JAPAN INTERNATIONAL COOPERATION AGENCY

ALEXANDRIA GOVERNORATE
GENERAL FOLLOW-UP DEPARTMENT
THE ARAB REPUBLIC OF EGYPT

No. 2

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT IN ALEXANDRIA
IN
THE ARAB REPUBLIC OF EGYPT

MARCH, 1995

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PREFACE

In response to a request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Solid Waste Management in Alexandria and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Egypt a study team headed by Mr. Hideo Miyamoto, deputy director of First Basic Design Study Division, Grant Aid Study and Design Department, JICA and constituted by members of Yachiyo Engineering Co., Ltd., from August 5th to September 10th, 1994.

The team held discussions with the officials concerned of the Government of Egypt, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then a mission was sent to Egypt in order to discuss a draft report, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the teams.

March, 1995

Kimio Fujita
President
Japan International Cooperation Agency

March, 1995

Mr. Kimio Fujita
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of Solid Waste Management in Alexandria in the Arab Republic of Egypt.

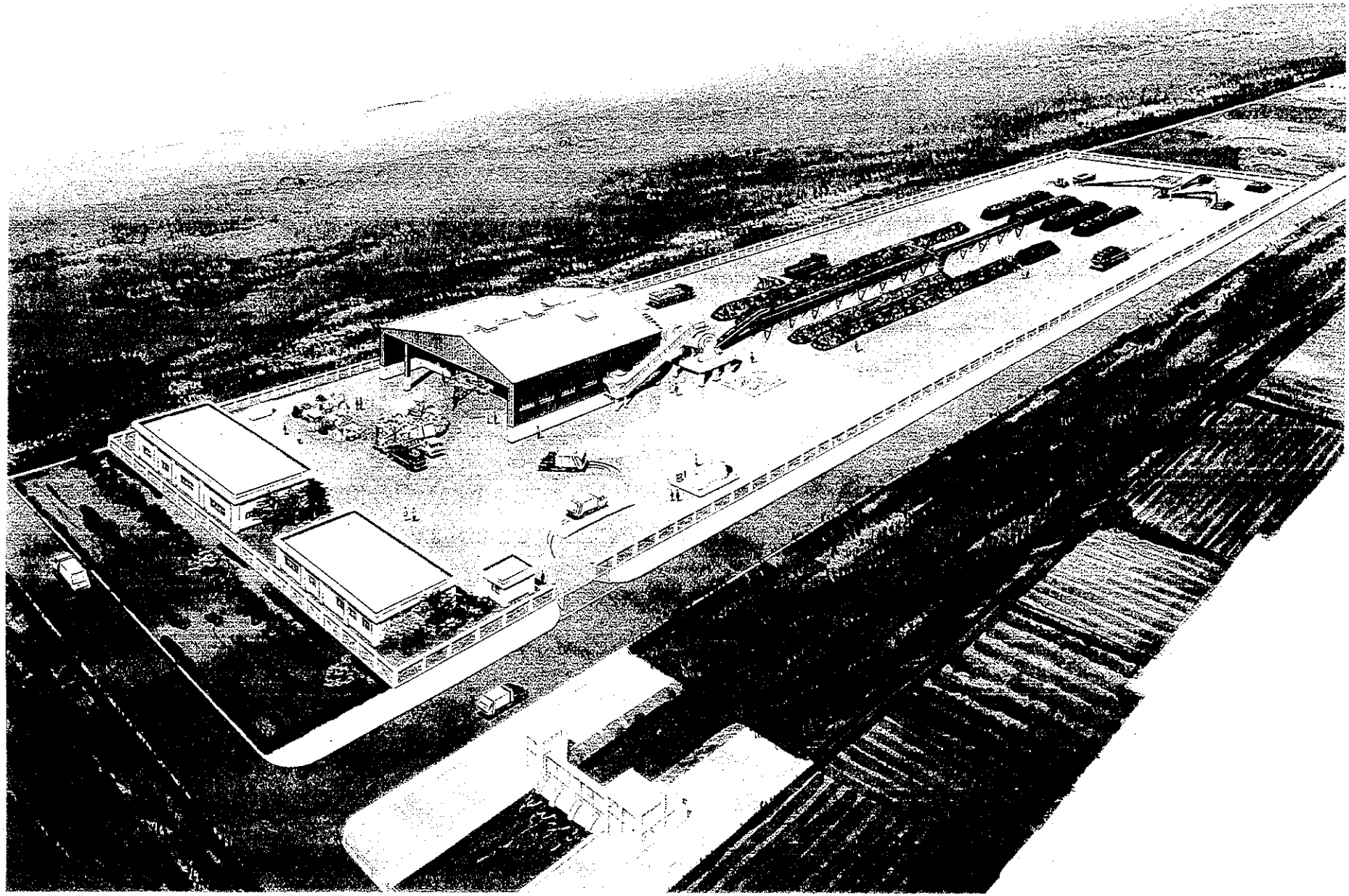
This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period July 29th, 1994 to March 24th, 1995. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Egypt and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express out sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, Department of Urban Engineering in the University of Tokyo and Environment Management Bureau of Osaka City Government. We would also like to express our gratitude to the officials concerned of General Follow-Up Department of Alexandria Governorate, JICA Egypt Office, the Embassy of Japan in Egypt for their cooperation and assistance throughout our field survey.

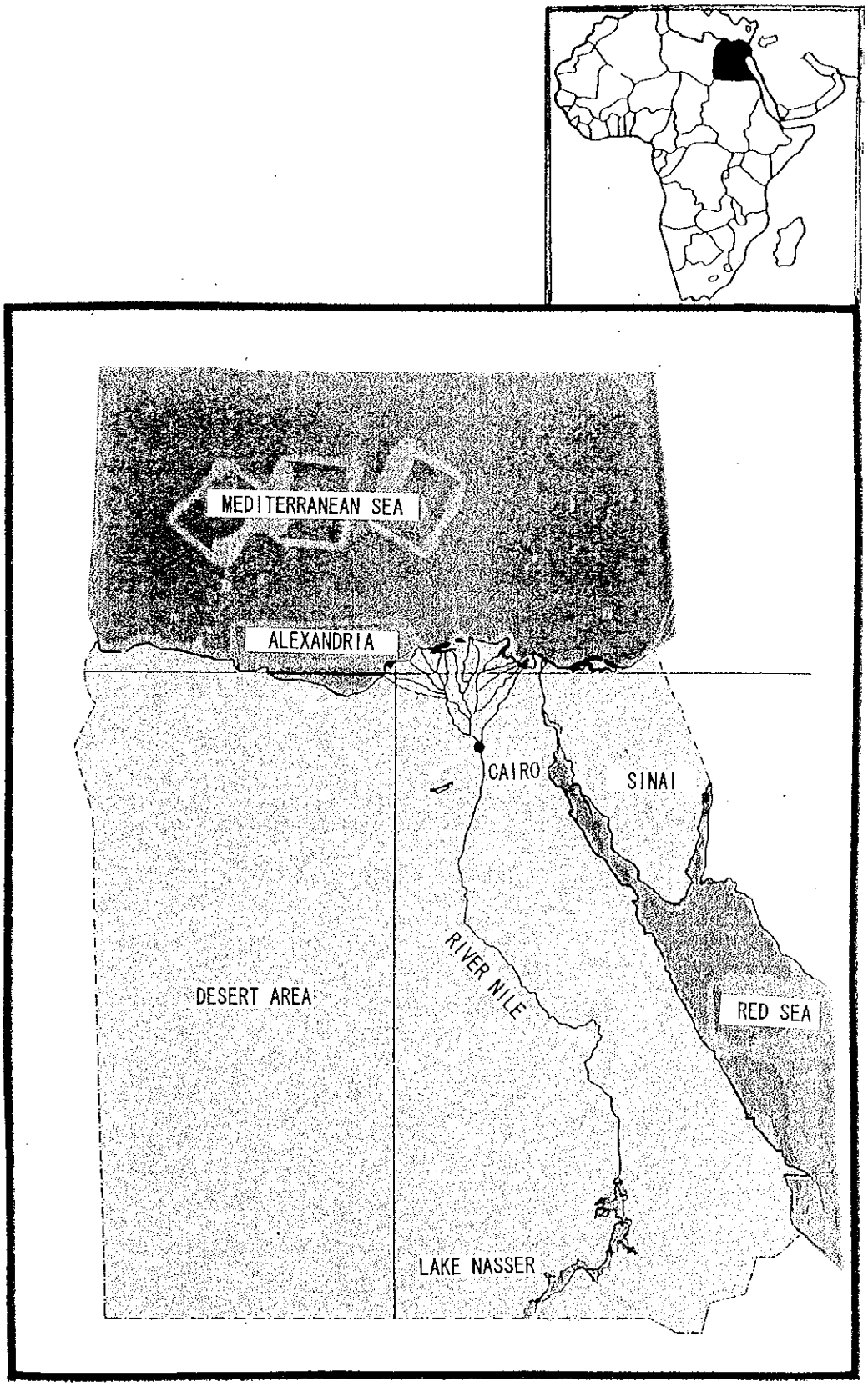
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

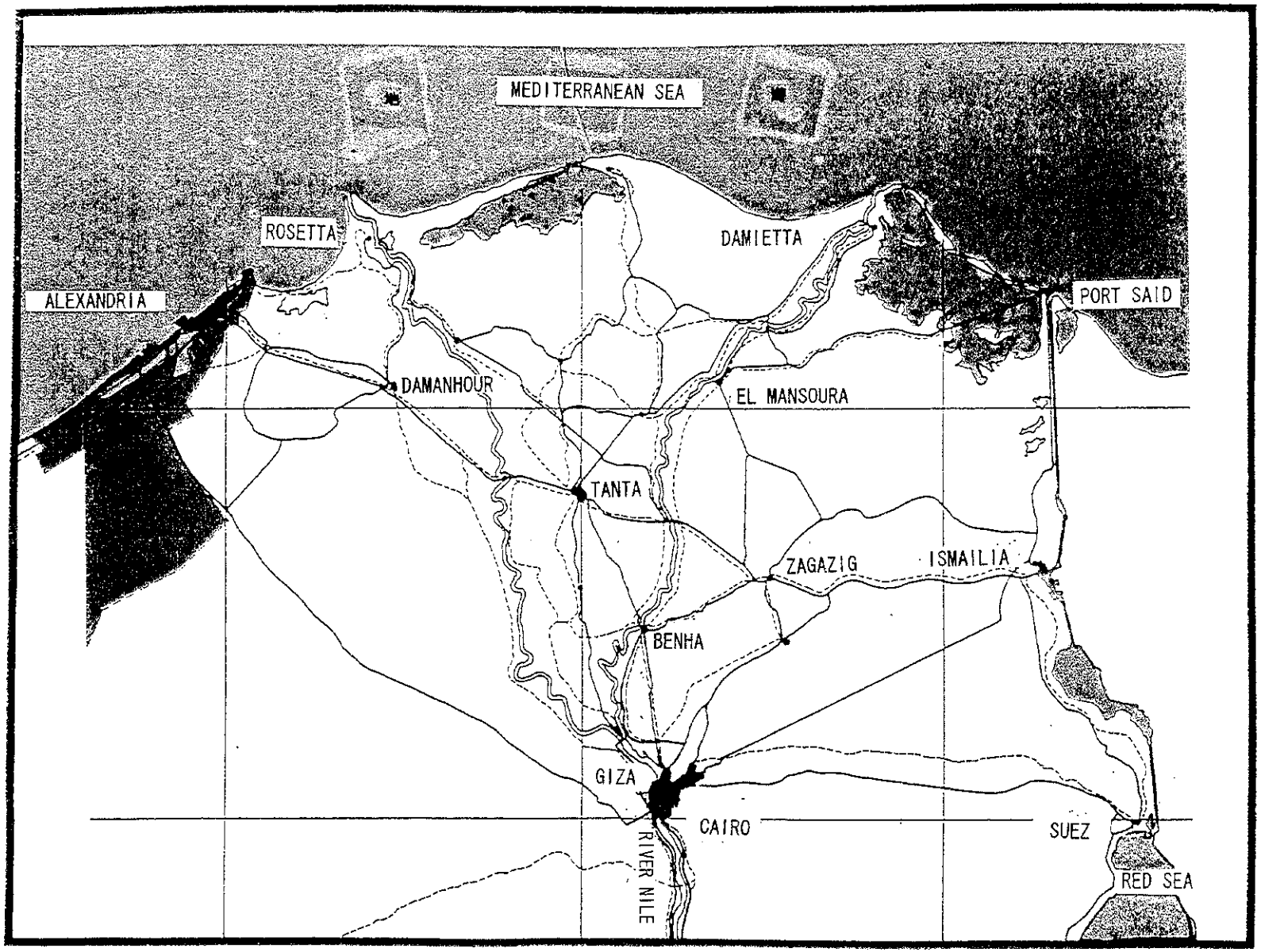
Kango Mito
Project Manager,
Basic design study team on
The Project for the Improvement
of Solid Waste Management in Alexandria
Yachiyo Engineering Co., Ltd.



