2.8 Compost Demand and Supply

2.8.1 Introduction

Intermediate treatment system is not always required for the solid waste management which is orginally being practiced with collection and disposal systems in the long history. However, when the solid waste management is implemented by more appropriate techniques for the purpose of conserving life environments and imporving public sanitation, adoption of the intermediate treatment system will become inevitable.

Solid waste management, at the same time, is the disposing of materials of no further use generated from the daily living of the people. Among these materials, there are still many which may be recovered for reuse by the people.

Intermediate treatment process is applied to recover resources from the municipal wastes. Accordingly, following three items are comprehensive to achieve the purpose of intermediate treatment of the solid wastes.

- Improving efficiency of solid waste disposal system
- Recovery of materials for reuse
- Recovery of conversion products and energy

From the commercialization point of view, solid waste management is not possible without collection fee from residents and/or Government subsidy. Even if revenue from the materials recovered from intermediate treatment facilities are to be considered, a substantial recovery of the costs of the solid waste management work is not expected.

However, apart from the management point of view, resource recovery from the solid wastes will become a prospective public need in consideration of the saving of national resources. In other words, economic effects by the resource recovery from the process create possibilities of securing benefits to the national economy from the solid waste management.

One of the purposes of the Feasibility Study is to examine the feasibility of implementing a project to adopt composting process to the intermediate treatment facilities, and the purpose of this section is to study about compost demand and supply balance within the Alexandria Governorate region as well as studying the effects on application of compost derived from solid wastes.

Quantitative predicition of the compost demand and supply is carried out basically for the region within the Alexandria Governorate to focus on present amount as of 1985 and on future amount in 2005. For predicition of the compost demand, following items are studied from Section 2.8.2 to 2.8.4.

- Present situation of agriculture in Alexandria Governorate and future porspects.
- Utilization and conditions of chemcial and organic fertilizers, market structure, etc.
- Major crops cultivated in the region, seasonal planted areas, etc.
- Fertilization design for the major crops.
- Compost demand in the Alexandria Governorate region in 1985 and in 2005.

Meantime, all the compostable materials available for the alternative use of the compost from municipal solid wastes are predicted in order to examine the balance between the demand and the supply deficit or surplus. Following organic matters are grasped in terms of quantity of the compostable materials in Section 2.8.5.

- Animal husbandary wastes
- Peat moss
- Sewage sludge
- Municipal solid wastes

Feasibility of composting of the municipal solid wastes depends to a great degree on securing sales routes for the final products. Therefore, marketing structure will be suggested in Section 2.8.6.

In the final Section 2.8.7, the effects on application of compost to the agricultural lands will be studied. These effects or benefits are examined for the items listed below, and the results will be further analysed in evaluating economic benefit of composting, which will be described in Chapter 6 of the Main Report and in the Supporting Report.

- Effects of composting
- Effects of compost application to the soil
- Quantitative prediction on Increase of crop productivity
- Quantitative prediction on Saving in chemical fertilizer
- Quantitative prediction on Ssving in irrigation water

2.8.2 Agriculture in Alexandria Governorate

(1) Agriculture in Egypt

Agriculture in Egypt has been very active since many centuries benefiting from conditions such as the plentiful Nile Water, quasi-tropical climates, duration of sunshine, etc., all of which enable year-round cultivation.

Agriculture land has developed in the belt zone lines along the Nile Valley from the Aswan High Dam to Cairo and in the Nile Delta from Cairo toward the coastal line of the Medeterranean Sea. Approximately 3 % of the whole land area of Egypt or 6.5 million feddan (2.73 million hectare) is developed for agricultural land. Among them, the area of one million feddan (0.42 million hectare) have been newly developed during the period 1952 to 1976 by the reclamation of desert lands. On the contrary, 0.5 million feddan (0.22 million hectare) of the agricultural land area have decreased during the same period.

The Government has targetted food security as the fundamental aim of its agricultural policy which is being implemented by increasing domestic crop production and by obtaining foreign currency from exporting of agricultural products with high international price such as cotton and rice for the purpose of importing foods such as wheat flour, etc. Instead, despite the efforts, economy in Egypt is in decline due to freezing of petroleum price since the beginning of 1980's in addition to the trading imbalance between the export of cotton/rice, etc and the import of wheat/flour, etc. Consequently, due to the shortage of the foreign currencies, the Government is being compelled to raise domestic food production rate without relying on the foods from abroad.

Agriculture occupies a major portion under the New National Five Year Plan(1982/83 to 1986/87)and the food security policy is vigorously implemented by means of the horizontal and the vertical expansion of agriculture produce.

The horizontal expansion is implented to increase new agricultural lands by the reclamation of arid lands. General Section Authority for Agriculture Development, Ministry of Agriculture(MOA) is responsible for the development of agricultural land basically in the arid lands to allocate the newly reclaimed lands. Fig. 2-8-1 indicates the locations of the agricultural companies in whole Egypt. Vertical expansion of agriculture, increase of productivity of land in other words, is carried out by means of the improvement of irrigation and drainage system, increase of the amount of fertilizer and agricultural chemicals, and the culturing of different kind of crops.

Cultivation season in Egypt is divided into three seasons which are the winter period (November to May), the early-summer period(May to October) and the late-summer period (August to October). The late-summer crops are the so called Nile crops such as maize for a major crop cultivated in the flood area of the Nile and irrigated by the flood water. After the construction of the Aswan High Dam, cultivation of the Nile crops are decreasing with no flood water expected due to the control of river water by the Dam and the Nile crops shall be categorized by the summer crops. Moreover, the flood control of the Nile has stopped periodical supply of nutrients to agricultural land in the form of the Nile silt and it makes the farmers rely much on using chemical fertilizers as alternatives to the natural benefits the Nile silt.

Tab. 2-8-1 indicates the planted area of major crops cultivated in Egypt in 1952, 1976 and in 1981. Wheat and clover are planted in summer period. Also, maize is planted for the major crop in the Nile period. Agricultural land is cultivated efficiently to raise the average national crop intensity up to around 200 %, and some kind of vegetables are cultivated three times a year.

(2) Agricultural Land and Crop Yield

Agricultural land area within the Alexandria Governorate in the last 4 years maintains an almost constant area as shown in the table below.

(unit:feddan)

Crop Year	Field	Orchard	Cultivated Land	Barren & Unused Land	Total Agricultural land
82/83	82,181	16,169	98,350	N.A.	N.A.
83/84	81,852	15,787	97,390	42,509	138,899
84/85	81,417	15,973	97,390	41,509	138,899
85/86	82,136	16,344	98,480	40,419	138,899

Note: Figures in 85/86 represent those planned.

About 98,000 feddan(41,200ha) or 70 % of the total agricultural land is cultivated and the rest comprises roads, canals, and rockey areas which are used for other than cultivation purposes.

Cultivated land is further divided into fields, 82,000 feddan(34,500 ha) or 84 % of the cultivated area and orchards, 16,000feddan(6,700 ha) or 16%.

Yield of the major crops from these lands during 1974 to 1984 is indicated in Fig. 2-8-2 together with the yield in whole Egypt for reference. A tendency of the Figure shows that the yield in the last 11 years remains almost the same level or decreases a little expect for vegetables such as tomato, cabbage, etc.

Tab. 2-8-2 indicate the production rate of the yields of major crops in Alexandria Governorate and in whole Egypt in 1983. Yield of figs in Alexandria forms almost half of the national production. Besides, broad beans, cauliflower, guava, marrow and cabbage form high rate of yield. Generally, vegetables and fruits are popular crops in the region but cotton, sugar cane and rice which are major crops in Egypt and competing crops in the international market are cultivated in a few areas.

(3) Land Use Plan

In 1982, Alexandria Governorate established a Comprehensive Plan for the year 2005 by the cooperation of Alexandria University. Development of agricultural land in the scheme is shown in Fig. 2-8-3. Judging from the land use map, agricultural land is expanded up to around 160,500 feddan or 67,400 ha in 2005 by reclaiming outskirts of the existing agricultural lands. As a result of the planning, agricultural land in future will be allotted mostly in Abbis area and in Ameriyah area along Desert Road and the existing agricultural lands located nearby town area will be relocated residential areas.

Currently, about 55% of the Total agricultural land is occupied by Maryut Agriculture Company and by Nahada Agriculture Company and the remaining portion is cultivated by the private farmers. Fig. 2-8-4 indicate the location of the agriculture companies active in the Alexandria region.

(4) Cultivation Condition

Soil Condition

Tab. 2-8-3 indicates the land is composed of traditional farming land and reclaimed land. Mamoura and Khorsed areas, located in the eastern part of the city, consist of the traditional farming land. Ameriyah area, south-west of the city, is mostly occupied by the reclaimed land which is covered with sandy soil from the desert. About 61,000 feddan(41,000 ha) or 63 % of the total cultivated land in Alexandria consist of the sandy reclaimed land as is easily learned from the soil map shown in Fig. 2-8-5.

Tab. 2-8-4 indicates the cultivated area, crops and soil constituents of the farms interviewed during the field survey. Most of the cultivated land is composed of calcareous soil which have turned into blackish due to increse of organic matters in the soil by years of cultivation.

Climatologic Condition

Annual precipitation ranges from 150 mm to 200 mm. Rainfall starts from October and end in March. Most of the precipitation concentrates during the said period and it enables the farmers to cultivate winter crops.

Average air temperature for a year is 15.1 degree centigrade. As for the air temperature, Alexandria area is in a very mild climate zone. Fig. 2-8-6 shows monthly average precipitation and air temperature from 1975 to 1979.

Irrigation Condition

Conditions of the mild climate and irrigation systems bring on a double cropping system to the Alexandria region. Moreover, some kind of vegetables such as tomatoes etc, are cultured three times in a year. However, the crop intensity of the region stays at 150 % which is lower than the level of the national average at 200%.

Typical cropping patterns in Alexandria region are listed as follows.

Pattern 1:	Wheat or Barley	Nov - Apr
	Tomato or Papper	Apr - Oct
Pattern 2:	Wheat or Barley	Nov - Apr
	Maize or Rice	Apr - Oct
Pattern 3:	Clover or Beans	Sep - Mar
	Tomato	Mar - Aug
Pattern 4:	Potato	Aug - Dec
	Water Melon	Jan - Jul
Pattern 5:	Cabbage	Aug - Jan
	Potato	Jan - Jun
Pattern 6:	Cabbage	Oct - Mar
	Cow Beans	Mar - Oct

In addition to the cropping patterns listed above, there are still many patterns of crop rotation since the climate is not a restricing factor for the crops required to plant in a definite season in the Alexandria region.

(5) Future Aspects

Future development of foreign trading in the Alexandria region is expected by utilization of the Alexandria Port and the industrial development in the hinterlands.

Meanwhile, the Government of Egypt has implemented the Third National 5 year Plan in which constitutes a major role with the aim of the agricultural development of securing more domestic foods. In view of this policy, agricultural development and enrichment should also be implemented in the Alexandria region.
The measures will be taken by the vertical and horizontal expansion of agriculture, or in other words, by the increasement of crop yields in raising the productivity of land and by the expansion of cultivated lands through the reclamation projects in desert areas.

At present, reclamation projects in the recent years are listed in Tab. 2-8-5 including the projects in the Baheira Governorate. From the Tab., total reclaimed land will reach about 500,000 feddan or 210,000 ha in the near future. These reclaimed lands are developed on the sandy calcareous soils in arid lands where it is required to apply organic soil conditioners prior to the cultivation. The compost demand for the said reclaimed lands is estimated at 4 million tons annually by the rate of application of 20 m^3 per feddan or 19 ton per hectare.

2.8.3 Utilization of Chemical and Organic Fertilizers

(1) Application of Chemical Fertilizer

Tab. 2-8-6 indicates the consumption of chemical fertilizers in whole Egypt from 1953 to 1983. As this Table shows, the consumption of chemical fertilizers has substancially increased since the construction of the Aswan High Dam in 1961. This drastic increase in reliance on chemical fertilizers is becoming economically and agriculrurally untenable.

Tab. 2-8-7 indicates the consumption of chemical fertilizers in Alexandria Governorate in 1984/1985. From the Table and the planted area of that year at 141,000 feddan(59,400 ha), average comsumption of N component per crop is estimated at 153 kg/ha. This consumption rate is larger than the rate of the world average at 41kg/ha or Japan at 133kg/ha in 1981. It is learned that the large consumption of nitrate fertilizer is characteristic of the agriculture in the Alexandria region and in whole Egypt. Manuring of potash fertilizer is not always required due to the sandy calcareous soils covered on most of the cultivated lands.

Production amount of chemical fertilizers are shown in Tab. 2-8-8. Judging from the relations with the consumption of chemical fertilizers shown in Tab. 2-8-6, nitrate fertilizer is sufficiently supplied from the domestic production. Supply of phosphatic and potash fertilizers rely on the imported fertilizers.

Meanwhile, organic soil conditioners such as animal manure or compost derived from municipal wastes will never replace chemical fertilizers, however, they can assist in controlling the consumption of chemical fertilizer, both by replacing humus in the soil and by providing some of the needed nutrients and trace elements. Careful evaluation of the relative merits of compost and chemcial fertilizers show that the best soil improvement strategy utilizing a combination of compost and chemical fertilizers would result in increase of crop yields which is not achieved with an application of chemical fertilizers alone.

Unfortunately, the supply of soil conditioners does not meet the rapid increasing demand of the farms. This has led to an even higher reliance on chemical fertilizers in Egypt.

(2) Application of Organic Fertilizer

Currently, there are four types of organic fertilizers available as soil conditioner in Egypt. These are :

- Animal manure
- Peat moss
- Sewage sludge
- Compost derived from municipal wastes

In most countries, agricultural wastes are fermented into barnyard manure as organic soil conditioners for the cultivated lands. In Egypt, agricultural residues are traditionally used as the fodders of animals or for the fuels for cooking after drying up. Straws such as wheat, rice, etc. are recently used at paper mill to add for long fibers to strengthen the reproduction papers. For that reason, utilization of agricultural residues are negligible when accounting the amount of compostable materials available in these areas.

Animal Manure

Field surveys of farmers and agriculture companies in the Alexandria region determined that most of the animal manure produced is used on-site. Only a small portion of the total amount generated is offered for sale.

Actual consumption amount of animal manures could not be obtained during the survey. But the actual consumption rates for the typical crops were obtained from the farmers interviewed and indicated in Tab. 2-8-9.

The table shows that the most of the farmers in this region use animal manures as organic fertilizers. Organic matters are not applied to the crops such as wheat, barley, maize and clover, further the application rate to the other crops is less than the optimum amount. It is considered that the shortage of supply and the increase of expense make the farmeres hesitate to apply sufficient amount of organic manures to the crops especially to the off-season crops indicated above.

Peat Moss

Peat moss is the product of the natural anaerobic decompostion of leaves and shrubs in swampy areas. It is mined, spread, dried, and refined to produce a homogenous end product rich in organic matter and nitrogen.

In Egypt, peat moss is used in gardening and plant nurseries and is in high demand for these apllications despite its high price.

All commercially sold peat moss is imported from Ireland and Sweden. The total guantities of peat moss imported for the years in 1975, 1977, 1982, and 1985 are shown as follows.

Year	Imported Quanity(ton)
1975	2,400
1977	2,700
1982	4,800 - 6,000
1985	6,500 - 7,000

Because peat moss is normally acidic(ph 4 -5.5), it is suitable mainly for alkaline soils. A high quality peat moss meets the following specifications:

Humidity content: Maximum of 45 - 50 % by weight
Ash content : Maximum of 4 % by weight

While peat moss is richer in organic matters compared with fine compost or sewage sludge, it is also very expensive in Egypt. Users of peat moss should therefore be willing to switch to fine compost once they are convinced of its utility and quality.

Sewage Sludge

An estimated total of 800,000 m/day of wastewater is generated in the Alexandria Governorate, of which 50 % is industrial wastewater.

There is only one sewerage treatment plant in Alexandria, which has not been functioning since 1979. This plant, located in the East District, has, since that time, suffered a series of breakdowns and has produced no sludge. Previously, the plant had a capacity to treat 65,000 m^3/day. Construction of another treatment plant, located in the West District, stopped several years ago, with the project far short of completion. The East and West wastewater treatment plants, when operating, will have a total capacity of 585,000 m^3/day.

These treatment plants could capture 27,500 m^3 of raw sludge per day at start-up, and could eventually reach a capacity of 38,500 m^3 per day by 1990.
Currently, all collected wastewater is discharged into the Mediterranean Sea and Lake Maryut.

Compost Derived from Municipal Wastes

A pilot compost plant has started operation at Abis, Alexandria, from November, 1984. The plant was designed with a capacity of treating 160 ton/day or 10 ton/hr raw waste to produce coarse and fine composts.

During the survey period, it was noted that customers are obliged to wait for purchasing the composts since the produced amount does not sufficiently meet with the demand of the customers due to the frequent suspension of plant operation.

Following figures are the amount of compost sold during January to July in 1985. Total amount of 3017 ton was sold during the period.

Type	Jan - Apr	May	Jun	Jul	Total
Fine Compost	245	247	403	32	927
Coarse Compost	200	200	590	1,100	2,090
Total	445	447	993	1,132	3,017

A farmer must sign the contract with the plant for purchasing of compost at least two weeks before the shipment. At present, there are 20 customers have contracted to purchase the compost from the plant. They are summarized as follows.

- Large customers (More than 200 tons)
  Coarse compost: 4 persons total 4,200 tons
  Fine compost : 2 persons total 1,400 tons

- Small Customers (Less than 200 tons)
  Coarse & Fine composts: 16 person ? tons

Selling price is now set at the following rate at the plant.

(Unit: LE/ton)

Amount	Fine Compost	Coarse Compost
Less than 50 ton	9	7
50 - 200 ton	8	6
200 - 1,000 tons	7	5
More than 1,000 tons	6	4

Quality analysis of composts was conducted for the samples in February 22nd, 1985 by the Environmental Health Department, Alexandria University. Tab. 2-8-10 indicates a part of the test results and the organic fertilizer specifications standardized by the law 100/1967. The results are obvious to meet with the required standard.

Some farmers have already applied the Abis composts to their lands for cultivation of crops. Tab. 2-8-11 indicates the results of interview to the farmers who arepurchasing the Abis's compost showing a positive

attitude by the farmers trying to apply for a test a new kind of organic manure produced from municipal wastes and searching for the effects on the crop growth.

Rate of the application of the compost ranges from 7 to 25 m^3/feddan or 7 to 24 ton/ha. Results of application, as the reports from the farmers, show better growing process of the crops comparing to the crops in the last year. Only problem of the Abis compost is the expensive selling price, one farmer reported to the interview. The price quoted by the farmer was around 5 LE/ton at the plant.

(3) Marketing System of Chemical and Organic Fertilizer

Marketing cycles of chemical and organic fertilizers are shown in Fig. 2-8-8. Chemical fertilizer is distributed to the farmers by the credit and Development Agricultural Bank and/or through the Agricultural Cooperative Society.

Chemical fertilizer is subsidized by the government. The farmers have to apply to the Agricultural Cooperative Society to obtain a certificate for purchasing the subsidized chemical fertilizer from the Bank. With the certificate, the Bank sells the subsidized fertilizers to the farmer by an institutional credit in installment on the conditions of 14 months redemption period and an annual interest of 4 %.

Tab. 2-8-12 lists the fertilization rate per crop type authorized for sale at the official subsidized rate for nitrogen fertilizer(15.5 % N content) through the Bank.

Market cycle of animal manures within Alexandria Govenorate is difficult to define because the farmers obtain most of their manure locally: from stable, cattle bredding stations, and poultry farms.

A large portion of the animal manure market is concentrated in the Abu El-Matammer village, Baheira Governorate, about 45 km away from Alexandria.

Abu El-Matameer is accessible to Alexandria agricultural lands, as well as lands under reclamation, by both Alexandria - Cairo desert and agricultural roads. These dealers are all transportation contractors and have large areas for manure. These dealers either blend the different kinds of manure or keep cattle manure separate. Sometimes, dealers store the manure for drying and maturation. The sources of manure for these dealers are cattle and chicken growing stations.

There are two main importers of peat moss:

- The Nile Company for Agricultural Exports, with head quarters at 19 El Goumhoreya Street, Cairo.
- The General Organization for Potato Growers, with headquarters at 110 Kasr El Eini Street, Cairo.

The Nile Company sells peat moss to a large number of customers, while the General Organization for Potato Growers has a more limited client base. El Nahada Agriculture Company imports its own moss from Holland for application to horiculture and fruits producion.

Currently, this product is selling for 7.9 Pounds Sterling per bale of 60 kg, equivallent to 13 LE per bale, CIF Alexandria Port, or about 217 LE per ton. The Nile Company sells peat moss to its clients at 500 to 600 LE per ton.

At present, compost of the Abis is selling well without having any particular marketing route. Management efforts made by the Abis plant might have brought in the good sales situation despite the low production level of the compost caused by chronic operation problems.
Basically, the compost is sold by ex-factory at Abis. But on payment of transportation costs, the compost is delivered to the farms by the plant's trucks.

Current prices for different kind of organic manure in the Alexandria region are shown in Tab. 2-8-13.

2.8.4 Demand of Compost

(1) Approach to Demand Prediction

In Section 2.8.2," (5) Future Aspects", compost demand of present and to be developed reclaimed lands in the Alexandria region including a part of the lands in Baheira Governorate was estimated to reach 4 million to per year in the near future.

In this Section the potential compost demand within the Alexandria Governorate is studied with the basic comprehension that the compost produced from the municipal wastes should be returned to or disposed on the lands within the area where the wastes are generated.

In general, newly reclaimed land must be applied with organic materials prior to the cultivation, needing a larger amount than that of the existing cultivated land, for a few years in the early stage of cultivation, and subsequently reducing the application rate with the passing of the years. After some years of cultivation, organic matters retained in the soils will be increased up to a certain level after the decompostition and the utilization by the plants. Taking acount of this point, application rate of compost is determined on the basis of the crop types planted on the existing cultivated lands.

Present planted land is based as of in 1984/85, meanwhile future planted area is determined by the agricultural land laid out in the Land Use Map of the Comprehensive Plan for 2005.

Annual compost demand is predicted by months for the year 1985 and 2005 by using matrixes composed with the factors of application rate by crop type and monthly planted area.

All the factors required for prediction such as the planted area, type of crops, compost application rate per crop, application month, method of prediction, etc. will be described hereinafter.

(2) Major Crops and Cultivated Seasons

Major Crops and Planted Area

Yields of typical crops cultivated within the farm land in Alexandria during the last 11 years were introduced in Section 2.8.2. With reference to them and to the result of planted area in 1984/85, Tab. 2-8-14 was prepared for the planted area of major crops as of the year in 1984/85.

Whole agricultural land area was determined at 160,500 feddan or 67,410 ha by measuring the area laid out for agricultural purposes on the Land Use Map for the year 2005.

Breakdown of the agricultural land into the planted areas by crop type was culculated from the present formation rate on the assumption that the type of crops to be planted would have no basic changes even in future. Following are the breakdown of the agricultural land at present and in future.

- Present Agricultural Land (1984/85)

Total Agricultural Land Area: 138,899 feddan
Barren and Unused Land Area : 41,509 feddan
Cultivated Land Area
Fields : 81,417 feddan
Orchard: 15,973 feddan

(Note: One feddan is equivalent to 0.42 hectare.)

- Future Agricultural Land(2005)

Total Agricultural Land Area: 160,500 feddan
Barren and Unused Land Area : 48,200 feddan
Cultivated Land Area : 112,300 feddan
Fields : 94,300 feddan
Orchard : 18,000 feddan

Tab. 2-8-15 indicates the future planted area in 2005 determined from the formation rate by crop type in 1984/85 under the condition that the present cropping system shall be continued in future.

Cultivation Season

Cultivation season in the Alexandria region is divided into summer and winter periods. The major crops cultivated in each period is listed as follows.

- Winter Crops

  Barley, Wheat, Broad Beans, Cabbage, Cauliflower, Tomato, Clover, etc.

- Summer Crops

  Rice, Maize, Tomato, Water Melon, Melon, Marrow Egg-plant, Grape, Guava, Fig, etc.

Alexandria region is situated in a comparatively suitable climate zone for most of the plants growing. Accordingly, cultivation seasons are not always divided clearly as tomato, potato, other vegetables are planted three times in a year.

Seasons of seeding, planting or transplanting and harvesting are presented in Tab. 2-8-16 for the major crops cultivated in the Alexandria region. This Table was prepared based on the data, informations, and discussions with professors of the faculty of Agriculture, Alexandria University.

(3) Application of Compost

Characteristics of Barnyard Manure and Compost

Prior to conducting the fertilizing design for the major crops, data on barnyard manure and compost are collected from several study reports to obtain fundamental chracteristics for design considerations. Tab. 2-8-17 and 2-8-18 indicate the analysis data of barnyard manure and of the compost derived from municipal wastes respectively.

From these tables, contents of fertilizer components in barnyard manure and in compost were determined as follows.

