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MINISTRY OF LOCAL ADMINISTRATION
MINISTRY OF STATE FOR ENVIRONMENTAL AFFAIRES
LATTAKIA CITY COUNCIL
HOMS CITY COUNCIL
THE SYRIAN ARAB REPUBLIC

THE STUDY ON

SOLID WASTE MANAGEMENT AT

LOCAL CITIES IN THE SYRIAN ARAB REPUBLIC

FINAL REPORT

SUPPORTING REPORT

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FINAL REPORT COMPOSITION

The Final Report is composed of the following reports:

1. SUMMARY REPORT
2. MAIN REPORT
3. **SUPPORTING REPORT**
4. DATA BOOK

ABBREVIATION

CDEARE	The Center for Environmental Development for Arab States and Europe
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
FAO	Food and Agricultural Organization of the United Nations
F/S	Feasibility Study
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GTZ	Deutsche Gesellschaft fur Techniche Zusammenarbeit
JICA	Japan International Cooperation Agency
METAP	Mediterranean Environmental Technical Assistance Programme
MOAAR	Ministry of Agriculture and Agrarian Reform
MOC	Ministry of Culture
MOE	Ministry of Education
MOH	Ministry of Health
MOI	Ministry of Information
MOLA	Ministry of Local Administration
MSEA	Ministry of State for Environmental Affaires
MSW	Municipal Solid Waste
O/M	Operation and Maintenance
PHC	Primary Health Care
PPP	Polluter Pays Principle
SCE	Supreme Council for Environment
SP	Syrian Pound
SPC	State Planning Commission
S/W	Scope of Works
SWM	Solid Waste Management
The Study	The Study on Solid Waste Management at Local Cities in the Syrian Arab Republic
UNDP	United Nation Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

CONTENTS OF THE SUPPORTING REPORT

APPENDIX SURVEY RESULTS AND QUESTIONNAIRE

PART I & II

MASTER PLAN AND FEASIBILITY STUDY ON SWM IN LATTAKIA AND THE THREE SURROUNDING CITIES

SECTION 1

SOLID WASTE MANAGEMENT PLAN

SECTION 1 SOLID WASTE MANAGEMENT PLAN

1.1 SITE SELECTION OF FUTURE DISPOSAL SITE

(1) General

The only large-scale disposal sites are the Al-Bassa disposal site and the Jableh city disposal site. Both disposal sites are located on the seashore. There are no feces and no heavy equipment. Solid waste is just dumped without any soil cover. Improvement of daily operation on final disposal is absolutely necessary and urgent. The existing disposal site shall be rehabilitated. It is noticed that Al-Bassa disposal site will be closed in near future because of the disturbance of tourism and a develop plan of the coastal road. Therefore new disposal site shall be selected and constructed.

The sites selection of major facilities required for solid waste management shall be processed obtaining consensus of relevant authorities and residents. The process shall have transparency, participation of relevant and accountability. However, terrible situation of existing disposal site caused by no covering soil and natural burning make difficult to have consensus of relevant. It is important to rehabilitate existing disposal site and improve daily operation of final disposal site to create acceptable image. It will be the good model that the pilot study conducting in this Study shows the actual effect of improvement and the effort of city and contribute to create consensus for selection of future disposal site.

(2) Formulation of the Site selection Committee

Site selection of a future disposal site in Lattakia is one of major issues of solid waste management in Lattakia. JICA study team recommended to Lattakia Governorate to formulate the site selection committee consisting all related authorities. The site selection committee was formulated and chaired by the Lattakia Governor. It held three times as follows:

		Contents
1. First meeting	Feb. 9	a. Explanation of the preliminary criteria of the site
2. Second meeting	June 26	b. Nomination of two candidate site
3. Third meeting	Aug. 16	c. Decision of the site at Qasia site

(3) Process of the site selection

The JICA Study Team submitted the preliminary criteria of the site selection of final disposal site as shown in Reference-1. It is expected that several candidate sites will be proposed by the members.

On June 26, Second meeting of the site selection committee was held and announced that there are two candidate sites for final disposal. The Team visited both sites and submitted the consideration on the proposed candidate sites as shown in Reference-2.

The future disposal site was decided at Qasia site on Aug. 16, 2001 in the third meeting of the site selection committee. At the time it is also confirmed that Al-Bassa disposal site will be used in middle term because further process is necessary to obtain the final approval from the Central Government and to secure the land property.

1.2 RENEWAL OF EQUIPMENT

All collection vehicles and heavy equipment are imported because of no local production of vehicles. Only tractor is produced in Syria Therefore, the local government in Syria is impossible to purchase or replace their equipment even they have intention to use their budget for that purpose, because no foreign currency is available for local government,

According to the available information, collection vehicles are purchased by the central government and distributed to local government. This is one reason that large compactor vehicles are used in small cities such as Jableh and Qurdaha city. Also, this is one reason that Al Haffeh city has only two tractors.

It is recommended to create a special fund and/or union with the support of the Ministry of Local Administration for renewal and/or purchasing collection vehicles because, only, the central Government can decide to import such equipment. And it will be an efficient measure to reduce frequent request to allocate the budget for purchasing new collection vehicles and/or equipment.

The source of the special fund and/or union will be as follows:

a. Small percentage, say 5 %, of the collected fees in each Governorate in the Syrian Arab Republic

b. Subsidy from the Central Government

c. Certain payment by the Governorate and/or city which received new equipment or vehicles. (Percentage of the require vehicle cost shall be examined by Syrian side.)

The role of this special fund and/or union is to buy new collection vehicles or equipment, directly and distribute to Governorate or city that strongly request to purchase collection vehicles and/or equipment in the field of solid waste management by “Keeping their Governorate or City Clean.” So they could manage using such equipment.

This recommendation needs further examination in detail with the cooperation of the related ministries.

REFERENCE-1

Preliminary Criteria of the Selection of Final Disposal Site

1) Basic conditions

Selection of the future final disposal site including existing site is very important issue for solid waste management plan. Possible sites for future disposal shall be selected and proposed considering following conditions:

(1) Final disposal site shall have enough capacity to use more than 20 years.

(2) The site shall be far from village and housing area to avoid negative impact to residents.

(3) The site shall be selected taking into consideration to avoid pollution of the water resource weather surface or groundwater, specially drinking water source.

(4) The site shall have little conflict with other land use including development plan.

(5) Possibility and difficulty of land acquisition shall be considered. Land acquisition shall be possible without serious problem.

(6) The site shall have no rare and/or special species for natural conservation.

Table-1 Preliminary Criteria of the Selection of Final Disposal Site

Items	Conditions	Remark
1. Required area	More than 50 ha	For 20 years use. If possible, 100 ha is desirable.
2. Distance from the center of city (Lattakia city center in this case)	Less than 50 km	If distance will be more than 20 km, transfer station shall be considered.
3. Distance from village or houses	More than 200 m	
4. Distance from Water resource	No intake and well for drinking water within the distance 1 km	No intake for drinking water in downstream of river
5. Distance from Airport	More than 4 km	
6. Other land use and development plan	Less conflict	
7. Land acquis1tion	No serious problem	
8. Ecology	No rare and/or special species in the site	

2) Process of the site selection

The process for selection of the future final disposal site will be carried out as shown in Table-2.

Table-2 Process of Site Selection

1. First stage	By	Remark
a. Preliminary criteria for final disposal site	Joint T	Feb.
b. List up of possible sites based on the preliminary criteria	Local C	End of Feb.
c. Preliminary survey and the proposal of a few candidate sites which have suitable conditions than others.	Joint T	Mar.
d. Selection of the candidate sites (2-3 sites)	Local C	Mar.
2. Second Stage		
a. Environmental survey and evaluation of the candidate sites	Joint T	May, June
b. Selection of one site to be the future final disposal site	Local C	June

Note: Local C The Local Committee for Solid Waste Management
Joint T Joint Team (JICA Study Team and Counter Part Team)

REFERENCE-2

Proposed Sites of Final Disposal in Lattakia Governorate

1) Proposed sites

There are two candidate sites for final disposal of solid waste in Lattakia Governorate. One site is located across the Lattakia-Aleppo road (Site 1) and another is located at Al Qasieh (Site 2).

2) Final disposal of solid waste

To secure the final disposal site for solid waste is an important and difficult issue. Until the life style will not produce solid waste, final disposal of solid waste is indispensable and its capacity will be consumed day by day.

No one want to have a final disposal site in the nearby. In Syria, there are no sufficient soil cover is conducting for disposal site and open dumping is used generally. Open dumping is not acceptable. Therefore, the experience of Damascus that conducting soil covering shall be learned.

It may be better to secure the final disposal site far from urban area to minimize the number of resident who will be affected the impact of the final disposal site. But open dumping is not accepted even the site is far away. In this sense, soil covering shall be implemented. At present, a pilot study to rehabilitate and improve operation of final disposal is being conducted at Al-Bassa disposal site. Experience of this pilot study shall be used properly.

One of the aims of this JICA Study is to formulate a master plan of solid waste management in the target year 2010. However, the final disposal site shall be secured considering long term necessity.

3) Recommendation

Usage of the ground water is a key factor for environmental evaluation on both sites. Therefore, it is necessary to survey the soil and ground water condition and well inventory of surrounding area of the site. It is important to confirm that the ground water at the site is not used for drinking water. Also the construction cost might be different by the soil condition.

a. According to the received information, many wells are in use at present around the site 1. It is necessary to take measures to prevent ground water pollution that means higher construction cost will be required. In case that the wells are in use for drinking water, it is better to avoid using the Site 1.

b. Based on the received information that the existing strata at the Site 2 consist of impermeable layer and having no ground water. It means almost no usage of ground water for drinking. Thus it is clear that the Site 2 has an important advantage.

c. Transportation cost will be cheaper in the Site 1. Site 2 shall be developed together with procurement of collection vehicle. It will be difficult to maintain solid waste collection service by present aged vehicle.

4) Remarks

a. The Site 1 may require transfer stations for Al-Haffeh, Qurdaha and Jableh City to cope with transportation distance of solid waste. The compost plant may be located at the Site 1 or at the old compost plant site.

b. The Site 2 may requires transfer stations for Qurdaha and Jableh City. Compost plant may be located on the Site 2 or the old compost plant site. The old compost plant site will be preferable to earlier implementation of the project of compost plant.

c. It is not clear how long it may needs to secure the Site 1 and/or Site 2. Thus until the future disposal site will be opened, solid waste shall be disposed at Al-Bassa disposal site.

Table-1 Comparison of the Two Candidate Sites

Items	Criteria	Site 1	Site 2
1. Required area	More than 50 ha	Slightly less	○
2. Distance from collection area	Less than 50 km	○	○
3. Distance from village and housing area	More than 200m	○	○
4. Distance from water resource	No intake and well for drinking water with 1 km	Further information is required	○
5. Relation with other land use	Less conflict	○	Near military area
6. Distance from an airport	More than 4 km	○	○
7. Land acquisition	No serious problem	○	Army property
8. Ecology	No rare species	○	○

Note: ○: Satisfied

SECTION 2

SOLID WASTE AMOUNT AND COMPOSITION ANALYSIS

SECTION 2 SOLID WASTE AMOUNT AND COMPOSITION ANALYSIS

2.1 SURVEY IN WINTER

2.1.1 Solid Waste Amount Survey at Source

(1) Objective of the Survey

The objective of the solid waste amount survey at source is to identify the amount of the waste generation rates of household and commercial premises and to take sample for analysis solid waste composition in addition to laboratory analysis. The sampling area is selected in Lattakia and Jableh Cities considering difference of population size. The results obtained can, also, be applied for Al Haffeh City and Al Qurdaha City.

The survey will provide basic information required for formulation of the Solid Waste Master Plan.

(2) Methodology of the Survey

1) Survey Period

The Survey was carried out in winter season. The survey period was eight continuos days. The starting and ending dates for the Survey is shown in Table 2.1.1.

Table 2.1.1 Starting and Ending Dates of Solid Waste Amount Survey

Survey Location	Starting Date	Ending Date	Remarks
1. Lattakia City	February 10	February 17	- First sample received on February, 11
2. Jableh City	February 11	February 18	- First sample received on February, 12

2) Number of the Collected Samples and Locations

The total number of collected samples for both Lattakia City and Jableh City is 133. The following Table 1.1-2 will show the number and generated place of the collected samples for both cities.

Table 2.1.2 Samples Number and Generated Place

Category	Generated Place	Lattakia City	Jableh City	Total
Household	High Income	20	5	25
	Middle Income	40	5	45
	Low Income	30	5	35
Commercial	Shopping Street	3	1	4
	Private Office	3	1	4
	Restaurant	3	1	4
	Hotel	2	-	2
Public Institution	Public Office	2	1	3
	School	2	1	3
Market		3	1	4
Public Place	Road	2	-	2
	Public Garden	2	-	2
Total		112	21	133

The number of collected samples for middle and high income households, in Lattakia City, were revised based on the received information from the Counterpart Team concerning the percentage of high, middle and low income to the total population and area of Lattakia City. These percentages are described as follow:

- High Income: 15%.
- Middle Income: 55%.
- Low Income: 30%.

The following Table 2.1.3 will show the locations of the collected samples by districts in Lattakia City and Jableh City.

Table 2.1.3 Location of Collected Samples by District

City	Lattakia City	Jableh City
Generated Place	District Name	District Name
High Income	Soleeba District	Job Jowaikha and El Jabibat Districts
Middle Income	Soleeba, Tishreen University, Tabiat and Jumhoria Districts	Job Jowaikha, El Omara and El Jabibat Districts
Low income	Ugariat, Al-Baath and Al- Quds District	El Balda El Qadima and El Faid Districts
Shopping Street	Sheikhdaher District	El Balda El Qadima District
Private Office	Soleeba District	El Ezaa District
Restaurant	Sheikhdaher District	El Jobibat District
Hotel	Kalaa District and Sheikhdaheer Districts	---
Public Office	Sheikhdaher and Soleeba Districts	El Balda El Qadima Sistrict
School	Soleeba Districts	El Balda El Qadima District
Market	Al-Bath, Soleeba and Sheikhdaher Districts	El Balda El Qadima District
Road	Kalaa and Owena Districts	---
Public Garden	Soleeba and Sheikhdaher Districts	---

Location map of sample locations is attached.

3) Method of Selecting Sample Locations

In order to get representative results on generated quantities as well as their composition. JICA Study Team with the sincere cooperation with the Counterpart Team selected the locations of the samples to fulfill the survey goals for Lattakia and Jableh Cities taking into consideration the following for each category and generating place:

- Household samples, high, middle and low, represent the actual three income levels and are located in districts of highest population density.
- Shopping Street samples were selected by choosing two or three shops located in different three commercial streets of Lattakia City Center. The selected shops represent the major commercial activities such as clothing, shoes, women and baby wear, kitchen shop, photo shop, men's wear and pharmacy. For Jableh City the samples were selected from the main commercial street in the city.
- Private Office sample were selected to represent the different activities for these office such as lawyer, import and export company and accounting office. For Jableh City the selected sample was a wholesaler trading company.

- Restaurant samples were selected by choosing three typical types and sizes of Lattakia's restaurants- big, medium and fast food restaurant. A Big size restaurant was selected in Jableh City.
- Hotel samples were selected to represent four star hotels and popular hotels in Lattakia. Five star hotel was not selected because it is actually a resort area.
- Public office samples were selected to present typical public offices in Lattakia and Jableh cities by choosing medium size public offices.
- School samples were selected to represent elementary education as one sample and the other sample to present preparatory and secondary schools. Also, the preparatory and secondary school works two shifts a day and represents one of the common cases for schools in Lattakia. As for Jableh City, an elementary school was selected and it works two shifts.
- Market samples were selected to represent three sizes of markets, big, medium and small. In addition, the small market is located in low-income area. As for Jableh City, the sample was selected from the main vegetable and fruit market.
- Road sweeping samples were selected for branch and minor streets. Mechanical sweepers sweep main streets.
- Public park samples were selected to present medium size gardens and children gardens.

4) Waste Sample Collection System

a. Residential Areas (High, Middle and Low Income Household)

- Before proceeding to the survey for measurements, interview was conducted with each of the chosen household owners to explain the purpose and the method of the survey. Upon receiving the approval of the household owner to participate in the survey, the data concerning the number of inhabitants, floor area and code number of the household was recorded.
- Distribution of marked bags (approx. 40 liter capacity) to each household one day before collection day.
- Collect the plastic bags filled with solid waste from each household at a fixed time in the morning and bring it to the measuring place.

b. Commercial Areas (Shopping street, Private office, Restaurant and Hotel)

- Before proceeding to the survey for measurements, an interview was conducted with each of the chosen sample owners to explain the purpose and the method of the survey. Upon receiving the approval of the sample owner to participate the survey, the data concerning the number of staff, floor area and code number of the sample was recorded. For Private offices data concerning the activity was recorded. Also, records for number of beds in the hotels were recorded.
- The above steps (b) and (c) for households were followed.

c. Public Institution (Public Office, School)

- Before proceeding to the survey for measurements, an interview with the school manger and public office manger was conducted to explain the purpose and the

method of the survey. Upon receiving the approval of the manger to participate the survey, the data concerning the number of staff (and pupils of the school), floor area and code number of the sample was recorded.

- The above steps (b) and (c) for household were followed.

d. Market

- Before proceeding to the survey for measurements, an interview with the market stalls owners was conducted to explain the purpose and the method of the survey. Upon receiving the approval of the owner to participate in the survey, the data concerning number of stalls, floor area of stalls and code number of the sample was recorded.
- The above steps (b) and (c) for household were followed.

e. Public Place (Road and Public Park)

- Before proceeding to the survey for measurements, A request to the manual street sweeping supervisor and garden supervisor to collect the generated wastes every day in the plastic bags distributed for this purpose instead of sending it to the containers. The data concerning the swept length, street distance, garden area and code numbers of the samples were recorded.
- The above steps (b) and (c) for household were followed.

f. Waste Measurement and Recording

- Upon completing the collection procedure, the samples are transferred to the measuring yard.
- The samples are classified into their categories using the fixed ticket on the plastic bag to show the code number for each household (high, middle and low income), commercial area, market, etc.
- Measuring the weight of each sample and recording the weight on the respective record sheet.
- Measuring the volume for each sample by opening the plastic bag and emptying the waste in a calibrated plastic barrel of capacity 40 liter. To have an accurate measure of the volume, left the barrel to a height of about 30 cm and drop it and repeat lifting and dropping three times. Record the volume on the respective record sheet.
- After recording the weigh and volume, the bulk density (kg/l) and the unit generation for a household (kg/cap./day & l/cap./day)), for market (kg/100 m^2/day & l/100 m^2/day), etc.

(3) Survey Results and Analysis

The main purpose of the survey and analysis is to determine the generation rate and bulk density of the generated municipal wastes in Lattakia City and the surrounding three cities.

1) Unit Generation and Bulk Density

The results of the unit generation and bulk density for each category of the survey items are shown in Tables 2.1.4 and 2.1.5.

Table 2.1.4 Bulk Density and Unit Generation Rate for Household

City	Lattakia City		Jableh City	
Generated Place	Unit Generation kg/cap./day	Bulk Density kg/l	Unit Generation kg/cap./day	Bulk Density kg/l
High Income	0.562	0.164	0.619	0.190
Middle Income	0563	0.190	0.519	0.172
Low income	0.383	0.248	0.378	0.186
Average Unit Generation	0.502		0.506	

The average unit generation rate for households for the two cities is 0.504 kg/cap./day. Although the unit generations rate for low income households are slightly low, but the average value is reasonable comparing to other Cities. Almost, the same results in MED URBS study in 1995 were obtained.

Table 2.1.5 Bulk Density and Unit Generation Rate for Commercial, Public Institution, Market and Public Place

City	Lattakia City		Jableh City	
Generated Place	Aver. Unit Generation kg/100m^2/day	Aver. Bulk Density kg/l	Aver. Unit Generation kg/100m^2/day	Aver. Bulk Density kg/l
Shopping Street	1.759	0.042	7.449	0.097
Private Office	2.34	0.096	0.844	0.099
Restaurant	17.968	0.179	5.766	0.185
Hotel	0.142 kg/bed/day	0.176	----	----
Public Office	1.026	0.072	0.024	0.062
School	0.279 kg/cap/day	0.018	0.026 kg/cap/day	0.089
Market	75.675	0.330	85.193	0.186
Road	14.784	0.183	---	---
Public Garden	0.419	0.115	---	---

2.1.2 SOLID WASTE COMPOSITION SURVEY AT SOURCE

(1) Objective of the Survey

The goal of the solid composition survey at source is to determine waste composition for the generated waste from the households and the commercial activities. It is important to have such data at source because solid waste composition will be changed during the process of solid waste collection due to mixing of several wastes. Therefore, the sample is taken at the solid waste amount survey at source as described in Section 4.1.

(2) Number of Samples and Survey Period

To obtain the actual measure for the composition analysis and to prepare the representative samples for chemical analysis and Carbon/Nitrogen ratio, measures were made for the following numbers of samples shown in Table 2.1.6.

Table 2.1.6 Samples Number

Category	Generated Place	Lattakia City	Jableh City	Total
Household	High Income	2	1	3
	Middle Income	4	1	5
	Low Income	3	1	4
Commercial	Shopping Street	2	--	2
	Private Office	2	--	2
	Restaurant	2	--	2
	Hotel	2	--	2
Public Institution	Public Office	2	--	2
	School	1	--	1
Market		2	--	2
Public Place	Road	(2)	--	(2)
	Public Garden	(2)	--	(2)
Total		22(26)	3	25(29)

Note: Samples value in the ( ) are applied for the composition and bulk density survey.

(3) Methodology for Composition Survey

- The measures for composition survey and laboratory samples were made according to the following Table 2.1.7.

Table 2.1.7 Schedule of Implementing Composition Analysis & Laboratory Samples

Day	Day-3 Feb. 13		Day-4 Feb. 14		Day-5 Feb. 15		Day-6 Feb. 16		Day-7 Feb. 17		Day-8 Feb. 18	
Analysis	LS	Comp	LS	Comp	LS	Comp	LS	Comp	LS	Comp	LS	Comp
High income	L & J	L & J	L	L								
Middle income	L & J	L & J	L	L	L	L	L	L				
Low income	L & J	L & J	L	L	L	L						
Shopping St.					L	L	L	L				
Private office			L	L	L	L						
Restaurant	L	L	L	L								
Hotel			L	L	L	L						
Public office							L	L	L	L		
School									L	L		
Market							L&L	L&L				
Road								L		L		
Public park						L				L		

Notes: L= Lattakia City J= Jableh City
LS= Laboratory Sample Comp. = Composition Analysis

- Upon completion of weight and volume, mix the collected wastes in one day for one income level, for example the ten households for low income are mixed together and then start sort procedure.

- Sort, separately, the voluminous materials of the mixed wastes, which are mainly the combustible materials (food, paper, plastic, textile, wood and leather).
- Sieve the remaining part of waste using 5mm sieve to remove materials of diameter less than 5mm. For the surveyed households, this material is rice and tea, while it is dust and sand in the other categories.
- Continue sorting, separately, the non-combustibles (glass, metal, ceramic and stone).
- Measure the weight of each individual material and calculating the percentage of each weight to the total weight.
- In order to prepare a representative sample for the laboratory, a weight of approximately two kilograms was prepared by mixing each material with its percentage to the total weight.
- The laboratory samples were securely bagged and sent to the laboratory.

(4) Results of Composition Survey

1) Solid Waste Quality at Source

After the analysis of solid waste composition, same samples were sent to laboratory to make further analysis on moisture, combustible and ash contents of solid waste, and also C/N Ratio. Result of analysis is shown in Table 2.1.8 and Table 2.1.9.

Table 2.1.8 Solid Waste Composition (%)

Waste Type	Moisture (%)	Combustible (%)	Ash (%)	C/N Ratio
Domestic Waste	62.1	19.5	18.4	57.3
Commercial Waste	57.8	22.7	19.5	67.3
Office and School	28.4	44.1	27.5	64.8

Table 2.1.9 Results of Solid Waste Analysis

	Moisture (%)	Ash (%)	Combustible (%)	C/N Ratio
Domestic Waste				
Lattakia				
High Income				
13th Soleeba	63.57	7.57	28.86	86
14th Tishrenn Un	59.31	16.38	24.31	51
Middle Income				
13th Soleeba	53.44	22.21	24.35	55
14th Tabiat	68.33	9.58	22.08	40
15th Tishrenn Un	65.03	5.36	29.61	31
16th Jumhoria	78.13	3.65	18.22	53
Low Income				
13th Al Quds	36.18	54.18	9.64	21
14th Uariat	71.63	9.00	19.37	126
15th Al Baath	68.07	19.44	12.49	44
Weighted Average				
Jableh				
High	68.82	7.43	23.75	31
Middle	72.56	12.03	15.40	68
Low	73.10	7.09	19.81	82
Average				
Other Waste				
Shopping Street				
15th Soleeba	28.67	24.94	46.39	110
16th Sheikhdaher	37.86	35.55	26.59	91
Office				
14th Soleeba	3.77	85.58	10.65	22
15th Soleeba	43.40	3.78	52.82	43
Restaurant				
13th Sheikhdaher	74.97	7.73	17.30	56
14th Sheikhdaher	24.57	57.26	18.16	28
Hotel				
14th Kalaa	60.87	8.02	31.12	89
15TH Sheikhdaher	64.81	12.05	23.14	58
Public Office				
16th Sheikhdaher	33.87	13.23	52.90	110
17th Soleeba	54.35	5.48	40.17	79
School				
17th Soleeba	6.42	29.48	64.10	70
Market				
16th Soleeba	86.75	3.35	9.90	47
16th Al Baath	83.97	6.92	9.11	59

2) Solid Waste Analysis at Compost Plant

Solid waste entered into the compost plant in Lattakia and Damascus was analyzed on physical composition, and chemical elements.

The results is shown in Table 2.1.10.

Table 2.1.10 Solid Waste Analysis at Compost Plant

		1	2	3	4	5	6	7	8	9	Average	Average
1	Hauled Waste	Lattakia	Lattakia	Lattakia	Lattakia	Lattakia	Lattakia	Lattakia	Lattakia	Lattakia		
	Date	18	18	18	19	19	19	20	20	20		
	Collection Place	Hameedia	Soleeba	Kamiliya	Mashaher	Ziraa	Oniya	Shehraslan	Shehraslan	Shehraslan		
	Sample Weight (kg)	13.44	13.12	12.13	12.82	13.44	12.25	13.30	11.97	12.65		
1	Physical Composition (%)											
	Foods	51.33	56.00	43.50	56.00	28.50	76.10	20.27	60.97	38.96	51.91	49.97
	Paper	17.11	28.30	5.40	6.70	50.10	4.30	12.96	12.19	31.17	18.65	21,68
	Textile	4.28	0.50	0.50	0.00	0.00	0.00	3.60	0.00	3.90	0.88	1.95
	Plastic	20.32	10.00	39.40	10.00	16.30	15.00	12.80	9.75	25.97	18.50	17.86
	Plants/Tree	6.42	4.00	5.40	0.00	4.00	4.30	3.80	0.00	0.00	4.02	0.00
	Rubber/Leathers	0.00	0.00	0.00	6.60	0.00	0.00	0.00	0.00	0.00	1.10	0.00
	Metals	0.54	1.00	5.40	10.00	0.00	0.00	0.00	7.32	0.00	2.82	3.66
	Bins	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Glasses	0.00	0.00	0.00	6.80	0.10	0.10	9.56	0.00	0.00	1.17	0.00
	Soil/Stone/Ceramics	0.00	0.20	0.40	3.90	1.00	0.20	37.01	9.77	0.00	0.95	4.89
	Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
1	Chemical Elements (%)											
	Carbon	57.69	59.33	58.41	57.71	58.60	58.40	57.44	58.00	58.17	58.36	57.87
	Hydrogen	4.46	4.28	4.34	4.36	4.36	3.32	4.23	4.60	4.41	4.19	4.41
	Nitrogen	1.32	1.20	1.25	1.35	0.90	1.17	1.02	1.22	1.01	1.20	1.08
	Phosphor	0.24	0.36	0.32	0.59	0.08	0.55	0.11	0.15	0.27	0.36	0.18
	Sulfur	0.33	0.47	0.48	1.28	0.33	0.54	0.55	0.46	0.43	0.57	0.48
	Oxygen	35.96	34.36	35.20	34.71	35.73	36.02	36.65	35.57	35.71	35.33	35.98
	Total	100.00	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.00		
1	Carbon/Nitrogen	43.70	49.44	46.73	42.75	65.11	49.91	56.31	47.54	57.59	49.61	53.82

3) Analysis on Compost Produced in Lattakia and Damascus

The compost produced in Lattakia and Damascus compost plant is analyzed. The results is shown in Table 2.1.11.

