
PART II

***FEASIBILITY STUDY ON THE
PRIORITY PROJECT AT LATTAKIA
AND THE THREE SURROUNDING CITIES***

PART II FEASIBILITY STUDY ON THE PRIORITY PROJECT AT LATTAKIA AND THE THREE SURROUNDING CITIES

1. Outline

The following priority projects were selected in the Master Plan in order to improve solid waste collection, promotion of recycling and improvement of final disposal:

- a. Improvement of solid waste collection and street sweeping, introduction of source separate collection, and procurement of collection and street sweeping equipment
- b. Construction of Lattakia recycle center (rehabilitation of old compost plant and construction of a sorting center)
- c. Rehabilitation of Al-Bassa disposal site and improvement of operation of final disposal
- d. Enhancement of public awareness on solid waste and environment
- e. Establishment of related organization and institutions

2. Framework of the Priority Project

(1) Target Year

According to the Master Plan, Qasia new disposal site is planned to start operation in 2008. Until that time, solid waste shall continue to be disposed at the Al-Bassa disposal site. The Master Plan proposes to implement project in two phases. Therefore, the priority project shall be planned assuming the year 2006, the mid-year of the Master Plan, to be the target year.

(2) Implementation Schedule

It is desirable to implement the priority projects as soon as possible. However, it is necessary to consider the time required to secure the budget and to make the detailed design, procurement and construction schedules. Actual schedule will be set so that the detailed design will take place in the first half of 2002, and procurement and construction will be implemented in the latter half of 2002, 2003 and 2004.

Concerning rehabilitation of Zones, I and II and implementation of disposal until 2003 at Al-Bassa, it will be necessary to lease heavy machinery and start work immediately. Accordingly, Lattakia City will need to secure the necessary budget for renting the equipment, etc.

(3) Organization and Institutions

Solid waste collection and disposal have so far been implemented under the responsibility of each municipality, however, the result of this has been open dumping of waste in each city, generation of environmental pollution around the disposal sites in Lattakia and Jableh, and implementation of no measures to deal with these problems. In future, when introducing sanitary landfilling, a setup that considers inter-municipal disposal will be required. Moreover, there are many other issues that cannot be dealt with on the municipal

level, for example the proper management of medical waste. Therefore, a new inter-municipal organization and institutions shall be set up to coincide with implementation of the priority projects.

(4) Enhancement of Public Awareness

The cooperation of citizens is essential for reducing the volume of waste and introducing separate collection. Accordingly, it is necessary to increase public awareness on solid waste and environment through public information activities and campaigns.

3. Improvement of Solid Waste Collection and Introduction of Separate Collection

3.1 DIRECTION OF IMPROVEMENT

To improve the solid waste collection, collection service shall be expanded to the suburban area and collection ratio of solid waste shall be increased to 85% in year 2006 with renewal and procurement of collection vehicles.

On the other hand, separate collection will be introduced in middle and high income area to construct a society that generates as little environmental pollution as possible, and to promote recycling waste.

Moreover, since it is planned for final disposal to be carried out at Al-Bassa disposal site until 2007, waste collected in each city shall be directly transported to Al-Bassa disposal site.

3.2 TARGETS AND DESIGN CONDITIONS OF WASTE COLLECTION IMPROVEMENT

- a. The target waste collection rate shall be 85% in 2006, and domestic waste, commercial waste (including market waste), park and street waste, non-infectious medical waste and small-scale factory waste shall be collected.
- b. Source separate collection shall be introduced from high and middle-income residential regions. Under this program, the separation shall be done for organic and inorganic waste. It is planned to collect 20 tons/day of inorganic waste in line with the scale of the reusable materials sorting center. Market waste shall be collected as organic waste and treated at composting facilities. In the rest of cities, mixed collection shall be continued as it is currently being done.
- c. The forecast for waste collection amount is as shown in Table 3.2.1. This shows that the amount in 2006 will be 390 tons/day.

Table 3.2.1 Collection Amount Target by Waste Type in 2006

Waste Type	2006 (ton/day)	
	Generation	Collection
Domestic waste	351.2	298.5
Separated organic	-	71.2
Separated in-organic	-	20.1
Mixed	-	207.2
Commercial waste	81.8	69.6
Market waste (organic)	-	25.0
Others (mixed)	-	44.6
Road & park waste	16.1	15.3
Medial waste (non-infectious)	2.8	2.8
Industrial waste (small-scale)	10.4	9.3
Total	462.3	389.5

The collection amount target by each city in 2006 is shown in Table 3.2.2.

Table 3.2.2 Collection Amount Target by City in 2006

Waste Type	(Unit: ton/day)				
	Lattakia	Jableh	Qurdaha	Al-Haffeh	Total
Mixed waste	201.3	45.3	21.3	11.2	279.1
Separated organic waste	74.4	12.2	6.5	3.1	96.2
Separated in-organic waste	14.0	3.4	1.8	0.9	20.1
Total	289.7	60.9	29.6	15.2	395.4

3.3 COLLECTION SYSTEM

As for the collection system of separated organic waste and mixed waste, the current system of using containers and daily collection shall be continued in principle at Lattakia, Jableh and Qurdaha. And at Al-Haffeh collection shall be done by use of plastic bags. In addition, large compactor trucks are currently used for container collection. However, in consideration of existing conditions in the collection region, medium size compactor trucks shall be introduced.

For the collection of separated inorganic waste, plastic bag collection shall be done twice per week because small amounts are generated and there are no storage problems at each household.

3.4 STREET SWEEPING

At Lattakia, Jableh and Qurdaha, street sweeping is mainly being carried out with mechanical equipment, and in future the same sweeping practice shall also be continued. For other streets, manual sweeping in combination with waste collection shall be carried out as it is currently being done. Furthermore, at the smallest city of Al-Haffeh, all street sweeping shall be carried out manually. The total length of streets to be swept is shown in Table 3.4.1.

Table 3.4.1 Road Length for the Road Sweeping

(Unit: km)

Item	Lattakia	Jableh	Qurdaha	Al-Haffeh
Main road	76.7	54.0	NA	NA
Other road	229.1	52.0	NA	NA
Total	305.8	106.0	14.8	NA

3.5 RENEWAL OF EQUIPMENT

Vehicles procured before 1990 shall be renewed in 2006. The equipment required to raise collection rates to 85% and to introduce source separate collection is as indicated in Table 3.5.1. This shows that 63 collection vehicles are required in total. Of these 45 will need to be newly procured. Moreover, eight (8) street sweeping vehicles will be required, of which two (2) will need to be newly purchased.

Table 3.5.1 Equipment for Collection and Road Sweeping in 2006

(Unit: nos)

Item	Lattakia			Jableh			Qurdaha			Al-Haffeh			Total		
	Ex	New	Total	Ex	New	Total	Ex	New	Total	Ex	New	Total	Ex	New	Total
Collection															
Compactor (9 ton)	9	-	9	1	-	1	3	-	3	-	-	-	13	-	13
Compactor (8m ³)	-	15	15	-	7	7	-	-	-	-	-	-	-	22	22
Compactor (4m ³)	-	7	7	-	3	3	-	1	1	-	3	3	-	14	14
Dump truck (6m ³)	1	2	3	-	2	2	-	1	1	-	1	1	1	6	7
Tractor	2	-	2	-	-	-	1	-	1	1	-	1	4	-	4
Shovel loader	-	1	1	-	1	1	-	-	-	-	-	-	-	2	2
Wash container	-	1	1	-	-	-	-	-	-	-	-	-	-	1	1
Sub total	12	26	38	1	13	14	4	2	6	1	4	5	45	63	63
Sweeping															
Mechanical sweeper	3	-	3	1	-	1	1	-	1	-	-	-	5	-	5
Water tank	-	2	2	-	-	-	1	-	1	-	-	-	1	2	3
Sub total	3	2	5	1	-	1	2	-	2	-	-	-	6	2	8

Note: () shows the number of existing equipment which can be used in 2006

3.6 OPERATION AND MAINTENANCE PLAN

Waste collection and street sweeping work shall be implemented as shown in Table 7.2.5 in the Part I.

The numbers of personnel required for waste collection and street sweeping are 719 personnel as shown in Table 3.6.1. At this moment, a total of 818 personnel are engaged in waste collection and street sweeping in the four (4) cities. Except for Lattakia City, the numbers of personnel in the other three (3) cities must be increased. However, in Lattakia it is necessary to decrease the number of people doing manual sweeping in accordance with the upgrading of the equipment as well as for the improvement of cooperation in waste issues by residents. It is also necessary to switch over those surplus people to the waste treatment and disposal divisions, for the purpose of cost reduction in waste disposal.

Table 3.6.1 Required Personnel for Collection and Road Sweeping in 2006

(Unit: person)

Personnel	Lattakia	Jableh	Qurdaha	Al-Haffeh	Total
Collection					
Supervisor	10	4	2	2	18
Driver	42	16	7	6	71
Worker	83	31	14	11	139
Sub total	125	51	23	19	218
Sweeping					
Supervisor	36	1	1	1	
Driver	6 (12)	1	2		
Worker	6 (24)	1	2		
Manual sweeper	374	31	9	6	
Sub total	446	34	14	7	501
Total	571	85	37	26	719

4. Development of Lattakia Recycling Center at Al-Bassa

In accordance with the Master Plan, Al-Bassa recycle center shall be constructed on the site of the old compost plant. Project components of the recycle center are rehabilitation of the old compost plant and construction of a sorting center. The layout of Al-Bassa recycle center is shown in Figure 4.1.1.

4.1 REHABILITATION OF THE OLD COMPOST PLANT

(1) Rehabilitation Policy and Plant Capacity

The old compost plant in Al-Bassa was constructed 20 years ago and the facilities and equipment are deteriorated. Furthermore, the composting system itself was not suited to producing good quality compost. Therefore, the old compost plant shall be rehabilitated on the condition that all equipment will be renewed, and the plant building will be reused as much as possible with partial repairs.

Since old compost plant produced poor quality compost, recovery of farmers trust on compost will be essential. Therefore, the plant capacity shall initially be 25 tons/day in single shift operation, however, it is planned to increase this to 50 tons/day over two-shift operation as soon as the compost quality and demand are confirmed.

(2) Facilities Plan

The contents of facilities preparation concerning rehabilitation of the old compost plant are indicated in Table 4.1.1.

Table 4.1.1 Major Facilities for the Rehabilitation of Existing Compost Plant

Process	Facility/ Equipment	Q'ty	Specification
Reception (Reception bldg.)	Truck scale	1	50 ton, load cell type
	Pre-sorting yard	1	220 m ² , open-air
	Feeding conveyor	1	5 t/h, apron conveyor, 5 m ² hopper
Hand sorting	Hand sorting conveyor	1	5 t/h, belt conveyor, 2.2 kw
	Magnetic separator	1	5 t/h, 1.5 kw
	Sorted waste conveyor	1	5 t/h, belt conveyor, 2.2 kw
Pulverizing	Pulverizer	1	5 t/h, rotary blade type, 110 kw
	Conveyor	1	3.8t/h, belt conveyor: 1.1t/h, belt conveyor
Fermentation/ Maturing	Primary fermentation yard	1	Fermentation period: 2 weeks, Rehabilitation of existing bldg. (1,040m ²)
	Secondary fermentation yard	1	Fermentation period: 6 weeks, Rehabilitation of existing bldg. (1,280m ²)
Refining	Screen	1	1.3 t/h, trammel type, 2.2kw
	Conveyor	1	1.1t/h, belt conveyor: 0.2t/h, belt conveyor
Equipment	Wheel loader	4	1.2m ³ : 3 nos.: 3.1 m ³ : 1nos.
	Dump truck	1	8 ton
Others	Electricity	1	180kVA (Rehabilitation of existing facility)
	Control facilities	1	Control house, fence & gate, etc. (Rehabilitation of existing facility)

The system flow and material balance for composting are indicated in Figure 4.1.2 and Figure 4.1.3 respectively.

(3) Compost Demand and Sale Plan

As a result of the compost demand survey implemented in the Study, it is estimated that demand for compost in and around Lattakia is approximately 52,500 tons/year.

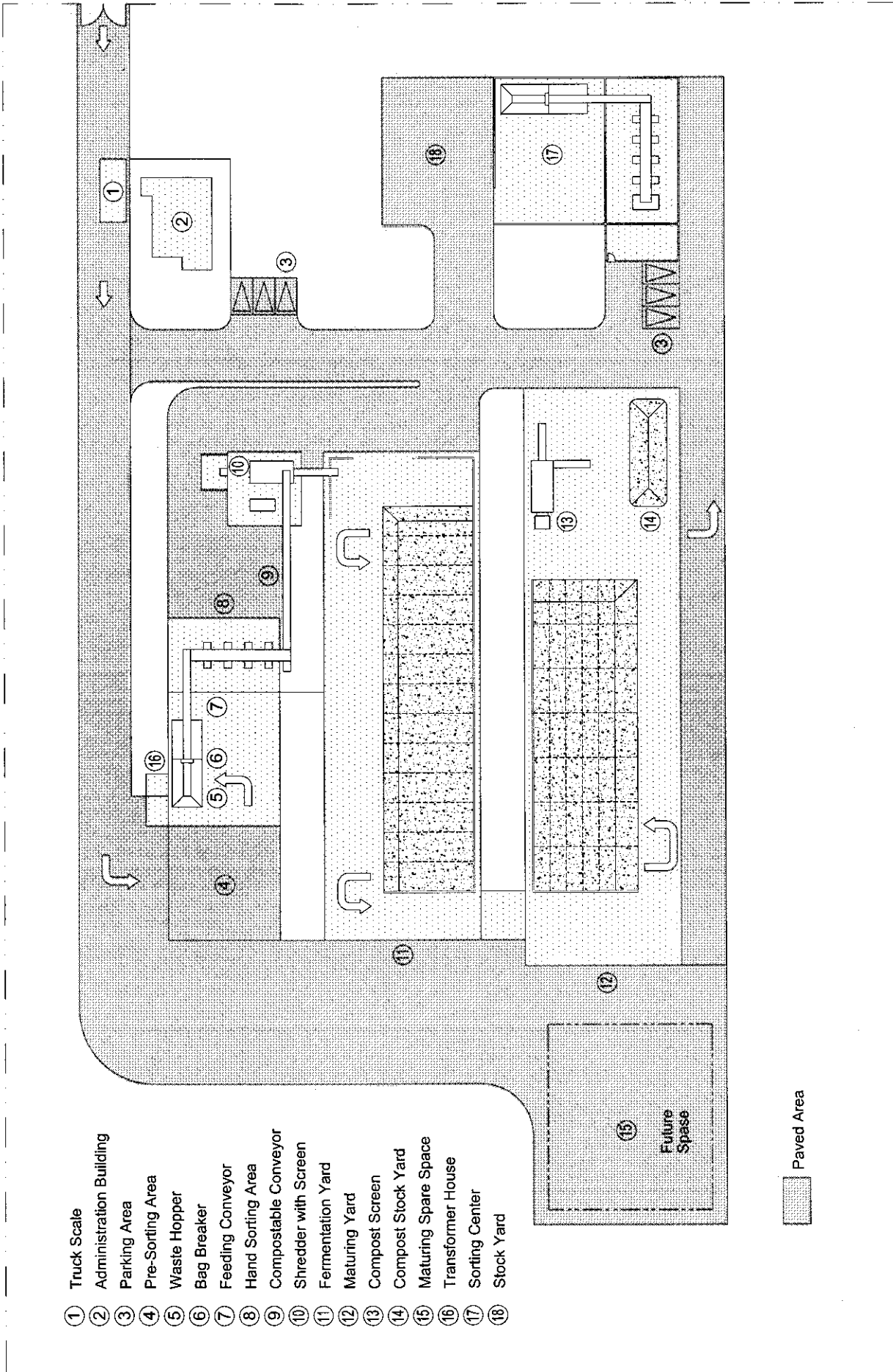
Table 4.1.2 shows the quantities of compost produced and reusable materials recovered at the composting plant together with the sales revenue from each. It is forecast that sales of compost product and recovered reusable materials could generate annual income of approximately SP 3.3 million/year in the case of two-shift operation.

Table 4.1.2 Amount of Compost Product and Sorted Recyclables

Item	1 shift operation (25 ton/day)		2 shift operation (50 ton/day)	
	Amount (ton/year)	Income (SP/year)	Amount (ton/year)	Income (SP/year)
Compost product	1,938	678,000	3,875	1,356,000
Recyclables	403	1,008,000	806	1,922,000
Total	2,341	1,686,000	4,681	3,278,000

(4) Operation and Management Plan

The rehabilitated compost plant will initially be operated by 26 persons when operating under one shift in 2005, however, in 2010 it will be operated by 38 persons when it is switched to two shifts following confirmation of the demand for compost.



- ① Truck Scale
- ② Administration Building
- ③ Parking Area
- ④ Pre-Sorting Area
- ⑤ Waste Hopper
- ⑥ Bag Breaker
- ⑦ Feeding Conveyor
- ⑧ Hand Sorting Area
- ⑨ Compostable Conveyor
- ⑩ Shredder with Screen
- ⑪ Fermentation Yard
- ⑫ Maturing Yard
- ⑬ Compost Screen
- ⑭ Compost Stock Yard
- ⑮ Maturing Spare Space
- ⑯ Transformer House
- ⑰ Sorting Center
- ⑱ Stock Yard

▨ Paved Area

Scale
 0 5 10 15 20 m

Figure 4.1.1 General Plan of Lattakia Recycling Center

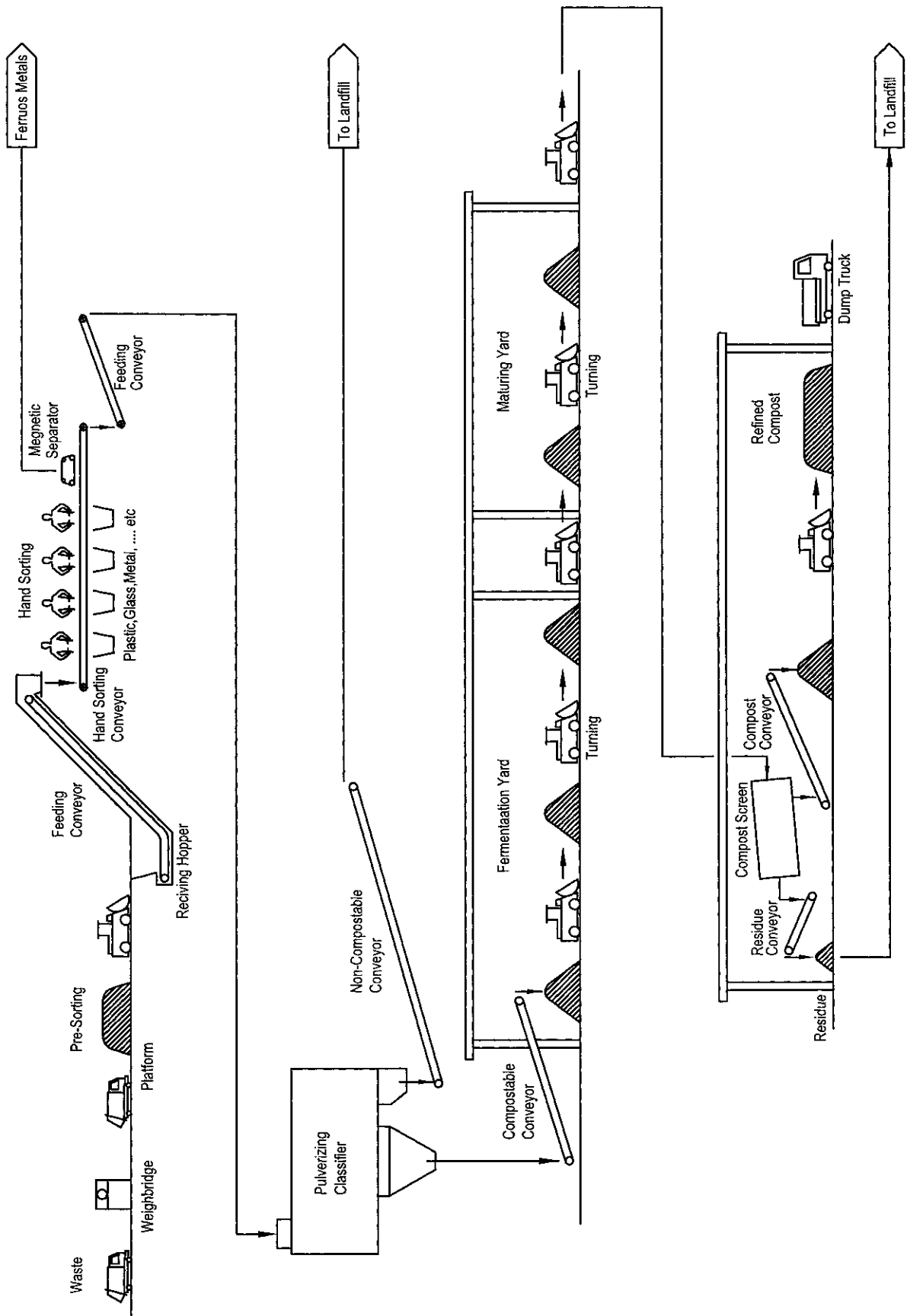
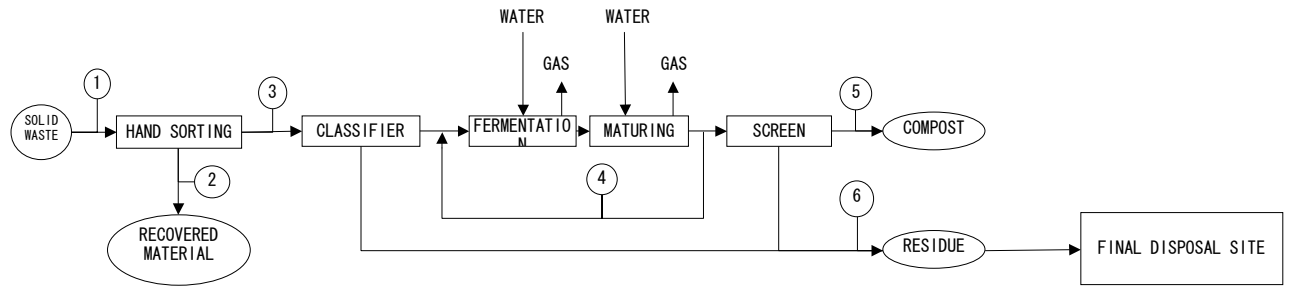


Figure 4.1.2 System Flow of Composting



ITEM	① MSW INPUT	② RECOVERD MATERIAL	③ AFTER HAND SORTING	④ RECYCLE COMPOST	⑤ FINE COMPOST	⑥ TOTAL RESIDUE
QUANTITY (t/d)	50.0	2.5	47.5	8.0	12.5	12.5

① MSW	COMPSITION (%)	WEIGHT (t) (t/d)
Food, Vegetable	83.5	41.8
PAPER	4.7	2.4
PLASTIC	6.2	3.1
METAL	0.8	0.4
GLASS	0.6	0.3
Others	4.4	2.2
TOTAL	100	50

RECOVERED MATERIAL	
MATERIAL	② HAND (t/d) SORTING
PAPER	0.6
PLASTIC	1.6
METAL	0.2
GLASS	0.2
TOTAL	2.5

IN PUT (t/d)		OUT PUT (t/d)	
SOLID WASTE	50.0	CONPOST	12.5
WATER	0.3	RESILDUE	2.5
		RECOVERED MATERIAL	12.5
		GAS, VAPOR	22.8
TOTAL	50.3	TOTAL	50.3

Figure 4.1.3 Material Balance of Composting (2 shift operation, 50 ton/day)

4.2 SORTING CENTER

(1) Introduction

The sorting center, which is scheduled to start operation in 2005, shall recover paper, textiles, plastics, metals and glass. The sorting center shall receive inorganic domestic waste that has been separated at the source, and it shall have a treatment capacity of 20 tons/day.