- Chracteristics of Barnyard Manure

  Component of Three Major Elements
  N: P_2O_5: K_2O=0.5%: 0.25%: 0.5%(Wet Base: 75% Moisture Content)

  N: P_2O_5: K_2O=2.0% : 1.0% : 2.0%(Dry Base)

  Amount of Three Major Elements per ton
  N: 5.0Kg, P_2O_5: 2.5Kg, K_2O: 5.0Kg

  Efficiency compared to Chemical Fertilizer
  N: 70%, P_2O_5: 70%, K_2:90%

  Amount of Three Major Elements per ton in Conversion to Chemical Fertilizer
  N= 3.5Kg, P_2O_5= 1.75Kg, K_2O= 4.5 Kg

- Characteristics of Compost Derived from Municipal Wastes

  Component of Three Major Elements(Dry Base)
  N: 1.24 - 2.30%, Ave. 1.73%
  P_2O_5: 0.48 - 3.57% Ave. 1.13%

  K_2O: 0.61 - 3.13% Ave. 1.89%

  Amount of Three Major Elements per ton (Wet Base:30%)
  N: 12.1Kg, P_2O_5 7.9Kg, K_2O: 13.2Kg

  Efficiency compared to Chemical Fertilizer
  Same as the Barnyard Manure

  Amount of Three Major Elements per ton in Conversion to Chemical Fertilizer.
  N: 8.5Kg, P_2O_5 : 5.5Kg, K_2O: 11.9Kg

Fertilization Design

Standard fertilizing rate of major crops are tabulated in Tab. 2-8-19. These datum were obtained from the office of the Ministry of Agriculture in Alexandria and also collected in Japan.

Proper timings and comparatively large amount of fertilizing by organic manure brings in sufficient growth of the plants without application of chemical fertilizer. However, as reported in many literatures, application of organic manure gives better effects on the plant growth when the chemcial fertilizers are added together.

This effect occurs as a result of the nature of slow-acting and soil conditioning effects of organic manure usually applied as a basal dressing and the nature of quick-acting effects of chemical fertilizer applied as a top or side dressing giving sufficient nutrients and trace elements under the improved soil conditions.

Newly reclaimed land requires more fertilizer than the amount to be applied on the existing cultivated land since the newly reclaimed land contain less humus and nutrients in the soils. However, after years of cultivation by manuring, fertilizing components increase in the soils up to a certain level, which is almost same level with the existing agricultural lands.
After due consideration of the conditions described above, fertilizing design was conducted to determine the amount of fertilizing using chemical fertilizer with barnyard manure for the existing cultivated lands and presented in Tab. 2-8-20.

The fertilizing rates tabulated in the Table were determined by referring to the standard fertilizing amount practiced in Egypt which has already been shown in Tab. 2-8-19. Amount of basal manures were obtained from the standard fertilizing design suggested by Chiba Prefectural Government in Japan.

As described hereinbefore, organic manure is used as a basal dressing applied in prior to cultivation or during the preparation of lands for seeding. It is also reported that the application of basal dressing in proportion of 2/3 to 1/2 of organic manure with the remaining amount supplemented by chemical fertilizers gives good effects in the plant growth.

With this regard, application amount of compost is based on applying 2/3 of the total basal manure requirement for cereal crops such as wheat, barley, etc. and 1/2 for vegetable crops and fruits.

Tab. 2-8-21 represent a method of computation based on the amount of N component shown in Tab. 2-8-20. In computation, N content was determined at 8.5Kg in one ton of compost. However, application of compost to rice and clover were not considered with reference to the present cultivation method practiced in the Alexandria region even though the application of compost gives good effects on the plant propagation process. As a result of computation, the compost demand for each crop type is shown as follows.

Type of Crops	Planned Compost Demand (ton/ha)
Barley/Wheat	15
Broad Beans	10
Maize	20
Potato/Tomato	20
Egg-plant	10
Other Vegetables	10
Grapes	10
Other Fruits	5

Finally, Tab. 2-8-22 was prepared as fertilizing design of major crops using compost with chemcial fertilizers, which was determined from the gross three major elements shown in Tab. 2-8-20 and the amount of the components obtained in conversion of compost application amount shown in Tab. 2-8-21.

(4) Demand Prediction

In prediction of compost demand within the Alexandria Governorate, the season of compost application was determined at the time of preparation of the fields for the forthcoming seeding season of each crop, in other words, compost is applied as a basal manure.

Compost demand fluctuates seasonaly since the crop is seeded, planted or transplanted in accordance with the nature of respective crop type. Tab. 2-8-23 indicate the month of compost application by crop type. The Tab. indicate that compost for the summer crops is applied from January to April and from August to November for the winter crops.

Demand prediction is carried out for the present(1985) and the future(2005). To simplify the computation, following items are taken into consideration as premises.

- Area of future cultivated land is determined on the basis of the land use Map prepared with the Comprehensive Plan of Alexandria for 2005 and the same type of crops shall be planted.

- Compost demand is predicted on the lands under cultivation and the loading of compost change with the type of crops but not with the type of the soils.

- Compost is applied as a basal manure and used with chemical fertilizers. From 2/3 to 1/2 of the total requirement of nitrogen of the bassal manure is supplied by compost.

- Demand of chemical fertilizer is predicted only for reference tentavively determining the month of fertilizing to be the same as the compost application month.

Secondly, following matrixes were prepared for prediction of the demand of compost and chemical fertilizers in each month.

Matrix A: Crop type/Month of application/planted area

	Month	Barley/Wheat	B. Beans	- - -	Other Fruits
	Jan	$a_{1\cdot1}$	$a_{1\cdot1}$	- - -	$a_{1\cdot m}$
	Feb	$a_{3\cdot1}$	$a_{3\cdot2}$	- - -	$a_{3\cdot m}$
A(ha) =	Mar	$a_{3\cdot1}$	$a_{3\cdot2}$	- - -	$a_{3\cdot m}$
	-	-	-	- - - - -	
	-	-	-	- - - - -	
	-	-	-	- - - - -	
	Dec	$a_{12\cdot1}$	$a_{12\cdot2}$	- - -	$a_{12\cdot m}$

Matrix B: Fertilizer type/Crop type/Unit fertilizing amount

	Crop Type	Compost	- -	K_2O
	Barley/Wheat	$b_{1\cdot1}$	- -	$b_{1\cdot n}$
	B.Beans	$b_{2\cdot1}$	- -	$b_{2\cdot n}$
B(ton/ha) =	Cabage/Cauli.	$b_{3\cdot1}$	- -	$b_{3\cdot n}$
	-	-	- -	-
	-	-	- -	-
	Other Fruits	$b_{m\cdot1}$	- -	$b_{m\cdot n}$

Matrix C: Fertilizer type/Month of application/Fertilizing amount

	Month	Compost	- -	K_2O
	Jan	$c_{1\cdot1}$	- -	$c_{1\cdot n}$
	Feb	$c_{2\cdot1}$	- -	$c_{2\cdot n}$
C(ton) =	Mar	$c_{3\cdot1}$	- -	$c_{3\cdot n}$
	-	-	- -	-
	-	-	- -	-
	-	-	- -	-
	Dec	$c_{12\cdot1}$	- -	$c_{12\cdot n}$

Compost demand is computed by the following equation.

Matrix C = Matrix A X Matrix B

As a result of computation, compost demand or Matrix C is obtained as the figures shown in Tab. 2-8-24 and 2-8-25 for the year in 1985 and 2005 respectively. Fig. 2-8-9 indicates the monthly demand plotted from the Matrix C. Also, the annual compost demand is summed up from the Tables and shown as follows.

(Unit: 1,000 ton/year)

Year	Compost	Chemical Fertilizer (Component)		
		N	P_2O_5	K_2O
1985	577	5,928	2,423	994
2005	667	6,824	2,792	1,135

When the compost is not applied, the demand of chemical fertilizers increase subsequently and are computed from the different fertilizing rates. The result is indicated in Tab. 2-8-26 and 2-8-27 for reference. Annual demand of chemical fertilizers are therefore obtained as the amount in the followings.

(Unit: 1,000 ton/year)

Year	Compost	Chemical Fertilizer (Component)		
		N	P_2O_5	K_2O
1985	0	10,835	5,150	6,253
2005	0	12,490	5,942	7,207

2.8.5 Supply of Compost

(1) The potential compost demand was estimated at 577 thousand ton per year in 1985 and at 677 thousand ton per year in 2005 in the previous Section 2.8.4.

In this section 2.8.5, supply potential of compost is to be predicted in order to study a balance between the supply and the demand of compost with regard to the total compostable materials in the Alexandria region.

Following organic materials were selected for the alternative materials of compost available in the region.

- Municipal solid wastes
- Animal manure
- Sewage sludge
- Peat moss
- Agricultural wastes

Prediction of the quality of compost is based on the plant capacity of 460 ton per day (existing plant 160 ton/day and proposed plant 300 ton/day by the weight of raw garbage base) by assuming the moisture content of the matured compost is 30%. Also, the prediction of animal manures and sewage sludge are carried out on condition that the moisture content is adjusted at 10% after fermenting and drying as practiced generally in this region.

Total supply quantity of all the compostable material is then converted into the amount of compost derived from municipal wastes to examine the balance of compost demand and supply.

Details are discussed further in the following paragraphs.

(2) Compostable Material

Municipal Solid Wastes

Total production amount of compost is estimated from the plant capacity of the existing plant (160 ton/day) and the proposed plant (300 ton/day). In estimation, these plants are operated by the rated capacity for 300 days in a year or 82% of operation ratio. Then, annual production amount of compost is obtained from the following calculation assuming the conversion rate of the compost from the raw garbage by 25%.

$$Q \text{ (ton/year)} = (160 + 300) \text{ t/d} \times 300 \text{ days} \times 25\%$$
$$= 34{,}500 \text{ ton/year}$$
or
$$= 2{,}875 \text{ ton/month}$$

Animal Manure

Number of livestock animals breeded within the Alexandria Governorate area is indicated in Tab. 2-8-28.

Among the animal breeded, excrements of cattle and fowls are recovered for the animal manure. Excrements from other animals such as goats, sheeps, etc. are considered very difficult to recover due to the situations of

breeding, they are breeded in pasture. Further, for pigs, only a limited numbers are breeded mostly by zabaleen and the amount of excrements is negligible.

i. Number of Cattle

Fig. 2-8-10 indicates the numbers of cattle breeded in the last 11 years quoted from Tab. 2-8-28 and the future trend line drawn by extending the past rising trend. From the Figure, numbers of cows and bulls in 2005 reaches 76,000 heads which is increased 49% from the numbers in 1985. Also, the number of buffaloes amount to 47,000 heads in 2005 with the increase of 29% of the numbers in 1985.

Meanwhile, the cattle breeded in 1985 is itemized in the following number of the adult and calves

Cattle	More than 2 years	Less than 2 years	Total
Cows and Bulls	41,273	9,807	51,080
Buffaloes	31,255	5,215	36,470

Breakdown of the cattle numbers are estimated by the same ratio with the 1985 and shown in the followings.

Cattle	More than 2 years	Less than 2 years	Total
Cows and Bulls	61,600	14,400	76,000
Buffaloes	40,400	6,600	47,000

ii. Number of Chicken

Tab. 2-8-29 and 2-8-30 indicate the number of meat chickens and laying chickens in 1979. Total numbers of chickens in 1979 are shown as follows together with the numbers being breeded at present as of 1985.

Type	1979	1985
Meat Chickens	5,726,000	10,202,000
Laying Chickens	557,000	650,000

Number of laying chickens in future are listed as follows quoted from Tab. 45, Comprehensive Plan of Alexandria for 2005.

Year	Average Egg Production per year	Number of Laying Chicken (1000)
1985/90	40 million eggs	222.2
1990/95	95 " "	527.7
1995/2000	170 " "	944.4
2000/2005	250 " "	1388.8

Assuming the increase of meat chickens similarly to that of the laying chickens, total number of meat chicken in the period 2000 - 2005 amount to 21.7 million heads by the increment of 2.13 times from 10.2 million heads in 1985. However, it should be reminded that the meat chicken breeding is rotated 5 times in a year resulting in the numbers of breeding chicikens in one day amounting to one fifth of the annual breeding numbers.

iii. Generation Rate of Animal Manure

Generation rate of animal excrement is reported in many literatures. In this study, only dungs are the subject of considerations for the animal manures to be recovered. The generation rate of the different type of animals are presented as follows.

Cattle:	:	25	kg/head/day	(82% moisture content)
Young Cattle:	:	12.5	"	(" " ")
Meat Chicken	:	0.12	"	(75% " ")
Laying Chicken	:	0.12	"	(" " ")

When the animal manures are fermented and dried for a month or two months, moisture content decreases till 10%. Therefore, the generation rate of the animal manures are accounted as the weight of the final products shown below.

Cattle	:	5	kg/head/day	(10% moisture content)
Young Cattle	:	2.5	"	(" " ")
Meat Chicken	:	0.033	"	(" " ")
Laying Chicken	:	0.033	"	(" " ")

These figures represent the recovery rate of the animal dung by 100%. In general, recovery rate is about 80% for the cattle and almost 100% for the chickens breeded in the growing stations. However, in this study, recovery rate is determined at 100% for both cattle and chickens with the intention of estimating the total potential of the animal manure supply and it makes the demand and supply study in the safe side.

Quantity of daily manure to be produced within the Alexandria Governorate region in 1985 and in 2005 are indicated in Tab. 2-8-31. From the Table, monthly and annual generation quantities are calculated as follows.

Type of Animal	Quantity of Animal Manure (ton)			
	1985		2005	
	Monthly	Annual	Monthly	Annual
Cattle	12,000	144,000	16,890	202,680
Chicken	2,640	31,680	5,670	68,040

Sewage Sludge

As already mentioned, at present, all sewage is discharged into the Medeteranean Sea and the Lake Maryut without leaving any sludge available for the utilization as one of the compostable material.

The Governorate plans to consturct sewage treatment plant by 1990. With the plant, generation quantity of the raw sludge is estimated at 38,500 m^3/day. When the plant is operated in 2005, sewage sludge is generated 385 ton/day as dry base.

In Egypt, sewage sludge is generally dehydrated on the drying beds to leave the moisture content about 10% for the use of organic manure from the sewage. Accordingly, the daily generation rate of the dried sewage sludge (10% moisture content) is estimated at 428 ton/day, equivalent to 12,840 ton/month or 154,080 ton/year.

Peat Moss and Agricultural Wastes

Currently, utilization of peat moss and agricultural wastes are practiced in a very limited area due to the traditional reasons mentioned in Section 2.8.3. Agricultural wastes are used for purposes other than the farm yard manure or green manure. While the peat moss is imported for the particular use by horiculture and plant nursery.

Judging from the traditional way of utilization of the agrecultural wastes and the price of peat moss, for the time being, possitive use of these compostable materials are not expected. Accordingly, agricultural wastes and peat moss are neglected as supply sources.

(3) Demand and Supply Balance

Conversion of Different Type of Compostable Materials into the Amount of the Compost from Municipal Wastes

Demand of organic manure within the Alexandria region is predicted as the amount of compost derived from municipal waste. However, the organic manures are supplied not only from the compost but also from any kind of compostable materials such as the animal manures and sewage sludge.

Each type of compostable material is different in the fertilizing effects especially due to the amount of three major elements contained in the material.

With this regard, it its necessary to convert all the compostable material into the amount equivalent to the municipal waste compost for the purpose of concluding the study on the balance between the demand and supply capabilities.

Conversion to the quantity of compost is carried out on the basis of the content of nitrogen content and the ration of effectiveness against chemical fertilizer which are inherent in each compostable materials by the result of composting.

Tab. 2-8-32 indicates the nature of each compostable material with respect to the nutrient components. Referring to the Table, nitrogen content of each compostable material was determined to be the fundamental factor for conversion and tabulated in Tab. 2-8-33 and 2-8-34 with the conversion rate to compost. The conversion rate was calculated from the proportion of nitrogen content in one ton of compost and other compostable materials to be converted.

Consequently, the supply amount of all the compostable materials obtained in the previous paragraph was re-predicted by the conversion rates. The result is presented in Tab. 2-8-35.

Therefore, the total amount of compostable materials produced in the Alexandria region amount to 220 thousand tons in 1985 and to 652 thousand tons in 2005 as of the amount equivalent to the compost from municipal wastes.

In final, the balance between the demand and supply of compost is computed from the figures obtained above and listed as follows.

	1985	2005
Supply (1,000 ton/year)	220	652
Demand (" ")	577	667
Balance (" ")	-357	- 15

As a result, demand exceeds the supply in 1985 and 2005. However the deficiency is becoming small toward the future due to the rapid increase of animal manure and sewage sludge planned to be discharged from 1990.

Deficiency of compost in 2005 was predicted at 15,000 ton/year. This amount is equivalent to the 200 ton/day compost plant on condition of the conversion rate of compost at 25% and 300 days operation in a year.

But, to the contrary, judging from the fact that all the farmer do not always apply compost to their land or, in other words, a marchant can not sell all his goods to the consumers, total capacity of 460 ton/day of the compost plant would be the maximum plant capacity in view of the result of the demand and supply study predicted for within the governorate region.

2.8.6 Marketing of Compost

(1) Fluctuation of Compost Demand and Storage Considerations

With regard to the compost marketing, seasonal fluctuation of the demand and the constant supply are the key factors on the occasion of compost sales in consideration of the stock yards for shipping. If the organic manure is not available at the time of plowing of the land for the coming planting season, effects of compost application become less even though the organic manure is applied later on.

On Fig. 2-8-11 the monthly accumulated amount of the demand and the supply amount of organic manures generated in the region are drawn. The difference in two curves in the Figure represent a required storage amount or a surplus amount of supply. No surplus amount is recognized from the Figure. It is evident that the maximum storage requirement of all organic manure produced in the region amount to 55 thousand tons in June, 1985 and to 166 thousand tons in November, 2005.

Huge storage area is seemed to be required over the entire agricultural area to keep organic manures for the timely application the land. However, the storage area would not be a problem of the respective farmer. Namely, if the land requires 50 m^3/ha (20 ton/ha) organic manures, required storage area is roughly calculated 6 x 6 m in area with 1.5 m high piling. This area is equivalent to only 0.36% of the cultivated land per hectare.

From this calculation, it is suggested that the required storage area of compost occurs from the demand and supply imbalance that shall be provided on the respective cultivated land of the farmer.

(2) Marketing System

As described in Section 2.8.3, currently, animal manure is marketed by the dealers in Abu-El Matameer village in Baheira Governorate. Manager of Abis compost plant contacted the animal manure dealers in order to contract for the marketing and distribution of the compost.

The prospective annual contracts would establish agreements for purchase and distribution of compost from the plant at a set schedule.

There are many merits to adopt this marketing route because the dealers have established an efficient marketing network with well defined clients, large storing areas, and cheap transportation means.

Unfortunately, the response of the dealers at present is not possitive. However, it is believed that more time is needed untill the advantage of compost will become obious among the farmers and in turn increase demand for the compost. Only then, the dealers will enter the compost market with the aim of dealing in a new business good.

In any cases, more negotiations of the plant manager and the dealers will be necessary.

The other great possibility of the compost marketing is held by the Credit and Development Agricultural Banks. There are six branch offices of the banks in Alexandria Governorate which sell the quotas of chemical fertilizers and agricultural chemicals to the farmers at a subsidized cost on installment.

Since the Bank have established distribution system of chemical fertilizers, compost produced from the New Abis compost plant will possibly be well marketed through the channels of the Banks.

Moreover, the Banks could establish a policy which forces farmers to add organic fertilizers for the efficient utilization of chemical fertilizers for the increase of crop productivity.

As a result, two possibilities for the marketing route for the Abis compost are suggested. Either one or both of them will be served by compost dealers, however, this suggestion will need to be examined in detail before being implemented.

2.8.7 Effects of Compost Application

(1) Effects of Composting

Composting of municipal wastes is of great effect from both the public health and the agricultural points of view.

Health aspects are achieved not only by composting but also by incineration. Improved living environments associated with sanitary treatment and disposal of solid wastes prevent the residents from suffering diseases by means of the destruction of the causative organisms of the faecal-borne diseases or their removal from the environment.

Incineration of solid wastes accomplish the satisfactory control of these diseases as well as the incineration completely achieve the destruction of the pathogens.

In the process of composting, temperature of the compost pile rises 60 to 65 C due to the fermentation of organic materials. Many literatures report that the pathogenic bacterias will be unable to survive when all parts of a compost pile are subjected to temperatures about 55 to 60 C for longer than 30 minutes to one hour. From this fact, it is evident that composting of solid wastes contribute to the improvement of public health.

However, qualitative evaluation of the effects of composting by itself would be almost impossible since there are many factors that affect the improvement of public health. In these factors, water supply, sewage treatment and other environmental facilities are involved complicatedly in addition to the solid waste management.

With regard to the agricultural aspects, effects of composting arise from the application to agricultural lands. These effects are recognized as the improved soil conditions which bring on preferable environment for the plant growth originated from the supply of humus and nutrients by the application of compost to the soils.

Particularly in Egypt, most of the soils in arid lands contain organic matters with only 2% or less amount and it requires the fertilization by organic manures prior to the cultivation as well as the construction of irrigation canals.

Soil conditioning effects are contributed due to the existence of humus in the soils. In other words, humus from the organic manures has properties valuable to soil conditioning.

Effects of humus to the improvement of soil condition and growing vegetation are summarized as follows.

- Improves physical character: Organic matter markedly improve the physical character of the soil, making it easier to till. Organic matter supports earth worms which in turn keep the soil porous, thus greatly increasing aeration. During heavy rains these worm holes and porous soil texture increase percolation which reduces surface runoff and erosion.

- Increases moisture holding capacity: The organic matter is very absorptive of moisture and holds it like a sponge. Thus, in periods of drought, a crop planted in fields containing large amounts of organic matter will remain green and grow, whereas crops in soil without organics may wither and die.

- Reduces leaching of chemical fertilizer especially nitrogen and phosphorous: The presence of adequate organic matter reduces the amount of chemical fertilizer required by as much as 40%. This is largely due to the prevention of leaching. With the organic matter present, the water does not wash the chemical fertilizer out of the soil as it does in barren soils. Nitrogen added as a fertilizer is in a soluble state and can be readily leached away from a barren soil, however, in the presence of organic matter and biological activity, large portion of this soluble nitrogen is converted into organic nitrogen as micro-organism bodies. As these micro-organisms die, the nitrogen again becomes available to the plant roots. In the interim period, it is neither lost by leaching nor by loss to the atmosphere, in the form of ammonia. The same phenomenon occurs with phosphorous. About 95% of the soluble phosphorous can, as shown by actual test, be converted into organic bodies and living protoplasm, and released slowly to the plant rather than being lost by leaching.

- Healthy biological activity stimulates root growth: Experiments by soil scientists indicate that the presence of organic matter is a prerequisite to a healthy biological activity of the soil, and the presence of a healthy biological activity in the soil is very stimulating to root growth. Roots have been shown to grew several times as fast where organic matter is high, as compared with ordinary barren soil.

- Makes otherwise insoluble minerals available to plants: Biological activity in the soil is also essential to the breakdown of many insoluble mineral compounds required for healthy plant growth, such as rock phosphates. Without the presence of organics, valuable minerals would be unusable by crops.

- Regarding the effects of compost when applied to the soils, study is carried out hereinafter with the following three benefits which are considered to be possible of qualitative analysis.

(2) Increasement of Crop Productivity

Because of the properties of compost as the organic soil conditioner and the supply source of various nutrition elements, susceptibility of crops to parasites and infectious diseases is decreased to effect the promotion of the plant growing. Consequently, the yield of crops increase remarkably especially in loose sandy soils, in heavy clay soils, and in saline and alkaline soils. Benefit of the increased yield is calculated as indicated in the flow diagram hereunder.

BENEFIT CALCULATION FOR THE INCREASE OF CROP PRODUCTIVITY

Compost Production:
300 t/d x 300 day x 25%
= 22,500 ton/ye ar

Rate of increasement of crop productivity is determined at 30% from the references attached.

Compost is applied to the major crops shown below
Cereal Crop;Winter Crop;Wheat
Vegetables;Summer Crop;Tomato
Fruits Tree;Year-round;Grape

Import price is applied to the price of wheat. Market prices are applied to the prices of tomato and grapes.

