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No. 2

FEASIBILITY STUDY ON SHARQIYA SEWERAGE SYSTEM
IN THE ARAB REPUBLIC OF EGYPT

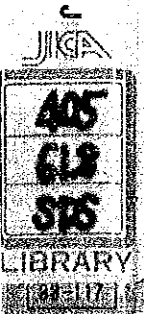
FEASIBILITY STUDY ON SHARQIYA SEWERAGE SYSTEM IN THE ARAB REPUBLIC OF EGYPT

FINAL REPORT VOLUME TWO MAIN REPORT

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SEP. 1988

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JAPAN INTERNATIONAL COOPERATION AGENCY



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**FEASIBILITY STUDY ON
SHARQIYA SEWERAGE SYSTEM
IN THE ARAB REPUBLIC OF EGYPT**

FINAL REPORT
VOLUME TWO MAIN REPORT

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PREFACE

In response to the request of the Government of the Arab Republic of Egypt, the Japanese Government decided to conduct the Feasibility Study on Sharqiya Sewerage System in the Arab Republic of Egypt and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Egypt a survey team headed by Mr. Heiichiro MAKINO of Tokyo Engineering Consultants Co., Ltd., comprising members of Tokyo Engineering Consultants Co., Ltd. and Nihon Suido Consultants Co., Ltd. from July to September, 1987 and January to March, 1988.

The team had discussions with the officials concerned of the Government of Egypt and the Governorate of Sharqiya, and conducted a field survey. After the team returned to Japan, further studies were made and the present report has been prepared.

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

I wish to express my deep appreciation to the officials concerned of the Government of Egypt and the Governorate of Sharqiya for their close cooperation extended to the team.

September, 1988



Kensuke Yanagiya
President
Japan International Cooperation Agency

September, 1988

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Sir:

LETTER OF TRANSMITTAL

It is our pleasure to submit to you the Final Report of the Study on Sharqiya Sewerage System in the Arab Republic of Egypt.

The field survey and study have been conducted during the period from July 1987 to September 1988.

This Report consists of four volumes: VOLUME ONE - Summary Report, which provides the summary of the study and recommendations; VOLUME TWO - Main Report, which describes the results of survey and analysis; VOLUME THREE - Appendices, which contains the details regarding the technical, legal and socio-economic aspects; VOLUME FOUR - Drawings, which contains maps and drawings.

We hope that realization of the proposed schemes would greatly contribute to improve the sanitary and environmental conditions in the Sharqiya Governorate.

Finally, we take this opportunity to express our sincere gratitude to Japan International Cooperation Agency, Ministry of Foreign Affairs and Ministry of Construction of the Government of Japan, the Embassy of Japan in Egypt, Advisory Committee and the officials concerned of the Government of the Arab Republic of Egypt which gave useful advice to the Study Team during the study period.

Respectfully yours,



HEIICHIRO MAKINO

Team Leader

for the

Study on Sharqiya Sewerage System

FEASIBILITY STUDY
ON
SHARQIYA SEWERAGE SYSTEM
IN
THE ARAB REPUBLIC OF EGYPT

FINAL REPORT

CONSTITUENT VOLUMES

VOLUME ONE SUMMARY REPORT
VOLUME TWO MAIN REPORT
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Units and Acronyms

Agencies

ARWSS	Abbasa Regional Water Supply System
CAPMAS	Central Agency for Public Mobilization and Statistics
GOPP	General Organization for Physical Planning
GOSSD	General Organization for Sewerage and Sanitary Drainage
IBRD	International Bank for Reconstruction and Development
JICA	Japan International Cooperation Agency
MOIC	Ministry of International Cooperation
MOP	Ministry of Planning
NOPWASD	National Organization for Potable Water and Sanitary Drainage
U.N.	United Nations
UNDP	United Nations Development Program
WHO	World Health Organization

Technical Terms

AC	Asbestos Cement
BOD	Biochemical Oxygen Demands 5-day, at 20°C
Cl	Chloride Ion
CI	Cast Iron
COD	Chemical Oxygen Demands
CP	Clay Pipe
DO	Dissolved Oxygen
DWF	Dry Weather Flow
H ₂ S	Hydrogen Sulfide
MLSS	Mixed Liquor Suspended Solids
MPN	Most Probable Number
pH	The reciprocal of the logarithm of the hydrogen-ion concentration
P/S	Pumping Station
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
SRT	Sludge Retention Time
SS	Suspended Solids
STP	Sewage Treatment Plant
TS	Total Solids

Units

atm	Atmosphere
cm	Centimeter
dia.	Diameter
fd	Feddan (0.42 ha)
gcd	Grammes per capita per day
ha	Hectare
hr	Hour
in.	Inch
km	Kilometer
lcd	Liters per capita per day
l/sec	Liters per second

Units (cont'd)

m	Meter
m/s	Meters per second
mm	Milimeter
m ²	Square meter
m ³	Cubic meter
mg/l	Miligrammes per liter
m ³ /day	Cubic meters per day
m ³ /min	Cubic meters per minute
m ³ /m ² /day	Cubic meters per square meter per day
kl/day	Kiloliters per day
KW	Kilowatt

Economic and Financial Terms

AIC	Average Incremental Cost
B/C	Benefit to Cost Ratio
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
LE	Egyptian Pounds
NPV	Net Present Value
OCC	Opportunity Cost of Capital
pts	Piasters (1/100 LE)
PW	Present Worth

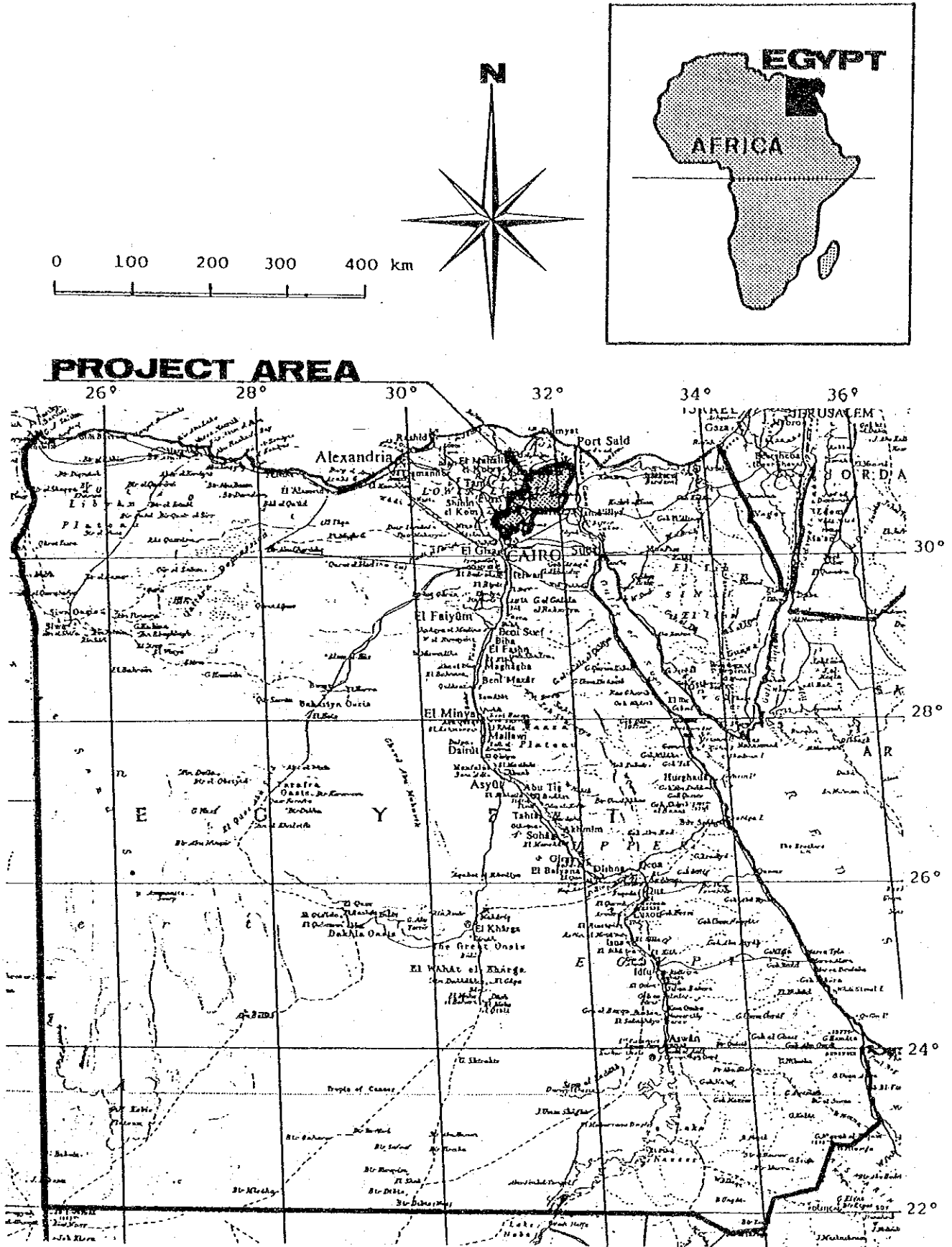
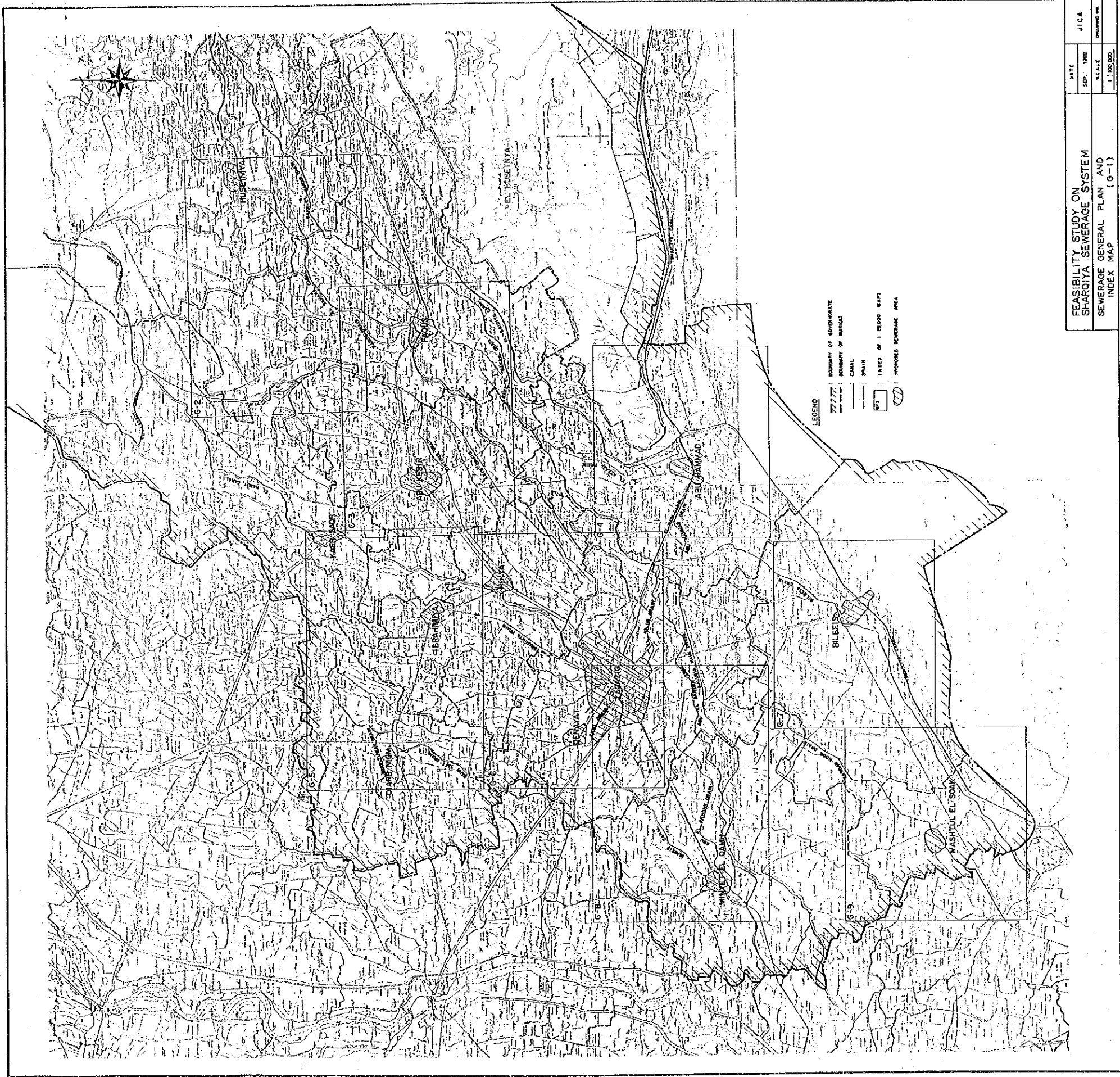


Fig. 1 Location of the Study Area



FEASIBILITY STUDY ON SHARIYA SEWERAGE SYSTEM		DATE	JICA
SEWERAGE GENERAL PLAN AND INDEX MAP (G-1)		SEP. 1988	ENGINEER
		SCALE	1:50,000

CHAPTER - ONE

INTRODUCTION



CHAPTER ONE

INTRODUCTION

1.1 Project Background

The Sharqiya Governorate lies in the eastern part of the Nile Delta. The Governorate extends approximately 100 km northeast to southwest and 40 km northwest to southeast, covering a total area of about 4,200 km². Zagazig City, the capital of the Governorate, lies at a longitude of 31°30' east and at a latitude of 30°43' north, and is about 80 km northeast of Cairo.

The present population of the Sharqiya Governorate which is about 3.254 million, is expected to continue growing to reach 5.154 million by the year 2005. Rising standards of living have caused and will cause an increasing rate of consumption of water, with the attendant increase in waste discharge to irrigation canals and drains.

There are, at present, sewerage systems in twelve cities, but without proper treatment of wastewater. Most of the wastewater collected through sewer reticulations are discharged directly to irrigation drains, or in case of toilet wastes from homes, after passing through either septic tanks, trashes, or cesspits, leach into the ground where the soil is permeable.

The result of the discharge of most of the wastewaters, without treatment, is gross pollution, which produces septicity in the canals and drains at many locations. The deterioration of sanitary conditions in the area, particularly in and around the urban builtup districts, has become deplorable and measures against the pollution are urgently required.

In order to meet the basic demands of public sanitation in the area and to set up a good link between the projects for drinking water and sanitary sewerage, the Sharqiya Governorate requested the Government of Japan for a long-term program and a feasibility study of a water supply and sewerage system.

In response to the request, the Government of Japan completed the feasibility study on water supply systems in 1984, and the feasibility study on sewerage system (the study) has been implemented within the frame work of the Agreement on Technical Cooperation between the Government of Japan and the Government of Egypt, signed on June 15th, 1983.

The Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, undertakes the Study in close cooperation with the Egyptian Government authorities concerned. JICA preliminary study team visited Cairo and the project area in April, 1986. The Scope of Work was signed on March 26th, 1987.

The Governorate of Sharqiya (the Governorate) will act as a counterpart agency to the Japanese study team and also as a coordinating body in relation to other relevant organizations for smooth implementation of the Study.

1.2 Objectives of the Study

The main purpose of the Study is to develop an appropriate sewerage plan up to the year 2005, including a feasibility study for the first phase program of sewerage for the year 1995. More specifically, the objectives are :

- (a) To formulate a long-term program as the basic concept for the sanitation improvement program by the Governorate up to the year 2005, and identify the first phase program to be provided by 1995 (Phase I Study).
- (b) To carry out a feasibility study for the first phase program identified in the long-term program (Phase II Study).
- (c) To transfer technology to the Egyptian counterpart from the study team throughout the course of the Study.

1.3 Scope of the Study

To carry out the Study, the following will serve as the scope of the study.

1.3.1 Study Area

- (1) The study area of the Phase I Study covers the Sharqiya Governorate, but excludes Tenth of Ramadan and new other desert urban areas.
- (2) The study area of the Phase II Study is to be selected from the results of the Phase I Study.

1.3.2 Target Years

The target year for the long-term program is 2005. For the feasibility study of the first phase program, 1995 is considered as the target year. However, for the planning of main sewers, the conditions at 2040 will be considered.

1.3.3 Contents of the Study

The Study comprises field surveys and data collection in Egypt and analytical and design work both in Egypt and Japan, and more specifically includes the following work items:

- (1) Phase I Study - Preparation of a long-term program
Data collection and analysis
 - Population
 - Land use
 - City development plans
 - Natural conditions (topographic, meteorological and hydrological data)
 - Soil and geological conditions
 - Water use and wastewater quantities and characteristics
 - Sewerage and related facilities
 - Institutional and financial conditions
 - Previous studies (Provincial water supply projects, JICA's study on Sharqiya water supply system, etc.)

Study of the present status of sewerage and sanitary conditions based on the above-mentioned data

Definition of planning criteria

- Target year (2005)
- Definition of planning area
- Conformity with JICA study on Sharqiya water supply system

Formulation of a long-term program

- Required new facilities
- Rehabilitation of existing facilities
- Night soil management in rural areas
- Economic, financial and social analysis
- Organization and institution (including manpower development plan)
- Implementation plan

Identification of the first phase urban sewerage project up to 1995

(2) Phase II Study - Execution of feasibility study

Identification of scope of proposed project

Ground survey

- Water and wastewater quality survey
- Topographic survey for proposed facilities

Facility planning

- Design criteria
- Examination of alternatives
- New sewerage facilities
- Rehabilitation of existing facilities
- Preliminary engineering design
- Cost estimation

- Procurement planning of construction materials and estimation of manpower requirements.

