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THE FEASIBILITY STUDY ON REFUSE COLLECTION, TREATMENT AND DISPOSAL IN ALEXANDRIA OF THE ARAB REPUBLIC OF EGYPT

SUMMARY

MARCH 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a feasibility study on the Refuse Collection, Treatment and Disposal Project in Alexandria and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA established an advisory committee on this Project chaired by Dr. Sachiho Naito and sent to Egypt a survey team during the periods of 11 August to 10 December 1984 and 29 June to 10 October 1985.

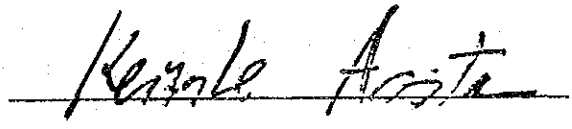
A field survey was carried out on the whole area of the Governorate of Alexandria and a detailed survey was conducted on the Middle District designated as an object of the feasibility study, with the cooperation of the officials concerned of the Central Government and the Alexandria Governorate.

Further studies were made in Japan based on the result of the field survey, and the Final Report is now ready for submission.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Arab Republic of Egypt and the Governorate of Alexandria for their close cooperation extended to the JICA study team.

March, 1986



Keisuke Arita
President
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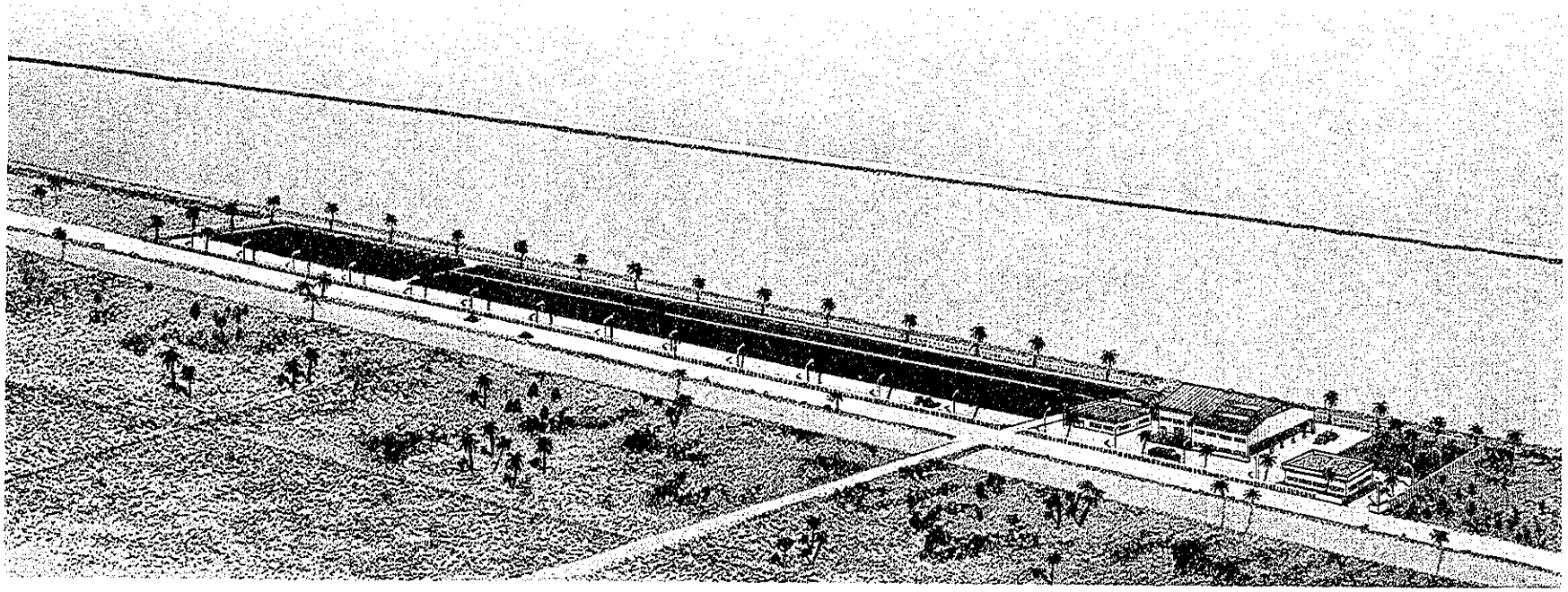

INTRODUCTION

In response to the request of the Government of the Arab Republic of Egypt for the technical cooperation in conducting the feasibility study on refuse collection, treatment and disposal system in the City of Alexandria, the Government of Japan has agreed to provide the service of a team of Japanese experts to undertake the feasibility study within the general framework of technical cooperation between Japan and Egypt which is set forth in the Agreement on Technical Cooperation between the Government of Japan and the Governement of the Arab Republic of Egypt entered into force on the 31st of January, 1984.

The Progress Reports I and II, drawn up on the basis of the results of the two field surveys which extended over approximately 8 months, and were carried out jointly with the offices of the General Follow-up Department (hereinafter referred to as "counterpart") of Alexandria Governorate, have already been presented.

After that, the JICA Study Team has set itself to the task of drawing up the Feasibility Study on the basis of data and information collected successfully thanks to the enthusiastic cooperation of the counterpart, and now it is ready to present the relevant report.

Generation of waste is an unavoidable consequence of the socio-economic activities of the human being, however on the other hand, its prompt elimination from the sphere of the said activities, as well as the elimination of its harmful properties, stabilization and restoration to the nature, is an important task assigned to the human being in these days, when natural environment conservation is a subject being proclaimed on an earthwide basis.

In the recent years the production activities in the various fields accompanying the economic development are changing rapidly and the development pace is accelerating, and both the variety and the volume of the wastes generated as a result of the said activities are increasing at an astonishing rate. These wastes contain substances exerting conspicuously baneful influence on the natural environment in considerable quantity, and the stabilization of their noxious properties is becoming increasingly difficult.

Under the circumstances, authorities of cities all over the world in charge of waste management are being faced at problems varying degrees of seriousness, requiring proper solution, and as a matter of fact not only the administrative authorities in charge of the matter but also scholars armed with scientific background and experience, as well as technical personnel of private firms are nowadays contriving together to solve the said problems.

On the other hand, it must be borne in mind that the political and economic activities of the human being have the intrinsic tendency of focusing their efforts on production fields in pursuit of economic benefits, and the solid waste management, which belongs to the so-called venous industrial sector which does not bring about direct values and benefits, as well as the technical developments required to upgrade its level, are prone to be left behind.

The said state of affairs occurred also in Japan, and only a few scholars have been carrying out researches on the matter for more than twenty years. Only after the oil crisis in 1973 the solution of the solid waste management problem, including salvage of the natural resource from wastes, began to attract the attention, concurrently with the worldwide tendency of natural resources conservation.

It must be borne in mind however, that the characteristics of solid wastes are changing both qualitatively and quantitatively, concurrently with changes and development occurring in the socio-economic activities. Such being the case, continuous research and development are required in connection with solid wastes, as long as those related to production are progressing.

Needless to say that the solid waste management problems of Alexandria has its own peculiarities, but from the aforesaid intrinsic standpoint the situation is the very same, and improvement of the solid waste management system must be put forward on the basis of a long-range plan, in order to preserve the scenic beauty of Alexandria as a world-famous resort city, and to restore it to the lofty position it once held among the ancient cities of the world during the Greek and Roman civilizations.

The current state of the solid waste management system of Alexandria, which is developing rapidly under the said circumstances, is outlined in the followings.

- For the most part the executive entity in charge of the solid waste management system has switched from the Zabbaleen, which has a long history, to the Districts, which are public institution, while the ADS activity is being strengthened so as to support the Districts.

- So far it used to be relatively easy to secure landfill sites in the neighbourhood, but site acquisition is becoming increasingly difficult of late.

- The level of financial independency is low, and the solid waste management system is relying on aids provided by foreign countries and subsidies of the Central Government for funds required in connection with facility improvement and renovation of equipment.

- The Abis Compost Plant (10 t/hr) has started its operation as an intermediate treatment facility, but the compost selling price of 9 LE/t is lower than that one planned at the beginning.

This report contains the Master Plan covering the totality of Alexandria, which is the proposition for improving the solid waste management system of the city drawn up with the aforementioned facts as background, and the feasibility study on three projects consisting of collection service improvement, sanitary landfill at Moharam Bey Square Dump Site and the New Compost Plant in the Middle District requiring priority improvement and implementation, with 2000 as target year.

In essence, this report regards the "accomplishment of the objective with minimum expenditure" as the first axiom, and proposes the sanitary landfilling as best alternative regarding solid waste management system.

From another standpoint, it is also true that great hopes are rising for expansion of compost plants in connection with the intertwining of needs related to three distinct factors;

- the desert forestation program being developed in nationwide scale as a state-policy of Egypt

- the improvement of the farming productivity and the effective utilization of the potential value of waste materials

- the extension of the service life of the landill sites through the volume reduction of solid wastes.

The feasibility of the construction of a compost plant with 300 t/d capacity is examined from the aforementioned standpoint, in addition to the sanitary landfilling.

This feasibility study is carried out on many premises, but in particular the increase of crop yield brought about improvement of farming productivity resulting from the application of compost exerts a sensitive effect on the cost benefit ratio, as mentioned in the text of the report.

As a matter of fact, there is no data referring to the improvements attained through application of compost in Egypt, and in this study the said improvement is assumed to be 30%, based on the experimental data obtained in Japan.

Furthermore, the conditions regarding the introduction of foreign loans and the conditions of the subsidies to be provided by the Central Government exert decisive influence on the feasibility of the compost plant development.

Under these circumstances, it is particularly important to analyze and check the various conditions involved from various standpoints, so as to prevent the failure in the attainment of the intrinsic purpose of the solid waste management system due to the financial burden attributable to the introduction of further compost plants, as mentioned in the recommendations.

This study, started in March 1984 in response to the request of the Alexandria Governorate to JICA, was carried out with the invaluable support and kind cooperation of the counterparts under the command of Mr. Saad Rafael, General Manager of the Follow-up Department of the Alexandria Governorate, and it is a pleasure for the JICA Study Team to present the Final Report to the Alexandria Governorate.

Precondition of Feasibility Study

Exchange rate	:	1.00 US$ = 1.33 LE = 205 ¥
Loan condition		
- Foreign	:	5-year grace period and 20-year repayment with 4% interest per year
- Local	:	5% of annual interest
Inflation	:	not considered
Market area for compost	:	within Alexandria Governorate (660 t/d)
Compost selling price		
- Fine compost	:	9 LE/t
- Coarse compost	:	7 LE/t
Selling price of reusable material		
- Iron	:	9 LE/t
- Glass	:	20 LE/t
- Paper	:	40 LE/t
- Plastic	:	120 LE/t
- Textile	:	20 LE/t
Unit price of utilities		
- Electricity	:	0.0482 LE/Kwh
- Water	:	0.12 LE/m^3
- Fuel	:	0.203 LE/l
Average wage for each rank		
- Managerial personnel	:	1,800 LE/year
- Technical staff	:	1,800 LE/year
- Driver	:	2,400 LE/year
- Worker	:	1,440 LE/year
- Sweeper	:	960 LE/year

Collection charge

- Ordinary households : 9 LE/year
- Business establishement
  - * Small scale : 1.8 PT/kg
  - * Large scale : 2.3 PT/kg

Personnel to be required in 2000

- Collection and sweeping : 786 persons
- Transfer station : 49 persons
- MBSDS : 28 persons
- Compost plant : 105 persons

Compost plant specifications

- Yearly operation day : 300 days
- Daily operation hour : 8 hr/shift x 2 shifts = 16 hours
- Daily treatment capacity : 300 t/d
- Hourly treatment capacity : 23.57 t/hr
- Fermenting period : 5 weeks
- Maturing period : 4 weeks
- Resources recovery rate in year 2000
  - * Fine compost : 24%
  - * Reusable material : 7%

Amortization

- Machinery : 15 years
- Civil and building structure : 30 years
- Vehicle : 5 years

Maintenance cost

- Plant facilities : 2% of machinery and installation cost
- Vehicle : 8% of vehicle purchasing cost

Effectiveness of compost application as soil conditioner

- Increasing rate of crop yield : 30%
- Decreasing rate of irrigation water : 40%

ABBREVIATION

ADS	:	ASSOCIATION FOR DEVELOPMENT OF SOCIETY
AGOSD	:	ALEXANDRIA GENERAL ORGANIZATION FOR SANITARY DRAINAGE
ALT.	:	ALTERNATIVE
ARC	:	AGRICULTURAL RESEARCH CENTER
B/C	:	BENEFIT/COST
BHN	:	BASIC HUMAN NEEDS
DWC	:	DRINKING WATER CANAL
EIRR	:	ECONOMIC INTERNAL RATE OF RETURN
EDS	:	EASTERN DISPOSAL SITE
F/S	:	FEASIBILITY STUDY
IBRD	:	INTERNATIONAL BANK OF RECONSTRUCTION AND DEVELOPMENT
JICA	:	JAPAN INTERNATIONAL COOPERATION AGENCY
MBSDS	:	MOHARAM BEY SQUARE DUMP SITE
NPV	:	NET PRESENT VALUE
O/M	:	OPERATION AND MAINTENANCE
PLAN 2005	:	ALEXANDRIA COMPREHENSIVE MASTER PLAN 2005
S.R.	:	SUPPORTING REPORT
S.W.M.	:	SOLID WASTE MANAGEMENT
USAID	:	UNITED STATES AID
WDS	:	WESTERN DISPOSAL SITE

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1. Outline of the Study

1.1 Background

Alexandria has the largest trading port in Egypt and is also renowned worldwide as a tourist city. The solid waste management (hereinafter referred to as s.w.m.) is not yet well developed in every aspect from discharge to disposal. For this reason, formulation of drastic countermeasures is a matter of urgency.

The Governorate of Alexandria aims to improve its urban environment and hygienic condition as befitting an international tourist resort. The system to be developed will be the one with appropriate technology to fully reflect the socio-economic background and technical capacity of Alexandria, and also that which enables recovery and effective utilization of reusable materials generated from solid wastes.

1.2 Objectives

The objectives of this study are as follows:

- To acquire an understanding of the present state as well as problems associated with municipal s.w.m. in Alexandria.

- To prepare a Master Plan to improve the public health and preserve environment of the city of Alexandria from technical, economic and social viewpoints.

- To carry out a Feasibility Study of the s.w.m. improvement project for the Middle District with the target year of 2000 seeking the possibility to obtain the financial arrangements for the project implementation.

1.3 Scope of the Study

(1) Study Area

The area covered in the Master Plan is the city area of Alexandria which is composed of six districts; from east to west, Montazah, East, Middle, Gomrok, West and Ameriyah District. As a result of the Master Plan study, the Middle District was selected as the target area for the feasibility study necessitating immediate improvement of the present situation of the s.w.m.

(2) Type of Solid Waste to be Studied

The type of solid waste to be studied is so-called municipal solid wastes, which consist mostly of household and commercial wastes. Wastes in liquid and sludge forms, and wastes which should be disposed of at the responsibility of the industries themselves, such as wastes from port and marine vessel, construction and demolition wastes and agricultural wastes, are excluded from the scope of this study.

(3) Scope of the Study

The study aims at a grasp of the present state of s.w.m. in Alexandria and at preparation of a master plan (Phase I and Phase II), as well as execution of a feasibility study on s.w.m. in the Middle District (Phase III).

In the study, the following are taken into consideration.

a. In phase I, the current state of s.w.m. throughout Alexandria is studied in detail in conjunction with the administrative structure. As a result, problem recognition and definition concerning technical, economic or social viewpoints were pointed out as the basic data for the development of the responsive Master Plan and for the Feasibility Study.

b. In phase II, several alternatives were drawn up, evaluated and the best one was selected to perform systematic s.w.m. for the Alexandria area. In order to do this, the alternatives for each function of the s.w.m. were compared and the advantages and disadvantages of each alternative were discussed from technical, economic and social viewpoints.

c. The study in Phase III was confined to the improvement of s.w.m. in the Middle District. This necessitates a thorough understanding that the study is only a part of the program for the whole city and that it is to serve as a basis for implementing the improvement of s.w.m. in other districts. The Middle district was selected in the latter half of Phase II, through discussion with counterparts, considering the urgency and necessity for improvement of the s.w.m. system in said district.

2. Master Plan

In consideration of the situation outlined below, a Master Plan in this study was prepared with emphasis on the improvement measures with respect to the technical aspects which is supported with organizaiton, management and financial plans necessary to guarantee the accomplishment of the s.w.m. plan.

2.1 Present Problems and Subjects to be Improved

Problems on the present condition and subjects to be improved for the s.w.m. in Alexandria are summarized on Table 2-1 and Fig. 2-1 respectively.

Table 2-1 PRESENT PROBLEMS OF THE S.W.M. IN ALEXANDRIA

Items		Contents
Collection and Sweeping	General	* Insufficient collecion service. * Scattered wastes on the streets. * Waste stations are open-type. * Lack of citizenry cooperation for waste discharge.
	Collection	* Waste stations are not allocated in an appropriate manner. * No regulations regarding waste discharge (hours and vessel). * Non effective use of collection vehicles due to inadequate maintenance system. * No proper standard for collection vehicle's allocation including assistants. * Waste amount is not measured. * The working conditions related to the collection are unbearable for workers.
	Street Sweeping	* Sweeper also collects wastes in addition to sweeping job. * The street sweeping amounts to excessively large proportion of total s.w.m. cost. * Daily sweeping is an overservice for residential area. * There are no manuals regarding the sweeping work. * Shortage of equipments and its insufficiency.