Planted area of the crops are obtained from the ratio of the present planted area
Cereal Crop;36,692 fed.;34%
Vegetalbes;56,429 fed.;52%
Fruits Tree;15,973 fed.;14%

Method of Calculation;
(Yield per ha) x (Rate of Increase)
x (Application Area by Crop Type)
x (Price of Crop)

Application rate of compost is determined as follows;
Wheat ;15 t/ha
Tomato;20 "
Grape ;10 "

Crop	Yield (t/ha)	Rate of Increse (%)	Appli. Area (ha)	Unit Price (LE/t)	Benefit (LE)
Wheat	2.157	30	453	160	47
Tomato	15.714	30	692	300	979
Grape	8.809	30	186	750	369
Total	-	-	1,331	-	1,395

Average application amount of compost per ha is obtained from the cultivation of the objective crops by the calculation shown below;
15 t/ha x 34% + 20 t/ha x 52%
+10 t/ha x 14% = 16.9 t/ha

Application Area with the Compost from 300 t/day Plant;
22,500 t/yr / 16.9 t/ha = 1,331 ha

Planted Area of Each Crop Within the Application Area of 1,331 ha;
Wheat ;1,331 ha x 34% = 453 ha
Tomato;1,331 ha x 52% = 692 ha
Grape ;1,331 ha x 14% = 186 ha

REFERENCES ON THE TEST DATA WITH REGARD TO THE EFFECT OF COMPOST APPLICATION TO THE CULTIVATED LAND

DATA 1

SOURCE: "Yukibutsu Seyoo no Riron to Oyo" (Theory and Application for Utilization of Organic Materials), Issued by Nosan Gyoson Bunka Kyokai (Cultural Association of Agricultural and Fishing Communities) -- NGBK, Japan

Tab. 4.2 EFFECTS OF APPLICATION OF FARMYARD MANURE BY CROP TYPE

Crop Type	No. of Test Field	Yield Index of to the Control Applied by N,P,K Fertilizer (Average)	Ave. Appli. Rate (t/ha)	Remarks
Sugar Beet	3	99	2.38	
Maize	10	126	1.57	Including soiling dent corn, sweet corn
Pulse	8	123	1.68	Including kidney bean, soy bean, peanut
Tubers	18	118	1.55	Including potato, sweet potato
Wheat/ Barley	36	131	1.30	Including barley, wheat, naked barley, oat's
Other	15	115	1.30	Including sorgo, Italian ryegrass, rice lettuce, onion, radish etc.
Sub-T	90	125	1.55	Field Crops Total
Rice 1	40	110	1.05	Well-drained paddy
Rice 2	16	111	1.18	Wet paddy
Sub-T	56	110	1.10	Rice Total
Total	146	119	1.38	Field Crop + Rice

Note: Results from the continous application of farmyard manure conducted by the Prefectural Agricultural Experiment Stations in Japan. May, 1973

DATA 2

SOURCE: DITTO

Tab. 7.5 EFFECTS OF APPLICATION OF COMPOST AND OF SLUDGE

Year		1965 Summer	1965 Winter	1966 Summer	1966 Winter	1967 Summer	1967 Winter	1968 Summer
Control		100 6,240kg	100 258kg	100 162kg	100 286kg	100 652kg	100 302kg	100 647kg
Compost/Every Cropping	2t	126	125	132	111	131	127	144
Compost/Every Year	4t	139	125	148	107	130	135	138
Compost/ Every Other Year	8t	129	132	128	112	118	137	146
Compost	16t	156	146	160	121	133	137	131
Sludge/Every Cropping	2t	102	150	158	117	120	130	141
Sludge/Every Year	4t	146	127	156	113	137	138	134
Sludge/ Every Other Year	8t	151	125	133	114	128	143	127
Sludge	*16t	169	152	154	124	135	127	119
Farmyard Manure	*16t	168	142	152	117	120	128	114

Note: 1) The figures represent the yield index against the control in kg/10 a.

2) Summer Crop: Sorgo (Sweet Potat in 1966 only)
Winter Crop: Naked Barley (Wheat in 1965 only)

3) * indicates the application of the manure only in the first year of the start of the experiment.

DATA 3

SOURCE: Environmental Quality International, Cairo, Egypt

The benefits of compost have been amply demonstrated under a wide range of climatic conditions. Crop yields with compost have been tested with a variety of crops. For example, the Buhler Brothers' Company has tested the effects of composting on wheat, barley, and orchard crops. In these tests, the compost load was 47 m^3 (density: 400 kg/m^3) for the sandy soil prevailing in the Arab Emirates. In response, crop yields increased from 28 to 120 percent, with a decrease in water requirements ranging from 18 to 63 percent, depending on the crops being grown.

DATA 4

SOURCE: Agricultural Research Center, Cairo, Egypt

Tab. (1) EFFECT OF PROLONGED APPLICATION OF CHEMICAL FERTILIZERS AND ORGANIC MANURES ON CROP YIELDS (EVALUATION OF RESULTS 1919-1955, VALUES ARE GIVEN AS % OF THE CONTROL)

Corp	Control	Mineral Fertilizers		Organic manuring
		Nitrogen	Nitrogen + Phosphorus	
Cotton	100	143	188	181 (96)
Wheat	100	147	192	264 (138)
Maize	100	155	229	245 (107)
Clover	100	100	265	437 (165)

Source: Alaa El-Din et al ; (1983)

( ) indicate the index corresponding to the (N + P).

DATA 5

SOURCE: DITTO

TAb. (2) EFFECT OF PROLONGED APPLICATION OF CHEMICAL FERTILIZERS AND ORGANIC MANURES ON CROP YIELDS AND THE SOIL CONTENTS OF PLANT NUTRIENTS (AVERAGE VALUES OF 43 YEARS EVALUTION OF PERMANENT EXPERIMENT OF BAHTEEEM)

		Control	Chemical Fertilizers			Organic manuring
			N*	NP**	NPK***	
Crop Yield % (1959-1962)		100	151	165	143	212.5 (149)
Organic matter	%	1.08	1.16	1.17	1.17	2.51
Total nitrogen	%	0.072	0.077	0.077	0.076	0.153
NH^{+}_{4} - N	ppm	4.2	5.1	4.2	5.1	9.2
$NO^{\sim}_{3}$ - N	ppm	15.9	17.2	17.0	17.7	29.4
P_2O_5	ppm	56.1	51.2	104.4	101.6	313.2
p^H		8.2	8.4	8.3	8.3	7.6

( ) indicate the index corresponding to the (N + P + K).

* N = Nitrogen

** NP = Nitrogen + Phosphorus

*** NPK = Nitrogen + Phosphorus + Phtassium

Source : Taha et al; (1966)

(3) Saving of Chemical Fertilizer

By the application of compost, nutrients such as N, P, and K are supplied to the soils. It is therefore possible to reduce the chemical fertilizers adding to the soils by the amount equivalent to the effective fertilizing components contained in compost. Calculation of the benefit of the decreased amount of chemical fertilizers are shown in the followings.

Benefit Calculation for the Saving of Chemical Fertilizer

Same crop type is applied as follows;
Cereal Crop;Winter Crop;Wheat
Vegetables;Summer Crop;Tomato
Fruits Tree;Year-round;Grape

Import price of chemical fertlizer is applied.(C & F in Alex. Port)

Application Rate of Chemical Fertilizers in Single Use; (Kg/ha)

Crop	Component N	P_2O_5	K_2
Wheat	210.5	75	90
Tomato	365	170	205
Grape	270	125	150

Method of Calculation;
(Saving amount by Component)/ (contents in Fertilizer) X (Appli. Ares) X (Price of Fertilizer)

Application Rate of Chemical Fertilizers when compost is Applied together;(kg/ha)

Crop	Component N	P_2O_5	K_2O	N
Wheat	82.5	0	0	
Tomato	195	60	0	
Grape	85	70	31	

Saving Amount of Chemical Fert. When Compost is Applied;(kg/ha)

Crop	N	P_2O_5	K_2O
Wheat	127.5	75	90
Tomato	170	110	205
Grape	85	55	119

Some application area is applied as follows;
Wheat;453 ha
Tomato;692 ha
Grape;186 ha

Contents of Component in the Chemical Fertilizers Actually Applied;
Ammonium Sulfate; 20 % as of N
Superphosphate; 45 % as of P_2O_5
Potassium Sulfate; 33 % as of K_2O

Fert. Type	Crop Type	Saving Amount (kg/ha)	Contents In Fert (%)	Appli. Area (ha)	Unit Price (LE/t)	Benefit (LE)
	Wheat	127.5	20	453	94	27
	Tomato	170	20	692	94	55
	Grape	85	20	186	94	7
	Sub-T	-	-	-	-	89
P	Wheat	75	45	453	160	124
	Tomato	110	45	692	160	27
	Grape	55	45	186	160	4
	Sub-T	-	-	-	-	43
K	Wheat	90	33	453	227	28
	Tomato	205	33	692	227	98
Grape	Grape	119	33	186	227	15
	Sub-T	-	-	-	-	141
	Total	-	-	-	-	273

(4) Saving of Irrigation Water

The aggregation of soil particles of crumbling property promoted by humus originated from compost contributed to increase the water-retention capacity of the soil and it makes available to save the irrigation water.

Benefit is caluculated from the difference of the construction costs of the irrigation canals tentatively designed for the lands with and without compost application for convenience of the study purposes. Method of calculation is shown as follows.

Irrigation Water Consumption of the Saving of Irrigation Water

Irrigation Watar Consumption in Egypt:
6,500 cmy/feddan=15,000 cm/ha

Various water loss from the canal is determined by 20 % of the flowrate

Rate of the Irrigation Water Saved by Compost Application: 40%

Flowerate to Supply Unit Cultivated Area After Compost Application:
18,600 cmy X 60 % = 11,160 cmy/ha

Irrogation area is determined at the same area with the compost application area at 1,331 ha.

For the calculation of the sectional area of the canal, Manning equation is applied by the conditions;
n=0.02, i=1/100

Clearance
0.5 m
x m Water Depth
0.5 m 1.5 m, Sediments

Result of Calculation
-Without Compost Application

4.43.m
0.5 m
0.465 m
0.5 m
1.5 m

Sectional Area:4.344 sqm
- With compost Application

4.19 m
0.5 m
0.354 m
0.5 m
1.5 m

Sectional Area: 3.827 sqm

Condition of Construction of Canal

canal Ag. Land
100 m
(1,331 ha)

(66,550 m) 100 m

Method of Caculation:
Benefit estimated from the balance of the construction and maintenance costs between the canal in the cases of with and without compost application.
Construction Cost:(1,735 -

- 1,528) X 10^3= 207 X 10^3 LE

Maintenance Cost:(3 % of the

construction cost)= 6 X 10^3 LE/y

Tab. 2-8-1 PLANTED AREA OF MAJOR CROSS IN EGYPT

(Unit: 1000 feddan)

Crop Type	1952	1976	1981
Winter Crop (Total)	4,364	5,042	5,105
Wheat	1,402	1,396	1,400
Clover	2,202	2,757	2,778
Beans	355	298	282
Other	405	591	645
Summer Crop (Total)	3,026	5,122	4,994
Cotton	1,967	1,248	1,178
Rice	362	1,074	954
Millet	378	446	400
Maize	27	1,490	1,434
Sugar Cane	92	243	251
Vegetables	118	389	428
Other	82	232	349
Nile Corp (Total)	1,824	734	795
Maize	1,677	401	489
Vegetables	71	186	165
others	76	150	141
Fruit Tree	94	313	368
Total	9,308	11,211	11,259

Source: Statistical Yearbook 1982.

Tab. 2-8-2 RATE OF YIELD OF MAJOR CROPS PRODUCED IN ALEXANDRIA GOVERNORATE

Crop	Crop Yield (ton)		Production Rate of
	Egypt	Alexandria	Alexandria (%)
Wheat	13,307,431	27,544	0.21
Barley	1,097,322	72,859	6.64
Maize *1	19,522,244	58,108	0.30
Rice	2,439,965	9,690	0.40
Potato	1,094,248	39,310	3.59
Dry Beans *2	1,340,567	6,769	0.50
Broad Beans	164,488	31,600	19.21
Tomatoes	2,861,661	125,759	4.39
Marrow	464,113	49,844	10.74
Green Peas	113,292	7,698	6.79
Cauliflower	94,518	16,014	16.94
Cabbage	383,731	32,745	8.53
Egg-plant	296,853	23,190	7.81
Watermelon	1,141,907	46,391	4.06
Clover *3	2,736,719	31,087	1.14
Olive	8,090	386	4.77
Apricots	59,935	2,091	3.49
Fig	9,454	4,478	47.37
Guava	115,963	17,403	15.01
Citrus	1,105,503	12,801	1.16
Grape	343,483	14,039	4.09

Note:
*1 Unit: Erdab (One Erdab is equivallent to 150 kg to 155 kg depending on type)
*2 Unit: Erdab, data in 1981
*3 Platend area in feddan

Tab. 2-8-3 TOTAL RECLAIMED AND TRADITIONAL CULTIVATED LAND AREAS

Type of land	Area (feddans)			
	Maamoura	Khorshed	Ameriyah	Total
Reclaimed land	-	-	61,449	61,449
Traditional farm land	10,761	14,975	10,844	36,580
Total	10,761	14,975	72,293	98,029

Source: Environmental Quality International (EQI), Cairo, Egypt

Tab. 2-8-4 TYPICAL FARM LAND IN ALEXANDRIA GOVERNORATE BY PLANTED AREA, TYPES OF CROPS, AND NATURE OF SOIL

Farm Owner	Location	Planted area (feddans)	Type of Crop		Nature of Soil
			Winter	Summer	
Hussam El Moshedy	El-Masaref-Kom Esho	44	Clover+Barley	Maize	Black
Abdel Hadi Ahmed Abbas	Baghdad Village Maryout Zone	10	Tomatoes	Watermelon+Maize	Sandy Black Calcareous
Abdel Sayed Abdel Latif	El Gazaer Village	10	Figs	Grapes+Watermelon	Sandy Black Calcareous
Abdel Latif Radwan	El Gazaer Village	4	Courget+Carrots	Tomatoes	Black Sandy Calcareous
Maryout Agricultural Co. (Mohamed Gamal Gaafar)	Maryout	23,656	Clover+Wheat+Barley + Green vegetables	Maize+Melon+Clover	Black Sandy Clacareous
Nour el Din el Sherif	Khorshed	85	Oranges	Pears	White Calcareous
Abdel Rahman Khalifa	Hosh 4 - El Basra Village Maryout Zone	10	Beans	Watermelon	Black Sandy Calcareous
El Nahda Co. (Makhlouf & Shafik)	Km 30 Alexandria - Cairo Desert Road	(2,976)	Plant Nursering	Pasteous grass	Black Sandy Calcareous
Sayed Ghareeb Ahmed	El Basra village Maryout Zone	10	Beans+Clover+Wheat + Tomatoes	Watermelon+Maize	Black Sandy Calcareous
Mohamed Fathi Mohamed	Bahgdad Villaqe Maryout Zone	12	-	Grapes+Figs +Watermelon	Black Sandy Calcareous
Ramadan Ahmed Abdel Ghani	Sixth Village Abis	50	Apple+Peach+Guava +Pears+Prunes		White Calcareous
Ibrahim Kassem	El Tarh - Cobaniat Abu Qir	50	Orange		Black
Ali El Loubeik	El Tarh - Cobaniat Abu Qir	8	Orange		Black
Khamis Marhash	Poleen - El Tarh Kafr El Dawar	5	Orange		Black

Tab. 2-8-5 RECLAMATION LANDS IN ALEXANDRIA REGION

Reclamation Land	Land Area (feddan)
Existing Reclamation Land	
Maryut Agriculture Company	46,500
Extension of Maryut Ag.Co.	16,400
El Nahada Ag.Co.	14,000
North Taharir Ag.Co.	39,600
Noba-cid Co.	24,000
Egyptian Vineyard Co.	15,000
West Nobaraya Co.	16,000
Sub-total	171,500
Current Reclamation Project	
South Taharir Ag.Co.	29,000
Sold to Private Farmers	19,200
Other Area	44,800
Sub-total	93,000
Land to be Reclaimed by 1987 under the Current 5 Year Project	
Extension of West Nobaraya Ag.Co.	56,000
Baheira Ag.Co.	30,000
Other Area	133,000
Sub-total	219,000
	(300,000 final scale)
Total Reclamation Area	483,500 feddan or 203,000 ha

Tab. 2-8-6 CONSUMPTION OF CHEMICAL FERTILIZERS APPLIED TO AGRICULTURAL LAND IN WHOLE EGYPT WHOLE EGYPT (1953 - 1982/83)

(Unit: 1000 ton)

Year	Nitrogenous Fertilizer	Phosphatic Fertilizer	Potash Fertilizer
1953	648	92	-
.	.	.	.
.	.	.	.
1961	700	165	6.0
.	.	.	.
.	.	.	.
1966	1,140	244	1.2
.	.	.	.
.	.	.	.
1974	1,125	290	3.8
1975	2,578	303	3.9
1976	2,646	382	6.2
1977	2,797	441	5.6
1978	3,135	606	7.4
1980	3,764	783	23.0
1980/81	3,684	696	19.6
1981/82	4,037	893	23.0
1982/83	4,255	952	20.0

Source: Statistical Yearbook, ARE

Tab. 2-8-7 CONSUMPTION OF CHEMICAL FERTILIZERS APPLIED TO AGRICULTRUAL LAND IN ALEXANDRIA GOVERNORATE (Oct. 1984 - Sept. 1985)

(unit: ton)

Type of Chemical Fertilizer		Source	Distributed Amount from The Bank *1 to Farmers	Distributed Amount from the Bank to Agri. Companies and ACS *2	Total
Nitrate	(31%)	Local Talkha Factory	1,230	4,643	5,873
Nitrate	(33%)	Imported	1,680	7,655	9,335
Ammonium Sulphate	(20%)	Imported	1,240	3,609	4,849
Urea	(46%)	Local Abou Kir Factory	1,283	3,669	4,952
Urea Antiblock	(46%)	"	718	1,289	2,007
Super Phosphate	(15.5%)	"	2,876	12,514	15,390
Triple Super Phosphate	(44%)	Imported	261	32	293
Triple Super Phosphate	(45%)	"	83	355	438
Potash Sulphate	(33%)	"	15	25	40
Conversion to the Component N				2,711	9,072
P_2O_5					13
K_2O					

(Note) *1 Development and Credit Agricultural Bank
*2 Agricultural Cooperative Society

Tab. 2-8-8 LOCAL PRODUCTION OF CHEMICAL FERTILIZERS IN EGYPT

(Unit: 1,000 ton)

Type of Chemical Fertilizer		Year					
		1978	1979	1980	1980/81	1981/82	1982/83
Super Phosphate		494	483	488	474	512	588
Calcium Nitrate	(15.5%)	1,386	1,701	2,584	3,346	4,122	4,133
Urea	(46%)	-	-	3,571	3,777	3,987	4,464
Ammonium Nitrate	(31%)	301	512	-	633	570	621
Ammonium Sulphate	(20.6%)	11	13	-	9	10	-
Triple Super Phosphate	(43%)	27	18	19	18	-	-

Note: For reference, imported amount of chemical fertilizers are indicated as follows.

Type of Fertilizer	Imported Amount (1,000 ton) 1979	1980
Ammonium Nitrate	112	124
Ammonium Sulphate	124	12
Phosphate	16	41
Potassium	N.A.	N.A.
Others	N.A.	N.A.

Source: Statistical Yearbook, ARE

Tab. 2-8-9 ACTUAL APPLICATION QUANTITY OF ORGANIC FERTILIZER

(Unit: m^3/feddan/year)

Crop	Actual Quantities		
	Cattle Manure	Chicken Manure	Compost
Wheat	-	-	-
Barley	-	-	-
Maize	-	-	-
Beans	10	7	20
Water Melon	10-20	5-10	-
Melon	-	7	-
Orange	5-7	-	20-25
Prune	5-7	-	20-25
Guava	5-7	-	20-25
Figs	5	-	-
Grapes	5-10	-	-
Clover	-	-	-
Horiculture	Peat Moss: Not Availble		

Tab. 2-8-10 RESULT OF COMPOST ANALYSIS

Item	Fine Compost	Coarse Compost	Standard (Law 100/1967)
Nitrogen	1.2%	1.1%	0.5 + 0.04% min.
Organic Matter	19.3%	21.1%	18 + 1% min.
Moisture Content	20.5%	22%	30 + 2% max.
Bulk Density	691 kg/m^3	615 kg/m^3	750 + 40 kg/m^3 max.
Sodium Chloride	1.3%	0.8%	5 + 0.5% max.
C/N Ratio	1/16	1/19	1/18 - 1/25
Particle Size	Size is satisfied for easy application		Fine compost for easy application

Note: 1) Date of Sampling: February 22, 1985

2) Analysis were conducted under the supervision of Dr. Olfat El Sebaai, Professor of Environmental Chemistry, Environmental Health Department, Alexandria University.

Tab. 2-8-11 RESULT OF INTERVIEW TO THE FARMERS WHO APPLIED ABBIS COMPOST

Questions	Form A	Form B	Farm C	Farm D
Name of Farmer	: Dakrowni Mohamed Ibrahim	: Abd Ellatief El Said	: Ramadan ahmed Abdul Ghany	: Ahmed Fouad Aly Kasem
Address	: Extension of Village 8	: El Gazaeer Village	: Abis 6th Village	: Aly farm El Tarh Kafr El Dawar Bahera
No. of Family Labourers	: 1, only himself	: 3	:6	: 10
No. of Employee	: Depend on Kind of Crop	: 4 to 5	: 40 to 50 labourers during harvesting	: 12, 50 labourers during harvesting
Total Agricultural land	: 5 feddan	: 9 feddan	: 50 feddan	: 125 feddan
Planted Area	: 5 feddan	: 9 feddan	: 45 feddan	: 125 feddan
Fallow Land Area	: Nothing	: Nothing	: Nothing	: Nothing
Barren & Unused Land Area	: Nothing	: Nothing	: 5 feddan	: Nothing
Major Crops	: Spinach, Clover, Potato & Watermelon, Potato-Feb. to May Tomato or any other vegetables-May to Sept. Spinach-Beginning of Sept.	: Last Year-Watermelon, Tomato, Spinach, Clover & Maize This Year-Tomato (2 fed.), Spinach (1 fed.) Marrow (6 fed.), Clover & Maize Next Year-Same as this year	: Orchard, Apple, Guava, Apricot, Peach & Plum, Some vegetable crops under trees	: Orchard, Orange & Mandaren
Soil Condition	: Light Soil	: Yellow Calcareous Soil	: White Mud Salty Soil	: Land Mud
Improvement of Soil Fertility	: Applying Organic Fertilizer	: Applying Chemical Fertilizer	: By using garbage	: By using garbage
Procurement of Organic Fert.	: Neighboring Livestock Farm	: Neighboring Poultry Farms	: Garbage from Zabaleen (private garbage collector)	: Neighboring Farms
Type of Organic Fert. & Price	: Animal Manure, 5 LEm^3	: Chicken Manure, 4 LE/m^3	: Garbage, LE/ton	: Farmyard Manure, 5 LE/ton
Application Rate	: 28 m^3/feddan	: 5 m^3/feddan	: 20 m^3/feddan	36 m^3/feddan
Seasons & Frequency of Application	: Prior to Cultivation	: Winter Period	: Late Autumn & Before Flowering	: Once in a year
Procurement of Chemical Fert.	: Agri. Cooperation Society	: Agri. Cooperation Society	: Agri. Cooperation Society	: Agri. Cooperation Society
Type of Chemical Fert. & Price	: Urea-7.25 LE/50 kg Nitrate-6 LE/50 kg Super Phosphate-2 LE/50 kg	: Urea-7.25 LE/50 kg Nitrate-6 LE/50 kg Super Phosphate-2 LE/50 kg	: Urea-7.25 LE/50 kg Nitrate-6.0 LE/50 kg Super Phosphate-2.0 LE/50 kg	: Urea-6.5 LE/50 kg Nitrate-5.5 LE/50 kg
Application Rate	: Clover-1 ton 5 days after planting of Super Phosphate 1 to of Nitrate & 1 ton of Phosphate Potato-1 ton to Nitrate & 1 ton of Phosphate 50 days after plant Watermelon-500 kgs Nitrate before and after 20 days of planting	: Tomato-250kg/fed. of Urea & 500 kg/fed. of Super Phosphate when compost is not available	: Apple-Nitrate 600 kg, Phosphate 200 kg Potash 50 kg Guava-Nitrate 400 kg, Phosphate 150 kg Potash 50 kg	: 400 to 500 kg/feddan
Seasons of Application	:	: Before seeding & in the middle of growing	: Late autumn & before flowering	: 3 to 4 times in a year especially in Feb.

Questions	Form A	Form B	Farm C	Farm D
Reasons of Purchasing Abis Compost:	: As for a Test Application	: The Talk of the Person	: As a new kind of fertilizer	: Good effects on soil
Reputation of Abis Compost	: Good	: Good	: Good	: Nowadays bad, because of it is wet
Type of Weight of Compost Contracted	: Fine Compost, 200 ton	: Fine Compost, 200 ton	: Fine Compost, 1,200 ton	: Coarse Compost 1,200 ton
Price of Compost Purchased	: 9 LE/ton including transportation	: 7 LE/ton	: 8 LE/ton including transportation	: 5.5 LE/ton
Application Rate	: 7 m^3/feddan	: 25 m^3/feddan	: 15 m^3/feddan, twice in a yea	: 20 m^3/feddan
Method of Application	: Spreading by Hand	: Spreading by Hand	: Spreading around the trees by hand	: Spreading by hand
Seasons & Frequency of Application	: Anytime When Obtained	: Before seeding	: After harvesting, twice in a year	: Once in a year, anytime depend on labor force
Quality of Abis Compost	: Good, due to its effects on land fertility	: Good, because it helps the plant grow better	: Good, No plastics, clean	: Good, but wet
Problems of the Abis Compost	: High Price, 5 LE/ton will be preferable	: High Price, 5 LE/ton will be preferable	: Require to inform component analysis and iron content	: High moisture content
Remarks	: Transportation Cost-2 LE/ton by Abis's truck	: Neighbouring farmers are waiting for the results of tomato cultivation of which compost was applied. At present, these farmers are quite satisfy with the growing process in this year comparing to the last year.	: Transportation by Abis's truck	: The farmer will give up to buy more compost because it is sold with the same price nevertheless it is wet. (The farmer purchased unmatured compost, though once refused to sell, with the mutual understanding between the farmer and the plant manager to store the compost untill it would have been matured.)