Table 2.1.11 Quality Compost

		1	2	3	4	5	6	7	8	9	Average	Average
2	Compost	Lattakia	Lattakia	Lattakia	Lattakia	Lattakia	Lattakia	Damascus	Damascus	Damascus		
	Date	18	18	18	19	19	19	20	20	20		
Impurities	Plastic (%)	1.28	1.12	1.89	0.63	3.22	2.14	3.23	5.49	4.50	1.71	4.41
	Glass Stone	15.90	30.80	16.60	20.40	22.40	44.20	5.38	2.81	6.49	25.05	4.89
	Total	17.18	31.92	18.49	21.03	25.62	46.34	8.61	8.30	10.99	26.76	9.30
2	Particle Size (%)											
	more than 25 mm	0	0	0	0	4	4	0	0	0	1.33	0.00
	5 - 25 mm	52	84	76	72	82	86	89	88	85	75.33	87.33
	2 - 5 mm	19	6	6	10	4	2	6	7	9	7.83	7.33
	under 2 mm	29	10	18	14	10	12	5	5	6	15.50	5.33
	Total	100	100	100	96	96	100	100	100	100		
2	Compost Element (%)											
	Organic Composition	36.35	24.31	39.00	31.89	30.69	30.55	48.73	52.94	39.50	32.13	47.06
	Hydrogen	5.63	5.74	5.62	5.63	5.44	5.36	8.63	9.44	9.14	5.57	9.07
	Moisture	12.90	13.63	12.68	13.23	11.69	10.44	37.04	43.59	41.10	12.43	40.58
	Metal/Glass	< 1.00	4.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	1.10	0.50
	C/N Ratio	16.10	17.40	20.70	34.90	30.20	39.30	78.60	52.00	65.40	26.43	65.33
3	Heavy Metal (mg/kg)											
	Pb (120,150)	95.2	121.5	522.1	150.1	113.4	83.3	168.9	142.8	116.9	180.9	142.9
	Cu (150,250)	261.2	334.8	137.3	180.5	1,577.4	175.8	180.8	137.5	168.5	444.5	162.3
	Ni (50,70)	47.0	51.6	50.9	55.8	80.4	50.9	22.1	17.0	16.9	56.1	18.7
	Cr (100,150)	64.9	43.6	51.6	53.1	72.7	41.1	41.3	59.3	37.1	54.5	45.9
	Cd (3,5)	0.932	0.822	7.336	0.393	0.912	0.584	0.504	0.818	0.922	1.8	0.7
	Zn (350,500)	508.7	499.9	442.1	602.6	428.8	390.7	608.4	411.3	361.2	478.8	460.3
	Hg (1.0,3)	2.890	3.058	2.425	5.349	2.891	1.903	3.247	1.136	0.823	3.1	1.7
	As (15,25)	1.798	1.612	2.066	3.579	3.079	2.269	0.811	0.917	0.736	2.4	0.8

4) Solid Waste Composition

The following Table 2.1.12 shows the results for the solid waste composition.

Table 2.1.12 Solid Waste Composition (%)

Item	Food, Veg .& Fruit	Paper	Plastic	Rubber & Leather	Wood	Textile	Metal	Glass	Ceramic	Stone & Sand	5 mm & Less (organic)	Bones	Plant leaf	Other Material <5mm	Total
For Lattakia															
High income	37.00	4.28	5.99	0.00	0.06	0.36	0.35	0.72	0.35	0.00	0.71	0.00	0.00	0.00	49.82
Percentage	74%	9%	12%	0%	0%	1%	1%	1%	1%	0%	1%	0%	0%	0%	100%
Middle income	77.61	13.74	8.87	0.55	0.42	1.32	2.06	1.99	0.92	0.00	2.45	0.34	0.26	0.00	110.53
Percentage	70%	12%	8%	0%	0%	1%	2%	2%	1%	0%	2%	0%	0%	0%	100%
Low income	70.99	4.12	7.27	0.00	0.87	3.34	1.33	1.22	0.00	2.30	1.32	0.80	0.00	0.00	93.56
Percentage	76%	4%	8%	0%	1%	4%	1%	1%	0%	2%	1%	1%	0%	0%	100%
Shopping st.	1.32	2.80	2.02	0.00	0.10	0.00	0.09	1.15	0.00	0.00	0.00	0.00	0.00	0.00	7.48
Percentage	18%	37%	27%	0%	1%	0%	1%	15%	0%	0%	0%	0%	0%	0%	100%
Office	0.00	0.57	0.32	0.00	0.00	0.00	0.00	0.00	0.00	5.20	0.00	0.00	0.00	0.00	6.09
Percentage	0%	9%	5%	0%	0%	0%	0%	0%	0%	85%	0%	0%	0%	0%	100%
Restaurant	44.34	6.23	3.50	0.00	0.00	0.00	2.22	16.00	0.00	0.00	0.06	0.15	0.00	0.00	72.50
Percentage	61%	9%	5%	0%	0%	0%	3%	22%	0%	0%	0%	0%	0%	0%	100%
Hotel	27.28	2.34	1.76	0.00	0.70	0.90	0.66	1.20	0.00	0.00	0.00	0.38	0.00	0.00	35.22
Percentage	77%	7%	5%	0%	2%	3%	2%	3%	0%	0%	0%	1%	0%	0%	100%
Public office	0.00	4.88	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13	0.00	0.00	0.00	5.48
Percentage	0%	89%	6%	0%	0%	0%	0%	0%	0%	2%	2%	0%	0%	0%	100%
School	0.37	6.00	1.00	0.00	0.52	0.00	0.75	0.20	0.00	0.70	0.00	0.00	0.00	0.00	9.54
Percentage	4%	63%	10%	0%	5%	0%	8%	2%	0%	7%	0%	0%	0%	0%	100%
Market	73.62	0.93	1.27	0.00	0.00	0.23	0.16	0.00	0.00	0.09	0.00	3.84	0.00	0.00	80.14
Percentage	92%	1%	2%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	100%
Road	37.81	20.32	19.90	2.57	0.18	2.33	0.96	1.62	0.00	12.05	0.00	0.00	3.60	7.10	108.44
Percentage	35%	19%	18%	2%	0%	2%	1%	1%	0%	11%	0%	0%	3%	7%	100%
Public park	4.53	0.82	1.51	0.02	0.00	0.13	0.09	1.40	0.00	0.31	0.00	0.00	18.22	0.00	27.03
Percentage	17%	3%	6%	0%	0%	0%	0%	5%	0%	1%	0%	0%	67%	0%	100%
For Jableh															
High income	6.60	1.60	0.80	0.00	0.00	0.34	0.00	0.32	0.00	0.00	0.06	0.00	9.72	0.00	19.44
Percentage	34%	8%	4%	0%	0%	2%	0%	2%	0%	0%	0%	0%	50%	0%	100%
Middle income	13.25	1.15	1.04	0.00	0.06	0.10	0.00	0.00	0.00	0.80	0.34	0.00	16.74	0.00	33.48
Percentage	40%	3%	3%	0%	0%	0%	0%	0%	0%	2%	1%	0%	50%	0%	100%
Low income	13.12	0.15	0.73	0.00	0.00	0.36	0.00	0.00	0.17	0.00	0.05	0.00	14.58	0.00	29.16
Percentage	45%	1%	3%	0%	0%	1%	0%	0%	1%	0%	0%	0%	50%	0%	100%

(5) Recommendations and Conclusion

During the survey preparation and meetings with the Lattakia, Jableh and Al-Haffeh Mayors, and the responsible persons in the cleansing departments of these cities. These officials explained to the JICA Study Team that the quantity and quality of the generated wastes in their cities are different seasonally (winter and summer) due to the following reasons:

- There are increases of the population in their cities due to arrival of the citizens of these cities who are working in other Governorate to stay in their hometown during the summer holidays. In addition, there are many tourists arrive to Lattakia, Jableh, Al-Haffeh in summer season.
- There are more types of agricultural products in summer than these ones in winter.
- The summer products (watermelon, molekhia, etc.) produce a lot of wastes.
- They are facing severe problems due to the increase of wastes in summer, although they are working very hard to overcome the problem.

Based on the above, the officials requested JICA Study Team to extend a supplementary survey in the summer season to conclude the actual increase and propose the solution.

It could be useful to extend the same survey in summer using the same categories, generated places and numbers of this survey.

2.2 SURVEY IN SUMMER

2.2.1 Solid Waste Amount Survey at Source:

(1) Objective of the Survey

The objective of the solid waste amount survey at source in summer is to judge and identify any changes of the waste generation rates of household and commercial premises due to seasonal change. And also, to conclude the changes of waste composition due to the difference of agricultural products between summer and winter. The changes of the obtained results, if any, can be applied for Al-Haffeh City and Al Qurdaha City.

The survey will provide additional information can be applied in formulating the Solid Waste Master Plan.

(2) Methodology of the Survey

1) Survey Period

The Survey was carried out in summer season. The survey period was eight continuous days. The starting and ending dates for the Survey is shown in Table 2.2.1.

Table 2.2.1 Starting and Ending Dates of Solid Waste Amount Survey

Survey Location	Starting Date	Ending Date	Remarks
1. Lattakia City	July 24	July 31	- First sample received on July, 25 and last sample received August, 1
2. Jableh City	July 25	August 1	- First sample received on July, 26 and last sample received August, 2

2) Number of the Collected Samples and Locations

The total numbers of collected samples for both Lattakia City and Jableh City were amended to be 130 because the school samples were omitted due to school closing for summer holiday. The following Table 2.2.2 will show the number and generating place of the collected samples for both cities in summer season.

Table 2.2.2 Samples Number and Generated Place

Category	Generated Place	Lattakia City	Jableh City	Total
Household	High Income	20	5	25
	Middle Income	40	5	45
	Low Income	30	5	35
Commercial	Shopping Street	3	1	4
	Private Office	3	1	4
	Restaurant	3	1	4
	Hotel	2	-	2
Public Institution	Public Office	2	1	3
Market		3	1	4
Public Place	Road	2	-	2
	Public Garden	2	-	2
Total		110	20	130

The same number of other collected samples for households and commercial premises and other activities were taken the same as the numbers in winter survey.

Locations of the summer survey are the same as winter survey to have the actual changes of the unit generation rate and the composition analysis, if any. The following Table 2.2.3 will show the locations of the collected samples by districts in Lattakia City and Jableh City.

Table 2.2.3 Location of Collected Samples by District

City	Lattakia City	Jableh City
Generated Place	District Name	District Name
High Income	Soleeba District	Job Jowaikha and El Jabibat Districts
Middle Income	Soleeba, Tishreen University, Tabiat and Jumhoria Districts	Job Jowaikha, El Omara and El Jabibat Districts
Low income	Ugariat, Al-Baath and Al- Quds District	El Balda El Qadima and El Faid Districts
Shopping Street	Sheikhdaher District	El Balda El Qadima District
Private Office	Soleeba District	El Ezaa District
Restaurant	Sheikhdaher District	El Jobibat District
Hotel	Kalaa District and Sheikhdaheer Districts	---
Public Office	Sheikhdaher and Soleeba Districts	El Balda El Qadima Sistrict
Market	Al-Bath, Soleeba and Sheikhdaher Districts	El Balda El Qadima District
Road	Kalaa and Owena Districts	---
Public Garden	Soleeba and Sheikhdaher Districts	---

Location map of sample locations is attached.

3) Method of Selecting Sample Locations

To have the actual and representative changes of the results on generated quantities as well as their composition due to the seasonal change the following was taken into consideration in Summer Survey:

- The same sample number and locations, procedures and consideration that were made in the winter survey were applied in the summer survey.
- It can be refer to "Survey in Winter" for more detail about method of selecting sample locations.

4) Waste Sample Collection System

The mentioned procedures in Winter Survey for sample collection were followed. These procedures can be summarized as follow:

- Interview to explain the purpose of the survey.
- Distributing the plastic bags one day before the collection day.
- Recording the number of inhabitant of the household and/ or users of the selected premises and the floor area.
- Recording the code number.
- Collecting plastic bags filled with waste at fixed time.

Refer to the Winter Survey for the detailed procedures.

5) Waste Measurement and Recording

a. Upon completing the collection procedure, the samples are transferred to the measuring yard.

b. The samples are classified into their categories using the fixed ticket on the plastic bag to show the code number for each household (high, middle and low income), commercial area, market, etc.

c. Measuring the weight of each sample and recording the weight on the respective record sheet.

d. Measuring the volume for each sample by opening the plastic bag and emptying the waste in a calibrated plastic barrel of capacity 40 liter. To have an accurate measure of the volume, left the barrel to a height of about 30 cm and drop it and repeat lifting and dropping three times. Record the volume on the respective record sheet.

e. After recording the weigh and volume, the bulk density (kg/l) and the unit generation for a household (kg/cap./day & l/cap./day), for market (kg/100 m^2/day & l/100 m^2/day), etc.

(3) Survey Results and Analysis

The main purpose of the survey and analysis is to determine the generation rate and bulk density of the generated municipal wastes in Lattakia City and the surrounding three cities in summer season.

1) Unit Generation and Bulk Density

The results of the unit generation and bulk density for each category of the survey items are shown in Tables 2.2.4 and 2.2.5.

Table 2.2.4 Bulk Density and Unit Generation Rate for Household

City	Lattakia City		Jableh City	
Generated Place	Unit Generation kg/cap./day	Bulk Density kg/l	Unit Generation kg/cap./day	Bulk Density kg/l
High Income	0.782	0.176	0.927	0.216
Middle Income	0.634	0.180	0.548	0.201
Low income	0.432	0.257	0.507	0.269
Average Unit Generation	0.616		0.661	

Table 2.2.5 Bulk Density and Unit Generation Rate for Commercial, Public Institution, Market and Public Place

City	Lattakia City		Jableh City	
Generated Place	Aver. Unit Generation kg/100m^2/day	Aver. Bulk Density kg/l	Aver. Unit Generation kg/100m^2/day	Aver. Bulk Density kg/l
Shopping Street	1.054	0.025	2.005	0.041
Private Office	0.197	0.032	0.746	0.034
Restaurant	14.164	0.154	4.554	0.251
Hotel	21.52 kg/bed/day	0.192	----	----
Public Office	0.496	0.39	0.220	0.049

City	Lattakia City		Jableh City	
Generated Place	Aver. Unit Generation kg/100m^2/day	Aver. Bulk Density kg/l	Aver. Unit Generation kg/100m^2/day	Aver. Bulk Density kg/l
Market	34.589	0.157	275.238	0.229
Road	8.528	0.189	---	---
Public Garden	0.737	0.107	---	---

2) Comparison of Summer and Winter Surveys

The following Table 2.2.6 is to show the comparison of the obtained results in Summer and Winter seasons for household.

Table 2.2.6 Comparison of Bulk Density and Unit Generation Rate for Household

City	Summer				Winter			
	Lattakia City		Jableh City		Lattakia City		Jableh City	
Generated Place	Unit Gen. kg/cap/d	Bulk Den. kg/l	Unit Gen. kg/cap/d	Bulk Den. kg/l	Unit Gen. kg/cap/d	Bulk Den. kg/l	Unit Gen. kg/cap/d	Bulk Den. kg/l
High Income	0.782	0.176	0.927	0.216	0.562	0.164	0.619	0.190
Middle Income	0.634	0.180	0.548	0.548	0.563	0.190	0.519	0.172
Low income	0.432	0.257	0.507	0.269	0.383	0.248	0.378	0.186
Average Unit Generation	0.616		0.661		0.502		0.506	
General Average	0.638 Kg/capita/day				0.504 Kg/capita/day			

As explained above the general average of the unit generation was increased in summer than in winter but it is still within the normal limits.

Table 2.2.7 Comparison of Bulk Density and Unit Generation Rate for Household

City	Summer				Winter			
	Lattakia City		Jableh City		Lattakia City		Jableh City	
Generated Place	Unit Gen. kg/100m^2/d	Bulk Den. kg/l	Unit Gen. kg/100m^2/d	Bulk Den. kg/l	Unit Gen. kg/100m^2/d	Bulk Den. kg/l	Unit Gen. kg/100m^2/d	Bulk Den. kg/l
Shop. Street	1.054	0.025	2.005	0.041	1.759	0.042	7.449	0.097
Private Office	0.197	0.032	0.746	0.034	2.34	0.096	0.844	0.099
Restaurant	14.164	0.154	4.554	0.251	17.968	0.176	5.766	0.185
Hotel	21.52 kg/bed/d	0.192	-	-	0.142 kg/bed/d	0.176	-	-
Public Office	0.486	0.39	0.220	0.049	1.026	0.072	0.024	0.062
Market	34.589	0.157	275.238	0.229	75.675	0.330	85.193	0.186
Road	8.528	0.189	-	-	14.784	0.183	-	-
Public Garden	0.737	0.107	-	-	0.419	0.115	-	-

The following comments can be concluded from the above table:

- Although data concerning the occupancy of the hotels could not be obtained, for summer and winter, because the hotel owners refused to pass this information, but it is clear that the unit generation rate for hotels is increased because of the high occupancy in the summer season.
- The unit generation for restaurant was decreased because the selected samples are for restaurants located in the city center. Those restaurants have fewer guests in summer because most of the people prefer coastal restaurant in summer.
- The unit generation of shopping street, private office and public office was decreased because of the summer holidays.

- The unit generation for public garden and road was increased because people in summer stay up to late evening in gardens and streets.
- The unit generation for market area in Jableh was increased and it is understandable because of the nature of type agricultural products in summer and that was the same reason for the increase of the unit generation for the household.
- As for Lattakia the unit generation for market area was decreased and there is no clear reason for that, unless in summer many sellers on the side walks surrounding the markets are selling the same vegetable and fruits that sold in the stalls from which the samples are collected. Such sellers may cause decrease the amount of sales for the stalls. Fewer numbers of sidewalk sellers were existing in winter season.

2.2.2 SOLID WASTE COMPOSITION SURVEY AT SOURCE

(1) Objective of the Survey

The goal of the solid composition survey at source in summer is to determine the variation in waste composition for the generated waste from the households and the commercial activities. It is important to have such data at source because solid waste composition will be changed during the process of solid waste collection due to mixing of several wastes. Therefore, the sample is taken at the solid waste amount survey at source as described in Section 4.1.

(2) Number of Samples and Survey Period

To obtain the actual measure for the composition analysis and to prepare the representative samples for chemical analysis and Carbon/Nitrogen ratio, measures were made for the following numbers of samples shown in Table 2.2.8.

Table 2.2.8 Samples Number

Category	Generated Place	Lattakia City	Jableh City	Total
Household	High Income	2	1	3
	Middle Income	4	1	5
	Low Income	3	1	4
Commercial	Shopping Street	2	--	2
	Private Office	2	--	2
	Restaurant	2	--	2
	Hotel	2	--	2
Public Institution	Public Office	2	--	2
Market		3	--	2
Public Place	Road	(2)	--	(2)
	Public Garden	(2)	--	(2)
Total		22(26)	3	25(29)

Note: Samples value in the ( ) are applied for the composition and bulk density survey. The sample of school was omitted because of the school closing for summer holiday and additional sample for market was made to replace the omitted sample.

(3) Methodology for Composition Survey

- The measures for composition survey and laboratory samples were made according to the following Table 2.2.9.

Table 2.2.9 Schedule of Implementing Composition Analysis & Laboratory Samples

Day	Day-4 July 28	Day-5 July 29	Day-6 July 30
Analysis	Comp	Comp	Comp
High income	L&L	J	
Middle income	L	L&L&L&J	
Low income		L&L&L&J	
Shopping St.	L&L		
Private office	L&L		
Restaurant		L	L
Hotel	L&L		
Public office		L	L
Market	L	L&L	
Road			L&L
Public park	L	L	

Notes: L= Lattakia City J= Jableh City
Comp. = Composition Analysis

- Upon completion of weight and volume, mix the collected wastes in one day for one income level, for example the ten households for low income are mixed together and then start sort procedure.
- Sort, separately, the voluminous materials of the mixed wastes, which are mainly the combustible materials (food, paper, plastic, textile, wood and leather).
- Sieve the remaining part of waste using 5mm sieve to remove materials of diameter less than 5mm. For the surveyed households, this material is rice and tea, while it is dust and sand in the other categories.
- Continue sorting, separately, the non-combustibles (glass, metal, ceramic and stone).
- Measure the weight of each individual material and calculating the percentage of each weight to the total weight.

(4) Results of Composition Survey

The following Table 2.2.10 shows the obtained results for the compassion analysis in summer survey.

Table 2.2.10 Solid Waste Composition (%) – In Summer

Item	Food, Veg.& Fruit	Paper	Plastic	Ruber & Leather	Wood	Textile	Metal	Glass	Ceramic	Stone & Sand	5 mm & Less (organic)	Bones	Plant leaf	Other Material <5 mm	Total
For Lattakia															
High income	52.26	6.41	6.14	0.00	0.28	0.1	1.29	1.06	0.00	0.00	0.04	0.06	0.00	0.00	68.75
Percentage	76%	9%	9%	0%	0%	0%	2%	2%	0%	0%	0%	0%	0%	0%	100%
Middle income	101.42	12.12	10.44	0.31	0.00	2.10	1.76	0.82	0.00	0.14	0.00	0.60	0.00	0.00	129.71
Percentage	78%	9%	8%	0%	0%	2%	1%	1%	0%	0%	2%	0%	0%	0%	100%
Low income	69.47	3.74	9.78	0.57	0.54	4.39	0.74	0.47	0.00	5.68	0.40	0.29	0.00	5.10	101.17
Percentage	69%	4%	10%	1%	1%	4%	1%	0%	0%	6%	0%	0%	0%	5%	100%
Shopping st.	0.00	1.43	1.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.69
Percentage	0%	53%	42%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Office	0.00	0.77	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95
Percentage	0%	81%	15%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Restaurant	37.10	3.16	5.13	0.00	0.00	0.7	1.02	4.54	0.00	0.00	0.00	0.00	0.00	0.00	51.65
Percentage	72%	6%	10%	0%	0%	1%	2%	9%	0%	0%	0%	0%	0%	0%	100%
Hotel	25.40	1.90	2.29	0.00	0.00	0.33	1.23	0.81	0.00	0.17	0.00	1.34	0.00	0.18	33.65
Percentage	75%	6%	7%	0%	0%	1%	4%	2%	0%	1%	0%	4%	0%	1%	100%
Public office	0.00	2.26	0.72	0.00	0.00	0.00	0.10	0.20	0.00	0.14	0.00	0.00	0.14	0.00	3.56
Percentage	0%	63%	20%	0%	0%	0%	3%	5%	0%	4%	0%	0%	4%	0%	100%
Market	54.96	1.80	2.30	0.00	0.00	0.00	0.00	0.10	0.00	0.44	0.00	0.00	0.00	0.00	59.60
Percentage	92%	3%	4%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	100%
Road	20.15	7.50	10.33	0.40	0.17	1.50	0.71	0.86	0.40	4.81	0.00	0.00	3.36	15.47	65.66
Percentage	31%	11%	16%	1%	0%	2%	1%	1%	1%	7%	0%	0%	5%	24%	100%
Public park	4.63	5.40	3.87	0.00	4.00	0.78	0.21	0.68	0.00	2.00	0.00	0.00	8.05	0.00	
Percentage	16%	18%	13%	0%	14%	3%	1%	2%	0%	7%	0%	0%	27%	0%	100%
For Jableh															
High income	5.40	1.82	2.03	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.49
Percentage	57%	19%	21%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Middle income	12.02	1.10	1.80	0.00	0.00	0.12	0.43	0.05	0.00	0.00	0.00	0.00	0.00	0.00	15.52
Percentage	77%	7%	12%	0%	0%	1%	3%	0%	0%	0%	0%	0%	0%	0%	100%
Low income	10.40	1.60	1.30	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	13.55
Percentage	77%	12%	10%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	100%

(5) Conclusion and Comments

Comparing the summer and winter survey results, the following can be noticed:

- The percentage of food, vegetable and fruits for household in Lattakia has an average increase for the three income levels of about 9%.
- The percentage of food, vegetable and fruits for household in Jableh has an average increase for the three income levels of about 30%.

From the above we reach to the same result which caused the increase of the unit generation for household in summer season. This result is the nature of agricultural products in summer season, like water melon and molokhia, is the reason in addition to many families store some foods to use in winter season.

It is necessary to have seasonal surveys for the Lattakia and Jableh to monitoring the seasonal changes in both the generated solid waste amount and the solid waste composition. These surveys can be made, seasonally, by both cities with their own staff.

2.3 SOLID WASTE AMOUNT TRANSPORTED TO THE EXISTING COMPOST PLANT AND AL-BASSA

2.3.1 Survey in Summer

(1) Objective of the Survey

The collected solid waste collected in Lattakia City is transported to Al Bassa disposal site. The compost plant was closed. The survey aims to determine the amount of solid waste is transported to Al Bassa disposal site in summer. The survey will determine the service ratio of solid waste collection in Lattakia City.

(2) Methodology of the Survey

1) Survey Period

The Survey was carried out in summer season for eight continuous days during the period from July 25 to August 1, 2001.

2) Method of Survey

The survey includes all vehicles entering the disposal site along the whole day (morning and evening times. Time of arrival and departure, type and plate numbers of the vehicle were recorded. Also, records for the weight of collection vehicles from Lattakia city were recorded by using the weigh bridge existing in the closed compost plant at Al-Bassa entrance.

(3) Survey Result

The results of the survey are summarized in the following Table 2.3.1 (1) and 2.3.1 (2). During the survey period, the total number of vehicles dumped waste in Al Bassa dumpsite were 267 vehicles. Out of this number 248 vehicles were from Lattakia and the remaining 19 were from outside.

The amount of waste transported from Lattakia, during the eight days, was 1,725 tons and of the average was daily 216 ton/day.

The average collection ration in summer is about 70% assuming that an amount of 330 ton/day of waste could be generated using the following formula:

- Domestic waste amount = (population) x (unit generation rate)
  = (366,000 person) x (0.63 kg/cap/day) / 1000 = 231 ton/day
- Commercial waste = 30% of total waste = 99 ton/day
- Total = 330 ton/day

Table 2.3.1 (1) Solid Waste Amount Transported to Al Bassa in Summer

Day	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul	1-Aug	Total
No. of arrival (Trip)									
Morning shift from Lattakia	12	7	9	12	12	10	10	10	82
Night shift from Lattakia	17	21	15	24	21	17	26	25	166
Sub-Total from Lattakia	29	28	24	36	33	23	36	35	248
From outside Lattakia	2	4	0	3	2	4	2	2	19
Total	31	32	24	39	35	27	38	37	267
Solid waste amount (Ton)									
Morning shift (La)	71.0	43.9	63.2	76.9	84.0	73.5	74.2	53.3	540.0
Night shift (La)	87.2	128.8	103.2	160.2	137.5	193.5	196.6	178.1	1,185.1
Total from Lattakia	158.2	172.7	166.4	237.1	221.5	267.0	270.8	231.4	1,725.0

Table 2.3.1 (2) Trips and Solid Waste Amount transported to Al-Bassa Disposal Site

Day	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul	1-Aug	Total
No. of arrival (Trip)									
Morning shift (La)	12	7	9	12	12	10	10	10	82
Night shift (La)	17	21	15	24	21	17	26	25	166
Total	29	28	24	36	33	27	36	35	248
From outside	2	4	0	3	2	4	2	2	19
Total	31	32	24	39	35	31	38	37	267
Solid waste amount (Ton)									
Morning shift (La)	71.0	43.9	63.2	76.9	84.0	73.5	74.2	53.3	540.0
Night shift (La)	87.2	128.8	103.2	160.2	137.5	193.5	196.6	178.1	1,185.1
Total from Lattakia	158.2	172.7	166.4	237.1	221.5	267.0	270.8	231.4	1,725.0

Note: Estimated amount
Population x 0.63 kg/person
x 8 day x 100 %/ 70%

Breakdown	25-Jul	26-Jul	27-Jul	28-Jul	29-Jul	30-Jul	31-Jul	1-Aug	Total	Population	Estimated	Collection
A1 Sheekhdahar	25.6	18.3	29.0	54.8	42.5	48.6	43.9	31.1	293.8	29,724	214	137.3%
A2 Al Oweena	9.4	6.8	8.8	16.4	18.7	54.5	41.9	24.9	181.4	12,512	90	201.4%
A3 Al Kala									-	14,350	103	0.0%
A4 Al Soleeba	16.2	17.4	20.5	21.0	20.0	28.2	26.1	26.8	176.2	60,383	435	40.5%
A5 Tabiat									-	20,115	145	0.0%
Sub total A	51.2	42.5	58.3	92.2	81.2	131.3	111.9	82.8	651.4	137,084	987	66.0%
B1 Tishreen UN	10.6	14.8	9.8	9.5	0.9	10.0	15.0	19.8	90.4	19,186	138	65.4%
B2 Al Quds	31.5	38.8	5.7	22.9	19.1	31.3	34.3	33.9	217.5	27,702	199	109.0%
Sub total B	42.1	53.6	15.5	32.4	20.0	41.3	49.3	53.7	307.9	46,888	338	91.2%
C1 Al Thawra				8.0	9.3	5.0			22.3	34,565	249	9.0%
C2 Al Baath		7.9	6.0	16.0		27.2	15.7	11.0	83.8	21,667	156	53.7%
C3 Al Sabea	17.1	13.5	27.4	31.7	33.1	18.2	35.9	29.2	206.1	12,339	89	232.0%
C4 Tishreen									-	18,190	131	0.0%
Sub total C	17.1	21.4	33.4	55.7	42.4	50.4	51.6	40.2	312.2	86,761	625	50.0%
D1 Ogareet	21.3	13.4	9.9	12.6	27.0	7.4	20.0	23.3	134.9	23,290	168	80.4%
D2 Besnada									-	19,977	144	0.0%
Sub total D	21.3	13.4	9.9	12.6	27.0	7.4	20.0	23.3	134.9	43,267	312	43.3%
E1 Al Gomhoria	16.2	26.5	20.1	22.2	22.4	12.4	14.0	7.2	141.0	33,776	243	58.0%
E2 Al Assad	10.3	15.3	29.2	22.0	19.0	24.2	24.0	24.2	168.2	18,000	113	148.3%
Sub total E	26.5	41.8	49.3	44.2	41.4	36.6	38.0	31.4	309.2	51,776	367	84.3%
Total Lattakia	158.2	172.7	166.4	237.1	212.0	267.0	270.8	231.4	1,715.5	365,776	2,634	65.1%

SECTION 3

COMPOSTING PLAN

SECTION 3 COMPOSTING PLAN

3.1 COMPOST DEMAND SURVEY

3.1.1 General

The objective of the survey is to determine the extent of the potential market for compost in Lattakia. The survey collected data through interviews with selected farmers in the study area. General conditions are as follows:

(1) Study Area

Study area is within 50 km from existing compost plant in Lattakia.

