FINAL PROGRESS REPORT
ON FIELD SURVEY,
KAHLAA RICE FARM PROJECT
IN
THE REPUBLIC OF IRAQ

FEBRUARY 1979

KAHLAA RICE FARM PROJECT FIELD SURVEY TEAM
JAPAN INTERNATIONAL COOPERATION AGENCY

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

P.O. BOX 216 MITSUI BLDG
2-1, NISHI-SHINJUKU, SHINJUKU-KU TOKYO
160 JAPAN

H.E. Mr. Latef Nessaif Jassem
The Minister of Agriculture
and Agrarian Reform,
The Government of the Republic of Iraq

February 18, 1979
Baghdad

Letter of Transmittal

Sir;

We take the pleasure of submiting herewith twenty copies of our final progress report on field survey for feasibility study on the Kahlaa Rice Farm Project, Amara, Missan province, in accordance with the scope of works signed by your Ministry and Japan International Cooperation Agency dated August 10, 1978.

We sincerely hope that this report, outcome of our field survey during about 4.5 months, would be helpful for the feasibility study on the Project, which is scheduled to be started in the middle of this year 1979.

In this opportunity, we would like to extend our heart-felt appreciations to you for the whole-hearted cooperations and assistances bestowed to us by your Governmental officials during the field survey period.

Hoping again that the feasibility study to construct a modernized rice farm of 8,000 Ha in the lower Mesopotamian plain will be successfully completed by the joint efforts of the both Governments of the Republic of Iraq and Japan, we remain,

Yours very truly,

Daizo Iseno
Team Leader

بسم الله الرحمن الرحيم

MINISTRY OF AGRICULTURE AND
AGRARIAN REFORM
FOREIGN RELATION SECTION

وزارة
الزراعة والإصلاح الزراعي
العلاقات

REF. NO.

DATE

العدد ٨٩٨٥
التاريخ ١٩٧٩/٢/١٨

TO: JAPAN INTERNATIONAL COOPERATION -
AGENCY
(JICA)

Dear Sirs,

We kindly certify that we have received 20 Twenty copies of the First Progress Report and other (20) Twenty copies of the Final Report submitted by the Japanese team regarding the feasibility study on Kahlaa Rice Farm Project in Missan.

With regards.

Yours faithfully,

MINISTER OF AGRICULTURE AND
AGRARIAN REFORM

الى / وكالة التعاون الدولي
اليابانية (جايكا)

بعد التحيـــة

نؤيد استلامنا لعشرين نسخة من التقرير الدولي وعشرين نسخة من التقرير النهائي المقدم من قبل الفريق الياباني القائم بدراسة الجدوى الاقتصادية لمزرعة رز الكحلاء في ميســـان .

مع التقديـــــر .

م. وزير الزراعة والاصلاح الزراعي

نسخة منه الى /
مديرية العلاقات
الاتفاقيات/ اليابان

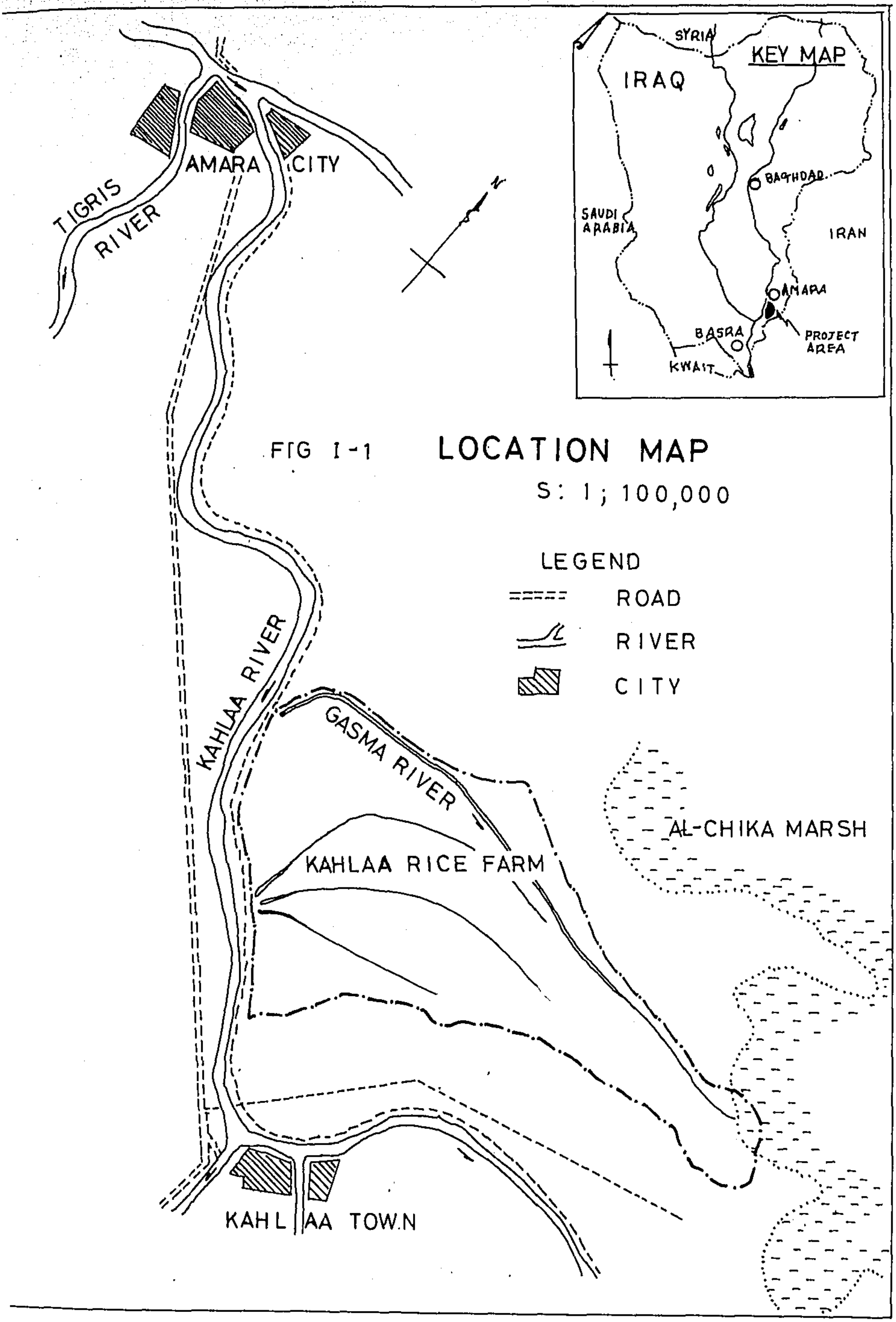

FIG I-1 LOCATION MAP

S: 1; 100,000

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CHAPTER I. INTRODUCTION

I-1. OBJECTIVES AND SCOPE OF WORKS OF THE FIELD SURVEY

In accordance with the Scope of Works for the feasibility study on the Kahlaa Rice Farm Project signed by the Ministry of Agriculture and Agrarian Reform, the Government of the Republic of Iraq, (hereinafter referred to as "the Government") and the Japan International Cooperation Agency Mission on August 10, 1978, a field survey team consisting of four engineers and experts was dispatched to Iraq, as detailed in I-3 hereinafter, in order to study the present conditions of agriculture, land use and irrigation/drainage in the Project Area and collect necessary basic data and information for the feasibility study on the Project prior to the dispatchment of the major force of the feasibility study team, which is now scheduled in the middle of 1979. The field survey team mainly conducted studies on irrigation requirements, water source, soil and groundwater. Study results as well as data and information so far collected have been incorporated in two volumes of the Progress Report, however, descriptions on the "Topography, Geology and Soils" and "Agriculture" in the First Progress Report, which was submited in the later part of December 1978, have been summarized in this report so that this Final Progress Report can be consistent convering the whole aspects of the Field Survey.

I-2. GENERAL OUTLINE OF THE PROJECT AREA

The Kahlaa Rice Farm Project Area of about 8,000 Ha is located about 20 km south-east of Amara city, Missan province, in the south-western part of the lower Mesopotamian plain. (See Fig. I-1. LOCATION MAP) Amara city, one of the major agricultural production areas in Iraq, specially of paddy rice, is located on the banks of the Tigris river about 150 km north-north-east of Basra city. The land productivity is, however, not satisfactorily high due to soil salinity and poor irrigation and drainage at present. Under the situations, the implementation of Amara Irrigation Project is on the way by the Government aiming at area-wide improvement and development for agricultural production as well as for flood control.

A comprehensive study on this large-scaled development project was carried out by the Government during 1961 to 1965 in order to equip the service area of about 300,000 Ha with adequate irrigation and drainage facilities so that the lower Tigris water could be rationally distributed to various parts of the project area for irrigation purpose as well as for diverted release of floods. The Government commenced the construction of such facilities in 1972, and has started the operation of Butairia head regulator, Areedh flood escape and Kahlaa and Musharrah head regulators as of the end of 1978. (See Fig. I-2. AMARA IRRIGATION PROJECT MAP) In addition, installation of several pump stations, erection of regulation gates and excavation of main irrigation and drainage canals are scheduled successively.

The Kahlaa Rice Farm Project Area is located in the eastern portion of this irrigation project area. In more detail, it is located on the left bank of the Kahlaa river, one of the five biggest canals branching off from the Tigris, and is surrounded by the Gasma river, a tributary of the Kahlaa, in the north, by another tributary of the Kahlaa in the south and by the marsh of Hor El-Cheka in the east. The above-mentioned Gasma river and other tributaries of the Kahlaa river run to the marsh through the Project Area, branching off numerous artificial canals which flow toward various directions. Topographically, the Project Area is extremely flat though it inclines quite gently toward the east, repeating a fine micro-relief.

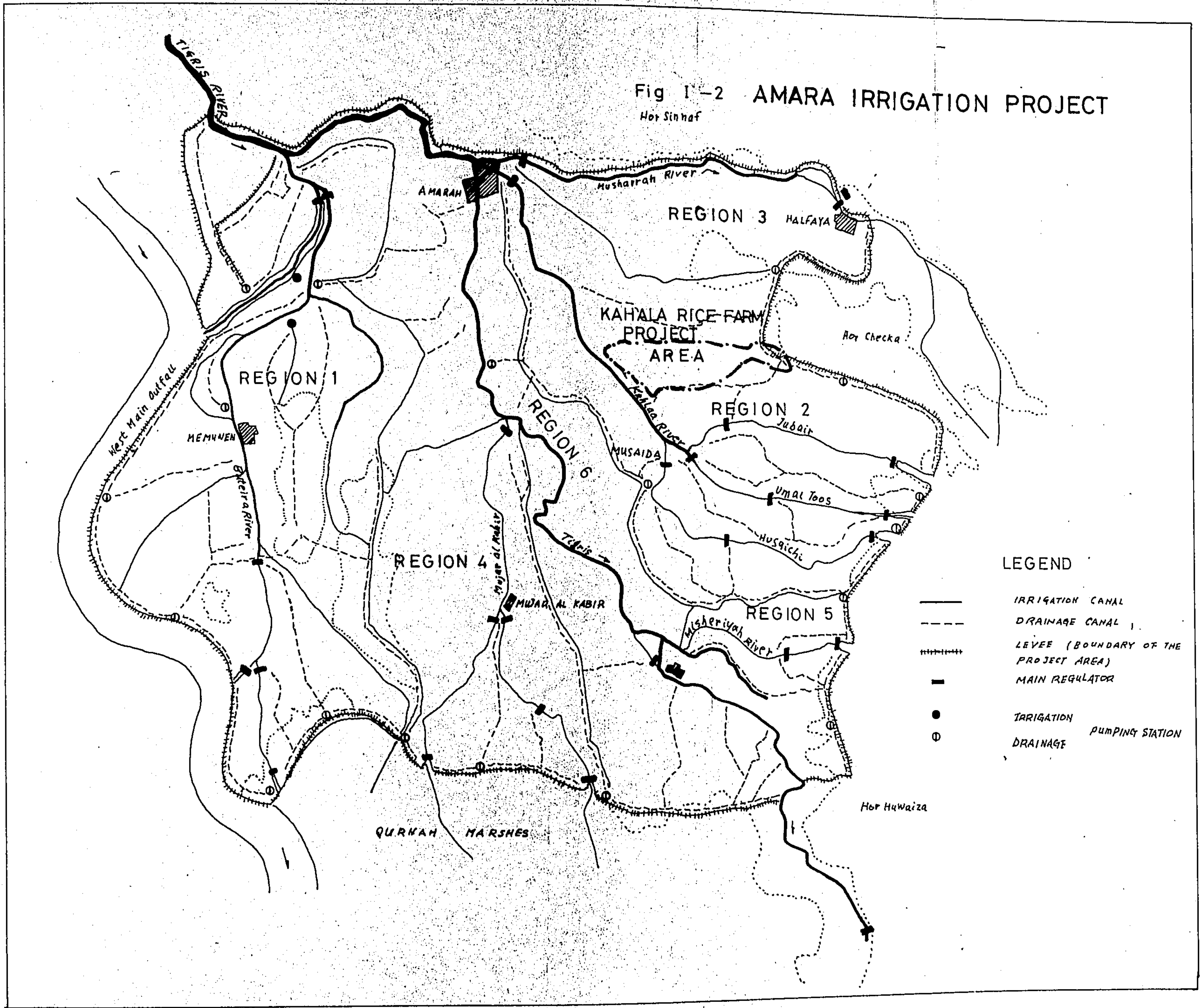


Fig I-2 AMARA IRRIGATION PROJECT
Hor Sinnaf
Tigris River
Musharrah River
AMARAH
REGION 3
HALFAYA
KAHALA RICE FARM PROJECT AREA
Hor Checka
REGION 1
West Main Outfall
MEMUNEN
Butteira River
REGION 6
REGION 2
Jubair
MUSAIDA
Kahlaa River
Umal Toos
Husaichi
Tigris
REGION 4
Majar al Kabir
MAJAR AL KABIR
REGION 5
Misheriyah River
Hor Huwaiza
QURNAH MARSHES
LEGEND
IRRIGATION CANAL
DRAINAGE CANAL
LEVEE (BOUNDARY OF THE PROJECT AREA)
MAIN REGULATOR
IRRIGATION
DRAINAGE
PUMPING STATION

I-3. PARTICIPANTS IN THE FIELD SURVEY

(1) Field Survey Team and Advisory Group

The Japan International Cooperation Agency dispatched the Kahlaa Rice Farm Project Field Survey Team to Iraq for about 4.5 months from October 12, 1978 to February 21, 1979, and let it conduct the above-mentioned studies. The Advisory Group consisting of two members arrived in Iraq together with the team, and performed their given duties during eleven days up to October 23, 1978. The member lists of them are:

Advisory Group

Name	Capacity	Belonging
Mr. Yoshikazu Yoshida	Irrigation and Drainage	The Water Resources Development Public Co-operation, Ministry of Agriculture, Forestry and Fishery, Japan
Mr. Takao Isoyama	Coordination	Japan International Co-operation Agency, Japan

Field Survey Team

Name	Capacity	Belonging
Mr. Daizo Iseno	Irrigation and Drainage (Team Leader)	Sanyu Consultants, Inc.
Mr. Toshitake Nakayama	Project Planning	- do -
Mr. Katsuyuki Akagawa	Agriculture	- do -

Name	Designation	Belonging
Mr. Ryoichi Kawasaki	Soils	Sanyu Consultants Inc.

In addition to the members listed above, Mr. Noboru Moritani of Sanyu Consultants, Inc. was dispatched to Iraq for about two months from December 6, 1978 to February 21, 1979, and assisted the Field Survey Team in report preparation.

(2) Counterpart Personnels

Close cooperation and assistance were rendered to the Field Survey Team by the counterpart personnel of the Government of the Republic of Iraq whose names are recorded below;

Counterpart Personnels

Name	Designation	Belonging
Mr. Ghazi Al-Daghistani	General Coordination	Chief, Department of Foreign Relations, Ministry of Agri-culture and Agrarian Reform (MAAR)
Mr. Raad Hammed	Agronomy	Agricultural Engineer Missan Agricultural Office, MAAR
Mr. Noori Abed Ali	Irrigation	Irrigation Engineer, Missan Irrigation Office, Ministry of Irrigation
Mr. Abed Alla Werawesh	Soils	Soil Engineer, Missan Soil Office, SOSLA

Aparting from the counterpart personnels, warm-hearted assistances were bestowed by the official of Amara Agriculture Office, specially by Mr. Falhi Hessen, President, Mr. Mousa Khalaf, Vice-President, and Mr. Dair Abed Al-Koreem, Chief of Planning Division.

Furthermore, the Survey Team made contact with and got valuable advices and information from the following officials;

Name	Position
Dr. Mohammed A Al-Najim	Dean of Agricultural College, University of Basra
Mr. Abed Al-Karim Raheem	Division Chief, Missan Irrigation Office
Mr. Helal Laftah	Division Chief, Missan Meteorological Office
Dr. Abed Al-Wahhb Esmoeel Allam	Technical Advisor, Amara State Sugarcane Farm
Mr. Ali Salman	Chief of Agricultural Research Divisio Amara State Sugarcane Farm
Mr. Kalaf Mehana	Chief of Rental Station of Machinery, Missan
Mr. Faker Saloomy	Chief, Missan Soil Office, State Organization of Soils and Land Reclamation

CHAPTER II. FIELD SURVEY

II-1. SURVEYING ACTIVITIES

The Field Survey Team conducted the following studies during the survey period;

1) Reconnaissance survey in the Project Area and its vicinity;

2) Study on present irrigation and drainage systems;

3) Study on present farm management;

4) Study on salinization of soils;

5) Soil survey;

6) Water source survey;

7) Groundwater survey; and

8) Study on irrigation requirements.

The above-mentioned studies and surveys were carried out under the cooperation of the Ministry of Agriculture and Agrarian Reform, Missan Agricultural Office, Amara Office of the Ministry of Irrigation and Amara Soil Office of the State Organization of Soil and Land Reclamation.

II-2. DATA COLLECTION

In spite of every possible effort of each survey team member, data collection could not be smoothly carried out due to the limited time, linguistic hindrance and the long distance between Amara and Baghdad. However, under the whole-hearted assistance of the Iraqi Governmental official, specially of the counterpart personnels, the following data could be obtained;

(1) Meteorology

a. Total Sunshine Duration at Amara Meteorological Station (1976 to 1978)

b. Daily Rainfall at Amara Meteorological Station (1973 to 1978)

c. Monthly Mean Soil Temperature in Celsius Centigrade (1973 to 1977)

d. Mean Monthly and Annual Relative Humidity in Percent

e. Daily Temperature in Celsius Centigrade, Rainfall and Evaporation at Amara, Nasiriya, Diwaniya and Nataf (1977)

f. Daily Maximum and Minimum Temperature in Celsius Centigrade (1975 to 1976)

g. Meteorological Data of Amara Sugarcane Factory (1965 to 1975)

(2) Agriculture

a. Flora of Iraq, Volume I (Reference only)

b. Flora of Iraq, Volume II (Reference only)

c. Flora of Iraq, Volume IX (Reference only)

d. Poisonus Plants of Iraq (Reference only)

e. Monograph on the Cucurbitacene (Reference only)

f. The Wheat Response to Nitrogen and Phosphorus Contents of Soil, No. 3, Feb. 1977

g. Evaluation of Soil Fertility and its Effect on Yield of Regional Crops in Lower Mesopotamian Plain, No. 4, Jan. 1977

h. Evaluation Maps of Fertility of Some Iraqi Soils and the Response of Regional Crops to Fertilizers in Farm Fields, No. 36, Sept. 1977

i. Amber Rice Plantation, by Dr. Sabri Sibahi

j. Development of Rice Farming in Iraq

k. Final Report for Rice Experiment, 1975 (Arabic)

l. Modern Method of Paddy Cultivation at Middle South Region in Iraq (Arabic)

m. Central Statistic Organization Index Number for Agricultural Crops in Iraq for the Years 1961 to 1977, Feb. 1978 (Reference only)

(3) Soils

a. Soil and Soil Conditions in Iraq, by Dr. P. Buringh, Baghdad, 1960 (Reference only)

b. Soil Classification Maps in Bahatha Area (Scale: 1/10,000), State Organization of Soil and Land Reclamation (SOSLA)

*/ The maps cover two-third of the Project Area.

c. Soil Investigation Data of Mijer and Kahlaa Rice Experimental Farms, 1976, SOSLA

d. Soil Investigation Data of Sugarcane Project in Amara, Agrar & Hydro-Technik GMBH, 1978

e. Irrigation Improvement in Amara Area, Final Planning Report, Volume III. "Soil Survey and Land Classification", by M. Allaherdi & Assoc. Iraq, CEKOP, Poland, Baghdad, 1966

f. - do -, Volume III, Appedix I, Maps

g. - do -, Volume III, Appedix II, Part-1

h. - do -, Volume III, Appendix II, Part-2

(4) Irrigation and Drainage

a. Irrigation Improvements in the Amara Area, Final Planing Report, Volume I. Irrigation and Drainage, by M. Allahwerdi & Assoc-Iraq, CEKOP-Poland, Baghdad, Iraq, 1965

b. - do -, Volume II. Hydrology (1963)

c. - do -, Volume II. Hydrology, Appendix A.

d. - do -, Volume II, Hydrology, Appedix B.

e. Interim Planning Report on Irrigation Improvements in Amara Area, Volume I. General Sketch of Irrigation and Drainage, M. Allahwerdi & Assoc-Iraq and CEKOP-Poland, Baghdad, Iraq

f. Interim Planning Report, Volume IV. Foundation Explorations

g. Preliminary Design Memorandum on Irrigation Improvement in the Amara Area, by H. Allahwerdi & Assoc-Iraq, CEKOP-Poland

h. Hydrological Survey of Iraq, Main Report, 1963, Harza Engineering Co., Chicago, Binnie & Partners, London

i. Five-day and Monthly Statistics of River Gauge Reading for the Year 1970, (issued as Irrigation Directrate General Technical Circular)

j. Amara Barrage and Drainage System Projecting the Amara Town, July 1966, Polservice, Polish Consulting Engineers, Baghdad, Iraq

k. Summary of Monthly Precipitation at Stations in Iraq, 1887 to 1958, Hydrological Survey of Iraq, May 1959

l. Discharge for Selected Gauging Stations in Iraq, 1930 -1956, Hydrological Survey of Iraq, May 1958

m. Progress under Planning, 1972, the Ministry of Planning, the Republic of Iraq

n. Consumptive Use for Agricultural Crops (Table) Amara Irrigation Office, Ministry of Irrigation

o. Drainage and Soil Reclamation of Missan Sugarcane Project, Dr. Ibrahm M. Hbib

(5) Maps

a. Controlled Mosaic Photo Maps, (Scale: 1/10,000) 10 sheets, 1962, Topo-survey Department

b. Aerial Photograph, (Scale: 1/35,000), 31 sheets, 1962, Topo-survey Department,

c. Topographic maps, (Scale: 1/10,000)

*/ The preparation is on the way by the Topo-survey Department.

d. Land Use Map, (Scale: 1/10,000), Soil Survey Office

CHAPTER III. SURVEY RESULTS

III-1. RECONNAISSANCE SURVEY OF THE PROJECT AREA AND ITS VICINITY

(1) Land Conditions

The Project Area inclusive of its vicinity, which is called "Al-Bahatha", is topographically flat and lowlying. The undulation ranges in 0.5 to 1.0 meters. The land of Al-Bahatha is classified into the cultivated land, lowland and waste land.

The cultivated land is relatively high in elevation, and mostly located along the Kahlaa river. Irrigation water is supplied to the land by means of pumping up this river water.

The lowland extends near the reedy Al-Chika marsh, and is categorized as a waste land.

The waste land is located between the cultivated land and the lowland. A part of the waste land has been abandoned by farmers because of too long distance to the Kahlaa river, water source for irrigation, and the remaining part due to a high soil salinity, which was brought about by repeated irrigation in old days. Weeds such as "shock", "equal" and "toltia" are growing in the waste land. Even such saline soil weeds do not grow in some parts of the waste land due to too high soil salinity.

According to the land use map prepared by the Department of Land and Survey, Amara Agricultural Office, the ratio of the arable land, waste land (uncultivated land), and marsh area in the Project Area is 50, 35 and 15 percent, respectively. (See Fig. III-1-1. Land Use Map, 1977)

No on-farm facilities are seen in the Project Area except various earth canals excavated exclusively for irrigation; farm fields are not equipped with drainage canals nor farm roads. It seems that farmers do not feel so much inconvenience at such farm field without drainage canals nor farm roads because the runoff of rainy water is very small due to the very small precipitation of about 200 mm per annum, and because the transportation of agricultural products, etc., is mostly made by animal-power which needs only a narrow path.

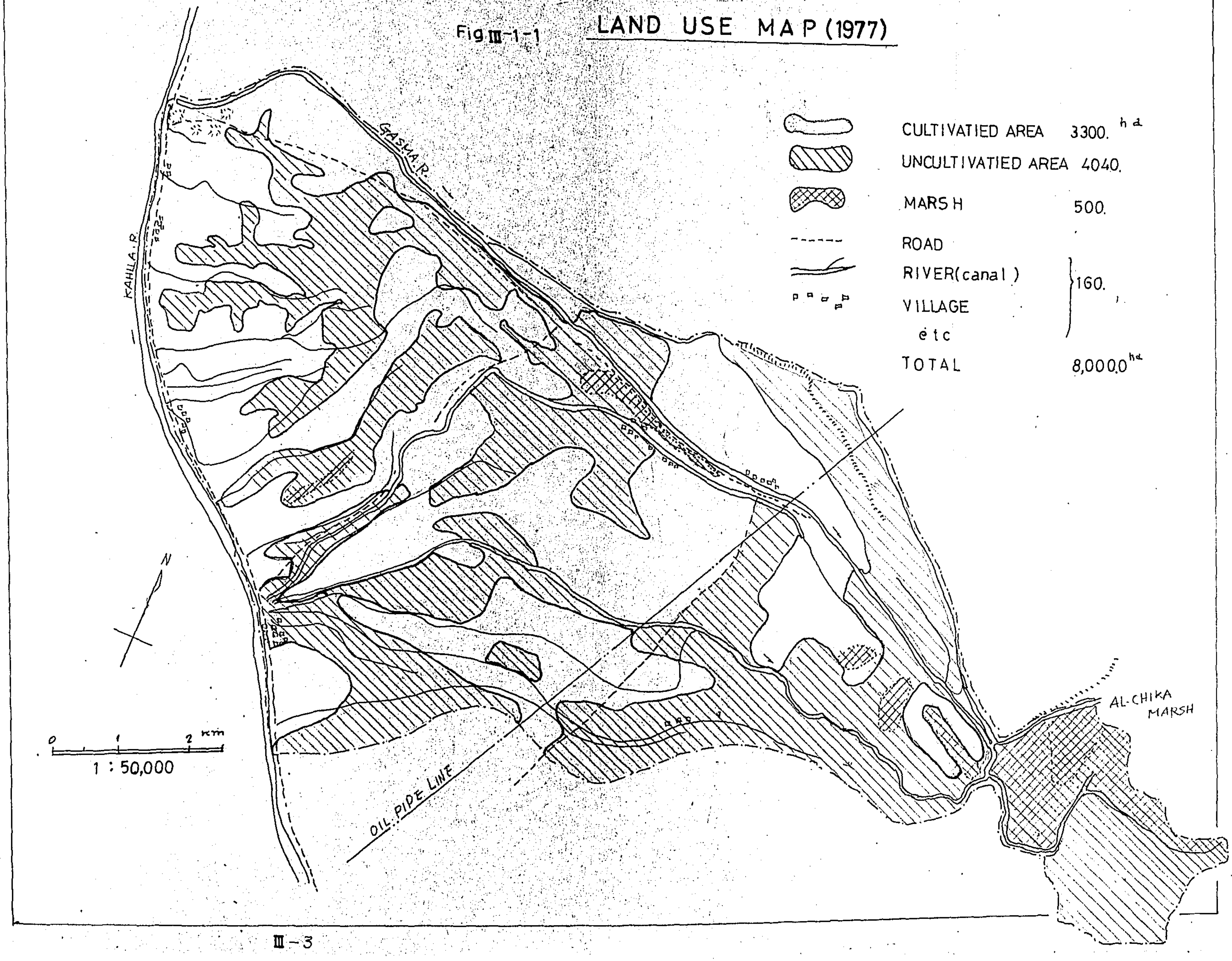
Under the circumstances, the following should be put in focus in planning the Kahlaa Rice Farm;

a) Improvement of irrigation facilities;

b) Construction of drainage facilities;

c) Improvement of soil conditions(in relation to soil salinity);

Fig III-1-1 LAND USE MAP (1977)



d) Land consolidation;

e) Construction of farm roads; and

f) Introduction of various agricultural facilities.

