THE REPUBLIC OF IRAQ

INTERIM REPORT
ON
FEASIBILITY STUDY
FOR
KAHLAA RICE FARM PROJECT

SEP, 1979

JAPAN INTERNATIONAL COOPERATION AGENCY

[redacted]

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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Director General of the General Body
for Agriculture Applied Research,
The Ministry of Agriculture and Agrarian Reform,
The Government of the Republic of Iraq

Date: 12 September 1979
Our Ref. No. KRPP-041

Letter of Transmittal

Dear Sir:

We take the pleasure of submiting herewith twenty (20) copies of our Interim Report on the Feasibility Study for Kahlaa Rice Farm Project in Missan in accordance with the Scope of Works signed by your Ministry and Japan International Cooperation Agency dated August 10, 1979.

In this opportunity, we wish to extend our heartfelt appreciations for the whole-hearted cooperation and assistance bestowed to us by your Government both in Baghdad and in Amara in the course of field study for the said feasibility study.

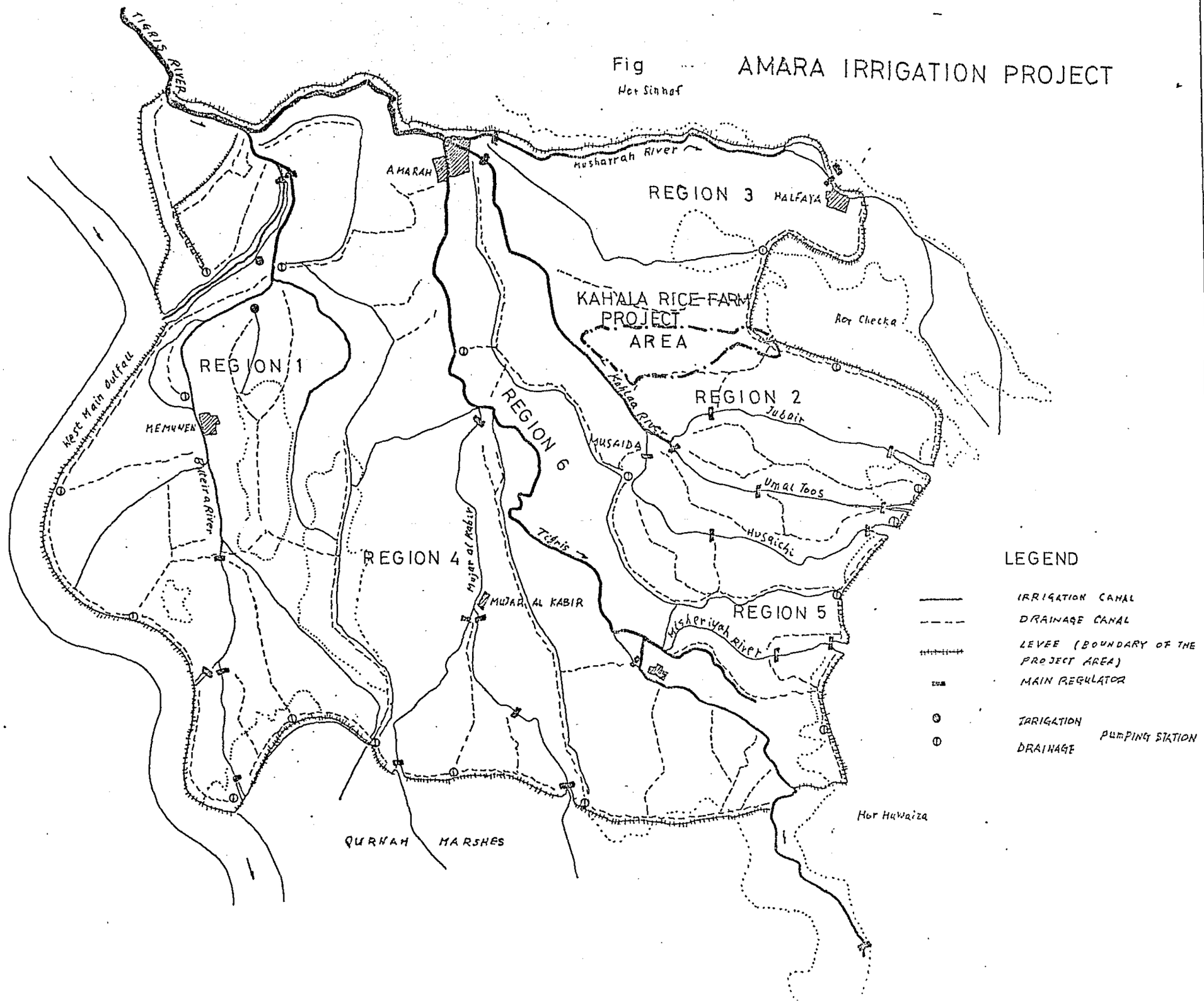
After leaving Baghdad in this month, our team will continuously conduct the feasibility study on the Project, home-office works in Japan, for about two months and a half so that we will be able to submit our final draft report in the middle of November, 1979.

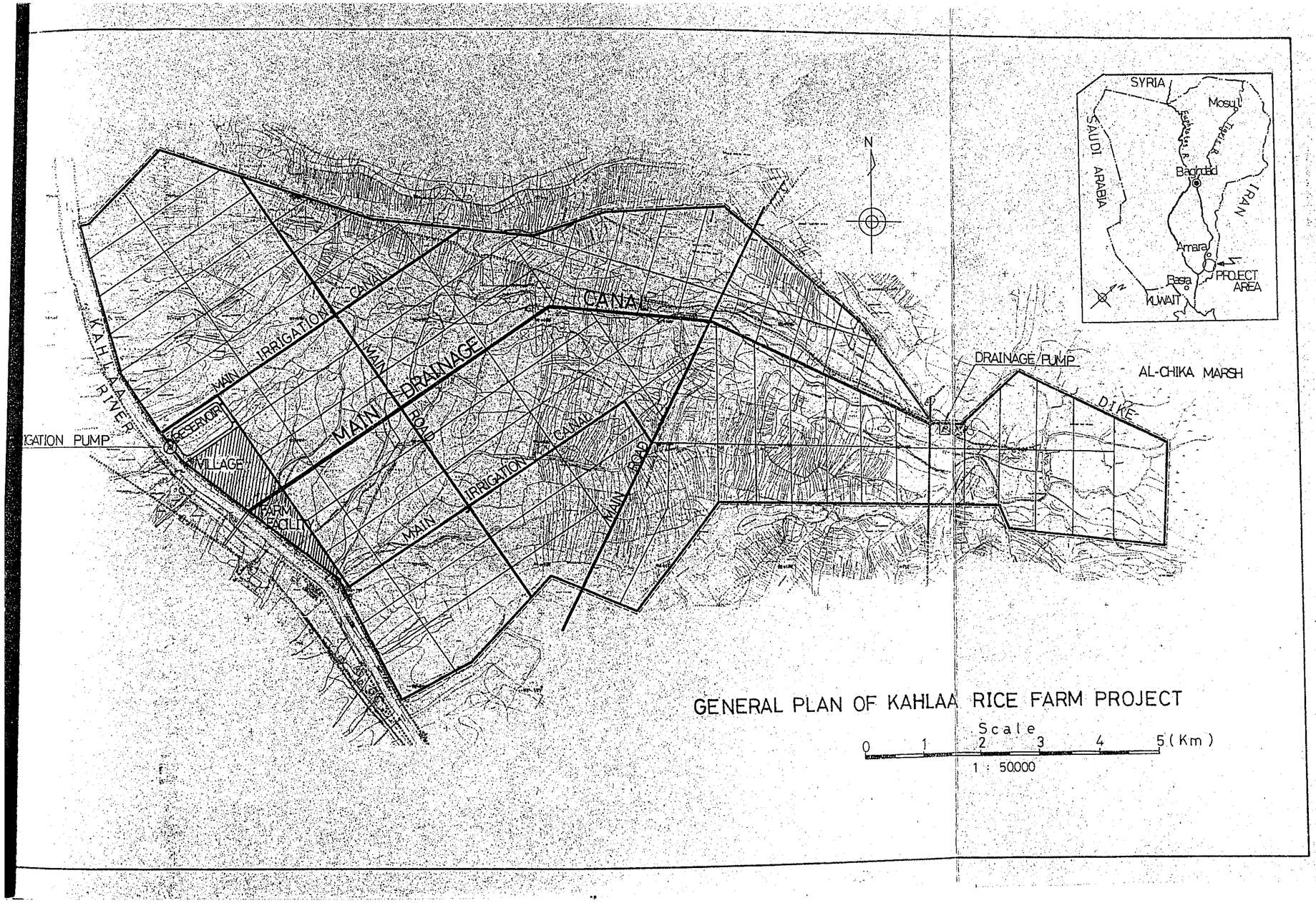
Thanking, again, and hoping that the modernized rice farm will be successfully materialized in the lower Mesopotamian plain, we remain,

Yours faithfully,

Daizo Iseno
Leader of JICA F/S team,
Kahlaa Rice Farm Project

Fig ... AMARA IRRIGATION PROJECT





GENERAL PLAN OF KAHLAA RICE FARM PROJECT

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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	: square kilometer
MSM, 10^6 m^2	: million square meter
lit, l	: liter
cu.m, m^3	: cubic meter
MCM, $10^6 m^3$	: million cubic meter
lit/sec	: liter per second
m/s	: meter per second
ppm	: part per million
g	: gram
kg	: kilogram
ton, m.t	: metric ton
EL	: elevation
MSL	: mean sea level
FWL	: full water level
HWL	: high water level
LWL	: low water level
sec.	: second
min.	: minute
hr.	: hours
max.	: maximum
min.	: minimum
%	: percent
No.	: number
^oC	: degree centigrade
Hp	: horse power
EC	: electric conductivity
ET:	: evapotranspiration
N	: nitrogen
P	: phosphorus
K	: potassium
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 AND RECOMMENDATIONS

A. Summary

The field works for the feasibility study on Kahlaa Rice Farm Project were conducted aiming to construct a large-scaled modernized rice farm of about 8,000 ha in Missan province located in the lower Mesopotamian plain and to realize a rationalized agricultural production in this rice farm. Studies were mainly focussed on the necessary farm and related facilities, selection of crops to be cultivated, cultivation method and infrastructural improvement and development.

Based on such studies, the Project plans have been formulated as briefly explained herein.

Cropping:

This Project has been taken up to attain an increased paddy production, therefore, the stress has been put on paddy in the Project planning. However, in order to make the best use of labor and farm machinery and the farm itself, the cultivation of wheat, barley and berseem has been proposed. In addition, the introduction of a combined cropping of paddy and summer crops has been planned to increase soil fertility and control weeds. Paddy of Amber varieties, whose culitvation has been encouraged by the Government, will be grown in this rice farm.

Mechanized Farming:

The mechanized farming would be prerequisite for operation and management of this rice farm due to the following reasons;

- o The mobilization of sufficient laborers to operate this large-scaled rice farm will be difficult. At present the Project Area of more than 8,000 ha has a quite small population of about 600 persons.
- o Soils are very compact under dry conditions.

In order to complete the paddy sowing in a vast rice farm area within a limited optimum sowing season, aircraft-operating direct sowing to submerged fields has been proposed, taking into consideration the following;

- o The direct sowing to submerged fields is a deeply-rooted traditional method of paddy planting in Amara and its vicinity.
- o This planting method has obtained good experimental results in Iraq.

The education and training of the rice farm staff will be required since the aircraft sowing might need some skills.

Farm Management:

Paddy requires various farm practices such as seed production and preparation, plowing, puddling, sowing and harvesting in addition to the continueous irrigation and careful weeding, control and prevention. Therefore, taking into consideration an optimum scale of farm management area, this rice farm will be divided into four farm management blocks, and rice cultivation will be consistently made in each block by the staff who are exclusively responsible for that farm management block.

An experimental farm is planned to conduct various experimentations specially required in the Project.

The target yield is determined at five tons per hectare. This target yield will be attained in the fifth year after the commencement of cultivation.