(2) Survey Method

The survey was made by interviewing the following assembly, cooperative, organic fertilizer seller, and 50 selected farmers by questionnaires as well as showing typical samples of compost produced in the existing compost plant in Damascus.

- Lattakia Assembly of Farmers' Union Lattakia
- Farmers' cooperative in Bdemune, Farmers' cooperation in Al Bassa, Lattakia Assembly

(3) Selection of Farmers to be Interviewed

50 large-scale farmers were selected for the interview within 50 km from existing compost plant for the three categories below.

- 10 farmers who have been purchasing the compost from the existing compost plant:
- 10 farmers who have stopped purchasing the compost from the existing compost plant:
- 30 farmers who have never purchased the compost:

3.1.2 Collection of Related Information

Main collected information is as follows.

(1) General Information

1) Farmers' Union Organization

Lattakia Farmers' Union consists of four (4) Assemblies, i.e. Jableh, Qurdaha, Al-Haffeh, and Lattakia. These Assemblies consist of 108 cooperatives 8and farmers belong to the cooperative). Figure 3.1.1 shows Lattakia Farmers' Union Organization Chart.

2) Market Flow of Fertilizer

The farmers purchase the compost from Lattakia Municipality, while they purchase organic fertilizer such as cow manure from sellers and chemical fertilizer from the farmers' Assembly as shown in Figure 3.1.2.

3) Land Use

101 ha, approximately 44 % of total area in Lattakia in 1998, is cultivated land as shown in Table 3.1.1.

Table 3.1.1 Land Use in Lattakia in 1998

Land		Area (1,000ha)
Cultivated land	Irrigated	34
	Non-irrigated	67
	Sub-total	101
Uncultivated		10
Sub-total of arable land		111
Steppe		28
Forest		5
Non-arable land		86
Total		230

Source: The statistics Bureau in The Ministry of Agriculture.

4) Chemical Fertilizers

Around 10,000 ton of chemical fertilizer is produced every year and the selling cost range from approximately 5,000 to 12,000 SP/ton. The detail is shown in Table 3.1.2.

Table 3.1.2 Production and Price of Chemical Fertilizers

Fertilizers	Nitrogen			Phosphate	Potassium	Total
	Urea	33% Nitrate	30% Nitrate	P_2O_5	K_2O	
Price (SP per ton)	7,700	6,600	5,400	8,300	12,100	-
Production (ton)						
1995			6,608	2,357	989	9,054
1996			6,678	2,430	894	10,002
1997			6,770	2,564	1,145	10,479
1998			6,782	2,203	931	9,966
1999			6,54	1,653	920	8,927

Source: The statistics Bureau in The Ministry of Agriculture.

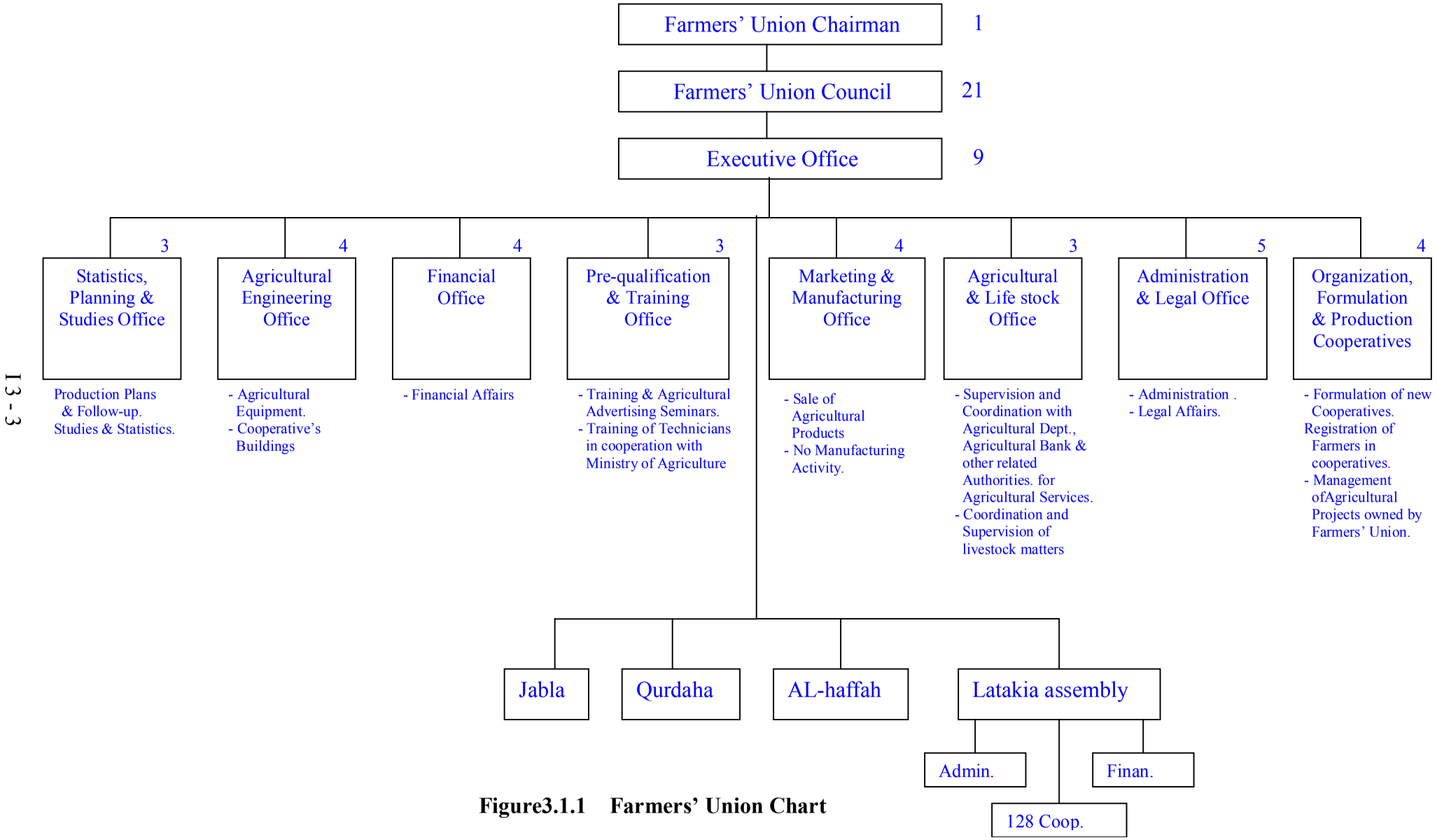
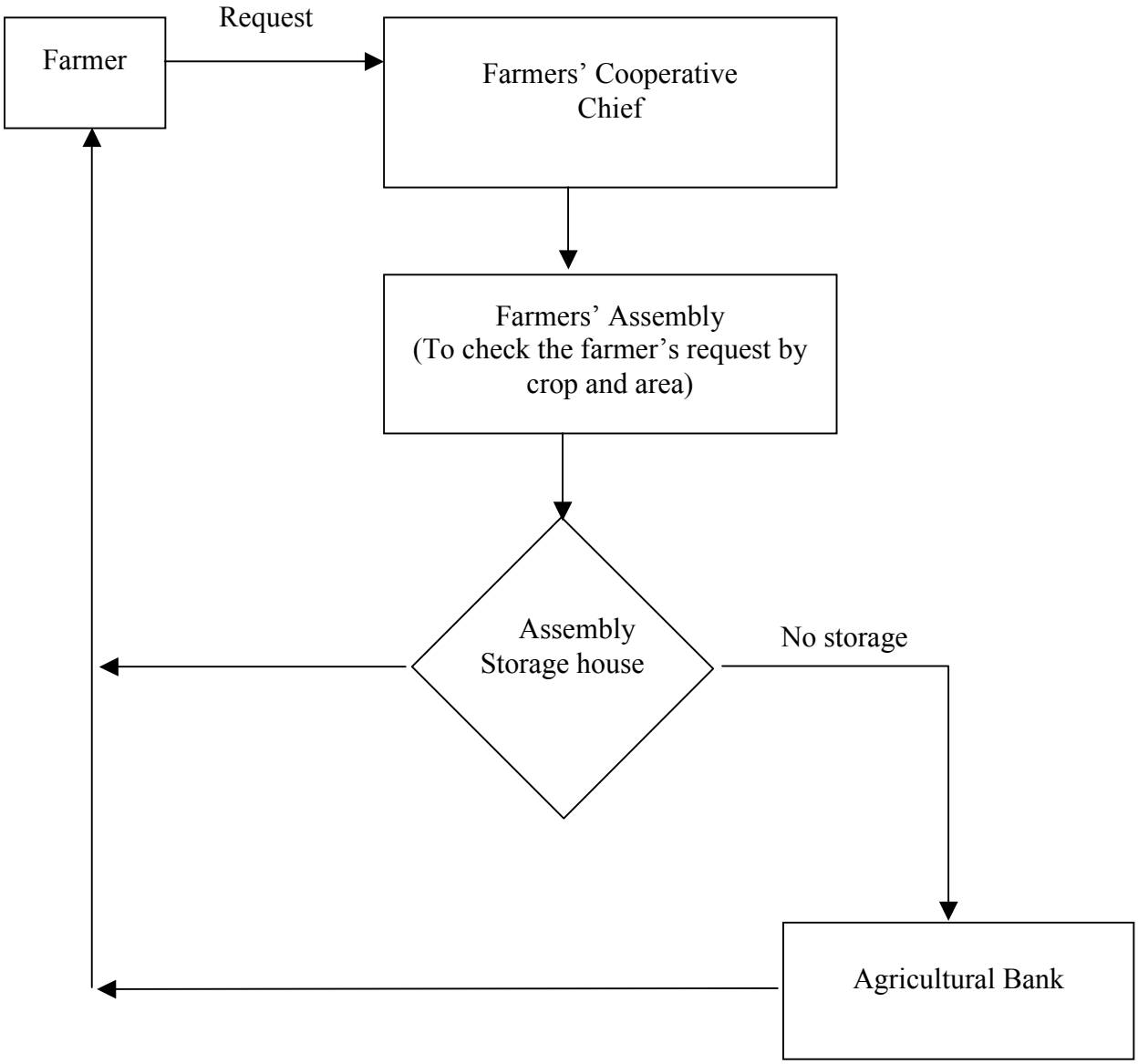


Figure3.1.1 Farmers' Union Chart



(*1): Farmers sometimes use vehicles owned by the co-operatives.

Figure 3.1.2 Market Flow of Chemical Fertilizer

5) Organic Fertilizers

Around 175,000 ton of organic fertilizes are produced every year and the selling cost ranges from 1,000 to 2,000 SP/ton as shown in Table 3.1.3.

Table 3.1.3 Production and Price of Organic Fertilizers

Fertilizers	Cattle	Sheep & goats	Poultry	Total
Price (SP per ton)	1,000	1,600	2,000	-
Production (ton)				
1995	152,082	3,265	19,994	175,341
1996	155,052	3,454	20,385	178,891
1997	96,532	3,922	21,361	121,815
1998	146,049	2,124	18,868	167,041
1999	151,072	2,758	20,117	173,947

Source: Estimated value using number of livestock.

6) Agricultural Production

In 1999 about 73 % of agricultural production was fruit and 23 % is vegetables. Table 3.1.4 shows the agricultural production in the last 5 years.

Table 3.1.4 Agricultural Production

Year	Crops		Vegetables		Fruits		Total	
	IRRI	NON-IRR	IRRI	NON-IRR	IRRI	NON-IRR	IRRI	NON-IRR
1995	10,860	48,726	235,000	41,821	475,828	158,589	721,688	249,136
	59,586		276,821		634,417		970,824	
1996	12,737	57,134	231,642	46,687	575,474	167,710	819,853	271,531
	69,871		278,329		743,184		1,091,384	
1997	12,459	40,639	175,139	45,155	449,697	146,163	637,295	231,957
	53,098		220,294		595,860		869,252	
1998	14,671	49,452	204,829	51,147	600,597	177,102	820,097	277,701
	64,123		255,976		777,699		1,097,798	
1999	11,759	30,512	176,906	36,091	567,677	114,209	756,342	180,812
	42,271		212,997		681,886		937,154	

Source: The statistics Bureau in The Ministry of Agriculture.

(2) Soil Condition

1) Agricultural Settlement

Syria is divided into five agricultural settlement zones. Lattakia belongs to the first zone distinguished by annual rainfall over 350 mm. The first zone is subdivided into two divisions:

- An area with annual rainfall over 600 mm where non-irrigated crops could be successfully planted.
- An area with annual rainfall between 350-600, and not less than 300 mm during two thirds of the related period i.e. it is possible to get two crops for each three year period.

2) Soil Group

80 % of soil in Lattakia is classified Red Mediterranean which is the soil formed at the Mediterranean coast (for this reason it is called Mediterranean). It is a mix of clay, sand, and lime. The clay may be yellow, black, or red. Red is the most common (for this reason it is called red). The detail is shown in Table 3.1.5.

Table 3.1.5 Soil Condition of Lattakia

(1,000 hectares)

SOIL GROUPS	Red Mediterranean	Alluvial (*)	Soil Formed by Groundwater	Total
Area	184	22	24	230

Source: The statistics Bureau in The Ministry of Agriculture.

*Note) Alluvial group includes clay, sand, or lime deposited by running water.

3.1.3 Interview Survey of Farmers' Awareness of Compost

The interview was done using questionnaire and showing sample of compost produced in Damascus compost plant.

The interview sheet (questionnaire) and result are attached as Appendix I, II-4-1.

Survey conclusions are as follows:

(1) Farmers who Purchase Compost

1) Reasons for Continuing to Purchase

- Low price : 100%
- Good for sandy soils: 100% (those who have sandy soil.)
- Good for crops : 30%

2) Suggestions

- Improving the quality : 100%
- Increasing the quantity (big farms) : 70%
- Changing the plant site for bad odor : 20%
  (neighbor villages, especially the Al-Bassa)

(2) Farmers who have Stopped Purchasing Compost

1) Reasons for Stopping

- Bad quality : 70%
- No availability : 20%
- Bad odor : 10%

2) Possibility of Resuming Purchasing

70% of farmers who have stopped purchasing will resume purchasing if the reasons for stopping are being removed. (The team believes the ratio will go beyond 90 % if the suggestions are executed and these farmers notice the continuity of good production of the plant for reasonable period).

(3) Farmers who have never Purchased Compost

1) Farmers who have no Previous Knowledge about Compost

Theses farmers compose 70% of farmers who have never purchased compost.

a. Percentage interested in purchasing

52% of them are interested in purchasing compost.

48% 0f them are not interested in purchasing compost.

b. Reasons for lack of interest

- Undecided (40%*: 19%**)
- Produce organic fertilizer at their farms (20%: 9.5%)
- Used to organic fertilizers (10%: 5%)
- Do not use organic fertilizers (20%: 9.5%)
- Do not care in low price of compost (small farms) (10%: 5%)

Note *: Percentage of farmers who are not interested in purchasing compost.
**: Percentage farmers who have no previous knowledge about compost

c. Conclusions

If the compost plant products a good quality compost and in enough quantity, we can add the farmers who have no decision (19%), because the survey team believes that their attitude is affected by the negative experiences of other farmers with the compost plant as a conservative estimate we can add a ratio of 10%.

Therefore, 62% of farmers who have no previous knowledge about compost are likely to interested in purchasing compost.

This is equal to 43.3% of farmers who never purchased compost.

2) Farmers who have Previous Knowledge about Compost

Theses farmers compose 30% of farmers who never purchased compost.

a. Reasons for not purchasing

- Crops do not require compost 11%
- Produce organic fertilizer at their farms 34%
- Used to organic fertilizers 22%

- Very bad odor of the compost 22%
- No availability 11%

b. Ratio of interesting in purchasing

56% of these farmers are interested in purchasing compost if the plant produces enough quantity and good quality. This is equal to 16.8% of farmers who have never purchased compost.

3) Total Ratio of Farmers Interested in Purchasing Compost

From the who farmers who never purchased compost, the ratio who are interested in purchasing compost will be:

43.3 + 16.8 = 60.1

For practical considerations, we can adopt the ratio of 50% as a ratio of Lattakia farmers who will purchase the compost.

50% of Lattakia farmers are likely to purchase compost.

This ratio will be reached only if the compost plant and the Union of Farmers meet certain conditions.

4) Conditions Required to Meet the Possible Ratio of Purchasing Compost

a. Conditions required to be met by the compost plant

- Producing a compost of good quality (such as Damascus one at least).
- Producing enough quantity.
- Continuity in production (availability throughout the year).
- Reducing the very bad odor.

b. Conditions to be met by Union of Farmers

- Promoting the compost use by informing the farmers about its advantages (70% of farmers do not know about compost) through printed materials, public meetings, symposiums, and sessions of cooperatives and assemblies of farmers.
- Using the compost at the public farms to show the good result to the doubtful and uncertain farmers.
- Establishing centers to distribute the compost in the regions. (Al-Haffeh, Al-Qurdaha, and Jableh ; and other far villages).

3.1.4 Estimated Amount of Compost Demand in Lattakia

According to results of compost demand survey, compost demand in Lattakia is estimated as follows.

(1) Organic Fertilizer Demand

$W_O = A \times F$

W_O : Organic fertilizer demand (ton/year)

A : Cultivated land area (Approx. 100,000 ha / 1,000,000 Donom)
F : Unit organic fertilizer consumption (0.35 ton/Donom/year)

Therefore,

W_O =1,000,000 x 0.35
= 350,000 ton/year

(2) Compost Demand

$W_C = WO \times R \times C$

WC : Compost Demand (ton/year)
WO : Organic fertilizer demand (350,000 ton/year)
R : Farmers ratio who are likely to purchase compost (0.5)
C : Compost using ratio of farmers who tend to purchase compost to organic fertilizer (0.3)

Therefore,

WO = 350,000 x 0.5 x 0.3
= 52,500 ton/year

3.2 EXISTING COMPOST PLANT

3.2.1 Operation of Compost Plant

(1) Outline of The Plant

Lattakia compost plant is located near the El Hemi village in Al Bassa about 15 km from the center of Lattakia city. The plant, which has the capacity of 100t/day, was constructed 1979 to 1980 by French technology and started operation in 1981. It is now almost nonfunctional.

(2) Present Operation Condition

Operation record of the plant in the year 2000 is shown in Table 3.2.1.

Table 3.2.1 Operation Records of Compost Plant in 2000

Month	TREATED GARBAGE QUANTITY (TON)	Sold compost quantity (ton)	Maintenance & operation cost (SP)			
			Elec.	Salary	Mainte-na nce.	Total
Jan.	390	55	12,400	145,000	10,500	167,900
Feb.	330	57	12,000	145,000	15,010	172,010
Mar.	480	39	12,950	145,000	-	157,950
Apr.	420	46	12,500	145,000	-	157,500
May	360	64	12,100	145,000	-	157,100
Jun.	300	-	11,990	145,000	-	156,990
Jul.	390	-	12,450	145,000	18,250	175,700
Aug.	420	48	12,550	145,000	-	157,550
Sep..	390	49	12,500	145,000	-	157,500
Oct.	360	115	11,000	145,000	3,100	159,100
Nov.	300	97	12,800	145,000	11,450	169,250
Dec.	360	49	12,200	145,000	-	157,200
Total	4,500	619	147,440	1,740,000	58,310	1,945,750

Source: Compost plant operation record

The present operation conditions of the plant are summarized as follows:

- The annual total treatment amount of 4,500 ton is only 15% of the plant capacity i.e. 100t/d x 300day/year =30,000ton/year.
- The ratio of compost quantity sold against incoming waste amount was 14% average and 32% maximum in October and November.
- The unit-selling price of the compost produced in this plant was 350 S.P. per ton. This is the lowest unit price for compost for any plant in Syria i.e. Damascus: 450 S.P., Aleppo: 370 S.P. for 1st grade and 140 S.P. for 2nd grade. Lattakia compost is the cheapest because it is the poorest quality.
- The annual income for 2000 was 216,650 S.P. (619ton x 350 S.P./ton). It covered only 11 % of annual operation and maintenance costs (1,945,750 S.P.).
- The old equipment does not produce good quality compost and demand for compost is low. Therefore very little compost is sold.

(3) Treatment Process

The treatment process of the plant is composed of the following three stages shown in Figure 3.2.1. The general plant layout is shown in Figure 3.2.2.

1) Primary Treatment Stage

At the Primary treatment stage, the non-compostable substances i.e. plastic, textiles, leathers, and metals are removed by sieve and magnetic separator. The raw compost materials are pulverized and homogenized by the crusher (RASP). Main equipment and facilities are:

- Weighbridge
- Receiving pit with volume of 300m^3
- Primary sieve
- Magnetic separator
- Crusher (RASP)

2) Biological Treatment Stage

At the biological treatment stage, the raw compost materials are transformed into compost by fermentation. During this process the raw materials are turned over 4 times for fermentation period of 8 to 10 days by the turning machine (SILODA) with paddle wheel.

However, SILODA broke down in 1995, the present turning over is done by wheel loader. The fermented compost is then left to cure in the open air for maturing for several weeks.

3) Final Treatment Stage

At the final stage, the matured compost is conveyed by wheel loader to the vibrating sieve with 16 mm holes for removing foreign substances such as glass, metals and plastics.

(4) Organization of Compost Plant

The plant is operated by 2 sift team from 7:30 to 14:30 and from 15:30 to22:00. The organization chart is shown in Figure 3.2.3.

3.2.2 Actual Market Condition of the Compost in Lattakia

(1) Compost Production and Quantity of Compost Sold

More than 2,800 ton of compost was produced and more than 1,500 ton of compost was sold in 1995 as shown in Table 3.2.2. However, in 2000 only 619 ton of compost was sold due to the poor quality of the compost. These amounts of compost sold are less than 1 % of organic fertilizers.

Table 3.2.2 Compost Production and Amount of Sold Compost

(ton)

Year	1995	1996	1997	1998	1999	2000
Production	2,820	2,370	2,040	1,600	1,470	1,350
Compost sold	1,565	1,412	1,395	1,122	1,023	619

Source: Compost plant record

(2) Compost Selling Price

The compost selling price in Syria is shown in Table 3.2.3.

Table 3.2.3 Compost Selling Price

(S.P. per ton)

Class	Price		
	Lattakia	Aleppo	Damascus
First Class	350 (No separated)	370	450 (Mixed)
Second Class		140	