(2) Land Use in the Project Area

According to the data of the Department of Land Survey, Amara Agricultural Office, the land use as of 1977 was as tabulated below. (See Fig. III-1-1)

Table III-1. Land Use in the Project Area as of 1977

Land Category	Area (Ha)	Percent (%)
1. Cultivated land	2,200	27.5
Crops		
Barley	1,000	
Wheat	764	
Broad beans	125	
Summer crops	235	
Paddy rice	76	
Total	2,200	
2. Arable land *1/	1,100	13.8
3. High salinity land *2/	4,040	50.5
4. Road *3/	22	0.3
5. River *4/	100	1.3
6. Oil pipeline *5/	3	-
7. Villages	35	0.4
8. Marsh	500	6.2
Total	8,000	100.0

Note: *1/ The land which was not practically cultivated with crops in 1977, but its soil and water utilization conditions are deemed suitable to crop cultivation with an EC value of less than 25 mmho/cm.

*2/ The EC value is more than 25 mmho/cm. Mostly located in the eastern part of the Project Area

*3/ Total length: 27,000 m, no lining

*4/ Total length: 47,000 m, main canals of earth made

*5/ Total length: 5,000 m

The total of the cultivated land and arable land is equivalent to 41 percent of the gross Project Area. Salinization of soils forced farmers to give up cultivation in such area, and the abandoned area has been further salinized due to the raise of groundwater and its evaporation during the time when it has been left as fallow land. The social factors such as a decrease of population seem to have also taken part in the series of salinization of soils in the Project Area.

One of the special features of the Project Area is a quite low density of on-farm facilities such as roads, natural and artificial canals and farm villages. The total area occupied by on-farm facilities inclusive of villages is only two percent of the gross Project Area. It should be also noted that reedy marsh occupies six percent of the gross Project Area.

III-2. FARM MANAGEMENT IN THE PROJECT AREA AND ITS VICINITY

Mainly interview with farmers was conducted in order to study the existing farm management in the Project Area and its vicinity. As a result, it was found out that barley, wheat, tomatos and broad beans are mainly raised during winter seasons while paddy, cucumber, corn, tomatos and millet in summer seasons. Heavy farm machinery, mainly tractors, are partially operated for plowing, seeding and transportation of agricultural inputs and outputs. The farm management is mostly simple and extensive. Fertilizers and agricultural chemicals are hardly applied. Weeding is not made. Harvesting and short-distance transportation are made by man and animal power. The present agriculture is detailed in III-6. "AGRICULTURE" hereinafter.

There is a fully operated state sugarcane farm in Mejar about 25 km south of the Project Area, on the right bank of the Tigris river. The topographic, water quality, soil and climate conditions of this sugarcane farm are much similar to these of the Project Area. Therefore, the farm management in the sugarcane farm is considered to render a good guidance in planning the rice farm in the Project Area.

A detailed explanation on this sugarcane farm is made in the next paragraph. (See Fig. III-3-1, page III-8)

III-3. OUTLINE OF THE STATE SUGARCANE FARM

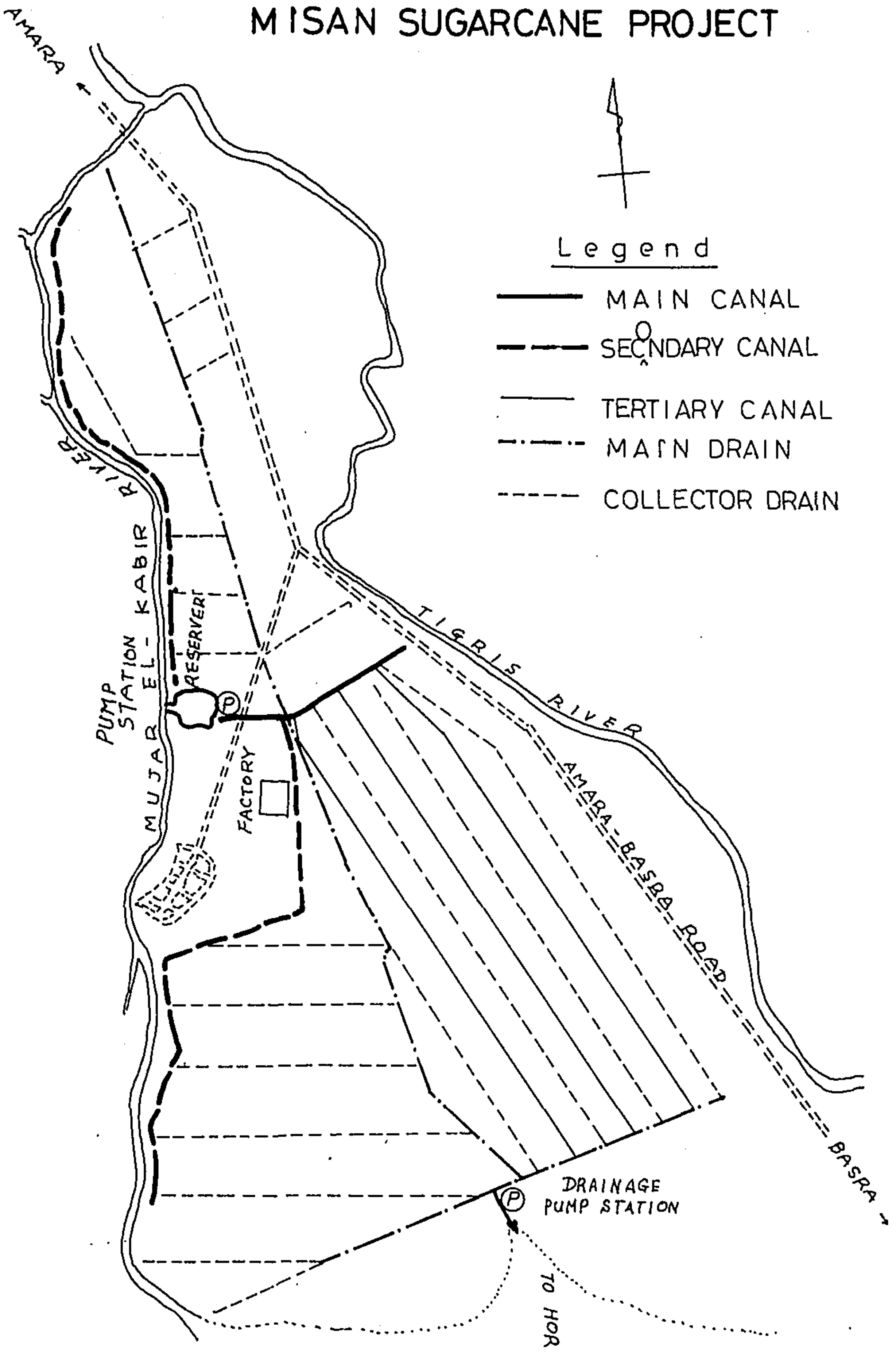
The Government constructed a state sugarcane farm of about 4,250 Ha in the gross project area of 6,250 Ha at El-Mejar located near the Kahlaa Rice Farm Project Area during five years from 1965 to 1970, and established a sugarcane factory mainly in 1971. The major facilities of the sugarcane farm are as follows:

a.	Total project area:	6,250 Ha
b.	Reservoir:	Gross capacity of approx. 1,000,000 cu.m with the reservoir area of 30 Ha
c.	Main drainage canals:	20.4 km
d.	Tile drains:	65.5 km
e.	Collector drains:	65.5 km
f.	Irrigation pump:	One station with 10 units of pump
	Pump capacity:	2 cu.m/sec each
g.	Drainage pump:	One station with five units of pump
	Pump capacity:	1.5 cu.m/sec each

Brief introduction to the irrigation, farm plot, drainage and operational aspects (organization, cultivation and manage-

Fig III-3-1

MISAN SUGARCANE PROJECT



ment, etc.) of this state sugarcane farm is herein made.

(1) Irrigation

i) Unit Duty of Water

The unit duty of water of the sugarcane farm during the peak season from June to August ranges in 14 to 17 mm/day, though it periodically goes up to 25 mm/day. It is generally accepted that the evapo-transpiration (Et) of a sugarcane farm is equivalent to the evaporation of the class A pan (Ea), i.e., the relation of the two is one to one. The above-mentioned unit duty of water is, therefore, the evaporation during such season. The unit duty of water in the months of May and September ranges in 8 to 12 mm/day.

ii) Leaching Requirement

In this sugarcane farm, an irrigation water of about 1,000 mm is supplied to fields prior to seed sowing for the purpose of leaching as detailed in vii) herein.

iii) Irrigation Requirement

The irrigation requirement inclusive of various losses is 96 donam per cubic meter per second. Since the intermittent irrigation of seven-day interval has been adopted, a water quantity required for one hectare of sugarcane field is computed as follows;

$$q = 1 \text{ cu.m/sec/24 ha (96 donam)}$$
$$= 0.042 \text{ cu.m/sec/ha/7 day}$$
$$= 0.006 \text{ cu.m/sec/ha}$$

This water quantity is converted to the water depth as follows:

$$Qh = \frac{0.006 \times 8.64 \times 10^4}{1 \times 10^4} = 52 \text{ mm/day}$$

On the assumption that the water requirement per day (h) is 17 mm, the irrigation efficiency (P) is computed as follows;

$$Qh = \frac{h}{P} = 52 \text{ mm/day} \qquad \therefore P = E/Qh = 17/52 = 33 \%$$

On the other hand, the water requirement in the aspect of irrigation facilities' capacity is estimated as follows;

$$\frac{\text{Facilities' capacity}}{\text{Gross irrigation area}} = \text{Water requirement in Unit Area}$$

Where,

Facilities' capacity:	2 cu.m/sec x 10 unit
	= 20 cu.m/sec
Gross irrigation area:	4,000 Ha

$$\therefore q = 20/4,000 = 0.005 \text{ cu.m/sec/Ha}$$

The above-mentioned water quantity is converted to the water depth of 43 mm/day. In case that the irrigation efficiency is 40 %, the water requirement is equivalent to 17 mm/day.

iv) Water Distribution

- o Start of pump operation: 4:30 AM
- o Arrival of irrigation water at terminal irrigation canals: 6:00 AM
- o Irrigation:

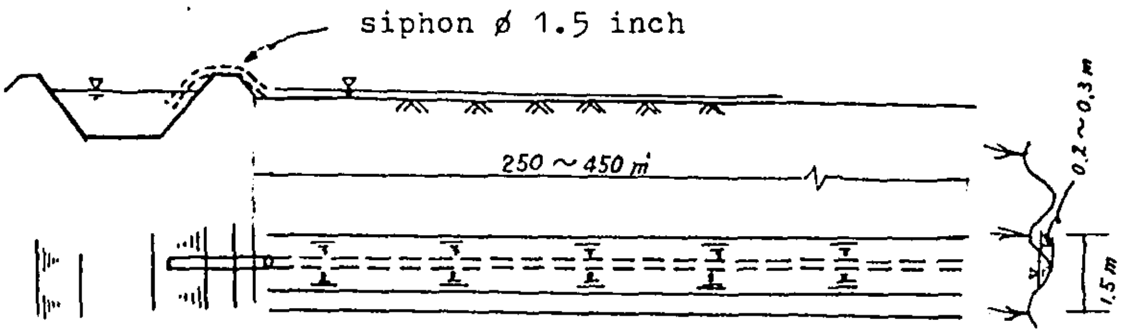
  Peak seasons:- Three shift

  - 6:00 AM to 2:00 PM
  - 2:00 PM to 10:00 PM
  - 10:00 PM to 6:00 AM

  Ordinal seasons:-

  - 6:00 AM to 6:00 PM or 7:00 PM with the operation time of 12 to 13 hours per day

v) Irrigation Method

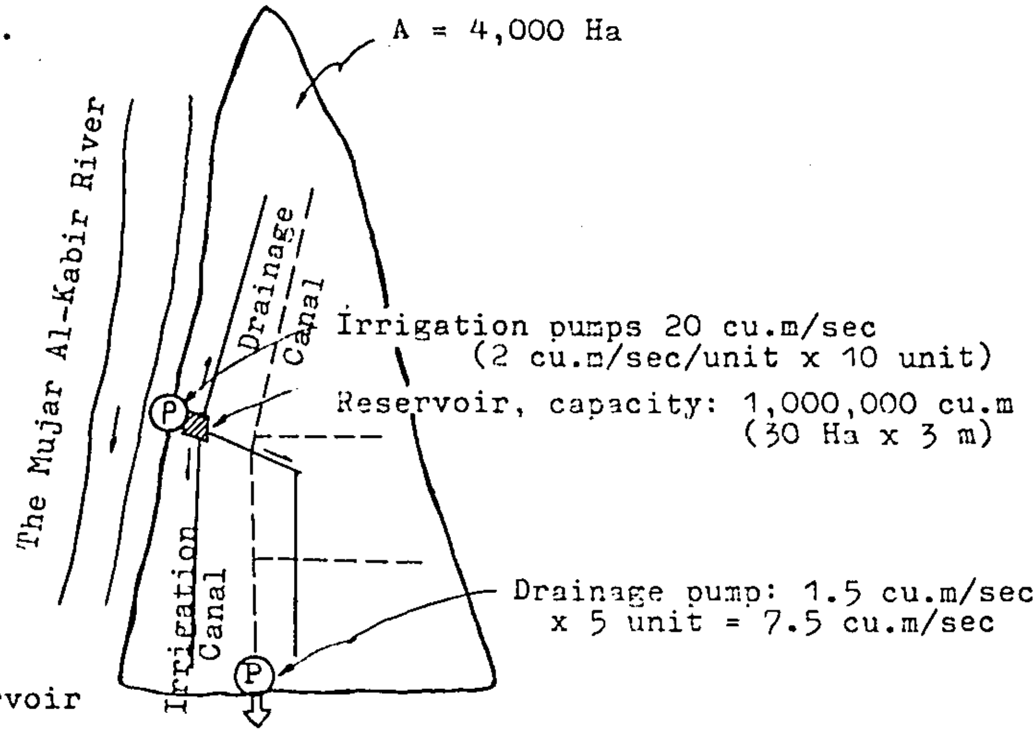


Irrigation water supply to a furrow is made as follows;

Required time for irrigation:	3.5 hours
Required water quantity:	2.2 to 2.8 lit/sec
Minimum head requirement:	10 cm

Note: Officers in charge of the sugarcane farm operation have an opinion that the irrigation efficiency of

60 to 65 % should be applied in place of the above-mentioned 40 %. However, the sugarcane farm actually consumes irrigation water of 20 cu.m/sec. Even around 30 % of the above-mentioned water is used for leaching, still the irrigation requirement and its efficiency are quantitatively contradictory each other to an extent.

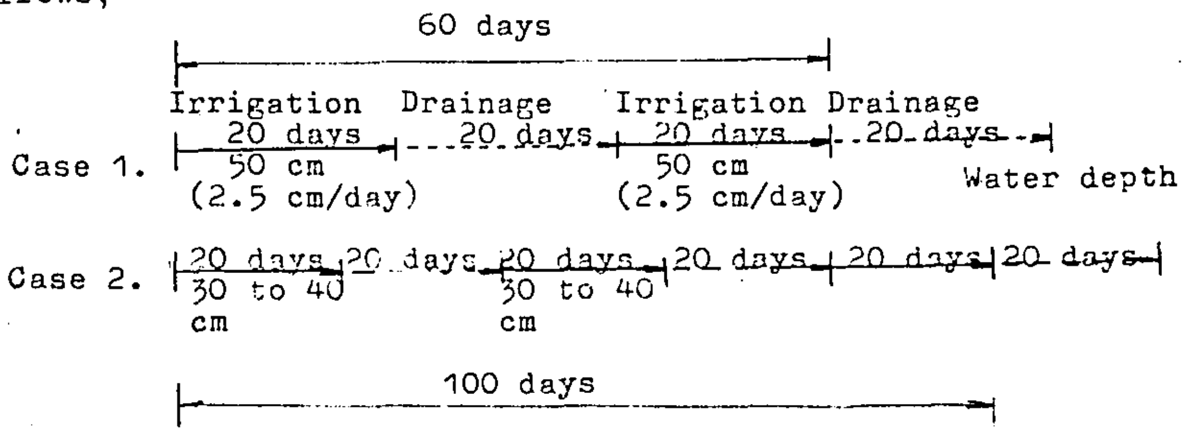


vi) Reservoir

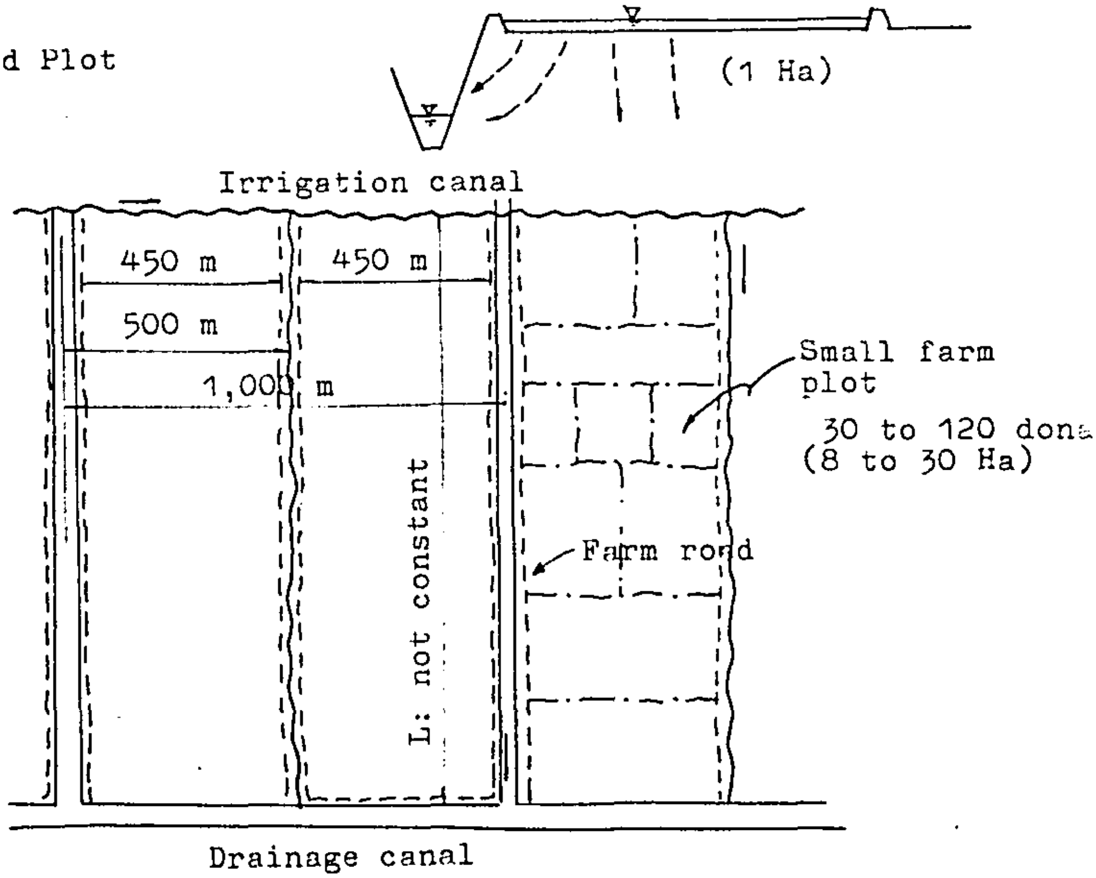
The sugarcane farm is equipped with a reservoir having a capacity of about 1,000,000 cu.m for desilting and for irrigation during repair of pump, etc. This water volume is equivalent to the irrigation water to be consumed in an ordinal day. The diversion of water from this reservoir to the main irrigation canal is made by gravity. Intake discharge is controlled by gate operation.

vii) Leaching

Leaching is conducted in a unit area of one hectare prior to sowing of sugarcane seeds. For this purpose, the combination of irrigation and drainage is repeated as follows;



viii) Field Plot



(2) Drainage

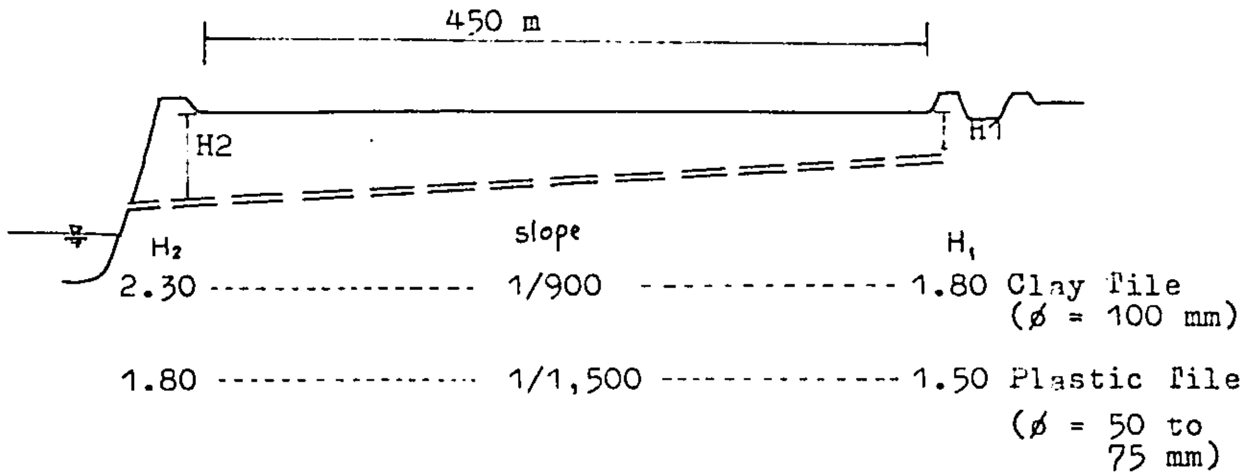
i) Drainage Water

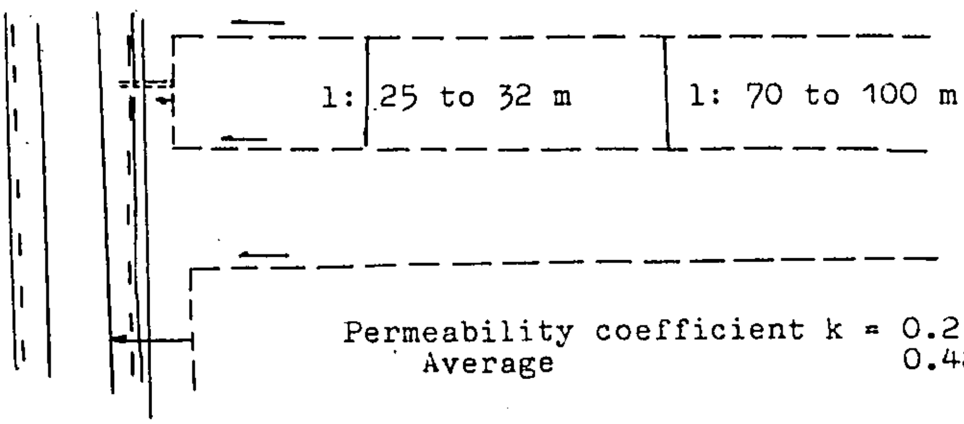
Drainage water flowing into the main drainage canal from branch drainage canals is finally pumped up to the marsh by five units of pump having a capacity of 1.5 cu.m/sec each.

ii) Under-drain

Clay tile (interval: 70 to 100 m)

Plastic tile (interval 25 to 32 m)





Permeability coefficient k = 0.2 to 2.0 m/day
Average 0.48 m/day

(3) Organization and Facilities of the Sugarcane Factory

i) Officers and Laborers

Officer	240 persons
Laborer	2,000
Total	2,240 persons

400 persons:	Sugarcane factory
600	Agriculture
200	Services
400	Seasonal employees

Planting seasons: August to October

Harvesting seasons: December to May

200	Drivers, maids and others

Actual working hours: Eight hours

ii) Facilities

For officers:	One village with 150 houses with a hospital, primary school, cooperative shop, cinema theater, restaurant, motel and athletic field equipped with tennis court and softball ground
For laborers :	Three villages with 100 houses each (Laborers are entitled to use the above-mentioned facilities (for officers))

(4) Cropping in the Sugarcane Farm

The gross acreage of 6,250 Ha of this sugarcane farm consists of the cropping area of about 4,250 Ha (17,000 donam) and the other areas for factory, offices, canals, roads, villages, etc. The first planting of sugarcane started in October 1968, and the operation of the factory in February 1970.

i) Varieties and Fertilizers

Soils of the sugarcane farm are composed of silty clay and silty clay loam, and are cultivated with the following sugarcane varieties;

NCo 310:	About 80 % of the cropping area
C.P. 52 to 68:	7 %
C.P. 44 to 101:	7 %

Furthermore, the experimental cropping of thirty-two varieties is on the way.

Urea of 70 kg/donam is twice applied to the sugarcane farm; 35 kg/donam during March to April and 35 kg/donam about 45 days after the first application. The T.S.P. of about 50 kg/donam is applied during the sowing period.

ii) Control and Prevention

a) Red Spider Mites

Reportedly, red spider mites take place almost every year from June to July. As a countermeasure, the metasystox (25%) of 1.2 lit/Ha mixed with water of 100 liters is sprayed.

to the field. The life cycle is 11 to 13 days.

b) Borer

The outbreak of borers has been recorded during March to September, specially in summer seasons, but no insecticide is introduced.

c) Chemicals for Weeding

The following chemicals are utilized for weeding. (As for weeds growing in the sugarcane farm, see Table III-3-1.)