(2) Planning conditions

Planning conditions of the sorting center are shown in Table 4.2.1.

Table 4.2.1 Planning Condition of Sorting Center in Al-Bassa

No.	Item	Conditions
1.	Location	Adjacent to old compost plant in Al-Bassa
2.	Area	2.2 hectare (including old compost plant)
3.	Service area	Lattakia, Jableh, Qurdaha, and Al-Haffeh city
4.	Year operation started	2005
5.	Type of waste received	Source separated in-organic waste (domestic waste)
6.	Plant capacity (Receiving waste amount)	20 ton/day
7.	Sorting method	Manual sorting
8.	Sorted recyclables	Paper, plastic, textile, metal and glass
9.	Target amount of sorted recyclables	25% of receiving waste (about 5 ton/day)
10.	Estimated amount of residue	75% of received waste (about 15 ton/day)
11.	Handling of sorted recyclables	Sell to middlemen (Sorted recyclables will be collected/transported by them)
12.	Handling of residues	Transported/ disposed by the Recycling Center

(3) Recycling Target

The target for recovery of reusable materials at the sorting center (recycle target) shall be 25% of incoming waste.

Table 4.2.2 shows the quantity and sales revenue of reusable materials that are recovered at the sorting center, judging from the makeup of inorganic domestic waste. It is estimated that revenue of approximately SP 3.0 million/year can be obtained from the sale of recovered reusable materials.

Table 4.2.2 Recyclable Amount Collected at Sorting Center

	Composition/ in-organic waste *1) (%)	Received waste amount (ton/day)	Collected recyclables (ton/day)	Collected recyclables *2) (ton/year)	Unit price (SP/ton)	Income (SP/year)
Food, Vegetable	32.9	6.6	--	--	--	--
Paper	20.6	4.1	2.0	620	1,500	930,000
Plastic	19.1	3.8	1.9	589	3,000	1,767,000
Textile	4.5	0.9	0.4	124	1,000	124,000
Metal	3.4	0.7	0.4	124	1,000	124,000
Glass	2.7	0.5	0.3	93	1,500	139,500
Others	16.8	3.4	--	--	--	--
Total	100.0	20.0	5.0	1,550		3,084,500

Note: *1) shows the waste composition of source separated in-organic waste (based on the result of source separation campaign carried out by the JICA Study Team) *2) Annual operation day is 310 days/year

(4) Facilities Construction Plan

Processes at the sorting center are broadly divided into receiving and feeding, sorting, storage, and operation. Major facilities and equipment required for each process in construction of the sorting center are as indicated in Table 4.2.3.

Table 4.2.3 Major Facilities of Sorting Center

Process	Facility/ Equipment	Q'ty	Specification/ Dimension
Receiving & Supply	Truck scale ^{*)}	1	50 ton, load-cell type
	Stockyard: Receiving waste	1	50 m ²
	Receiving hopper	1	5 m ³ , steel structure
	Feeding conveyor	1	5 ton/h, 0.75m wide, apron conveyor
Sorting	Hand-sorting conveyor	1	5 ton/h, 0.75m wide, belt conveyor
	Container/ handcart	15	1.0-1.5 m ³ with caster
Storing	Stockyard: Recyclables	5	130 m ²
	Stockyard: Residue	1	40 m ²
Equipment	Wheel loader	1	120 HP, Bucket: 1.5m ³
	Dump truck ^{*)}	1	8 ton
Others	Sorting building	1	200m ²
	Receiving building	1	300m ²
	Control house	1	50m ²

Note: ^{*)} will be implemented by the compost plant (joint operation)

(5) Operation and Maintenance Plan

The number of personnel required for operating the sorting center including those shared with the compost plant is 19.

5. Rehabilitation and Operation Improvement of Al-Bassa Disposal Site

5.1 REHABILITATION POLICY

Rehabilitation at Al-Bassa disposal site shall be carried out over the following two stages:

Zones, I and II: Implementation under the municipal budget

Zone III: Implementation as part of the priority project (construction of managed disposal site)

The commissioning periods and disposal quantities of each zone are as indicated below.

Table 5.1.1 Waste Disposal Amount in Al-Bassa

Zone	Operation period	Existing waste (m ³)	Daily incoming waste (m ³)	Total (m ³)
Zone I & II	2001 – 2003	86,100	345,000	431,100
Zone III	2004 – 2007	72,800	686,400	759,200

5.2 FACILITY PLAN

(1) Zones I and II

The main facilities required for development of Zones I and II at Al-Bassa disposal site are as follows.

Table 5.2.1 Major Facilities in Al-Bassa Disposal Site (Zone I & II)

Major facilities	Specification	Quantity
Disposal area	Are including surrounding embankment	112,400m ²
Leachate collection facility	Perforated RC pipe, diameter: 300mm	1,000m
Gas removal facility	Length: 4.5m	12 nos.
Operation road	Width: 5m, gravel road	1,500m
Enclosing fence	Net fence, height: 2m	1,600m

(2) Zone II

The main facilities required for development of Zone II at Al-Bassa disposal site are as follows.

Table 5.2.2 Major Facilities in Al-Bassa Disposal Site (Zone III)

Major facilities	Specification	Quantity
1. Area for re-arrangement of existing accumulated waste		
Disposal area	Are including surrounding embankment Cover soil, thickness: 50cm	30,400m ²
Gas removal facility	Length: 4.0m	8 nos.
2. Area for construction of medium-term disposal site		
Capacity		700,000m ³
Liner	Clay laying, thickness: 60cm	165,800m ²
Leachate collection facility	Perforated RC pipe, diameter: 300mm	1,000m
Leachate control reservoir	Leachate re-circulation system: 1,250m ³	1 nos.
Rainwater collection facility		2,400m
Gas removal facility		45 nos.
Access road	Width: 7m, asphalt pavement	1,200m
Operation road	Width: 7m, gravel pavement	500m
Control building		50m ²
Enclosing fence	Net fence, height: 2m	2,100m

5.3 OPERATION AND MAINTENANCE PLAN

Equipment required for implementing landfilling at Al-Bassa disposal site is as follows.

Table 5.3.1 Number of Required Equipment

Equipment	Specification	Quantity
Bulldozer	200HP	1
Excavator	Bucket: 0.7m ³	1
Dump truck	10 ton	1

The number of personnel required to carry out operation and management of Al-Bassa disposal site will be six (6) in Zones I and II and 15 in Zone III. Moreover, monitoring of groundwater shall be implemented by using the monitoring well that was installed during the Pilot Study.

5.4 OPERATION IMPROVEMENT OF DISPOSAL SITE

Landfilling disposal shall be carried out using the push-up/cell method that was used during the Pilot Study. Earth covering shall be implemented without fail and the thickness of earth covering shall be 20-30 cm for covering performed on the same day and intermediate covering, and around 50 cm for final covering.

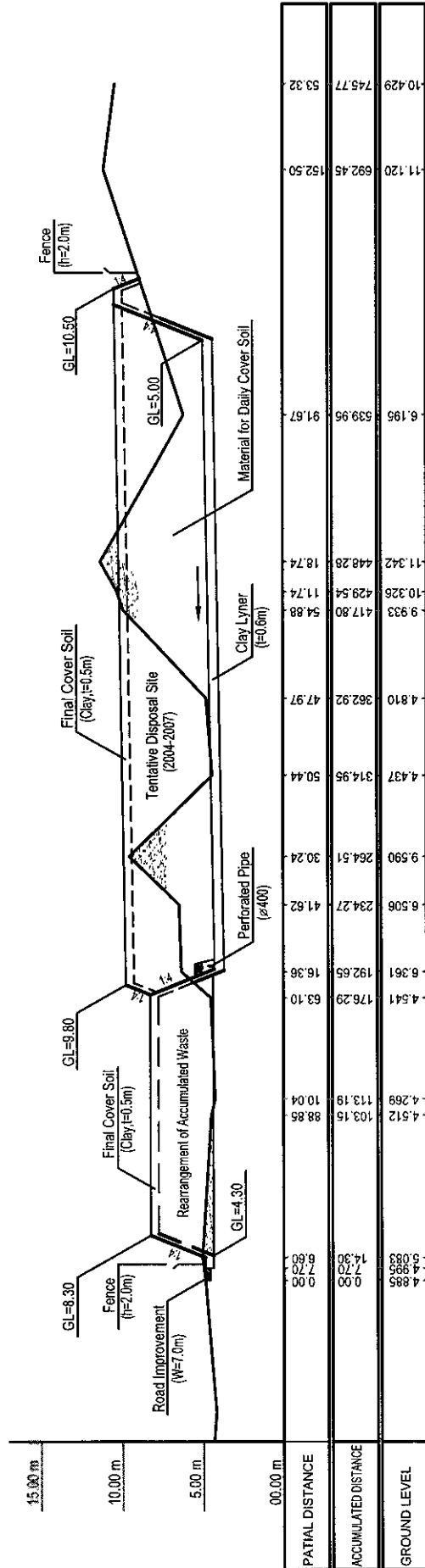
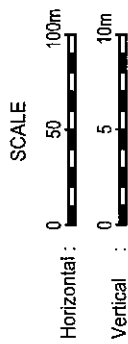
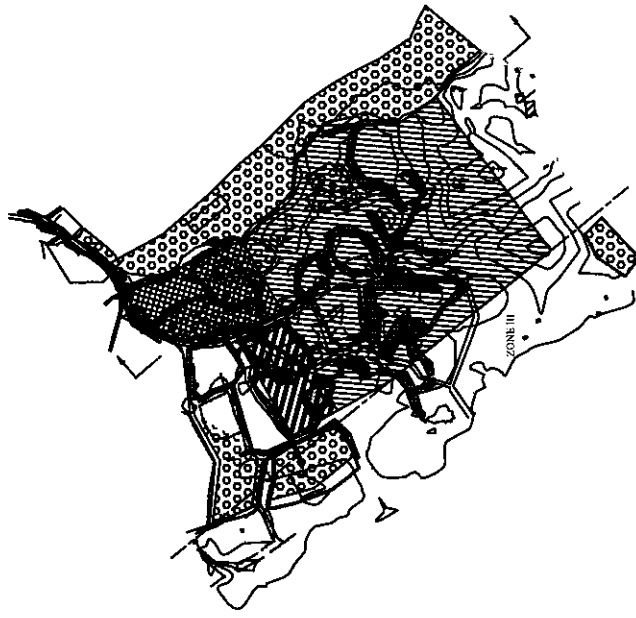


Figure 5.4.1 Rehabilitation Plan of Al-Bassa Disposal Site Zone III

6. Enhancement of Public Awareness

6.1 OUTLINE

It is planned to introduce separate collection to promote recycling and to produce better quality of compost. Therefore, it is necessary to obtain public cooperation on proper solid waste discharge and source separation. To enhance public awareness on solid waste management, a section for public awareness shall be established and various campaigns shall be conducted.

6.2 ORGANIZATION ARRANGEMENT

Lattakia and the three surrounding cities shall set-up a public awareness section as shown Table 6.2.1. The public awareness section will be responsible on enhancement of public awareness on solid waste management through publicity of problems and future direction, and coordination of various campaigns. It is necessary to provide internal training for all staffs on public awareness through seminars and training.

Table 6.2.1 Public Awareness Section

City	New Section	Position	Persons	Establishment Year
Lattakia	Public Awareness Section	Cleansing Department	3	2002
Jableh	Public Awareness Section	Cleansing Department	1	2002
Al-Haffeh	Public Awareness Section	Cleansing Department	1	2002
Qurdaha	Public Awareness Section	Cleansing Department	1	2002

6.3 CAMPAIGNS

(1) Campaign Activities and Timings

Yearly campaign and specific campaigns shall be conducted in parallel with the schedule of projects as shown in Table 6.3.1. The campaigns shall be taken community participatory approach.

Table 6.3.1 Topics in Priority Projects and Campaign Timings in F/S

Topics	2001	2002	2003	2004	2005	2006
1 Improvement of Collection/Vehicles			New Vehicles Phase I	New Collection System		
2 Separate Collection				Preparation		
3 Improvement <i>Al-Bassa</i> Disposal Site			Rehabilitation			
4 Recycle Center at <i>Al-Bassa</i>			Compost/Sorting			
5 New Disposal Site in <i>Qasia</i>						Construction
6 Transfer Station						Construction
Public Awareness Section		Introduction				
Timing of the Campaigns	△	▲	▲	▲	▲	▲

: Preparation, Procurement, Rehabilitation & Construction : Implementation △: JICA's Campaign ▲: Campaigns

(2) Specific Campaigns

Specific campaigns on the events of SWM shall be implemented through the mass media and other media. Demonstration of new equipment and facilities shall be included in this campaign. Contents and timing of specific campaigns are shown in Table 6.3.2.

In 2004, preparation of source separation starts in the study area. The campaign shall implement at the same time including a guidance of proper discharge and separation, supervision and guidance of discharge manner, public opinion survey. As well, women's cooperation is extremely required for the campaigns.

(3) Regular Campaigns and Activities

Yearly comings shall be conducted to explain present problems and future plan of solid waste management. Also, Cleansing Day and Cleansing Week shall be set and conduct cleansing activity in communities and schools including environmental education on that day and week.

Table 6.3.2 Specific Campaigns and Regular Activities

Year	Specific Campaigns	Yearly Campaigns and Regular Activities
2002	<ul style="list-style-type: none"> Publicity Campaign for Opening the Public Awareness Section (1 day) 	<ul style="list-style-type: none"> Yearly Campaign during Al Mahabba Festival at the Sport Center in Lattakia (10 days) The Cleansing Day (1 day) The Cleansing Week (2 times) (1 week)
2003	<ul style="list-style-type: none"> Publicity Campaign on New Collection Systems and Vehicles (3 days) Publicity Campaign on Rehabilitation of the related Facilities in <i>Al-Bassa</i> (3 days) 	<ul style="list-style-type: none"> Yearly Campaign during Al Mahabba Festival at the Sport Center in Lattakia (10 days) The Cleansing Day (1 day) The Cleansing Week (2 times) (1 week)
2004	<ul style="list-style-type: none"> Demonstration Campaign on New Collection System (1 week) Campaign for Waste Separation at the Source (More than one month) 	<ul style="list-style-type: none"> Yearly Campaign during Al Mahabba Festival at the Sport Center in Lattakia (10 days) The Cleansing Day (1 day) The Cleansing Week (2 times) (1 week)
2005	<ul style="list-style-type: none"> Demonstration Campaign on Operation of the Related Facilities in <i>Al-Bassa</i> (1 week) 	<ul style="list-style-type: none"> Yearly Campaign during Al Mahabba Festival at the Sport Center in Lattakia (10 days) The Cleansing Day (1 day) The Cleansing Week (2 times) (1 week)
2006	<ul style="list-style-type: none"> Publicity Campaign on Construction of the New Facilities in <i>Qasia</i> (3 days) 	<ul style="list-style-type: none"> Yearly Campaign during Al Mahabba Festival at the Sport Center in Lattakia (10 days) The Cleansing Day (1 day) The Cleansing Week (2 times) (1 week)

Note: Numerical values in the parenthesis stand for the expected day(s), Week or Month

6.4 OTHER ACTIVITIES

It will be necessary to organize scavengers and discipline on safety works considering better cooperation between scavengers and local government.

7. Institutional Development for Intermunicipal Disposal

7.1 CLEANSING ORGANIZATION IN EACH CITY

In line with the procurement of collection equipment for carrying out waste collection and improvement of street sweeping, it is necessary to prepare the cleaning organization in each city. The required personnel in each city in 2006 are as shown in Table 7.1.1. Since the project aims to improve the efficiency of primary collection and other work based on procurement of collection equipment and cooperation from citizens, it is planned for personnel to be decreased in Lattakia. Accordingly, it is necessary to actively promote reassignment of personnel to treatment and disposal work.

Table 7.1.1 Required Personnel on SWM in 2006

Item	Lattakia	Jableh	Qurdaha	Al-Haffeh	Total
Manager	1	1	1	1	4
Administration	3	1	1	1	6
Collection	132	50	19	19	220
Road sweeping	426	40	17	7	490
Others ^{*)}	59	1	1	1	62
Total	621	93	39	29	782
Current personnel	723	77	32	18	838

Note: *) Others consist of road occupancy, construction debris handling and public relation.

7.2 ARRANGEMENT OF THE TREATMENT AND DISPOSAL SETUP

Al Bassa recycling center and disposal site shall be developed and will receive waste transported from Lattakia and the three surrounding cities. Therefore, it is necessary to establish an operation and management organization for these facilities to cope with intermunicipal disposal. Required personnel in the operating setup are as indicated in Table 7.2.1.

Table 7.2.1 Required Personnel in Al-Bassa Recycling Center & Disposal Site

Item	Compost plant	Sorting center	Disposal site	Total
Person	26 (12)	17 ^{*)}	15	58 (12)

Note: *) Manager and engineer are not included because they will jointly work at Recycling center

() shows the additional person in case the plant operate by two shifts

The new organization shall initially be established under the supervision of Lattakia Municipal Government. Moreover, as is described in the Master Plan, when introducing medical waste collection and constructing the new disposal site, this organization will need to be regarded as part of Lattakia Governorate.

8. Cost of Priority Project

8.1 INVESTMENT COST

The estimated investment cost of the priority project is shown in Table 8.1.1. Total investment cost of priority project will be 551.9 million SP.

Table 8.1.1 Investment Cost of the Priority Project

Item		(Unit: Thousand SP) Investment cost
1. Collection & Road Sweeping	Collection equipment	155,557
2. Recycling Center	Compost plant	199,000
	Sorting center	33,260
3. Al-Bassa Disposal Site	Zone I & II	730
	Zone III	88,480
	Disposal equipment	29,840
4. Public Awareness		8,965
5. Organization set-up		-
Sub-total		515,832
6. Engineering service		36,108
Total		551,940

8.2 OPERATION AND MAINTENANCE COST

Operation and maintenance cost of the priority project is shown in Table 8.2.1. As shown in the table, total operation and maintenance cost in year 2006 will be approx. SP 100million.

Table 8.2.1 Operation and Maintenance Cost for the Priority Project in 2006

Item		(Unit: Thousand SP/year) O/M cost
1. Collection & Road Sweeping	Collection equipment	88,172
2. Recycling Center	Compost plant	3,553
	Sorting center	2,995
3. Al-Bassa Disposal Site	Landfill operation	8,966
4. Others		1,097
Sub-total		104,743
5. Income for selling	Compost	678
	Recyclables	4,093
Total		99,972

Note: Depreciation is not included

9. Financial Plan

9.1 INVESTMENT PLAN

(1) Annual Investment

Investment cost of the priority projects according to the implementation schedule is as indicated in Table 9.1.1. The project cost will be SP 551.9 million.

(2) Sources of Finance

Sources of finance for the project are not as yet decided. Since Lattakia and the three surrounding cities do not possess funds and it will be necessary to revise the law and implement large-scale increases in cleansing fees in order to repay investment costs, funds other than those from the municipality own budget will be required for implementation.

Furthermore, to ensure continuation of the solid waste management, it will be necessary to secure final disposal sites into the future. Therefore, as is indicated in the Master Plan, it is necessary for Qasia disposal site to be constructed in 2008. Concerning investment for Qasia disposal site and costs of renewing waste collection facilities and equipment in future, it will be necessary for cities to cover these expenses via their own funds or loans.