On-farm Development:

Taking into account the submerged cultivation, a special characteristic in paddy cultivation, and the operation of heavy farm machinery, the standard farm plot with the rectangle shape of 0.75 ha (3 donums) (50 m x 150 m) is designed. Irrigation/drainage facilities and roads have been planned in consideration of future farm management and leaching requirement, etc. The main dimensions are as follows;

i.	Cultivated area:	A = 6,000 ha
ii.	Irrigation	
	Irrigation area:	A = 6,000 ha
	Irrigation water requirement:	Q = 24.0 cu.m/sec
	Irrigation facilities:	
	o Pump station	One place
	o Reservoir	One place

o Main canals	L = 19.6 km
iii. Drainage	
Drainage area:	A = 8,160 ha
Drainage discharge:	Q = 14.2 cu.m/sec
Drainage facilities:	
o Pump station	One place
o Main canals	L = 14.6 km
o Field drains	A = 6,000 ha
iv. Trunk roads	L = 21.0 km

Cost and Economic Analysis:

Premising the target yield of five tons per hectare, the economic and financial analysis have been conducted and summerized below;

i. Roughly estimated total project cost excluding the price escalation:

21.2 million I.D.
(or 71.6 million US$)

ii. Project cost per hectare excluding the price escalation:

Gross area:	C = 2,600 I.D./ha (or 8,780 US$)
Net cultivation area:	C = 3,530 I.D./ha (or 11,950 US$)

iii. Incremental annual benefit with the target yield of 5 ton/ha:

B = 1.9 million I.D.
(or 6.3 million US$)

iv. Benefit-cost ratio (B/C) and Economic Internal Rate of Return

B/C ratio with the interest of 5 %	1.02
IRR	5.3 %

B. Recommendations

1. The land aquisition for the Project shall be started as soon as possible.
2. The Project Team shall be organized in close relation with Missan Agriculture Office.
3. Further studies will be required on the possibility to introduce other paddy varieties than Amber such as IR varieties.

4. Detailed soil survey shall be conducted.

5. In parallel with the construction of major facilities and on-farm development, the proposed experimental farm shall be established in order to let it conduct experimentations specially required in the Project inclusive of the paddy sowing by aircraft, leaching and paddy yield tests, etc.

6. The puddling shall be conducted in land preparation.

7. The self-sufficiency of high quality seed within the Project will be indispensable for this rice farm. Technical improvement in seed production shall be planned.

8. Groundwater control by under drains shall be adopted for paddy.

9. Amara Irrigation Project shall be planned taking into account the water requirement in Kahlaa Rice Farm Project.

10. The tree planting program will be required for the green belts proposed in the Project.

11. The proposed Kahlaa bridge shall be constructed before the commencement of the major construction works in the Project.

12. The rice processing facilities shall be replenished, keeping pace with the Project implementation.

13. The existing villages will be pulled down for construction of the rice farm, therefore, the proposed village for farmers in the Project Area and newly mobilized rice farm personnels and laborers shall be constructed in the early stage of the Project implementation.

14. Livestock farming program in the vicinity of the Project Area shall be planned in the early stage, taking into consideration the annual feeder crops production such as berseem in the Project.

15. For smooth execution of the Project, consultants having rich experience in rice farm development shall be employed.

CHAPTER I. INTRODUCTION

1. Objective and Scope of the Feasibility Study

Field works for the feasibility study on Kahlaa Rice Farm Project were conducted from June 21 to September 13, 1979 by the Feasibility Study Team of Japan International Cooperation Agency in accordance with the Scope of Works signed by the both Government of Iraq and Japan. Since the basic data collection and preliminary studies were conducted from October 1978 to February 1979 as a part of this feasibility study, the field studies were focussed on supplemental data collection, study on present land and water utilization for agriculture in summer seasons, soil survey and plan formulation of the Project.

2. Background of the Project

The Project Area and its neighborhood are located in the lower Mesopotamian plain, and is one of the major agricultural production areas in Iraq, specially of paddy rice. For further development of agriculture, the Government has been undertaking various development projects. Amara Irrigation Project is one of such projects, and now on the way for rationalization of water distribution and flood control in the lower Tigris river system. Kahlaa Rice Farm Project Area is a part of this project area.

3. Feasibility Study Team

The team was organized by nice engineers and experts listed below;

Name	Assignment
Mr. Daizo Iseno	Project planning (Team Leader)
Mr. Kazuo Nakabayashi	Soils
Mr. Fumimichi 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

Two members of the Advisory Group to the team, Dr. Hiroshi Ito and Mr. Yasuyuki Sakai, visited Iraq together with the team, and made, within the limited stay period of 11 days from June 21 to 31, 1979, the preliminary arrangements for smooth execution of studies, and gave various precious advices to the team. The names of the Advisory Group are;

Name	Assignment	Position
Mr. Ryotaro Sudo	Project Planning	Chief of Land Consolidation Div., Dept. of Construction Engineering, Bureau of Structural Improvement, Ministry of Agriculture, Forestry and Fishery (the MAFF)
Dr. Hiroshi Ito	Agriculture	Professor of Ishikawa Prefectural College of Agriculture
Mr. Yoshikazu Yoshida	Irrigation	Chief of No. 1 Construction Div., No.1 Dept. of Construction Engineering, the Water Resources Development Corporation
Mr. Yasuyuki Sakai	Agricultural Machines	Technical Guidance Officer of the Bureau of Agri. Sericulture and Horticulture, the MAFF

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

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

Name	Position
Dr. Tarik A. J. Tabrah	Director General (D.G.) of the General Body for Agriculture Applied Research, Ministry of Agriculture and Agrarian Reform (MAAR)
Mr. Kadhim Mohamad Al-Mustaf	Assistant D.G of the General Body for Agriculture Applied Reseach, the MAAR
Mr. Omar Ali Ammen	Director of the Cereal Crops Dept., the General Body for Agriculture Applied Research the MAAR
Dr. Khalid Taka	Director of the General Laboratory, the State Organization of Soils and Land Reclation
Mr. Falhi Hessen	President of Missan Agriculture Office
Mr. Mousa Khalaf	Vice-President of Missan Agri. Office

The field works were conducted with the following counterpart personnels;

Name	Position
Mr. Ghazi Al-Daghistani	General Coordinator, Chief Officer, Department of Public Relations, the MAAR
Mr. Isam Najjar	General Coordinator, Chief of Rice Section, the General Body for Agriculture Applied Research, the MAAR
Mr. Raad Hamid	Agriculture Engineer, Missan Agriculture Office
Mr. Noori Abed Ali	Irrigation Engineer, Missan Irrigation Office
Mr. Faker Saloomy	Chief, Missan Soil Office, State Organization of Soils and Land Reclamation
Mr. Rjih H. Segar	Soil Expert, State Organization for Soils and Land Reclamation

CHAPTER II. THE PROJECT AREA

A. Location and General Features

The Kahlaa Rice Farm Project Area of about 8,000 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, on the left bank of the Kahlaa river, one of the five biggest rivers branching off from the Tigris.

The Project Area is surrounded by the Gasma river, artificial canal branching off from the Kahlaa river, in the north, by another tributary of the Kahlaa in the south and by Al-Chikke marsh in the east. The above-mentioned Gasma river and other tributaries of the Kahlaa river run to the marsh through the Project Area branching off numberous artificial canals which flow to various directions.

Topographically, the Project Area is extremely flat though it inclines quite gently toward the east, repeating fine micro-relieves.

Soil fertility is no high due to soil salinity and poor irrigation and drainage.

As for the agriculture in the Project Area, the major agricultural crops are the winter crops of wheat and barley, etc. Paddy and sorghum are grown in summer seasons, however, their cultivated areas are much smaller than those of winter crops. All farm practices are made by man power except plowing.

About 270 households of farmers live in the Project Area. Therefore, the population density is very thin.

Due to quite a few rainfalls, irrigation is prerequisite for crop cultivation. In other words, no crops can grow in the Project Area without artificial irrigation. A part of the Project Area is equipped with irrigation canals, and the Kahlaa water is pumped up and conveyed through such canals. 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 a salts accumulation on field surface, and presently more than a half of the Project Area is a sort of wastland.

B. Physical Conditions

1. Topography and Geology

The Project Area is situated at the southern most of the Amara deltaic plain, bordering on the Kahlaa river in the west and facing to Al-Chikke marsh in the east, and has, as a whole, an extremely gentle slope of about 1/6,000 toward the east. 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 to the marsh is 4.0 to 4.5 m.

There are repeating micro-relief of around one meter formed by natural floodings and also by aged artificial canals developed in all directions. Various shapes of depressions surrounded by such micro-relief exist here and there.

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

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 the 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 continueously supplied by farmers.

2. Climate and Hydrology

The Project Area is characterized by short cool winters and long hot summers. Spring and autumn seasons are extremely short. The climate is so called "continental semi-arid type."

Rainfall records observed at Amara Sugarcane Factory present that the mean annual rainfall during the period of 1965 to 1975 is 161 mm, out of which 103 mm (62 %) fall on during winter seasons from November to March. It does not rain in summer seasons from May to September.

The annual temperature ranges from 10.9 °C in January to 34.9 °C in July, and the mean temperature is 23.4 °C. The maximum and minimum temperatures so far recorded are 47.5 °C in July and 0 °C in January. The daily range of 12 °C during winter seasons is relatively low in comparison with that of 18 °C in summer seasons.

Similarly, the daily and annual ranges of relative humidity are high, and the mean value is 61 %. The observation records with class A pan show that the annual evaporation is high at 3,314 mm, and mostly the evaporation ranges from 90 mm (2.9 mm/day) in January to 508 mm (16.4 mm/day) in July.

Concerning winds, velocity and direction have been observed at Amara Meteorological Station. The data show that daily mean velocity ranges from 2.4 m/sec in December to 6.5 m/sec in June. Strong winds ranging from 20 to 33 m/sec come in summer seasons of May to September. Generally, the north-west winds prevails around the Project Area throughout the year though the south-eastern winds sometimes blows in winter. Strong winds in summer accelerate evaporation and adversely affect to crops.

The Kahlaa river is the sole water source for the Project. The river discharge is controlled by the regulator newly constructed in 1978 across the upper reaches of this river. This regulator is operated by Amara Irrigation Office, and water levels and discharges have been observed at the upstream and downstream of the regulator. In addition, water levels of the Kahlaa river has been observed, since 1974, at Al-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 is 7.94 m whereas the minimum water level at the same place is 4.00 m. At Kahlaa gauge no observation was made when these maximum and minimum water levels were recorded at the regulator.

Regarding the river discharge controlled by the regulator, the daily discharge on monthly mean basis ranges from 390 cu.m/sec in April 1976 to 25 cu.m/sec in November, 1975. The annual runoff of the Kahlaa river in 1975 amounted to 4,428 MCM of which 74 % occurs from December to June.

The maximum and minimum water levels at the proposed pump station site at 15 km downstream of the regulator are estimated, based on the water slope obtained from observed water levels at the regulator and Kahlaa gauge, as follows;

- o Maximum water level: E.L. 7.30 m
- o Minimum water level: 3.80 m

Regarding the water quality, specially the electric conductivity (EC) of the river water, observation were conducted in February and July, 1979. The average EC value at 25 °C is 0.7 mmho/cm.

The groundwater survey was conducted, during the field work periods in 1978 and 1979, to clarify groundwater tables and qualities in the Project Area. The observation data show that the water table near the Kahlaa river ranges in 0.60 to 1.40 m below the ground surface, and its EC value in 9 to 14 mmho/cm during winter seasons. In the vicinity of Al-Chikka marsh, the groundwater table ranges in 1.90 to 2.90 m below the ground surface, and the EC value shows 5 to 9 mmho/cm. In summer seasons, the groundwater table seems to be at 2.5 m below the ground surface near the Kahlaa river though such observation is now on the way. Near the marsh, the depth of groundwater becomes 2.8 m. In general, the EC value of groundwater is higher than that of the crop tolerance level. Under the situations, no groundwater is available for irrigation.

Provided that the river water is directly used for irrigation without any treatment, silt accumulation occurs in irrigation canals and also on farm land, thus, hinders the operation and maintenance of irrigation facilities and planted crops growth. To avoid such, a desilting basin will be required in utilizing the Kahlaa water for the Project. Water samples collected from the Kahlaa river are now under analysis inclusive of their silt content. Judging from the data on the Mujar Al-Kahbir river running near the Project Area, silt content of the Kahlaa river might fall in 0.69 to 2.81 gram/lit and the mean value be 0.82 gram/lit.

3. Soils

Soils in the Project Area are alluvial soils which have been formed by the 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 strongly related to the soil distribution. In general, salinity of soils is strong and natural fertility is rather poor.

Amara Irrigation Project office and the State Organization for Soils and Land Reclamation, Missan Branch, 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 the soil and groundwater samples collected from these test pits and auger holes are now under physical and chemical analysis at the Soil & Water Testing Laboratory, Abu-Ghraib, the State Organization for Soils and Land Reclamation.

The above-mentioned soil surveys reveal 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 reapperas the kaleidoscopic change 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 the 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 the salinization. In such abandoned or fallow lands natural vegetations, mainly shok and agul are seen.

Needless to say, the major constraint 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 stagnent water for a long period. Contrary to this, the 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 method of these soils, introduction of leguminous plants for soil improvement as well as optimum fertilization should be tested in the proposed experimental farm.