Tab. 2-8-12 AUTHORIZED QUANTITIES OF NITROGEN FERTILIZER (15.5% N) TO BE SOLD AT THE OFFICIAL SUBSIDIZED RATE

Crop	Quantity of Nitrogen Fertilizer* (kg/feddan/season)
Wheat	250
Barley	250
Maize	350
Clover	200
Beans	50
Vegetables	56-600 **
Carrots	300
Watermelon	300
Melon	300
Orange	150-500 ***
Pears	300
Apple	150-500 ***
Peach	300-500 ***
Prune	500
Guava	-
Figs	-
Grapes	200

Note:

* Source: Ministry of Agriculture - Agro-economic Publication 1979

** Depends on Crop

*** Depends on Age of Tree

Tab. 2-8-13 PREVAILING PRICES FOR ORGANIC MANURE IN THE ALEXANDRIA REGION

Dealer	Price (LE/m3)
Animal Manure	
Maryút Company (Cattle growing stations)	6.5
Egyptian Egg and Poultry Company	7.0
Abu El-Matameer	7.5-8.0
Compost	
Abis Plant	4.0-9.0*
Peat Moss	
Nile Company	500-600

Note: The price exclude transportation costs.

* indicate the price in LE/ton

Tab. 2-8-14 PLANTED AREA IN 1984/85

Winter Crops	Planted Area (fed)	Ratio A (%)	Ratio B (%)	Summer Crops	Planted Area (fed)	Ratio A (%)	Ratio B (%)
Cereal Crops				Cereal Crops			
Wheat	3,233	3.3	4.0	Rice	4,775	4.9	5.9
Barley	8,991	9.2	11.0	Maize	12,965	13.3	15.9
Broad Bean	5,820	6.0	7.1				
Others	908	0.9	1.1				
Clover	32,349	33.3	39.7				
sub-total	52,301	52.7	62.9	sub-total	17,740	18.2	21.3
Vegetables				Vegetables			
Tomato	6,158	6.4	7.6	Tomato	10,598	10.9	13.0
Marrow	1,596	1.6	2.0	Potato	3,788	3.4	4.0
Cabbage	2,363	2.4	2.9	Egg Plant	1,973	2.0	2.4
Cauliflower	1,631	1.7	2.0	Marrow	7,270	7.5	8.9
Lettuce	1,203	1.2	1.5	Negro Beans	1,213	1.2	1.5
Green Peas	1,562	1.6	1.9	Water Melon	10,336	10.7	12.8
Others	3,077	3.2	3.8	& Melon			
				Others	4,109	4.2	5.0
sub-total	17,590	18.1	21.7	sub-total	38,839	39.9	47.6
Total fields	68,891	70.8	84.6	Total fields	56,579	58.1	69.4
Fruits				Fruits			
Citrus	1,410	1.4	8.8				
Grape	3,957	4.0	24.8				
Fig	2,689	2.8	16.8	same as the winter crop season			
Guava	2,598	2.7	16.3				
Pears	1,626	1.7	10.2				
Other	3,694	3.8	23.1				
sub-total	15,973	16.4	100.0	sub-total	15,973		
Total in Winter	84,864	87.1	-	Total in Summer	72,552	74.5	-

Total Cultivated Area : 97,390 feddan (70.1%)
Field : 81,417 feddan
Orchard : 15,973 feddan
Barren, under reclamation, etc. : 41,509 feddan (29.9%)
Total Agricultural Land : 138,899 feddan (100%)

Note: Ratio A represents the ratio to the Total Cultivated Area.
" B " " " " Fields or Orchard Areas respectively.

Tab. 2-8-15 PLANTED AREA IN 2005

Winter Crops	Ratio B (%)	Planted Area (fed)	Summer Crops	Ratio B (%)	Planted Area (fed)
Cereal Crops			Cereal Crops		
Wheat	4.0	3,772	Rice	5.9	5,564
Berley	11.0	10,373	Maize	15.9	14,994
Broad Bean	7.1	6,695			
Others	1.1	1,037			
Clover	39.7	37,437			
sub-total	62.9	59,314	sub-total		20,558
Vegetables			Vegetables		
Tomato	7.6	7,167	Tomato	13.0	12,259
Marrow	2.0	1,886	Potato	4.0	3,772
Cabbage	2.9	2,735	Egg Plant	2.4	2,263
Cauliflower	2.0	1,886	Marrow	8.9	8,393
Lettuce	1.5	1,415	Negro Beans	1.5	1,415
Green Peas	1.9	1,792	Water Melon	12.8	12,070
Others	3.8	3,583	& Melon		
			Others	5.0	4,715
sub-total	21.7	20,464	sub-total	47.6	44,887
Total fields	4.6	79,778	Total fields	69.4	65,445
Fruits			Fruits		
Citrus	8.8	1,584			
Grape	24.8	4,464			
Fig	16.3	3,204	same as the winter season		
Guava	16.3	2,934			
Pears	10.2	1,836			
Other	23.1	4,158			
Total Orchard	100.0	18,000	Total Orchard	100.0	18,000
Total Planted Area:		97,778	Total Planted Area:		83,445
Fallow Land Area:		14,552	Fallow Land Area:		28,855

Total Cultivated Area : 112,300 feddan
Fields : 94,300
Orchard : 18,000

Note: Ratio B represent the ratio to the Fields or Orchard areas respectively, which are the same ratio with the present formation ratio.

Tab. 2-8-16 CULTIVATION SEASONS OF MAJOR CROPS

Crops \ Month	Jan. B	Jan. M	Jan. E	Feb. B	Feb. M	Feb. E	Mar. B	Mar. M	Mar. E	Apr. B	Apr. M	Apr. E	May B	May M	May E	Jun. B	Jun. M	Jun. E	Jul. B	Jul. M	Jul. E	Aug. B	Aug. M	Aug. E	Sep. B	Sep. M	Sep. E	Oct. B	Oct. M	Oct. E	Nov. B	Nov. M	Nov. E	Dec. B	Dec. M	Dec. E	Remarks
Winter Crops																																					
Barley and Wheat													o																		o						
Broad Beans										o																					o						
Cabbage & Cauliflower		o				o																o			o												
Tomato				o					o																o			o			o						
Clover							o																		o						o						
Summer Crop																																					
Rice							o			o															o			o									
Maize													o												o			o									
Tomato				o						o												o															
Potato	o												o			o																		o			
Water-Melon & Melon				o												o						o															
Marrow										o									o			o															
Egg Plant				o				o											o			o															
Fruits																																					
Grape																			o						o												
Fig																						o			o												

Legend: o indicate the seasons for seeding
o " " " planting or transplanting
o " " " harvesting
B: Begining of the month
M: Middle " " "
E: End of " " "

Tab. 2-8-17 N, P, AND K CONTENTS IN FARMYARD MANURE

(Unit: wet base %)

Data	Moisture Content	N	P_2O_5	K_2O	Remarks
Data 1					
Minimum	39.6	0.07	0.03	0.09	
Average	75.1	0.39	0.19	0.70	
Maximum	93.2	1.07	0.57	2.22	
Data 2					
Agri Institute	-	0.53	0.20	0.60	
General Farm	-	0.63	0.47	0.85	
Good Farm	-	0.79	0.69	0.85	
Data 3					
Fresh Manure	71.0	0.45	0.21	0.96	
Half-Matured Manure	75.0	0.50	0.26	0.52	3.5 months
Full-Matured Manure	79.0	0.58	0.30	0.63	6 months
Data 4					
Component (kg/ton)	650-750	5-7	3-4	6-8	
Data 5					72 samples
Minimum	-	0.10	0.05	0.26	
Average	-	0.36±0.14	0.21±0.12	0.83±0.45	
Data 6					
Average	75.3	0.59	0.23	0.66	40 samples
Data 7					105 samples
Minimum	39.6	0.07	0.03	0.09	
Average	75.1±12.2	0.39±0.17	0.19±0.09	0.70±0.45	
Maximum	93.2				

Source: Data 1 - Data 4
Yukibutsu Hiryo no Tsukurikata Tsukaikata (production and utilization method of Organic Manure), Issued by Nosan Gyoson Bunka Kyokai (Cultural Association of Agricultural and Fishing Community, Japan - NGBK)

Data 5 - Data 7
Yukibutsu Seyoo no Riron to Oyo (Theory and Application for Utilization of Organic Materials), Issued by NGBK, Japan)

Tab. 2-8-18 N, P, AND K CONTENTS IN COMPOST FROM MUNICIPAL WASTES

(Unit: dry base %)

Compost Plant	T-N	T_2O_5	T-K_2O	CaO	MgO
Beppu	1.24	0.60	1.56	3.20	0.33
Saga	1.50	0.70	1.70	4.27	0.31
Toyohashi (1)	2.12	1.15	2.46	7.28	0.58
" (2)	1.49	0.71	2.61	5.86	0.50
Kanuma (1)	2.11	1.23	3.13	5.61	0.47
" (2)	2.18	3.57	2.23	6.01	2.82
Nagasaki	1.26	0.56	1.61	4.08	0.36
Itoh (1)	2.02	0.48	1.81	5.07	0.37
" (2)	1.57	0.50	1.16	3.84	0.31
" (3)	2.30	1.28	0.61	9.49	0.44
Hoojyo	1.26	1.57	1.93	5.10	0.52
Kuriyama	1.09	1.66	0.96	3.22	0.97
Average	1.73	1.13	1.89	5.44	0.64

Source: Study report from "Improvement of Composting Process of Municipal Refuse and Agricultural Use of the Product (1976 - 1980)", prepared by the National Institute of Agricultural Sciences.

Tab. 2-8-19 STANDARD FERTILIZING AMOUNT OF MAJOR CROPS

(Unit: dry base %)

Crops	Egypt (Alexandria) Chemical Fertilizer *1			Egypt (Alexandria) Fertilizer Component *2			Japan (Chiba Pref) Fertilizer Component *2			
	N. Fert. 15.5%	P. Fert. 15%	K. Fert. 48%	N	P_2O_5	K_2O	N	P_2O_5	K_2O	Barnyard Manure
Barley	300	100	-	111	36	-	80	80	60	20000
Wheat	450	100	-	166	36	-	80	80	80	20000
B.Bean	150	200	100	55	71	114	70	70	70	20000
Rice	220	110	-	81	39	-	80	70	90	-
							100			
Maize	600	-	-	221	-	-	360	250	340	20000
Clover	-	300	-	-	107	-	270	150	270	-
Tomato	800	300	100	295	107	114	260	340	260	20000
Potato	800	450	100	295	161	114	180	150	180	20000
Marrow	350	300	50	129	107	57	180	220	140	20000
Cabbage	350	300	50	129	107	57	250	150	200	20000
Caulifl.	350	300	50	129	107	57	180	220	140	20000
W.Melon	350	300	50	129	107	57	100	200	150	20000
Egg Plant	700	150	50	258	54	57	370	300	330	20000
Grape	300	200	50	111	71	57	150	100	150	10000
	-750	-300		-277	-107					
Fig	400	150	50	148	54	57	150	130	140	20000
Guava	400	150	50	148	54	57	-	-	-	-

Note: 1) feddan = 0.42 ha
2) N.Fertilize (Sodium Nitrate) contains 15.5% of N
P. " (Sper Phosphate) " 15% of P_2O_5
K. " (Potash Chloride) " 48% of K_2O
3) Unit *1 kg/feddan
*2 kg/ha

Table 2-8-20 FERTILIZING DESIGN OF MAJOR CROPS

(Unit: Kg/ha)

Crops	Fertilization Design: Three Major Elements N	P_2O_5	K_2O	Barnyard Manure (t/ha)	Elements in Conversion of Barnyard Manure N	P_2O	K_2O
Barley/ Wheat	140 (140)	40 (40)	-	(20)	210 (210)	75 (75)	90 (90)
B.Beans	55 (55)	70 (70)	-	(20)	125 (125)	105 (105)	90 (90)
Rice	80 (40)	40 (40)	-	-	80 (40)	40 (40)	-
Maize	220 (160)	-	-	(20)	290 (230)	35 (35)	90 (90)
Clover	-	110	-	-	-	110	-
Tomato/ Potato	290 (230)	135 (110)	115 (90)	(20)	365 (300)	170 (145)	205 (180)
Egg Plant	260 (140)	55 (45)	120 (70)	(20)	330 (210)	90 (80)	210 (160)
Other Vegetables	130 (65)	110 (110)	120 (80)	(20)	200 (135)	145 (145)	210 (170)
Grapes	200 (60)	90 (40)	120 (40)	(20)	270 (130)	125 (75)	210 (130)
Other Fruits	150 (45)	55 (25)	120 (40)	(20)	220 (115)	90 (60)	210 (130)

Note: 1) ( ) indicate the amount to be applied as basal dressing.
2) 20 tons of barnyard manure contains the three major elements of fertilizer with the amount of 70Kg, 35Kg and 90Kg for N, P_2O_5 and K_2O respectively.

Tab. 2-8-21 PLANNED STANDARD APPLICATION MOUNT OF COMPOST FOR MAJOR CROPS

(Unit: ton/ha)

Crops	Calculation				Planned Application Amount of Compost
	Kg/ha		Kg/ton. compost	t/ha	
Barley/Wheat	(210 x 2/3)	/	8.5 =	16.5	15
Broad Bean	(125 x 2/3)	/	8.5 =	9.8	10
Rice	-			-	-
Maize	(230 x 2/3)	/	8.5 =	18.0	20
Clover	-			-	-
Tomato/Potato	(300 x 1/2)	/	8.5 =	17.6	20
Egg Plant	(210 x 1/2)	/	8.5 =	12.4	10
Other Veget-Crops	(135 x 1/2)	/	8.5 =	7.9	10
Grape	(130 x 1/2)	/	8.5 =	7.6	10
Other Fruits	(115 x 1/2)	/	8.5 =	6.8	5

Note: One ton of compost (30% moisture content) contains the effective three major elements of fertilizer with the amount of 8.5Kg, 5.5Kg and 11.9 Kg for N, P_2O_5 and K_2O respectively.

Table 2-8-22 FERTILIZING OF MAJOR CROPS BY USING COMPOST

(Unit: Kg/ha)

Fertilizer	Basal Dressing									Top (Side) Dressing			Total Three Major Elements Supplied by Compost & Chemical Fertilizer								
	N			P_2O_5			K O			N	P_2O_5	K_2O	N			P_2O_5			K_2O		
Crops	Compost	Chem. Fert.	Subtotal	Compost	Chem. ost	Subtotal	Compost	Chem. Fert.	Subtotal	Chem. Fert.	Chem. Fert.	Chem. Fert.	Compost	Chem. Fert.	Total	Compost	Chem. Fert.	Total	Compost	Chem. Fert.	Total
Barley/Wheat	127.5	82.5	210	82.5	-	82.5	178.5	-	178.5	-	-	-	127.5	82.5	210	82.5	-	82.5	178.5	-	178.5
Broad Bean	85	40	125	55	50	105	119	-	119	-	-	-	85	40	125	55	50	105	119	-	119
Rice	-	40	40	-	40	40	-	-	-	40	-	-	-	80	80	-	40	40	-	-	-
Maize	170	60	230	110	-	110	238	-	238	60	-	-	170	120	290	110	-	110	238	-	238
Clover	-	-	-	-	-	-	-	-	-	-	110	-	-	-	-	-	110	110	-	-	-
Tomato/Potato	170	130	300	110	35	145	238	-	238	65	25	25	170	195	365	110	60	170	238	25	263
Egg Plant	85	125	210	55	25	80	119	6	125	120	10	25	85	245	330	55	35	90	119	31	150
Other Vege.	85	50	135	55	90	145	119	11	130	65	-	20	85	115	200	55	90	145	119	31	150
Grape	85	45	130	55	20	75	119	-	110	140	50	40	85	185	270	55	70	125	119	40	159
Other Fruits	42.5	72.5	115	27.5	32.5	60	59.5	50.5	110	105	30	40	42.5	177.5	220	27.5	62.5	90	59.5	90.5	150

Note: Compost is applied to each crop as for a basal dressing with the amount indicated below.

Barley/Wheat: 15 ton/ha
Broad Bean : 10 "
Maize : 20 "
Tomato/Potato: 20 ton/ha
Egg Plant : 10 "
Other Vege. : 10 "
Grape : 10 ton/ha
Other Fruits: 5 "

Tab. 2-8-23 SEASONS OF APPLICATION OF COMPOST FOR MAJOR CROPS

Crops \ Month	Jan.			Feb.			Mar.			Apr.			May			Jun.			Jul.			Aug.			Sep.			Oct.			Nov.			Dec.			Remarks
	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	B	M	E	
Winter Crops																																					
Barley and Wheat																												----	----	----							
Broad Bean																												----	----	----							
Cabbage & Cauliflower																						----	----	----													
Tomato																									----	----	----										
Others																						----	----	----	----	----	----										
Summer Crop																																					
Maize										----	----	----																									
Tomato	----	----	----																																		
Potato																																					
Water-Melon & Melon	----	----	----																																		
Marrow							----	----	----																												
Egg Plant				----	----	----																															
Other				----	----	----	----	----	----																												
Fruits																																					
Grape				----	----	----																															
Fig				----	----	----																															
Others	----	----	----	----	----	----																															

Tab. 2-8-24 COMPOST DEMAND IN 1985

Matrix A: Planted Area by Crop Type and By Month (ha)

	Barley/ White	B. Bean	Cabbage Califl.	Tomato 1	Others 1	Maize	Tomato 2	Potato	W.Melon/ Melon	Marrow	Egg- Plant	Others 2	Grape	Fig	Other Fruits
Jan.	0	0	0	0	0	0	4451	0	4362	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	0	0	0	0	829	1118	1662	1129	1959
Mar.	0	0	0	0	0	0	0	0	0	3053	0	1117	0	0	1958
Apr.	0	0	0	0	0	5445	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug.	0	0	1677	0	0	0	0	0	0	0	0	0	0	0	0
Sep.	0	0	0	2586	1753	0	0	0	0	0	0	0	0	0	0
Oct.	5134	2444	0	0	1752	0	0	0	0	0	0	0	0	0	0
Nov.	0	0	0	0	0	0	0	1381	0	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix B: Fertilization Amount by Crop Type and by Fertilizer Type

	Compost (ton/ha)	Chemical Fertilizer (kg/ha) N	P_2O_5	K_2O
Barley/Wheat	15.0	82.5	0.0	0.0
B. Bean	10.0	40.0	50.0	0.0
Cabbagae/Cauliflower	10.0	115.0	90.0	31.0
Tomato 1	20.0	195.0	60.0	0.0
Others 1	10.0	115.0	90.0	31.0
Maize	20.0	120.0	0.0	0.0
Tomato 2	20.0	195.0	60.0	0.0
Potato	20.0	195.0	60.0	0.0
Water Melon/Melon	10.0	115.0	90.0	31.0
Marrow	10.0	115.0	90.0	31.0
Egg-Plant	10.0	245.0	35.0	31.0
Others 2	10.0	115.0	90.0	31.0
Grape	10.0	185.0	70.0	31.0
Fig	5.0	177.5	62.5	90.5
Other Fruits	5.0	177.5	62.5	90.5

Matrix C: Compost and Chemical Fertilizer Demand by Month

	Compost (ton)	Chemical Fertilizer (kg) N	P_2O_5	K_2O
Jan.	132640	1369575	659640	135222
Feb.	51530	1187265	438975	391343
Mar.	51490	827095	497675	306469
Apr.	108900	653400	0	0
May	0	0	0	0
Jun.	0	0	0	0
Jul.	0	0	0	0
Aug.	34300	394450	308700	106330
Sep.	69240	705750	312840	54312
Oct.	101450	521315	122200	0
Nov.	27620	269295	82860	0
Dec.	0	0	0	0
Total	577170	5928135	2422890	993676

Tab. 2-8-25 COMPOST DEMAND IN 2005

Matrix A: Planted Area by Crop Type and By Month (ha)

	Barley/ White	B. Bean	Cabbage Califl.	Tomato 1	Others 1	Maize	Tomato 2	Potato	W.Melon/ Melon	Marrow	Egg- Plant	Others 2	Grape	Fig	Other Fruits
Jan.	0	0	0	0	0	0	5149	0	5069	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	0	0	0	0	950	1288	1875	1270	2208
Mar.	0	0	0	0	0	0	0	0	0	3525	0	1287	0	0	2207
Apr.	0	0	0	0	0	6297	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug.	0	0	1941	0	2040	0	0	0	0	0	0	0	0	0	0
Sep.	0	0	0	3010	2039	0	0	0	0	0	0	0	0	0	0
Oct.	5941	2812	0	0	1752	0	0	0	0	0	0	0	0	0	0
Nov.	0	0	0	0	0	0	0	1584	0	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix B: Fertilization Amount by Crop Type and by Fertilizer Type

	Compost (ton/ha)	Chemical Fertilizer (kg/ha) N	P_2O_5	K_2O
Barley/Wheat	15.0	82.5	0.0	0.0
B. Bean	10.0	40.0	50.0	0.0
Cabbagae/Cauliflower	10.0	115.0	90.0	31.0
Tomato 1	20.0	195.0	60.0	0.0
Others 1	10.0	115.0	90.0	31.0
Maize	20.0	120.0	0.0	0.0
Tomato 2	20.0	195.0	60.0	0.0
Potato	20.0	195.0	60.0	0.0
Water Melon/Melon	10.0	115.0	90.0	31.0
Marrow	10.0	115.0	90.0	31.0
Egg-Plant	10.0	245.0	35.0	31.0
Others 2	10.0	115.0	90.0	31.0
Grape	10.0	185.0	70.0	31.0
Fig	5.0	177.5	62.5	90.5
Other Fruits	5.0	177.5	62.5	90.5

Matrix C: Compost and Chemical Fertilizer Demand by Month

	Compost (ton)	Chemical Fertilizer (kg) N	P_2O_5	K_2O
Jan.	153670	1586990	765150	157139
Feb.	58529	1345090	497795	442262
Mar.	59155	945123	571018	348906
Apr.	125940	755640	0	0
May	0	0	0	0
Jun.	0	0	0	0
Jul.	0	0	0	0
Aug.	39810	457815	358290	123411
Sep.	80590	821435	364110	63209
Oct.	117235	602613	140600	0
Nov.	31680	308880	95040	0
Dec.	0	0	0	0
Total	666600	6823586	2792003	1134927

Tab. 2-8-26 DEMAND OF CHEMICAL FERTILIZERS IN SOLITAR USE IN 1985

Matrix A: Planted Area by Crop Type and By Month (ha)

	Barley/ White	B. Bean	Cabbage Califl.	Tomato 1	Others 1	Maize	Tomato 2	Potato	W.Melon/ Melon	Marrow	Egg- Plant	Others 2	Grape	Fig	Other Fruits
Jan.	0	0	0	0	0	0	4551	0	4362	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	0	0	0	0	829	1118	1662	1129	1959
Mar.	0	0	0	0	0	0	0	0	0	3053	0	1117	0	0	1958
Apr.	0	0	0	0	0	5445	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug.	0	0	1677	0	1753	0	0	0	0	0	0	0	0	0	0
Sep.	0	0	0	2586	1752	0	0	0	0	0	0	0	0	0	0
Oct.	5134	2444	0	0		0	0	0	0	0	0	0	0	0	0
Nov.	0	0	0	0	0	0	0	1381	0	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix B: Fertilization Amount by Crop Type and by Fertilizer Type

	Compost (ton/ha)	Chemical Fertilizer (kg/ha) N	P_2O_5	K_2O
Barley/Wheat	0.0	210.0	75.0	90.0
B. Bean	0.0	125.0	105.0	90.0
Cabbagae/Cauliflower	0.0	200.0	145.0	150.0
Tomato 1	0.0	365.0	170.0	205.0
Others 1	0.0	200.0	145.0	150.0
Maize	0.0	290.0	35.0	90.0
Tomato 2	0.0	365.0	170.0	205.0
Potato	0.0	365.0	170.0	205.0
Water Melon/Melon	0.0	200.0	145.0	150.0
Marrow	0.0	200.0	145.0	150.0
Egg-Plant	0.0	330.0	90.0	150.0
Others 2	0.0	200.0	145.0	150.0
Grape	0.0	270.0	125.0	150.0
Fig	0.0	220.0	90.0	150.0
Other Fruits	0.0	220.0	90.0	150.0

