FEASIBILITY REPORT
ON
KAHLAA RICE FARM PROJECT
IN
THE REPUBLIC OF IRAQ

(MAIN REPORT)

MARCH, 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request in December 1976 of the Government of the Republic of Iraq, the Government of Japan decided to conduct a survey on rice farming in Iraq.

The Japan International Cooperation Agency, entrusted by the Japanese Government to carry out the survey, dispatched to Iraq a preliminary survey team in June 1977. The team surveyed the possibility of increasing rice production in the southern part of the country. It selected Najaf and Missan Provinces as areas suitable for development and made a suggestion to conduct a feasibility study on a rice farm project there.

The Government of Iraq, recognizing the importance of a modern rice farm project, requested the Japanese Government in April 1978 to conduct a feasibility study on a project to establish a mechanized rice farm in the Kahlaa District near Amara City, Missan Province.

The JICA dispatched to Iraq in October 1979 a feasibility study team headed by Mr. Daizo Iseno of Sanyu Consultants Inc. The present report is based on the results of the study as well as of the consultations with officials of the Government of Iraq.

I sincerely hope that this report will prove to be useful as a basic reference for development of the project.

I am particularly pleased to express my appreciation to the officials concerned of the Government of the Republic of Iraq for their close cooperation extended to the Japanese team.

March 1980

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency

Mr. Keisuke Arita
President,
Japan International Cooperation Agency,
Tokyo, Japan

Date: 10 March, 1980

LETTER OF TRANSMITTAL

Subject: Final Report of the Feasibility Study on Kahlaa Rice Farm Project in the Republic of Iraq

Dear Sir;

We have the honor of submitting herewith the captioned report, outcome of our three months' field survey from June 20 to September 14 and 80 days' home office study to establish a state rice farm of about 8,100 ha located some 20 km south of Amara city, Missan province and to materialize an effective farm management system for paddy production supported by large-scaled farm mechanization.
This report has been prepared based on various discussions made between the Governmental agencies concerned and us.

This report is comprised of the two volumes as follows;

Volume 1. Main report
Volume 2. Appendix

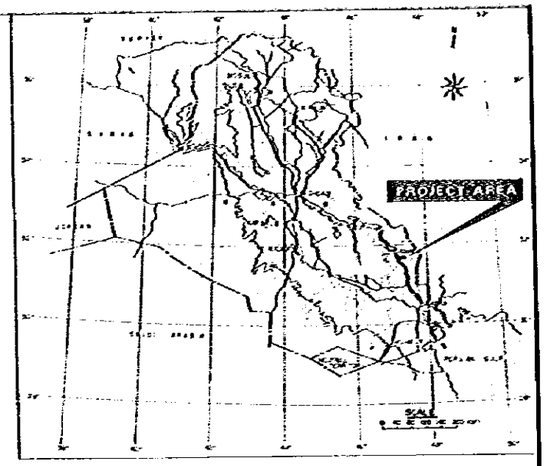
We sincerely hope that this rice farm project would be helpful in future agricultural development to be implemented in the lower Mesopotamian plain and could contribute to the social and economic development in the area involved as well as to promotion of friendship between the two countries.

Finally, we take this opportunity to express our deep gratitude to the both Governments' agencies concerned for their valuable assistance and cooperation extended to us throughout the survey period and in compilation of this report.

Respectfully yours,

Daizo Iseno
Team Leader for Kahlaa Rice Farm Project

PROJECT MAP FOR KAHLAA RICE FARM PROJECT



FARM BLOCK 1

FARM BLOCK 2

FARM BLOCK 3

FARM BLOCK 4

EXISTING OIL PIPE LINE

AL-DHKA MARSH

TO AMARA

KAHLAA RIVER

TO KAHLAA

PROJECT OFFICE AND FARM FACILITIES

LEGEND

- EXISTING ROAD
- EXISTING OIL PIPE LINE
- MAIN AND SECONDARY IRRIGATION CANALS
- TERTIARY IRRIGATION CANALS
- MAIN AND SECONDARY DRAINAGE CANALS
- GREEN BELT
- MAIN ROAD
- DIKE
- SERVICE ROAD
- RAILWAY
- IRRIGATION PUMPING STATION
- DRAINAGE PUMPING STATION
- REST HOUSE PLACE
- PROJECT OFFICE AND FARM FACILITIES
- FARM OPERATION BASE

SCALE

0 0.5 1.0 1.5 2.0 KM

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ABBREVIATIONS AND GLOSSARY

mm	:	millimeter
cm	:	Centimeter
m,	:	meter
km	:	kilometer
sq.cm, cm^2	:	square centimeter
sq.m, m^2	:	square meter
sq.km, km^2	:	sqaure kilometer
MSM, $10^6 m^3$	:	million square meter
Donum	:	Iraq unit of area, 1 Donum = 0.25 ha
l , lit	:	liter
cu.m, m^3	:	cubic meter
MCM, $10^5 m^3$	:	million cubic meter
lit/sec	:	liter per second
cu.m/sec	:	cubic meter per second
lit/sec/ha	:	liter per second per hectare
m/s	:	meter per second
PPM	:	part per million
mm/hr	:	millimeter per hour
mm/d	:	millimeter per day
m/ha	:	meter per hectare
t/ha	:	ton per hectare
kg/ha	:	kilogram per hectare
kg/cm^2	:	kilogram per square centimeter
mmho/cm	:	millimho per centimeter
g	:	gram
kg	:	kilogram
ton, m.t	:	metric ton

EL	:	elevation above mean sea level
MSL	:	mean sea level
FWL	:	full water level
HWL	:	high water level
sec.	:	second
minu.	:	minute
hr.	:	hour
min.	:	minimum
max.	:	maximum
%	:	per cent
No.	:	number
°C	:	degree centigrade
°F	:	degree fahrenheit
Cl	:	chlorine
HP	:	hourse power
ET	:	evapotranspiration
N	:	nitrogen
P	:	phosphorus
K	:	potassium
A.S.	:	ammonium sulphate
T.S.P.	:	triple super phosphate
O & M	:	operation and maintenance
B/C	:	benefit-cost ratio
F/Y	:	fiscal year
I.D.	:	Iraqi Dinar (US$3.38)
US$	:	United States Dollar (0.2961 I.D.)

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Background of the Project

1. The Republic of Iraq has the national land of about 440,000 sq.km. Its population is about 12 million. The per capita income is 942 US$ equivalent as of 1974.

2. Iraq has a vast and flat cultivable area of 12 million hectares in total. However, the present area under cultivation is 5.7 million hectares, that is, nearly a half of the cultivable area. Furthermore, the cropping area excluding fallow is 3.5 million hectares.

3. Wheat, barley and paddy rice are the major crops in Iraq. However, Iraq is presently an importer of the two major crops of wheat and paddy rice. Wheat of 512,000 tons and paddy rice of 120,000 tons were imported in 1975 to meet the domestic demand of these agricultural crops.

4. Agricultural production in Iraq much depends on irrigation and soil fertility. Salt accumulation on farm land is one of the major restrictive factors in agricultural production.

5. Farm land is classified, based on irrigation methods, into a rainfed area, natural irrigation area adjacent to river courses and artificial irrigation area by pump, etc. The statistic data indicate that about a half of the total farm land is rainfed, 30% is naturally and 20% is artificially irrigated as of 1976.

6. Agricultural production in Iraq has been carried out by private farmers, cooperative farmers, group-farmers and state farms. The number of state farms as of 1974 was eight, and totally farm land of 77,000 hectares belonged to the eight farms.

7. The Five-Year National Economic Development Plan, 1975 to 1980, aims at the annual growth rate of 7.1% in the agricultural sector. The Government has planned a sharp increase of rice production

from 60,000 tons to 480,000 tons during the five-year period.

8. The Government has positively started development in the agricultural sector, and various irrigation and drainage projects are on the way for an increased agricultural production through mechanized farming to attain self-sufficiency of the major crops.

Project Area

9. The Project Area is located about 400 km south-east of the capital city, Baghdad. In more detail, it is situated at 20 km south of Amara city, Missan province, and it is a part of Amara irrigation project.

10. The Project Area is a part of the Amara delta formed by floods from the Tigris and its tributaries. The Kahlaa river, a tributary of the Tigris, runs along the eastern boundary of the Project Area.

11. Amara city is located in the middle of the National road No. 6 connecting Baghdad and Basra, the biggest port town in Iraq.

12. The population in Missan province as of 1977 has been estimated at about 370,000. In general, the rural population has decreasing whereas the population in big cities in Iraq is increasing.

13. Soils in the Project Area are Quaternary alluvial ones formed by sedimentation of suspended materials transported by the Tigris and its river system. The Project Area has a quite gentle slope of about 1/10,000, and its elevation ranges in E.L. four to seven meters.

14. Soils in the Project Area are mostly silty loam brown in color, and salinized, more or less, due to continuous over-irrigation since old days and a great deal of evaporation of groundwater.

15. Climate in the Project Area is of continental arid zone-type characterized by short and cold winters and long and extremely hot summers. The averaged annual temperature is 23.9°C, but the monthly temperature in July when paddy grows is 35°C with the maximum of more than 50°C. The averaged annual precipitation

is 171 mm, and it rains concentratedly in winter seasons. The averaged annual wind velocity is 4.3 m/sec. Burning winds come from the north-west during May to September.

16. The Kahlaa discharge ranges in the maximum of 470 cu.m/sec to the minimum of 20 cu.m/sec. The Tigris discharge is controlled by Kut regulator and the Kahlaa water by Amara regulator. High water seasons come in March to June whereas low water seasons from September to November. The electric conductivity of the Kahlaa water is in the order from 0.47 to 1.27 mmho/cm.

17. Irrigation in the Project Area has a long history, but the facilities are primitive and poor. The Project Area has no drainage facilities.

18. The averaged cropping area per farm household is about 6.0 ha. Mainly, barley, wheat, sorghum, broad bean and tomatoes are grown. Paddy is partially raised, but its cropping area is very small.

The Project

19. The Project aims to construct a state rice farm having the total area of 8,160 ha (with the cultivated area of 6,300 ha), and to establish an effective technical farm management system for paddy production supported by large-scaled farm mechanization.

20. The first priority in the Project planning has been given to paddy cultivation, however, upland crops of wheat and barley will be partially raised as the second crops of paddy. The target yield of unhulled rice has been determined at 4.5 tons. The gross production is estimated at 27,900 tons per year, accordingly. The total production of barley and wheat will be 5,300 tons.

21. All farm practices from plowing to havesting will be mechanized consistently and systematically. Farm machinery of 453 units or 22 types will be introduced such as tractors, drill seeders, combines, etc.

22. The water source of the Project is the Kahlaa river, a tributary of the Tigris. The water of 27.0 cu.m/sec required for the Project will be diverted from the Tigris river to the Kahlaa river, and lifted to the Project area by pump. For silt treatment of the river water, a desilting reservoir of about 40 ha will be constructed.

23. As for irrigation, the flood irrigation has been planned for paddy cultivation. The peak net water requirement has been computed at 36.6 mm/day or 4.24 lit/sec/ha. The total water requirement inclusive of necessary water for upland crops and trees in wind-breakers has been calculated at 311 million tons.

24. The construction of drainage facilities is prerequisite for agricultural development in saline soil zones. Since the precipitation is extremely small, the drainage facilities in the Project will mainly function to remove leaching water, surplus irrigation water and groundwater. The total drainage discharge of 5.4 cu.m/sec, or 0.81 lit/sec/ha will be delivered to Al-Chikke marsh by pump.

25. Wind-breakers have been planned to protect agricultural crops from burning north-west winds prevailing around the Project Area.

26. Farm plots for flood irrigation have been planned for paddy cultivation. The size of a farm plot will be 1.5 ha of 150 m x 100 m.

27. Farm management will be independently conducted in each of four farm operation units.

28. The rice farm will require 130 officials, 60 skilled laborers, 110 unskilled laborers and 20 to 70 man-days of seasonal laborers. The labor requirement per annum is estimated at 44,000 man-days.

29. The construction of an experimental farm with the area of 90 ha has been planned to conduct various researches, experimentations and seed production required for the rice farm.

30. The proposed major facilities are as follows:

o	Irrigation canals:	Main irrigation canals	14 km
		Secondary irrigation canals	31 km
o	Drainage canals:	Main drainage canals	16 km
		Secondary drainage canals	46 km
o	Desilting reservoir:	Water depth (one unit)	1.5 m
		Reservoir area	40 ha
o	Roads:	Main roads	25 km
		Service roads	173 km
o	Pump facilities:		
	Irrigation pump -	Total discharge	27 cu.m/sec.
		Bore diameter	ø 1,000 mm
		Unit	11
	Drainage pump -	Total discharge	5.4 cu.m/sec.
		Bore diameter	ø900 mm
		Unit	Three
o	Incidental structures to canals:	Diversion boxes	43 units
		Checks	4
		Spillways	6
		Road crossings	38
o	On-farm facilities:	Irrigation ditches	65 m/ha
		Farm drains	56
		On-farm roads	100
		Underdrains	243
o	Wind-breakers:	Permanent	290 ha
		Supplemental	40

o Buildings:	Farm management office	2,000 sq.m.
	Farm warehouse	2,500
	Experimental warehouse	300
	Workshop	2,400
	Pest house	300
	Warehouses in farm management bases (two)	1,000

31. The construction of rice processing center, village for state farm employees and bridge across the Kahlaa river has been planned in relation with the Project.

Project Cost and Benefit

32. The Project cost has been estimated at 20,271,000 I.D. or 68,516,000 US$ based on the prevailing price rates as of October 1979 disregarding the price escalation. The Project cost consists of the foreign currency portion of 12,221,000 I.D. or 41,307,000 US$ and the local currency portion of 8,050,000 I.D. or 27,209,000 US$.

33. The benefit accrued from the Project will be an incremental production of paddy, wheat and barley. The target yields will be attained in the sixth year from the commencement of cultivation. The annual incremental benefit has been estimated at 1,901,000 I.D or 6,421,000 US$.

Project Evaluation

34. The project has been evaluated economically feasible from the viewpoints of the prevailing investment standard in Iraq, internal rate of return and B/C ratio.

o B/C ratio

Internal Rate	Economic	Financial
3 (%)	1.39	1.08
5	1.11	0.81
8	0.81	0.68

o Internal Rate of Return (%) 6.2 6.0

Recommendations

Wide-ranged recommendations have been made as follows:

1. Land acquisition for construction of the rice farm should start at the soonest possible.

2. The Project team should be organized for implementation of the Project in the way to strengthen line-up of the Missan Agriculture Office.

3. The major crop to be grown in the Project is paddy rice. Mainly Amber varieties will be raised. However, in order to elongate paddy cropping seasons, the other varieties inclusive of IR varieties will be grown in the Project for the time-being. Efforts should be made to separate the early, medium and late-maturing lines of Amber so that only Amber will be raised in the Project in future.

4. Paying careful attentions to weed control and soil fertility, a rationalized cropping focusing upon paddy should be established.

5. Detailed soil survey should be further conducted covering the whole Project Area.

6. In parallel with the rice farm construction, an experimental farm should be installed to let it systematize farm management techniques, breed and maintain basic seed, conduct paddy yield trials, establish a leaching method and conduct education and training of paddy experts, etc.

7. Self-sufficiency of high quality seeds within the farm has been planned. This plan has a special importance in the Project. Efforts in upgrading seed breeding techniques should be emphasized.

8. The rice farm staff and officials in charge of the water source management in the lower Tigris system should always have close contact each other in order to secure, with priority, a necessary quantity of irrigation water in the Project (in relation with Amara Irrigation Project).

9. Special attention should be paid to afforestation.

10. As a related facility to the Project, Kahlaa bridge should be constructed as soon as possible for smooth construction in the Project.

11. As a related facility to the Project, a rice processing center should be constructed in parallel with the progress in construction works in the Project.

12. As a related to the Project, a village for farm staff mobilized from outside the Project Area and farmers presently living in the Project Area should be constructed as soon as possible.

13. Consultants with rice experience in agricultural development for rice production should be employed for smooth execution of the Project.

CHAPTER I. INTRODUCTION

General Outline

The Republic of Iraq has achieved a remarkable development in its mining sector, specially in the petroleum industry. On the contrary, agriculture has been left behind in progress mainly due to difficulties in dealing with severe natural conditions. In order to attain a well-balanced economic development and to cope with an increasing population, agricultural development for self-sufficiency of major crops is one of the national target of Iraq. The Government of the Republic of Iraq (hereinafter called "the Government") has taken it up in the Five-Year National Economic Development Plan (NEDP), 1975 to 1980, and energetically started various agricultural development projects. Above all, rice is one of the main cereal foods in Iraq, and the Government has planned to expand the present paddy cropping area of about 30,000 ha to 140,000 ha within the NEDP period.

Background of the Project

In accordance with the request of the Government for technical assistance in establishment of a state rice farm, a long-cherished-agricultural development plan, the Government of Japan dispatched a preliminary survey mission for agricultural improvement headed by Mr. Motonaga Ohto, and let it study possible ways to increase rice production in Iraq. Based on the preliminary survey report, the Government made a request to the Government of Japan for technical cooperation in execution of the feasibility study on establishment of a mechanized state rice farm in Amara City, Missan province.

The Japan International Cooperation Agency, executing agency of the Japanese Government for overseas technical assistance, made a contract with Sanyu Consultants Inc., for execution of the feasibility study, and dispatched two study teams lined up by engineers and experts of the said consulting firm, one team for basic data collection and preliminary study and the other for plan formulation and technical/economic studies on the feasibility of Kahlaa Rice

Farm Project.

Objective and Scope of the Feasibility Study

The feasibility study on Kahlaa Rice Farm Project was conducted to establish a rice farm of about 8,160 ha in Amara, Mission. Since basic data collection and preliminary study were already carried out from October 1978 to February 1979 as a part of this feasibility study, the study this time was focussed on supplemental data collection, survey on present land/water utilization for agriculture in summer seasons, soil survey and the Project plan formulation based on such studies and surveys.

Advisory Group and Feasibility Study Team

The feasibility study team conducted field survey in Iraq for about three-month period from June 20 to September 14, 1979.

Two members of the advisory group to the team visited Iraq together with the team members, and made, within the limited stay period of 11 days from June 21, 1979, preliminary arrangements for smooth execution of the study, and gave precious advices to the team.

Members of the advisory group and the study team are tabulated below;

List of Advisory Group Members

Name	Assignment	Position
Mr. Ryotaro Sudo	Project Planning	Chief of Land Consolidation Division, Department of Construction Engineering, Bureau of Structural Improvement, Ministry of Agriculture, Forestry and Fishery
Dr. Hiroshi Ito[a/]	Agriculture	Professor of Ishikawa Prefectural College of Agriculture
Mr. Yoshikazu Yoshida	Irrigation	Chief of No.1 Construction Division, No.1 Department of Construction Engineering, Water Resources Development Corporation

Name	Assignment	Position
Mr.Yasuyuki Sakai*/	Agricultural Machinery	Technical Guidance Officer of Bureau of Agriculture, Sericulture and Horticulture, Ministry of Agriculture, Forestry and Fishery

*/ Visited Iraq with the study team from June 20 to 31, 1979.

List of Feasibility Study Team Members

Name	Assignment
Mr. Daizo Iseno	Project Planning (Team Leader)
Mr. Kazuo Nakabayashi	Soils
Mr. Fuminichi Obu	Irrigation and Drainage
Mr. Masaki Hayashidani	Design of Structures
Mr. Seiji Takeuchi	Farm Land Development
Mr. Osamu Suzuki	Construction Planning
Mr. Hirokazu Kohriki	Agronomy
Mr. Katsuyuki Akagawa	Farm Management and Extension
Mr. Shoji Yamada	Agricultural Economics

Coordination

In addition to the above-mentioned team members, Mr. Noboru Moritani of Sanyu Consultants Inc., was dispatched to Iraq for coordination of the team.

Cooperation of the Iraqi Government

Whole-hearted assistances and cooperations were bestowed to the team by the Government, directly by the following officials;

Name	Belonging
Dr. Tarik A. J. Tabrah	Director General of the General Body for Agriculture Applied Research, Ministry of Agriculture and Agrarian Reform
Mr. Kadhim Mohamad Al-Mustaf	Assistant Director General of the General Body for Agriculture Applied Research, Ministry of Agriculture and Agrarian Reform

Name	Belonging
Mr. Omar Ali Ammen	Director of the Cereal Crops Department, the General Body for Agriculture Applied Research, Ministry of Agriculture and Agrarian Reform
Dr. Khalid Taka	Director of the General Laboratory, State Organization for Soils and Land Reclamation, Ministry of Irrigation
Mr. Falhi Hessen	President of Missan Agriculture Office, Ministry of Agriculture and Agrarian Reform
Mr. Mousa Khalaf	Vice-president of Missan Agriculture Office, Ministry of Agriculture and Agrarian Reform

The field survey was conducted mainly in Amara and Baghdad with the all-out cooperation of the following counterpart personnel;

Counterpart Personnel

Name	Assignment	Position
°Mr. Ghazi Al Baghistani	General Coordination	Chief Officer, Department of Public Relations, Ministry of Agriculture and Agrarian Reform
Mr. Isam Najjar	Agriculture	Chief of Rice Section, the General Body for Agriculture Applied Research, Ministry of Agriculture and Agrarian Reform
Mr. Raad Hamid	Agriculture	Agricultural Engineer, Missan Agriculture Office, Ministry of Agriculture and Agrarian Reform
Mr. Noori Abed Ali	Irrigation	Irrigation Engineer, Missan Irrigation Office, Ministry of Irrigation
Mr. Faker Saloomy	Soils	Chief, Missan Soil Office, State Organization for Soils and Land Reclamation, Ministry of Irrigation

Name	Assginment	Position
Mr. Rahih H. Segar	Soils	Soil Expert, State Organization for Soils and Land Reclamation, Ministty of Irrigation

Organization to which the team contacted during the study period and data collected are listed in Appendices 1-1 and 1-2.

