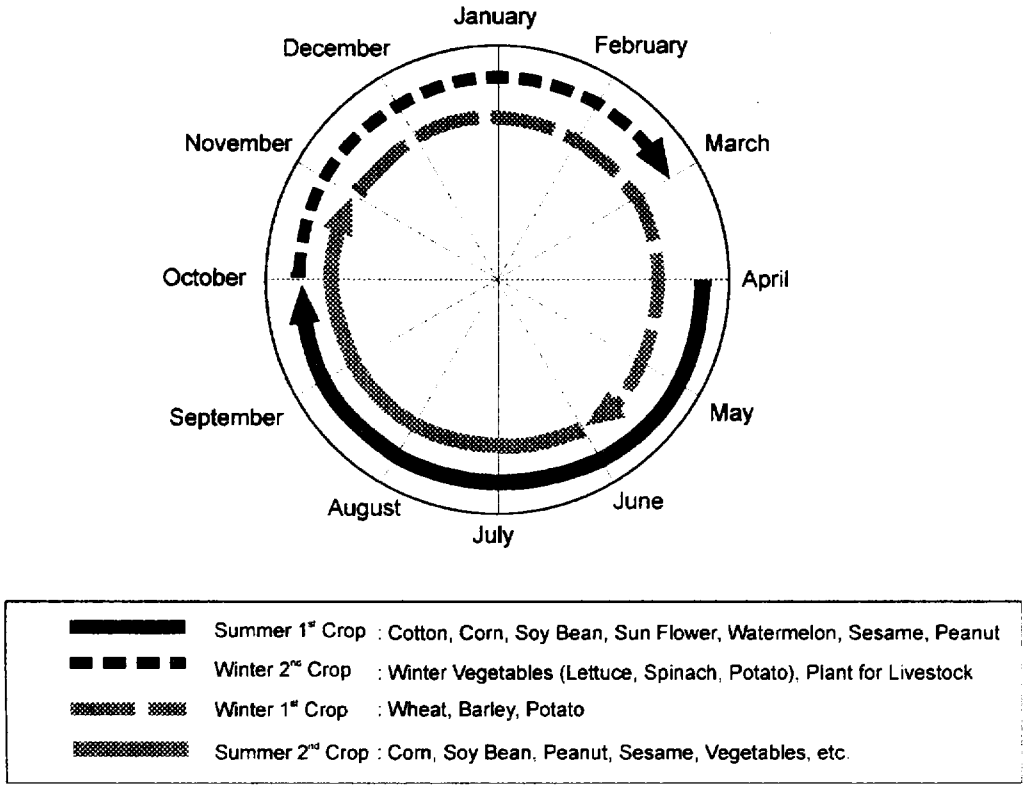


Figure 7-25: Annual Cycle of Field Crop Cultivation in the Target Area

Table 7-22: Price of Main Agricultural Products and Estimated Income of Farmer in Surveyed Village of Adana Province (1998)

Type of Crop	Price (TL/Kg)	Yield (Kg/ha)	Income per ha (Million TL)	Cost of Organic Fertiliser Per ha/Year (Million TL)	Cost of Labour for Farm Work/ha (Million TL)	Expense Percentage of Organic Fertiliser/ha (Million TL)
Wheat	50,000-70,000	3,000-6,000	150-420	50	30	19-50%
Corn	60,000-70.000	6,000-10,000	360-700	50	30	11-22%
Cotton	100,000-150,000	1,000-4,000	100-600	50	30	13-80%
Citrus	70,000-80,000	50,000-60,000	3,500-4,800	17	30	0.9-1.3%
Grape	80,000-100,000	20,000-30,000	1,600-3,000	17	30	1.5-3%

From the table, it can be clearly seen that income from field crop per hectare is quite less than when compare with fruit orchard or vegetable farm. Furthermore, if field crop farmers want to apply organic fertiliser like compost to their farm land, the expense cost of compost including labour cost will be 10-80% of total income per ha. On the other hand, fruit orchard is not only bring a lot of income to farmer but also expense cost for application organic fertiliser is less than 3%. However, farmers of

field crop farm may face some difficulties to change type of crop to fruit for higher income. For example, there is no irrigation system in their farm land. Or they do not have enough cash because they have to wait for 4-5 years until fruit trees are able to give production while field crop is mostly cash crop that brings income twice a year to farmers.

c.1.2 Chemical Fertiliser

From the questionnaire survey to the selected village, it can be said that main fertiliser being used in Adana is chemical fertiliser because of its price, effectiveness and easy use. There are 2 main ways for application, dilute with water and spread by tractor, and spread directly into farm land. The amount of fertiliser used in farm and period of using is depended on type of crop as shown in the table below.