Table 9.1.1 Financial Plan

	(1) Investment and O/M Cost																				
	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017	2,018	2,019	2,020	
1. Construction																					
Disposal site	0	730	81,505	36,815		76,490	77,370						29,840			76,490	77,370				456,610
Transfer station						23,360	72,060										49,700				144,120
Compost plant			116,500	82,500	0	0								21,776					141,912		362,868
Sortin center			14,000	19,260										5,260					15,850		54,370
Collection			155,557									49,096	155,557				110,888				581,966
Medical																					0
Public Awareness	1,494		1,868	2,241	1,868	1,494															8,965
Engineering	156	26,364	9,857	131	7,094	18,353															61,955
Sub total	0	2,380	395,794	150,673	1,999	108,438	278,671	0	0	0	0	49,096	185,397	27,036	0	76,490	236,958	0	157,762	0	1,670,684
2. Operation																					
Disposal site	8,195	16,390	16,390	8,310	8,946	8,966	8,996	12,620	12,640	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	238,843
Transfer station								7,987	7,987	7,987	7,987	7,987	7,987	7,987	7,987	7,987	7,987	7,987	7,987	7,987	96,031
Compost plant					3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	80,416
Sortin center					2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	2,955	47,280
Collection	110,981	110,981	88,172	88,172	88,172	88,172	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	1,754,290
Medical																					0
Others	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	1,097	20,843
Sub total	119,176	129,468	106,659	97,579	104,723	104,743	100,861	111,872	113,856	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	2,237,703
Total	119,176	130,848	501,453	248,252	106,722	213,181	379,532	111,872	113,856	113,706	113,706	162,802	299,103	140,742	113,706	190,196	350,664	113,706	271,468	113,706	3,908,397

	(2) Cash Flow																					
	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017	2,018	2,019	2,020		
Revenue																						
1. Remaining																						
Fee from FH	7,600	14,205	14,587	36,095	37,066	38,063	143,631	147,495	151,462	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	2,301,106	
Fee from commercial	30,000	36,426	36,426	36,426	36,426	36,426	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	1,324,654	
Sub sidy	89,461	77,837	72,800	36,400	36,400	36,400															349,298	
Sales of compost					4,093	4,093	678	678	678	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	1,356	18,984	
Sales of reusable					4,093	4,093	4,093	4,093	4,093	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	5,007	76,456	
Sub total	127,061	129,468	129,813	108,921	114,663	115,660	227,868	231,732	237,291	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	241,366	4,070,498	
Grant (100%)	0	2,380	395,794	150,673																	548,847	
Loan (70%)					1,399	75,907	195,070	0	0	0	34,367	129,778	18,925	0	53,543	165,871	0	110,433	0	785,293		
Sub total	127,061	130,847	519,607	259,594	116,062	181,567	422,938	231,732	237,291	241,366	241,366	275,733	371,144	260,291	241,366	294,909	407,236	241,366	351,789	241,366	5,404,638	
2. Expense																						
Capital invest	7,885	2,380	395,794	150,673	1,999	108,438	278,671														0	
Operation	119,176	129,468	106,659	97,579	104,723	104,743	100,861	111,872	113,856	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	113,706	1,678,579	
Loan repayment																						0
Loan interest(8%)																						0
Sub total	127,061	130,848	501,453	248,252	106,722	213,433	393,436	160,270	160,075	157,746	155,537	202,484	342,792	205,337	178,215	250,922	409,806	179,743	334,285	193,161	4,651,827	
Balance	0	-0	18,154	11,342	9,340	-21,866	29,502	71,462	77,216	83,620	85,799	73,249	28,352	54,954	63,150	43,987	-2,568	61,623	17,514	48,184	753,011	
Accumulation	0	-0	18,153	29,495	38,836	16,969	46,471	117,933	195,149	278,769	364,568	437,817	466,168	521,122	584,272	629,259	625,690	687,313	704,867	753,011		
Remaining loan	0	0	0	0	1,399	77,166	264,505	237,267	210,030	182,792	155,555	162,684	261,788	237,061	191,517	199,655	322,357	282,109	352,284	301,002		
Total debt	0	-0	18,153	29,495	37,436	-60,187	-218,034	-119,335	-14,881	95,977	209,013	275,132	204,380	284,061	392,755	429,604	303,333	406,204	352,533	452,008		
Debt ratio	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	6.1%	20.9%	19.5%	18.2%	17.3%	16.4%	18.1%	26.8%	26.7%	25.2%	24.5%	27.4%	26.0%	26.0%	32.9%	

9.2 REVENUE AND EXPENDITURE OF SWM

(1) Cleansing Fees and Revenue

Waste treatment costs excluding depreciation expenses will be SP 100.0 million/year in 2006, that is almost same as present expenditure on solid waste management. Therefore, the operation and maintenance cost in 2006 could be covered through present revenue from cleansing fees and subsidies from the general budget of municipal government.

As, it is necessary to prepare own fund for future investment and repayment, improvement of fee collection rate and revise of cleansing charge shall be realized as mentioned in the master plan. The target revenue and fee collection rate of cleansing charge will be SP 74.5 million and 80 %.

The schedule of revision is as follows:

- Improvement of fee collection rate in year 2002 and target revenue will be SP 51 million
- First revision of cleansing charge to SP 500/year in 2004 and target revenue will be SP 74.5 million
- Second revision of cleansing charge to SP 1,500/year in 2007 or later and revenue will be SP 222 million

(2) Expenditure

When above revenue from cleansing charge will be secured, it will be necessary for each city to outlay costs equivalent to existing subsidy up to 2004 in order to cover the operation and maintenance cost. If second revision will be realized in 2007, it will be necessary for each city to outlay costs equivalent to roughly half of existing subsidies (SP 36.4 million) during 2004~2006. If second revision will be delay, each city shall outlay costs equivalent to existing subsidies until realization of second revision. After second revision, no subsidy will be required.

(3) Cash Flow

The cash flow in the case that the second revision will be done in 2007 is as shown in Table 9.1.1. Concerning investment from 2006 onwards, this will need to be implemented with ample consideration given to raising cleansing fees even further.

10. Evaluation of the F/S Projects

10.1 TECHNICAL EVALUATION

(1) Improvement of Collection and Street Sweeping

The priority project aims increase collection ratio 85% in 2006 from 72% at present.

When introducing new collection equipment, vehicles shall basically consist of medium size compactors rather than the present large size vehicles considering topographical conditions in the collection districts. Existing collection systems shall be respected so that

container collection as a rule is carried out in Lattakia, Jableh and Qurdaha and collection in plastic bags is carried out in Al-Haffeh. It is judged that implementation of these measures will enable the collection target to be achieved and is comfortably feasible in technical terms.

(2) Introduction of Source Separate Collection

The source separate collection is planned to introduce into middle and high income area and a ratio of generated domestic waste shall be 26% in 2006 (approximately 10,000 households). Source separate collection was carried out in the Pilot Study, and active participation of citizens was obtained at this time. Therefore, it is judged that source separate collection is very possible if carried out in tandem with PR campaigns.

(3) Construction of Al Bassa Recycle Center (Rehabilitation of the Old Compost Plant and Construction of a Sorting Center)

a. Rehabilitation of the Old Compost Plant

In carrying out rehabilitation of the old compost plant at Al-Bassa, all equipment shall be renewed but the existing buildings shall be repaired and utilized as much as possible.

The operation of the compost plant will be initially conducted over one shift (25 tons/day) and later being increased to two shifts (50 tons/day) when the quality and demand for compost have been confirmed. Therefore the produced compost could be sold and this facility is thought to be comfortably feasible.

b. Construction of the Sorting Center

The sorting center will recover paper, fibers, plastics, metals and glass and will have a capacity of 20 tons/day.

Considering that this facility will target inorganic waste that is separated at the source and will adopt simple but sure manual screening in the reusable materials recovery process, this facility is judged to be very feasible in technical terms.

(4) Rehabilitation and Improvement of Operation of Al-Bassa Disposal Site

Rehabilitation of Al-Bassa disposal site shall be implemented over two phases, i.e. Zone I and II in the first phase, and Zone III in the second phase. All work components are an extension of the technology that was implemented in the Pilot Study, and in Zone III, water barrier works, leachate treatment site and storm water drainage facilities are added to these. As for the landfilling method, the push-up/cell system and earth covering method implemented in the Pilot Study shall be introduced. Therefore, the rehabilitation and improved operation of Al-Bassa disposal site is judged to be technically viable.

10.2 ECONOMIC AND FINANCIAL EVALUATION

10.2.1 Economic Evaluation

In the economic assessment, the same method used and described in section 10.2 of Part I is applied. Moreover, since a feature of the solid waste management is that final disposal sites need to be secured, assessment is conducted assuming that Qasia final disposal site is constructed as indicated in the Master Plan. However, construction of the planned compost plant and sorting center at Qasia is excluded in the analysis.

(1) Quantifiable evaluation

Out of the above, quantifiable benefits are as follows: 1) benefits resulting from removal of solid waste, 2) benefits of compost production, and 3) benefits of reusable materials recovery. The economic value of these benefits is as follows.

- a. Concerning the solid waste elimination effect, the amount beneficiaries are willing to pay shall be the benefit. Taking this willingness to pay, the number of households and waste collection rate into account, the estimated benefit will be SP 196.2 million in 2006. Incidentally, this amount beneficiaries are willing to pay roughly works out at 1% of income and is a fair level.
- b. Effect of compost production
The project intends to introduce a 50-tons/day compost plant, and this will initially handle 25 tons/day of waste and produce 6.25 tons/day of compost up to 2010. From 2010 onwards, it is planned for the plant to handle 50 tons/day of waste and produce 12.5 tons/day of compost. It is estimated that benefit of the compost will be SP 5.0 million in 2005 and SP 10.0 million in 2010 separately.
- c. Reusable materials recovery effect
In the project, it is planned to recover 1.25 tons/day of reusable materials at the compost plant for the foreseeable future and 2.5 tons/day in 2010. Moreover, at the sorting center, it is planned to recover five 5 tons/day of reusable materials. It is estimated that this benefit will be SP 4.1 million in 2005 and SP 5.0 million in 2010.

Calculating from the above estimates of cost and benefit, the economic internal rate of return works out as 9.2% as indicated in Table 10.2.1.

(2) Qualitative evaluation

- Rehabilitation and covering soil will improve environmental condition of existing disposal site and reduce air pollution, odor and waste scattering.
- Disposal amount will be decreased through composting and recycling in total 42.5 ton/day and global warmig gases will be decreased.
- The quality of agriculture production will be improved through us age of compost.
- Introduction of separate collection and promotion of recycling will contribute to increase public awareness on solid waste and residents cooperation will be increased.

(3) Conclusion

The economic internal rate of return of the priority project will be 9.2% and higher than the master plan. In addition to the above quantifiable effects, when non- quantifiable effects such as reduction of final disposal quantities (37.5 tons/day in compost treatment, 5 tons/day at sorting facilities), environmental improvement at Al-Bassa disposal site, and promotion of tourism resulting thereof are taken into account, it is possible to view the project as a viable undertaking.

Table 10.2.1 FIRR for the Priority Project

(Unit: SP million)

Year	Balance	Coat			Benefit			
		Total	Invest	Operation	Total	Willingness	Compost	Reusable
2001	0.0	0.0	0.0		0.0			
2002	-2.4	2.4	2.4		0.0			
2003	-320.4	501.6	395.9	105.7	181.2	181.2		
2004	-62.3	248.3	150.7	97.6	186.0	186.0		
2005	88.7	111.4	6.7	104.7	200.1	191.0	5.0	4.1
2006	-7.9	213.2	108.5	104.7	205.3	196.2	5.0	4.1
2007	-169.2	379.7	278.8	100.9	210.5	201.4	5.0	4.1
2008	104.1	111.9	0.0	111.9	216.0	206.9	5.0	4.1
2009	107.6	113.9	0.0	113.9	221.5	212.4	5.0	4.1
2010	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2011	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2012	70.3	162.8	49.1	113.7	233.1	218.1	10.0	5.0
2013	-73.2	306.3	192.6	113.7	233.1	218.1	10.0	5.0
2014	92.3	140.8	27.1	113.7	233.1	218.1	10.0	5.0
2015	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2016	42.9	190.2	76.5	113.7	233.1	218.1	10.0	5.0
2017	-117.6	350.7	237.0	113.7	233.1	218.1	10.0	5.0
2018	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2019	-38.4	271.5	157.8	113.7	233.1	218.1	10.0	5.0
2020	119.4	113.7	0.0	113.7	233.1	218.1	10.0	5.0
2021	345.7	-345.7	-345.7					
Total	657.6	3,327.5	1,337.4	1,990.1	3,985.1	3,774.6	135.0	75.5
IRR	9.2%							

10.2.2 Financial Evaluation

It will be necessary to procure funds other than those from the municipality own budget to cover investment costs when actually implementing the project. Moreover, as is indicated in the financial plan, it will be necessary to raise cleansing fees by 2010 in order to ensure sustained operation of the solid waste management. However, since the ratio of cleansing fees following the price increases will still only be around 1% of household income, this will be acceptable for residents. Moreover, if investment cost of the priority project can be subsidized, it will be possible to sustain the solid waste management by financing investment from 2006 onwards.

Furthermore, the compost plant and sorting center can cover operation and maintenance costs excluding personnel expenses by means of revenue from the sale of compost and reusable materials.

10.3 ENVIRONMENTAL EVALUATIONS

Two subject projects were selected among the feasibility study projects according to proposed environmental guideline in Syria. Those two projects are located in the existing disposal site in Al-Bassa and both projects aim to improve existing waste disposal. The location of the sites is shown in Figure 10.3.1.

- Development of Lattakia Recycling Center (Composting plant and sorting center)

- Rehabilitation and rearrangement of Al-Bassa Disposal site and improvement of operation of final disposal site

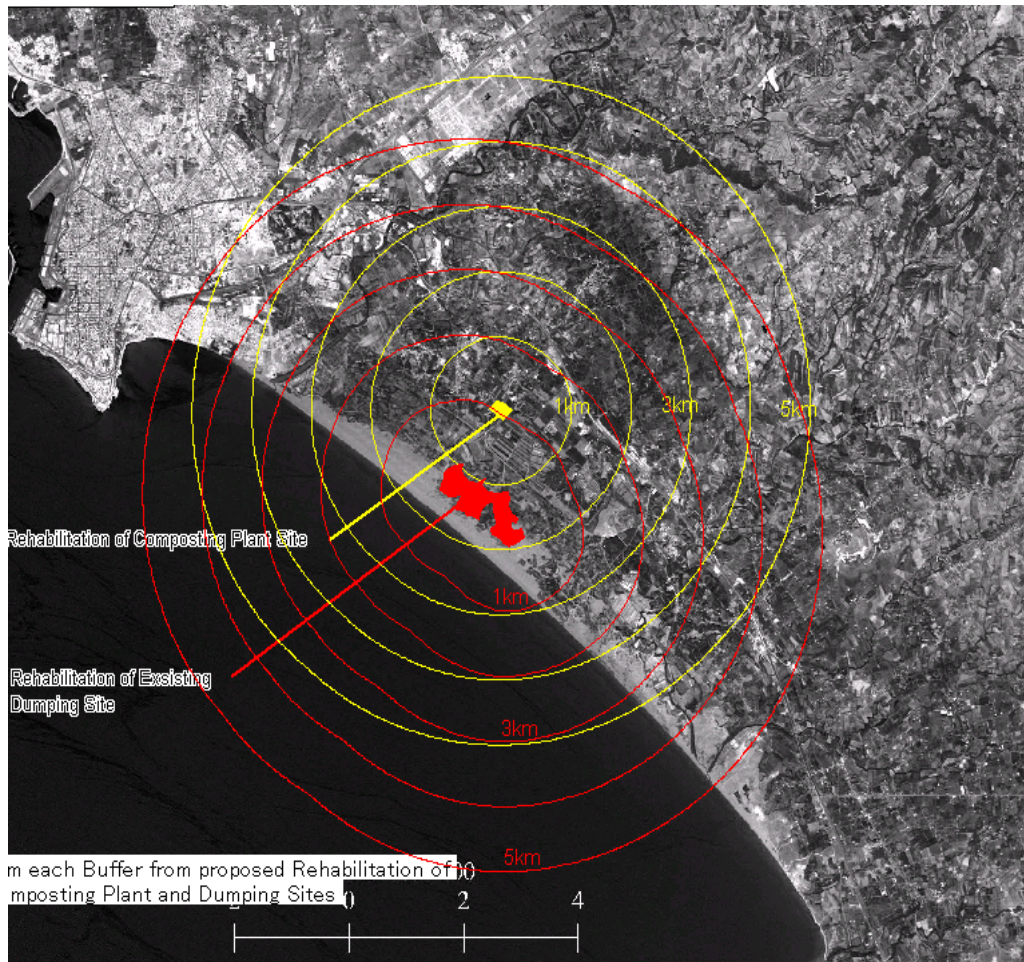


Figure 10.3.1 Location of SWM Facilities in Al-Bassa

(1) Potential Impact and Its Mitigation Measures

1) Lattakia Recycling Center

The project aims to renew existing composting facility and most of the facility there except building is renewed. Also, the capacity of the compost plant is half of old plant. Hence, it is minimized adverse environmental impact caused by project implementation. Although, it is doubt about offensive odour to a few houses located next to the site during the operation stage. Potential impact and its mitigation measures are examined as follows:

a. Offensive Odour, noise and vermin

Offensive odour is occurred during the compost production process. It is minimized by proper fermentation of the organic waste at approximately 70 degree Celsius so that the odour will be minimized. In addition to this, the heat will exterminate vectors and pests. Generation of vermin will be minimized in the site. Then, low rotary motion of the classifier machine, which is used at beginning of the waste classification, high noise will not be generated. A key point of the mitigation measure is proper operation so that skilled staff should be assigned.

b. Leachate

It is unavoidable aspect that water percolates from organic waste. Residual water namely leachate is recycled in the process of compost production according to the plan. Consequently leachate will not be discharged except residues. However, it is essential that water quality shall be monitored periodically in case of deterioration of ground water by unexpected percolation.

2) Rehabilitation and rearrangement of Al-Bassa Disposal site

As well as Lattakia Recycle Center, the project aims to rehabilitate and rearrangement of existing disposal site using sanitary landfill method. It is therefore significant adverse environmental impact will not be occurred by the project implementation. However, proper leachate management and landscape shall be considered during the design and operation stage. Potential and its mitigation measure are examined as follows:

a. Deterioration of Water Quality by Leachate

Leachate management of landfill site is a key issue on environmental consideration of waste disposal management. The mitigation measures shall be taken from design stage and the design shall include the measures in order to minimize adverse impacts. In addition to this, it is important that periodical waster quality monitoring in the site shall be done during the operation stage. Key component of leachate management is shown in following table.

b. Restoration and Preservation of Coastal Landscape

Costal landscape shall be restored that presently disorder waste management has deteriorated the landscape when the site is rehabilitated. The plan proposes soil coverage in order to avoid scattering of the waste, offensive odour and spontaneous combustion. Planting trees and shrubs are quite helpful to maintain coastal ecosystem. The restoration of coastal landscape shall be considered after the disposal site closed due to valuable coastal area originally.

Table 10.3.1 Key Component of Leachate Management

Key Items	Contents
Minimization of leachate generation	Control of surface and groundwater inputs Minimization of amount of precipitation coming into contact with waste by use of small cell Conservative design of cell size Phased disposal and progressive restoration Use of low permeability cap Shaping of final landform to encourage surface water run-off away from active phases Control of liquid waste input Use of solidification process as an alternative to direct landfill of waste
Contaminant of leachate within the landfill	Use of a double or composite liner system incorporating protection of the synthetic liner (500mm clay layer is proposed on this project) Construction of the liner above the maximum ground water recovery level Retention of sufficient unsaturated zone to provide for attenuation of leachate Perimeter and cell bounding with low permeability bund walls Low permeability of cap Quality control of liner installation
Control over leachate quality	Leaching tests on incoming waste Ban on specific wastes Recirculation
Collection and disposal of leachate as it is generated	Leachate collection pipe work system Leachate collection sumps within each phase Pumps for removal of leachate to a specification which will resist attack from high-strength leachate Leachate treatment prior to discharge to sewer system
Monitoring	Internal leachate monitoring to measure head of leachate Interspace drain monitoring to check for leachate Groundwater monitoring borehole for long term monitoring The aim should be to monitor at source of the contaminants as well as along the potential groundwater pathways
Contingency plans	In the event of the groundwater contamination being detected

Reference: Environmental Assessment for Waste Treatment and Disposal Facilities, Judith Petts and Gev Eduljee

(2) Conclusion

Proposed plans, recycling center and rehabilitation of Al-Bassa disposal site, include sufficient component and well-organized schemes will have no major negative potential impact of environment. Appropriate construction and operation with mitigation measures are the conditions for minimization of the environmental impacts. The improvement of collection system will improve the service efficiency of collection and haulage of the waste to the disposal site, as a result, living environment and public health condition will be advanced. Consequently the proposed projects have beneficial impacts on the environment and public health condition, and Lattakia, Jableh. Al-Haffeh and Qurdaha municipalities will receive environmental benefit from the projects.

10.4 SOCIAL CONSIDERATIONS

(1) Fee Collection and Low Income Groups

The project aims to build the financial base of the solid waste management based on the principle of burden by beneficiaries. Accordingly, since it is important to raise cleansing

fees for this purpose, the burden placed on low-income households may increase. In consideration of this, the fee collection rate is set low at 80%. Moreover, since households with income of no more than SP 4,000/month account for 14%, exemption of cleansing fees for low-income groups is possible.

(2) Employment Opportunities

The cleansing utility in Lattakia and the three surrounding cities employs 838 workers. In the present situation, since cooperation by citizens is scarce and there is a shortage of equipment, many personnel are engaged in primary collection and street sweeping. In the project, however, since it is intended to procure equipment and secure the cooperation of citizens in relieving the burden of primary collection, it should be possible to reduce personnel provided that sufficient cooperation is forthcoming from citizens. However, the project intends to respect existing systems and consider additional personnel for realizing appropriate treatment and disposal in future, and therefore additional employment opportunities will be secured. For this reason, manual sorting lines are planned at the compost plant and sorting center in order to recover reusable materials.