CHAPTER II. ECONOMIC BACKGROUND OF THE PROJECT

A. National Land and Population

Iraq has the national land of about 438,000 sq.km inclusive of a huge desert of about 167,000 sq.km (38%) and mountainous area of about 92,000 sq.km (21%). The cultivated land is about 57,000 sq.km. It borders on Iran, Saudi Arabia, Syria, Jordan, Kuwait and Turkey.

The population as of 1977 was about 12 million. The population increase in the seven years from 1970 to 1977 was about 2.6 million. Therefore, the averaged annual increase of population is only 380,000, but the increase rate is high around 3.3%. The population in Baghdad, capital city of Iraq, and Basra, the biggest port town, is about 3 million and 0.9 million, respectively. Population in big cities are thickening.

B. National Economy

The per capita income increased from U.S. Dollar 458 equivalent in 1973 to U.S. Dollar 942 equivalent in 1974 due to a sharp escalation of oil price. This value arrived at U.S. Dollar 1,308 equivalent in 1976. However, the per capita income in the agricultural sector increased only from U.S. Dollar 240 equivalent in 1973 to U.S. Dollar 253 equivalent in 1976. The statistic data of 1963/72 indicate that the agricultural sector contributed to 22% to 23% of the annual income of the whole nation, which clearly points out a low growth in the agricultural sector. As for the domestic gross product by sectors during 1973 to 1976, the mining sector increased its share from 36.2% to 54.0%, and the construction sector also from 3.6% to 7.7%. On the contrary, the agricultural sector decreased its share from 14.2% to 7.6%.

An averaged actual growth rate per year of the gross national product during the ten years from 1964 to 1974 is 5.4%. The same growth rate within the five years from 1969 to 1974 is 6.8%. Contrarily, the actual growth rate in the agricultural, sector during

the above-mentioned ten years is 4.5%, and that in the five years is very low as 0.8%. It indicates that agricultural production in Iraq has not yet been stabilized.

Petroleum occupies an extemely big portion in foreign trade of Iraq. The percentage of petroleum export out of the total export increased from 94.5% in 1973 to 98% in 1974. The total export excluding petroleum is of only about 3 million dinar. A percentage of the export of agricultural products out of the non-petroleum sectors decreased from 82% in 1964 to 53% in 1973 though the export of dates palm has been gradually increasing recently.

The foreign trade of Iraq shows a chronic excess of import of agricultural products. The statistic data indicate that Iraq has been an importer of wheat and rice since the early 1970s. Iraq had a bad harvest in 1975, and the production of these agricultural crops decreased to 845,400 tons and 60,540 tons, respectively. In order to cover the shortage, wheat of 512,000 tons and rice of 120,000 tons were imported.

C. Agricultural Production

The cropping area and yield per unit area of wheat, one of the major crops in Iraq, have been both retarded since 1970. The gross annual agricultural production goes up and down in every two years. The cropping area of rice, a summer crop, is decreasing, but its yield per hectare increased from 2.4 tons in 1970 to 3.1 tons in 1977 due to the introduction of commercial fertilizers.

It is clear that agriculture in Iraq basically depends upon irrigation and soil fertility. Soils in a huge area have been salinized. Reportedly, about 30% of arable land in Iraq has been already fallow due to high salinization of soils. In southern Iraq, about 60% of arable land is under the influence of salinization. Arable land of 20 to 30% out of the total has been already abandoned by farmers, which has resulted in a decline in agricultural productivity.

Restrictive factor in agricultural development in the central and southern Iraq is hardness in irrigation and drainage. On the other hand, agriculture in the northern Iraq has encountered with difficulty in water and soil management. Pump irrigation and leaching have a special importance in the central and southern Iraq, accordingly.

D. Present Farm Management Systems

In accordance with the Agrarian Laws of No.30 of 1958, No.117 of 1970 and No.90 of 1976, about 7.44 million donums were distributed to about 235,000 farm families. The averaged distributed area per farm family is computed at 31.5 donums (7.9 ha). The Agrarian Law No.33 defines the upper limit of agricultural land ownership, establishment of a cooperative system oriented toward fostering the interest of the state and peasantry, organizing agricultural relation and guaranteeing fair right for agricultural workers.

The agricultural population and farm-households as of 1974 are about 4 million persons and 617,000 families, respectively. Since the land under cultivation in the whole Iraq is 23 million donums, cultivated area per farm-household is computed around 37 donums, that is, 9.3 ha. However, cropping area is 14 million donums, that is, about 22 donums (5.6 ha) per farm-household.

Four farming systems have been adopted in Iraq, that is, private farming, cooperative farming, collective farming and state farming. The number of agricultural cooperatives was 1,606 as of 1977. Agricultural cooperatives of 283 have been established in relation with agricultural development projects. The cooperative farming is made at 79 farms. The number of state farms as of 1974 was eight, and a farm land of 307,632 donums in total belongs to them.

E. Development Plan

Iraq has enforced four five-year national economic development plans since 1961. Presently, the fourth development plan is under

operation aiming at a rapid economic development and strengthening of the socialistic structure. The fourth development plan aims to attain the averaged annual growth rate of 16.8%, 15.5%, 32.3% and 7.1% in the national income, petroleum resource, manufacturing and agricultural sectors, respectively. In the agricultural sector, the plan aims to attain the following wheat and paddy rice production, two major crops in Iraq, in both irrigated and rain-fed areas.

Table 2-1 Wheat and Rice Production in the Fourth Five-Year Economic Development Plan

	1975			1980		
	Area (10^3 donum)	Yield/ Unit Area (kg/donum)	Total Yield (10^3 ton)	Area (10^3 donum)	Yield/ Unit Area (kg/donum)	Total Yield (10^3 ton)
Wheat	6,054	197.2	1,194	5,588	365	2,041
Paddy	120	506	60.5	560	850	476

In promoting the economic development, the Government has put into focus strengthening of its public sector, specially the state enterprises. Effort has been made, with special attentions, in agricultural development aiming to expand farm land by constructing irrigation and drainage facilities as well as to attain a high productivity of land and labor through mechanized and rationalized farming as seen in on-going agricultural development projects such as Khalis, Great Mishkhab, Tarthar, etc.

Kahlaa Rice Farm Project Area is a part of Amara Irrigation Project Area which is on the way for rationalized distribution of the lower Tigris waters and flood control in the service area of about 330,000 ha in the south of Amara. The paddy production in Missan province is lower than that of Najah province due to its high soil salinity and low farming techniques. Kahlaa Rice Farm Project will contribute to the Five Year Development Plan through an increased rice production supported by a large-scaled farm mechanization.

CHAPTER III. THE PROJECT AREA

A. Location and General Features

Kahlaa Rice Farm Project Area of about 8,160 ha is located about 20 km south of Amara city, Missan province, in the south-eastern part of the lower Mesopotamian plain. In more detail, it is located on the left bank of the Kahlaa river, one of the five biggest tributaries of the Tigris.

Topographically, the Project Area is extremely flat though it inclines quite gently, with a slope of about 1/10,000, toward the east, that is, to Al-Chikke marsh, repeating micro-relief of 0.5 to 1.0 m. Depressions are mostly salinized to a considerable extent.

Geologically, soils in the Project Area consist of silt or silty loam. The land productivity is not high due to soil salinity and poor irrigation and drainage.

As for agriculture in the Project Area, the winter crops of wheat and barley are the present major crops. Paddy and sorghum are grown in summer seasons, however, their cropping areas are much smaller than those of the winter crops. Due to a small annual precipitation of around 171 mm which concentrates in winter seasons, irrigation is prerequisite for crop cultivation, in other words, no crops can grow without artificial irrigation in the Project Area. A part of the Project Area is equipped with irrigation canals to which the Kahlaa water is lifted. However, the capacity of existing pumps is small. Canals are poor and mostly deteriorated.

The Project Area has no drainage system. Irrigation without drainage has caused salt accumulation on farm land, and presently more than a half of the Project Area has been a sort of wasteland.

All farm practices are made by man-power except plowing. About 270 farm households live in the Project Area of 8,160 ha. The

population is very thin, accordingly. Moreover, it is decreasing year by year.

B. Natural Conditions

1. Topography and Geology

The Project Area is situated at the southern rest of the Amara deltaic plain, bordering on the Kahlaa river in the west and facing Al-Chikke marsh in the east, and has, as a whole, an extremely gentle slope of about 1/10,000.

The elevation of the river levee in the western part ranges in 6.5 to 7.0 m whereas that of the eastern most facing the marsh is 4.5 to 5.0 m.

The Project Area repeats micro-relief of less than 1.0 m formed by natural floodings and also aged artificial canals developed in all directions. Various shapes of depressions surrounded by such micro-relief are seen here and there.

Along the Kahlaa river there are several small hills of two to three meters high, and also flat flooding basins. In the western half of the Project Area, a micro-relief interval is relatively long. On the other hand, in the eastern half, the micro-relief repeats itself at a very narrow interval.

Soils of the Project Area consist of thick Quaternary alluvial deposits, and geologically fall in a category of recent alluvium in the Quaternary, namely, the deltaic plain has been originally formed by sedimentation of suspended materials, mainly silts brought into the huge shallow lake by flows of the Tigris and its tributaries. It has been, then, modified by irregular natural floodings and by river bed shiftings. Furthermore, it is still developing due to sedimentation of silts in irrigation water continuously supplied by farmers.

2. Climate and Hydrology

(a) Climate

Climate in the Project Area is characterized by short and cold winters and long summers with intense heat. Spring and autumn seasons are extremely short. It is so called the "continental arid type" climate.

Rainfall records observed at Amara during 1966 to 1978 indicate that the averaged annual rainfall is 171 mm out of which 80% falls in winter seasons from November to March. It hardly rains in summer seasons from June to September.

The annual temperature ranges from 10.9°C in January to 35.1°C in July, and the mean temperature is 23.9°C. The maximum and minimum temperatures recorded in the past 14 years from June 1965 to June 1979 are 51.0°C and -4.0°C in January. The daily temperature range of 12°C during winter seasons is relatively low in comparison with that of 18°C in summer seasons.

The observation records with class A pan show that the annual evaporation is high at 3,231 mm with the maximum evaporation of 489 mm in July (16.3 mm/day) and the minimum evaporation of 83 mm in January (2.7 mm/day).

Concerning winds, the observation data recorded at Amara meteorological station show that the daily mean velocity ranges from 3.0 m/sec in December to 6.6 m/sec in June. The averaged annual wind velocity is 4.3 m/sec. Strong instantaneous winds of 20 to 30 m/sec come in summer seasons from May to September. Generally, the north-western and western winds prevail around the Project Area throughout the year though the south-eastern and eastern winds sometimes blow in winter seasons.

Climatic observation data are shown in Appendix 3B-1.

(b) Hydrology

(i) The Kahlaa River

The Kahlaa river is the sole water source for the Project. The river discharge is artificially controlled by the regulator recently constructed across the upper reaches of this river. The water levels and discharges have been observed at the immediately upstream and downstream of the regulator. Furthermore, water levels of the Kahlaa river has been observed, since 1974, at Kahlaa town located about 24 km downstream of the regulator.

Observation records during January 1974 to June 1979 show that the maximum water level at the downstream of the regulator was 7.75 m whereas the minimum 4.00 m. At Kahlaa town no observation was made when these maximum and minimum water levels were recorded at the regulator.

Regarding the river discharge, the daily maximum discharge of 470 cu.m/sec was recorded in April 1974 whereas the minimum of 20 cu.m/sec in November and December 1975 and in November 1978. As for runoff of the Kahlaa river, high water seasons come from March to June, and low water seasons from September to November. The river discharge starts to decrease in July every year. The regulator has been operated in close connection with Kut regulator installed across the Tigris at about 200 km north-west of Amara city. The regulators release water every six days during summer seasons.

(ii) Groundwater

In parallel with the soil survey, the groundwater survey was conducted during the field survey periods of December 1978 to February 1979 (winter) and July to August 1979 (summer). However, the number of observation points in the winter is not enough to clarify groundwater distribution in the whole Project Area.

Judging only from observations made in the summer, groundwater in present irrigation areas along the Kahlaa river stands high from

0.60 to 1.40 meters below ground surface whereas it stands low in and around the heart of the Project Area ranging from 2.20 to 3.00 meters below ground surface though it gets again high near Al-Chikke marsh ranging from 0.60 to 1.00 below ground surface. (See Appendix 3B-2)

In general, the salinity of groundwater is high with the EC value of more than 10 mmho/cm, specially in summar seasons, except limited areas along existing irrigation canals and the march.

(iii) Quality of the Kahlaa Water

Judging from water quality measurements of the river water conducted during the field survey and also from analytical data of the Tigris water prepared by the Irrigation Office, Missan, the EC value of the Kahlaa water ranges in 0.47 to 1.26 mmho/cm with the averaged value of 0.8 mmho/cm. In general, having a seasonal fluctuation, it shows a high value during low water seasons from August to December.

As for silt content of the Kahlaa river, no data are available at present. Based on the analytical data of the Kujar Al-Kahbir river water which diverges from the Tigris near the Kahlaa, the silt content ranges in 0.01 to 2.30 gram/lit. The larger the river discharge, the higher the silt content, and vice-versa. 75% of the observation data show a higher silt content than 1 gram/lit.

Under the situlations, if such silty water is directly diverted to the irrigation system without silt treatment, a big volume of silt will be accumulated on canal bottoms and farm field surfaces, which results in difficulties of operation and maintenance. Therefore, it will be necessary to construct a desilting reservoir at the diversion point of the Kahlaa water to the Project Area. The proposed desilting reservoir will be enough to cope with the estimated silt judging from discharges and silt accumulation observed at the desilting reservoir of Amara sugarcane farm.

The observation and analytical data regarding water qualities

of groundwater, river waters, canal waters and marsh water are shown in Appendix 3B-2.

3. Soils

Soils in the Project Area are alluvial ones which have been formed by sedimentation of suspended materials transported by the Tigris and its tributaries in advance of Amara inland delta development. In addition to natural floodings of rivers and river-bed shiftings in the process of the delta formation, artificial irrigation has greatly affected to the soil formation.

All soils show the stratified layers which are different in color, structure or texture. The groundwater conditions are closely related to the above-mentioned soil distribution. In general, salinity of soils is strong and natural land productivity is rather poor.

Amara Irrigation Project Office and the State Organization for Soils and Land Reclamation, Missan, have conducted soil surveys in the Project Area. In the Feasibility Study, 12 test pits and 32 auger holes were dug over the entire Project Area, and physical and chemical analyses of soil and groundwater samples collected from these test pits and auger holes were conducted at the Soil & Water Testing Laboratory, Abu-Ghraib, State Organization for Soils and Land Reclamation, Ministry of Irrigation.

The above-mentioned soil survey revealed that most of the Project Area is covered by the silted basin soils which mainly consist of silty clay, silty clay loam, sandy clay loam and very fine sandy loam. The fine alternation of clay, silt and very fine sand is observed here and there in the Project Area as if it reappears the Kaleidoscopic changes of the sediment accumulation in old days. And, in the slightly depressed area where its ground surface is by 0.5 to 1.0 m lower than that of the surrounding area, the basin & irrigation depression soils are distributed. The ground surface has developed peculiar takhyr-like cracks due to seasonal submergence.

Sometimes, strong salt crust formation is observed.

In general, the groundwater table is high and the drainage is poor. In addition, a narrow belt of the river levee soils exist in the western end of the Area along the Kahlaa river. On the other hand, the silted Hor soils exist at the eastern corner of the Project Area along the lowest reaches of the Gasma river. The former has a medium coarse texture and moderately well drainage so it is cultivated with dates palm or vegetables, and the latter has a rather fine texture and extremely poor drainage so a part of it is cultivated with paddy rice.

Main characteristics of the soils are outlined herein. The horizontal variations of soils are complex due to the intricated micro-relief and groundwater conditions. In general, the coarse textured soils are found near the Kahlaa river or heads of irrigation canals, and the fine textured soils in the lower ends of irrigation canals. Almost all soils in the Project Area have been cultivated before, however, most of them have been abandoned by farmers due to salinization. In such abandoned or fallow lands natural vegetation, mainly shok and agul, are seen.

Needless to say, the major constraint factor of soils in the Project Area is salinity. Most of soils shows strong salt accumulation. It appears that the soils near the marsh are relatively free from salt accumulation because of the stagnant water for a long time. On the contrary, salt accumulation by capillary movement of saline water is very serious in the depression soils where the underflow of the groundwater is least.

Therefore, in the process of land reclamation in the Project, an artificial field drainage system should be installed in order to leach such soils with sufficient water. Furthermore, careful water management shall be undertaken during cropping period to prevent soils from secondary salinization. The leaching methods of these soils, introduction of legumious plants for soil improvement as well as optimum fertilization should be tested in the proposed

experimental farm.

C. Present Agriculture

1. Land Use

The annual precipitation of 171 mm in Amara is very small. Furthermore, it rains concentratedly in winter seasons. Irrigation is, therefore, prerequisite for crop growth in the Project Area throughout the year. The major restrictive factor in the land use is difficulty in securing irrigation water and improvement of saline soils.

The Project Area of 8,160 ha consists of the cultivated area of 3,460 ha, highly salinized fallow of 4,040 ha, marshy land of 500 ha, which is submerged in winter seasons, and the other area of 160 ha occupied by villages, canals, roads, etc.

In general the single cropping a year prevails in the Project Area though vegetables are raised twice a year in a small acreage. The summer crops of sorghum and paddy are grown in 284 ha (8%) whereas the winter crops of wheat and barley in 1,878 ha (54%). The rest of 1,298 ha (38%) is fallow.

Shok and agul, salt tolerant plants, grow in some saline soil areas, but even such plants cannot grow in highly salinized areas.

2. Farming Conditions

Out of the present total cropping area of about 3,460 ha in the Project Area, the summer crop cultivation area in the year 1977, winter crop cultivation area in the year 1977/78 and yields of such crops are tabulated below;

Table 3-1 Summer Crops in the Project Area, 1977

Crop	Area (ha)	Yield (kg/ha)	Total Production (ton)	Cropping Period	Remarks
Paddy	37.5	952	35.7	Jul. to Nov.	(or to the end of Nov.)
Sorghum	225.0	700	157.5	Jul. to Oct.	
Vegetables	13.5	7,000	96.25	Apr. to Sep.	
Corn	6.25	-	-	May to Sep.	
Water Melon	1.25	-	-	Apr. to Aug.	
Total	283.75		289.45		

Source: Data of Missan Agriculture Office

Table 3-2 Winter Crops in the Project Area, 1977/78

Crop	Area (ha)	Yield (kg/ha)	Total Production (ton)	Cropping Period	Remarks
Wheat	750	800	600	Nov. to Apr.	
Barley	1,000	1,000	1,000	Mid-Nov. to Apr. or Dec. to Apr.	
Broad Bean	125	3,600	450	Sep. to End-Dec.	
Tomatos	1.75	8,000	14	Oct. to Mar.	
Onion (dry)	0.25	-	-	Oct. to Mar.	
Vegetables	1.25	7,000	8.75	Oct. to Mar.	
Total	1,878.25		2,072.75		

Soruce: Data of Missan Agriculture Office

All farm households in the Project Area are subscribers of Al-Mabade Agricultural Cooperatives, and one farm household, as a rule, cultivates 7.5 to 10.0 ha (30 to 40 donums) of farm fields with summer crops and 0.5 to 7.5 ha (2 to 30 donums) with winter crops under the agricultural production program of this cooperative. Based on this production program, the cooperative allots a cultivated area of major crops to each farm household. Reportedly, fertilizers have been hardly utilized in the Project Area. Paddy seed of about 120 kg,

mostly local varieties of "Graiba" is sown to one hectare of pump-irrigated paddy fields. The existing paddy fields have no under-drainage system. The intermittent irrigation of five days, that is, four days' supply and one day's suspension of irrigation water, is repeated three time immediately after the direct sowing of paddy to submerged paddy fields, and the continuous irrigation follows it until two weeks before harvesting.

Presently, paddy fields in the Project Area have no drainage facilities, and the repeated irrigation plus raise of groundwater table plus a great deal of evaporation with an extremely high temperature have incurred salt accumulation on soil surface. A severely salinized part of such paddy fields has been abandoned by farmers since crops do not grow any more.

The fertilizer application criteria published by the Directorate General of Agricultural Guidance, Ministry of Agriculture and Agrarian Reform, suggest to apply ammonium salphate of 600 kg and triple superphosphate of 180 kg to paddy during its cropping season, and it is reported that A.S. of 200 kg and T.S.P. of 100 kg are, in general applied to wheat. But such fertilizers are actually hardly utilized in the Project Area as already mentioned above. Reportedly, some farmers have the experience to suffer from fertilizer damages, namely, fertilizers sometimes resulted in a decrease of crop yield due to unforeseen difficulty in water management though it seems to have happened in a quite limited area and cropping seasons when irrigation water was not sufficiently available.

3. Agricultural Input Materials

Al-Mabade Cooperative takes charge of group purchasing of agricultural input materials for farmers in the Project Area, however, quantity of such materials handled by this cooperative has not been expressed in figure. The Government has encouraged farmers to apply the following fertilizers to paddy and wheat.