Table 7-23: Period of Cultivation, Harvesting and Using Fertiliser

Type of Crop	Period		Chemical Fertiliser Use		
	Cultivation	Harvesting	Use per Year	Using Period	Amount
Field Crop					
Wheat	November-December	May-June	2 times	1. October 2. February	1,000 kg/ha 1,000 kg/ha
Corn					
- 1st Crop	April-May	September-October	2 times	1. April 2. June	1,000 kg/ha 1.000 kg/ha
- 2nd Crop	June	November-December	2 times	1. May 2. September	1,000 kg/ha 1,000 kg/ha
Cotton	March-April	September-October	2 times	1. April 2. June	1,000 kg/ha 1,000 kg/ha
Fruit					
Citrus	October	November	3 times	1. December 2. February-March 3. May-June	500 kg/ha
Watermelon					
- Green House	January-February	May-June	3 times	1. October 2. January 3. March	1,000 kg/ha
- Open Area	March-April	July-August	4 times	1. December 2. April 3. May 4. Late May	1,000 kg/ha
Vegetable					
Tomato, Pepper, Egg Plant, Onion, etc.	4-6 Times/Year	4-6 Times/Year	7-8 times	Before cultivation and 20 days after harvesting	1,000 kg/ha

The price of chemical fertiliser is highly depended on its type as explained before. Another factor which effect to the price is transportation cost. Farmers will buy fertiliser from big market in case they have enough cash. If not, they will ask Agricultural Credit Cooperative (ACC) to arrange. After harvesting, farmers will pay back to ACC with interest.

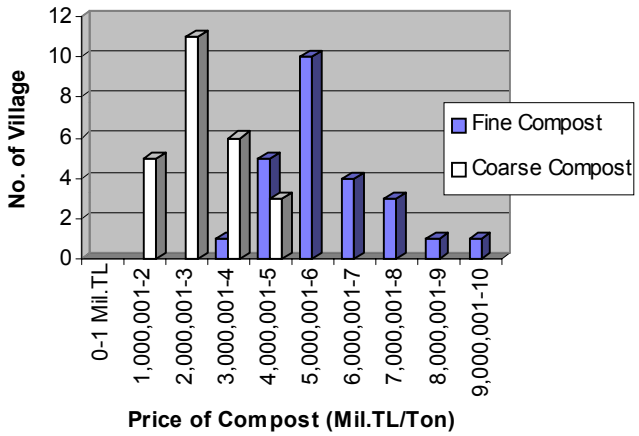
c.1.3 Organic Fertiliser

For organic fertiliser, farmers of field crop farm do not apply organic fertiliser in their farm land. Only farmers of fruit orchard and vegetable garden use organic fertiliser to improve their soil quality or to prepare land for cultivation from late autumn to early of winter (September-January).

Farmers apply organic fertiliser each 2-3 years. Organic fertiliser that being used mainly is animal cow manure which price is somewhere around 1.5-5 million TL/ton but it is not available all time. However, farmers in some villages do not like cow manure because there are seeds of weed in cow manure and make problem to their farm. Some farmers said that there is a lot of nitrogen in animal cow manure that makes their fruit trees have many leaves and branches but less fruits. All of farmers in surveyed villages are willing to use compost. However, they always say that they will firstly try to use compost, if getting good result they will use continuously and price is not a problem.

c.1.4 Compost Price

It's quite difficult to obtain the expected price of compost (the farmer's willingness to buy the compost) in the target area. Because farmers in Adana Province have never experienced about compost. Therefore, the study team prepared compost samples as stated earlier for showing farmers in surveyed village. Then, questions regarding expected price of compost are proceeded to farmers in order to obtain their idea how much the price of compost should be. The answer from farmers regarding this subject is shown in the following figure.



Compost Price/Ton (A)	Fine Compost		Coarse Compost	
	No. of Village (B)	(A)x(B) Mil.TL	No. of Village (C)	(A)x(C) Mil.TL
0-1 Mil.TL	-	-	-	-
1,000,001-2 Mil.TL	-	-	5	7.5
2,000,001-3 Mil.TL	-	-	11	27.5
3,000,001-4 Mil.TL	1	3.5	6	21
4,000,001-5 Mil.TL	5	22.5	3	13.5
5,000,001-6 Mil.TL	10	55.5	-	-
6,000,001-7 Mil.TL	4	26.5	-	-
7,000,001-8 Mil.TL	3	22.0	-	-
8,000,001-9 Mil.TL	1	8.5	-	-
9,000,001-10 Mil.TL	1	9.5	-	-
Total	25	148	25	
Average Expected Price		5.9		2.8

Figure 7-26: Answer Regarding Compost Price by Selected Village

From the above figure, the study team considers the expected price of fine compost and coarse compost should be 5.9 million TL/ton and 2.8 million TL/ton, respectively. However, if the farmers notice the compost will actually contribute to improve the crop yield, there is a high possibility to increase the price more.

c.1.5 Application of Compost

MoE has a draft guideline for the use of compost in agriculture as shown in the table below. The use of compost for gardening, sylviculture and landscape architecture is shown in the table far below.