(3) Waste-pickers

There are approximately 60 waste-pickers at Al-Bassa disposal site and they recover plastic and metal reusable materials. Cooperation will be required from waste-pickers in order to implement earth covering and prevent environmental pollution at the final disposal sites. This is also required in order to secure safety of work. Concerning this point, moves to achieve cooperation were already started in the Pilot Study with the trial implementation of work methods in harmony with waste-pickers and registering of waste-pickers. These activities shall be further advanced in the project.

Moreover, in the project it is planned to carry out source separation of domestic waste into organic waste and inorganic waste. Organic waste shall be treated at the compost plant, and reusable materials shall be taken from inorganic waste at the sorting center. Since inorganic waste contains a lot of reusable materials, efficient recovery is possible. Therefore, recovery at the sorting center is more desirable than recovery at the disposal site in terms of both work environment and quality of recovered materials. When implementing the project, an appropriate recovery system shall be constructed while cooperation is sought from waste-pickers.

11. Recommendations

11.1 SYSTEM OF FEES

In order to secure the sustained operation of the solid waste management, it is necessary to procure and renew the necessary equipment and secure funds for doing this. For this reason, cleansing fees must be modified to appropriate levels. In Lattakia and the three surrounding cities, it is first necessary to increase the collection rate of fees from domestic users. Next, domestic fees need to be revised so that they are SP 500/year/household in Lattakia and SP 200/year/household in the surrounding three cities.

In the long term, revision of the national law on fees will be necessary, and fee systems on the national and municipal levels must be established so that around 1% of household incomes are collected.

11.2 ESTABLISHMENT OF SYSTEMS FOR EQUIPMENT RENEWAL

Apart from tractors, all waste collection vehicles and heavy machinery are imported items. Even if local governments intend to use their budgets for purchasing such equipment, they are unable to purchase and renew waste collection equipment because they have no foreign currency. Accordingly, central government subsidization is relied on for purchasing all waste collection vehicles. However, the central government is also financially restricted and can only respond to part of the need. As a result, each city in Syria is confronted with equipment shortages and deterioration.

Cities in future will need to advance fee collection that covers equipment costs including depreciation costs. This will enable them to raise funds for procuring equipment. At the same time, in order to overcome the above situation, it is necessary for local governments to cooperate in establishing a special fund for equipment renewal and setting up a system for the import and purchase of waste collection equipment with support from the Ministry of Local Government. Sources of finance and functions of this fund are as follows:

Sources of finance:

- a. Accumulation of part of cleansing fee income in each municipality (for example, 5%)
- b. Central government subsidies (for example, 30%)
- c. Repayment by the benefiting local authorities

Roles:

- a. Review of local authority purchasing plans
- b. Import and distribution of cleansing equipment
- c. Financial control

11.3 PROMOTION OF COMPOST USE

Composting is a common means of recycling organic waste, however, there is little point in doing this if farmers do not use the compost product. Accordingly, it is first necessary to produce good quality compost, while at the same time farmers must promote the utilization of compost. For this purpose, the following measures are required:

- a. Promotion of study and research into the effects and uses of compost
- b. Dissemination of the effects and uses of compost
- c. Encouragement of compost use

11.4 ESTABLISHMENT OF INTER-MUNICIPAL SYSTEMS

The financial base of small and medium municipalities is fragile. Therefore, the leading city in each Governorate should take the initiative in cooperation with Governorate governments in building inter-municipal waste management systems that incorporate these smaller municipalities. The project will be a model undertaking in this respect, and it is hoped that similar systems are adopted in other regions too.

11.5 ESTABLISHMENT OF HAZARDOUS WASTE MANAGEMENT SYSTEM

Hazardous waste needs to be treated and disposed according to its properties. If one considers the present capacity of local authorities, it is necessary for such a treatment and disposal system to be advanced under the initiative of the central government.

PART III

***FEASIBILITY STUDY ON
THE COMPOST PLANT IN HOMS***

PART III FEASIBILITY STUDY ON THE COMPOST PLANT IN HOMS

1. Outline

The master plan on solid waste management for Homs City was prepared in the “Homs Solid Waste Management Study” (METAP-EIB Study) and was presented in the revised interim report in January 2001. The major proposal of the master plan is that the existing disposal site at Dir Baalbeh be closed down and a new disposal site be constructed at Maghlia about 30 km northwest of Homs. The master plan proposes that a transfer station be constructed at the present disposal site and that recycling systems including a compost plant be promoted. This study aims to conduct a feasibility study on compost plant construction scheduled for introduction based on the master plan. The location map of the waste-related facilities is shown in Figure 1.1.1.

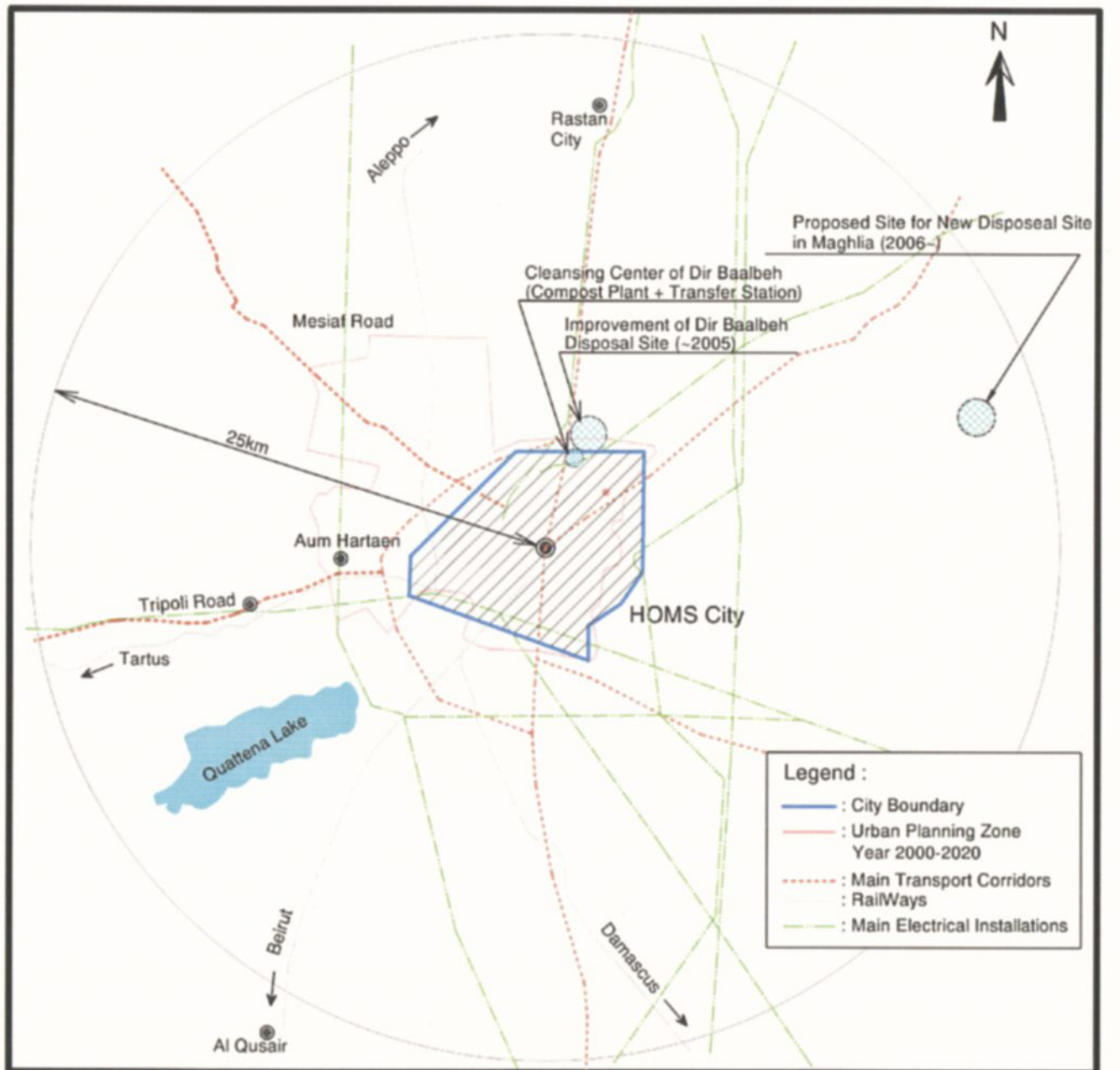


Figure 1.1.1 Location of Proposed SWM Facilities in Homs

2. Review of the Master Plan for Solid Waste Management in Homs City

2.1 OUTLINE OF THE MASTER PLAN

In the master plan for solid waste management in Homs City, Maghlia located approximately 26 km northwest of Homs City has been selected from a number of candidate sites as the location of the new disposal site. Also, concerning the project scenario, out of the three alternatives to 1) construct the most economic and basic system, 2) adopt the basis system and introduce partial recycling, and 3) introduce full-scale recycling, the plan to adopt a basic system and also introduce partial recycling was selected. This plan entails the phased introduction of recycling for construction waste materials, a compost plant and a sorting center. Moreover, for this purpose, it is planned to introduce source separate collection of domestic waste. Incidentally, Japanese cooperation is anticipated for provision of the collection equipment.

2.2 COMPOST PLANT

It is proposed that the master plan for Homs City be implemented over the following stages. Moreover, although no clear statement is given concerning the site of the compost plant, two candidate sites that can be considered are the existing disposal site and the new disposal site at Maghlia. Therefore it is necessary to carry out site selection upon carrying out comparison of these two sites.

a. Market and garden waste composting facility

- Construct a facility for treating 7,500 tons/year (approximately 25 tons/day) in 2005.
- Expand this to 11,000 tons/year (approximately 35 tons/day) in 2011.

b. Separated domestic inorganic waste composting facility

- Construct a 4,000 tons/year (approximately 15 tons/day) test plant in 2007.
- Build a 35,000 tons/year (approximately 100 tons/day) full-scale plant in 2011.
- Expand this to 70,000 tons/year (approximately 200 tons/day) in 2013.

2.3 DESIGN POPULATION AND QUANTITY OF WASTE

The population of Homs City in the 1994 census was 814,201, and it is estimated that this will increase to 1,002,306 by 2001 and 1,130,732 by 2005 judging from the subsequent annual rate of growth of 3%. The amount of waste according to the master plan is as shown in Table 2.3.1.

Table 2.3.1 Waste Generation Amount Forecast in Homs

Waste type/ Year	(Unit: ton/year)		
	2000	2005	2010
Domestic waste	152,700	178,600	210,500
Commercial waste	24,400	28,600	33,700
Public facility waste	46,100	48,900	51,400
Industrial waste	33,900	39,100	45,100
Medical waste	400	500	600
Total	257,100	295,200	341,300
Waste amount per day	704 ton/day	809 ton/day	935 ton/day

Source : Interim Report, Homs Solid Waste Management Study

3. Solid Waste Management in Homs City at Present

3.1 COLLECTION AND TRANSPORT

(1) Equipment

The equipment currently used in waste collection and street sweeping is as indicated in Table 3.1.1.

Equipment that was purchased prior to 1990 and has been in use for more than 10 years consists of 24 compactors, four (4) tractors and four (4) dump trucks. Also, six (6) mechanical sweepers and two (2) tank trucks were also purchased before 1990.

Table 3.1.1 Current Equipment for Collection and Road Sweeping

Equipment	Brand	Capacity (m ³)	Quantity (nos.)	Production year	Trip number
Compactor	Heil	15	4	1996	2.5
	Heil	15	5	1997	2.5
	Heil	15	2	1998	2.5
	Zel	4	1	1957	3
	Mack	12	11	1978	2.5
	Mercedes	10	1	1954	2.5
	Kamaz	10	1	1980	2.5
	Nissan*	10	1	1975/99	2.5
	Toyota	8	4	1986	3
	Toyota	3	5	1986	4
Tractor	Somega	4	3	1973	2.5
	Forat	4	7	1993	2.5
	Forat	4	3	1995	2.5
	Forat	4	4	1997	2.5
Dump truck	Mercedes	6	1	1954	3
	Nissan	12	1	1975	3
	Fiat	12	2	1975	3
Wheel loader	Case	2	1	1995	
	Case	0.5	1	1995	
	Denber	0.5	2	1993	
M. Sweeper	Eligin	1	6	1975	
Water tank	KMC	5	1	1971	
	Fiat	12	1	1975	
Tractor	Forat	4	3	1994	
	Forat	4	1	1995	

(2) Personnel

The numbers of municipal employees engaged in waste collection and street sweeping are as shown in Table 3.1.2.

Table 3.1.2 Number of Staffs for Waste Collection and Road Sweeping

(Unit: person)

Item/ Shift	Morning 7:00-15:00	Service 14:00-22:00	Night 21:00-5:00	Market 17:00-1:00	Total
Crew of truck	117	33	62	—	212
Market cleansing	81	—	44	50	175
Plant & dirt collection	26	—	11	—	37
Street sweeping	150	61	344	—	555
Total	374	94	461	50	979

3.2 INTERMEDIATE TREATMENT AND FINAL DISPOSAL

There are no intermediate treatment facilities in Homs City. All collected waste is disposed at Dir Baalbeh disposal site. This disposal site, located in the north of Homs City approximately 6 km from the city center, covers an area of approximately 30 ha. However, earth covering is not carried out at this site, and the only heavy machinery here is a single wheel loader.

Based on the findings of a survey of incoming vehicles to the site in August 2001, the average amount of waste at this time was 734 tons/day., During this period, mainly Heil and Mack compactors making on average three trips per day collected approximately 500 tons/day of waste. Since the estimated amount of generated waste in 2000 is 704 tons/day, this means that 1.04 times the average amount was carried into the site during the survey period because the survey was conducted during the summer when waste discharge increases seasonally

3.3 MEDICAL WASTE TREATMENT

The types and numbers of medical agencies in Homs City are as shown in Table 3.3.1.

The amount of medical waste generated in 1999 was estimated as 400 tons/year.

Table 3.3.1 Hospital in Homs

Type	Number	Bed number	Remarks
Public hospital	3	416	Under jurisdiction of Health Directorate
Private hospital	21	322	
NGO hospital	3	181	
Military hospital	1	326	Under jurisdiction of Military
Total	28	1,245	

3.4 ORGANIZATION AND INSTITUTIONS

The municipal cleansing department implements solid waste management in Homs City. The Cleansing Department is composed of sections in charge of general affairs (6 personnel), disposal sites (8), waste collection and street sweeping (979), technology (21), cleansing vehicles control, penalties (14) and pest control (28, also responsible for container cleaning), etc. In all, the Cleansing Department is operated by 1,056 employees consisting of 441 regular employees and 615 temporary employees. Also, the Parks Department is responsible for managing construction waste materials.

3.5 ECONOMIC AND FINANCIAL CONDITIONS

(1) Gross Regional Domestic Product

The gross regional domestic product of Homs Governorate in 1998 was SP 52,768 million, and the per capita figure was SP 34,130. Gross regional domestic product in Homs City is estimated as SP 31,494 judging from the population ratio. Moreover, assuming the economic growth rate after 1998 to be 2%, it is estimated that gross regional domestic product and per capita GRDP in 2001 will be SP 33,420 million and SP 33,343 respectively.

(2) Domestic Income and Expenditure

Refer to the findings of the citizen awareness survey in Lattakia, if domestic income is assumed to be approximately 60% of gross regional domestic product, this works out as approximately SP 20,000/year/person. Incidentally, it is estimated that 15% of households have income of SP 4,000 or less.

(3) Budget

Budget in Homs City is as indicated in Table 3.5.1. Budget revenue in 2000 was SP 523.0 million and expenditure was SP 602.6 million. Moreover the waste management cost was SP 130 million, accounting for 21.6% of the city expenditure.

Table 3.5.1 Budget of Homs City

(Unit: Thousand SP)

Item	1996	1997	1998	1999	2000	2001
Income						
Taxes & Fees	411,131	422,075	296,696	319,705	326,600	328,689
Receipts from investment	50,278	71,102	112,029	67,611	178,300	217,300
Other Local fees and Taxes	304,191	141,392	63,807	47,195	47,665	58,660
Other income	0	0	50,000	0	50,000	50000
Total	765,600	634,569	522,532	434,511	522,970	654,649
Expenditure						
Salaries	127,205	139,434	157,242	155,060	169,145	182,795
Administrative expenses	148,385	167,267	147,285	130,324	132,550	122,700
Capital expenditures	451,929	426,068	406,198	108,187	275,000	325,000
Transfers	4,901	5,425	5,416	5,239	5,420	5,204
Debt service & commitments	33,180	68,825	66,823	90,396	20,450	18,950
Cultural center	0	0	0	0	0	0
Total	765,600	807,019	782,964	489,206	602,565	654,649

(4) Fee Collection

In Homs, cleansing fee is collected from households and commercial entities. Cleansing fee for household is ranged from 75 to 250 SP/year (for medium income households, it is 150 SP/year). Income from cleansing fees in 2000 was SP 80 million (SP 6 million from household and SP 74 million from commercial entities), accounting for 61.5% of waste management costs. However, SP 74 million (92.5%) of this income is collected from business establishments, which means that it will be necessary to strengthen fee collection from households in future. These collected fees are equivalent to 0.23% of gross regional domestic product.

4. Feasibility Study Framework

(1) Scale of the Compost Plant

The master plan proposes that the compost plant be introduced in stages. The first stage is construction of a simple plant with capacity of 25 tons/day for the composting of market/green waste, and the second stage is a pilot plant with capacity of 15 tons/day for the composting of domestic organic waste. The third stage is the construction of a full-scale compost plant (100 tons/day, two lines) which is proposed for 2010 onwards following confirmation of demand and feasibility at the pilot plant.

Therefore, the following three alternatives for the capacity of the compost plant are considered.

- Alternative 1 Simple compost plant targeting market waste (25 tons/day)
- Alternative 2 Pilot plant targeting market waste and domestic organic waste (40 tons/day)
- Alternative 3 Larger pilot plant (50-100 tons/day)

To develop a full-scale compost plant in future, it is necessary to first construct a pilot plant targeting organic domestic waste with market waste. According to the results of the compost demand survey, it is reported that demand exists for approximately 44 tons/day, although this depends on the quality and price of compost. When this demand is converted into plant scale, this is equivalent to approximately 120 tons/day. Therefore, scale of the compost plant shall initially be set at 50 tons/day, with the possibility of this being increased to 100 tons/day in two-shift operation after the demand for compost has been confirmed.

(2) Site of The Compost plant

The site of the compost plant was decided at Dir Baalbeh, the land adjacent to the present disposal site, following comparison with the new Maghlia disposal site. Land covering an area of 8.6 ha has already been secured at this site. However, since there have been numerous complaints against the present disposal site for a long time now, when constructing the compost plant, it will be necessary to carry out rehabilitation of the existing disposal site and improvement of disposal work (implementation of earth covering). Moreover, since there are demands for the early construction of the new disposal site, it will be necessary to construct a transfer station at the same time.

(3) Works to be Implemented in Tandem with Compost Plant Construction

As was mentioned above, the construction of compost plant shall be conducted together with the rehabilitation and improvement at the neighboring existing disposal site, construction of the transfer station and procurement of collection equipment to introduce source separate collection. Moreover, implementation of medical waste treatment is also required. Also, it is necessary to enhance public awareness to introduce the separate collection. As a compost plant and a transfer station will be constructed on this site, the site shall be developed as a center for solid waste management and called "Homs Cleansing Center".

(4) Compost Plant Implementation Schedule

When one considers the deteriorated current state of collection equipment in Homs City, it is desirable to implement the above project as soon as possible. However, when project design, procurement, construction schedule and budget measures are taken into account, the actual schedule will see implementation of planning and design in the first half of 2002 and procurement and construction in 2003 and 2004.

The earliest that equipment for disposal site improvement can be procured is the start of 2004, which is still another 2.5 years away. Until then, rehabilitation of the existing disposal site must be continued. Furthermore, when carrying out future disposal, Homs City must rent the necessary heavy machinery and implement earth covering in order to mitigate environmental pollution. Homs City will need to bear the burden of these costs.

Additionally, construction of a new disposal site is an essential condition for improvement of the solid waste management in Homs City. The Syrian side shall implement construction of the new site at the same time as construction of the compost plant. Operations are expected to start for the new disposal in 2005, or at the latest in 2006.

5. Waste Collection Improvement and Introduction of Source Separation

5.1 IMPROVEMENT POLICY AND WASTE COLLECTION AMOUNT

(1) Waste Collection Improvement Policy

The waste collection rate in Homs City is just 72%, and improvement is especially required in outlying low-income districts. Therefore, in addition to improving the collection rate to 85%, source separate collection shall be introduced in line with construction of the compost plant. The project target year shall be 2006. Moreover, it is planned to construct a new disposal site at Maghlia, which is located 26 km northwest of Homs City. Concerning transport of waste to the new disposal site, it is planned to construct a cleansing center next to the existing disposal site and carry out transferred transport. Accordingly, collected waste will be transported to and disposed at the existing disposal site for the immediate future. Moreover, following construction of the new disposal site, waste will be carried to the transfer station located

next to the existing disposal site. Also, it is planned to transport separated organic waste to the compost plant.

- a. Target year: 2006 (collected waste is transported to the compost plant or transfer station)
- b. The target waste collection rate in 2006 shall be 85%. Domestic waste, commercial waste (including market waste), public facilities waste, and non-infectious hospital waste shall be collected. Also, harmless waste generated by small and medium size factories in the city shall be collected separately.
- c. Source separate collection targeting organic waste and inorganic waste shall be introduced from middle and high-income districts. In line with the scale of the compost plant, it is planned to start source separate collection from collection of 50 tons/day of organic waste. Moreover, market waste shall be collected as organic waste and treated at the compost plant. As for other districts, mixed collection shall be continued as at present.

(2) Waste Collection Amount

The planned amount of waste collection in 2006 is 614 tons/day as indicated in Table 5.1.1.