Source: Interview results in each compost plant

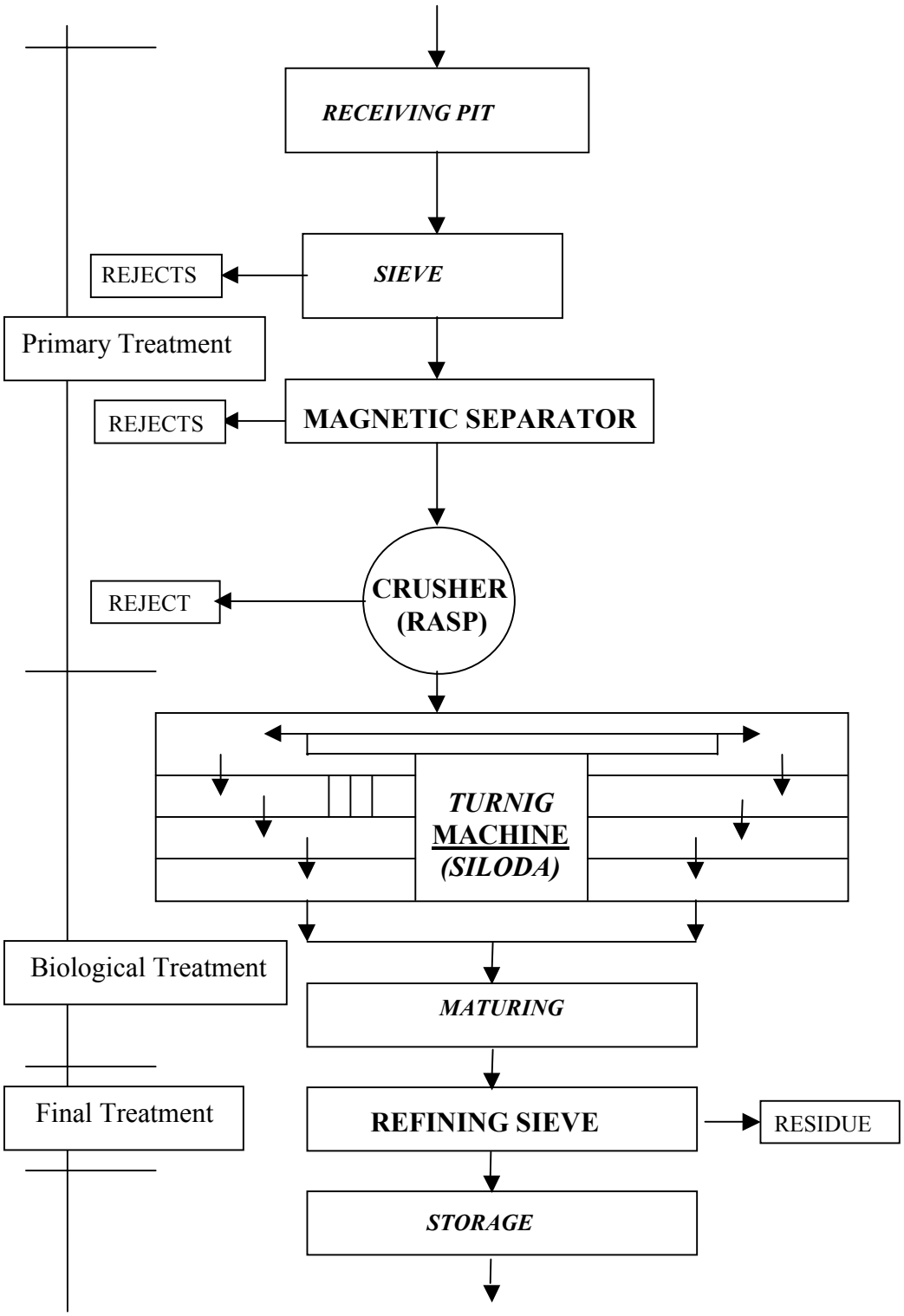


Figure 3.2.1 Treatment Process

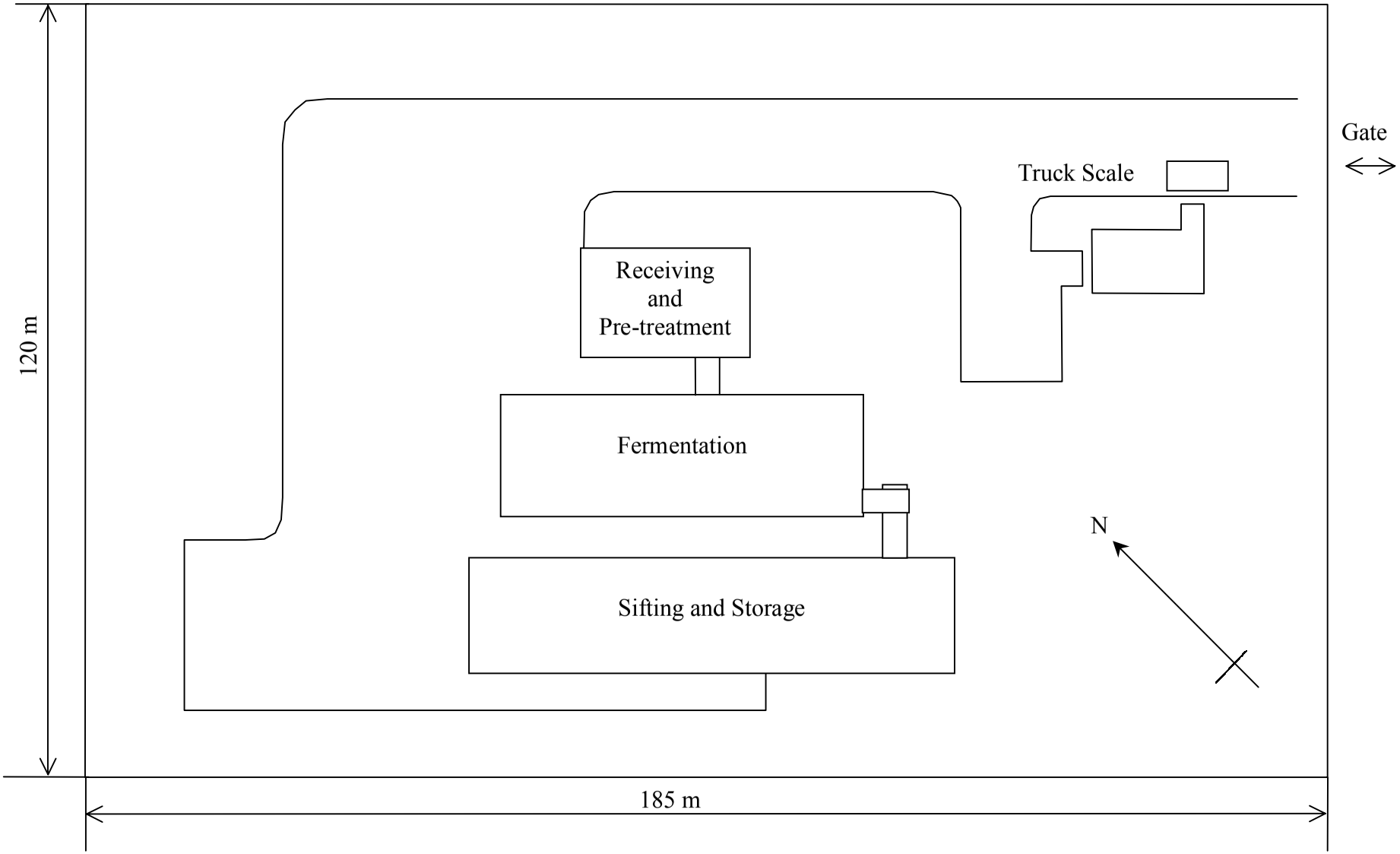


Figure 3.2.2 Layout of Existing Compost Plant

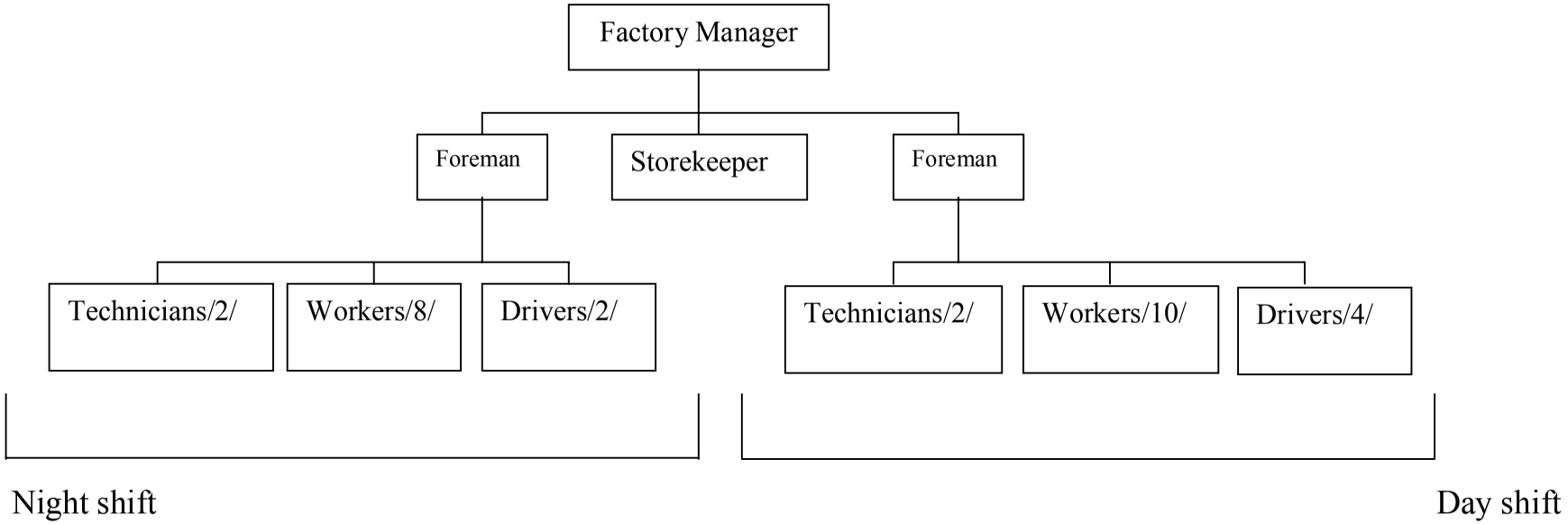


Figure 3.2.3 Compost Plant Organization Chart

(3) List of Farmers

Table 4.2.4 shows the quality of compost bought by formers from Lattakia compost plant in the last six months.

Table 3.2.4 List of Farmer Who Bought Compost During Last 6 Months

No.	Farmer's Name	Quantity (ton)	Address
01	Saleh Issa	15	Al-Hanadeh Village
02	Ssuhail Nasser	27	Al-Hanadeh Village
03	Agriculture Management	1	Agriculture Research Center
04	Samer Zahra	5	Al-Hanadeh Village
05	Akel Zahra	8	Al-Hanadeh Village
06	Ibrahim Ttarraf	20	Fideo Village
07	Gaiath Yassin	10	Jablehh City
08	Basem Arous	18	Al-Hanadeh Village
09	Daoud Jaloud	14	Al-Bassah Village
10	Ssafi Ttaman	9	Al-Bassah Village
11	Kaser Arous	15	Al-Hanadeh Village
12	Daniel Arous	12	Al-Hanadeh Village
13	Ali Gharib	7	Al-Bassit Town
14	Ibrahim Grarib	6	Al-Bassit Town
15	Habib Al-Kkaddar	9	Al-Hanadeh Village
16	Nafie Issa	9	Al-Hanadeh Village
17	Atta Arous	9	Al-Hanadeh Village
18	Adel Jaloud	15	Al-Bassah Village
19	Shahdeh Arous	45	Al-Hanadeh Village
20	Nasser Ghadban	30	Fideo Village
21	Amin Kassem	30	Fideo Village
22	Shaaban Hamdan	20	Al-Bassah Village
	Total	334	

Of the 334 ton compost sold in total, 172 ton (50%) was sold to the Al-Hanadeh Village located 5km away from the Lattakia compost plant, followed by 80 ton in the Fideo Village located 10km away. The farmers in Al-Bassit Town located more than 50km away from the compost plant were the most distant purchaser with small quantity of only 13 ton.

3.3 DAMASCUS COMPOST PLANT

Damascus compost plant has been operated for 10 years since 1991 and total compost production amount is approximately 300,000m^3 (150,000 ton).

On the other hand sales are approximately 54,000,000 SP, consequently unit price becomes approximately 178 SP/m^3 (356 SP/ton).

Detailed production record is shown in Appendix I, II-4-2

SECTION 4

COLLECTION AND TRANSPORT

SECTION 4 COLLECTION AND TRANSPORT

4.1 TIME AND MOTION STUDY IN LATTAKIA AND THREE SURROUNDING CITIES

4.1.1 Objective

The objective of this study is to understand the present collection and transport system so as to obtain basic data to formulate the solid waste management improvement.

4.1.2 Scope of the Study

Scope of an analysis of the present collection and transport operation is as follows:

- Efficiency of the collection equipments
- Suitability of collection routes
- Suitability of collection frequency and time
- Crews' behavior

4.1.3 Outline of the Study

Fifteen collection vehicle samples were selected from among the operated vehicles in Lattakia, Jableh, Qurdaha, and Al Haffeh after discussion with the Counterpart team. Fifteen collection vehicles represent:

- Each vehicle type in service
- Each zone used for collection in Lattakia
- Each city used for collection
- Each collection shift in Lattakia and Jableh

Table 4.1.1 Collection Vehicle for Time And Motion Study

Vehicle No	City	DATE	Maker	Vehicle type	Loading Capacity	Shift
1	Lattakia	2001/2/14	Heil	Compactor with loading system	9t	Morning
2	Lattakia	2001/2/14	Heil	Compactor with loading system	9t	Night
3	Lattakia	2001/2/15	Fiat	Manual fill compactor	5t	Morning
4	Lattakia	2001/2/15	Man	Compactor with loading system	8t	Night
5	Lattakia	2001/2/17		Tractor	4t	Morning
6	Lattakia	2001/2/17	Fiat	Compactor with loading system	6t	Night
7	Lattakia	2001/2/18	Fiat	Manual compactor	5t	Night
8	Lattakia	2001/2/19		Mechanical Road Sweeper	-	Morning
9	Lattakia	2001/2/19		Tractor	2t	Morning
10	Lattakia	2001/2/20		Dump Truck	6t	Morning
11	Lattakia	2001/2/20	Mack	Compactor with loading system	7t	Night
12	Jableh	2001/2/21	Heil	Compactor with loading system	9t	Morning
13	Jableh	2001/2/21	Heil	Compactor with loading system	9t	Night
14	Qurdaha	2001/2/22	Heil	Compactor with loading system	9t	Morning
15	Haffeh	2001/2/24		Tractor	4.6t (2.5m^3)	Morning

The surveyor followed the motion of each vehicle during one shift from the departure of a garage to the return to the garage. The surveyed vehicle delivered the waste to the final disposal site in Al Bassa. On the way, the entire vehicles go to the compost plant and were weighed by the weighbridge there. Survey results in Lattakia and three surrounding cities are summarized in Table 4.1.2.

Table 4.1.2 Results of Time and Motion Survey in Lattakia

Morning Shift

Veh No.	City	Maker	Type of vehicle	Capacity (t)	No of worker* (person)	Trips	Loaded waste Amount (t)	crew's workload (t/person)	Collection Efficiency (min/ton)	Transport velocity (km/h)
1	Lattakia	Heil	Mechanical Compactor	9.0	4	1	7.6	1.9	17.5	15.20
3	Lattakia	Fiat	Manual fill Compactor	5.0	4	2	8.8	2.2	33.1	12.93
5	Lattakia		Tractor	4.0	3	1	3.1	1.0	22.2	16.91
9	Lattakia		Tractor	2.0	3	1	2.1	0.7	31.3	9.13
10	Lattakia		Dump truck	6.0	4	1	5.0	1.3	19.7	15.53
12	Jabla	Heil	Mechanical Compactor	9.0	4	2	15.1	3.8	18.5	15.77
13	Jabla	Heil	Mechanical Compactor	9.0	4	1	5.4	1.3	37.1	17.19
14	Quldaha	Heil	Mechanical Compactor	9.0	4	1	6.7	1.7	35.6	28.63
15	Haffeh		Tractor	4.6	3	1	3.1	1.0	45.9	2.42

Night Shift

Veh No.	City	Maker	Type of vehicle	Capacity (t)	No of worker* (person)	Trips	Loaded waste Amount (t)	crew's workload (t/person)	Collection Efficiency (min/ton)	collection velocity (km/h)
2	Lattakia	Heil	Mechanical Compactor	9.0	4	2	14.0	3.5	12.9	16.99
4	Lattakia	Man	Mechanical Compactor	8.0	4	2	12.0	3.0	16.1	19.53
6	Lattakia	Fiat	Mechanical Compactor	6.0	4	2	12.0	3.0	23.2	16.58
7	Lattakia	Fiat	Manual fill Compactor	5.0	1	1	2.0	2.0	53.1	8.95
11	Lattakia	Mack	Mechanical Compactor	7.0	4	2	9.0	2.3	12.5	17.88

Note: No of worker includes driver.

4.2 EXISTING EQUIPMENT

Existing equipments at Lattakia and three surrounding cities are as follows:

4.2.1 Lattakia

(1) Municipal Waste Collection Equipment

Table 4.2.1 Present Waste Collection Equipment in Lattakia

Type	Manufacturer	Capacity (t)	Nos.	Purchased year
Compactor	Mack	8.9	11	1978
	Fiat	8.9	5	1983
	Heil	8.7	4	1995
	Man	8.0	5	1994
	Fiat	3.8	8	1983
Tractor	(Large)	5.0	2	1968
		5.0	2	1973
		5.0	1	1976
	(Small)	4.0	6	1976
		4.0	2	1999
Dump Truck	Fiat	7.52	1	1983
	Kamaz	7.52	1	1983
	Volvo	12	1	1994
Total			49	
Loader	Michigan	1	1	1983
	Benati	1	1	1983
Washing container	Fiat	8.9	1	1973

Source: Cleansing department in Lattakia city

Table 4.2.2 Present Sweeping Equipment in Lattakia

Type	Maker	Capacity (t)	Nos.	Purchased year
Sweeper	Eveco	3.4	3	1994
	Elgen	3.0	2	1970
Water Tank	Fiat		1	-
	Volvo		2	-
Total			8	

Source: Cleansing department in Lattakia city

Table 4.2.3 Present Equipment for Construction Debris in Lattakia

Type	Maker	Capacity (t)	Nos.	Purchased year
Dump truck	Volvo	12.0	1	1994
	Fiat	7.52	3	1983
Tractor	(Syrian)	4.1	2	1974
	(Syrian)	4.1	1	1999
Loader	Masi	1.0	1	1995
	Volvo	1.0	1	1976
	Case	0.6	1	1983
	Bobcat	0.6	1	1980
	Dumper	0.5	1	1983
	Chec	-	-	-
Total			13	

Source: Cleansing department in Lattakia city

4.2.2 Jableh

Table 4.2.4 Present Waste Collection Equipment in Jableh

Type	Maker	Capacity (t)	Nos.	Purchased year
Compactor	Heil	9	1	1998
	Fiat	9	1	1983
	Mack	6	1	1978
Tractor		$2m^3$	3	1975
Total			6	
Loader	(Standby)	$2m^3$	1	1975
		$1.5m^3$	1	1983
	(weak)	$1.5m^3$	1	1983

Source: Cleansing department in Jableh city

Table 4.2.5 Present Sweeping Equipment in Jableh

Type	Maker	Capacity (t)	Nos.	Purchased year
Sweeper	Argen		1	1999
			1	1986

Source: Cleansing department in Jableh city

4.2.3 Qurdaha

Table 4.2.6 Present Equipment for Collection and Sweeping in Qurdaha

Type	Maker	Capacity (t)	Nos.	Purchased year
Compactor	Heil	9	2	1999
	Fiat	6	1	1998
Total			3	
Sweeper	Argen		1	1998
Water tank	Kamaz	$8m^3$	1	1985
Water tank	Scania	$20m^3$	1	1997
Total			3	

Source: Cleansing department in Qurdaha city

Table 4.2.7 Present Equipment for Construction Debris Collection in Qurdaha

Type	Maker	Capacity (t)	Nos.	Purchased year
Tractor	Forat	4	1	1996
Loader	Daewoo	0.7	1	90’
	Bobcat	1	1	1987
Total			3	

Source: Cleansing department in Qurdaha city

4.2.4 Al-Haffeh

Table 4.2.8 Present Waste Collection Equipment in Al-Haffeh

Type	Maker	Load Capacity (t)	Nos.	Purchased year
Tractor	Romania	2.5	1	1970
		2.5	1	1997
Dump truck	Demper	$1m^3$	1	1980
Total			3	

Source: Cleansing department in Al-Haffeh city

4.3 OPERATION AND MAINTENANCE

4.3.1 Basic Data Collection Vehicle for Priority Project

(1) Basic Condition

Collection efficiency in the collection area:
20 min/ton for container collection (25 min/ton applied for three surrounding cities)

35 min/ton for hand collection

Transport speed:	30 km/h
Tractor speed:	15 km/h
Discharge time:	10 min
Rest:	60 min
Working period in one shift:	8 hours (incl. 1hr' rest)

(2) Available Trips and Capacity for Equipment

Table 4.3.1 Load Capacity for Equipment in 2006

Vehicle type	Capacity	Available trips per one shift	Load capacity per one shift (ton/shift/unit)	Necessity vehicles (unit)
Lattakia				
Medium compactor	$8m^3$	3	8.64	15
Small compactor	$4m^3$	3.5	5.04	7
Dump truck	$6m^3$	3	5.18	2
(Heil compactor)	8.7t	2	12.53	4
(Man compactor)	8.0t	2	11.52	5
(Volvo dump truck)	12.0t	1	8.60	1
(Tractor)	4.0t	1.5	2.88	2
Jableh				
Medium compactor	$8m^3$	2	5.76	7
Small compactor	$4m^3$	2.5	3.60	3
Dump truck	$6m^3$	2	3.46	2
(Heil compactor)	9.0t	1	9.72	1
Qurdaha				
Medium compactor	$8m^3$	2.2	6.34	1
Dump truck	$6m^3$	2.38	4.11	2
(Heil compactor)	9.0t	1.38	8.94	1
(Fiat compactor)	6.0t	1.45	6.26	1
(Tractor)	4.0t	1	2.88	1
Al-Haffeh				
Small compactor	$4m^3$	2.42	3.48	3
Dump truck	$6m^3$	2.26	3.91	1
(Tractor)	2.5t	1	2.88	1

Note: ( ) indicates present vehicles used in 2006

4.3.2 Basic Data Collection Vehicle for Master Plan

(1) Basic Condition

Collection efficiency in the collection area:
20 min/ton for container collection (25 min/ton applied for three surrounding cities)

35 min/ton for hand collection

Transport speed:	30 km/h
Tractor speed:	15 km/h
Discharge time:	10 min
Rest:	60 min
Working period in one shift:	8 hours (incl. 1hr' rest)

(2) Available Trips and Capacity for Equipment

Table 4.3.2 Load Capacity for Equipment in 2010

Vehicle type	Capacity	Available trips per one shift	Load capacity per one shift (ton/shift/unit)	Necessity vehicles (unit)
Lattakia				
(To Al-Bassa)				
Medium Compactor	$8m^3$	3	8.64	6
Small compactor	$4m^3$	3.5	5.04	4
(To Qasia)				
Medium compactor	$8m^3$	2.5	7.20	35
Small compactor	$4m^3$	2.5	4.32	8
Dump truck	$6m^3$	3	4.32	2
(Tractor)	4.0t	1.5	4.32	2
Jableh				
Medium compactor	$8m^3$	3.5	10.08	7
Small compactor	$4m^3$	4.5	6.48	3
Dump truck	$6m^3$	4	6.91	2
(Heil compactor)	9.0t	1.5	9.72	1
Qurdaha				
Small compactor	$4m^3$	4.5	6.48	1
Dump truck	$6m^3$	4	6.91	2
(Heil compactor)	9.0t	1.5	9.72	1
(Fiat compactor)	6.0t	2.5	10.80	1
(Tractor)	4.0t	2	5.76	1
Al-Haffeh				
Small compactor	$4m^3$	3.5	5.04	3
Dump truck	$6m^3$	3	5.18	1
(Tractor)	2.5t	2.5	4.50	1

Note: ( ) indicates present vehicles used in 2010

4.4 COST ESTIMATION

4.4.1 Conditions for Estimation

(1) Salaries

Supervisor: 127,983 sp/year
Driver: 87,456 sp/year
Collection worker: 73,200 sp/year

(2) Fuel and Lubricants

Fuel (diesel) unit cost: 6.5 sp/liter
Operation time: 8 hours
Lubricants: 20% of annual fuel cost

Table 4.4.1 Fuel and Lubricants Cost for each Equipment Unit

Vehicle type	HP	Fuel consumption	Amount of fuel		Annual fuel cost	**Total (incl. Lubricants)**
Unit		Lit/hp/hr	Lit/day	Lit/year	Sp/unit	**Sp/unit**
Large compactor	300	0.04	96	28032	182208	**218,650**
Medium compactor	140	0.04	44.8	13082	85030	**102,036**
Small compactor	110	0.04	35.2	10278	66810	**80,172**
Tractor			52.7	15388	100025	**120,030**
Dump truck	120	0.04	38.4	11213	72883	**87,460**
Wheel loader	120	0.115	110.4	32237	209539	**251,447**
Others	120	0.03	28.8	8410	54662	**65,595**
Mechanical sweeper	110	0.048	42.24	12334	80172	**96,206**
Tank truck	120	0.03	28.8	8410	54662	**65,595**

(3) Maintenance and Repairs

(40% of vehicle cost)/(vehicle age)

(4) Indirect Cost and misc.

20% of the above costs

Investment costs covered purchase of equipment for renewal. Costs and haulage capacities are shown below:

Table 4.4.2 Unit Cost of Equipments to be procured

	(SP)
$8m^3$ compactor	3,424,000
$4m^3$ compactor	2,336,000
$6m^3$ dump truck	1,784,000
Wheel loader	7,008,000
3000liter tank truck	2,816,000
$3m^3$ road sweeper	4,096,000
$1m^3$ container	6,500

Investment cost and operation cost from the year 2001 to 2010 is shown in the following Table 4.4.3.

Table 4.4.3 Total Cost for Collection and Transport from 2001 to 2010

Unit: SYP

Year	Investment Cost	O/M Cost	Total
2001		110,981,102	110,981,102
2002		110,981,102	110,981,102
2003	155,556,000	88,171,943	243,727,943
2004		88,171,943	88,171,943
2005		88,171,943	88,171,943
2006		88,171,943	88,171,943
2007	110,888,000	84,260,320	195,148,320
2008		84,260,320	84,260,320
2009		84,260,320	84,260,320
2010		84,260,320	84,260,320
Total	266,444,000	566,826,730	833,270,730

Table 4.4.4 Procurement and O/M Cost in Lattakia and Three Surrounding Cities

				2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Lattakia			unit										
O/M	1	Personnel	sp	55,463,715	55,463,715	44,199,999	44,199,999	44,199,999	44,199,999	39,478,023	39,478,023	39,478,023	39,478,023
	2	fuel/lubricants	sp	9,351,598	9,351,598	5,298,882	5,298,882	5,298,882	5,298,882	6,297,382	6,297,382	6,297,382	6,297,382
	3	repair/maintenance	sp	10,933,470	10,933,470	5,608,090	5,608,090	5,608,090	5,608,090	6,028,980	6,028,980	6,028,980	6,028,980
	4	others	sp	15,149,757	15,149,757	11,021,394	11,021,394	11,021,394	11,021,394	10,360,877	10,360,877	10,360,877	10,360,877
	TOTAL		sp	90,898,539	90,898,539	66,128,365	66,128,365	66,128,365	66,128,365	62,165,262	62,165,262	62,165,262	62,165,262
Procurement			sp	0	0	94,659,000	0	0	0	110,459,000	0	0	0
2. Jableh													
O/M	1	Personnel	sp	6,149,958	6,149,958	7,337,655	7,337,655	7,337,655	7,337,655	7,337,655	7,337,655	7,337,655	7,337,655
	2	fuel/lubricants	sp	1,865,081	1,865,081	1,695,992	1,695,992	1,695,992	1,695,992	1,695,992	1,695,992	1,695,992	1,695,992
	3	repair/maintenance	sp	1,291,920	1,291,920	1,605,263	1,605,263	1,605,263	1,605,263	1,633,863	1,633,863	1,633,863	1,633,863
	4	others	sp	1,861,392	1,861,392	2,127,782	2,127,782	2,127,782	2,127,782	2,133,502	2,133,502	2,133,502	2,133,502
	TOTAL		sp	11,168,351	11,168,351	12,766,692	12,766,692	12,766,692	12,766,692	12,801,012	12,801,012	12,801,012	12,801,012
Procurement			sp	0	0	42,755,000	0	0	0	286,000	0	0	0
3. Qurdaha													
O/M	1	Personnel	sp	3,358,731	3,358,731	2,982,636	2,982,636	2,982,636	2,982,636	2,982,636	2,982,636	2,982,636	2,982,636
	2	fuel/lubricants	sp	1,357,085	1,357,085	876,056	876,056	876,056	876,056	876,056	876,056	876,056	876,056
	3	repair/maintenance	sp	1,178,240	1,178,240	1,051,073	1,051,073	1,051,073	1,051,073	1,065,373	1,065,373	1,065,373	1,065,373
	4	others	sp	1,178,811	1,178,811	981,953	981,953	981,953	981,953	984,813	984,813	984,813	984,813
	TOTAL		sp	7,072,867	7,072,867	5,891,718	5,891,718	5,891,718	5,891,718	5,908,878	5,908,878	5,908,878	5,908,878
Procurement			sp	0	0	9,351,000	0	0	0	143,000	0	0	0
4. Al Haffeh													
O/M	1	Personnel	sp	1,323,534	1,323,534	2,153,085	2,153,085	2,153,085	2,153,085	2,153,085	2,153,085	2,153,085	2,153,085
	2	fuel/lubricants	sp	174,920	174,920	415,434	415,434	415,434	415,434	415,434	415,434	415,434	415,434
	3	repair/maintenance	sp	36,000	36,000	252,453	252,453	252,453	252,453	252,453	252,453	252,453	252,453
	4	others	sp	306,891	306,891	564,195	564,195	564,195	564,195	564,195	564,195	564,195	564,195
	TOTAL		sp	1,841,344	1,841,344	3,385,167	3,385,167	3,385,167	3,385,167	3,385,167	3,385,167	3,385,167	3,385,167
Procurement			sp	0	0	8,792,000	0	0	0	0	0	0	0
Total O/M Cost of 4 cities			**sp**	**110,981,102**	**110,981,102**	**88,171,943**	**88,171,943**	**88,171,943**	**88,171,943**	**84,260,320**	**84,260,320**	**84,260,320**	**84,260,320**
Total Procurement cost of 4 cities			**sp**	**0**	**0**	**155,556,000**	**0**	**0**	**0**	**110,888,000**	**0**	**0**	**0**

SECTION 5

ENVIRONMENTAL CONSIDERATIONS AND URBAN PLANNING

SECTION 5 ENVIRONMENTAL CONSIDERATIONS AND URBAN PLANNING

5.1 ENVIRONMENTAL ASPECTS

5.1.1 Environmental Administration and Legislation

(1) Administration

The Syrian Government established a ministerial post for the environment in 1987 titled Ministry of State for Environmental Affair (MSEA). The minister oversees the General Committee for Environmental Affairs (GCEA) and ten intersectional committees. The Scientific and Environmental Research Center (SERC) serves as the research arm of the Ministry.

The highest authority responsible for implementing environmental protection resides with the Higher Council for Environmental Safety, which is chaired by the Prime Minister and has as its members a number of relevant ministers.

MSEA has created ten (10) local administrative offices as the Environmental Directorate. There is one in Lattakia and the Lattakia Environmental Directorate comprises eight departments with sixty six (66) staff as of March 2001; organization chart is shown below, is responsible for the Lattakia Governorate area.

As far a waste disposal management's concerned, there has hitherto been no national strategy or coordination of these activities, however, the MSEA is currently coordinating a number of regional action program aimed at training local staff in solid waste management.

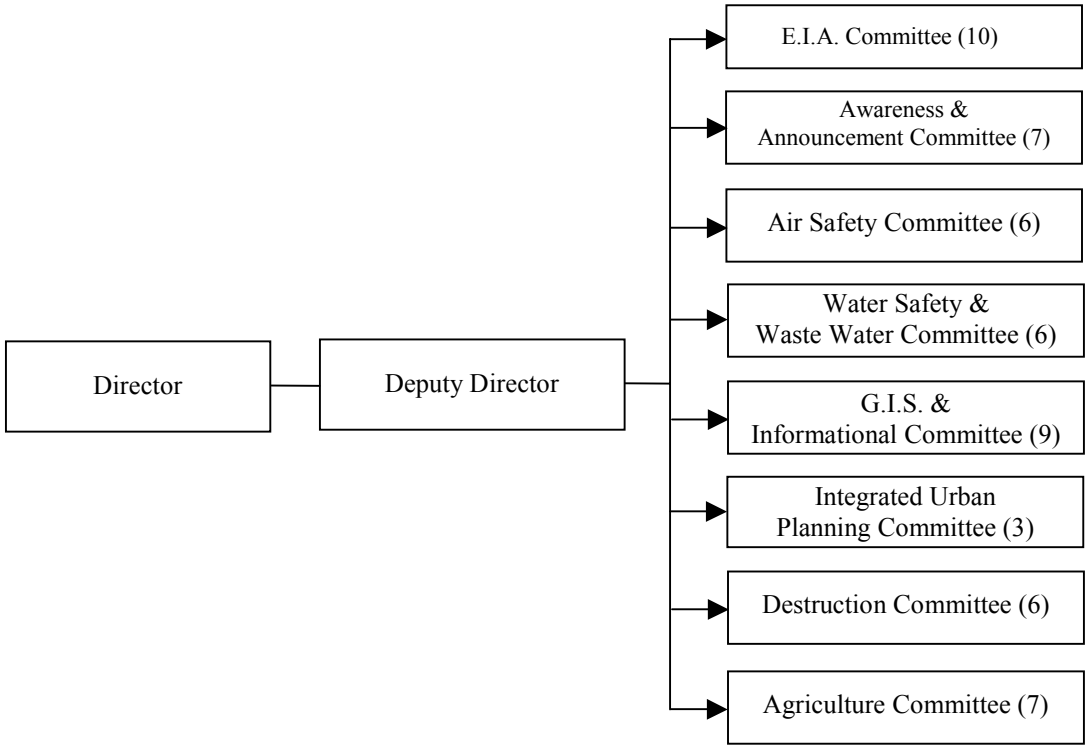


Figure 5.1.1 Organization Chart of Lattakia Directorate, Ministry of State for Environmental Affairs

(2) Environmental Legislation

Since 1995 there have been a number of draft Environmental Protection Laws, the latest in September 2000 and this bill is expected to be approved by cabinet and the president soon. The new bill has proposed some important aspects as follows;

a. Enhancement of authority of Minister of State for Environment Affairs, and the Minister is appointed as Chairman of Supreme Council for Environment instead of Prime Minister
b. Enactment of Environmental Impact Assessment (EIA) and formulation of EIA procedure
c. Decentralization of authority to Local Environmental Directorate and its institutional capacity building
d. Establishment of Environmental Fund for rehabilitation of environment
e. Formulation of ambient quality standard such as water quality standard by areas of water, discharge water quality standard, air quality standard by zones, etc.