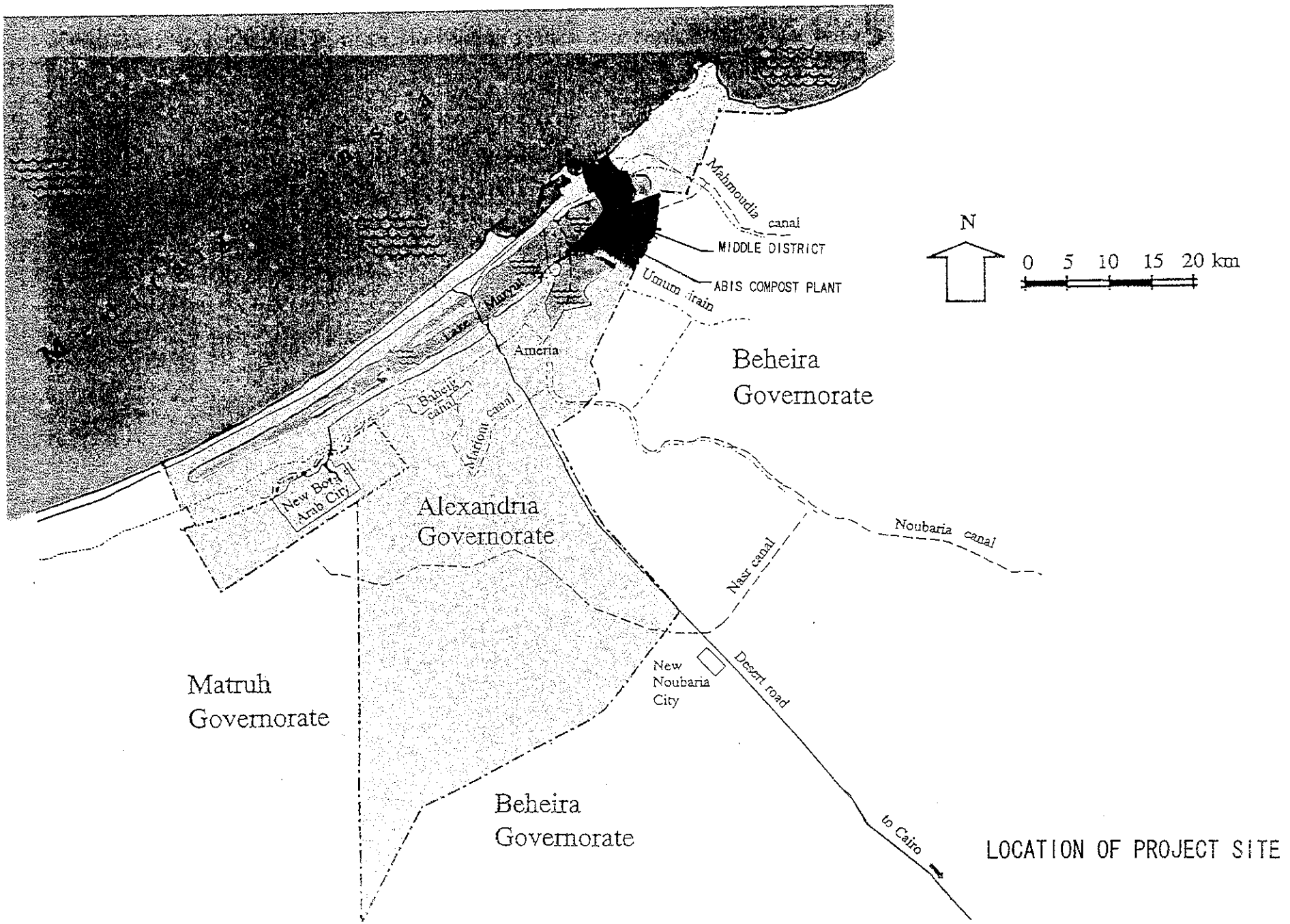
THE PROJECT FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT IN ALEXANDRIA



THE ARAB REPUBLIC OF EGYPT

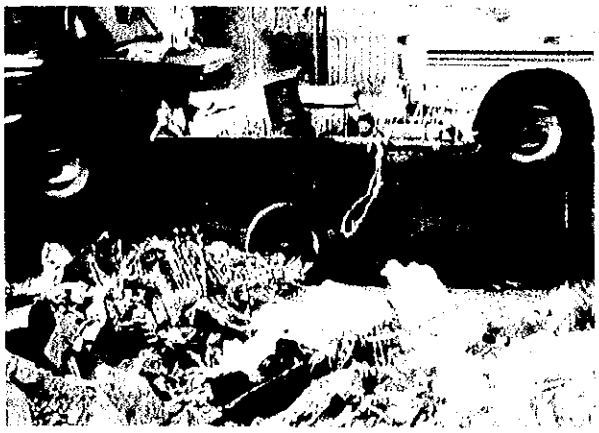


LOCATION OF ALEXANDRIA

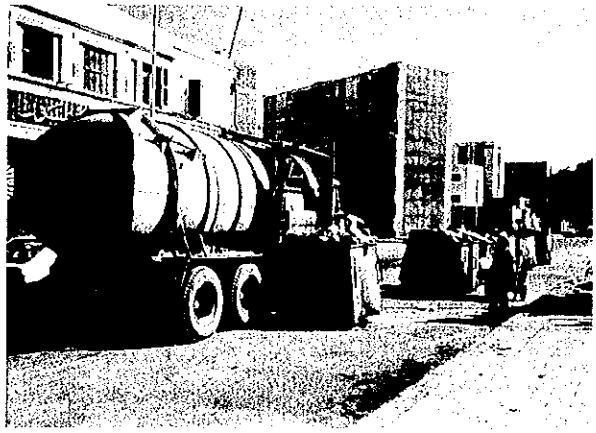


LOCATION OF PROJECT SITE

Garbage Collection and Haulage in Middle District



Hand Cart for Garbage Collection
(Transporting garbage on the road to open station)

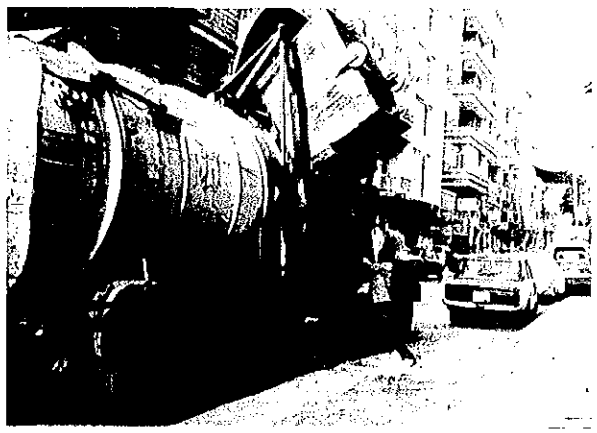


Garbage Container and Compactor Vehicle
(deteriorated)

Open Station (causing waste littering and bad smell)

Collection in Open Station

One of the Containers

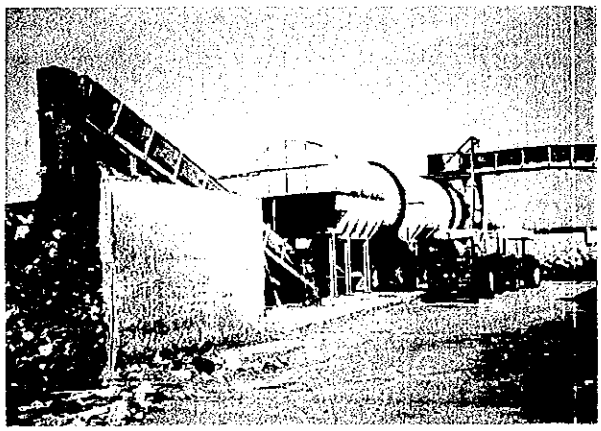


Collection of Garbage in Container by TRUXMORE

Abis Compost Plant

Garbage Collection Vehicles from
Middle District to Abis Compost Plant

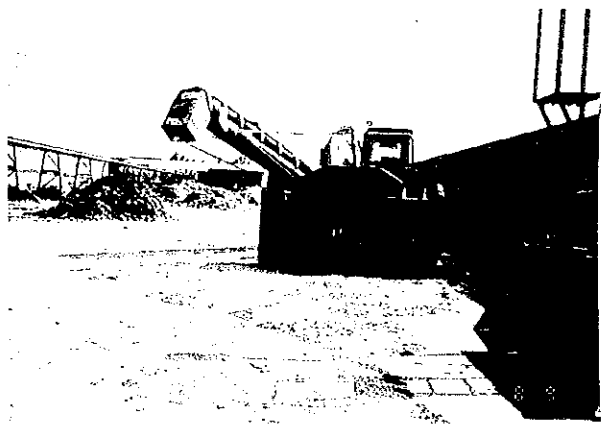
Waste Storage and Feeding Loader



Stabilising Drum and Screen
(pulverizing and classifying waste)

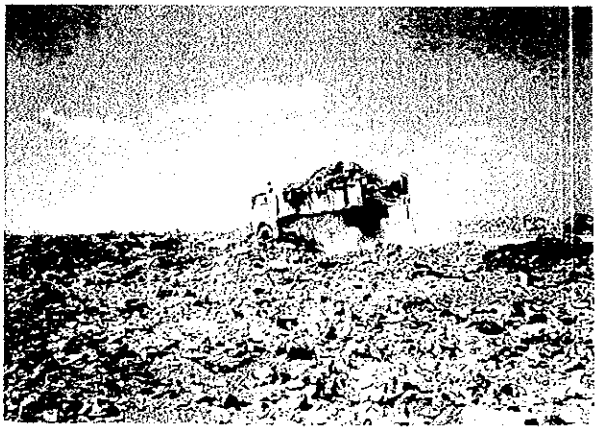
Farmentation and Maturing Yard

Vibrating Screen

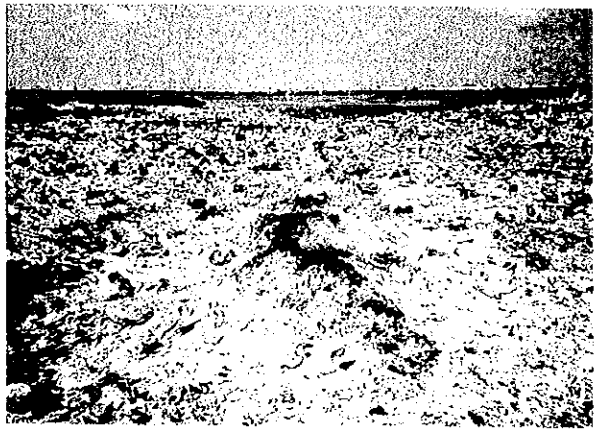


Turning Machine

Final Disposal Site

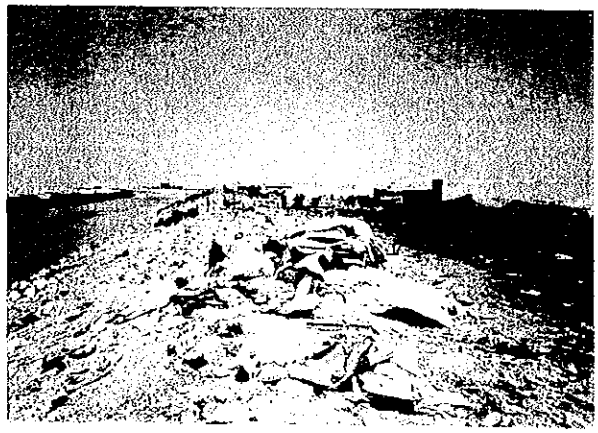


Garbage Collection Vehicle
in Abis Final Disposal Site



Fire Caused by Spontaneous Combustion
can be seen in Abis Final Disposal Site

Bulldozer for Abis Final Disposal Site



Ameriyah Final Disposal Site

General View of Ameriyah Final Disposal Site
(Fire Caused by Spontaneous Combustion can be seen)

SUMMARY

The Arab Republic of Egypt (herein referred to as Egypt), which possesses a land area of 1,001,000 km^2 and a population of roughly 56 million (as of 1993), is located in the north-eastern part of Africa. 96% of the country is desert and almost the whole population is concentrated in the remaining 4%, which consists of plain lying alongside the Rive Nile. The Egyptian economy is severely hampered by a perennial budget deficit, trade deficit and accumulated foreign debts. The per capita GNP is low at $ 630 (1993).

The city of Alexandria, which is Egypt's second city with a population of 3.47 million (1994), lies 230 km to the north-west of the capital Cairo. As well as being a world famous tourist spot, Alexandria is also an important industrial center accounting for some 40% of Egypt's total industrial production and possessing the largest trade port in the country. It is thus a city of great economic importance to Egypt. For this reason, Alexandria is the destination of many job seekers from the surrounding areas and its recent rate of population increase is high at 3% per year.

The concentration of the population into cities like Alexandria has brought about a deterioration in the urban living environment, and the Government of Egypt has made resolution of the problem of solid waste management in particular a matter for urgent attention. The Government of Egypt requested to the Government of Japan its technical cooperation for a development study on solid waste management in Alexandria city. In response to this request, the Government of Japan instructed JICA to prepare a master plan designed to gain a general understanding of the solid waste management situation in Alexandria and improve the urban environment by raising the level of public sanitation in technical, economic and social terms, and also conduct a feasibility study (F/S) in order to investigate ways to make improvements to solid waste management in a designated district by the target year of 2000. The F/S lasted from August 1984 to March 1986.

The population increase of Alexandria since completion of the F/S has been startling. Between 1984 and 1994, the population leaped by some 20% from 2,884,000 to 3,470,000. This has brought with it a similar increase in solid waste generation quantities. Between 1984 and 1994, the amount of waste generated in Alexandria jumped from 1,250 tons/day to 1,740 tons/day. Judging from the number of waste collection vehicles currently owned by Alexandria and those operating figures, it is estimated that some 500 tons of waste per day is being unlawfully disposed of and left untouched. If such adverse factors as the recent deterioration of collection vehicles, increasing levels of traffic congestion and the growing

remoteness of final disposal sites are taken into consideration, the situation is probably much worse than this figure suggests.

Within Alexandria, the operation rate of collection vehicles is particularly low in Middle District where it is only 30%. Uncollected and unlawfully dumped waste can be seen everywhere throughout the district and this is damaging the living environment. Moreover, because the city's two final disposal sites, which are located in the suburbs, do not carry out sanitary landfill disposal of waste, secondary pollution from fires, air pollution and harmful insects caused by spontaneous combustion and foul odors is having a detrimental effect on the living environment of surrounding areas.

Viewing this situation with deep concern, the Government of Egypt has requested to the Government of Japan the provision of Grant Aid for the procurement of collection and haulage vehicles and equipment, construction of a compost plant and a transfer station, and procurement of equipment for final disposal site operation, in line with the findings of the F/S, in order to improve the capacity of the solid waste management system in Alexandria.

In response to this request, the Government of Japan instructed JICA to carry out a Basic Design Study. The Basic Design Study team was sent to Egypt for a period lasting from August 5th to September 10th, 1994, and again in order to explain the contents of the Draft Report from February 3rd to February 12th, 1995.

In the course of its field surveys and discussions with those concerned on the Egyptian side, the study team gained a general understanding of the current conditions and problem areas of the solid waste management system in Alexandria. As a result of its findings, the team confirmed that there are many points requiring improvement in the areas of collection and haulage, intermediate treatment and final disposal.

The Project components are in accordance with the priority projects plan compiled in the original JICA F/S, and are also in line with the important environmental sector targets within the Third 5-year Socioeconomic Development Plan (1992-1997). These targets refer to "strengthening of financial bases for local government cleansing activities and mechanization of the collection process as far as possible" and "examination and implementation of municipal waste compost plant construction in the cities."

The components of the request which has targeted Middle District as the subject area are ① procurement of collection and haulage vehicles and equipment, ② construction and procurement of related equipment for a compost plant with a capacity of 300 tons/day, ③ construction and procurement of related equipment for a transfer station, and

④ procurement of final disposal site operation equipment for the Abis Disposal Site. Item ③ has been excluded from the scope of the Project because it was found to be unnecessary during the early stages of the study.

With regards to item ②, the introduction of the new compost plant is considered highly significant and viable in that, although the intermediate treatment management itself after the introduction will be financially in the red taking into account the personnel expenses and depreciation of the facility, it is judged advantageous because some profits are expected to be produced by economic benefits from saving of chemical fertilizers, increase in the crop yield, saving of irrigation water, etc. and volume reduction of solid waste. Volume reduction will become essential from now on for the reasons that the acquisition of the final disposal site will be more difficult and the site, if any, will be found a the remote place. Moreover the new compost plant is expected to make a major contribution to the supply of compost for use on farmland, the expansion of which is an important national policy. Concerning the capacity of the plant, if it is made 300 tons/day, the overall compost production of Alexandria will be trebled and there are doubts as to whether or not the extra compost could be sold off. Moreover, because equipment at the existing Abis Compost Plant is due for renewal and suspension of operations due to repair activities is foreseen, it is considered an urgent issue to construct an alternative plant that possesses an equivalent capacity and can fulfill the functions of the existing plant. For these reasons, it is concluded that it is appropriate to set a capacity of 150 tons/day for the new plant.