C. Present Irrigation, Drainage and On-farm Conditions

1. Irrigation and Drainage

Starting from intake facilities installed along the left bank of the Kahlaa river, the present irrigation canals extend toward the east through the Project Area. However, canals themselves are very primitive 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 irrigation facilities in the Project Area are only irrigation

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 the marsh.

The irrigation water through this canal conveys a great deal of silt materials. In consequence, the fuction of this canal was paralyzed, and improvement has been undertaken by Amara Irrigation Office.

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

The Al-Bahatha river with 12 km of length runs across the southern parts of the Project Area. This river is deteriorated at present due to silt accumulation and poor maintenance. The Ijiayil and Najiya rivers 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 relatively easily supplied by pumps. These cropping lands are cultivated with wheat, barley and vegetables during winter seasons, and with paddy during summer seasons. 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 along the long side. Roads of 30 to 50 cm runs along main canals. Tractors with harrow which are operated for plowing travel across other farm plots to arrive at a farm plot.

It seems that farmers do not feel so much inconvenience at such farm plots. However, in order to realize the mechanized agriculture with heavy farm machines, the Project will require the following;

i) Improvement of irrigation facilities;
ii) Construction of drainage facilities;
iii) Improvement of soils specially of saline soils; and,
iv) Construction of roads.

D. Present Agriculture

1. Land Use

The Project Area of 8,160 ha consists of the cultivated area of 3,460 ha, high salinity land of 4,040 ha, marsh area of 500 ha and the other area of 160 ha which is occupied by villages, canals, roads, etc. (see Table 1)

Out of the cultivated land of 3,460 ha, eight percent or 284 ha is cultivated with summer crops, and 52 % or 1,878 ha with winter crops. The rest of 38 % or 1,298 ha is fallow.

In general, the single cropping a year is adopted in the Project Area except a small scaled cultivation of vegetables. Mainly sorghum is grown in summer seasons. Paddy is also one of the summer crops, but its cropping area is only about 38 ha. Barley and wheat are the major crops in winter seasons. In winter, about 93 % of the total cropping area is cultivated with these two crops.

The shortage of labor has made it inevitable for farmers to adopt the single cropping a year and to fallow a vast area of 1,298 ha. The present poor irrigation facilities are another restrictive factor in agricultural production in the Project Area, specially in paddy cultivation. However, in this year of 1979, the paddy cultivation area was remarkably expanded to 115 ha due to the efforts of the Government in encouraging paddy cultivation and in improvement of irrigation facilities, etc.

Farm plots of paddy fields are very small, mostly less than five ares, and their shapes are irregular. On the other hand, farm plots of upland fields are large, mostly more than ten ares, and their shapes are of long rectangles. The fallow lands are scattered among these farm plots. These fallow lands were cultivated with crops in some years, but left as fallow again in the other years.

Table 1. Present Land Use (1977/78)

(Unit: ha)

Item		Area
1. Cultivated Area		
a. Summer crops		
	Paddy	38
	Sorghum	225
	Vegetables	21
	Sub-total (1)	284
b. Winter crops		
	Wheat	750
	Barley	1,000
	Broad beans	125
	Vegetables	3
	Sub-total (2)	1,878
c.	Arable land (fallow land) 1/ (3)	1,298
	Total (1) + (2) + (3)	3,460
2. Non-Cultivated Area		
	High salinity area 2/	4,040
	Marsh	500
	Roads and canals	122
	Villages and others 3/	38
	Total	4,700
	Grand Total	8,160

Source: Data of the Department of Land Survey, Missan Agriculture Office

Note: 1/ : The land was practically cultivated with no crops in 1977, however, its soil and water utilization conditions are deemed suitable to crop cultivation with an EC value of less than 25 mmho/cm

2/ : The EC value of soils is more than 25 mmho/cm at 25 °C. Mostly located on the eastern part of the Project Area.

3/ : Villages and oil pipeline sites

Weeds such as shock, equal and toltis having a high salt tolerance grow in saline soils, but even such saline soil weeds do not grow in some parts of high saline land in the Project Area. In the marsh, the equatic plants such as cattail and reed, etc, thickly grow.

In seven villages along the left bank of the Kahlaa river live 271 farm families.

As for transportation, an oil company's road runs from the east to west starting at the ferry of the Kahlaa river. It branches off to the north along the marsh. In addition, the left bank of the Kahlaa river functions as a trunk road to lead to Amara city. Aparting from these roads, the Project Area is not equipped with so called roads except tortuous farm roads. The transportation by vehicle is no more available once such farm roads go across an existing irrigation canal with water.

Earth canals of irregular shapes meander through the Project Area to the marsh from pump stations located along the left bank of the Kahlaa river.

2. Farm Conditions

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

Table 2. 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. - Nov.	(or - end Nov.)
Sorghum	225	700	157.5	Jul. - Oct.	
Vegetables	13.5	7,000	96.25	Apr. - Sept.	
Corn	6.25	-	-	May - Sept.	
Water Melong	1.25	-	-	Apr. - Aug.	
Total	283.75		289.45		

Source: Data of Missan Agriculture Office

Table 3. 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. - Apr.	
Barley	1,000	1,000	1,000	Mid-Nov. - Apr. or Dec. - Apr.	
Broad Bean	125	3,600	450	Sept. - End-Dec.	
Tomatos	1.75	8,000	14	Oct. - Mar.	
Onion (dry)	0.25	-	-	Oct. - Mar.	
Vegetables	1.25	7,000	8.75	Oct. - Mar.	
Total	1,878.25		2,072.75		

Source: Data of Missan Agriculture Office

All farm households in the Project Area belong to Al-Mabade Agricultural Cooperative, 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 production program of that cooperative. Based on this production program, the cooperative allots a cultivated area of major crops to each farm household. It is reported that fertilizers have been hardly utilized in the Project Area. Paddy seed of about 120 kg are sown to one hectare of pump-irrigated paddy fields. Mostly local varieties of "graiba" are grown. The existing paddy fields have no underdrainage system. The intermittent irrigation of five days, that is, four days' supply and one day's suspension of irrigation water, is repeated three times immediately after the direct sowing of paddy seed to submerged paddy fields, and the continueous 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 a 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 there any more.

The fertilizer application criteria published by the Directorate General of Agricultural Guidance, the Ministry of Agriculture and

Agrarian Reform suggests to apply the A.S. of 600 kg and T.S. P. of 180 kg to paddy during the cropping season, and it is reported that the 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 crops 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 available.

3. Agricultural Imput Materials

Al-Mabade Cooperative takes charge of group purchasing of agricultural imput materials for farmers in the Project Area, however, quantities of such materials handled by this cooperative have not been expressed in figure. Imput materials for paddy and wheat cultivations suggested in the cultivation text book "Amber Rice Cultivation in Middle Uphrates Area" are as follows;

Table 4. Imput Materials for Amber-33 and Wheat Cultivation

Material:	Quantity (kg/ha)	Unit Price (fils)	Price (I.D./ha)
Paddy cultivation: 1/			
Seed	120	137.42	16,490.4
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
Arodram	6 lit	1,808.0	10,848
Total			54,324.4
Wheat cultivation: 2/			
Seed	120	65.74	7,888.8
A.S.	200	17.6	3,520
T.S.P.	100	35.7	3,570
Total			14,978.8

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

2/ : Data of Missan Agriculture Office

The total cost of agricultural materials for paddy cultivation is computed at I.D. 48,662.4 on the assumption that the A.S. of 400 kg and T.S.P. of 120 kg are consumed for it. It seems that nearly the same quantity and kinds of fertilizers are applied to wheat and barley. According to the data of Missan Agriculture Office, fertilization as suggested in the above-mentioned text book has been put into action in ten percent of the total paddy cropping area in Missan province, and neither fertilizers nor agricultural chemicals are utilized in the remaining 90 %.

Fertilizer application should be planned in close relation with the 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 application is harmful in crops cultivation. Under the circumstances, in parallel with the Project execution, the technical guidance in fertilizers and chemical application will be indispensable.

4. Farm Mechanization

Plowing and stamping are the major mechanized farm practices in Iraq. Most farm machines are lent from the Agricultural Machine Rental Stations to farmers though some agricultural cooperatives and individual farmers have their own farm machines.

In the Project Area, farm machines of Missan Agricultural Machine Rental Station are operated, on the lental basis, for plowing and stamping. The Rental Station has totally 397 units of farm machinery including tractor's attachments. (see Table 5) These farm machinery are mostly used for plowing and stamping though some are for harvesting. Under the situations, all farm practices except plowing and stamping are made by man or animal power.

As already described above, the single cropping a year is adopted. Therefore, the farm machines are needed twice a year for land preparation in winter and summer crops cultivations. Reportedly, it sometimes occurs that farmers cannot complete sowing of crops in the optimum sowing seasons due to the delay in land preparation.

The Station has 70 wheat and three paddy harvestors, but the total capacity of them is not enough to meet the present requirement.

Table 5. Main Farm Machines of Missan Agri. 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 6. Livestock Breeding at Present

Domestic Animal	Whole Iraq	Missan Prov.(A)	Al-Kahlaa(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	-	-
Swam & 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 numbers breeded in Missan province are raised in Al-Kahlaa area. It suggests that Al-Kahlaa area has played an important role in livestock farming in Missan province. It is expected that the livestock farming in this area will be further promoted by means of introducing feeder crops in the Project.

6. Farm Household Economy

According to the Annual Abstract of Statistics, 1976, the cultivated area in Iraq is 5.75 million hectares in spite that this country has a vast arable land of 12 million hectares. The cropped area is three million hectares which is equivalent to 52 % of the total cultivated area.

The present land use in the Project Area is much similar to the above-mentioned nation wide land use in Iraq. The cultivated area of the Project Area consists of the cropped area of 1,878 ha and the fallow of 1,298 ha. In the aspect of farm economics, this fallow functions as reserved fields.

Table 7. Land Use, 1977 and 1977/78

Winter Crops		Summer Crops			
Kahlaa Gada (A) ha	Project Area (C) ha	Kahlaa Gada (B) ha	Project Area (D) ha	(B)/(A) %	(D)/(C) %
6,262	1,878	5,103	284	81	15

As shown in the above table, the cropped area of the Project Area in the summer of 1977 is equivalent to 15 % of that in the winter of 1977/78, whereas the same percentage of Kahlaa Gada arrives at 81 %. This low percentage in comparison with that of Kahlaa Gada proves that the land use in the Project Area is quite extensive. The total Project Area of 8,160 includes the high saline land of 4,040 ha. If this high saline land and the fallow with a 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 costs survey, the net income by products are

as follows;

Table 8. 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 1976
5/ : The winter of 1975/76
6/ : The year of 1976

The production cost items of the above table consist of seeds, fertilizers, machinery, labor, land rental and taxes, etc. The farm gate prices of crops are abstracted from "Index Numbers for Agricultural Crops in Iraq".

As is seen in the above table, the net income per donum derived from wheat and barley cultivations are only 17 % and 16 % of the net income per donum in paddy cultivation. It is clear that paddy is the most profitable to farm household economy, if adequate irrigation water is available.

The cropping area in Kahlaa gada was 5,103 ha (20,412 donums) in the summer of 1977, and 6,262 ha (25,047 donums) in the winter of 1977/78. The gross farm income is estimated at about 740,000 I.D. The averaged gross income per farm household derived from cropping is, therefore, computed at about 890 I.D. since Kahlaa Gada has 825 farm households. The farm management survey conducted by the Agricultural Economist of the study team revealed that an averaged farmer has the following income;

Table 9. Averaged Farm Income

1.	Family members:	12 persons
	Main family laborers:	3 persons
2.	Cropped area:	
	Paddy, Amber variety	1 donum
	Graiba variety	5 donums
	Wheat	8 donums
	Barley	12 donums
	Broad bean	4 donums
3.	Livestock farming	
	Horse	1 head
	Cow	2 heads
	Sheep	30 heads

4. Farm income: (Unit: I.D.)

	Gross Income	Farm Income
Crops	725	575
Livestock farming	375	300
Total	1,100	875

5. Farm income per day: 2.4 I.D. (875 I.D. ÷ 365 days)

Farm income per day per family member 200 fils (2.4 I.D. ÷ 12 persons)

The prevailing farm wage rate in the Project Area as of the field survey period is one Dinar. If the Kahlaa Rice Farm employs such farmers after the implementation of the Project, the above- mentioned farm income will be earned by about two family laborers.

7. Processing and Marketing of Agricultural Products

Farmers in the Project Area sell their cereal products to one of the three Centersof Marketing in Amara. In case of paddy, for instance, farmers pack threshed rice in sacks of 80 to 100 kg contents, and transport 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 of paddy and also price for payment to farmers. The paddy rice handled by the Centers of Marketing is only of Amber varieties.

The purchasing price of the first grade Amber paddy at the Center is 95 I.D./ton, and that of the second grade 80 I.D./ton.