Table 3-3 Input Materials for Paddy, Amber-33, and Wheat

Material	Quantity[3] (kg/ha)	Unit Price (fils)	Price (I.D/ha)
Paddy cultivation:[1]			
Seed	120	137.42	16.490
A. S.	600	17.6	10.560
T.S.P.	180	1,000.0	6.426
Stam-F34	10 lit	1,000.0	10.000
Arodran	6 lit	1,808.0	10.848
Total			54.324
Wheat cultivation:[2]			
Seed	120	65.74	7.888
A.S.	200	17.6	3.520
T.S.P.	100	35.7	3.570
Total			14.978

Source: 1/ "Amber Rice Cultivation in Middle Uphrates Area" by Dr. Sabri Sibahi, 1976.

2/ Data of Hissan Agriculture Office

3/ The quantity of seeds to be planted to a hectare should be determined based on experimental results to be obtained at the proposed experimental farm. Furthermore, experimentations should be conducted to determine the optimum quantity of the other agricultural input materials to be supplied.

The total agricultural materials cost in paddy cultivation is computed at I.D. 54,324 per hectare. It seems that nearly the same quantity and kinds of fertilizers are applied to wheat and barley. According to the data of Hissan Agriculture Office, fertilizer application as suggested in the above-mentioned text book has been put into action in ten percent of the total paddy cropping area in Hissan province, and neither fertilizers nor chemicals have been utilized in the remaining 90%.

Fertilizer application should be planned in close relation with a water management schedule during cropping seasons. As already mentioned, the present farm facilities are too poor to set up a water management schedule, and it happens that fertilizer is harmful in

crop cultivation. Under the circumstances, in parellel with the Project implementation, the technical guidance in fertilizer and chemical application will be indispensable.

4. Farm Mechanization

Plowing and farrowing are the major mechanized farm practices in Iraq. Most farm machines are rent from agricultural machine rental stations to farmers though some agricultural cooperatives or individual farmers have their own farm machines.

In the Project Area, farm machines of Nissan Agricultural Machine Rental Station are operated, on the rental basis, for plowing and farrowing. The Rental Station has totally 397 units of farm machinery inclusive of tractor's attachments (see Table 3-4). These farm machineries are mostly used for plowing and farrowing though some are for harvesting. Under the situations, all farm practices except plowing and farrowing are done by man or animal power.

As described above, the single cropping a year is adopted. Therefore, farm machines are needed twice a year in land preparation for winter and summer crops. Reportedly, it sometimes occurs that farmers can not complete sowing in optimum seasons due to the delay in land preparation. The Station has 70 wheat harvesters and three paddy harvesters, but the total capacity of them is not enough to meet the present requirement.

Table 3-4 Main Farm Machines of Nissan Agric. Machine Rental Station

Machine	Unit
Tractor	132
Combine	73
Plow	121
Disk harrow	10
Drill seeder (with fertilizer)	20
Others	41
Total	397

5. Livestock Farming

The following table shows the present livestock farming in the entire Iraq, Missan province and Al-Kahlaa.

Table 3-5 Present Livestock Breeding

Domestic Animal	Whole Iraq	Missan Prov. (A)	Al-Kah-laa(B)	B/A x 100
Cow	1,804,235	218,067	16,308	7.5
Buffalo	145,535	22,832	2,995	13.1
Sheep	8,400,939	417,664	38,368	9.2
Goat	2,989,270	19,350	860	4.4
Camel	52,352	-	-	-
Horse	69,140	5,817	393	6.8
Donkey	459,244	15,139	679	4.5
Mule	27,979	13	-	-
Hen	13,934,705	246,515	18,442	7.5
Turkey	833,000	4,845	-	-
Swan & Goose	451,520	38,925	-	-
Others	157,450	26,776	-	-

Source: Whole Iraq: Annual Abstract of Statistics, 1976
Missan Province: Annual Abstract of Statistics, 1976
Al-Kahlaa: Missan Agriculture Office, 1978

About 13% of buffaloes, nine percent of sheep and seven percent of both hens and cows out of the total of Missan province are raised in Al-Kahlaa area. It suggests that Al-Kahlaa area has played an important role in livestock farming of Missan province. It is expected that the livestock farming in this area will be further promoted by the Project.

6. Farm Household Economy

The Annual Abstract of Statistics, 1976, indicates that Iraq has a cultivable land of about 12 million hectares out of which the land under cultivation is 5.75 million hectares. The cropped area is 3.5 million hectares which is equivalent to 60% of the total land under cultivation.

The present land use in the Project Area is more or less similar to the above-mentioned nation-wide land use. The cultivable land in the Project Area consists of the cropped area of 1,878 ha and fallow of 1,298.

The cropped area of the Project Area in the summer of 1977 is equivalent to 15% of that in the winter season of 1977/78, whereas the same percentage of Kahlaa gada arrives at 81%. This low percentage proves that the land use in the Project Area is still quite extensive. The total Project Area is 8,160 ha inclusive of wasteland. If this high saline land and the fallow with a relatively low salinity can be utilized for agriculture, the land use will become intensive, and the farm economy would be much improved. But, as a matter of course, such improvement is beyond the capacity of individual farm household economy. According to the agricultural production cost survey by the Government, the net income by crops are as follows:

Table 3-6 Net Farm Income in Missan Province

Crop	Yield (kg/donum)	Unit Price (I.D./ton)	Gross Income (I.D./donum)	Production Cost (I.D/donum)	Net Farm Income (I.D./donum)
Paddy	500 /1	64.2 /3	32.1	10.01 /4	22.09
Wheat	200 /2	39.6	7.92	4.14 /5	3.78
Barley	250 /2	31.8	7.95	4.34 /5	3.61
Green Gram	169 /2	13.3	12.39	3.49 /6	8.90

Crop	Percent (%)	
Paddy	(100)	(580)
Wheat	(17)	(100)
Barley	(16)	(94)
Green Gram	(40)	(235)

NOTE: /1: The year of 1977
/2: The winter of 1977/78
/3: Unit price means the farm gate price
/4: The year of 1976
/5: The winter of 1975/76
/6: The year of 1976

Under the situations, a rationalized irrigation system will surely bring about a high profitability of paddy in the Project Area.

Farm household economic investigation conducted in the study revealed that the farm household income per day is 2.4 Dinars as shown in Table 3-7. Whereas, the prevailing Governmental farm wage is one Dinar. If the Kahlaa Rice Farm employs farmers, the above-mentioned income will be earned by about two family laborers.

Table 3-7. Farm Household Economy

Item		Quantity
1) Family labor		
Family members:		12 persons
Main family laborers:		3 "
2) Cropped area		
Paddy -	Amber varieties:	1 donum
	Graiba varieties:	5 "
Wheat		8 "
Barley		12 "
Broad bean		4 "
3) Livestock farming		
Horse		1 head
Cow		2 "
Sheep		50 "
4) Farm income		
Gross income		1,100 dinars
Farm income		875 "
5) Farm income per day		2.4 "
6) Farm income per family member per day		0.200 "

7. Processing and Marketing of Agricultural Products

Amara has three centers of marketing, and farmers in the Project Area sell their cereal products to one of them. In case of paddy, for instance, farmers pack threshed rice in sacks of 80 to 100 kg content, and bring it to a center of marketing by rental truck chartered by their group. Officers of the center inspect rice brought into by farmers, measure its weight and moisture content, evaluate its quality and decide the grade and price of paddy rice for payment to farmers. The paddy rice handled by these centers of marketing is only Amber varieties. The purchasing price of the first grade Amber paddy is 95 I.D./ton, and that of the second grade is 80 I.D./ton.

Every paddy rice of 50 tons is packed in hemp sacks with 60 kg content, and sent to a silo by truck or trailer. Silos, processing center of rice, are located in the suburbs of Amara, and collect 150 tons of paddy per day from these three centers of marketing during the peak seasons. At a silo, grains of barnyard grass, dust and other impurities are removed. After that, paddy rice is stored in the silo, keeping its moisture content at 14 to 15%. Totally, Amara has 132 units of silo with storage capacity of 120 tons each. So the total storage capacity is about 16,000 tons. It was informed during the field survey that all the silos were full with paddy rice brought from Missan, Al-Najah and Quadif provinces in 1978. A rice mill has been built near the silos. Its capacity is ten tons per hour with the maximum capacity of 12 tons.

The processing and purchasing process of wheat and barley is similar to that of paddy rice described above.

8. Research and Extension

Iraq has nine agricultural experimental stations out of which Mishkhab Rice Experimental Station in Najaf province is specialized in paddy-related experiments, and furnished the team with useful information in planning the new rice farm in the Project.

The experimental farm of this station is 50 ha. The staff is lined up by one chief of the station, two plant breeding experts, one researcher, one plant protection expert, one weed control expert, one farm machinery engineer and eight other personnel. Out of 15 members in total, five are graduates from agricultural colleges, three from the institutes of agricultural technology and seven from agricultural high schools.

Experiments are mainly focused on fertilizer response of paddy, mainly, Amber and partially IR, American and Chinese varieties. basic seed of such varieties are raised in the seed field of 18 ha.

The experimental station has adopted the dry sowing method by seeder, and obtained a good yield of 2.8 tons per hectare on an average (1972 to 1974).

When this station accomplished a satisfactory result in its experimentation, such new method is taken up in extension services by the Directorate of Farmer's Education and Extension.

The land productivity in Najaf and Quadif provinces both located in the Euphrates zone is said more than two tires of that in Missan province. The Station staff pointed out the major reasons as follows:

- o Careful farm practices and management such as harrowing, two times' plowings and land levelling, etc;
- o Farmers' willingness in farm management for an increased production;
- o Lower soil salinity; and,
- o Soil fertility.

Thirty-five extension workers of ten extension centers are in charge of extension services in Missan province.

1) Extension Workers

An agricultural branch office is lined up with one to six extension workers, 2.6 workers on an average, mostly graduates from agricultural high schools or from the institutes of agricultural technology. In accordance with an extension program prepared by extension offices these extension workers made guidance to some selected farmers in fertilizer and agricultural chemical application. Based on the program, seeds, fertilizers and chemicals are accommodated to the farmers. In harvesting, extension workers measure and compare grain weights of paddy harvested in fertilizer-applied fields and other fields in the presence of farmers, and let them understand the importance of scientific farming. After harvesting, they collect loaned money for agricultural input materials from such farmers.

2) Extension Services

In addition to the above-mentioned, various trainings are conducted not only for farmers but also extension workers themselves and cooperative officials for upgrading their technology. The audio-visual training by movies has obtained a good result.

9. Farmers' Organizations

The Agrarian Reform of 1958 made active movement toward cooperatives. The number of agricultural cooperatives expanded from 17 in 1961 to 1,606 in 1977. At present, Hissan province has 103 agricultural cooperatives, and in Al-Kahlaa gada, one compound agricultural cooperative and nine agricultural cooperatives have been organized. Al-Kahlaa branch office of Asara Agriculture Office has the cooperative section lined up by ten personnel. One cooperative officer is responsible for guidance of two cooperatives in agricultural technology, administration, credit, etc. An opinion or a request of cooperative members is discussed at the council meetings of the provincial and national levels, and adopted in the policy and programming when it is approved. There is another farmers' organization called the General Federation of Cooperative Society Farmers. Hissan province has 18 branch offices of this organization. At present, eight units of pump are operated in the Project Area out of which six are for profit-making. Farmers who use water from such pumps have organized privately a group to collect water charge.

10. Credit

General rural credit is extended by the Agricultural Bank in the public sector and by agricultural cooperatives in the private sector. The Agricultural Bank has been established under the Agricultural Bank Law of 1946. With the inception of July 14 Revolution in 1958, the law was revised to meet the requirements in the agrarian reform, and rural loan fund has been increased. Loans have been extended from the Bank to the agricultural cooperatives for agricultural supplies, machines and implements, cooperative marketing, animal wealth, agricultural services and other purposes.

The Agricultural Cooperative Bank for the purpose of loaning to agricultural cooperatives was established in 1956, and the Government had invested 51% and the other member the rest of 49%. The procedure in obtaining an agricultural loan for purchasing agricultural inputs such as fertilizers, seeds, pumps, etc., is described below;

A subscriber's request for loan is reported to the Cooperative Section of Kahlaa Branch, Missan Agriculture Office, in writing, by the agricultural cooperative to which the subscriber belongs through the Compound Agricultural Cooperative, and the Cooperative Section forwards this document to the Agricultural Bank, Missan. For loan negotiation, the head and cashier of the Compound Agricultural Cooperative visit the Bank together with a cooperative officer-in-charge, and if the Bank approves it, the requested loan of money is directly paid to manufacturers or dealers of agricultural input materials in check. The interest of two percent a year is paid to the Bank by the subscriber through the Compound Cooperative after harvesting of crops.

D. Present Irrigation, Drainage and On-Farm Conditions

1. Irrigation and Drainage

Starting from intake facilities installed along the left bank of the Kahlaa river, present irrigation canals extend toward the east through the Project Area, but the canals themselves are very primitive in structure and old as local people call these artificial earth canals the "rivers", and the irrigation follows a time-honored traditional method.

As for the irrigation method, the furrow irrigation is adopted in cultivation of barley, wheat, broad beans, corn and tomatoes. Irrigation water is intermittently supplied to these crops throughout the year. For paddy cultivation, the border irrigation is adopted.

The existing irrigation facilities in the Project Area are only canals and pump stations. Along the left bank of the Kahlaa river, ten pump stations have been installed for irrigation of about 4,000 ha.

All the pumps are of volute-type driven by diesel engines, and have a lift of three to four meters. Out of the present irrigation canals, the Gasma river, the biggest canal in the Project Area having the length of 18 km and capacity of one cubic meter per second, runs along the northern boundary of the Project Area from the west to east, and empties itself into Al-Chikke marsh. The irrigation water through this canal conveys a great deal of silt materials. In consequence, the function of this canal was paralyzed, and improvement has been undertaken by Amara Irrigation Office.

The Muallaya river (canal) with 13 km long delivers the Kahlaa water lifted at Al-Bahatha pump station to northern part of the Project Area, and flows in parallel with the Gasma river near Halim Assayhul village.

The Al-Bahatha river (canal) with 12 km long runs across the southern part of the Project Area. This river is deteriorated at present due to silt accumulation and poor maintenance. The Ijiayil and Hajiya rivers (canals) running near the southern boundary of the Project Area are also deteriorated.

2. On-farm

Almost all the present cropping lands are located on the western part of the Project Area to which the Kahlaa water can be easily supplied by pumps. In cultivated areas, farm plots of various shapes and scales are seen, but mostly have a rectangle shape with the length of run (long side) of 300 to 400 m and the width of plot (short side) of 30 to 50 m. A main canal runs along the short side of such farm plots, and a farm ditch to the direction of the long side. Roads of 30 to 50 cm wide runs along main canals. Tractors with harrow, which are operated for plowing, travel across other farm plots to arrive at a farm plot. No drainage facilities were provided at all.

In order to realize the mechanized agriculture with heavy farm machines, one of the pre-requisite project components, the Project will require the following:

- o Improvement of irrigation facilities;
- o Construction of drainage facilities;
- o Improvement of soils specially of saline soils by leaching;
- o On-farm development inclusive of construction of terminal facilities; and,
- o Construction of roads.

CHAPTER IV. THE PROJECT

A. Objectives and Components of the Project

1. Objectives

The Kahlaa Rice Farm Project has been taken up to attain an increased production of paddy rice to contribute to the national food policy. In addition, it is expected that this rice farm will function as a model pilot farm for future agricultural development projects in Iraq, and that this Project will bring about a big impact on the rural economy of Missan province and its vicinity, increasing the farm labor demand through deployment of the modernized rice farm operation.

For this purpose, land consolidation, construction of irrigation and drainage facilities and installation of farm facilities have been planned.

2. Project Components

The Project will include the following components:

i) Construction of the State Rice Farm

a) Irrigation and drainage facilities: Construction of pumping facilities, desilting reservoir, irrigation and drainage system and on-farm facilities.

b) Farm facilities: Installation of a farm warehouse, a machinery/implement warehouse, workshop and aircraft runway.

c) Related facilities: Construction of a bridge across the Kahlaa river and housing for the village.

d) Rice processing facilities: Consisting of milling, drying and storage facilities.

ii) Establishment of Mechanized Technical System for Farm Operation/Management

e) Mechanized rice cultivation techniques: Introduction of mechanized rice cultivation techniques with well-controlled water management.

f) Management of the state rice farm: Establishment of farm management organization for smooth operation/management of this rice farm.

iii) Establishment of an Experimental Farm

Establishment of an experimental farm of about 90 ha for various researches, experimentations, trainings and demonstration.

B. Project Plan Formulation

Kahlaa Rice Farm Project is a national agricultural development project aining to attain the self-sufficiency of rice, one of the main crops in Iraq, and to function as a pilot farm for future agricultural development in the way of large-scaled and fully mechanized farming.

In formulating the Project plan, studies were conducted from various angles on every requisite for operation of this rice farm under the natural conditions of the Project Area in the arid zone characterized by extremely high temperature, quite a few rainfalls and saline soils as well as the social conditions prevailing in Iraq. Selection of crops to be grown, cropping schedule in relation with rotational cropping, farm practices, farm mechanization, weed control and desalinization of saline soils, etc., are, therefore, put into focus in the study.

The Project still involves various unknown factors. Some of them should be decided based on experimental cultivation results before or in the initial stage of the main farm operation whereas farming environments with high soil salinity, poor soil fertility and seasonal burning winds, etc., should be improved by repeated fertilizer application,

leaching and provision of wind-breakers in a relatively long period. The long-termed farm management plan should be formulated based on experimental results to be obtained in the experimental farm taking into consideration various factors inclusive of the international and domestic demand trend of agricultural products.

Under the situations, the study has been conducted based on the following concepts:

1. Cropping Schedule

The first priority in scheduling has been given to paddy production for the following reasons:

i) The Government has taken up this Project for an increased rice production through establishment of an effective farm management system with full mechanization;

ii) Paddy is the most profitable among the others; and,

iii) The introduction of second crops has been planned in this study for effective utilization of land, machinery and labor during off-seasons of paddy cultivation. However, taking into account the economic number of farm machinery and labor as well as salt accumulation on soil surface caused by continuous cultivation, the second crops will be cultivated in a limited area.

The rotational cropping of paddy and other crops such as sugarcane, sorghum, green gram, berseem and vegetables is effective to control paddy weeds and intensify the land use. However, labor-consuming cultivation of summer crops, except paddy, might be hardly possible due to very high temperature in the Project Area. Furthermore, no crops can be introduced to the Project if their cropping seasons overlap the paddy growth period. Careful attention should be paid to salt accumulation on soil surface in determining the cropping schedule. In this connection, it is important to leave farm land as fallow for a period in order to recover its soil fertility.

2. Mechanized Farming

Heavy farm machines will be utilized due to the following reasons:

i) Soils in the Project Area become solid when dry because their organic matter content specially humus is very small. Moreover, it will be difficult to mobilize sufficient laborers to conduct farm practices without such machines;

ii) Only a few varieties of paddy can be grown in the Project Area. Therefore, an optimum period for farm practices is quite short, which makes it indispensable to introduce farm machines with a high operation efficiency; and,

iii) Land levelling to keep level the farm plot water has a special importance in paddy cultivation. Sufficient puddling should be practiced for direct sowing of paddy to submerged fields by seeder.

3. Paddy Cultivation

For paddy cultivation, various varieties and sowing methods should be introduced to elongate the paddy cropping season. The paddy growth period under the natural conditions of the Project Area is from March to November. Experimental paddy cultivation inclusive of the two croppings a year should be conducted in the experimental farm by introducing both transplanting and direct sowing to dry fields, etc.

Amber varieties whose production has been encouraged by the Government will be mainly cultivated in the Project. However, IR varieties will be also partially cultivated for the time-being in order to elongate the paddy cropping season. In parallel with improvement of Amber seed, IR varieties' cultivation area will be decreased, and only Amber with high commercial value will be raised in the Project in future.

The direct sowing to submerged fields will be mainly conducted to grow early-maturing, medium-maturing and late-maturing varieties though the direct sowing to dry fields and transplanting are also experimentally adopted. The major reasons why the direct sowing to submerged fields has

been put into focus are as follows:

i) The direct sowing to submerged fields is the traditional way in planting local varieties of paddy to saline soil in the Project Area;

ii) Paddy seed planted directly to dry fields does not germinate uniformly. On the other hand, stabilized germination can be expected in the direct sowing to submerged fields;

iii) Suitable seedling breeding methods required for transplanting have not yet well developed in the Project Area; and,

iv) In case of sowing to submerged fields, levelling should be completely made in the course of puddling, and percolation is controlled to a satisfactory extent.

4. Sowing

Introduction of a riding-type multi-drilling seeder has been proposed, with the first priority, for direct sowing to paddy to submerged fields, taking into account the operation efficiency of this machine, labor requirement in planting, specially a high yield expectable in this sowing and easy field management inclusive of water management, weed control, prevention and fertilizer application.

The broadcasting by light aircraft is quite effective in paddy sowing to a vast area in a limited period, and it is expected that a yield of paddy planted in this method will gradually increase, with some improvement, in future. Therefore, this sowing method is given the second priority in this study.

Experimental transplanting of young seedlings of early-maturing varieties and throwing transplanting of sheaves of paddy seedlings (very-early maturing and late-maturing varieties) will be conducted in the experimental farm to be constructed so that the paddy cropping season will be elongated to the maximum extent possible.

5. Weed Control

Careful puddling will be conducted two times prior to sowing and mechanized weeding to control paddy weeds to the maximum extent possible. Supplementally, chemicals will be utilized. For transplanted paddy, the ordinary weeding with M-O Satan, etc., is considered sufficiently effective to meet the requirement.

In future, paddy weeds should be exterminated by the rotaional cropping of paddy and upland crops as practiced in Mediteraman paddy areas so that paddy can be cultivated without herbicide.