Trade Name	Chemical Name	Application
Gexaprin (W.P.)	Ametryne	4 to 6 kg/Ha/100 lit water, for pre-emergence
Gexapax	Atrazine	4 to 6 kg/Ha/100 lit water, for pre-emergence
Dalapon 24-D		4 to 6 kg/Ha/100 lit water, against perenial weeds 3.2 to 4 lit/Ha/100 lit water, against wide leave weeds

(5) Farm Management Cost

The farm management cost during 1966 to 1968 inclusive of the expenses for tile drains, cultivation, planting, harvesting and irrigation amounted to I.D. 60 per donam. The itemized breakdown of such farm management cost is not available.

Table III-3-1. Weeds in State Sugarcane Farm, Amara

Scientific Name	Family	English Name	Colloquial Name
Lagonychium farctum (Banks et Soland) Bobr	Mimosaceae	Prosopis	Shoke, Kharnoob and Bagangal
Alhagi maurorum medic	Papilionaceae	Prickly alhagi Sinai manna	A'agool
Silybum marianum (L.) Gaertn	Compsitae	Milk thistle, St. Mary's Holy thistle, Lady's thistle	Kollaghan
Centaurea paiiescens del	Compositae	Pale century, Pale star thistle	"Kạssoob" for matured plant "Murraire" for seedlings
Cynodon dactylon (L.) pers	Gramineae	Bermuda grass, Dog's grass Devil grass, etc.	Thayyel
Dichanthium annuiatum (forsk.) stapf	Gramineae	Hairy-node bear-grass	Zamgoom Seephone
Imperata cylindrica (L.) P. Beanv	Gramineae	Cylindrical here's tail, Blady grass	Haefa
Phragmites communis trin	Gramineae	Common reed	Qabab

(6) Water Management

Except the peak season of mid-summer, the intermittent irrigation of a five to seven day interval is conducted for 12 to 13 hours per day, while, in the peak seasons, 24-hour irrigation is continued for two to three week period.

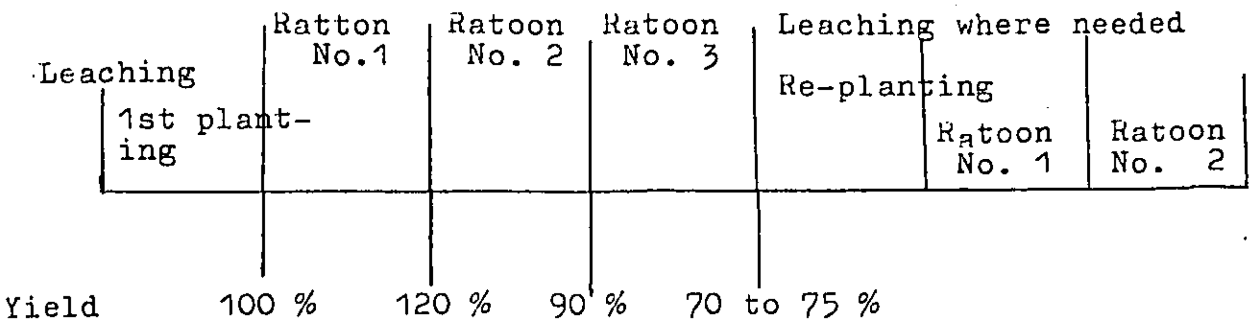
(7) Harvesting

Harvestors, Australia made Toff Brothers, are operated to cut sugarcane stems in the length of 30 to 40 cm and load it with a five to six ton container. In case of harvesting by man-power, loaders are used. Such works are made during mid-November to late-April, and to the end of June in some years.

The operation and maintenance periods of the sugarcane factory are:

o Refinery:	330 day per year;
o Milling:	Mid-November to end-June; and (Full time operation)
o Maintenance:	One month per year.

Leaching, Cropping Rotation and Re-leaching



Period:

The first cropping:	16 months
The first ratoon cropping:	12
The second ratoon cropping:	12
The third ratoon cropping:	12
Fallow	6

Totally four-time harvestings in five year period (58 months)

The first cropping of sugarcane was made when the soil salinity of the farm decreased to the target EC of 4 mmhos/cm as a result of leaching operation. Sugarcane stems of about 60 cm were transplanted in rows with the interval of 1.5 m. Fertilizers were applied as explained above. The first harvesting was conducted 16 months after the transplanting, and the second harvesting of ratoon sugarcane about 12 months after the first harvesting. The yield of the second harvesting increased to 120 % of the first one due to the fact that the plant could put down its roots to the optimum depth of 80 to 100 cm from the ground surface during this period. The growth period was also shortened by four months in comparison with the first cropping, which resulted in a high economic efficiency of the farm. After harvesting the third and fourth ratoons, leaching was conducted where it is needed. After leaching, such portion of farm is kept as fallow land for six months.

(8) Working Hours

Summer seasons:	6:00 AM to 2:30 PM
Winter seasons:	6:30 AM to 3:00 PM

Eight hours exclusive of the lanch break of 30 minites

(9) Trainings

The following trainings are conducted:

- o Laborers' training, (one-week, two-week and one-month training courses for sugarcane farm laborers after the employment)
- o Factory laborers' training
- o Administrative staff training
- o Accounting staff training
- o Management staff training
- o Technical staff training

(10) Farm Machinery

The sugarcane farm is equipped with farm machines listed in Table III-3-2.

Table III-3-2. List of Farm Machines, Amara State Sugarcane Farm

Farm Machine	Model	Year	Hp	Unit
Grader	M2460			1
Grader	11621-C			1
Grader	RB-22			3
Power shovel	933			1
Buldozer	D4D			1
Buldozer	D6B			2
Buldozer	D6C			1
Buldozer	D7F			1
Buldozer (Komatsu)	D75			4
Scraper (Caterpilla)	619			3
Michigan scraper	210			5
Buldozer	D8			5
Michigan	280			3
Buldozer (Komatsu)	D155			2
Grader (Caterpilla)	NO12			2
Grader (Allis-Chalmess)	MF100			1
Generator	D398			5
Massy forgson	MF175	1965		4
Massy forgson	MF185	1975		20
Massy forgson	MF135	-		1
Anter	60	1971		3
Anter	70	1973		4
Anter	80	1974		5
Jhon deer	4020	1969	96	28
Jhon deer	4020	1970	96	16
Loader	12100	1971		14

Farm Machine	Model	Year	Hp	Unit
Allis garma	TL545	-		2
Volvo	LM6201 640	1978		3
Volvo	LM840	1968		2
Volvo	LM6401 641	1968		2
Volvo	LM7841	-		2
Volvo	LM1254	1969		1
Volvo	50CH220	1968		1
Forgoson	155-155L	-		3
Volvo	LM846	1972		4
Fork lift	130126 D84	-		8
Fork lift	17333	-		3
Toff Brothers	CH364			16
	Petter A-121			12
Car	Bedford A-121			13
Water pump	Foraman 209		6 to 8	

III-4. SALINIZATION OF SOILS

Based on the data prepared by the State Organization of Soil and Land Reclamation (SOSLA), which covers two-third of the Project Area, the distribution of saline soils in the Project Area is estimated as follows;

ECe (mmho/cm)	SOSLA Classification	Percent (%)
0 - 4	S-0	3
4 - 16	S-1 and S-2	77
16 - 25	S-3	18
More than 25	S-4	2
		100

According to SOSLA data, the relation between soil salinity and crop growth is as follows;

Class	ECe (mmho/cm)	Crop Growth
S-0	Below 4	Salt free soils which can be cultivated with any agricultural crops.
S-1	4 - 8	Slightly saline soils which can cultivated with paddy rice, but vegetables suffer from the salinity to an extent.
S-2	8 - 16	Moderately saline soils in which wheat suffers from the salinity to an extent. Soils of this

Class	ECe (mmho/cm)	Crop Growth
		class are not suitable to paddy and vegetables.
S-3	16 - 25	Strongly saline soil which can cultivated with barley, but in which wheat and vegetables can not grow.
S-4	More than 25	Very strongly saline soils. No crops can grow in this class of soils except some pastures.

The whole Project Area being covered by saline soils except only three percent of its gross acreage, all crops raised in the Project Area are suffering from salts to a certain degree. Under the circumstances, it seems that the conception of "saline soil damage on agricultural crops" does not go current. The land whose soils can be cultivated with crops, or the land where crops can grow, is evaluated as "arable land". Needless to say, the desalinization will be one of the major factors for future agricultural development in the Project Area. Detailed explanation on salinity is made in III-5. "TOPOGRAPHY, GEOLOGY AND SOILS" as a part of the descriptions on soils.

III-5. TOPOGRAPHY, GEOLOGY AND SOILS

(1) General

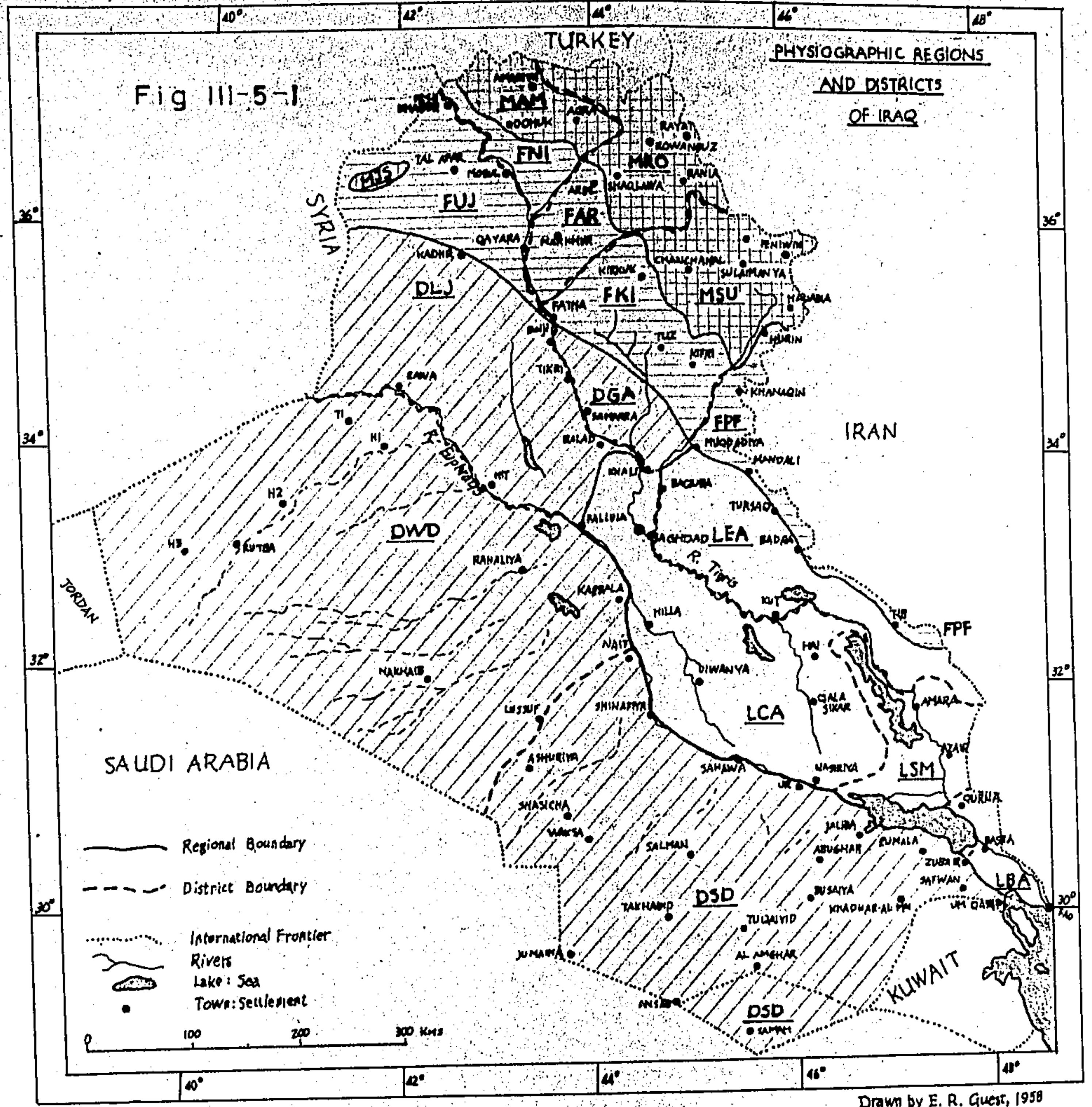
This paragraph mentions about general topography, geology and soils as well as saline/saline-alkali conditions and water logging in Iraq.

(i) Topography and Geology

Iraq is topographically and physiographically classified into four regions, that is, the mountain region, upper plain and foot-hill region, desert plateau region and lower Mesopotamian region, and each region is further divided into four to five districts. (See Fig. III-5-1. Pysiographic Regions and Districts of Iraq)

The lower Mesopotamian region, alluvial plain formated by the Tigris and Euphrates river, consists of the four districts of the eastern alluvial plain, central alluvial plain, southern marsh and Basra estuarine district. The Project Area is located near the northern most of the southern marsh.

Iraq is geologically and geomorphlogically divided into three portions of the Iraqi portion of the Arabian Shield, Zagross ranges and the foot-hills and the Mesopotamian plain. (See Fig. II-5-2. General Geological Map) The geological



Drawn by E. R. Guest, 1958

M - MOUNTAIN REGION

MAM	Amadiya District
MRO	Rowanduz District
MSU	Sulaimaniya District
MJS	Jabal Sinjar District

F - UPPER PLAINS AND FOOTHILLS REGION

FUJ	Upper Jazira District
FNI	Nineveh District
FAR	Arbil District
FKI	Kirkuk District
FPF	Persian Foothills District

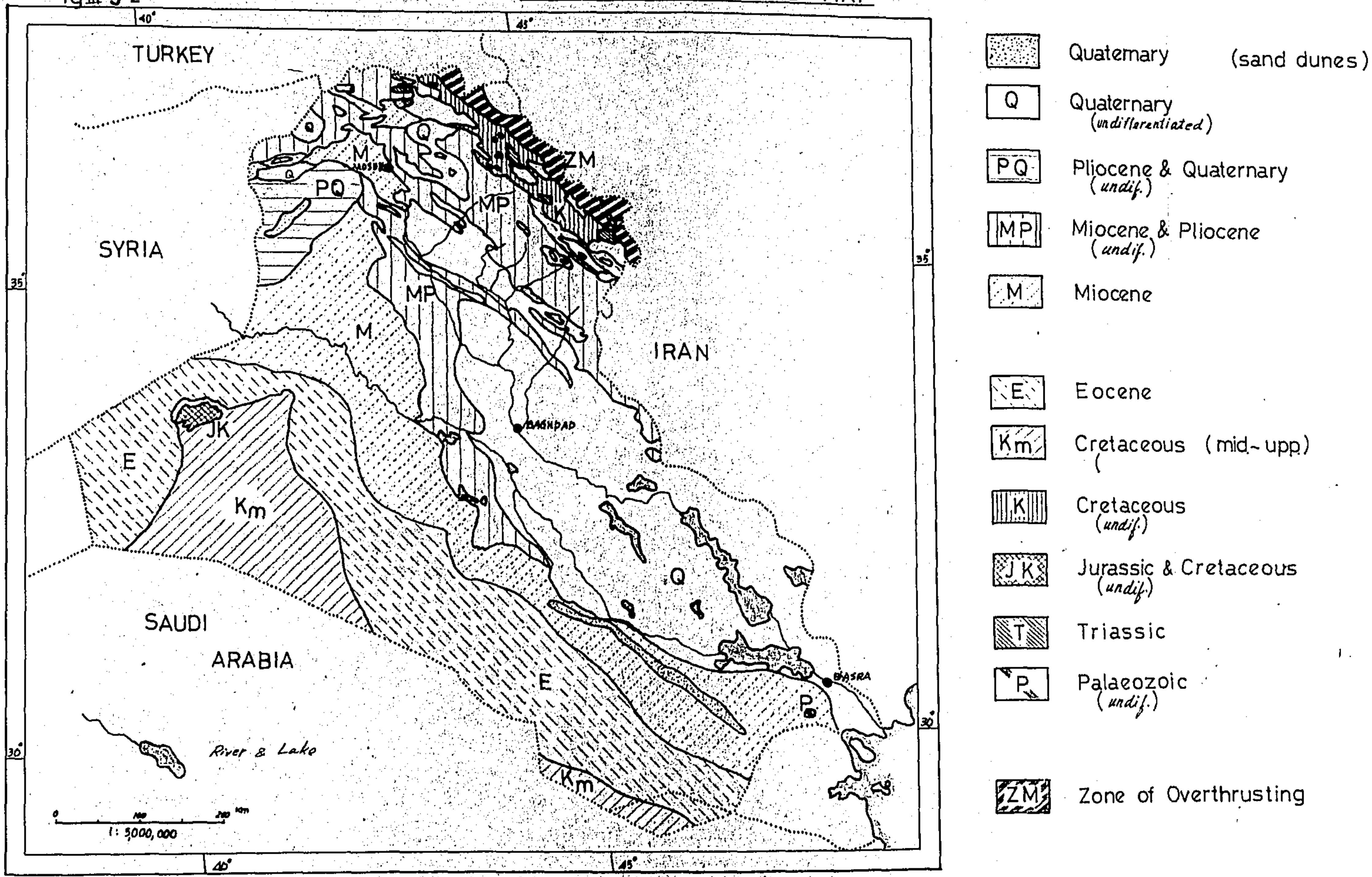
D - DESERT PLATEAU REGION

DLJ	Lower Jazira District
DGA	Ghurfa-Adhaim District
DWD	Western Desert District
DSD	Southern Desert District

L - LOWER MESOPOTAMIAN REGION

LEA	Eastern Alluvial Plain District
LCA	Central Alluvial Plain District
LSM	Southern Marsh District
LBA	Basra Estuarine District

Fig III·5·2 GENERAL GEOLOGICAL MAP



From W.A.Macfadyen's map

stratigraph of Iraq by W.A. Macfadyen is reproduced in the following;

Table III-5-1. Summary of Geological Stratigraphy

By W.A. Macfadyen

Geological Period		Formation	Remarks
Quarternary	Recent	Delta fan, sand dunes	Gravel, sand, silts
	Semi-recent	Mesopotamian Alluvium	and clay
	Pleistocene	River Terraces	(mainly gravel)
	Pliocene	Bakhtiari Group	Conglomerates of L.S.
	Plio-Miocene	Red clay	Clay silt and limeston
		Dibdibba beds	Sandy gravel
	Miocene	Upper fars series	Marls, siltstone and sandstone
Tertiary		Lower fars series	Marls, siltstones and anhydrite/gypsum bed
		Euphrates limestone	Shelly, dolomitized lime stone with few anhydrite
	Eocene	Limestone	Limestone and marls
	Cretaceous	Limestone	Limestone and marl
Mesozoic	Jurssic & Cretaceous	Sandstone	Sandstone with some limestone and marl
	Trias	Shales	Shales, dolomite, lime-stone
Palaeozoic (undifferentiated)		Jabal Sanam Beds	Pebby marls, conglomerate, weathered igneous dikes.
(Zone of Overthrusting)			Basic igneous rocks, cherts, sheles, schists and limestones

(ii) Soils

Due to various topographic conditions, existance of geologically unlike base rocks and also different climate condtions, many kinds of soils are distributed in this country, However, soils in Iraq are roughly classified into three blocks as follows;

a. The upland and mountain area;
b. The desert; and
c. The lower Mesopotamian plain area.

The Soils Sketch Map of Iraq by Dr. Buringh is reproduced as Fig III-5-3.

(iii) Saline/Saline-Alkali and Water-logging

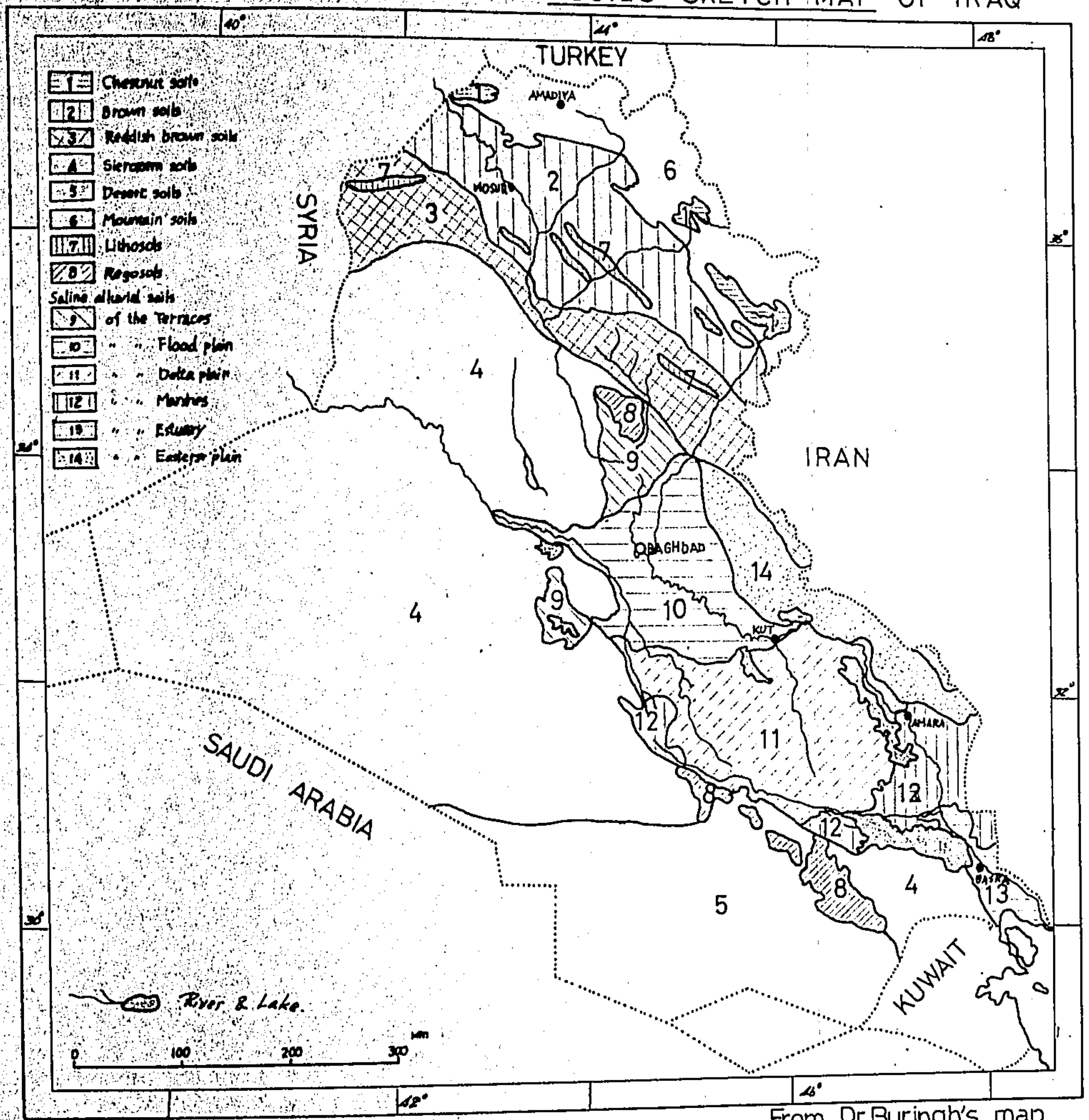
One of the major problems involved in soils of the middle to south Iraq is that of soil salinity. The water-logging is another problem of the southern lower Mesopotamian plain soils.

The saline soil is called "Solonchack" in the terminology for the international soil classification, whose original meaning is "soils containing much salts". US Salinity Laboratory defines the saline soil as follows:

"The soils whose ECe is more than 4 mmho/cm at 25°C and whose exchangeable sodium percent (ESP) is less than 15. Ordinary PH of such soils is less than 8.5."

Fig III 53

SOILS SKETCH MAP OF IRAQ



From Dr. Buringh's map

In the same manner, the saline-alkali soils are defined as follows:

"Soils whose ECe is greater than 4 mmho/cm at 25°C, and whose ESP is greater than 15."

The salinization or saline-alkalinization is brought about by accumulation of disolved salts in the upper layer of soils as follows:

a) Salts accumulation by irrigation water;-

If drainage is unfavorable, irrigation water settles most of its salts content on the surface of irrigated area after its evaporation. According to De Shruter (1953), irrigation water with a considerably low salt content results to add one ton/ha/year of salts to the irrigated area, if the drainage is poor.

b) Accumulation of salts from groundwater

The groundwaters in Mesopotamian plain have a high to very high content of salts. Where groundwater is high, such salty water is pulled up by the capillary actions of dry soils, and water evaporates remaining salts on the soil surface. Seepage water from canals shows the same action mentioned above.

In addition to these, sea waters and wind, etc. cause salinization of soils. In any case, soil salinization is brought about by the arid climate with a great volume of evaporation and with extremely small precipitations.

Disolved salts most predominantly consist of Nacl, and are composed of $Mgcl_2$, $CaSO_4 2H_2O$ and $CaCO_3$, etc. Water-logging is also a factor to decrease the soil fertility and land productivity, and one of the severe problems in agricultural production in the southern Iraq. Reportedly, such a big area of 10,000 sq.km suffers from the water-logging in Iraq. Over-irrigation, flooding and tidal water intrusion plus poor natural and artificial drainage cause the water-logging in flat and lowlying areas near marsh and hor.

(2) Soils in the Project Area

Soils in the Project Area are handled herein in some detail based on the findings and observation results during the field survey, data and information so far collected and also some references.

Soil profiles were prepared by means of excavating three test pits, and ten auger holes were dug at a certain interval in the Project Area. In order to observe groundwater tables, a polyethylene pipe of three inches diameter with holes was put into each auger hole. As for the sample soils, the measurement of field moisture contents and bulk density of undisturbed samples was conducted at the laboratory of a sugarcane factory, while chemical analysis of extructs and physical property analysis of the disturbed samples were made in the Central Laboratory, SOSLA, Al-Greib, Baghdad. Groundwater tables and EC values were measured at the test pits and auger holes in case some water was standing. Water quality analysis was conducted by sampling groundwaters and surface waters at several points. Measurement of bearing capacity of soils was conducted, and the permeability test also.

i) Geological Structure and Soil Formation

Being located in the southern part of the lower Meso-potamian plain, soils in the Project Area are geologically simple, consisting of thick Quaternary Alluvial deposits transported by the Tigris.

It is said that the inland delta in which the Project Area is located was formated in the 16th century, and that the Project Area and its neiborhood had been covered by shallow water of a huge lake before that. Under the situations, agriculture in the Project Area is just a few centuries old in spite that the area is now a part of the Mesopotamian plain, one of the birthplace of agriculture.

More particulary, the Project Area and neiborhood have been formated by actions of the Kahlaa river, one of the five biggest tributaries of the Tigris. The "Kahlaa delta arm" formated by this river extends toward the south-south-east between Amara city and Kahlaa town, and near Kahlaa town, it branches off to various directions forming a fan-wise shape as a whole. The Project Area is located in the middle point of this Kahlaa arm.

Aparting from it, so called "dispersal canals" run from the Kahlaa river to the east and empty themselves into the hor, a remaining part of the above-mentioned huge lake. With such background, the Project Area is mostly flat though its topographic conditions are slightly different by portion.