Every 50 tons of paddy rice are packed in hemp sacks with 60 kg content, and send to a silo by truck or trailer. The silos, processing center of rice, are located in the suburbs of Amara, and collect 150 tons of paddy per day from the three Center of Marketing during the busy seasons. At a silo, grains of barnyard grass, dust and other impurities are removed. After that, paddy rice is stored in the silos keeping its moisture content at 14 to 15 %. The storage capacity of one unit of silo is 120 tons. Totally Amara has 132 units. So, the total storage capacity is about 16,000 tons. It was informed during the field investigation that all the silos were filled with paddy rice brought from Amara, Al-Najaf and Quadif province in the last year of 1978.

A rice mill has been built near the silos. Its capacity is ten tons per hour with the maximum capacity of 12 tons.

8. Research and Extension

Iraq has nine agricultural experimental stations out of which Mishkhab Rice Experimental Station located in Najaf province is specialized in paddy experimentations, and furnishes us with useful information in planning a new rice farm in the Project. Therefore, the existing status and activities of this experimental station are described in some detail.

The total acreage of 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 totally 15 members, five are the graduates from agricultural colleges, three from the institutes of agricultural technology and seven from agricultural high schools.

Experiments are mainly made on fertilization effects to paddy yield, for this purpose, 60 varieties, mostly local varieties and some IR, American and Chinese varieties, are grown in the test fields.

Specially, fertilization tests are focussed on Amber varieties whose cultivation is domestically encouraged. This station also raises various foundation seeds of paddy in 18 ha of seed fields.

Mishkhab Rice Experimental Station is equipped with various machines and implements such as rotary harrow attachment from Japan, direct planters, Model BDG-14, from China, 13-lane seed drills with3.5 m drilling width, four-lane plows and speed sprayers, etc.

The experimental station has adopted the dry method in seeding, and obtained good results. Seed drills are used for seeding. When this station accomplished a satisfactory result in its experimentations, such a new farming method is taken up in extension services. The new farming method is first reported to the Directorate of Farmers' Education and Extension, and if accepted, the extension workers of the Directorate actually conduct the demonstration trials of that method, selecting farmers' paddy fields of 1.25 to 2.5 ha (5 to 10 donums)

The land productivity in Najaf, Qadesiya province, located in the Euphrates zone, is said more than two times of that in Missan province. The staff of Mishkhab Rice Experimental Station itemize the major reasons as follows;

- o Careful weed control specially of barnyard grasses;
- o Careful farm practices and management such as harrowing, two times plowings and land leveling, etc.;
- o Farmers' willing 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. (see Table 10)

1) Extension Services on the Fields

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 farmers in fertilizers and agricultural chemical application, selecting some farmers. Based on the program, seeds, fertilizers and chemicals are accommodated to such

selected farmers. In harvesting, extension workers measure and compare grain weights of paddy rice harvested in fertilizers applied fields and other fields in the presence of farmers, and let them understand the importance of scientific farming. After harvesting, extension workers collect loaned money for agricultural imput materials from such farmers.

2) Extension Activities

In addition to the above-mentioned demonstration, wide-ranged training is conducted for extension purposes, aiming at level-up of not only farmers but also extension workers themselves and cooperative officers. The audio-visual education with film shows has born fruitful results.

Table 10. Extension Centers and Extension Workers in Missan

Place	Extension Center	Female Ext. Workers	Exten. Workers for Youth	Total Worker
Ali-Al-Graby	1	1	1	2
Ali-Al-Sharky	1	1	1	2
Quamit	1	2	2	4
Al-Amara	1	5	1	6
Al-Maymouna	1	2	1	3
Al-salam	-	1	1	2
Al-Majar Al-Qaber	1	1	2	3
Al-Adel	-	-	1	1
Qulat Salm	1	1	1	2
Al-Azeir	1	2	2	4
Al-Kahlaa	1	1	2	3
Al-Rafey	-	1	1	2
Al-Mesharak	1	1	1	2
Total	10	19	16	35

9. Farmers' Organization

In accordance with the Agrarian Laws No. 30 of 1958, No. 117 of 1970 and No. 90 of 1975, about 7.44 million donums of farm land were requisitioned as of the end of 1976, and about 7.42 million donums were disbuted to about 235,000 beneficiaries. The averaged distributed area per beneficiary is computed at 31.5 donums (7.9 ha).

The Agrarian Reform Law No.33 was laid down for defining the upper limit of agricultural land ownership, establishment of a cooperative system oriented towards fostering the interest of the state and peasantry, organizing agricultural relation and guaranteeing fair right for agricultural workers.

The Agrarian Reform of 1958 made the movement toward cooperatives active. The number of agricultural cooperatives expanded from 17 in 1961 to 1,606 in 1977. At present, Missan province has 103 agricultural cooperatives, and in Al-Kahlaa Gada, one compound agricultural cooperative and nine agricultural cooperatives have been organized.

Al-Kahlaa Agricultural Branch Office has the Cooperative Department lined up by ten officers. One cooperative officer is responsible for guidance of two cooperatives in agricultural technology, administration, credit, etc. An opinion or a request of a cooperative member is discussed at the council meetings of the provincial and national levels, and adopted in the policy and programming when it is approved.

10. Credit

The general rural credit is extended by the Agricultural Bank in the public sector and agricultural cooperatives in the private sector.

The Agricultural Bank has been established based on the Agricultural Bank Law of 1946. With the inception of July 14 Revolution in 1958, the Law was revised to attain the agrarian reform. Rural loan fund has been increased. The 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 with the purpose of loaning to agricultural cooperatives was established in 1956, and the Government

invested 51 % and the other membership the rest of 49 %. The procedure for farmers to obtain an agricultural loan to purchase agricultural imputs such as fertilizers, seeds, pumps, etc., is described below;

A subscriber's request for loan is reported to the Cooperative Department of Kahlaa Agricultural Branch in writing by the agricultural cooperative through the Compound Agricultural Cooperative, and the Cooperative Department forward such 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 imput materials in check. The interest of two percent a year is paid back to the Bank by the subscriber through the Compound Cooperative after harvesting.

CHAPTER III. THE PROJECT

A. Objectives and Components of the Project

1. Objective

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 it is also expected that this Project will bring about a big impact upon the rural economy of Missan province and its vicinity.

2. Project Components

The Project will include the following components;

i) Construction of the State Rice Farm:

a) Irrigation and drainage facilities:

The construction of pumping facilities, a reservoir, irrigation and drainage systems and on-farm facilities

b) Farm facilities:

The provision of farm store, equipment store, workshop, machinery garage and aircraft runway

c) Related facilities

The construction of bridge across the Kahlaa river and provision of necessary facilities from improvement of living environment

d) Rice processing facilities:

The installation of rice processing facilities consisting of milling, drying and storage facilities

ii) Establishment of Mechanized Agriculture

e) Mechanized rice cultivation technique:

The introduction of mechanized rice cultivation technique together with well-controlled water management

f) Management of the state rice farm

The establishment of farm management organization for this rice farm

iii) Establishment of an Experimental Farm

The establishment of an experimental farm of about 20 ha equip-

ped with all necessary infrastructural facilities for experimentations required in the Project, demonstration and training.

B. Development Strategy

In execution of agricultural development projects like Kahlaa Rice Farm Project, two stages of development strategy are required, that is, a short-term and long-term operation plannings.

The short-term strategy aims to implement a project and attain the full benefit as scheduled, so timely arrangement and execution of construction works for facilities, farm operation, imput materials supply and marketing of agricultural products, etc. are the major subjects of this strategy. For this, the financial arrangement and also flexible services and functions of the administrative organization in charge for coordination and mobilization of administrative and technical officials and laborers are prerequisite. Specially in Kahlaa Rice Farm Project, the proposed experimental farm will play an important role in attaining quickly the benefit, in more detail, in establishment of the technical system of farming required in operating this large-scaled rice farm with heavy farm machinery. As a matter of course, the introduction of farm machinery on schedule and securing of a necessary irrigation water volume are involved in this strategy.

On the other hand, the long-term strategy aims at full operation of rice farm with a modernized farm management technique. In farm management planning, the following should be taken into consideration;

i. Establishment of a self-supporting farm budget system with the back-up of clear financial recording and analysis
ii. Suitable labor control to grow laborers' consciousness for increased productivity
iii. Proper maintenance of irrigation and drainage facilities, farm machines and others

C. Project Formulation

In formulating the Project plan, studies were focussed on the requisites of this rice farm in attaining an increased rice production, specially on crops selection and determination of the scopes of farm mechanization and infrastructural improvement and farm management system.

1) Crops

The final target is, as already repeated above, an increased rice production. Therefore, paddy has the first priority in every aspect. However, taking into account the best use of labor and farm machinery in winter seasons, the introduction of wheat and barley cultivation has been planned. Furthermore, the combination cropping of paddy and upland crops (feeder crops) was studied to control weeds in paddy fields and promote the livestock farming. The Amber varieties are advantageous in marketability and saline soil tolerance.

2) Mechanized Rice Farming

Farm mechanization is prerequisite in operation and management of this large-scaled rice farm. Therefore, mechanized farm practices has been planned covering land preparation, sowing, harvesting, prevention and control, fertilizer application and transportation, etc. Careful studies have been conducted on mechanized sowing of paddy, and the direct sowing to submerged fields by aircraft has been proposed in this plan, paying attentions to the following;

- o The direct sowing to submerged fiels is the traditional method of paddy sowing in the Project Area and its neighborhood.
- o Rice experimental stations in Iraq have obtained good results by applying this method of sowing.
- o The wet method is advantageous in conducting land leveling and percolation control of irrigation water for paddy growth.
- o Paddy should be sown to the vast area of 6,000 ha within the limited optimum sowing season.

3) Farm Management

The successful farm management for this large-scaled rice farm will ultimately depend upon capability of the management organization to be established. In farm management planning, the concept of "unit farming system" has been introduced as detailed hereinafter so that elaborative farm management could be materialized. The unit farming area is about 1,500 ha.

4). Layout of the Farm

i. Land Use

In land use planning, attentions have been paid to secure the largest cultivation area possible within the Project Area of 8,160 ha, and to formulate the best suited land use to the operation of heavy farm machinery to be introduced.

ii. Irrigation

In order to utilize the Kahlaa water, a pump station, a reservoir and irrigation networks have been planned, taking into consideration the following;

- o The pump irrigation is inevitable since the gravity irrigation is topographically difficult.
- o The irrigation plan with two pump stations is economically disadvantageous.
- o A reservoir is necessary for silt treatment of irrigation water.
- o The silt treatment will be difficult if the existing Gasma river is used as a part of the irrigation system. Moreover, the irrigation through the Gasma river premises plural number of pump stations, which results in much construction as well as operation and maintenance costs.

iii. Drainage

In order to drain rainy waters and control groundwater, a drainage pump station and drainage networks have been planned. The drainage water will be delivered to Al-Chikka marsh. So, the natural drainage is impossible during high water seasons of the marsh. The location of this drainage pump station is proposed at the eastern most of the Project Area in consideration of the topographic conditions. Each farm plot will be equipped with underdrains for groundwater control and leaching of soils.

iv. Farm Land Development

The land reclamation has been planned to meet the following requirements;

- o Mechanized farm management;

- o Rationalized farm management for paddy cultivation;
- o Rationalized irrigation and drainage control.

v. Related Facilities

The following related facilities will be needed for farm management;

- o Village for officers and laborers;
- o Kahlaa bridge of about 300 m long and 8 m wide for transportation of construction equipment and materials as well as agricultural imput and output.
- o Rice processing center for the Project and its vicinity.

D. Project Planning

1. Irrigation Plan

(a) Crop Water Requirement

The following equation was applied in calculation of the reference crop evapotranspiration (ETo), based on the recommendations made by the FAO Group for a better definition of the effect of climate on crop water requirement, but still employing the Blaney-Criddle temperature and day length related to the consumptive use factor;

$$ETo = C\ (P(0.46\ T + B)) \qquad \text{mm/day}$$

Where,

- ETo: Reference crop 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 annual 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

Based on the observed data at Amara Sugarcane Factory and at Amara Meteorological Station such as temperature, humidity, sunshine duration and wind velocity, the mean ETo during the period of 1966 to 1978 is computed as follows;

Table 11. Reference Evapotranspiration (ETo)

Month	Daily (mm/day)	Monthly (mm)
Jan.	2.0	62
Feb.	2.9	81
Mar.	4.0	124
Apr.	5.4	162
May	8.7	270
Jun.	11.0	330
Jul.	11.1	344
Aug.	10.4	322
Sept.	9.2	276
Oct.	5.2	161
Nov.	4.3	129
Dec.	2.1	65
Mean	6.4	194
Annual	-	2,326

After the determination of ETo, crop evapotranspiration (ET crop) can be predicted applying the appropriate crop coefficient (KC). The KC value relates to the evapotranspiration of a disease-free crop grown in large fields under the optimum soil, water and fertility conditions and achieving full production potential under the given environments.