Institutional and organizational planning

- Appropriate institutional structure
- Organization of institutions
- Users' charge system

Project evaluation

- Financial evaluation (least cost analysis)
- Economic evaluation
- Environmental and social evaluation

Implementation program

- Implementation schedule
- Disbursement schedule

1.4 Undertaking of the Study

The Government of Egypt has accorded privileges, immunities and other benefits to the study team, and through the authorities concerned, taken necessary measures to facilitate smooth conduct of the Study.

The Government of Japan, through JICA, has taken necessary measures to despatch the study team to Egypt and to perform technology transfer to the Egyptian counterpart personnel in the course of the Study. The project organization is described in Appendix-XIII "Study Organization," Volume Three.

The study team commenced the work on 15th July 1987, starting the field work in Egypt from 23rd July 1987 upon arrival in Cairo. The study team proceeded to the City of Zagazig on 24th July to undertake the initial survey and discussions with the Governorate for the Study. The first field work lasted until 30th September 1987 and the study team left Egypt on the same day. The work for the Phase I Study was completed by 22nd December 1987, and the results thereof were presented in the form of an Interim Report, which was submitted to the Governorate and other agencies concerned in January 1988.

Following the discussions and confirmation of the Interim Report, and in particular identification of the first Phase program up to 1995, the study team commenced the second field work for the feasibility study, which lasted from 6th January to 19th March 1988 at the study area.

1.5 Acknowledgements

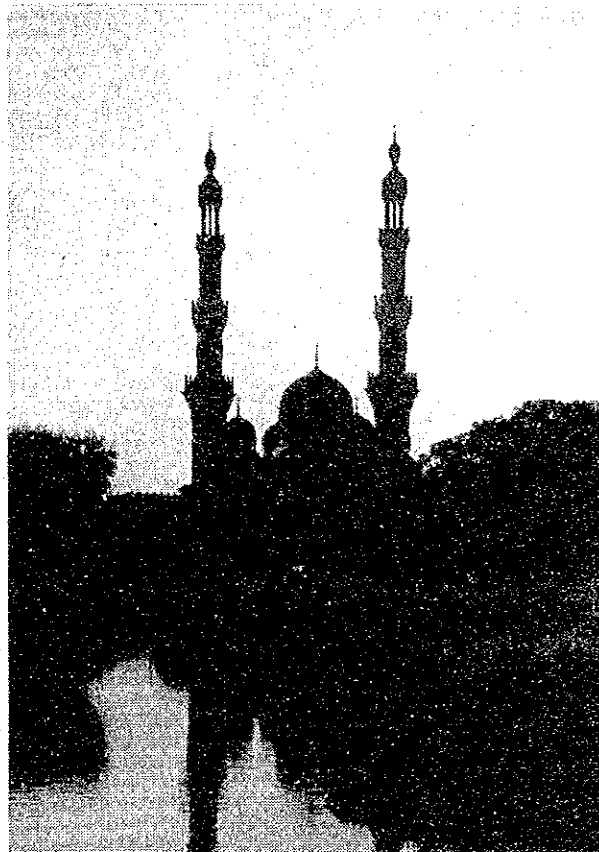
The courtesy and cooperation extended to the Advisory Committee and the study team during the course of the study by the following agencies are gratefully acknowledged :

- The Sharqiya Governorate
- Zagazig City
- Bilbeis City
- Abu Kebir City
- Faqus City
- Minyet El Qamh City
- Huseiniya City
- Kafr Saqr City
- Abu Hammad City
- Ibrahimiya City
- Hihya City
- Diarb Nigm City
- Mashtul El Soak City
- Qenayat City
- National Organization for Potable Water and Sanitary Drainage (NOPWASD)
- Ministry of Planning (MOP)
- Ministry of International Cooperation (MOIC)
- Central Agency for Public Mobilization and Statistics (CAPMAS)
- Institute for National Planning, Ministry of Planning (INP)
- Ministry of Finance

In addition, the advice and assistance provided by the counterpart staff and other personnel of the Sharqiya Governorate are deeply appreciated.

CHAPTER - TWO

PRESENT CONDITION OF THE STUDY AREA



CHAPTER TWO

PRESENT CONDITION OF THE STUDY AREA

2.1 Introduction

This chapter provides background information and data used in Chapter Three to estimate future wastewater production and disposal, and to establish the basis for sewerage and sanitation systems planning, and in Chapters Four, Five and Six to develop the specific proposals for both the long-term and the first phase programs covering the period 1988 through 2005.

This chapter therefore discusses the conditions in the study area; population and land use, existing water and sanitation service levels, wastewater production patterns, and environmental problems in the area. The data are largely based on field surveys and investigations, specially undertaken on two occasions for this feasibility study from July through September 1987 and from January through March 1988 by the JICA study team in the study area. All the previous studies and information collected by the present study as listed in "References" of this report, have been reviewed and, where necessary, revised in the light of the current conditions of the area.

The data presented herein are, therefore, more up-to-date than those in previous reports and studies. Unless otherwise stated, all cost data in this report are at mid-1987 prices. The planning period adopted for the first phase program is up to 1995 and for the long-term program up to 2005.

Detailed data obtained and calculations for engineering and financial studies are separately provided in Volume Three "Appendices". Corresponding reference numbers are indicated as needed for convenience. Volume Four "Drawings" contains maps and drawings which illustrate proposed sewerage systems.

2.2 Natural Conditions

2.2.1 Location, Geology and Topography

(1) Location

The Sharqiya Governorate is located in the northeastern part of the Nile Delta, which lies over the two branches of the Nile, Rosetta and Damietta Branches. They begin at the Delta Barrage, about 2.5 km north of Cairo. The Delta belongs to the Lower Egypt of the Nile Valley, one of the three major geographical regions in Egypt, and is the most fertile land in the world.

On the east, the Governorate borders with Ismailia Governorate which includes the Suez Canal; on the west, it adjoins Daqahliya Governorate; while on the south, it is adjacent to Qalyubiya and Cairo Governorates. On the north, Sharquiya faces the Lake of Manzala which is connected to the Mediterranean Sea.

(2) Topography

The Governorate stretches about 100 km from northeast to southwest and 40 km from northwest to southeast, covering 4,191 km² (997,742 feddans), which occupies about 0.4 percent of the land area of Egypt.

Agriculture land area occupies about 2,868 km², accounting for about 68 percent of the Governorate, while residential (including areas in the process of development) and desert areas occupy 632 km² and 691 km², respectively, and lies in the southern portion of the Governorate. The areas of each Markaz are shown in Table 2.1.

The elevation of the Delta range approximately from 10 m in the southwest to 3 m in the northeast, as the flows of many canal branches and drains run down from southwest to northeast. Many canals from the River Nile and its branches have been developed in the Delta alongside the drains, contributing various kinds of agricultural products over several thousands of years. Along with canals, main roads, railways, villages and urban areas have also been developed.

The desert areas have long been a barrier to human settlement, however, the Tenth of Ramadan, one of the satellite cities of the Greater Cairo, is now under construction with other new desert cities, and new canals are being extended for future development.

Zagazig City, the capital of the Governorate, is situated about 83 km northeast of Cairo, at a longitude of approximately 31°30' east and a latitude of 30°43' north.

(3) Geology

The Pleistocene is recognized by the heavily rainy age in Egypt. The loose materials transported by the Nile River from the Ethiopian and Sudan rocks were deposited forming the Delta aquifer. These strata are dominated by unconsolidated coarse sands and gravels with occasional clay lenses.

The recent sediments began at the end of the rainy age. During this period, the following phenomena took place :

- The seashore took its present location.
- The Nile Delta was raised above sea level.
- The top soil of the Delta was formed of Nile alluvium.
- Human civilization began to appear.

The top boundary of the deltaic deposits is a formation belonging to the Holocene. This formation, which acts as a cap of aquifers, is a semipervious clay and silt aquitard. The clay cap contains the subsoil water body in the Nile Delta.

Its phreatic water is referred to as shallow or simply water table. This water comes from the infiltration water and the seepage from the irrigation network. The average recommended values of the vertical and horizontal permeability of the clay cap are 25 and 250 mm/day, respectively. The clay cap thickness can be divided into two layers. The first layer is the upper clay cap, thickness of which is not more than 20 m and acts as an aquitard of low permeability. The second layer, a lower clay sand layer, is a few meter thick and is of high permeability. The profile is shown in Figure 2.1.

Table 2.1 Present Land Use in Sharqiya Governorate

(feddan)

Markaz	Cultivated Area			Desert	Rest	Total
	Fruits	Crops	Total			
Zagazig	1,119	53,127	54,246	-	10,655	64,901
Huseiniya	14,334	134,836	149,170	139,443	39,080	327,693
Kafr Saqr	1,558	71,737	73,295	9,424	21,175	103,894
Faqus	11,173	72,748	83,921	1,719	17,306	102,946
Abu Kebir	3,089	36,391	39,480	-	7,051	46,531
Abu Hammad	11,727	38,060	49,787	7,247	9,242	66,276
Ibrahimiya	100	16,934	17,034	-	2,362	19,396
Hihya	608	23,858	24,466	-	3,259	27,725
Diarb Nigm	339	44,158	44,497	-	7,005	51,502
Bilbeis	7,889	50,159	58,048	6,681	18,522	83,251
Minyet El Qamh	6,858	52,650	59,508	-	8,982	68,490
Mashtul El Soak	1,019	14,465	15,484	-	2,621	18,105
Qenayat	247	13,687	13,934	-	3,100	17,034
Total (feddan)	60,060	622,810	682,870	164,514	150,360	997,744
(ha)	25,224	261,580	286,804	69,096	63,151	419,051
(%)	6.0	62.4	68.4	16.5	15.1	100

Note : Rest includes areas under development and reclamation.

Source: "Agriculture Circle per Year 1986"
Information Center of Sharqiya Govenorate

(4) Hydrogeology

The aquifer system consists of alluvial sediments. These sedimentary deposits contain two layers within which groundwater can flow. The lower layer is formed of highly permeable graded sand and gravel, and the upper one is formed by the clay-silt layer of relatively low horizontal permeability and very low vertical permeability. The impermeable Pliocene clay constitute the base of the system, sealing off any upward or downward flow through this aquiclude. The depth of the aquifer ranges from 100 to 900 m below ground level. The depth of the fresh water (up to 1000 ppm salinity) bearing zone ranges from zero to 300 m. In the north and east directions, the depth decreases because of sea water intrusion from the Mediterranean Sea and the Suez Canal.

2.2.2 Climatic Conditions

(1) Temperatures

The climate in Sharqiya is characterized as hot and dry weather in summer from May to September, but with relatively mild weather in the rest of the year. Records of the temperatures in Zagazig City are available since the 1930's, and are shown in Table 2.2. The highest temperature ever recorded was 46.2°C, which occurred in the month of June, followed by the second highest temperature of 45.8°C in May. Although the temperatures for about half the year are higher than 30°C, the heat is not too oppressive due to low humidity, ranging between 50 and 60 percent. The lowest temperature of 0.8°C was recorded in December. The annual average temperature is 21°C, with the average monthly maximum and minimum temperatures of 35°C and 6.1°C, respectively.

(2) Rainfalls

The precipitation in the Sharqiya region is low compared with the cities along the Mediterranean coast. As shown in Table 2.3 and Figure 2.2, the average annual rainfall in Zagazig City is 29.3 mm, mostly concentrated in winter seasons from October to March. The maximum daily rainfall ever recorded was 24.0 mm which occurred on November 5th, 1932, followed by the second highest precipitation of 23.4 mm on April 23rd, 1946. Daily and monthly rainfall data are available, however, self-registering records indicating short-term rainfall intensities were not obtainable.

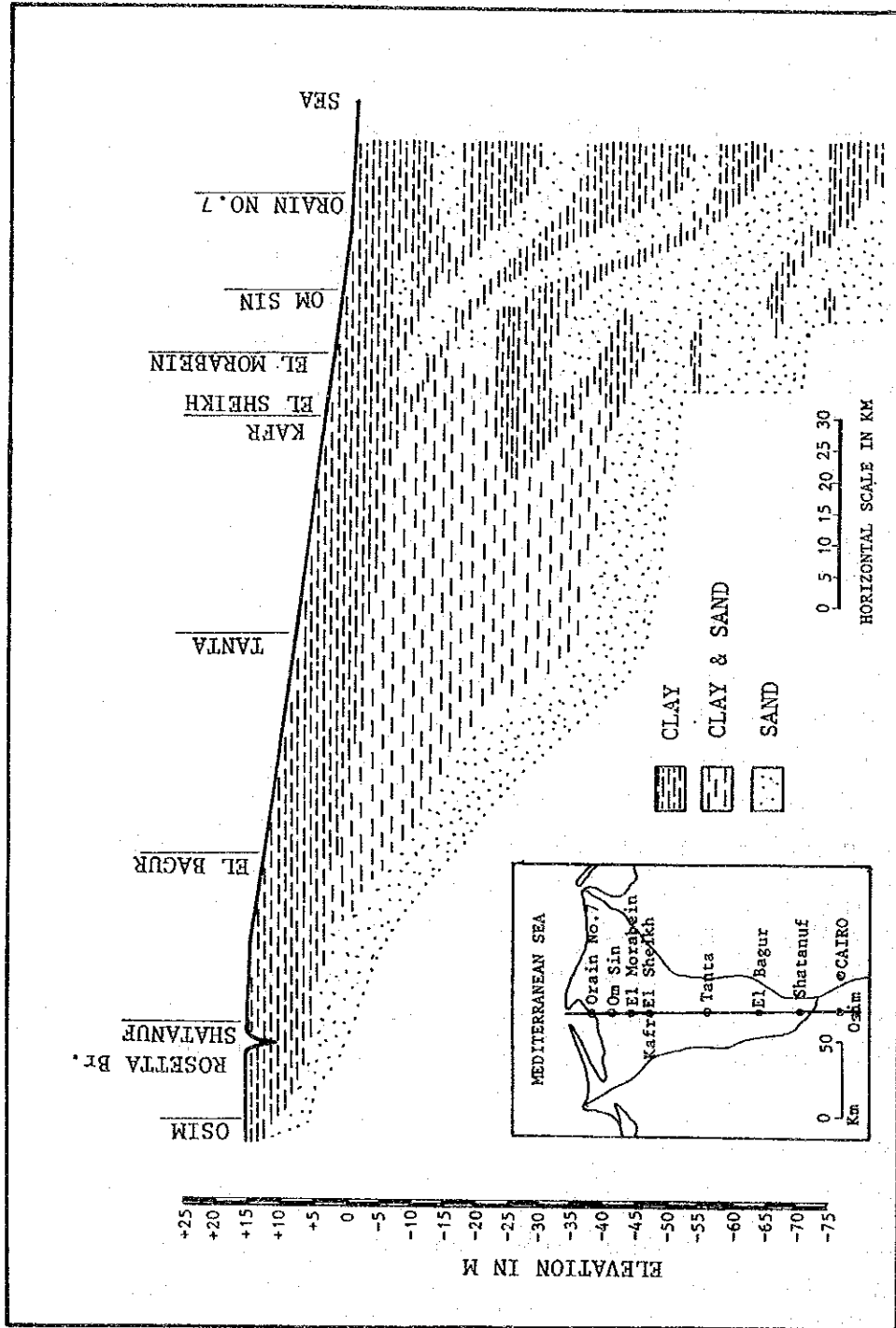


Figure 2.1 Geological Profile

Table 2.2 Temperatures in Zagazig City

(in degrees Centigrade)

Month	Ave. Monthly		Ave.	Max.	Min.
	Max.	Min.			
Jan.	20.1	6.1	13.1	28.8	1.4
Feb.	21.3	6.8	14.0	35.6	3.0
Mar.	23.8	8.9	16.4	38.2	1.2
Apr.	28.0	11.7	19.8	42.7	4.9
May	31.9	15.5	23.7	45.8	8.4
June	34.1	18.3	26.2	46.2	11.7
July	35.0	20.0	27.5	41.3	15.7
Aug.	34.7	20.2	27.4	40.5	15.4
Sept.	32.6	18.4	25.5	40.8	13.6
Oct.	30.5	16.5	23.5	39.4	9.4
Nov.	26.3	13.1	19.7	39.4	5.0
Dec.	21.7	8.6	15.2	35.8	0.8
Ann. Ave.	28.3	13.7	21.0	-	-

Source : NOPWASD (Ref.No.6)

Table 2.3 Rainfall Records in Zagazig City

Month	Monthly ave. rainfall (mm/month)	Highest rainfall (mm/day)	Date	No. of days with rainfall (days)	
				Less than 1 mm/day	More than 1 mm/day
Jan.	5.1	16.7	1/11/1960	2.0	1.5
Feb.	5.1	11.4	22/2/1943	2.3	1.7
Mar.	4.0	22.0	17/3/1947	1.1	0.8
Apr.	1.8	23.4	23/4/1946	0.6	0.5
May	1.3	10.0	2/5/1946	0.3	0.3
June	negligible	0.3	12/6/1931	0	0
July	0	0	-	0	0
Aug.	0	0	-	0	0
Sept.	negligible	negligible	17/9/1932	0	0
Oct.	1.9	2.4	22/10/1937	0.4	0.3
Nov.	4.4	24.0	5/11/1932	1.0	0.8
Dec.	5.7	12.0	6/12/1956	2.4	2.0
Ann. Rainfall	29.3				

Source : NOPWASD (Ref. No. 6)

Although sufficient data to develop rainfall-intensity-duration relationship are lacking, NOPWASD estimated the daily average rainfall intensity as 5.3 mm for sewerage planning purpose.