Matrix C: Compost and Chemical Fertilizer Demand by Month

	Compost (ton)	Chemical Fertilizer (kg) N	P_2O_5	K_2O
Jan.	0	2497020	1389160	1566760
Feb.	0	1625270	722390	1004550
Mar.	0	1264760	780870	919200
Apr.	0	1579050	190575	490050
May	0	0	0	0
Jun.	0	0	0	0
Jul.	0	0	0	0
Aug.	0	686000	497350	514500
Sep.	0	1294290	693660	792390
Oct.	0	1383640	641670	682020
Nov.	0	504065	234770	283105
Dec.	0	0	0	0
Total	0	10834095	5150445	6253115

Tab. 2-8-27 DEMAND OF CHEMICAL FERTILIZERS IN SOLITAR USE IN 2005

Matrix A: Planted Area by Crop Type and By Month (ha)

	Barley/ White	B. Bean	Cabbage Califl.	Tomato 1	Others 1	Maize	Tomato 2	Potato	W.Melon/ Melon	Marrow	Egg-Plant	Others 2	Grape	Fig	Other Fruits
Jan.	0	0	0	0	0	0	5149	0	5069	0	0	0	0	0	0
Feb.	0	0	0	0	0	0	0	0	0	0	950	1288	1875	1270	2208
Mar.	0	0	0	0	0	0	0	0	0	3525	0	1287	0	0	2207
Apr.	0	0	0	0	0	6297	0	0	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug.	0	0	1941	0	2040	0	0	0	0	0	0	0	0	0	0
Sep.	0	0	0	3010	2039	0	0	0	0	0	0	0	0	0	0
Oct.	5941	2812	0	0		0	0	0	0	0	0	0	0	0	0
Nov.	0	0	0	0	0	0	0	1584	0	0	0	0	0	0	0
Dec.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Matrix B: Fertilization Amount by Crop Type and by Fertilizer Type

	Compost (ton/ha)	Chemical Fertilizer (kg/ha) N	P_2O_5	K_2O
Barley/Wheat	0.0	210.0	75.0	90.0
B. Bean	0.0	125.0	105.0	90.0
Cabbagae/Cauliflower	0.0	200.0	145.0	150.0
Tomato 1	0.0	365.0	170.0	205.0
Others 1	0.0	200.0	145.0	150.0
Maize	0.0	290.0	35.0	90.0
Tomato 2	0.0	365.0	170.0	205.0
Potato	0.0	365.0	170.0	205.0
Water Melon/Melon	0.0	200.0	145.0	150.0
Marrow	0.0	200.0	145.0	150.0
Egg-Plant	0.0	330.0	90.0	150.0
Others 2	0.0	200.0	145.0	150.0
Grape	0.0	270.0	125.0	150.0
Fig	0.0	220.0	90.0	150.0
Other Fruits	0.0	220.0	90.0	150.0

Matrix C: Compost and Chemical Fertilizer Demand by Month

	Compost (ton)	Chemical Fertilizer (kg) N	P_2O_5	K_2O
Jan.	0	2893190	1610340	1815900
Feb.	0	1842510	819655	1138650
Mar.	0	1447940	896370	1052850
Apr.	0	1826130	220395	566730
May	0	0	0	0
Jun.	0	0	0	0
Jul.	0	0	0	0
Aug.	0	796200	577245	597150
Sep.	0	1506450	807355	922900
Oct.	0	1599110	740835	787770
Nov.	0	578160	269280	324720
Dec.	0	0	0	0
Total	0	12489690	5941475	7206670

Tab. 2-8-28 YEARLY CENSUS FOR THE DIFFERENT TYPES OF CATTLE HEADS IN ALEXANDRIA GOVERNORATE

Type of Cattle	Total Number of Heads											
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1985
Cow and Bulls	32,375	33,622	34,869	36,116	37,363	38,610	39,857	41,104	42,351	43,598	44,845	51,080
Buffaloes	26,855	27,496	28,137	28,778	29,419	30,060	30,701	31,342	31,987	32,624	33,265	36,470
Goats	17,906	18,371	18,836	19,301	19,766	20,231	20,696	21,161	21,626	22,091	22,556	24,881
Sheep	66,373	68,078	69,783	71,488	73,193	74,898	76,603	78,308	80,013	87,718	83,423	91,948
Camel	1,392	1,367	1,317	1,292	1,267	1,267	1,242	1,217	1,192	1,167	1,142	588

* Alexandria Master Plan "Alexandria University and Governorate of Alexandria" Volume (4) November 1983

** Calculated using data in Table ( )

Tab. 2-8-29 CHICKEN GROWING STATIONS BY THE SECTOR IN ALEXANDRIA GOVERNORATE

Sector	No. of stations	No. of Units per station	No. of Chicken per unit	No. of cycles per year	Annual products capacity
Government Sector					
Agricultural Companies	1	5	10,000	5	250,000
General Poultry Co.	6	12	11,000	5.5	4,133,700
Authorities of the Faculty of Agriculture	1	2	2,500	5	25,000
Governorate	1	-	-	-	-
Private Sector					
Private Sector	50	1	4,142	5.5	889,317
Individuals	-	-	-	-	27,633
Total	-	-	-	-	5,325,650

Source: Ministry of Agriculture - Agro-economic Publications 1979 P. 425

Tab. 2-8-30 EGG PRODUCTION FARMS BY SECTOR IN ALEXANDRIA GOVERNORATE

Sector	No. of farms	Total No. of units	Total No. of chicken
Government			
Ministry of Agriculture (El Montazah Research Center)	1	-	2,500
Faculty of Agriculture	1	13	3,250
Governorate	6	6	502,000
Public Sector	8	19	48,378
Total	-	-	557,128

Source: Ministry of Agriculture - Agro-economic Publication 1979 P. 425

Tab. 2-8-31 DAILY GENERATION RATE OF ANIMAL MANURE AS 10% MOISTURE CONTENT

Type of Animal	Generation Rate (kg/head/day)	Number of Animal		Quantity of Animal Manure (ton/day)	
		1985	2005	1985	2005
Cattle					
Cows & Buffaloes					
More than 2 years	5	41,273	61,600	206	308
Less than 2 years	2.5	9,807	14,400	25	36
Buffaloes					
More than 2 years	5	31,255	40,400	156	202
Less than 2 years	2.5	5,215	6,600	13	17
Sub-total	-	-	-	400	563
Chicken					
Meat Chicken	0.033	2,040,400	4,340,000	67	143
Laying Chicken	0.033	650,840	1,388,800	21	46
Sub-total	-	-	-	88	189
Total	-	-	-	488	752

Tab. 2-8-32 NUTRIENTS OF VARIOUS TYPE OF COMPOSTABLE MATERIALS

Type of Org. Manure	State	Content (%)	Three Elements N (%)	Major P_2O_5 (%)	K_2O_5 (%)	Remarks
Cattle	dry	8.0	1.7	0.6	1.2	1)
	dry	(1.85)	(1.85)	(0.65)	(1.30)	
	dry	60	0.8	0.8	1.0	2)
			(2.00)	(2.00)	(2.50)	
	raw	84.3	0.28	0.42	0.63	3)
			(1.8)	(2.7)	(4.0)	
	raw	81.2	0.34	0.41	0.08	3)
			(1.81)	(2.18)	(0.42)	
	raw	81.9	0.43	0.38	0.29	4)
			(2.38)	(2.10)	(1.60)	
	dry	31.2	1.11	1.72	1.23	4)
			(1.61)	(2.50)	(1.79)	
	raw	80	0.30	0.20	0.10	5)
			(1.50)	(1.00)	(2.50)	
	raw	80	0.33	0.22	0.11	6)
			(1.67)	(1.11)	(0.56)	
Range	dry-base	-	1.50 - 2.38	0.65 - 2.0	0.42 - 0	
Chicken	dry	8.6	1.1	-	-	1) Laying Chicken
			(1.20)	-	-	
	dry	16.08	2.5	-	-	1) Meat Chicken
			(2.98)	-	-	
	dry	15	3.5	4.5	3.0	2)
			(4.10)	(5.30)	(3.50)	
	raw	75 - 80	1.15	2.15	0.58	3)
			(4.6)	(8.6)	(2.3)	
	raw	65.11 - 66.58	2.32 - 2.47	3.41 - 2.93	1.31 - 1.25	3)
			(6.65 - 7.39	(9.77 - 8.77	(3.75 - 3.47	

Type of Org. Manure	State	Content (%)	Three Elements N (%)	Major Elements P_2O_5 (%)	K_2O_5 (%)		Remarks
	raw	65.4	1.66	2.92	1.79	4)	
			(4.90)	(8.44)	(5.17)		
	dry	12.5	3.78	4.59	2.03	4)	
			(4.32)	(5.25)	(2.32)		
	raw	80	1.24	1.10	0.42	5)	
			(6.20)	(5.50)	(2.10)		
	raw	56	2.76	2.60	1.44	6)	
			(6.27)	(5.92)	(3.27)		
Range	dry-base	-	1.20	5.30	2.10		
			- 7.39	- 9.77	- 5.17		
Pig	dry	60	1.2	2.0	1.2	2)	
			(3.00)	(5.00)	(3.00)		
	raw	81.1	0.74	0.91	0.13	3)	
			(3.9)	(4.8)	(0.7)		
	raw	73.9	1.39	1.46	0.37	3)	
			(5.33)	(5.59)	(1.42)		
	raw	76.6	0.63	0.92	0.28	4)	
			(2.69)	(3.93)	(1.20)		
	raw	82.0	0.60	0.50	0.40	5)	
			(3.33)	(2.78)	(2.22)		
	raw	82	0.68	0.56	0.45	6)	
			(3.75)	(3.13)	(2.50)		
Range	dry-base	-	2.69	2.78	1.20		
			- 5.33	- 5.59	- 3.00		

Type of Org. Manure	State	Content (%)	Three Elements N (%)	Major Elements P_2O_5 (%)	K_2O_5 (%)		Remarks
Sewage Sludge	dry	43	2 - 5	1 - 2	0.2	1)	
			(3.51	(1.75	(0.35		
			- 8.77)	- 3.51			
	dry	13.43	2.19	1.83	0.026	3)	
			(2.53)	(2.11)	(0.03)		
	raw	94	0.069	0.036	0.006	6)	
		- 97	- 0.312	- 0.24	- 0.036		
			(2.3	(1.2	(0.2		
			- 5.2	- 4.0)	- 0.6)		
Range	dry base		2.3	1.2	0.03		
			- 8.77	- 4.00	- 0.60		

Note: Data sources are listed as follows.

1) Feasibility Study for Waste Collection and Resource Recovery in Five Governorates, Environmental Quality International, Egypt

2) Chikusan Shisetsu Keikaku Sekkei, (Planning and Design of Animal Husbandary Facilities), Issued by Buneido, Japan

3) Yukibutsu no Riyo (Utilization of Organic Materials), Issued by Nosan Gyoson Bunka Kyokai (Cultural Association of Agricultural and Fishing Communication) -- NGBK, Japan

4) Yukibutsu Seyoo no Riron to Oyo (Theory and Application for Utilization of Organic Materials), Issued by NGBK, Japan

5) Yukibutsu Hiryo no Tsukurikata Tsukaikata (Production and Utilization Method of Organic Manure), Issued by NGBK, Japan

6) Composting, Saitary Disposal and Reclamation of Organic Wastes, Harold b. Gotaas, World Health Organization, 1956

Tab. 2-8-33 AVERAGE NUTRIENT CONTENTS IN VARIOUS TYPES OF COMPOSTABLE MATERIALS

Type of Manure	State	Moisture Content (%)	Three Major Elements N (%)	P_2O_5 (%)	K_2O (%)
Cattle	dry base	0	2.00	2.00	2.50
	dry	10	1.80	1.80	2.25
	raw	82	0.36	0.36	0.45
Chicken	dry base	0	4.00	5.00	3.50
	dry	10	3.60	4.50	3.15
	raw	75	1.00	1.25	0.875
Pig	dry base	0	3.00	4.00	3.00
	dry	10	2.70	3.60	2.70
	raw	80	0.60	1.20	0.60
Sewage Sludge	dry base	0	2.50	2.00	0.30
	dry	10	2.25	1.80	0.27
	thickened	97	0.075	0.06	0.009

Note: For references, characteristics of peat moss used in Egypt is noted below.

Moisture Content = Maximum of 45-50% by weight
Ash Content = Maximum of 4% by weight
Three Major Elements = Peat moss normally does not contain any nutrients but is often enriched with chemical fertilizers up to a rate of 1% nitrogen, 1% phosphate and 1.7% potassium.

Tab. 2-8-34 CONVERSION RATE OF COMPOSTABLE MATERIALS

Type of Manure	N Content (%) dry base	wet base	Efficiency of N against Chemical Fert. (%)	Weight of N Per 1 ton Manure (%)	Conversion Ra to Compost from Refuse
Cattle	2.00	1.80 (10%)	30	5.4	0.64
Chicken	4.00	3.60 (10%)	70	25.2	2.96
Sewage Sludge	2.50	2.25 (10%)	70	15.8	1.86
Compost	1.73	1.21 (30%)	70	8.5	1.00

Note: Figures in ( ) represent moisture content

Tab. 2-8-35 QUANTITY OF COMPOSTABLE MATERIALS AFTER CONVERSION TO COMPOST FROM REFUSE

Type of Manure	Conversion Rate to Compost (%)	Predicted Amount 1985 (ton/yr)	Predicted Amount 2005 (ton/yr)	Predicted Amount Conversion of Compost 1985 (ton/yr)	Predicted Amount Conversion of Compost 2005 (ton/yr)
Cattle	0.64	144,000	202,680	92,160	129,715
Chicken	2.96	31,680	68,040	93,773	201,398
Sewage Sludge	1.86	-	154,080	-	286,589
Compost	1.00	34,500	34,500	34,500	34,500
Total	-	210,180	459,300	220,433	652,202

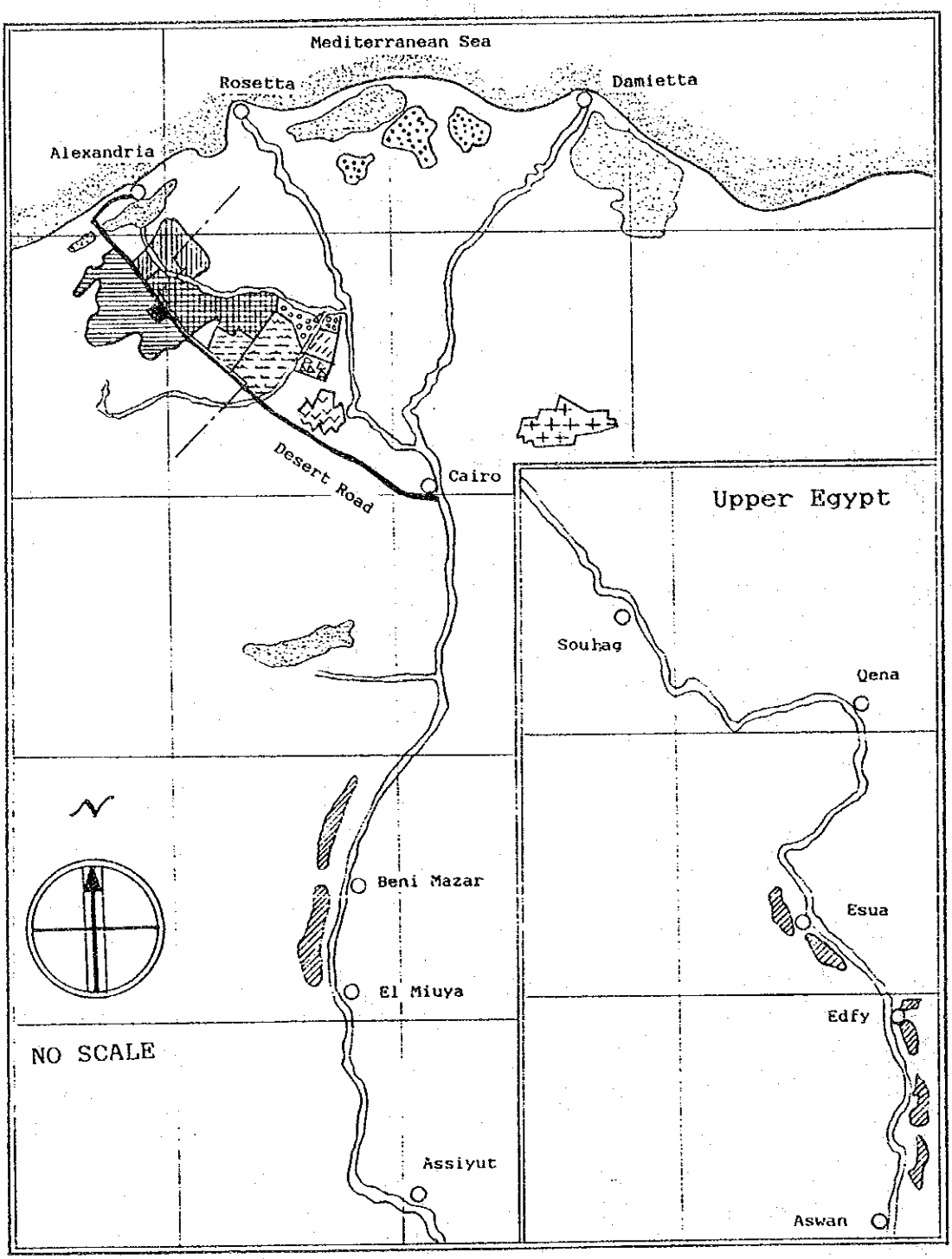


Figure 2.8.1 LOCATION OF AGRICULTURAL COMPANY IN EGYPT
(Under the jurisdiction of the General Section
Authority for Agricultural Development)

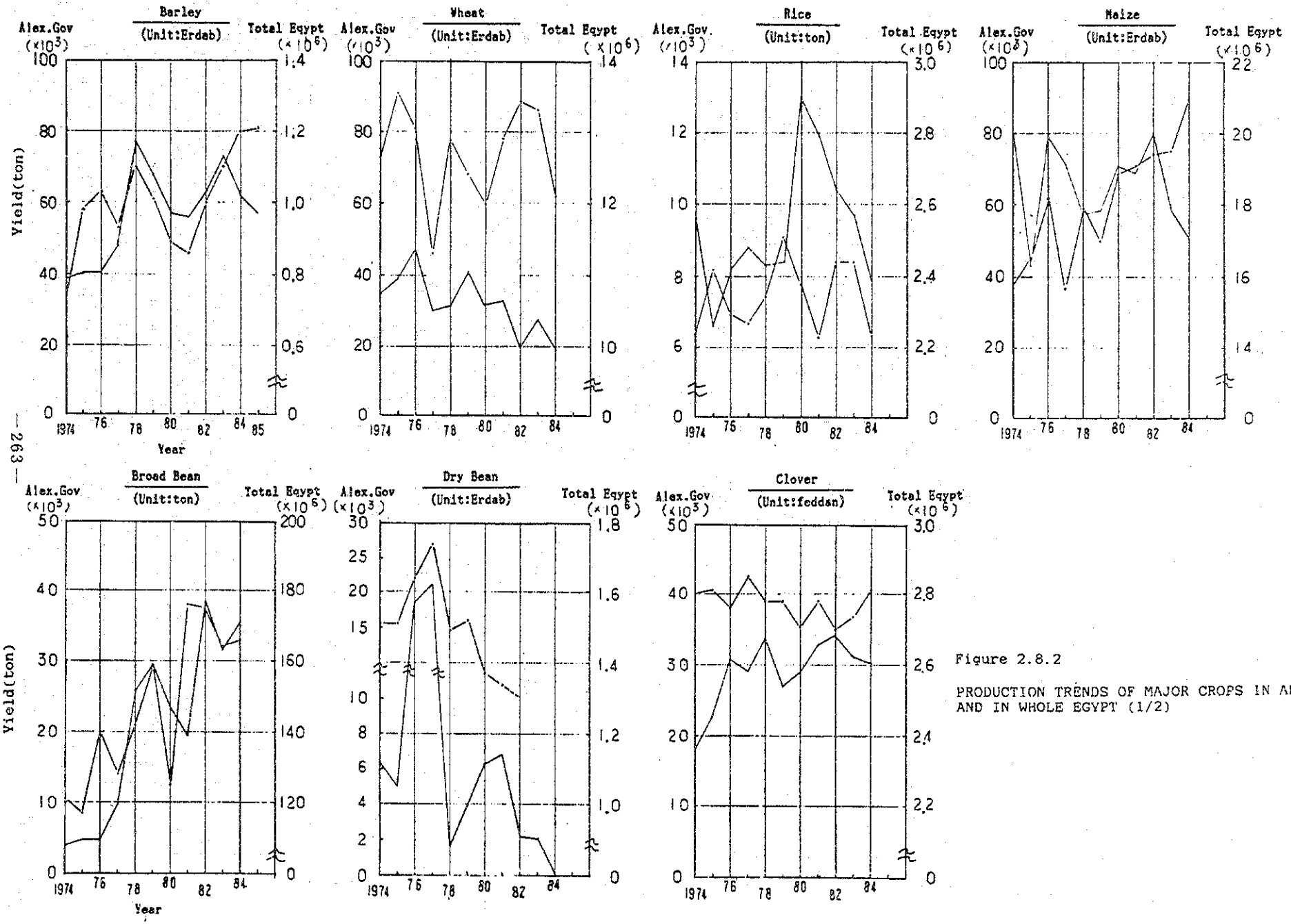


Figure 2.8.2

PRODUCTION TRENDS OF MAJOR CROPS IN ALEX. GOV. AND IN WHOLE EGYPT (1/2)

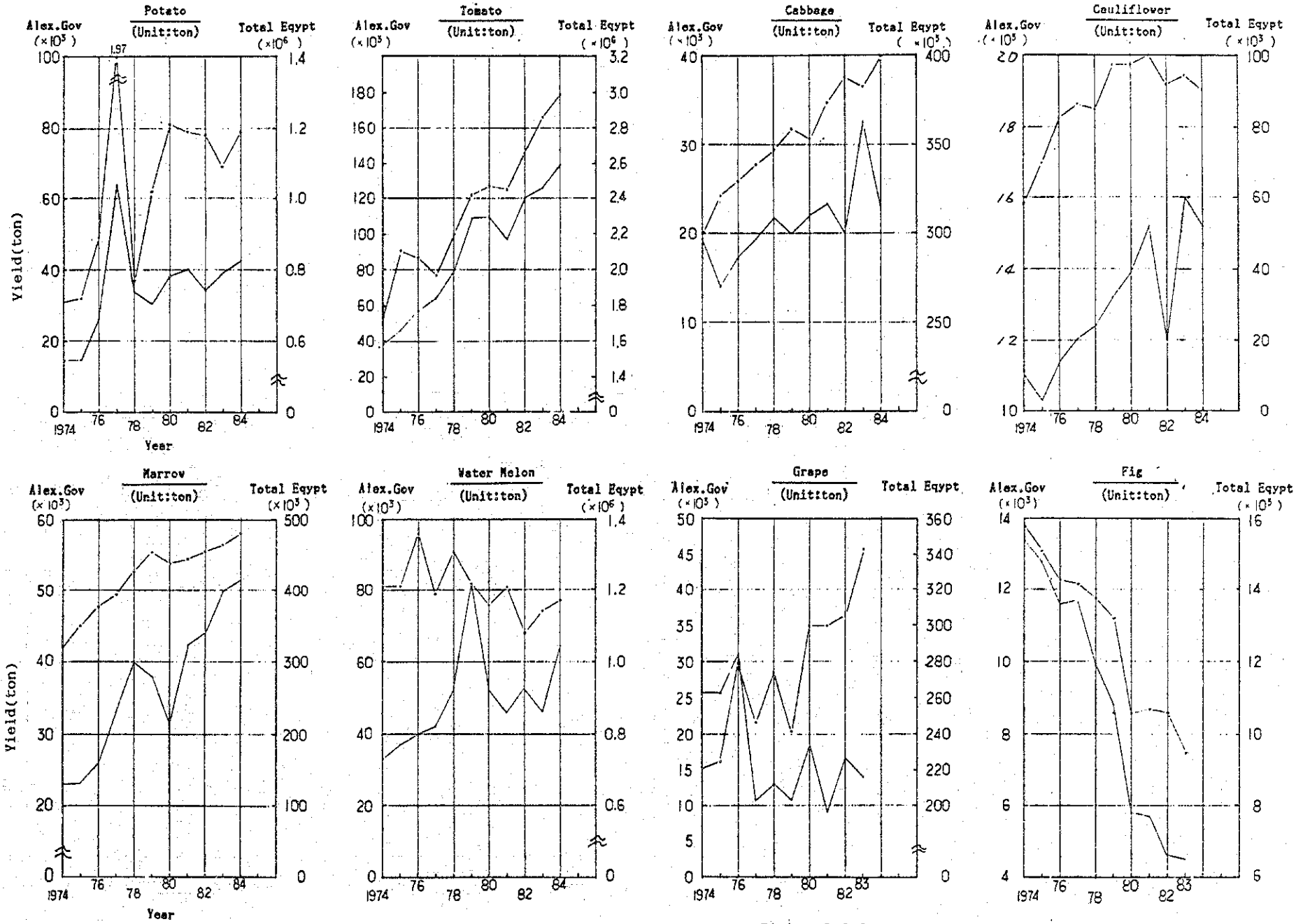


Figure 2.8.2 PRODUCTION TRENDS OF MAJOR CROPS IN ALEX. GOV. AND IN WHOLR EGYPT (2/2)