(3) Implementation of Environmental Impact Assessment

Current Environmental Law has excluded EIA aspects. However, following Syrian's recognition of the importance of environmental issues, EIA has been carried out with reference to EU or International Organizations. Accordingly, the latest bill which includes EIA shall consider application of EIA study to this study even though not yet enacted.

According to the bill, the Annex indicates activity types that are required EIA Study. Regarding solid waste projects, it is categorized as urban sanitation on the Activity No.11 shown in following table which are required EIA.

Table 5.1.1 Requirement of EIA for Urban Sanitation Projects

No.	Subjects	Descriptions
No. 11.1	Sanitary Landfill	More than 5ha landfill
No. 11.2	Urban Sanitation Master Plan	More than 100,000 population
No. 11.3	Waste Disposal Plant	More than 250,000 tones of annual disposal capacity
No. 11.4	Harmful Waste Disposal	All of the projects

Source: Draft Environmental Protection Law-Annex, Ministry of State for Environmental Affairs, Sep. 2000

(4) Proposed Procedure of EIA

The procedure of EIA is proposed to formulate after the bill is approved by the Government, whereas the draft has already been discussed in the Ministry. The procedure is briefly explained as follows:

a. Registration of EIA; a project proponent shall submit activity plan to the Ministry
b. EIA Unit in the Ministry shall inspect type of project if EIA is required based on the Guidelines. The Unit informs the proponent of the result within six days.
c. EIA Unit will carry out preliminary EIA if required in order to judge whether full scale EIA is required, and the Unit shall inform the proponent of the result within three weeks.
d. If it is judged that full scale EIA is required, the proponent shall carry out EIA, and the result as a draft report shall be presented to the Ministry and

stakeholders. In addition public hearings shall be held in archive to get consensus from them. Moreover the Ministry shall make comments on the draft within thirty days.

e. The proponent shall submit final EIA report taking into consideration the resolution of the public hearing and the comments made by the Ministry.

f. The Ministry shall inspect the report and judge the project authorization, then inform the proponent of the final result within six working days.

g. The Ministry shall issue the project authorization to the proponent.

5.1.2 Current Solid Waste Management and Predicted Environmental Impacts

(1) Current Solid Waste Management in Syria

Waste generated by human activity accounts for the majority of Municipal waste is largely dominated among the waste generated by human activities. Cleanliness department of municipalities is responsible for collection and transport to disposal site of the municipal solid wastes. In general, of which 90% in urban area and 60% in rural area are collected properly[1] in Syria. Majority of waste collected is disposed to land located on the skirt of the cities as shown in Table 5.1.2. A few municipalities, Damascus and Doma, have been operating sanitary landfill sites, while the other municipalities have deposited collected wastes on the dumping sites designated by municipalities.

Table 5.1.2 Solid Waste Management in Several Municipalities

Municipality	Type of Landfill	Location	Available composting capacity
Jbab	Open dump with burning	1 km east of the village	None
Al Zabadanee	Dump with burning followed by application of soil cover	Near by mountain	None
Daraa	Open dump	City edge	None
Daraa	Open dump with burning	13km from the city center	None
Al Swida	Open dump with burning	4km southwest of the city	None
Harrasta	Open dump with burning	City edge	None
Doma	Sanitary landfill	25km southeast of the town	None
Lattakia	Landfill and compost	16km form the city	60-70t/day
Hama	Cemetery	1km north of the city	None
Homs	Open dump	3km north of the city	None
Allepo	Open dump	5km northeast of the city	None
Damascus	Sanitary landfill	35km south of the city	700t/day

Source: State of the Environment, April 1998 World Bank/UNDP (ASCWA/WHO, 1993)

There are some designated dumping sites in the Study Area, one is in Lattakia called Al Bassa dumping site that is being operated by Lattakia and Quardaha Municipalities jointly, and the others are in Jabla and Al Haffah municipalities. As well as the other municipalities in Syria, the municipalities have been mainly deposited wastes collected in the dumping sites. However, there is a reasonable recycling aspect that the collected organic wastes are used for producing compost nearby the Al Bassa. In addition, it is

[1] State of the Environment, April 1998 World Bank/UNDP

observed that indiscriminate wastes are separated to pick metals up by Gypsies, then sell them to factories as a recycling.

The most important of solid waste management is disposal. The dumping sites are likely to be rarely controlled. The haulage of wastes from cities is properly done, however disposal of the wastes are improper management. Al Bassa dumping site, which is located on the Mediterranean Sea coast and tiny seaside vegetation and dunes has been receiving and dumping municipal wastes from Lattakia and Qurdaha without proper sanitary foundations since 1970's shown in following pictures. In addition to the dumping sites, some of informal wastes dumped in the Study Area are observed.

Indiscriminate dumping causes contaminate surface, subterranean and the sea waters easily. Decomposition of organic wastes in landfill, untreated leachy water pollutes soil and surrounding water bodies.

Lattakia urban area scene from Al Bassa Dumping site

Leachate water from indiscriminate wastes

Haulage of municipal waste to dumping Site

Informal waste separation activities

Figure 5.1.2 Scenes of Al Bassa Dumping Site

(2) Environmental Impacts

Negative environmental impacts are only a result of solid waste disposal. Improper solid waste management causes all type of environmental degradation; air, soil and water. Indiscriminate wastes dumping generate odor and greenhouse gases, cause degradation of subterranean and surface waters and contaminate soil.

Health and safety issues arise from improper solid waste management. Human fecal matters are commonly found in municipal waste. Insect and rodent vectors are attracted to the waste and can spread disease. Using polluted water by solid waste for bathing, irrigation, and drinking water can also expose individuals to disease organisms and other contaminants.

Adverse effects on dumping site is associated with following impacts:

- Surface and subterranean water pollution
- Air pollution (smoke and odor)
- Public health risks (communicable disease passed on by vermin, insect, scavenging animals, etc.)
- Public safety impact
- Visual impact and littering

5.1.3 Issues And Potential Solutions

Four points are identified for the issues and the possible solutions based on the preliminary study in terms of environmental considerations.

(1) Lack of administrative capacity of landfill site management in terms of environmental protection and urgent requirement for rehabilitation of Al Bassa dumping site and others

Existing dumping site is insufficient management and the environmental condition of the site is seriously threatened by the solid waste dumping. The management capacity of the municipalities and Lattakia environmental Directorate should be enhanced through proper trainings such as series of training program for solid waste management provided by MSEA.

In addition, as earlier as possible, Al Bassa dumping site should be rehabilitated properly in terms of environmental protection. The site located in environmentally fragile areas on the coastal line and the wastes are scattered and dumped widely in disorder. This causes serious environmental impacts in the site and surrounding areas. There is no accurate environmental inspection data, however it seems to be major source of pollution in the area. Environmental monitoring or inspection of the site and surrounding area is also required.

(2) Lack of environmental legislation for waste disposal management

There is neither proper institutional system for environmental protection nor proper practice on waste disposal management. Without any legal support, it is hardly to manage the waste disposal. Currently the new bill of Environmental Protection Law is proposed although it takes long time to realize practical manner on that. Proper environmental legislation for solid waste disposal management is required.

(3) Necessity of strategic solid waste management in terms of environmental impact mitigation

In order to carry out effective solid waste disposal management, a strategic management is required to formulate. In addition enhancement of the management is also important. Currently approximately 260 tones/day of waste are generated from Lattakia and Qurdaha municipalities. Of which 12 tones/day waste is used for composting. However

half of produced compost is unsold due to lower quality and compost left is disposed as dump. Effectiveness (wastefulness) shall be considered in the management.

Waste hierarchies[2] are usually established to identify key elements of the management plan comprised of the following order:

- Reduce
- Reuse
- Recycle
- Recover
- Waste transformation through physical, biological, or chemical process (e.g. composting, incineration)
- Land fill

(4) Necessity of environmental awareness on solid waste management to the people and business proponent

Successful management comes with much effort of participants involved. Environmental awareness of the management must be a good tool for both citizens and business proponents in order for reducing an amount of solid waste and proper disposal. There are some experimental activities on that. Environmental labeling helps rising consciousness and momentum of the management. The labeling is to provide accurate information of products what shall be disposed. Environmental education is another idea. The education shall be done through existing education system at school especially for primary education and various kinds of social groups. This will enhance to give knowledge of the practical management.

[2] What a waste: Solid Waste Management in Asia, May 1999, The World bank

5.2 INITIAL ENVIRONMENTAL EXAMINATION OF THE CANDIDATE SITE

5.2.1 Location and Features of the New Qasia Landfill Site

(1) Location

The site is located in approximately 17 km away from the centre of Lattakia City, which is northeast direction on the way to Al Haffeh shown in Figure 5.2.1. Actually the site lies on a small gradual valley where is a little distance from the main road.

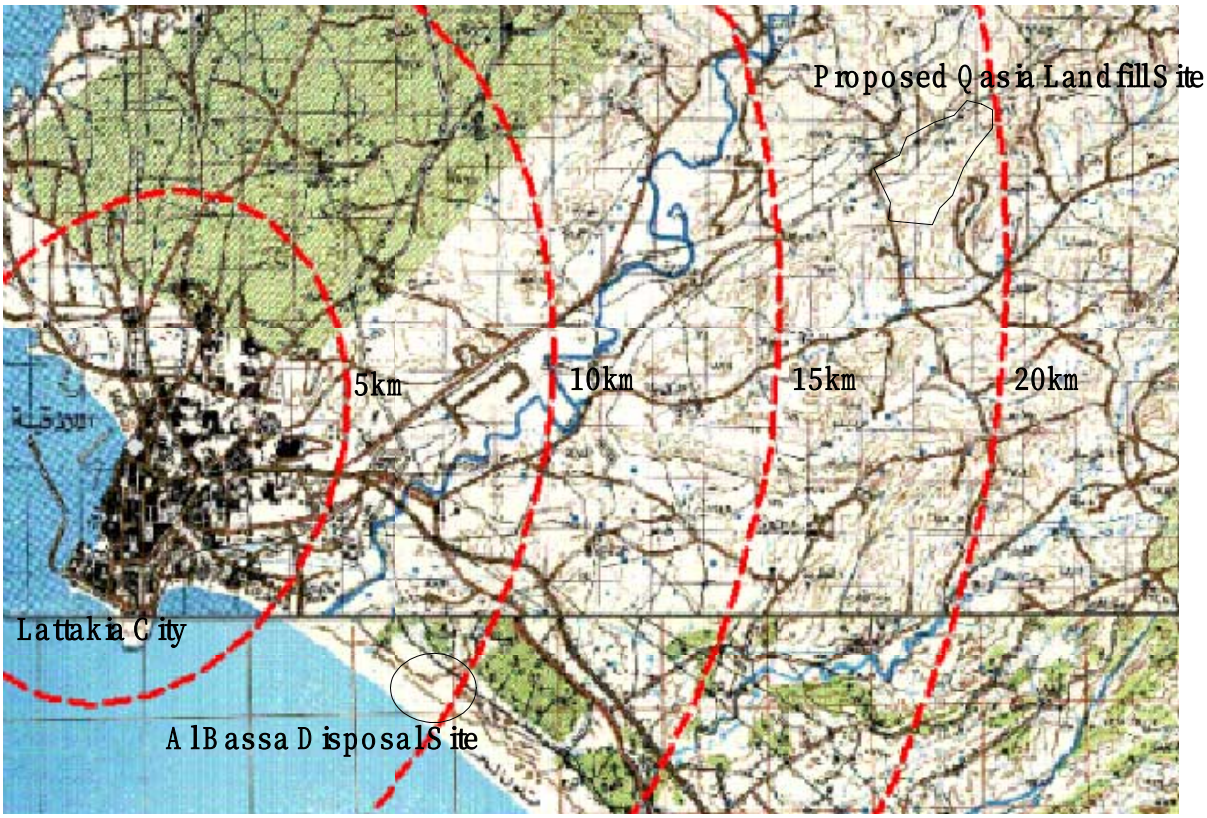


Figure 5.2.1 Location Map of the Candidate Site

(2) Features

One of small sequence valley in connection with Al Kabir river basin is the proposed landfill site shown in Figure 5.1.2. The scene is taken from satellite image called SPOT Image.

The land is presently owned by the military and it seems to be a reserve land. There is no military facility seen in the land.

The land forms a gradual small valley with seasonal river, and there are some shrubs along the river system. The land is pasture through the year and some sheep breading is seen.

The landowner controls the access to the land and permission is required to enter the land.

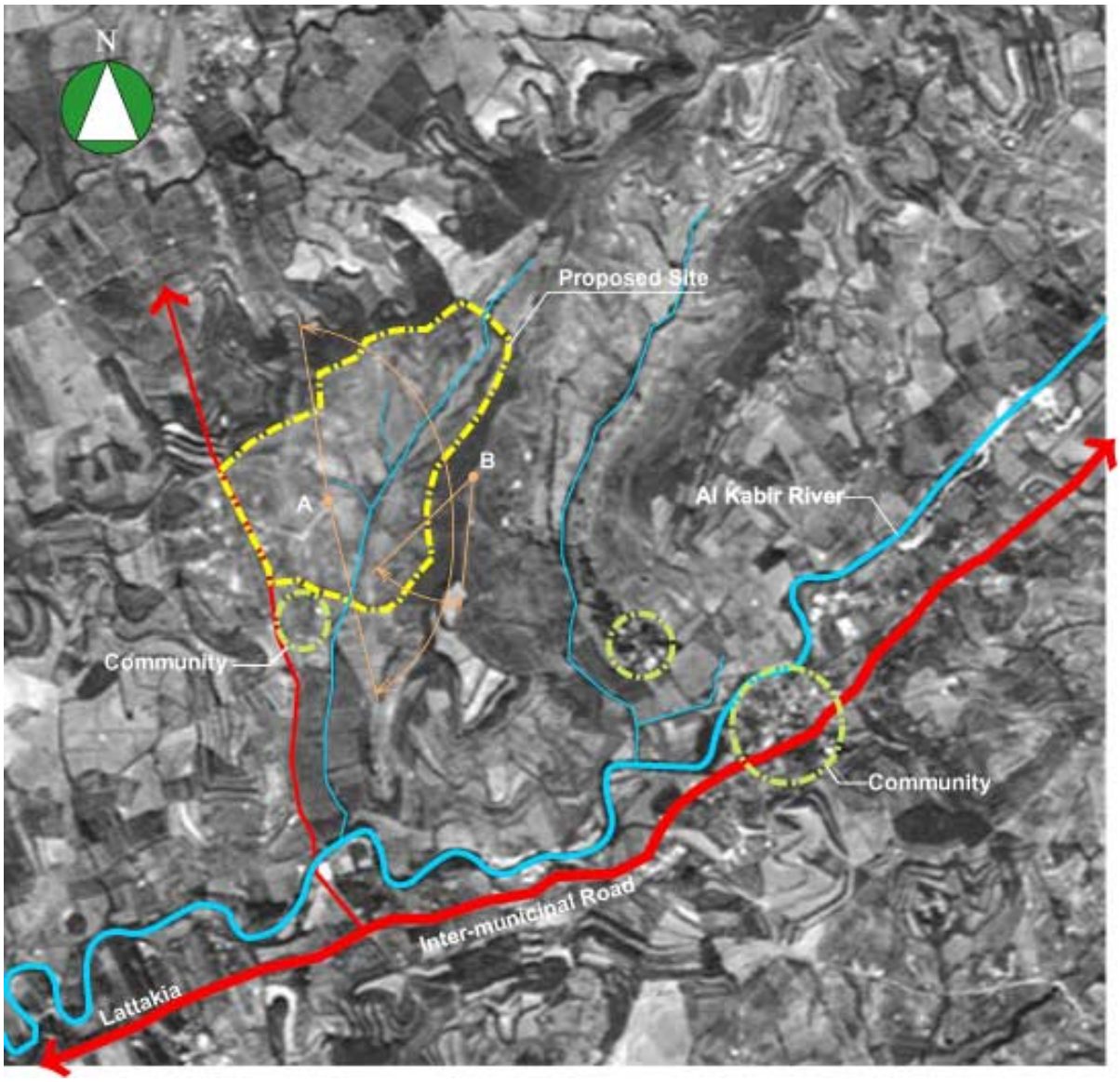


Figure 5.2.2 Satellite Image of the Candidate Site

(3) Site Observation

The Study Team and Counterpart Team did an observation for the candidate site in 27June 2001. Summary of the results are as follows:

The Site:	
Topography	• The site forms a small valley (appx.50 ha) and there is a seasonal river • The valley has gradual slop form north to south
Land Use	• Pasture land, grove land, sheep and goat breeding were observed
Land Ownership	• Presently this land belongs to Ministry of Defence, surrounding area also belongs to the ministry
Flora	• No primary vegetation
Surrounding Area:	
Road conditions	• Asphalt rods are provided in the community and beside the site
Land Use	• Land use of the surrounding area varies, some part is looks like a reserve land for military, grove land, other agricultural land, etc
Community and economic activities	• There is some communities at lower basin of the valley. They must be farmer. Grove land (Citrus and olive trees) and tobacco leaves and some vegetables were observed
Water use	• Some well were observed in the farms • It is doubt that residents use well water for drinking

Panoramic View in the Site from "A" Point – from Upper Basin to Lower Basin

A View of the Southern Part of the Site from Point "A" (Lower Basin of the Site)

A View of the Site form Point "B",

An Informal Settlement near the Point "A"

Figure 5.2.3 Current Scene of the Candidate Site- Qasia

5.2.2 Environmental Considerations for The New Inter-municipal Landfill Site

It is predicted in general that the significant environmental impacts caused by solid waste management facilities is final disposal site, and it is also predicted that the impacts are occurred intensively during the operation stage rather than construction stage.

On this proposed master plan, two disposal sites are proposed that one is located in existing dumping site, namely Al Bassa disposal site and the other one is proposed in Qasia as an inter-municipal disposal site. The Al Bassa disposal site is used till the year 2007, then the dumping site shifts to new Qasia site after year 2008.

The Al Bassa site includes existing waste disposal facilities and the proposed plans are mainly focusing on rehabilitation of them so that new negative environmental impacts are hardly expected there and it is essential that the Initial Environmental Examination shall carry out for the inter-municipal disposal site in Qasia in order to clarify environmental factors to be surveyed at design stage. Though environmental consideration in Al Bassa site shall be made in the course of the study.

(1) Initial Environmental Examination (IEE) of New Inter-municipal Disposal Site

IEE was carried out for a new inter-municipal disposal site based on existing information collected in reference with the occurrence and environmental factors of disposal site and the occurrence and environmental factors of solid waste disposal project shown in Table 5.2.2 and Figure 5.2.1.

Table 5.2.1 Occurrence and environmental factors of Disposal Site

Stages	Environmental Factors / Occurrence Factors		Air Pollution	Water Pollution	Noise and Vibration	Odour	Topography/ Geology	Flora/Fauna	Visual amenity
Construction	Transport of construction materials		✓		✓				
	Earth work (filling)		✓	✓	✓				
	Earth work (cutting)		✓	✓	✓				
	Earth work (cutting trees)			✓	✓				
	Excavation for foundation		✓		✓				
	Piling				✓				
	Construction of access road								✓
	Construction of Buildings (Maintenance Quarters)								✓
	Site (special occupancy and topographical change)						✓	✓	✓
Dumping	Transport of Waste		✓		✓	✓			
	Dumping work		✓		✓				
	Decomposition and existence of waste	Liquid		✓					
		Volatile				✓			
		Decay				✓			
		Floating/ scattering	✓						✓
		Food for animals							✓
Existence	Decomposition of waste	Liquid		✓				✓	✓
		Volatile				✓			
		Decay	✓			✓			

Source: Note: "✓" shows environmental impacts.

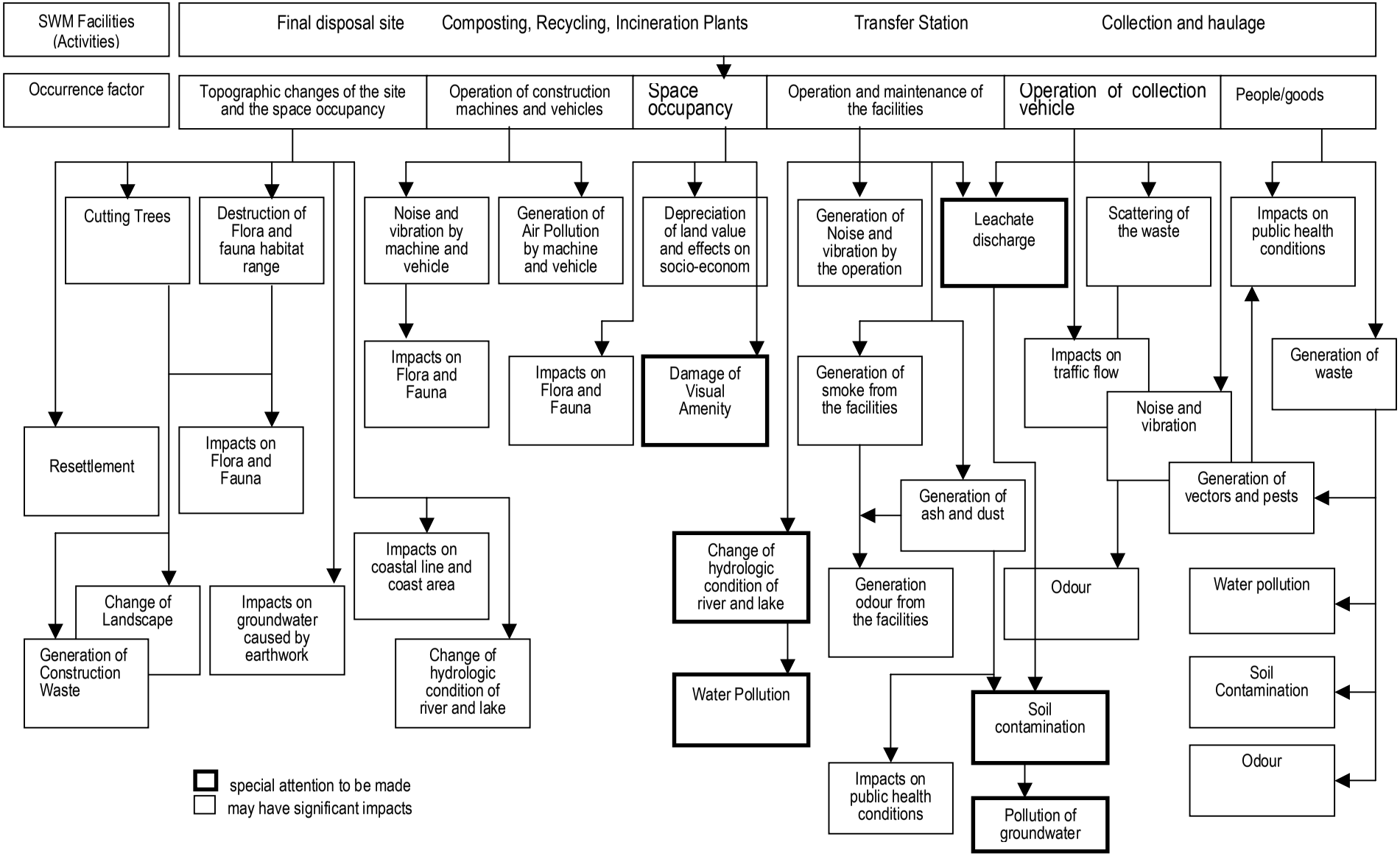


Figure 5.2.4 Impact Prediction Flow of SWM

Source: Environmental Guideline-SWM, JICA and JICA Study Team

(2) Screening and Scoping of the New Inter-municipal Disposal Site

The purposes of screening and scooping are to identify the potentials of significant impacts caused by project implementation and to formulate the essentials of the further environmental impact study.

1) Screening Results

The following table shows the results of the screening in each environmental factors and it is concluded that further environmental examination is required.

Table 5.2.2 Screening of New Inter-municipal Disposal Site

No.		Environmental Items	Description	Evaluation	Remarks (Reason)
Social Environment	1.	Resettlement	Resettlement by occupancy of proposed project	No	No resident in the site. There are some farmer near by
	2.	Economic Activities	Loss of productive opportunity such as land and change of economic structure	No	Agriculture exist in adjacent area
	3.	Traffic and Public Facilities	Increasing traffic congestion and accident, and influence on hospital and school	No	No public facility in the site
	4.	Split of Communities	Split of Communities by obstruction of traffic	No	The site is single lot.
	5.	Cultural Property	Loss of cultural property and decreasing of the values	No	No cultural heritage exits in the sites
	6.	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, and common rights of forest	Unknown	Wells for agriculture exists near by
	7.	Public Health Condition	Generation of vectors and pests, deterioration of hygiene conditions	Unknown	Waste may attract vectors and pests
	8.	Waste	Occurrence of construction waste, ash, etc	Unknown	
	9.	Hazards (Risk)	Increase of possibility of danger of landslide and accident	No	Low possibility
Natural Environment	10.	Topography and Geology	Change of valuable topography and geology by excavation or filling works	Unknown	No large scale structure or earth work
	11.	Soil Erosion	Surface soil erosion by rainwater after land development (vegetation removal)	Unknown	Subjected area is developed already
	12.	Ground Water	Degradation by polluted discharge water from the site	Unknown	Main work is Filling
	13.	Hydrological Situation	Change of river flow and riverbed condition due to landfill and drainage	Unknown	No structure will be built on the rivers
	14.	Coastal Zone	Changes of topographical conditions in coastal area and coastal vegetation	Unknown	The site is located on the coastal area
	15.	Flora and Fauna	Obstruction of breeding and extinction of spices due to change of habitat condition	No	There is no primary vegetation
	16.	Meteorology	Change of temperature, precipitation, wind, etc., due to large-scale development.	No	There are no large scale development
	17.	Landscape	Change of topography and vegetation by land development and harmonious obstruction by structural objects	Yes	Visual amenity will be changed by SWM facilities

No.		Environmental Items	Description	Evaluation	Remarks (Reason)
Pollution	18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	Unknown	Impact by exhaust gas from
	19.	Water Pollution	Pollution by inflow of soil and discharge waster from facilities into rivers and ground waster	Unknown	Less impact by road facilities
	20.	Soil Contamination	Soil contamination by incinerated ash, non-combustion waste and those escapes and diffusion	Unknown	May have discharge waster
	21.	Noise and Vibration	Noise and vibration generated by collection vehicles and disposal site	No	During construction and operation
	22.	Land Subsidence	Deformation of land and land subsidence due to the lowering of ground water	No	Sensitive lands do not exist in the subject area
	23.	Offensive Odour	Generation of exhaust gas and offensive odour from disposal facilities	Unknown	No factor
		Overall evaluation	Environmental Impact Assessment (EIA) is required or not		From the results of the evaluation, EIA is required.

Especially geological condition there is unknown so that it might affect on surface and ground waster quality. Wells are seen in adjacent area and theses are used for mainly agriculture. It is therefore detail environmental survey shall be carried out in design stage.

2) Scoping Results

Following to the screening procedure discussed in the previous section, scoping for further examination was carried out and the results were as follows.