Items		Contents
	Organization and institution	* Fragile organization. * No training course for the technician and workers. * The collection system of the fine is too fragile.
Final Disposal		* Serious environmental problems in the surrounding areas of the disposal sites resulting from Open-dumping. * Non scheduled acquisition of final disposal sites. * It is a problem to securing proper disposal sites. * Non unified management system of the disposal sites.
Compost Plant		* Difficulty of full capacity operation. * Low effeciency in hand sorting system. * Considerably cheaper selling price of compost.
Organization	General	* The law prohibits the charge collection for the waste collection or disposal services of districts. * Dual system consisting of the district service and ADS service is currently in use. * The Cleansing Section of the districts has no competence regarding operation plans including finance, management of workers and procurement of equipment.
	Institutional aspects	* Law and regulations regarding s.w.m. are not sufficient. * The supervision and guidance system is not sufficent.

Items		Contents
	Organizational aspects	* The General Follow-Up Dept. is put in an unfavourable position regarding the formulation and execution of the budget. * Fragile cooperation between the Central Workshop and the District Garage. * The systematic collection service is difficult due to dual-system operation by ADS and district. * The citizenry are confused with the dual-system operation of cleansing service. * The planning sector is fragile. * Shortage of technical personnel.
Finance	Soild waste management	* Current charge system of ADS shall be revised to obtain thorough realization of the beneficiaries-shall-pay principle. * Shortage of financial resources to cover the vehicle purchasing and maintenance cost. * The expenditures consist mostly of wages and incentives which will increase greatly the financial burden in the future.

1. Improvement in the collection service and containment of littering on streets

Even now, there are still uncollected areas, and the irregularity of collection and low collection frequency are inviting garbage throwing and the uncooperative discharge manner of the citizenry. Garbage throwing and littering make the burden of street sweeping extremely heavy. In Alexandria, however, further population growth and expansion of its urban area are anticipated. Thus, the city must establish its collection service system to cope with the increase in the waste amount and the expansion of its collection area.

2. Improvement of street sweeping activities

Inadequacy of the collection system is inviting an increase in waste littering on the streets and the need for street sweeping over the entire area. The cost of street sweeping must be reduced by improving the collection service, reducing street sweeping frequency to once a week in sub-streets and gaining the cooperation of the citizenry to discharge waste properly.

3. Securing the cooperation of inhabitants

Even if the collection service were to be improved, its effect would not be secured without the cooperation of the inhabitants in the manner of waste discharge (abiding by the rules and, as the case may be, cooperating in separate discharge), and such cooperation is also important in rationalizing waste collection and street sweeping.

4. Formation of a rational collection, haulage and street sweeping system

To solve the foregoing problems in collection and street sweeping, the collection, haulage and street sweeping system must be expanded, and in view of the limited financial resources available to the city, it must be rationalized to the maximum extent possible. For this purpose, the following measures necessary for rationalization must be taken upon review of the available technical systems.

[Collection & haulage]

- Optimization of the method, frequency and time schedule of collection and conditions of stations, etc.
- Formation of a collection system for narrow streets
- Replenishment of equipment and supplies for collection and haulage and establishment of a setup for maintenance
- Optimization of work sharing in street sweeping and waste collection activities (Division of responsibility, scope of work assigned to each worker, etc.)
- Improvement in technical competence and morale of workers
- Optimization of geographic distribution of garages and transfer stations and strengthening of hauling function
- Proper handling of summer vacationers' waste

[Street sweeping]

- Use of machanical sweepers for main streets and optimum placement of waste stations
- Improvement of sweeping frequency and method
- Intensification of sweeping equipment and supplies and improved maintenance
- Raising of workers' morale

5. Formation of proper treatment and disposal system

- In Alexandria, open dumping and open-air burning of waste in the fields are practiced now, which is helping to reduce the volume of wastes and leading to the extended use of the landfill sites. Deterioration of the environment near the landfill sites is so serious now that a shift to sanitary landfilling is being called for.
- Acquisition of landfill sites will become increasingly difficult in the longer range so that it is necessary to secure disposal sites systematically and also to be prepared for haulage to more distant locations.
- Treatment for waste volume reduction is needed considering the difficulty in finding suitable disposal sites in near places.
- Attention must also be paid to the kinds of wastes which are currently excluded from the objects of the solid waste management by the city.

6. Formation of recycling system

In Egypt, urban wastes have large potential value as resources, and it is highly probable that the formation of a recycling system for composting of organic wastes, and utilization of metals, glass, plastics will lead to resources conservation and waste volume reduction.

7. Formation of a rational treatment and disposal system

[Treatment]

- Optimum geographical distribution and improvement of the treatment system and facilities (composting, sorting, etc.)
- Improvement in efficiency of maintenance, operation and control
- Improvement in the technical competence of personnel and reduction in the rate of employee turnover
- Preservation of environmental sanitation in the neighborhood
- Integration of the salvaging work at open stations and disposal sites into the process of the intermediate treatment facilities

[Disposal]

- Systematic securing disposal sites
- Adoption of proper method for sanitary landfilling
- Formation of a market system for compost and other recovered materials
- Observation of the disposal regulations
- Preservation of environmental sanitation in the neighborhood of disposal sites

Improvement in organization and management

- Reorganization for integration of systems (particularly strengthening of the planning unit and integration of the collection vehicle management system and the collection activity operating system)
- Reduction in the rate of worker turnover by improving working environment and wage rate (method of collection and sweeping [cleansing], improvement and fuller provision of equipment, supplies and clothings, training system)
- Betterment in the work and manpower management and appraisal system and fostering of technical personnel

[Collection, haulage and street sweeping]

- Optimization of the division of responsibility in waste collection and street sweeping among Governorate, district and citizens and sharing of work between districts and ADS (Separation of street sweeping, waste collection from household, and collection of commercial and industrial wastes in each zone)
- Establishment of a mutually cooperative relationship with citizens' and local organizations (Formation of a system and program to enlighten the inhabitants)

[Intermediate treatment and final disposal]

- Formation of a regional waste treatment and disposal system and clarification of division of responsibility and work sharing
- Formation of a market for salvaged reusable materials
- Rationality in operating the treatment and disposal system

Improvement in the financial and institutional arrangement

- Clarification of organizational responsibilities, optimization of service and charge by systematic collection of charges, complete enforcement of the waste management charge (Establishment of a system, regulation for collection of charges, system for collecting charges)
- Increase in financial resources and efficient distribution of financial resources (effective utilization of various sources of fund)
- Operation of business activities such as waste treatment and disposal, composting, etc. and clarification of the sharing of operating cost
- Sound management of money flow for operating the system and handing out incentive money
- Establishment of a self-supporting financial arrangement without depending on foreign aid in the longer range
- Administration of a system of levying a fine against illegal throwing of wastes
- Enactment of a legislation with respect to the responsibility for street sweeping
- Establishment of a system for collecting fees on voluntarily hauled in wastes

Fig. 2-1 THINGS TO BE DONE FOR THE IMPROVEMENT OF THE S.W.M. SYSTEM

2.2 Preconditions

The preconditions for conducting master plan study are summarized in Table 2-2.

Table 2-2 PRECONDITIONS FOR PLANNING

Target year	:	2000 A.D.
Study area	:	Whole urban area in Alexandria in the year 2000
Waste to be covered	:	Domestic, commercial, street sweeping and summer vacationers' waste generated from the above mentioned study area.
Estimated daily waste amount in target year	:	1,460 ton of domestic waste, and 759 ton of commercial waste, totalling 2,219 ton. Besides this, 360 ton of summer vacationers' waste during the three months between June and August.

Estimated waste composition*

Garbage/ Grass	Papers	Text-iles	Plas-tics	Metals	Glass	Others
51	23	6	9	6	4	1

* Note: Weight % of each component on a wet basis

2.3 Development of Alternatives and Evaluation

(1) Development of Alternatives

The s.w.m. system is composed of the combination of the processes shown in Fig. 2-2, which are the typical processes commonly adopted for the s.w.m.

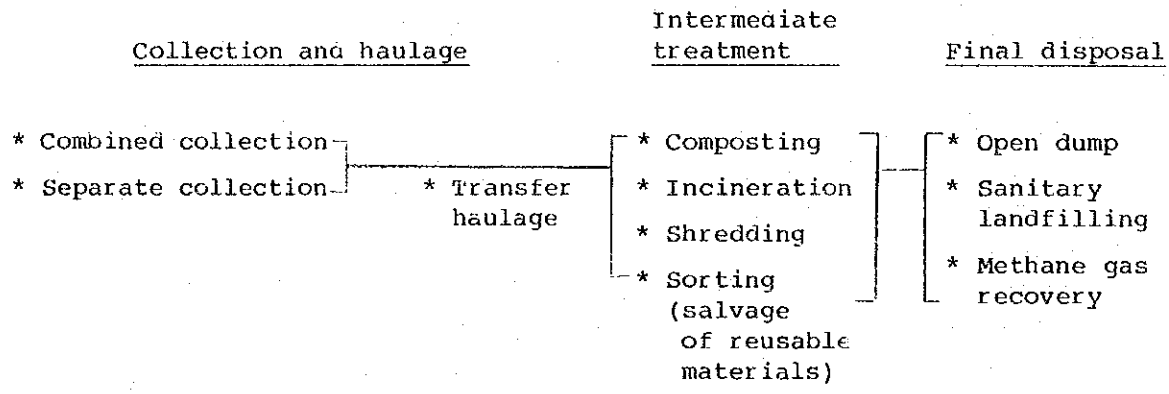


Fig. 2-2 TYPICAL SYSTEMS FOR EACH PROCESS

In order to select the suitable systems for the s.w.m. in Alexandria from the processes presented above, the appropriate system for each process which is best suitable to the requirement of the city was selected from the several substitute processes.

As a result of this study, separate collection method, incineration and shredding, methane gas recovery, and open dumping were eliminated from the list.

The following five alternatives, which are the combinations of the remaining technical systems, were proposed through the screening process of the development of alternatives.

a. Alternative-1: Full Composting

All wastes are hauled to the compost plants. All residual rejects at the compost plant will be disposed of at the sanitary lanfill sites to be constructed at Green Belt within a distance of 20 km range from the collection areas.

b. Alternative-2: Sanitary Landfilling in Green Belt
All collected wastes are disposed of at the same landfill sites planned in Alternative-1.

c. Alternative-3: Sanitary Landfilling in Desert
All collected wastes are hauled to the desert landfill sites to be developed within a distance of 70 km range from the collection areas via transfer stations and disposed of by sanitary landfilling.

d. Alternative-4: Full Sorting
All collected wastes are sorted to recover reusable materials at the sorting plant before disposing of at the same landfill sites planned in Alternative-1.

e. Alternative-5: Composting and Sorting
Wastes collected from Middle, Gomrok and West Districts are converted into compost at the Abis Compost Plant and the compost will be used for the cover material of landfilling. In the other districts, waste will be sorted for recovery of reusable materials at the sorting plant and the remaining are disposed of by sanitary landfilling at the same sites planned in the Alternative-1.

(2) Evaluation of Alternatives from Financial and Managerial Viewpoint

Project cost, financial scale and other financial aspects of each alternative planned for the year 2000 are summarized in Table 2-3.

Table 2-3 EVALUATION OF ALTERNATIVES

(Million LE/year)

	Alt.-1	Alt.-2	Alt.-3	Alt.-4	Alt.-5
Operational cost	22.7	13.8	16.8	19.4	21.2
Ranking	V	I	II	III	IV
Financial scale	17.3	12.8	13.1	15.6	15.5
Ranking	I	V	IV	II	III
Balance	-5.4	-1.1	-3.7	-3.8	-5.7
Ranking	IV	I	II	III	V
Balance before depreciation	6.2	5.1	3.7	5.9	5.0
Ranking	I	III	V	II	IV

Based on the results tabulated above, each alternative was evaluated from the financial and managerial viewpoint as follows:

a. Alternative-1: Full Composting

This alternative has the largest financial scale because it incurs the largest costs and sales revenues of compost and reusable materials. As a result, the shortage of financial resources amounts to 5,400,000 LE/year. If this shortage should be borne by the residents, their burden will multiply by 2.6 against 2% rent, set up for the financial resources in the Master Plan.

If the compost, etc. will not be sold, for any reasons, deficit of the financial resources shall reach 7,100,000 LE/year and the s.w.m. in Alexandria will fail. However, because of the balance amount of 6,200,000 LE/year before subtracting depreciation, and in case of the procurement of the financial resources expected through assistance from foreign aid and/or from the Central Government, this alternative will be upwardly evaluated from the financial aspect.

b. Alternative-2: Sanitary Landfilling in Green Belt

This alternative is the most realistic one when considering the financial scale of the Alexandria Governorate and the affordability of the residents, because it incurs the smallest project cost.

Furthermore, this alternative has advantageous characteristics from the operational reliability aspect because of no revenues from compost and reusable materials included, which involves many uncertainties as things now stand.

c. Alternative-3: Sanitary Landfilling in the Desert

Financial balance is inferior to the Alternative-2; however, it is superior to the other three resource recovery type alternatives.

d. Alternative-4: Full Sorting

Among the three resource recovery type alternatives, this is the most advantageous alternative plan in terms of balance of revenues and expenditure. It should be noted, however, if the disposal site is constructed far away, the balance becomes considerably worse. In other words, this alternative involves the uncertainty in respect to the location of disposal site and the marketability of the reusable materials. Therefore, the alternative involves operational and financial problems.

e. Alternative-5: Composting and Sorting

This alternative is the worst in terms of managerial and financial viewpoints because of the utilization of compost as cover material.

From the result of evaluation aforementioned, Alternative-2 was selected as the optimum alternative from the managerial point of view.

Meanwhile, agricultural promotion and afforestation of the desert land are strongly anticipated in Egypt. So, the significance of composting will increase when the economic effects of the compost application to the lands are taken into consideration. In that case, the method of evaluation other than the managerial viewpoint of the s.w.m. shall be applied, but the implementation of the compost project shall not worsen the financial base of the s.w.m.

(3) Overall Evaluation

Overall evaluation of each alternative is summarized in Table 2-4.

Table 2-4 OVERALL EVALUATION OF ALTERNATIVES

	Evaluation as a Technical System	Evaluation from Organizational and Financial Viewpoint
Alternative-1	o A large volume reduction can be achieved prolonging the life of landfilling sites. o Utilization of potential value of wastes as resources can be achieved by composting and reusable material recovery. o Higher project cost will be required.	o Requires a staff of about 570 persons for the compost plant operation, thus requiring organizational expansion. o Requires large investment in facility improvement and construction. o When the profit from sale of compost and reusable materials decreases, it will incur the risk of encroaching upon the financial basis of the Governorate. o Accordingly, this alternative has a higher degree of uncertainty from organizational and financial viewpoint compared to other alternatives.

Evaluation as a Technical System	Evaluation from Organizational and Financial Viewpoint
Alternative-2	
o Requires the largest area for landfilling sites, and it is thus predicated on their availability. o Operating expense can be the lowest among the alternatives and the project cost of s.w.m. is also the cheapest. o Less utilization of potential value of waste.	o Requires the smallest manpower and expenses. Thus, the system affords the highest safety from organizational and financial viewpoint. o There is uncertainty to secure landfilling sites in the vicinity.
Alternative-3	
o Requires the largest area for landfilling sites, and it is thus contingent on their availability. o As it enlarges the areas in which landfilling sites can be sought, it will become easier to secure landfill sites. o Sanitary lanfilling in the desert involves lower disposal cost in comparison with Alt.-2, but increase in haulage cost more than offsets that saving. o Less utilization of potential value of wastes	o In comparison with Alt.-2, haulage cost is substantially larger. Organizational expansion also becomes inevitable such as the requirement of transfer stations. o Therefore this alternative is not superior to Alt.-2 from organizational and financial viewpoint.
Alternative-4	
o As it includes the recovery of reusable materials, the demand for landfilling sites can be reduced. But the amount of waste to be disposed of will be still about 50% larger than Alt.-1. o Composition of waste subject to landfill will become relatively suitable. o Expansion of manpower for sorting of reusable materials becomes necessary.	o Requires 441 workers for sorting of reusable materials. o Requires investment in sorting facility and additional expenses for sorting operation, but a fair portion of expenses can be recovered by the revenue from sale of reusable materials and by reduction in the amount to be disposed of. (Facility investment cost is 70% that of Alt.-1)

Evaluation as a Technical System	Evaluation from Organizational and Financial Viewpoint
o Cost is approximately the same as Alt.-1 but number of vehicles and manpower will be larger.	
Alternative-5	
o This alternative is conceivably possible if difficulty is encountered in formation of a market for the compost. Further it allows the most effective utilization of resource value of wastes. o It is a system that lies somewhere between Alt.-1 and Alt.-4.	o The lowest-ranking alternative from the financial viewpoint. o As the compost is used for cover material, financial uncertainty in selling the compost is eliminated.