Soils in the Project Area have been formated by silting of suspended solids transported by the Tigris, and micro-topographically or in the aspect of micro-profile, the surface layer has been affected by artificial irrigation as well as by cultivation activities.

Due to the above-mentioned formation process;

a) All soils form well marked layers;

b) Each bed and layer are usually different each other, and they also hardly demonstrate the horizontal continuity;

c) In the other words, soils have big horizontal differences in their type and condition;

d) Soils are strongly affected by groundwater with a high elevation;

e) Rich micro-relief of the ground and intricate arrangement of permeable and impermeable layers create particularily complicated groundwater conditions;

f) Flatness with very small slope gradient of the area results in poor natural drainage;

g) All layers contain a considerable quantity of non-active lime, usually amounting to 20 to 35 %;

h) Most soils contain moderate volume of gypsum (0.2 to 2.0 %);

i) Young irrigation deposits cover the previous bottoms of the marsh;

j) There is a continuous accumulation of salts particularly of the sodium-chlorine to sulphate types;

k) Genetic types of salinity is found such as internal solonchack, external solonchack, flood solonchack, puffed solonchack, sabakh soils and takyr-like soils; and

l) The young alluvial deposits undergo the gradual natural soils.

Note: a) E.R. Guest "Flora of Iraq"

b) W.A, Macfadyen "Flora of Iraq"

c) U.S. Salinity Laboratory Staff "Diagnosis and Improvement of Saline and Alkali Soils"

d) Dr. A. El-Dujaili & Hamid N. Ismail "Country Report of Iraq, Salinity Seminar, Baghdad"

e) - do -

f) M. Allahwerdi & Assoc., CEKOP "Irrigation Improvements in the Amarah Area, Final Planning Report, Vol. III."

g) - do -

All soils are originated from the delta deposits, but the size of soil particles varies place to place due to different sediment conditions. In addition, rivers have taken various courses in the process of the delta plain formation. Soil profiles show, therefore, a plenty of longitudinal and latitudinal variations. Furthermore, the microtopographical and sedimentological confusions caused by artificial irrigation have made the soil profiles complicated. Soils in the Project Area are divided into five groups as follow; (CEKOP Classification)

a. River levee soils;
b. Silted basin soils;
c. Depression soils;
d. Hor soils; and
e. Miscellaneous soils.

The distribution of these soils is shown in Fig. III-5-4. Semidetailed Soil Map (deproduction from the CEKOP Report)

ii) Soil Classification

a. River Levee Soils:

The river levee soils are distributed in the western most of the Project Area along the Kahlaa river, forming a narrow belt-like shape. New dikes have been recently constructed along this river, so natural conditions of the levees can be hardly observed. In general, the soils have a medium light texture and moderately well drained conditions. The salinity is very weak.

b. Silted Basin Soils:

The silted basin soils extend toward the marsh from natural river levees, forming an extremely flat land. Most of the Project Area is covered by the soils though some depression soils are scattered in such area. Since this category of soils occupies a vast area, most test pits and auger holes dug during the Field Survey have been located in the soils.

The soils mainly consist of silty clay, silty clayey loam and silt or very fine sand loam, etc. The fine alter-

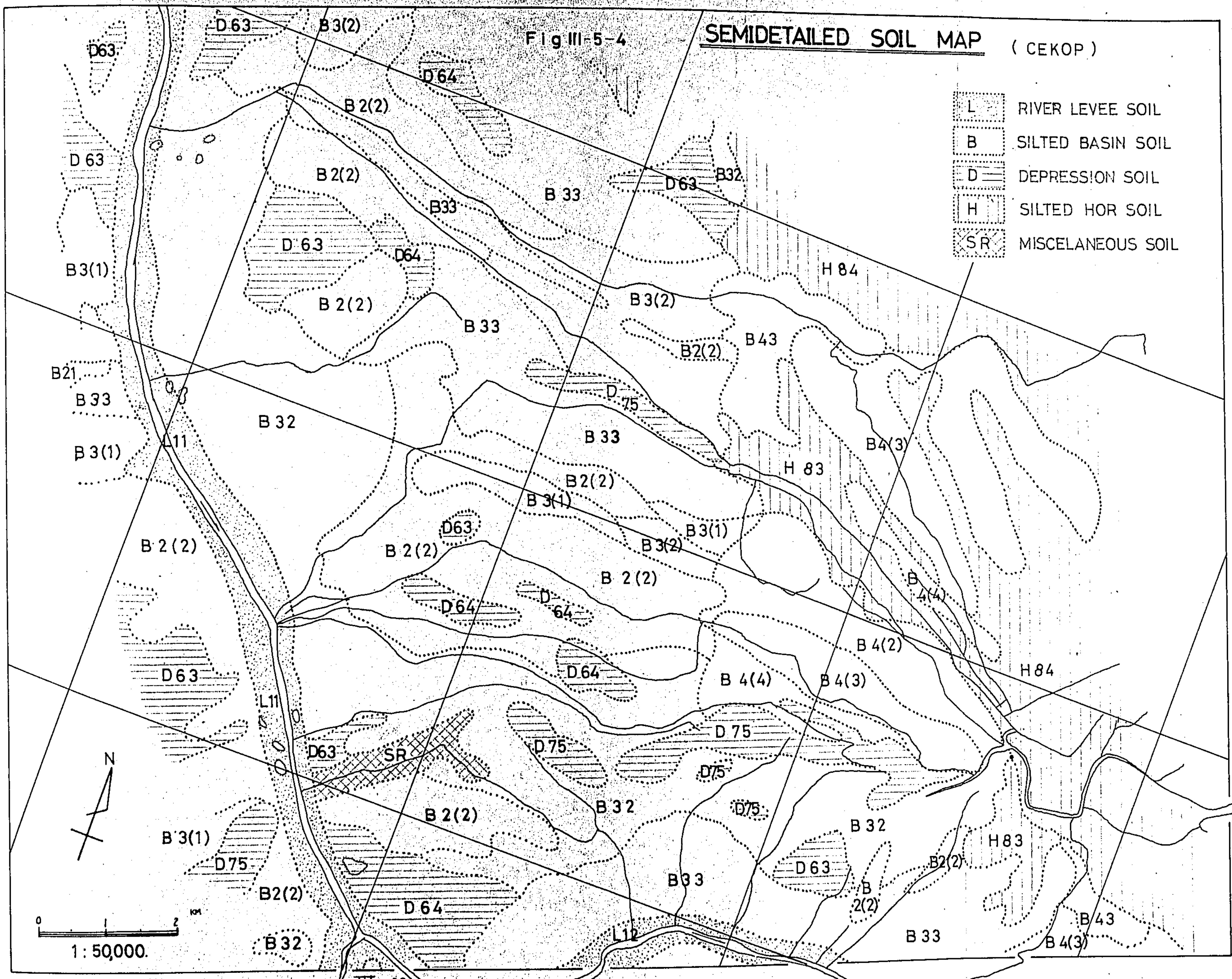


Fig III-5-4
SEMIDETAILED SOIL MAP (CEKOP)
L RIVER LEVEE SOIL
B SILTED BASIN SOIL
D DEPRESSION SOIL
H SILTED HOR SOIL
SR MISCELANEOUS SOIL
D63
D 63
B3(2)
D64
B 2(2)
D 63
B 2(2)
B 33
D63
B32
B33
D 63
D64
B3(1)
H 84
B 2(2)
B 33
B 3(2)
B 43
B2(2)
B21
B 33
D 75
B 32
B 33
B 3(1)
L11
B4(3)
H 83
B 2(2)
B 3(1)
D63
B 3(1)
B 3(2)
B 2(2)
B 2(2)
B 2(2)
B 4(4)
D 64
D 64
B 4(2)
D 63
D 64
B 4(4)
B 4(3)
H 84
L11
D 75
D63
SR
D 75
D75
N
B 2(2)
B 32
D75
B 32
B 3(1)
H 83
D 75
D 63
B2(2)
B 2(2)
B 33
B2(2)
D 64
B 43
0 1 2 KM
B 33
L12
B 4(3)
B 32
1: 50,000.

ation of these is observed here and there as if it re-appears the kaleidoscopic changes of the sediment accumulation conditions in old days. At the auger holes Nos. 1 to 4 a dark gray layer exists at the elevation of more than two meters below the ground surface. This layer suggests that the groundwater table is high. It is also recognized that there is a layer containing much organic materials in the elevation of more than one meter below the ground surface. The permeability coefficient of the soils is, in general, relatively high, ranging in the middle of the order 1×10^{-4} in spite that the soils contain much SiC and Sicl. The permeability efficient to horizontal directions at an elevation below the groundwater table is very high, ranging in the higher order of 10^{-4}cm/sec to the lower order of 10^{-3}cm/sec. Salinity of the soils is different place to place but mostly high.

c. Depression Soils:

The depression soils are distributed in slightly depressed areas whose ground surface elevation is by 0.5 to 1.0 meters lower than that of the surrounding portions. The soils are scattered in the north-western portion, northern portion along the Gasma river, central portion surrounded by a group of branch canals of Al-Bahatha canal and eastern most of the Project Area. The test pit No. 3 is located in the depression soils in the eastern most of the Project Area. All the ground surface has peculiar taknyz-like cracks due to the standing water in rainy seasons and drain in dry seasons. The soils have a heavy texture of dark-colored SiC and Sicl, etc. The groundwater table seems generally high in the soils as a grey layer containing much shells is observed. The permeability coefficient is so small as less than 1 x 10^{-4}cm/sec.

d. Hor Soils:

The hor soils are distributed at the eastern most of the Project Area along the lowest reaches of the Gasma river. The marsh is dried up only for a short period in dry seasons, and under water almost throughout the year. Under the circumstances, such soils are generally of a heavy texture, and have a extremely small permeability coefficient. The soil salinity is very low or none, so the hor soil zone outside the Project Area is partially cultivated with paddy rice.

e. Miscellaneous Soils:

The miscellaneous soils are such as river crevasse soils, etc.

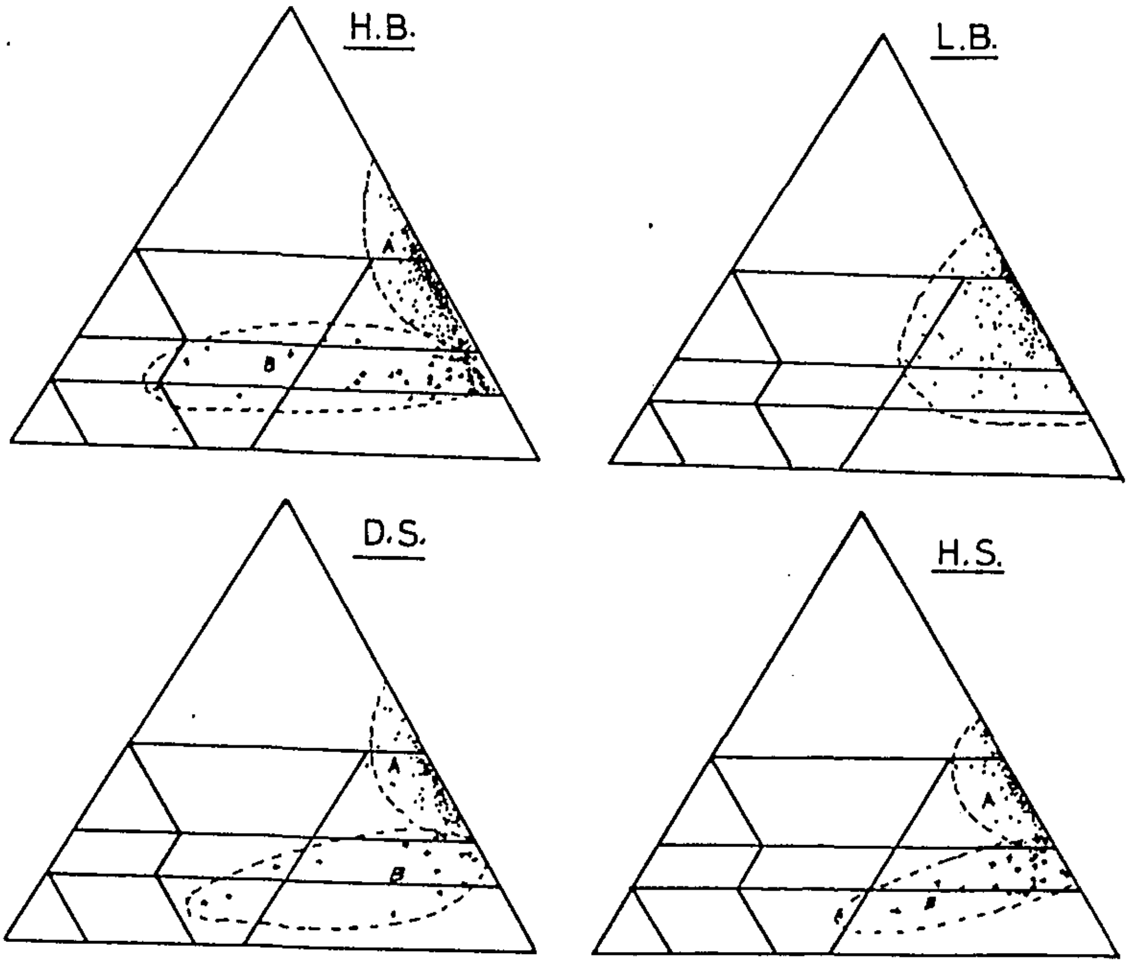
(As for the soil textures of them, a diagram is reproduced from the CEKOP Report. See Fig. III-5-5.)

iii) Salinity

The soil salinity in the Project Area and its neiborhood is high. Large waste lands where no plant grows are seen. Such waste lands were mostly cultivated in old days, but abandoned by farmers due to too high salinity. The salinization of soils is mostly brought about by salty water supply for irrigation without proper natural or artificial drainage system. The natural groundwater table is, as a rule, more than three meters lower than the ground surface elevation. However, it is artificially raised by irrigation and seepage water from canals during irrigation seasons. The salinization of soils is accelerated through the process of evapolation of surface water, raise of groundwater by capillary phenomenon followed by its evapolation. According to Welstor, soils are salinized within seven to 25 years, if over-irrigation is repeated in cultivated land not equipped with sufficient drainage systems. There is a big difference between the "Present Land Use" in the CEKOP Report and actual land use at present, which suggests that soils

Fig. III-5-5.

DIAGRAM OF SOIL TEXTURES



H.B.: High silted Basin Soils

A : Layers of the upper 150 cm
B : Substratum layers

L.B.: Low silted Basin Soils

D.S.: Depression Soils

A : Layers of the upper 150 cm
B : Layers deeper than 150 cm

H.S.: Hor Soils

A : Typical layers
B : Layers occasionally occur.

from CEKOP REPORT

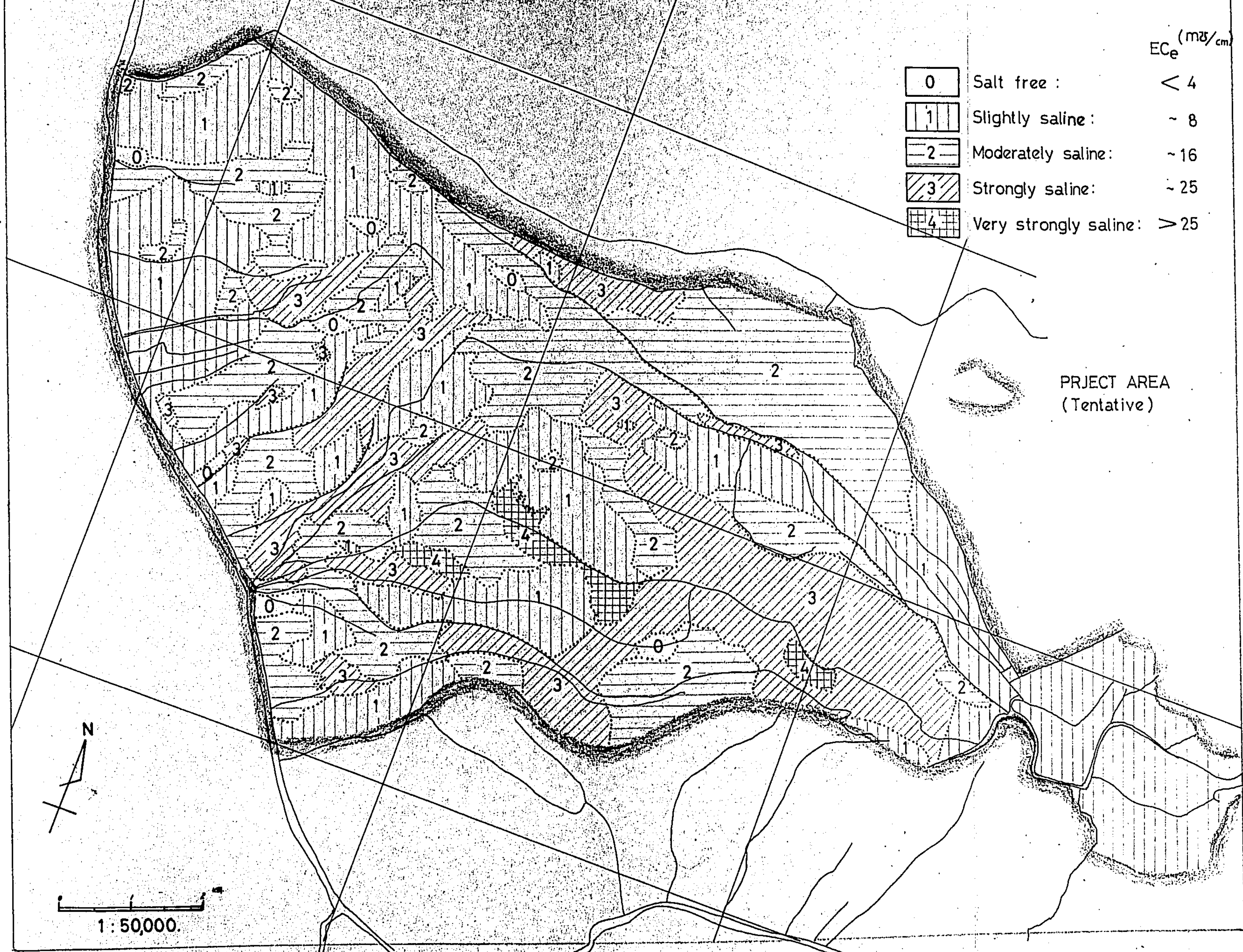
have been salinized rapidly.

During the Field Survey period the morphological salinity classification could not be conducted since the topographic map, basic information for such study, was not available. It is noted that the "relative location of the various soil salinity types" by Dr. P. Buringh can be applied to soils in the Project Area as it is. Data given in the CEKOP Report are too old in consideration of the fact that the salinity of soils easily changes within a few years. Under the circumstances, the descriptions herein made are based on results of soil survey conducted by Amara Branch Office of SOSLA, and also our findings and observations. The SOSLA has conducted electric conductivity measurement and soil texture recording at two profile pits and 305 auger holes in Al-Bahatha, which covers about two-third of the Project Area. The salinity classes of soils at 307 points in total are statistically summarized in III-4. "SALINIZATION OF SOILS". The soil salinity classification of the Project Area is shown in Fig. III-5-6.

The ralation of salinity condition and soil classification is as follows:

Fig III-5-6

ROUGH SALINITY MAP



a. River levee soils: Weakly salinized

b. Silted basin soils: Most strongly salinzed

c. Depression soils: Considerably salined

d. Hor soils: Weakly salinized

iv) Alkali Conditions

It is said that the saline soils in Mesopotamia mostly fall in the category of saline-alkali soils. Soils in a considerably large acreage of the Project Area are of the saline-alkali. The ESP of soils in Amara area is shown below. (Reprint from the CEKOP report);

EC (mmho/cm, 25°C)	ESP
0 - 4	3
4 - 8	7
8 - 16	13
16 - 30	16
30 - 60	22
More than 60	49

The soils of high salinity than S2 or S3 are under the saline-alkali conditions. The relation between various saline or saline-alkali soils and crop growth has been already mentioned in II-4. "SALINIZATION OF SOILS", page III-24 to -25.

2) Problems and Countermeasures

Soil problems in the course of development of this large-scaled rice farm might be those of i) soil texture and fertility, ii) salinity and alkalinity, iii) drainage and iv) excavation and construction.

i) Soil texture and fertility

Most soils distributed in the Project Area, specially soils of upper layers than the depth of 150 cm from the ground surface, are of a heavy texture, and have been extremely compacted. So, such soils are not suitable for paddy cultivation so far they are kept as they are now. However, this problem could be relatively easily solved by the agricultural technology such as introduction of heavy farm machinery for plowing, etc., and by application of course organic matters.

It is generally said that the natural soil fertility in Mesopotamian plain is much lower than that in the Nile basin due to the quality of suspended solid in the Tigris and Euphrates waters and also due to the arid climate conditions. However, soil profiles show that there is a layer containing a considerable amount of humus in the depth of 0.5 to 2.0 m in the Project Area. Furthermore, it was found out during the Field Survey that the soils have an organic matter content of one to two percent though, as a matter of course, it is not sufficient for paddy growth. Needless to say, such soil conditions could be easily improved by fertilizer application though the cost required for it is anther matter.

ii) Salinity and Alkali Conditions

The salinity and alkalinity are the biggest problem to be solved. No crops except limited ones can grow well in soils of S1 and S2 with the ECe of 4 to 16 mmho/cm. Specially in high salinity soils of more than S4, crop cultivation is impossible. Since soil dressing, etc. for such vast area might be out of the question, the only practical method for improvement is the leaching of salts in soils. Fortunately, most salts well dissove in water while harmless or useful lime and gypsum, etc., are insoluble. According to the results of leaching trial tests conducted in various places in Iraq inclusive of that in the sugarcane farm located near the Project Area, salts in soils can be relatively easily washed away. In paddy cultivation, irrigation water is supplied for most part of its growing period, that is, leaching is continuously conducted during such period. There is an example in the USA that the paddy cultivation was introduced only during the soil improvement period by leaching. It seems that some varieties of paddy rice have a considerably high tolerance against salinity. It could be paradoxically said that the paddy is the most suitable crop for the agriculture in saline soil areas.

On the other hand, leaching results in alkalinization of soils if the soils are of saline-alkali. Soils with a higher salinity than that of S2 class falls in the category of saline-alkali soils. Their ESP is more than 15. In order to prevent such soils from alkalinization, a sufficient calcium will be required to neutrilize the ESP. In general, gypsum or calcium sulphate is applied as chemical amendment. Soils of the Project Area contain natural gypsum to an extent. Moreover, the gypsum content of soils is bigger than what is logically needed for ESP neutrilization. Further studies might be required, but the alkalinity seems not so much troublesome.

iii) Drainage Conditions

Drainage is very important for leaching as well as for paddy cultivation. Soils in the Project Area, specially these of upper layers than the depth of 150 cm from the ground surface elevation, are of heavy texture of C or SiC.

Therefore, their permeability is not sufficient. However, their permeability to horizontal directions is relatively good. A considerable amount of course soils is distributed in the depth of more than 150 cm from the ground surface elevation. Under the circumstances, it is considered that, if the Project Area is equipped with a necessary density of artificial drainage canals, a satisfactory drainage condition can be realized though further studies will be required.

iv) Excavation and Construction Conditions

Soils in the Project Area are very hard and well compacted, and seem to have sufficient bearing capacities for structural facilities such as canals, dikes and farm roads. However, the above-mentioned should be taken with some discount in planning construction. Specially, when soils are granular, subangular or prismatic, it is well anticipated that rainy water causes erosion or collapse of excavated soil surface. Rainy water does not sink to deep layers, and only surface soils of about 10 cm thick are saturated. This phenomenon is remarkable in puffed solonchack and sabakh soils. In the areas with such soils transportation by vehicle is impossible for a few days after a rain.

This fact should be fully taken into consideration in planning future field activities, specially construction works. Paying attention to the fact that soils in the Project Area are originally river deposits, careful study should be conducted on foundations when heavy structures such as bridges and pump stations, etc., are planned.

Soils in the Project Area can be utilized as earth materials without problems in the aspects of their permeability and size of particles. What is only anticipated is the low field moisture of the soils.

III-6. AGRICULTURE

(1) Present Agriculture

The existing conditions of agriculture in the entire Iraq, Missan province, Kahlaa district and the Project Area are outlined herein.

(i) Agriculture in the entire Iraq

According to the statistic data on agricultural crops in Iraq for the years 1961 to 1977, a gross cultivated area in 1977 was 7,247,413 donam, and the gross farm income is ID. 169,170,627. The cultivated area by crop is as follows;

Table III-6-1. Cultivated Area by Crop, 1977

Crop	Area (donam)	Percent (%)
Cereals	6,005,238	83
Oil seeds	74,039	1
Tuber and bulb crops	68,698	1
Legumes	181,596	3
Industrial crops	155,597	2
Vegetables	762,245	10
Total	7,247,413	100

The cereals, whose cultivation area occupies more than 83 percent of the gross cultivation area, consist of the following;

Table III-6-2. Cereals and their Yields, 1977

Crops	Area (donam)	Percent (%)	Yield (ton)	Yield/donum (kg)
Wheat	3,430,400	57.12	695,700	203
Barley	2,143,500	35.69	457,700	214
Paddy	253,940	4.23	199,240	785
Millet	3,590	0.06	626	174
Sorgum	47,501	0.79	9,224	194
Corn	126,307	2.11	82,204	651
Total	6,005,238	100.00	1,444,694	

From the view points of cropping area and yield, wheat is the most predominant while from the view point of yield per unit area, paddy rice prevails over the others, which suggests the importance of paddy rice in the future agriculture in this country. The recent production, export and import of wheat and paddy are tabulated below;

Table III-6-3. Wheat Production and its Import/Export

Year	Production (ton)	Import (ton)	Export (ton)	Total (ton)	Per capita Consumption (kg)
1970	1,235,690	90,000	0	1,325,690	1,404
1971	822,300	955,000	0	1,777,300	182
1972	2,625,300	61,000	28,000	3,658,300	264
1973	956,788	154,000	143,000	967,788	93
1974	1,338,900	672,000	6,000	2,004,900	186
1975	845,400	512,000	4,000	1,353,400	122
1976	1,312,400	-	-	-	-
1977	695,700	-	-	-	-

Table III-6-4. Paddy Production and its Import/Export

Year	Production (ton)	Import (ton)	Export (ton)	Total (ton)	Per capita Consumption (kg)
1970	180,150	2,000	0	110,090	11.7
1971	306,700	97,000	0	281,020	29.4
1972	267,830	33,000	0	193,698	19.2
1973	156,620	16,000	0	109,972	10.6

Cont/d

Year	Production (ton)	Import (ton)	Export (ton)	Total (ton)	Per capita Consumption (kg)
1974	69,280	198,000	0	239,568	22.3
1975	60.540	120,000	0	156,324	14.1
1976	163,360	-	-	-	-
1977	199,240	-	-	-	-

Source: Agricultural crops in Iraq for the year 1961 to 1977, Annual Abstract Statistics, 1975-1976, FAO Trade Year Book)

Note: Yield of pollished rice is 108,090 tons in 1970, 184,020 tons in 1971, 160,698 tons in 1972, 93,972 tons in 1973, 41,568 tons in 1974, 36,324 tons in 1975, 98,016 tons in 1976 and 119,544 tons in 1977, respectively, on the assumption of the convert rate of paddy rice to milled rice of 60 %.