ET crop = KC ETo

The selection of an appropriate KC value is made as shown in Table 12, taking into account the crop characteristics, time of planting or sowing and the stage of crop development and climatic conditions prevailing in the given area.

Table 12. Selected KC Values for Each Crop

Month	Paddy	Berseem	Green Gram	Wheat	Barley	Trees
Jan.	-	1.0	-	1.1	1.1	0.9
Feb.	-	1.0	-	1.1	1.1	0.9
Mar.	-	1.0	-	1.1	1.1	0.9
Apr.	-	1.0	-	0.2	0.2	0.9

(Continued)

Month	Paddy	Berseem	Green Gram	Wheat	Barley	Tree
May	-	-	-	-	-	0.9
Jun.	1.05	-	-	-	-	0.9
Jul.	1.1	-	0.7	-	-	0.9
Aug.	1.35	-	1.0	-	-	0.9
Sept.	1.35	-	0.9	-	-	0.9
Oct.	1.0	-	-	-	0.3	0.9
Nov.	1.0	1.0	-	1.1	1.1	0.9
Dec.	-	1.0	-	1.1	1.1	0.9

The ET crop values are, thus, predicted by applying ETo and KC. The following table shows the mean ET crop for the period of 1966/78.

Table 13. Crop Evapotranspiration (ET crop)

Month	Paddy		Berseem		Green Gram		Wheat		Barley		Tree	
	D.M. 1/	M. 2/	D.M.	M.	D.M.	M.	D.M.	M.	D.M.	M.	D.M.	M.
Jan.	-	-	2.0	62	-	-	2.2	68	2.2	68	1.8	56
Feb.	-	-	2.9	81	-	-	3.2	89	3.2	89	2.6	61
Mar.	-	-	4.0	124	-	-	4.4	136	4.4	136	3.6	112
Apr.	-	-	5.4	43	-	-	1.1	22	1.1	17	4.9	147
May	-	-	-	-	-	-	-	-	-	-	7.8	242
Jun.	11.6	266	-	-	-	-	-	-	-	-	9.9	297
Jul.	12.2	396	-	-	7.8	225	-	-	-	-	10.0	310
Aug.	14.0	435	-	-	10.4	322	-	-	-	-	9.4	291
Sept.	12.4	373	-	-	8.3	232	-	-	-	-	8.3	249
Oct.	5.2	161	-	-	-	-	-	-	1.6	16	4.7	146
Nov.	4.3	43	4.3	120	-	-	1.3	23	4.7	142	3.9	117
Dec.	-	-	2.1	65	-	-	2.3	72	2.3	72	1.9	59
Mean	10.0	279	3.5	83	8.8	260	2.4	68	2.8	77	5.7	174
Annual	-	1,674	-	495	-	779	-	410	-	540	-	2,087

Note : D.M. shows the daily mean ET crop (mm/day)
M. means the monthly ET crop (mm)
Based on the proposed cropping pattern, the averaged growing period of each crop is as follows:

Paddy:	154 days
Berseem:	157
Green Gram:	88
Wheat:	159
Barley:	177
Trees	365

(b) Leaching Requirement

The leaching requirement means the minimum water volume necessary to leach the root zone soils of a crop in order to control its soil salinity below the tolerable level of that crop as follows;

Table 14. Crop Salt Tolerance Level 1/

(Unit: mmho/cm)

	100 %		90 %		75 %		50 %		
Crop	ECe 2/	ECw 3/	ECe	ECw	ECe	ECw	ECe	ECw	Max. ECe 4/
Paddy	3.0	2.0	3.8	2.6	5.1	3.4	7.2	4.8	12
Berseem	1.5	1.0	3.2	2.1	5.9	3.9	10.3	6.8	19
Green Gram 5/	1.0	0.7	1.5	1.0	2.3	1.5	3.6	2.4	7
Wheat	6.0	4.0	7.4	4.9	9.5	6.4	13.0	8.7	20
Barley	8.0	5.3	10.0	6.7	13.0	8.7	18.0	12.0	28
Tree 6/	4.0	2.7	6.8	4.5	10.9	7.3	17.9	12.0	32

Note: 1/ Source: Ayers R.S. and Westcot, D.W. Water quality for agriculture

2/ ECe : Electric conductivity of the soil saturation extract

3/ ECw : Electric conductivity of the irrigation water

4/ Max. ECe: Maximum tolerable electric conductivity of the soil saturation extract

5/ Data on beans are applied.

6/ Data on palm are applied.

The following equation is available for comuting the leaching requirements in case of sandy loam to clay loam soils under good drainage conditions and with a small rainfall, provided that the surface irrigation is applied.

$$LR = \frac{ECw}{5ECe - ECw} \times \frac{1}{Le}$$

Where, Le: Leaching efficient

According to the water analysis result, the electric conductivity of the irrigation water is 0.7 mmho/cm on an average. Provided that the leaching efficient is 60 %, the leaching requirements to lower the soil salinity to the salt tolerance level of crops are obtained as follows;

Table 15. Leaching Requirements for Each Crop

(Unit: %)

Crop	Yield Potential 100 %	90 %	70 %	50 %
Paddy	8	6	5	3
Berseem	17	8	4	2
Green Gram	27	17	2	6
Wheat	4	3	2	2
Barley	3	2	1	1
Trees	6	4	2	1

The leaching requirements thus obtained should be taken into account in computation of the irrigation water requirements.

(c) Irrigation Efficiency

In calculating the project irrigation requirements, an efficiency factor should be taken into account to compensate the conveyance losses and application loss. 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 proposed reservoir, and subdivided into two stages as follows;

$$EP = Ea \cdot Ed$$

Where, Ea: Field application efficiency

Ed: Distribution efficiency inclusive of the conveyance efficiency

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

$$Ea = 0.7$$

$$Ed = 0.85$$

Therefore,

$$Ep = 0.70 \times 0.85 = 0.60$$

(d) Irrigation Water Requirements

Based on the proposed cropping pattern and intensity, the irrigation requirements, in consideration of the leaching and estimated irrigation efficiency, have been calculated on monthly basis by applying the following equation;

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

Where, V: Monthly water requirement in cu.m.
Ep: Project irrigation efficiency 0.60
A: Cropped acreage of each crop in ha
ET: Crop evapotranspiration in mm/day
Pe: Percolation in mm/day Pe = 7 mm/day (growing season)
(Note: Pe is taken into consideration for only paddy)
N: Number of days in each month
Re: Monthly effective rainfall in mm
LR: Leaching requirement (ratio)

Table 16. Average Monthly Water Requirement

(Unit: MCM)

Month	Paddy	Berseem	Green Gram	Wheat	Barley	Trees	Total (cu.m/sec)
Jan.	-	0.76	-	0.24	0.12	0.11	1.23 (0.5)
Feb.	-	0.20	-	0.49	0.24	0.18	1.11 (0.5)
Mar.	-	2.99	-	0.94	0.46	0.46	4.85 (1.8)
Apr.	-	0.62	-	0.03	0.02	0.51	1.18 (0.5)
May	13.03	-	-	-	-	0.99	14.02 (5.2)
Jun.	48.68	-	-	-	-	1.21	49.89 (19.2)
Jul.	53.55	-	3.11	-	-	1.25	57.91 (21.6)
Aug.	58.58	-	4.41	-	-	1.19	64.18 (24.0)
Sept.	52.38	-	3.17	-	-	1.01	56.56 (21.8)
Oct.	19.02	-	-	-	0.05	0.60	19.67 (7.3)
Nov.	2.05	1.85	-	0.16	0.48	0.48	5.02 (1.9)
Dec.	-	1.04	-	0.35	0.15	0.16	1.70 (0.6)
Annual	247.29	7.46	10.69	2.21	1.52	8.15	277.32

(e) Land Preparation and Land Soaking for Paddy Rice

The land preparation of paddy fields such as plowing and leveling can be gradually made in winter seasons after harvesting winter crops. However, the land soaking, i.e., puddling, shall be completed within 40 days from May 14 to June 24 in the paddy area. In one rotation unit of 18 ha, the land soaking might be made as follows;

Date	Farm practices	Water supply
May 13	Top soil saturation 1/	95 mm/day 2/
14	Puddling	95 3/
15	Submerging	20 4/
16	-do-	20
17	-do-	20
18	-do-	20
19	-do-	20
20	Sowing	-
	Total	290 mm

Note: 1/ : To saturate top soils with 15 cm deep. Irrigation water should be supplied one day ahead of puddling in consideration of the required time of 7 to 8 hours for water to fill a farm plot.

2/ : 150 (top soil depth) x 0.5 (void) + 7 (percolation) + 13 (evaporation) = 95 mm/day

3/ : 7 (percolation) + 13 (evaporation) + 75 (standing water) = 95 mm/day

4/ : 7 (percolation) + 13 (evaporation) = 20 mm/day

On May 14 the irrigation water of 95 mm shall be supplied to submerge paddy fields for execution of puddling and sowing. The total water requirement for land preparation and soaking for paddy cultivation amounts to 290 mm.

(f) Peak Water Requirement

Out of the whole irrigation period, the peak water requirement appears in the last week of June when top soil saturation and puddling are made in the final block of the paddy area.

Taking into account the time lag of top soil saturation, puddling

and sowing, the weighted value of irrigation requirement is obtained as follows;

Weighted Net Water Requirement for Paddy Cultivation

Date		Requirement
June	23	22.7 mm/day
	24	20.9
	25	19.1
	26	19.1
	27	19.1
	28	19.1
	29	19.1
	30	19.1

The peak water requirement in paddy fields occurs in June 23, amounting at 22.7 mm/day which is equivalent to 23.6 cu.m/sec for the whole paddy field area, if the irrigation efficiency of 60 % is applied. In this time no crops except trees of the green belt are irrigated. The water requirement for the green belt area of 230 ha, that is, a half of the total green belt area, is 0.4 cu.m/sec. Therefore, the peak water requirement in the Project arrives at 24.0 cu.m/sec.

2. Drainage Plan

Drainage is essential for successful irrigation. Without proper drainage, irrigation results in rapid raise of groundwater tables as well as soil salinization. To avoid crop damages due to salt accumulation in the root zone, leaching shall be practised during, before or after cropping seasons. Excess water on soil surface will be drained by the surface drainage system, while that in sub-soils will be removed by underdrainage system. Excess water may be practically discharged or removed from soils naturally, but supplemental drainage facilities will be required.

(a) Drainage in the Normal Time

Irrigation will be practised almost throughout the year. In summer seasons, a great deal of irrigation water is supplied to paddy as standing water is required for its growth. As mentioned in the Irrigation

plan, leaching to contemplate 100 % yield of paddy rice requires seven percent of water to meet the crop water requirement. The peak crop water requirement during paddy growth season appears in August, and its volume of 14 mm/day. Therefore, in this period, leaching requirement becomes almost 1 mm/day which is less than the percolation volume of 7 mm/day.

The irrigation water to be applied, in consideration of percolation volume also, covers this leaching requirement. A fraction of irrigation water, i.e., percolation, gradually flows through soils and finally reaches the groundwater table, conducting salts accumulated in the root zone of crops which ranges in one to two meters below the soil surface.

Once irrigation is interrupted, the groundwater will be sucken by the capillary action through dry soils under the arid climate. In consequence, the water evaporates, resulting salt accumulation on soil surface. This fact reveals that, during the crop growing seasons, the groundwater table should be kept below the root zone of crops by means of appropriate drains, such as clay or plastic tiles. Based on experience obtained at Amara Sugarcane Factory and the Lower Khalis Project, plastic tiles are favorable from the view point of construction and maintenance.

In consideration of soil conditions, rooting depth of crops and the observed groundwater tables, tile drains will be placed at 1.5 m below the ground surface. Drainage requirement is determined, in this stage of the study, at 7 mm/day which is equivalent to the percolation observed in the existing paddy fields with irrigation water.

(b) Drainage of Probable Rainfall

The annual rainfall of 161 mm concentrates in winter seasons. The observation records of Amara Sugarcane Factory in the past ten years from 1965 to 1975 indicate that the daily maximum rainfall of 44.6 mm occurred in 1969, which is approximately equivalent to the rain of ten-year-return period.

In winter seasons, as shown in the proposed cropping patter, 30 % of farm fields will be cultivated with berseem, wheat and barley, and the rest of 70 % will be fallow. Once such rainfall comes to the fallow land, rainy water percolates at the rate of 18 mm/day which is the mean value observed under dry soil conditions. In the cropped area soils are

kept wet by irrigation water, and the percolation rate is estimated at 7 mm/day. A weighted average of percolation rate for the unit area becomes 15 mm/day.