Table 5.1.1 Collection Amount Target by Waste Type in 2006

(Unit: ton/day)

Waste Type	Generation Amount	Collection Amount
Domestic waste	504.7	429.2
Separated organic	-	30.3
Separated in-organic	-	8.5
Mixed	-	390.4
Commercial waste	80.9	71.1
Market (organic)	-	19.7
Others (mixed)	-	51.4
Public facility waste	135.4	113.5
Total	721.0	613.8

(3) Waste Collection System

In the case of mixed collection and separate collection of organic waste, the present system shall be respected and container collection shall basically be conducted on a daily basis. Collection is currently done mainly by large compactors, however, considering conditions in the target area, medium size compactors shall be introduced.

Concerning collection of inorganic waste, since generated quantities are small and it would not be difficult for households to temporarily keep the waste in the house, this shall be discharged in plastic bags and collected twice per week. Moreover, since plastic bags will be loaded manually, small compactors shall be introduced.

(4) Street Sweeping

Present street sweeping practices shall be maintained, i.e. mechanical street sweeping shall be implemented on main roads and manual street sweeping shall be conducted on

minor roads at the same time as primary collection. The extension of main roads is 95.5 km and sweeping is carried out two or three times per day on important roads.

5.2 EQUIPMENT PROCUREMENT PLAN

It is considered that vehicles purchased after 1990 can still be used in 2006; meanwhile, since vehicles purchased prior to 1990 will be more than 15 years old by 2006, they will need to be renewed.

The equipment required in order to improve the waste collection rate to 85% and to carry out source separate collection is as indicated in Table 5.2.1. The required number of collection vehicles is 79, of which it will be necessary to procure 50. Moreover, nine (9) street sweeping vehicles will be required, and it will be necessary to purchase all of these.

Table 5.2.1 Equipment for Collection and Road Sweeping in 2006

Item	Vehicle Type	Number of Vehicles		
		Existing	New	Total
Collection	Large compactor	12		12
	Medium compactor		39	39
	Small compactor		6	6
	Dump truck		5	5
	Tractor	14		14
	Wheel loader	3		3
	Total		29	50
Road Sweeping	Road sweeper		6	6
	Tank truck		3	3
	Total	0	9	9

5.3 OPERATION AND MAINTENANCE PLAN

Waste collection and street sweeping work shall be implemented as shown in Table 5.3.1.

Table 5.3.1 Waste Collection and Street Sweeping Work

Item		Contents
1.	Collection system	In principle, daily collection and sweeping Two (2) shifts operation, day and night, and necessary vehicles and personnel for each shift shall be arranged (8 operation hours).
2.	Organization of waste collection crew	One driver for a collection vehicle with 2 workers. One supervisor for every 5 vehicles. One supervisor, one driver and one worker for a wheel loader.
3.	Organization of street sweeping crew	One operator with one sweeper. For manual sweeping, one handcart for each worker. One team consists of one supervisor and ten workers.
4.	Method of discharging	Daily discharging of mixed collection and separated organic waste to containers. Discharging of separated inorganic waste in plastic bags to collection points twice a week.
5.	Maintenance of equipment	Daily maintenance shall be carried out by driver and periodical inspection and repairing shall be contracted out to a specialized private company.

The numbers of personnel required for waste collection and street sweeping are as indicated in Table 5.3.2. In line with the future procurement of equipment and improvement of citizen cooperation, it will be necessary to reduce personnel conducting manual work and to switch over those surplus people to the waste treatment and disposal divisions, for the purpose of cost reduction in waste disposal.

Table 5.3.2 Required Personnel for Collection and Road Sweeping in 2006

Item	Number of personnel
Collection	
Supervisor	20
Driver	88
Worker	172
Sub-total	280
Sweeping	
Supervisor	56
Driver	15
Worker	15
Manual sweeper	528
Sub-total	614
Total	894

6. Development of Homs Cleansing Center at Dir Baalbeh

A cleansing center, to function as the foundation of the solid waste management in Homs City, shall be constructed on land adjoining the existing disposal site (Dir Baalbeh). Project components of the cleansing center are composting facilities, transfer station and medical waste treatment facilities. Also, site shall be secured for future construction of a sorting center. The layout of Homs City cleansing center is shown in Figure 6.1.1.

6.1 COMPOST PLANT

(1) Development Policy

Since there are no composting facilities in Homs City and nearby farmers have no experience of using compost, only 15% of farmers have knowledge about compost. Therefore, the facilities to be introduced shall be treated as a pilot plant and it shall act as a model recycling facility in the area of quality control and sales promotion of compost products and sorted reusable materials.

Plant capacity shall initially be 50 tons/day in single shift operation, however, it is planned to increase this to 100 tons/day over two-shift operation as soon as the compost quality and demand are confirmed.

(2) Planning conditions

The planning conditions for the compost plant are indicated in Table 6.1.1.

Table 6.1.1 Planning Condition of Compost Plant in Homs

Item	Planning Condition
Location	Dir Baalbeh
Capacity	1 shift operation: 50 ton/day (2 shift operation in future: 100 ton/day)
Receiving waste	1 shift operation: Market waste (25 ton) & separated domestic waste (25 ton) (2 shift operation: Market waste (25 ton) & separated domestic waste (75 ton))
Material balance ^{*)}	Compost product : 25% Recyclables : 5% Residue : 25%
Operation hour	Receiving hour : 21:00 – 05:00 (Stock at the receiving yard) Operation hour : 07:00 – 15:00 (Actual working hour: 6 hours)

Note: ^{*)} shows the ratio (%) against receiving waste amount

Based on the waste quality survey in Homs and waste separation campaign in Lattakia, planned waste quality received at the compost plant is settled as shown in Table 6.1.2.

Table 6.1.2 Waste Quality for the Plan

(Unit: %, Wet base)

Waste type	Food, vegetable	Paper	Plastic	Metal	Glass	Others	Total
Market	83.4	3.9	7.3	0.6	0.5	4.5	100
Domestic	73.0	8.4	7.5	0.6	1.5	9.0	100
Design	75.6	7.3	7.4	0.6	1.2	7.9	100

Note: Design waste quality is calculated as a weighted average between market and domestic waste.

(3) Facilities Plan

Table 6.1.3 shows an outline of the facilities required for construction of the compost plant. The material balance of the plant and site facility plan are shown in Figure 6.1.2 and 6.1.3, respectively.

Table 6.1.3 Contents of Compost Plant Facilities

Process	Facility/ Equipment	Q'ty	Specification
Reception (Reception bldg.)	Truck scale	1	50 ton, load cell type
	Pre-sorting yard	1	450 m ² , open-air
	Feeding conveyor	1	10 t/h, apron conveyor, 10 m ³ hopper
Hand sorting	Hand sorting conveyor	1	10 t/h, belt conveyor, 3.7 kw
	Magnetic separator	1	10 t/h, 2.2 kw
	Sorted waste conveyor	1	10 t/h, belt conveyor, 3.7 kw
Pulverizing	Pulverizer	1	7.6 t/h, rotary blade type, 180 kw
	Conveyor	1	7.6 t/h, belt conveyor: 2.2 t/h, belt conveyor
Fermentation/ Maturing	Primary fermentation yard	1	Fermentation period: 2 weeks, 5,400 m ² , open-air
	Secondary fermentation yard	1	Fermentation period: 6 weeks, 7,200 m ² , open air
Refining	Screen	1	2.5 t/h, trommel type, 3.7 kw
	Conveyor	1	2.5 t/h, belt conveyor: 0.4 t/h, belt conveyor
Equipment	Wheel loader	4	1.2 m ³ : 3 nos.: 3.1 m ³ : 1 nos.
	Dump truck	1	8 ton
Others	Electricity	1	300kVA
	Control facilities	1	Control house, parking, guard house, etc.

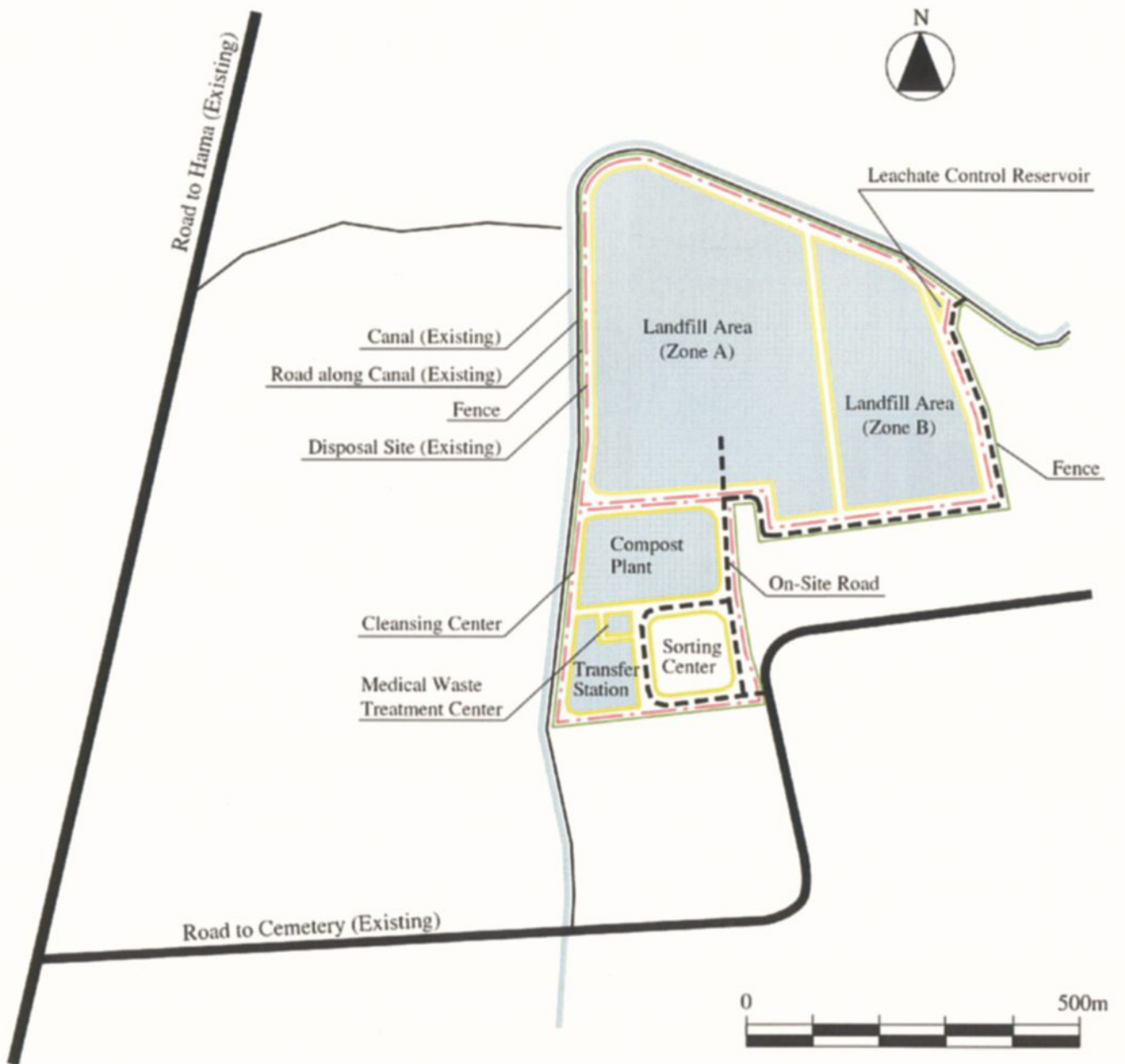
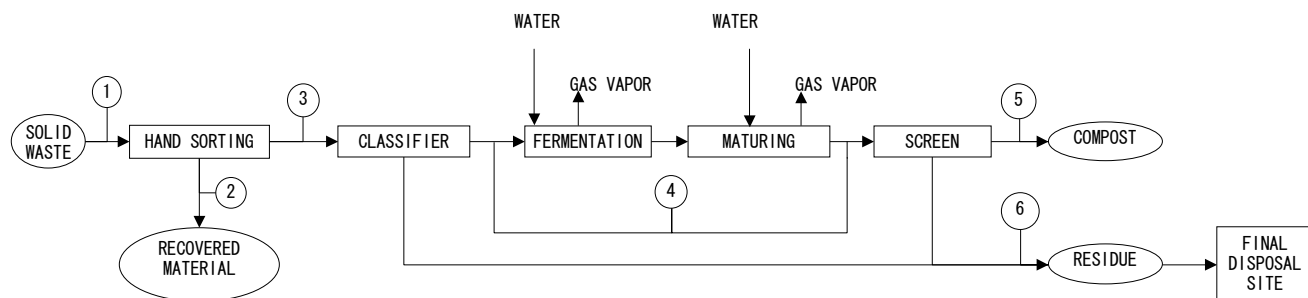


Figure 6.1.1 Layout Plan of Homs Cleansing Center



ITEM	① MSW INPUT	② RECOVERD MATERIAL	③ AFTER HAND SORTING	④ RECYCLE COMPOST	⑤ FINE COMPOST	⑥ TOTAL RESIDUE
WET WEIGHT (t)	100.0	6.4	93.6	16.0	25.0	25.0

① SOLID WASTE	COMPSITION (%)	WEIGHT (t)
FOOD, VEGETABLE	75.6	75.6
PAPER	7.3	7.3
PLASTIC	7.4	7.4
METAL	0.6	0.6
GLASS	1.2	1.2
OTHERS	7.9	7.9
TOTAL	100	100

RECOVERED MATERIAL	
MATERIAL	② HAND SORTING
PAPER	1.8
PLASTIC	3.7
METAL	0.3
GLASS	0.6
TOTAL	6.4

INPUT(t/d)		OUTPUT (t/d)	
SOLID WASTE	100.0	CONPOST	25.0
WATER	0.6	RESIDUE	25.0
		RECOVERED MATERIAL	6.4
		GAS VAPOR	44.2
TOTAL	100.6	TOTAL	100.6

Figure 6.1.2 Material Balance of Composting (2 shift operation, 100 ton/day)

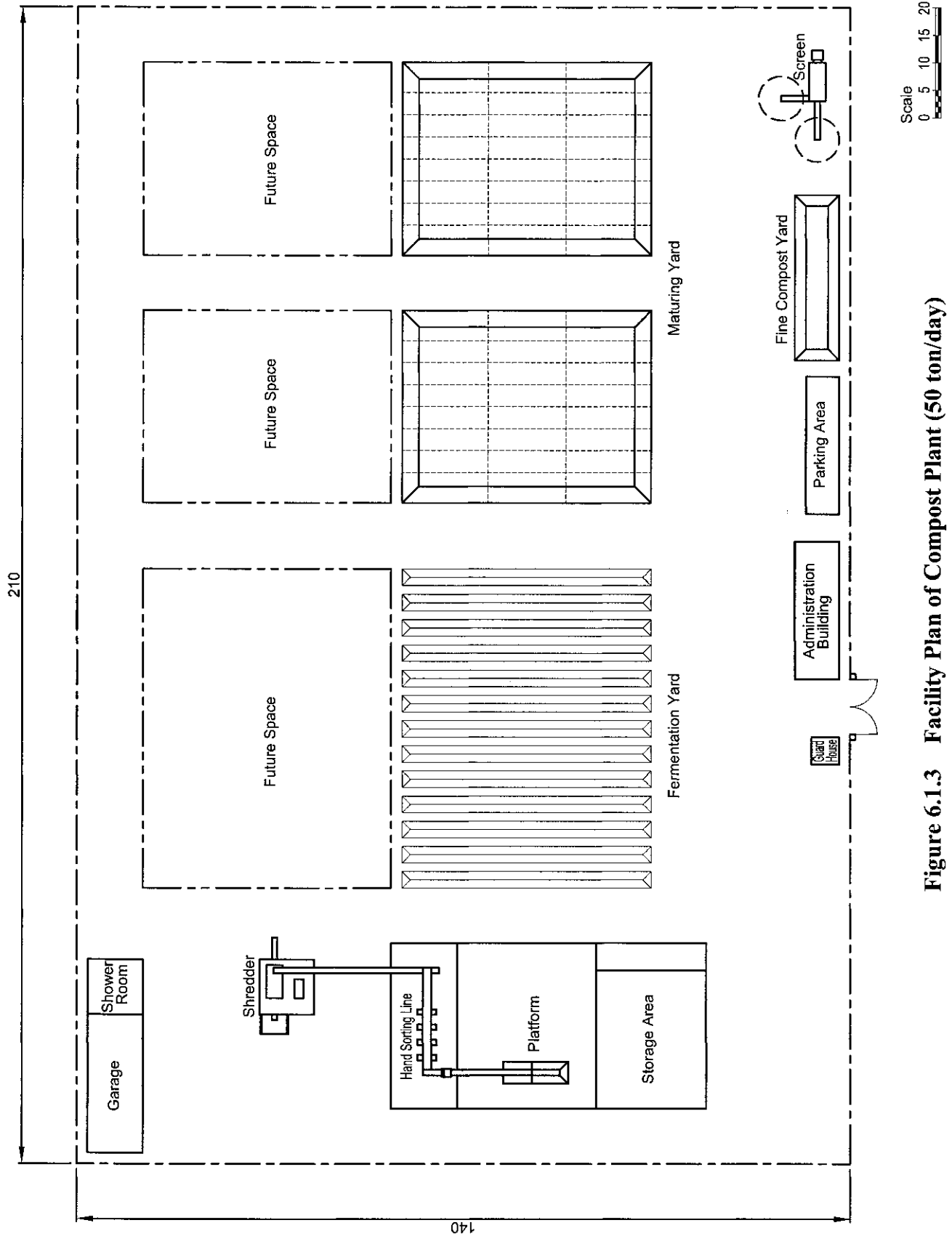


Figure 6.1.3 Facility Plan of Compost Plant (50 ton/day)

(4) Compost Demand and Sale Plan

As a result of the compost demand survey implemented in the Study, it is estimated that demand for compost in and around Homs City is approximately 16,000 tons/year.

Table 6.1.4 shows the quantities of compost produced and reusable materials recovered at the composting plant together with the sales revenue from each. It is forecast that sales of compost product and recovered reusable materials could generate annual income worth approximately SP 7,363,000/year in the case of two-shift operation.

Table 6.1.4 Amount of Compost Product and Sorted Recyclables

Item	1 shift operation (50 ton/day)		2 shift operation (100 ton/day)	
	Amount (ton/year)	Income (SP/year)	Amount (ton/year)	Income (SP/year)
Compost product	3,875	1,356,000	7,750	2,713,000
Recyclables	992	2,325,000	1,984	4,650,000
Total		3,681,000		7,363,000

(5) Operation and Management Plan

The compost plant shall initially be operated by 32 persons when operating under one shift in 2005, however, in 2010 it shall be operated by 50 persons when it is switched to two-shift operation following confirmation of the demand for compost

6.2 TRANSFER STATION

(1) Planning Conditions

The capacity of transfers station is 800 ton/day considering necessary transfer amount of solid waste in 2010. Planning conditions for the transfer station are indicated in Table 6.2.1.

Table 6.2.1 Planning Condition of Transfer Station

Item	Planning condition
Location	Dir Baalbeh
Service area	Homs city
Waste transfer distance	30 km
Area	2.5 hectare (Total area of Homs cleansing center)
Waste amount transferred	2006 : 702 ton/day 2010 : 788 ton/day
Capacity	800 ton/day
Re-loading system	Direct loading
Number of re-loading station	1
Upper level of re-loading station	GL+484.80 (4.5m higher than lower level)
Receiving waste type	Domestic waste, commercial waste, road sweeping waste, small & medium scale industrial waste
Operation hour	Receiving hour : 21:00 – 05:00 (Stock at the receiving yard) Operation hour : 07:00 – 19:00 (Actual working hour: 10 hours)
Transfer vehicle operation	3.5 trips/day/unit (average)

(2) Facilities Plan

The main facilities and equipment of the transfer station are shown in Table 6.2.2. Moreover, design layout of the plant is shown in Figure 6.2.1.

Table 6.2.2 Major Facilities of Transfer Station

Item	Facility/ Equipment	Quantity	Remarks
Common facilities in Cleansing Center	Area	86,000m ²	
	Gate	2 units	W=16m (main gate) & 6m (sub gate)
	Fence	920m	H=2m (surroundings of cleansing center)
	Green/ buffer zone	13,000m ²	
	Drainage	1,200m	350mm x 350mm
	Well	1 unit	Diameter: 350mm
	On-site road	7,200m ²	Asphalt pavement
	Main control building	410m ²	
	Rest house for workers	270m ²	
	Guardhouse	14m ²	
	Truck-scale house	18m ²	
	Truck-scale	2 unit	50 ton, load cell type
Transfer station	Retaining wall	80m	H=4.5m
	Upper level (re-loading stn.)	2,600m ²	Concrete pavement
	Waste storage yard (upper)	700m ²	
	Yard (lower)	6,500m ²	Parking, etc./ asphalt pavement
	Control house	14m ²	
	Fuel station	1 unit	
	Car washing facility	1 unit	
Equipment for transfer station	Wheel loader	2 units	3m ³
	Pick-up	1 unit	

(3) Operation and Management Plan

The number of personnel required for operating the transfer station will be 27 (excluding drivers of transport vehicles).