Table 7-24: Use of Compost in Agriculture

Application	Purpose	Necessary Compost Quantity	Application Frequency	Application Modus
Preparation of fields	Improving the soil quality	<15 kg/m^2	Once	Mixing with soil down to a deep level
Humus earth for beet, carrot, potatoes and other field vegetables	Enriching of humus earth	3-5 kg/m^2	Each 2 years	Superficial mixing with soil
Fertiliser for beet, carrot, potato and other field vegetables	Fertiliser	3-6 kg/m^2	Yearly	Superficial mixing with soil
Wheat, yeast, barley, rye	Fertiliser and enriching humus earth	2-4 kg/m^2	Each 2 years	Superficial mixing with soil
Pasture	Enriching humus earth	3-6 kg/m^2	Each 2 years	Superficial spreading over the soil

Source : Draft Technical Report 8-Task 1.b by DHV Consultants BV submitted to Ministry of Environment of Turkey, April 1999.

Table 7-25: Application of Compost in Gardening, Sylviculture and Landscape Architecture

Application	Recommended Compost Quantities (m^3/ha)	Application Frequency
Tree nurseries	10-14	Each 2 years
Fruit trees	10-14	Each 3 years
Landscape architecture, planting on roadsides/kerbsides	500-700	Once
Lawn care	10-14	Once a year
Maintenance of sport areas	25-35	Once a year
Care of flowers and similar plants	15-21	Once a year
Growing of flowers and similar plants	6-8.5	Once a year

Source : Draft Technical Report 8-Task 1.b by DHV Consultants BV submitted to Ministry of Environment of Turkey, April 1999.

Also, Mersin GM has a user guide of compost. The user guide recommends the following doses for use of compost as shown in table below.

Table 7-26: Guideline for Use of Compost Issued by Mersin GM

Place for Use	Dose per 10 Ha (100,000 sq.m.)	Dose if Use Every Year per 1 Dekar (1,000 sq.m.)
Vine Yard	100 ton/2 years	500 kg
Park and Flower Stand	35 ton/2-3 years	100-180 kg
Fruit Orchard	100 ton/2-3 years	300-500 kg
Garden	50-200 ton/2-3 years	200-900 kg
Green Area	35 ton	180 kg
Forest	100-200 ton once	-
Uncultivated Soil	100-500 ton once	-

Source : Feasibility Report on Rehabilitation of Composting Plant and Construction of Sanitary Landfill, December 1991.

From the above tables, it can be said that the amount of compost to be applied in farm is depended on type of crop. MoE recommends the appropriate amount of compost use for field crop is 20-40 ton/ha for each 2 years, 30-60 ton/ha yearly for vegetables garden and 10-14 ton/ha each 3 years for fruit orchard. Meanwhile, Mersin GM recommends amount of compost use about 10 ton/ha each 2 years for vine yard and 10 ton/ha each 2-3 years for fruit orchard but no suggestion for field crop and vegetable garden.

Based on the above, the study team set-up a minimum ratio for compost application in order to estimate demand as follows;

- For field crop farm 20 ton/ha for each 2 year
- For fruit orchard 10 ton/ha for each 3 year
- For vegetable farm 30 ton/ha for yearly

e.1.6 Compost Demand

From the results of questionnaire survey to selected village, the study team found that there are some problems for field crop farmers to apply compost. Even farmers realise that their land are getting worse because of chemical fertiliser and fire after harvesting. However, field crop farmers have quite less or no demand on compost due to the following 4 main problems.

- First problem, average income of field crop farmers is less as clearly shown before in Table 7-22. Application of organic fertiliser will cost about more than 10% up to 80% of total income from field crop farm. Therefore, field crop farmers are mostly not able to afford other fertiliser additional from chemical fertiliser.