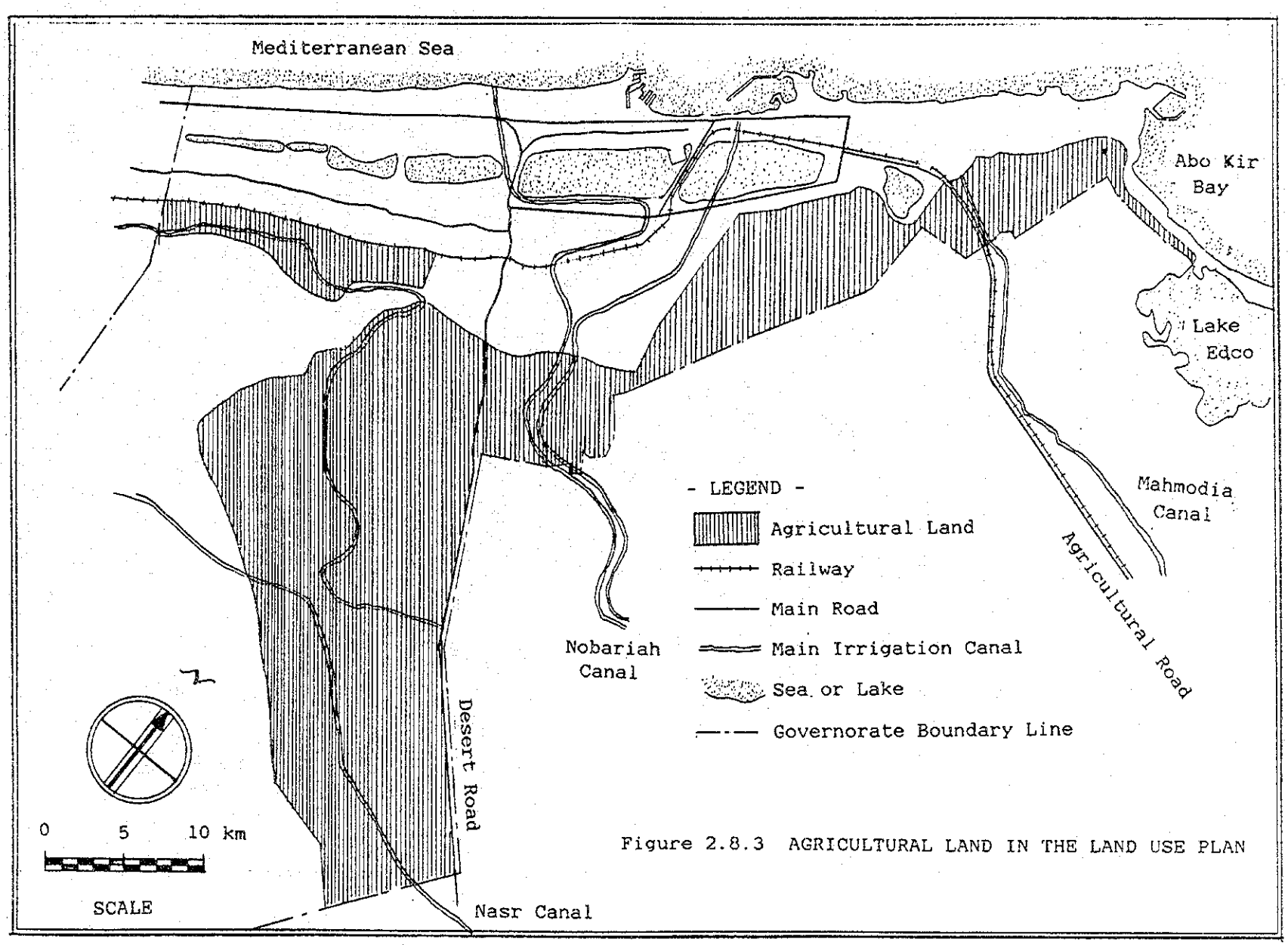


Figure 2.8.3 AGRICULTURAL LAND IN THE LAND USE PLAN

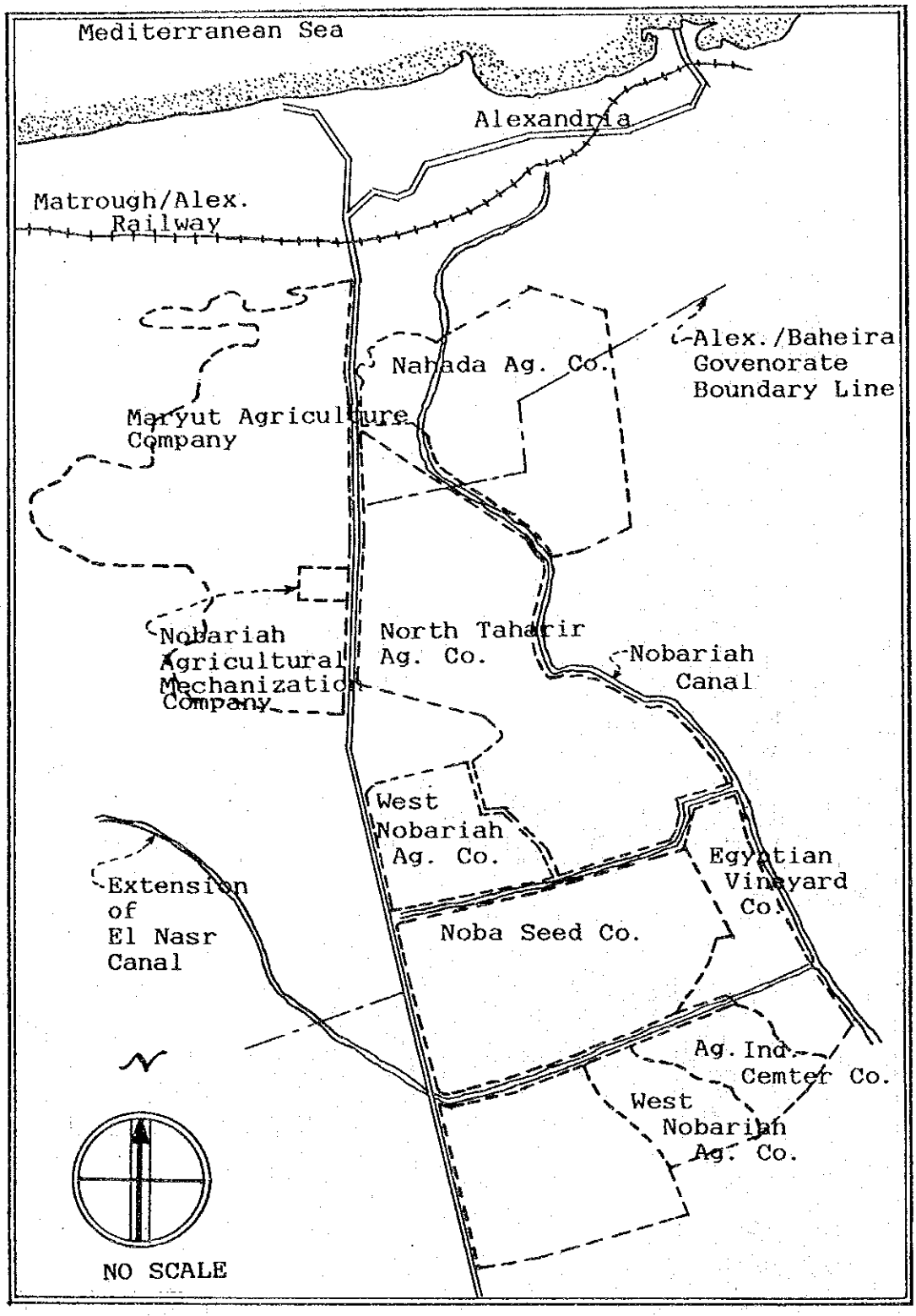


Figure 2.8.4 LOCATION OF AGRICULTURE COMPANY IN ALEXANDRIA REGION

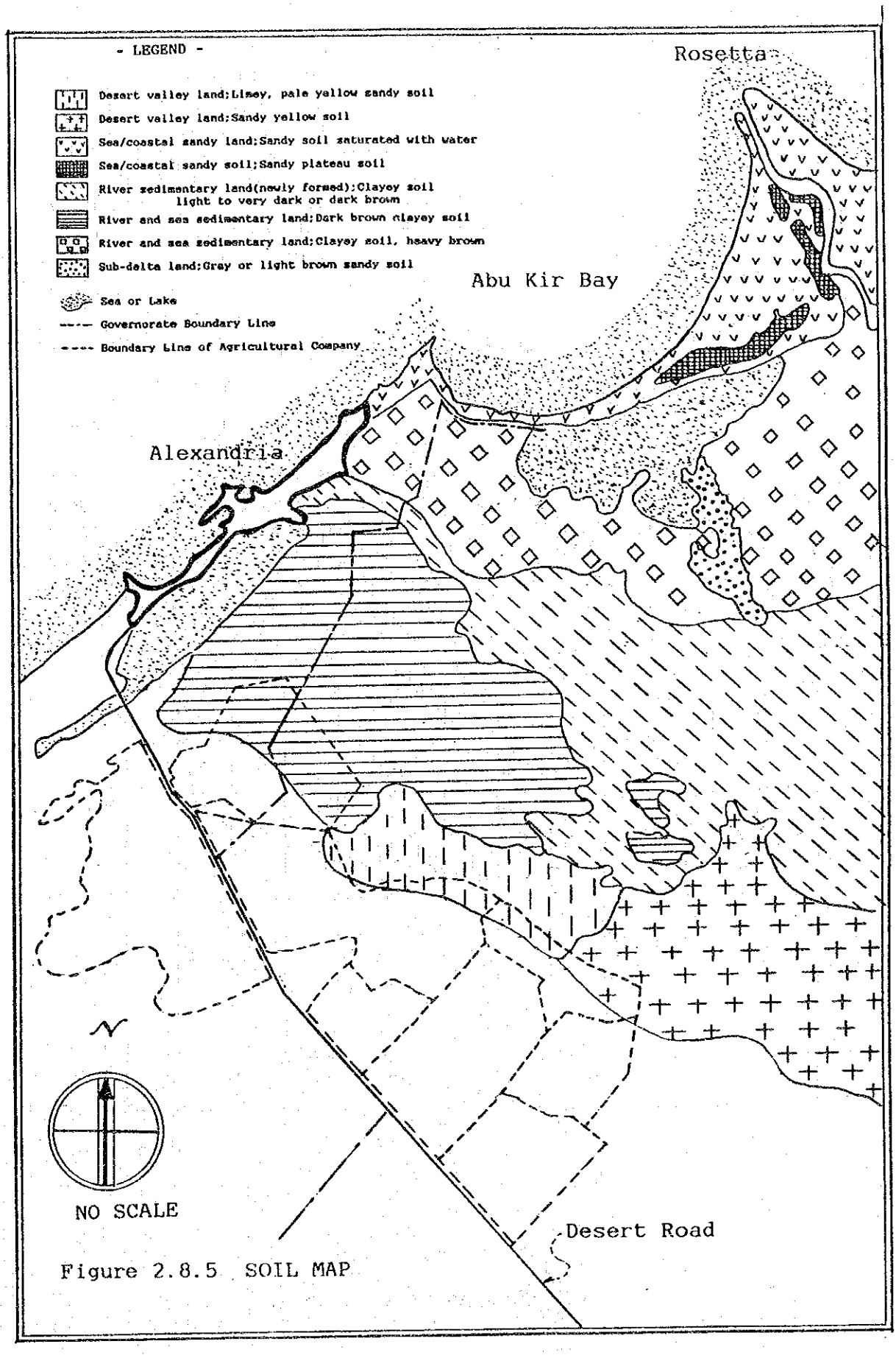


Figure 2.8.5 SOIL MAP

Rainfall in Alexandria

(unit:mm)

Month / Year	1	2	3	4	5	6	7	8	9	10	11	12	Total
1975	51.9	30.1	3.8	0.2	0.0	0.0	0.0	0.0	0.0	4.8	2.2	54.2	147.2
1976	39.1	31.1	6.9	6.0	3.2	0.0	0.0	0.0	Tr	17.0	47.1	13.5	163.9
1977	38.9	17.3	18.4	1.3	0.9	0.0	2.0	0.0	0.0	26.0	2.0	75.9	182.7
1978	59.5	5.6	20.7	Tr	0.0	0.1	0.0	0.0	0.1	7.8	16.9	60.1	170.8
1979	6.1	8.4	6.0	2.0	Tr	Tr	0.0	0.0	0.0	3.3	32.6	111.4	169.8
Average	39.1	18.5	11.2	1.9	0.8	0.0	0.4	0.0	0.0	11.8	20.2	63.0	166.9

Air Temperature in Alexandria

(Max. + Min.)/2

(unit:C°)

Month / Year	1	2	3	4	5	6	7	8	9	10	11	12	Ave.
1975	13.0	13.6	16.0	19.2	21.4	24.2	25.9	26.6	25.4	22.3	18.9	15.2	20.1
1976	13.3	12.5	15.6	19.0	22.2	23.6	25.9	26.2	24.2	22.5	19.6	15.8	20.0
1977	13.9	15.7	15.7	19.3	22.7	25.3	26.9	27.3	26.0	21.5	19.2	14.4	20.7
1978	13.8	15.0	14.9	18.9	22.0	24.7	26.3	25.9	24.8	23.2	18.0	15.4	20.2
1979	13.7	15.5	17.6	19.5	21.8	25.8	26.4	26.5	25.2	23.1	19.8	14.9	20.8
Ave.	13.5	14.5	16.0	19.2	22.0	24.7	26.3	26.5	25.1	22.5	19.1	15.1	20.4

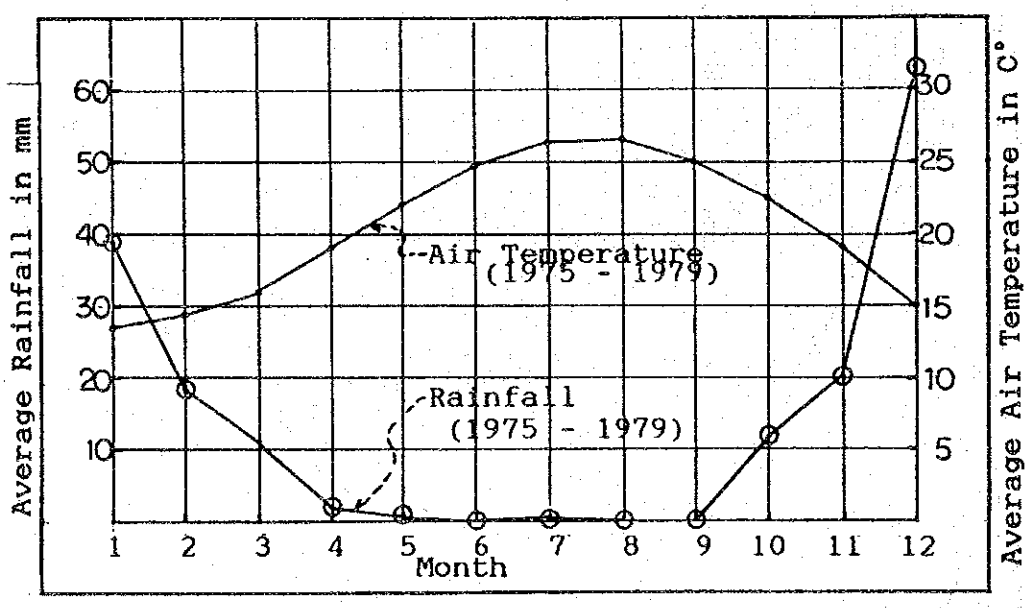
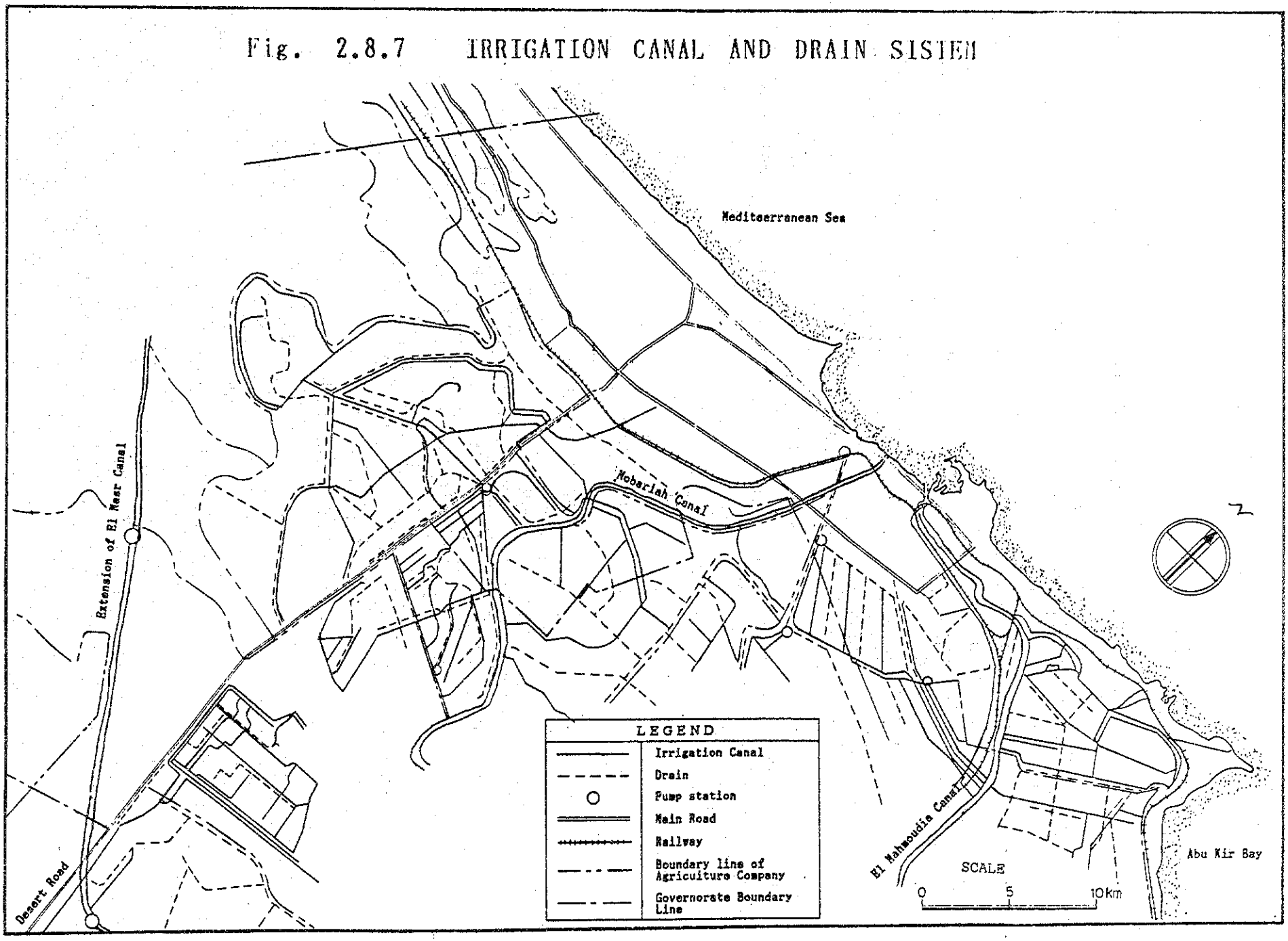
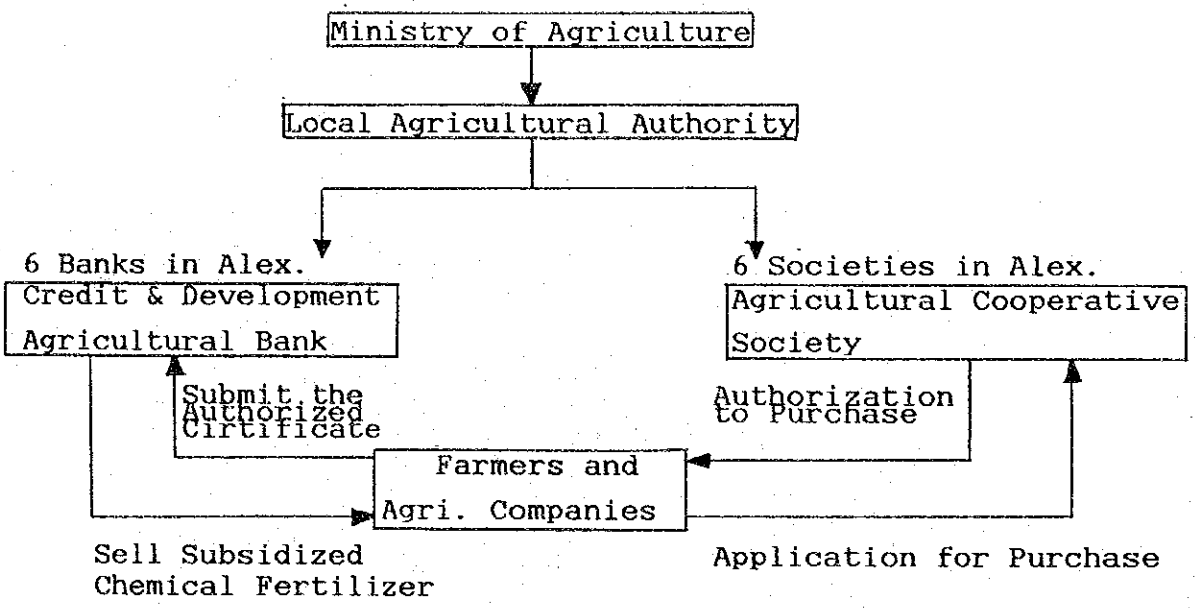