The work contents of the Project, which were compiled by the study team based upon its findings after its return to Japan, are as described in the following table. As can be seen from this, the Project shall be executed over two phases. Phase 1 comprises the plan for procurement of collection and haulage vehicles and equipment, and the plan for procurement of final disposal site operation equipment. The aim of the former is to urgently resolve the deterioration of the urban environment in Middle District caused by the declining collection rates of insufficient and deteriorated vehicles and equipment, and the latter plan is designed to enable sanitary landfill disposal in order to prevent the occurrence of secondary pollution from fires and foul odors etc. Phase 2 comprises the plan for compost plant construction and related equipment procurement in order to promote achievement of the solid waste management system objectives of reduction and stabilization of waste quantities and the rendering of waste harmless through intermediate treatment.

Outline of Project Components

Project Area	Phase 1	Phase 2
Vehicles and Equipment Procurement Plan	① Procurement of collection and haulage vehicles and equipment • 15 m^3 compactors : 21 • 10 m^3 compactors : 18 • 15 m^3 arm-roll container trucks : 10 • 1 m^3 containers : 3,214 • 15 m^3 containers : 34 ② Procurement of final disposal site operation equipment • Back hoe (0.7 m^3) : 1 • Dump trucks (11 ton) : 2 • Bulldozers (16 ton marshlands bulldozers) : 2 • Landfill compactors (20 ton) : 2 • Motor sprinkler : 1	
Construction Plan		Construction of compost plant and procurement of related equipment - Construction of compost plant • Treatment capacity : 150 tons/day - Procurement of related equipment • Turning machine (560 m^3/hour) : 1 • Wheel loaders (2 m^3) : 4 • Dump trucks (8 ton) : 5 • Truck scales (30 ton) : 2 (New compost plant and Abis Compost Plant)

The related organizations on the Egyptian side are the Alexandria Governorate, which will be the responsible and coordinating organization, and the General Follow-up Department, which will be the executing organization for the Project.

In the event that the Project is implemented under the Grant Aid extended by the Government of Japan, major works to be undertaken by the Egyptian side will be the reclamation of the compost plant construction site and the extension of utility (water, electricity etc.) lines to the site for execution of Phase 2. The estimated cost for the works is about 2,700,000 LE.

The execution periods to be required for the Project are estimated as follows:

Phase 1 : Detailed design - 2 months
Equipment procurement and transportation - 8.5 months
Phase 2 : Detailed design - 4.5 months
Equipment procurement and construction works - 18 months

Moreover, the Government of Egypt and the Alexandria Governorate need to fulfill their responsibilities such as the reclamation of all work sites (including land for temporary equipment and materials storage) and extension of utility lines by the prescribed dates, and also cooperate with the Japanese side in carrying out notification and coordination activities with all related ministries and agencies on the Egyptian side in order to facilitate the smooth implementation of the Project.

The following major beneficial effects can be expected to be obtained through execution of the Project.

① Comprehensive waste collection throughout the Middle District will become possible and the collection system will be improved. This will allow the 715,000 residents of Middle District to enjoy the benefits of more efficient collection service, including 140,000 residents who at present are not provided with any collection service at all. Furthermore, the problem of scattered and unlawfully dumped waste will be resolved, thus leading to an improvement of the living environment.

② Construction of the new compost plant will lead to a reduction in waste quantities equivalent to 20% of the waste discharge of Middle District (about 30,000 tons/year). Moreover, the increase in the supply of compost (about 12,000 tons/year) will enable soil improvement to be carried out on a land area of roughly 1,300 feddan (about 560 ha) each year.

③ The implementation of sanitary landfill disposal through daily earth covering will prevent the scattering of waste, occurrence of foul odors and outbreak of fires caused by spontaneous combustion, and thus lead to an improvement of the living environment in areas around disposal sites.

Moreover, the total maintenance and operation cost of solid waste management after completion of the Project is expected to be 45.8 million LE including depreciation cost, which judging from the size of the solid waste management budget in Alexandria, can be comfortably afforded. It is thus considered that the implementation of the Project with the Government of Japan's Grant Aid possesses a great degree of significance.

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DEFINITIONS OF TERMS

Alexandria City:	This is commonly used to refer to the urban part of Alexandria Governorate, Alexandria City itself does not actually exist as a self governing unit. In this Report, "Alexandria City" refers to the urbanized area of the same Governorate composed of the districts of Montazah, East, Gomrok, Middle, West and Ameriyah where the solid waste management covers. The city area accounts for around 10% of the total Governorate area.
Alexandria Governorate:	This is composed of the above mentioned six districts and is Egypt's second largest Governorate in population following that of Cairo.
Feddan:	The unit of area that is used in Egypt. One feddan = 0.42ha = 4,200m^2.

ABBREVIATIONS

SWM	Solid Waste Management
F/S	Feasibility Study
JICA	Japan International Cooperation Agency
USAID	United States Agency for International Development
ADS	Association for Development of Society
E/N	Exchange of Notes
GNP	Gross National Product
GDP	Gross Domestic Product
ODA	Official Development Assistance
LE	Egyptian Pound
B/C	Cost Benefit Ratio
EIRR	Economic Internal Rate of Return
EIA	Environmental Impact Assessment

CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

1.1 Background of the Project

The economy of the Arab Republic of Egypt (herein referred to as Egypt) is severely hampered by a perennial budget deficit, trade deficit and accumulated foreign debts. The per capita GNP remains low at $ 630 (as of 1992).

The modern city of Alexandria is situated on the Mediterranean Sea some 230 km to the north-west of the capital Cairo. Alexandria has a population of 3,470,000 (as of 1994), only exceeded by that of Cairo. Its economic importance to Egypt is great as 40% of the country's industry is concentrated there and it is the site of the country's largest trade port.

The concentration of the population into cities like Alexandria has caused a deterioration in the urban living environment, and the Government of Egypt has made resolution of the problem of solid waste management (hereinafter referred to as "SWM") a matter for urgent attention. The Government of Egypt requested to the Government of Japan its technical cooperation for a development study on SWM and disposal in Alexandria. In response to this, the Government of Japan instructed JICA to prepare a master plan designed to gain a general understanding of the SWM situation in Alexandria and improve the environment by raising the level of public sanitation in technical, economic and social terms, and also conduct a F/S in order to investigate ways to make improvements to designated district SWM by the target year of 2000. The F/S lasted from August 1984 to March 1986.

The population increase of Alexandria since completion of the F/S has been startling. Between 1984 and 1994, the city's population leaped by some 20% from 2,884,000 to 3,470,000. The increasing population concentration has brought with it similar increases in solid waste discharge quantities. Between 1984 and 1994, the amount of waste generated in Alexandria jumped from 1,250 tons per day to 1,740 tons per day. Judging from the number of waste collection vehicles presently owned by the city of Alexandria and those operating figures, it is estimated that some 500 tons of waste is being unlawfully disposed of every day. If such adverse factors as the recent deterioration of collection trucks, increasing levels of traffic congestion and growing distances from final disposal sites are taken into consideration, the situation is probably much worse than this figure suggests. The Government of Egypt, which has made the environment sector an important item within its Third 5-year Socioeconomic

Development Plan (1992-1997), regards improvement of the municipal SWM system as a matter for urgent attention and based upon the F/S results, requested to the Government of Japan provision of grant aid for the construction of a compost plant, equipment for refuse collection and haulage, construction of a transfer station and procurement of final disposal site operation equipment in order to improve the SWM capability level in Alexandria.

1.2 Outline of the Request and Main Components

Alexandria, which boasts Egypt's largest trade port and is known throughout the world as a tourist destination, is beset with a SWM that is lacking in all areas from waste discharge through to final disposal.

As the first step towards improving the SWM in Alexandria, the Government of Egypt has requested to the Government of Japan assistance in the form of the construction of the facilities and provision of equipment related to collection and haulage, waste treatment and final disposal in order to improve the SWM situation in the Governorate's Middle District. Of the six districts in Alexandria, Middle District is where commercial and public facilities such as central government branch agencies and the Governorate offices are concentrated and where the population density is particularly high.

The contents of the request made by the Government of Egypt are as indicated in Table 1.2.1.

Table 1.2.1 Contents of the Request

No.	Request Contents
1	Provision of waste collection and haulage vehicles: - Compactor vehicles : 65 - Container vehicles : 4 - Light trucks : 15 - Special truck : 1
2	Construction of compost plant and provision of related equipment: - Construction of a compost plant with a treatment capacity of 300 tons/day - Provision of equipment for the plant
3	Construction of a transfer station and provision of related equipment: - Construction of a transfer station with a handling capacity of 480 tons/day - Provision of equipment for the station
4	Provision of sanitary landfill equipment for a final disposal site: - Back hoe : 1 - Dump trucks : 2 - Bulldozer : 1 - Landfill compactors : 2 - Motor sprinkler : 1

Table 1.2.2 shows the execution setup for SWM in Alexandria. The Project related organizations on the Egyptian side are as follows.

Responsible and supervisory organization:
Alexandria Governorate.

Executing organization:
General Follow-up Department of the Alexandria Governorate.

Operation and maintenance organizations:

- Collection and haulage equipment : Middle District Cleansing Department.
- Compost plant : Central Department for Cleansing and Beautification of the Alexandria Governorate.
- Final disposal site operation equipment : Central Department for Cleansing and Beautification of the Alexandria Governorate.

Table 1.2.2 Execution Setup of SWM in Alexandria City

	Project Coordination and Supervision	Operation and Maintenance
Road sweeping	General Follow-up Dept.	Cleansing department and ADS (Association for Development Society) in each district
Collection and haulage		Each district's cleansing department and ADS and the Central Dept. for Cleansing and Beautification
Intermediate treatment (compost plant)		Central Dept. for Cleansing and Beautification
Final disposal		

1.3 Projects and/or Program of Other Donors

1.3.1 Assistance Trends of Other Nations and International Agencies

Between 1985 and 1986, construction of compost plants was carried out with assistance from the World Bank and European nations. These plants are currently operating smoothly and based upon these results, the Government of Egypt is aiming to promote the construction of compost plants in cities throughout the country. This can be gathered from the fact that compost plant construction has been made an important target within the Third 5-year Socioeconomic Development Plan. In Port Said, a compost plant that will be able to treat 300 tons of municipal waste per day is currently being constructed with USAID. The Government of the United States is also currently investigating the possibility of compost plant construction in Ismailia too.

Table 1.3.1 indicates those compost plants in operation or under construction in Egypt and also their locations.

In 1986, the World Bank carried out feasibility studies in the 5 cities of Alexandria, Giza, Tanta, Zagadig and Asyut. Moreover, solid waste collection and haulage vehicles have been provided for Alexandria through loan aid from the United States, however as will be stated in a later section (3.5.4), this has not led to an overall improvement of solid waste collection in the city as a whole or in Middle District.

The Project components of waste collection and haulage vehicle provision, compost plant construction and the provision of equipment for use in final disposal site operation are designed to further advance the improvements that have been already

made to SWM through the above mentioned assistance projects, and do not overlap with those other project activities.

Table 1.3.1 Compost Plants in Operation (or Under Construction) in Egypt

Location No.	City	Treatment Capacity (tons/day)	Form of Funding	Year of Operation Commencement
①	Cairo, Shobra District	160	World Bank loan to Cairo Governorate	1985
②	Cairo, El Salam City	100	Loan from Denmark	1986
③	Cairo, Mokattam District	100	Private sector investment	1986
④	Alexandria, Abis	160	World Bank loan to Alexandria Governorate	1985
⑤	Giza	100	Loan from Denmark	1986
⑥	Damietta	160	Loan from Switzerland to Damietta Governorate	1986
⑦	Post Said	300	Grant aid from the United States	Under construction (scheduled to start operating in 1997)

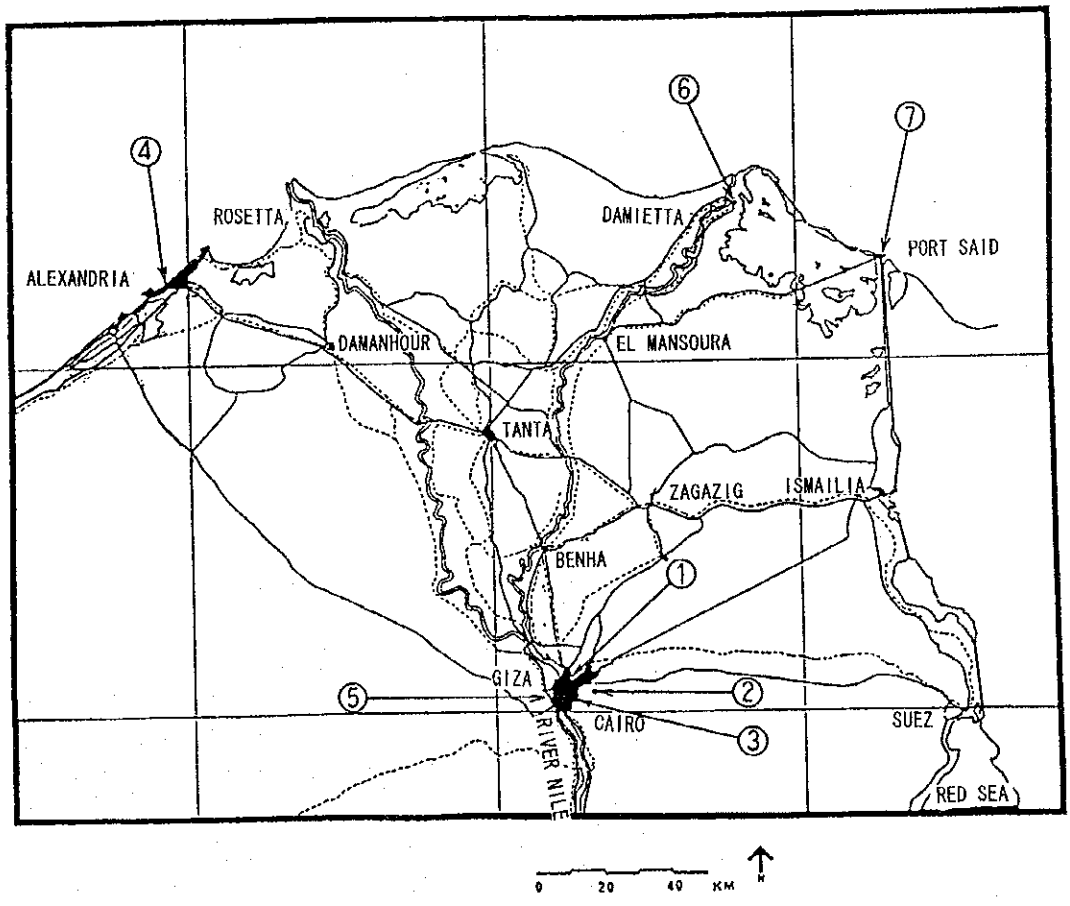


Fig. 1.3.1 Location of Compost Plants in Egypt

1.3.2 Relation to the Project

One of the Project components is a plan to construct a new compost plant to act as an intermediate treatment facility. The scheduled construction site lies some 4 km south-west of the Abis Compost Plant, which started operations in 1985 through World Bank assistance (loan).

The plans for the new compost plant shall be compiled with ample consideration given to the current situation and problem areas in the existing Abis Plant.