(3) Winds

Table 2.4 shows the monthly wind velocities and directions in Zagazig city. The annual average wind velocity in the area is 2.8 knots. Wind velocities during the months of February, March and April are higher than other months of the year, reaching an average velocity of 3.2 knots.

Figure 2.3 shows the direction of winds throughout the year in Zagazig. The dominant wind directions are from northeast, north, northwest and southwest.

(4) Relative humidity

The relative humidity in the region is generally low, ranging between 30 percent and 85 percent depending on the time and season. Figure 2.4 shows the average humidity at 7:00 a.m., 12 noon and 6:00 p.m. Humidity is high in December and January, and low in May.

(5) Evaporation

Figure 2.5 shows the average daily evaporation rate month-wise. The highest evaporation rate of 6.3 mm/day occurs in May, while the lowest evaporation of 2 mm/day is observed during December. As can be seen from Figures 2.4 and 2.5, the humidity and evaporation are somewhat interrelated. During highly humid months, evaporation is low, e.g., in November, December and January when the humidity is about 75 to 81 percent, the evaporation decrease to 2.1 to 2.3 mm/day.

Table 2.4 Wind Velocities and Direction in Zagazig

	Ave. velocity in knot	North	Northeast	East	Southeast	South	Southwest	West	Northwest	Velocity lower than 1 knot in any direction
January	2.9	8.1	10.5	1.9	4.2	3.8	36.9	6.8	10.7	17.1
February	3.2	10.2	13.8	2.0	4.4	3.6	3.2	7.2	14.7	13.9
March	3.2	11.8	17.0	3.7	5.2	2.2	22.6	6.6	17.1	13.8
April	3.2	17.4	21.8	3.8	3.8	1.4	12.9	5.7	20.0	13.2
May	2.9	22.7	24.2	3.8	3.3	1.8	7.8	3.8	21.0	11.6
June	2.6	23.6	15.9	1.6	1.5	1.0	5.8	5.5	30.6	14.5
July	2.3	22.7	8.7	0.3	0.6	0.4	7.8	9.5	33.5	16.5
August	2.3	22.0	6.5	0.5	0.7	1.0	8.6	9.6	31.6	19.5
Sept.	2.0	23.7	7.8	1.1	0.8	1.4	7.9	8.5	30.3	19.5
October	2.0	24.2	15.5	2.1	1.7	1.3	8.9	5.2	20.8	20.3
Nov.	2.0	17.5	14.7	2.4	2.1	1.8	17.0	5.8	17.5	21.2
Dec.	2.3	10.6	10.3	1.8	4.3	3.2	30.9	5.4	11.4	22.1
Average	2.6	17.9	13.9	2.1	2.7	1.8	16.5	6.6	21.6	16.9

Source: NOPWASD

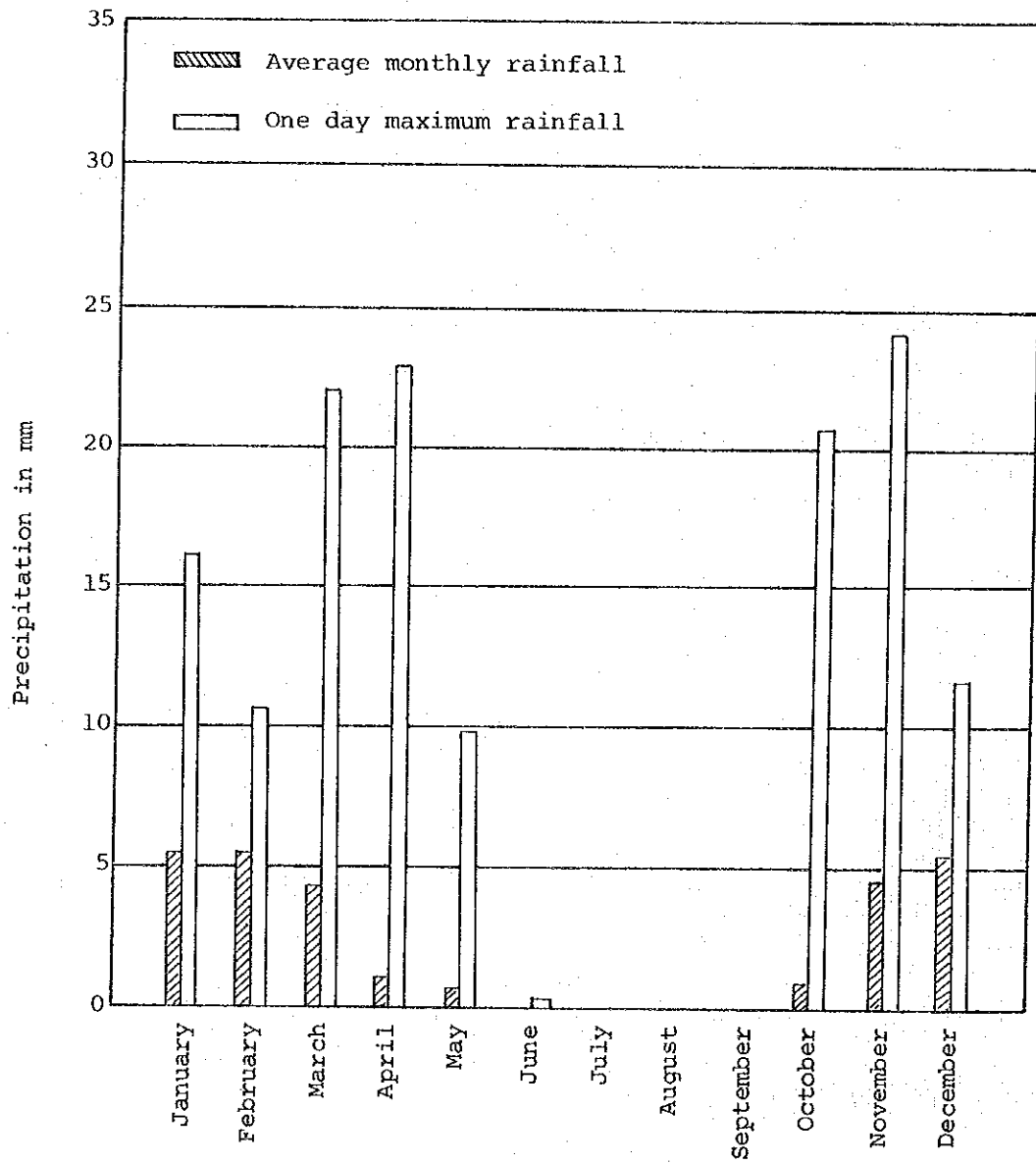


Figure 2.2. Monthly Rainfall in Zagazig City

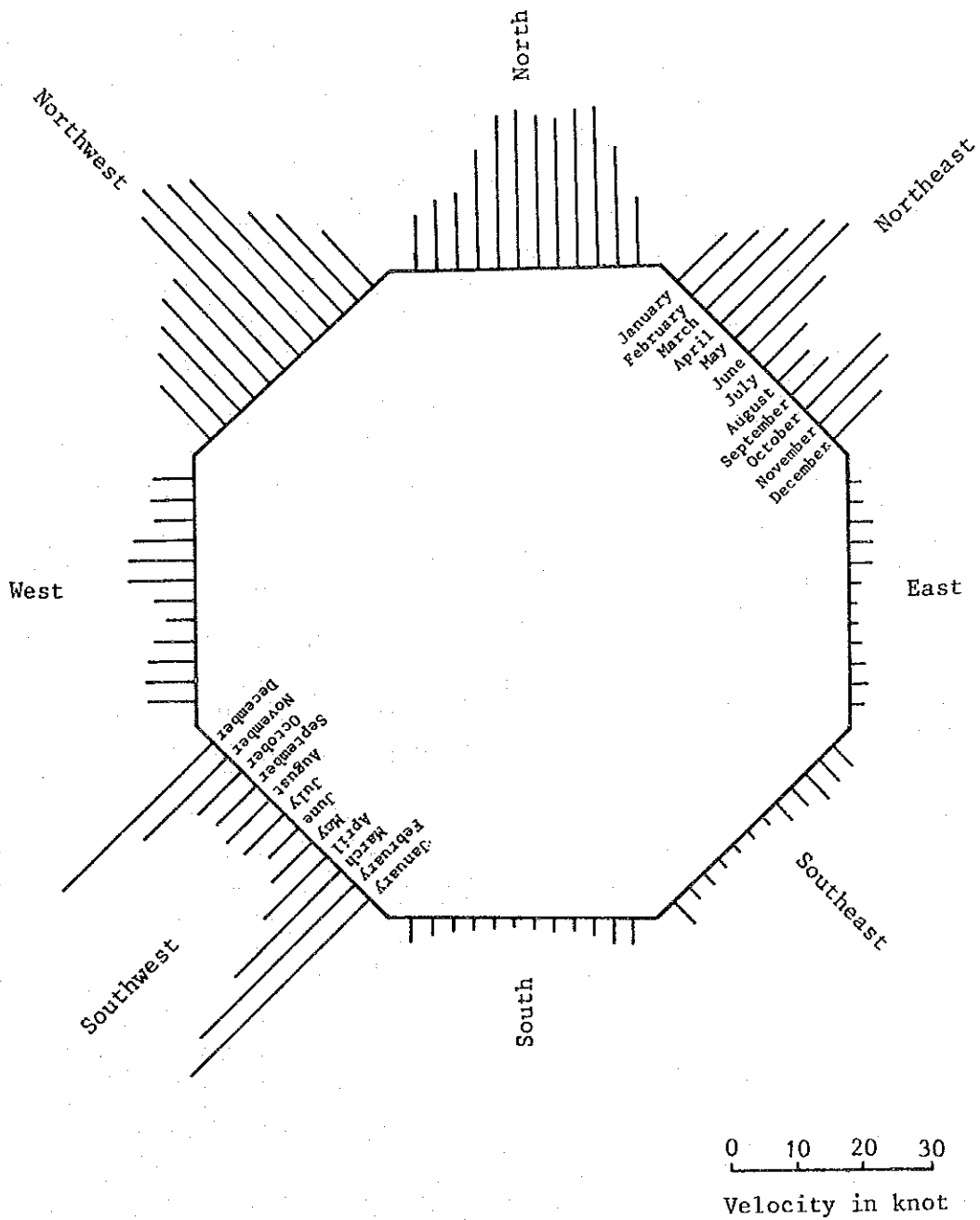


Figure 2.3 Wind Velocity and Direction in Zagazig City

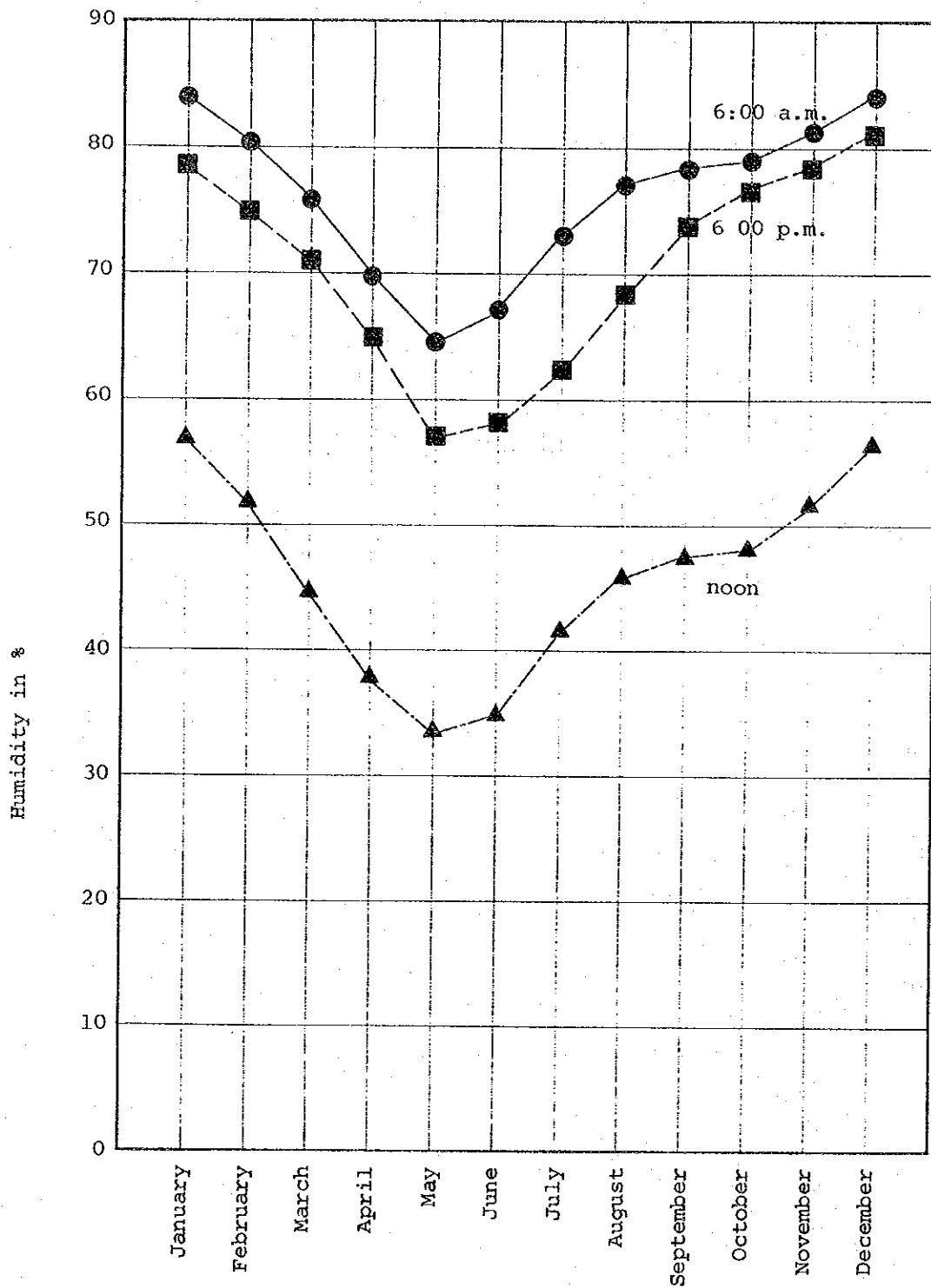


Figure 2.4 Humidity in Zagazig City

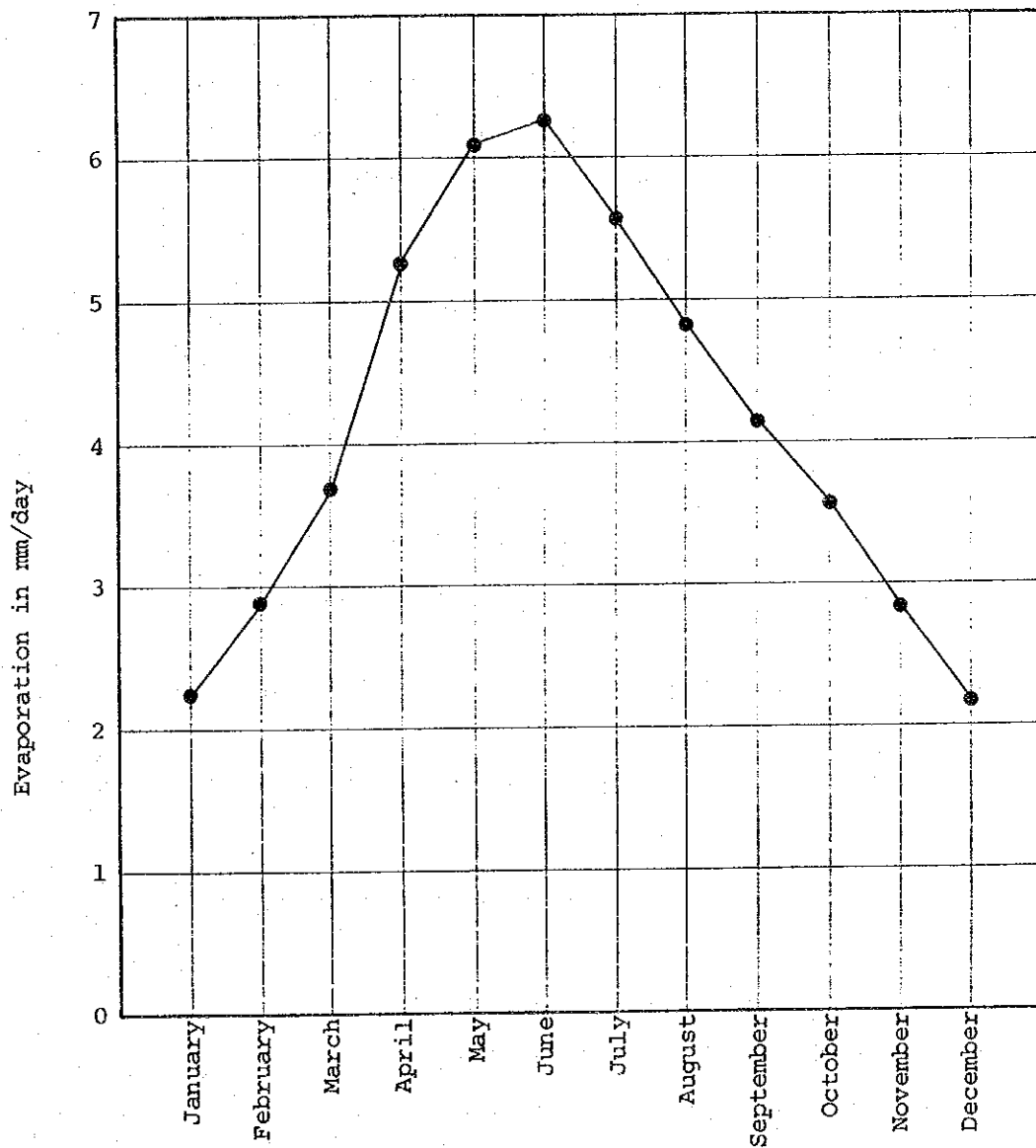


Figure 2.5 Evaporation in Zagazig City

2.3 Socio-Economic Conditions

2.3.1 National Economy

In recent years, Egypt has taken many steps focussing on economic development. The Government has formulated medium-term development programs i.e., the first five-year plan (1982/83-1986/87), and lately, the second five-year plan (1987/88-1991/92). The programs basically consist of fiscal, balance of payment, credit and investment policies and above all, measures to transform the productive sectors focusing on agriculture, energy and industry. Upon completion of the first reform plan, the Government has embarked on the second plan for social and economic development commencing from July, 1987.