This will flow through soils and tile drains to be installed, and be collected to the drainage canals.

Excess water on soil surface may appear for a short period, and partially be removed from soil surface by natural means, however, it might be better to keep such excess water in the farm land surrounded by borders to use it for desalinization of soils in non-irrigated area, and let it be gradually drained through the tiles.

3. Farm Land Development Plan

(a) Principles in Land Reclamation Plan

The principles to be considered in land reclamation planning for the Project migh be as follows;

(i) Fully mechanized farm management:

For the farm practices to grow paddy and upland crops such as wheat and barley, etc., an integrated and full-scaled farm mechanization should be established in the Project.

(ii) Paddy cultivation:

Paddy of commercial varieties, Amber, should be grown in the Project Area during summer seasons.

(iii) Water management:

The rotational irrigation system should be established, based on a rationalized irrigation scheme, for effective water use. The water and farm management should be smoothly carried out in each farming 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 (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 skelton 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 and paddy sowing by aircraft. The separation of irrigation and drainage canals is prerequisite for drainage improvement by 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 rotation unit.

(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 due to the same reason mentioned above.

(2) Size of Plots and Land Reparcelling Plan

The size of plots should be determined 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 1/6,000, the Project Area has no restrictions in determine the direction of the length of run (long side of a farm plot) from the view point 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 time to cover the whole farm plot having a very long length of run with irrigation water. In addition, land leveling in one plot will be also difficult.
- As a matter of course, a size of farm plots should be designed in close relation with the 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:

- In general, a width of plot ranging in 1/3 to 1/5 of the length of run is the most effective from the view point of tractor operation.
- 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.

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

- If the width of plot is determined at 50 m, the acreage of one farm plot conrresponds to the multiple of "donum".

Taking into consideration the above-mentioned, the width of plot has been determined at 50 m in the Project plan.

As a conclusion, the size of farm plots is determined at 150 m x 50 m which is equivalent to three donums (0.75 ha). This farm size satisfies all the requirements discussed above.

(c) On-farm Water Management System

Irrigation System:

The water distribution system 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 releases 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. Figure 4 shows the schematic water distribution system of on-farm level.

It is generally accepted that the most desirable length of a farm ditch is 300 to 600 m from the view point of water management.

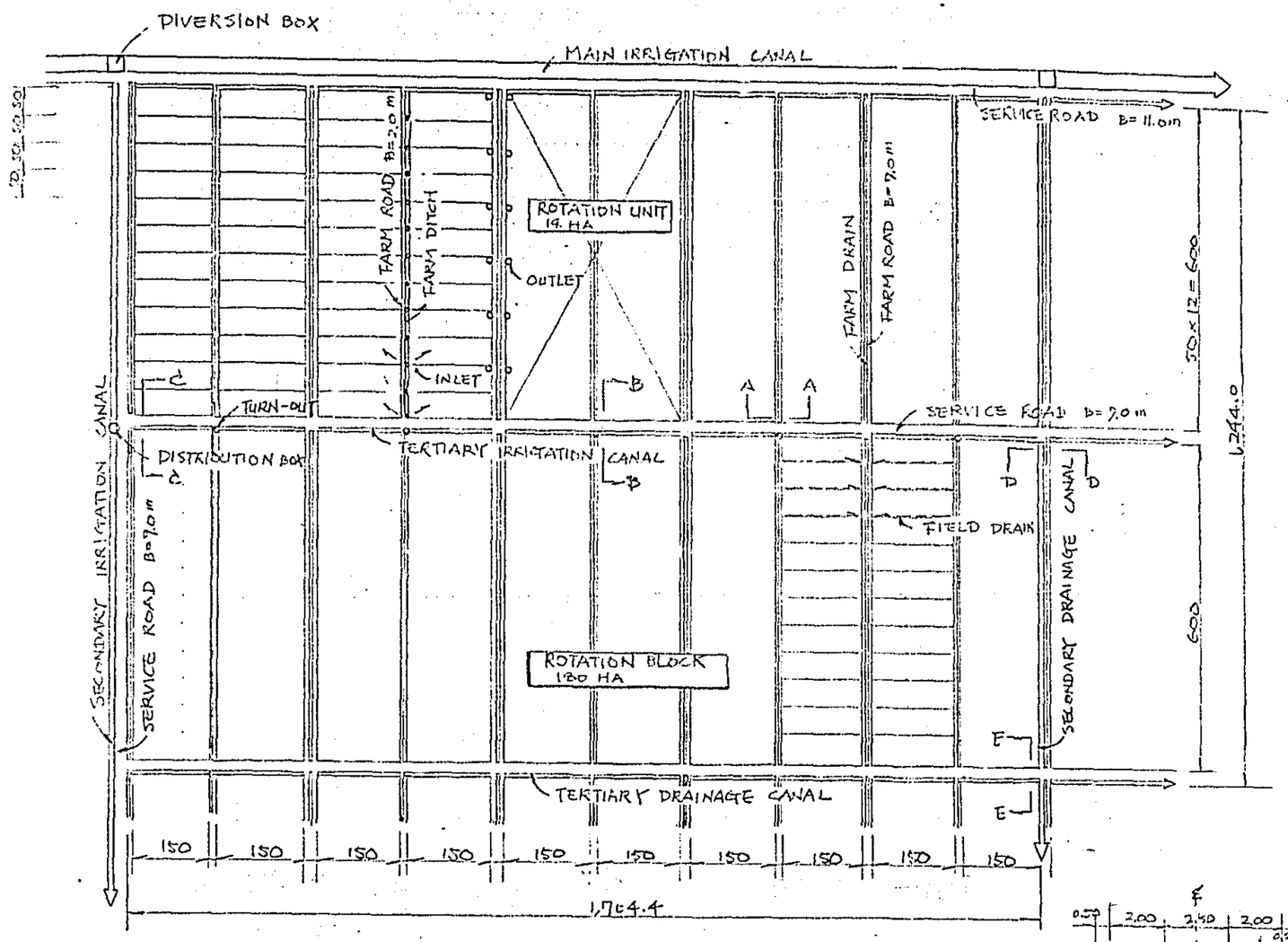
In the Project, the length of farm ditches is decided at 600 m (50 m x 12 plots). Therefore, one farm ditch supplies irrigation water to the area of 18 ha (one rotation unit). Since two farm dtiches are placed to strech out to opposite directions each other from one turn-out, one turn-out diverts and delivers irrigation water to the area of 36 ha (irrigation unit) through these two farm ditches.

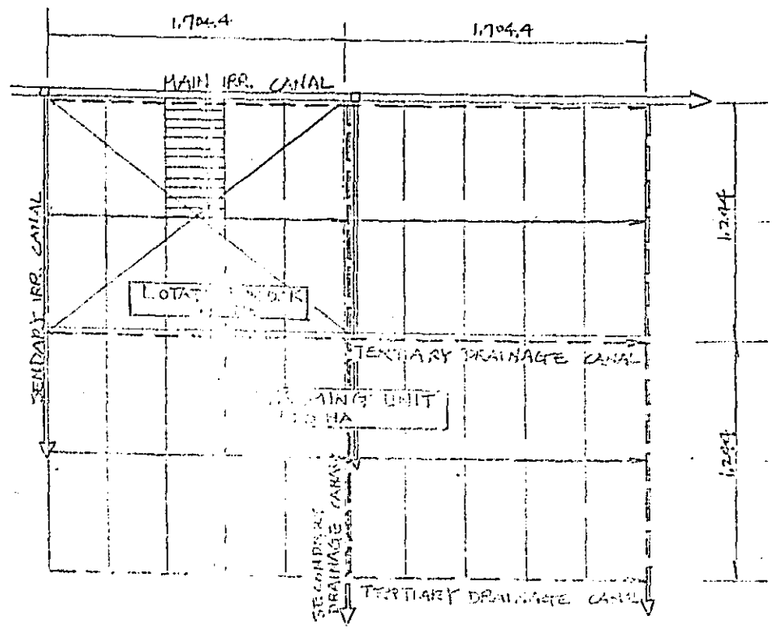
One tertiary canal is planned to command five irrigation units of 180 ha (rotation block) so the length of a tertiary canal will be about 1.7 km.

Irrigation water supply during the land preparation season of 40 days from May 13 to June 23 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 view point of water management. This irrigation block will coincide with one farming unit (operation unit) in the aspect of farm management in the field.

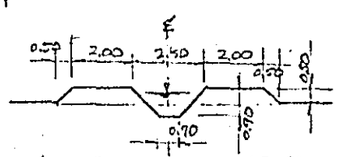
FIGURE 1

LAYOUT OF ON-FARM WARTER DISTRIBUTION SYSTEM (Scale 1 : 1000)

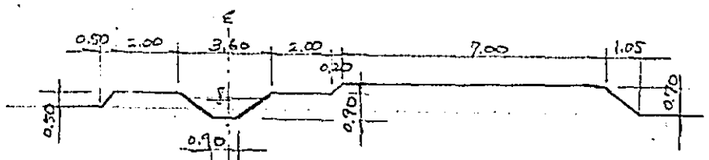




FARM UNIT 0.75 HA (150 m x 50 m)
ROTATION UNIT 18 HA (0.5 ha x 24 plots)
IRRIGATION UNIT 36 HA (18 ha x 2 units)
ROTATION BLOCK 180 HA (36 ha x 5 units)
IRRIGATION BLOCK 720 HA (180 ha x 4 blocks)
(OPERATION UNIT)



SEC. A~A (S=1/200)



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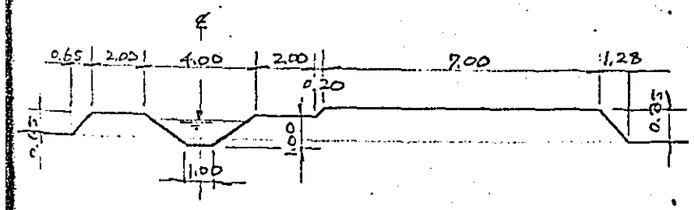

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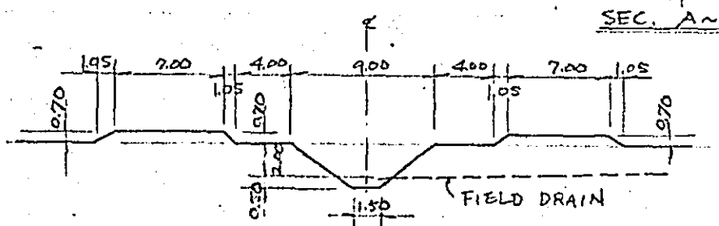
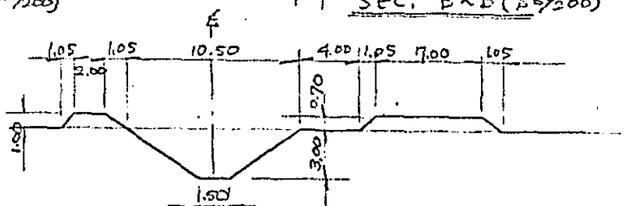


SEC. D~D (S=1/400)



SEC. E~E (S=1/400)

The design capacity of tertiary irrigation canals and farm ditches is 5.96 lit/sec/ha and 13.74 lit/sec/ha, respectively. Outline of the on-farm irrigation facilities are described below;

Tertiary irrigation canals:

Irrigation canals with concrete lining to convey water from secondary canals to farm ditches. The design capacity is 1.07 cu.m/sec to 0.7 cu.m/sec.

Turn-outs:

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

Service roads (Type C)

Roads 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 0.25 cu.m/sec.

On-farm roads (Type E):

The terminal roads provided along the both sides of farm ditches for operation and maintenance of facilities. The width is two meters. No pavement.

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.

Culvert (1):

The facilities installed under on-farm roads (Type D) to let tertiary canal water go across the on-farm roads. Box culverts will be used for this purpose.

Drainage System:

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 600 m as same as that of farm ditches. Excess water or drainage water in fields will be drained to the farm drains through outlets installed for every two farm plots. Therefore, one farm drain commands the area of 18 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 of farm drains is designed at 2.5 m below the ground surface.

Drainage water in the farm drains is conveyed to a tertiary drainage canal as shown in Figure 1 .

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

Tertiary drainage canals:

Earth drainage canals to convey drainage discharge to a secondary drainage canal.

Service roads (Type C)

The roads provided along tertiary drainage canals for maintenance of the canals. The width of these roads is seven meters. No pavement.

Farm drains:

Terminal earth drainage canals

On-farm roads (Type D):

The terminal roads provided along the both sides of a farm drain for transporation 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. A pipe with 250 mm diameter and 8.0 m long will be used.

Field drains:

A plastic subsurface drainage pipe with collecting holes. The pipes will be installed for saline soil improvement by leaching.