The Alternative-2 of the sanitary landfilling for the entire amount of waste is considered the most appropriate as the basis for the s.w.m. system of Alexandria. In this evaluation, priority was given to emphasizing the reduction of financial burden rather than to the effects of the resource recovery in s.w.m. systems in terms of resource recycling, reutilization and waste amount reduction.

If the burden on the financial resources for s.w.m. can be alleviated by receiving financial subsidy from the Central Government to subsidize a part of the facility construction and compost products sale (from the viewpoint of national economy such as increasing crop yield), the construction of compost plant should be considered as a part of the s.w.m. system.

2.4 Planning Goals

Planning goals were established as shown in Table 2-5 based on the subjects to be improved in the s.w.m. system and the results of alternative evaluation.

Table 2-5 PLANNING GOALS

Item	Planning Goals
Collection	By the system of periodical collection at specified discharge stations, wastes shall be collected daily in the densely inhabited areas and at least twice a week in other areas.
Citizenry cooperation	On the basis of periodical collection service, cooperation of the citizens in discharging waste with regularity (discharge to a specified station on a specified date and time) shall be secured.
Street sweeping	To rationalize street sweeping activities and improve street environment through reorganization of street sweeping management system based on the street waste reducing by improving the collection service and securing citizenry cooperation.
Treatment and disposal	The entire amount of collected wastes will be disposed of by sanitary landfilling. (However, the system of utilizing resources by composting while disposing of the residues by sanitary landfilling will be considered if the investment cost for facility improvement and/or the construction is available as subsidies from the Central Government so as not to put financial pressure on the s.w.m.)
Organization and management	The basic goal is to strive for unified management of planning, control and field operations by the Cleansing Authority to be established. Also, efforts for progressive improvement of organization shall be made by improving the pay and technical skill of workers.
Finance and administration	Establishment of self-supporting financial basis by streamlining total s.w.m. system and by securing financial resources.

The planning horizon of this Master Plan is approximately 15 years during which effort should be made to attain the foregoing planning goals. The shift from the prevalent s.w.m. to the target one, however, will not only involve the task of having to improve facilities and equipments that require a large investment but also tasks that are likely to take a long time to accomplish, such as securing the citizenry cooperation, improvement in pay and technical skill of the cleansing workers and coordination with other related governmental organizations.

In view of the above, an approach of staged improvement becomes inevitable in attaining the planning goals. Hence the improvement plan was formulated on the policy of sequential improvement, starting with the Middle District which comprises the central area of Alexandria, then going on to other existing urban areas, and over to Montazah and Ameriyah Districts where urban development is anticipated to take place in the 1990s.

2.5 Collection, Haulage and Street Sweeping System

(1) Collection

As a rule, wastes shall be discharged in plastic bags, but in consideration of the extra burden that this method entails, discharging of wastes in containers will also be permitted. The method of waste collection shall be the combined collection at specified discharge stations.

In Middle, Gomrok, East and West Districts where the larger amount of waste is generated, the stations shall be placed at 3/ha and the wastes shall be collected every day.

In Montazah and Ameriyah Districts where the lesser amount of waste is discharged, the stations shall be placed at 2/ha and the wastes shall be collected twice a week. The collected wastes shall be directly hauled to the Abis compost plant and the final disposal site. Frame of collection system is summarized in Table 2-6.

Table 2-6 FRAME OF COLLECTION SYSTEM

Item	Frame
Discharge station	Discharge stations shall be placed on the shoulder of road or on the sidewalk clearly marked as the station so that the waste carrying distance from homes would be 50-100 m or less. 3 stations/ha shall be placed in highly populated areas like Middle, Gomrok, West and East Districts and 2 stations/ha in low population density areas like Ameriyah and Montazah Districts. Discharge station, however shall not be placed in the center area of Middle District.

Item	Frame
Collection frequency	As waste generation rate is quite high in Middle, Gomrok, West and East Districts, collection service shall be daily, while for low waste generation rate areas like Montazah and Ameriyah Districts, collection shall be made twice a week with due regard to household storage and collection efficiency. Waste generated from markets shall be collected twice or three times per day, but the wastes in the suburban areas shall be collected twice or three times per week.
Discharge Method	Present practice of waste discharge to communal container or open space in bulk shall be terminated. Instead, waste should be discharged by using specified bags. The bag discharge method shall be induced to the low income area with confirmation of its possibility. Special facilities such as hospital, hotel, market, etc., including suburban area shall continue to use the communal container system.
Discharge Time	Waste discharge time shall be from eight o'clock in the evening to eight o'clock in the next morning.
Collection Method	All solid wastes shall be collected at waste discharge stations. In areas where discharge by plastic bags is possible, collection by open dump trucks shall be acceptable, while in other areas, compactor vehicles shall be dispatched.
Collection Equipment	Compactor vehicles or open dump trucks shall be dispatched depending on how much the practice of discharging by bags has been implemented, and on pavement conditions of roads. To improve the service level, medium sized vehicles possible to enter into a 4 to 6 m wide road shall be mainly provided. Container vehicle shall be provided for waste collection of special facilities.

(2) Street Sweeping Plan

Street shall be swept manually and the street sweeping system shall be separated from the general waste collection in order to increase sweeping efficiency.

Total length of the main streets with 346.4 km and secondary streets with 1,157 km within the planned city area will be subject to street sweeping.

Frame of the street sweeping system is shown in Table 2-7.

Table 2-7 FRAME OF THE STREET SWEEPING SYSTEM

Item	Frame
Street sweeping system	Street sweeping shall be carried out manually, and each sweeper shall be assigned a street section or area of streets to take care of. Mechanical sweeping shall be applied to the trunk roads.
Reloading system	Haulage vehicles shall be provided for street waste as exclusive use. All street wastes collected by hand cart shall be reloaded to the haulage vehicles.
Storing system for collected street waste	Street waste collected by the sweepers shall be packed in plastic bags and placed at the stations for haulage.
Frequency	Main streets and secondary streets shall be swept once to 3 times a day. Other streets shall be swept once to 3 times a week. Actual frequency shall be determined with consideration of street or area conditions.
Sweeping hours	The main streets shall be swept in the early morning in order to finish before the start of the daily activity of the people. Other streets shall be swept from 6:00 a.m. to 12:00 a.m. in same schedule as the present practice in summer and 7:00 a.m. to 1:00 p.m. in winter.

Item	Frame
Equipment	Each sweeper shall be provided with a broom or a green basket available in Alexandria. Furthermore, hand cart manufactured in the workshop shall be provided depending on the conditions of the street waste generation. And mechanical sweeper shall be used on the trunk roads.
Manpower plan	One sweeper shall be assigned for every 1.2 km of the main streets and every 0.5 km of the other streets.

(3) Staged Improvement Plan of Collection, Haulage and Street Sweeping

The staged plan for collection, haulage and street sweeping system in each district is shown in Table 2-8.

The 15 years duration up to 2000 shall be divided into 3 stages. At the 1st stage, collection and street sweeping shall be completely improved in the Middle District, then this improvement plan shall be expanded to the other districts during the 2nd and 3rd stages.

Table 2-8 STAGED PLAN FOR COLLECTION, HAULAGE AND STREET SWEEPING

District	1st Stage	2nd Stage	3rd Stage
Middle District	Rearrangement of waste stations and communal containers, and establishment of bag-packed with regular discharge and collection system in the north area. Tentative reorganization of the street sweeping system.	Gradual expansion of the bag-packed collection areas except for low income area and of the reorganization of the street sweeping system.	Expansion of the bag-packed collection system for the low income area.

District	1st Stage	2nd Stage	3rd Stage
Gomrok, West and East Districts	Preparatory stage for shifting to a new collection and street sweeping system, on the basis of the current system	Establishment of the bag-packed regular discharge. Rearrangement of stations and communal containers. Implementation of regular collection system. Expansion of the collection area. Gradual shift to once to three times street sweeping a week on the secondary streets.	Unification of the waste discharge method and abolition of the communal containers. Gradual expansion of the bag-packed collection areas and regular collection. Establishment of once to three times street sweeping a week on the secondary streets.
Ameriyah and Montazah Districts	Ditto	Twice a week collection and weekly street sweeping shall be induced for new urban area.	Service shall be extended to the urban area to be newly developed.

2.6 Intermediate Treatment and Final Disposal Plans

The basic topic of concern in intermediate treatment and final disposal is the transition to sanitary landfill. Because the introduction of compost treatment invites an increase in financial burden, in principle such introduction is made only within the range which can accommodate it.

(1) Intermediate treatment plan

In the evaluation of the alternatives, alternative 2, calling for sanitary landfill of the entire amount, was selected as the optimum choice. It also has to be kept in mind that great hopes are held that the promotion of the compost project will contribute to the salvage of reusable materials, reduction in waste amount and to the greenification of the desert area around Alexandria.

The existing intermediate treatment facilities consist of the Abis Compost Plant with a treatment capacity of 10 t/hr, or 48,000 t/year. Here, we will evaluate the effects which the introduction of a single new plant would have in terms of economic benefit at the national level and in terms of financial influences on the Alexandria Governorate, in order to determine whether such introduction is feasible or not.

(2) Final Disposal

As for the final disposal site, for the time being the system shall be operated at the existing site. In the middle- and long-term, appropriate sanitary landfilling site shall be secured at the vicinity of the green belt or the like. The following two sites is planned in this connection as shown in Fig. 2-3.

- Eastern Final Disposal Site (EDS)
- Western Final Disposal Site (WDS)

The amount of waste to be disposed of at the two sites in 2000 will reach to approximately 1,000,000 m^3/year and the outline and facilities of the landfill sites will be as listed in Table 2-9.

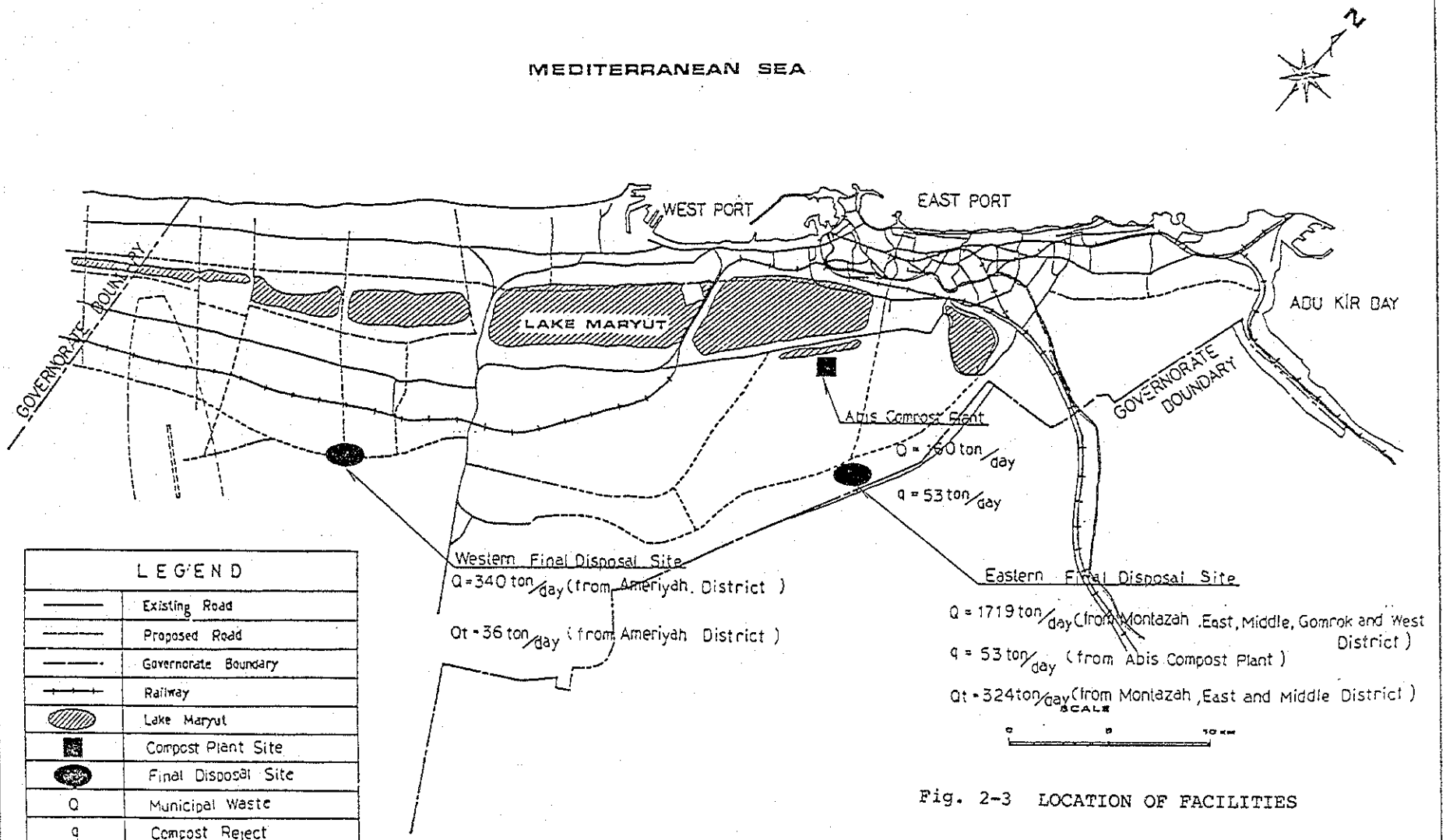


Fig. 2-3 LOCATION OF FACILITIES

Table 2-9 OUTLINE AND FACILITIES FOR THE DISPOSAL SITE

Item	Outline
Landfilling method	Sanitary landfilling
Composition of the landfilling layers	Waste layer : 3 m Daily earth cover: 0.3 m Final earth cover: 1 m
Capacity	2,570,000 m^3 per 1 Block
Cover material	Earth excavated at site
Area	1 Block 81 ha
Main facilities	Embankment, road, administrative facilities, truck scale

2.7 Organizational Plan

The Cleansing Authority is planned to be established to consolidate the integrated system for the s.w.m., because the establishment of the Cleansing Authority will be advantageous for achieving the planned goals related to the organizational and administrative aspects, and furthermore it is promoted as a national-policy in Egypt.

As things now stand, the waste collection service is executed with deficient planning, such as empirical allotment of the collection vehicles. And, there is no middle- and long-range plans for securing the landfilling sites. Under the circumstances, the planning and administrative functions of the organization are ineffective and insufficient.

On the other hand, the technical level and social status of the workers are the problems to be solved appropriately with the improvement of the management system, as mentioned before in this study.

With regard to these points, the planning and administrative systems shall be strengthened by a radical reorganization, appropriate training programs, and planning and technical manuals, accompanied with measures for their practical utilization within the organization, so as to improve the technical standard of the personnel.

2.8 Financial Plan

For the time being the s.w.m. of Alexandria can count upon foreign aid for constructing its facilities, purchasing collection velicles, etc., but it is indispensable to consolidate its independent financial base until 2000 so as to achieve a self-supporting operation of the system.

At the same time, additional financial resources shall be obtained for the improvement of waste collection services, the construction and operation of the compost plant, the execution of sanitary landfilling, the betterment for workers' welfare, and the subsequent increase of personnel involved to cope with advancing urbanization, which will exceed decreasing number of the workers by rationalization of street sweeping.

Therefore, measures shall be taken to establish the self-supporting financial base through a shift in organizational structure to the Authority, in addition to the aforementioned improvement of the planning and administrative functions of the organization and cost-reduction through rationalized waste collection, treatment and disposal.

The basic lines for the consolidation of the financial base are as follows.

a. The subsidies from the Central Government as the financial resources shall be expanded in proportion to the expansion of personnel. And the Cleansing Fund and the income from the charge for collection services shall be reinforced in the following lines.

b. The revenue of the Cleansing Fund shall be increased through revision of the house rental fee, and thoroughgoing collection of fine and 2% of house rental, etc.

c. The charge collected from dischargers shall be fixed according to the suggestion that the burden to the household should not surpass yearly 18 LE including the cost for plastic bags. On the other hand, the "beneficiaries-should-pay principle" shall be applied to the collection of waste discharged by business, commercial and other kinds of establishments.

The portion of foreign aid in the financial resource will be reduced.

3. Priority Project and Preliminary Design

3.1 Selection of Priority Project

The Feasibility Study is implemented for the three projects to improve the s.w.m. system in the Middle District, which is the city center of Alexandria. These improvements are expected to exert pervasive effects towards the whole city area and also anticipated to be the preferential plan by the Governorate of Alexandria.

(1) Collection, Haulage and Street Sweeping Improvement Project in the Middle District

The plan of the improvement project for collection, haulage and street sweeping systems is drawn up in conformity with the frame proposed in the Master Plan.
The waste collection, haulage and the street sweeping plan, in combination with the new Abis Compost Plant project and the sanitary landfilling project at MBSDS, will upgrade the cleansing service of the Middle District to a level close to the target established in the Master Plan and improve the environmental sanitation of the area.

This will show the Governorate of Alexandria the knowhow for implementing the project and the effect of the system proposed in the Master Plan, and also this will eventually lead to the development of the cleansing work throughout the city along the guidelines of the Master Plan.

(2) Sanitary Landfilling Project at MBSDS

The plan for implementing the sanitary landfilling at the MBSDS where wastes from the Middle, Gomrok and part of the West District are being disposed is drawn up.