Regarding the component of collection and haulage vehicles and final disposal site equipment, the vehicles provided through assistance from the United States etc. have deteriorated to a point where operating efficiency levels are extremely low. The Project therefore includes a plan to provide equipment based upon the assumption that existing vehicles will become out of use by the year 2000.

CHAPTER 2

OUTLINE OF THE PROJECT

CHAPTER 2 OUTLINE OF THE PROJECT

2.1 Objectives of the Project

The following sections give a summary of the understanding of the problems to be addressed by each Project component and the methods to be taken through implementation of the Project for problem resolution.

(1) Waste Collection and Haulage

The existing problems concerning collection and haulage and the methods for their resolution are shown in diagrammatic form in Fig. 2.1.1.

As can be clearly seen from Fig. 2.1.1, improvement of the collection and haulage system cannot be achieved through the efforts of the collecting side alone. Only when the cooperation of the residents or collection service beneficiaries (discharge side) is obtained can the effects of improvements be realized. Consequently, the first objective is to prepare a collection setup for which it is easy for residents to give their cooperation and support. This shall be achieved through the rehabilitation and procurement of collection vehicles and equipment.

The Project site is to be Middle District in Alexandria.

(2) Compost Plant for Intermediate Treatment

The purpose of intermediate treatment within the SWM is to reduce quantities of waste for disposal, and render waste harmless.

Due to the following factors, the increased remoteness of the final disposal site from the collection area in the future has become inevitable.

① The increased level of municipal waste discharge caused by the recent concentration of the population in the city.
② The increasingly high degree of land utilization in the city suburbs.
③ The Farmland Alternative Use Prohibition Ordinance etc. designed to advance agricultural development, which has been a major policy objective for some time now.

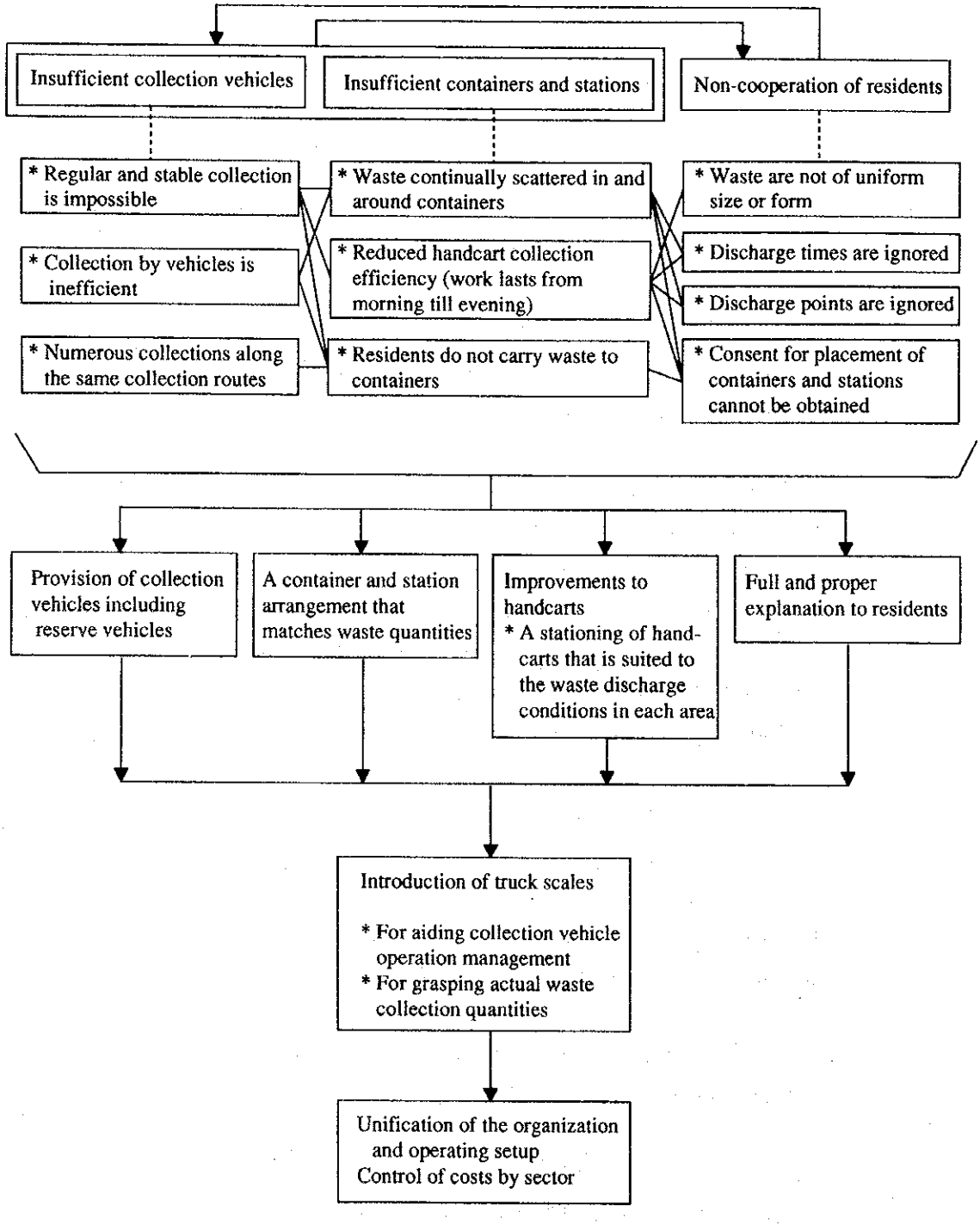


Fig. 2.1.1 Existing Collection and Haulage Problems and Improvement Plan

For this reason, the importance of constructing an intermediate treatment plant in order to reduce and stabilize disposal waste and make waste harmless is significant. The implementation of the Project can thus be described as a touchstone in establishing the general direction to be taken by all future policies for improving the intermediate treatment system in Alexandria.

The Project site to be served by the new compost plant shall be Middle District and the actual plant construction site shall be Abis Extension in Middle District.

(3) Final Disposal

Final disposal is currently being carried out in the form of simple open dumping, which as well as leading to air pollution through the outbreak of foul odors and spontaneous combustion, also leads to outbreaks of harmful insects. The resulting environmental degradation around the final disposal sites has thus reached extreme levels.

Furthermore, control over the amount of waste brought in is simply limited to recording of the number of incoming vehicles, and because hazardous waste and medical waste from hospitals etc. is brought in unchecked, there are serious problems concerning safety levels too.

The main reason for such a poor disposal situation lies in the fact that there is not enough site operation equipment to allow sanitary landfill disposal to be carried out. In order to rectify this situation, heavy machinery such as bulldozers etc. shall be procured, and moreover, truck scales vital for proper disposal site operation and management shall also be procured. The truck scales are to be provided for the existing Abis Compost Plant and the new compost plant.

The subject site for implementation of this component shall be the Abis Final Disposal Site.

2.2 Basic Concept of the Project

2.2.1 Assistance Policy

The Project has been planned based upon the request of the Government of Egypt which was made in accordance with both the master plan and feasibility study relating to SWM in Alexandria implemented in 1986 by JICA. The contents and objectives of the Project based upon the request are as follows.

1) The provision of collection and haulage vehicles in order to swiftly remove solid waste from the urban area and so contribute to the preservation of the living environment and improvement of the public sanitation level.

2) The construction of a compost plant in order to lower costs of haulage and disposal through reducing quantities of solid waste, and to promote the conversion of waste into compost and the recycling of reusable waste materials.

3) The provision of heavy machinery needed for sanitary landfill disposal through daily earth converting in order to prevent the outbreak of spontaneous combustion, harmful insects and foul odors in and around the final disposal sites.

Of these items, 1) and 3) can be said to be fully verified as appropriate Project objectives in view of the fact that the said vehicles and equipment are currently lacking in quantity and are seriously deteriorated, meaning that the primary objectives of the SWM system are not being accomplished, and that the collection and disposal of solid waste is causing serious damage to the living environment and level of public sanitation.

Regarding item 2) - construction of a new compost plant, the final disposal site was assumed some 60 km away from the city center,while the site for this Project at the time of the F/S is much closer at around 10 km away. This means that the facility construction would not produce any beneficial effect in terms of haulage cost reduction at the present time.

However, in view of the fact that construction of a final disposal site within a 10 km area centered around the airport is impossible due to regulations concerning existing cultivated land, planned development land within the Alexandria Governorate area and aircraft flying safety levels, it has become certain that the new disposal sites to

be used from the year 2000 onwards will be located in an industrial area to the west of Ameriyah or in the desert south of Borg el Arab some 30 to 60 km away from the city center. The reduction of waste quantities in order to lower the cost of haulage to final disposal sites has thus become an issue that cannot be ignored.

Moreover, this Project objective is considered to be appropriate in that plans for the new compost plant will investigate the following issues, which have been problematic for the existing compost plant, and thus pursue ways to expand the autonomous financial base of the SWM sector.

① Compost demand and price trends
② Retrieval rate and price trends of reusable items
③ Securing of a system for inducement of market demand including prices offered by farmers
④ Tracking of the progress of specific measures designed to strengthen the financial base of SWM activities

Furthermore, the Abis Compost Plant has been operated smoothly for almost 10 years now, and collection of waste with vehicles provided through European and American assistance has been performed since the 1970's. It can therefore be appreciated that the Alexandria Governorate possesses the experience and technical capacity to handle the facilities and equipment to be constructed and provided in this Project.

Moreover, it is judged that implementation of the Project will not cause any problems in terms of the financial capacity of the Alexandria Governorate to operate the system. This is because although the actual collection and disposal quantity of solid waste will increase by 20%, and disposal costs will rise due to the daily covering of waste with earth, the increased efficiency levels of waste collection and haulage will mean that the cost of SWM in 2001 will only be 5% more than what it was in the 1993/1994 budget.

Concerning the sanitary landfill, although the present disposal site is operated as an open landfill, sanitary landfill disposal involving daily earth covering was carried out at the Moharam Bey Final Disposal Site under the technical supervision of JICA engineers at the time of the 1985 F/S. It is therefore considered that sanitary landfill disposal can be implemented if the necessary equipment is provided under the Project.

SWM in Alexandria has been carried out with the aid of collection and haulage vehicles and disposal site heavy machinery provided by European countries and America since the late 1970's. However, such assistance has been implemented without the establishment of a long term plan which foresees future conditions, and so the effects of such assistance have merely been limited to project life units. Because the components of this Project have been compiled with ample consideration given to both the F/S and master plan previously implemented by JICA and the assistance from European countries and America, the benefits resulting from the project shall be of a long term nature.

2.2.2 Results of Examination of the Request Contents

(1) Examination of Collection and Haulage Vehicles

1) Examination of the Collection and Haulage System

The following issues have been identified in the current collection system, which involves packed waste discharge, door to door collection by handcart and then carried to the nearest container.

- Distances between handcart collection areas and containers are great.
- Collection efficiency levels are low due to door to door collection.
- Transfer of waste from handcart to container is difficult.
- Because the number of containers is insufficient, waste from containers along the same route needs to be collected three or more times a day.

Moreover, the major collection vehicles operating in Middle District are all at least seven years old and their deteriorated conditions is causing extremely low operation rates. For these reasons, piles of uncollected waste are left lying all over Middle District and this is leading to a deterioration of the living environment.

In order to improve this waste collection situation and to raise work efficiency levels, close cooperation between the waste discharge side (residents) and waste collection side (public bodies and private contractors) is indispensable.

At present the interests of both sides are currently in conflict. On the one hand, the residents want to freely discharge waste at any time and hope for a clean environment all the time, and on the other hand those responsible for collection seek to implement an efficient collection system under the limited available

finances. Moreover, it is necessary to give some consideration to the creation of a working environment that is both safe and clean for operators involved in collection work.

It is clear that a comprehensive examination, which takes land use and road traffic conditions in the study area into consideration, is indispensable in constructing a comprehensive waste discharge, collection and haulage system.

Numerous alternatives can be considered for a collection system that meets the conditions necessary for improving collection work efficiency levels. The alternative plans for waste discharge and collection equipment shown in Table 2.2.1 have been devised for the Project, which will assume as a precondition almost the same level of collection service (daily collection, mixed collection and set discharge times) currently being provided.

Table 2.2.1 Collection System Alternatives

Form of Discharge	Discharge Points	Collection Vehicle
* Loose state * Bin (70ℓ) * Bag	* Container * Station * Door to door	* Normal truck * Dump truck * Arm-roll container truck * Compactor

① Form of Discharge and Discharge Points

a. If 70ℓ (liter) waste bins are used, they will be discharged at the entrance of each household. However because most people in Middle District live in medium income level apartment blocks, they have nowhere to put such holders.

b. Discharge of waste in the loose state will make the discharge points an eye sore and create sanitary problems, as well as make loading onto collection vehicles time consuming and lower vehicle utilization efficiency.

c. Discharge of waste in bags causes no problem in terms of discharge space, however the door to door collection is far more inefficient than the other methods.

In consideration of the above points and because of superior collection efficiency, waste discharge in bags and collection in containers or at stations shall be adopted as the optimum alternative.

② Collection Vehicles

Assuming that waste is discharged in bags for collection in containers or at stations, the waste collection costs per ton for each type of collection vehicle can be calculated as shown in Table 2.2.2.

Table 2.2.2 Waste Collection Costs by Collection Vehicle Type

(Unit: LE)

	Compactor				Dump Truck	Arm-roll Truck
	15m³	12m³	10m³	8m³	8m³	15m³
Personnel costs	12,360	12,360	12,360	12,360	16,920	10,080
Fuel and oil costs	21,725	13,759	11,587	10,138	10,138	15,931
Maintenance costs	19,792	18,145	15,042	12,000	8,000	17,733
Subtotal	53,876	44,264	38,988	34,498	35,058	43,745
Depreciation costs (#1)	61,562	56,250	47,712	39,583	27,708	53,696
Total	115,438	100,514	86,700	74,082	62,767	97,441
Collection cost (LE/ton) (excluding #1)	10.69	11.71	11.22	12.41	22.70	10.37
Collection cost (LE/ton) (including #1)	22.91	26.60	24.95	26.65	40.65	23.10

As is clear from Table 2.2.2, 15 m^3 arm-roll container truck are the most economical, however because the areas where 15 m^3 containers can be placed are limited, 15 m^3 compactors shall be used as the main vehicle type in other areas and 10 m^3 compactors shall also be adopted where appropriate in consideration of road and traffic conditions.

Because it is thought that it will take some time to obtain the cooperation of residents in carrying waste to the containers and stations, the present door to door collection by hand carts shall be continued for a while, but then gradually eliminated.

Fig. 2.2.1 illustrates the above discharge and collection system.

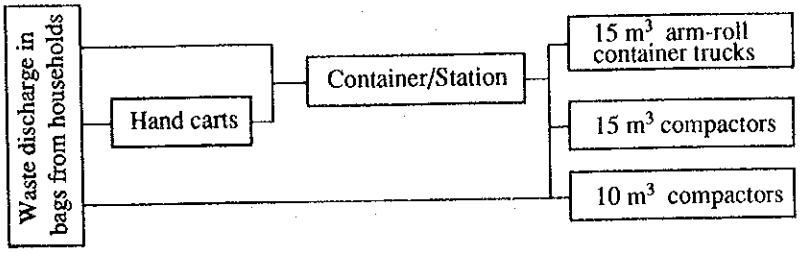


Fig. 2.2.1 Discharge and Collection System

2) Required Quantities of Collection and Haulage Vehicles

The Project collection system described above shall mainly consist of collection by 15 m^3 and 10 m^3 compactor vehicles and collection by 15 m^3 arm-roll container trucks in areas where containers can be placed alongside roads. The required numbers of such vehicles have been estimated with proper consideration given to planned waste discharge quantities, the collection share of each vehicle type and the compaction coefficient, haul efficiency, operating efficiency and also standby units for each vehicle type.