Table III-6-5. Paddy Cropping Area and Yield

Year	Cropping Area (Ha)	Yield (ton)	Yield/Ha (ton)
1970	74,577.5	180,150	2.415
1971	109,085	306,700	2.812
1972	94,062.5	267,830	2.848
1973	63,960	156,620	2.448
1974	31,415	69,290	2.204
1975	29,880	60.540	3.024
1976	52,407.5	163,360	3,116
1977	63,485	199,240	3,156

Table III-6-6. Wheat Cropping Area and Yield

Year	Cropping Area (Ha)	Yield (ton)	Yield/Ha (ton)
1970	7,034,138	1,235,690	0.704
1971	3,793,200	822,300	0.868
1972	1,914,600	2,625,300	1.372
1973	1,156,100	956,788	0.828
1974	1,633,325	1,338,900	0.820
1975	1,407,650	845,400	0.600
1976	1,499,300	1,312,400	0.876
1977	857,600	695,700	0.812

Annual per capita consumption of wheat in Iraq is 100 kg while that of paddy 15 kg. As clear in Tables III-6-5 and 6, yield of wheat and paddy rice have big yearly fluctuations.

ii) Agriculture in Missan Province

The gross area of Missan Province in 16,774 sq.km. Its population is about 420,000 with the population density of 25 person per sq.km. According to the statistic data of the Government, paddy rice (55,910 donam), green gram and corn were mainly grown in the summer season of 1976, while barley (72,600 donam) and wheat (62,300 donam) were the major crops raised in the winter season of 1975/76. The yield of paddy rice, barley and wheat was 31,070, 21,800 and 19,400 tons, respectively. The cropping area of paddy rice was remarkably expanded in 1977 in comparison with these before that year. (55,910 donam in 1976 while 102,000 donam in 1977). Moreover, the production of barley and wheat has been also increased. As for livestock breeding, the following domestic animals are raised as of 1976 in addition to camels, horses, donkeys, hen, turkeys, swans and geese, etc.

Domestic Animal	Head
Cow	218,067
Buffalo	22,832
Sheep	417,664
Goat	19,350

iii) Agriculture in Kahlaa Gada

Agriculture in Kahlaa Gada ("gun" in Japanese), in which the Project Area is located, is characterized by its large scaled paddy production. According to the statistic data of Amara Agricultural Office, paddy rice was raised in the area of about 3,900 Ha in 1977. The yield of 500 kg per donam is a little higher than that in the Project Area. Crops raised in Kahlaa Gada and their yields are tabulated below:

Table III-6-7. Summer Crops in Kahlaa Gada, 1977

Crop	Cultivated Area (donam) Irrigated Area	Rainfed Area	Fallow Land	Total Area	Yield Yield/ Donam (kg)	Total Yield (ton)
Rice	15,477			15,477	500	7,738.5
Corn (White)	3,780			3,780	200	756.0
Corn (Yellow)	500			500	300	150.0
Tomato	15			15	1,000	15.0
Vegetables	460			460		
Others	180			180		
Total	20,412			20,412		8,659.5

Table III-6-8. Winter Crops in Kahlaa Gada, 1977/78

Crop	Cultivated Area (donam) Irrigated Area	Rainfed Area	Fallow Land	Total Area	Yield Yield/ Donam (kg)	Total Yield (ton)
Wheat	8,239			8,239	180	1,483.02
Barley	15,732			15,732	237	3,728.48
Onion (dry)	90			90	575	51.75
Flax	38			38	100	3.80
Tomato (covered)	17			17	1,000	17.00
Radish	90			90	1,000	90.00
Turnip	121			121	210	25.41
Carrot	20			20	1,500	30.00
Beans	700			700	351	245.00
Total	25,047			25,047		5,674.46

Table III-6-9. Summer Crops in Al-Kahlaa and Al-Rafey, 1978

Crop	Al-Kahlaa Cultivated Area (donum)	Al-Kahlaa Yield/Donum (kg)	Al-Kahlaa Total Yield (ton)	Al-Rafey Cultivated Area (donam)	Al-Rafey Yield/Donam (kg)	Al-Rafey Total Yield (ton)
Paddy	220			11,252		
Corn (white)	3,790			15		
Corn (yellow)	957			0		
Tomato	26			4		
Vegetables	1,000			200		
Others	309			11		
Total	6,302			11,482		

Note: Kahlaa Gada was divided into two portions of Al-Kahlaa Nafea and Al-Rafey Nafea in Jaunary 1978.

iv) Agriculture in the Project Area

Cropping in the Project Area is shown in Tables III-6-10 and 11 below:

Table III-6-10 Summer Crops in the Project Area, 1977

Crops	Cultivated Area (donam)	Yield/Donam (kg)	Total Production (ton)	Growth Period
Paddy	150	450	67.5	Jul. to Nov. or to the end Nov. *1/
Sorghum	900	150 - 200	157.5	Jul. or the early Aug. to Oct. *2/

Cont/d

Crops	Cultivated Area (donam)	Yield/ Donam (kg)	Total Production (ton)	Growth Period
Vegetables	55	1,500 - 2,000	96.25	
Corn	25	-	-	
Water Melon	5	-	-	
Total	1,135		321.25	

Note: *1/ No fertilizer application

*2/ Feeder crop, no fertilizer application

Table III-6-11. Winter Crops in the Project Area, 1977/78

Crops	Cultivated Area (donam)	Yield/ Donam (kg)	Total Production (ton)	Growth Period
Wheat	3,000	200	600	Nov. to Apr. */
Barley	4,000	250	1,000	Nov or Mid-Dec. to Apr. */
Broad Beans	500	800 - 1,000	450	Sept. to end Dec. */
Tomato (covered)	7	2,000	14	Oct to Mar.
Onion(dry)	1		-	
Vegetables	5	1,500 - 2,000	8.75	
Total	7,513		2,072.75	

About 150 donam (38 Ha) in the Project Area have been annually cultivated with paddy rice. However, its scale is very small in comparison with that of barley and wheat (winter crops). The number of farm house-holds in the Project Area is about 195, and the population is about 600. Irrigation water is prerequisite for both summer and winter croppings.

The major agricultural facilites in the Project Area are eight units of pump and one tractor, which are operated mostly on contract basis.

Paddy:

The acreage of 150 donam was cultivated with paddy rice in the Project Area in the year 1977. Varieties of paddy being raised in the Project Area are Graibe (90 %) and Amber-33 (10 %). Since no fertilizers nor agricultural chemicals are applied the yield remains very low as 0.8 to 1.8 ton/ha. Mostly for ocal consumption only. Straw is used to feed domestic an mals. In general, plowing is made by heavy tractor, anl harvesting and threshing by man and animal powers.

Wheat:

Wheat cultivation is most predominent in the Project Area. No fertilizers nor agricultural chemicals are used. As a result, the yield remains low as 0.8 to 1.0 ton/ha. A conbine is operated for harvesting.

Vegetables:

Vegetables are grown and brought to market. Summer crops are tomato, cucumber, melon, water melon, egg plant, ladies finger, etc., while winter crops are tomato, onion, turnip, carrot, leek, lettuce, etc.

(2) Paddy Rice Cultivation

It is the special characteristic of paddy rice that it requires a great volume of irrigation water and high soil fertility for its growth. The present distribution of paddy fields in Missan Province renews our understanding on the importance of water and soil fertility for paddy growth. Paddy fields are limited to riverine portions and areas adjacent to the marsh where a natural manuring or earth-up is made by irrigation with abundant water. In a vast area soils have been salinized due to repeated artificial irrigation without proper drainage. Not only paddy rice but also other crops cannot grow in such area. In short, since water and fertile soils are prerequisite for paddy growth, the agricultural development for paddy production means to provide artificially paddy plant with necessary or optimum circumstances for its growth where such water and soils are unavailable under the natural conditions.

The present paddy cultivation is somewhat extensive. Therefore, it is clear that improvement in seed pretreatment, fertilizer and agricultural chemical applications, harvesting practices, etc. will result in an increase of yield per unit area to a considerable extent.

Farm operation is made as follows;

a) Plowing: The period is from February to April. Tractors are introduced for this work and harrowing.

b) Land-leveling:

April to May. Meraza, a comb harrow with about 2 m wide, is pulled by tractor for this purpose.

c) Sowing: Early-June to June 20. Germinated seeds are directly sown to paddy fields in which water has been kept in the depth of 10 to 15 cm. About 90 % of paddy is of the Graibe variety, and the remaining 10 % the Amber-33 and Naima varieties.

d) Irrigation: Mid-June to mid-September. Water kept standing in paddy fields for sowing is drained a few days after sowing, and irrigation is started about three weeks later. The intermittent irrigation of a 7 to 10 day interval is adopted.

e) Farm Management:

Mostly without fertilizers nor chemicals though sulphate anmonium of 100 kg/donam and superphosphate of 30 kg/donam are partially applied.

f) Weeding: No weeding is made.

g) Harvesting and Threshing:

Mannual harvesting with a sickle. Threshing is made by tractor or cow by way of treading on.

h) Marketing: Dried grains with wind are packed in a 80 to 100 kg sack, and brought to the Center of Marketing. The price ranges in 80 to 95 I.D./ton.

Some countermeasures will be required in future against or for the following:

a) Weeding;

b) Farm management; and

c) Prevention and control.

Fertilizer Application Test for Paddy Cultivation

The State Organization of Soil and Land Reclamation has conducted various fertilizer application tests for paddy cultivation in Kahlaa and Al-Mejar. Kahlaa is a flat land and the soil fertility is kept high due to the natural earthing-up by floodings of river water during high water seasons, while Al-Mejar is a pump irrigation area without flooding. Experimental cultivation of paddy is conducted in farm plots of 40 sq.m (5 m x 4 m) mainly to make clear effects of quantitative and seasonal applications of fertilizers. The test results are summarized as follows:

a) The E.C. value of 1.1 mmho/cm in Kahlaa is lower than that of 7.6 mmho/cm in Al-Mejar.

b) In general, fertilizers are more effective in Al-Mejar than in Kahlaa.

c) Yield of paddy is different by test plot. However, an averaged yield of 1,310 kg/donam (Amber-33, 1976) in fertilizer-applied test plots is much high than that of 447 kg/donam in the test plot to which no fertilizers are applied.

Since the Project Area is mostly flat, and the pump irrigation will be the premise for agriculture, test data in Al-Mejar might be helpful for further study and planning.

Paddy varieties grown in Iraq and their characteristics are tabulated below:

Table III-6-12. Characteristics of Paddy Varieties in Iraq

	IR-8	IR-22	IR-20	Amber33	Bazyan56	Enaima45
Weight of 1,000 grains (g)	26	20.7	15.3	20	26.2	21.7
Weight per Hectoliter (kg)	66.5	67.4	63.2	65.4	61.5	72.8
Brown rice in hulling (%)	73.8	73.6	68.4	73.1	76.6	73.4
Length of grain (mm)	8.6	8.6	8.0	8.9	7.8	7.7
Width of grain (mm)	3.3	2.7	2.6	2.6	3.4	2.8
Length/ width	2.6	3.2	3.1	3,4	2.3	2.8
Wite rice (%)	64.5	66.0	60.1	62.3	61.7	65.0
Pulverizer (%)	8.25	7.65	8.25	10.85	15.30	8.40
Length of grain white rice (mm)	6.3	6.5	5.5	6.4	5.5	5.9
Width of grain, White rice (mm)	2.6	2.0	2.0	1.9	2.9	2.6
Protein in white rice (%)	7.42	7.93	7.94	7.75	7.62	8.71
Oil in white rice (%)	2.40	2.40	3.17	3.19	2.44	2.27
Moisture content, white rice (%)	14	14	14	14	14	14
Anmonium sulphate (kg/doanm)	150	150	150	100	100	100
Triple super phosphate (kg/donam)	25	25	25	25	44	25
Growth period (day)	130	130	135-145	130-140	130-140	120-130
Length of plant (cm)	70-80	70-80	75-85			110-150.

Cont/d

Table III-6-12. Characteristices of Paddy Varieties in Iraq

Variety	Sowing period	Harvesting period	Yield (kg/donam)	Weight (g) 1,000 grain	Length (cm) of plant	White (%)	Fertilizer (kg/donam)
Amber *1/	June	end/Oct. - Nov.	600-700 (no fertilizer) 900-1,100 (with fertilizer)	20.1	110-120	60	A.S. 100-120 T.S.P 25
Naima *2/	end/Apr to early May	end/Oct	500-700	21.7	110-115	60-65	A.S. 100-120 T.S.P. 25
Graibe *3/	end/Apr. to early May	Oct.	500-600	-	100	-	A.S. 100-120 T.S.P. 25
Hwezawy *4/	Apr. to early May	Oct.	500-600	-	100	-	A.S. 100-200 T.S.P. 25
IR-22 IR-26 *5/	1-15 May	Early Oct.	1,300-1,800 (with fertilizer)	20.7	80-85	45-60	A.S. 150 T.S.P. 33

Note: A.S. = Ammonium sulphate T.S.P. = Triple superphosphate

Remarks:

*1/ Good

*2/ Cultivation is not made due to its low yield and poor quality of harvested paddy

*3/ Suitable only in Missan. Cultivation is not made in the other provinces.

*4/ Cultivation is not made due to its low yield and poor quality.

*5/ With fertiler and insecticide application, and with land leveling works, etc.

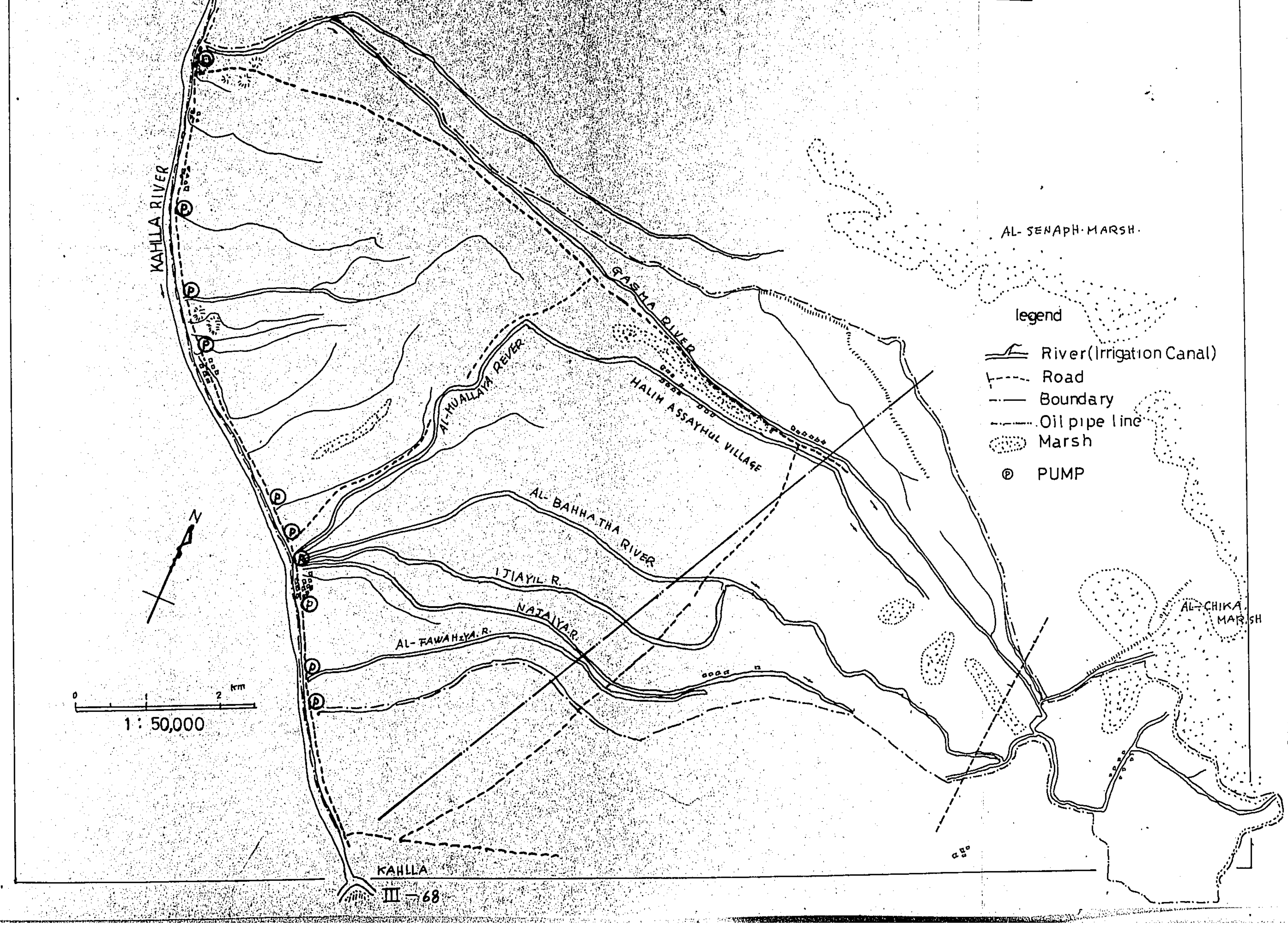
III-7. IRRIGATION AND DRAINAGE

(1) Existing Irrigation and Drainage Systems

The existing irrigation systems in the Project Area are not technically modernized, but the irrigation itself has a time-honored tradition as artificial irrigation canals constructed in old days are called "river" without distinguih-ing these canals from natural rivers. This way of dealings with irrigation seems a positive consequence of agricultural circumstances with arid climate where crops cannot grow with-out artificial water supply. The Project Area is not equip-ped with effective drainage facilities. Cultivated areas in old days are abanduned by farmers due to too high soil salini-ty brought about by repeated irrigation without proper drainage. All the canals shown in Fig. III-7-1, "Present Irrigation and Drainage Systems" are exclusively for irrigation; no drainage facilities exist in the Project Area.

The furrow irrigation is intermittently made through-out the year for cultivation of barley, wheat, broad beans, corn, tomatos and paddy rice by means of pumping up the Kahlaa water. The major irrigation facilities in the Project Area are;

Fig III-7-1 **PRESENT IRRIGATION & DRAINAGE SYSTEMS**



a) Pump Stations

Pump stations listed in Table III-7-1 are usually operated for all day long in peak seasons. (See Fig. III-7-1 as for the location of pumping stations) The prime-mover of these pumps is diesel engine. The pump heads range in 3.0 to 4.0 m in summer seasons, while less than 3.0 m during winter to spring seasons when the water level of the Kahlaa river, water source, is high.

Table III-7-1. Pumping Stations in the Project Area

Name	Service Area(donam)	Type	Diameter m/m	Head (m)	Horse Power	Pump Unit
Khamas	-	Volute	100	3.5	5	1
Hamid	-	"	300	"	66	"
Hatem	-	"	300	"	50	"
Al-Bahatha-1.	-	"	250	"	40	"
Al-Bahatha-2.	2,080	"	300	"	47	"
Abad Al-Jabar	4,020	"	350	"	85	"
Hussain Ali	800	"	300	"	50	"
Said	6,500	"	300	"	42	"
Sadem	1,500	"	300	"	65	"
Abed Al-Rahim	1,000	"	250	"	28	"

Note: Owner's name is given to his pump station.

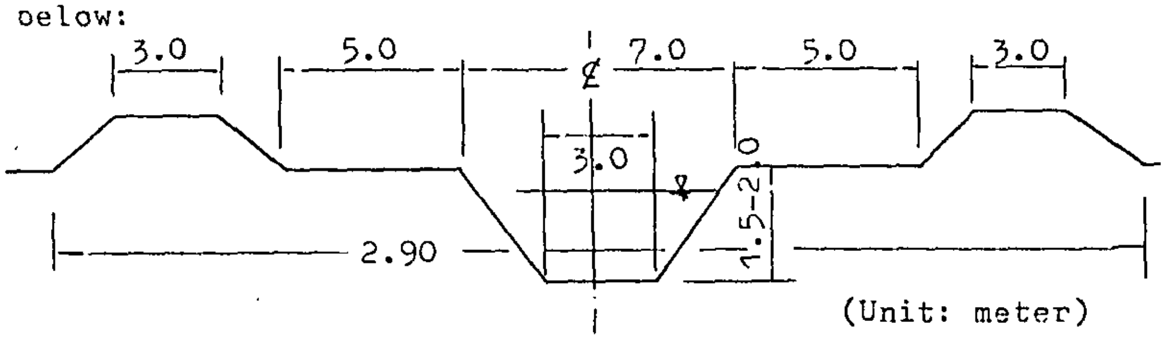
b) Irrigation Canals

The existing conditions of irrigation canals, which are called "rivers", are explained herein. (Reference is also made to Fig III-7-1 as for canal routes)

The Gasma river:

Total length:	18 km
Discharge quantity:	0.95 cu.m/sec
Water source:	The Kahlaa river
Intake method:	Pumping and gravity

The Gasuma river runs along the northern boundary of the Project Area from the east to west, and empties itself into the marsh. The repair of this canal has been completed as of February 1979. The typical cross section is illustrated below:



(Unit: meter)

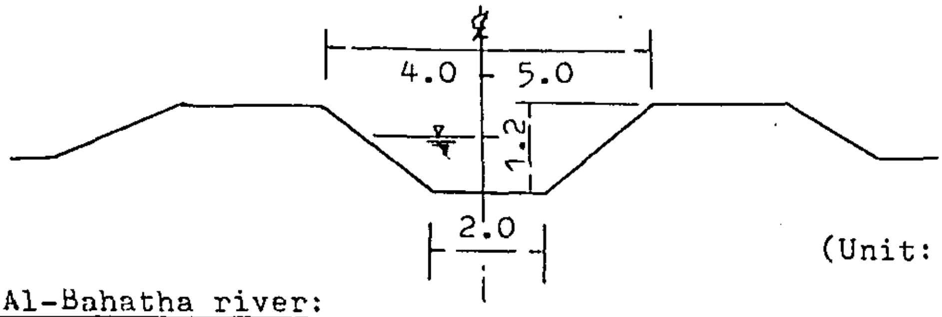
Slope:	1/5,000 to 1/7,000
Discharge quantity:	0.95 cu.m/sec
Service area:	10,000 donam (2,500 Ha)

The Muallaya river:

Total length:	13 km
Discharge quantity:	Not clear

Water source:	The Kahlaa river
Intake method:	Pumping (Al-Bahatha pumping station)

The Muallaya river runs to the north from Al-Bahatha pump station, and flows in parallel with the Gasma river near Halim Assayhul village. The typical cross section of this canal is as follows:

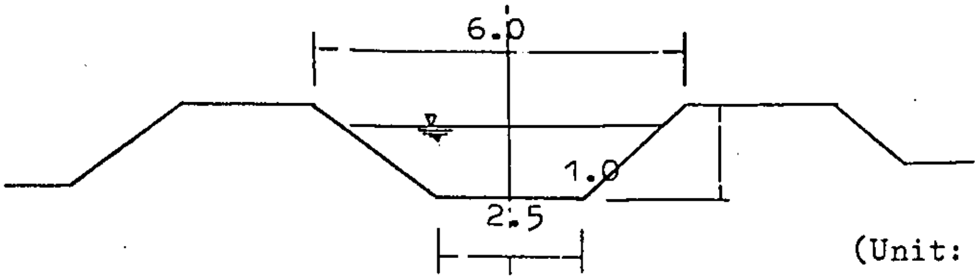


(Unit: meter)

<u>The Al-Bahatha river:</u>

Total length:	12 km
Discharge quantity:	Not clear
Water source:	The Kahlaa river
Intake method:	Pumping (Al-Bahatha pumping station)

This river runs across the center of the Project Area, so it is the most important canal for agriculture in the Project Area. However, the river is deteriorated at present. Much sediment is accumulated on the canal bottom due to poor maintenance because of the recent increase of fallow land in its service area. The typical cross section is as follows:



(Unit: meter)

The Ijiayil river:

Total length: 7 km

Discharge quantity: Not clear

Water source: The Kahlaa river

Intake method: Pumping

This irrigation canal is also severely deteriorated.

The Najaiya river:

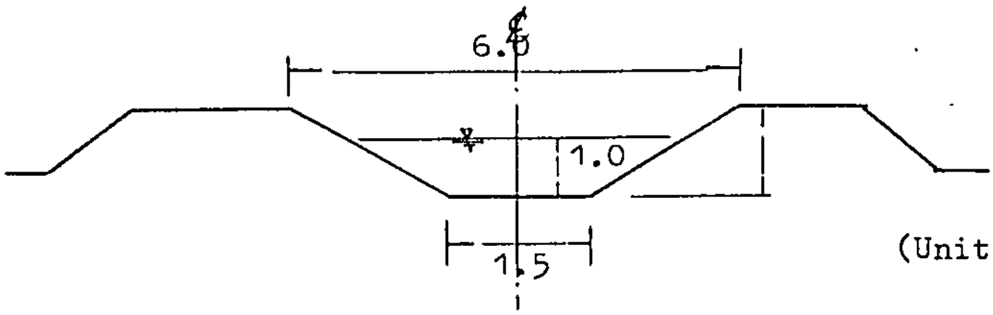
Total length: 9 km

Discharge quantity: Not clear

Water source: The Kahlaa river

Intake method: Pumping

The typical cross section of this canal is as shown below:

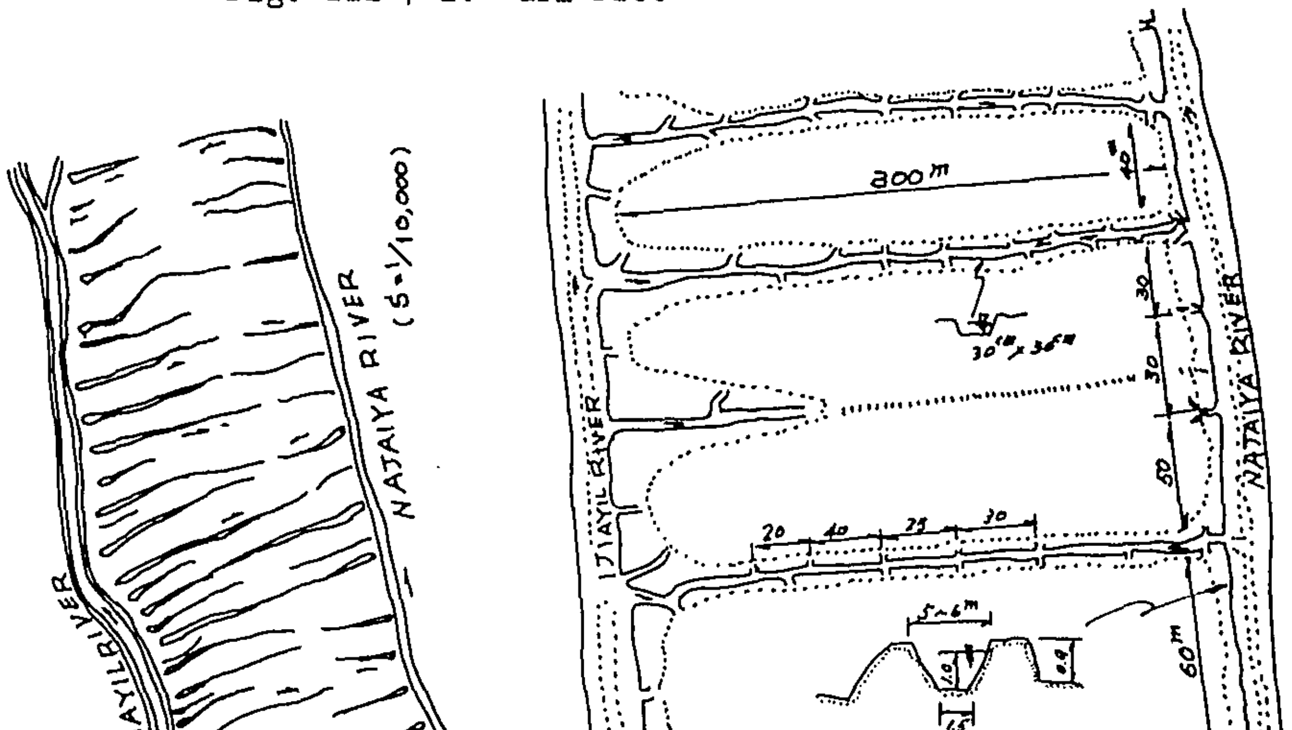


(Unit: meter)

C) Farm Plot

Various shapes and scales of farm plots are seen in the Project Area, but most farm plots are of rectangle shapes with the long side of 300 to 400 m and the short side of 30 to 50 m as illustrated in Fig. III-7-2. A main canal runs along the short side of farm plots, and a farm ditch along the long side. Roads of 3C to 50 cm wide runs along the main canals. Tractors with harrow, which are operated for plowing, etc., travel on farm field surface since no farm roads are available.