The implementation of the sanitary landfilling at the MBSDS shall lead to the transfer of appropriate landfilling technology, which shall be the base of the waste disposal system to be adopted in Alexandria, and furthermore it is in breaking the deadlock related to securing future disposal sites, which, as a matter of fact, is partly brought about by the open dumping without a thoroughgoing control being implemented so far in the city, and in particular it is considered that the sanitary landfilling scheme can be a indispensable countermeasure for attaining the consent of the relevant authorities for securing future disposal sites in the Green Belt proposed in the Master Plan.

The Master Plan proposes securing eastern and western disposal sites in the Green Belt located within 20 km distance from the city center, but in reality the implementation of the Plan 2005, which is the superior plan of this project, is behind schedule. Such being the case, the quarry site in Ameriyah District is regarded as the most prospective site for the disposal site after finishing the landfill operation at the MBSDS, although efforts are still being made to secure appropriate sites in the Green Belt. Therefore, the sanitary landfilling at the quarry site shall be taken into consideration in this study.

(3) New Abis Compost Plant Construction Project

The construction of the New Abis compost plant will bring about effective utilization of wastes as well as reduction of waste amount. Also, if the compost could be produced stably with satisfaction of the customers as to its quality and quantity, the composting scheme would consolidate its positive evaluation from the standpoint of the national economy, including the possibility of opening the way for establishing a subsidy system on the national level. Such being the case, this composting plant should be regarded as an important project in view of its multifarious potentialities.

As can be seen, the composting project is expected to develop the resource recovery and effective utilization of waste in the s.w.m. of Alexandria in the long-run.

The new plant capacity is determined on the basis of the following:

a. Compost demand in the Alexandria Governorate at present exceeds the amount produced in the 460 t/d compost plant, and the demand in 2005 of all agricultural lands within the area is estimated to reach 660 t/d in consideration of the amount of all other organic fertilizers available within the area.

b. Since the construction of the compost plant should conform to the policy of realizing the establishment of an independent financial base for the cleansing service in Alexandria, the introduction of new plant shall be limited to one plant while the financial base is still immature.

c. The site area for the new compost plant arranged by the Alexandria Governorate adjoins to the existing plant and the area can allow the construction of the plant of 250 to 350 t/d in capacity.

d. 300 t/d is the desired capacity of the plant by the authorities of the Alexandria Governorate.

e. Since the construction site for the new plant is located near the Middle District, the plant will be used primarily to treat waste generated in that district. Accordingly, if the scale of the plant is set at 300 t/d, then when combined with the 160 t/d capacity of the existing plant, the resulting capacity will be 460 t/d. This figure is adequate to meet the treatment needs of the Middle District in 1990.

In consideration of the foregoing five items, it is recommended to construct a compost plant with a capacity of 300 t/d for treating waste primarily generated in the Middle District.

3.2 Collection, Haulage and Street Sweeping Services

(1) Objectives of the Project

The project for improving the collection, haulage and street sweeping services consists of the following three components.

- Establishment of new waste collection system
- Construction of transfer station
- Reorganization of street sweeping system

Furthermore, the waste collection system shall be changed to the single shift system, and the equipment maintenance system shall be improved, so as to attain a high operation rate for the collection vehicles.

(2) Establishment of Collection and Haulage System

The collection system shall be established in accordance with the following scheme in consideration of the characteristics of the various areas and waste sources concerned.

a. Residential Area

Waste packed in plastic bags shall be discharged at the collection points within the specific time, then the discharged waste shall be collected by the middle-sized compactor vehicles.

b. City Center

Waste packed in plastic bags shall be discharged by the entrances of the buildings within the specific time, and the discharged waste shall be collected by lightweight collection vehicles then reloaded to middle-sized compactor vehicles for haulage.

c. Markets

Waste collection at markets shall be carried out by middle-sized compactor vehicles, separately from ordinary residential areas and from the City Center.

d. Other Specific Facilities

Communal containers shall be installed at special facilities such as schools, hospitals, stations, etc., and the waste collection shall be done by using container vehicles (Truxmore).

e. Beaches

Summer vacationers' waste at the beaches shall be collected with special collection vehicles equipped with crane.

The new waste collection system shall be implemented in steps by dividing the Middle District in two parts, north and south, with the implementation in the northern side to be finished by 1990 and in the southern side to be finished between 1991 and 1995. In the low-income areas, however, the new system shall be applied by 2000.

(3) Transfer Station

Transfer station with the capacity of 480 t/5hr shall be constructed for long distance haulage after finishing the landfilling operation at MBSDS. The transfer station is to be constructed adjacent to the Abis Compost Plant.

(4) Reorganization of the Street Sweeping System

The current street sweeping service intermingled with waste collection service shall be improved, and the street sweeping system shall be reorganized based on the following scheme.

a. Main Streets and Secondary Streets in the City Center

Sweeping service in the main streets and in the secondary streets of the City Center shall be carried out 1 to 3 times a day by the sweepers using brooms and 2-barrel type hand carts that are currently used in part of the city. Waste collected by the sweepers shall be reloaded to small-sized dump trucks for haulage.

b. Streets in Residential Areas

Sweeping services in residential areas shall be carried out by 1 to 3 times a week, and the sweeper shall be assigned the street predetermined for each day of the week by the same manner mentioned above.

The reorganization of the street sweeping system shall be carried out in steps, concurrently with the implementation of the new waste collection system, i.e., by 1990 in the northern side and between 1991 and 1995 in the southern side of the Middle District.

(5) Procurement of Materials and Equipments

The materials and equipment required for implementing the improvement project shall be procured in conformity with the scheme shown in Table 3-1. The project shall be implemented by dividing it in two stages, first stage by 1990 and second stage thereafter.

Table 3-1 PROCUREMENT OF MATERIALS AND EQUIPMENT

(units)

Waste Collection	1st Stage (- 1990)	2nd Stage (1991 - 2000)
Compactors	24	41
Container vehicles	2	2
Lightweight Collection vehicles	11	4
Special vehicles	1	0
Total	38	47
Containers	40	55

Transfer Station	1st Stage (- 1990)	2nd Stage (1991 - 2000)
Transfer station	1	-
Truck tractors	11	1
Semi-trailers	11	1
Wheel loaders	4	1
Large-sized dump trucks	6	1

Street Sweeping	1st Stage (- 1990)	2nd Stage (1991 - 2000)
Two-barrel hand carts	191	113
Small-sized dump trucks	3	2

(6) Operation and Administration Plan

The personnel required in connection with the improvement of the waste collection, haulage and street sweeping services in the Middle District will amount to 706 persons in 1990 and 786 in 2000.
Furthermore, the transfer station will require 43 persons in 1990 and 49 by the year 2000.
The materials and equipments to be procured consist mostly of collection vehicles which requires periodic replacement due to its service life as shown in Table 3-2.

Table 3-2 EQUIPMENT REPLACEMENT PLAN

Equipment	1986-1990	1991-1995	1996-2000
Collection vehicle			
Compactor vehicle	0	24	48
Container vehicle	9	6	4
Lightweight collection vehicle	0	11	13
Small-sized dump truck	8	0	0
Large-sized dump truck	11	0	0
Special vehicle	0	1	1
Total	28	42	66
Transfer Station			
Truck tractor	0	10	12
Semi-trailer	0	10	12
Wheel loader	0	4	5
Large-sized dump truck	0	6	7
Total	0	30	36
Street Sweeping			
Small-sized dump truck	0	3	5
Mechanical sweeper	1	1	1
Hand cart	89	191	304
Total	90	195	310
Container	167	40	84

(7) Project Cost

The project cost required for improving the collection system is shown in Table 3-3. The first stage of this project, including transfer station, requires 5,150,000 LE, and the second stage requires 2,889,000 LE.

Table 3-3 INVESTMENT COST FOR THE IMPROVEMENT OF WASTE COLLECTION, HAULAGE AND STREET SWEEPING SERVICES

(1,000 LE)

	1st Stage			2nd Stage		
	Foreign	Local	Total	Foreign	Local	Total
Waste Collection, and street sweeping	1,575	39	1,614	2,467	33	2,500
Transfer station						
-facilities	382	671	1,053	-	-	-
-vehicles	2,136	-	2,136	263	-	263
Sub total	4,093	710	4,803	2,730	33	2,763
Engineering services	195	49	244	124	2	126
Physical contingency	41	62	103	-	-	-
Total	4,329	821	5,150	2,854	35	2,889

The O/M costs including depreciation for the waste collection and haulage service requires 1,274,000 LE/year in 1990 and 1,690,000 LE/year in 2000, while the street sweeping service requires 444,000 LE/year and 390,000 LE/year, respectively. Also, the transfer station costs 749,000 LE/year in 1990 and 854,000 LE/year in 2000, respectively as shown in Table 3-4.

Table 3-4 OPERATION AND MAINTENANCE COST

(1,000 LE/year)

	1990	2000
Waste collection and haulage	1,274	1,690
Street sweeping	444	390
Transfer station and haulage	749	854
Total	2,467	2,934

(Note: Including depreciation cost)

3.3 Sanitary Landfilling at MBSDS

(1) Planned Disposal Amount and Landfilling Period

The areas subject for waste disposing of are the Middle, Gomrok and part of the West District. The total amount of waste discharged from these areas until the end of 1990 is expected to amount to 1,140,000 ton or 1,540,000 m^3.

Since the landfilling capacity where sanitary landfilling is planned is 920,000 m^3, landfilling operation is available from January 1988 to October 1990.

(2) Basic Measure

Environmental pollution in adjacent areas shall be eliminated by carrying out the sanitary landfilling. In particular, sanitary landfilling will be effective in preventing contamination in the drinking water canal and securing the safety of aircrafts approaching and taking off from the El Nozha Airport.

(3) Design of Facilities

The layout plan is shown in Fig. 3-1 consisting of the facilities listed below.

- Stock yard for cover soil
- Site access road
- Leachate treatment facilities (pump station, leachate regulating pond, etc.)
- Office building
- Weigh bridge
- Fences (around the site)
- Gas removal facilities

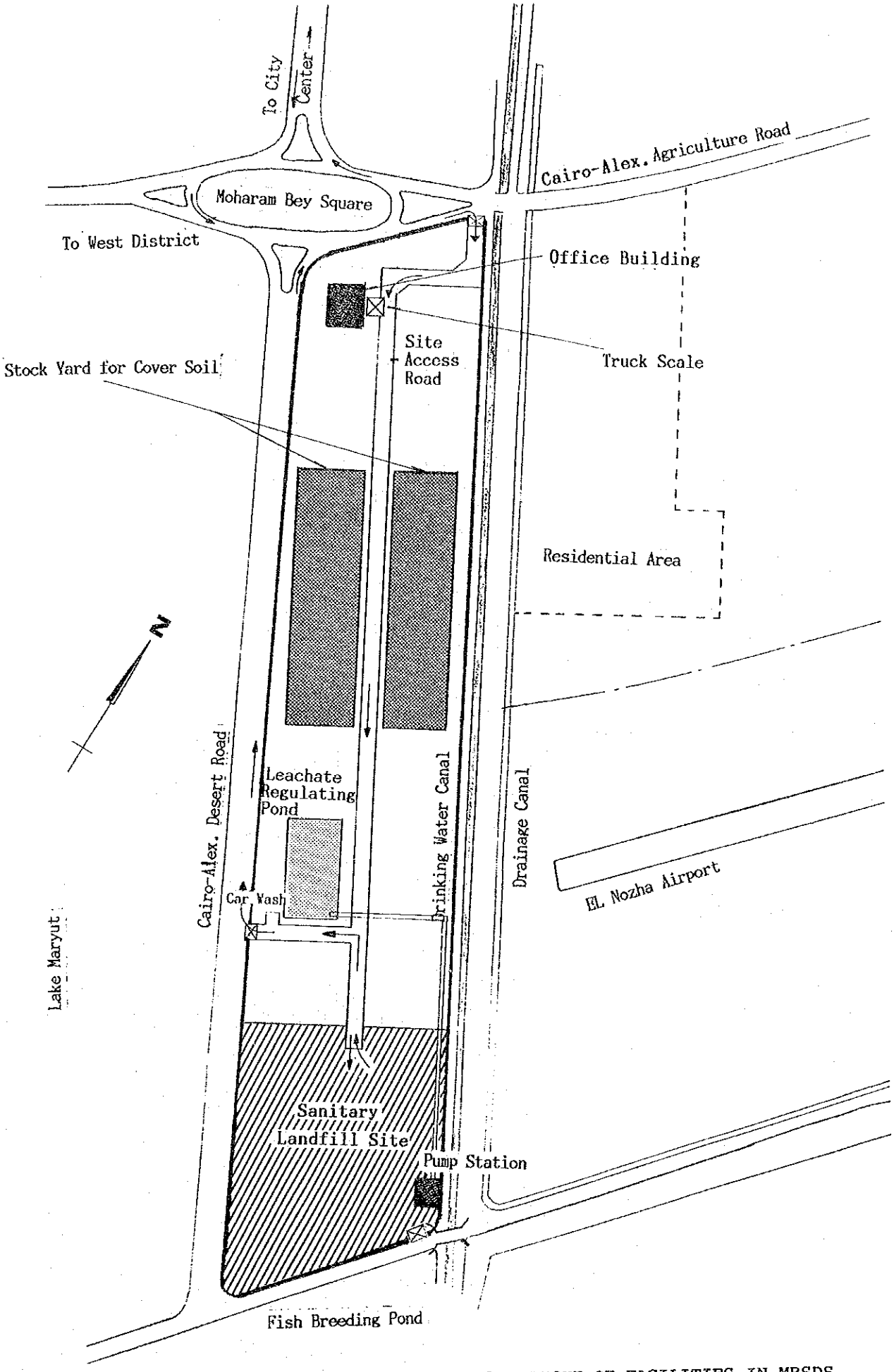


Fig. 3-1 LAYOUT OF FACILITIES IN MBSDS

(4) Landfilling Plan

The sanitary landfilling shall be carried out in 2 layers by cell landfill method. Daily and intermediate cover should have 15 cm or more in thickness, and the final cover should have at least 50 cm thickness. The required quantity of 450,000 m^3 for covering should be secured by excavating the bottom of the disposal site.
Following equipments are required to execute the sanitary landfilling.

- Landfill compactor, 20-ton class : 2 units
- Back-hoe, 0.7 m^3 class : 1 unit
- Dump truck, 11-ton class : 2 units
- Bulldozer (for swamp use), 14-ton class : 1 unit
- Motor sprinkler, 10 m^3 : 1 unit

(5) Operation and Administration Plan

Operation and administration of the disposal site are carried out by the following scheme.

- Operating hours : 12-hours, from 6:00 to 18:00
- Shift system : 2 shifts
- Required personnel : 28 persons

(6) Project Cost

The project cost consists of the facilities construction and purchasing the equipments as shown in Table 3-5, and amount to 4,075,000 LE in total.

Table 3-5 INVESTMENT COST OF THE PROJECT FOR SANITARY LANDFILL AT MBSDS

(1000 LE)

Item	Foreign	Local	Total
Facilities Construction	738	1,735	2,473
Equipments	1,126	-	1,126
Engineering Services	160	69	229
Sub Total	2,024	1,804	3,828
Physical Contingency	74	173	247
Total	2,098	1,977	4,075

The operation and maintenance cost amount to 187,000 LE/year. When the depreciation costs of the facilities and equipments is considered it amounts to 1,413,000 LE/year.

3.4 New Abis Compost Plant

(1) Scale of the Facilities

The scale of the facilities composing the New Abis Compost Plant are as follows.

- Capacity : 300 t/d
- Working hours : 16 hr/d (14 hr/d for waste feeding)
- Working days : 300 d/year
- Site area : 6 ha
- Location : Beside the existing Abis Compost Plant

(2) Process Flow

The compost plant consists of the reception process with shovel loaders, the pre-treatment by selective pulverizing classifire and the fermentation process by windrow. The hand picking and post-refining processes are also added for complete functioning as composting process.

(3) Material Balance

Conversion of 300 t/d of waste with the composition predicted for 2000 to produce 72.9 t/d of compost and 21 t/d of reusable materials. The amount of rejects from the process amount to 119.4 t/d.

(4) Design of Facilities

Layout plan is shown in Fig. 3-2 consisting of the facilities listed below.

- Waste reception facilities (weigh bridge and storage)
- Pre-treatment facilities (hand sorting facilities, pulverizers, etc.)