- Second problem is size of farm land. Size of field crop farm is normally large. Therefore, spreading organic fertiliser like compost is quite hard work. In case of hiring labour, the cost is too expensive to afford. Labour cost/person/day is about 2-5 million TL which can work only 2-3 dekar of farm land in a day. Therefore, the field crop farmers are not able to hire labour to spread organic fertiliser.

- The third problem is the place to stock compost. According to MoE, the suitable amount of compost to apply for field crop farm is 20-40 ton/ha. Therefore, if a farmer of 5 ha field crop farm wants to apply compost he needs to stock compost about 100-200 ton (200-400 m^3). While if he use chemical fertiliser it will be only 5 ton. Therefore, there is no place to stock compost.
- The last problem is transportation. Transportation cost of compost 100-200 ton is surely very expensive.

Hence, the study team surely believes that there is very few or no demand on compost for field crop farm. On the other hand, demand on compost is incredibly high for farmers of fruit orchard and vegetable garden. Farmers like to apply organic fertiliser for improving/conditioning their land before cultivation time from late autumn to early of winter (October-January). Demand of compost will be seasonally very high in that period. There is demand of compost again in April before cultivation period of green house vegetable and watermelon garden. For the remaining of the year, demand of compost will be low.

Finally, the study team concluded that the potential users of compost in Adana Province are fruit orchard and vegetable garden. Therefore, from Figure 7-24, the amount of compost demand can be estimated as follows;

Demand of compost for fruit orchard = 216,000 (ha) x 10 (ton/ha)/3 (year)
= 720,000 (ton/year)

Demand of compost for vegetable garden = 101,250 (ha) x 30 (ton/ha)/1 (year)
= 3,037,500 (ton/year)

Total demand of compost (ton/year) = 720,000 + 3,037,500
= 3,757,500

Hence, potential demand of compost in Adana Province is 3.7 million ton/year. From this figure, the demand on compost can be estimated seasonal demand as shown in following figure.

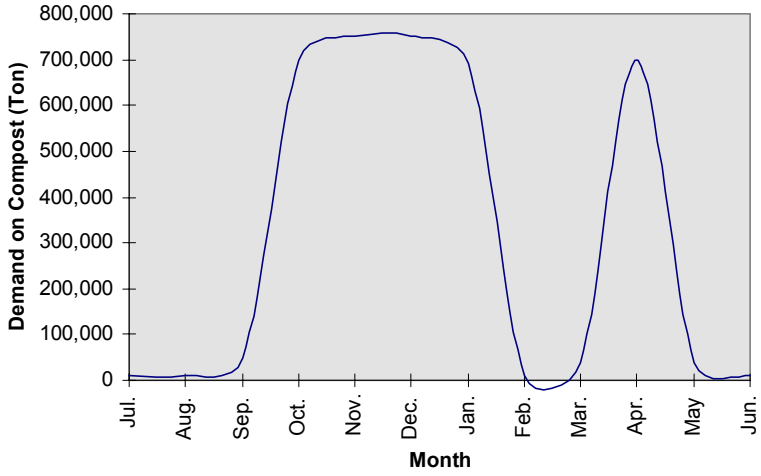
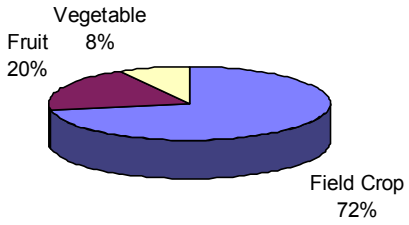


Figure 7-27: Seasonal Demand on Compost in Adana Province

c.2 Icel Province

c.2.1 Agricultural Situation

According to the data from Administration of Agriculture and Village Affairs of Icel Province in 1998, 25% or 406,000 ha from total area (1.6 million ha) of Icel Province is formed of agricultural land. This is divided further into 3 main type of crops as shown in the figure below. The more detail breakdown on agricultural land of Icel Province is tabulated in the table below.



Type of Crop	Farm Area (ha)	Percent
Field Crop	293,523	72
Fruit	79,151	20
Vegetable	33,326	8
Total	406,000	100

Figure 7-28: Agricultural Land by Type of Crop in Icel Province

Table 7-27: Breakdown of Agricultural Land of Icel Province (1998)

Agricultural Land	Area (Ha)
Field Crop	293,523
Garden	42,794
- Citrus (Lemon, Mandarin, Sour Orange Grape Fruit)	24,346
- Other Fruit	18,449
Vine Yard	18,749
Vegetable	33,326
- Green House	25,023
- Open	8,303
Olives	6,079
Others	11,529
Total	406,000