(1) First five-year development plan (1982/83-1986/87)

In recognition of the need for structural changes, the objectives set in the plan were to overcome the following constraints:

- structure of output which was biased towards non-commodity production,
- overburdened infrastructure,
- high level of deficit in current account balance,
- excessive dependence on petroleum, Suez Canal, tourism and remittance income
- high level of budget deficit and excessive monetary expansion, fuelling inflation,
- public sector pricing policy which did not reflect real opportunity cost leading to distortions in the financial structure and liquidity shortages in public companies,
- inadequate managerial capacity and institutional framework for public and private sectors.

To remedy these, the plan aimed at;

- maintaining a high level of growth,
- increasing the rate of national savings,
- funding development on commodity producing sectors,
- developing human resources,
- correcting persistent balance of payment deficits, and
- introducing proper pricing policies together with effective management to increase the efficiency of public sector enterprises.

These objectives have been translated into macro-economic targets, as depicted in Table 2.5.

Table 2.5 Resource Balance and Growth Rates Planned in First Five-Year Development Plan (1982/83-1986/87)

(In millions of LE, 1981/82 prices)

	Resource Balance			Growth Rates
	1981/82	1982/83	1986/87	1981/82- 1986/87
<u>Total Resources</u>				
GDP at factor cost	19,639	21,316	28,920	8.1
GDP at market prices	20,727	22,562	31,305	8.6
Resource gap	2,604	2,019	1,135	(-)18.1
- Imports of goods	8,015	8,132	9,535	3.5
- Exports of goods	5,411	6,113	8,400	10.5
Total resources (GDP at market prices + resource gap)	23,331	24,581	32,440	8.5
GNP at market prices	21,301	23,001	31,940	8.4
<u>Total Expenditure</u>				
Final consumption	18,181	14,260	23,950	5.7
- Public		3,931	5,320	7.9
- Private		15,329	18,630	5.1
Gross investment	5,150	5,321	8,490	10.5
Gross fixed investment	4,950	5,421	8,390	11.1
- Public	4,158	6,439		
- Private		1,263	1,951	
Changes in stocks	(+)200	(-)100	(+)200	

Source: Ministry of Planning

During the period 1982/83 - 1986/87, the overall economy (GDP) grew at the rate of 6.8% p.a. against the planned rate of 8.1% p.a. On an annual basis, it was 9.9% in 1982/83, 8.0% in 1983/84, 7.4% in 1984/85, 4.8% in 1985/86 and 4.2% in 1986/87. The cause for this rapid economic decline was recent exogenous changes as well as a decline in the major source of foreign revenues e.g., oil exports, etc.

In terms of sectoral performances, electricity, and mining and industries played a leading role achieving a growth rate of 13.5% (against the planned rate of 10.7%) and 9.1% (10.3%) respectively while agricultural, petroleum and construction sectors remained at lower levels of 3.5% (3.7%), 7.7% (12.2%) and 3.3% (8.3%), respectively.

From external trade point of view, there are four major foreign exchange earners for Egypt i.e., petroleum, Suez Canal revenue, tourism and workers' remittances.

a) Petroleum

During the planned period, the price of oil was steadily falling from US\$38 per barrel in 1981 to below US\$10 per barrel in 1986 in spite of strong expectations placed on this sector. Correspondingly, the volume of oil production also fell. Up to 1985 the production exceeded 900,000 barrels per day, however, from 1986 the Government curbed production to about 650,000 barrels per day, just enough to meet domestic requirements, payments to foreign oil companies and to fulfill long-term agreements. It has fluctuated since then, reflecting international market conditions. Because of these elements, the revenues of petroleum exports grew far less than had been expected, resulting in sharp decline from LE 1.9 billion in 1982/83 to LE 0.7 billion in 1986/87.

b) Suez Canal

The Suez Canal revenues increased after completion of expansion program in 1980, however, dropped in 1984/85 when the volume of traffic fell due to the lower oil production in the Gulf. The toll revenues rose again in 1985/86 as oil production rebounded and the Government revised toll rate upward. The actual revenues increased from about LE 700 million in 1982/83 to LE 800 million in 1986/87.

c) Tourism

Tourism has generated considerable foreign exchange for the country and a significant source of income for the service sector. Many European and North American tourists come for cultural reasons while visitors from Arab countries come mainly for leisure. In the recent years, however, the tourist expenditures have been relatively stagnant, totalling approximately LE 300 million in 1982/83 and LE 400 million in 1986/87. This was partly due to security problems in the Mediterranean area and partly due to higher attraction to tourists to exchange foreign currency in the free market. The Government sought to direct more tourist transactions through the banking system by the recent introduction of flexible commercial bank rates.

d) Workers' Remittances

There is no reliable statistical data on the number of Egyptian workers living abroad. They are estimated to be three millions altogether, most of whom are unskilled or low-skilled, however, there are also professionals, teachers and researchers. The level of recorded remittances fluctuated over the years. It rose from LE 2.6 billion in 1982/83 to LE 3.3 billion in 1983/84 and then fell to LE 2.5 billion in 1985/86 and again increased to LE 3.2 billion in 1986/87. The amount of overseas workers' remittances are extremely significant in the balance of payment for Egypt and in fact, it exceeded the total revenues of exports in 1986/87.

The details of international balance of payment during 1981/82-1986/87 are illustrated in the Table 2.6.

Table 2.6 Balance of Payment

(in billion of LE)

	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Current Account Balance	-1.8	-0.8	-1.1	-1.3	-1.6	-2.1
Trade Balance	-2.9	-2.5	-3.2	-3.2	-3.0	-4.8
Exports	3.7	3.9	4.2	4.3	3.8	2.9
Petroleum	1.9	1.9	1.8	1.8	1.7	0.7
Imports	6.6	6.4	7.3	7.5	6.8	7.7
Non-Factor Service	0.3	0.3	-0.2	-0.2	-0.3	0.1
Receipts	1.9	2.3	2.2	2.3	2.2	3.4
Suez Canal	0.6	0.7	0.7	0.6	0.7	0.8
Tourism	0.3	0.3	0.2	0.2	0.3	0.4
Payments	1.6	2.0	2.4	2.5	2.5	3.3
Net Factor Service						
Workers' remittance	1.7	2.6	3.3	2.9	2.5	3.2
Interest payment	-0.6	-0.8	-0.8	-0.7	-0.9	-1.0

Source: Ministry of Planning

e) External Debt

The external debt for Egypt is large and growing. It is estimated, according to 'World Debt Table (1986-87), IBRD', that at mid-1985 the external debt totalled US\$24.3 billion disbursed and outstanding. Of the total debt, the publicly guaranteed medium and long-term debt was reported to account to US\$17.8 billion and private non-guaranteed debt was US\$750 million. In addition, the total short-term obligations are estimated to amount to US\$5.8 billion. The total scheduled debt service payments in 1985 are estimated to about US\$2.2 billion, giving a debt service ratio of 33.9%. During 1986/87, the total external debts are projected to rise to US\$40.0 billion. It has been pointed out that Egypt's external debt burden has become unsustainable without appropriate economic reform and strong support from the international community.

Under these situations, Egypt has been recently engaged in the serious negotiations with the International Monetary Fund (IMF) and international creditors over rescheduling part of the country's large external debt. In May 1987, a consensus was reached on rescheduling of a total US\$7.5 billion in interest and principal payments due by June 1988 and provided Egypt with additional stand-by credit of US\$325 million for structural adjustment and international balance of payment relief. The Egyptian Government, in return, assured the streamlining of exchange rates i.e. gradual shift to a unified floating exchange rate, trimming of budgetary deficit, particularly liberalizing public sector and raising energy and agricultural prices. The need to make continuing refinements and adjustment to economic system is a formidable task for Egypt.

Table 2.7 Structure of External Obligations (in million of US\$)

	1980	1981	1982	1983	1984	1985
<u>Multilateral</u>	2,872.2	3,046.6	3,234.8	3,506.2	3,737.5	3,967.6
IBRD	420.5	539.8	616.1	728.2	889.8	1,032.5
IDA	308.8	394.0	510.1	649.0	743.7	801.6
<u>Bilateral</u>	7,803.3	8,432.1	9,003.2	9,189.8	9,835.6	10,835.8
<u>Supplier Credit</u>	951.9	1,496.4	1,655.0	1,738.4	1,996.4	2,100.0
<u>Private Banking</u>	760.4	692.2	838.1	968.8	798.4	847.8
<u>Private Nonguaranteed</u>	265.0	320.0	455.0	600.0	550.0	750.0
<u>IMF Credit</u>	177.3	99.1	57.4	51.6	48.3	41.2
<u>Short-Term Debt</u>	4,475.0	4,475.0	4,900.0	6,000.0	6,800.0	5,800.0
<u>Total External Debt</u>	17,305.1	18,552.4	20,143.6	22,054.9	23,766.3	24,342.4
<u>Total Debt Service</u>	1,401.4	1,892.0	1,889.8	1,945.1	1,827.8	2,248.9
<u>Total Export of Goods & Service</u>	6,515.4	6,937.0	7,220.2	7,262.8	7,376.0	6,634.0
<u>Debt Service Ratio (%)</u>	21.5	27.3	26.2	26.8	24.8	33.9

Source: World Debt Tables, 1986-1987, IBRD

f) Consumer Price Index and Interest Rate

The Egyptian economy has been experiencing inflationary tendencies. The Government has adopted a credit control policy to curb domestic liquidity and thereby reduce inflationary pressures. Through 1985, inflation slightly decreased due to the imposition of this credit control mainly on the private sector, yet inflationary pressures have risen again since then. During 1980-1986, it was revealed that the average consumer price increase was 15% p.a.

On the other hand, domestic interest rates are relatively low compared with domestic inflation. Table 2.8 indicates the Central Bank discount rates for the years between 1980-1986. It is evident that the rates have been negative in real terms for most of the period.

It is imperative, therefore, that to promote domestic investment by the private sector, commodity price increase must be further controlled by all means.

Table 2.8 Consumer Price Change and Domestic Interest Rate

	Consumer Price Index (1966=100)	Change in Consumer Price (%)	Central Bank Discount Rate (%)
1980	274.4	24.5	10.0-11.0
1981	307.0	11.9	12.0
1982	356.0	16.0	13.0
1983	422.1	18.6	13.0
1984	505.2	19.7	13.0
1985	556.1	10.1	13.0
1986	663.1	19.2	13.0

(Source: CAPMAS and Central Bank of Egypt)

(2) New Five-Year Development Plan

From July 1987, the Second Five-Year Plan for Social and Economic Development (1987/88-1991/92) was launched succeeding the previous quinquennial plan (1982/83-1986/87). The major objectives set forth in the Plan are as follows:

- To improve productivity through optimum investment allocations and thereby enlarge commodity production,
- To enhance export promotion efforts and restore external equilibrium by reducing dependency on foreign assistance,
- To further mobilize domestic savings, and
- To enlarge role of private sector through increased private sector investment.

On the basis of the above objectives, the overall investment plan and sectoral investment distribution plan were announced and summarized in the Tables 2.9 and 2.10.

Under these sectoral budget allocations, the Government of Egypt anticipates an annual economic growth rate of 5.8% during the plan period which is, in effect, substantially lower than the previous plan's target of 8.1%. It is conceived that this is a reflection of the actual economic performance achieved between 1982/83 and 1986/87, which was 6.8% per annum.

As for sectoral orientation, it should be noted that the growth target for petroleum sector, in particular, is set at a substantially lower rate of 2.3% (against the previous 12.2%) while the industry and mining sector as well as electricity sector are expected to lead the Egyptian economy at 8.4% (10.3%) and 7.1% (10.7%) respectively during new Five-Year period.

Table 2.9 Total Investment of the New Five-Year Plan
Distributed by Sector

(in millions LE, 1986/87 prices)

	Public Sector	Private Sector	Total
Agriculture	852.3	2,650.0	3,502.3
Irrigation/Drainage	1,434.9	-	1,434.9
Industry/Mining	5,790.5	6,400.0	12,190.5
Petroleum	1,114.5	-	1,114.5
Electricity	4,761.3	-	4,761.3
Construction	631.0	550.0	1,181.0
<u>Total Commodity Sectors</u>	<u>14,584.5</u>	<u>9,600.0</u>	<u>24,184.5</u>
Transport/Communication	4,703.1	1,400.0	6,103.1
Suez Canal	240.0	-	240.0
Commerce	233.2	80.0	313.2
Finance/Insurance	143.1	-	143.1
Tourism	208.1	220.0	428.1
<u>Total Productive Services Sectors</u>	<u>5,527.5</u>	<u>1,700.0</u>	<u>7,227.5</u>
Housing	167.1	6,600.0	6,767.1
Public Utilities	4,016.6	-	4,016.6
Education	1,628.9	35.0	1,663.9
Others	1,093.8	15.0	1,108.8
<u>Total Social Services Sectors</u>	<u>8,804.6</u>	<u>6,700.0</u>	<u>14,404.6</u>
<u>Total Fixed Investment</u>	<u>27,816.6</u>	<u>18,000.0</u>	<u>45,816.6</u>
Investment Expenditure	683.4	-	683.4
<u>Grand Total Investment</u>	<u>28,500.0</u>	<u>18,000.0</u>	<u>46,500.0</u>

Source: Ministry of Planning

Table 2.10 Growth Targets and Actual Achievements by Sector in Previous and New Five-Year Development Plans

	Previous Plan(1982/83-86/87)		New Plan(1987/88-1991/92)
	Planned(%)	Actual(%)	Planned(%)
GDP	8.1	6.8	5.8
Commodity Sector	8.5	6.2	5.8
Agriculture	3.7	3.5	4.1
Industry/Minning	10.3	9.1	8.4
Petroleum	12.2	7.7	2.3
Electricity	10.7	13.5	7.1
Construction	8.3	3.3	5.9
Productive Service Sector	7.2	7.1	5.6
Social Service	8.1	8.0	6.2

Source: Ministry of Planning

In terms of financial resources for development investment, it is envisaged that private sector contribution would be sought further. The proportion of the private sector fund, therefore, would be increased from 24.7% to 38.7%, indicating more active role to be played by the private sector (refer to Table 2.11).

Table 2.11 Financial Contribution by Public and Private Sector

(in billion of LE)

	Previous Plan				New Plan	
	Planned (%)	Actual (%)	Planned (%)	Actual (%)	Planned (%)	Actual (%)
Public Sector	25.9	75.3	27.1	74.5	28.5	61.3
Private Sector	8.5	24.7	9.3	25.5	18.0	38.7
Total	34.4	100.0	36.4	100.0	46.5	100.0

As for public sector investment, the financial resources to be tapped for funding are as follows:

Table 2.12 Resources for Public Sector Investment

	Previous Plan		(in billion of LE)	
	Planned (%)	Actual (%)	New Plan Planned (%)	
National Investment Bank	14.5(53.7)	13.0(50.1)	14.7(51.6)	
Self-Financing	4.5(16.5)	6.3(24.5)	6.6(23.2)	
Foreign Assistance	8.1(29.8)	6.6(25.4)	7.2(25.2)	
Total	27.1(100.0)	25.9(100.0)	28.5(100.0)	

As shown above, it is expected that under the new Plan international assistance would remain at a significant level of 25.2% of the total financial resources. In view of present debt problem faced by Egypt, considerable efforts would be essential to realize the above target.