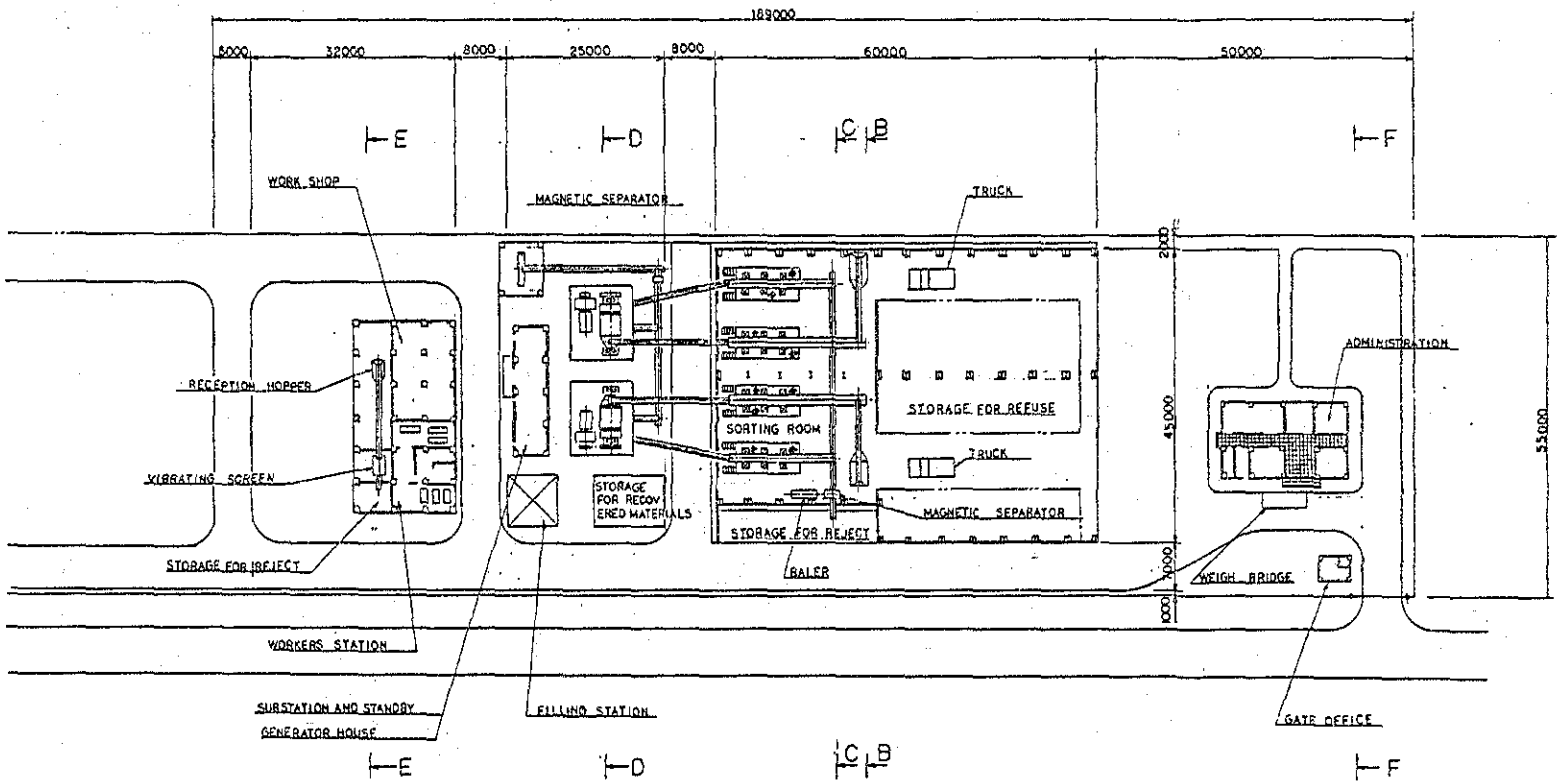


Fig. 3-2 LAYOUT OF NEW ABIS COMPOST PLANT

- Fermentation yard
- Refining facilities (vibrating screen)
- Standby generator
- Administration office, etc.

(5) Operation and Maintenance Plan

The operation and staffing plan of the New Abis Compost Plant are followings:

- Annual operation days : 300 days
- Daily operation hours : 16 hours, from 7:00 to 23:00
- Operation system : 2 shifts
- Personnel : 105 persons in total

(6) Project Cost

The project investment cost consists of the construction cost of the facilities, purchase cost of materials and equipments, etc. Total project investment cost excluding price contingency amounts to 14,051,000 LE as shown in Table 3-6.

Table 3-6 INVESTMENT COST OF THE PROJECT FOR NEW ABIS COMPOST PLANT

(1000 LE)

Item	Foreign	Local	Total
Construction cost of facilities	7,398	3,436	10,834
Purchase cost of materials and equipments	896	-	896
Engineering services	776	353	1,129
Sub Total	9,070	3,789	12,859
Physical contingency	814	378	1,192
Total	9,884	4,167	14,051

Operation and maintenance cost amounts to 583,000 LE/year. If the depreciation costs of the facilities and the equipments are considered, the cost amounts to 1,474,000 LE/year.

4. Project Evaluation

4.1 Framework of Evaluation

The undermentioned basic measures are adopted for the project evaluation, in view of the specific characteristics of the s.w.m.

(1) Basic Measures

a. The projects are financially evaluated based on the financial capacity of Alexandria.

b. The least cost method is applied for the evaluation and examination of the projects.

c. In the economic evaluation, qualitative analysis using consolidated indices of various elements is adopted. Also the calculation of economic benefits for the compost application is made when possible.

(2) Methods of the Economic Evaluation

The undermentioned steps are adopted for the economic evaluation of the project.

a. The effects of improvements in the waste collection service and execution of sanitary landfilling are evaluated by qualitative analysis.

b. The effects of the compost plant are evaluated not only by qualitative analysis, but also by quantitative analysis.

c. As for the benefits and expenditures of the compost plant, only the quantifiable ones are calculated.

d. The project is regarded as feasible from the viewpoint of economic evaluation when the benefit/cost ratio equals or exceeds one.

(3) Method of the Financial Evaluation

The projects shall be integrated into one, comprising waste collection, treatment and disposal, although each project has distinct target areas.

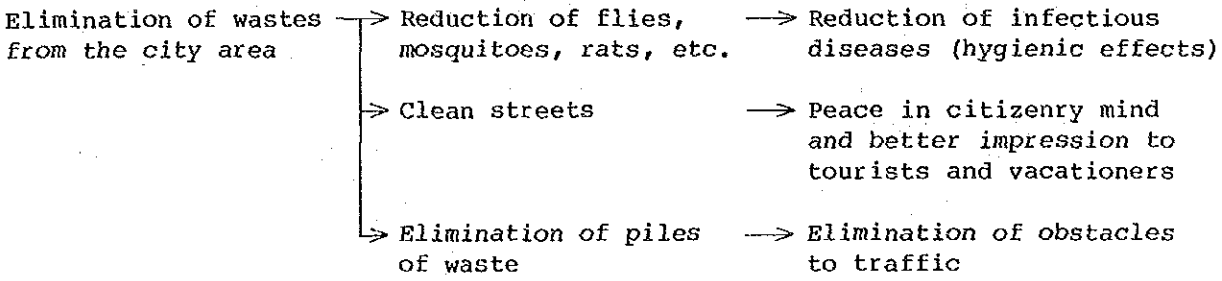
Therefore, this study divides the projects into two parts for independent financial evaluations. And subsequently the comprehensive project is evaluated examining the balance between the revenue and expenditure expected for the Middle Distrct.

4.2 Evaluation of Waste Collection and Final Disposal Improvement Project

(1) Effects of the Waste Collection Service Improvement Project

Needless to say the aims of the cleansing service in urban areas are to collect and eliminate as soon as possible the waste generated as a result of the daily urban life and to preserve and improve the public health and environment.

The waste collection service brings about the undermentioned contents.



And consequently a comfortable living environment is secured.

Of course up to now, efforts have been made to improve the waste collection service, but actually there are remaining areas where a satisfactory collection is difficult, and areas where a regular collection at fixed time is not being carried out, and further improvements are being required as a result.

The waste collection experiments carried out during the course of this study indicate that substantial efficiency improvement can be obtained through the implementation of collection at fixed time using plastic bags. Furthermore, the combined collection system should be introduced in conformity with the characteristics of each area, and door-to-door collection for the City Center using lightweight collection vehicles for narrow alleys is necessary.

It is presumed that careful implementation of the aforementioned scheme, including public relations efforts that will change popular consciousness of environment and sanitation, will result in further increasing effects of the aforementioned waste collection service improvement project.

(2) Effects of the Waste Disposal Improvement Project

The subject of the highest priority regarding the waste disposal improvement project is the switching from the current open dumping to the sanitary landfilling to realize the preservation and improvement of the public health and environment. In other words, the sanitary landfilling, by cell method with earth cover shall make it possible to store the waste without baneful influence to environment with subsequent volume reduction, decomposition and stabilization through the metabolic function of the nature.

Environmental pollution in the adjacent areas which used to occur using the conventional open dumping system, and the resulting difficulty for securing new disposal sites, can be solved through the impiementation of the sanitary landfilling system.

The waste disposal improvement project at MBSDS has the purpose of consolidating appropriate technologies regarding sanitary landfilling, which is expected to become the basic scheme for the waste disposal in Alexandria. Concurrently the project shall make it possible to transfer the technologies to other landfilling sites.
Furthermore, positive effects can be expected as underlisted.

a. The disposal site is located at the closest distance from the city center of Alexandria, and it can minimize the costs of the waste collection and haulage through an effective operation of the collection vehicle and so on.

b. The introduction of the sanitary landfilling at MBSDS adjacent to the airport will contribute to securing the safety of the aircrafts by minimizing the flocks of birds and open burning of wastes.

c. Leachate shall be prevented from infiltrating in the adjacent drinking water canal by laying filters between the disposal site and the canal, so as to collect and drain the leachates.

d. Such problems as scattered waste, spontaneous combustion, bad smell, breeding of rats and insects, etc., can be avoided by the sanitary landfilling.

e. The introduction of the sanitary landfilling contributes to the upkeep and maintenance of the landscape at the gateway of Alexandria.

f. Furthermore, the installation will bring about the underlisted positive collateral effects.

- Safety of the site will be guaranteed through the prompt removal and dispersion of the generated gases.

- Safety of the landfilling work will be guaranteed by preventing the access of scavengers into the site.

- Working conditions of the site will be improved.

- Access of specific noxious materials will be restricted by inspecting the hauled wastes at the entrance of the site.

g. Effects related to the future utilization of the completed disposal site. The implementation of the sanitary landfilling in the site, which is currently a swamp, makes it possible to utilize land resources effectively. Therefore an orderly development of the city is promoted through an appropriate combination of the disposal site plan with the regional and the urban planning.

(3) Financial Evaluation

The waste collection and disposal improvement project, which is expected to bring about the aforementioned effects, is evaluated as follows from the financial standpoint, within the conventional budget and the revenue from the reinforced charge collection.

The total revenue of the s.w.m. in the Middle District amounts to approximately 1,900,000 LE, and the portion of charge collection accounts for only 16%. On the other hand, the revenue is expected to be raised to 3,300,000 LE in 1990 and 4,000,000 LE in 2000 as a result of the reinforced charge collection and other relevant measures as shown in Table 4-1.

The expenditure, excluding depreciation, required for the waste collection and disposal services is expected to amount to 1,700,000 LE in 1990 and 2,000,000 LE in the year 2000. The above mentioned revenue can fully meet these expenditures. On the other hand, the financial evaluation taking account of the depreciation is explained in the followings.

a. If the depreciation of the facilities for the disposal site and the transfer station is borne by the Middle District in correspondence to the portion of the waste amount generated in the Middle District, the project will have a surplus of 200,000 LE in 1990, when the sanitary landfilling at MBSDS will finish, and in 2000 it will result in a surplus of 900,000 LE.

b. If the total depreciation of the facilities including MBSDS and the transfer station is borne by the Middle District, the project would result in a deficit of 400,000 LE in 1990. That being so, the depreciation of the facilities shall be borne by other districts as well, proportionally to the amount of waste to be hauled therein. After finishing the landfilling operation at MBSDS however, the project would result into some margin of surplus even in this case.

Table 4-1 BALANCE OF THE IMPROVEMENT PROJECT

(1,000 LE)

	1985	1990		2000	
		Case 1	Case 2	Case 1	Case 2
Revenue					
Wages	666	815	815	868	868
Chapter 3	714	707	707	352	352
Cleansing fund	209	212	212	217	217
Resident	125	125	690	125	992
Business establishment	175	175	860	175	1,584
Total (A)	1,889	2,034	3,284	1,737	4,013
Expenditure					
Personnel	1,015	1,281	1,281	1,415	1,415
Maintenance	225	307	307	384	384
Fuel	59	136	136	173	173
Others	10	14	14	11	11
Sub-total	1,309	1,738	1,738	1,983	1,983
Depreciation					
- Vehicles	387	486 (486)	486 (486)	640 (640)	640 (640)
- Transfer station	-	388 (226)	388 (226)	434 (254)	434 (254)
- Final disposal	-	1,072 (626)	1,072 (626)	327 (192)	327 (192)
Sub-total	387	1,946 (1,338)	1,946 (1,338)	1,401 (1,086)	1,401 (1,086)
Total (B) (B')	1,696 (1,696)	3,684 (3,076)	3,684 (3,076)	3,384 (3,069)	3,384 (3,069)
Balance (A-B) (A-B')	193 (193)	-1,650 (-1,042)	-400 (208)	-1,647 (-1,332)	629 (944)

Note: case 1 means no-improvement of charging system

: case 2 means improvement of charging system

: ( ) means burden of Middle District in proportion of waste amount generated

Such being the case, it is concluded that the project is sufficiently feasible from the financial standpoint as well.

It should be taken into consideration however, that the project is feasible in the Middle District because it has a high population density, resulting into an efficient collection service, and furthermore because the collection of charges for commercial wastes is easy due to the concentration of commercial and business establishments. Inversely, this financial condition can not be regarded as necessarily applicable to the other districts.

4.3 Evaluation of the New Abis Compost Plant

(1) Economic Evaluation

a. Conditions of Evaluation

The economic evaluation of the Compost Plant construction is carried out on the following conditions. Moreover, qualitative benefits in terms of social and economic viewpoints are pointed out as follow:

- Since the destination of collection vehicles is fixed for hauling waste during long range by the construction of compost plant, stable services of collection and haulage can be easily maintained.

- More effective landuse is expected due to minimization of landfill site through reduction of waste amount

- It is expected for personnel to develop their technical and managerial skill through on the job training at the compost plant. Citizenry consciousness as to resource saving will increase through demonstration of resource recycling at compost plant.

i) Items for the benefits

- Increase in the crop yield
- Saving of chemical fertilizers
- Saving of irrigation water
- Recycling of reusable materials
- Saving of waste haulage cost due to the reduction of the waste amount to be disposed of
- Saving of waste disposal cost due to the reduction of the waste amount to be disposed of

ii) Items for the costs

- Compost plant construction cost
- Vehicle purchase cost (including reject haulage vehicles)

- Compost haulage vehicle
- Plant O/M cost (including reject haulage)
- Compost haulage O/M cost

iii) Project life: 15 years

iv) The final disposal sites are assumed to be used during the undermentioned periods.

	1985	1990	1995	2000	2005
MBSDS					
Quarry site (35 km from the Middle District)					

b. Benefits

i) Increase in the crop yield

- Object of the benefit
  Additional harvest of wheat, tomato and grape cultivated in Alexandria, resulting from the compost application.
- Yield increase rate : 30%
- Amount of the benefit : 1,395,000 LE/year

ii) Saving of chemical fertilizers

- Object of the benefit
  Decreased chemical fertilizers equivalent to the nutrients of the compost.
- Amount of the benefit : 273,000 LE/year

iii) Saving of irrigation water

- Object of the benefit
  Saving of irrigation canal construction and maintenance cost resulting from saving irrigation water.
- Amount of the benefit : 213,000 LE/year

iv) Recycling of reusable materials

- Object of the benefit
  Recycled reusable materials
- Recycling rate
  1990 4.45%
  2000 6.92%
- Amount of the benefit:
  1990 140,000 LE/year
  2000 168,000 LE/year

v) Saving of waste haulage cost

- Object of the benefit
  Saving of haulage cost to the disposal site due to the reduction of waste amount
- Amount of the benefit : 166,000 LE/year

vi) Saving of the disposal cost

- Object of the benefit
  Saving of disposal cost due to the reduction of waste amount
- Amount of the benefit :
  1990 123,000 LE/year
  2000 96,000 LE/year

c. Cost

- Compost plant construction cost	13,108,000 LE
- Vehicle purchase cost	941,000 LE
- Compost haulage vehicle purchase cost	120,000 LE
- Plant O/M cost	582,000 LE/year
- Compost haulage O/M cost	61,000 LE/year

d. Benefit/Cost Ratio

The total amount of the benefits with 0% discount rate during the 15 years of the project life is 31,731,000 LE, and the total cost is 25,936,000 LE, resulting into a B/C ratio of 1.22.

And the EIRR (Economic Internal Rate of Return) of the project is 4.4%.

e. Sensitivity Analysis

The results of the sensitivity analysis carried out by taking into account the crop yield increase rate, the construction and O/M cost of the compost plant, which are the most important factors related to the costs and benefits of the project, are shown in Table 4-2.

Table 4-2 SENSITIVITY ANALYSIS RELATED TO THE ECONOMIC EVALUATION OF THE COMPOST PLANT

	FLUCTUATION RATE	EIRR
Crop yield increase rate	+33%	8.9
	±0%	4.4
	-20%	1.3
Plant construction cost	+33%	0.9
	0%	4.4
	-33%	10.1
Plant O/M cost	+33%	2.3
	0%	4.4
	-33%	6.4

f. Economic Evaluation and Feasibility of the Project

When the EIRR is 4.4%, it is relatively difficult to avoid shifting of the implementation priority to other projects with higher EIRR because the opportunity cost of the capital is rather low from the common sense of project evaluation. In some case, however, the result of the sensitivity analysis indicates EIRR reaching to 10.1%.