Culvert (2):

The facilities installed under on-farm roads (Type D) in order to make drainage water flow across the on-farm roads. Box culverts will be used for this purpose.

(e) Land Leveling

The land leveling in land reclamation works is important for both paddy growth and farm management. The land leveling in one farm plot of 150 m x 50 m aims to keep the difference in elevation of the farm plot surface within 10 cm.

(f) Model Design of On-farm Facilities

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 will be carried out in Japan on the topographic map of the selected sample area. The data on work volumes and costs obtained in the model design could be applied to the computation of those required in land reclamation works for the whole Project Area. The sample area has been selected in Tel El-Ahmar located near the Kahlaa river, and its topographic survey is on the way.

4. Road Plan

The proposed roads in the Project are classified as follows;

Main roads:

The main roads function as trunk roads for transportation of agricultural imput and output within the Project Area, and also function as connecting roads to the national highway No. 6 which runs along the right bank of the Kahlaa river. In principle, each farm unit will be provided, at least, with one or two main roads (crossing each other). In addition, the existing oil company's roads running from the north to south in the eastern part of the Project Area would be used as a main road. For this purpose, some improvement and asphalt 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 have the width of 11 m (effective width:

9 m), and will be paved by asphalt materials.

Service roads:

Service roads have two types of width, nine meters and seven meters.

The nine-meter-wide service roads will be provided along main and secondary irrigation and drainage canals for operation and maintenance of constructed facilities as well as for transportation of products and production materials. The service roads also function to connect main roads, other serive roads and on-farm roads each other. All the nine-meter-wide service roads will be paved with base coarse materials.

The seven-meter-wide service roads will be provided along tertiary irrigation and drainage canals for operation and maintenance of facilities and also for transportation. No pavement is planned for these service roads.

On-farm roads:

On-farm roads, which are terminal roads in fields, are planned to be located at the interval of every 150 m along the width of plot, namely, at the both sides of farm-ditch and farm drain. The roads along farm ditches will have the width of two meters, and those along farm drains the width of seven meters. The latter roads will be used to let farm machines enter into field plots. No pavement is planned for on-farm roads.

5. Reservoir Plan

(a) Functions of the Proposed Reservoir and its Location

A reservoir is planned to satisfy the following requirements;

(i) Sediment treatment of silt

According to the laboratory analysis of the Kahlaa water, sole water source for this Project, the river water contains silt of about 800 g/cu.m on an average. Therefore, silt of about 280×10^3 cu.m. per annum will be sedimented in canals and fields, provided that the river water is directly flown

into the Project Area, and it will result in frequent maintenance of facilities. Consequently, a reservoir for sediment treatment will be required.

(ii) Operation and management of irrigation pump

The automatic operation of the irrigation pump depending on free surface water level has been planned. Therefore, a reservoir, having a certain storage capacity, will be needed.

(iii) Countermeasure against unexpected trouble of pumps

Stabilized and continueous water supply is prerequisite for rice cultivation. Specially, suspension of irrigation in sowing seasons, for instance, due to unexpected trouble of pumps or power failure will bring about severe adverse effects on farm practices and, to the end, on paddy yield. To cope with such accidents, some volume of stored water should be always ready to be supplied beforehand. In addition to this reservoir, a supplemental water will be lifted by a diseal generator-driven pump to be installed in the pump station in case of such accidents.

Taking into consideration the above-mentioned requirements, a reservoir having a storage capacity of about $1,400 \times 10^3$ cu.m is planned in the Project, and its location is decided at the central part of the western Project Area boundary along the Kahlaa river, just adjacent to the proposed pump station site.

(b) Required Storage Capacity of the Reservoir

The required storage capacity of this riservoir is determined as follows;

a) Required capacity for sediment treatment of silt	380×10^3 cu.m.
b) Operation and management of the irrigation pump (effective depth: 6 m)	240×10^3 cu.m
c) Countermeasure against unexpected trouble of pump (trouble hours: 12 hrs)	780×10^3 cu.m
Total	$1,400 \times 10^3$ cu.m

6. Dike Plan

The eastern part of the Project Area located on the right side of

the existing oil company's road is a lowlying area having an elevation of about four meters above mean seas level. It is submerged during winter seasons due to the raise of Al-Chikka marsh water. In order to protect the Project Area from marsh water intrusion, the construction of a dike is planned.

The top elevation of the proposed dike is decided at E.L. 5.80 m above mean sea level, taking into account the maximum water level of Al-Chikka marsh of 4.8 m as well as the top elevation of the existing oil comapany's road (E.L. 5.8 m).

7. Green Belts Plan

Winds mostly blow from the north-west in and around the Project Area. Specially during summer seasons, top soils exposed to hot and dry winds are brown up. In order to protect the surface soils of farm fields, and also to make the farm livable and comfort as much as possible during the climatic extremes, the wind-breaking green belts has been proposed.

The total acreage of them is 450 ha, that is, 90 ha along the Kahlaa river with 100 m wide, 340 ha along roads and canals in the Project Area with 30 m wide and 20 ha in housing area.

Date palm, tamarix and eucalyptus, etc., could be grown in such green belts 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.

E. Proposed Agricultural Development

1. Proposed Land Use

The Project Area, having the Kahlaa river flowing along its western boundary, is blessed with water source for irrigation. Being locatated in the lower Mesopotamian plain, the Project Area is very flat with a extremely gentle slope of less than 1/6,000, and it has no climatic hindrance in paddy cultivation though dry and hot summer winds blowing from the north-esat might have some possibility to criple paddy growth.

On the other hand, its soils have been mostly salinized to a considerable extent. But such saline soils will be improved by leaching.

In order to realize an increased agricultural production focussing on paddy rice, the land use tabulated on the next page has been proposed. In the proposed land use, the total cultivated area will be 6,000 ha, and non-cultivated area 2,160 ha. This non-cultivated area includes 20 ha of the proposed experimental farm.

The whole cultivated area of 6,000 ha will be so designed to have necessary functions of paddy fields, and its 90 % and 10 % will be rotationally cultivated with paddy and upland crops in summer seasons, respectively. The winter crops will be grown in about 30 % of the total cultivated area. (see Figure 2. Proposed Cropping Pattern)

Each of farm plots will have the length of run of 150 m and the width of plot of 50 m, so the size of one farm plot is three donums (0.75 ha). Roads will be so located that every farm plot is accessible without going across the other farm plots. The irrigation and drainage canals will be separately constructed along the width of plot respectively.

Trunk roads with 11 m wide (effective width: 9 m) and 21 km in total length and service roads with 9 m wide (effective width: 7 m) and 36 km in total length have been planned for transportation of heavy farm machines in the Project Area.

The Kahlaa water will be pumped up and released to tertiary irrigation canals and farm ditches through main and secondary irrigation canals with 60 km long in total.

The total length of main and secondary drainage canals will be 52.9 km. Excess water will be collected through these drainage canals and delivered to Al-Chikka marsh.

Kahlaa Rice Farm will be operated as one of the state farms after its implementation. Therefore, the construction of farm management office, village for officers and laborers, etc., has been proposed in addition to farm facilities which are directly required for agricultural production.

Table 17. Proposed Land Use

(Unit: ha)

Item	I 1/ 2/ 1	I 1/ 2/ 2	II 3	II 4	III 5	III 6	IV 7	IV 8	Total
1. Cultivated Area									
a. Summer crops:									
Paddy (90 %)	570	610	670	550	850	740	850	560	5,400
Green Gram (10 %)	60	70	80	60	100	80	90	60	600
Sub-total (1)	630	680	750	610	950	820	940	620	6,000
b. Winter crops									
Berseem (20 %)	130	140	150	120	190	160	190	120	1,200
Wheat (7 %)	40	50	50	40	60	60	60	40	400
Barley (3 %)	20	25	25	20	30	30	30	20	200
Sub-total	190	215	225	180	280	250	280	180	(1,800)
2. Non-cultivated Area									
a. Experimental farm									20
b. Green belts along the Kahlaa river									90
c. Public facilities									220
d. Reservoir									50
e. Main & secondary canals and roads									750
f. On-farm facilities									1,030
Sub-total (2)									2,160
Total (1) + (2)									8,160

Note: 1/ Farming unit

2/ Operation unit

2. Proposed Cropping Pattern

(a) Selection of Crops

The five crops of paddy, green gram, wheat, barley and berseem have been selected for cultivation in this rice farm, taking into consideration the following;

Paddy:

This Project has been originally taken up aiming at an increased production of paddy rice. Furthermore, it is clear, as a result of the feasibility study, that the natural conditions of this farm are favorable for paddy cultivation.

Green Gram:

The green gram will be cultivated after harvesting paddy, which will be effective for weed control in paddy fields. Furthermore this upland crop will contribute to increase soil fertility to a great extent.

Wheat:

An increased yield of wheat can be expected since a sufficient irrigation water is supplied in the Project. Moreover, the wheat cultivation will be helpful, in the farm management aspect, to make the best use of labor and farm machines, in other words, to keep the idle seasons of them at minimum.

Barley:

In addition to the advantages mentioned above, the introduction of this winter crop will smooth the peak requirement of labor and farm machines.

Berseem:

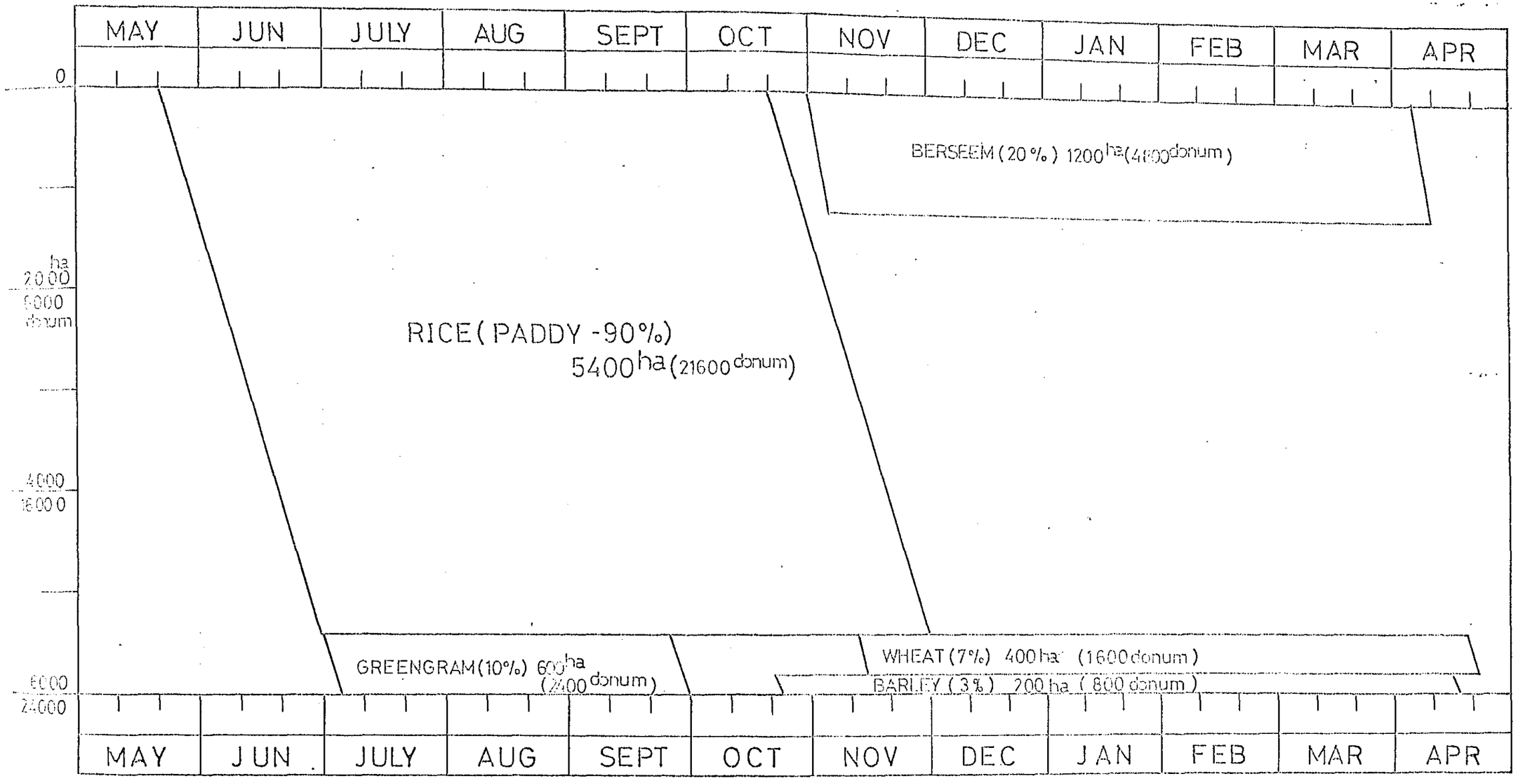
The cultivation of berseem aims to increase the soil fertility of paddy fields, and also to promote the livestock farming in Amara area. It will also contribute to the economic use of labor and farm machines.