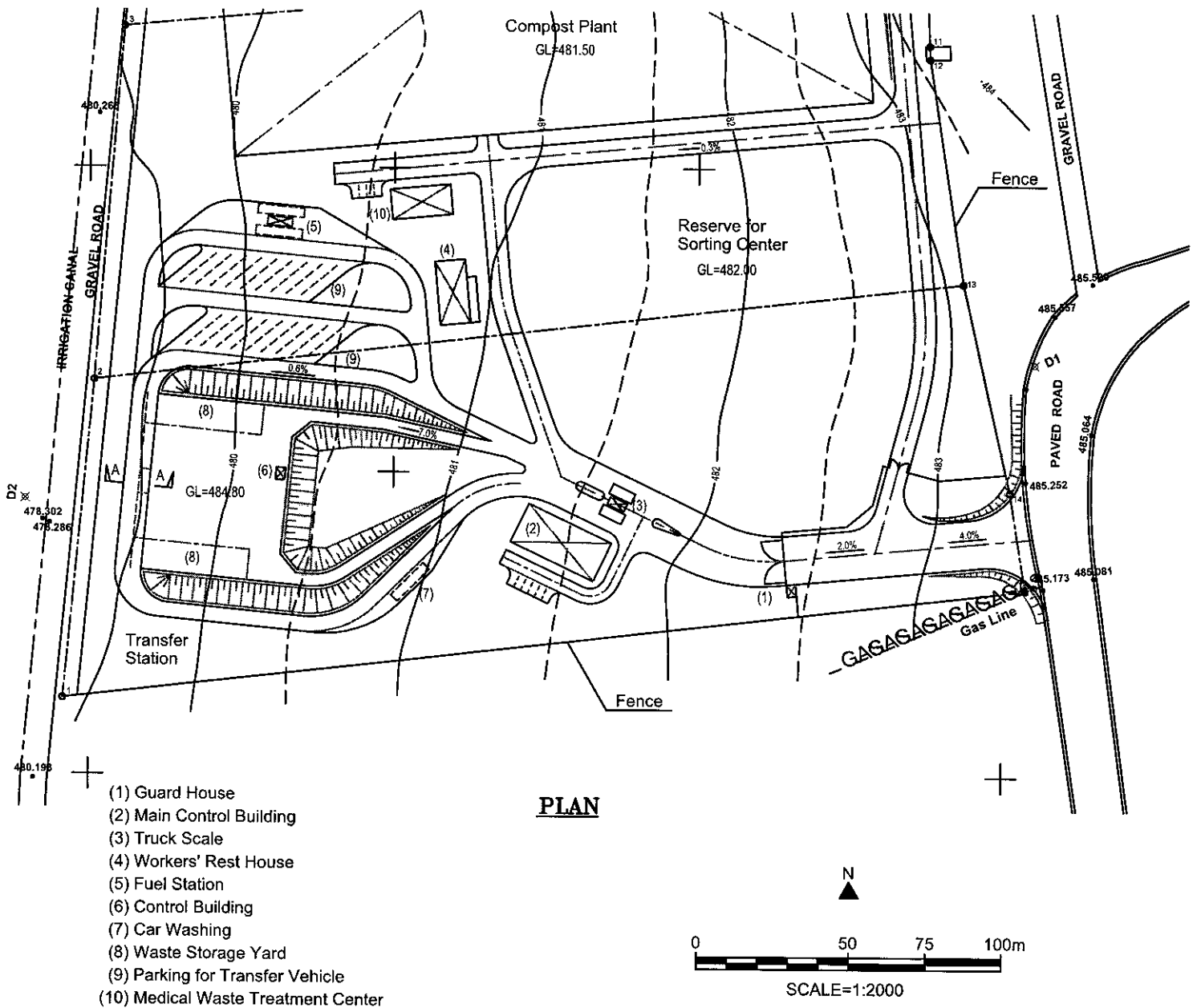
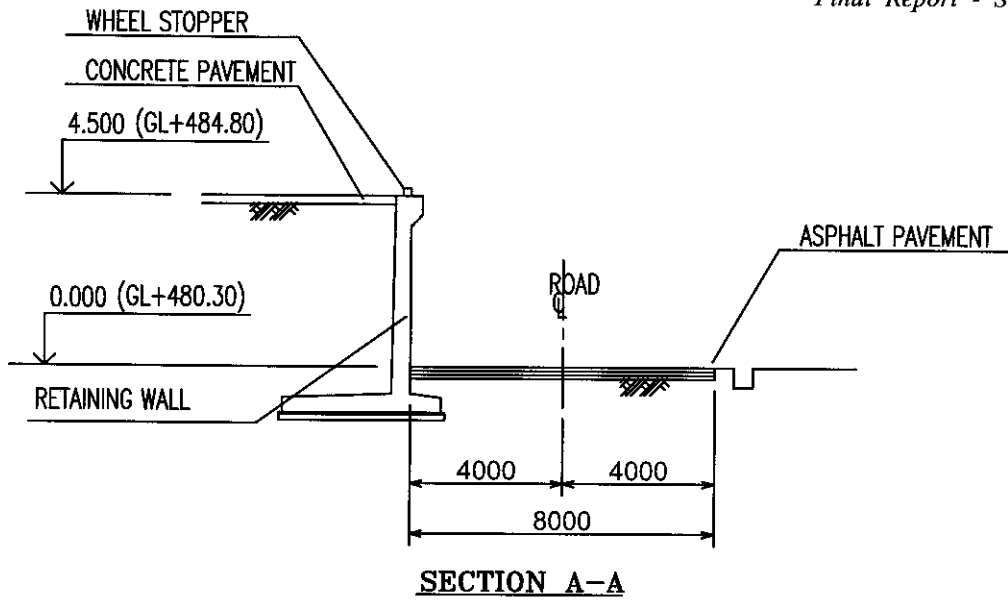


Figure 6.2.1 Layout Plan of Transfer Station

7. Rehabilitation of Existing Disposal Site and Operation Improvement

7.1 REHABILITATION OF EXISTING DISPOSAL SITE

Homs City has been advancing rehabilitation of the existing disposal site at Dir Baalbeh since January 2001. Earth covering and installation of gas removal pipes have been carried out over approximately 2 ha in the northwest section. However, since there is a shortage of equipment for implementing landfill disposal work, earth covering is not implemented in other sections. Since it takes time to procure heavy equipment, it is necessary for the city to raise the budget for renting machinery for carrying out earth covering.

Moreover, in Homs City, following the METAP study, construction of a new disposal site is planned at Maghlia some 30 km to the east of the city center. Since the new disposal site is assumed to be commissioned in 2006, the rehabilitation plan for Dir Baalbeh was compiled assuming that this site will continue to be used until 2005.

Rehabilitation at Dir Baalbeh disposal site shall be carried out over the following two stages:

Zone A: 2001-2003, Implementation using lental equipment

Zone B: 2004-2005, Preparation of temporary disposal site A design diagram of the rehabilitation is shown in Figure 7.1.1. The commissioning periods and disposal quantities of each zone are as indicated in Table 7.1.1.

Table 7.1.1 Waste Disposal Amount in Dir Baalbeh Disposal Site

Zone	Operation period	Waste disposal amount
A (West side)	2001 – 2003	826,200m ³
B (East side)	2004 – 2005	589,700m ³

(1) Facility Plan

The main facilities required for rehabilitation of the disposal site are as shown in Table 7.1.2.

Table 7.1.2 Major Facilities in Dir Baalbeh Disposal Site

Major facilities	Specification	Quantity
Zone A		
Disposal area	Including surrounding embankment	180,000m ²
Operation road	W=5m, gravel pavement	2,000m
as removal facility	L=6.0m/nos.	48 nos.
Zone B		
Capacity		600,000m ³
Leachate collection facility	Perforated RC pipe, diameter: 300mm	1,000m
Leachate control reservoir	Leachate circulation system, capacity=325m ³	1 nos.
Rainwater collection facility	400mm x 400mm	2,400m
Gas removal facility		19 nos.
Operation road	W=7m, gravel pavement	850m
Zone A&B (common facility)		
Enclosing fence	H=2.0m	2,100m
Green/ buffer zone		27,000m ²

(2) Equipment Provision and Operation and Maintenance Plan

Equipment required for implementing landfilling at Dir Baalbeh disposal site is as shown in Table 7.1.3.

Table 7.1.3 Number of Required Equipment

Equipment	Specification	Quantity
Bulldozer	200HP	2
Excavator	Bucket: 0.7m ³	1
Dump truck	10 ton	1

The number of personnel required to carry out operation and management of Dir Baalbeh disposal site will be six (6) in Zone A and 12 in Zone B. Moreover, monitoring of groundwater shall be implemented periodically by using the existing monitoring well.

7.2 IMPROVEMENT OF LANDFILL OPERATION

Landfilling disposal shall be carried out using the waste push-up and cell method that were used during the Pilot Study at Al-Bassa disposal site in Lattakia. Earth covering shall be implemented without fail and the thickness of earth covering shall be 20-30 cm for intermediate covering, and around 50 cm for final covering.

8. Medical Waste Management

The current state of medical waste treatment in Homs City is appalling and formulation of an appropriate treatment plan is required.

The starting point for formulation of an appropriate treatment plan for medical waste is separation of medical waste inside each discharging medical agency. Four groupings were defined for the purpose of separation: 1) infectious medical waste, 2) general waste similar to that discharged by ordinary households, 3) chemical and pharmaceutical waste including radioactive waste, and 4) waste composed of human body parts or tissue.

Of the above classifications, concerning general waste, this shall be collected and transported by the municipal cleansing department and disposed in the final disposal site in the same system used for urban waste.

Concerning chemical and pharmaceutical waste including radioactive waste, this shall be appropriately treated according to nationally established legislation.

In compiling the project plan, infectious medical waste shall be targeted for appropriate treatment.

Concerning the appropriate treatment of infectious waste (estimated generated amount: 0.82 tons/day in 2010), it is necessary to construct a new operating organization for separately collecting, transporting, treating and disposing of infectious waste apart from other urban waste.

Concerning the collection and transport of infectious waste, the three special collection vehicles (airtight and corrosion-proof) shall be used to collect and transport waste by individually visiting medical agencies.

Concerning intermediate treatment, one high-pressure sterilization system possessing treatment capacity of 100 kg/hour shall be newly installed to carry out the intermediate treatment of infectious waste.

Concerning final disposal, special zones for disposing of infectious waste shall be secured in disposal sites.

9. Enhancement of Public Awareness

9.1 OUTLINE

It is planned to introduce separate collection to promote recycling and to produce better quality of compost. Therefore, it is necessary to obtain public cooperation on proper solid waste discharge and source separation. To enhance public awareness on solid waste management, a section for public awareness shall be established and various campaigns shall be conducted.

9.2 ORGANIZATIONAL ARRANGEMENT

Homs City shall set-up a public awareness section. The public awareness section shall be responsible on enhancement of public awareness on solid waste management through publicity of problems and future direction, and coordination of various campaigns. Required staff will be three (3) persons. It is necessary to provide internal training for all staffs on public awareness through seminars and training.

9.3 CAMPAIGNS

(1) Campaigns Activities and Timing

Yearly campaign and specific campaigns shall be conducted in parallel with the schedule of projects as shown in Table 9.3.1. The campaigns shall be taken community participatory approach.

Table 9.3.1 Events and Campaign Timing

Topics	2001	2002	2003	2004	2005	2006
1 Improvement of Collection/Vehicles			New Vehicles	New Collection System		
2 Separate Collection				Preparation		
3 Improvement <i>Dir Baalbeh</i> Dumping Site			Rehabilitation			
4 Compost Plant in <i>Dir Baalbeh</i>			Cleansing Center	Construction		
5 Transfer Station in <i>Dir Baalbeh</i>				Construction		
6 New Disposal Site in <i>Maghlia</i>				Construction		
Public Awareness Section		Introduction				
Timing of the Campaigns		▲	▲	▲	▲	▲

— : Preparation, Procurement, Rehabilitation & Construction — : Implementation ▲ : Campaigns

(2) Specific Campaigns

Specific campaigns on the events of SWM shall be implemented in advance through the mass media and other media. Demonstration of new equipment and facilities shall be included in this campaign. Contents and timing of specific campaigns are shown in Table 9.3.2

In 2005, source separation starts in the study area. The campaign shall implement at the same time including a guidance of proper discharge and separation, supervision and guidance of discharge manner, public opinion survey. As well, women's cooperation is extremely required for the campaigns.

(3) Regular Campaigns and Activities

Yearly campaigns shall be conducted to explain present problems and future plan of solid waste management. Also, Cleansing Day and Cleansing Week shall be set and conduct cleansing activity in communities and schools including environmental education on that day and week.

Table 9.3.2 Specific Campaigns and Regular Activities

Year	Specific Campaigns	Yearly Campaigns and Regular Activities
2002	<ul style="list-style-type: none"> • Publicity Campaign for Opening the Public Awareness Section (1 day) 	<ul style="list-style-type: none"> • Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2003	<ul style="list-style-type: none"> • Publicity Campaign on New Collection System and Vehicles (3 days) • Publicity Campaign on improvement of disposal site and construction of the compost plant in <i>Dir Baalbeh</i> (3 days) 	<ul style="list-style-type: none"> • Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2004	<ul style="list-style-type: none"> • Demonstration Campaign on New Collection System (1 week) • Campaign for Waste Separation at the Source (More than one month) 	<ul style="list-style-type: none"> • Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2005	<ul style="list-style-type: none"> • Publicity Campaign on Construction of the transfer station and the new disposal site (3 days) • Demonstration Campaign on Operation of the Cleansing Center in <i>Dir Baalbeh</i> (1 week) 	<ul style="list-style-type: none"> • Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)
2006	<ul style="list-style-type: none"> • Demonstration Campaign on operation of the New Facilities in <i>Maghlia</i> (3 days) 	<ul style="list-style-type: none"> • Yearly Campaign during a festival (7-10 days) • The Cleansing Day (1 day) • The Cleansing Week (2 times) (1 week)

Note: Numerical values in the parenthesis stand for the expected day(s), Week or Month

9.4 OTHER ACTIVITIES

It will be necessary to organize scavengers and discipline on safety works considering better cooperation between scavengers and local government.

10. Institutional Arrangement

10.1 ORGANIZATION OF HOMS CITY CLEANSING DEPARTMENT

It will be necessary to reorganize the Homs City Cleansing Department in line with the improvement of waste collection and street sweeping and procurement of equipment. In the project, it is planned to improve the efficiency of solid waste primary collection work, etc. through providing equipment and securing cooperation from citizens. Therefore, since it is planned to reduce personnel working in the Cleansing Department, it will be necessary to switch over those surplus people to the waste treatment and disposal divisions. Necessary personnel in Homs City are as indicated in Table 10.1.1.

Table 10.1.1 Required Personnel on SWM in Homs City

Item	Person
Manager	1
Administration	6
Collection	280
Road sweeping (include primary collection)	614
Others *)	66
Total	967
Current personnel	1,056

Note: *) Others consist of maintenance, road occupancy, pest control and public relation.

10.2 CLEANSING CENTER

Since it is planned to newly construct a cleansing center in the project, it will be in charge of the transfer station, compost plant and medical waste. Moreover, until the new disposal site at Maghlia opens, the cleansing center shall be responsible for final disposal carried out at the adjoining Dir Baalbeh disposal site. The necessary organization and personnel are as indicated in Table 10.2.1.

Table 10.2.1 Required Personnel in Homs Cleansing Center

	Compost plant	Transfer station	Disposal site	Medical waste	Total
Personnel	32 (50)	27	12	15	86

Note: () shows the additional person in case the plant operate by two shifts

11. Project Cost

11.1 INVESTMENT COST

Investment cost of the feasibility study projects related to the compost plant in Homs is shown in Table 11.1.1. Total investment cost of the projects is estimated to SP 775.7 million. New disposal site in Maghlia will start operation in 2006; however, investment cost of it is not included.

Table 11.1.1 Investment Cost

(Unit: Thousand SP)

Item		Investment cost
1. Collection & Road Sweeping	Collection equipment	201,996
2. Cleansing Center	Compost plant	350,000
	Transfer station	64,604
3. Dir Baalbeh Disposal Site	Rehabilitation	30,817
	Disposal equipment	45,960
4. Medical Waste Treatment		22,280
5. Public Awareness		9,341
6. Organization set-up		-
Sub-total		724,998
7. Engineering service		50,750
Total		775,748

11.2 OPERATION AND MAINTENANCE COST

Operation and maintenance cost of the projects is shown in Table 11.2.1. As shown in the table, total operation and maintenance cost in year 2006 will be approx. SP 142.2 million.

Waste transfer system will be introduced in Homs in accordance with the opening of new disposal site in Maghlia. Waste transfer activity will be contracted out to the private company.

Table 11.2.1 Operation and Maintenance Cost in 2006

(Unit: Thousand SP)

Item		O/M cost	Remarks
1. Collection & Road Sweeping	Collection equipment	111,535	
2. Cleansing Center	Compost plant	4,861	One shift operation
	Transfer station	11,296	Transfer: contract-out
3. Dir Baalbeh Disposal Site	Landfill operation	15,592	
4. Medical Waste Treatment		2,098	
5. Others		524	
Sub-total		145,906	
6. Income for selling	Compost	-1,356	One shift operation
	Recyclables	-2,325	One shift operation
Total		142,225	

Note: Depreciation is not included

12. Financial Plan

12.1 INVESTMENT PLAN

(1) Annual Investment

Project investment based on the priority works implementation schedule is as indicated in Table 12.2.1. It will be necessary to cover project cost of SP 775.8 million.

(2) Sources of Finance

Sources of finance for the project are not as yet decided. Since Homs City does not possess funds and it will be necessary to revise the law and implement large-scale increases in fees in order to repay investment costs, subsidization (grants) from the funds other than those from the municipality own budget will be required for the immediate future.

Furthermore, to ensure continuation of the solid waste management, it will be necessary to secure final disposal sites into the future. Therefore, as is indicated in the master plan, it is necessary for Maghlia disposal site to be constructed in 2006. Concerning investment for Maghlia disposal site and costs of renewing waste collection facilities and equipment in future, it will be necessary for cities to cover these expenses via their own funds or loans.

12.2 REVENUE AND EXPENDITURE OF SWM

(1) Cleansing Fees and Revenue

Waste treatment costs excluding depreciation expenses will be SP 142.2 million in 2006 that is 10% higher than present expenditure. Also the repayment of loan used for new disposal site shall be born from the revenue of cleansing fee and the subsidy from general budget of the municipality. As it will be difficult to increase the subsidy, the revenue of cleansing fee shall be increased to cover these costs.

For the immediate future, it will be necessary to keep cleansing fees fixed and strive to raise collection rates. If the collection rate is raised to 80%, revenue from household fees will be SP 25.1 million (currently 6 million) and revenue from business establishment fees will be SP 74 million (same as present). However, in 2006, it will be necessary to revise the present legal limit for household cleansing fees to SP 500/year/household. As a result of this revision, assuming the collection rate is 80%, revenue from fees in 2006 will be SP 85.3 million from household fees and SP 74 million from business establishment fees, making SP 159.3 million in total.

Moreover, in Homs City, since it will be necessary to pay for the new disposal site via loans, in future it will be necessary to revise the law on cleansing fees and raise the household fee to SP 1,000/day. Moreover, even following this revision, since fees will still only account for around 1% of household incomes, it is considered to be an affordable level for citizens

(2) Expenditure

Leaving aside depreciation cost and taking revenue from compost and reusable material sales into account, expenditure in Homs City in 2006 will be SP 142.2 million. Therefore, in order to cover the operation and maintenance cost, it will be necessary for the city to outlay costs equivalent to roughly half of existing subsidies (SP 49 million) in 2006 too.

(3) Cash Flow

Assuming that this project will be implemented by subsidies or grant of the central government and the construction of the new disposal site will be carried out using loans according to the master plan, cash flow will be as indicated in Table 12.2.1. By implementing the project with central government subsidies and carrying out revision of cleansing fees, it should be possible to build a setup that allows new disposal site construction and other investments to be covered by loans.