Fig. III-7-2. Farm Plot



(2) Present Irrigation and Drainage

At present, irrigation water is intermittently supplied with a seven to 20 day interval. In case of Hussain pump irrigation system, about 800 donam (200 Ha) of land is irrigated during about 20 days. On the assumption that the pump discharge is 200 lit/sec with full-day operation, the daily consumption of irrigation water is computed as follows;

$$H = \frac{0.20 \text{ cu.m/sec} \times 24 \text{ hr/day} \times 3{,}600 \text{ sec/hr} \times 20 \text{ day}}{200 \text{ Ha} \times 10{,}000 \text{ sq.m/Ha} \times 20 \text{ day}}$$

$$= 8.6 \times 10^{-3} \text{ m/day} = 8.6 \text{ mm/day}$$ (Barley)

An irrigation water being supplied in one irrigation interval is:

$Qr = 8.6$ mm/day x 20 day = 172 mm/irrigation (one time)

A farm field of 1.2 to 3.0 H_a is surrounded by farm ditches equipped with many inlets. Drainage is not made. The canals are for irrigation, and have no drainage function, In general, the bottom elevation of such irrigation canals is such irrigation canals is only about 20 cm lower than the farm field surface elevation. A farm ditch bottom is almost the same to the farm field surface in elevation, so such farm ditches can not have drainage function.

(3) Irrigation Requirement

In general, an irrigation water requirement in a paddy field is computed based on observation data of transpiration, evaporation and percolation. During the Field Survey period, such observation was carried out at two test fields and in one existing paddy field. In determining the location of test fields, due attention was paid to their soil textures and availability of water. The location of test fields is shown in Fig. III-7-3, and results of observation are as follows;

<u>Test Field No. 1</u>

(i) Field Conditions for the First Observation

a) Groundwater level: 1.4 m below the field surface

b) A ditch of about one meter deep was excavated along the circumference of the test field to facilitate percolation.

c) The test field was constructed in cultivated area so its surface had been furrowed.

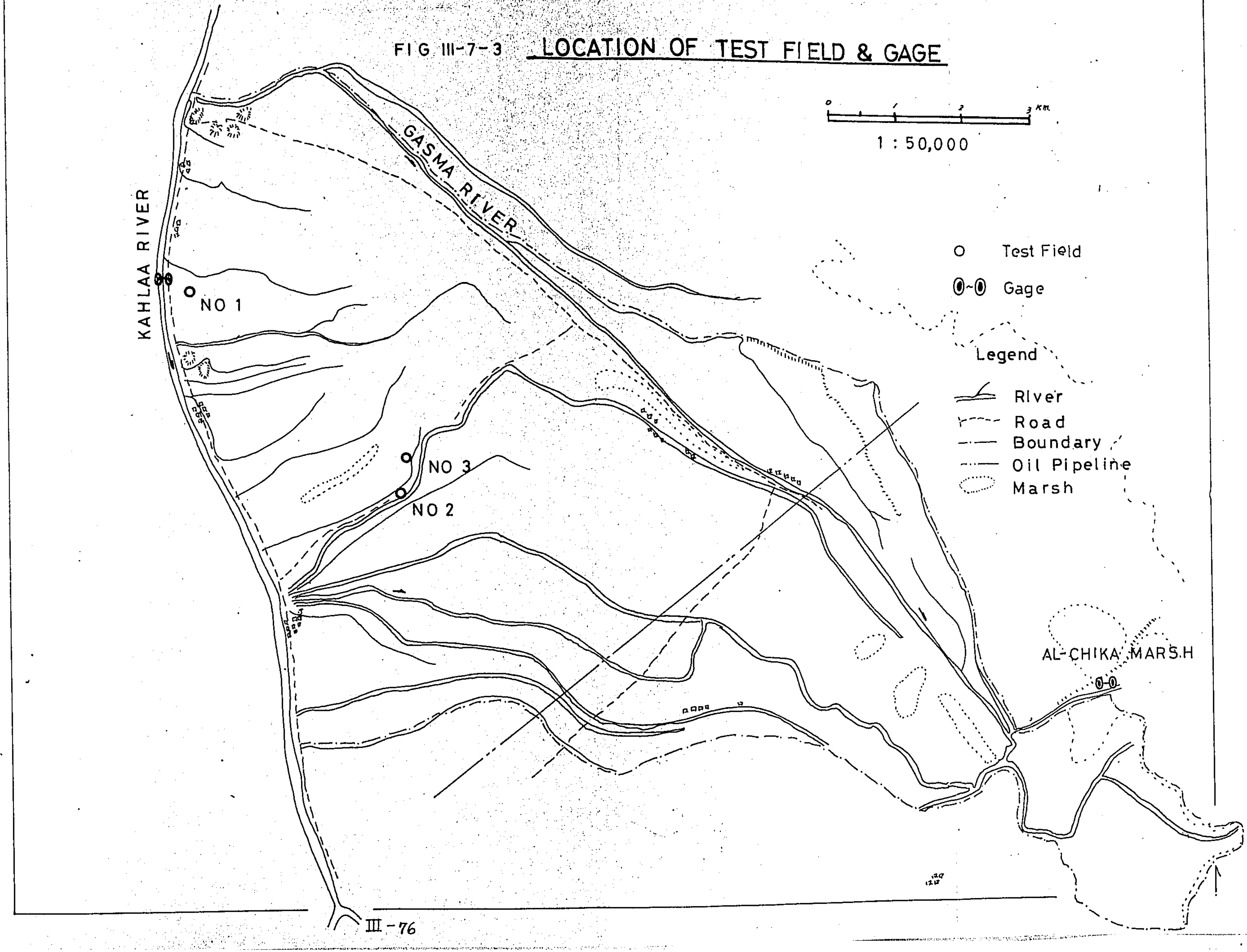
d) The soil texture is Sicl.

e) Irrigation water quality: EC 0.88 mmho/cm at 25°C

f) Atmospheric temperature: 25°C

g) Evaporation (E) with a 20 cm diameter evaporator

FIG III-7-3 LOCATION OF TEST FIELD & GAGE



Evaporating period: 24 hours from 12:00, October 8, to 12:00 October 9, 1978

Evaporated water volume:

110 cc (1,300 cc - 1,190 cc)

Evaporation (E) = Evaporated water volume (VE) ÷ Evaporator's surface area (sq.cm)

= 110cc ÷ 314 sq.cm = 0.35 cm

= 3.5 mm/day

h) Section of the test field (See Fig. III-7-4)

Full water area: 9.5 m x 9.5 m = 90.25 sq.m

i) Puddling

No puddling, etc. was provided.

(ii) Observation Results

a) water volume (V) supplied to the test field and time (T) required to supply water

V = 8.492 cu.m. (including the standing water of 3 cm deep on the field surface)

T = 95 minites

The above-mentioned water volume (V) is converted into the water height (H) of 94.1 mm as follows;

$$H = V \div A$$

$$= 8.492 \text{ cu.m} \div 90.25 \text{ sq.m} = 94.2 \text{ mm}$$

b) Decreased water during 24 hours

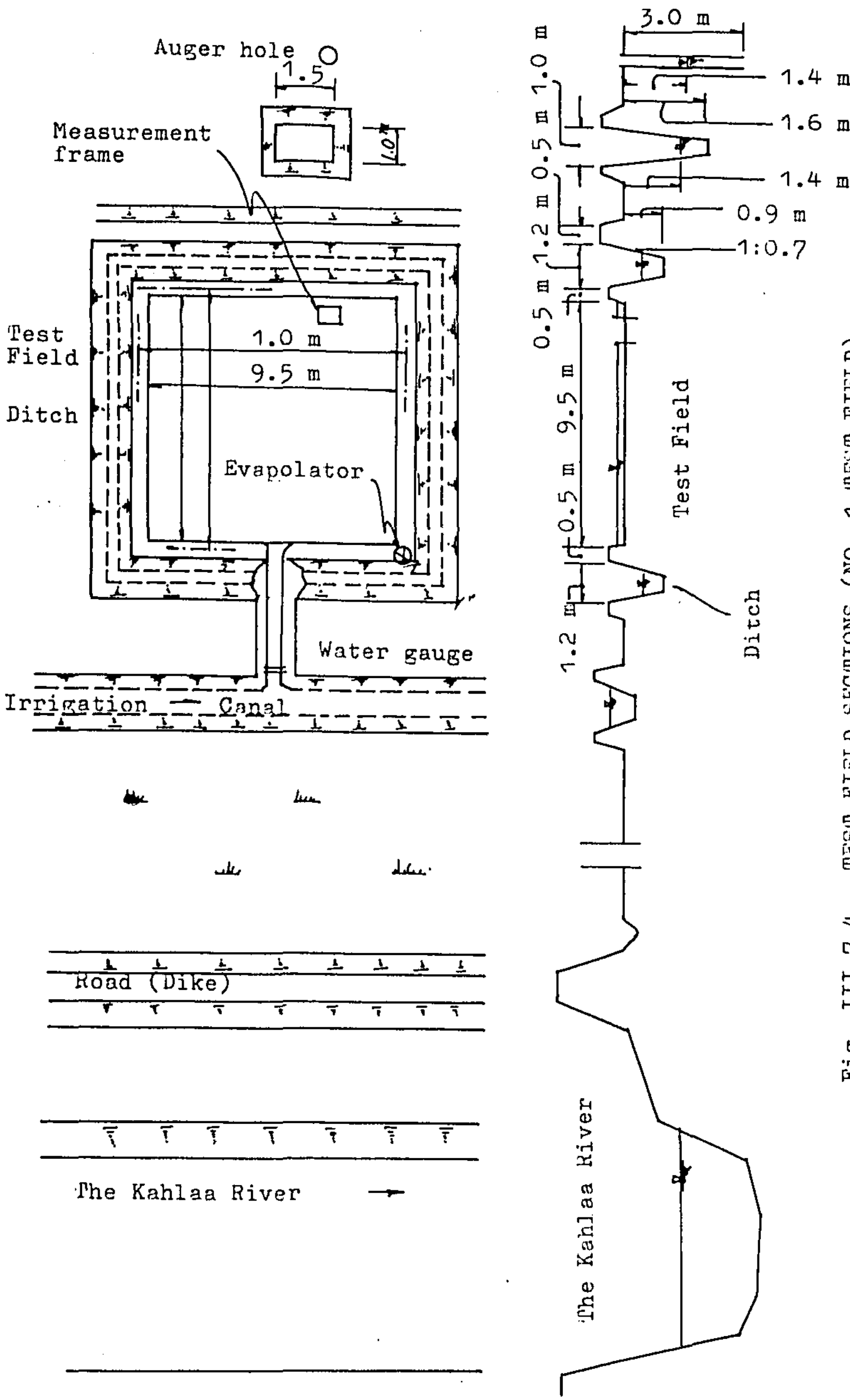


Fig. III-7-4. TEST FIELD SECTIONS (NO. 1 TEST FIELD)

All the water volume suppied was percolated within 24 hours.

(iii) Considerations

In general, the water volume required to saturate the dry soils of a farm field is equivalent to the total porus space of the soils above the groundwater table. It seems that the water volume supplied to the test field was less than the total porus space of soils. A considerably big volume of water seems to be required to fill such porus space with water. In order to let the irrigation water stand on paddy fields, a bigger volume of water than that of the existing upland field irrigation is required.

(iv) The Second Observation at the Test Field No. 1.

The results of the second observation at the test field No. 1 during January 13 to 15, 1978 are tabulated below;

Table III-7-2. Water Quality at Test Field No. 1

Unit: Water quality (EC) mmho/cm
Water Temperature (WT) °C

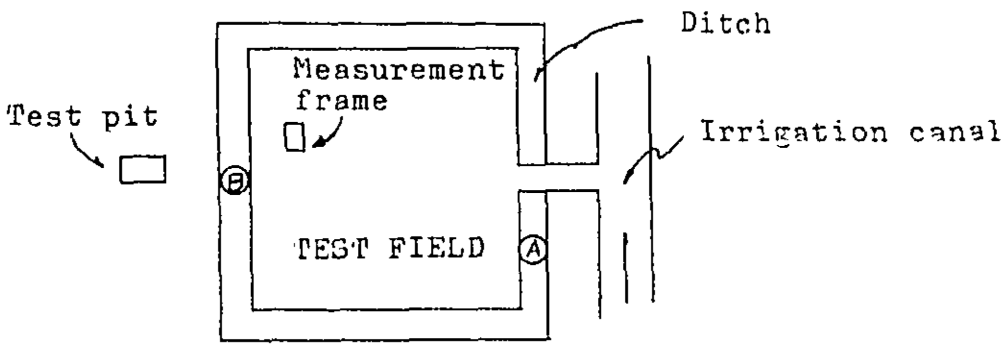
	Date of Observation		
	Jan. 13	Jan. 14	Jan. 15
Irrigation Water			
EC	0.72 (0.93)	0.74 (0.93)	-
WT	13.5	14.5	-
Drainage Water at Ditch A			
EC	7.30 (9.32)	1.42 (1.95)	1.30 (1.70)
WT	14.0	11.0	13.0

Cont/d

	Jan. 13	Jan. 14	Jan. 15
Drainage Water at Ditch B			
EC	6.20 (8.02)	3.00 (4.02)	2.70 (3.41)
WT	13.5	12.0	14.5
Test Pit, Water Surface			
EC	7.00 (8.90)	7.00 (8.73)	7.00 (9.39)
WT	14.2	15.0	12.0
Test Pit, One Meter Below the Water Surface			
EC	9.20 (11.69)	9.10 (11.35)	8.20 (11.00)
WT	14.2	15.0	12.0

Note: The figures with parentheses are converted EC values at 25°C.

The location of the irrigation canal, ditches and test pit is illustrated below;



o Water volume supplied to the test field (V), time required to supply water (T) and the depth of standing water on the field surface (Hf);

The First Date of Observation:

V_1 = 10.5 cu.m. (116 mm)

T_1 = 80 min

Hf_1 = 60 mm

The Second Date of Observation:

V_2 = 6.3 cu.m. (70 mm)

$T_2 = 55$ min

$Hf_2 = 70$ mm

o Water Requirement in Depth (D);

	The 1st day *1/	The 2nd day *2/	Average
Farm Plot D	210 mm/day	116 mm/day	163 mm/day
N-type D	354 mm/day	184 mm/day	268 mm/day

Note: *1/ The observation was made 4 hours after installation of the gauge, and the observed depth is converted into that in a day.

*2/ The observation was made 6 hours after water supply, and the observed depth is converted into that in a day.

o Field Conditions for Observation:

a) The test field had a rainfall of about 10 mm three days ahead of the first observation day.

b) Water surface in the surrounding ditches is kept at 60 cm below the field surface.

c) The field surface has well developed cracks.

d) Roots of weeds such as Agul and Shock are seen within the depth of 70 cm below the field surface. Some Shock plants have roots of 2 to 3 meters.

o Considerations

a) The water volume supplied to the test field during the two days was 16.8 cu.m in total. Since the test field surface area is 90.25 sq.m, the water volume is converted into the water depth of 0.186 m. (H = V/A = 16.8/90.25)

b) The observation of water requirement in depth could not but be conducted within four to six hours after water supply because it was difficult to make water be standing on the field for more than six to ten hours.

c) The water requirement in depth observed in the first day is larger than that observed in the second day.

d) The evapo-transpiration of 1.6 mm/day was recorded both in the first and second days.

e) Based on the above-mentioned, the following could be said;

- The difference in the water requirements in depth observed in the two days and difficulty to let water be standing on the field surface for more than ten hours after water supply suggest that the observed values are not stabilized ones but of the early stage having a characteristic of the water requirement for surface soil puddling. (about 200 mm)
- The minimum water requirement in depth so far observed

was 116 mm/day. But this not a stabilized one. The actual water requirement might be much smaller than the above-mentioned.

- Under the circumstances, the observation should be continueously conducted, but rains made it impossible.

Test Field No. 2

a) Water Quality (EC: mmhos/cm)

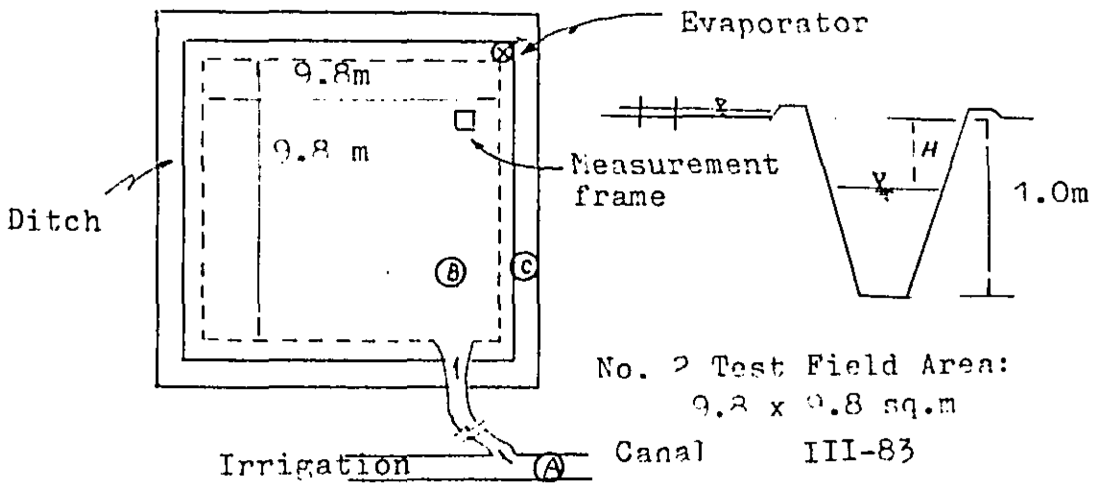
Table III-7-3. Water Quality in Test Field No. 2

Unit: water quality (EC) mmhos/cm
Water temperature (WT) °C

	Date of Observation		
	Jan. 29	Jan. 30	Jan. 31
Irrigation water A			
EC	-	0.65 (0.81)	-
WT		15.0	
Irrigation Water B			
EC	-	1.13 (1.34)	
WT		17.0	
Drainage water C			
EC		6.70 (8.06)	7.00 (8.73)
WT		16.5	15.0

Note: The figures with parentheses are converted EC values at 25°C.

The location of the irrigation canal and ditches is illustrated below:



b) The water volume supplied to the test field (V), time required for water supply (T) and the depth of standing water on the field surface (Hf):

The first day of observation

V_1 = 13.2 cu.m (137 mm)

T_1 = 25 min

Hf_1 = 60 mm

The second day of observation

V_2 = 7.2 cu.m (75 mm)

T_2 = 65 min

Hf_2 = 60 mm

c) Water requirement in depth (D)

	The 1st day	The 2nd day
Farm Plot D	- *1/	100.8 mm/day *2/
N-type D	- *1/	86.4 mm/day *2/

Note: *1/ The team member in charge returned to the test field six hours after water supply, and found that all the water had been percolated within the hours.

*2/ The water requirement in depth observed five hours after water supply is converted into that in a day.

d) Field Conditions for Observation

- It rained a few days ahead of the observation. Pools formed around the test field.

- The groundwater table observed in the ditches dug along the circumference of the test field was 70 cm, 40 cm and 30 cm below the field surface on January 29, at 12:00 and 17:00 of January 30, 1979, respectively. The water table went up to a remarkable extent after water supply to the test field.
- The test field is located in a fallow land where even weeds such as Shock and Agul do not grow maybe due to too high salinity of soils.
- The soil texture is of silty clay loam. The soils have no crack. The soils were plowed to a depth of about 5 cm so that the observation could be made under a cultivated condition.
- Evaporation: 1.6 mm/day

e) Considerations

o The standing water of about 60 mm deep was completely percolated within six to ten hours in both cases. The water volume is equivalent to 200 mm in total.

o The ground water table is so high as 40 cm below the field surface. The percolation is high in spite that the field surface is kept wet.

o The following are considered based on the above-mentioned observation results;

- The water volume required for the early stage of irrigation (water requirement for puddling) might be more than 200 mm.
- The speed of percolation gradually got low. Therefore, the daily water requirement might be smaller than the observed value of 86.4 mm/day if farm plots adjacent to a farm field are kept under the irrigated conditions.

Test Field No. 3

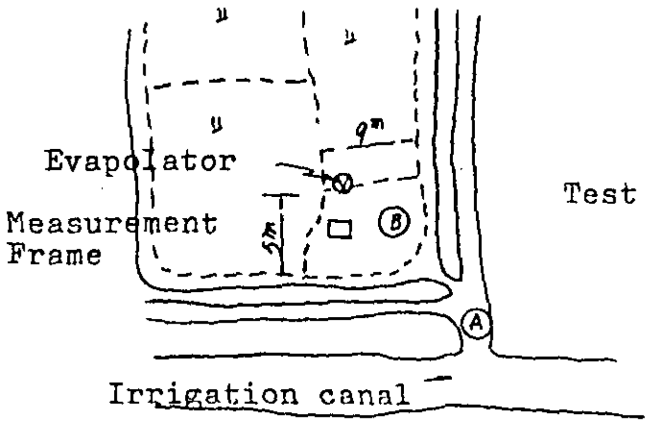
a) Water Quality (EC: mmho/cm)

Table III-7-4. Water Quality in Test Field No. 3

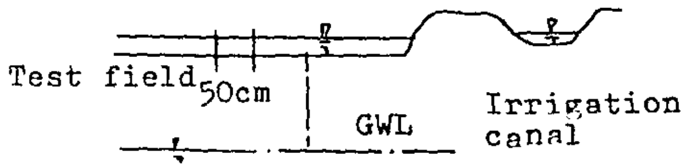
Time and Date		Irrigation Water	Water in Test Field
Jan 31 (13:00)	EC	0.75 (0.96) mmho/cm	1.00 (1.10) mmho/cm
	WT	14 °C	20.3 °C
Feb 1 (13:00)			
Before irrigation			
	EC		1.9 (1.98) mmho/cm
	WT		25 °C
After irrigation			
	EC	0.67 (0.75) mmho/cm	0.95 (1.06) mmho/cm
	WT	19.5 °C	20.0 °C
Feb 2 (13:00)			
	EC		0.90 (1.00) mmho/cm
	WT		20.0 °C

Note: The figures with parentheses are converted EC values at 25 °C

Present Paddy Field



Test Field Surface Area:
A = 45 sq.m



b) Water requirement in depth (D)

	Ist day	2nd day	Average
Farm Plot D	75 mm/day	70 mm/day	72.5 mm/day
N-type D.	72	70	71.0

c) Farm Conditions for Observation

- Farm field cultivated with paddy rice as stumps of paddy plant grown in the previous season are seen.
- The soil texture is of silty clay loam having a brown color as a rule. Soils below 10 cm from the field surface contain black humus.
- Near the test field an irrigation canal with almost the same elevation to the test field surface elevation runs. (No drainage canal was prepared for this test)
- Evaporation

  The evaporation was 1.8 mm/day in the first day and 2.6 mm/day in the second day with the average of 2.2 mm/day.

e) Considerations

o The test field No. 3 was selected at an existing paddy field so that the water requirement in depth of the present paddy fields could be observed. The figure ranges in 70 mm/day to 75 mm/day.

o The percolation is 68.8 mm/day with the averaged water requirement in depth of 71 mm/day and evapotranspiration of 2.2 mm/day.

Survey Results of Irrigation Requirement:

i) Field Survey

The Field Survey for irrigation requirement was conducted at three test fields as follows:

a) Test Field No. 1:	Soil texture: Sicl Presently cultivated area with a low soil salinity of EC 2 to 5 mmho/cm
b) Test Field No. 2:	Soil texture: Sicl Farrow land due to too high soil salinity (EC: 49.8 mmho/cm)
c) Test Field No. 3:	Soil texture: Sicl Present paddy field (1978) EC: under analysis

As a result of the observation at the three test fields, very interesting facts are found out as follows;

a) The farm fields have a high permeability. Specially, roots of weeds spreading to the depth of about one meter below the ground surface seems to facilitate the percolation, which will contribute much to the leaching in the early stage.

b) In the test fields No. 1 and No. 2 and even in the test field No. 3, which is located in the present paddy field, the plowsole has not been developed, which causes a high percolation.

c) Due to the limited observation period, no conclusion can be arrived at regarding the water requirement in depth, however, the following could be found out;

The water requirement in early stage:

More than 200 mm

Daily water requirement in depth:

Partially more than 70 mm/day

Data Collection for Irrigation Requirement:

The following data could be obtained:

a) Consumptive Use of Crops in Iraq, Amara Irrigation Office

b) Pan-evaporation (Meteorological data), Sugarcane Factory

c) Monthly Evaporation Data, Amara Irrigation Office

The consumptive use of water by crops in Amara area is estimated and shown in the following table. Consumptive use of water is different by crop, but mostly ranges in 2.0 to 25.0 mm/day. The maximum is 25.0 mm/day of paddy plant. It seems that monthly fluctuation of the consumptive use of water by a certain plant shows a similar curve to that of monthly fluctuation of pan-evaporation. Some inconsistencies are seen between the observation data and the existing ones of the water requirement. Further study will be required.