6. Layout of the Farm

Only indispensable facilities for paddy cultivation in the Project Area have been planned as follows:

i) Irrigation system to supply the Kahlaa water to the Project Area;

ii) Drainage system inclusive of underdrain required for leaching;

iii) Land reclamation to construct farm plots to keep irrigation water at an optimum depth on its surface;

iv) Wind-breaks to protect crops from prevailing north-west dry and burning winds; and,

v) Rest places with shadow for laborers and farm machines.

7. Experimental Farm and Seed Farm

An experimental farm with a laboratory and a workshop will be installed for experimentations and researches required in the Project. In order to produce seed with a high quality, the experimental farm will be equipped with a seed farm, refrigerator, workshop, etc., required for test cultivation of various varieties, maintenance and propagation of basic seed. An basic seed farm and certified seed farm will be installed in future to meet the seed requirement not only in the Project Area but also in the whole Missan province.

8. Stage Development of the Rice Farm

Rice cultivation in Iraq has remained still primitive, and most farm practices are made by man or animal power. Under the situations, the stage development of cultivation techniques and education/training of experts and skilled laborers, etc., should be planned.

In the first stage, a mosque, houses for officials and laborers, a primary school and a clinic will be constructed. Garage for machines, workshop, meteorological station, warehouses and so forth will be also built in parallel with the land reclamation and construction of the major facilities such as the pump station for irrigation, main irrigation and drainage canals.

In the second stage, operation of the experimental farm inclusive of cultivation and leaching tests and the construction of on-farm facilities will start.

In the third stage, operation of the whole main farm will be commenced. In order to establish a mechanized rice production system, farm techniques to be developed in the experimental farm should be introduced to operation of the main farm.

9. Environmental Improvement

The environmental improvement should be planned to let laborers permanently settle in the Project and willingly engaged in operation and management of this rice farm. The major farm facilities will be located adjacent to the village. Houses for rice farm officials will be located a little apart from these for laborers.

C. Proposed Agricultural Development

1. Land Use Plan

The land classification has been made, based on soil survey, as follows:

Land Classification	Area (ha)	(%)
First class	0	0
Second class	158	2.0
Third class	4,647	56.9
Fourth class	2,182	26.7
Fifth class	1,173	14.4
Total	8,160	100.0

Lands have been classified taking into consideration the following;

1. Topographic constraints;
2. Soil constraints specially soil salinization; and,
3. Necessity of countermeasures against the above-mentioned constraints in on-farm development.

In the other words, the first class requires no special measures; the second class land requires some preventive countermeasures against re-salinization of soils caused by irrigation; the third requires general measures to prevent soils from salinization; the fourth requires dense facilities for leaching and the last requires measures for drainage.

As seen in the above-table, almost the whole cultivated area requires some measures against soil salinization. About 14 % of it is the marshy depression so the drainage will be necessary.

A land use plan for the rice farm of 8,160 ha in total has been formulated taking into account the topographic, soil, hydraulic and environmental conditions for growth of agricultural crops. The cultivated area inclusive of the experimental farm of 90 ha is 6,300 ha, which is equivalent to 77 % of the gross Project Area. The main irrigation and drainage canals and farm roads will occupy 420 ha or 5.1 % of the gross area, and on the on-farm facilities, 960 ha or 11.8 %. The windbreaks of 330 ha or 4.8% has been planned to protect crops from burning north-west winds prevailing in the lower Mesopotamian plain. The desilt-

Table 4-1 Proposed Land Use

(Unit: ha)

Item	Block I	Block II	Block III	Block IV	Total
Gross Area	1,790	1,660	2,720	1,990	8,160
Cultivated Area	1,420	1,300	1,910	1,580	6,210
Experi. Farm	-	-	90	-	90
On-farm Facilities	220	200	300	240	960
Main Canal and Roads	40	100	160	120	420
Wind-breaks	100 (10) 1/	60 (10)	110 (10)	50 (10)	330 (40)
Desilting Reservoir	-	-	40	-	40
Public Facilities	-	-	110	-	110

1/ The parenthesized figures show the Cesbania planted area.

ing reservoir will occupy 40 ha of 0.5 %. For the village and farm facilities, an area of 110 ha 1.4 % has been allotted.

The whole cultivated area will be developed to paddy fields. Paddy will be grown in summer seasons whereas upland crops of barley and wheat in winter seasons. The proposed land use is tabulated as follows (see Table 4-1).

2. Cropping Schedule

a) Introduction of Crops

Paddy will be mainly raised in the Project, and supplementally upland crops of barley and wheat will be introduced as secondary crops because they are advantageous in salt tolerance, marketability and mechanized farming. Moreover, these crops are traditional crops in the Project Area. Paddy of mainly Amber varieties will be cultivated whose production has been encouraged by the Government and has a high commercial value in Iraq. (see Appendix 4C-1 and Figure 4-1)

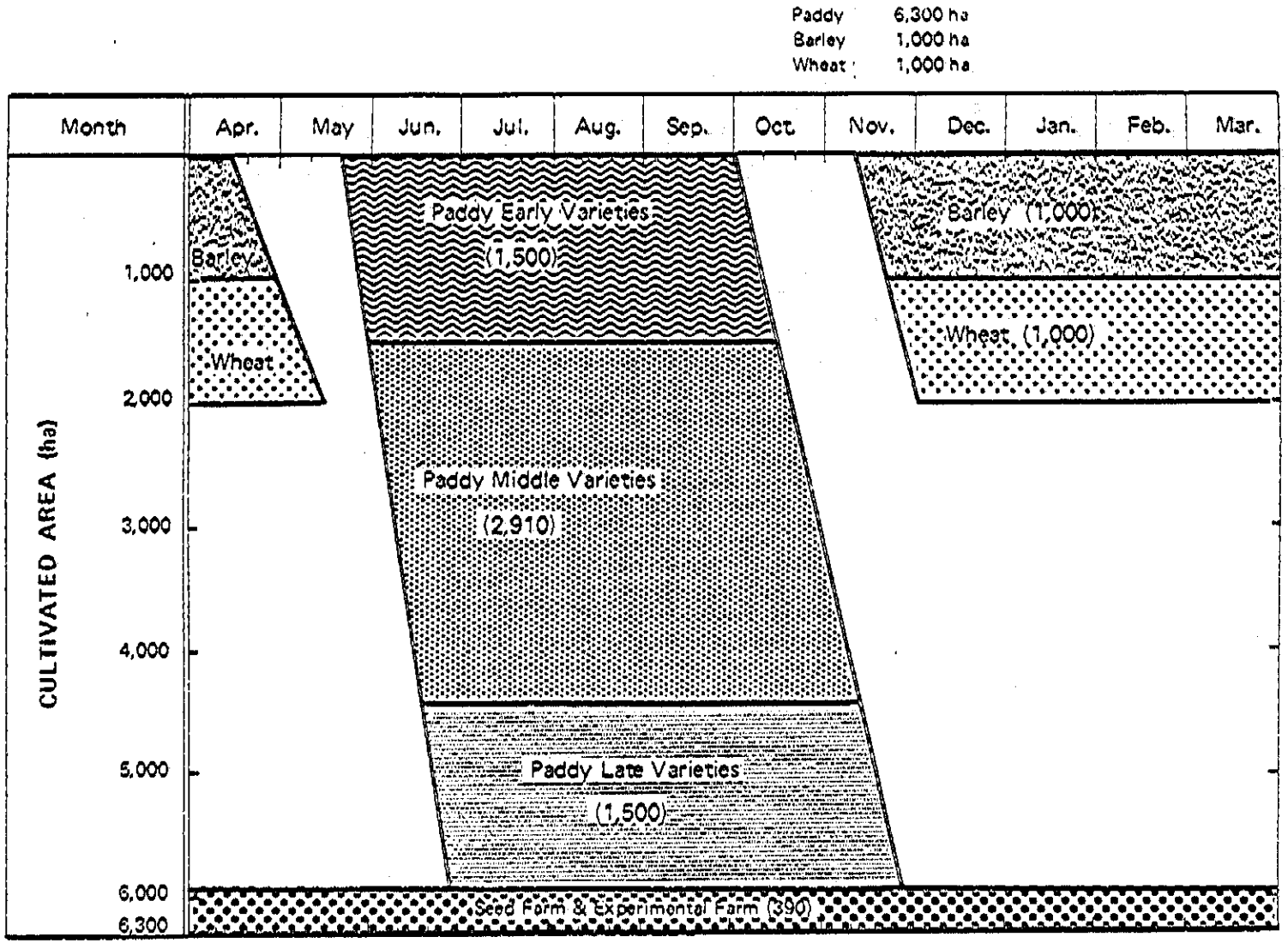


FIGURE 4-1 PROPOSED CROPPING PATTERN

b) Cropping Schedule

Out of the total paddy cultivation area of 6,210 ha, early-maturing, medium-maturing and late-maturing lines will be grown in 1/4, 2/4 and 1/4, respecdtively, in order to elongate[/1] the paddy cultivation period by 40 days. (Paddy is planted from the end of May to the end of June, and harvested from October to November) so that the peak demand of labor force in preparation for sowing, sowing and harvesting will be kept at the lowest possible. The cropping schedule should be made out to intensify the land use. The introduction of barley and wheat in 2,000 ha in total is meaningful in this sense. It increases the cropping rate to 130%. It also contributes to the best use of labor force of the permanent employees and farm machinery. However, paddy harvesting seasons and wheat sowing season overlap in October and November in case of rotational cropping of paddy and wheat. Therefore, the cropping area of wheat will be limited. At present farm land of about 2,000 ha is cultivated with wheat and barley. Taking this into consideration, barley and wheat cultivations in 1,000 ha each have been planned in order to elongate the cropping season of winter crops. The best suited rotational cropping of paddy and upland crops should be determined taking into account salt tolerance of crops, weed control, soil fertility, labor distribution, water requirement, profitability and the national policy, etc. Further study will be required in future on the rotational cropping not only of paddy and wheat/barley but also of paddy and sorghum, millet, berseem or industrial crops for this purpose. Six types of rotational cropping with estimated gross income are shown in Appendix 4C-2.

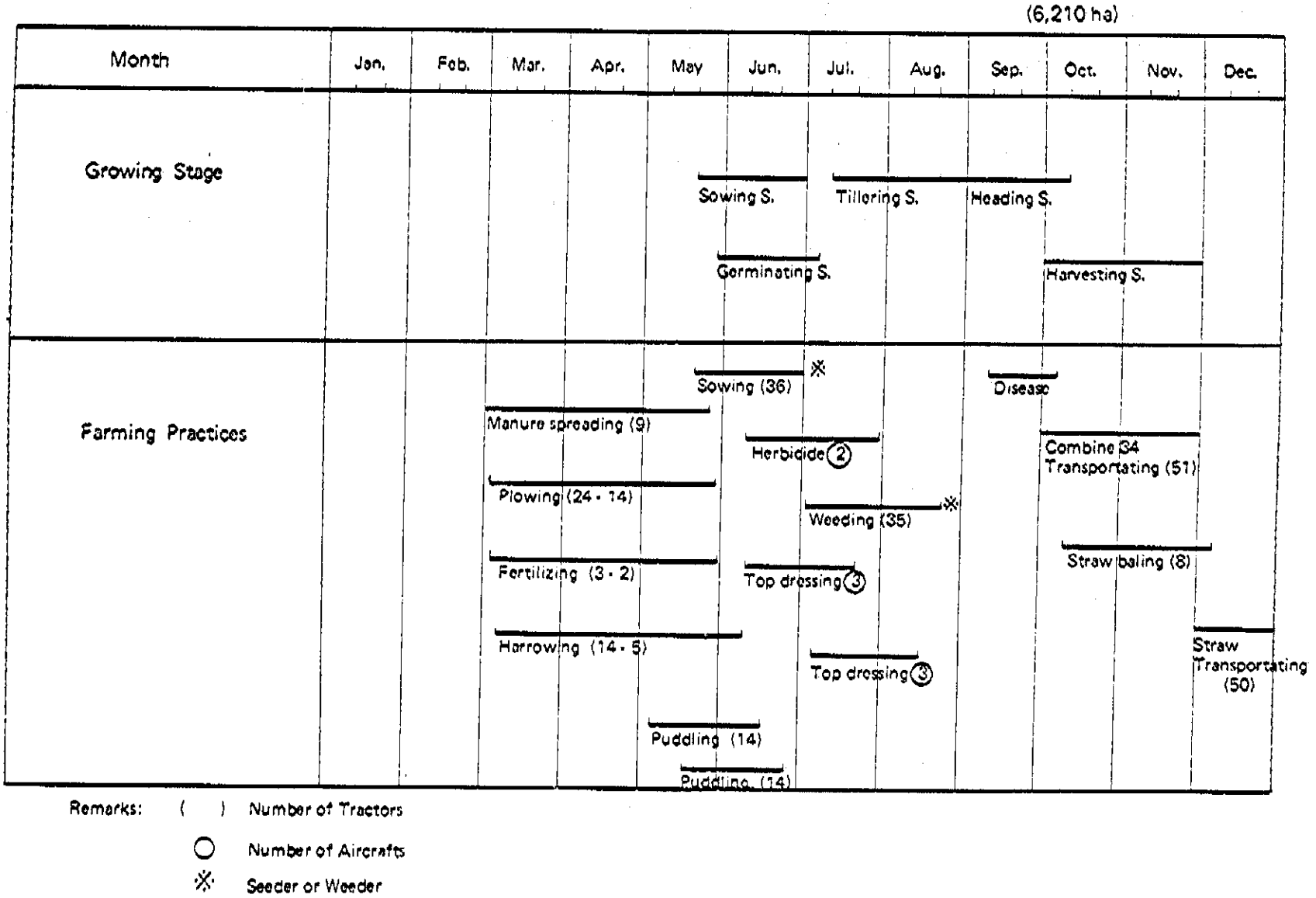
3. Proposed Cropping Pattern

a) Paddy Cultivation

The cropping calendar of paddy is shown in Figure 4-2. Input materials per hectare in paddy cultivation are tabulated in Appendix 4C-3.

/1 --- The paddy cultivation season can be expanded not only by introduction of different varieties but also by introduction of different cultivation methods such as transplanting. The experimental cultivations should be conducted inclusive of two paddy croppings a year. The experimentations will be useful in determining the cropping schedule.

FIGURE 4-2 CROPPING CALENDER FOR PADDY



Remarks: ( ) Number of Tractors

○ Number of Aircrafts

※ Seeder or Weeder

Varieties

Mainly Amber varieties whose cultivation has been encouraged by the Government will be introduced. Most Amber varieties are of the medium-maturing lines, but some are of the other lines. Therefore, their early-maturing and late-maturing lines will be separated in experimental seed breeding in order to elongate the cropping season of paddy. If a single line of paddy is raised in a vast area, the optimum cultivation season is short, and once an insect or pest breaks out, its damage is serious. An operational mistake of a farm also brings about severe damages to paddy yield.

Seed Screaning

In order to secure purified seed of a high quality, seed screaning will be made at the seed center.

Compost Spreading

Compost/1 will be produced in the wind-breaker zones, and spread to the whole main farm before plowing in order to supply organic matters to soils.

Plowing, Fertilizer Application and Harrowing

In farm field where wheat or barley is raised after harvesting paddy, paddy straw will be mixed with soils in the course of plowing in Autumn prior to wheat sowing. In the single cropping fields, compost will be spread in Spring. Bottom plow will be operated for plowing in the above-mentioned two cases./2 Commercial fertilizers such as Urea and T.S.P. will be sprayed by broadcaster after plowing. Disc-harrow will be operated for harrowing.

NOTES: /1 --- It has been planned to produce compost in the five-month period from December to April. However, further study on the necessary period and ways, such as watering, etc., for compost production should be made in future since humidity is very low in the Project Area.

/2 --- Bottom plow will be operated for plowing because soils, having a few organic matters, are solid and its operation is effective to mix straw with soils. However, rotary, which can make simultaneously compost mixing, plowing and harrowing, will be operated in future when physical conditions of soils are improved in the course of organic matter application and careful repeated cultivation of crops.

Puddling

Puddling is practiced two times by puddling rotors after irrigation water supply mainly in order to keep level farm plot surface and to control the percolation of irrigation water as well as for weed control, that is, the first puddling about two weeks ahead of sowing and the second one three days before sowing. The flood irrigation will be continued after the second puddling.

Sowing

Three ways of paddy sowing are considered, that is, drill seeding in to upland, direct sowing to submerged fields by drill-seeder and aircraft broadcasting. In addition, transplanting is also considered for paddy planting. In the Project, the direct sowing to submerged fields is deemed the most suitable in paddy planting by ridding-type multi-drilling seeder. (see Appendix 4C-3)

Weeding and Top-dressing

Herbicide will be sprayed by aircraft about three weeks after sowing. Paddy weeders will be operated by 30 to 35 days after sowing. In addition, weeding mainly of barnyard is humanly conducted in July and August. The majority of weeds is barnyard and chufa.

The top-dressing will be practiced twice by aircraft, the first one in the middle to the end of June and the second one in the early July to the middle of August.

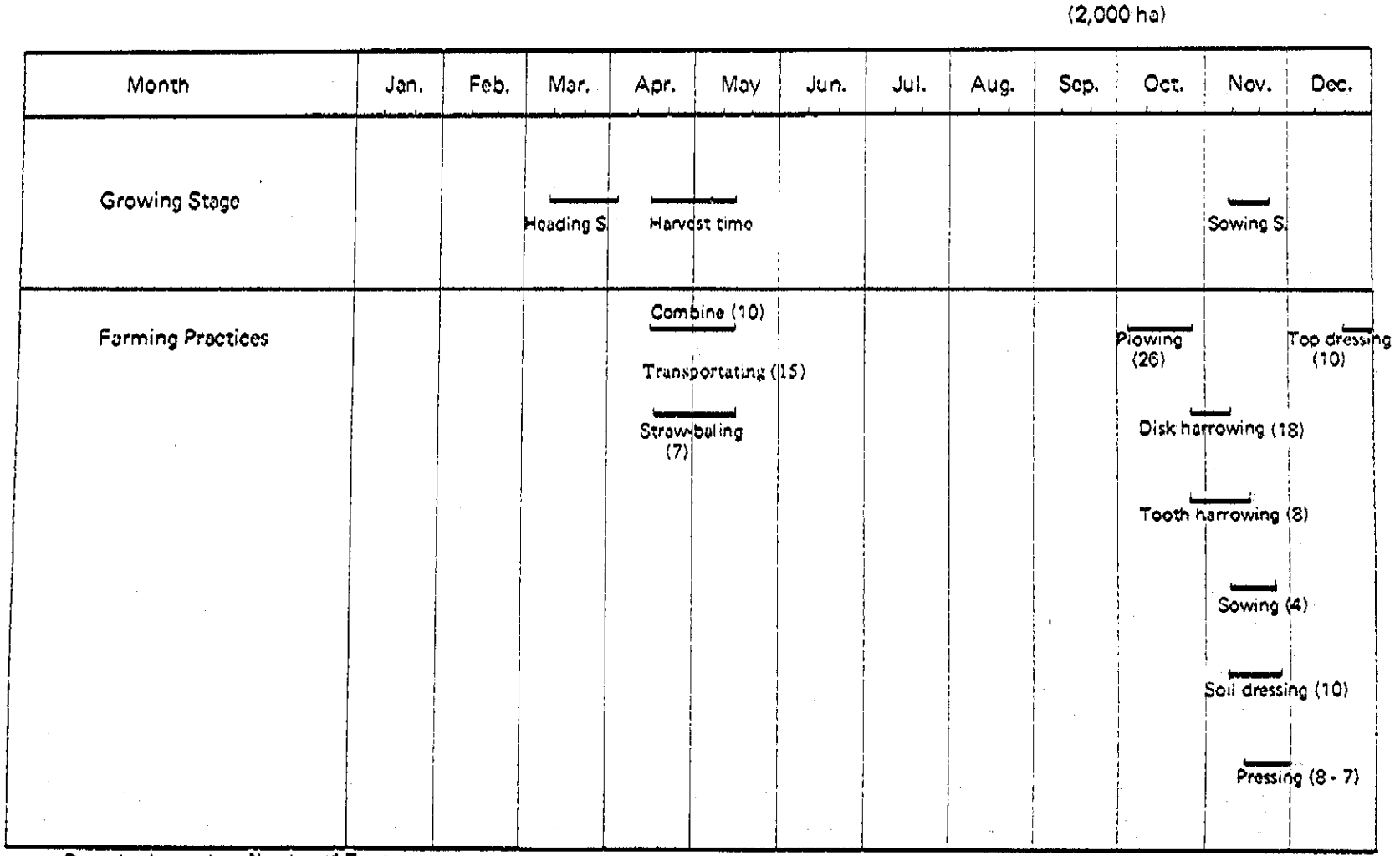
Harvesting

Combines will be utilized for harvesting. Unhulled rice is hauled to rice mills by trailer. Rice straw will be cut by chopper and buried in soils in the course of plowing in case that the second crops are to be cultivated in the relevant farm plots. Straw in the other farm plots will be piled up in the wind-break zones to produce compost.

b) Barley and Wheat Cultivation

The cropping calendar of barley and wheat is shown in Figure 4-3. The farm practices for these crops are mentioned in detail in Appendix 4C-3/5.

FIGURE 4-3 CROPPING CALENDER FOR BARLEY & WHEAT



Seed Screaning

Barley and wheat seeds of a high quality will be secured by seed screaning at the seed center as same as that for paddy.

Plowing and Harrowing

Plowing will be practiced immediately after havesting paddy. After disc-harrowing, tooth harrows will be operated for harrowing and levelling.

Sowing and Fertilizer Application

Seed mixed with fertilizers is spread by broadcaster. After spreading, seed is covered with soils by tooth harrow, and cultipacker operation follows it.