Waste treatment facilities are part of the infrastructure for environmental conservation, and they are public facilities that should not be operated with the purpose of making profits. Moreover, these facilities are aimed at the treatment of waste which becomes unnecessary in the living circumstances. So it is unreasonable to expect benefit in the project evaluation based on waste.

That being so, if the implementation of any project referring to the development of public facilities related to basic human needs (BHN), such as waste treatment plants, should bring about any benefit or if the B/C of the project should be equal to or larger than 1.00, the project should be approved.

The fact that the B/C is 1.02 with a discount rate of 4.0% can be interpreted that when the project is carried out by using a loan with 4% interest, it brings about 2% of profit in terms of economic benefit. Therefore, if the project in question should be implemented by introducing loans whose annual interest rates do not surpass approximately 4%, the implementation of the project would be regarded as feasible from the economic evaluation, by taking into consideration the special characteristics of the BHN-type projects.

(2) Financial Analysis

a. Premises of the Financial Evaluation

i) The plant is assumed to operate 300 days per year.

ii) The personnel taken into consideration in this study consist of 105 workers (including the 16 administrative staff dealing with both new and existing plants).

iii) The income sources consist of the compost and reusable materials selling profits and the basic wage subsidy.

The compost selling price is assumed to be 9 LE/t, by taking into consideration the price of the fine compost of the existing Abis Plant.

As for the reusable materials, it is assumed that they will bring about a selling income of 1.87 LE/t of waste in 2000.

b. Evaluation Results

The financial balance of the New Abis Compost Plant is shown in Table 4-3. As can be seen, there is a deficit even when the depreciation is excluded.

From the standpoint of the chemical composition of the compost, it is presumed to become practically equivalent to chemical fertilizers at a price of 14 LE/t, and in this case the project would almost balance without considering facilities and equipment depreciation.

However, if the repayment is taken into account, it will be impossible to repay by the selling profit of the compost that is sold at 9 to 14 LE/t because the annual repayment amounts to 1,167,000 LE under the condition of 4% interest loan with 15-year repayment.

Furthermore, the annual repayment amounts to 382,000 LE for only the foreign portion of the loan under the condition of 5-year grace period and 20-year repayment with 4% interest. Therefore it is impossible even to make the repayment of foreign loan by relying exclusively on the compost plant operation.

As can be seen, it is unavoidable to conclude that the compost plant construction project is unfeasible from the standpoint of the financial evaluation. The project will become feasible only when a special subsidy is provided from the standpoint of farming promotion or when the required costs are borne as an integral part of the s.w.m. system.

Table 4-3 BALANCE OF NEW ABIS COMPOST PLANT

(1000 LE)

Item	Amount	Remarks
Revenue		
Basic wages	96	105 persons
Selling income		
- Compost	203	Fine compost 9 LE/t
- Reusable materials	169	
Total (A)	468	
Expenditure		
Personnel	177	
Utilities		
- Electricity	81	1,680 MWH/year
- Water	5	36,000 m^3
- Fuel	110	363 kl for vehicle and 180 kl for machinery
Maintenance	209	2% of machinery cost and 12% of vehicle cost
Total (B)	582	
Balance (A-B)	-114	
Depreciation (D)	891	
Cost including depreciation (E)=(B)+(D)	1,473	
Balance (A-E)	-1,005	
Interest (F)	382	4% interest for foreign portion with 20 years redemption after 5 years
Total cost including interest (G=E+F)	1,855	
Balance (A-G)	-1,387	

4.4 Overall Financial Evaluation

(1) Conditions of the Financial Evaluation

The financial evaluation consists of examining and evaluating the possibility of consolidating independent financial resources by 2000 through the improvement of the charge collection in the Middle District.

Two criteria are defined for evaluating the prospect of consolidating financial resources.

Generally, it is recognized that the depreciation cost is considered for evaluating the establishment of the self-supporting financing in the s.w.m. However, in connection with this project, the self-supporting financing is defined as the realization of the following conditions.

a. Possibility for annual repayment of the foreign loan under the condition of 4% interest, 5-year grace period and 20-year repayment.

b. Gradual reducing of the grant for purchase of collection vehicles, down to zero in 2000.
   In other words, the financial evaluation of the project is carried out on the premise of liberation from the reliance on foreign aid, securing the continuity of the cleansing operation by using exclusively self financial resources.

As shown in Table 4-4, required total investment cost of three projects is 23,285,000 LE (16,310,600 LE in foreign portion) by 1990, and total investment cost including second step investment for collection vehicles is 26,225,800 LE (19,165,400 LE in foreign portion).

Meanwhile, the area to be covered by this project is a composite one, and it is not reasonable to put the totality of the burden on the back of the Middle District. Therefore, this project is evaluated on the premise of the undermentioned financial resources and cost sharing scheme.

a. The basic wage provided by the Central Government is assumed to increase corresponding to the personnel increase required for the implementation of the project.

b. The Middle District's share of the Cleansing Fund is assumed to increase proportionally to the population growth in the district.

c. As for the Chapter 3 of the Governorate budget, which composes the investment financial resources, a half of its sum relying upon the foreign grants will go down to zero and remaining half is assumed to increase, but its total sum in 2000 is assumed to decrease to approximately a half of the sum corresponding to 1985.

d. As for the burden upon the citizens and business establishments, the charge collection shall be expanded in the 1985-1990 period. (The charge collection rate will be improved to 70% in 2000, with a burden of 1 LE/month for high-income households and 0.5 LE/month for low-income households).

e. As for the cost sharing, the Middle District shall bear the totality of its waste collection and street sweeping cost, and the cost of other projects shall be borne in proportion to the discharged waste amount by the respective district.

f. Foreign currency loans are assumed to cost an annual interest rate of 4%, and short-term loans are assumed to cost 5% interest rate, which is the same as in other state-run enterprises.

Table 4-4 TOTAL COST OF THE PROJECTS

(1000 LE)

	First Stage			Second Stage			Total		
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
Col./Sweep	4,093.0	709.9	4,802.9	2,730.7	32.8	2,763.5	6,823.7	742.7	7,566.4
Disposal	1,864.0	1,735.0	3,599.0	0.0	0.0	0.0	1,864.0	1,735.0	3,599.0
New Abis	8,294.0	3,436.3	11,730.3	0.0	0.0	0.0	8,294.0	3,436.3	11,730.3
Sub total	14,251.0	5,881.2	20,132.2	2,730.7	32.8	2,763.5	16,981.7	5,914.0	22,895.7
Eng. Service	1,131.0	470.4	1,601.4	124.1	1.5	125.6	1,255.1	474.1	1,727.0
Phy. Contin.	928.6	622.8	1,551.4	0.0	0.0	0.0	928.6	622.8	1,551.4
Total	16,310.6	6,974.4	23,285.0	2,854.8	34.3	2,889.1	19,165.4	7,008.7	26,174.1
Price Contin.	836.1	1,437.7	2,273.8	71.4	7.7	79.1	907.5	1,445.4	2,352.9

(2) Finanical Evaluation

The cash flow of the project is shown in Fig. 4-1, and its financial evaluation is summarized as follows:

a. A considerable shortage of funds will occur in 1990, 1995 and 2000, when the collection vehicles will be renovated, and in 1987 when the MBSDS will be constructed. Shortage of funds will occur in other years as well, but it will mount to barely 10% of the revenue.

b. In 2000 there will be no cumulative short-term loan, and a repayment of 2,635,000 LE will be made in connection with foreign loans (26% repayment rate), and the financial performance of the project can be regarded as satisfactory.

Therefore, examining the three projects as a whole, it may safely be said that the project in question is feasible from the standpoint of its financial balance.

(3) Sensitivity Analysis

The sensitivity analysis is carried out on the construction cost, collection vehicles purchase cost, compost selling amount and price, foreign loan interest rate and charge collection rate.
Results of the sensitivity analysis indicate that the compost selling amount does not exert so much influence on the project feasibility, but inversely any change in the construction cost, collection vehicles purchase cost and charge collection rate exerts conspicuous influence on the project feasibility.

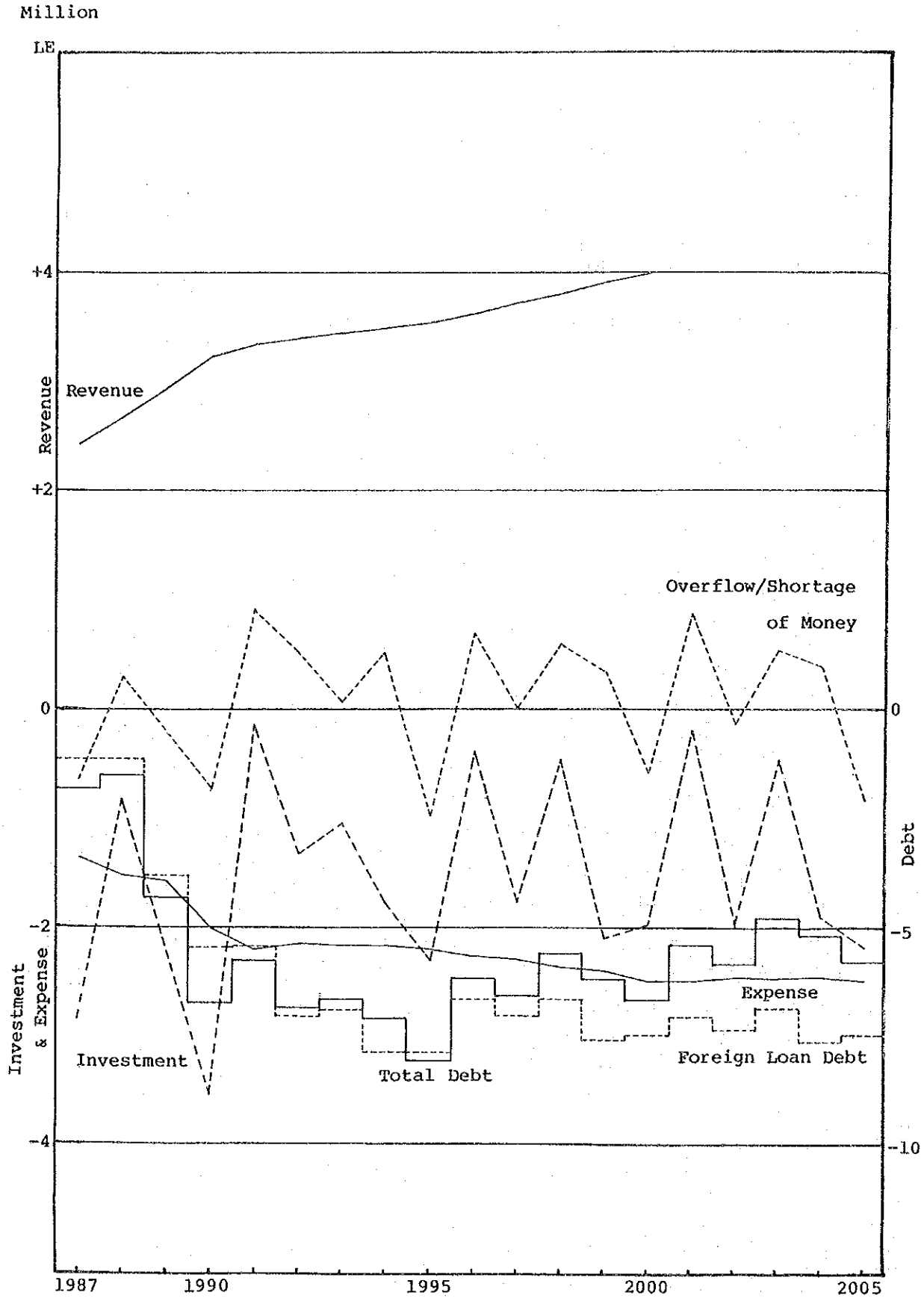


Fig. 4-1 MONEY FLOW OF THE PROJECT FOR MIDDLE DISTRICT

4.5 Conclusion

Following detailed consideration of the feasibility of implementing the s.w.m. improvement project in the selected Middle District, it has been determined that of three sub-projects comprising this project -- the collection project, the new Abis Compost Plant project and the sanitary landfilling project -- both the collection and sanitary landfilling projects are feasible in both technical and financial terms. On the other hand, if the new Abis Compost Plant were to be constructed independently, it would not be financially feasible even though it may be technically and economically feasible.

Nevertheless, the solid waste improvement project which includes all three of these projects would be financially feasible owing to the expanded financial resources to be derived through collection charges.

Financially, an investment of 26,000,000 LE including 19,200,000 LE in foreign currency, will be required for constructing facility and purchasing equipment relating to the improvement project, and operating expenses will increase nearly two-fold by the year 2000 to 2,500,000 LE.

On the other hand, the scale of financial resources will expand by 4,000,000 LE per annum -- 1.6 times greater than current collection, treatment and disposal management costs -- achieved through the introduction of a new collection fee system and increased income deriving from enhanced services made possible by improved collection.

A look at the cumulative funding situation through the year 200 reveals that while long-term loans reach 25,700,000 LE, repayment is made of 2,600,000 LE, or 10%. Capital surplus (internal reserve) therefore can be achieved in the amount of 1,600,000 LE, and this and other factors eliminate any worries of a financial nature.

Technically speaking, as the operating records of the existing compost plant indicate, the plant is not currently working at its planned capacity. However, it is believed that a recovery to the planned capacity can be achieved if part of the facilities are improved and personnel are trained. It may further be said that the outlook for the project's operation is very bright: e.g., the quality of the compost presently being produced clears Egyptian standards, sales exceed production, and the selling price of compost can be expected to rise in the future.

In the matter of reforming the management organization, which is indispensable to the stable operation of the project, already preparations are under way to establish a Cleansing Authority. It can be expected that organized planning, management, training, public relations work, etc. by this organization will become possible, and thereby contribute to the improvement of the operating base itself.

The following benefits can be expected through implementation of the project:

(1) Improvement in collection, transport and road sweeping

- By rapidly removing waste generated through urban activities from the urban area, the urban environment can be maintained and protected, and public sanitation can be improved.

- The enhancement of the urban environment through the above means can invite increased development of a tourist industry, which in turn can add vigor to the social and economic activities of Alexandria.

- Improvement in collection charges through enhanced collection services will lead to expansion in the project's financial resources. This in turn will enable a financial plan of outstanding self-sufficiency, including acquisition of labor through an independent supply system and allocation of required materials and equipment.

(2) Sanitary landfill project in Moharam Bey

- The project will protect the environment around the disposal site and improve public sanitation.

- By achieving early stabilization and eliminating the polluting effects of the disposed waste, various land uses become possible.

- Based on the above, the public consciousness of the nearby residents toward landfill can be improved, and this in turn will facilitate acquisition of disposal sites in the adjacent areas.

- The project will contribute to the safety of aricraft taking off and landing at El Nozha Airport, as well as to protection water quality in the water canal.

(3) Project introducing compost facilities

- Assuming capital investment at 4% interest per annum, net present value (NPV) of 448,000 LE can be expected during the project's 15-year lifetime.

- The composition of waste will become appropriate for landfill, thereby permitting land reuse within a short period after landfill has been completed.

- The above advantage will make it easier to acquire landfill sites in adjacent areas through temporary conversion of agricultural lands.

- Because the waste amount can be reduced through recycling of resources, the disposal site can be utilized for a longer period of time.

- If the quality of compost and its stable supply can be guaranteed, the market around Alexandria can be expanded and pricing can be improved, thereby enhancing the potential for introducing additional facilities.

- It is possible to improve the supply system through independent financial resources, thereby leading to expectations of an expansion in the employment market.

This completes the discussion on the project's feasibility and potential effects. Table 4-5 shows the cumulative sum of income revenue by the year 2000 to support the operation of the project. It is seen that the rate of dependency on collection charges is high at 49%; on the other hand, income from the compost project accounts for no greater than 2%, even including reusable products.

Table 4-5 CUMULATIVE INCOME BY FINANCIAL RESOURCE BY 2000

Resource	Income (1000 LE)	Percentage
Subsidies	12,423	24
Investment	9,288	18
Cleansing fund	3,413	7
Collection charges	25,255	49
Compost sales profit	590	1
Profit from reusable items	496	1
Total	51,465	100

In other words, the introduction and operation of the compost plant are feasible only when collection fees are included, based on the improvement of services through enhanced collection. It should be kept firmly in mind that the independent introduction of the compost project by itself is not feasible.

4.6 Economic and Financial Evaluation of the Alternative Compost Plant

It was concluded that even the compost plant, planned in Section 5.3 as object of this Feasibility Study, can be made perfectly feasible by improving the charge collection scheme. When the current economic and financial situation of Egypt is taken into consideration however, it is desirable to examine the economic and financial evaluation of the alternative with further cost saving in the construction and operation.

That being so, the economic and financial evaluation of a plant having practically the same specifications as that one of the IBRD project is carried out here. The conclusion of this evaluation are as follows:

a. Benefits mounting to LE 32,387 thousand are expected during the 15-year life cycle, and on the other hand the NPV (Net present value) (benefit-cost) will amount to LE 12,759 thousand.

b. The project has a high EIRR mounting to 11.9%, and therefore it can be regarded as high priority one from the standpoint of national economy.

c. The balance of incomes and expenditures before depreciation is improved, because the costs are cut down.