(2) Examination of the Compost Plant

1) Positioning of the Compost Plant as an Intermediate Treatment Facility

The Government of Egypt, which has made the promotion of municipal waste quantity reduction and resource utilization of waste in Egypt's major cities an objective within the Third 5-year Plan, has put forward the construction of municipal waste compost production facilities as an important policy issue.

In Alexandria, where waste quantity reduction has become an urgent issue since the 1980's due to the rapidly increasing amounts of municipal waste and the difficulty of securing a future site for sanitary landfill disposal, the Governorate obtained loan aid from the World Bank to investigate the possibility of constructing a compost plant for use as a much needed waste intermediate treatment facility. With the help of this assistance, the Abis Compost Plant which has a treating capacity of 160 tons/day was constructed and started operations in 1985. The following sections describe the manner in which the operating performance of this plant until now is assessed.

① Financial Assessment

The recent financial balance of the Abis Compost Plant which is shown in Table 2.3.8 indicates that it made a maximum profit of 47,000 LE in 1992/1993 and a minimum profit of 10,000 LE. Its average annual profit over the last three years has been 35,000 LE, indicating that its financial performance is good. The breakdown of operation costs (1993/1994) at the plant are as shown below.

Repair costs	90,612 LE
Utility costs	85,083 LE
Incentive	136,689 LE
Subtotal	312,384 LE
Basic salaries	109,200 LE

Of the above items, repair costs fluctuate greatly from year to year and thus affect the final balance. However, it should be noted that the plant is unable to cover the basic salaries, which are furnished by the Alexandria Governorate.

As can be seen from the sales revenue trends also shown in Table 2.3.8, sales have gradually increased from 309,000 LE in 1991/1992 to 341,000 LE in 1993/1994. This, however, is largely due to increased selling unit prices of compost.

The ratio of compost sales compared to reusable material sales is roughly 5:1 with compost sales accounting for the major share. It is thought that this trend will continue unless improvement of the reusable waste material retrieval line is carried out.

The sale prices of compost per ton since the plant started operating are as shown in Table 2.3.7. When the plant first started operation in 1985, the sale prices of fine compost and coarse compost were 7.5 LE and 5.5 LE respectively, however these have risen to 25.0 LE and 11.0 LE respectively since July 1992.

Judging from this and the fact that compost prices can be expected to continue rising in line with the inflation rate, it is probable that there will be no major change to the financial balance in future. However, the compost plant needs to exert more effort in managing the compost market and increasing sales profits.

One concern is that because the plant itself has reached 10 years of age, it is likely that repair costs will start to gradually rise and put increasing pressure on the financial balance.

② Technical Assessment

The compost production quantities of the Abis Compost Plant are as shown in Table 2.3.6. Over the past five years the annual production of coarse and fine compost has been over 20,000 tons and around 1,000 tons respectively, figures which exceed the initial design production levels. Table 2.2.3 shows the results of analysis of compost produced at the plant. The compost meets the applicable product standard that is prescribed in Egypt.

Table 2.2.3 Compost Analysis Results

	Fine Compost	Coarse Compost	Compost Product Standard in Egypt (Law No. 100,1967)
Nitrogen	1.0	0.9	0.5 + 0.04% or more
Organic matter	22.6	18.6	18 + 1% or more
Water content	11.5	38.0	30 + 2% or more
Unit weight	635	783	750 + 40 kg/m^3 or less
Nitrogen/carbon ratio	1 : 23	1 : 22	1:1 - 1:25

Although control over compost production and quality levels still requires improvement in technical terms, it is assessed that there are no major obstacles to future plant operation. The points requiring improvement are as follows:

a. Repair or renewal of the truck scale for weighing incoming waste quantities
b. Attachment of a uniform feed device to the apron conveyor
c. Widening of the hand sorting line conveyor belt
d. Proper control of fermentation and maturation

In view of the plant's operation performance, the Government of Egypt has the aim of introducing a new compost plant as intermediate treatment facility within the SWM system in Alexandria, to rehabilitate and expand compost production facilities in the area.

③ Benefits of Compost Plant Introduction

The merits to be gained through the introduction of a compost plant are indicated in Table 2.2.4 and Fig. 2.2.2.

Table 2.2.4 Benefits of Compost Plant Introduction

Waste reduction, stabilization and safety benefits	- High level utilization of land is possible due to longer useful lives of disposal sites - Early utilization of land after disposal sites are no longer useful - Reduction of environmental dangers around the disposal sites - Reduction in traffic density leading to lower air, noise and vibration pollution levels - Improvement of the landfill working environment due to less crude waste being accepted - Savings can be made on waste haulage and final disposal costs (374,000 LE/year)
Waste recycling (into compost) benefits	- Prevention of water and soil pollution due to less use of chemical fertilizers and agricultural chemicals - Improvement of the agricultural working environment due to the removal of individual raw waste compost piles on farms - Increased agricultural yields (3,210,000 LE/year) due to improved fertility levels and revitalized soil - Cost savings on chemical fertilizers and agricultural chemicals (422,000 LE/year) - Savings on irrigation water (1,570,000 LE/year) - Stronger financial base of the SWM system due to profits from the sale of more compost (195,000 LE/year)
Other benefits	- Initial investment and running costs are cheap compared to existing compost plants - Contribution to a higher level of intermediate treatment (compost conversion) technology in Egypt - Preservation of natural resources through the conversion of waste into a useful resource - Stronger financial base of the SWM system due to profits from the sale of reusable materials (156,000 LE/year)

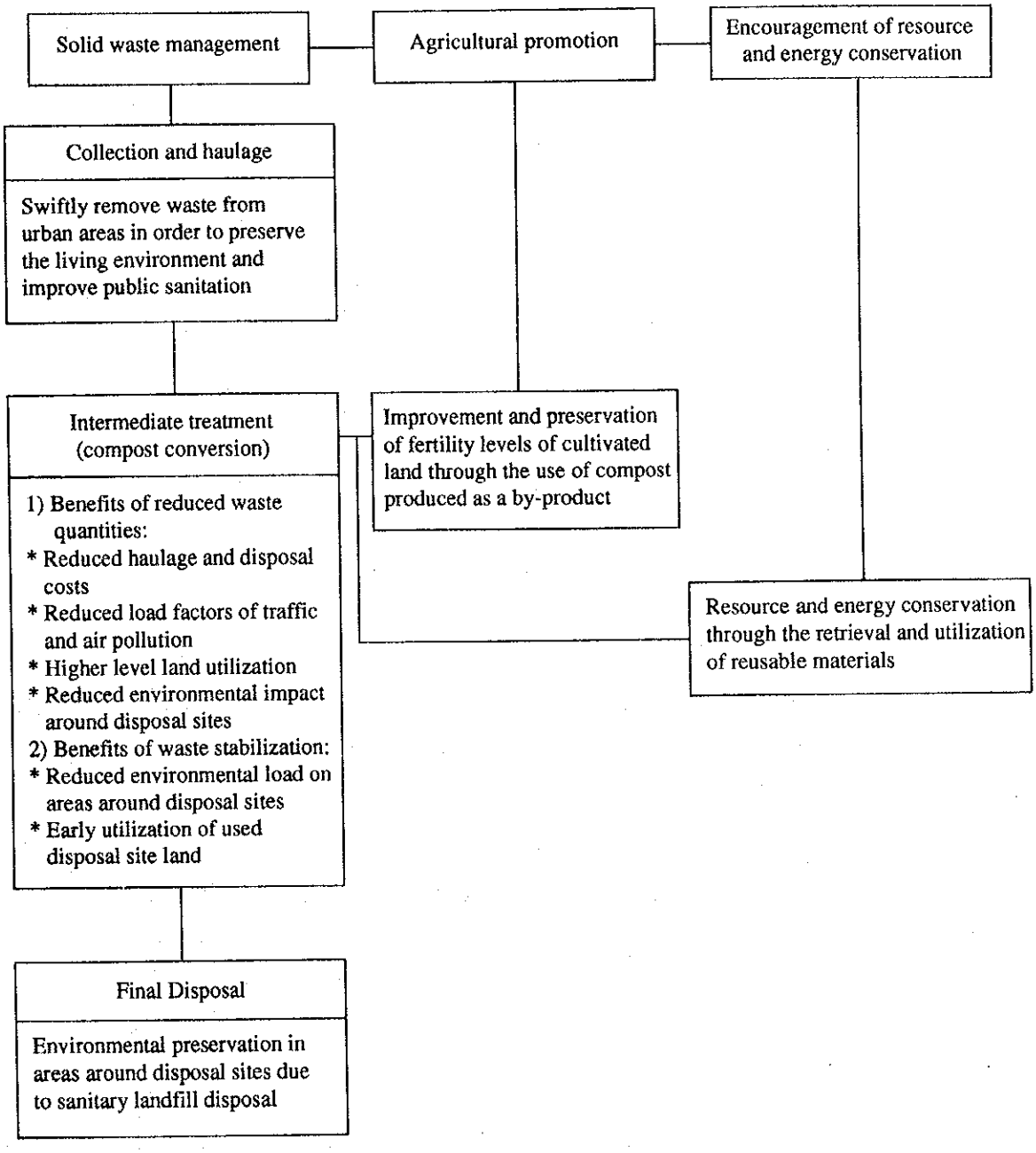


Fig. 2.2.2 Objectives of SWM

2) Economic Analysis

The economic benefits that can be estimated in the case where a compost plant with a treatment capacity of 150 tons/day is constructed shall be examined in order to obtain the economic internal rate of return (EIRR).

① Economic Benefits

The following five items can be considered as measurable economic benefits to be obtained through the construction of a compost plant.

a. Reduced use of chemical fertilizers
b. Increased production of agricultural products
c. Reduced use of irrigation water
d. Reduced waste haulage quantities
e. Reduced waste for final landfill disposal

a. Benefit from Reduced Use of Chemical Fertilizers

Table 2.2.5 shows the amounts of chemical fertilizers that can be saved in the production of wheat, tomatoes and grapes if compost is used as fertilizer.

Table 2.2.5 Chemical Fertilizer Reduction Quantities

(kg/feddan)

	Nitrogen content N	Phosphorous content P	Potassium content K
Wheat	54	32	38
Tomatoes	71	46	86
Grapes	78	23	50

In terms of fertilization efficiency, that of the nitrogen content of ammonium sulfate is 20%, that of the phosphorous content of perphosphoric acid is 45% and that of the potash content of potassium sulfate is 33%. Table 2.2.6 shows the consequent cost of each chemical fertilizer can be saved per feddan for each crop, based upon the above figures.

Table 2.2.6 Chemical Fertilizer Savings by Crop

	Reduced Quantity (kg/feddan)	Fertilization Efficiency (%)	Price (LE/ton)	Saving (LE/feddan)
N (nitrogen content)				
- Wheat	54			76
- Tomatoes	71	20	282	100
- Grapes	78			109
P (phosphorous content)				
- Wheat	32			34
- Tomatoes	46	45	480	49
- Grapes	23			24
K (potash content)				
- Wheat	38			78
- Tomatoes	86	33	681	177
- Grapes	50			103
Total				
- Wheat				188
- Tomatoes				326
- Grapes				237

Assuming that the total annual production of raw compost is around 15,000 tons, the amount used for fertilization per feddan is 10 tons, and that 7,500 tons is used for each of tomato and grape cultivation, the amount of money that can be saved through reduced use of chemical fertilizers can be calculated in the following way:

$$7{,}500 \text{ tons} \div 10 \text{ tons/feddan} \times 563 \text{ LE/feddan} = 422{,}250 \text{ LE}$$

b. Benefit from Increased Production of Agricultural Products

The benefit to be obtained from increased agricultural yields varies depending on crop patterns. As was the case in calculating the benefit to be gained from reduced use of chemical fertilizers, the benefit gained from increased production of tomatoes and grapes shall be calculated assuming that the 15,000 tons of compost is divided equally between the two crops as fertilizer. Because, according to a report by the National Research Institute of Egypt, increased production rates are 25-35%, a uniform rate of 30% shall be assumed.

Table 2.2.7 Benefit Gained from Increased Agricultural Yields

	Yield (tons/feddan)	Yield Increase (tons/feddan)	Cultivated Area (feddan)	Import (LE/ton)	Benefit (LE)
Tomatoes	6.60	1.98	750	900	1,336,500
Grapes	3.70	1.11	750	2,250	1,873,125
Total					3,209,625

If greater weight is applied to more expensive crops, the economic benefit will become greater. For example, if all of the compost is used for fertilization purposes in grape cultivation, the total benefit will be 3,375,000 LE.

In reality, the use of compost as fertilizer is relatively common in the cultivation of fruit, however assuming it is used equally between tomatoes and grapes, as was the case when calculating the benefit of reduced use of chemical fertilizers, an annual benefit of 3,210,000 LE shall be assumed.

c. Benefit from Reduced Use of Irrigation Water

In the case of Egypt which relies on the Nile River for all of its water requirements, various benefits can be envisioned for the effective diversion of irrigation water for other purposes. The F/S estimates that an annual benefit of 6,000 LE can be obtained from reductions in irrigation channel construction costs.

In this case, the benefit shall be calculated as the amount remaining after land development construction costs are subtracted from the yield obtained from farmland newly developed through savings made on reduced use of irrigation water.

Assuming an irrigation water requirement of 6,500 m^3 per feddan and a 40% reduction in the water requirement through the use of compost fertilizer, the use of 15,000 tons of compost will allow enough irrigation water for 1,500 feddan to be saved, and this will allow an extra 400 feddan of land to be developed for cultivation. It shall further be assumed that the newly developed land could produce an annual yield worth 600 LE/feddan in the first year and 300 LE/feddan from the second year onwards.

Moreover, the costs of construction on the developed land shall be assumed to be 2,000 LE/feddan. These shall be covered by funds which are unredeemable for five years and redeemed after 15 years with annual interest at 5%.