Irrigation

For easy irrigation ridges will be put in farm plots at an adequate interval in parallel with the direction of the width of plot (short side) of farm fields. The border irrigation will be intermittently conducted at eight days' interval. (see Appendix 4D-2)

Top-dressing

Top dressing will be practiced by broadcaster at the end of December.

Harvesting

Barley and wheat will be harvested by combine, and their grains will be hauled to the mill by trailer. It might be possible to sell baled straw to livestock farmers outside the Project Area.

c) Compost

Paddy straw will be used for production of compost. Such straw will be heaped in the wind break zones. Calcium cynamide equivalent to about two percent of the straw weight and an adequate volume of water will be added to piled straw in order to accelerate its fermentation. About one month after straw heaping, water and calcium cynamide equal to about one percent of the straw weight will be additionally supplied, and heaped straw will be upset. Compost producing seasons will be from December to April. The total compost production per annum is estimated about 34,400 tons.

4. Population and Labor Forecast

Statistic data of this country indicate that the annual increased rate of population in Iraq is 3.25% from 1960 to 1970, and 2.8% from 1971 to 1975. In the year 1975, about 36% of the total population belonged to the rural population whereas the rest of 64% in the urban population. The rural population has increased at the rate of 0.2% during these five years while the increased rate in the urban area is high at 4.3%, which indicates that population are increasing in the big cities. However, the percentage of agricultural laborers out of the total population is still not decreasing.

Table 4-2 Distribution of Labor Force

(Unit: '000 persons)

Year	Total Laborers		Laborers in Agric. Sector		Laborers in the Non-Agric. Sector	
	Person	%	Person	%	Person	%
1960	1,599.7	100	733.9	46	865.8	54
1965	1,985.3	100	1,009.6	51	986.7	49
1970	2,506.7	100	1,385.7	55	1,122.0	45
1971	2,592.6	100	1,434.7	55	1,157.9	45
1972	2,676.6	100	1,486.2	56	1,190.4	44
1973	2,762.2	100	1,540.4	56	1,221.8	44
1974	2,851.4	100	1,596.6	56	1,254.8	44
1975	2,941.4	100	1,654.4	56	1,287.0	44

Source: Data issued by Ministry of Planning, Labor Force Department.

Missan province is a typical rural area having the agricultural population rate of 60%. The population tendency in Missan province might be similar to the nationwide tendency as mentioned above. By applying the above annual population growth rate, the populations in the whole Iraq and Missan province in the year 1985 are forecast as follows:

Population Forecast

(Unit: '000 persons)

	1975	1985
Whole Iraq	11,124	14,662
Missan Province	370	454

Agricultural labor has been constantly short in Iraq due to the low growth rate of rural population and also shortage of farm machines. To cope with such situations, the Government has already taken up the large-scaled mechanized agriculture in its agricultural development policy.

The Kahlaa Rice Farm will require many skilled and unskilled laborers as well as farm operation and management officers. It is expected that this rice farm will employ, with the first priority, farmers now living in the Project Area. Statistically, the number of farm households in the Project Area is 270. However, the actual number seems a little smaller than that of the above judging from the distribution of houses.

After the completion of the Project, a part of these laborers would be employed as skilled or unskilled laborers such as drivers and operators. Based on the labor requirement plan shown below, the permanent labor of about 170 persons and temporary seasonal labor of about 70 persons will be required. It seems that labor shortage in both agricultural and industrial sectors will not concur for the time-being. It is expected that farmers in the Project Area will be permanently employed by the rice farm as a measure to secure permanently necessary labor force.

5. Farm Mechanization Plan and Labor Requirement

a) Farm Machines

A large-scaled farm mechanization has been planned in the Project taking into consideration the following:

- o Farm operation area is vast. Moreover, soils in the Project Area get solid when dry.
- o It might be difficult to mobilize a sufficient number of paddy farm laborers. A high efficiency in farm operation with a limited labor force will be prerequisite for this rice farm.

Table 4-3 Farm Machinery (Paddy, Barley and Wheat)

Equipment	Unit
Motor Car	4
Survey Car	14
Pick-up	10
Wheel Tractor	85
Crawler Tractor	8
Botton Plow	26
Disk Harrow	16
Tooth Harrow	10
Puddling Rotor	31
Broadcaster	4
Culti-Packer	8
Combine	37
Trailer	56
Motorcycle	50
Grain Pump	2
Tank Lorry	2
Water Pump	30
Ridger	8
Seeder & Weeder	40
Manure Spreader 3t	8
Hay Baler	9
Front Loader	4
Total	452
Workshop	1
Seed Center	1

- o A few paddy varieties could be introduced due to various restrictions. Therefore, an optimum season of each farm practice is short.

Farm machines will be introduced to all farm practices from land preparation to harvesting. Therefore, 462 farm machines of 22 types such as tractors, seeders, etc., will be utilized (see Table 4-3, Page IV-19) The major farm machines will be tractors of 70 to 110 Hp with necessary attachments. Aircraft will be operated for top-dressing, weeding and prevention and control in paddy cultivation. Harvesting will be made by 120 Hp combine. The machinery cost required for paddy and wheat/barley is estimated at 166,092 I.D. (26.4 I.D/ha) and 43,230 I.D. (21.6 I.D./ha), respectively, (see Table 4-4).

Check and overhaul of a machine should be, in general, made before and after its operation, but the maintenance works for the farm machinery of this farm will be made during the six months from January to March and from July to September when such machinery are not busy. Operators will take part in check and overhaul of the machines under the guidance of workshop staff. Farm machinery will be shedded in the garage of the Farm Management Office during off-seasons, but during busy seasons farm machines will be deposited to the farm operation base to be located in each farm operation unit in order to save the travelling time.

The operation efficiency of each farm machine is shown in Appendix 4C-5.

Table 4-4 Machinery Cost

(Unit: I.D.)

Items	Paddy	Barley	Wheat
Annual Depreciation Cost	126,897	16,688	16,688
Fuel Expenses	11,644	1,183	1,183
Repair Cost	27,551	3,744	3,744
Total	166,092	21,615	21,615
I.D/ha	26.4	21.6	21.6

b) Labor Requirement

Under the farm mechanization system mentioned in the above paragraph, the labor requirement is estimated as follows:

Labor Requirement in the Farm

	Labor Requirement (Man-day/year)	(Man-day/ha)	Cropping Area (ha)
Paddy (one cropping)	33,647	5.4	6,210
Wheat & barley (one cropping)	7,713	3.9	2,000
Experimental farm	2,030	22.5	90
Production of compost	752	0.2	4,300
Total	44,142		

The peak demand for labor will appear twice a year for sowing and harvesting. The required labor force is 190 to 240 man-days (see Appendix 4C-5.) Such labor force will be constantly required from plowing to harvesting seasons. 170 laborers will be permanently employed, and the rest will be seasonally recruited. Seasonal laborers required are estimated at 20 man-days in paddy sowing and about 70 man-days in paddy harvesting.

Except special occupational types, such labor force will be sufficiently supplied in Amara area. Farmers presently living in the Project Area would be, in principle, employed by the rice farm. Under the situations, sufficient training for paddy cultivation will be needed.

6. Agricultural Input Materials

For stabilized agricultural production, smooth supply of agricultural input materials is important. A quantity of agricultural input materials to be supplied to the farm has been determined taking into account the target yield of each crop. In this study, such quantity has been determined based on experimental data obtained in Iraq inclusive of data of the text book "Amber Paddy Cultivation in Middle Euphrates". Annual input materials requirement per hectare by crops is

as follows:

Table 4-5. Agricultural Input Materials Per Hectare

Crops	1986 8th	1987 9th	1988 10th	1989 11th
Paddy				
Seed (kg/ha)	100	100	100	100
Urea (kg/ha)/1	145	204	230	260
T.S.P. (kg/ha)	98	135	154	174
Granular phlazorate/2	15	15	15	15
Powder Kitajin	30	30	30	30
Machinery cost/3	(6.2) 26.4	(6.2) 26.4	(6.2) 26.4	(6.2) 26.4
Wheat				
Seed (kg/ha)	120	120	120	120
Urea (kg/ha)	209	235	260	260
T.S.P. (kg/ha)	70	78	87	87
Machinery cost (I.D./ha)	(4.9) 21.6	(4.9) 21.6	(4.9) 21.6	(4.9) 21.6
Barley				
Seed (kg/ha)	120	120	120	120
Urea (kg/ha)	139	157	174	174
T.S.P. (kg/ha)	70	78	87	87
Machinery cost (I.D./ha)	(4.9) 21.6	(4.9) 21.6	(4.9) 21.6	(4.9) 21.6

/1 --- Urea of 260 kg is applied two times, 90 kg for basal dressing and 170 kg for top-dressing. Experimentations on effects of Urea basal dressing in cation soils will be required.

/2 --- Effectiveness of the herbicide "Sunbird" has been already tested during these two years in Japan, but application of Pylazorate has been planned in this study since the above-mentioned herbicide has not yet been put on sale.

/3 --- The machinery cost covers the depreciation cost, fuel cost and repair cost. Figures in parenthesis show the cost excluding the depreciation cost.

Supply of seed with a high quality has a special importance in farm operation and management. Therefore, it has been planned to install an basic seed farm and a seed farm for seed breeding within the Project.

Table 4-6 Agricultural Input Materials Required

Material		1986	1987	1988	1989	1990	1991	Remarks
Paddy seed	(ton)	278	484	621	621	621	621	120 kg/ha
Wheat seed	(ton)	55.2	93.6	120	120	120	120	120 kg/ha
Barley seed	(ton)	55.2	93.6	120	120	120	120	120 kg/ha
Urea	(ton)	563.18	1,157.5	1,659.93	1,950.84	2,007.5	2,048.6	For three crops
T.P.S.	(ton)	336.84	693.74	1,001.24	1,155.95	1,227.14	1,254.54	-do-
Granular Pylazorate	(ton)	41.7	72.6	93.15	93.15	93.15	93.15	For paddy
Powder Kitazin	(ton)	83.4	145.2	186.3	186.3	186.3	186.3	-do-
Machinery cost	(I.D)	93,264	161,472	207,144	207,144	207,144	207,144	For three crops

As for fertilizers, urea and T.S.P. will be applied to attain the target yields. For maintenance of land productivity, compost will be produced of paddy straw with calcium cynamide (totally 645 kg) to recover organic matter content of soils.

Paddy weeds decrease the paddy yield to a great extent. Therefore, in addition to puddling and mechanized weeding, herbicide of low toxicity will be supplementally utilized. Careful attentions have been paid in weeding planning to avoid the destruction of the natural environmental system.

Taking into consideration the scale of cultivated area in each year and a required fertilizer volume, the agricultural input material supply until the full benefit year of 1991 has been scheduled (see Table 4-6).

The target yield of paddy will be attained in the sixth cropping year from the commencement of cultivation in the farm. The agricultural input materials required in the full benefit stage are as follows:

Item	Area (ha)	Total Weight	Remarks
Paddy seed	6,210	621	
Wheat seed	1,000	120	
Barley seed	1,000	120	
Urea	8,210	2,048.6	Three crops
T.S.P.	8,210	1,254.54	-do-
Granular pyrazorate	6,210	93.15	Paddy
Powder Kitajin	6,210	186.3	Paddy
Machinery cost	8,210	207,144 I.D.	Three crops

7. Agricultural Production

a) Target Yield

The construction of this rice farm has been planned to meet the minimum requirement for paddy cultivation in the farm such as elimination of soil salinity and irrigation water supply. With rationalized farm management inclusive of self-sufficiency of high quality seed, appropriate fertilizer application and careful weed control, the yield of crops will increase to a great extent. The target yields of paddy,

wheat and barley have been determined as shown in Table 4-7. In determining the target yield of paddy, reference was made to experimental data of Mishkhab Rice Experimental Station and the State Organization for Soils and Land Reclamation, Missan as well as data of the textbook "Amber Paddy Cultiviation in Middle Euphrates Area", Dr. Sabri Sibahi, Engineer of Agriculture, 1976, whereas, in determining the target yields of wheat and barley, to data of the Central Research Station, Abu-Ghraib, Baghdad.

Table 4-7. Target Yields of Paddy, Wheat and Barley
(Unit: ton/ha)

	Present		Future					
	Project Area /1	Whole Iraq /2	1986	1987	1988	1989	1990	1991
Paddy	0.952	2.24	2.5	3.5	4.0	4.5	4.5	4.5
Wheat	0.8	0.789	2.4	2.7	3.0	3.0	3.0	3.0
Barley	1.0	0.931	1.8	2.1	2.3	2.3	2.3	2.3

NOTE: The target yields are underlined.

Source: /1 --- Data of Missan Agriculture, 1977/78.
/2 --- Data in the National Development Plan, 1976 to 1980.
(The yields as of 1975 are abstracted above.)

b) Production Program

On-farm development in the Project will be completed in three years. Annual production of crops should be computed for each construction block until the target yield is attained accordingly. The cropping area and on-farm development program up to 1991 (the 13th year) are tabulated (see Table 4-8).

Gross Production of Crops by Year

(Unit: ton)

Crops/Year	1986	1987	1988	1989	1990	1991
Paddy	6,950	14,880	21,755	25,545	27,260	27,945
Wheat	1,104	2,010	2,772	2,934	3,000	3,000
Barley	828	1,542	2,126	2,256	2,300	2,300
Total	8,882	18,432	26,653	30,735	32,560	33,245

Table 4-8 On-farm Development and Cropping Schedule

(Unit: ha)

Item		1983	1984	1985	1986	1987	1988	1989	1990	1991
Experi. farm		Construction 90	Leaching 90	Cropping 90	Cropping 90	Cropping 90	Cropping 90	Cropping 90	Cropping 90	Cropping 90
Construction Block	A	-	Construc-tion	Leaching	Cropping	Cropping	Croppinh	Cropping	Cropping	Cropping
	B	-	-	Construc-tion	Leaching	-do-	-do-	-do-	-do-	-do-
	C	-	-	-	Construc-tion	Leaching	-do-	-do-	-do-	-do-
Construction area		-	2,780	2,060	1,370	-	-	-	-	-
Leaching plan		-	-	2,780	2,060	1,370	-	-	-	-
Paddy										
Cropping Area		-	-	-	2,780	4,840	6,210	6,210	6,210	6,210
A		-	-	-	2,780	2,780	2,780	2,780	2,780	2,780
B		-	-	-	-	2,060	2,060	2,060	2,060	2,060
C		-	-	-	-	-	1,370	1,370	1,370	1,370
Wheat										
Cropping Area		-	-	-	460	780	1,000	1,000	1,000	1,000
A		-	-	-	460	460	460	460	460	460
B		-	-	-	-	320	320	320	320	320
C		-	-	-	-	-	220	220	220	220
Barley										
Cropping Area		-	-	-	460	780	1,000	1,000	1,000	1,000
A		-	-	-	460	460	460	460	460	460
B		-	-	-	-	320	320	320	320	320
C		-	-	-	-	-	220	220	220	220

As seen in the above table, the target yield of paddy will be attained in 1991, that is, the 13th year from the feasibility study in 1979 and the sixth year from the commencement of cultivation in 1986. The gross yield of paddy, wheat and barley is 27,945 tons, 3,000 tons and 2,300 tons, respectively. After the sixth year from the commencement of cultivation in 1991, the production of crops will be stabilized, or gradually increase as a result of progress in rationalization of farm management and introduction of new farm techniques, etc.

8. Marketability of Agricultural Products

Comparison is made between the agricultural products accrued from the Project in the full benefit stage and the present products from the whole Missan province as follows:

Target Production in the Project and Present Production in the Whole Missan Province

(Unit: ton)

Crops	Target Production in the Project	Present Production the Whole Missan	
Paddy Rice	27,900	51,000	(1977)
Wheat	3,000	15,660	(1977/78)
Barley	2,300	28,958	(1977/78)

As seen in the above table, wheat and barley to be produced in the Project are small in comparison with their gross production in the whole Missan province. Therefore, the impact brought about by the increased production of wheat and barley would not be so big. It is considered that such products will be consumed within the province.

Missan province, one of the major paddy producing provinces in Iraq, is an exporter of paddy rice to the other provinces. The rice cultivation area in the province is equivalent to about 20% of the total in Iraq as of 1977.

Paddy rice to be produced in the Project will be also exported to the other provinces. The following table shows demand and supply

of paddy rice in Nissan province in cases of "with the Project" and "without the Project".

Demand and Supply of Paddy Rice, Nissan

(Unit: '000 tons)

Year	Demand/1	Supply/2	Surplus Rice	
			With Project	Without Project
1975	16.3	31-51	-	14.7 to 34.7
1985	26.0	51 + 27.9	52.9	-

/1 --- The figures are computed based on population forecast and annual per capita consumption of paddy rice.

/2 --- Paddy of 31,000 tons was produced in 1976 whereas that of 51,000 tons was recorded in 1977. The estimated paddy rice production of 78.9 tons is computed as follows: 51,000 + 27,900 - Where paddy rice of 27,900 tons is increased in production with the Project.

The above table shows that the Nissan province will export the surplus rice of about 53,000 tons to the other provinces.

9. Farm Operation and Management

a) Basic Plans for Farm Operation

Two farm management plans have been formulated. One is a short-term plan for the initial stage of establishment of the rice farm (about 13 years), and the other is a long-term plan for the full benefit stage of the Project. Strategically, the basic plans for each stage are described as follows:

1) Farm operation plans in the initial stage

i) Line-up of administrative officers, engineers and laborers in an early stage (person/organization in charge: Director General);

ii) Construction of houses and office buildings in an early stage (Director General and the Department of General Affairs);

iii) Construction and operation of the experimental farm so that experimental results will be introduced to the main farm operation (Department of Experimentation).

iv) Construction of irrigation and drainage facilities on schedule (Department of Facilities).

v) Construction of farm facilities and introduction of farm machinery (Department of Experimentation and Departments of Field Crops);

vi) Construction of the rice processing center on schedule (the Grain Board and Director General);

vii) Careful scheduling of farm practices (Departments of Field Crops, Department of Experimentation and Department of Management);

viii) Preparation and supply scheduling of agricultural materials (Department of Management);

ix) Water management scheduling based on cropping schedule, inclusive of contact to the Ministry of Irrigation for Water Distribution (Department of Facilities);

x) Sale of agricultural products (Department of Management);

xi) Labor management (Department of General Affairs);

xii) Coordination among related departments for the best farm management (Director General).

2) Farm operation in the full benefit stage

i) To attain the target profit under the independent profit system (Director General);

ii) Labor management (Department of General Affairs);

iii) Coordination among departments (Director General, Deputy Director General and Advisors);

iv) Procurement of agricultural input materials and sale of agricultural products (Department of Management);

v) Operation and maintenance of farm machinery and instruments (Department of Machinery);

vi) Experimentation, research and technical guidance (Department of Experimentation);

vii) Farm practices scheduling (Department of Field Crops)

viii) Operation and maintenance of water utilization facilities (Department of Facilities);

ix) Establishment, operation and maintenance of the seed center (Department of Experimentation)

b) Organization

The operation and management of this rice farm will be mainly made by one Director General, one Deputy Director General, three Advisors with the support of about 130 officials of 24 sections under nine departments, 60 skilled laborers and general laborers of about 30,000 man-days per year.

The organization for operation and management of the rice farm will be headed by the Director General. Deputy Director General will support the Director General with close contact with three Advisors. The Organization Chart is shown in Fig. 4-4.

c) Characteristics of the Rice Farm Operation

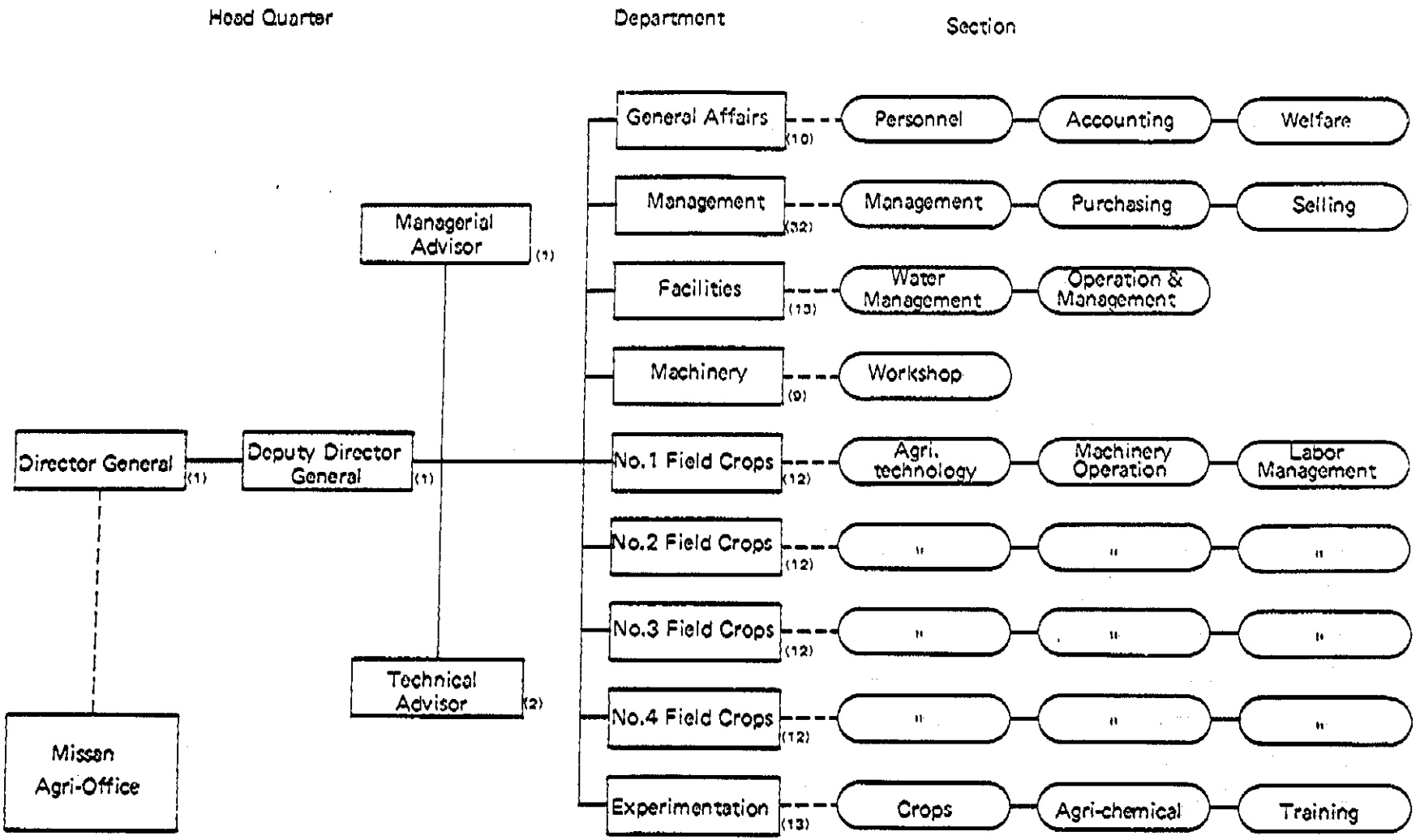
The rice farm will have the following special characteristics for smooth farm management.