   It must be borne in mind however, that the income will be insufficient to cope with the depreciation cost and the interests, unless considerable amounts of subsidies are taken into consideration.

d. Internal reservations mounting to LE 9,030,000 can be expected also in the implementation plan, and therefore this project is regarded as perfectly feasible as long as satisfactory charge collection and financial resources of Budget Chapter 3 are secured.

Construction cost of this alternative is 9,960,830 LE and operation cost is 1,127,162 LE/year (450,230 LE/year excluding depreciation). These costs are approximately similar to the plant cost proposed by IBRD in the estimation based on the same conditions.

5. Implementation Plan

(1) Schedule

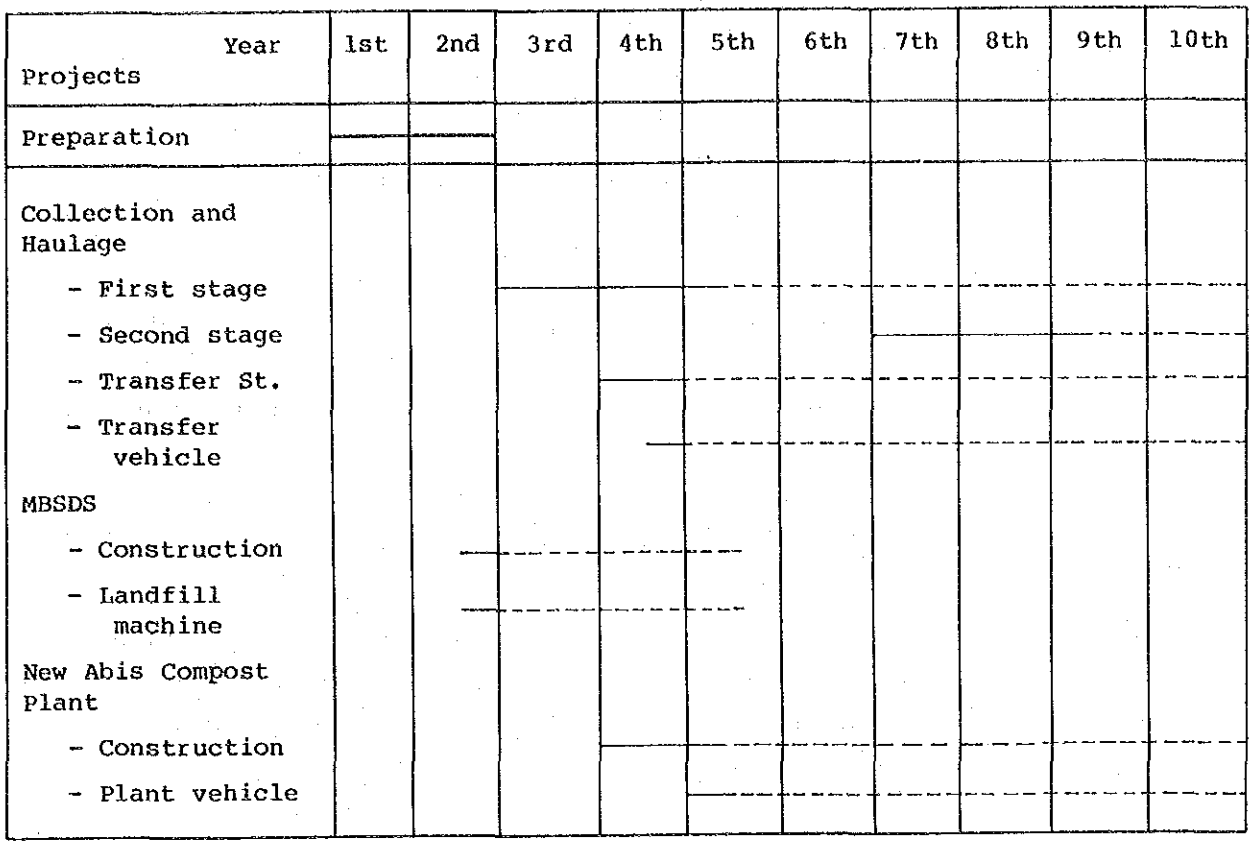
With the target year of 2000, the Collection Improvement Project will cover a longer period than the life of equipment. Therefore, the implementation shall be divided into two stages. The first stage of the project shall cover the 5-year period from present to 1990, during which the collection and haulage system in the northern area of the Middle District shall be improved and transfer station shall be constructed.

The MBSDS will be terminated and the New Abis Compost Plant will start its operation in 1990, as described below. Following the first stage, the second stage will commence in 1990 to improve the collection and haulage system in the southern area of the Middle District with the target year of 2000.

At present MBSDS is being landfilled by open dumping. It is an urgent task to switch to sanitary landfilling for environmental conservation in adjacent areas, and to introduce measures for the more effective use of this site for prolonging its life span as much as possible. For these requirements, it is necessary to implement this project at the earliest possible date.

The New Abis Compost Plant Construction Project shall be completed by 1990, the year when the MBSDS will be terminated, because one of the objective of the project is to lessen the increased haulage cost due to the remote location of the future disposal site. By the same reason, the transfer station shall also be constructed by 1990.

The implementation schedule is shown in Fig. 5-1.



Note: ——— Construction and procurement

------ Operation

Fig. 5-1 IMPLEMENTATION SCHEDULE

(2) Executive Agency

Although cleansing service in Alexandria has been managed by both the Governorate and ADS, the service will be transferred to unitary management by Cleansing Authority which will be newly organized.

Thus, this Cleansing Authority is expected to become the promoter of the projects in its implementation. Since those projects will become the first major project for the Cleansing Authority, a project division should be established in the Authority to manage the projects.

(3) Financial Plan

a. Basic Measure

On the premise of future switching to the Authority, the financial resources of the project should be secured as follows:

i) The basic wages should be paid every year by the Central Government, in correspondence to the number of personnel, but the incentives and the like should be paid with independent financial resources, by improving the charge collection.

ii) Charges, mounting to 1 LE/month for high-income household and 0.5 LE/month for low-income household, should be collected from the citizenry, and the collection rate should be improved to 70% or more in 2000. The charges corresponding to the s.w.m. cost shall be collected from commercial and business establishments as well.

iii) Selling profits of compost and reusable materials should be regarded as cash revenue.

iv) As for the purchase of collection vehicles, the relevant cost should be covered under the budget given in Chapter 3 alloted to the Middle District in correspondence to the waste amount and charge collection. As for the burden of other districts regarding the construction of the final disposal sites, compost plant, etc., to be used in common with other districts as well, they should be provided by the Central Government or the Alexandria Governorate, in the form of additional subsidy to the Chapter 3.

v) The foreign currency portion of the investment cost of the plant and facilities should be covered with 4% annual interest rate loans with 5-year grace period and 20-year repayment.

b. Investment costs and O/M cost

All investment costs and O/M cost for the three projects are taking into account as lump sum for analyzing the financial condition.
As for the short-term loans, they should be available at 5% annual interest rate, in the same way as in the case of other state-owned enterprises.

c. Money Flow and Problems

The money flow is shown in Table 5-1, and as can be seen, short-term loans will be required in 2000, but inversely, in cumulative terms the project in question is expected to result in internally retained surplus amounting to 3,600,000 LE. That sum added to the previously repayed portion amounts to 10,000,000 LE, indicates that the project will be able to repay approxi- mately 43% of the foreign loans.

The said fact can be interpreted as leading to the consolidation of independent financial resources.
But on the other hand, the project suffers the risk of falling in financial difficulties if the charge collection would be insufficient or if it would be impossible to secure financial resources for the compost and MBSDS project to be borne by other districts, as can be seen from the results of the sensitivity analysis.

Such being the case, further efforts of the authorities concerned are required for the successful implementation of those projects.

Table 5-1 MONEY FLOW OF THE PROJECTS

(1000 LE)

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Revenue																	
Resident	125	238	351	464	577	690	720	750	779	809	839	870	900	931	961	992	10,996
Company	175	297	419	542	664	786	847	908	970	1,031	1,092	1,163	1,234	1,306	1,377	1,448	14,259
Cleansing Fund	209	210	210	211	211	212	213	213	214	214	215	215	216	216	217	217	3,413
Budget Chapter 3 *1	714	713	2,423	710	6,691	6,169	668	1,125	730	1,466	1,179	620	943	416	1,441	1,020	27,028
Waged from Central Gov.	666	690	714	726	750	868	911	902	893	884	880	899	917	936	954	973	13,563
Composts	0	0	0	0	0	0	203	203	203	203	203	203	203	203	203	203	2,030
Recycle of Materials	0	0	0	0	0	70	144	149	153	158	162	166	171	175	180	184	1,712
Sub total (A)	1,889	2,148	4,117	2,653	8,893	8,795	3,706	4,250	3,942	4,765	4,570	4,136	4,584	4,183	5,333	5,037	73,001
Expense																	
Personnel	1,015	1,072	1,129	1,167	1,224	1,452	1,533	1,525	1,516	1,508	1,511	1,546	1,581	1,616	1,651	1,686	22,732
Maintenance	225	236	246	286	296	565	675	681	687	693	720	729	739	748	757	767	9,050
Fuel	59	61	63	88	90	191	250	252	256	258	262	266	270	275	279	283	3,203
Others	10	10	10	14	14	57	99	99	98	98	97	97	97	97	97	97	1,091
Interests	0	8	0	82	82	356	576	572	615	602	660	669	642	658	622	675	6,819
Sub total (B)	1,309	1,387	1,448	1,637	1,706	2,621	3,133	3,129	3,172	3,159	3,250	3,307	3,329	3,394	3,406	3,508	42,895
Balance (A-B)	580	761	2,669	1,016	7,187	6,174	573	1,121	770	1,606	1,320	829	1,255	789	1,927	1,529	30,106
Investment *2																	
Local (C)	735	109	2,536	832	3,327	3,504	158	638	1,097	528	2,037	446	1,101	475	869	1,707	20,099
Long Term Loan (Local)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Term Loan (Foreign)	0	0	2,045	0	6,847	5,516	0	1,182	100	2,181	941	100	1,182	0	2,281	941	23,316
Foreign Grant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub total	735	109	4,581	832	10,174	9,020	158	1,820	1,197	2,709	2,978	546	2,283	475	3,150	2,648	43,415
Repayment (D)	0	0	0	0	0	0	102	102	445	720	720	780	785	894	941	946	6,435
Short Term Loan (A-B-C-D)	155	-652	-133	-184	-3,860	-2,670	-313	-381	772	-358	1,437	397	631	580	-117	1,124	-3,572

Note: *1 Budget chapter 3 means investment budget for the s.w.m. in Alexandria Governorate

*2 Investment includes replacement cost for equipments

6. Organization and Finance for the Cleansing Authority

The cleansing service of Alexandria, the main part of which is the s.w.m., will be operated by the Cleansing Authority which will be established on the basis of the Law No. 61/1963.

The organizational and financial plan required for the implementation of the service in conformity with the Master Plan are described in the followings on the premise of its operation by the Authority.

6.1 Organizational Scheme of the Authority

The work alloted to the Authority is expected to include the services financed by Cleansing Fund, such as the street beautification, maintenance of public lavatories, disinfection around urban area, and capture of stray cats and dogs.

The organization chart is shown in Fig. 6-1, and personnel required for the Cleansing Authority in 2000 is shown by its section in Table 6-1.

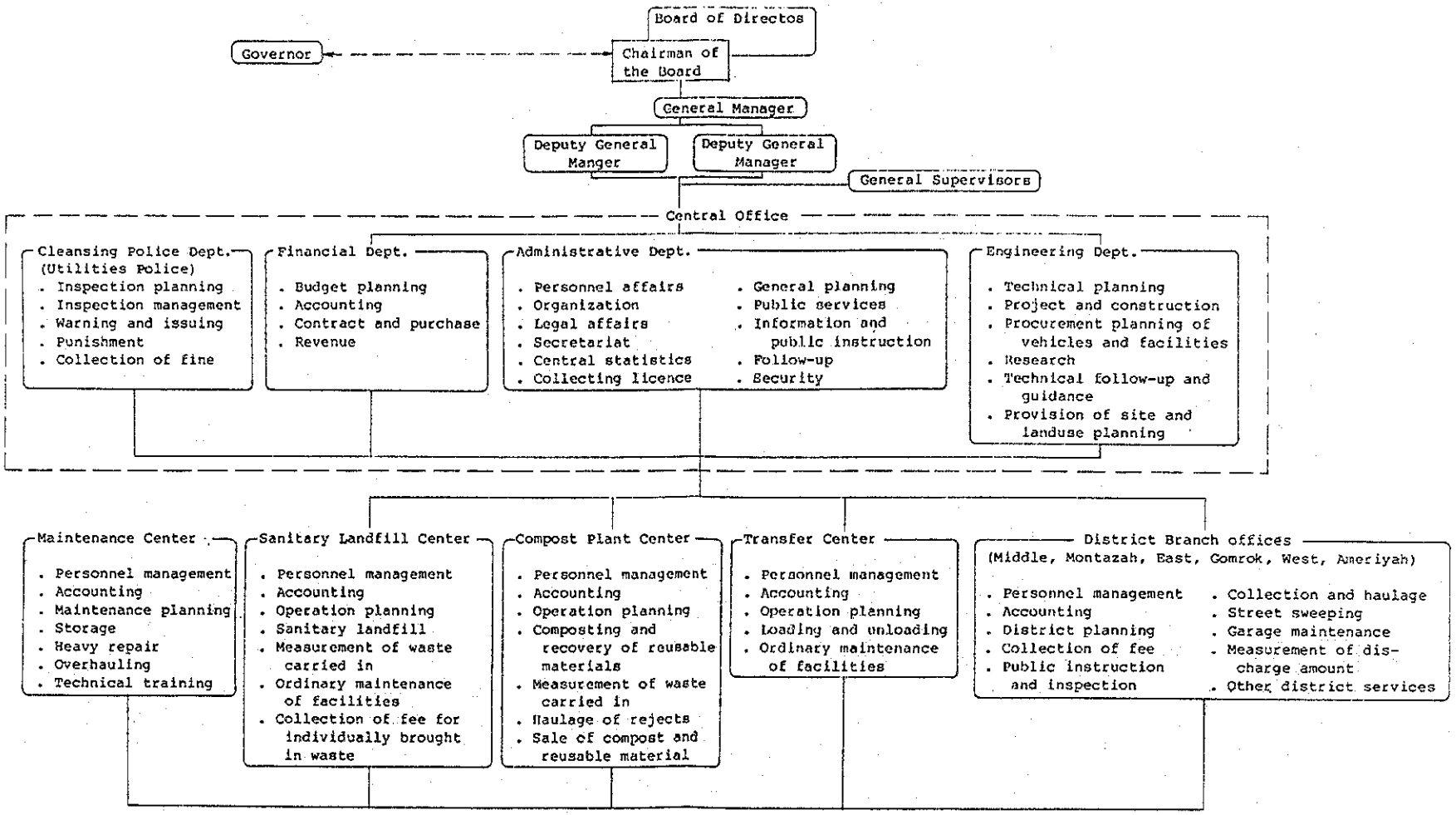


Fig. 6-1 ORGANIZATION CHART OF THE CLEANSING AUTHORITY

Table 6-1 PERSONNEL REQUIRED FOR THE CLEANSING AUTHORITY IN 2000

(Person)

Classification of workers / Section	High position jobs group		Specialist jobs group		Technical jobs group		Supervisory job group		Other jobs group			Total
	Administrative	Engineering	Law finance administrative	Engineering	Assistant engineer	Driver	Fee collector, Inspector, Police	Work master	Office clerk	Collection worker	Sweeper, WC keeper, Others	
Central Office	5	2	18	14	6	9	60	-	43	-	6	163
Transfer Center	-	1	1	1	2	24	-	2	3	10	5	49
Sanitary Landfill Center	-	1	3	3	5	35	11	3	3	12	6	82
Compost Plant Center	-	1	3	3	14	26	4	6	7	90	16	170
District Branch Office	6	-	57	38	57	522	405	245	152	1,635	2,231	5,348
Total	11	5	82	59	84	616	480	256	208	1,747	2,264	5,812

Scheduled personnel expansion up to 2000 is shown in Table 6-2.

Table 6-2 PERSONNEL EXPANSION PLAN OF THE CLEANSING AUTHORITY UP TO 2000

	Administrative jobs		Technical jobs		Super-visory jobs	Other jobs		Total
	High position	Specialist	Driver	Others		Clerk, Assistant for col-lection	Sweeper, Others	
1990	12	66	339	47	327	985	2,065	3,841
1995	15	120	449	74	616	1,391	1,984	4,649
2000	16	141	616	84	736	1,955	2,264	5,812

6.2 Financial Plan

The Cleansing Fund is practically the only independent financial resource of the cleansing service, and there is a chronic shortage of funds for the workers' wage, maintenance cost for vehicles and other equipment, and so on. This has resulted in a serious obstacle to the satisfactory operation of the cleansing service.

Furthermore, it is indispensable to improve the current financial system which relies heavily on grant provided by foreign countries as financial resource for the purchase of collection velicles and the construction of facilities.

(1) Framework of the Financial Resources

The financial resources of the Authority consist of the following items.