(3) Public Utilities Sector

Public utilities development is one of the country's basic needs, yet, it failed to receive due attention in the years preceding the First Five-Year Plan when compared to the support given to other sectors. This has led, in fact, to numerous problems and constraints at the present. The Second Five-Year Plan, therefore, gives increased attention to this sector, as a part of a long-range strategy for socio-economic development.

These policies may be summarized as follows:

1. Conservation of water use, restriction of losses and the study of the application of progressive pricing to water consumption.
2. Upgrading the manufacture of plumbing fixtures to ensure that they conform to international standards.
3. Making the greatest use possible of non-traditional methods to supply drinking water to areas lacking it by using artesian wells where possible and portable filtration stations.

4. Coordination and integration of water and sewerage projects in accordance with urban plans.

5. Supplying trained manpower to water and sewerage utilities.

The Second Five-Year Plan seeks, to achieve the following objectives:

1. To increase potable water supply from 8.6 million m³/day in 1986/87 to 12.4 million m³/day at the end of the Plan (1991/92). Of this 3.8 million increase, 1.9 million will be in Cairo, 0.3 million in Alexandria and 1.6 million will be in other governorates.

2. Wastewater drainage capacities will have to be increased to meet the expansion in the consumption of potable water.

3. Investment allocated to public utility projects during the Second Plan are estimated at about LE 4,017 million, representing about 8.7% of total planned investment (8.2% in previous plan). The distribution of these funds is shown below in Table 2.13.

Table 2.13 Investment Amount to Public Utilities Projects

(in million of LE)

	New Five-Year Plan		1987/88	
		%		%
Potable Water	1,435.0	35.7	297.0	40.6
Wastewater	2,296.0	57.2	385.0	52.6
Other	285.6	7.1	50.0	6.8
Total	4,016.6	100.0	732.0	100.0

As this table shows, wastewater projects have been allocated more than 57% of the total public utility investment during the next five years to meet the increased consumption of water.

For the Sharqiya Governorate, it is expected that an amount of LE 16.75 million for the water supply sector and LE 19.0 million for the sewerage sector under the Ministry of Housing budget will be allocated, and LE 2.5 million and LE 2.5 million, respectively, under the Governorate budget for 1987/88-1991/92. The details of the budget are illustrated in the Tables 2.14 through 2.16.

Table 2.14 New Five-Year Development Plan (1987/88-1991/92)
Investment Plan Under Ministry of Housing for Sharqiya

(Unit: 1000LE)

Sector	Total	Local	Foreign	Loan
1. Water supply				
Water Filtration Unit for Cities	800	550	50	200
Water Filtration Unit for Villages	950	700	50	200
Renovation of Abbasa Treatment Plant	15,000	10,000	5,000	-
<u>Sub-Total</u>	<u>16,750</u>	<u>11,250</u>	<u>5,100</u>	<u>400</u>
2. Sewerage				
Treatment Plant at Zagazig	8,000	6,900	270	830
Treatment Plant at Minyet El Qamh	9,000	8,140	350	510
Treatment Plant at Faqus	2,000	1,900	100	-
<u>Sub-Total</u>	<u>19,000</u>	<u>16,940</u>	<u>720</u>	<u>1,340</u>
<u>Total</u>	<u>35,750</u>	<u>28,190</u>	<u>5,820</u>	<u>1,740</u>

Table 2.15 First Year Investment Plan under Ministry of Housing for Sharqiya (1987/88)

(Unit: 1000LE)

Sector	Total	Local	Foreign	Loan/ Credit
1. Water supply				
Water Filtration Unit for Cities	350	300	50	-
Water Filtration Unit for Villages	250	200	50	-
Renovation of Abbasa Treatment Plant	3,000	1,200	1,800	-
<u>Sub-Total</u>	<u>3,600</u>	<u>1,700</u>	<u>1,900</u>	-
2. Sewerage				
Treatment Plant at Zagazig	1,000	680	320	-
Treatment Plant at Minyet El Qamh	-	-	-	-
Treatment Plant at Faqus	-	-	-	-
<u>Sub-Total</u>	<u>1,000</u>	<u>680</u>	<u>320</u>	-
<u>Total</u>	<u>4,600</u>	<u>2,380</u>	<u>2,220</u>	-

Table 2.16 New Five-Year Development Plan (1987/88-1991/92) Investment Plan under Sharqiya Governorate

(Unit: 1,000LE)

Sector	Total Investment		1st Year (1987/1988)	
	Requested	Approved	Requested	Approved
Water Supply (Pipeline only)	68,000	2,500	2,700	500
Sewerage	149,410	2,500	23,282	500

(4) Exchange Rate Reform

After several trials over the past years, the Government has devised a set of reforms to the exchange rate system. The new measures for setting up a free foreign exchange market are contained in three decrees, issued on 11 May, 1987 by the Economy and Foreign Trade Ministry.

a) Decree 222: This permits accredited banks, about 40 institutions, to buy and sell foreign currency on their own account and on their own responsibility. The exchange rate will be set daily by a committee of not more than eight bankers. Meetings will be attended by observers from the Ministry of Economy and Foreign Trade and the Central Bank of Egypt. The committee will decide the rate on the basis of a realistic appraisal of supply and demand for foreign exchange. The committee will announce a buy/sell rate for the dollar.

b) Decree 223: Banks are authorized to use the free foreign exchange market rate for various defined transactions such as;

- remittances from Egyptian workers abroad,
- tourist revenues,
- bank purchases of all kinds of monetary instruments,
- exports of military equipment,
- frozen meat, chicken and fish,
- agricultural machinery and inputs,
- requirements of industry, power and communication sector,
- materials for construction sector, and
- repatriation of profits from investment projects/Law 43

c) Decree 224: A private-sector importer is now obliged to provide cash cover in foreign currency for at least 35 percent of the value of a letter of credit (L/C) on application. The remainder must be paid on opening L/C. However, the banks are allowed to consider financing this latter portion of the L/C within appropriate credit limits of the bank and its customer. The 35 percent cover is also required on application for supplier credits.

d) New Exchange Rates (11 May, 1987)

According to the Decrees 222, 223 and 224 of exchange rate reform described above, new exchange rate set forth are as follows:

- a. Free Market Bank Rate: U.S.\$ 1.0 = L.E. 2.165/2.17 (buy/sell)
- b. Official Commercial Bank Rate: U.S.\$ 1.0 = L.E. 1.36, to be retained for certain transaction (e.g. customs)
- c. Official Fixed Rate: U.S.\$ 1.0 = L.E. 0.70, to be maintained for government account, exports of oil, cotton and rice, revenue from Suez Canal and Sumed pipeline and imports of basic commodity (e.g. wheat and flour)

Apart from the above, there is an unofficial free market rate which is U.S.\$ 1.0 = L.E. 2.15 (10 May, 1987) and it is expected that the Free Market Bank Rate will take over the unofficial free exchange rate shortly.

2.3.2 Regional Economy

(1) Population

Sharqiya has the third largest population after Cairo and Dakahlia in Egypt. It amounts to 3,254,000 which is about 7.0 percent of the total population. Out of 3,254,000 the majority, or 2,542,000 inhabit in the rural area while only 22 percent of the population live in the urban area. Over the last ten years between 1976 and 1986, it is estimated that population of Sharqiya has grown at the average rate of 2.2 percent p.a. which is slightly higher than 2.1 percent for all Egypt.

Table 2.17 Population Growth in Sharqiya and Egypt

	1976	1986	Growth rate (%)
Egypt	37,891,000	46,694,000	2.1
Sharqiya	2,618,000	3,254,000	2.2

(2) Agriculture

The Sharqiya is considered to be one of leading agricultural governorate in Nile Delta. It has about 683,000 feddan of the cultivated land area which represents 70 percent of the total land area of Sharqiya and 9 percent of the total cultivated land of Egypt. It is envisaged that additional 400,000 feddan, presently desert and lakes, will be further reclaimed and become arable land for agricultural production. At present, the cultivated land area in Sharqiya is distributed by Markaz as shown in the Table 2.18.

Table 2.18 Cultivated Area in Sharqiya

Markaz	Cultivated Area (feddan)			Administrative
	Fruits	Crops	Sub-total	Area (feddan) Total
Zagazig	1,119	53,127	54,246	64,901
Qenayat	247	13,687	13,934	17,034
Minyet El Qamh	6,858	52,650	59,508	68,490
Bilbeis	7,889	50,159	58,048	83,251
Mashtul El Soak	1,019	14,465	15,484	18,105
Abu Hammad	11,727	38,060	49,787	66,276
Diarb Nigm	339	44,158	44,497	51,502
Hihya	608	23,858	24,466	27,725
Ibrahimiya	100	16,934	17,034	19,396
Abu Kebir	3,089	36,391	39,480	46,531
Kafr Saqr	1,558	71,737	73,295	103,894
Faqus	11,173	72,748	83,921	102,946
Huseiniya	14,334	134,836	149,170	327,693
Total	60,060	622,810	682,870	997,744

Source: Information Center, Sharqiya Governorate
Note : 1 Feddan = 0.42 ha

Major agricultural crops produced in the study area are wheat, maize, rice, cotton, and beans. Their cultivated area and production volume by crop are summarized in Table 2.19.

Table 2.19 Agricultural Crops Production Volume in Sharqiya

	Feddan	t
<u>Winter crop</u>		
wheat	145,000	240,000
beans	18,000	126,000
jute	8,000	25,000
<u>Summer crop</u>		
maize	217,000	444,000
rice	144,000	386,000
cotton	125,000	159,000
peas	4,000	9,000
<u>Autumn crop</u>		
maize	29,000	44,000

(3) Industry

As the Governorate is located at eastern part of the Nile River which links Cairo with Suez Canal and the Sinai regions, this geographical advantages give Sharqiya a special importance in industrial and commercial activities, especially as a center for agricultural and industrial products distribution in the adjacent governorates.

The main industries located in Sharqiya, which are on the whole agro-based industries are food, livestock, dairy products, animal feeds, textile and garment, and building material industries. Besides, numerous cottage-type industries exist in such fields as engineering, machinery, furniture and soft drinks. The size of the existing industrial establishments are rather small and medium scale of which capitals range from LE 5,000 to LE 3,000,000. The dispersion of these industries by Markaz is as follows;

Zagazig:

land reclamation/chicken farming (Capital: LE 10,000)
confectionary (LE 10,000)
spaggetti/baking (LE 1,130,000)
contractor (LE 1.000 mill.)
foods (LE 1.00 mill.)
building materials (LE 250,000)
cement brick/tile (LE 750,000)
skinning (LE 10,000)
electric tools (LE 1.5 mill.)
garment (LE 6,000)
furniture (LE 10,000)
plastics (LE 60,000)
livestock (LE 10,000)

Bilbeis:

bricks (LE 95,000)
chicken farming (LE 10,000)
cement bricks (LE 10,000)
livestock (LE 20,000)

Faqus:

livestock (LE 45,000)
meat/milk (LE 60,000)
air conditioner (LE 1.0 mill.)
chicken/eggs (LE 35,000)
biscuit (LE 20,000)
textile (LE 10,000)
spaghetti/macaroni (LE 30,000)
packaging (LE 5,600)

Huseiniya:

furniture (LE 200,000)
cement bricks (LE 100,000)
land developer (LE 250,000)
building materials (LE 500,000)
foods (LE 50,000)
concrete pipe (LE 200,000)
packaging (LE 100,000)
cement (LE 150,000)

Diarb Nigm:

garment (LE 1.5 mill.)
cement bricks (LE 30,000)

2.4 Population and Land Use

2.4.1 National Census

The national census were conducted in 1882, 1897, 1907, 1917, 1927, 1937, 1947, 1960, 1966, 1976 and 1986. CAPMAS is the organization responsible for the conduct of the census, analysis of the data and publication of the results. It is also responsible for estimating the future population of the country and analyzing internal migration.

The records of 1960, 1966, 1976 and 1986 census, containing a breakdown of the population down to the village level, are available in Arabic at CAPMAS. The total Egypt and governorate-wise population in 1986 are given in the preliminary report.

The census records of Sharqiya Governorate, from 1882 to 1986, are presented in Table 2.20, and populations by Markaz from 1960 to 1986 are shown in Table 2.21.

Table 2.20 Sharqiya Governorate Census Records

Year	Male	Female	Total	Egypt ('000)	Ratio (%)
1882	227,768	229,663	457,431	6,712	(6.82)
1897	367,615	367,170	734,885	9,669	(7.60)
1907	435,076	437,397	872,473	11,190	(7.80)
1917	462,884	475,108	937,992	12,718	(7.38)
1927	521,377	550,752	1,072,129	14,178	(7.56)
1937	575,412	597,046	1,173,458	15,921	(7.37)
1947	668,072	693,591	1,361,663	18,967	(7.18)
1960	913,878	905,920	1,819,798	26,085	(6.98)
1966	1,058,803	1,049,168	2,107,971	30,076	(7.01)
1976	1,334,860	1,283,078	2,617,938	36,626	(7.15)
1986	1,584,844	1,669,456	3,254,300	48,205	(6.75)

Source : CAPMAS

Note : Governorate boundary not confirmed

Ratio : Sharqiya to all Egypt

The Population of the Tenth of Ramadan and other new desert cities is deducted from the 1986 census record.

The total population of the Governorate in the 1986 census includes the population of the Tenth of Ramadan and another new desert cities. As these areas are out of the study area, all figures in the tables exclude the population in the Tenth of Ramadan etc. The population figures for the Tenth of Ramadan and other cities have been estimated based on the information obtained from CAPMAS and the Governorate.

The population of the Sharqiya Governorate has been around 7 percent of the total Egyptian population for decades, although its land area accounts for only 0.4 percent. Among the Marakaz in the Governorate, Huseiniya is the largest in area, occupying around 30 percent of the entire Governorate, followed by Kafr Saqr, Faqus, Minyet El Qamh, Bilbeis, Abu Hammad, Zagazig and other Marakaz. The smallest Marakaz, Qenayet and Mashtul El Soak, account for about 2 percent each.

From the population viewpoint, Zagazig is the largest, accounting for about 20 percent of the entire Governorate, followed by three Marakaz, Minyet El Qamh, Faqus and Bilbeis, each accounting for about 12 percent. The smallest Marakaz in population, similar to the area figures, are Qenayat, Mashtul El Soak and Ibrahimiya, each having 1 to 3 percent of the total Governorate population.

From also has the largest urban population of 245,500, followed by Bilbeis 96,500, Abu Kebir 69,500, Faqus 48,600 and Minyet El Qamh 45,900. The other eight cities are comparatively small, having populations of 20,000 to 30,000. The average population densities in each Markaz, calculated by its population and inhabitable area are relatively high, ranging from as high as approximately 30 persons/ha in Zagazig to as low as 4 to 5 persons/ha in Huseiniya and Qenayat. In most of the other Markaz, it is about 10 to 15 persons/ha. The population densities in each Markaz according to the 1986 census are shown in Table 2.22.

The general trend and tendencies are described in the succeeding sections.

Table 2.21 Markaz Population by Census

Markaz		1960	1966	1976	1986
Zagazig	U	124,417	151,186	202,575	245,500
	R	224,104	255,859	312,336	418,400
	T	348,521	407,045	514,911	663,900
Huseiniya	U	7,696	10,024	14,385	17,800
	R	109,465	126,728	185,100	253,400
	T	117,161	136,752	199,485	271,200
Kafr Saqr	U	7,790	9,856	13,726	19,300
	R	137,211	159,389	191,632	131,600
	T	145,001	169,245	205,358	150,900
Faqus	U	13,180	40,561	39,090	48,600
	R	197,210	203,918	251,747	332,700
	T	210,390	244,479	290,837	381,300
Abu Kebir	U	36,800	41,789	54,858	69,500
	R	100,405	112,915	115,661	146,800
	T	137,205	154,704	170,519	216,300
Abu Hammad	U	11,509	13,591	17,595	24,300
	R	131,405	148,191	180,739	190,600
	T	142,914	161,782	198,334	214,900
Ibrahimiya	U	(14,915)	(16,476)	18,522	24,500
	R	-	-	52,674	66,700
	T	-	-	71,196	91,200
Hihya	U	15,519	17,696	22,774	29,300
	R	106,907	121,164	86,594	111,400
	T	122,426	138,860	109,368	140,700
Diarb Nigm	U	12,456	14,372	21,535	32,200
	R	118,601	135,568	162,374	208,600
	T	131,057	149,940	183,909	240,800

Table 2.21 Markaz Population by Census (Cont'd)

Markaz		1960	1966	1976	1986
Bilbeis	U	37,941	55,070	69,112	96,500
	R	206,275	233,994	208,550	273,400
	T	244,216	289,064	277,662	369,900
Minyet El Qamh	U	18,464	31,533	33,609	45,900
	R	202,443	224,567	266,145	341,100
	T	220,907	256,100	299,754	387,000
Mashtul El Soak	U	(18,244)	(20,301)	22,270	28,700
	R	-	-	51,658	68,100
	T	-	-	73,928	96,800
Qenayat	U	(15,949)	(18,396)	22,677	29,400
	T	(15,949)	(18,396)	22,677	29,400
Total	U	285,772	385,678	552,728	711,500
	R	1,534,026	1,722,293	2,065,210	2,542,800
	T	1,819,798	2,107,971	2,617,938	3,254,300

- (Note) 1. 1976 populations were adjusted according to current Markaz boundaries.
2. Qenayat City was included in Zagazig rural population in 1960 and 1966.
3. Markaz population of 1986 census does not include the population of the Tenth of Ramadan, and other new desert cities.
4. Abbreviation employed in the table:

U: Urban
R: Rural
T: Total

Table 2.22 Population Densities in Markaz

Markaz	Population (person)	Inhabitable Area (feddan)	Area (ha)	Population Density (person/ha)
Zagazig	663,900	54,246	22,783	29.1
Huseiniya	271,200	149,170	62,651	4.3
Kafr Saqr	150,900	73,295	30,784	4.9
Abu Kebir	216,300	39,480	16,582	13.0
Abu Hammad	214,900	49,787	20,910	10.3
Ibrahimiya	91,200	17,034	7,154	12.7
Hihya	140,700	24,466	10,276	13.7
Diarb Nigm	240,800	44,497	18,689	12.9
Bilbeis	369,900	58,048	24,380	15.2
Minyet El Qamh	387,000	59,508	24,993	15.5
Mashtul El Soak	96,800	15,484	6,503	14.9
Qenayat	29,400	13,934	5,852	5.0
Total	3,254,300	682,870	286,804	12.0

2.4.2 Administrative Changes

After the execution of the 1976 National Census, merger and separation were effected on three occasions among the Marakaz and villages.