Table 2.2.8 Benefit Gained From Reduced Irrigation Water

(LE)

Year	Repayment Principal	Principal Remainder	Interest	Repayment Total	Income	Agricultural Expenditure	Benefit
1		1,200,000	60,000	60,000	720,000	480,000	180,000
2		1,200,000	60,000	60,000	960,000	360,000	540,000
3		1,200,000	60,000	60,000	1,320,000	360,000	900,000
4		1,200,000	60,000	60,000	1,800,000	360,000	1,380,000
5		1,200,000	60,000	60,000	2,040,000	360,000	1,620,000
6	120,000	1,080,000	54,000	174,000	2,400,000	360,000	1,866,000
7	120,000	960,000	48,000	168,000	2,400,000	360,000	1,872,000
8	120,000	840,000	42,000	162,000	2,400,000	360,000	1,878,000
9	120,000	720,000	36,000	156,000	2,400,000	360,000	1,884,000
10	120,000	600,000	30,000	150,000	2,400,000	360,000	1,890,000
11	120,000	480,000	24,000	144,000	2,400,000	360,000	1,896,000
12	120,000	360,000	18,000	138,000	2,400,000	360,000	1,902,000
13	120,000	240,000	12,000	132,000	2,400,000	360,000	1,908,000
14	120,000	120,000	6,000	126,000	2,400,000	360,000	1,914,000
15	120,000	0	0	120,000	2,400,000	360,000	1,920,000
Annual average							1,570,000

d. Benefit from Reduction of Waste Haulage Quantities

The quantity of waste to be carried from the collection area to the disposal sites will be reduced due to intermediate treatment. However, because the existing disposal site is next to the site planned for the new compost plant, the said benefit will only appear from the fourth year when a new disposal site shall be opened.

Reduced quantity (year) : 27,000 tons
Haulage unit cost : (between compost plant and new disposal site)
17.57 - 12.89 = 4.68 LE/ton
Haulage vehicle depreciation : (between compost plant and new disposal site)
23.62 - 18.03 = 5.59 LE/ton
Haulage cost saving : 27,000 × (4.68+5.59) =277,000 LE/year

e. Benefit from Less Waste for Final Landfill Disposal

As well as reducing waste haulage quantities, intermediate treatment will also lead to less waste requiring final landfill disposal.

Reduced quantity (year)	: 27,000 tons
Landfill unit cost	: 1.63 LE/ton
Landfill equipment depreciation	: 1.96 LE/ton
Landfill cost saving	: 27,000 × (1.63+1.96) = 97,000 LE/year

② Calculation of the Economic Internal Rate of Return (EIRR)

In addition to the above benefits, when the Economic Internal Rate of Return (EIRR) and Cost Benefit Ratio (B/C) are calculated based upon consideration of the initial compost plant construction investment cost, they work out to 2.70% and 1.23 respectively as shown in Table 2.2.9.

The conditions for calculation are as follows:

- Of the construction cost, the cost related to the future expansion shall be reducted.
- The operating period shall be 15 years.
- The salvage value of mechanical equipment after 15 years shall be 10%.
- The salvage value of civil engineering and building structures shall be 50% (possible for a further 15 years of use upon renewal of mechanical equipment).
- In-site heavy machinery shall be assumed to require renewal after eight years and this shall be added to the investment cost appropriately.

Table 2.2.9 Calculation of the EIRR

(Unit: 1,000 LE)

	Economic Benefit		Economic Cost		Balance
	Benefit	Salvage Value	Construction Cost	Running Costs	
1	0		31,000	0	-31,000
2	0		31,000	0	-31,000
3	5,298			343	4,955
4	5,298			343	4,955
5	5,298			343	4,955
6	5,298			343	4,955
7	5,575			343	5,232
8	5,575			343	5,232
9	5,575			343	5,232
10	5,575			343	5,232
11	5,575		3,500	343	1,732
12	5,575			343	5,232
13	5,575			343	5,232
14	5,575			343	5,232
15	5,575			343	5,232
16	5,575			343	5,232
17	5,575	4,155		343	9,887
Subtotal	119,385	4,155	65,500	5,145	
Benefit Total		86.672	Cost Total	70,645	
				B/C (0%) = 1.23	
				EIRR = 2.70%	

Table 2.2.10 Economic Benefit Breakdown

(Unit: 1000 LE)

	Chemical Fertilizer Cost Reduction	Increased Agricultural Yields	Irrigation Water Reduction	Haulage Cost Reduction	Disposal Cost Reduction	Total
1	422	3,209	1,570	0	97	5,298
2	422	3,209	1,570	0	97	5,298
3	422	3,209	1,570	0	97	5,298
4	422	3,209	1,570	0	97	5,298
5	422	3,209	1,570	277	97	5,575
6	422	3,209	1,570	277	97	5,575
7	422	3,209	1,570	277	97	5,575
8	422	3,209	1,570	277	97	5,575
9	422	3,209	1,570	277	97	5,575
10	422	3,209	1,570	277	97	5,575
11	422	3,209	1,570	277	97	5,575
12	422	3,209	1,570	277	97	5,575
13	422	3,209	1,570	277	97	5,575
14	422	3,209	1,570	277	97	5,575
15	422	3,209	1,570	277	97	5,575

Table 2.2.11 Economic Cost Breakdown

(Unit: 1000 LE)

	Personnel Costs	Utilities Costs	Maintenance Costs	Incentive Costs	Compost Sales	Reusable Material Retrieval	Total
1	91	222	290	91	-195	-156	343
2	91	222	290	91	-195	-156	343
3	91	222	290	91	-195	-156	343
4	91	222	290	91	-195	-156	343
5	91	222	290	91	-195	-156	343
6	91	222	290	91	-195	-156	343
7	91	222	290	91	-195	-156	343
8	91	222	290	91	-195	-156	343
9	91	222	290	91	-195	-156	343
10	91	222	290	91	-195	-156	343
11	91	222	290	91	-195	-156	343
12	91	222	290	91	-195	-156	343
13	91	222	290	91	-195	-156	343
14	91	222	290	91	-195	-156	343
15	91	222	290	91	-195	-156	343

3) Compost Sales Plan

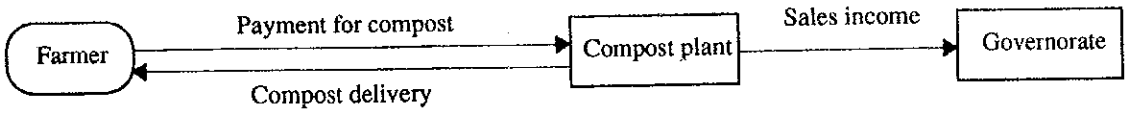
The executing organization on the Egyptian side, the General Follow-up Department has drawn up a compost sales plan in order to secure customers and sale routes for the compost that will be produced at the new plant. The contents of the plan are as described in the following sections. The smooth implementation of these contents is vital to the realization of the objectives of the Project.

① Sales Routes

In the case of the existing Abis Compost Plant, the compost product is sold directly at the plant to farmers who take it way by their own vehicles.

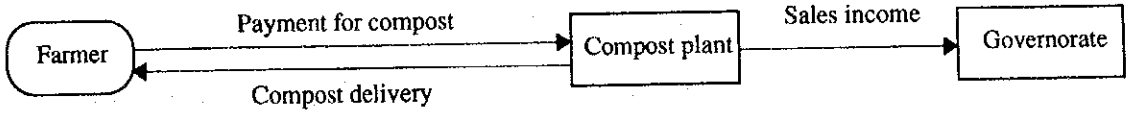
In the case of the new compost plant, the alternative sales routes illustrated in Fig. 2.2.3 shall be utilized to promote the sale of the compost product after the plant has started operating. Along the route for Alternative 4, requests to buy 160,000 tons of compost per year have been sent by the Abhalga Trade Supply Public Corporation and two wholesalers in Alamdi.

[Abis Compost Plant]

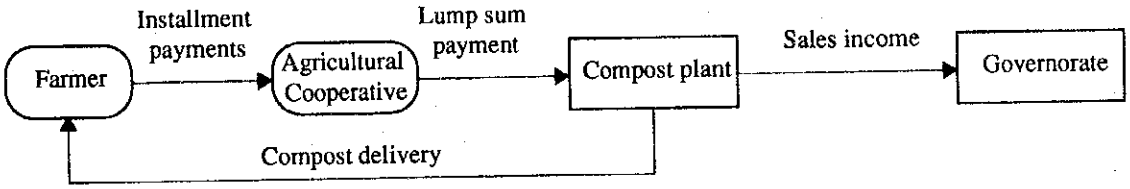


[New Compost Plant]

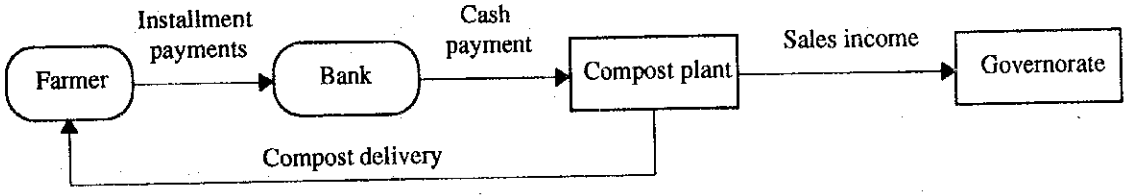
Alternative 1: direct contracts between plant and farmers



Alternative 2: contract between plant and Agricultural Cooperative



Alternative 3: contract between plant and Trust Development Bank



Alternative 4: contract between plant and wholesaler

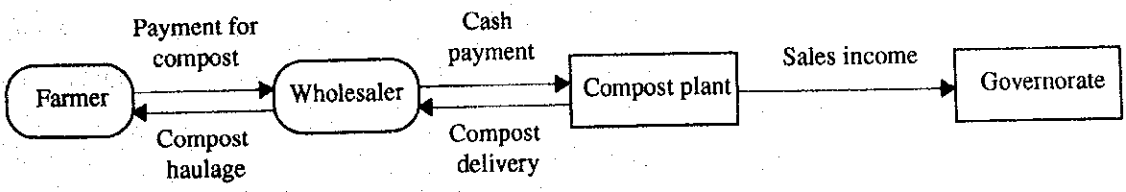


Fig. 2.2.3 Compost Sales Routes

② Sales Promotion Measures

The following measures are planned in order to promote the sale of the compost product and to develop new customers.

a. Designate responsibility for sales inside the plant.

b. Strive to make quality improvements in the final product.

c. Selectively determine waste collection areas to ensure that medical waste and industrial waste does not mix in with the compost raw material.

d. Advertise the compost product.

e. Perform periodic laboratory analysis of the product in order to ensure it is safe for use.

f. Incorporate compost utilization into agricultural promotion loans.

g. Establish fair but competitive prices for the compost product in order to encourage its purchase.

h. Devise sales methods which provide a high quality service so as to satisfy customer needs.

③ Evaluation on Sales Plan

a. It is understood that the compost demand of 2,003,201 ton/year, which is shown in Chapter 2 of the Plan, does not necessarily mean the actual demand but the potential demand.

b. The actual need of 1,740,188 ton/year is corresponding to the amount of which all the farmers in Alexandria (about 50,000) purchase 34 tons every year. However, in practice, it can be side that the actual demand will considerably be small taking into account the average cultivated field area per an individual farmer (about 3 feddans), affordability in buying compost, frequency of compost application on the field, etc. Therefore, this demand will not lead to the conclusion that the extra compost products from the new plant can be sold out.

c. It can be appreciated that the Egyptian side has been making contact with big-amount purchasers such as agricultural cooperatives, etc. and trying to expand and establish the new sales routes.

4) Scale of the New Compost Plant

The necessity of introduction (construction) of a new compost plant, the benefits of which as an intermediate treatment facility were described in 2), is rapidly increasing due to the fact that the fertility of the Nile Delta farmland to the south-east of the city is deteriorating, and that the demand for organic fertilizer for use on wide expanses of farmland newly developed as part of the recent national policy of desert reclamation has risen.

However, if the balance for new plant operation is estimated using the performance of the Abis Compost Plant as a base, the costs that can be covered through revenue from compost and reusable material sales are limited to repair expenses, fuel costs, utilities (gas, electricity) and incentive costs. It will not be able to cover employee basic salaries and equipment and facility depreciation costs, which means that if left to operate autonomously, it will inevitably become a loss making concern.

The following sections therefore investigate the effects placed on the finances of the Alexandria Governorate by the overall cost of waste management from collection through to disposal, according to different scopes of the new compost plant in order to ascertain what the optimum scope of the new plant should be.

Table 2.2.12 shows a comparison of waste collection and haulage costs between the case where new vehicles and equipment are introduced and the case where the current situation is maintained. It shall be assumed that the new disposal site is 30 km away from the city center and that the costs of haulage to the next new disposal site are 10% more than that to the new disposal site.

Table 2.2.12 Collection and Haulage Costs

(Unit: LE/ton)

New Equipment Introduction	Disposal Site	City ↔ Compost Plant	City ↔ Disposal Site	Compost Plant ↔ Disposal Site
Not provided (all districts except Middle District)	Existing	17.70	17.70	0.00
	New	17.70	22.90	5.20
	Next New	17.70	25.19	7.49
Provided (Middle District)	Existing	12.89	12.89	0.00
	New	12.89	17.57	4.68
	Next New	12.89	19.33	6.44

The assumed preconditions for disposal site use shall be ① use of the existing site until 2000, ② use of the new disposal site 30 km away from 2001, and ③ use of the next new disposal site even further away from 2006. Following the improvements to the collection system, final disposal shall involve daily earth covering of waste.

Based upon the above conditions, the total SWM costs by year in each of the following four cases are as indicated in Table 2.2.13.

Case A: where the current situation is maintained

Case B: where collection is improved in Middle District only

Case C: where collection is improved in Middle District and a 150 ton/day compost plant is constructed

Case D: where collection is improved in Middle District and a 300 ton/day compost plant is constructed

Table 2.2.13 SWM Costs by Year (by Case)

(Unit: 1,000 LE)

Case A (current situation unchanged, 160 tons/day compost production capacity)					
	1994	2000	2001	2005	2006
Collection	11,303	13,848	18,219	20,417	22,989
Treatment	422	422	422	422	422
Disposal	782	967	997	1,121	1,151
Total	12,507	15,237	19,638	21,961	24,562
Returns	341	341	341	341	341
Balance	12,166	14,896	19,297	21,620	24,221
Case B (Middle District collection improved, 160 tons/day compost production capacity)					
	1994	2000	2001	2005	2006
Collection	11,303	12,945	17,244	19,316	21,761
Treatment	422	422	422	422	422
Disposal	782	1,221	1,260	1,417	1,454
Total	12,507	14,588	18,906	21,154	23,637
Returns	341	341	341	341	341
Balance	12,166	14,247	18,565	20,813	23,296
Case C (Middle District collection improved, 310 tons/day compost production by 1998)					
	1994	2000	2001	2005	2006
Collection	11,303	12,945	17,098	19,225	21,387
Treatment	422	1,116	1,116	1,116	1,116
Disposal	782	1,187	1,216	1,388	1,426
Total	12,507	15,248	19,430	21,759	23,913
Returns	341	692	692	692	692
Balance	12,166	14,556	18,738	21,067	23,221
Case D (Middle District collection improved, 460 tons/day compost production by 1998)					
	1994	2000	2001	2005	2006
Collection	11,303	12,945	16,971	19,063	21,313
Treatment	422	1,499	1,499	1,499	1,499
Disposal	782	1,133	1,173	1,329	1,366
Total	12,507	15,577	19,643	21,891	24,178
Returns	341	1,043	1,043	1,043	1,043
Balance	12,166	14,534	18,600	20,507	23,135

The total SWM costs by each case in 2001, when the existing Abis Final Disposal Site will become full and waste disposal will be shifted to the new final disposal site 30 km away from the city center, and in 2006 when disposal will be shifted to the next new site, are indicated in Table 2.2.14.