Table 12.2.1 Financial Plan

(1) Investment and O/M Cost (Unit: S.P1,000)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Investment cost																				
Capacity building																				
Collection equipment			201,996					93,300					201,996					93,300		
Transfer facility			21,582	43,022										21,440						
Sorting center			214,000	136,000										32,500						
Compost plant				3,300	63,700			3,300												
Landfill				450	8,300							95,200				67,000				
Access road																				
Dir Baalbeh			30,817																	
Equipment			45,960																	
Healthcare waste			22,280																	
Landfill																		15,800		
Public awareness		1,494	1,868	2,241	2,241	1,494														
Engineering		1,589	576,198	187,701	74,398	1,589														
Sub total	0	1,589	576,198	187,701	74,398	1,589	0	96,600	63,700	0	0	95,200	254,436	53,940	0	67,000	0	212,030	134,530	8,000
Operation cost																				
General cleansing	112,149	112,149	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535	111,535
Sep. collection																				
Market																				
Healthcare																				
Household waste																				
Transfer station																				
Station					4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285	4,285
Transportation					7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011	7,011
Compost plant					4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861	4,861
Sanitary landfill					15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154	15,154
Access road					438	438	438	438	438	438	438	438	438	438	438	438	438	438	438	438
Dir Baalbeh	14,647	29,294	29,294	15,154	15,154															
Healthcare waste																				
Treatment					2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068	2,068
Landfill					524	524	524	524	524	524	524	524	524	524	524	524	524	524	524	524
Others					1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527	1,384,527
Total	126,796	141,967	141,353	127,213	138,457	146,906	146,036	149,411	149,550	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701

(2) Cash Flow (Unit: S.P1,000)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1 Revenue																				
Remaining																				
Fee from HH	6,000	31,187	32,142	82,812	85,338	85,338	85,338	85,338	85,338	85,338	170,677	170,677	170,677	170,677	170,677	170,677	170,677	170,677	170,677	170,677
Fee from commercial	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000	74,000
Subsidy	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971	48,971
Sales of compost				1,356	1,356	1,356	1,356	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713	2,713
Sales of reusable				2,325	2,325	2,325	2,325	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650	4,650
Sub total	128,971	154,158	155,113	205,783	211,990	211,990	211,990	166,701	166,701	166,701	252,040	252,040	252,040	252,040	252,040	252,040	252,040	252,040	252,040	252,040
Grant	0	1,598	576,198	181,263	2,241															
Loan				16,438	72,157	799		48,300	31,850	0	0	47,600	127,218	26,970	0	39,500	0	106,015	67,265	5,600
Total	128,971	155,757	731,312	403,485	286,989	212,790	163,019	215,001	198,551	166,701	252,040	299,640	379,258	279,010	252,040	295,540	252,040	359,055	319,305	257,640
2 Expende																				
Capital investment	0	1,589	576,198	197,701	74,398	1,589	0	96,600	63,700	0	0	95,200	254,436	53,940	0	67,000	0	212,030	134,530	8,000
Operation	126,796	141,967	141,353	127,213	138,457	146,906	146,036	149,411	149,550	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701	149,701
Loan repayment					1,644	8,960	9,939	13,769	16,954	16,954	16,954	16,954	16,954	16,954	16,954	16,954	16,954	16,954	16,954	16,954
Interest					1,315	6,956	6,311	5,996	8,745	10,191	8,835	7,479	9,930	18,371	17,773	14,934	15,352	12,829	18,786	21,182
Total	126,796	143,566	717,551	324,914	215,814	163,320	161,287	290,647	238,764	176,847	175,491	269,334	435,782	256,448	202,964	259,909	196,597	406,104	340,333	219,740
Balance	2,175	12,191	13,760	78,570	70,574	49,469	1,733	-45,545	-37,213	-10,146	76,549	30,305	-56,524	-22,562	49,076	25,031	55,442	-49,049	-21,028	37,899
Accumulation	2,175	14,366	28,126	106,697	171,271	226,740	228,473	182,927	145,714	135,569	212,118	242,423	185,899	208,460	257,536	283,167	338,609	290,560	269,532	307,431
Remaining loan	0	0	0	16,438	86,951	78,891	69,952	109,312	127,393	110,438	93,484	124,129	229,633	222,167	186,677	191,904	160,960	234,631	264,781	229,524
Total debt	2,175	14,366	28,126	90,258	90,919	147,849	159,921	73,615	18,321	25,130	118,634	118,294	-43,734	-13,706	70,889	91,263	178,249	55,729	4,751	77,907
Debt ratio	0.0%	0.0%	0.0%	0.0%	1.4%	7.5%	9.4%	6.7%	13.5%	16.3%	10.2%	9.7%	12.6%	21.0%	21.1%	17.1%	18.6%	17.6%	22.3%	24.6%

13. Project Evaluation

13.1 TECHNICAL EVALUATION

(1) Construction of Homs Cleansing Center

a. Compost Plant Construction

The demand of compost is estimated to be 16,000 ton/year according to the compost demand survey in Homs. The compost plant is planned to be operated initially from one (1) shift and produce 4,500 ton/year of compost. Later it will be increased to two shifts when the quality and demand for compost have been confirmed. It is intended to accept only suitable waste for composting, such as market waste and domestic organic waste that is separated at the source, in order to produce better quality compost. To sum up, this facility presents no technical problems and is thought to be quite feasible.

b. Transfer Station Construction

It has been decided to adopt direct reloading system at the transfer station. The system is technically simple and easy for operation and maintenance. Therefore the proposed transfer station is judged to be technically valid.

(2) Improvement of Collection and Street Sweeping

The project aims to increase the waste collection rate from approximately 72% at present to 85% by expanding services in outlying areas by the target year of 2006. The collection system employed in the project is mainly the compactor-container collection system and it is same at present. Concerning renewal of collection equipment, medium size compactors shall be introduced in consideration of local topographical conditions. It is judged that these measures will enable the collection rate to be raised to 85% and is very feasible in technical terms.

(3) Introduction of Source Separation

In order to introduce recycling and produce good quality compost, source separate collection shall be introduced at middle and high income area. When introducing source separate collection, as was carried out in the Pilot Study in Lattakia, it is essential to obtain the active participation and cooperation of citizens. Therefore, it is important to implement source separate collection in tandem with campaigns to enhance citizen awareness.

(4) Rehabilitation and Operation Improvement of Dir Baalbeh Disposal Site

Since the new disposal site at Maghlia is assumed to start operation in 2006, Dir Baalbeh disposal site will be used up to 2005. Rehabilitation of Dir Baalbeh disposal site has almost same technical contents implemented in the Pilot Study at Lattakia. Therefore, it is judged that the rehabilitation and operation improvement of Dir Baalbeh disposal site is technically valid.

(5) Medical Waste Treatment

Medical waste hardly undergoes any separation and treatment in hospitals, and it is disposal with municipal waste. In order to improve medical waste management, independent collection using special collection vehicle for infectious waste will be introduced and the medical waste treatment facility equipped with an autoclave will be constructed at the Homs cleansing center. As the autoclave is generally used for treatment of infectious waste, this proposal is considered to be technically valid.

13.2 ECONOMIC AND FINANCIAL EVALUATION

(1) Economic Evaluation

In the economic evaluation, economic cost and benefit estimation and cost-benefit analysis are conducted, and the economic internal rate of return is computed. Also, a qualitative evaluation is conducted. Moreover, since a feature of the solid waste management is that final disposal sites need to be secured, assessment is conducted assuming that Maghlia final disposal site is constructed as indicated in the master plan.

1) Economic Cost

In carrying out economic assessment, financial costs are directly converted into economic costs.

2) Economic Benefits

Benefits resulting from implementation of the project can be considered as follows.

Table 13.2.1 Quantifiable and non-quantifiable benefit

Type	Benefit
Quantifiable benefit	Elimination of solid waste: protection of the urban living environment, improvement of public sanitation
	Compost production: reduction of chemical fertilizer, increase in production, reduction of irrigation water consumption,
	Recovery of reusable materials: recovery of reusable materials
Non-quantifiable benefit	Environmental protection: reduction of pollutant, reduction of disposal quantities, reduction of global warming gases
	Compost production: improvement of quality of agriculture product
	Other benefit: increase of public awareness, promotion

3) Quantifiable evaluation

Quantifiable benefits are 1) benefits resulting from removal of solid waste, 2) benefits of compost production, and 3) benefits of reusable materials recovery. The economic value of these benefits is as follows.

- a. Concerning the solid waste elimination effect, the amount beneficiaries are willing to pay shall be the benefit. Using the findings of the citizen awareness survey implemented in Lattakia, the average amount beneficiaries are willing to pay shall be set at roughly 1% of average household income. Concerning

stores, etc. since SP 74 million is already collected in Homs City, this shall be regarded as the amount beneficiaries are willing to pay. Taking this willingness to pay, number of households and waste collection rate into account, the estimated benefit will be SP 266.2 million in 2005.

b. Effect of compost production

The project intends to introduce a 100-tons/day compost plant, and this will initially handle 50 tons/day of waste and produce 12.5 tons/day of compost. From 2008 onwards, it is planned for the plant to handle 100 tons/day of waste and produce 25 tons/day of compost. The effects of composting can be divided into the fertilizer reduction effect, agricultural production increased income effect, and water consumption reduction effect. In economic terms, these effects work out as SP 580, SP 1,500 and SP 500 per ton of compost respectively. It is estimated that this benefit will be SP 10.0 million in 2005 and SP 20.0 million in 2010.

c. Reusable materials recovery effect

In the project, it is planned to recover 2.5 tons/day of reusable materials at the compost plant for the foreseeable future and 5 tons/day in 2010. It is estimated that this benefit will be SP 2.3 million in 2005 and SP 4.7 million in 2010.

Calculating from the above estimates of cost and benefit, the economic internal rate of return works out as 11.7%, shown in Table 13.2.1.

4) Qualitative evaluation

- Rehabilitation and covering soil will improve environmental condition of existing disposal site and reduce air pollution, odor and waste scattering.
- 75 ton/day of final disposal amount will decrease through composting process and global warming gases will be decreased
- The quality of agriculture production will be improved through usage of compost.
- Introduction of separate collection and promotion of recycling will contribute to increase public awareness on solid waste and environment and residents cooperation will be increased.

5) Conclusion of economic evaluation

The economic internal rate of return is a high figure for the solid waste management. Moreover, in addition to the above quantifiable effects, there are non-quantifiable effects such as reduction of final disposal quantities (75 tons/day in compost treatment) and environmental improvement at the existing disposal site. Since the existing disposal site has been the subject of numerous complaints in the past, it is judged that environmental improvement of the site will contribute to environmental improvement of Homs City overall and is a valid undertaking.

13.2.1 Financial Evaluation

The results of the economic analysis indicate that the project is a viable undertaking. Meanwhile, it will be necessary to procure funds other than those from the municipality own budget to cover investment costs when actually implementing the project.

Moreover, as is indicated in the financial plan, it will be necessary to raise cleansing fees to SP 500/year for household in order to ensure sustained operation of the solid waste management.

Furthermore, the cleansing fee shall be raised again to SP 1,000/year by 2010 to cover the repayment of loan to be used for renewal of equipment and facilities. However, since the ratio of cleansing fees following the price increases will still only be around 1% of household income, this will be acceptable for residents and the project will be valid in financial view point.

Furthermore, the compost plant can cover operation and maintenance costs excluding personnel expenses by means of revenue from the sale of compost and reusable materials.

Table 13.2.2 EIRR for the Priority Project

(Unit: SP million)

Year	Balance	Cost			Benefit			
		Total	Invest	Operation	Total	Willingness	Compost	Reusable
2001	0.0	0.0	0.0	0.0	0.0			
2002	-1.6	1.6	1.6	0.0	0.0			
2003	-462.1	717.1	576.3	140.8	255.0	255.0		
2004	-63.9	324.4	197.7	126.7	260.5	260.5		
2005	66.2	212.3	74.4	137.9	278.5	266.2	10.0	2.3
2006	131.5	147.0	1.6	145.4	278.5	266.2	10.0	2.3
2007	133.0	145.5	0.0	145.5	278.5	266.2	10.0	2.3
2008	45.4	245.5	96.6	148.9	290.9	266.2	20.0	4.7
2009	78.2	212.7	63.7	149.0	290.9	266.2	20.0	4.7
2010	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2011	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2012	46.5	244.4	95.2	149.2	290.9	266.2	20.0	4.7
2013	-112.8	403.7	254.5	149.2	290.9	266.2	20.0	4.7
2014	87.8	203.1	53.9	149.2	290.9	266.2	20.0	4.7
2015	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2016	74.7	216.2	67.0	149.2	290.9	266.2	20.0	4.7
2017	141.7	149.2	0.0	149.2	290.9	266.2	20.0	4.7
2018	-86.1	377.0	227.8	149.2	290.9	266.2	20.0	4.7
2019	23.0	267.9	118.7	149.2	290.9	266.2	20.0	4.7
2020	133.7	157.2	8.0	149.2	290.9	266.2	20.0	4.7
2021	0.0	0.0	0.0					
Total	660.7	4,472.4	1,837.0	2,635.4	5,133.1	4,775.1	289.9	68.0
EIRR	11.7%							

13.3 ENVIRONMENTAL EVALUATIONS - HOMS

Three (3) components of the feasibility study projects, a construction of the Homs cleansing center located at adjacent area of existing Dir Baalbeh disposal site, rehabilitation of existing disposal site and construction of a medical waste treatment facility in the center, will be subject of the EIA according to proposed environmental guideline in Syria.



Occurring smoke from the disposal site



Cemetery lies on the next land (east side)

Figure 13.3.1 Scene of the Adjacent Lands

(1) Potential Impact of Environment and Its Mitigation Measures

1) Homs Cleansing Center at Dir Baalbeh

The Homs Cleansing Center will be constructed at adjacent area of the present disposal site at Dir Baalbeh located at boundary of the Homs Municipality. Surrounding area of the center is the present disposal site and agriculture land and there are few residents in surrounding area. The cemetery of Homs is located east side with the distance of 500m.

a. Composting Plant and Sorting Center

In operation stage, offensive odor and surface and ground water degradation are concerned on adverse environmental impacts. However, waste water will be re-used to maintain proper moisture contents in the fermentation process. Also, there are few inhabitants there. Thus, there is negligible impact, although it is essential that monitoring shall be done as well as other solid waste management facilities there.

b. Transfer Station

In connection with disposal at the Magliah new landfill site, this facility starts to operate. According to the plan, the capacity is 800 tones per day and transfer trucks carry in and out the waste 140 times a day. It is doubt about scattering the waste, offensive odor and percolating waste water when they operate. Hence, the operation management shall be considered transferring schedule, which the trucks do not gather at same time, and loading the waste shall be appropriated to avoid stock of waste and maintenance of the facility shall be sufficient.

c. Rehabilitation of Existing Disposal Site

A primary measure, soil covering, is proposed in order to avoid spontaneous combustion, scattering the waste and mitigation of the offensive odor. Therefore, environmental condition of surrounding area will be much improved. Also, the leacated will be collected and circulated in the disposal site. However, periodical monitoring will be essential to avoid water pollution.

d. Establishment of medical waste management in HOMS

It is proposed to collect infectious waste independently using special collection vehicle and to treat using an autoclave at cleansing center. To separate infectious waste at source shall be carefully conducted using color coding. Since the treatment facility is small scale, environmental impact of surrounding area will be small. Hence, proper operation and skilled staff shall be considered

(2) Conclusion

The projects is planned to improve negative impact of existing disposal site through rehabilitation and covering soil of existing disposal site, then construct Homs cleansing center at adjacent area. Since there are few residents at surrounding area, negative impact of the new facilities will be minimized through proper operation of facilities. Also it is expected that environmental condition of surrounding area will be much improved through rehabilitation and covering soil of existing disposal site. Also, solid waste disposal will shift to new disposal site after 2006.

The project will contribute for efficient transportation, promotion of recycling, minimization of negative impact caused by existing disposal site and safe treatment of infectious waste. Also it is noted that expansion of solid waste collection service will largely improve living and urban environment of Homs city.

13.4 SOCIAL CONSIDERATIONS

(1) Fee Collection and Low Income Groups

The project aims to build the financial base of the solid waste management based on the beneficiaries to pay principle. Accordingly, since it is important to raise cleansing fees for this purpose, the burden placed on low-income households may increase. In consideration of this, the fee collection rate is set at a low of 80%. Moreover, since households with income of no more than SP 4,000/month account for just 14% of all households, exemption of cleansing fees for low-income groups is possible.

(2) Employment Opportunities

The cleansing utility in Homs City employs 1,056 workers. In the present situation, since cooperation by citizens is scarce and there is a shortage of equipment, many personnel are engaged in primary collection and street sweeping. In the project, however, since it is intended to procure equipment and secure the cooperation of citizens in relieving the burden of primary collection, it should be possible to reduce personnel provided that sufficient cooperation is forthcoming from citizens. However, the project intends to respect existing systems and consider additional personnel for realizing appropriate treatment and disposal in future, and therefore additional employment opportunities will be secured. For this reason, manual sorting lines are planned at the compost plant and sorting center in order to recover reusable materials.

(3) Waste-pickers

There are approximately 100 waste-pickers at the existing disposal site in Homs City and they recover plastic and metal reusable materials. In the project, it is planned to

carry out separation of domestic waste into organic waste and inorganic waste at the source. Initially, it is planned to treat organic waste at the compost plant and to dispose of inorganic waste at the disposal site. Since inorganic waste contains a lot of reusable materials, efficient recovery is possible and it is thought that waste-pickers can make a contribution to the working environment. It is planned to construct a sorting center in future, and it should be possible to obtain cooperation in the building of an appropriate recovery system within this work.

Cooperation will be required from waste-pickers in order to implement earth covering and prevent environmental pollution at the final disposal sites. This is also required in order to secure safety of work. Concerning this point, it is intended to adopt a cautious approach while bearing in mind the experience gained during the Pilot Study in Lattakia.

14. Recommendations

14.1 SYSTEM OF FEES

In order to secure the sustained operation of the solid waste management, it is necessary to procure and renew the necessary equipment and secure funds for doing this. For this reason, cleansing fees must be modified to appropriate levels. In Homs City, it is first necessary to increase the collection rate of fees from domestic users. Next, domestic fees need to be revised so that they are SP 500/year/household.

In the long term, revision of the national law on fees will be necessary, and fee systems on the national and municipal levels must be established so that around 1% of household incomes is collected.

14.2 ESTABLISHMENT OF SYSTEMS FOR EQUIPMENT RENEWAL

Apart from tractors, all waste collection vehicles and heavy machinery are imported items. Even if local governments intend to use their budgets for purchasing such equipment, they are unable to purchase and renew waste collection equipment because they have no foreign currency. Accordingly, central government subsidization is relied on for purchasing all waste collection vehicles. However, the central government is also financially restricted and can only respond to part of the need. As a result, each city in Syria is confronted with equipment shortages and deterioration.

Cities in future will need to advance fee collection that covers equipment costs including depreciation costs. This will enable them to raise funds for procuring equipment. At the same time, in order to overcome the above situation, it is necessary for local governments to cooperate in establishing a special fund for equipment renewal and setting up a system for the import and purchase of waste collection equipment with support from the Ministry of Local Government. Sources of finance and functions of this fund are as follows:

Sources of finance:

- a. Accumulation of part of cleansing fee income in each municipality (for example, 5%)

- b. Central government subsidies (for example, 30%)
- c. Repayment by the benefiting local authorities

Roles:

- a. Review of local authority purchasing plans
- b. Import and distribution of cleansing equipment
- c. Financial control

14.3 PROMOTION OF COMPOST USE

Composting is a common means of recycling organic waste, however, there is little point in doing this if farmers do not use the compost product. Accordingly, it is first necessary to produce good quality compost, while at the same time, farmers must promote the utilization of compost. For this purpose, the following measures are required. Particularly in Homs City and its environs, since awareness of compost is low, it will be important for the purpose of expanding demand to spread know-how about the effects and methods of use of compost in cooperation with agricultural agencies.

- a. Promotion of study and research into the effects and uses of compost
- b. Dissemination of the effects and uses of compost
- c. Encouragement of compost use

14.4 COOPERATION WITH SURROUNDING MUNICIPALITIES

The financial base of small and medium municipalities is fragile. Therefore, Homs City should take the initiative in cooperation with the Governorate in building an inter-municipal waste management system that incorporates these smaller municipalities. Concerning Maghlia new disposal site, transfer facilities and treatment of medical waste, in consideration of utilization by surrounding cities, it is desirable that the area as a whole tackle improvement of the sanitary environment and prevention of illegal disposal.

14.5 ESTABLISHMENT OF HAZARDOUS WASTE MANAGEMENT SYSTEM

Hazardous waste needs to be treated and disposed according to its properties. If one considers the present capacity of local authorities, it is necessary for such a treatment and disposal system to be advanced under the initiative of the central government.

PART IV

PILOT STUDY IN LATTAKIA

PART IV PILOT STUDY IN LATTAKIA

1. Introduction

The following three pilot studies have been carried out with the close cooperation between JICA Study Team and Syrian Counterpart Team.

- Production of Better Quality Compost
- Public Awareness Campaign on Environment
- Rehabilitation and Operation Improvement of Al Bassa Disposal Site

2. Production of Better Quality Compost

2.1 PURPOSE

The master plan has proposed to employ composting to treat organic waste. The pilot study was planned in order to; (1)st examine the production feasibility of good quality compost made from two waste generation sources; food markets and source separated domestic waste (organic), (2)nd introduce continuous production of a better quality compost and (3)rd expand the market demand of compost by providing good quality compost.

2.2 OUTLINE

- Location : Premises in the existing compost plant (Al-Bassa)
- Period : 16th June to end of August 2001 (supervised by JICA Study Team). After September, the Syrian side continued the work on their own.
- Waste type : Market waste/Aphamia market
Domestic waste/200 households in Al Soleiba District
- Waste amount : About 1 ton/day

2.3 COMPOST PRODUCTION PROCESS

Compost production process is shown as follows.

- Reception : Approximately 1 ton of waste has been received daily and measured by truck scale.
- Hand sorting : Plastic, paper, glass, metal, etc. have been manually removed from the received waste.
- Crushing : Hand sorted waste has been crushed to less than 50 mm by the shredder procured by the JICA Study Team.

- Primary fermentation : Primary fermentation period is two weeks. Waste has been turned over by wheel loader once a day.
- Secondary fermentation : Maturing (secondary fermentation) period is three weeks. Waste has been turned over by wheel loader twice a week.
- Screening : Vibrating screen of 16mm mesh and hand screen of 10mm mesh have been used.

2.4 IMPLEMENTATION

(1) Equipment

Equipment used for the pilot study is listed in Table 2.4.1.

Table 2.4.1 Equipment List of Compost Pilot Study

No.	Name of Equipment	Specification	Q'ty
1	Crusher	2 shaft type, 5.5 HP	1
2	Plastic bucket	Plastics, 120 liters	5
3	Weighing scale	Mechanical balance type, 0.1-200kg	1
4	Vibrating screen	16 mm holes	1
5	Hand screen	500 x 1000mm, 10mm (mesh)	1
6	Spray nozzle and hose	Multi spraying type, 1/2' x 50m	1
7	Moisture meter	Infrared light type, 0.2%	1
8	Thermometer	Digital type, 0-150 °C	1

(2) Procedure

Figure 2.4.1 shows the procedure of the pilot study.



Hand Sorting



Shredding



Primary fermentation



Turning



Secondary fermentation



Screening

Figure 2.4.1 Procedure of the Compost Product

2.5 RESULT OF THE STUDY

- (1) Amount of Treated Waste : During the pilot study period, 103 tons of market waste and 11 tons of separated domestic waste (organic) have been treated, as shown in Figure 2.5.1.