As same as Adana, there are many types of crop in Icel Province from field crop like wheat, and corn, fruit like citrus (lemon, mandarin, sour orange, grape fruit) and grape, vegetables like tomato, pepper and onion. Field crop farm and vine yard mainly

located in mountainous area. While fruit orchard and vegetable garden are planted in the flat area.

c.2.2 Chemical Fertiliser

The outcome of questionnaire survey to selected village in Icel Province is same as Adana in term of chemical fertiliser. Chemical fertiliser is the main fertiliser being used in Icel Province. There are many elements of chemical fertiliser being used mainly in Icel Province such as 15:15:15, 20:20:0, 18:46:0, etc. The price of chemical fertiliser is highly depended on its element which almost varies from 30-70 million TL/ton. The period to use chemical fertiliser is depended on type of crop as shown in the following table.

Table 7-28: Period of Cultivation, Harvesting and Fertiliser Use

Type of Crop	Period		Chemical Fertiliser Use		
	Cultivation	Harvesting	Use per Year	Using Period	Amount
Field Crop					
Wheat	November-December	May-June	2 times	1. October 2. February	1,000 kg/ha 1,000 kg/ha
Corn					
- 1st Crop	April-May	September-October	2 times	1. April 2. June	1,000 kg/ha 1.000 kg/ha
- 2nd Crop	May-June	November-December	2 times	1. May 2. September	1,000 kg/ha 1,000 kg/ha
Fruit					
Grape	January-March	June-July	1 times	November-February	300 kg/ha
Citrus	February-March	October-December	3 times	1. December 2. February-March 3. May-June	500 kg/ha
Vegetable					
Tomato, Pepper, Egg Plant, Onion, etc.	4-6 Times/Year	4-6 Times/Year	7-8 times	Before cultivation and 20 days after harvesting	1,000 kg/ha

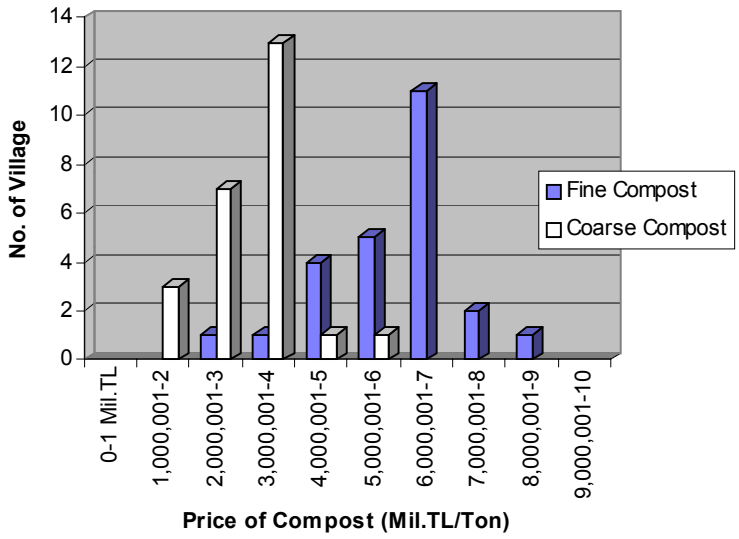
c.2.3 Organic Fertiliser

As same as Adana, field crop farmers do not apply organic fertiliser in their farm. Only farmers of fruit orchard and vegetable garden used organic fertiliser such as animal cow manure, chicken manure or compost to improve their farm land. Price of organic fertiliser mainly cow manure is somewhere around 3-8 million TL/ton. It's highly depended on transportation cost. There are difference ways for application organic fertiliser; mixed into top soil, laid on the surface in a thin layer, placed around the trunk of fruit trees or dilute with water and irrigate to farm land.

c.2.4 Compost Price

It's difficult to obtain the expected price of compost (the farmer's willingness to buy the compost). Due to the impression of farmers to compost from Mersin GM is mostly pessimism. Therefore, the study team improved present compost by sieving in order to show farmers during questionnaire survey. Then, questions regarding expected price of compost are proceeded to find how much the price of compost

should be. The answer from farmers regarding price of compost is shown in the figure below.