Table 5.2.3 Scoping of the New Inter-municipal Disposal Site

No.		Environmental Items	Evaluation	Remarks (Reason)
Social Environment	1.	Resettlement	D	Resettlement will not occur. The site is located in special land use.
	2.	Economic Activities	C	Agriculture in adjacent areas may have impacts by change of ground water level and amount
	3.	Traffic and Public Facilities	C	Access road to the site is insufficient conditions for heavy collection vehicle
	4.	Split of Communities	D	Non-access controlled roads will not create split
	5.	Cultural Property	D	There is no cultural properties identified
	6.	Water Rights and Rights of Common	C	Farmer in adjacent area uses water resources. Change of the resources may affect on the rights
	7.	Public Health Condition	C	There is a community adjacent to the site
	8.	Waste	C	Scattering of waste form the site may occur.
	9.	Hazards (Risk)	C	Low possibility for natural disasters to occur
Natural Environment	10.	Topography and Geology	B	Large land development is not included
	11.	Soil Erosion	C	Large scale of soil erosion has not been identified
	12.	Ground Water	B	There is no large scale underground structure planned
	13.	Hydrological Situation	B	No large scale excavation will be included
	14.	Coastal Zone	D	Project area is inland
	15.	Flora and Fauna	C	It is secondary vegetation area and there is no valuable flora and fauna identified.
	16.	Meteorology	D	Large scale felling and construction of high building is not planned
	17.	Landscape	B	The site may have impacts on adjacent hilly arable landscape.

No.		Environmental Items	Evaluation	Remarks (Reason)
Pollution	18.	Air Pollution	C	Scattering of ash dust may cause air pollution depend on wind direction to adjacent community during the construction and operation stage
	19.	Water Pollution	B	Existence of the waste and the leachate may cause degradation of water quality in lower river basin.
	20.	Soil Contamination	C	Existence of waste may cause soil contamination through the leachate
	21.	Noise and Vibration	C	There is impact on noise and vibration by increasing traffic volume during operation stage
	22.	Land Subsidence	D	No sensitive lands exist in the project area
	23.	Offensive Odour	C	Decomposition of waste may cause offensive odour depend on wind direction

Note1: Evaluation categories:
A: Significant impact is predicted
B: Some impact is predicted
C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses)
D: No impact is predicted. EIA is not necessary

Note 2: The evaluation should be made with reference to the Explanation of Item.

Environmental factors that Special attention has to be paid are following subjects.

- Topography and Geology
- Ground Water
- Hydrological Situation
- Landscape
- Water Pollution

Moreover, viewpoints from different angle of the environmental impacts, which is project cycle, were considered for overall evaluation of scooping. Following table show predicted impacts before operation and operation phase.

Table 5.2.4 Matrix for Scoping Results Classified by the Project Cycle

Major facilities, activities Which may cause impacts			Project Activities						
			Overall Evaluation	Before Operation		Operation			
				Reclamation and spatial occupancy	Operation of construction equipment	Occupancy of land	Operation of vehicle	Operation of facilities	Corpus of people and goods
Social Environment	1.	Resettlement							
	2.	Economic Activities	✓			✓			
	3.	Traffic and Public Facilities	✓			✓			
	4.	Split of Communities							
	5.	Cultural Property							
	6.	Water Rights and Rights of Common	✓	✓					
	7.	Public Health Condition	✓					✓	
	8.	Waste							
	9.	Hazards (Risk)	✓						
Natural Environment	10.	Topography and Geology	✓	✓					
	11.	Soil Erosion	✓						
	12.	Ground Water	✓✓	✓✓				✓✓	
	13.	Hydrological Situation	✓✓	✓✓				✓✓	
	14.	Coastal Zone							
	15.	Flora and Fauna	✓	✓					
	16.	Meteorology							
	17.	Landscape	✓	✓		✓			
Pollution	18.	Air Pollution	✓						
	19.	Water Pollution	✓✓	✓				✓✓	
	20.	Soil Contamination	✓					✓	
	21.	Noise and Vibration	✓		✓		✓		
	22.	Land Subsidence							
	23.	Offensive Odour	✓✓					✓	

Note:

✓✓: The environmental items to which special attention has to be paid. They might be serious impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.

✓: The environmental items that may have a significant impact depending on the scale of the project and site condition

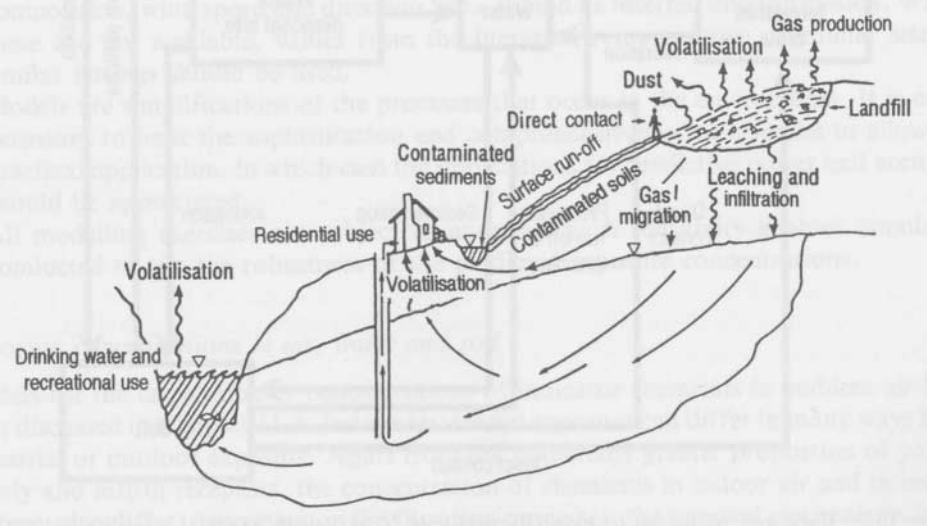
No mark: The environmental items requiring no impact assessment since the anticipated impacts are, in general, not significant.

5.2.3 Overall Evaluation and Environmental Considerations

In conclusion, it is anticipated that implementation of the master plan will contribute to mitigating environmental impacts compared to current disposal management. However further environmental study shall be carried out for detail evaluation and formulation of countermeasures. Remarkable aspects are explained as follows:

(1) From Al Bassa to Qasia Inter-municipal disposal site

It is proposed that existing Al Bassa disposal site will be closed in 1997, and then a new inter-municipal disposal site in Qasia will be opened. Viewpoint from environmental burden in the areas, environmental impacts will be decelerated. The location of Al Bassa is located in fragile coastal area while the inter-municipal disposal site is located in isolated inland where is 17km from Lattakia centre. In addition to this, sanitary landfill is proposed there while Al Bassa site is presently dumping the waste with soil cover method partially.



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

Figure 5.2.5 Conceptual Model of Landfill Exposure Sources and Environmental Pathway

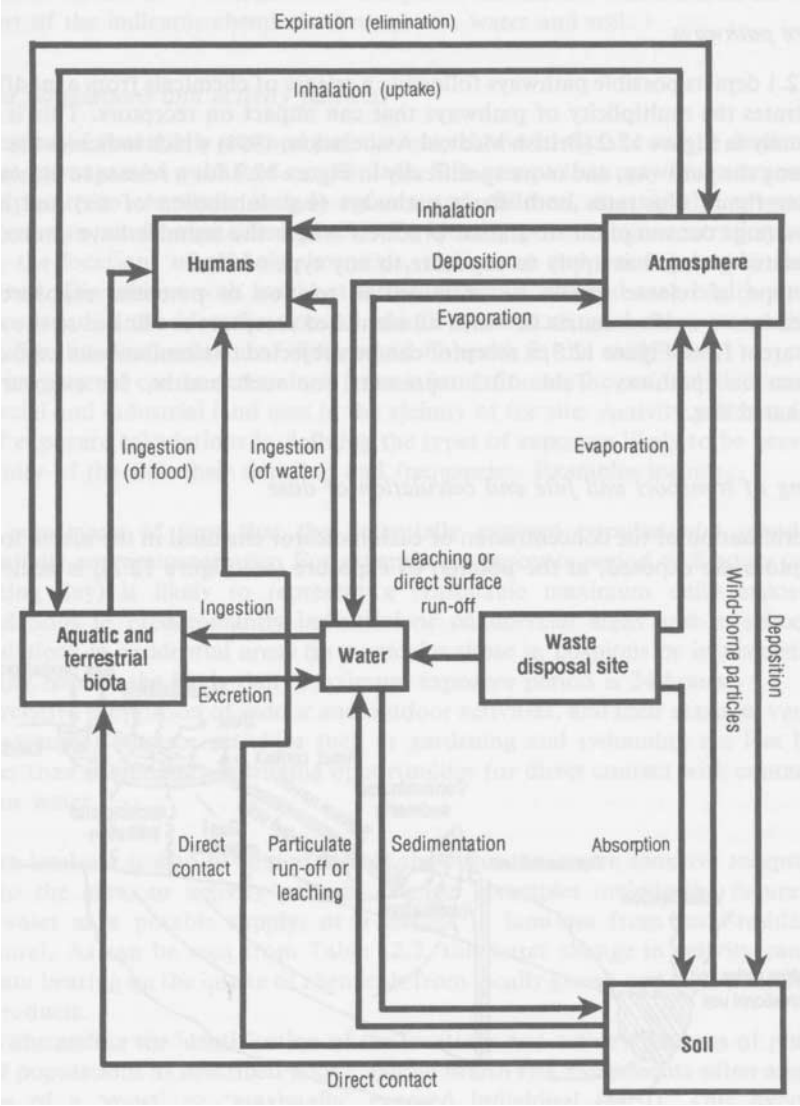


Figure 5.2.6 Exposure Pathway to Man

(2) Groundwater and hydrological condition in Qasia

The site forms a small valley and there is a small seasonable river. Construction of disposal site in upper basin, groundwater quality and flow may be affected. It is necessary to have detail survey on this matter in design phase.

(3) Water Rights in Qasia Site

Wells are seen in the community and adjacent farms. When the plan changes topographical and geological conditions there, the ground water condition may be affected. It is necessary to survey these conditions in design stage.

(4) Resettlement may cause in Inter-municipal Disposal Site

Depend on the scale and works of the plan, resettlement may cause in adjacent community. Based on observation of the site, some farmers' housings are seen and they have used ground water for their farms. Once topographical condition changes, the ground waster condition might be affected so that they discontinue to work there.

(5) Al Bassa Site

As it is explained in previous section, existing dumping site is proposed as master plan site especially up to third quarter of the Plan duration. The plan contains rehabilitation of existing SWM facilities such as disposal site and composting plant. In general there is no significant impact on the plan however miner impacts are identified as follows:

1) Proper treatment of leachate from the disposal site

The leachate from the site may cause ground water pollution and may affect on ecosystem. So far this relation is unknown, though it is necessary to have detail survey further.

2) Haulage of waste from cities

The site will be used till third quarter of the planning period. Current road condition there is insufficient and heavy compactors transport municipal waste every day. The degraded access roads condition may cause spreading wastes on the routes.

In addition, surrounding area of collection bins in the city is insufficient management and this condition generates offensive odour and attracts vectors and pests. Promotion and prevalence of the proper management should also be introduced on the public awareness activities in the plan.

Many of existing collection vehicles have insufficient maintenance in terms of safety driving. It is seen that some collection vehicles that tale lamps had gone at night and one of headlight also had gone. Proper maintenance of these vehicles should be considered.

3) Improving visual amenity in Al Bassa Site

The site is located in one of the most scenery dune along the Mediterranean Sea coast in the region. While the scene of dumping site including coastal area is terrible; for example, scattering of the waste, dispersion of the smoke, awful offensive odour, disordered dumping and spreading the waste in the area, etc. The proposed rehabilitation includes countermeasures against to such negative aspect of the site, though visual amenity and ecosystem there should be considered on the rehabilitation plan.

5.2.4 Environmental Effectiveness of Solid Waste Disposal Management

Environmental Effectiveness is defined as the positive environmental aspects by the implementation of the proposed Master Plan when compared to current waste disposal management. The Master Plan is composed of basic improvement of waste disposal management facilities such as sanitary landfill, rehabilitation of existing the disposal site, renewal of composting plant, recycling centre, and transfer station. Consistent implementation of the Plan and its proper operation will contribute to a variety of environmental practices, as described as follows:

(1) Global Environmental Issues:

1) Promotes environmentally sound practices, such as reduced methane generation

The emission of landfill gases produced by the anaerobic and aerobic decomposition of organic matters is major source of green house gases, which is responsible for global warming and ozone depletion. It is assumed that one million tones of unsorted municipal waste contains approximately 0.3 million tones of carbon in various forms.

Experimental research and process modelling demonstrate that about 0.2 million tones would be converted to landfill gases consisting of 0.09 million tons carbon dioxide and 0.09 million tones methane. Landfill gases from landfills account nearly half of the anthropogenic source of methane. Landfills have proven to be only partially successful since up to 60% of the methane generated escapes through leakage. It is clear to prevent landfilling of organic waste is a measure and composting is one of the simplest ways to prevent emission of methane because the organic fraction of the waste stream is diverted from landfill[3].

(2) Regional Environmental Issues:

1) Creation of Environmentally Sound Cities

The solid waste management proposed in the Master plan brings wide range of environmental effectiveness in the cities. Waste separation at source will increase enlightenment of municipal waste disposal manner, and improvements of collection and haulage system with sufficient collection vehicles and equipments will be sufficient for keeping clean the cities. In addition, recycling activity may effect reducing the waste amount. Rehabilitation and rearrangement of Al Bassa Disposal site and construction of Recycling Centre are the other hand of the management body. Sufficient capacity and appropriate operation will be essential, then, as results, the plan will contribute to create sound cities in terms of hygiene and living environment.

(3) Environmental Issues on the site:

1) Minimize environmental damage from indiscriminate dumping at existing disposal site

Presently waste disposal management is under insufficient management condition and lack of equipment and inappropriate engineered measures are frequently seen. Proposed the rehabilitation and introduction of sanitary landfill method are suitable for maintaining the environment and the project will contribute to enhance positive aspects.

2) Improve coastal landscape and environmental conditions along the Mediterranean Sea Coast which is one of the most scenery area in this area

The existing disposal site is located on dune area, which is one of the most attractive scenes in this area. The proposed rehabilitation and the arrangement of the site are in order and effective for recovering coastal landscape and environment, which are presently degraded by the existing disposal activity.

3) Improve the quality of landfill leachate

Landfill leachate is created when water percolates through the waste and biological and chemical constituents from the waste are brought in to solution. Depending on the landfill design and prevailing weather condition, composting may not significantly reduce the quantity of landfill leachate, however it will improve quality of the leachate.

(4) Recycling Issues:

1) Improves recycling by removing organic matter from the waste stream

Recycling organic matter from the waste in the study area is suitable idea that 78% of the total collected municipal waste is organic and almost of all market waste is also dominated by organics. In addition to this, climate condition helps to introduce composting system as recycle of the waste.

[3] Composting and Its Application in Developing Countries, World Bank

The composting process reduces the waste amount, and enhances recycling the waste. 5% of the total waste amount is sorted and 20 % will be fine compost, 25% will be residue and 16% will be recycle compost. As a result, total amount of the organic waste will be 63.5%. In addition, another recyclable wastes such as plastics, glasses and metals are sorted and are used as supplement materials for new productions. Moreover the activity is also effective for enlightenment of waste disposal management at source.

2) Produces a valuable soil addictive – integral to sustainable agriculture

Utilization of compost product is an essential for agriculture in order for intergrading physiochemical soil structure. An organic component will introduce well-balanced nourishment in addition to the chemical fertilizers.

3) Enhances the effectiveness of fertilizer application

Organic manure namely the compost will improve nourishment of the soil and will enhance applicability of fertilizer. Chemical fertilizers are generally preferred over compost because they are easy to handle, store and apply, and a synergistic relationship exists between compost and chemical fertilizers, and greater fertilizer efficiency can be established through the use of compost in conjunction with chemical fertilizers (World Bank 1997a).

4) Can integrate existing informal sectors involved in collection, separation and recycling

There is an opportunity to involve informal sectors working on waste separation into integrated system. Presently scavengers are sorting valuable wastes, which are sellable metals, plastics and glasses. In order for proceed recycling and keeping safety on the site, scavengers cane be involved in the system. It is therefore social impact may be minimized.

5.3 ENVIRONMENTAL EVALUATION OF FEASIBILITY STUDY PROJECTS

5.3.1 Introduction

The environmental evaluation on the proposed feasibility projects was conducted according to applicable legal system in Syria and other references. The aim of the evaluation is to identify potential significant impacts and to make mitigation measures to those impacts.

In this evaluation, two solid waste facilities, recycling centre including composting and sorting centres and rehabilitation of Al Bassa disposal site were subjected as follows

(1) Development of Lattakia Recycling Centre (Composting plant and sorting centre)

(2) Rehabilitation and rearrangement of Al Bassa Disposal site and improvement of operation of final disposal site

The anticipated environmental impacts of the priority project are mostly beneficial in terms of urban environment and public health. Actually proposed project category is an urban environmental improvement. Significant beneficial effects of the project include improvement of living environment and public health conditions through proper waste collection, haulage and disposal.

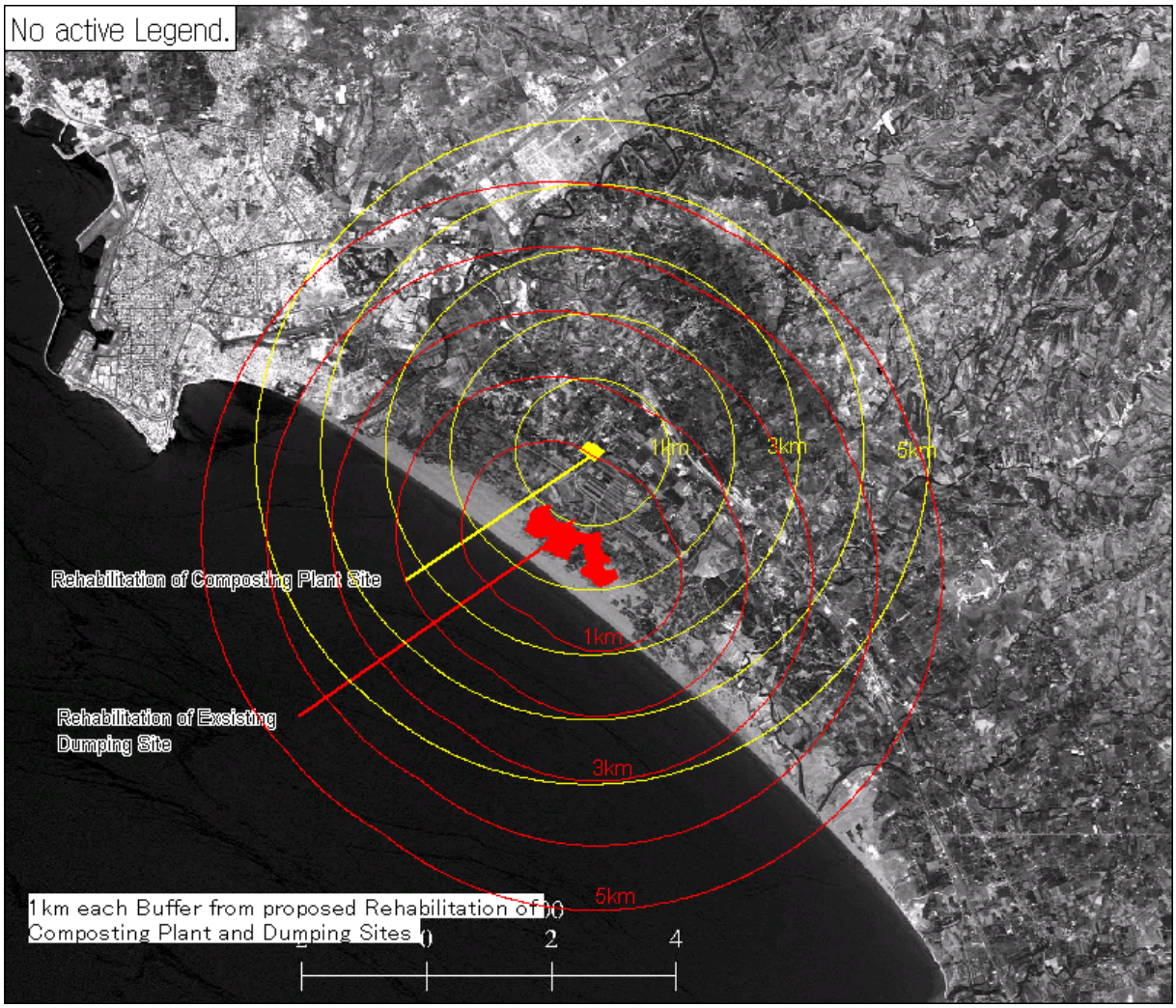


Figure 5.3.1 Location of the Feasibility Projects Site- Al Bassa

5.3.2 Potential Impact of Environment

The potential impacts on the selected feasibility study projects are explained below and summarized in Table 5.3.1.

(1) Development of Lattakia Recycling Centre (Composting plant and sorting centre)

There is neither major negative impact nor negative minor impact on this project. The project is proposed on existing composting plant site which is already closed, and the purpose of the project is renewal of the existing one.

Whereas it is doubt about negative impacts during the operation stage such as residue water, offensive odour, degradation of hygiene condition, noise, etc., though; the project component includes sufficient measures for such impacts.

Recycling of residue water is set. Leachate from organic waste is re-used for compost producing process. Offensive odour 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 that is used at beginning of the waste classification, high noise will not be generated. Residue and Low quality of produced compost remain; however, they will be disposed in the disposal site near by. So large amount of waste will not be generated.

Moreover, the composting process will contribute to reducing the waste amount and to enhancement of recycling the waste. 5% of the total waste amount is sorted and 20 % will be compost and 25% will be residue, then transport to the disposal site. Rest of the amount is reduced in producing of compost.

Furthermore, there are some residential houses next to the site. It is assumed that the impacts to the area will be low or negligible which is brought by new facilities. In deed, according to the household interview survey in Al Bassa area, approximately 85% of interviewee agreed on renewal of composting plant and construction of sorting centre.

It is therefore the project will not affect major negative environmental impact and the project will improve current conditions of the site.

(2) Rehabilitation and rearrangement of Al Bassa Disposal site and improvement of operation of final disposal site

The duration of the potential impact is limited due to the master plan schedule that the rehabilitated landfill site is closed by year 2007 then the final disposal site shifts to Qasia site which is opened to operate from year 2008.

There is no major negative impact on this project. This project is proposed o the existing disposal site and the project aims rehabilitation of the site due to insufficient management presently.

The existing disposal site in Al Bassa is divided by three areas called Zone I, II and III. Zone I will be restored by soil covering immediately and it will be closed after the rehabilitation. Zone III will be sanitary landfill after the rehabilitation and it is used up to year 2007, and then it will be closed. Zone II will remain as bush and agricultural lands. In deed, the size of area will be reduced compared to the existing one and the land will be used effectively.

Sanitary landfill is introduced to Zone III and necessary facilities are provided such as drainage system, impermeable layer by clay, fence, maintenance quarter, leachate reserve, separated cell for non-municipal waste, access road, etc.

On the rehabilitation of the site, covering soil on the waste has great effects on the management of landfill site. The soil covering reduces offensive odour, leachate, fire, scattering the waste, pests, etc., Therefore the negative impacts will dramatically be reduced by this activity.

Table 5.3.1 Summery of Potential Impacts of Environment on Al Bassa Site

		Major facilities, activities Which may cause impacts	Al Bassa Rehabilitation						Recycling Centre					
			Before Operation			Operation			Before Operation			Operation		
			Reclamation and spatial occupancy	Operation of construction equipment	Occupancy of land	Operation of vehicle	Operation of facilities	Corpus of people and goods	Reclamation and spatial occupancy	Operation of construction equipment	Occupancy of land	Operation of vehicle	Operation of facilities	Corpus of people and goods
Social Environment	1.	Resettlement												
	2.	Economic Activities												
	3.	Traffic and Public Facilities												
	4.	Split of Communities												
	5.	Cultural Property												
	6.	Water Rights and Rights of Common												
	7.	Public Health Condition												
	8.	Waste												
	9.	Hazards (Risk)												
Natural Environment	10.	Topography and Geology												
	11.	Soil Erosion												
	12.	Ground Water												
	13.	Hydrological Situation												
	14.	Coastal Zone												
	15.	Flora and Fauna												
	16.	Meteorology												
	17.	Landscape			✓									
Pollution	18.	Air Pollution												
	19.	Water Pollution					✓							
	20.	Soil Contamination												
	21.	Noise and Vibration												
	22.	Land Subsidence												
	23.	Offensive Odour											✓	

Note: "✓" shows potential impact of environment. "✓✓✓": high, "✓✓": moderate, "✓": low, no indication: negligible

In addition, drainage system including leachate reserve is planed and it encourages collecting leachate water. Aeration is also planed in the reserve and reserved collected water is recycled for sprinkling on the restored waste. Facilitating fence around the site is also effective to avoid scattering of the waste especially lightweight waste and to control access animals to the site.

Moreover, access road improvement, currently macadam pavement which is maintained poorly, will also be effective for smooth haulage of collected waste from the entrance to certain location.

Furthermore, the site lies on the seaside, which is fragile area, though the site is proposed 350 meters away form the shoreline. According to Ministry of

Communication, a coastal road is planed in the site between coastal line and the site. This clearance may not be affect on the coastal area and the proposed road.

Consequently the project itself is for improvement of the existing disposal site and there is no major potential impact of environment.

5.3.3 Mitigation Measures

(1) Development of Lattakia Recycling Centre

The project is to renew the existing composting plant and construction of sorting centre in the same site. Facilities are well sophisticated, and neither major nor minor potential impact of environment is anticipated.

Table 5.3.2 Mitigation Measures of Lattakia Recycling Centre

Measures	Design stage		Operation stage	
	Engineering Design	Design option	Construction	Operation
Measures at source	▪ Drainage system ▪ Leachate collection and treatment system ▪ Impermeable facility	▪ Dust prevention techniques ▪ Selection of Low noise and vibration method of construction ▪ Adoption of low noise and vibration equipment	▪ Reduction of emission by heavy construction machine and vehicle ▪ Adoption of low noise and vibration equipments	▪ Leachate collection and treatment (water pollution prevention) ▪ Waste quality monitoring
Impact mitigation measures			▪ Adoption of low noise and vibration equipment ▪ Dust prevention by tree buffer or screen fence	▪ Establishment of water quality monitoring (surface and ground water)
Natural environmental preservation measures	▪ Design with nature ▪ Design with visual amenity (height, form, colour)	▪ Adoption of surface soil preservation ▪ Adoption of transplantation	▪ Surface soil deposit ▪ Tree deposit ▪ Minimization of earth work and cutting tree	▪ Establishment of Environmental monitoring

According to the household interview survey, 60% of the total interviewee uses well water and of which 31% uses well water as drinking purpose. And 50% of total interviewee feels offensive odour from the site which is not only existing compost plant but also includes existing disposal site. In this condition and further unexpected impact, it is essentials that environmental mitigation measures should be considered.

Possible mitigation measures in consideration of project stage, which is design and operation stage and target fields such as measures at source, measure for impact and natural environmental prevention measures are explained shown in Table 5.3.2.

Establishment of regular monitoring system for the source, surface and groundwater and biological monitoring in the site is recommended in order to have proper maintenance of the centre. Visual amenity including landscaping is also essential to be considered. Planting trees, shrubs and groundcover plant encourage to microclimate there and mitigate offensive odour and scattering of dusts.

(2) Rehabilitation and rearrangement of Al Bassa Disposal site and improvement of operation of final disposal site

No major negative impact is anticipated while further mitigation measures are concerned in order for proper management of the landfill even it is fully equipped with sanitary landfill. Possible mitigation measures in consideration of project stage, which is design and operation stage and target fields such as measures at source, measure for impact and natural environmental prevention measures are explained shown in Table 5.3.3.

In addition, leachate management is a key of the landfill management and its component shown in Table 5.3.4 will help to enhance mitigation of environmental impacts. The major points are explained as follows:

- Minimization of leachate generation
- Contaminant of leachate within the landfill
- Control over leachate quality
- Collection and disposal of leachate as it is generated
- Monitoring
- Contingency plans

Table 5.3.3 Mitigation Measures of Landfill

Measures	Design stage		Operation stage	
	Engineering Design	Design option	Construction	Operation
Measures at source	Pollution prevention ▪ Drainage system ▪ Leachate collection and treatment system ▪ Impermeable facility ▪ Gas tap ▪ Scattering prevention net	Air and Water Pollution ▪ Dust prevention techniques Noise and Vibration ▪ Selection of Low noise and vibration method of construction ▪ Adoption of low noise and vibration equipment	▪ Reduction of emission by heavy construction machine and vehicle ▪ Adoption of low noise and vibration equipments ▪ Surface and groundwater degradation during the construction	▪ Planting and sprinkle water on the landfill (Scattering prevention) ▪ Soil covering on the waste (Odour and vermin prevention) ▪ Leachate collection and treatment (water pollution prevention) ▪ Gas tapping of landfill site (▪ Waste quality monitoring
Impact mitigation measures			▪ Limitation of chemical usage for construction works ▪ Adoption of low noise and vibration equipment ▪ Scattering prevention by tree buffer or screen fence	▪ Establishment of water quality monitoring (surface and ground water)
Natural environmental preservation measures	▪ Structural design ▪ Design with nature ▪ Structural design with characteristics of topography and geology ▪ Design with natural landscape ▪ Design with visual amenity (height, form, colour)	▪ Adoption of surface soil preservation ▪ Adoption of slope preservation ▪ Adoption of transplantation ▪ Adoption of flora and fauna conservation	▪ Surface soil deposit ▪ Tree deposit ▪ Minimization of earth work and cutting tree	▪ Soil covering (visual amenity) ▪ Extermination of vermin during land filling ▪ Establishment of Environmental monitoring

Other notable mitigation measure is landscaping. It is quite effective tool for maintaining of the landfill site. Covering soil on the waste and planting trees, shrubs and groundcovers are essential to maintain microclimate, visual amenity and prevention of dust and offensive odour. It is also contributed to recover consecutive coastal landscape which is used to be scenery area along the Mediterranean Sea. Presently the lands along the coast belong to Ministry of Tourism and they have proposed tourism development plans there.