Table 2.2.14 SWM Costs by Case in 2001

(Unit: 1,000 LE)

Collection	Present Situation Unchanged		Improvement to Collection in Middle District					
Capacity of Plants	160 tons/day		160 tons/day		310 tons/day		460 tons/day	
Case	A		B		C		D	
Year	2001	2006	2001	2006	2001	2006	2001	2006
Collection	18,219	22,989	17,244	21,761	17,098	21,387	16,971	21,313
Treatment	422	422	422	422	1,116	1,116	1,499	1,449
Disposal	997	1,151	1,260	1,454	1,216	1,410	1,173	1,336
Total	19,638	24,562	18,906	23,637	19,430	23,913	19,643	24,178
Returns	341	341	341	341	692	692	1,043	1,043
Balance	19,297	24,221	18,565	23,296	18,738	23,221	18,600	23,135

The following points can be concluded from the contents of this table.

a. Improvement of the collection system under Case B will allow collection costs to fall by 975,000 LE/year or 5.4% in 2001 compared to if the present situation (Case A) is maintained. This saving will increase even more in 2006. Therefore, if improvement of the collection system was carried out throughout all of the districts in Alexandria, the burden of the SWM system on the Government of Egypt's finances could be greatly reduced.

b. If collection system improvement was carried out and an intermediate treatment facility (compost plant) was also introduced at the same time, collection and haulage costs could be further reduced. The potential saving compared to Case B in 2001 would be 164,000 LE under Case D, and in 2006 this would be 348,000 LE under Case D and 174,000 LE under Case C.

c. The introduction of a compost plant would lead to a reduction in final disposal costs too. The potential saving in 2001 would be 87,000 LE under Case D and 44,000 LE under Case C. By 2006, the cost reduction would be almost the same in both cases.

d. When looking at the overall SWM costs, there would not be much difference in 2001 between those under Case A (maintenance of current situation) and Case D. By 2006 however, Cases B, C and D would allow

large savings compared to Case A. Of these, Case B would allow the smallest saving, and of the remaining two compost plant introduction cases, Case C (150 tons/day) would prove cheaper than Case D (300/tons/day) by 265,000 LE and is thus more advantageous.

e. The overall SWM costs by case after subtracting revenue from compost and reusable material sales are as indicated below.

(Unit: 1,000 LE)

	2001	2006
Case B (160 t)	18,565	23,296
Case C (310 t)	18,738	23,221
Case D (460 t)	18,600	23,135

This shows that the lowest costs in 2001 would be achieved under Case B at 18,565,000 LE, however in 2006 the lowest costs would be achieved under Case D at 23,135,000 LE. This indicates that reducing quantities of waste through the introduction of an intermediate treatment facility would prove beneficial in financial terms too.

The request made by the Government of Egypt was for the introduction of a 300 tons/day compost plant, however based upon the above examination results, the following conclusions have been drawn.

a. The overall SWM costs in 2006, when the disposal site will be shifted to a location more than 30 km away, would be cheaper in Case C and Case D (introduction of a 150 tons/day and 300 tons/day compost plant respectively) than in Case B (collection improvement only). Moreover, introduction of a new compost plant is considered to be highly significant in view of the economic benefits it would bring about, the growing importance of waste quantity reduction due to the increasing remoteness of and difficulty of land securing for disposal sites, and the fact that increased compost production could make a contribution to the national policy of farmland expansion.

b. The existing Abis Compost Plant has now reached its tenth year of operation and future suspension of operations due to repair of the plant's

aging equipment is forecast. For this reason, the effect that could be obtained from an alternative plant would be immense.

c. In technical terms, judging from the past performance of the Abis Compost Plant, a plant scale of 150 tons/day on a one train line is the upper limit for the proper removal of unsuitable waste items and retrieval of reusable material in the hand sorting process.

d. In financial terms, the total SWM costs in 2001 under each case are below 19 million LE, and when one considers that this would only represent an increase of 7% over the SWM budget for 1993/1994 (17,753,000 LE), it can be said that there would be no problems in terms of running the system.

On the other had, the personnel expenses and depreciation related to the new and existing compost plants, which are 5 million LE for Case-C and 7.2 million LE for Case-D, are not included in the above evaluation and therefore, if included, the SWM will become financially in the red.

However, the introduction of the new compost plant will become much viable taking into account the fact that, as mentioned before (refer to Table 2.2.9), some surplus against the cost is expected to be produced by economic benefits from such as saving of chemical fertilizers, increase in the crop field, saving of waste haulage cost and saving of the disposal cost by the introduction of the new compost plant.

e. Regarding the scale of the new plant, it is difficult to decide whether 150 tons/day or 300 tons/day would be better due to the existence of factors which can cause fluctuations in the sale of compost produce and reusable materials. If a plant with a capacity of 300 tons/day was introduced, the overall compost plant production capacity in Alexandria would be trebled to 460 tons/day, and it cannot be guaranteed that the existing retail system could sell all of the extra compost off.

In consideration of the above points, it is judged that the scale of the compost plant to be introduced under the Project is appropriate at 150 tons/day.

(3) Examination of the Transfer Station

The request for construction of an transfer station and procurement of related equipment is based on the assumption that the final disposal site will be situated some 60 km away from the city center. However, because the field survey concluded that the final disposal site to be used in the Project is to be within 30 km of the city, the transfer station was judged not to be necessary and thus excluded from the Project contents.

(4) Examination of Final Disposal Site Operation Equipment

1) Landfill Method at the Final Disposal Site

The landfill capacity at the Abis Disposal Site is currently 870 tons/day, however this shall be increased to 1,046 tons/day by the Project target year of 2000.

Because the present method of landfill disposal does not involve sufficient covering with earth, spontaneous combustion of the waste occurs thus causing a detrimental effect on the surrounding environment. Proper, sanitary landfill disposal of waste is necessary in order to preserve the environment in and around the disposal site. In order to achieve this, the waste must be sufficiently compacted and then covered with earth. An earth covering of 0.5 m is generally provided for each 3 m layer of waste.

2) Quantity of Covering Earth at the Final Disposal Site

The amount of covering earth required if 0.5 m is provided for each 3 m layer of waste will be 166 m^3/day by 2000. Because the covering earth cannot be obtained on the site, it needs to be brought in from outside, temporarily stored and then hauled to the landfill site for covering.

3) Required Quantities of Operation Equipment

The required quantities of each item of operation equipment were calculated based upon consideration of work loads equivalent to landfill quantities and the working capacity of each item of heavy machinery.

Given that the above examination has confirmed that Project implementation is both effective and practical, that the Egyptian side possesses the necessary implementation capability and that the Project effects are consistent with the Grant Aid System, it is judged that implementation of the Project through

Japanese Grant Aid is appropriate. Assuming the provision of Japanese Grant Aid as a precondition, the following sections will describe examination and basic design on the contents of the Project.

The contents of the request from the Government of Egypt and the Project work contents are as indicated in Table 2.2.15.

Table 2.2.15 Contents of the Request and the Project Work Contents

No.	Contents of Request	Project Work Contents	
		Phase 1	Phase 2
1.	Procurement of collection and haulage vehicles and equipment * Compactors : 65 * Container vehicles : 4 * Trucks : 15 * Large truck : 1	* 15 m^3 compactors : 21 * 10 m^3 compactors : 18 * 15 m^3 arm-roll container trucks : 10 * 1 m^3 containers : 3,214 * 15 m^3 containers : 34	——
2.	Construction of compost plant and procurement of related equipment - Compost plant construction * Treatment capacity : 300 tons/day - Related equipment procurement * Wheel loaders (1.5 m^3) : 4 * Dump trucks (8 ton) : 5 * Truck scale (30 ton) : 1 (for use at new compost plant)	——	- Compost plant construction * Treatment capacity: 150 tons/day - Related equipment procurement * Wheel loaders (2 m^3) : 4 * Dump trucks (8 ton) : 5 * Truck scales (30 ton) : 2 (one each for new compost plant and Abis Compost Plant)
3.	Construction of intermediate transfer station and procurement of related equipment - Intermediate transfer station construction * Treatment capacity: 480 tons/day - Related equipment procurement	None (not to be a subject of the Project)	
4.	Procurement of final disposal site operation equipment * Back hoe : 1 * Dump trucks : 2 * Bulldozer : 1 * Landfill compactors : 2 * Motor sprinkler : 1	* Back hoe : 1 * Dump trucks : 2 * Bulldozers : 2 * Landfill compactors : 2 * Motor sprinkler : 1	——

2.3 Project Implementation Setup

2.3.1 Organization and Manpower

(1) Organization of Alexandria Governorate

Alexandria Governorate is one of 26 such local government units in Egypt and the composition of its administrative organization is as illustrated in Fig. 2.3.1. The Governor, Secretary General and each district head are appointed by the central government.

The Secretary General is the effective head of administrative and executive affairs and possesses great authority and influence over decisions made concerning the SWM system in Alexandria.

The agencies directly concerned with SWM are the General Follow-up Department, the Central Department for Cleansing and Beautification and the six districts, which are responsible for actual collection and haulage work. In terms of manpower, the SWM sector is the largest sector within the Alexandria Governorate.

Incidentally, the public service sectors of Alexandria such as water supply, sewer system, electricity supply and public transport (trains and buses) are each operated by independent public corporations.

(2) SWM Operational Organization

The operating setup for SWM in Alexandria is as indicated in Fig. 2.3.2. All waste management activities from collection through to disposal are supervised by the Central Department for Cleansing and Beautification, which was established in 1987 with the Cleansing Follow-up Division of the General Follow-up Department as its core body.

In the implementation stage of the Project, the General Follow-up Department, which is the executing organization for the Project, will liaison closely and conduct follow-up work on the Project together with the Central Department for Cleansing and Beautification, which is to be the operating organization for the Project after its implementation. The organization structures of the General Follow-up Department and Department for Cleansing and Beautification are indicated in Fig. 2.3.3 and Fig. 2.3.4 respectively.

The divisions directly concerned with the Project are the Plant Operation Division (compost plant) and the Final Disposal Site Management Division, however waste collection and haulage activities shall be the responsibility of the Central Department for Cleansing and Beautification and the Middle District Cleansing Division.

Concerning the management of waste collection and haulage and the operation of the disposal site after Project execution, it is judged that the existing staff will be able to continue their responsibilities. However at the compost plant upper management staff shall be selected from qualified members in other sectors of the Governorate administration.

The total number of upper management staff at the compost plant will be 17 including the plant manager. Of these, 10 shall be technical and seven shall be administrative personnel.

Concerning the technical personnel, there are surplus staff in the Engineering Division and at the Central Workshop, and there are no problems concerning the selection and assignment of qualified members. The same can also be said of the required administrative management staff.

A big advantage is that the Abis Compost Plant has now been operating for some ten years, and because the mechanical and electrical equipment being used there is almost identical to the equipment that is planned for introduction at the new plant, it will be possible for the staff of the new plant to learn and master operation and maintenance techniques while the new plant is under construction. It is therefore felt that securing the necessary staff and technical know how for the new compost plant operation will not prove to be a problem.