Compost Price/Ton (A)	Fine Compost		Coarse Compost	
	No. of Village (B)	(A)x(B) Mil.TL	No. of Village (C)	(A)x(C) Mil.TL
0-1 Mil.TL	-	-	-	-
1,000,001-2 Mil.TL	-	-	3	4.5
2,000,001-3 Mil.TL	1	2.5	7	17.5
3,000,001-4 Mil.TL	1	3.5	13	45.5
4,000,001-5 Mil.TL	4	18.0	1	4.5
5,000,001-6 Mil.TL	5	27.5	1	5.5
6,000,001-7 Mil.TL	11	71.5	-	-
7,000,001-8 Mil.TL	2	15	-	-
8,000,001-9 Mil.TL	1	8.5	-	-
9,000,001-10 Mil.TL	-	0	-	-
Total	25	146.5	25	77.5
Average Expected Price	25	5.9	25	3.1

Figure 7-29: Answer Regarding Compost Price by Selected Village

From the above figure, the study team considers the expected price of fine compost and coarse compost should be 5.9 million TL/ton and 3.1 million TL/ton, respectively. However, if the farmers notice the compost will actually contribute to improve the crop yield, there is a high possibility to increase the price more.

c.2.5 Application of Compost

As described before, MoE and Mersin GM has the guideline for compost application by type of crop. Therefore, the study team applied the same amount of compost application for both Adana Province and Icel Province. It can be summarised as follows;

- For field crop farm 20 ton/ha for each 2 year

- For fruit orchard 10 ton/ha for each 3 year
- For vegetable farm 30 ton/ha for yearly

c.2.6 Compost Demand

As same as conclusion for Adana Province, there is no demand on compost for field crop farm in Icel Province while demand is incredibly high for fruit orchard like citrus, grape and vegetable garden. Compost demand period for the above-mentioned crop is seasonally high before cultivation time from late autumn to early of winter season (October-January). There is compost demand again in April for vegetable garden. Then, for the remaining of the year, demand of compost will be low.

Finally, the study team concluded estimated the potential amount of compost demand in Icel Province as follows;

Demand of compost for fruit orchard	=	79,151 (ha) x 10 (ton/ha)/3 (year)
	=	263,836 (ton/year)
Demand of compost for vegetable garden	=	33,326 (ha) x 30 (ton/ha)
	=	990,780 (ton/year)
Total demand of compost (ton/year)	=	1,263,616

Hence, demand on compost in Icel Province is 1.2 million ton/year.

From this figure, the demand on compost can be estimated seasonal demand as shown in following figure.

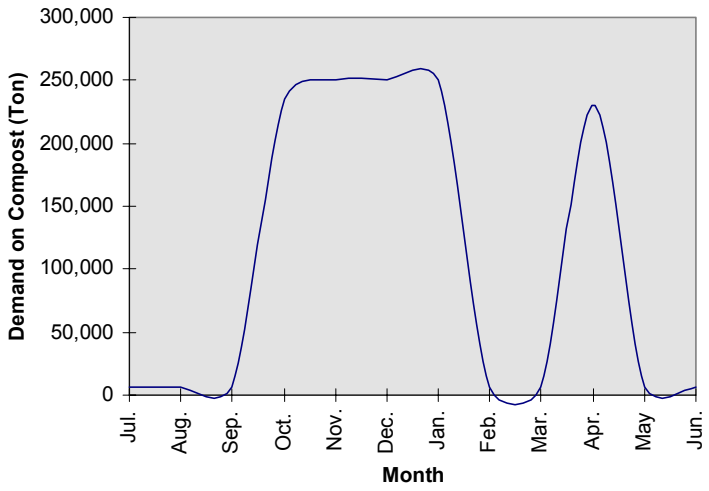


Figure 7-30: Seasonal Demand on Compost in Icel Province

d. Findings

- Income from field crop farm per ha is much less than fruit orchard, vine yard or vegetable garden. The cost to apply compost to field crop farm will be shared from 10-80% from total income. While compost application expense for fruit orchard and vine yard will be only 1-3% from total income.

- There is no demand for field crop farm due to the main reason that income from field crop is not enough to apply compost. On the other hand, it is clearly found that demand of compost is incredible huge amount for fruit orchard, vine yard and vegetable farm. It can be summarised as follows;

Province	Compost Demand (Ton/Year)
Adana	3,757,500
Icel	1,263,616
Total	5,021,116

- Demand of compost is fluctuated according to cultivation period. Demand will be overwhelmingly increased from October-January for fruit orchard, vine yard and green house vegetable. Then, demand of compost will be low and increased again in April for open vegetable farm. Therefore, the production of compost should be considered about stockyard for compost during low demand season.

- Expected price of compost that farmer's willingness to pay in the target area is summarised as follows;

Province	Price of Compost (Mil.TL/Ton)	
	Fine	Coarse
Adana	5.9	2.8
Icel	5.9	3.1
Average	5.9	2.9

- Quality of compost is the prime reason for farmers to apply compost as organic fertiliser to their farmland. If the result of yield crop is clearly improved after using compost from MSW, there is a high possibility to increase price more.