Table 5.3.4 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 bunding 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	▪ Lechate 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

5.3.4 Conclusion

Proposed plans, recycling centre 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 Quadaha municipalities will receive environmental benefit from the projects.

5.4 URBAN PLANNING AND POPULATION

5.4.1 Urban Planning

(1) Local Administration and Budgetary System

Syria has a centralized administrative system. At the sub-national level the important administrative unit is the Mohafaza, translated in to Governorate, which comes under the authority of central government and functions as an intermediary of national administration at the regional level. The structure of the local administration system is shown in Figure 5.4.1.

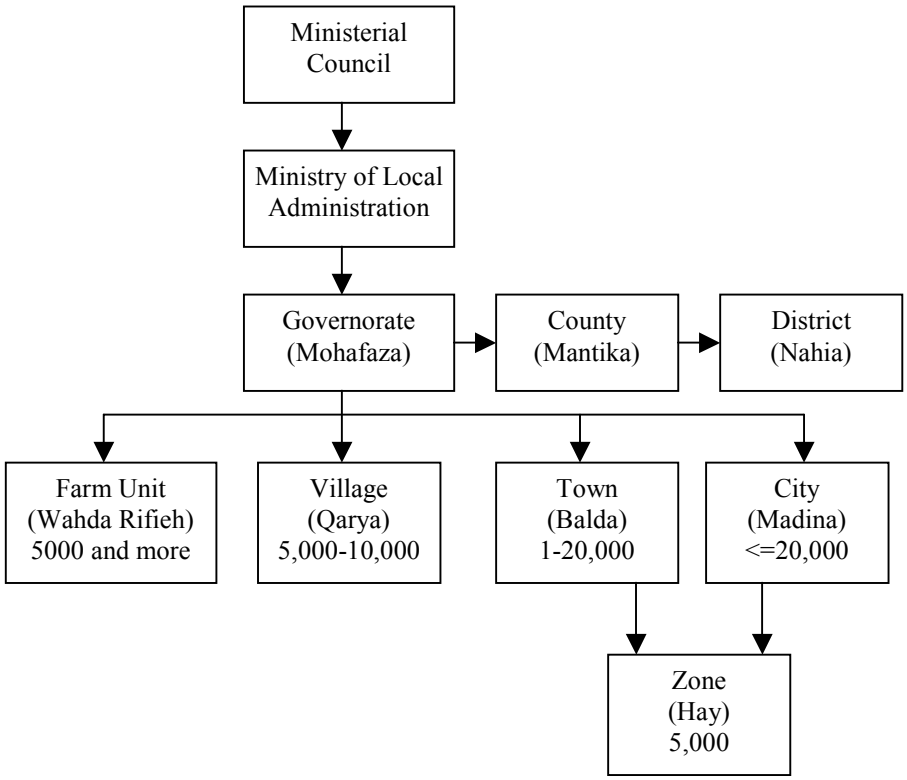


Figure 5.4.1 The Structure of the Local Administration System in Syria

Within each Mohafaza (Governorate) there is a hierarchy of administrative units. The city of Lattakia (Maitika) has the status of Municipality. The Lattakia Mohafaza (Governorate) is divided into four mantikas (County), Lattakia, Jableh, Al-Haffeh, Al-Qurdaha. Madina (Cities) like Jableh, Al-Haffeh, Al-Qurdaha are mantika centres serving a group of smaller districts (Nahias) and villages (Qurya).

The Mohafaza, therefore, is the closest to what could be called “local government”, but the name could be very misleading since powers of decision-making and policy implementation are rather limited. Each Mohafaza (Governorate) is structured by departments that each one dealing with fields of administration corresponding to different fields like supplies, industry, water supply, agriculture, tourism, etc.

The Mohafaza budget is financed by the Central Government transfers, adjusted according to expenditure priorities falling within the broad investment strategy of the nation’s Five year Economic Development Plans of the Central Planning Commission.

The Ministry of Local Government finances routine expenditure at the Mantika, Nahia and Village levels on education, social services, roads, etc. Large-scale infrastructure projects of national on regional importance such as major roads, irrigation dams, etc. are planned and executed by the Central Government, as they require technical competence and resources beyond the capabilities of the Mohafaza.

Associated with the need to establish effective planning functions in the Lattakia region is the question of required public finance, Central Government budget resource will continue to be the main source of finance for public expenditure in the region. As new development and greater activity is envisaged in the future, more revenues should be derived by the Mohafaza from local capacity for implementation of schemes to improve the environment and also to introduce cost recovery standards and cost consciousness in the provision and use of services.

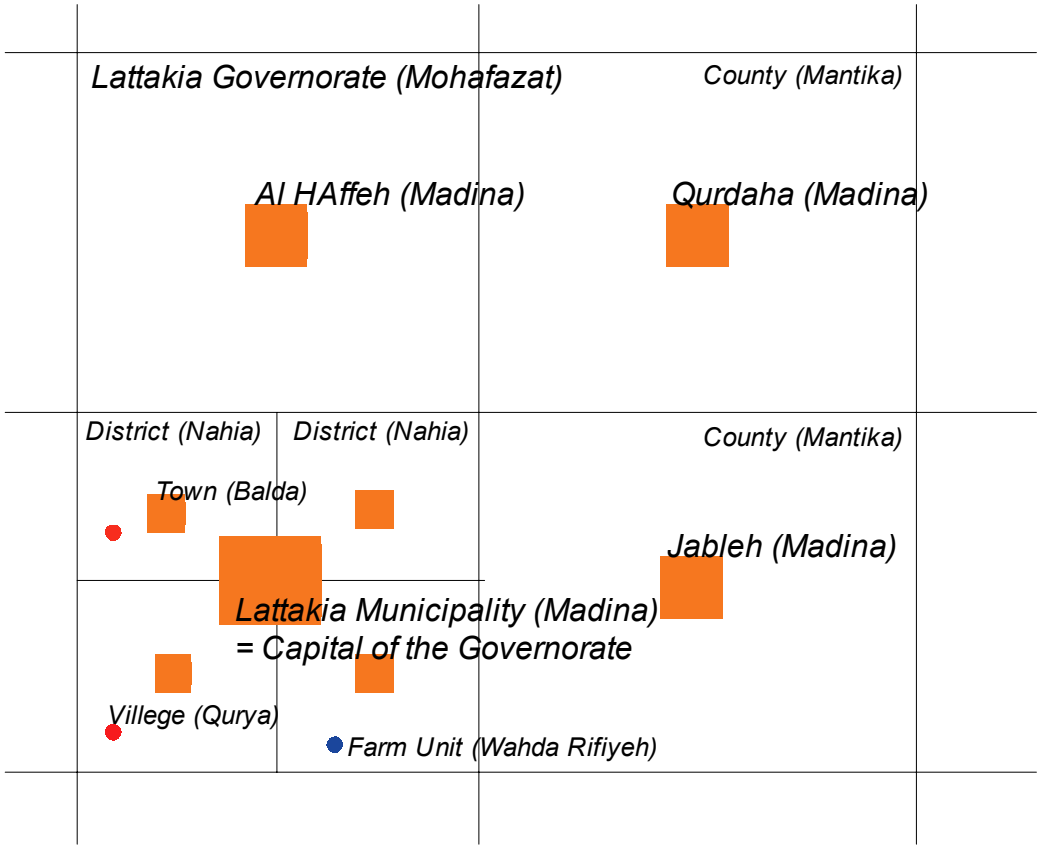


Figure 5.4.2 Conceptual Illustration of the Local Administration Structure in Lattakia Governorate

(2) Syrian Urban Planning System

Urban planning system had been influenced by former USSR that they had close relationship since the 1970s. In deed, Decree No.5 dated on 23/2/1983(amendments for Decree No.5, 1965) is the basis of urban planning in Syria presently and declares that the Ministry of Housing and Utilities is in charge of urban planning.

To fulfil the demand of the residential groups according to the available possibilities in the framework of the integrated regional planning for Syria, the decree stipulate following planning principles.

Urban Planning Basis: The General Engineering Specifications shall be applied for urban planning and buildings.

Planning Target: is the schedule that identify the present and future needs for any residential group according to the basis of the urban Planning based on the situation of this group, and the schedule identify the population and the population density types of services provided and the utilities.

General Urban Planning: is the plan that clarify the future prospect of residential group and it's expansion through identifying the urban borders, main road networks and land-use plan for the existing land whiten the boundary, as well as the method and the system of building for each area in parallel with the rules and aspects of the urban planning and the planning target.

Detail Urban Planning: is the plan that identifies all the planning details for main and secondary road networks, pedestrian path general vacant area and all the land use plan in details according to the plan of each area in parallel with the General Urban Plan.

The comportments of the plans are summarized below.

Table 5.4.1 Component of General and Detail Urban Plans

Plan	Contents	Plan Validity/ Frequency of planning
General Urban Plan	Boundary, major road network, land use	20 years/ every 20 years
Detail Urban Plan	Detail road network, open space, detail land use plan	Occasionally, if necessary

(3) Planning Procedure and Enforcement of Urban Plans

The planning procedure is clear while its enforcement system is rather veiled due to the influence of the centralized planning system which is still exists. Both of the procedures are explained as follows:

General Urban Plan:

- Ministry of Housing and Utility (MOHU) receives request from municipality that general plan is needed.
- MOHU approves the request and proceed the plan
- The municipality provides a tender of the works for consultants
- Selected consultant carries out the work
- MOHU also supervises the work

Detail Urban Plan:

- Municipality decides formulate a detail urban plan based on the General Plan formulated before.
- Municipality calls consultants for tender of the work.
- Selected consultant carry out the work.

(4) Urban Planning in the Study Area

Urban planning administration and planning are based on General Urban plans for cities. Municipalities in Syria have formulated and updated their General Urban Plans every twenty years. The Plans are formulated for twenty years period in accordance with planning criteria set at central government Entire municipalities of the Study Area are currently being preparation of updating existing the Plans as summarized below:

Table 5.4.2 Summary of Present and Proposed General Plans

Municipalities	Present Plan		Proposed Plan		Remarks
	Population / Planning Area	Target / Formulated Year	Population / Planning Area	Target / Formulation Year	
Lattakia	372,472 pop / 2,300 ha	Year 2005 / Year 1978	500,000 / 4,760 ha	Year 2020 / 2001	Expansion of tourist areas along the north-south coast areas with tourist facilities
Jableh	52,000 pop / 320 ha.	Year 2000 /	70,000 / 600ha	Year 2020 / 2001	Approval of the unity with Homimien and Bsisien villages is in process since 1991, albeit waste collection targeted for Bsisien (1,000 households approx.)
Al Haffeh	13,000 pop / 236 ha	Year 2000 /	25,000 / 450 ha	Year 2020 /2001	Total area in the city, about 1,000ha, unchanged even in the target year
Qardaha	20,000 pop / 226 ha	Year 2000 /	40,000 pop / 1,370 ha	Year 2020 / 2001	Actually 7 vicinity villages unifies in 2010 (1,370 ha.)

Source: Interviews with each municipality

In addition, current general urban plans in subject municipalities are shown in Annex 2-5.

(5) Current Land Use in Lattakia

Urbanization in Lattakia is extending to the north direction and the urbanization includes both formal and informal hosing areas. Large-scale housing developments are proposed northern fringe of the urbanized area. Indeed, public and private sectors are active for the development. Despite an informal housing is also growing at the skirt of the city. Current land use in Lattakia is shown in Figure 5.4.8 and current land use scenes are shown in following figures.

There are there major informal housing areas. One is located in southern part of Lattakia called Al Kuds along with the Mediterranean Sea coast. The other one is located in Ugarit and Bisnada zones where is northern part of the city. This is extending to sprawl agricultural area. Another one is Al Assad zone which is recently adopted to the city. This area is characterized by tourism.

One of the characteristics of the land use in Lattakia is that large amount of tourism facilities are located especially in northeastern and southern parts along the Mediterranean Sea. Lattakia is the coastal tourism center in Syria and tourist flow is dominated in summer season, which is from June to September.

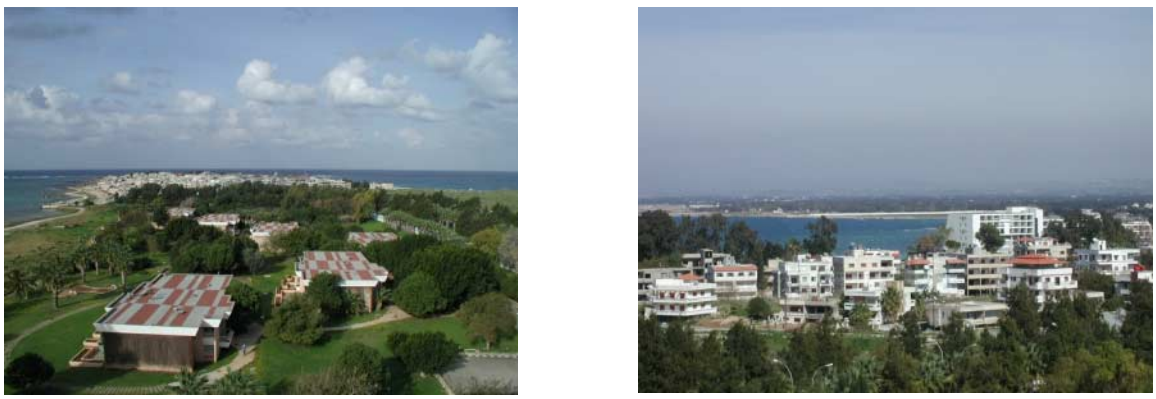
In relation with municipal solid waste management, disorder street conditions with high density at the areas are hazardous aspect. Collection and haulage of the waste to the disposal site has been affected or the service has not been provided properly in those areas. The tourism flow in summer season may affect increasing of municipal waste amount.

Informal Housing Area

Figure 5.4.3 Informal Housing Area in Lattakia

Newly Developed Residential Area

Figure 5.4.4 Housing Development Area in Lattakia



North-West Part of Lattakia

Villas and Five Star Hotel

Well-landscaped street

Five Star Hotel

Access Road to the Tourism Area

Pier and Pressure boats

Figure 5.4.5 Tourism Area –Al Assad Zone

Figure 5.4.6 Typical Housing Area


Figure 5.4.7 Tourism Villa Development Area

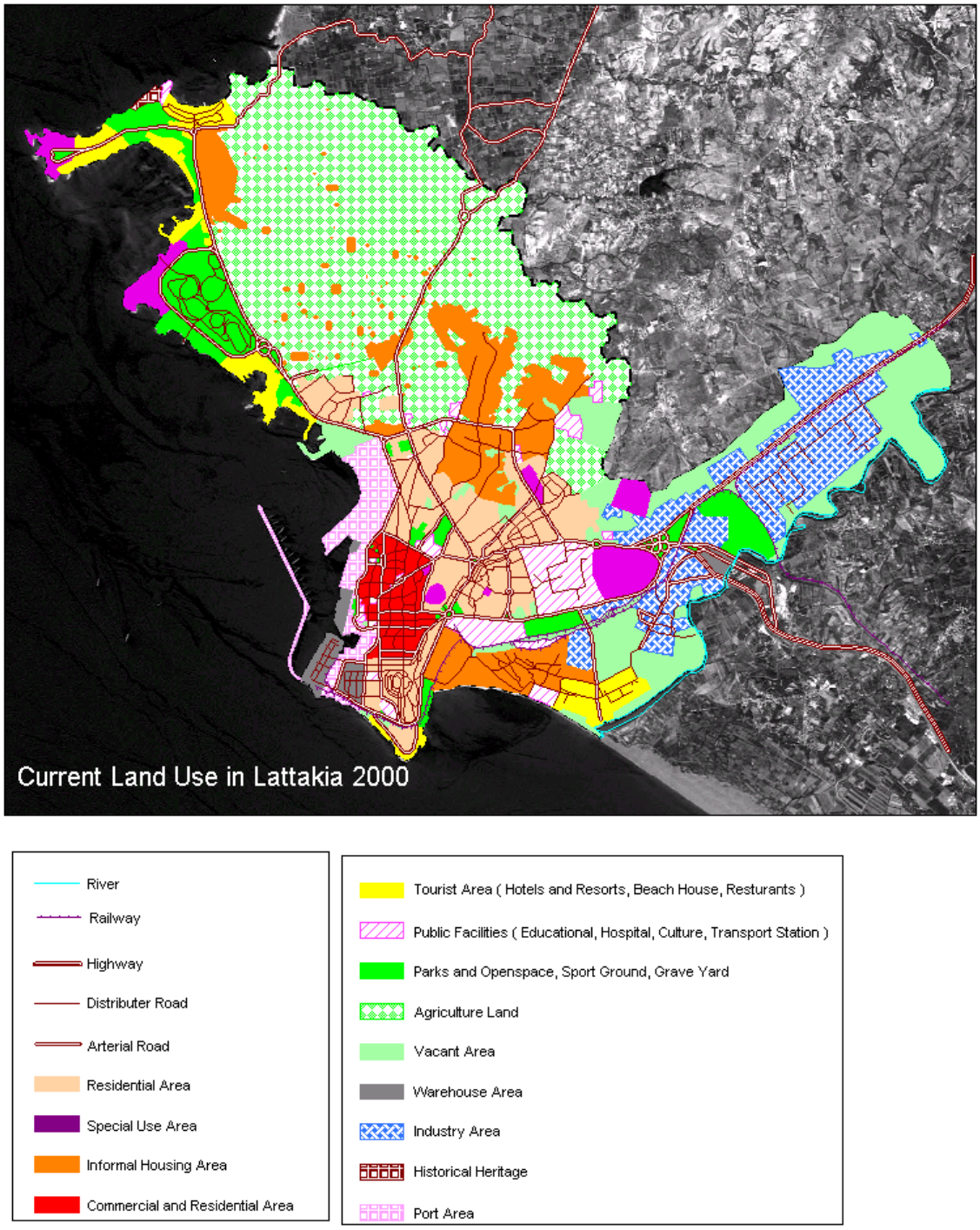
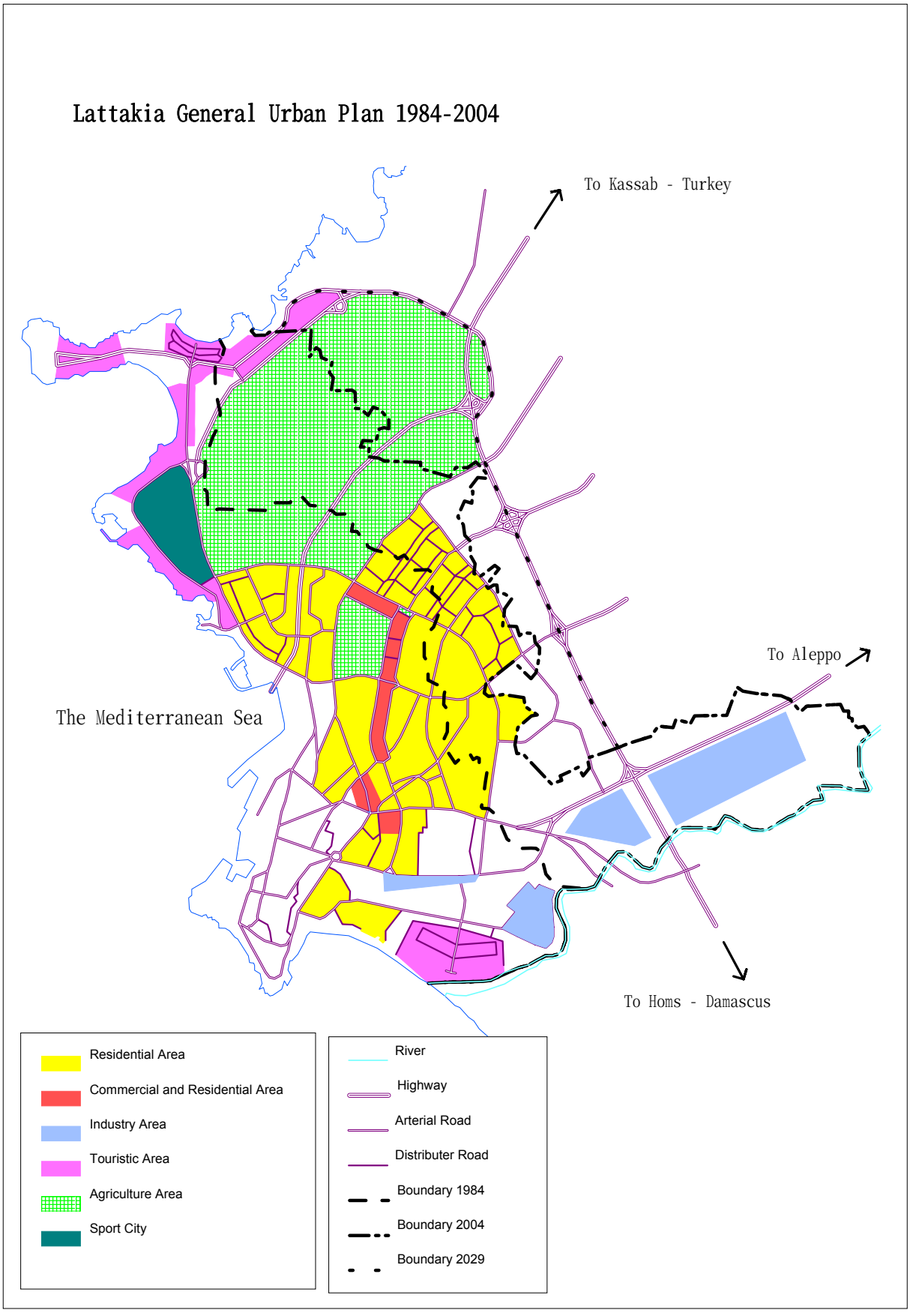
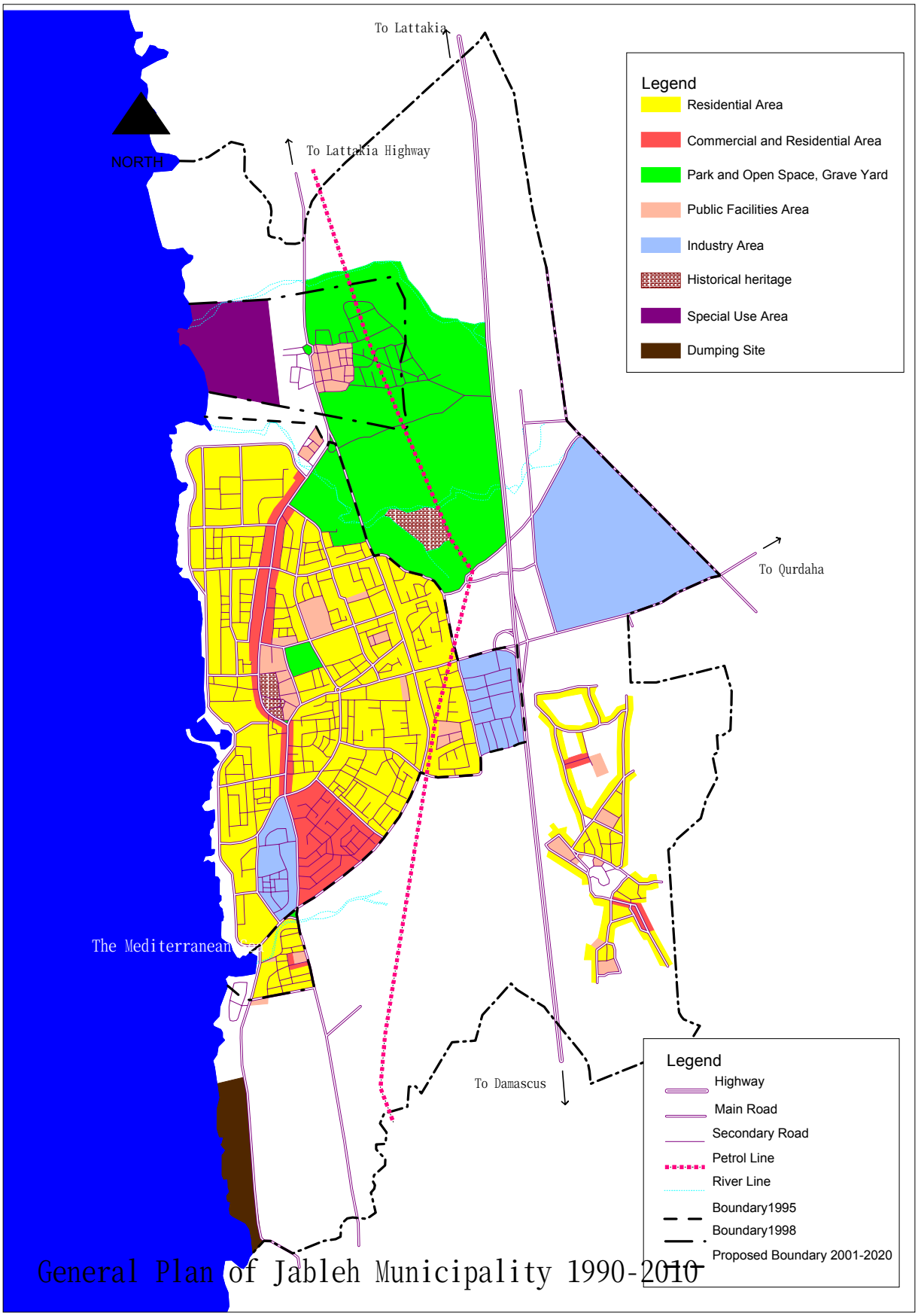