Fig. III-7-5. Monthly Evaporation & Pan-evaporation

		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Evaporation	1973	103.4	125.3	255.5	330.6	501.0	603.8	664.6	522.8	594.9	295.9	183.7	93.1
	1974	43.3	62.4	126.5	248.0	479.0	650.1	651.5	622.3	438.0	243.0	169.0	54.1
	1975	54.3	72.5	197.8	243.5	443.7	790.3	816.2	704.6	480.9	331.4	170.5	52.2
	1976	56.3	44.2	129.8	198.2	380.0	712.2	776.7	626.6	510.2	268.4	157.2	84.8
	1977	59.5	119.7	204.8	280.1	487.8	719.0	773.4	618.2	554.3	215.4	167.5	77.3
	1978	84.5	100.6	192.9	332.2	462.6	564.1	510.4	669.6	509.3	-	-	-
	mm/day	2.17	3.4	5.8	8.7	14.8	23.1	23.6	20.0	17.2	8.7	5.3	2.3
	Mean	316.8	94.9	182.9	260.1	438.3	695.1	732.5	618.8	515.6	270.8	157.6	92.3
Pan-Evaporation 1965-75	Mean	2.9	3.3	5.9	8.8	12.3	16.7	16.4	15.8	12.2	7.3	4.1	2.9 mm/day

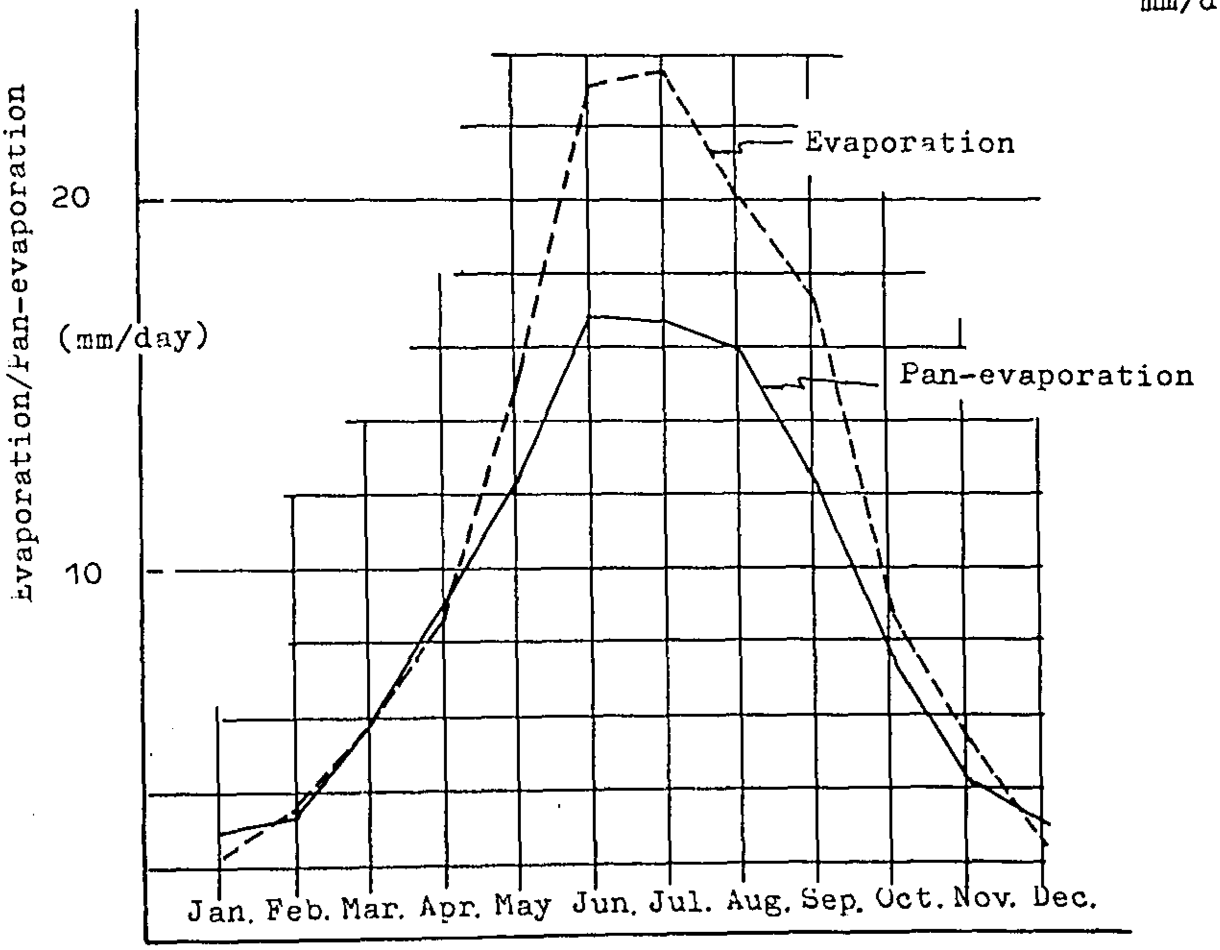


Table III-7-5. Consumptive Use of Water by Crop in Iraq

By Amara Irrigation Office

No.	Crop	Frequency of Irrigation	Duration (day)	Consumptive Use (mm)	Consumptive Use (ha/cu.m/sec) (donam/cu.m/s)	Consumptive Use (mm/day) *1/
1.	Wheat	6	166	857	1,763 (6,694)	5.2
2.	Barley	6	166	857	1,763 (6,694)	5.2
3.	Beans	6	181	365	4,285 (17,138)	2.0
4.	Alfalfa	17	365	3,280	962 (3,846)	9.0
5.	Onion	16	181	1,623	464 (3,854)	9.0
6.	Winter vegetable	5	122	350	3,011 (12,043)	2.9
7.	Other crops	6	181	803	1,948 (7,790)	4.4
8.	Cotton	16	214	1,872	933 (3,732)	9.7
9.	Seasam	8	122	1,463	721 (2,882)	12.0
10.	Corn	10	153	1,447	883 (3,532)	9.8
11.	Potato	8	153	856	1,544 (6,177)	5.6
12.	Millet	8	123	1,444	736 (2,944)	11.7
13.	Summer vegetable	13	275	1,705	1,394 (5,574)	6.2
14.	Summer crops	10	153	1,418	932 (3,729)	9.3
15.	Rice	23	214 (120)*2/	3,006	618 (2,470)	14.0 (25.0)/A
16.	Date palm	22	365	3,262	967 (3,867)	8.9

Note: *1/ Consumptive use/duration

*2/ Duration of irrigation (days) in the Project Area based on interviews with farmers

A_/ 3,006 mm/120 day = 25 mm/day

(4) Water Source

i) Data Collection and Water Level Observation

The existing data collection and water level observation of the Kahlaa river and Al-Chika marsh were carried out during the Field Survey period. The data collected are:

a) Discharge for Selected Gauging Stations in Iraq (1930 to 1965)

b) Water Level Gauging Reading and Discharge for the Tigris at Amara (1970 to November 1978)

c) Water Level Gauging Reading for the Kahlaa River (1975 to October 1978)

d) Daily Water Level Gauging for the Kahlaa River (1977)

The location of these gauging stations is shown in Fig. III-7-6. Results of the water level observation at the above-mentioned two places are tabulated below:

Table III-7-6: Water Levels of the Kahlaa River and Marsh

(Unit: m MSWL)

Kahlaa River

Date	Month	1978 Nov.	1978 Dec.	1979 Jan.	1979 Feb.	Remarks
1		-	-	-	-	
2		-	-	4.22	-	
3		-	-	4.51	-	
4		3.24	3.41	4.15	-	

Cont/d

Date	Month	Nov.	Dec.	Jan.	Feb.	Remarks
5		3.22	3.43	-	5.30	
6		3.22	3.43	-		
7		3.31	3.43	4.05		
8		3.30	-	4.00		
9		3.27	3.43	4.00		
10		-	3.43	4.6		
11		-	3.46	5.25		
12		-	3.46	-		
13		-	3.52	5.43		
14		-	3.71	5.52		
15		-	-	5.46		
16		-	5.75	5.39		
17		-	5.67	5.34		
18		3.42	5.55	5.25		
19		3.42	5.43	-		
20		3.42	5.27	5.85		
21		3.35	-	5.25		
22		3.35	-	4.99		
23		-	-	5.19		
24		-	-	5.35		
25		-	-	-		
26		3.34	-	-		
27		3.37	4.55	5.67		
28		3.37	4.56	-		
29		-	-	-		
30		-	4.32	-		
31		-	4.32	-		

Marsh

Date	Water Level
1978 Nov. 7	Less than 2.50 m
Nov. 27	- do -
Dec. 13	- do -
Dec. 17	2.55 m
Dec. 28	2.65
1979 Jan. 15	2.75
Jan 24.	2.85
Feb. 5	3.00

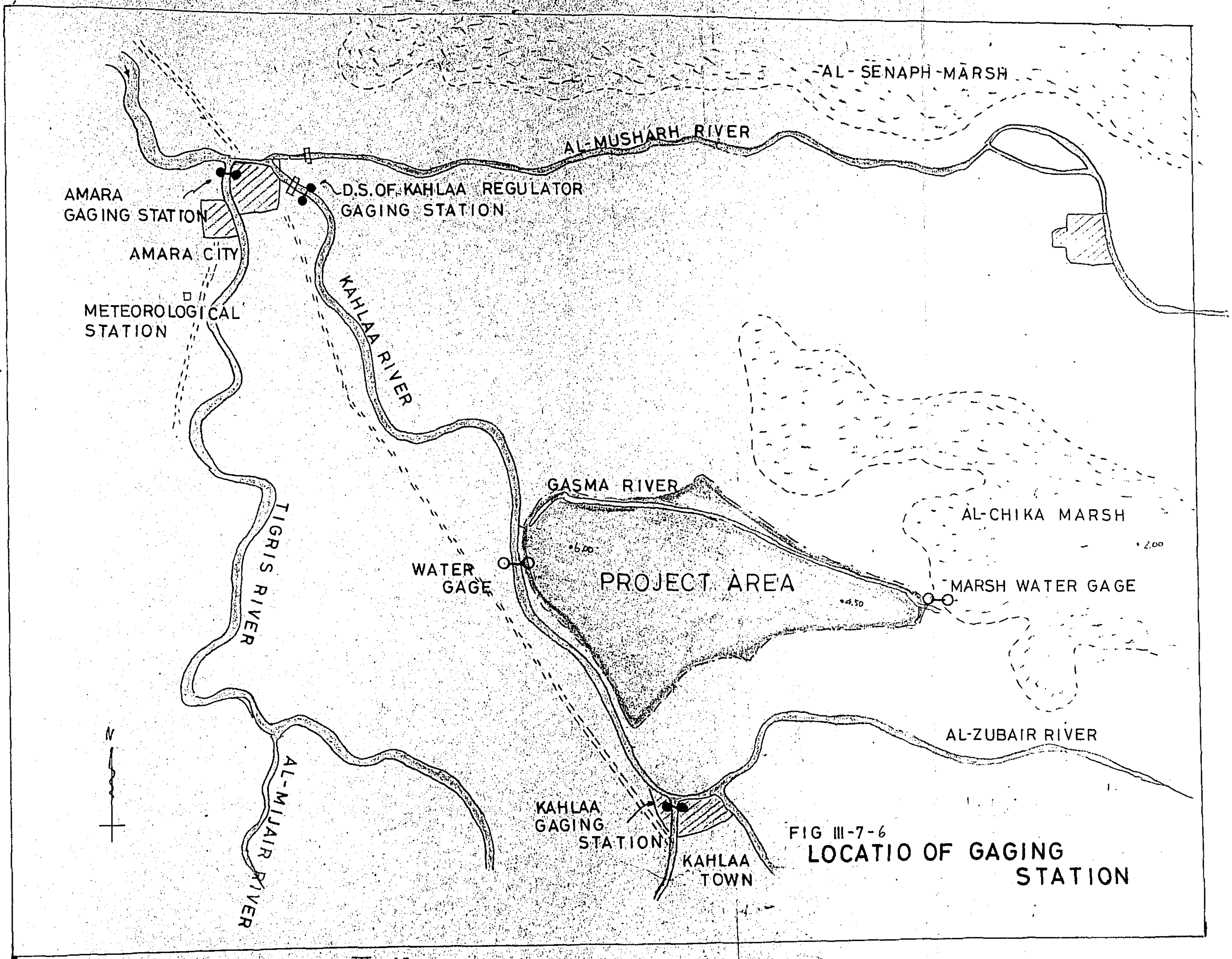


FIG III-7-6
LOCATIO OF GAGING STATION

Table III-7-7. Water Quality of Marsh and Test Pits

Date	Marsh	TP-1.	Tp-2.	TP-3.
Nov. 7	*	1.40 m (11.70) GTS 4.15 m	*	-
Nov. 27	*	1.60 GTS 3.95	*	2.90 m GTS 0.30 m
Dec. 13	*	1.40 (13.88) GTS 4.15	*	2.30 (5.50) GTS 0.90
Dec. 28	1.15 m (3.18) GTS 2.65 m	1.40 (13.88) GTS 4.15	*	-
Jan. 15	-	0.60 (8.73) GTS 4.95	*	-
Jan. 24	1.35 (3.16) GTS 2.85	0.60 GTS 4.95	*	2.20 (6.30) GTS 1.00

Note:

1. * No observation was possible due to too low water level.
2. - Observation has not yet conducted.
3. A figure without parenthesis shows a depth from the ground surface to the water level.
4. Figures with parentheses show EC values at 25°C.
5. GTS means height above the mean sea water level.

Table III-7-8. Water Level and Quality of the Kahlaa River, Marsh and Test Pits (5 Feb., 1979)

Item	Kahlaa River	Marsh	TP-1.	TP-2.	TP-3.
H. (m)	3.25	1.50	0.80	-	1.90
GTS (m)	5.30	3.00	4.76	-	1.30
WT (°C)	12.5	12.0	12.5	-	11.5
ECt (mmho/cm)	0.46	1.00	7.10	-	4.00
EC 25°C (do)	0.61	1.34	9.41	-	5.43
Remarks	*1/	*2/	*3/		*4/

Note:

H: Gauge reading for the Kahlaa river and the marsh,

Groundwater tables at TP-1, TP-2 and TP-3 are shown by the depth from the ground surface.

GTS: Height above the mean sea water level

-: No water was standing.

Remarks:

*1/ GTS = H + 2.05

*2/ GTS = H + 1.50

*3/ GL = 5.55

*4/ GL = 3.20

ii) Outline of Water Sources

a) The Tigris River

o Catchment area:	166,200 sq.km (on the down-stream reaches of Kut barrage)
o Average discharge:	1,160 cu.m/sec (at Kut)
o Maximum discharge:	8,000 cu.m/sec (at Kut)

Source: Irrigation Improvements in the Amara Area, Final Planning Report, Vol. I. Irrigation and Drainage

o Discharge range at Amara station	45.0 to 880.0 cu.m/sec

Source: Data of Amara Irrigation Office

Review on water distribution of the lower Tigris river (downstream of Kut barrage) is on the way in the Amara Irrigation Project. The main branches of the Tigris downstream of the barrage are the Garraf, Al-Butira, Al-Misharah and Kahlaa rivers.

b) The Kahlaa River

o Discharge quantity:	25.0 to 389.0 cu.m/sec
o Water level:	3.96 to 7.38 m (near the Project Area)

The river discharges are completely controlled by Kahlaa regulator. Amara Irrigation Office is responsible for the operation of this regulator. The daily fluctuation of water level at the downstream of Kahlaa regulator is shown in Fig. III-7-6.

c) Other Water Sources

Marsh:

The marsh water is abandunt, however, study in the aspect of water quality is needed, if it is used for irrigation. The EC value of the marsh water is generally so high as 2.5 mmho/cm, which is four to five times of that of river waters.

Groundwater:

The groundwater is not available for irrigation due to its too high EC value. (The EC value of 10 mmho/cm was observed during the Field Survey.)

iii) Water Quality

The quality of the Tigris water to be diverted to the Project Area is as follows;

a) pH: 7.6 to 8.4

b) EC value: 0.35 to 1.5 mmhos/cm (less than 1.0 mmhos/cm during January to July when the river discharge is abundant, while 0.8 to 1.5 mmhos/sec during August to December with relatively small discharge. See Fig. III-7-8.

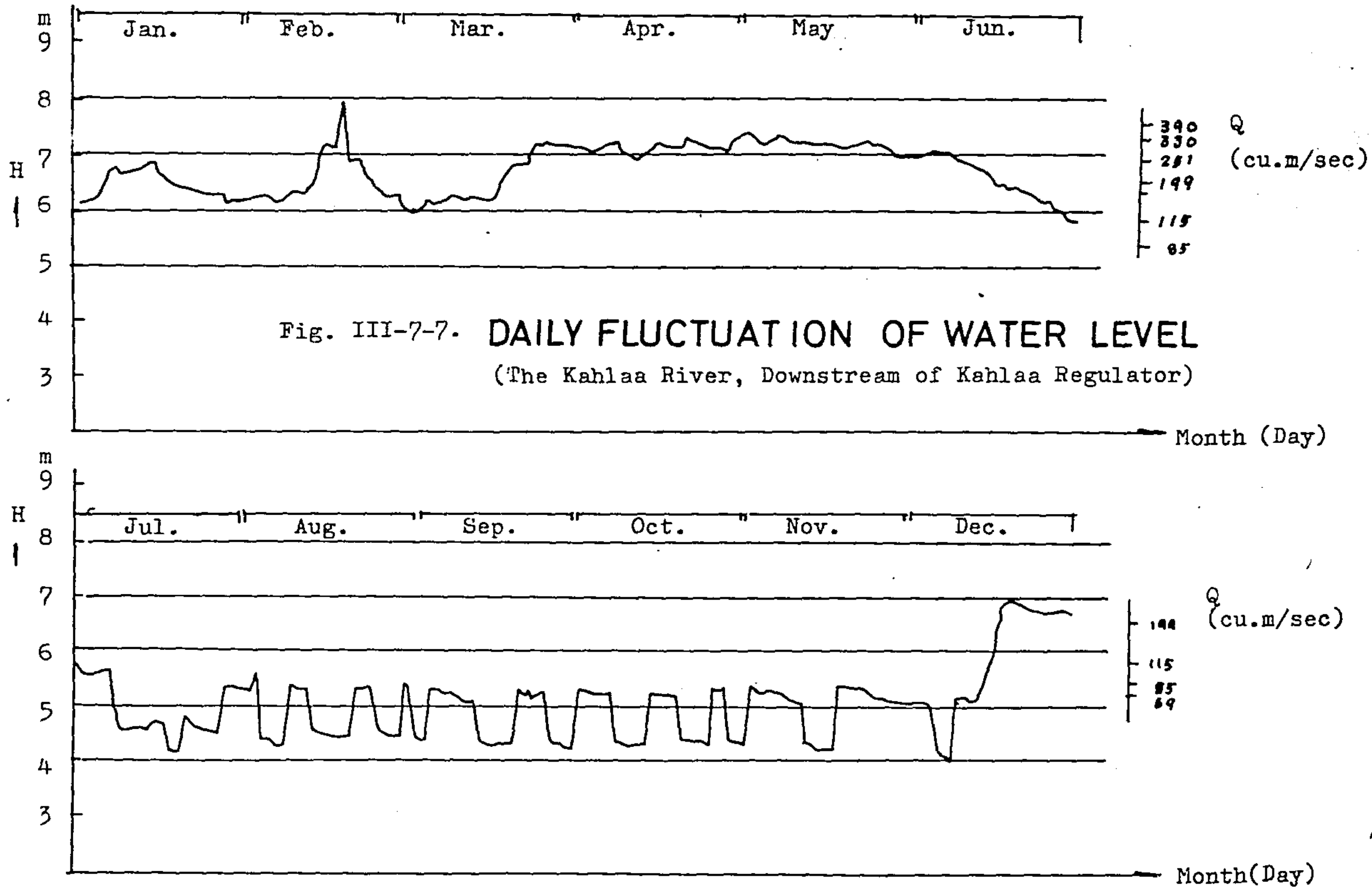


Fig. III-7-7. **DAILY FLUCTUATION OF WATER LEVEL**

(The Kahlaa River, Downstream of Kahlaa Regulator)

c) Silt

0.07 to 2.81 g/lit. According to "the Soil and Soil Conditions in Iraq," silt content of the Tigris water ranges in 0.17 to 2.3 g/lit.

d) SAR (Sodium Absorption Ratio)

0.57 to 3.02

e) Water Temperature: (the Kahlaa river)

20.8 °C Observation on November 8, 1978

15.5 °C Observation on December 12, 1979

The above-mentioned EC and SAR values suggest that the irrigation water for the Project Area falls in C2-S1 or C3-S1 of the diagram for classification of irrigation water by agriculture, Hand Bood 60, US Department of Agriculture. (See Fig. III-7-8 and -9)

Reference: Mujar Al-Kabir Water Quantity
Hydrological Survey of Iraq

For information, the quality of the Tigris, Euphrates, Diyala and Shatt Al-Arab rivers is shown below:

Table III-7-9. Water Quality of the Major Rivers in Iraq

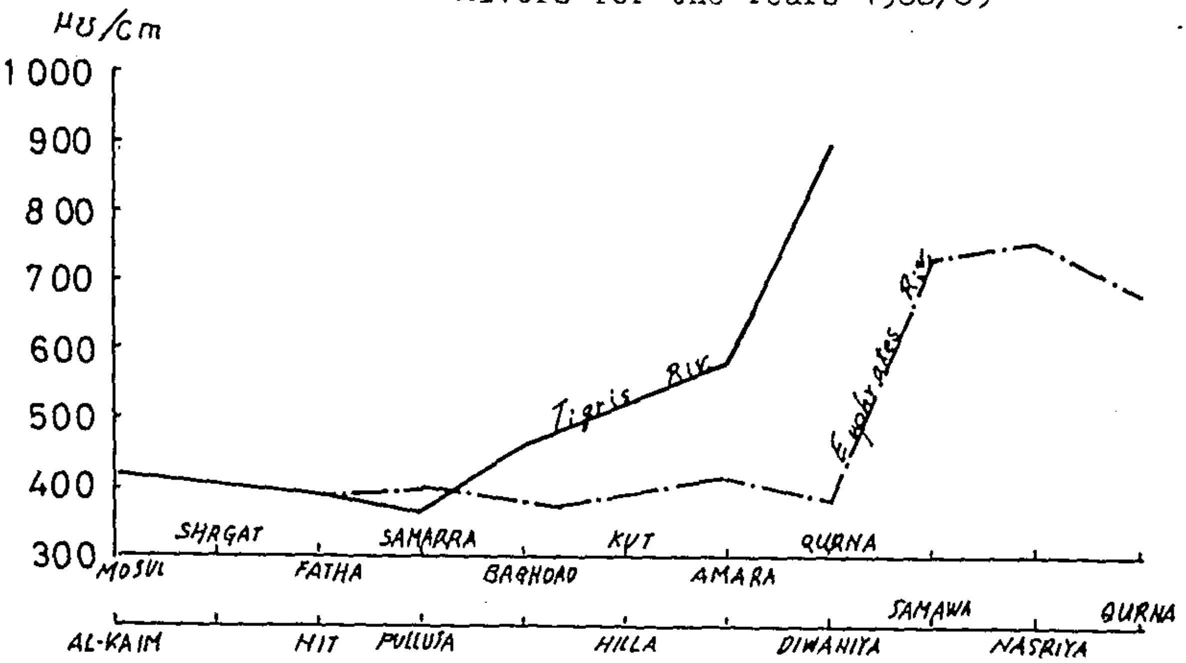
River	Location	EC (mmho/cm)	SAR	Salinity Class	Sodicity Class	pH
Tigris	Mosul	0.40	0.3	C2	S1	7.2
	Amara	0.65	-	C3	S1	-
	Qurna	-	1.5	-	-	8.5

Cont/d

River	Location	EC (mmho/cm)	SAR	Salinity Class	Sodicity Class	pH
Euphrates	Al-Kaim	0.58	0.9	C2	S1	7.2
	Qurna	0.96	2.2	C3	S1	8.6
Diyala	Ba'qouba	0.73	1.2	C2	S1	7.3
	Baghdad	1.05	1.8	C3	S1	7.9
Shatt Al-Arab	Quruna	0.90	2.0	C3	S1	7.5
	Fao	2.80	7.0	C3	S2	8.5

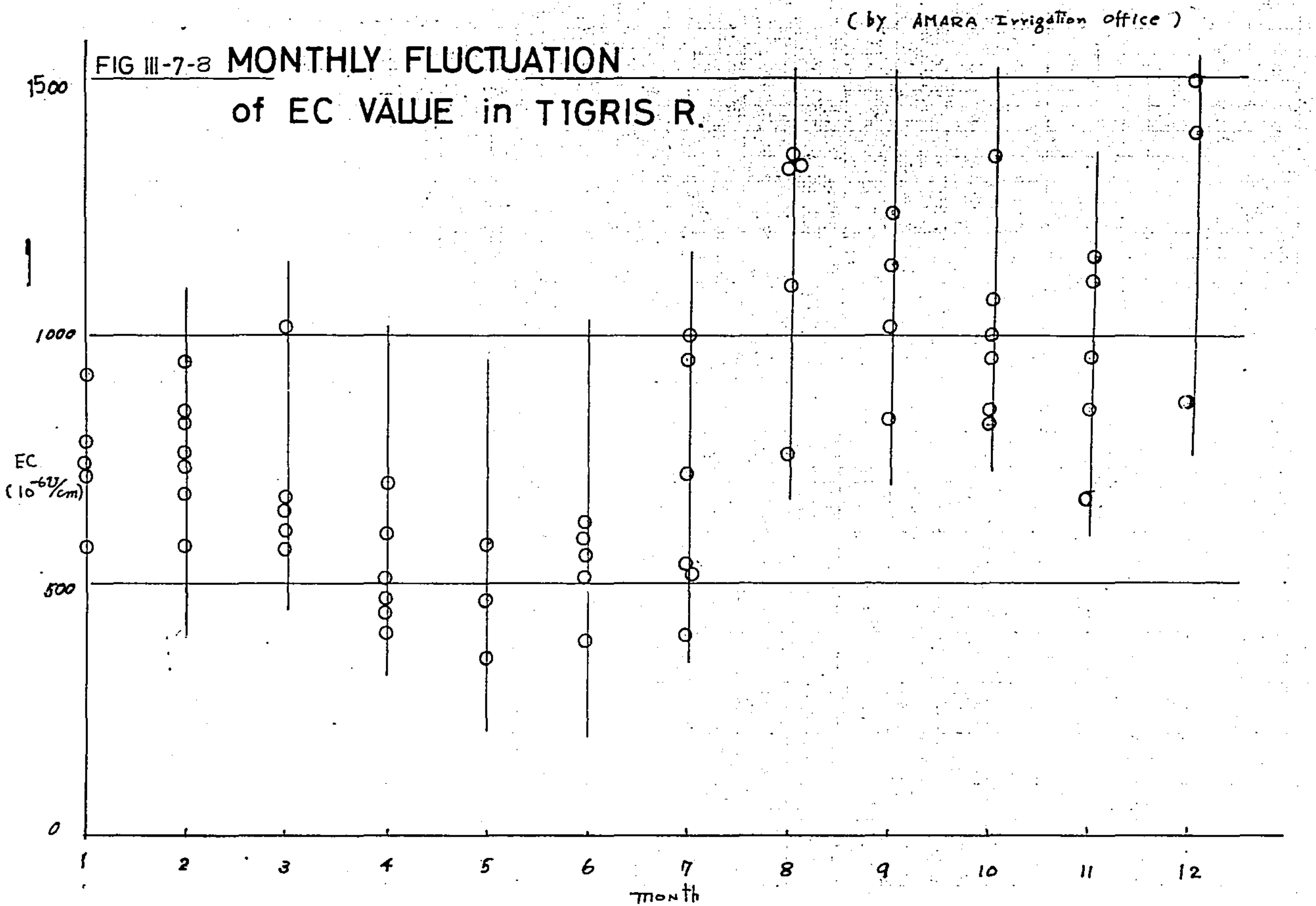
Source: Salinity Seminor, Baghdad, FAO, 1971

EC x 10^6 for the Euphrates and Tigris Rivers for the Years 1968/69



The following table shows the monthly fluctuation of water quality in the both rivers. It should be noted that the water quality of both rivers has a big seasonal difference.