Mashtul El Soak, separated from Bilbeis Markaz, was established as a Markaz in 1977. Ibrahimiya, then belonging to Hihya Markaz, was separated and formed as a Markaz in 1979 together with three villages of Abu Kebir Markaz and one village of Kafr Saqr Markaz. In addition, Qenayat was separated from Zagazig Markaz to form a Town in 1980 and currently given city status. Qenayat city is expected to become a city center with independent Markaz in the near future. The reorganization of Marakaz resulted in forming one city and two Marakaz.

As a result of these mergers, separations and renaming of areas, the Sharqiya Governorate is administratively divided into twelve Marakaz and one City. These administrative changes are summarized in the following table.

Table 2.23 Reform of Markaz

No.	Before Separation	After Separation	Year Undertaken
1.	Zagazig Markaz	Zagazig Markaz and Qenayat Town	1980
2.	Bilbeis Markaz	Bilbeis Markaz and Mashtul El Soak Markaz	1977
3.	Hihya Markaz	Hihya Markaz and Ibrahimiya Markaz (including 3 villages separated from Abu Kebir Markaz and 1 village separated from Kafr Saqr Markaz)	1979

Source : Planning Department, Sharqiya Governorate

2.4.3 General Trend of Population

The inter-census population growth rates of the Governorate from 1947 to 1986 are shown below :

Table 2.24 Urban and Rural Populations

Area	1947	1960	1966	1976	1986
Urban		285,772	385,678	552,728	711,500
Rural		1,534,026	1,722,293	2,065,210	2,542,800
Total	1,361,663	1,819,798	2,107,971	2,617,938	3,254,300

Note : The population of the Tenth of Ramadan and other new desert cities is excluded.

Table 2.25 Intercensal Population Growth Rate

(% per anum)

Period	Urban	Rural	All
1947-1960			2.59
1960-1966	5.83	2.05	2.64
1966-1976	4.33	1.99	2.42
1976-1986	2.87	2.31	2.43

In the Five-Year Plan for Economic and Social Development (1982/83 - 1986/87), it was taken up as one of strategic policies to control the population explosion in urban areas. Several population forecasts made by such various different organizations as CAPMAS, IBRD, U.N., etc. were evaluated in the National Urban Policy Study conducted in 1982 by General Organization for Physical Planning. All these studies forecast a decline in fertility and natural growth rates of the population.

The inter-census growth rates in the above tables clearly show the same tendency as stated and forecast in the Five-Year Plan and National Urban Policy Study. The urban population growth rate have been decreasing notably since 1960 census, although the growth rates in rural areas show an increasing trend in recent times.

2.4.4 Land Use

Sharqiya Governorate and every Markaz have planning departments/sections in their organizations to prepare physical plans for implementation. The present land use conditions, however, have not been studied yet by the departments/sections due to the lack of manpower. Instead, the Regional Office of the General Organization for Physical Planning (GOPP) has been studying and planning the present conditions and forecasts of land use of cities/areas in their order of importance.

The study on the land use for Bilbeis city was completed in 1985, and those for Zagazig and Abu Kebir cities are now under consideration by the Regional Office of GOPP. These are expected to be released within 1988 at the latest. The study for other cities/Marakaz in Sharqiya Governorate has not been initiated as yet.

The following current land use patterns of Zagazig, Bilbeis and Abu Kebir are extracted from studies conducted by the Regional Office, while that for Faqus is developed on the basis of the study by Faqus city. The land use of Minyet El Qamh was developed from the field survey by the Study Team.

(1) Zagazig City

The urbanized built-up area of Zagazig city has extended beyond the city boundary and such municipal services as water supply, garbage collection are provided by the city. The expanded area is mainly for residential purposes with some scattered commercial establishments and several types of small factories.

The most crowded commercial area is located in the central part of the city, between Muweis Canal and railways. The area is surrounded by administrative, educational and public service, and housing areas. On the outskirts of the city, there are universities and factories.

Population: 245,500 in 1986

Area : 970 ha

The present land use pattern is shown in Figure 2.6.

(2) Bilbeis City

The city has the second largest population in the Sharqiya Governorate. It is situated at the terminal of the Al Obour-Bilbeis corridor, which forms one of the main links connecting with the Greater Cairo through the Tenth of Ramadan, one of its satellite towns. In the southeastern part of the city, there is an air force base regarded as a strategic area.

The commercial area is along the two main streets which run in the center of the city from northeast to southwest, and from southeast to northwest as shown in Figure 2.7. Industrial area consisting of about 50 ha extends to the southeastern part between the city area and air force base. At present, factories processing agricultural products as wheat flour, chicken meat/egg and textiles, and precast concrete products, utilizing inexhaustible desert sand, are operational. The present land use in Bilbeis City is shown in Figure 2.7.

Population: 96,500 in 1986

Area : 460 ha

(3) Abu Kebir City

The city is a local business center of surrounding agricultural villages and is located about 20 km northeast of Zagazig city. The most busy and crowded commercial area of the city is around the railway station which extends along the streets. The population in the city area increased about 1.5 times between 1960 and 1976. Nevertheless this increase rate seems to be moderate when compared with those of Zagazig, Faqus, Bilbeis and Minyet El Qamh.

In the industrial area of some 4 ha, located at the northern part of the city, four processing factories are in operation at present, according to a questionnaire survey conducted by the Sharqiya Governorate. They consist of food processing, textile and ice producing factories. Figure 2.8 shows the present land use in Abu Kebir city.

Population: 69,500 in 1986

Area : 660 ha

(4) Faqus City

The city is located at some 30 km northeast of Zagazig city, and just adjacent to Abu Kebir Markaz. The city has been developing not only as a local center for collection/delivery of agricultural products for surrounding rural areas but also as a local administrative and educational center.

The most crowded commercial area that forms a center core of the city is divided into two parts by the Faqus Canal traversing the city from the west to the east.

The present city area is broadly classified into three areas depending on their activities; (a) commercial area, within which some factories are scattered, (b) area of governmental and institutional facilities, and (c) residential area with commercial establishments. The present land use map as shown in Figure 2.9 has been prepared according to this classification by the municipality. There are no large-scale factories and industrial area in the city.

Population: 48,600 in 1986

Area : 420 ha

(5) Minyet El Qamh City

The Minyet El Qamh Markaz is situated at the westernmost area of the Sharqiya Governorate, and is bordered by Shebien El Koom Governorate. The Minyet El Qamh city is the city center of the Markaz. The populations of the city in 1960 and 1976 were 18,464 and 33,609, respectively, or growing to 1.82 times the 1960 level in a period of 16 years. This figure is lower than that for all urban areas of the Governorate which is 1.93, but higher than that of Zagazig city, which is 1.63.

The Minyet El Qamh city has also been developing, like other cities, as a local economic and administrative center of the surrounding agricultural area. The city area can be broadly classified into two areas; commercial and residential, as shown in Figure 2.10. There are no large-scale factories in the city.

Population: 45,900 in 1986

Area : 600 ha

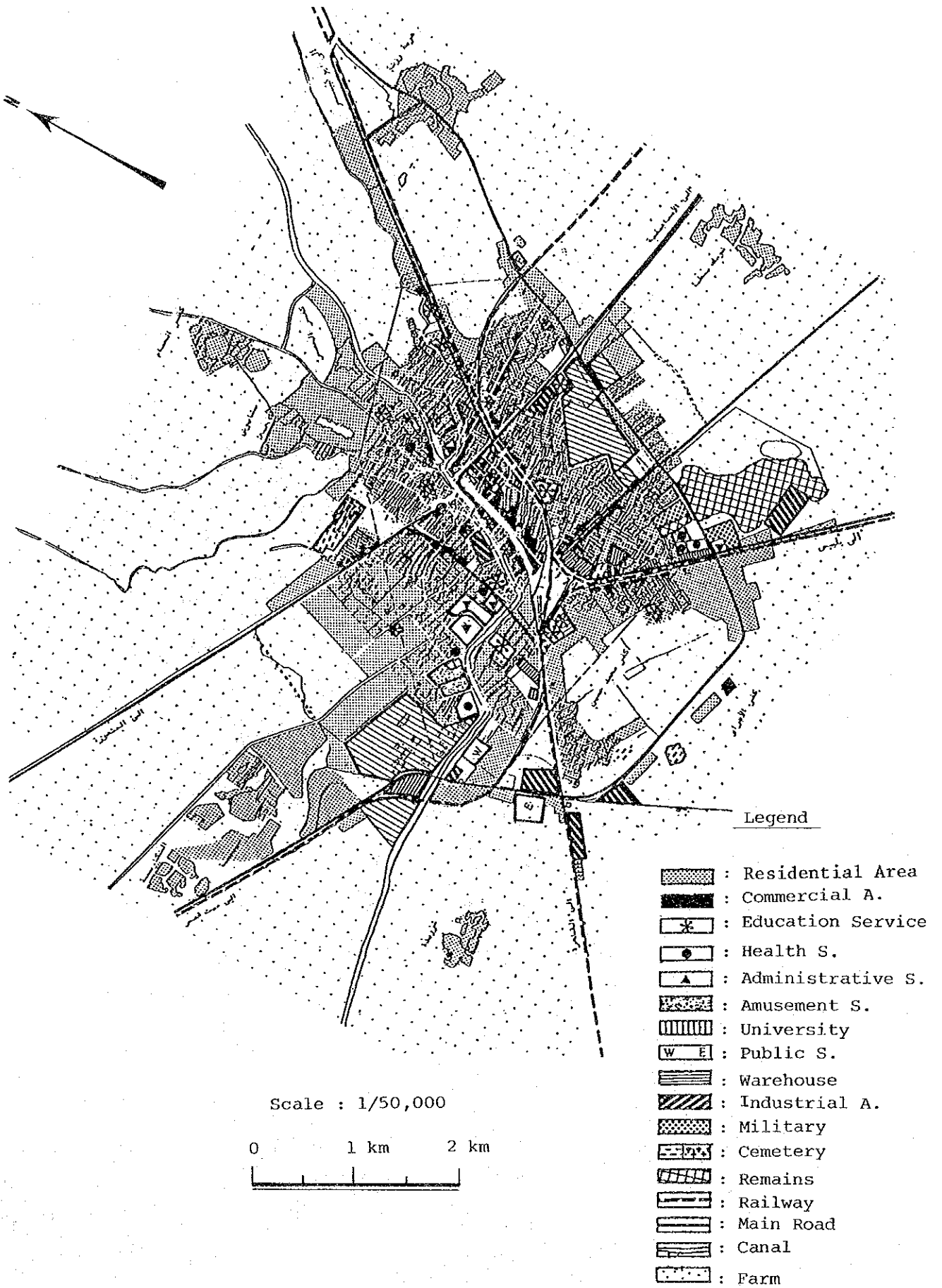


Figure 2.6 Present Land Use in Zagazig City

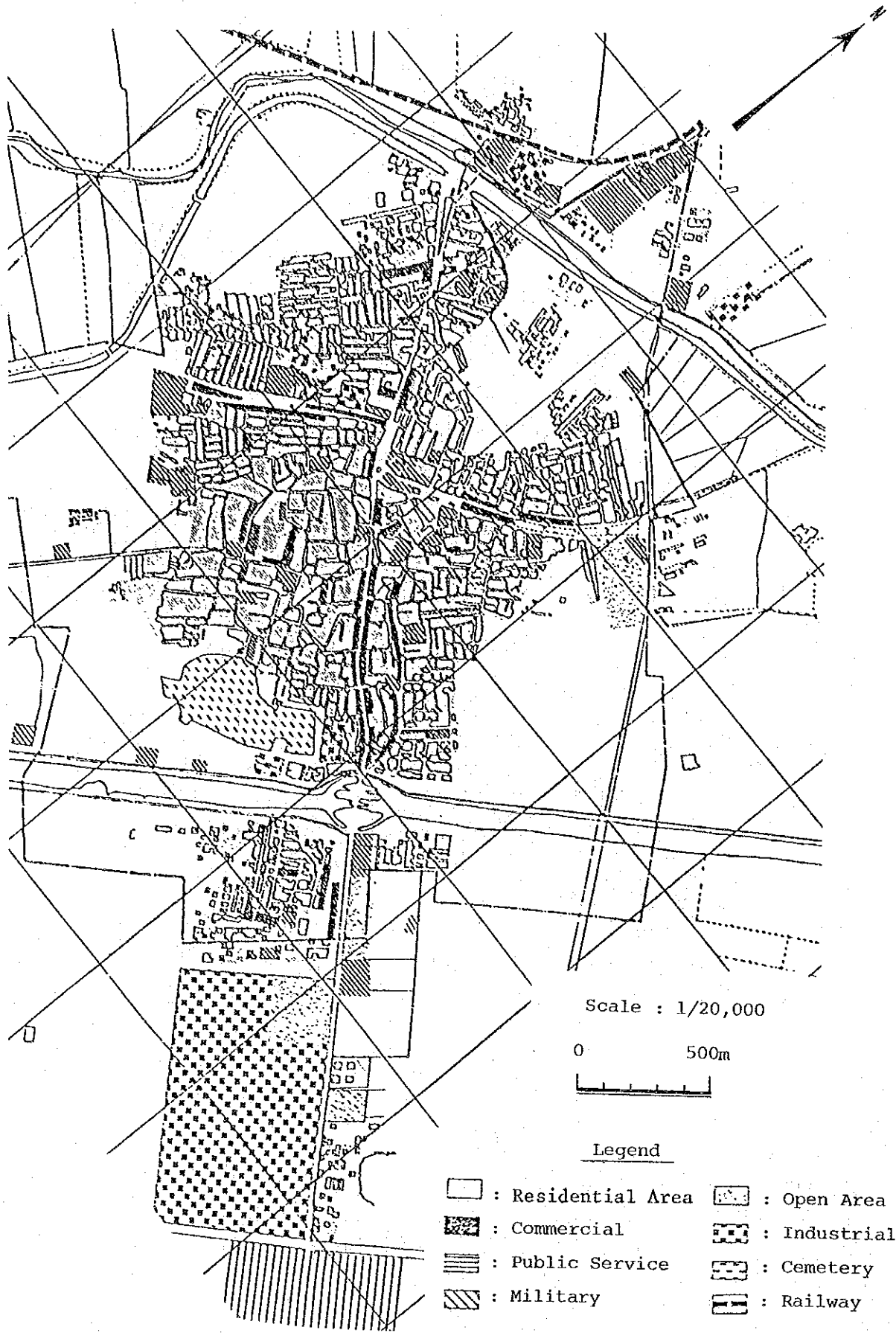
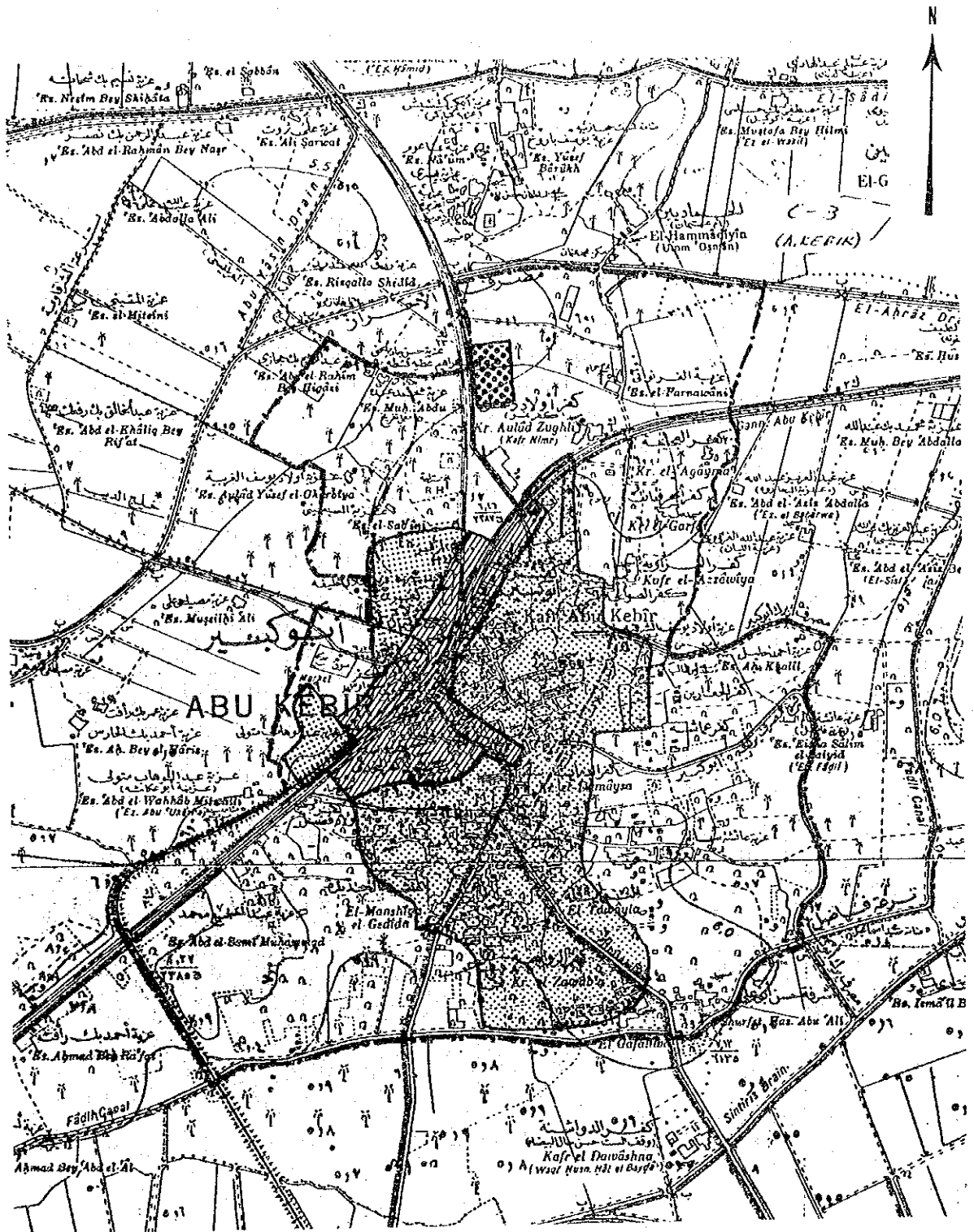