Figure 5.4.8 Current Land Use in Lattakia, Year 2000

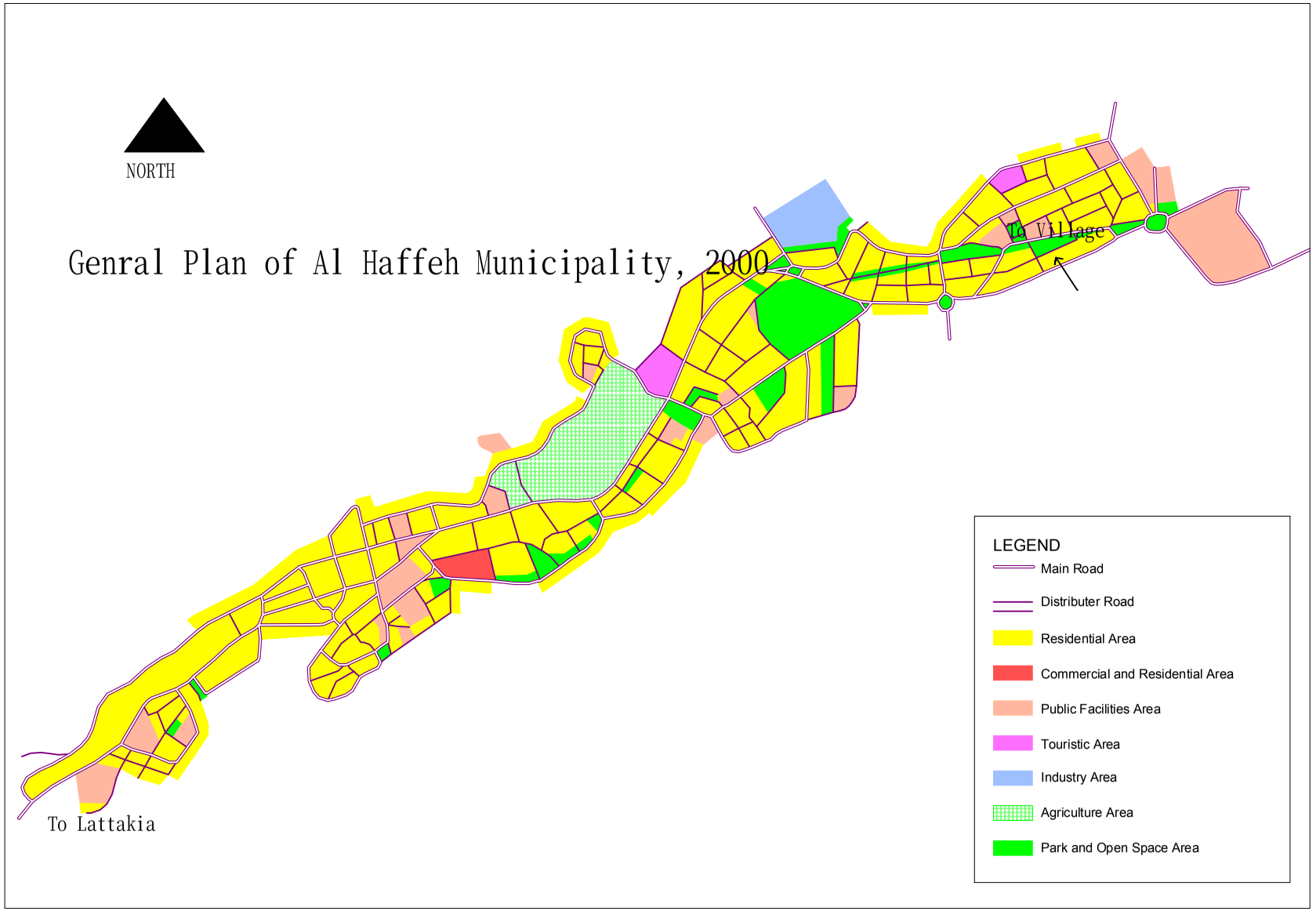
ANNEX 1 GENERAL PLAN – LATTAKIA



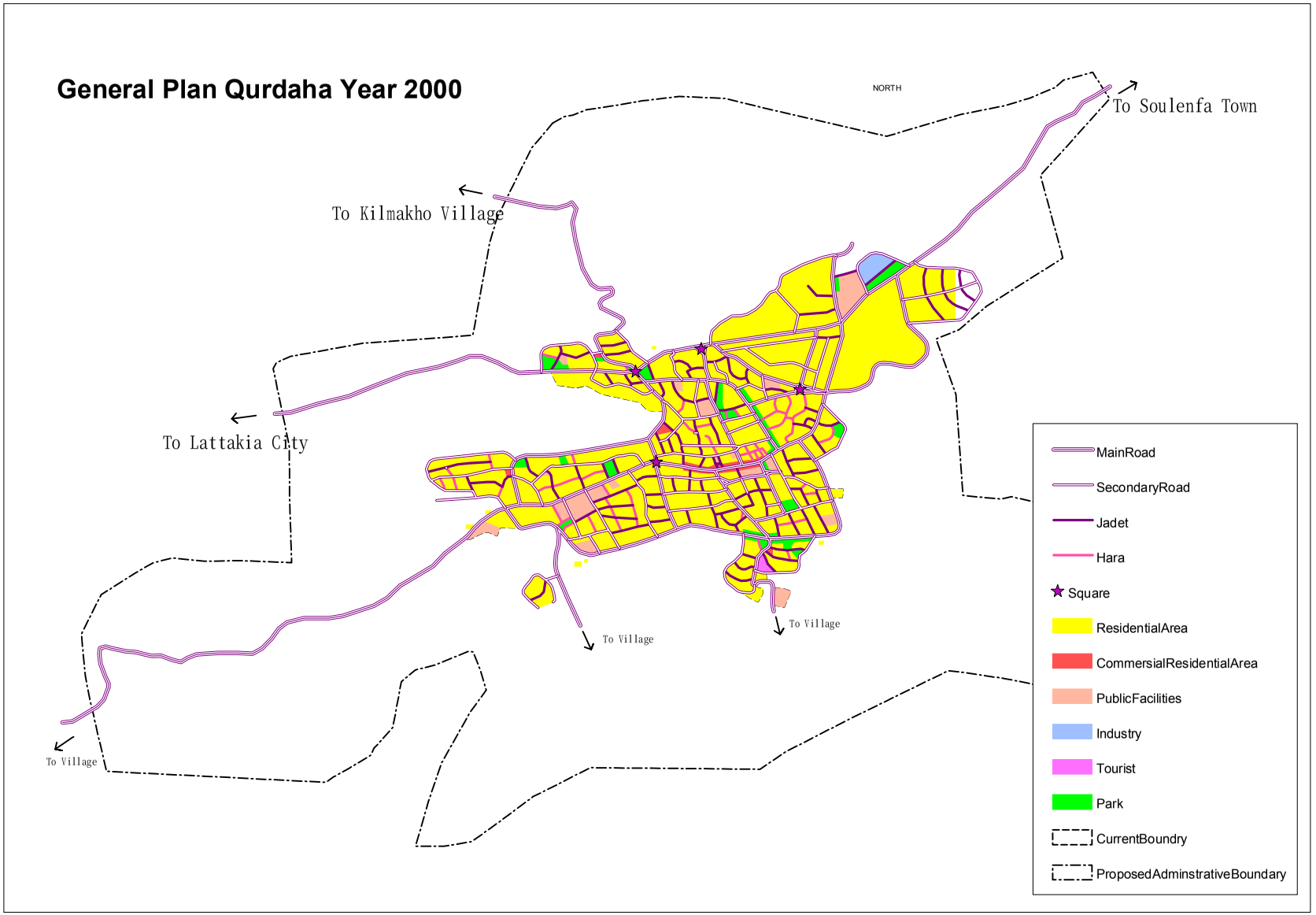
ANNEX 2 GENERAL PLAN – JABLEH



ANNEX 3 GENERAL PLAN – Al HAFFEH



ANNEX 4 GENRAL PLAN – QURDAHA



5.4.2 Population

Population projection is one of major socio-economic indices for formulation of plans, and the projection for year 2010, which is target year of the master plan on this study, was examined taking into consideration of Census[4] information and Civil Records[5]. In addition to this, tourist flows in subject areas were also explained as seasonal migration to those areas.

(1) Demographics Feature

1) Size of Population

Last three decades, the population size was tripled and the annual growth rate was decreased sharply. This is not only Lattakia Municipality but also entire Syria decreases the growth rate. During 1970s, the growth rate was more than 5% while 1990s, it was half of 1970s, and it is also expected to decreasing the growth rate up to the first decade of the 21st century by successful health policy and social changes.

Table 5.4.3 Size of Population-Lattaka Municipality

	Y1970	Y1980	Y1990	Y2000
Size of Population	1	1.6	2.3	3.0
Growth Rate		5.10%	3.62%	2.51%

Source: Civil Affair Department, Lattakia

2) Growth Factors

a. Fertility Rate

According to the census carried out in 1994, fertility rate was 3.4 per woman in urban area and 4.1 in rural area respectively. The rate was dramatically decreased compared to year 1970 and it tends to decrease. This was archived by reproductive health activities and social changes. In 1970, women's illiteracy rate was 73%, while in 1998 it was 22%. In addition to this, participation of women in economic activities is also increased that it was 8% of total labor force in 1970 while it is 17% in 1993. It is therefore fertility rate was dropped and it will decrease some more near future in accordance with socio-economic improvement.

Table 5.4.4 Fertility Rate (15-49y) in Syria

	Urban	Rural
Y1970	6.0	8.7
Y1981	5.7	8.5
Y1994	3.4	4.1

Source: Central Bureau of Statistics

b. Death Rate

Successful health policy in Syria has contributed to decrease death rate. The table shows that it is 12.6 deaths per thousand populations in 1960s in urban area while in 1990s it is 3 deaths per thousand populations. The death rate in urban area was significantly decreased which was less than one fourth.

[4] The Central Bureau of Statistics is a governmental organization, which has an authority to carry out Census. The Census subjects for residents in certain administrative border including citizens and non-citizens.
[5] Civil Affair Department of Ministry of Interior has an authority to register citizens.

Table 5.4.5 Death per thousand

	Urban Person/1000	Rural Person/1000
1960s	12.6	18.3
1970s	6.7	9.6
1990s	3.0	5.0

Source: UNDP

c. Infant Mortality Rate

Infant mortality rate relates to life expectancy at birth and the rate was improved dramatically during last three decades. End of 1960s the rate was 90 per thousand in urban area while in early 1990s the rate was improved at 34.

In addition to this, differences between urban and rural areas the rate shrink from 35 per thousand at the end of 1960s to 5 per thousand in early 1990s. This shows that health condition became similar between urban and rural areas.

Table 5.4.6 Infant Mortality Rate in Syria

	Urban (per 1,000)	Rural (per 1,000)	Balance (per 1,000)
End of 1960s	90	125	35
Early 1990s	34	37	5

Source: Human Development Report 2000 Syria, UNDP

d. Life expectancy

Lower death rate contributes to improve life expectancy for both sexes. Male and female's life expectancy during 1960s were 58.2 years and 60.6 years respectively while 1990s male and female's life expectancy were 62 years and 67.7 years. Female's life expectancy improved 12 %, which was more than male's one (7%) during four decades.

Table 5.4.7 Life Expectancy in Syria

	Male (Years old)	Female (years old)
1960s	58.2	60.6
1990s	62.0	67.7

Source: Human Development Report 2000 Syria, UNDP

e. Demographic Distribution in Urban Areas and Immigration

Annual population growth rate in urban area has been decreased

The urban population share increased from 37% of the total population in 1960 to 43.5% in 1970, and then to 47.1% in 1981[6]. This shows decline of rural to urban immigration.

(2) Conditions of the Projection

1) Base Information

There are two kinds of available information on population in the Study area. One is Census and the other one is Civil Records. Last Census was carried out in 1994 and it is expected to carry out next Census soon. The Census subjects to residents in certain area

[6] Human Development Report 2000 Syria, UNDP

such as administrative boundary including citizens and non-citizens. While the Civil Records is taking in account of Citizens only. Those two were considered as base information in order to estimate future population.

2) Growth Rate

The Central Bureau of Statistics (CBS) has estimated future population from year 1995 to 2005 based on the last Census carried out in 1994. According to estimation results, the annual average growth rate was 2.24% on the period and the annual growth rate in each year seems to be flat, which is 2.25-2.3%. Only year 1994-1995 has different growth rate, which is 1.89%. In addition, there is same growth rate applied for other municipalities as well as that of Lattakia Municipality.

Moreover according to the annual Civil Records obtained from Civil Affair Department of Lattakia Governorate, the average population growth rate of 1980s and 1990s were 3.62% and 2.51% respectively. In reference to the last Census, annual average growth rate of year 1994-2000 was 2.69%. In this regard, population growth rate is decreasing recently.

3) Conditions of the Projection

Taking in consideration of population numbers by the Census results in 1994 and the recent actual growth rate from Civil Records, which are year 1994-2000, an annual average growth rate, 2.69%, was applied for these projections throughout the year 2010. It is assumed that this rate is maximum growth rate for the first decade of this century.

(3) The Projection Results

The projection results based on the projection conditions explained previous course are shown in following table. Lattkia Municipality will reach to approximately 480,000 populations, which is 1.3 times of the year 2000 population. The rest of subject municipalities are same growth size. Jableh municipality will be approximately 120,000, Al Haffeh Municipality will be 30,000 and Qurdaha Municipality will be 63,000 populations.

Table 5.4.8 Results of Population Projections

	Y1994	Y2000	Y2005	Y2010
Lattakia	311,784	365,600	417,500	476,800
Jableh	77,000	90,300	103,200	117,900
Al Haffeh	19,518	22,900	26,200	30,000
Qurdaha	40,880	48,000	54,900	62,700

Source: JICA Study Team estimates Note: Y1994 is from Census 1994

(4) Tourism Migration

Lattakia municipal area is one of the most prestigious tourism areas in Syria and most of the tourism facilities in Lattakia Governorate are concentrated in Latakia Municipality such as accommodations, restaurants, summerhouse, rent apartments, etc. In order to estimate a number of tourist and tourism facilities for the estimation of waste generation amount, annual number of tourist and number of tourism facilities by types are considered.

1) Tourism Flow

The total number of tourist in Lattakia Governorate is approximately 200,000 annually, which is 12% of total tourists, approximately 1,640,000, in Syria as of 1999. The death

of the former President in 2000 is partly responsible for the decline. The effect of other factors on tourism's declines is unknown.

In addition, there are various kinds of tourism resource in this governorate so that tourism development and promotion will have an effect on tourist number in future.

Table 5.4.8 Tourism Flow in Lattakia Governorate and Syria, 1999

	Lattakia Governorate					All Syria			
	Syrian	Arab	Foreign	Total	Share	Syrian	Arab	Foreign	Total
January	5,820	596	1,008	7,424	8%	50,714	20,032	21,831	92,577
February	3,921	506	1,427	5,854	5%	48,397	19,726	46,893	115,016
March	10,659	1,758	3,257	15,674	10%	60,710	30,874	68,096	159,680
April	7,797	1,361	7,234	16,392	12%	60,612	31,332	43,678	135,622
May	6,709	1,111	4,981	12,801	10%	60,173	30,667	42,524	133,364
June	9,688	2,767	2,109	14,564	11%	57,505	38,390	39,095	134,990
July	22,019	9,773	2,455	34,247	22%	75,858	46,459	31,592	153,909
August	23,808	6,215	2,715	32,738	16%	87,390	58,619	57,223	203,232
September	22,874	5,482	3,524	31,880	16%	79,229	47,804	70,298	197,331
October	9,989	1,530	6,739	18,258	14%	56,413	34,391	44,118	134,922
November	4,830	955	2,708	8,493	8%	50,262	34,444	22,854	107,560
December	2,559	369	621	3,549	5%	40,181	19,975	15,293	75,449
Total	130,673	32,423	38,778	201,874	12%	727,444	412,713	503,495	1,643,652

Source: Statistical Abstract 2000

According to tourism statistics done by Directorate of Tourism in Lattakia, approximately 98% of the total tourist number in Lattakia Governorate is concentrated in the Lattakia Municipality. The remaining 2% are scattered over other territories of the Lattakia Governorate. Therefore the greater concern is for tourist number in the Lattakia Municipality.

2) Seasonal Frequency of Tourist Number

Tourists visit throughout the year but greater number of tourists is July, August, and September as defined as tourism high season. January to June and October are defined as medium season, and remaining will be defined as low season. In the high season, more than 30,000 tourists a month visit in the Lattakia Municipal area.

Table 5.4.9 Number of Tourist per night in Lattakia City

	Y1995	Y1996	Y1997	Y1998	Y1999	Y2000
January	8,236	5,386	5,199	5,141	7,320	5,889
February	4,477	6,603	6,758	7,546	5,784	5,378
March	11,471	10,163	10,131	7,304	13,200	12,642
April	11,486	16,695	15,701	18,709	16,158	13,868
May	12,573	11,359	11,937	10,858	12,676	12,011
June	9,612	9,883	10,601	9,364	14,298	11,416
July	12,469	15,846	16,654	34,119	32,030	24,733
August	26,627	25,992	26,896	45,287	33,085	34,517
September	15,044	14,642	20,690	33,468	31,486	32,908
October	13,974	14,125	14,524	16,233	18,149	16,720
November	7,853	7,441	7,081	9,536	8,428	7,654
December	7,077	6,441	7,304	6,943	3,499	3,663
Total	142,894	146,572	155,473	206,506	198,112	183,399
Growth		2.6%	6.1%	32.8%	-4.1%	-7.4%

Source: Tourism Directorate of Lattakia, Ministry of Tourism

3) Tourism Facilities

There is limited information so far. So it is assumed that 98% of tourism facilities in the Governorate are located in Lattakia Municipality based on tourist flow information in Latttakia Governorate classified by municipalities. The number of tourism facilities is shown in the following table and more than 6,200 beds are located in Lattakia Municipality area.

Table 5.4.10 Number of Hotels Classified by Category & Their Capacity in Lattakia Gvoernorate, Year 2000

	5 star	4 Star	3 Star	2 Star	1 Star	Hostel	Apartments	Total	Lattakia Municipality
No. of hotels	2	1	8	10	19	8	10	58	57
No. of rooms.	1,369	120	391	306	319	109	59	2,673	2,620
No. of beds	3,592	240	774	661	702	257	178	6,404	6,276

Source: Directorate of Tourism, Lattakia, Ministry of Tourism, 2000 and estimation by JICA Study Team

Besides hotel facilities there are another kinds of accommodation such as camping sites, beach cabins and rent villas shown in the following table. The total capacity (bed) is approximately 30,000 beds in the Lattakia Municipality area. In addition, there are approximately 18,000 restaurant and coffee shop seats in the Lattakia Municipality area.

Table 5.4.11 Tourist Accommodation and Restaurants in Lattakia Governorate

	Lattakia Governorate		Lattakia Municipality	
	Number	Capacity	Number	Capacity
Camping site	497	2,000	487	1,960
Beach Cabin	4,000	24,000	3,920	23,520
Rent Villa	1,500	5,000	1,470	4,900
Total	5,997	31,000	5,877	30,380
Restaurant	170	17,400	167	17,052
Coffee Shop	44	1,540	43	1,509
Total	214	18,940	210	18,561

Source: Directorate of Tourism, Lattakia, Ministry of Tourism, 2000 and estimation by JICA Study Team

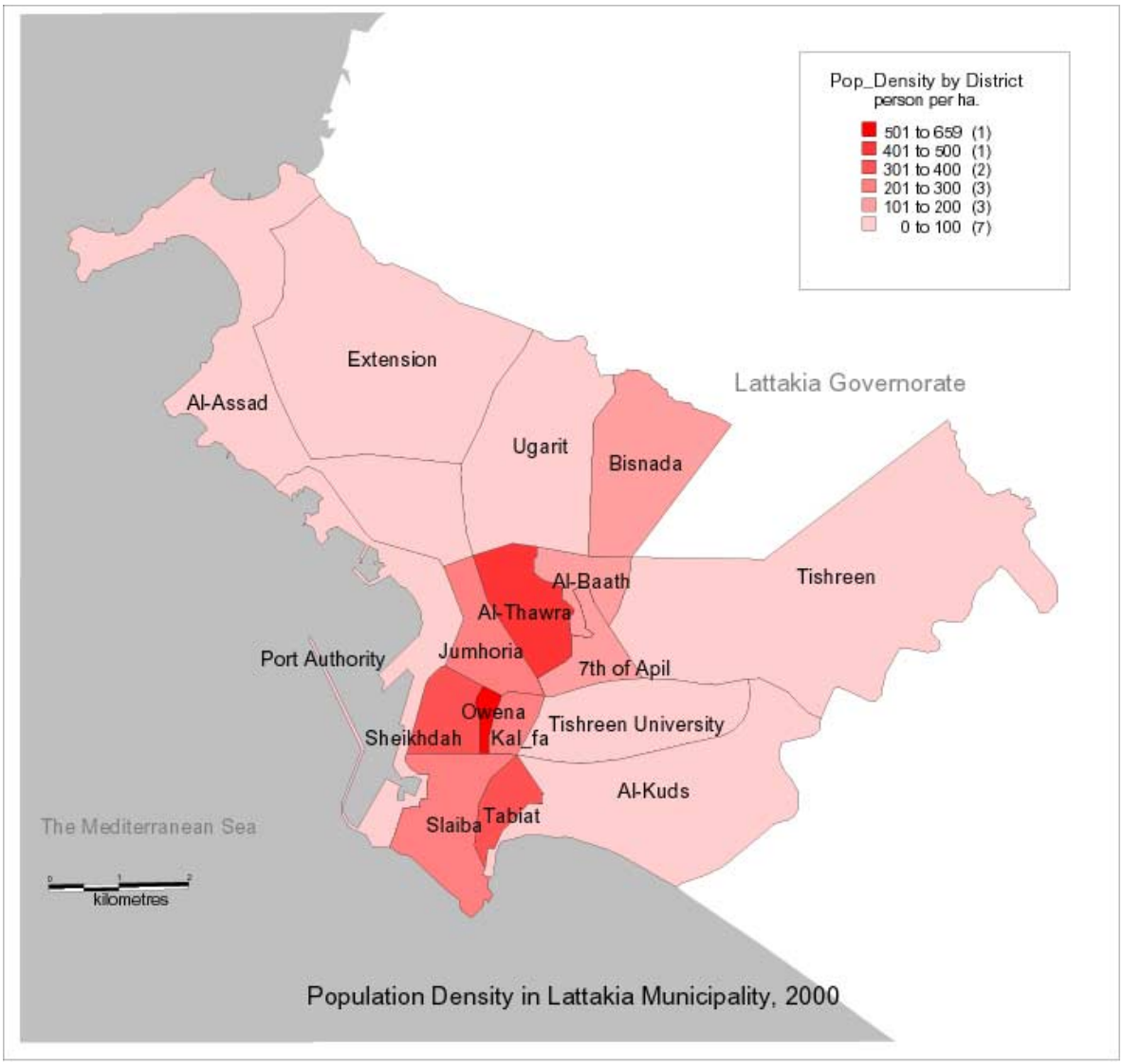


Figure 5.4.9 Population Density in Lattakia Municipality, Year 2000

SECTION 6

MEDICAL WASTE TREATMENT

SECTION 6 MEDICAL WASTE TREATMENT

6.1 MEDICAL WASTE MANAGEMENT

6.1.1 Existing Situation

The existing situation on medical waste management should be referred to "Public Awareness and Community Participation".

The inspection of the collection of medical waste conducted by Lattakia Municipality (compactor truck) was carried out by the Study Team on February 20th 2001. The waste of private hospital is brought to National Hospital.

Table 6.1.1 shows the results of the inspection.

Table 6.1.1 Summary of Inspection of Collection of Medical Waste

Name of Hospital	Type of Hospital	Type of Waste to be collected
Soued Hospital	Private Hospital	Papers, pharmaceutical waste: Total 3 plastic bags
Syrian Hospital	Private Hospital	Pharmaceutical waste : 1 plastic bag
Central Hospital	Private Hospital	Sharps (needles for injection), pharmaceutical waste: 2 plastic bags
Al Tabyat Hospital	Private Hospital	Sharps (needles for injection): 1 plastic bag
Al-Razi Hospital	Private Hospital	Bandage: 1 plastic bag
Al-Sofi Hospital	Private Hospital	Sharps (needles for injection), pharmaceutical waste: 2 plastic bags
Bahro Hospital	Private Hospital	Sharps (needles for injection), pharmaceutical waste: 1 plastic bags
National Hospital	Public Hospital	-

6.1.2 Medical Waste Treatment

(1) Collection Vehicle

1) Technical Requirement

According to WHO, the dedicated collection vehicle used to transport medical waste should fulfil the following criteria.

- The body of the vehicle should be of a suitable size commensurate with the design of the vehicle.
- There should be a bulkhead between the driver's cabin and the vehicle body, which is designed to retain the load if the vehicle is involved in a collision.
- There should be a suitable system for securing the load during transport.
- Empty plastic bags, suitable protective clothing, cleansing equipment, tools and disinfectant, together with special kits for dealing with liquid spills should be carried in a separate compartment in the vehicle.
- The internal finish of the vehicle should allow it to be steam-cleaned and the internal angles should be rounded.

- The vehicle should be marked with the name and address of the waste carrier.
- The international hazard sign should be displayed on the vehicle or container as well as an emergency telephone number.

2) Arrangement for Dedicated Collection Vehicle

The arrangement for the required collection vehicle is shown in Table 6.1.2.

Table 6.1.2 Arrangement of Collection Vehicle of Medical Waste

Name of City	Medical Establishment		Number of establishment to be collected							Required Number of Vehicle per Day
	Type	Number	Sat.	Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	
Lattakia	Public	5	5*1	5	5	5	5	5	0	1 nos. for Lattakia City
	Private	8	8*1	8	8	8	8	8	0	
	Health Center	27	9*2	9	9	9	9	9	0	
	Clinics	550	184*2	184	184	184	184	184	0	
	Sub Total	590	206	206	206	206	206	206	0	
Jableh	Public	1	1*1	1	1	1	1	1	0	2 nos. for Jableh, Qurdaha and Al Haffeh
	Private	2	2*1	2	2	2	2	2	0	
	Health Center	26	9*2	9	9	9	9	9	0	
	Clinics	100	34*2	34	34	34	34	34	0	
	Sub Total	129	46	46	46	46	46	46	0	
Qurdaha	Public	1	1*1	1	1	1	1	1	0	
	Private	0	0*1	0	0	0	0	0	0	
	Health Center	18	6*2	6	6	6	6	6	0	
	Clinics	20	7*2	7	7	7	7	7	0	
	Sub Total	39	14	14	14	14	14	14	0	
Al Haffeh	Public	1	1*1	1	1	1	1	1	0	
	Private	0	0*1	0	0	0	0	0	0	
	Health Center	22	8*2	8	8	8	8	8	0	
	Clinics	15	5*2	5	5	5	5	5	0	
	Sub Total	38	14	14	14	14	14	14	0	
Total										3

Notes: *1: Daily collection is conducted twice per week for public and private hospitals.
*2: Collection is conducted twice per week for health center and clinics.

3) Determination of Size of Collection Vehicle

The size of the dedicated collection vehicle is calculated as follows.

The weight of the waste at 2010: 1.48 t/d
3 vehicles are arranged: 1.48 / 3 = 0.5 t/d

The volume converted from the weight per 1 unit: 0.5 / 0.125 = 4.0 m^3/unit/day
The required volume of the collection vehicle by the rate of operation:
4.0 x 7 / 6 = 4.7 m^3/unit/day

The van type vehicle with 2.0 t payload is applied.

The internal volume of the vehicle: L x W x H = 2.7 x 1.6 x 2.0 = 8.6 m^3

The effective loading capacity is calculated as follows by assuming the effective loading ratio as 0.75: 8.6 x 0.75 = 6.5 m^3 > 4.7 m^3

(2) Final Disposal

Table 6.1.3 shows the required volume at the final landfill. The treated medical waste by the existing incinerator is transported to the final landfill.

Table 6.1.3 Required Embankment Volume at Final Landfill

Year	Weight (ton/day) (A)	Original Volume (m^3/day) (B)	Reduced Volume (m^3/day) (C)	Cover Soil (m^3/day) (D)	Total (m^3/day) (E)	Total (m^3/year)	Required Volume (m^3)
2003	1.39	11.12	1.11	0.39	1.50	547.94	
2004	1.41	11.28	1.13	0.39	1.52	555.82	
2005	1.42	11.36	1.14	0.40	1.53	559.76	
2006	1.43	11.44	1.14	0.40	1.54	563.71	
2007	1.44	11.52	1.15	0.40	1.56	567.65	2794.88*1
2008	1.45	11.6	1.16	0.41	1.57	571.59	
2009	1.47	11.76	1.18	0.41	1.59	579.47	
2010	1.48	11.84	1.18	0.41	1.60	583.42	
2011	1.49	11.96	1.20	0.42	1.61	589.25	
2012	1.51	12.08	1.21	0.42	1.63	595.14	
2013	1.52	12.20	1.22	0.43	1.65	601.09	
2014	1.54	12.32	1.23	0.43	1.66	607.11	
2015	1.56	12.44	1.24	0.44	1.68	613.18	
2016	1.57	12.57	1.26	0.44	1.70	619.31	
2017	1.59	12.69	1.27	0.44	1.71	625.50	
2018	1.60	12.82	1.28	0.45	1.73	631.76	6616.81*2

Notes: *1: Required volume for the treated medical waste at existing Al-Bassa rehabilitated landfill for the operation between 2003 to 2007.
*2: Required volume for the treated medical waste at new landfill for the 50 years' operation from 2008.
3: B=A/0.125
4: C=0.1 x B
5: D=0.35 x C
6: E=C + D

The filled embankment is assumed as the squared base with slope of 1:2, height h and the square length a.

Therefore, the volume, V is estimated as follows.

$V = (a+4h)^3/12 - a^3/12$

1) At Rehabilitated Al Bassa landfill

Embankment height is assumed as h = 5 m.
V > 2794.88
a +4h = 20 + 4 x 5 = 40 m

Therefore, 40 x 40 = 1,600 m^2 is required at minimum for the special section for the treated medical waste at the final landfill.

2) At new landfill

50 years' operation is estimated for the new landfill.
Embankment height is assumed as h = 5 m.
V > 5 x 6616.81 = 33084.05
a +4h = 80 + 4 x 5 = 100 m

Therefore, 100 x 100 = 1 ha is required at minimum for the special section for the treated medical waste at the final landfill.

6.2 COST OF MEDICAL WASTE MANAGEMENT

6.2.1 Capital Cost

Procurement of dedicated collection vehicles will be necessary for separate collection of medical waste.

Table 6.2.1 shows the summary of investment cost.

Table 6.2.1 Summary of Capital Cost

Unit in 1,000 SP

Item	Unit	Unit Price	Quantity	Amount
Dedicated Collection vehicle	nos.	2,160	3	6,480

(1) Operation and Maintenance Cost

The cost for purchasing containers, collection/transport and operating the special area at final landfill site will be generated for operation and maintenance.

Table 6.2.2 shows the summary of annual operation and maintenance cost.

Table 6.2.2 Summary of Annual Operation and Maintenance Cost

Unit in 1,000 SP

Item		Unit	Unit Price	Quantity	Amount
Personnel Cost					
	Manager	person	163.3	1	163.3
	Driver	person	87.5	3	262.5
	Worker/Crew	person	73.2	8	585.6
Sub Total					1,011.4
Collection Vehicle					
	Fuel	liter	0.00625	3,800	23.8
Sub Total					23.8
Dedicated Container					
	Plastic Bag	nos.	0.001	300,000	300
	Cardboard Box	nos.	0.002	260,000	520
Sub Total					820
Total					1,855.2