- Basic wage provided by the Central Government
- Cleansing Fund
- Revenues resulting from the implementation of the cleansing services (collection of charges, sales of compost and standardized plastic bags, etc.)
- Loans and subsidies (including aids provided by foreign countries)

The framework of each item is settled as shown in Table 6-3.

Table 6-3 FINANCIAL FRAMEWORK

Financial resources	Framework
Basic wage provided by the Central Government	The amount of basic wages provided by the Central Government is 20 percent greater than the amount that is simply calculated by multiplying the standard basic wage of each rank of workers with the number of workers of that rank.
Cleansing Fund	The Cleansing Fund will increase in proportion to the population growth.
Subsidies and loans	Grant from foreign countries should be reduced to zero by 2000. The subsidy from the Central Government under the concept of investment fund will increase in proportion to the increase of waste amount.
Collection charge revenue	- Charge collected from ordinary households * Average charge : 9 LE/year household The waste collection charge is set at the level of 0.5 LE/month household for low-income households and 1.0 LE/month household for middle- and high-income households, by taking into consideration the official rent classification of each household. - Charge collected from commercial and business establishments * Small- and middle-scale commercial and business establishments: 1.8 PT/kg * Large-scale establishments and establishment served by door-to-door collection: 2.3 PT/kg

Financial resources	Framework		
	- Collection rate in 2000		
		large scale establishments	household and other establishments
	Middle District	80%	70%
	Other Districts	70%	60%
Other service revenue	Selling profits of compost, reusable materials and plastic bags		

The overall financial resources, summarizing the results given in the above framework, are shown in Table 6-4.

Table 6-4 OVERALL FINANCIAL RESOURCES

(1000 LE/year)

Year		1990	1995	2000
Basic wage provided by the Central Government		3,107	3,875	4,865
Investment financial resources provided by the Central Government	Grant from foreign countries and foreign loans to be repayed	1,330	670	0
	Subsidies from the Central Government	1,110	1,260	1,420
	Sub-total	2,440	1,930	1,420
Cleansing Fund		1,510	1,725	1,940
Service revenue	Compost and reusable material selling profit	534	556	578
	Standard bag selling profit	105	188	459
	Waste collection charge revenue from ordinary households	2,436	3,420	4,569
	Waste collection charge revenue from establishments	1,732	2,722	3,866
	Sub-total	4,807	6,886	9,472
Total		11,864	14,416	17,697

The financial scale of the cleansing service system will amount to 17,697,000 LE/year in 2000.

The financial scales per capita and per ton of waste are 4 LE, 21.2 LE respectively in 2000. Overall financial resource in 2000 will consist of 36% subsidy from the Central Government, 10% from Cleansing Fund and 54% from service revenue profits.

It can be observed that the financial independency will be remarkably improved from the standpoint of extending service revenue portion to 54% in 2000 from barely 10% in 1984.

(2) Financial Plan of the Cleansing Authority

The money flow of the Cleansing Authority was calculated on the following premises and is shown in Fig. 6-2.

a. The financial resources presented in Table 6-4 are to be secured. Foreign grants are provided for commodities such as vehicles, so their amount is listed under investment in the money flow. The corresponding sum is subtracted from the local purchase funds.

b. In connection with the financial balance of the Authority until 1989, it is assumed that the running expenses will be kept balanced with revenue. As for the investment financial resources, it is assumed that subsidies of the Central Government will be available only for covering the local portion of the construction cost of the new Abis Compost Plant (300 t/d), transfer station and MBSDS landfilling site. As for the foreign portion, it is assumed that a 4%-interest loan with 5-year grace period and 20-year repayment will be available.

c. If surplus financial resources should result, they would be regarded as reserve funds and transferred to subsequent years. On the other hand, if deficit should result, loans should be arranged to cover it. No interest is taken into consideration in this connection.

The balance examined by considering only the running expenses including the payment of the loan interests is shown in Table 6-5, and a considerable surplus is indicated.

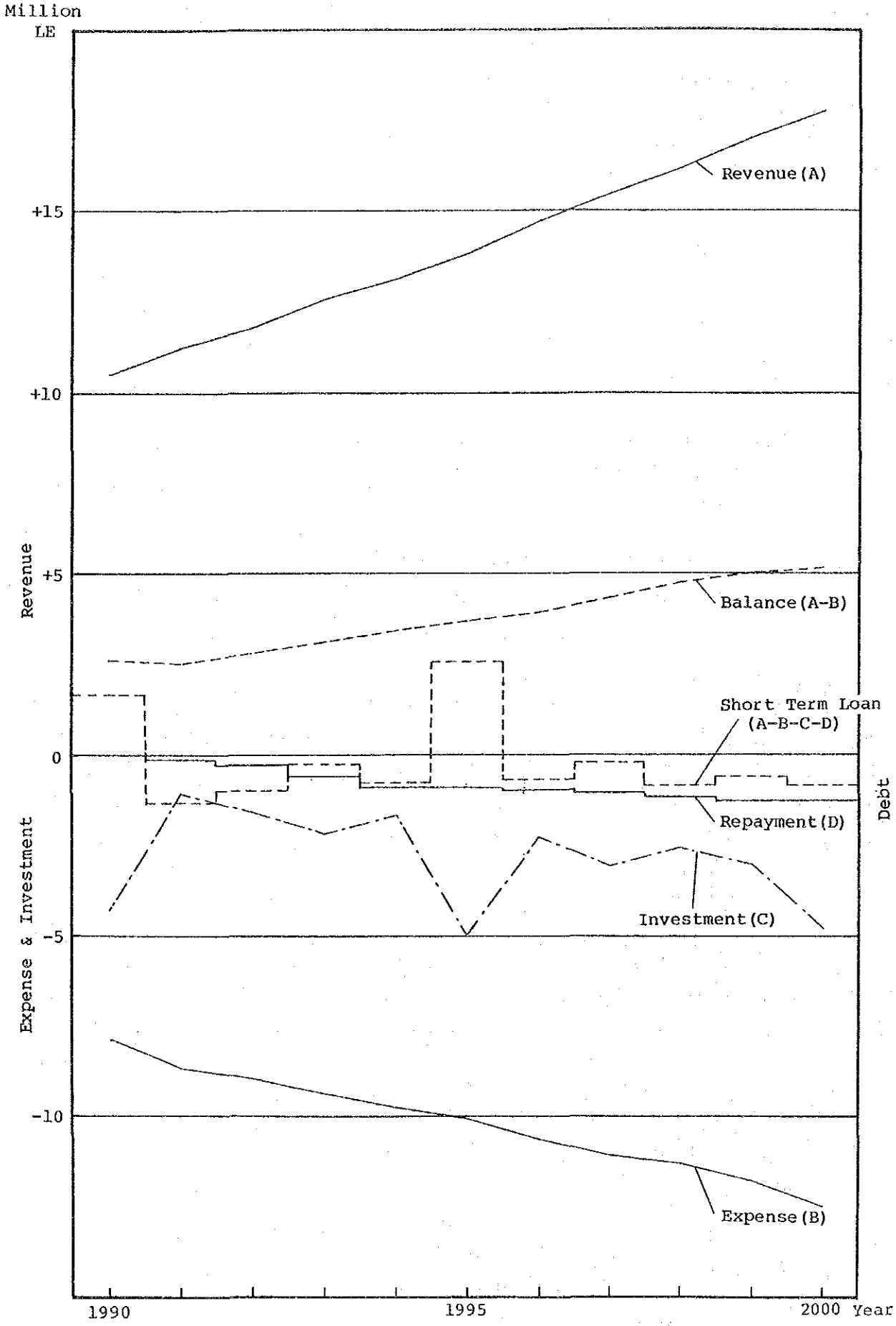


Fig. 6-2 MONEY FLOW OF THE CLEANSING AUTHORITY

Table 6-5 BALANCE CONSIDERING THE EXPENSES

(1,000,000 LE)

	1990	1995	2000
Revenue	11.9	14.5	17.7
Expenses	7.9	10.2	12.5
Balance	4.0	4.3	5.2

The investment expenses consist of the costs for purchasing vehicles and heavy construction equipments for the sanitary landfilling after 1990, and others are expected to amount to 63,200,000 LE for 11-years period from 1990 to 2000, with an average of 5,700,000 LE per year.

Of the total investment expenses, the foreign grants amount to 7,300,000 LE (11.6%) and long-term loans 24,100,000 LE (38.1%). The remaining part, which amounts to more than 50% of the total, is covered as direct expenditures by the service revenue of the Authority.

The actual sums that are spent every year consist of the direct expenditure and the repayment of the loans. The total expenditure in the 11-year period amounts to 40,500,000 LE, which corresponds to an annual average expenditure of 3,700,000 LE.

As for the overall balance of the Authority, a considerable cumulative surplus is expected at the middle period, but it will worsen in the latter years due to the gradual increase of the repayment burden and the lower work efficiency in the districts other than Middle District (increasing costs and less charge collection revenue). Ultimately the balance is expected to result in a small surplus of 700,000 LE in 2000.

7. Recommendations

In this report, the Master Plan, which defines the long-term developing measure of the s.w.m. improvement in Alexandria, the priority improvement projects to be implemented, and the organizational and financial plan of the Cleansing Authority which will be the executive agency in charge of the future s.w.m. are presented. It must be borne in mind, however, that there are various issues to be examined with care prior to the practical implementation of the said plans and projects. This chapter describes the issues associated with the implementation of the various plans and projects mentioned so far, in the form of recommendations.

Recommendation 1 Consolidation of an integrated operation scheme and independent financial base through the establishment of the Cleansing Authority

The most fundamental subject related to the improvement of the s.w.m. in Alexandria is the consolidation of an integrated operation scheme and an independent financial base. In this connection the establishment of a cleansing authority is highly desirable. Fortunately, preparations are being made for establishing a cleansing authority in Alexandria (henceforth called the Authority), and that being so it is very important to strengthen the organizational and financial systems of the Authority in conformity with the lines mentioned in this report.

Recommendation 2 Smooth transfer to the Authority

As thing now stand, the Governorate and the District authorities are in charge of most of the s.w.m. in Alexandria, and number of Zabbaleen are few. Under these circumstances, the transfer to the Authority is expected to be smooth compared with the case in Cairo and other cities.

However the ADS is expanding its cleansing service and it supports a large part of the finance of the service in question. Therefore, it is indispensable to transfer the personnel in the Cleansing Section of ADS to the Authority. It is also important to define the responsibilities of the Authority and the Central Workshop in the Directorate of the Ministry of Housing and Utilities for equipments purchase and their maintenance.

Recommendation 3 Enforcement of the cleansing ordinance (waste collection regulations)

The s.w.m. in Alexandria is regulated by the Law No. 38/1967. Although its prohibition on the collection of charge adversely affects the self-financing of the cleansing service, this can be solved through provision of the law establishing the Authority. Therefore, it may safely be said that no improvement in particular is required from the statutory standpoint.

While, a rule on waste collection has to be clearly written and to attain publicity so that improvements in collection and street sweeping systems can be achieved, and an understanding and cooperation of the citizenry about the collection of charge can be obtained. This collection rule have to include at least the type of container to be used for discharge, *discharge location, discharge time, collection time and frequency,* collection of the charge, and responsibilities of the citizenry and the Authority.

Recommendation 4 Strengthening of the technical capability of the personnel and the financial, administrative and planning functions

The examination of organizational aspects of the s.w.m. system in Alexandria indicated that the technical capability of personnel and the financial, administrative and planning functions of current system were very weak.

For the consolidation of an integrated operation and an independent financial base, not only an organizational and institutional improvement, but also the strengthening of the said capability and functions are indispensable.

The development of the technical capability of the personnel can be achieved by such measures as technical exchange with domestic and foreign cleansing organizations, and technical training and discipline of the workers.

As for the reinforcement of the financial, administrative and planning functions, the elimination of the excessive dependency on technical assistance from foreign countries and the exchange with domestic organizations having a great deal of experience, such as the Alexandria Water General Authority, should be considered.

Recommendation 5 Recruitment of qualified personnel and improvement of the wage level

The recruitment of qualified technical personnel is indispensable for realizing the said reinforcement of the organizational functions, and the improvement of the labor conditions up to a satisfactory level is required in this connection.

Improvement in the working conditions of the field workers, such as shortening of the working hours, can be realized as a result of the transfer to the Authority. However, the wage level set in this plan remain the same as the current state.

In order to recruit qualified personnel and to secure a decent standard of living for the workers, it is desirable that the improvement of the wage level is given a high priority when any surplus occurs in the budget.

Recommendation 6 Rationalization of the operation and expansion of the financial resources

The scale of the financial resources of the Authority in 2000 is projected to be approximately 18,000,000 LE and there is not so much margin in financing the cleansing service. Under these conditions, expenditure reductions through rationalization of the operation and expansion of financial resources are necessary for improving the wage level of personnel and upgrading the technical level of the system.

In this connection, rationalization of the collection and street sweeping works through the promotion of citizenry cooperation, improvement of the productivity of the final product in composting through the haulage of selected waste rich in organic material suited for composting, and other technical rationalizations are important. It is also important to expand the financial resource for wages through the application of the Law No. 26/1983 to the Cleansing Authority and to increase the revenue from the collection of charge through an effective implementation of the charge collection work.

Recommendation 7 Stepwise improvement of the collection and street sweeping services

Waste collection and street sweeping are the nucleus activities of cleansing services, and account for the largest portion of both operational expenditures and organizational activity.

Thus, the improvement of these services become the most important subjects regarding the technical aspects of the s.w.m. in Alexandria. The waste collection and street sweeping systems are related to each other as the improvement of the collection system reduces street waste. Both can be improved only with the understanding and cooperation of the citizenry and the improvement of the technical capability of the workers and the organizational system for the two services.

In order to realize the said improvements and upgradings in the long run, a stepwise planning is required. The Master Plan proposes to make improvements in Middle District at first, followed by the expansion of the systems throughout Alexandria. For the improvement process in each district, the following steps should be applied.

- First Step

  The collection service (e.g. providing reliable and regular collection) should be improved by utilizing the existing facilities and equipment efficiently so that regular discharge of waste by the citizenry can be attained. Also, common understanding about the scheduled collection service between the collection service sector and the citizenry should be formed. In this step, the collection method is not necessarily that with plastic bags.

- Second step

  The collection with plastic bags should then be applied to the area where the first step has already been implemented and the transfer to the plastic bag collection system is relatively easily done. For the new districts being planned, the plastic bag collection system is introduced from the beginning.

Recommendation 8 Introducing of new compost facilities

The introduction of a new compost plant incurs a substantial cost increase when compared with the sanitary landfill scheme.

In addition to the existing Abis Compost Plant, total compost capacity of both plants will reach to 460 t/d.

The construction of the new compost plant with a capacity of 300 t/d is planned in this report. However, the compost plant construction above this capacity should be implemented only after confirming the existence of favourable conditions such as the subsidies related to the utilization of compost by the agricultural sector, and thereby relieving any pressure on the finance for the s.w.m. in Alexandria. In other words, the construction of compost plants whose total capacity is over 460 t/d should be considered only on the premise that there is no risk of pressure on the financing of the s.w.m. system and that the marketability of compost in the Governorate of Alexandria is guaranteed. The compost demand in 2005 of the whole agricultural lands within the area is predicted to meet with the supply amount by adding another 200 t/d plant, or 660 t/d plant in total, in consideration of the amount of all organic manures available within the area.

Recommendation 9 Measures for securing landfill sites at an early time and in a systematic way

This report proposes the implementation of sanitary landfilling in the MBSDS for the time being. However, the MBSDS is not necessarily an appropriate site for landfilling. It was selected because it was the only site that could be secured within a short time.

Strictly speaking, landfill sites should be secured at places where no adverse environmental impact is expected, and the haulage distance is short.

In Alexandria, the difficulty in securing appropriate landfill site is not due to the physical shortage of land space, but due to the land use regulation concerning green and farming land development plan which restricts other land uses.

In this connection, the Cleansing Authority should provide other concerned authorities with the following information to obtain their cooperation.

- It is very important for the finance of the s.w.m. system to secure landfill site near the city areas.

- The use of the landfill site for greening and farming is possible by the implementation of sanitary landfill.

Recommendation 10 Securing of financial resources for the implementation of the priority project

The projects selected through the Feasibility Study require urgent implementation to improve present situation of the s.w.m. in Alxandria. Securing of the financial resources holds sway over the future implementation of the projects. Accordingly, 23,300,000 LE (including foreign portion of 16,300,000 LE) should be secured initially intending to perform the projects targetted in 1990 for the implementation of the first step of the integrated s.w.m. improvement project.

With regard to the financial resources, local portion should be obtained from the allocation of the Governorate Budget and from the subsidy of the Central Government and the foreign portion should be secured by a loan with an interest rate of about 4% or as less as possible from the relevant organizations of the international aid programs. Immediate determination is required on securing of the future financial resources.

Recommendation 11 Promotion of the project

Positive project promotion, such as an appropriate scheduling, will become important, as well as the securing of financial resources, in achieving successful result of the project. Accordingly, a service for the forthcoming step-by-step tasks such as detailed engineering designs, contracts, procurements of machinery, equipments and construction materials, and constructions should be completed by or in 1990 as a first stage for materialization of the project. Quick launching of the project implementation brings in the early solution of the s.w.m. problems in the city, and moreover makes it possible to improve public sanitation and the standard of living environment.

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