- Almost farmers do not know the ratio amount of compost to be applied in their field and how often it should be. Normally, farmers fill organic fertiliser or compost at the amount by their own ideas.

e. Recommendations

For compost marketing strategy, it is recommended that;

- Quality of compost is the most efficiency tool for marketing. The compost to be produced in M/P must be given high priority to this subject.

- In order to win user's confidence, the sample of compost to be produced in M/P should be analysed by respected institutions such as Cukurova University or a national laboratory. Therefore, the compost should not only meet regulations of MoE but also guarantee by a reliable institution.

- Marketing of compost should consider about packaging system for small users. The compost for packaging system will be compressed and subjected to market in a 50 kg. bag. This recommendation comes from a composting plant in Bangkok, Thailand that the study team observed. The composting plant in Bangkok, which capacity 1,000 ton/day, offers 2 type of compost to market. One is open system and another one, certainly, is packaging system. The

compost in packaging system is compressed like tablet and packed in a 50 kg. bag. By the package, small users of compost are convenience to transport.

- Furthermore, a package of compost should be printed about compost quality which follows regulations of MoE and guarantee by reliable institution as explained earlier.
- The proper ratio of compost to be applied in farm land should be suggested to farmers in order to achieve good results. This suggestion amount should be also printed at the package of compost.
- One of the most effective measure for compost marketing is to apply agent system. The expected qualified candidate is Agricultural Credit Cooperative (ACC) which has already well established in village level in the target area. From the preliminary discussion done by the study team and ACC in Mersin about possibility on this idea, the feed back that the team received was optimism. By applying sale agent system and packaging system, the market of compost can be expanded to neighbouring provinces of the target area.

7.4 Evaluation of the Pilot Project

7.4.1 Sofulu Disposal Site Improvement

The followings are the main findings from the experiment:

- A leachate circulation system as one type of leachate treatment method (without discharging leachate into a public water area) is applicable for the rehabilitation of the dump site.
- Since average annual precipitation (about 650 mm) of the target area is far less than evaporation, it is quite inexpensive method, especially on operation cost. Because it only requires a few electricity for operation of the system.
- The steep slope created by open dumping operation, which is a common view not only of Sofulu but also of many dumpsites in the country, is the main cause of spontaneous fire. It makes covering soil operation on the burning parts extremely difficult. The flattening the slope to extinguish fire is quite dangerous and requires considerable input of heavy equipment, expensive operation.
- The Adana GM acknowledged the sanitary landfill operation should be carried out from bottom of the site and required numbers of heavy machinery.

7.4.2 Separate Collection

a. Waste Collection Shift

At present, both the GSHC and all the district areas in Mersin receive waste collection services for general waste every day. During the pilot project on separate collection, a two shift collection service, one for compostable waste at 7:00 a.m. and the other for non-compostable waste at 9:30 a.m., was carried out. Residents discharged compostable waste into the non-compostable containers after the first shift collection, therefore separate collection, introduced at a city level, should be provided on alternate days, e.g., Monday, Wednesday, Friday, and Sunday for compostable wastes,

and Tuesday, Thursday, and Saturday for non-compostable wastes. Waste collection on alternate days would ensure that the waste is clearly separated, and it would reduce both time and transportation costs.

b. Separate Receptacles

Because most kitchens do not have a separate receptacle for different waste types, there is a need to promote the use of separate receptacles, or waste bins, for compostable and non-compostable wastes.

c. Wastewater Strainer

Residents often discharge kitchen waste into double lined plastic bags to avoid wastewater from leaking. This makes the removal of non-compostable materials at the recovery area very hard and unhygienic. Therefore to reduce wastewater and to eliminate the use of double lined bags, the use of a strainer, or water filter, in the kitchen sink is recommended. Residents should be informed on the use of strainers, that must become part of general life, through a public campaign.

d. Continuous Information

Most of the residents are willing to participate in separate collection. However, because residents are not well informed on how to separate waste, there is a need to constantly provide information to the residents through meetings and assemblies; SWM authorities should constantly monitor the waste separation activities, and select a representative to promote public awareness campaigns.

e. Public Education Programs

The AGM and the MGM, together with the district municipalities and with other relevant organisations and with the residents, should actively carry out campaigns on separate collection, and initiate public education programs to promote co-operation with SWM. SWM authorities and educational establishments must encourage waste separation and recycling programs at schools to widen the application of separate collection.

The pilot project on separate collection revealed the importance of such education programs for the master plan to succeed. Work meetings and assemblies, and solid waste education materials, such as pamphlets and education booklets, and other campaign items, such as visual projections and demonstrations, all proved to be successful during the study. In the future, these and other similar materials, should be used by the waste management authorities to promote separate collection and recycling.