Figure 2.8.6 RAINFALL AND AIR TEMPERATURE

Fig. 2.8.7 IRRIGATION CANAL AND DRAIN SISTEM



Chemical Fertilizer



Organic Manure

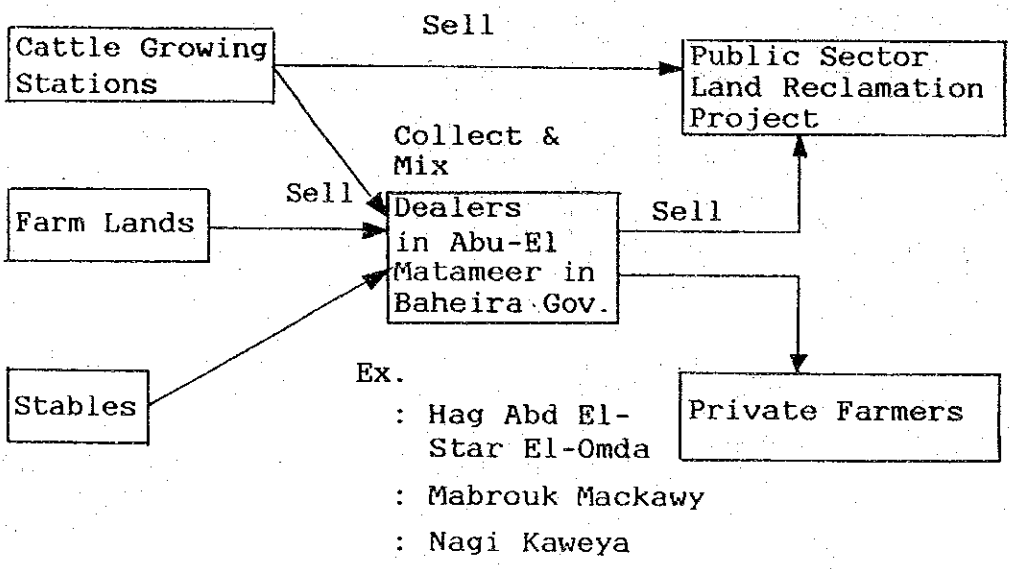


Figure 2.8.8 MARKET CYCLES OF CHEMICAL & ORGANIC MANURES

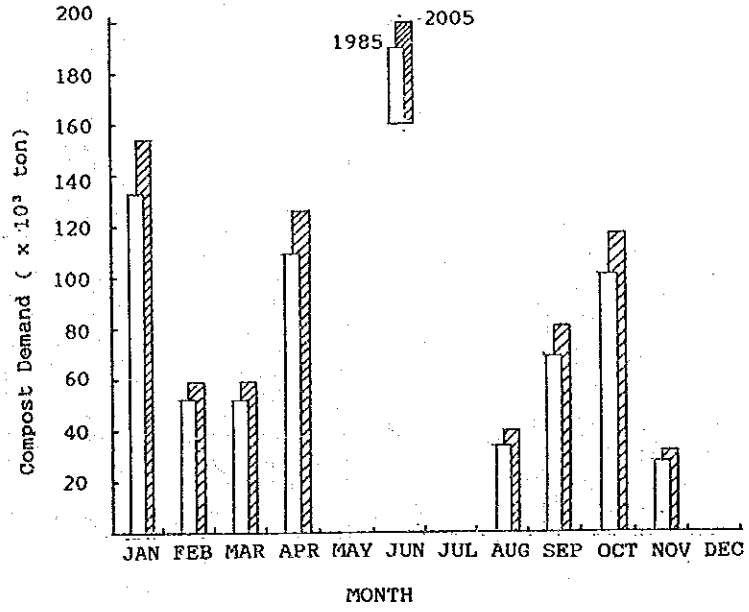


Figure 2.8.9 MONTHLY COMPOST DEMAND

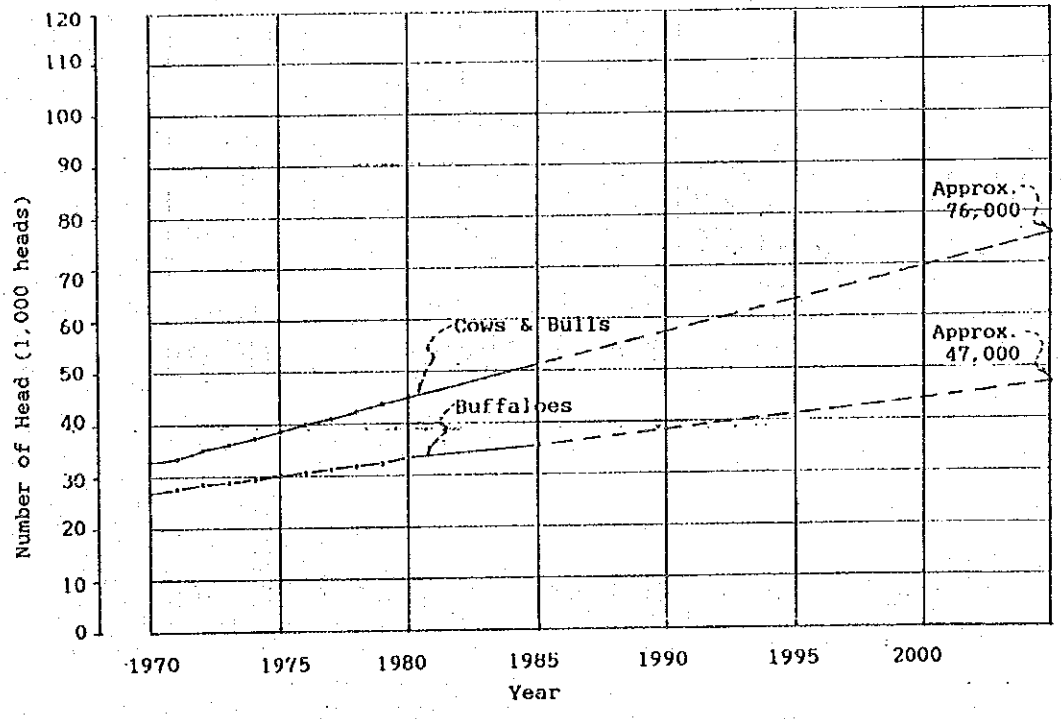


Figure 2.8.10 HISTRICAL NUMBERS OF CATTLE & FUTURE TREND

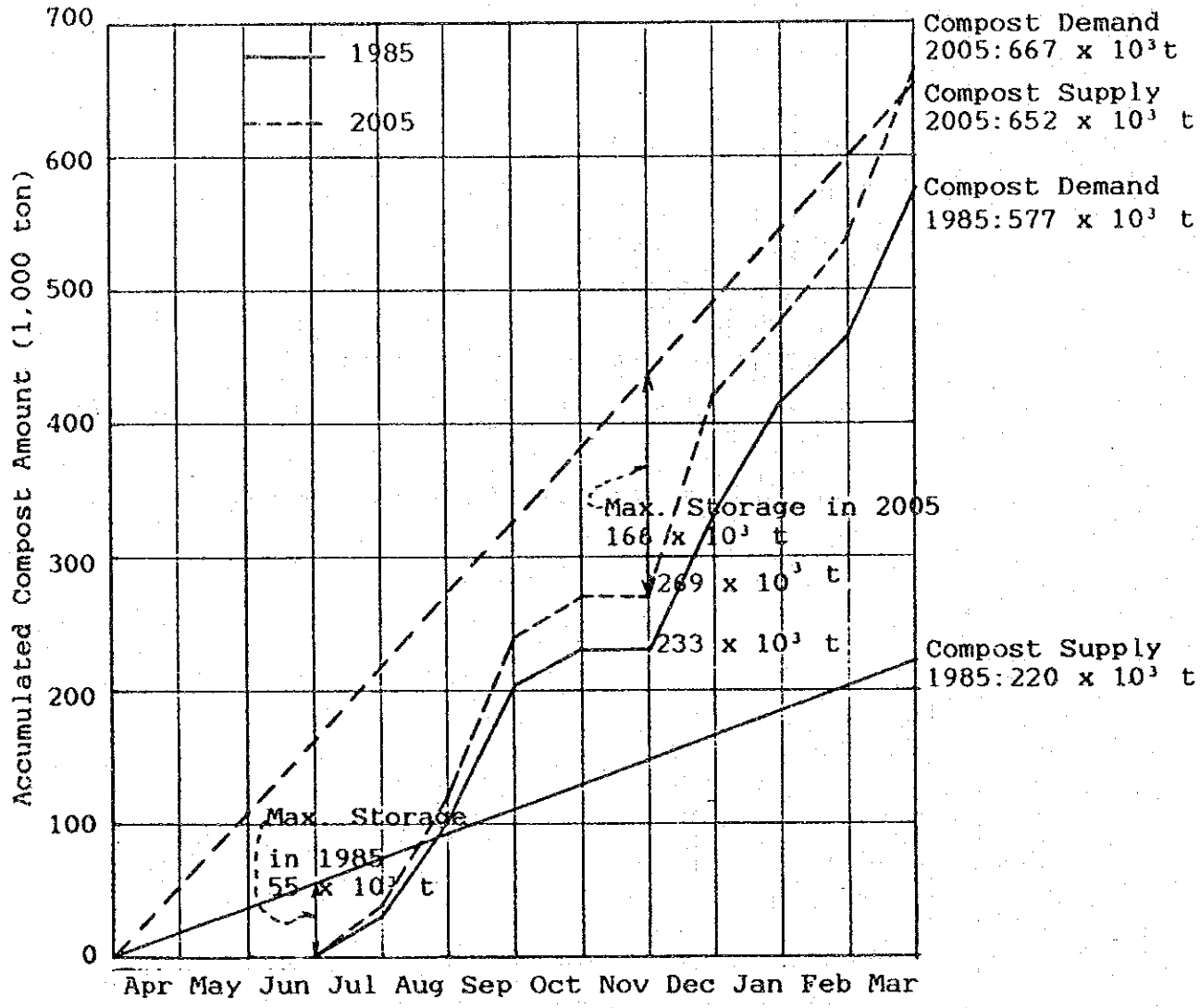


Figure 2.8.11 MASS CURVE OF COMPOST DEMAND & SUPPLY

2.9 Environmental Survey

2.9.1 Outline

Environmental survey was made by JICA Study Tem for the items mentioned below.

(1) Living environment

a. Water quality conditions around Dump Site

b. Conditions of dust around Dump Sites

c. Smoke pollution and malodor around Dump Sites

d. Population density conditions of flies at the representative areas of all the districts and Dump Site

e. Condition of traffic volume

(2) Various problems concerning wstes

2.9.2 Survey of living environment

This survey was made in view of that the information obtained from the survey will be useful in the future.

(1) Conditions of water quality around Dump Sites

The purpose of this survey is to know the influence of substances leached and eluted from the wastes disposed at the Dump Sites. Therefore, examination was made on the quality of water stagnant in Dump Site and various kinds of waste water flowing into Dump Site and water in Lake Maryout adjacent to Dump Site and the like.

Fig. 2-9-1 shows the places for water sampling, and

Tab. 2-9-1 shows Sample No., places for water sampling and detailed items of survey by water sampling.

Tab. 2-9-2 shows the results of water quality analysis (Note 1).

There is a fresh water canal [Sample (location) No. 2] flowing by Dump Site as a water intake, and a water outlet [Sample (Place) No. 7] for agriculture at the southern tip in Lake Maryout. As shown in Figure 2-9-1, Airport Dump Site is located at a beltlike area divided by the agricultural road and bank of Lake Maryout. Sewerage water from East districts and the waste water in large quantities from the open drainage canal are discharged to the drainage canal along the bank (east-northeast). Sample No. 3 is considered to be a mixture of leachate from Dump Site and miscellaneous waste water originating from a few residents in the surroundings.

The result of analysis of water quality of Sample (location) No. 1 are reasonable considering that in this place both the original lake water at Location No. 7 and water of the canal at Location No. 2 are joined.

Location No. 6 is the place separated from Dump Site by the bank. Its water quality value is very similar to the value at the outlet of Lake Maryout (Location No. 7) and the difference between the two is within a permissible error in measurement.

Locations No. 3, 4 and 5 (Note 2) show as a matter of course the characteristics of waste water in terms of DO, SS, counts of coliform group number, etc.

Sample No. 3 is alkaline and shows a high acid consumption. Considering higher SS, Cl^-, water hardness, total solid, fixed solid and volatile solid, ashing, due to the open air burning at Dump Site seems likely to effect the water quality.

In consideration of the results described above, the effect of landfilling disposal is not yet seen in Lake Maryout at present. However, the flow conditions of underground water must be examined.

Note 1) The results of water quality were based on the analysis carried out by the staff of Alexandria University on our request.

Note 2) Cl^-, SO_4^{-2}, T.S. and F.S. values of Sample No. 5 are higher than the others. This may be because the water from open drainage canal contain much salt drained from the land.

(2) Conditions of dust around Dump Sites

Wastes carried into Dump Sites are dried in an instant under the influence of Egyptian weather conditions (with little rainfall and great amount of sunlight, etc.) and are burned in open air by spontaneous combustion, and it may safely be said that the ground is covered with incinerated ahses. A considerable amount of dust is scattered by the departure and arrival of wastes collection vehicles, dumping of wastes and ground levelling work by bulldozers, etc. Furthermore, the effect of air borne dust due to combustion is considered to be great. The dust conditions were surveyed mainly in the areas around Airport Dump Site. Both settled and air borne dusts were surveyed.

Fig. 2-9-2 shows places of dust sampling for air pollution.

Number of sampling is 11. (four in Airport Dump Site, one in the agricultural road and six in points at about 3km from the Dump Site in the directions of S, NE, N, NW, W and SW).

Dust sampling was carried out for 2 weeks (settled dust) and 3 days (air borne dust).

Tab. 2-9-3 and 2-9-4 show the weather conditions

Tab. 2-9-5 shows the results (Note 3)

The direction and velocity of wind during the study period and relation between the points of measurement are as follows:

Stations 6 - 10 lie windward from Dump Site and Stations 5 and 11 are on the lee. Station 6 is at the agricultural road where there is heavy traffic of large sized trucks. Stations 7 and 11 are in the main industrial zone in the city, and Stations 8 - 10 are in the residential areas.

The same tendency is recognized in concentrations of both the air borne dust and settled dust except Station 5.

In the case of settled dust, 50% of the wind direction in the study period of 2 weeks was from NE-N-NW, and concentration of settled dust was maximum in Stations 1 - 4 of Dump Site and Stations 6, 7 and 11 showed the second largest figures. Stations 8 - 10 and 5 show low concentrations, and these results are reasonable enough taking into consideration the fact that these stations are farthest from the activity range of the city.

In the case of air borne dust, the wind direction in the study period was all from N-NE, and only Station 5 is affected by Dump Site.

In the open dump site, there are must ashes produced by spontaneous burning and dusts. The wind direction makes small the influence of these ashes and dusts on the residents.

Note 3) The results of dust analysis were obtained by the staff of Alexandria University at our request.

(3) Smoke pollution and malodor around Dump Sites

The living areas lie along the north side of Dump Site and a few dwellings are present on the west side.

In Dump Site, all the wastes carried into every day are open dumped and burning by spontaneous combustion and the quantity of smoke emitted is considerable. The wind direction in Alexandria City is north-northeast during around March to October, and becomes unstable in and after around November. In December and January, the wind direction becomes from northwest to southwest and unstable again.

Lake Maryout is in the south of Dump Site, and the smoke pollution for dwellings is fortunately avoided though much smoke is emitted in the summer season. In the winter season, the wind direction is changed toward the dwellings, but the trend of incineration is reduced since the rainy season sets in. Therefore, the large quantity of smoke as in the summer may not be emitted. In the season of unstable wind direction, the dwellings are directly hit by smoke.

An interview for smoke pollution and malodor was held with residents around Dump Site. Residents in the areas witin a distance of about 500m from Dump Site feel the smoke pollution and malodor when the wind blow from southeast-south-southwest and children mostly dislike it also shutting windows as a countermeasure.

(4) Population density conditions of flies at the representative areas of all the districts and Dump Site

Wastes to be dumped in Dump Site contain much garbages of home life, raw vegetables, fruits, fish, shellfish, meat rejected in the market, and putrescible and malodorous materials such as dead animals. These things create conditions suitable for occurrence of insect damage.

Variouis damages by insects gathering around wastes are expected, and a population density survey of flies, which are most closely related to everyday life, was carried out in Airport Dump Site and 8 areas of Alexandria.

Tab. 2-9-6 shows the method of survey.

Fig. 2-9-3 shows the sampling sites for fly survey, and Tab. 2-9-7 shows names of survey areas and their characteristics, etc.

Tab 2-9-8 shows survey results together with the values obtained in the survey made in March, 1974, for reference.

Survey results in 1974 and in 1984 differ in places and seasons of survey to some extent, and it may be risky to compare the results in the strict sense. In this survey, Dump Site had the highest population density, and Downtown had the lowest. In other areas, there may be almost the same values.

The foregoing are the actual conditions of water and air pollution (dust), smoke pollution, malodor and insect damage (flies). The use of the open dumping method as the final disposal one is regarded as undesirable since it is not good from sanitary point of view and it can be one of cause for environmental deterioration.

(5) Condition of traffic volume

Traffic volume on two main roads of Agriculture Road and Desert Road, and that on other roads, were surveyed hourly for twenty-four hours. Places for survey are shown in Fig. 4-2-12 in this supporting report. Tab. 2-9-9 from (1) to (8) show the results of traffic volume survey.

2.9.3 Various probelms concerning wastes

(1) Problems in main roads

In general, containers and open stations are scarcely found in main roads (including trunk and coast roads), with considerably heavy traffic and in commercial areas, and there seems to be no problem concerning wastes at a glance. But wide driveways and sidewalks very often induce people to make illegal parking of automobiles, causing traffic barriers. This is one of the factors that make road cleansing difficult.

(2) Problems of unpaved roads

In the case roads have paved driveways but sidewalks are incompletely paved, wastes and sand are accumulated along the boundary of driveways and sidewalks. (East and West Districts) Cleansing of these sand and waste requires much manpower.

On clay unpaved roads, wastes are seriously incorporated in earth and sand, and partly buried in earth and sandy unpaved roads (in Ameriyah, East and Montazah districts).

(3) Problems of insufficient sewerage network

In districts with insufficient sewerage network, household waste water, infiltrated into the ground, becomes condensed water and provides a wide range of wastes dumps incorporating wastes blown by winds while flowing over the ground, and putrefies, giving off malodor. This is concerned with not only waste cleansing problem but also public health, and construction of fully-equipped sewerage system is strongly recommended before waste cleansing problem is discussed (in Ameriyah and Montazah districts).

(4) Problems in installation of containers

No other types of vehicle except for big Truxmore are used to collect wastes from communal containers. Therefore the containers can only be installed in roads of somewhat large width. Furthermore, the number of installed containers does not correspond to the number of dwellings but tends to be determined rather by the number of Truxmore vehicles and by their operation program.

Containers in each area are always full of wastes, and overflowing wastes are piled up or scattered around them. This helps to spoil the beauty of the City.

(5) Problems in use of plastic bags

The use of plastic bags is producing a remarkable effect on the sanitary aspect and convenience for collection of wastes. However, plastic bags are limited only to commercial areas, and middle and high income areas at present, and are not widely utilized due to problems of economic burdens.

The following places are used as collection points, in front of houses, on the sidewalks, at open stations. While wastes are kept on such places, plastic bags are torn by dogs and cats causing scattering of wastes.

(6) Problems in reusable materials collection

Street sweepers start operation from early morning, to collect wastes at open stations and in the vicinity of containers, but reusable materials are collected by private collectors and Zabaleen. Wastes collected in one place with much effort are scattered considerably when reusable materials are being sorted by them, and some plastic bags are found torn.

(7) Problems in self-consciousness of wastes disposal

It seems that people, in general, have rather week consciousness that roads and plazas are public places, and that inhabitants are jointly responsible for keeping such places clean and sanitary. Even in the midtown, many ugly places with wastes scattered are observed between buildings or narrow lanes.

There are still many wastes on roads even in areas with sufficient land readjustment as in East and West districts

Tab. 2-9-1 LOCATIONS FOR WATER QUALITY SURVEY

Sample No.	Sampling Location	Detail Items of Survey by Water Sampling
1	Inlet of Lake Maryout	Influence of quality of water flowing from the fresh water canal
2	Outlet of canal	Water quality of the fresh water canal
3	Pond in Dump Site	Water quality of pond likely to be leached and eluted from wastes
4	Outlet of sewerage from East District	Water quality of sewage from East district discharged to part of Dump Site
5	Drainage canal from city	Water quality of water from sewerage outlet discharged to part of Dump Site
6	Lake Maryout	Quality of lake water likely to be affected by Dump Site
7	Outlet of Lake Maryout	Quality of lake water likely to be under the least influence of Dump Site

Tab. 2-9-2 RESULTS OF WATER QUALITY ANALYSIS

(Results of chemical analysis of water samples around Airport Dump Site)

October 1984

Sample		No.1	No.2	No.3	No.4	No.5	No.6	No.7
Item	Unit	Inlet of Lake Maryout	Outlet of Canal	Pond in Dump Site	Outlet of Sewerage from East Districts	Drainage Canal From City	Lake Mayout	Outlet of Lake Maryout
Temperature	°C	23.0	24.0	22.5	22.0	21.0	23.0	23.0
pH	-	7.0	7.2	8.1	7.0	8.0	7.0	7.0
Alkalinity	mg/l as $CaCO_3$	300	200	1,380	470	700	400	380
B.O.D.	mg/l	28	48	260	680	116	230	260
C.O.D.	"	124	351	880	1,060	704	1,230	1,410
D.O	"	5.8	4.0	0.0	0.0	1.6	7.2	8.0
S.S	"	10	12	2,300	382	161	57	83
PO^4	"	22	20	20	22.5	14.3	20	22.5
NH_3-N	"	14	5	0.32	0.28	6.0	10.0	10.0
NO_2-N	"	0.002	0.002	-	-	-	-	-
NO_3-N	"	6.3	5.8	6.0	6.0	5.7	5.9	5.7
Coliform group number	count/ml	$75x10^3$	$55x10^3$	$250x10^3$	$21.4x10^6$	$12.4x10^6$	$54x10^3$	$28x10^3$
Colon bacilli	MPN/110ml	$15x10^3$	$11x10^3$	$110x10^3$	$460x10^6$	$460x10^3$	$46x10^3$	$2.4x10^3$
Cl^-	mg/l	300	50	800	390	2,650	500	500
SO_4^{-2}	"	125	35	90	80	750	210	235
Total hardness	mg/l as $CaCO_3$	300	180	700	300	380	440	440
T.S *1	mg/l	1,014	312	2,767	1,245	5,795	1,504	1,461
F.S *2	"	854	204	2,188	795	5,427	1,264	1,180
V.S *3	"	160	108	579	450	368	240	281
D.S *4	"	1,004	300	468	863	5,634	1,447	1,378

*1: Total solids (at 110°C)
*2: Fixed solids (at 600°C)
*3: Volatile solid (VS = TS - FS)
*4: Disoluve solid (DS = TS - SS)

Tab. 2-9-3 METEOROLOGICAL DATA DURING STUDY PERIOD

Date	Relative Humidity (%)	Temperature (°C)	Rain Fall	N	NE	E	SE	S	SW	W	NW	
15/11	75.4	20.8		33.3	4.2	-	4.2	4.2	-	-	54.1	W.D.
				11.1	11.1	-	9.3	5.5			3.7	W.S.
16	66.5	20.6		-	-	-	41.6	-	37.5	16.7	4.2	W.D.
	-	-		-	-	-	12.4	-	21	25	26	W.S
17	66.6	20.9		-	-	-	-	12.5	-	37.5	50	W.D.
	-	-		-	-	-	-	9.2	-	21.6	16.8	W.S.
18	76.1	18.5		-	-		16.7	33.3	20.8	20.8	8.4	W.D.
	-	-		-	-	-	3.5	7	15.5	17.7	11.1	W.S.
19	71.5	17.9		8.3	12.5	16.6	8.3	33.3		8.3	12.5	W.D.
	-	-		9.2	5	5.5	11.1	5.4		12.0	14.2	W.S.
20	74.9	17.9		4.2	29.2	45.8	16.6	4.2				W.D.
	-	-		14.8	12.8	5.2	2.2	1.8				W.S.
21	75.8	17.4		-	-	4.2	25	45.8	20.8	4.2	-	W.D.
	-	-		-	-	3.7	6.5	6.6	14.4	11.1	-	W.S.
22	67.3	18.5		-	-	-	-	33.2	41.8	25	-	W.D.
	-	-		-	-	-	-	18.5	25.2	18.1	-	W.S.
23	73	14.7		-	-	8.4	16.6	45.8	25	4.2	-	W.D.
	-	-		-	-	2.8	8.9	18.5	33.9	33.3	-	W.S.
24	68.4	17.1		8.3	-	4.2	-	4.2	4.2	-	79.1	W.D.
	-	-		24	-	1.8	-	1.8	5.5	-	17.8	W.S.
25	77.5	16.5		20.8	12.5	8.4	-	8.4	12.5	8.3	29.1	W.D.
	-	-		7.4	1.8	1.8	-	1.8	3.7	2.7	7.4	W.D.
26	77.8	18.1		50	41.6	8.4	-	-	-	-	-	W.D.
	-	-		13.9	7.8	1.8	-	-	-	-	-	W.S.
27	77	19.7		79.2	20.8	-	-	-	-	-	-	W.D.
	-	-		14	16.6	-	-	-	-	-	-	W.S.
28	79.5	19.6		50	50	-	-	-	-	-	-	W.D.
	-	-		12.0	6.3	-	-	-	-	-	-	W.S.
29	75	19.2		79.2	20.8	-	-	-	-	-	-	W.D.
	-	-		10.2	5.9	-	-	-	-	-	-	W.S.
30	75.6	17.4		20.8	54.2	25	-	-	-	-	-	W.D.
	-	-		18.1	8.1	5.5	-	-	-	-	-	W.S.

Tab. 2-9-4 PERCENT OF WIND DIRECTION AND AVERAGE WIND SPEED DURING THE PERIOD OF SAMPLING AIR BORNE DUST AND SETTLED DUST

(KM/HR)

		N	NE	E	SE	S	SW	W	NW
26/11	W.D.	70	30	-	-	-	-	-	-
8 a.m. to 6 p.m.	A.W.S.	17.2	14.2	-	-	-	-	-	-
27/11	W.D.	70	30	-	-	-	-	-	-
8 a.m. to 6 p.m.	A.W.S.	20.3	18.5	-	-	-	-	-	-
28/11	W.D.	60	40	-	-	-	-	-	-
8 a.m. to 6 p.m.	A.W.S.	14.5	10.6	-	-	-	-	-	-

SETTLED DUST DURING THE LAST 2 WEEKS OF NOV.

	N	NE	E	SE	S	SW	W	NW
W.D%	22.1	15.4	7.5	8.1	14.1	10.2	7.8	14.8
A. W.S.	12.5	8.3	4.5	4.6	10.4	20.8	19.5	9.3

Tab. 2-9-5 CONCENTRATIONS OF SETTLED DUST AND AIR BORNE DUST IN TONS/MILE^2/MONTH AND GM/M^3 RESPECTIVELY DURING THE PERIOD OF STUDY

Station	Location	Air Borne Dust 26/11	27/11	28/11	Average	Dust Fall (Settled Dust
1	Dump site	596	537	610.5	581.1	359
2	" "	496.6	387.5	410.0	431.3	300
3	" "	310	196	230	245.3	288
4	" "		No Electricity			202
5	South of dump site	227	-	-	227	25
6	Agricultural road (N)	270	210.9	220	233.6	158
7	Seyouf (NE)	222	214	236	224	128
8	Children hospital Boulkly (N)	168	145	179	164	35
9	NIOSH (NW)	156	163	151	156.6	23
10	HIPH (W)	149	139	132	140	27
11	National Textile (SW)	226	217	247	230	132

Tab. 2-9-6 METHOD FOR SURVEY OF FLY POPULATION DENSITY

(1) The grid method was used in this survey.