FIG III-7-8 MONTHLY FLUCTUATION of EC VALUE in TIGRIS R.



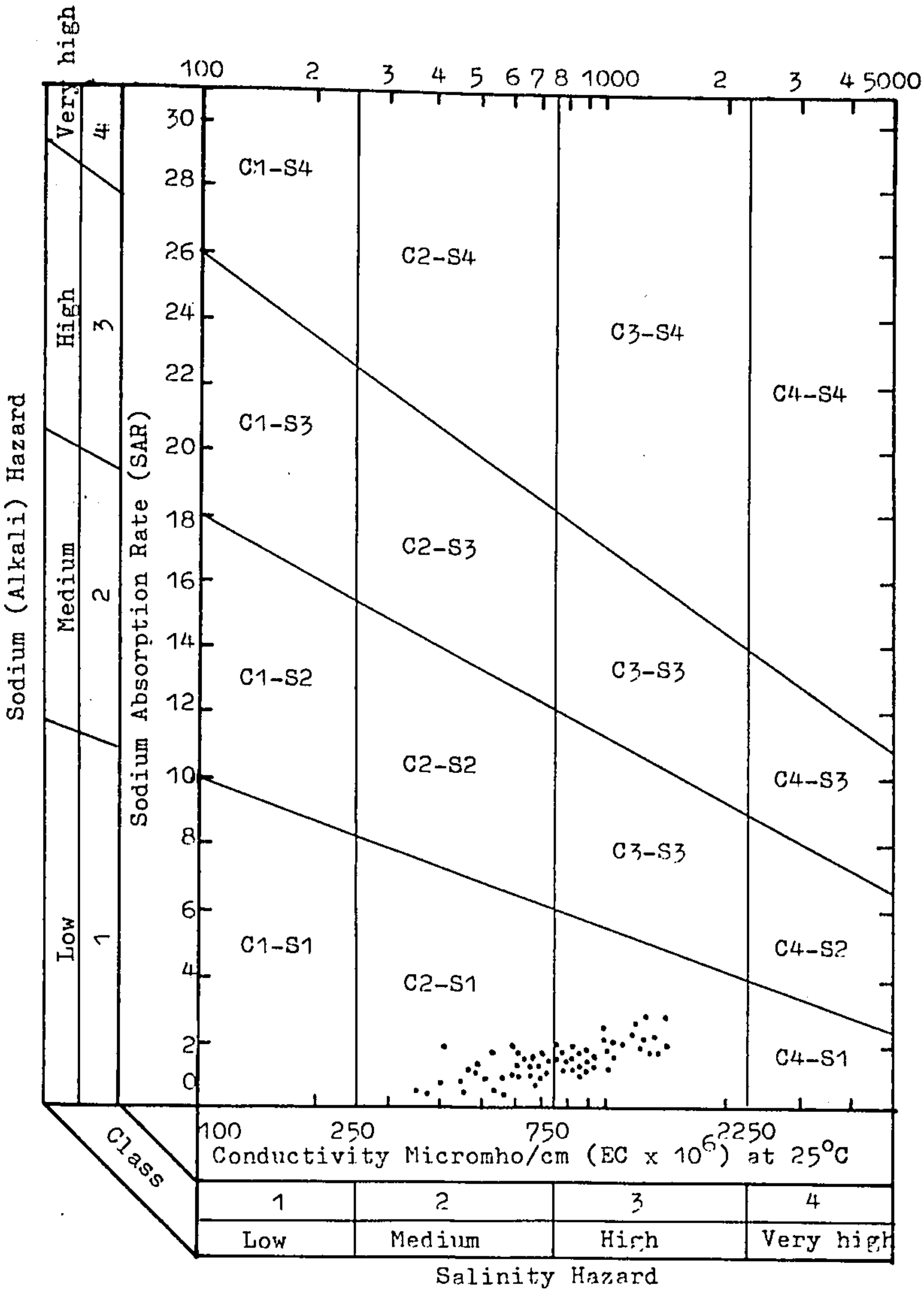


Fig. III-7-9. Diagram for the Classification of Irrigation Waters

Table III-7-10. Total Salts of the Tigris and Euphrates

River	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Tigris	250	250	220	190	190	190	230	280	300	320	330	370
Euphrates	255	228	388	484	470	422	420	410	270	394	404	296

Note: Total salts in ppm

The data on the Tigris water were collected at Baghdad. during 1924 to 1950, while the data on the Euphrates water at Fallujah in 1950.

Source: Salinity Seminar, Baghdad, FAO, 1971

The following table shows Ionic composition of the both rivers.

Table III-7-11. Ionic Composition of the Tigris and Euphrates(mm/lit)

River	Ca	Mg	Na	HCO3	SO4	Cl
Tigris	2.78	1.64	0.71	3.58	0.94	0.63
Euphrates	3.92	2.84	0.66	2.92	1.79	2.10

It has been already mentioned that salts in groundwater directly affect the salinization of soils. The quality comparison of groundwater and irrigation water at the same location is shown in the next page. In general, the groundwater in the northern part of Iraq is lower than that in the southern Iraq, and the nearer to the both rivers, the lower is the salinity, and vice versa.

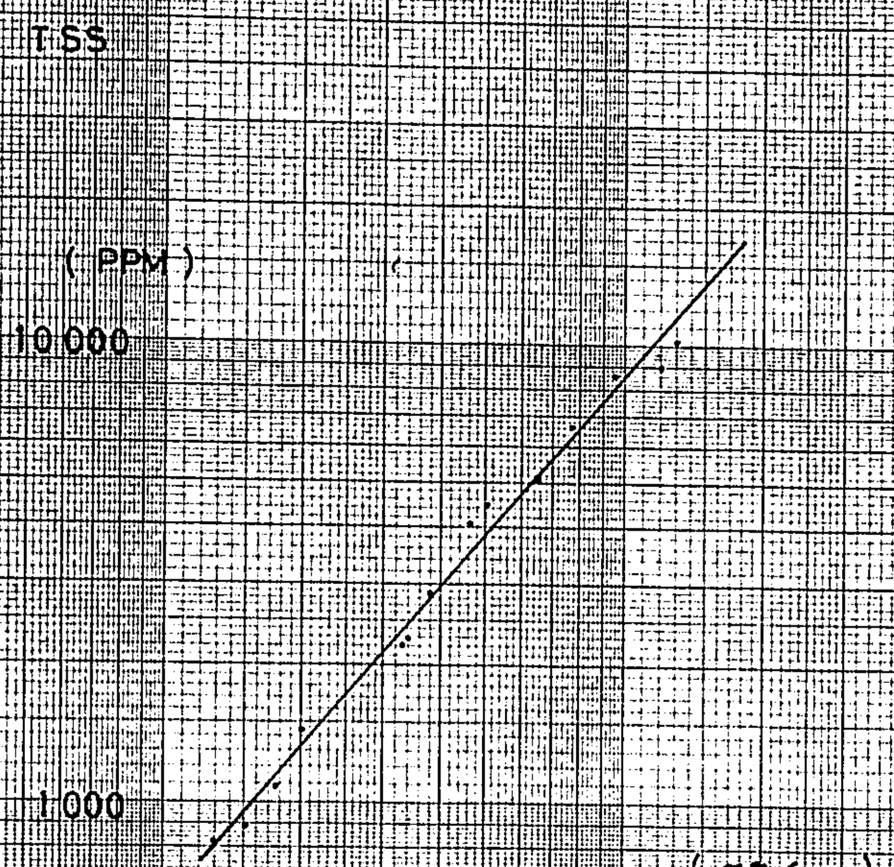
Table III-7-12. Quality Comparison of Irrigation Water and Groundwater

River and Location	EC x 10^3 (mmho/cm)	Ca	Mg	Na	Cl	SO4	HCO3	CO3
		Soluble cation and anious (me/l)						
Tigris, Baghdad								
- Irrigation water	0.04	1.6	2.4	2.8	0.9	5.6	0.8	0.3
- Groundwater	6.00	1.6	4.0	84.2	6.3	42.0	33.7	8.3
Euphrates, Yousifiyah								
- Irrigation water	0.42	2.4	0.8	0.9	1.2	nil	1.6	1.0
- Groundwater	6.90	6.0	16.0	57.6	36.0	29.0	7.7	4.5
Shatt Al-Arab, Basra								
- Irrigation water	0.75	4.0	3.4	3.7	3.6	3.6	2.6	1.0
- Groundwater	39.00	6.2	232.0	882.0	1,041.0	173.0	1.8	0.6
Sea water	60.00	22.0	122.0	524.0	588.0	64.0	2.4	1.0

Source: Salinity Seminar, Baghdad, FAO, 1971

In this report, the electric conductivity is always used as a barometer of salinization. Actually, an EC value has a very good correlation with a total soluble salt (TSS) though the correlation shows some difference by area. The relation of the EC and TSS based on groundwater survey data obtained in Rumaitha area is shown in Fig. III-7-10, which might be helpful to understand the correlation of them in Mesopotamian plain.

Fig. III-7-10. Relation of the [illegible] and TSS
Groundwater in [illegible] Area



(5) Groundwater Survey

Groundwater table and its quality were measured at test pits Nos. 1 and 3 and auger holes Nos. 4 and 5. No water was found standing in the test pit No. 2 and the other auger holes. The result of measurement is tabulated below:

Table III-7-13. Groundwater in the Project Area

Location	Depth (m)	Temperature (°C)	EC (mmho/cm)	EC at 25 °C (mmho/cm)
TP No. 1	1.5	17.3	11.80	14.03
TP No. 3	2.8	16.3	4.55	5.54
AG No. 4	1.6	24.3	9.10	9.23
AG No. 5	1.0	20.8	7.40	8.08

Note: TP: Test pit AG: auger hole

According to the observation at the end of November, 1978, the Kahlaa river surface water had the EC value of 0.78 mmho/cm at the water temperature of 21.7 °C, which is converted to 0.83 mmho/cm at 25 °C, while the irrigation canal surface water near the test pit No. 1 the value of 0.95 mmho/cm at 18.5 °C, that is, 1.09 mmh/cm at 25 °C. The result of groundwater analysis sampled at the test pit No. 1 has been already shown in Table III-7-7.

III-8. OTHER SURVEY RESULTS

The permeability test and bearing capacity measuring were conducted for the soil samples obtained at the ground surface, one meter below the ground surface and the bottom of test pits. The permeability test of samples obtained at a higher portion than the groundwater table was conducted in conformity to the Method No. 3 of the design criteria for land reclamation, the Ministry of Agriculture, Forestry and Fishery, Japan, and the same test for the samples obtained at a lower part than the groundwater table was made in conformity to the Method No. 4 of the above-mentioned. The bearing capacity test was conducted with a portable cone-penetrometer at each 10 cm deep. The bearing capacity at almost every testing depth was too high to peneturate the cone into soils by man-power. The permeability and bearing capacity at each testing or measuring point are tabulated below:

Table III-8-1. Permeability and Bearing Capacity

Place	Depth	Permeability		Bearing Capacity
		Method *1/	Permeability (cm/sec)	(kg/sq.cm)
TP No. 1	0.0	No.3	1.61 x 10 - 4	10 cm: 6.3
				20 cm: 8.7
				50 cm: 9.8
				60 cm: 10.8

Cont/d

Place	Depth	Permeability		Bearing Capacity (kg/sq.cm)
		Method *1/	Permeability (cm/sec)	
TP No. 1	0.5	-	-	
	1.0	No. 3	1.32 x 10 - 3	10.8
	1.6	No. 4	5.27 x 10 - 3	10.8
TP No. 2	0.0	No. 3	9.56 x 10 - 4	10 cm: 4.5 15 cm: 10.8
	1.0	No. 3	5.92 x 10 - 4	10.8
	3.0	No. 3	1.24 x 10 - 4	10.8
TP No. 3	0.0	No. 3	5.18 x 10 - 4	10.8
	1.0	No. 3	9.25 x 10 - 5	10.8
	2.8	No. 4	2.71 x 10 - 3	10.8

Note: TP: Test pit

*1/ Method Number of the design criteria for land reclamation, the Ministry of Agriculture, Forestry and Fishery, Japan

III-9. MAPS

A topographic map of Amara area was prepared by the CEKOP in 1962. Based on this map, a 1/10,000 topographic map with 25 cm contour of the Project Area is now under preparation by the Topo-survey Office, the Government of Iraq. This new map will consist of ten sheets. Three sheets, which cover the main portion of the Project Area are under printing as of the middle of February 1979, and the remaining seven sheets are scheduled to be completed in the early April of this year 1979.

The maps obtained during the Field Survey period, aparting from the above-mentioned, are;

a) Mosaic Photograph (1/10,000), 10 sheets for the whole Project Area, which was also prepared by the Topo-survey Office

b) Aerial Photograph (1/35,000), 31 sheets for the whole Project Area, prepared by the Topo-survey Office

III-10. SELECTION OF THE PROJECT AREA

Indispensable conditions of a rice farm project area might be as follows;

a) The area has unity in the aspects of irrigation and drainage systems as well as administration;

b) The area has a favorable geological and soil condition for paddy growth;

c) The area is advantageous in securing necessary irrigation water;

d) The area has a favorable drainage condition;

e) The area is not isolated socially and economically so that the impact of the project will spread over the neiborhood; and

f) The whole area has no hinderance in construction of farm fields.

Taking into consideration the above-mentioned conditions, it is recommeded to set the westeen bounds of the Project Area along the Kahlaa river, water source river for the proposed rice farm, the western bounds along the boundary with Al-Chika marsh to which drainage water will be pumped up after the implementation of the Project, the northern bounds along the northern most of the Gasma river service area and the southern bounds along the southern most of the Al-Fawahiya river service area, which is also the southern boundary of the jurisdiction of Al-Mabade Cooperative. So, the selected area of a deformed triangle shape somewhat enlarged to the direction of the north to south is almost the same to the proposed Field Survey area, which is called "the Project Area" in this report, and the whole area belongs to Al-Mabade Cooperative.

Kahlaa city is located within the primary economic life sphere of people in the area. Moreover, Amara city, the center of Missan province in every aspect, is situated with the distance of 15 km from it. Therefore. this city will play a role of the core city of the Project Area, with the betterment of transportion and communication systems, for operation and management of this rice farm inclusive of maintenance aspect of agricultural production facilities and also daily lives of officials and laborers. Final determination of the Project Area should be made based on the soil and topographic survey now on the way at Iraqi side.

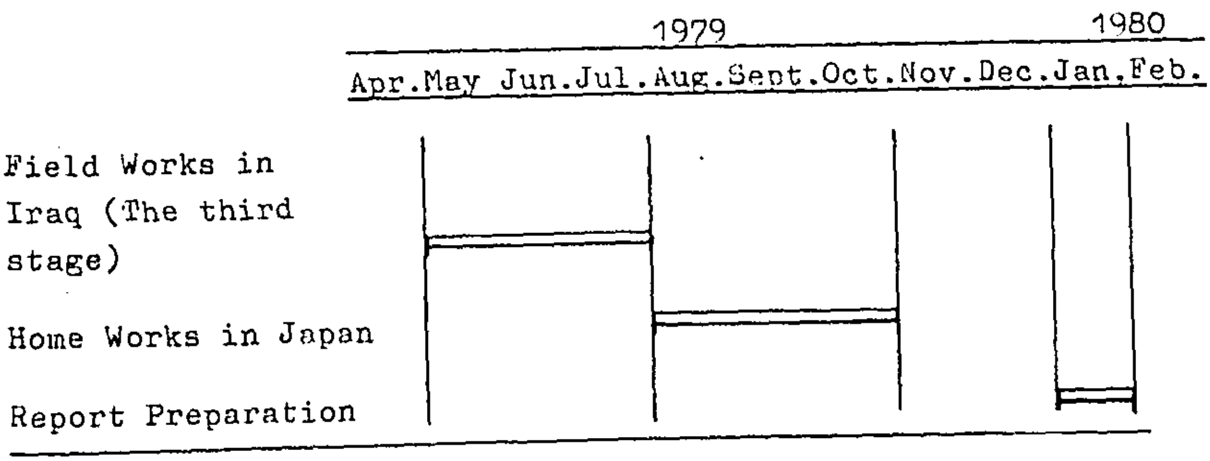
CHAPTER IV. SCHEDULED STUDY

IV-1. FEASIBILITY STUDY

The dispatchment of the major force of the feasibility study team for Kahlaa Rice Farm Project is scheduled in the middle of this year 1979. The study team will carry out the field investigation in Iraq for three months, and, in Japan, formulate the Project plans inclusive of preliminary design of the rice farm and verify the technical and economic feasibility of the Project. The draft feasibility report of the Project will be submited to the Government in the later part of 1979, and the final feasibility report in January 1980.

IV-2. WORKS SCHEDULE

The work schedule for the feasibility study is as follows:



IV-3. SUBJECTS IN THE STUDY

(1) Organizational Aspect

The construction of a large scaled rice farm having a service area of 8,000 Ha is a new type of agricultural development in Iraq. The line-up of technical staff will be prerequi- for successful implementation of the Project. It is expected that a project team consisting of a sufficient number of engineers and specialists, who can exclusively engaged in the Project, will be organized at Iraqi side from the feasibility study stage. The training of paddy specialists should be started at the soonest possible.

(2) Preparation of Basic Data

Topographic and soil maps are the most important basic data for plan formulation of the rice farm. As for the topography, the major part of the map preparation works has been completed by the Government as of February 1979. Regarding the soils, survey for the two-third of the Project Area has been completed. It is hoped that the remaining works for both will be completed as soon as possible. The movement of Al-Chika marsh would give a big influence on the Project, so it is requested to conduct the topographic survey and water level observation of the marsh for the plan formulation.

(3) Irrigation Water

In arid zone a yield of crops depends directly upon a water volume to be supplied. Specially, irrigation water is of vital importance in paddy production. According to the observation data of Amara Irrigation Office, the total discharge of the Kahlaa river, water source for the Project Area, decreases to 25 cu.m/sec in the low water seasons during the paddy growth period. In consideration of necessary water volume for irrigation in the lower basin of the Project Area, this discharge seems not sufficient for the Project. Under the circumstances, the water distribution in the entire lower Tigris river system should be carefully reviewed in order to secure necessary water for this Project Area.

APPENDIX I. LABORATORY ANALYSIS

(1) Soil Analysis

Soil analysis was conducted at the Central Laboratory, SOSLA, in accordance with the request of the Field Survey Team. The number of samples and sampling points are shown below; (Regarding the location of test pits and auger holes, turn to the next page.)

Sampling Points	No. of Samples
TP-1	3
TP-2	4
TP-3	6
Total	13

Sampling Points	No. of Samples
AG-1	7
AG-2	7
AG-3	8
AG-4	3
AG-5	4
AG-6	7
AG-7	7
AG-8	6
AG-9	6
AG-10	8
Ttoal	63

(2) Water Analysis

Water sampling was carried out at the Kahlaa river, test pit No. 1 and Al-Chika marsh on December 28, 1978, and the analysis was requested to the above-mentioned laboratory. The results are tabulated on page -3-.

LOCATION OF TEST PITS AND AUGER HOLES

RESULTS OF SOIL ANALYSIS (1979)

Samp. name	Depth in cm	EC_e (mU/cm)	TSS (PPM)
TP_1	0~20	2.12	2,860
TP_2	1~5	7.71	9,240
TP_3	0~30	5.78	8,130
AG_1	0~15	19.8	28,650
AG_2	0~20	3.34	3,400
AG_3	0~10	67.8	63,870
AG_4	210~240	5.64	6,240
AG_5	0~20	49.8	54,780
AG_6	0~20	57.1	74,670
AG_7	0~20	3.17	4,230
AG_8	0~20	45.7	49,970
AG_9	0~40	63.5	81,850
AG_{10}	0~20	105.4	183,440

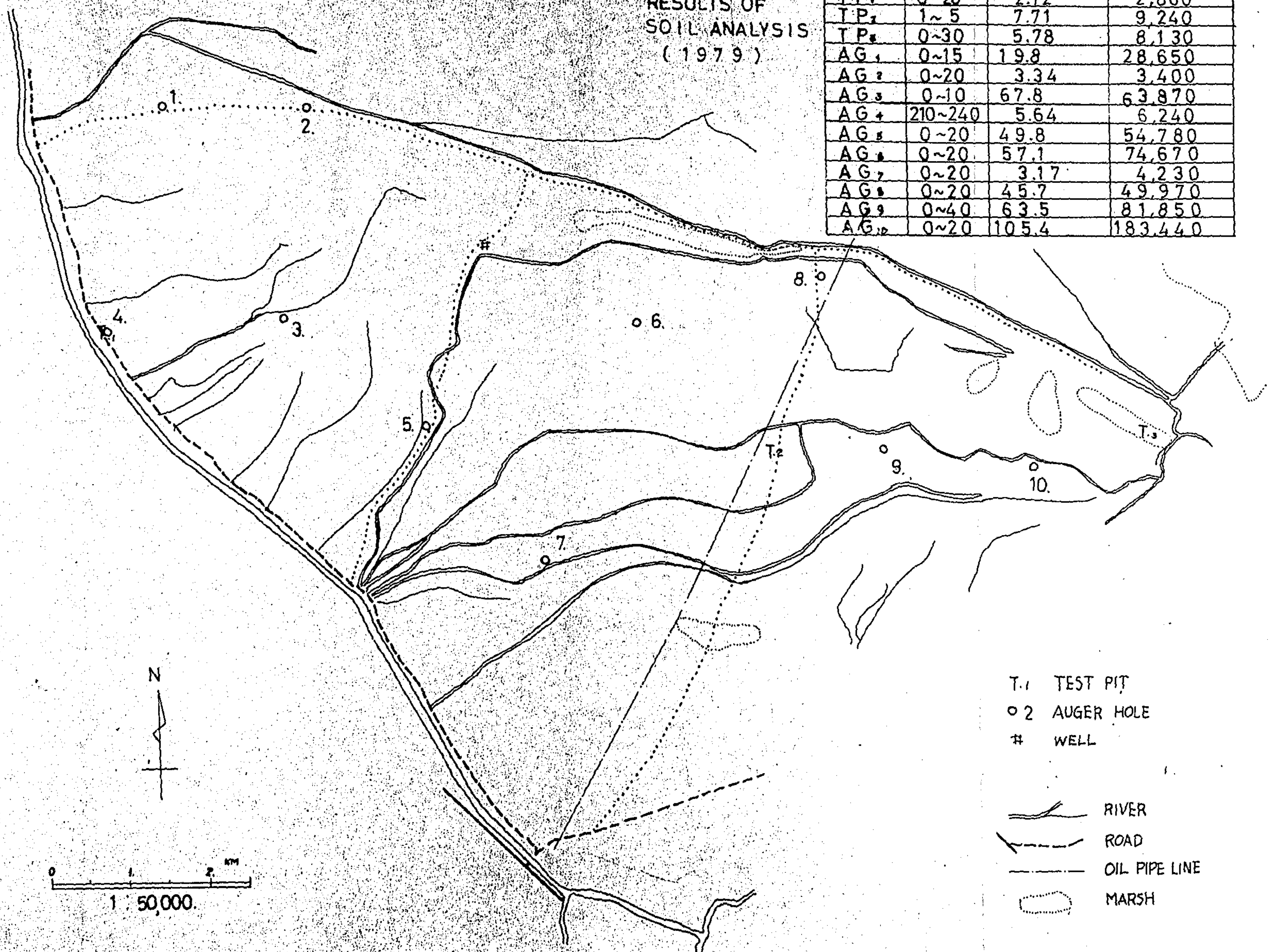


Table A-1. Water Analysis

Analytic Item	Kahlaa water	Groundwater	Marsh water
P.H.	7.9	8.1	8.1
EC (mmho/cm)	0.874	11.916	2.780
Calcium (me/lit)	4.8	24.0	10.0
Magnesium (me/lit)	2.0	72.0	10.4
Sodium (me/lit)	2.9	92.0	14.8
Kalium (me/lit)	0.07	0.89	0.15
Chloride (me/lit)	2.2	59.0	15.0
Sulphate (me/lit)	4.8	114.0	16.0
Bicarbonate (me/lit)	2.6	5.6	4.8
CO_3	0	0	0

APPENDIX II. EXCHANGE OF VIEWS AT THE UNIVERSITY OF BASRA

The Field Survey Team had an opportunity to exchange views on general agriculture in Iraq with Dr. Mohammed A Al-Najim, Dean of the Agriculture College, University of Basra on January 20, 1979. The major information obtained is briefly described herein:

(1) Saline Soils and Desalinization

Soils of the lower Mesopotamian plain have been salinized to a great extent. The soil salinization is one of the pressing problems in agriculture of Iraq. Soil salinity is severe as go to the lower basins of the Tigris and Euphrates. It is not rare in the neighborhood of Basra that soils have an EC value of more than 100 mmho/cm. The soil salinity in Amara city, which ranges in 8 to 26 mmho/cm, is much lower than that in Basra district. The best method for improvement of saline soils is leaching with water. The SOSLA is responsible for experiment of desalinization of soils by leaching. The dean advised the team to contact to two personnel of the SOSLA for further information on leaching.

(2) Land Systems

The land systems in Iraq are roughly as follows:

a) Cooperative System

A member farm house-hold of an agricultural cooperative association occupies a unit farm field of about 30 donam, out of which 28 donam should be cultivated with a designated crop under the Governmental agricultural production program. Such farm house-hold can cultivate the remaining two donam with any crops. The present Project Area has adopted this system.

b) Group Farming System

A group of 30 to 50 farm house-hold occupies a farm field of about 1,500 donam, and cultivates it with a special crop designated under the Governmental agricultural production program.

c) State Farm System

All who work in a state farm are salaried public officials. Most large-scale state farms have adopted this system.

(3) Fertilizers

The extension services for fertilizer application have been carried out by the Government. The following quantity of fertilizers is applied as a rule:

P_2O_5:	60 kg/donam in basal dressing
N:	25 to 30 kg/donam as additional manure

Iraq has a sufficient production capcity of these fertilizers. The production of fertilizers is mainly made in Basra area. One-third of the production is domestically consumed, and the remaining two-third is exported to the other Arablic countries.

(4) Water Quality

The water quality of the upper Tigris and Euphrates rivers is much different from that in the lower reaches of these rivers. Salt content of the Shatt Al-Arab is so high as 1,400 to 1,800 p.p.m, but that in Amara area is much lower than this. The salt content of water in Amara area is mostly less than 1,000 p.p.m, which will bring about no problem in the aspect of water quality for irrigation. Moreover, Amara area is fortunate with water volume in comparison with Basra area. Careful study should be conducted, if the marsh water is utilized for irrigation and also for leaching since it contains some Na_2CO_3, and furthermore, its EC value is somewhat of troublesomeness.