Figure 2.7 Present Land Use in Bilbeis City



Legend

Scale : 1/25,000
 0 500 m 1 km

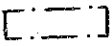



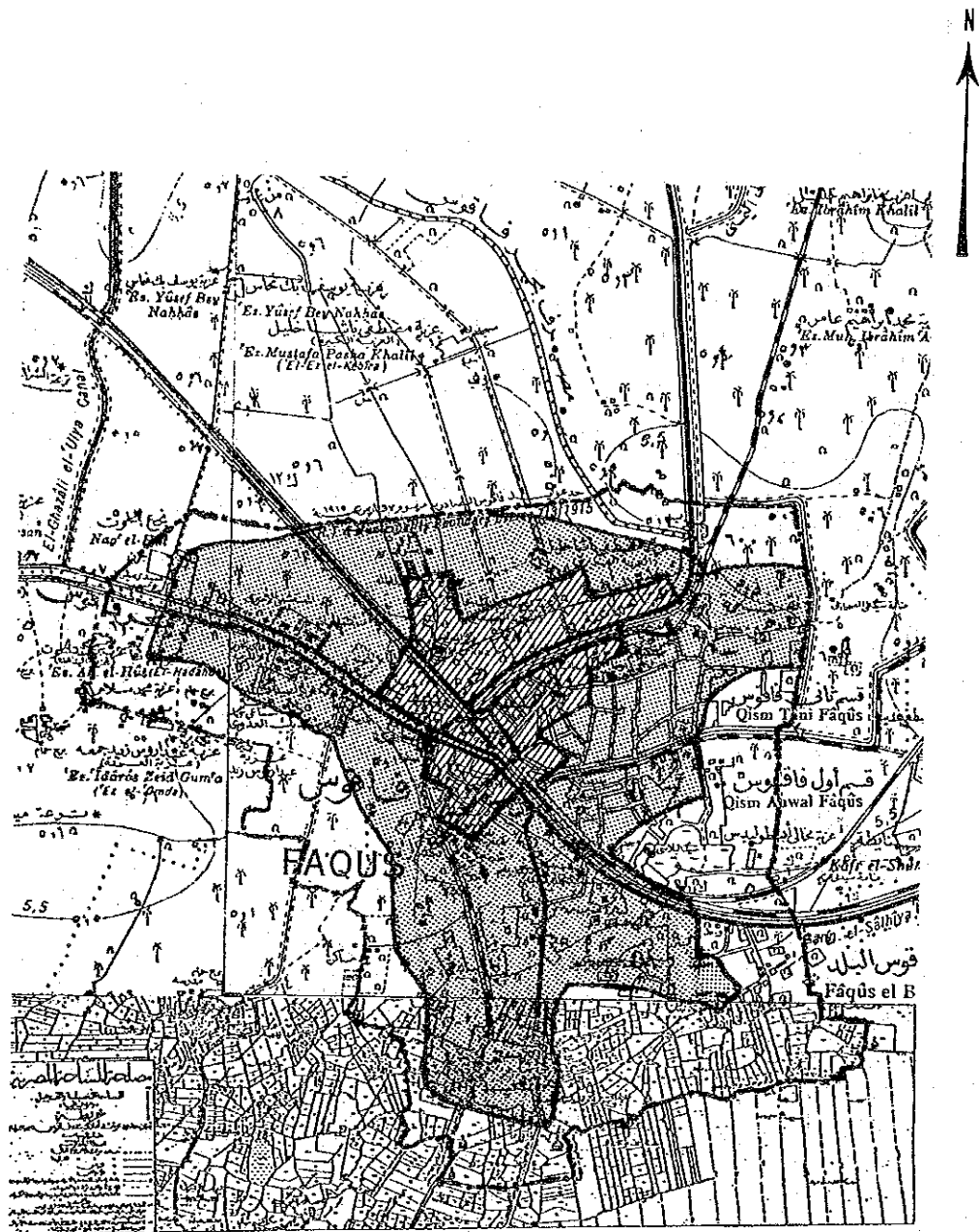
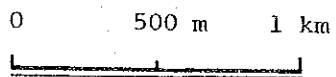
-  : City Boundary
-  : Commercial Area
-  : Residential Area
-  : Industrial Area

Figure 2.8 Present Land Use in Abu Kebir City



Scale : 1/25,000



Legend




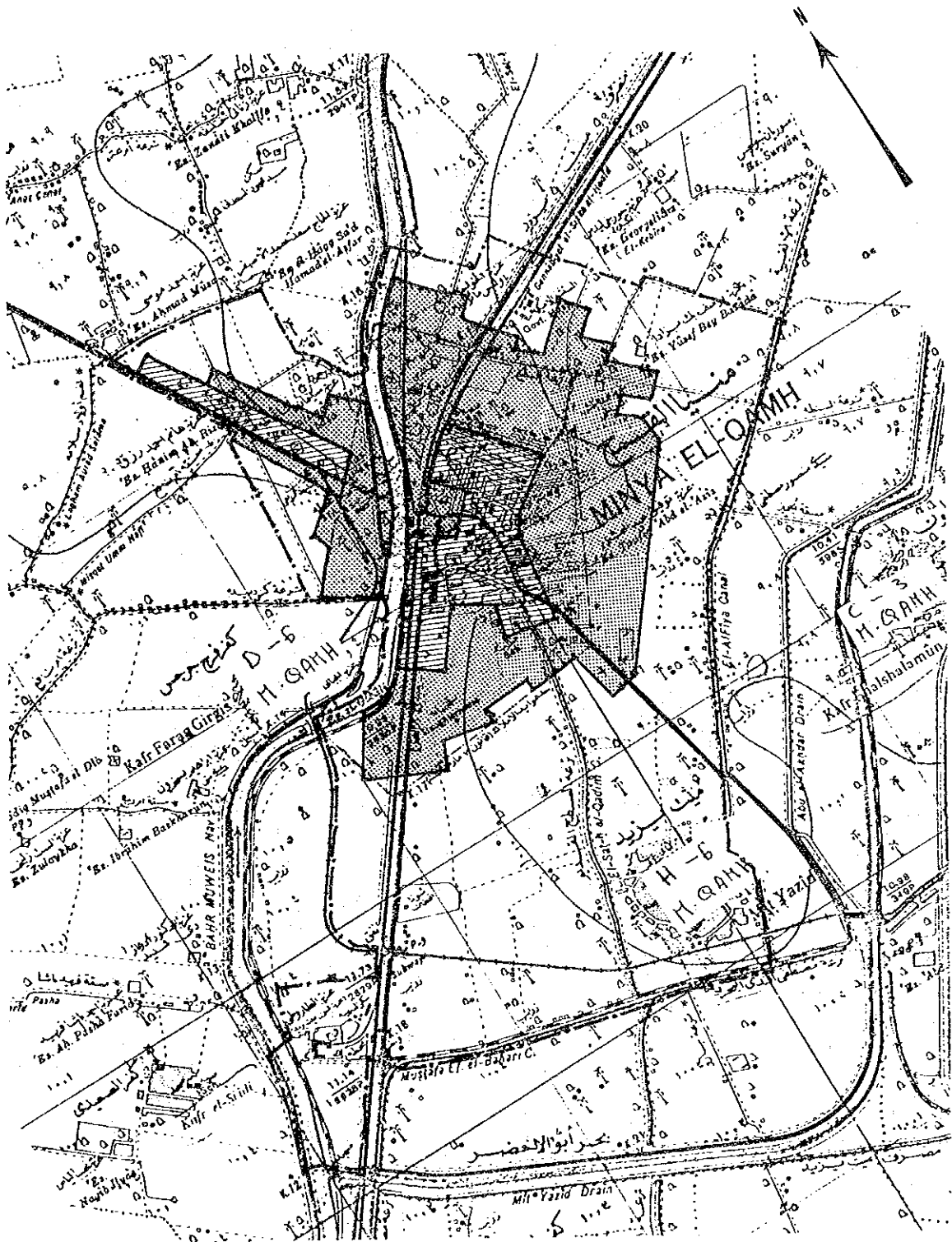
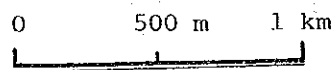
-  : City Boundary
-  : Commercial Area
-  : Residential Area

Figure 2.9 Present Land Use in Faqus City



Scale : 1/25,000



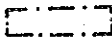


-  : City Boundary
-  : Commercial Area
-  : Residential Area

Figure 2.10 Present Land Use in Minyet El Qamh City

2.5 Public Health Conditions

2.5.1 Medical and Health Services

The Sharqiya Governorate has been exerting efforts to combat infections, and endemic diseases by extensive health services to the people, especially for rural areas. Medical services are made available to all the people in the Governorate.

Hospitals and clinics are also provided in all the major cities with a number of doctors, specialists, nurses and assistants. As of 1987, there are a total of 1,512 beds in public and central hospitals, for a variety of diseases. A total of 713 doctors are now working in the clinics and hospitals, of which 264 are specialist assistant doctors and 449 are resident doctors. The numbers of specialist assistant and resident specialist attached to the municipal centers are listed in the following table.

Table 2.26 Number of Doctors in Municipal Centers

Municipal Center	Specialist Assistant	Resident Specialist	Total
1. Zagazig	47	103	150
2. Bilbeis	26	41	67
3. Minyet El Qamh	24	54	78
4. Abu Hammad	10	28	38
5. Diarb Nigm	21	38	59
6. Karain	5	12	17
7. Zawamel	5	6	11
8. Hihya	14	45	59
9. Abu Kebir	16	25	41
10. Kafr Saqr	17	21	38
11. Huseinia	16	41	30
12. Faqus	27	23	50
13. Qenayat	12	22	34
14. Ibrahimia	5	7	12
15. Mashtul El Soak	19	10	29
Total	264	449	713

Source : Sharqiya Governorate

2.5.2 Incidence of Diseases

The prevalent causes of the mortality, more or less related to waterborne diseases, are bilharzia (schistosomiasis), amoebic dysentery, ankylostomiasis, diarrhoea, enteric fever, cholera, poliomyelitis, infective hepatitis, and food poisoning. Among the above, more rampant diseases are bilharzia and amoebic dysentery for which official data have been obtained and they are indicated in Table 2.27. Comparing the numbers of cases in 1980, 81 and in 1985, 86, bilharzia decreased substantially to about a half, but amoebic desentry remained almost constant.

The waterborne diseases are, in general, closely related to the inadequacy of piped water supply and number of the diseases decreases as the per capita water consumption increases and sewerage service level is upgraded.

Table 2.27 Incidence of Waterborne Diseases 1980, 1981-1985, 1986

Markaz	Area	Bilharzia				Amoebic dysentery			
		1980	1981	1985	1986	1980	1981	1985	1986
Zagazig	urban	2,923	3,504	3,260	2,100	209	687	447	700
	rural	16,575	15,144	6,423	6,101	4,471	3,287		
Huseiniya	urban	981	1,032	605	447	860	920	700	711
	rural	11,490	14,037	8,847	8,600	3,145	3,548		
Kafr Saqr	urban	9,566	2,591	1,742	1,971	6	13	45	118
	rural	12,597	11,060	6,163	5,990	1,727	1,304		
Faqus	urban	1,856	1,413	1,451	1,873	243	307	787	461
	rural	10,370	15,226	3,348	3,208	2,730	2,277		
Abu Kebir	urban	8,348	1,933	1,205	840	833	803	664	443
	rural	6,848	8,520	3,754	3,102	1,573	1,826		
Abu Hammad	urban	1,721	1,483	1,284	713	158	140	137	820
	rural	6,561	8,828	5,011	3,727	1,177	2,728		
Ibrahimiya	urban	834	711	506	618	140	209	43	46
	rural	2,521	2,006	1,840	1,499	370	521		
Hihya	urban	1,206	1,082	1,018	895	50	50	99	69
	rural	2,894	9,204	3,258	3,430	1,534	1,386		
Diarb Nigm	urban	1,464	1,105	1,049	983	36	45	3	88
	rural	7,086	8,306	3,315	3,355	2,124	1,930		
Bilbeis	urban	1,694	1,215	662	525	477	318	60	312
	rural	6,957	9,156	3,806	2,480	2,714	2,598		
Mashtul El Soak	urban	1,109	1,037	600	601	462	607	21	23
	rural	2,289	2,204	787	1,011	740	1,052		
Minyet El Qamh	urban	1,200	964	531	695	507	468	231	859
	rural	7,987	8,758	5,398	6,342	1,425	1,908		
Qenayat	urban			2,261	1,242			709	615
Total	urban	32,902	18,070	16,174	13,503	3,981	4,567	3,946	5,265
	rural	94,175	112,449	51,950	48,845	23,730	24,365		
	total	127,077	130,519	68,124	62,348	27,711	28,932		

2.6 Canals and Drains

Canal networks in the Governorate have been elaborately constructed a long time ago to provide irrigation water and drinking water to inhabitants. Drain network systems which collect drain water distributed from canal system have also been constructed parallel to canal construction. These systems have ensured high agricultural productivity in the Delta. The Ministry of Irrigation, through its district office, directly controls the flow and maintains water courses and related facilities because of their importance. Regulations are enacted to preserve water quality in the canals and the drains. Extension and upgrading of the sewerage systems in the urban areas and improvements of the excreta disposal systems in the rural areas are major factors to maintain water quality standards in the canals and the drains.

2.6.1 Canals

Figures 2.11 and 2.12 show the existing and planned canal systems in the Governorate. Canals flowing down through the Governorate originate in the Nile River. Major canals run towards the north and except the Ismailiya Canal, eventually discharge the water to Manzala Lake. The canal system in the Governorate can be classified into two groups according to their source of water inflow; receiving water from the Taufiki Rayab Canal, and from the Ismailiya Canal.

The Muweis Canal, which flows through the northwestern part of the Governorate, takes water from the former group, whereas the El Wadi and El Saidiya canals belongs to the latter group. As shown in Figure 2.11, the El Hanut and El Wadi Canals receive wastewaters pumped up through drain pumping stations. At Hanut, the El Hanut Canal receives domestic and irrigation wastewaters lifted by the drain pumping station, and the canal water downstream from the point is polluted. Another drain pumping station discharges wastewaters to the El Wadi Canal and additional drain pumping station to this canal is under consideration.

The Ismailiya Canal takes water from the Nile River in Cairo. The canal flows towards the northeast and crosses the southern part of the Governorate until it crosses the boundary with Ismailiya Governorate. El Wadi Canal, a branch of the Ismailiya Canal, flows down through Abu Hammad and, at Abu El Akhdar, flows into the Faqus Canal. The El Saidiya Canal is also a branch of the Ismailiya Canal. The Canal, after being branched at a point close to the El Wadi Canal branch, flows northeast. The Faqus Canal takes water from the Abu El Akhdar Canal and further flows down to Faqus city. This canal already receives wastewaters from the El Wadi Canal, and it is due to receive additional wastewater in the future from a drain pumping station now under consideration.