7.4.3 Compost Quality Improvement

a. Fundamental Issues

The pilot project conducted by the JICA study term had two components: separate collection and compost production. The purpose of the latter component was to look at the following issues.

- Improvement of the existing facility.
- Recovery of non-compostable wastes.

- Facilitation of fermentation.
- Management improvement of the compost plant.

It should be noted that the pilot project produced compost from separately collected compostable wastes unlike the existing plant.

The results of the study analysis regarding the improvement of compost quality are described below.

b. Physical Composition Analysis

Table 7-29 presents the result of physical composition analysis.

The findings drawn from the analysis is as follows.

- Fine compost, i.e., underflow material of 25mm sieves, contains more compostable matter than coarse compost, i.e., oversize material.
- Fine compost has more plastics and less ceramic or stone than mature compost before sieved. The contents of other components do not show any change.

These findings of this physical composition analysis suggest that the quality of mature compost can be upgraded by sieving.

Table 7-29: Physical Composition Analysis

Item	Mersin Compost Plant	
	1998*	
	Present Compost	
	Coarse	Fine
Compostable matter	60.2%	87.8%
Paper	1.0%	1.1%
Textile	5.7%	1.3%
Grass and Wood	1.0%	0.6%
Plastic	11.9%	5.8%
Rubber and Leather	0.7%	0.4%
Metal	0.0%	0.0%
Bottle and Glass	0.5%	0.4%
Ceramic and Stone	19.0%	2.6%
Total	100%	100%

Note : Analysis by JICA Study Team in October 1998.

c. Sieve Analysis

The result of the sieve analysis is shown in Table 7-30.

The following was found.

- The particle size of compost produced by the pilot project tends to be smaller than that of compost from the Mersin compost plant.
- As for compost products of the pilot project, with or without manual sorting does not make any difference in particle size distribution.

This sieve analysis implies that the large particles contained in raw material become less by separately collecting compostable materials. Manual sorting will be unnecessary since it does not influence particle size distribution.

Table 7-30: Sieve Analysis

Item	Mersin Compost Plant		Compost Produced from Pilot Project	
	1998*		1999**	
	Coarse	Fine	With Manual Sorting	Without Manual Sorting
			Fine	Fine
over 19 mm sieve	45.3%	15.8%		
% passing 19 mm sieve	20.6%	12.9%		
% passing 11.2 mm sieve			14.2%	9.4%
% passing 8 mm sieve	10.6%	4.7%		
% passing 5 mm sieve			25.2%	18.2%
% passing 2 mm sieve	23.5%	43.7%	44.1%	49.3%
% passing 0.5 mm sieve		22.9%	15.4%	23.0%

Note : *Analysis by JICA Study Team in October 1998.
**Analysis by JICA Study Team for pilot project in August 1999.

d. Chemical Analysis

The result of chemical analysis is presented in Table 7-31.

The following can be pointed out.

- The chemical components of compost produced at the Mersin compost plant and compost produced by the pilot project do not show major difference.
- The C/N ratio, one of the key factors to evaluate compost quality, is in an appropriate range in the both cases, although there is a discrepancy.

It is presumed from this chemical analysis, therefore, that the separate collection of compostable wastes does not give influence on compost quality.

Table 7-31: Chemical Analysis

Item	Mersin Compost Plant		Compost Produced from Pilot Project
	1991*	1998**	1999***
	Present Compost		Without Manual Sorting
	Fine	Fine	Fine
Dry matter, DM (%)	87%	83.8%	---
Carbon (mg/kg DM)		25.1%	26.0%
Nitrogen (mg/kg DM)		1.3%	2.3%
pH	8.6	8.5	7.71
Pb (mg/kg DM)	36	66.6	109.8
Cd (mg/kg DM)	0.6	11.0	52.5
Cr (mg/kg DM)	12 to 16	124.5	11.69
Cu (mg/kg DM)	117 to 251	247.2	9.9
Ni (mg/kg DM)	86	55.0	28.33
Hg (mg/kg DM)	0.1 to 0.2	Trace	Trace
Zn (mg/kg DM)		49.7	208.3

Note : * Chemical analysis carried out by DTI, Denmark for the Feasibility Study on Rehabilitation of Composting Plant and Construction of Sanitary Landfill, Ramboll & Hannemannas, December 1991.
** Analysis by JICA Study Team in October 1998.
*** Analysis by JICA Study Team for pilot project in June 1999