- Farming Unit System

Taking into consideration the proposed irrigation system in the whole Project Area and operation efficiency of farm machines to be introduced, the Project Area will be divided into four farming units so that farm management will be independently carried out in each farming unit.

This farming unit system aims to define responsibilities of the field crops department to be organized for each farming unit, to let it practice a scrupulous farm operation in each unit and to level-up

FIGURE 4-4 ORGANIZATION CHART OF THE RICE FARM



Note: The parenthesized figures show numbers of staff.
The total number is 130 persons.

farm practices and management through mutual efforts of the four farming units.

Block	Main Farm	Seed Farm	Total
No. 1 Farming Unit	1,420	-	1,420
No. 2 Farming Unit	1,300	-	1,300
No. 3 Farming Unit	1,610	300/1	1,910
No. 4 Farming Unit	1,580	-	1,580
Total	5,910	300	6,210

/1 --- The seed farm of 300 ha is located in the No. 3 Farming Unit. However, its operation and management will be conducted by the Department of Experimentation.

- The Experimental Farm and Self-sufficiency of Seeds

There are many subjects to be studied in operation of this rice farm. For this purpose, various researches and experimentations will be conducted in the experimental farm. New farming techniques developed in researches and experimentations will be introduced elastically to the main farm operation. Furthermore, a basic seed farm will be located in the experimental farm, and, with the seed farm to be constructed in No. 3 Farming Unit adjacent to the experimental farm, plays a role to supply necessary seeds for the Project.

10. Experimental Farm

a) Objectives

Advanced techniques will be required for management of the large-scaled rice farm in Arara since the Project Area has the following natural and social restrictive factors in farm management because the Project Area is situated in the arid zone.

i) Saline soils peculiar to the arid zones;

ii) Poor environment for labor with high temperatures and heat winds;

iii) Cropping environment in which no crops can grow without irrigation;

iv) Absence of a large-scaled rice farm operation system.

The experimental farm will be operated to improve the on-farm conditions and establish a rice production system so that a high yield of paddy will be attained under the social and natural conditions as already described.

A relatively large area of 90 ha has been allotted to the experimental farm premising that a large-scaled rice farm operation is carried out in the cultivated area of 6,210 ha. The experimental farm includes a basic seed farm. A seed farm has been planned adjacent to the experimental farm for self-sufficiency of seeds.

The experimental farm will handle only subjects directly involved in the Project as follows:

b) Test Items Expected

i) Breeding works and varietial trial: Screaning of eary-maturing, medium-maturing and late-maturing lines as well as salt tolerant varieties;

ii) Sowing test: Sowing methods, critical sowing season, seed requirement and seed preparation for planting;

iii) Cultivation test: Transplanting, direct sowing and two crops a year cultivation.

iv) Fertilizer application test: Fertilizer requirement and response, and application period in relation with the growth of crops;

v) Weeding test: Weeding by the rotational cropping of paddy and upland crops;

vi) Control and prevention test: Kind and quantity of necessary agricultural chemicals;

vii) Operational test of farm machines: Farm machine operation in actual farm practices and improvement of machines;

viii) Leaching test: Methodological test for leaching and water requirement for this purpose;

ix) Water management test: Optimum irrigation methods and irrigation water requirements;

x) On-farm test: Relation between a scale of farm plots and water management in irrigation and drainage inclusive of the influence of winds;

xi) Soil fertility test: Effect of compost application and application methodology;

xii) Wind-breaking test: Effect of wind-breakers;

xiii) Others: Fish culture, etc.

In experimentation, priority should be given to i), ii), iii), vii), and viii) as itemized above.

c) Field Training for Paddy Cultivation

The experimental farm will be utilized for practical training of agronomists in charge of paddy cultivation, machine-operators, skilled laborers. Training for tractor operation ploving, etc., will be able to conduct during winter seasons, i.e., off-seasons of paddy cultivation.

d) Self-sufficiency of Seed

For self-sufficiency of paddy seed with a high quality, the rice farm will be equipped with basic and fundational seed farms of 18 ha and a commercial seed farm of 300 ha. It is recommendable to secure a commercial seed within the Project selected by themselves. For this purpose, experts in breeding should be assiged to the Department of Experimentation which will be responsible for management of the seed center. Further details are explained in Appendix 4C-8.

11. Farm and Related Facilities

The major facilities such as a farm management office and farm facilities as well as a village for the rice farm staff will be located in the middle of the Project boundary facing the Kahlaa river.

The cultivated area of 6,300 ha will be divided into four farming units of about 1,500 ha, and farm operation will be independently conducted in each farming unit. Two farm operation bases equipped with a pool for input materials and farm machines and rest room will be constructed in the Project. The farm management office will be responsible for integrated management of farm operation in the whole Project.

The farm operation and related facilities proposed are as follows:

a) Farm operation facilities

i)	Farm Management Office	One building (2,000 sq.m)	Office work
ii)	Warehouse (Farm)	One building (2,500 sq.m)	Storage of seeds, fertilizers and chemicals
iii)	Warehouse (Materials)	One building (300 sq. m)	Storage of research materials, farm instrument, etc.
iv)	Workshop	One building (2,400 sq.m)	Building: 1,200 sq. m Concrete floor: 1,200 sq.m
v)	Garage & Gas Station	One building (6,500 sq.m)	for tractors, trucks and combines, etc.
vi)	Workers' Rest House	One building (300 sq.m)	
vii)	Runway	Two places (180,000 sq.m)	40 m x 1,000 m x 2 places
viii)	Farm operation Base	Two places (6,000 sq.m)	3,000 sq.m x 2 places Farming warehouse and pool: 500 sq. m Pool for machines: 2,500 sq.m
ix)	Seed Center	One building (300 sq.m)	

b) Related Facilities

Related facilities required for farm operation are as follows:

i) One village for the rice farm staff;

ii) Rice processing facilities for the Project and rice cultivated farmers in the south of Anara City;

iii) Kahlaa bridge for transportation of agricultural inputs and outputs and for traffic of inhabitants in the Kahlaa left bank tract. (Also for the oil company.)

These facilities will be located in the middle of the Project boundary facing the Kahlaa river.

The outline of each facility is described below:

i) One village for rice farm workers

(1) Housing 330 houses (Population: 1,600 persons)

Farm official	130 houses
Laborers	170 houses
Farm families presently living in the Project Area and seasonal laborers	30 houses

(2) Public facilities

Educational facilities (one primary school and one training center)

Social welfare facilities (one mosque, one clinic, one meeting hall and one small park)

Recreation facilities (one playground, one tennis court and one movie theater, etc.)

Marketing facilities (one grocery store and one market, etc.)

Drinking water supply system and sewerage (lump-sum)

Road and drainage systems in the village (lump-sum)

(3) Sites

Housing Area: 30 ha (About 1,000 sq. m for each household with kitchen garden

Public facilities: 20 ha

Educational facility:	2 ha
Social welfare facility:	1 ha
Recreation, marketing and drinking water supply facilities and sewerage	2 ha
Village road and drainage systems	5 ha
Unallotted land for future use	10 ha

Ornamental forest for the village 35 ha

ii) Processing facilities

In order to process paddy rice of about 28,000 tons and wheat and barley of 5,300 tons in total, processing facilities will be installed adjacent to the village.

If the facilities have a surplus capacity, these will be operated for farmers in the southern area of Amara (mainly for paddy cultivating farmers).

iii) Kahlaa bridge

Kahlaa bridge will be constructed across the Kahlaa river at Al-Bahatha, the middle point of the Project boundary facing to the Kahlaa;

Bridge length: L = 300 m (Width: 7 m)
Access road: L = 400 m (Width: 9 m)

D. The Project Plan

Kahlaa Rice Farm Project aims to construct a mechanized state rice farm with a high production efficiency so that the modernized agriculture focusing upon rice production will be developed in Amara area. For this purpose, necessary infrastructural improvement will be implemented in the Project.

No agricultural plants can grow in the arid zone without irrigation. Therefore, irrigation is, needless to say, prerequisite for agriculture in Amara area. In addition, the special importance of drainage in the arid zone has been recognized recently, that is, the great effect of drainage as a countermeasure against salt accumulation on soil surface which has been brought about by repeated irrigation without drainage, and caused a decline in agricultural production in Iraq.

Apart from the importance of irrigation and drainage, the modernized agriculture requires farm improvement for smooth managerial practices, weed control and water management. Furthermore, unforgetable is a

countermeasure against north-west burning winds prevailing in summer seasons.

The infrastructural improvement in the Project has been planned to cover the minimum requirements of the rice farm.

1. Comparative Study on Irrigation and Drainage Systems

In determination of irrigation and drainage systems, topographic conditions of a given project area, available water resources, present irrigation and drainage canals and proposed farming are the major factors to be taken into consideration.

The Project Area has a quite gentle slope of about 1/10,000 from the Kahlaa river levee to Al-chikke marsh. The water source for the Project is the Kahlaa river running along the western boundary of the Project Area. With such topographic conditions, the Project Area is very advantageous in constructing an irrigation system.

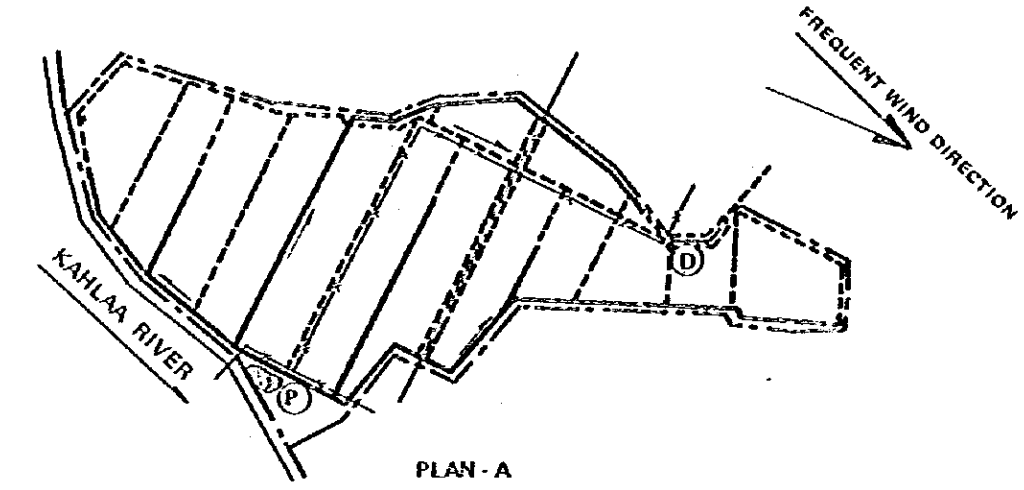
The pump irrigation will be adopted since the water source level ranges in W.L. 6.95 to 3.40 m whereas the elevation of cultivated area in EL 6.5 to 4.5 m. Present irrigation system is, as mentioned in 3.D.1. irregular and extremely primitive. Except the Gasma river whose rehabilitation has been just completed (discharge quantity: Q=1.0 cu.m/sec), none of the present canals might be available in the Project as they are.

Skeleton of the proposed irrigation and drainage systems has been studied in consideration of the most appropriate locations of main farm roads, farm facilities, wind-breakers and so forth. As a result, the following three alternative plans have been proposed.

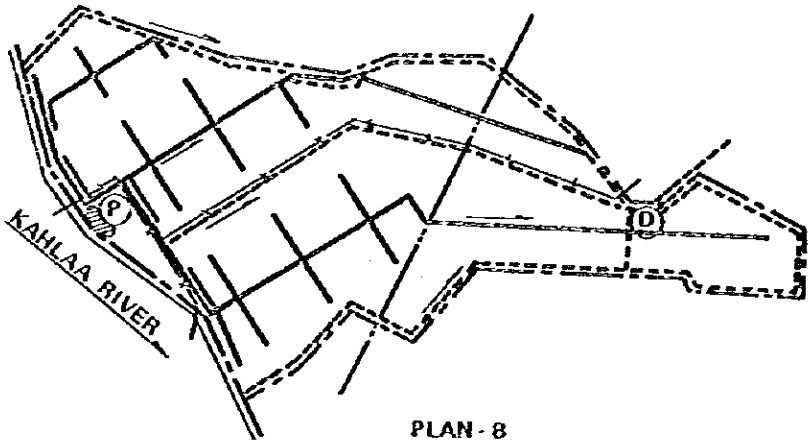
Alternative Plan A

In the Alternative Plan A, water source facilities are located in the middle of the western Project boundary facing to the Kahlaa river, and main irrigation and drainage canals at the right angle with north-west winds. This plan has the following advantages;

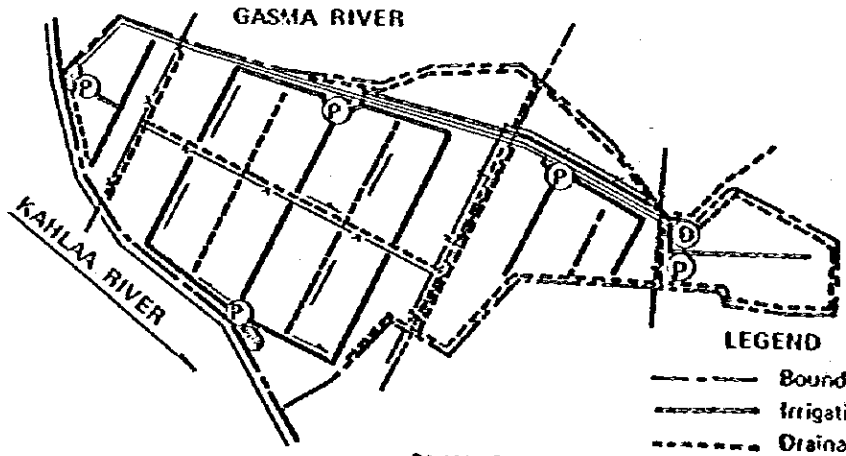
FIGURE 4-5 ALTERNATIVE PLAN OF IRRIGATION AND DRAINAGE SYSTEM



PLAN - A



PLAN - B



PLAN - C

LEGEND

- Boundary of Project Area
- Irrigation Canal
- Drainage Canal
- Oil Pipe Line
- (P) Irrigation Pumping Station
- (D) Drainage Pumping Station
- Sedimentation Basin
- Boundary of Irrigation Area

- The O/M of facilities and farm management will be rationalized since farm facilities can be located adjacent to water source facilities.
- Both banks of main irrigation and drainage canals will be afforested. Therefore, crops in the Project Area will be effectively protected from the north-west winds.
- The skeleton of the proposed irrigation and drainage systems will coincide with the course of oil pipeline running through the heart of the Project Area. Therefore, canal embankments and roads will be laid to protect the pipeline.

Alternative Plan B

The skeleton of irrigation and drainage canals is designed at the right angle with the Kahlaa river course as same as existing irrigation canals. This plan is helpful in the following:

- The water source facilities will be moved a little way to the east. However, the site is also appropriate from all angles.
- The skeleton of irrigation and drainage canals makes the best use of the topographic conditions in the Project Area. However, the wind-breakers do not fully work because they do not squarely face north-west.
- The direction of irrigation and drainage canals does not coincide with that of the oil pipeline. Therefore, many farm plots will be irregular in shape. Moreover, a total length of main and secondary canals will be long.

Alternative Plan C

In this plan, the existing Gasma river will be improved, and its water will be utilized for irrigation in addition to the direct lifting of the Kahlaa water. The plan has the following characteristics:

- The proposed skeleton of irrigation and drainage canals in this plan has the similar direction to that of the existing major

canals. However, in order to improve the existing Gasma river to have a required capacity and canal structure, the construction volume will be so big as required for a new canal construction along the same course.

- If the Gasma water is utilized for irrigation, the gravity irrigation is not available since the elevation of cultivated land ranges in 6.5 to 4.5 m while the water level in WL 6.95 to 3.40 m. Therefore, many pumps will be required along the Gasma river.
- In the Alternative Plans A and B, silt treatment of the Kahlaa water can be made at one desilting reservoir. One the other hand, such reservoir should be additionally constructed at the upper most of the Gasma river in the Plan C, and a supply tank has to be constructed for each pump station.

As a result of the above-mentioned comparative study, the Plan A has been proposed for the Project taking into account its advantage in wind-breaking effect, layout of water source and farm facilities, and water management, etc.

It is important to modernize irrigation systems for agriculture in Iraq, but it is also clear that leaching and drainage have a special importance for land reclamation in saline soil zone.

In addition to construction of irrigation and drainage systems, a drainage pump station will be installed near the Al-Chikke marsh to release surface and sub-surface drainage water to that marsh. Furthermore, the main drainage will be equipped with two drainage regulating gates to control groundwater (percolation) during the paddy irrigation period.

2. Irrigation Plan

a) Basic Concept in Planning

Irrigation and drainage plans for the Project should be formulated in close relation with Amara irrigation project since the net cultivation

area of 6,300 ha in the Project corresponds to ten percent of the total paddy area of 67,500 ha proposed in Amara irrigation project.

The proposed cropping pattern suggests to cultivate the whole cultivated area of 6,300 ha with paddy from May to November, and 2,000 ha with wheat and barley from November to April.

The Kahlaa river, a tributary of the Tigris river, is sole water source for the Project Area. The Kahlaa water will be lifted from the desilting reservoir to be constructed near the river bank to settle silt before its distribution to on-farm irrigation systems through main and secondary canals.

At present, soils in the Project Area have been salinized due to lack of drainage networks and absence of measures to control soil salinity. Therefore, as mentioned in relation with the drainage plan, leaching will be inevitably required in the reclamation stage of farm land. Even after the initial leaching, careful control of soil salinity will be essential for crop cultivation before or after irrigation periods. Leaching water should be supplied in addition to irrigation water.

As for the irrigation method, continuous irrigation of flooding type will be applied for paddy cultivation in order to avoid crop damage caused by high temperature and to prevent salt accumulation in the root zone soils. In case of wheat and barley, intermittent irrigation with border is favourable for farm practices after paddy harvesting and to suppress desalinization of the top soil as seen in furrow irrigation.

b) Irrigation Water Requirement

i) Crop Water Requirement

Potential evapotranspiration (ETo), generally recognized as fairly reliable index in calculating crop water requirement, can be determined by a number of methods, such as the evaporation measurement from

evaporation pan and the application of empirical equation based on the climatological data. In this study, evapotranspiration of the proposed crops is estimated by applying the following equation based on the recommendations made by the FAO Group. This equation defines clearly the effect of climate on crop water requirement, but still employing the Blaney-Criddle temperature and day length related to the consumptive use factor:

$$ETo = C[P(0.46T + 8)]$$

Where, ETo: Potential evapotranspiration in mm/day for the month considered.

T: The mean daily temperature in ^{o}C in the month considered.

P: The mean daily percentage of the total annula day-time-hours for the given month and latitude.

C: Adjustment factor which depends upon the minimum relative humidity, sunshine hours and day-time wind estimate (refer to "Guidelines for predicting crop water requirements", FAO, 1977, p.7).

Based on the observed data at Amara sugarcane factory and at Amara meteorological station, the mean monthly ETo during the period of 1966 to 1978 is calculated as follows:

Potential Evapotranspiration

(Unit: mm)

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Daily basis	2.0	2.9	4.0	5.4	8.7	11.0	11.1	10.4	9.2	5.2	4.3	2.5	-
Monthly basis	62	81	124	162	270	330	344	322	276	161	129	65	2,326

After the determination of ETo, crop evapotranspiration (ETcrop) can be predicted by applying the appropriate crop coefficient (Kc). The Kc values vary depending upon a growing period of crops and locality. No data on such values, however, are available in the vicinity of the Project Area, so that following values are selected, taking into account the characteristics of proposed crops, times of planting or sowing and the stage of crop development and climatic conditions prevailing in the

Area, in addition, referring to values adopted in Iraq or data collected by FAO.

Selected (Kc) Values for Proposed Crops

Month / Crop	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Paddy	-	-	-	-	1.05	1.05	1.1	1.35	1.35	1.0	1.0	-
Wheat	1.1	1.1	1.1	1.1	0.2	-	-	-	-	-	0.5	1.1
Barley	1.1	1.1	1.1	0.2	-	-	-	-	-	0.5	1.1	1.1
Trees	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

The ETcrop values are, thus, predicted by applying ETo and Kc as mentioned above. The following table shows the mean ETcrop for the period of 1966/78.