Besides the major canals, there are a number of small canals branched from the major canals. At many locations, drain waters are discharged from the drains and farmlands.

A water quality survey of the canals indicated that the conductivity and chloride concentrations were in the range from 600 S/cm and 83 - 100 mg/l, respectively at a location between Zagazig and Kafr Saqr; 1,500 S/cm and 246 mg/l at Hanut; and 1,600 S/cm and 260 mg/l at Dafau. It is obvious from this that the polluttional load on the canal waters is very high.

2.6.2 Drains

As illustrated in Figures 2.13 and 2.14, the Governorate area is covered by a network of drainage system, which collect wastewaters from both urban and rural areas. The wastewaters collected through a number of small branch drains flow into the major drains either by gravity or with the aid of pumps, and are eventually disposed of to Manzala Lake.

There are two major drains which pass through the Governorate. The Bahr El Bakar Drain which flows down through the eastern portion of the area, and the Bahr Haduas Drain covering the western part of the area, both of which finally discharge to Manzala Lake. Most of the urban areas of the Governorate are drainage basins to these two major drains.

The Kalubia Main Drain and the Bilbeis Drain join and form the Bahr El Bakar Drain. On the way down to Manzala Lake, the Drain receives wastewaters at several points pumped up from branch drains. Because most of the wastewaters from the eastern part of the Greater Cairo flow into the drain, the drain water has already been significantly contaminated, having BOD₅ of 50 mg/l or more (Ref.No.13). The waste loads have surpassed the assimilative capacity, and at many locations, where the flow velocity is low, organic solids tend to settle on the drain bottoms and anaerobic decomposition has set in, causing odor problems.

The Bahr Saft El Kebli Drain joins the Bahr Haduas Drain and flows further down towards the north and eventually discharges wastewaters to Manzala Lake. The Drain has many branch drains, most of which are provided with a pumping station at the terminus of the drain.

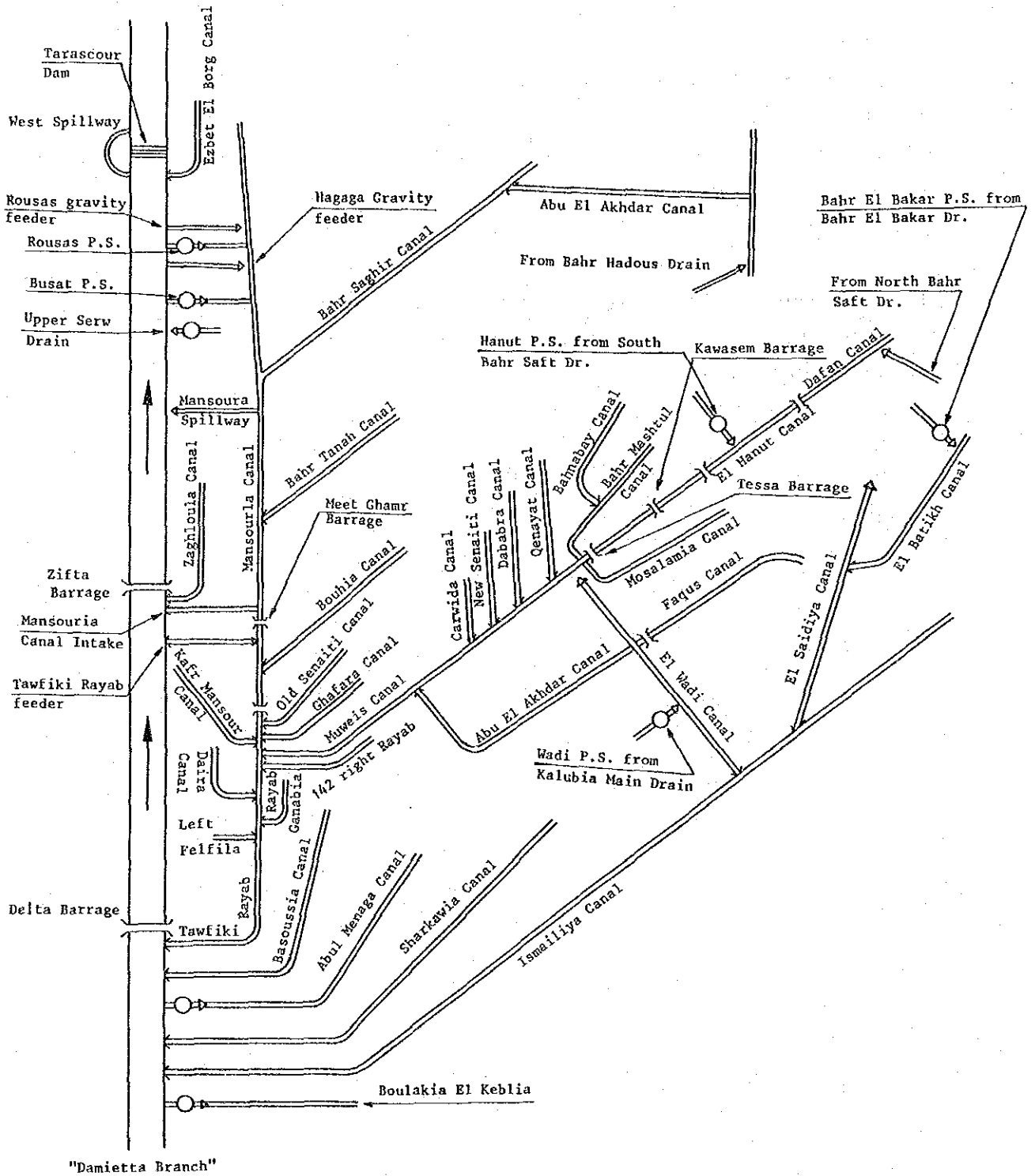


Figure 2.11 Existing Canal System

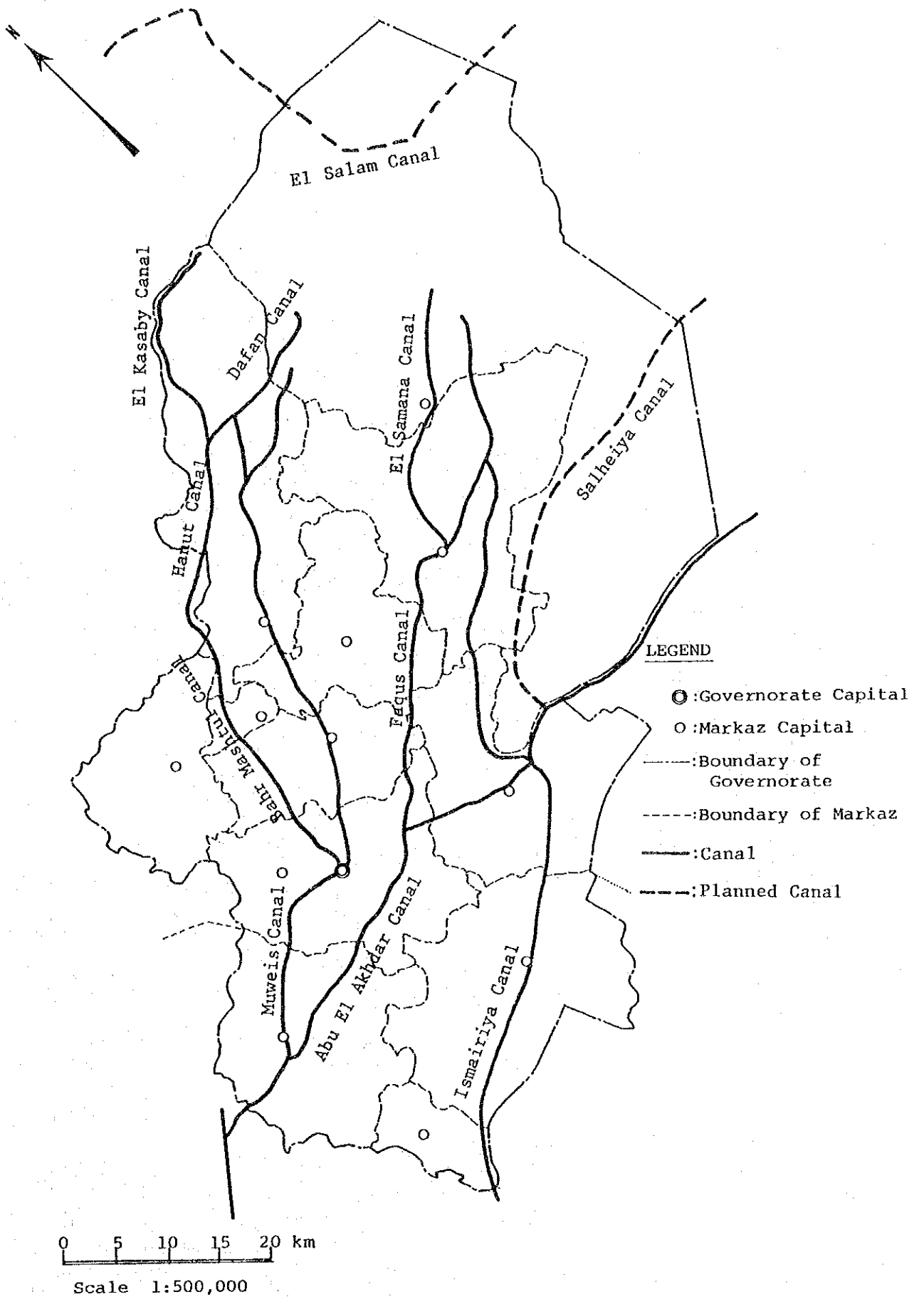


Figure 2.12 Planned Canal System

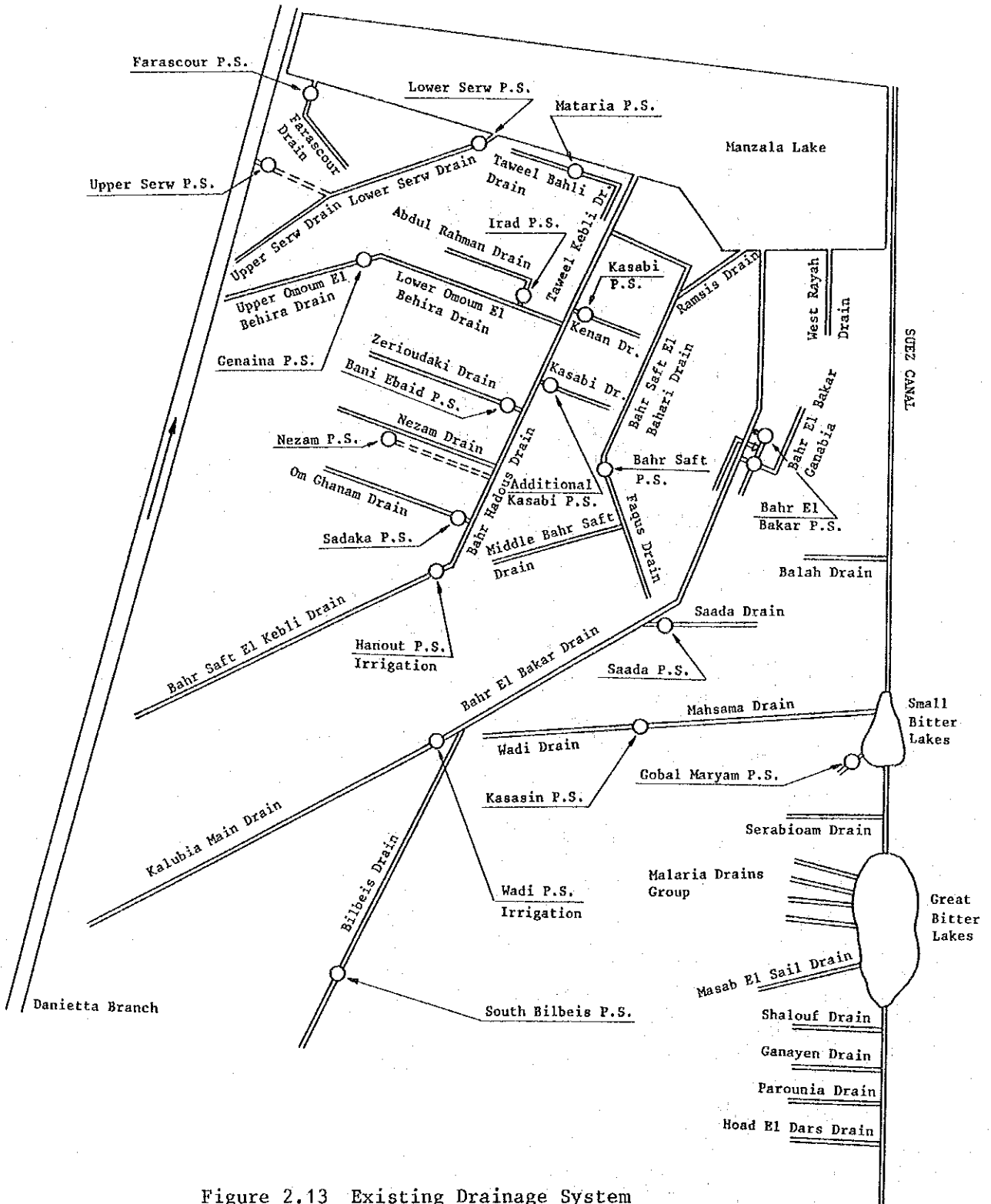


Figure 2.13 Existing Drainage System

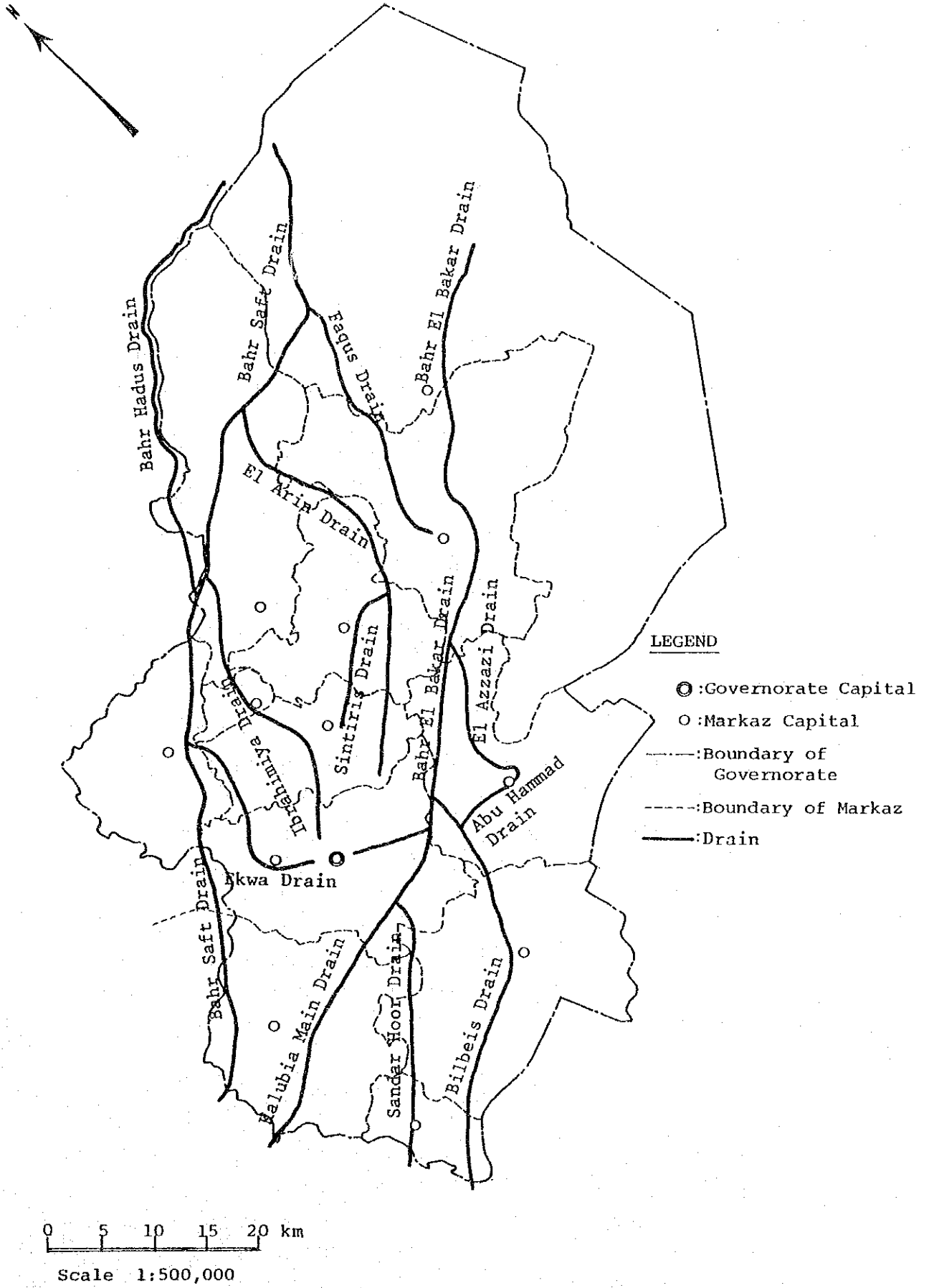


Figure 2.14 Drainage System in Sharqiya Governorate