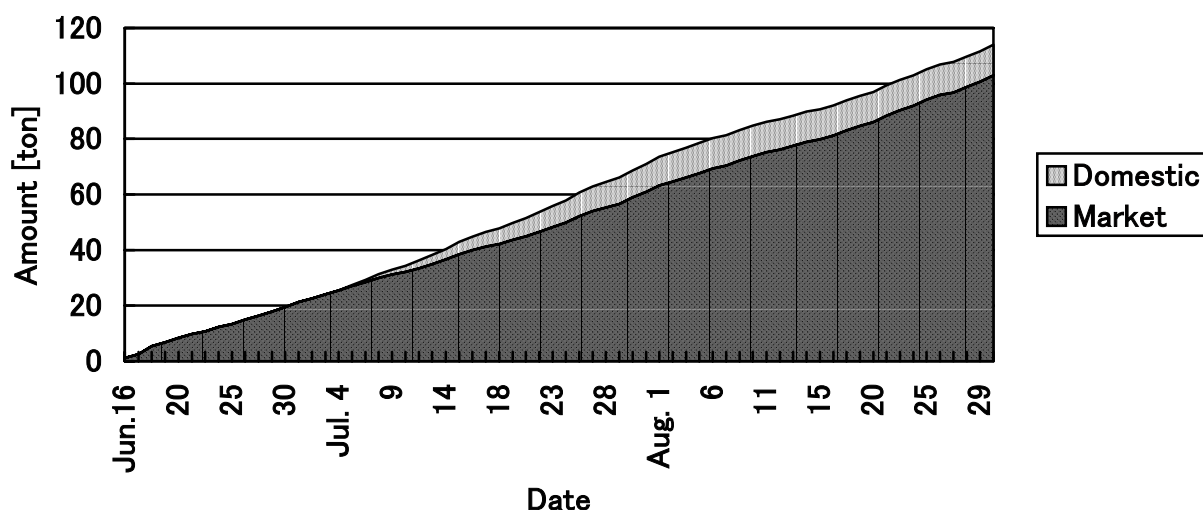


Figure 2.5.1 Waste Treated Amount

- (2) Waste Composition : Waste composition of market waste and separated domestic waste (organic) treated by the pilot study is shown in Table 2.5.1 and Table 2.5.2.

Table 2.5.1 Market Waste

(Unit: Wet Base %)

Vegetable/Fruit	Paper	Plastic	Metal	Glass	Others	Total
72.4	6.0	11.6	1.2	0.9	7.9	100.0

Table 2.5.2 Separated Domestic Waste

(Unit: Wet Base %)

	Vegetable/Fruit	Paper	Plastic	Metal	Glass	Others	Total
Organic	83.5	3.8	10.3	0.2	0.6	1.6	100.0
In-organic	22.0	23.7	30.5	3.9	8.3	11.6	100.0

- (3) Compost Production Ratio : Table 2.5.3 shows the compost production ratio of market waste and separated domestic waste.

Table 2.5.3 Compost Production Ratio

(Unit: Wet Base %)

Waste	Organic matter	Coarse compost	1 st screen reject	2 nd screen reject	Fine compost
Market waste	100	34.2	16.0	7.8	10.4
Domestic waste	100	23.5	4.4	8.9	10.2

- (4) Compost Quality : Compost quality of the pilot study satisfied the standards in Syria as shown in Table 2.5.4.

Table 2.5.4 Compost Quality of the Pilot Study

Item		Standard in Syria No.2014-1998 (Ministry of Industry)	Pilot study in Lattakia (Jun-Aug 2001)	Damascus Compost Plant Standard in Catalogue
Particle size (under 12mm)	%	>95	99.1-99.4	-
Organic Material	%	>35	40.1-43.2	45-50
C/N Ratio	-	<25	22.3-26.8	Approx. 30
Chemical Component	C	%	-	40-45
	N	%	-	1.5>
PH	-	5-8	7.20-8.32	6.5-7.8
Moisture	%	<35	28.6-28.9	25-30
Metal and glass	%	<1	0.08-0.26	-

(5) Heavy Metal contained in the Compost Product

Analysis of the compost product, made from market waste, showed that the copper content was between 362 to 494 ppm. In order to confirm this result, another sample was taken and analyzed, and the result was between 146 to 681 ppm.

The standard of copper content in Japan is 600 ppm (recommended standard by the Ministry of Agriculture, Forestry and Fisheries) and in Denmark it is 1,000 ppm respectively. The above figures are below these standards.

While, in case of the compost product made of domestic waste, mercury content was higher than the Syrian standard of 3 ppm. It was checked in another laboratory and the result was below the standard.

Considering the above items, it is recommended to continue monitoring the quality of compost products and produce compost that contains lower levels of heavy metals, and to promote the investigation and research on an accumulation of heavy metal at farm land where compost applied.

3. Public Awareness Campaign on Environment

3.1 PURPOSES

The purposes of this pilot study is summarized as follows:

- To heighten public awareness on environment and on SWM
- To conduct campaign involving all participants and concerns
- To introduce the community participation approach to all participants involved
- To promote good relation between the private sector (including the community) and the public sector

3.2 APPROACH

The campaigns followed the participatory approach as follows:

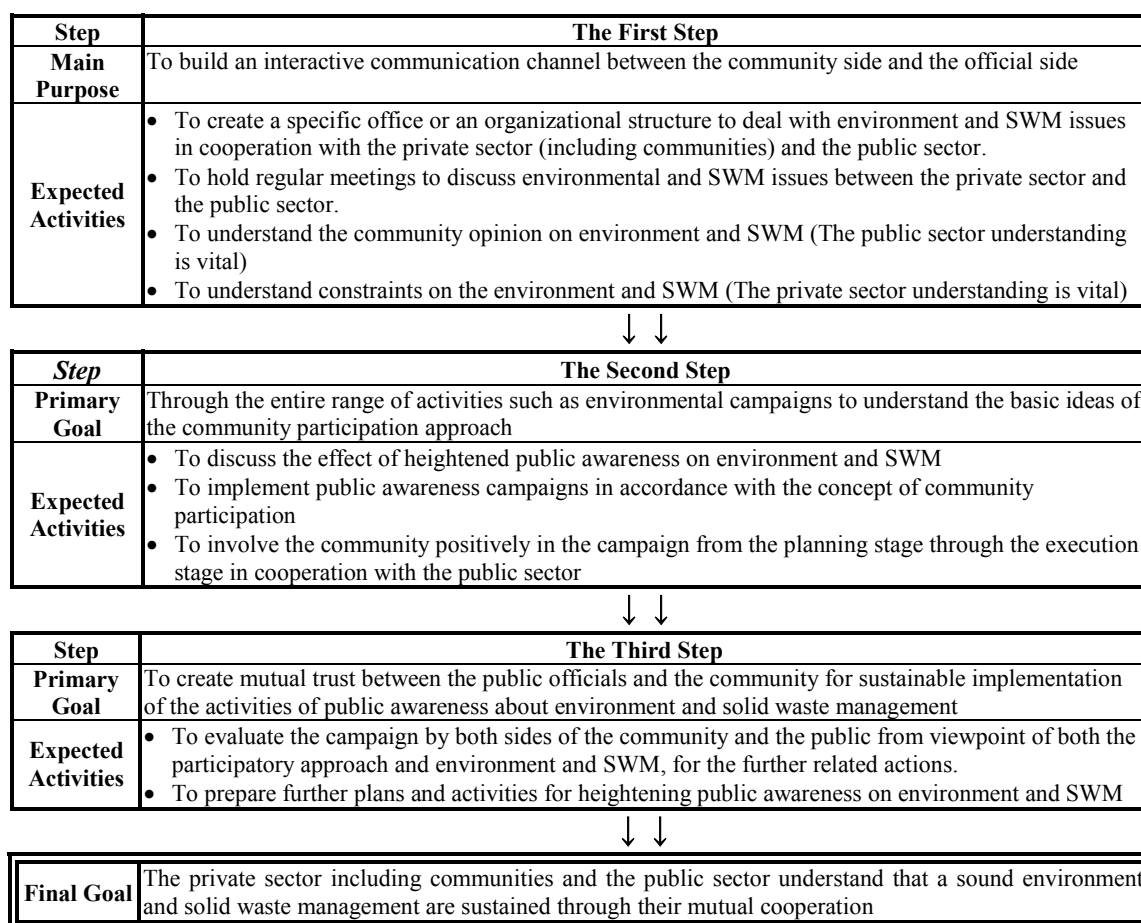


Figure 3.2.1 Step by Step Comprehension of Participatory Approach

3.3 EXECUTIVE STRUCTURE

The JICA Study Team played a role as a facilitator for preparing and implementing the campaigns. Consequently, an executive structure for the campaign was organized as shown in Figure 3.3.1. The local partners are summarized in Table 3.3.1.

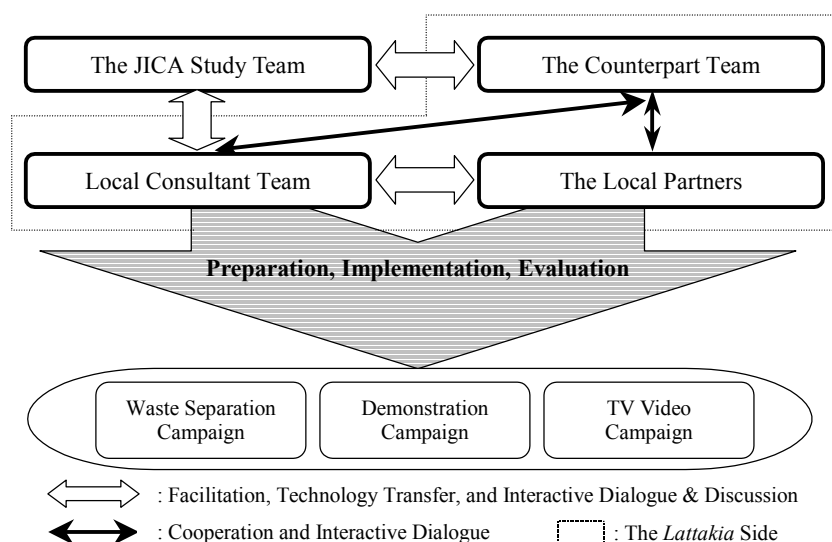


Figure: The JICA Study Team

Figure 3.3.1 Executive Structure

Table 3.3.1 Local Partners

The Private Sector	Public-Service Organizations	Governmental Entities
Community Representatives <i>Lattakia City</i> <i>Jableh City</i> <i>Qurdaha City</i> <i>Al-Haffeh City</i>	Public Unions and Entities <i>The Lattakia Women’s Union</i> <i>The Lattakia Sport Union</i> <i>The Lattakia Farmer’s Union</i> <i>The Sport City</i>	City Council <i>The Lattakia City Council</i> <i>The Jableh City Council</i> <i>Qurdaha City Council</i> <i>Al-Haffeh City Council</i>
Business Establishment An association of business establishment in <i>Lattakia</i> A Local Consultant	The Mass Media <i>The Lattakia Radio & TV Center</i> A Local Newspaper Agency	Directorates in <i>Lattakia</i> The Environmental Directorate The Health Directorate <i>The Lattakia Culture Center</i>

3.4 COMMUNITY EXPLANATORY MEETINGS

Community Explanatory Meetings on the campaigns were held through three steps as the initial action of the community participation approach.

(1) Explanatory Meetings 1 and 2

The following were decided with the consensus of the local partners.

- Campaign slogan : “Let’s keep our city clean and beautiful”
- Container colors : “Blue” for in-organic and “Violet” for organic waste
- Location of the separation: *Al-Slaibah, Zone A of Lattakia City*

(2) The Explanatory Meeting 3

The Explanatory Meeting 3 was held to evaluate all activities of the campaigns among the local partners.

3.5 CAMPAIGNS

Table 3.5.1 List of the Campaigns

	Target Groups	Main Activities
Waste Separation Campaign	The Primary Target: Housewives in selected households in the Study Area (200 households)	<ul style="list-style-type: none"> • An experimental practice of domestic waste separation at source. • The Separated organic waste is used as raw materiel for the compost pilot study. • Interview surveys (before and after the implementation of the separation) • An observation tour for the target group to inspect the pilot compost plant and compost as the final product made from the separated waste.
	The Secondary Target: Other family member in the households (3,000 households)	<ul style="list-style-type: none"> • A practical demonstration with printed materials
Demonstration Campaign on "Put Waste in a Container"	The Primary Target: Spectators at the <i>Al Mahaba</i> Festival (Approximately 10,000 spectators)	<ul style="list-style-type: none"> • To set dust bins or containers (30) at the entrances to major stadiums of Sport City (the venue of the Al Mahaba Festival) • To set signboards at the major entrances (10) to the stadiums • To exhibit a brief explanation of the process of compost production • To exhibit a sample of compost produced from waste • To prepare a leaflet about the importance of separated collections • To distribute the leaflet (2,000) • To conduct a questionnaire survey to identify public opinion about the campaign
	The Secondary Target: The Family members of the spectators (Approximately 50,000 households)	<ul style="list-style-type: none"> • An instructional information on SWM and compost with printed materials
TV Video Campaign	The Target Entire population in the study area	<ul style="list-style-type: none"> • To prepare a video program on the above campaigns to disseminate information related to the campaigns and activities of the JICA Study Team • To prepare a video program on a sound SWM, the importance of the separated collection and composting

3.6 TIMING AND SCHEDULES

Table 3.6.1 Timing and Schedules

	May	June	July	August
1. Waste Separation				
a. Preparation		▨		
b. Questionnaire surveys			▩	▩
c. Waste separation at source			■	
d. Observation tour			▲	
e. Data analysis/ Reporting				▨
2. Put Waste in the Container				
a. Preparation		▨		
b. Manufacturing the containers		▩	▩	
c. Prep. Signboards/leaflets etc.		▩	▩	
d. Prep. of compost exhibition			▨	
e. Campaign at Sport City				■
f. Questionnaire survey				▩
g. Data analysis/ Reporting				▨
3. TV Campaign				
a. Preparation		▨		
b. Produce a TV program		▩	▩	
c. Showing (at Sport City)				■
<Meetings>				
Meeting 1,2 and 3 (Evaluation)	▨ M1	▨ M2		▨ M3

Note:

- ▨ : Preparation ▩ : Questionnaire Surveys ■ : Implementation of Campaigns ▲ : Observation Tour
 ▨ : Data Analysis/Reporting ▩ : Manufacturing, Printing and Producing M : Explanatory Meetings

4. Rehabilitation and Operation Improvement of Al-Bassa Disposal Site

4.1 INTRODUCTION

(1) Purpose and major activities

This pilot study aims to present an improvement method for final disposal and the effectiveness through implementation of rehabilitation at part of Al Bassa disposal site and covering soil during disposal operation. Also, it aims to transfer the technology on proper disposal operation to the Syrian side. Major activities conducted in this pilot study are as follows:

- Rehabilitation of Al-Bassa disposal site by re-arrangement of existing disorderly accumulated waste.
- Introduction of proper landfill operation by waste push-up/cell method and covering with soil.
- Implement control of incoming vehicles and scavenging activities.

(2) Basic Conditions

Basic conditions of the pilot study area are summarized in Table 4.1.1.

Table 4.1.1 Basic Conditions of the Pilot Study Area

No	Item	Conditions
1	Location	Al-Bassa disposal site (Zone-I)
2	Area in total for the pilot study	2.5 hectare (part of Zone-I of Al-Bassa disposal site)
3	Area for the rehabilitation	1.5 hectare
4	Topographic feature	Basin at sandy hill (GL+5.0 – GL+12.0)
5	Existing accumulated waste amount	Approx. 7,400 m ³ (for only pilot study area)
6	Incoming waste amount	Approx. 240 ton/day (43 trips in average)

(3) Control Facilities and Equipment

Control facilities installed and equipment rented by the pilot study are shown in the Table 4.1.2.

Table 4.1.2 Control Facilities and Equipment Prepared for the Pilot Study

Item	Facilities/ Equipment	Quantity/ Dimension
Facilities	1. Fence	L=150m, H=1.8m
	2. Guard-house	A=30m ²
	3. Embankment	L=300m, H=W _{TOP} =5m
	4. Gas removal pipe	1 location, L=5.0m
	5. Leachate collection pipe	1 pipe, L=50m
	6. Monitoring well	1 nos., 12m depth
	7. Cover soil	Approx. 7,500m ³
Equipment	1. Bulldozer	1 nos., HP 200
	2. Excavator	1 nos., bucket 0.8m ³
	3. Dump truck	1 nos., 8 ton

4.2 IMPLEMENTATION SCHEDULE

Pilot study has been carried out in two stages, as shown in Table 4.2.1.

Table 4.2.1 Implementation Schedule

Item	June	July	August
<i>Stage-I: Rehabilitation</i>			
a. Site preparation/ access road improvement	■		
b. Construction of embankment	■	■	
c. Re-arrangement of existing waste	■	■	
d. Installation of leachate and gas pipe		■	
e. Improvement of site operation road		■	
f. Installation of control facilities	■	■	
<i>Stage-2: Operation improvement</i>			
a. Introduction of controlled landfill		■	■
b. Practice of incoming vehicle control		■	■
c. Practice of scavenging activity control			■

Note: In June, July and August 2001, the pilot study was carried out under the supervision of JICA Study Team. After September, the Syrian side continued implementation on their own.

4.3 UNDERSTANDINGS THROUGH THE PILOT STUDY

- Accumulated waste amount was not as much as it appeared to be. Therefore, it was possible to verify that the rehabilitation of Al-Bassa disposal site is not a difficult work and the Syrian side also recognize this.
- It was verified that the cover soil drastically reduced the generation of flies, self-burning of waste and offensive odors.
- Controlled landfill introduced in the pilot study was accepted by the Syrian side as a basic landfill system.
- Introduction of two working phases in the disposal site was essential for smooth landfill operations and safe scavenging activities.
- Waste-picker's participation was practiced and verified. It is recommended that waste-picker's participation shall be continuously introduced to maintain safe operation and sanitary condition.
- The efforts of the Syrian side on the implementation of the pilot study were sufficient. It is expected that the Syrian side will responsibly continue with the proper landfill work.

Photos of control facilities installed by the pilot study is shown in Figure 4.3.1 and improvement of landfill operation and sanitary condition with the participation of waste-pickers is shown in Figure 4.3.2, respectively. Figure 4.3.3 shows the comparison photo of before and after the pilot study.



<Control Office & Sign Board>



<Fence>



<Groundwater Monitoring Well>



<Leachate Collection Pipe>



<Gas Removal Pipe>



<Embankment>

Figure 4.3.1 Control Facilities installed by the Pilot Study



<Explanatory Meeting with Waste-pickers>



<Boots delivery to Waste-pickers>

Figure 4.3.2 Landfill Operation Improvement by the Participation of Waste-pickers

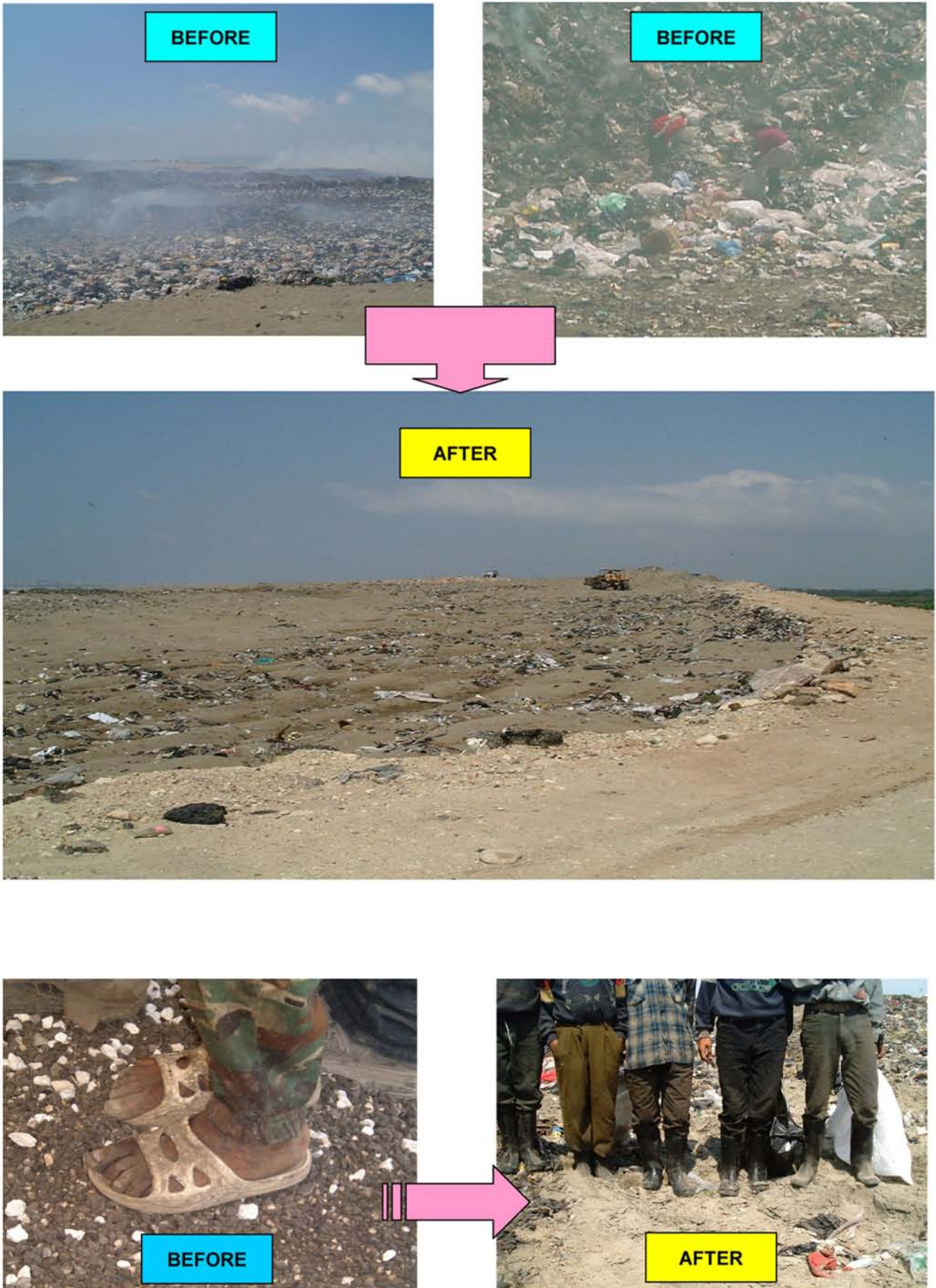


Figure 4.3.3 Before & After the Pilot Study