Crop Evapotranspiration (ETcrop)

(Unit: mm)

Month / Crop	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Paddy	-	-	-	-	9.1	11.6	12.2	14.0	12.4	5.2	4.3	-
Wheat	2.2	3.2	4.4	5.9	1.8	-	-	-	-	-	2.2	2.3
Barley	2.2	3.2	4.4	1.1	-	-	-	-	-	2.6	4.7	2.3
Trees	1.8	2.6	3.6	4.9	7.8	9.3	10.0	9.4	8.3	4.7	3.9	1.9

Monthly crop evapotranspiration in the period of 1966 to 1978 is shown in Appendix 4D-1.

ii) Leaching Water Requirement

The leaching water requirement means the minimum water necessary to leach the root zone soils of crops during the irrigation period after initial leaching made in reclaimed field.

After completion of initial leaching salts are accumulated on lower layers of soils or dissolve in the groundwater. Once water from the upper soil layer is interrupted in a non-irrigation or irrigation period, accumulated salts in the lower layer ascend by means by capillary attraction, consequently, resalinization of soils in the root zone are apt to occur.

Therefore, the effect of leaching on the root zone will not be appeared provided that only water corresponding to the consumptive use of crops is applied. To keep the soil salinity of the root zone within the tolerable limit of each proposed crop, at least the minimum water volume for leaching should be supplied in addition to the irrigation water.

Provided that the surface irrigation is applied, the following equation is available for computing the leaching water requirements in case of sandy loam to clay loam soils under good drainage condition with a small rainfall.

$$LR = \frac{Ecw}{5Ece - Ecw} \times \frac{1}{Le}$$

Where, LR: Leaching water requirement
Ecw: Electric conductivity of the irrigation water in mmho/cm
Ece: Electric conductivity of the soil saturation extract in mmho/cm
Le: Leaching efficiency

According to the water analysis result, the electric conductivity of the irrigation water is 0.8 mmho/cm on an average.

Provided that the leaching efficiency is 60%, the leaching requirement to lower the soil salinity to the salt tolerance level of a crop is obtained and expressed in the percentage to the crop water requirements as follows:

Leaching Water Requirements for Each Crop

(Unit: %)

Crop	Yield Potential			
	100%	90%	70%	50%
Paddy	8	6	5	3
Wheat	4	3	2	2
Barley	3	2	1	1
Trees	6	4	2	1

Crop salt tolerance level of each proposed crop is shown in Appendix 4D-1.

iii) Irrigation Efficiency

A part of irrigation water conveyed from the water source to the farm plots will be lost in the course of conveyance, distribution and farm application. In calculating the project irrigation requirements, those losses, i.e., an efficiency factor, should be taken into account to compensate.

The project irrigation efficiency (Ep) is defined as the ratio of a water volume directly made available to a crop and the water volume released from the water source, and generally subdivided into two stages as follows:

$$Ep = Ea \times Ed$$

Where, Ep: Project irrigation efficiency
Ea: Field application efficiency
Ed: Distribution efficiency inclusive of the conveyance efficiency.

In consideration of soil conditions in the Project Area and applied irrigation methods and structures, the following value is selected:

Efficiency	Paddy	Wheat, Barley & Tree
Ea	0.90	0.70
Ed	0.85	0.85
Ep	0.80	0.60

iv) Irrigation Water Requirements

Based on the proposed cropping pattern and intensity, the irrigation requirements for 6,300 ha of paddy, each 1,000 ha of wheat and barley and 330 ha of trees in wind-breaking green belts are calculated, in consideration of the leaching and estimated irrigation efficiency, by applying the following equation:

$$V = \frac{10}{Ep}\left(\frac{A(ETcrop + Pe) \times N - Re}{1 - LR}\right)$$

Where, V: Monthly volume of water requirement in cu.m
Ep: Project irrigation efficiency - paddy: 0.80; others: 0.60
A: Cropped acreage of each crop in ha

Eferop: Crop evapotranspiration in mm/day
Pe: Percolation rate during paddy growing season in mm/day, 15 mm/day
Pe is taken into consideration only for paddy.
N: Number of days in each month
Re: Monthly effective rainfall in mm
LR: Leaching requirement (ratio) excluding paddy

Mean monthly water requirements of each crop (averaged values observed during the period of 1966 to 1978) are as follows:

For paddy water requirements, a requirement during land soaking periods is taken into account, and the tree irrigated area is estimated at 170 ha, a half of the proposed area.

Monthly water requirements in each year are shown in Appendix 4D-1.

Mean Monthly Water Requirements

(Unit: million cu.m)

Crop \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Paddy	-	-	-	-	13.46	52.59	66.32	70.36	59.77
Wheat	0.59	1.20	2.14	2.78	0.17	-	-	-	-
Barley	0.58	1.19	2.11	0.21	-	-	-	-	-
Trees	0.07	0.16	0.28	0.37	0.69	0.83	0.92	0.85	0.74
Total	1.24	2.55	4.53	3.36	14.32	53.46	67.22	71.21	60.50
(m^3/sec)	0.46	1.05	1.69	1.30	5.35	20.63	25.10	26.59	23.34

Crop \ Month	Oct.	Nov.	Dec.	Annual
Paddy	24.23	2.68	-	289.41
Wheat	-	0.89	0.68	8.45
Barley	0.41	2.27	0.67	7.44
Trees	0.41	0.32	0.07	5.72
Total	25.05	6.16	1.42	311.02
(m^3/sec)	9.35	2.38	0.53	-

v) Peak Water Requirement

The peak water requirement appears in the latest period of puddling, for paddy cultivation which has been planned over the whole area, 6,300 ha.

Land soaking, i.e., puddling including pre-irrigation in the whole area is proposed to be started four days ahead of sowing, and completed within 40 days from May 14 to June 29.

Paddy fields are dry before puddling, and have well-developed cracks. Provided that puddling is made without pre-irrigation water under such conditions, a great deal of water would be required in its initial stage as verified in water requirement measurements at test fields (see Appendix 4D-1). In consequence, on-farm facilities of a big capacity will be required, which results in an extreme increase of construction cost.

Therefore, pre-irrigation and groundwater control should be made after completion of land preparation and levelling in order to decrease the percolation. At least, the porocity of plowing layers with 15 cm deep should be saturated.

To reduce the capacity of a tertiary irrigation canal, pre-irrigation should be executed for two days before puddling.

The total water requirement for land soaking, including pre-irrigation, puddling and maintenance water after puddling amounts to 250 mm (see Appendix 4D-1).

Land soaking will be finished in June 24 to 29. The peak water requirement in paddy fields occurs on June 24, and the volume is estimated at 29.3 mm/day, i.e., 3.39 lit/sec/ha, on the basis of weighted average of irrigation water requirement in consideration of the area under sowing and growing in a unit block. In case the irrigation efficiency of 80%, the gross irrigation water requirement is computed at 36.6 mm/day, i.e., 4.24 lit/sec/ha. Therefore, the gross irrigation requirement over the paddy area is 26.7 cu.m/sec.

In addition to this paddy requirement, trees planted in the green belt area of 170 ha, that is, a half of the total green belt area require irrigation water and their water requirement is 0.3 cu.m/sec.

Therefore, the peak water requirement in the Project arrives at 27.0 cu.m/sec in total.

c) Irrigation Facilities

i) Irrigation Canals

Irrigation canal networks will be laid from the north-east to south-west in parallel with the existing oil pipeline in order to decrease canals to run across the pipeline to the maximum extent possible and to protect crops from north-west winds by afforesting along canals. Further detail on irrigation facilities is shown in Appendix 4D-3.

Irrigation canals will be provided with concrete lining in consideration of the following:

- The irrigation area is extremely flat. Canals will have a quite gentle slope, accordingly. In order to keep the water level at the downstream end of canals at an appropriate height for irrigation, concrete lining to keep small the friction loss will be necessary.
- Banking will be made for all main and secondary canals. Therefore, concrete lining will be useful to prevent leakage and to protect the banks from erosion.

Classification of Irrigation Canals

The proposed irrigation canals are classified into main, secondary and tertiary canals and farm ditches by their functions. The main irrigation canals will be aligned along the Kahlaa river, water source for the Project, and the southern boundary of the Project Area. The secondary irrigation canals convey irrigation water from the main canals to tertiary irrigation canals. Therefore, secondary canals have been planned to run in parallel with the oil pipeline. Further detail on the secondary and tertiary canals is described in 4,D,4.

Typical Cross-Section of Irrigation Canals

The proposed irrigation canals will be paved with concrete of 10 cm thick, and take a trapezoid shape with the canal slope of 1:1.5. The hydraulic dimension and computation in detail are shown in Appendix 4D-3.

Discharge and Length of Canals

Canals	Quantity of Discharge	Length
Main Irrigation Canal	13.87 to 6.27 cu.m/sec	13.6 km
Secondary Irrigation Canal	7.60 to 2.22 cu.m/sec	31.0 km
Total		44.6 km

Related Facilities

Diversion boxes, checks, spillways, road crossings are the related facilities to main and secondary irrigation canals as follows:

- Diversion boxes

  The installation of diversion boxes of the double-gate type with a constant head has been planned to deliver irrigation water from main irrigation canals to second irrigation canals. Some diversion boxes will be provided to secondary irrigation canals, too, where required. The total number of diversion boxes will be 43.

- Checks

  Checks will be used to raise water level in irrigation canal when the water level is low. The total number of checks will be 4.

- Spillways

  Six spillways of the overflow type will be installed on main and secondary irrigation canals for emergent release of surplus water in these canals. This facility will be placed where canals have different cross-sections.

- Road crossing

  Totally 11 concrete box culverts will be installed to convey irrigation water across roads.

ii) Irrigation Pump

The water source for the Project is the Kahlaa river, which runs along the western boundary of the Project Area. Pumping facilities will be needed for irrigation water supply to the Project Area. Since the Kahlaa river has a quite gentle bed slope near the Project Area, the pump station can be located at any place along the Kahlaa river. However, based on careful studies on the proposed irrigation and drainage networks as well as topographic conditions of the Project Area, the pumping station site has been proposed in the middle of the western Project Area boundary. The irrigation system with one irrigation pump station is more economical and technically advantageous in operation and maintenance than that with plural one. Therefore, single pump station will be adopted to the Project.

The major dimensions of pump are as follows: (see Appendix 4D-4)

Item	Description
Type:	Vertical mixed flow pump
Bore diameter:	ø 1,000 mm
Unit:	Eleven (11)
Design discharge:	2.43 cu.m/sec/unit
Total pump head:	5.6 m
Prime mover:	Motor
Power per unit:	200 kw/unit

iii) Desilting Reservoir

Function

The Kahlaa water, water source for the Project, has a silt content of 800 g/sq.m on an average. If such silty water is directly released to the Project Area without any treatment, silt of 200,000 tons is estimated to accumulate in each year, on farm fields and canals, etc. Therefore, the construction of a desilting reservoir has been planned to make silt treatment prior to diversion of the Kahlaa water to the Project Area.

Dimensions

The desilting reservoir will be constructed in the middle of the western Project Area boundary facing the Kahlaa river. It is estimated that silt of about 154,000 cu.m will be annually deposited in the reservoir. A pump dredger will be continuously operated to remove deposited silt. Taking into consideration the annual silt deposit and operation depth of the pump dredger the reservoir has been designed to have an area of 40 ha and a depth of 1.5 m.

Further details in determination of the reservoir dimensions are described in Appendix 4D-6.

The necessary excavation in constructing the reservoir will be about 4.0 m deep from the present ground surface. Slope of the reservoir will be 1:1.5.

3. Drainage Plan

Drainage is essential for successful irrigation. Specially in the Project Area, irrigation without proper drainage results in rapid raise of groundwater tables as well as soil salinization.

To avoid crop damages due to salt accumulation in the root zone, first of all, leaching water shall be sufficiently supplied in the reclamation stage. Secondarily, salinity control on the farm land shall be regularly made by supplying leaching water as a part of irrigation requirements before or after cropping seasons.

Excess rainy water may be preferable to be retained on the field surface and to be gradually discharged by installed under-drainage system, taking into consideration the following points:

- Rainfall concentrates in the winter season and is negligibly small. Therefore, surface drainage facilities for rainy water will not be required.
- Retained water will be effective to leach salts in the root zone soils.
- Capacity of drainage facilities can be reduced.

a) Leaching in the Initial Stage

Leaching shall be practiced over the whole field in order to obtain a target yield of paddy rice as understood from the result of soil investigations. Regarding leaching in the initial stage, the following measures are proposed on the basis of leaching programs made at Amara sugarcane farm adjacent to the Project Area, where soil texture and quality of leaching water are similar to those of the area. (Refer to Appendix 4D-6)

- After reclaiming the land, ponds are prepared by ridges with 100 m width and 150 m length and underdrains are placed with 50 m interval. Before commencement of leaching works, fields shall be plowed in order to raise the leaching effect.
- The 1,000 mm water volume in total may be sufficient to leach, although the volume will vary depending on the soil depth. The favorable period to apply leaching water falls January to June when salinity of the river water descends.
- In case of low saline fields (less than 40 ton/ha), leaching practices will be made continuously for 60 days. On the other hand, in case of high saline fields (more than 40 ton/ha), intermittent leaching, 20 days' water supply and 20 days suspension will be made three times.
- To raise the collecting-efficiency of leached salts, underdrains are provided at one meter depth, and drain pipes are placed, filling with rice chaffs up to the surface of the field. This type of underdrains is so-called "underdrains with rice chaffs-wall". (See Appendix 4D-7)

In implementation of the Project, leaching tests shall be practiced in the experimental farm furnishing the same size of fields with irrigation and drainage facilities as proposed for the main farm.

Studies will be made on the method and period of leaching and on type, interval, depth of underdrains, etc. With the progress in experimentations, appropriate practices will be applied to the whole area.

b) Drainage

Drainage in the Project aims to collect and remove salty water used for leaching in order to prevent soils from resalinization during irrigation period.

During paddy cultivation in summer seasons, percolation of 15 mm/day has been taken into account in irrigation water requirement computation. This percolation will be enough to have a function of leaching though underdrainage system will be required to facilitate the percolation.

No salt accumulation will occur in the root zone of paddy field during irrigation periods since the standing waters suppress a rise of salt from lower layers. However, irrigation is interrupted two weeks before harvesting, and the absorption of salts accumulated in lower layers will occur by capillary action.

To intercept this capillary action, drainage of excess water retained in soils is inevitably required. Underdrains of rice chaffs will be effective in this regard.

In the present stage, typical layout of underdrains is made at 50 m interval with one meter depth.

In lowlying lands of the Project Area adjacent to the marsh where groundwater table is high, dense arrangement of underdrains will be necessary.

According to the proposed cropping pattern, 30 percent of the whole area is cultivated with wheat and barley in winter seasons. On the other hand, rainfall records observed at Amara City for 14 years reveal that mean annual value amounts to 171 mm of which 80 percent concentrates in winter seasons, and daily maximum rainfall is 45 mm. Once this maximum rainfall occurs, most of rainfall will infiltrate and be retained to the underground, considering that 70 percent of the whole area is under non-cultivation and fields are dry, moreover, having well-developed cracks.

Soils under irrigation for winter crops are keeping wet conditions. Although rainfall will be retained at one time on the surface of the field, most of rainfall will infiltrate to subsoil. Generally, as the groundwater table is descending, rapid drainage of retained water may not be required.

Considering the above mentioned matters, drainage amount is determined at 7 mm/day equivalent to to 0.81 lit/sec/ha.

c) Drainage Facilities

i) Drainage Canals

Earth canals have been proposed for drainage in the Project. Excavated soils in construction of drainage canals will be used for embankment of roads to be constructed along the both sides of such canals for transportation and canal protection. The drainage canal networks have been planned in close relation with the proposed irrigation system for drainage of surface and subsurface waters as well as for removal of surplus water.

Classification of Drainage Canals

The proposed drainage canals are classified into main, secondary and tertiary canals and farm drains. The main drainage canal will be located in relatively lowlying land in the northern part of the Project Area, mostly along the Gasma river which runs from the Kahlaa river to Al-Chikke marsh. It conveys drainage waters to the proposed drainage pump station. Secondary drainage canals will collect drainage water from tertiary canals and farm drains, and convey it to the main drainage canals. The farm drains are shown in 4-D-5.

Typical Cross-Section

The proposed cross-section of drainage canals is a trapezoid in shape and has the side slopes of 1:1.5.

One of the major functions of drainage in the Project is to remove groundwater for saline soil improvement. Therefore, drainage canals to collect sub-surface water from underdrains should have a discharge level

lower than the outlet of drain-pipes. Rain water as well as waters from a spillway will be allowed to flow within canal capacities.

Hydraulic computations and the diagram system of drainage is shown in Appendix 4D-4.

Discharge Quantity and Length of Canals

The proposed discharge quantity and length of canals are as follows:

	Discharge	Length
The main drainage canal	3.02 to 5.37 cu.m/sec (7.69 cu.m/sec)	15.7 km
Secondary drainage canals	1.17 to 0.07 cu.m/sec (7.69 to 1.23 cu.m/sec)	46.0 km
Total		61.7 km

NOTE: The figures in parenthesis show a discharge from spillways.

Related Facilities

Concrete box culverts will be installed at 27 places to convey drainage water across roads and irrigation canals. The description on road crossings is given in D-4 of Chapter IV.

ii) Drainage Pump Facilities

The proposed drainage system premises the delivery of drainage water to Al-Chikke marsh whose water level ranges in two to three meters with the maximum water level of 4.8 m. Under the circumstances, the natural gravity drainage is not available during the early stage of paddy cultivation.

The location of this drainage pump station has been decided at the northern end of the present oil company's road which is in a low-lying area facing Al-Chikke marsh.

Major Dimensions of Drainage Pump

Item	Description
Type:	Vertical mix flow
Bore diameter:	ϕ 900 mm
Unit:	Three
Designed discharge:	1.79 cu.m./sec/unit
Total pump head:	2.2 m
Prime mover	Motor
Power per unit	60 kw/unit

Details in determination of the major dimensions of drainage pump are described in Appendix 4D-5.

iii) Dike

The eastern part of the Project Area from the oil company's road is located in the swampy Al-Chikke marsh with the minimum elevation of EL 4.50 m, and is submerged during high water season in winter. Under the circumstances, the construction of dike along the Project Area boundary facing Al-Chikke marsh has been proposed to protect that part of the Project Area from intrusion of marshy water.

Scale

Taking into consideration the maximum marshy water level of 4.80 m, the elevation of this dike surface has been determined at EL 5.80 m, which is the same elevation of the oil company's road. The total length of this dike will be 10.3 km out of which the portion of 6.2 km will be placed on a weak foundation. The top width of dike will be seven meters, and paved by coarse materials for transportation.

Typical Cross-Section

Embankment materials for dike should have an appropriate bearing capacity and a perreability. Sandy silt materials forming the foundation of the Project Area are favorable in this aspect. In this case, a dike slope of 1:2.0 seems sufficient to protect the dike from outer strength. To protect the dike from marshy waves, riprap will be placed on the dike slope facing Al-Chikke marsh. The dike top surface will be paved with gravels for transportation purpose. The northern and eastern parts of the proposed dike have weak foundations, so foundation soils of about one meter deep on an average and partially of two to three meters deep will be replaced with soil materials having an adequate soil moisture ratio, which are available in the Project Area.

4. Farm Land Development Plan

a) Strategies in Land Reclamation Planning

Land reclamation in the Project aims to construct modernized farm fields equipped with rationalized on-farm facilities required for farm operation and management in order to attain an increased production of agricultural crops. In planning the land reclamation, various factors to be involved in production and operation/management of the state rice farm should be comprehensively taken into consideration. For this purpose, basic strategies for future development should be set up, and cropping pattern and farm mechanization system, etc., should be determined based on the strategies as follows:

i) Fully mechanized farm management: For the farm practices to grow paddy and upland crops, an integrated and full-scaled farm mechanization should be established in the Project.

ii) Paddy cultivation: Paddy of commercial varieties, Amber and IR should be grown in the Project Area during summer seasons.

iii) Water and farm managements: The rotational irrigation system should be established during land preparation period, based on a rationalized irrigation scheme, for effective

water use. The water and farm management should be smoothly carried out in each farming operation unit to be organized in the Project.

b) Land Reparcelling Plan

1. Principles in Land Reparcelling Planning

In order to materialize a farm land reparcelling covering all the requirements mentioned in item (a) above, due attentions have been paid to the following:

i) To plan it in close relation with the proposed farm mechanization plan;

ii) To plan it to meet requirements in the proposed farm management plan; and,

iii) To plan it to materialize the most effective irrigation and drainage water control.

Further details on the above mentioned are as follows:

i) To determine the location of main and service roads, the skeleton in land reparcelling, to meet the requirements in the proposed farm management plan as well as public facilities plan;

ii) To determine the location of irrigation and drainage canals paying careful attentions to the necessity of separating irrigation and drainage canals, a rational length of terminal canals, rotation irrigation during land preparation and chemical supply for weed control by aircraft. The separation of irrigation and drainage canals is prerequisite for drainage improvement and leaching. By this way, the farm management and irrigation water control are simplified and rationalized. In order to simplify the irrigation water supply and to systematize drainage, a commanding area of one turn-out is planned to correspond to one puddling rotation unit (18 ha).

iii) To provide all farm plots with the same width for simplifying the extension of new technical systems for paddy cultivation. To the farm plot of the same size, a certain quantity of chemicals can be sprayed for control of diseases and harmful insects. The same can be said in fertilizer application. Furthermore, planning and execution of puddling by tractor and the irrigation water management for puddling become simple and easy for the same reason as above mentioned.