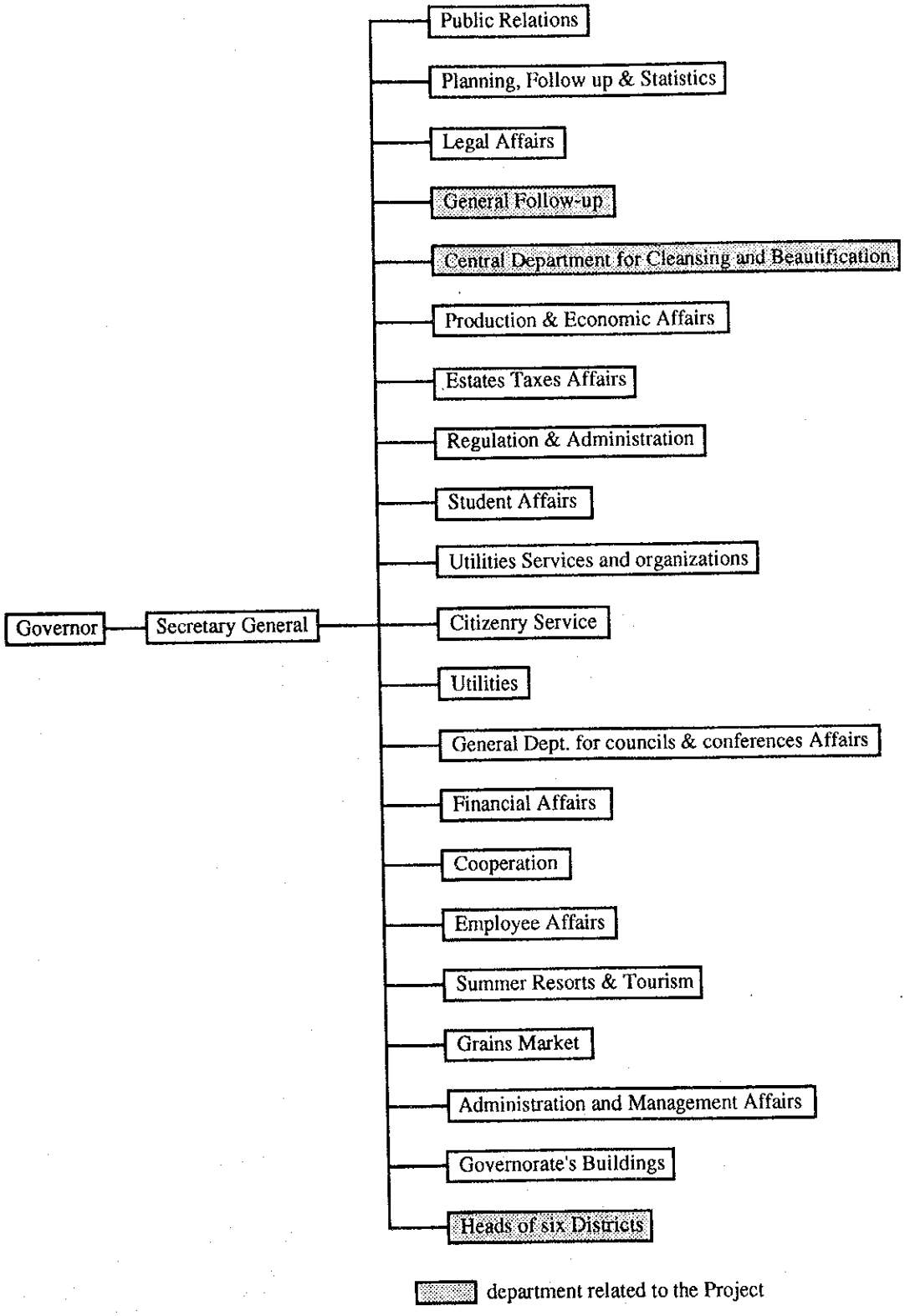


Fig. 2.3.1 Organization Chart of Alexandria Governorate

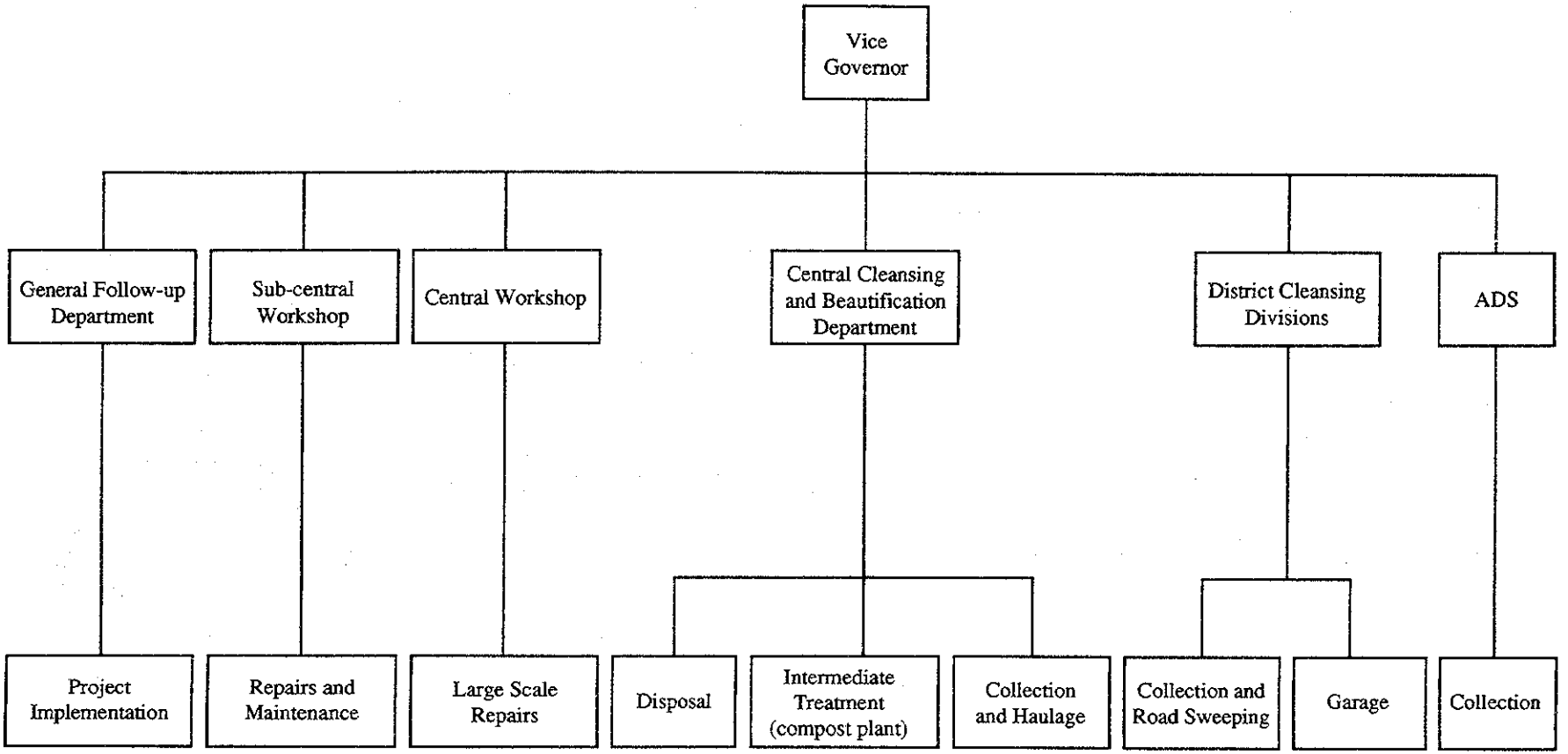
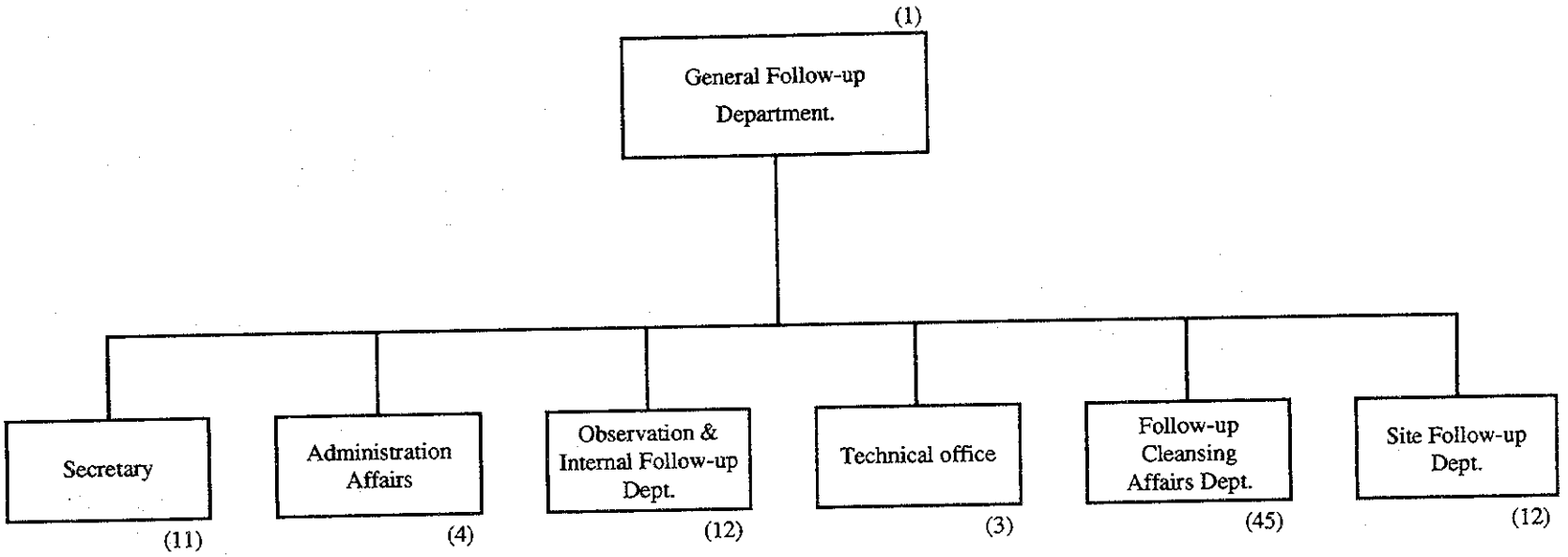


Fig. 2.3.2 Implementation Setup of the Solid Waste Management System in Alexandria



(Total number of employees : 88)

Fig. 2.3.3 Alexandria Governorate General Follow-up Department Technical-office

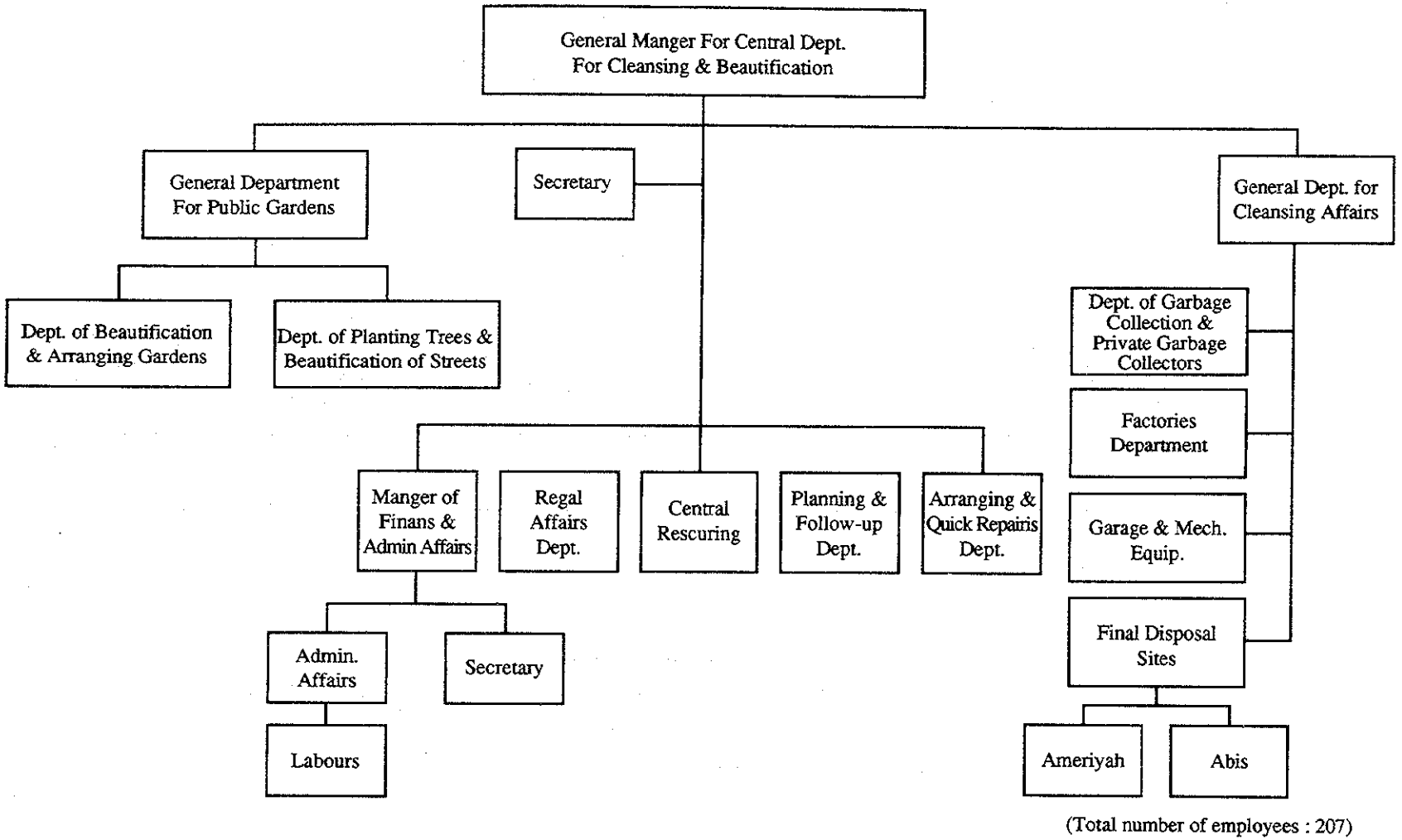


Fig. 2.3.4 Organization Chart for Central Dept. for Cleansing & Beautification

2.3.2 Project Site Conditions

2.3.2.1 Natural Conditions

The equipment provision plan and facility construction plan shall be compiled with consideration given to the following natural conditions.

(1) Climate

The Mediterranean climate of Alexandria with an average temperature of 24-30°C is mild compared to the semi-continental climate of the capital Cairo where average temperatures range from between 30-35°C. Alexandria is thus not only an international tourist destination, but also a summer resort for Egyptians and people from the other Gulf states.

The air is dry with a humidity rate of 70% all year round. Annual rainfall is around 200 mm, most of which falls during the winter months (from December to February). Due to the city's location on the sea, there are occasional strong winds and between March and April in particular, strong, sand bearing winds known as the Khamaseen blow.

Information on maximum, minimum and mean temperatures and rainfall levels etc. is shown in Ap 5.

(2) Topographical and Geological Conditions

As is indicated in Fig. 2.3.5, the scheduled site for construction of the new compost plant lies some 4 km south-west of the Abis Compost Plant. The new plant construction site is a long thin strip of land (60 m × 870 m) with Lake Maryut on the north side and a surrounding drainage channel on the south side. Like the site of the Abis Compost Plant, the construction site is on land that has been reclaimed from the lake.

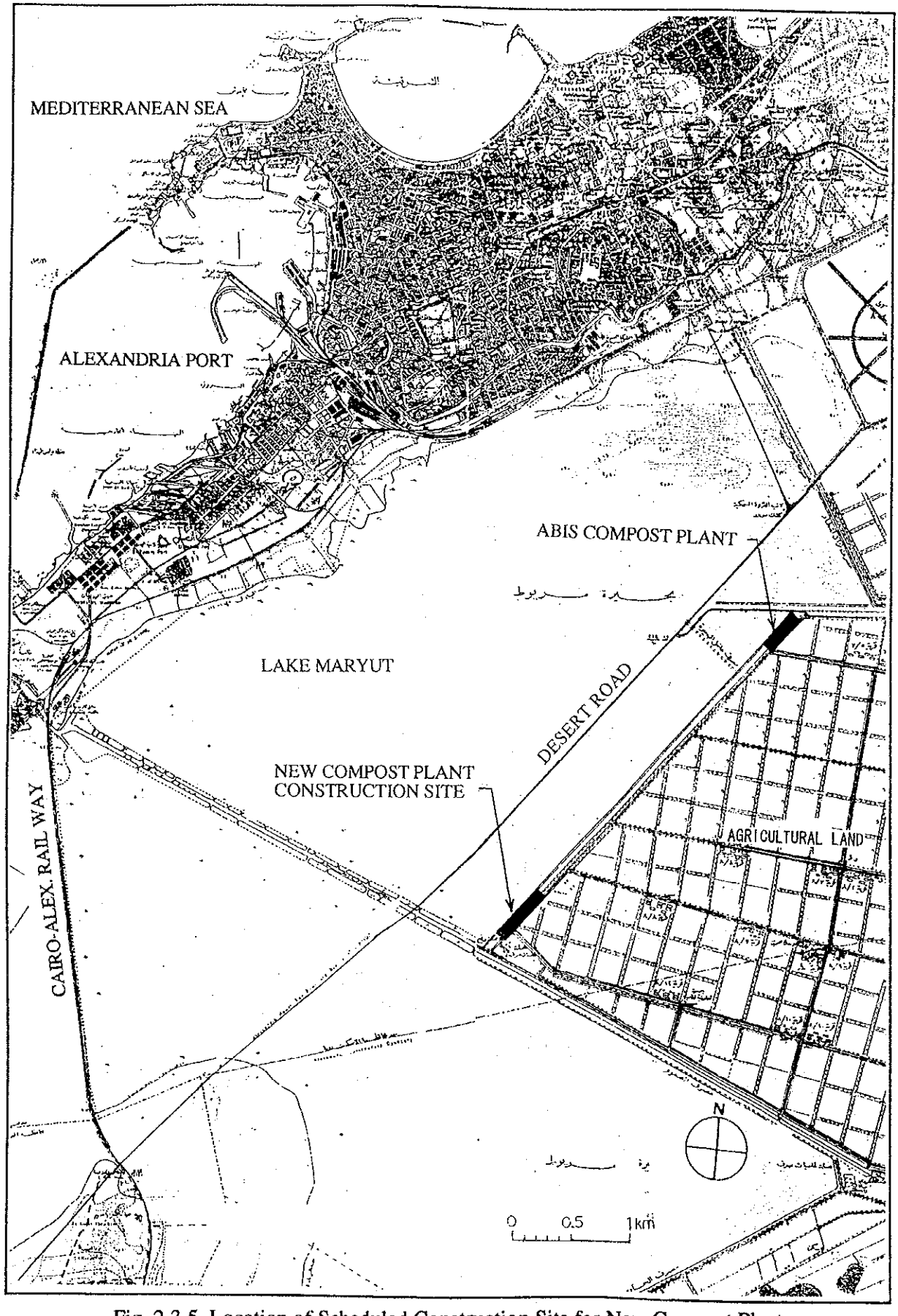


Fig. 2.3.5 Location of Scheduled Construction Site for New Compost Plant