(2) The grid size is 75cm x 75cm and made of 15 narrow wood strips 2cm wide.

(3) The grid was placed on wastes, and flies were driven away. After 30 seconds, the number of flies is counted as early as possible.

(4) If flies gather almost evenly on the grid, the number of the flies is counted on the quarter of the area to quadruple the obtained results. If fly population density is high, the number of flies on one grid is counted to multiply it by 15.

Tab. 2-9-7 SAMPLES SITES SPECIFICATION FOR FLY SURVEY

District	Sub District	Name of Main Street	Characteristic of Area
Ameriyah D.	Dekhila	Dekhila Street	Newly Residential Area without planning collection service is done only on main road.
West D.	Wardian	El Mex St. El Aman St.	Newly Residential Area with planning. Collection service is done.
Gomrok D.	Gomrok	El Nasr St. El Baharya St.	Old Residential Area without order. Collection service is done.
Middle D.	El-Ramel Station	Safya Zaghloul St., Saad Zaghloul St.	Commercial Area. Collection service is done.
	Moharam Bey	Moharam Bey	Old Residential Area in order. Collection service is done.
	Ibrahimiya	El Horriyia St. Omar lotfy St.	Old Residential Area in order. Collection service is done.
East D.	Ard El Mofty	Gamyla Bohraid St. Abussoliman St.	Newly Residential Area in order. Collection service is done only on main street.
Montazah	El Asafra	Malk Hefny St. Dr. El Nabawy El Mohandes St.	Newly Residential Area without order. Collection service is not done.
East	Airport Dump Site		Dump Site.

Tab. 2-9-8 FLY POPULATION DENSITY IN DIFFERENT AREAS OF ALEXANDRIA IN NOVEMBER 1984

Site	No. of Readings in each Site	Min. Fly/m^2	Max. Fly/m^2	Mean Fly/m^2 Nov.1984	Mean Fly/m^2 Mar.1974
El Dekhaila	31	5.0	216	36	-
El Wardian	33	15.0	123	35	71
El Gomrok	21	12.0	154	48	54
Down Town	31	2.5	23	6.0	36
Moherm Bek	24	12.0	185	64	57
El Ibrahimia	28	5.0	57	22	36
El Montazah (El Asafra)	16	8.0	93	32	-
Ard El Mofty	16	13.0	154	56	107
Dump Site	14	62.0	339	131	-

S.R. Tab. 2-9-9 RESULTS OF TRAFFIC SURVEY

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	1,086	208	79	119	1,492	13.27
8 — 9	1,041	224	92	28	1,385	8.66
9 — 10	1,046	294	155	22	1,517	11.67
10 — 11	1,238	276	158	12	1,685	10.09
11 — 12	1,151	339	112	13	1,615	7.74
12 — 13	1,027	313	115	18	1,473	9.03
13 — 14	1,007	248	132	21	1,408	10.87
14 — 15	1,003	285	103	32	1,423	9.49
15 — 16	935	208	99	35	1,277	10.49
16 — 17	1,119	165	63	14	1,361	5.66
17 — 18	745	185	65	20	1,015	8.37
18 — 19	803	172	72	14	1,061	8.11
Total in daytime	12,202	2,917	1,245	348	16,712	9.53
19 — 20	753	112	69	8	942	8.17
20 — 21	591	158	36	11	796	5.90
21 — 22	567	134	36	8	745	5.91
22 — 23	474	95	32	18	619	8.08
23 — 24	274	58	28	7	367	9.54
0 — 1	215	48	51	7	321	18.07
1 — 2	123	27	43	3	196	23.47
2 — 3	63	17	27	2	109	26.61
3 — 4	43	11	38	1	93	41.94
4 — 5	90	24	55	3	172	33.72
5 — 6	230	48	69	8	355	21.69
6 — 7	598	75	80	86	839	19.79
Total at nighttime	4,021	807	564	162	5,554	13.07
vehicles/day	16,223	3,724	1,809	510	22,266	10.41

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	771	181	73	33	1,058	10.02
8 — 9	910	254	102	26	1,292	9.91
9 — 10	1,074	410	90	16	1,590	6.67
10 — 11	1,251	323	150	15	1,739	9.49
11 — 12	1,185	304	150	18	1,657	10.14
12 — 13	1,105	267	128	17	1,517	9.56
13 — 14	1,009	246	123	17	1,395	10.04
14 — 15	2,042	256	98	30	2,426	5.28
15 — 16	1,034	286	95	80	1,495	11.71
16 — 17	1,248	223	86	55	1,612	8.75
17 — 18	566	254	60	20	900	8.89
18 — 19	1,126	215	83	21	1,445	7.20
Total in daytime	13,321	3,219	1,238	348	18,126	8.75
19 — 20	937	223	67	43	1,270	8.66
20 — 21	666	142	58	18	884	8.60
21 — 22	579	122	41	10	752	6.78
22 — 23	468	64	22	4	558	4.66
23 — 24	240	19	17	13	289	10.38
0 — 1	204	37	27	11	279	13.62
1 — 2	136	26	49	1	212	23.58
2 — 3	70	26	38	5	139	30.94
3 — 4	39	17	26	2	84	33.33
4 — 5	62	16	38	3	119	34.45
5 — 6	120	30	46	3	199	24.62
6 — 7	337	77	58	46	518	20.08
Total at nighttime	3,858	799	487	159	5,303	12.18
vehicles/day	17,179	4,018	1,725	507	23,429	9.53

S.R. Tab. 2-9-9 RESULTS OF TRAFFIC SURVEY

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	787	283	516	53	1,639	34.72
8 — 9	859	357	507	14	1,737	29.99
9 — 10	841	384	452	11	1,688	27.43
10 — 11	862	407	405	15	1,689	24.87
11 — 12	809	359	336	7	1,511	22.70
12 — 13	700	349	295	11	1,355	22.58
13 — 14	639	269	266	15	1,189	23.63
14 — 15	592	242	257	32	1,123	25.73
15 — 16	556	233	258	34	1,081	27.01
16 — 17	582	207	211	29	1,029	23.32
17 — 18	596	208	184	14	1,002	19.76
18 — 19	651	177	193	14	1,035	20.00
Total in daytime	8,474	3,475	3,880	249	16,078	25.68
19 — 20	481	168	103	16	768	15.49
20 — 21	459	136	106	22	723	17.70
21 — 22	392	111	100	10	613	17.94
22 — 23	322	99	133	16	570	26.14
23 — 24	183	78	104	11	376	30.59
0 — 1	126	45	104	5	280	38.93
1 — 2	64	31	119	8	222	57.21
2 — 3	32	38	83	1	154	54.55
3 — 4	15	53	86	0	154	55.84
4 — 5	37	74	136	1	248	55.24
5 — 6	104	148	191	15	458	44.98
6 — 7	301	159	380	43	883	47.90
Total at nighttime	2,516	1,140	1,645	148	5,449	32.91
vehicles/day	10,990	4,615	5,525	397	21,527	27.51

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	444	183	163	43	833	24.73
8 — 9	502	266	244	16	1,028	25.29
9 — 10	501	292	340	13	1,146	30.80
10 — 11	700	315	347	9	1,371	25.97
11 — 12	705	342	395	10	1,452	27.89
12 — 13	681	350	394	14	1,439	28.35
13 — 14	722	312	485	15	1,534	32.59
14 — 15	701	347	418	32	1,498	30.04
15 — 16	544	327	326	80	1,277	31.79
16 — 17	670	303	351	21	1,345	27.66
17 — 18	746	297	308	22	1,373	24.03
18 — 19	579	272	245	20	1,116	23.75
Total in daytime	7,495	3,606	4,016	295	15,412	27.97
19 — 20	647	169	221	14	1,051	22.36
20 — 21	562	151	161	10	884	19.34
21 — 22	493	129	161	10	793	21.56
22 — 23	396	96	137	11	640	23.13
23 — 24	237	59	144	15	455	34.95
0 — 1	126	34	120	8	288	44.44
1 — 2	75	28	94	5	202	49.01
2 — 3	37	20	87	1	145	60.69
3 — 4	26	16	72	7	121	65.29
4 — 5	27	15	74	4	120	65.00
5 — 6	75	52	102	16	245	48.16
6 — 7	222	78	112	23	435	31.03
Total at nighttime	2,923	847	1,485	124	5,379	29.91
vehicles/day	10,418	4,453	5,501	419	20,791	28.47

S.R. Tab. 2-9-9 RESULTS OF TRAFFIC SURVEY

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	199	106	84	25	414	26.33
8 — 9	330	169	188	28	715	30.21
9 — 10	437	227	117	28	809	17.92
10 — 11	511	203	183	11	908	21.37
11 — 12	434	176	173	14	797	23.46
12 — 13	416	175	144	9	744	20.56
13 — 14	484	200	203	9	896	23.66
14 — 15	539	233	196	46	1,014	23.87
15 — 16	571	251	197	135	1,154	28.77
16 — 17	667	238	172	44	1,121	19.27
17 — 18	495	205	142	24	866	19.17
18 — 19	656	187	133	10	986	14.50
Total in daytime	5,739	2,370	1,932	383	10,424	22.21
19 — 20	501	134	96	21	752	15.56
20 — 21	386	108	53	12	560	11.61
21 — 22	210	50	67	6	333	21.92
22 — 23	193	28	43	5	269	17.84
23 — 24	104	24	44	16	188	31.91
0 — 1	73	9	34	9	125	34.40
1 — 2	65	17	40	3	125	34.40
2 — 3	37	22	36	0	95	37.89
3 — 4	40	10	33	3	86	41.86
4 — 5	22	7	47	3	79	63.29
5 — 6	38	26	56	2	122	47.54
6 — 7	89	14	68	6	177	41.81
Total at nighttime	1,758	450	617	86	2,911	24.15
vehicles/day	7,497	2,820	2,549	469	13,335	22.63

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	808	245	214	133	1,400	24.79
8 — 9	657	220	175	17	1,069	17.96
9 — 10	535	248	158	10	951	17.67
10 — 11	596	254	145	10	1,005	15.42
11 — 12	526	223	136	20	905	17.24
12 — 13	419	192	136	17	764	20.03
13 — 14	432	160	108	28	728	18.68
14 — 15	415	159	94	30	698	17.77
15 — 16	424	129	94	18	665	16.84
16 — 17	372	98	60	12	542	13.28
17 — 18	365	96	75	20	556	17.09
18 — 19	316	110	77	8	511	16.63
Total in daytime	5,865	2,134	1,472	323	9,794	18.33
19 — 20	233	59	61	4	357	19.21
20 — 21	226	41	60	2	329	18.84
21 — 22	197	47	61	7	312	21.79
22 — 23	149	26	95	16	286	38.81
23 — 24	110	17	85	6	218	41.74
0 — 1	61	37	63	4	165	40.61
1 — 2	42	17	54	2	115	48.70
2 — 3	32	10	46	0	88	52.27
3 — 4	21	21	66	0	108	61.11
4 — 5	54	10	139	1	204	68.63
5 — 6	127	51	172	4	354	49.72
6 — 7	382	58	266	51	757	41.88
Total at nighttime	1,634	394	1,168	97	3,293	38.41
vehicles/day	7,499	2,528	2,640	420	13,087	23.38

S.R. Tab. 2-9-9 RESULTS OF TRAFFIC SURVEY

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	134	88	97	6	325	31.69
8 — 9	154	87	122	4	367	34.33
9 — 10	158	93	167	2	420	40.24
10 — 11	161	118	179	1	459	39.22
11 — 12	174	118	229	1	522	44.06
12 — 13	161	139	227	3	530	43.40
13 — 14	408	100	253	2	763	33.42
14 — 15	197	114	245	3	559	44.36
15 — 16	117	58	190	5	370	52.70
16 — 17	126	80	171	10	387	46.77
17 — 18	140	68	147	4	359	42.06
18 — 19	151	81	148	4	384	39.58
Total in daytime	2,081	1,144	2,175	45	5,445	40.77
19 — 20	145	48	70	3	266	27.44
20 — 21	118	51	83	4	256	33.98
21 — 22	120	63	109	0	292	37.33
22 — 23	98	27	98	2	225	44.44
23 — 24	75	27	101	2	205	50.24
0 — 1	48	8	83	2	141	60.28
1 — 2	33	6	43	1	83	53.01
2 — 3	17	4	57	2	80	73.75
3 — 4	7	5	33	0	45	73.33
4 — 5	7	7	40	0	54	74.07
5 — 6	17	16	44	1	78	57.69
6 — 7	67	30	54	9	160	39.38
Total at nighttime	752	292	815	26	1,885	44.62
vehicles/day	2,833	1,436	2,990	71	7,330	41.76

Time	Passenger car	Small truck	Large truck	Bus	Total	Rate of Large vehicle
7 — 8	152	58	106	0	316	33.54
8 — 9	151	130	334	4	619	54.60
9 — 10	193	131	313	3	640	49.38
10 — 11	187	148	279	5	619	45.88
11 — 12	202	150	255	4	611	42.39
12 — 13	207	126	190	1	524	36.45
13 — 14	164	113	164	1	442	37.33
14 — 15	148	94	136	1	379	36.15
15 — 16	149	104	137	7	397	36.27
16 — 17	120	83	157	13	373	45.58
17 — 18	134	70	137	9	350	41.71
18 — 19	145	51	111	2	309	36.57
Total in daytime	1,952	1,258	2,319	50	5,579	42.46
19 — 20	182	42	146	4	374	40.11
20 — 21	128	44	91	2	265	35.09
21 — 22	132	51	50	0	233	21.46
22 — 23	107	20	53	2	182	30.22
23 — 24	60	20	45	0	125	36.00
0 — 1	45	10	33	1	89	38.20
1 — 2	26	7	44	2	79	58.23
2 — 3	13	14	43	0	70	61.43
3 — 4	6	17	40	0	63	63.49
4 — 5	12	10	72	1	95	76.84
5 — 6	29	33	103	4	169	63.31
6 — 7	75	60	230	11	376	64.10
Total at nighttime	815	328	950	27	2,120	46.08
vehicles/day	2,767	1,586	3,269	77	7,699	43.46

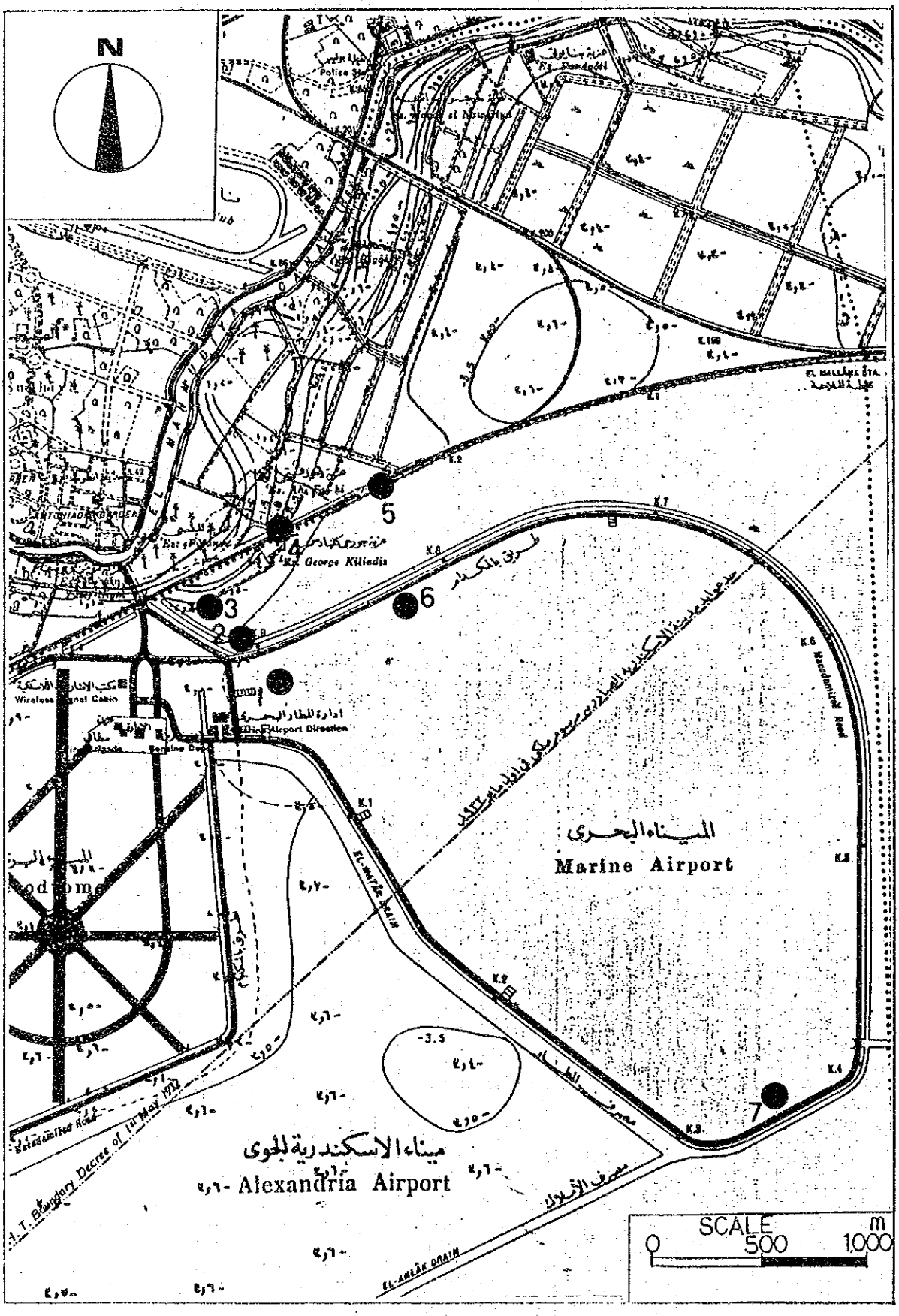


Fig. 2-9-1 SAMPLING LOCATIONS FOR WATER POLLUTION

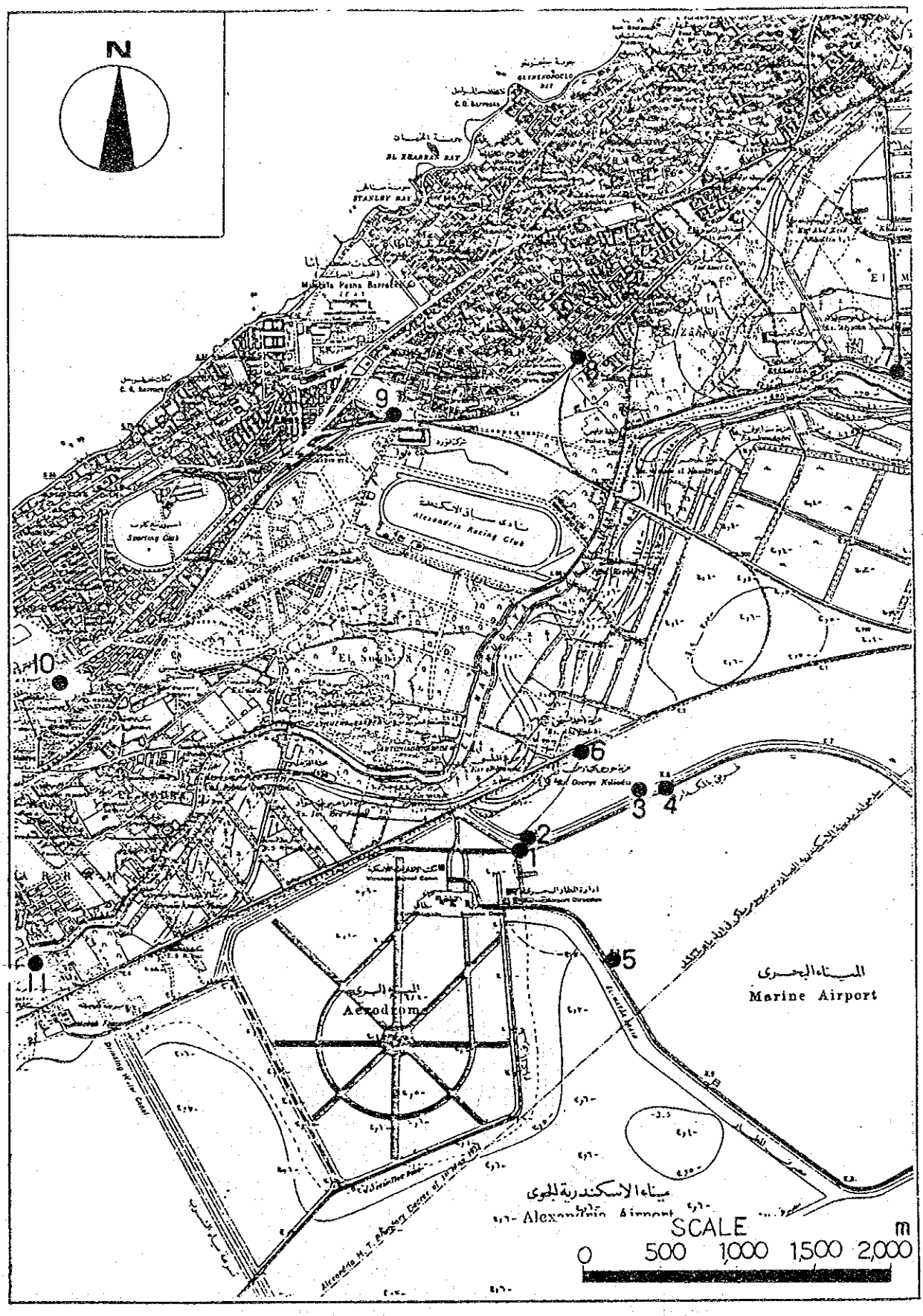


Fig. 2-9-2 SAMPLING LOCATIONS FOR AIR POLLUTION

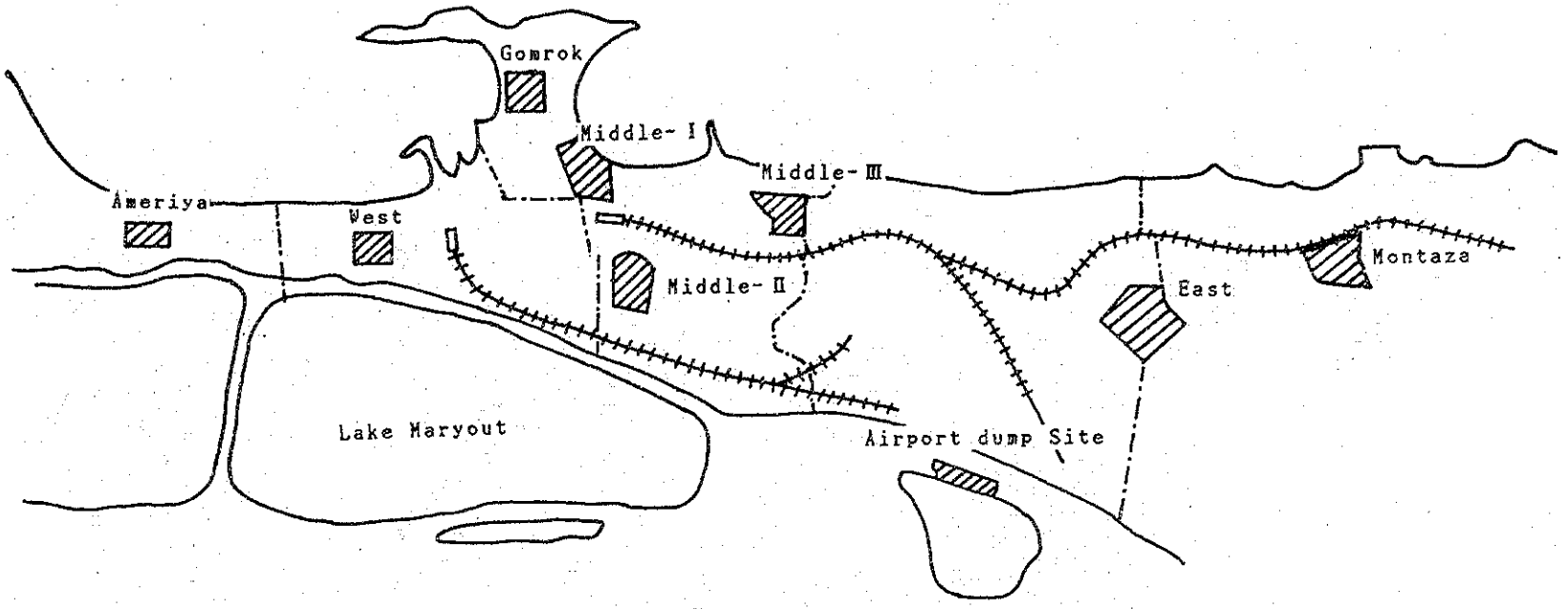


Fig. 2-9-3 AREAS OF FLY SURVEY