2. Size of Plots and Land Reparcelling Plan

The size of plots should be determined by paying careful attentions to the technical systems to be introduced for crops cultivation, crops to be grown, farm machinery to be operated as well as cultivation capacity per day. Being a very flat area with a slope of about 1/10,0000, the Project Area has no restrictions in determining the direction of the length of run (long side of a farm plot) from the viewpoint of earth works.

The width of plot (short side) and the length of run (long side) of plots should be determined in consideration of the following facts:

Length of run

- The longer is the length of run, the more advantageous is the tractor operation for land preparation. Furthermore, with a long length of run, the deduction ratio of land and construction cost can be kept small. If the length of run is too long, the irrigation water control becomes difficult because it takes a long tire to submerge such farm plot. In addition, land levelling in a plot will be also difficult. In general, it is said that the maximum suitable length of run is 100 m to 150 m from the stand point of water management, although the water management will be influenced by the distance from the farm ditch and farm drain, soil texture, depth of groundwater table, degree of land levelling and existence of field drain.

- As a matter of course, the size of farm plots should be designed in consideration of farm practices to be conducted. For the convenience in farm practices, the length of run and size of farm plots should be determined at a multiple of the units of length and acreage currently used in Iraq. "Donum" is used to express acreage in Iraq.

Taking into consideration carefully all of the above mentioned, and also based on inspection results of the Lower Khalis Project[/1], the length of run is determined at 150 m.

On the other hand, the width of plot should be determined based on the following:

Width of Plot

The width of plot should be determined in consideration of the allowable length of a farm ditch for the puddling rotation block. A length of the farm ditch is one of the major factors in determining the scale of its commanding area, commanding plot number, water management to supply evenly irrigation water to farm plots, densities of tertiary irrigation canals and on-farm roads along such canals as well as the construction cost of on-farm facilities. A long farm ditch makes the water management difficult and the construction cost high, whereas, a short ditch leads to high densities of tertiary canals and service roads, a high construction cost and a large reduction rate of land.

Under the situations, the desired length of a farm ditch is, in general, from 500 m to 600 m. In the Project, the length of a farm ditch is decided at 600 m. Consequently, an acreage of one puddling rotation block is 18 ha (300 m x 600 m) on an average.

The width of plot, a length obtained by dividing equally the above-mentioned 600 m, should be decided taking into account the following factors:

/1--- A state rice farm under construction by the Ministry of Agriculture and Agrarian Reform.

- A wide width of plot is convenient for diversification of crops and intensive land use whereas a narrow width of plot is suitable for intensive cultivation of paddy, if only paddy is grown in the farm plots.
- In general, a width of plot ranging from 1/3 to 1/5 of the length of run is the most effective from the viewpoint of tractor operation.
- If the width of plot is determined at 50 m, the acreage of one farm plot corresponds to the multiple of "donum".
- According to the calculation of earth-moving works (earth moving volume x hauling distance) in the sample area, the figures in case that the width of plot is short become small compared with those in case of long, when the length of run is 150 m. The following table indicates the earth-moving works in the following two cases in alternative plans: (1) land levelling within the plot without land adjustment in elevation, and (2) land levelling within block with land adjustment in elevation of 5 cm.

Result of Comparison Study on Earth-Moving Works

Alternative	Size of Plot (m)x(m)	Land Adjustment Within Plot: Earth Moving Works ($10^6 m^3$)	Land Adjustment Within Plot: Earth Moving Volume per Ha (m^3/ha)	Land Adjustment Within Block: Earth Moving Works ($10^6 m^4$)	Land Adjustment Within Block: Earth Moving Volume per ha /1 (m^3/ha)
A	150x600	13.63	658	13.63	658
B	150x300	5.48	484	19.22	866
C	150x200	3.24	416	18.28	782
D	150x150	2.24	371	18.55	806
E	150x100	1.68	327	15.57	686
F	150x50	1.45	282	13.95	610

NOTE: Detailed estimation is given in the table in Appendix 4D-8.

/1 --- Land adjustment in elevation: 5 cm

As is seen in the above table, Alternative Plans E and F reveal relative low figures in the earth-moving works out of the others.

From results of the above-mentioned studies, the width of plot is decided at 100 m. Therefore, an acreage of one farm plot is 1.50 ha (150 m x 100 m) and one puddling rotation block of 18 ha is to be divided into 12 plots.

c) On-Farm Water Management System

i) Irrigation System

The water distribution systems of on-farm level is discussed herein. Water of secondary canals will be distributed to tertiary canals through division boxes to be provided on the secondary canals, and then, water of tertiary canals will be released to farm ditches, terminal irrigation canals in fields, through turn-outs provided on the tertiary canals. In order to divert irrigation water from on-farm ditches to farm plots, inlets will be installed to farm plots (see Figure 4D-7 in Appendix 4D-8). As stated previously, the

length of farm ditch is decided at 600 m (100 m x 6 plots). Therefore, one farm ditch supplies irrigation water to the area of 18 ha (one rotation block). Since two farm ditches are placed to stretch out to opposite directions each other from one turn-out, one turn-out diverts and delivers irrigation water to the area of 36 ha (irrigation unit) through these two farm ditches.

One tertiary canal is planned to command five irrigation units of 180 ha (puddling rotation block), so the length of a tertiary canal will be about 1.7 km.

Irrigation water supply during the land preparation season of 40 days from May 16 to June 26 will be rotationally made (rotational irrigation) in one rotation unit of 18 ha per day, that is, the acreage of 720 ha is designed as one unit of irrigation area (irrigation block) from the viewpoint of water management. This irrigation block will coincide with one farming unit (operation unit) in the aspect of farm management in the field. As for irrigation except the puddling period, 24 hours continuous flood irrigation will be made.

The design capacity of tertiary irrigation canals and farm ditches is 5.42 lit/ha and 7.72 lit/sec/ha[/1], respectively. Outline of the on-farm irrigation facilities are described below.

Tertiary Irrigation Canals

Irrigation canals without lining to convey water from secondary canals to farm ditches. The tertiary irrigation canals are classified into two types depending upon the design capacity, that is, tertiary irrigation canals (1) and (2). The design discharges of them are q_1 = 0.98 cu.m/sec and q_2 = 0.59 cu.m/sec, respectively.

Turn-Outs

A device to divert water from a tertiary irrigation canal to farm ditches.

/1-- q_1=35.8 mm x 10^{-3} x 1.0 ha x 10^4 x 10^3/86,400 (1 - 0.10)(1 - 0.15)
= 5.42 lit/sec/ha.
q_2= 60.0 mm x 10^{-3} x 1.0 ha x 10^4 x 10^3/86,400 (1 - 0.10)=7.72 lit/sec/ha.

Service roads

Roads are provided along tertiary irrigation canals for operation and maintenance of facilities and transportation. The width of service roads is seven meters. No pavement.

Farm ditches

The terminal irrigation canals made of earth to convey water from a tertiary canal to farm plots through turn-outs. The design capacity is 0.14 cu.m/sec.

Inlet

A device to divert irrigation water from a farm ditch to farm plots. A pipe with the diameter of 250 mm and 2.5 m long will be utilized.

Check

The facilities to raise water level in the lower reaches of farm ditches for water management.

Road crossing

Type A: The facilities installed under the seven meters service roads, and on-farm roads to let tertiary irrigation canal (1) water go cross above roads. Box culverts will be used for this purpose.

Type B: The facilities installed under the on-farm road to let tertiary irrigation canal (2) water go cross the road. Box culverts will be used for this purpose.

Type C: The facilities installed under the road along farm ditch to let tertiary irrigation canal (1) water go cross the road. Box culverts will be used for this purpose.

Type D: The facilities installed under the road along farm ditch to let tertiary irrigation canal (2) water go cross the road. Box culverts will be used for this purpose.

The typical design of the related facilities is given in Drawing Nos. 5, 11, 13 to 17.

Drainage System:

ii) Farm drains, that is, terminal drainage canals constructed in fields, will be provided in parallel with the width of plot at the middle of two farm ditches, and its length is 1,200 m. Excess water or drainage water in fields will be drained to the farm drains through outlets installed for every farm plots. Therefore, one farm drain commands the area of 36 ha. The other drainage water to be released to the farm drains is subsurface drainage water. Subsurface drainage water is delivered to the farm drains from field drains to be provided for saline soil improvement by leaching. The depth and standard interval of farm drains are designed at 1.0 m below the ground surface and 50 m, respectively.

Drainage water in the farm drains is conveyed to a tertiary drainage canal as shown in Figure 4D-7 in Appendix 4D-8.

Outline of the on-farm drainage facilities are explained below:

Farm drain

Earth drainage canals to convey excess water from outlet, field drain and secondary drainage canals.

On-farm road

The terminal roads provided along the both sides of a farm drain for transportation into or out from farm plots. The width of these roads is seven meters.

Outlet

A device to drain water from a farm plot to a farm drain.

Road crossing

Type E: The facilities installed under the service road to let farm drain discharge go cross the roads. Box culverts will be used for this purpose.

Type F: The facilities installed under the service road along a secondary drainage canal to let farm drain discharge go cross the roads to the secondary drainage canal. Box culverts will be used for this purpose.

The typical design of the related facilities is given in Drawing Nos. 5, 11, 17 and 18.

The reduction ratio only in relation with on-farm facilities is estimated at 14.3 percent.

d) Land Levelling

The land levelling in land reclamation works is important for both paddy growth and farm management. The following procedure has been adopted in planning land levelling works; that is, (1) as the first step, land levelling works will be carried out within the plot (150 m x 100 m), and (2) after checking the obtained elevation of the plot, land adjustment in elevation within a block (150 m x 600 m) will be carried out, when the reversed elevation of plot more than five centimeters are observed among the estimated plot elevation in the block.

Based upon the above procedure, the calculation of land levelling work has been made in the selected sample area and its result is shown in Table 4D-22 and Figure 4D-8 in Appendix 4D-8. As is found in the Appendix, remarkable reversed elevation of plot is observed in the block Nos. 4, 5, 6 and 7, then the land adjustment in elevation will be needed in those blocks. As the results of land levelling and land adjustment in elevation, earth-moving volume per hectare has been estimated at 686 cu.m/ha.

e) Model Design of On-Farm Facilities in Sample Area

1) Purpose of Model Design

In order to give shape to the conceptional proposed on-farm facilities, the model design of roads, irrigation and drainage canals as well as land parcelling have been actually carried out for the sample area. Furthermore, the required land levelling works and hauling distance, etc. were estimated in order to apply their results to the design of on-farm development works in the whole Project Area.

2) Selection of Sample Area

Since the Project Area is located in the low-lying alluvial plain formed by the Tigris river and there exist topographically no sloping area and hilly land, one sample area is considered enough for the model design of on-farm facilities. The sample area covering about 100 ha has been selected in Tel. El-Ahamar located near the Kahlaa river.

3) Land Reparcelling and Typical Design

The land reparcelling in the sample area has been carried out based on the typical design of farm plot (150 m x 100 m). Estimation of earth-moving volume and design of facilities have been also made in accordance with the criteria. The result of calculation is shown in the following table. Typical layout for the sample area is shown in Drawing No. 13. Average density of on-farm facilities has been estimated at 64.7 m/ha for irrigation canals, 56.0 m/ha for drainage canals and 100.3 m/ha for on-farm road.

5. Road Plan

a) Classification of Roads

The proposed roads in the Project are are classified as follows:

Main roads

The main roads function as trunk roads for transportation of agricultural input and output within the Project Area, and also function

Table 4-9. Result of Typical Design of On-Farm Facilities in Sample Area

Description	Quantity of On-Farm Facilities	On-Farm Facilities Per Hectare
1. Net irrigation area (ha)	72.24	
2. Land levelling:		
Total earth moving volume (10^3cu.m)	59,547	824 cu.m/ha
Average hauling distance (m)	314.2	
3. Irrigation canal:		
Tertiary irrigation canal(1) (m)	578	8.0
Tertiary irrigation canal2) (m)	330	4.6
Farm ditch	3,763	52.1
Sub-total	4,671	64.7
4. Drainage canal:		
Farm drain (m)	4,042	56.0
5. Road		
Service road -		
Along teritary irrigation canal(1) (m)	875	12.1
Along tertiary irrigation canal(2) (m)	330	4.6
On-farm road (m)	6,036	83.6
Sub-total	7,241	100.3
6. Field drain (m)	17,551	243.0
7. Green belt (sq. m)	5,060	70.0
8. Road crossing (place)		
Type A	4	
Type B	2	
Type C	2	
Type D	2	
Type E	4	
Type F	4	
Sub-total	18	
9. Turn-out (place)	5	
10. Inlet (place)	35	
11. Check (place)	6	
12. Outlet (place)	58	

as connecting roads to the National Highway No. 6, which runs along the right bank of the Kahlaa river. In principle, each operation unit will be provided, at least, with one to two main roads crossing each other. In addition, the existing oil company's road running from the north to south in the eastern part of the Project Area would be utilized as a main road. For this purpose, some improvement and base coarse material pavement have been planned. Furthermore, the existing pipeline will be protected by embankment, and this embankment will be utilized as a main road.

These main roads will have the width of seven meters (effective width: five meters), and will be paved by base coarse materials.

Service roads

The service roads will be provided along main, secondary and tertiary irrigation and drainage canals for operation and maintenance of constructed facilities as well as for transportation of input and output. No pavement is planned for these service roads.

On-farm roads

On-farm roads, which are terminal roads in fields, have been planned to be located at the interval of every 300 m along the width of plot; namely, at the both sides of farm drain. The roads will have the width of seven meters. The roads will be used to let farm machines enter into field plots. No pavement is planned for on-farm roads.

b) Typical Cross-Section

Side slope

The proposed roads along the canal have a height of about 0.65 m to 0.85 m, so that necessary head of the irrigation canal waters can be secured. Therefore, a side slope of road embankment has been decided at 1:1.5.

Road width

Width of the proposed roads has been planned to be seven meters with the effective width of five meters, taking into account farm machinery to be introduced into the Project.

Cross-grade

In general, a cross-grade of base coarse pavement roads ranges from three to six percent. So all the proposed roads in the Project Area will be given the cross-grade of four percent on average.

Following table shows the major features of the proposed roads:

Major Features of the Roads

Type of Roads	Width (m)	Proposed Length (km)	Remarks
Main roads	7.0	25/1	Base coarse pavement
Service roads	7.0	173	No pavement
On-farm roads	7.0	632	No pavement

/1--- inclusive of 1.7 km of the improved oil company's road.

The road intensity in the Project is estimated at 131 m/ha. Typical cross-section of the roads is shown in Drawing No.11 herein attached.

6. Afforestation Plan

The north-west winds during the hot summer season bring about the severe problems to crop growth and living environment. In order to protect the crops to be introduced from such winds and to make the farm livable and comfort as much as possible during climatic extremes, the windbreaks have been proposed.

Three types of windbreaks are planned from viewpoints of their location and function, that is 1) windbreaks along the Kahlaa river, 2) windbreaks along the boundary of the Project Area, secondary

drainage canals provided at the right angles to the north-west direction winds and main road in the area and 3) wind-breaks along secondary and tertiary irrigation canals. The descriptions of these wind-breaks are given hereinafter.

Wind-breaks along the Kahlaa River

The permanent wind-breaks having the width of about 100 m have been planned at the western part of the Project Area along the Kahlaa river taking into account the following facts; it is desirous to provide the wind-breaks there to protect agricultural crops from hot winds and to improve living environment, since most inhabitants live along the Kahlaa river, and outside areas of the levee of the river are topographically complicated with depressions which were the borrow pits in constructing the Kahlaa bank.

Date palm, casuarina and eucalyptus, etc., could be grown in such ... wind-breaks since they have the following advantageous characteristics:

1) High resistance against saline soils;
2) High resistance against drought;
3) High growth rate;
4) High adaptability to severe natural conditions; and,
5) Easy propagation.

Wind-breaks along the Boundary of the Project Area, Secondary Drainage Canals and Main Roads

As mentioned above, the north-west winds prevail during the hot summer season in the Project Area. In order to cope with such winds, the permanent wind-breaks having 30 m wide, which will be provided at the right angles to the north-west direction wind with about 2,500 m interval on average have been proposed. The wind-breaks for the same purpose will be provided along the boundary of the Project Area and main roads.

The same kind of trees, which have been proposed for the wind-breaker along the Kahlaa river will be planted.

Wind-breaks along the Secondary and Tertiary Irrigation Canals

In order to expect the supplemental wind-breaks in the Project Area temporary wind-breaks with the width of five meters have been suggested along the secondary and tertiary irrigation canals, at the interval of about 600 m. Seshania will be planted for this purpose.

The total acreage of each type of wind-breaks mentioned above are as follows:

Type	Area (ha)	Remarks
Type 1	90	Permanent wind-breaks with 100 m wide
Type 2	200	Permanent wind-breaks with 30 m wide
Type 3	40	Temporary wind-breaks with 5 m wide
Total	330	

NOTE: Further study on effects of wind-breaker will be required in the determination of the width of wind-breakers.

E. Cost Estimate

The total investment cost exclusive of the price escalation during the construction period is estimated about 20.3 million I.D. (US$68.5 million) out of which 12.2 million I.D. (US$41.3 million) fall into the foreign currency portion, and the rest of 8.1 million I.D. (US$27.2 million) into the local currency portion.

The following table shows the breakdown of this investment cost, and further details are given in Appendix 4-E-1.

Investment Cost of the Project

(Unit: '000 I.D.)

Item	Foreign Currency	Local Currency	Total
1. Civil works	6,081	4,755	10,836
2. Construction and Maintenance Equipment	2,791	-	2,791
3. Farm facilities	-	689	689
4. Farm machinery and equipment	1,778	-	1,778
5. Operation and maintenance cost	-	795	795
6. Project facilities	9	221	230
7. Project administration	-	646	646
8. Consulting services	451	212	663
Sub-total (1 to 8)	11,110	7,318	18,428
9. Contingency	1,111	732	1,843
Sub-total (1 to 9)	12,221	8,050	20,271
10. Price escalation	4,316	3,512	7,828
Total (1 to 10)	16,537	11,562	28,099

The project cost per hectare is computed at 3,022 I.D. (US$10,214) in the following ways: (i) the depreciation cost of construction machines and equipment is involved in the unit cost of civil works; and (ii) the price escalation is not included in this computation (see Table 4 E-3 in Appendix 4 E-2).

The annual disbursement schedule for the investment cost is shown in Table 4 E-2 in Appendix 4 E-1. The cost estimate of the Project have been made in the following manners:

1) Civil Works

This item covers the construction cost for engineering works, construction material cost, fuel and oil cost, repair cost of equipment and labor cost. The construction cost for engineering works has been computed based on current related unit costs in Iraq, and it covers the depreciation cost of construction machines and equipment. The major engineering works are as follows:

Pumps: To include the cost of earth and concrete works and the equipment cost for pumps, motors and accessories, etc.

Desilting reservoir: To include the cost of dam body embankment and the costs of spillway gates and intake facilities.

Irrigation canals: To include the cost of earth works for main and secondary canals, the cost of concrete works for canal lining and the cost of related structures.

Drainage canals: To include the cost of earth works for main and secondary drainage canals and the cost of related structures.

On-farm: To include the cost of land levelling and construction of on-farm facilities such as tertiary irrigation canals, service roads, farm ditches, farm drains, on-farm roads and field drains.

Roads: To include the cost of construction of main and service roads with seven meters wide.

Dike: To include the cost for foundation treatment and embankment of the dike.

2) Construction Equipment

It is a premise in estimating this item that the construction and maintenance equipment and spareparts will be purchased by the Government in the lump-sum except small equipment available in Iraq. Such purchasing costs have been estimated based on c.i.f., Basra, and the custom duty and other local taxes to be imposed in Iraq are excluded in estimate. Unloading and transportation costs from Basra to the construction site in Amara are added to the above-mentioned purchasing costs.

3) Farm Facilities

This item covers the construction costs of all facilities which are deemed directly required for farming; namely, farm warehouse,

equipment warehouse, rest houses for the rice farm staff, workshop, machinery garage and aircraft runway, etc.

4) Farm Machinery and Equipment

This item covers the necessary costs of farm machinery and equipment for operation of the main and experimental farms and also the laboratory.

5) Operation and Maintenance Cost

This item involves the operation and maintenance cost for project facilities during the construction period of four years from the fiscal years 1984 to 1987, and also the salary and wage for governmental personnel to be assigned to the Project and skilled labor to be employed.

6) Project Facilities and Project Adminstration

Project facilities: This iten covers the required cost for project facilities such as buildings, furniture and equipment.

Project administration: This item covers the local overhead charge for governmental personnel in charge of management in the Project.

7) Consulting Services

This iten covers the engineering fee in final design, construction supervision and farming guidance.

8) Contingency

The contingency is appropriated, on total basis, to cope with minor quantitative difference, unforeseeable difficulties in construction, possible amendment of plans because, for instance, changes of site conditions and uncertainty of foundation conditions, etc. The adopted rate for this item is ten percent.

9) Price Escalation

The price escalation of nine percent per annum is allowed both for the foreign and local currency portions.

10) Unit Costs

The unit costs of construction materials applied to this estimate are the prevailing prices as of 1979 informed by the Ministry of Agriculture and Agrarian Reform. The labor cost has been estimated based on the wage rate by job type being applied by the said Ministry.

11) Foreign and Local Procurement of Materials

All the construction equipment, workshop, other imported equipment and materials such as deformed bar, etc., are employed by the foreign currency component, whereas the local currency component consists of the costs for labor, operation and maintenance of equipment and local materials.