(b) Crop and Cropping Pattern

(1) Crop Rotation

The two crop rotation systems has been planned as follows;

FIGURE 2 PROPOSED CROPPING PATTERN



	1st year	2nd year	3rd year
Type A.	Paddy - Berseem	Paddy - Berseem	Paddy - Berseem
Type B.	Paddy - Wheat	Paddy - Wheat	Green Gram - Barley

Note: Out of these crops, paddy and green gram are summer crops, and the others are winter crops.

(2) Cropping Pattern

The above-mentioned Type A cropping system will be introduced to 70 % of the total cultivated area, and the Type B to the rest of 30 % due to the following reasons;

Type A. The berseem sowing season falls in the early part of the paddy harvesting season. Taking it into consideration, 30 % of the paddy cropping area will be cultivated with this crop.

Type B. The wheat harvesting season falls in the land preparation period for paddy cultivation. Therefore, 30 % of paddy cropping area will be cultivated with wheat.

The cropping area by crops has been already shown in Table 17, and such area in one standard operation unit is indicated in Table 18.

(3) Seed Propagation of Paddy

The only one commercial variety, Amber, will be grown in this rice farm. The paddy cropping area of 5,400 ha requires paddy seed of 972 tons, but it seems difficult to secure this great volume of paddy seed from outside the Project Area. Therefore, it is planned to propagate, in the propagation farm of 300 ha, the high quality seed obtained in the experimental farm. This seed propagation farm will be prepared in the farming unit I.

Cropping Area by Seasons (Unit: ha)

	Paddy	Green Gram	Wheat	Barley	Berseem	Total
Summer	5,400	600	-	-	-	6,000
Winter	-	-	400	200	1,200	1,800
Total	5,400	600	400	200	1,200	7,800

Table 18. Cropping Area in Standard Operation Unit (720 ha)

(Unit: ha)

Rotation Type	Area	Summer Crops			Winter Crops				Total
		Rice	Green Gram	Sub-total	Wheat	Barley	Berseem	Sub-total	
Type A.	504	504	-	504	-	-	144	144	648
Type B.	216	144	72	216	48	24	-	72	288
1st	72	72	-	72	24	-	-	24	96
2nd	72	72	-	72	24	-	-	24	96
3rd	72	72	-	72	24	-	-	24	96
Total	720	648	72	720	48	24	144	216	936

Note: Land use rate = 130 %

3. Population and Labor Forecast

The nation-wide population of Iraq as of 1975 is estimated about 11.1 million by applying the annual population growth rates of 3.25 % from 1960 to 1970 and 2.8 % from 1971 to 1975. This population in 1975 consists of the rural population of 36 % and urban population of 64 %. The population statistics of this country shows that the growth rate of rural population has been fixed at 0.3 % since the year 1960 whereas the urban population has grown at the great percentage of five to nine.

Missan province is categorized as a rural area in the aspect of population with the rural population ratio of 60 %. By applying the above mentioned growth rate, the population in the whole Iraq and Mis province in the year of 1985 might be forecast as follows;

Table 19. Forecasting of Populations

(Unit: '000 persons)

	1975	1985
The whole Iraq	11,124	14,662
Missan province	370	454

The incremental population in rural area inclusive of that of Missan province seems to have been absorbed in the urban population, and as a result, the rural population growth rate has been almost fixed.

An average cropping area and arable land per farm household are estimated at 25 donums (6 ha) and 48 donums (12 ha), resepectively, based on the statistics of 1971. On the assumption that the number of main family laborers of one farm household is three persons, an average cropping area and arable area per main laborer are computed at 8.3 donums (2 ha) and 16 donums (4 ha), respectively.

Agricultural labor has been constantly short in Iraq due to the low growth rate of rural population and a great acreage of farm field per family laborers as mentioned above. To cope with such situations, the large-scaled mechanization of agriculture has been already taken up by the Government.

The Kahlaa Rice Farm will require many farm management and adminis-

tration officers as well as skilled and unskilled laborers. It is expected that this rice farm will employ, with a priority, farmers now living in the Project Area.

The actual number of farm households in the Project Area is estimated at 120 families from the map. On the assumption that one farm household has three main family laborers such as husband, wife and son or daughter, the total main family laborers are about 360 persons. After the completion of this Project, these laborers could be employed by the rice farm as unskilled or skilled laborers such as drivers. On the assumption that 30 % of the present population in the Project Area is of the aged, the number of laborers to be employed by the rice farm is forecast at about 250 persons.

4. Marketability of Agricultural Products

The five crops of paddy, green gram, wheat, barley and berseem are proposed as selected crops in the Project. The annual production of them is projected at 27,000 tons of paddy, 600 tons of green gram, 1,100 tons of wheat, 430 tons of barley and 36,000 tons of berseem (at the full benefit stage).

The following table shows the comparison of projected quantities of agricultural products in the Project Area in the fully benefited stage and the present production in the entire Missan province.

Table 20. Projected Production and Present Production in Missan

(Unit: ton)

Crop	Projection	Missan Production
Paddy	27,000	51,000 1/
Green Gram	600	-
Wheat	1,100	15,660 2/
Barley	430	28,958 2/
Berseem	36,000	2,994 2/

Note: 1/ Production in 1977
2/ Production in 1977/78

As seen in the above table, wheat, barley and green gram to be harvested are not so big in comparison with the present production of them in Missan, and these will be consumed in this province.

Missan province is one of the main rice production areas in Iraq, and an exporter of rice to the other province. The paddy field area in this province is equivalent to about 20 % of that total in Iraq as of 1977. An incremental rice derived from this Project would be also exported to the other provinces. The following table shows the balance of demand and supply of rice in Missan province in two cases of "with the Project" and "without the Project".

Table.21. Demand and Supply of Paddy in Missan Province

(Unit: '000 tons)

Year	Demand 1/	Supply 2/	Surplus w/ the Project	Surplus w/o the Project
1975	16.3	31 to 51	-	14.7 to 34.7
1985	26	51 + 27.0	52.0	

Note: 1/ : Culculation based on the population and per capita rice consumption projections

2/ : The production in 1975 is not statistically clear. Therefore, the productions in 1976 and 1977 are presented. The production in 1985 is estimated based on that in 1977 (51,000 tons) and the target yield of rice in the Project of 27,000 tons.

In the full benefit stage after the completion of the Project, Missan province will export a surplus paddy rice of about 52,000 tons to the other provinces in Iraq.

Berseem is harvested three times a winter season. The projected berseem yield of 36,000 tons can raise about 10,000 heads of cow. According to the livestock statistics, the number of cow in the year 1977 was 16,308 in Al-Kahlaa gada and 218,067 in the whole Missan province. Therefore, it is considered that the projected yield of berseem will be able to consume in livestock farming in and around Al-Kahlaa gada. For effective use of berseem to be produced in the Project, it is recommendable to establish a state livestock farm in the neighborhood of this rice farm

5. Agricultural Production

(a) Target Yield

The target yields of paddy, green gram, wheat, barley and berseem have been determined as shown in Table 17. In such determination, the reference was made to the experimental data of Mishkhab Rice Experimental Station and of the State Organization for Soils and Land Reclamation, Missan as well as to the data in the text book "Amber Paddy Cultivation in Middle Euphrates Area", Dr. Sabri Sibahi, 1976, for paddy yield, and to the experimental results of the Central Research Station, Abu-Ghraib, for the other crops.

Table 22. Target Yield per Hectare

(Unit: ton/ha)

Crop	Present Project Area 1/	Present Iraq 2/	1986 8th	1987 9th	1988 10th	1989 11th	1990 12th	1991 13th
Paddy	0.952	2.24	2.5	3.5	4.25	5.0	5.0	5.0
Green Gram	-	0.624	0.7	0.8	1.0	1.0	1.0	1.0
Wheat	0.8	0.788	2.4	2.7	3.0	3.0	3.0	3.0
Barley	1.0	0.930	1.8	2.1	2.3	2.3	2.3	2.3
Berseem	-	-	30.0	30.0	30.0	30.0	30.0	30.0

Source: 1/ : Data of Missan Agriculture Office, 1977 and 1977/78
2/ : Abstraction from the National Development Plan, 1971 - 1980

Note: o The underlined figures show the target yields.
o A conservative figures are adopted for berseem yields taking into account that the berseem sowing might be delay in some years for paddy harvesting.

(b) Cropping Schedule

For on-farm development, the cultivation area of the Project will be subdivided into three construction blocks, and the construction will be made at the pace of one block per year. Therefore, the cropping schedule before the full benefit year should be prepared for each of these three construction blocks.

Table 24 shows the construction schedule during the period of 1984 to 1991 and also the cropping or production schedule based on it. The crop target yields during 1986 to 1991 have been determined based on the construction schedule, possible leaching effects and supply program of agricultural imput materials, farm machinery and equipment. (see Table 25)

The full benefit of the Project is scheduled to be attained in the year of 1991, that is, the 13th year from 1979 when the feasibility study was conducted, and the sixth year after the commencement of cultivation. The target yields of paddy, green gram, wheat, barley and berseem are 27,000 tons, 600 tons, 1,200 tons, 460 tons and 36,000 tons, respectively. From the seventh year after the commencement of cultivation, yield of crops will be stabilized, or gradually increased with the progress in rationalization of farm management or introduction of new farming techniques, etc.

6. Farm Mechanization Plan and Labor Requirement

(a) Farm Mechanization

It is prerequisite for farm management of this large-scaled rice farm to introduce heavy farm machinery and mechanize farm practices as much as possible because of the following reasons;

- o The Project Area is quite thinly populated at present. Judging from the recent trend of rural population, it seems difficult to mobilize sufficient number of laborers and officers to manage the rice farm without full-scaled farm mechanization.
- o It is a Governmental policy to introduce the mechanized farming in agricultural development projects.

The major farm machinery to be introduced is 70 to 110 Hp tractors with their attachments. Studies were conducted from different angles on the sowing method of paddy, and as a conclusion on this stage of study, the wet method by aircraft has been recommended since the highest rate of germination can be expected in this method. The experimental sowing of paddy is one of the test items of the experimental farm to be provided. For paddy harvesting, 70 to 100 Hp combines will be utilized. The number of farm machinery required for each operation

unit and the mechanization system for each of the five selected crops are shown in Tables 26 and 27.

For operation of farm machines, the operation unit of 720 ha has been planned, taking into consideration the following;

(i) The most important farm practices in paddy cultivation is water management. The operation unit should be planned in close relation with the irrigation unit. The most desirable is to decide the irrigation unit itself as operation unit.

(ii) Both the sowing and harvesting seasons of paddy are determined at 40 days. On the assumption that the actual working hours per day is eight hours during such busy seasons, the work volume per day is determined at 18 ha, setting up the standard work volume at two hectare per hour. This acreage corresponds to 1/40 of the operation unit of 720 ha.

(b) Workshop

Totally 622 units or 21 kinds of farm machinery will be operated in the rice farm. Therefore, the establishment of a workshop has been planned. The workshop will be responsible for periodical check and emergent repair of farm machinery and overhaul of trucks and tractors. The major equipment required for this workshop will be;

- o Lifting and handling equipment;
- o Compressed air equipment;
- o Engine test and overhaul equipment;
- o Welding and blacksmith equipment;
- o Power tools;
- o Electrical test and maintenance equipment; and,
- o Washing and cleaning equipment.

(c) Labor Requirement

The total labor requirement is computed at 73,129 man-day per year tabulated in the following page.

Table 24. Construction and Cropping Schedule (1984-1991)

(Unit: ha)

	1984	1985	1986	1987	1988	1989	1990	1991
On-Farm Block								
Block I	Const.	Leach'g	1st paddy	2nd paddy	3rd paddy	4th paddy	5th paddy	6th paddy
Block II		Const.	Leach'g	1st paddy	2nd paddy	3rd paddy	4th paddy	5th paddy
Block III			Const.	Leach'g	1st paddy	2nd paddy	3rd paddy	4th paddy
Construction Area	1,310	2,310	2,380					
Leaching Area		1,310	2,310	2,380				
Production Area								
Block I			1,180	1,180	1,180	1,180	1,180	1,180
			(130)	(130)	(130)	(130)	(130)	(130)
Block II				2,070	2,070	2,070	2,070	2,070
				(240)	(240)	(240)	(240)	(240)
Block III					2,150	2,150	2,150	2,150
					(230)	(230)	(230)	(230)
Production Area (Paddy & Green Gram)								
Paddy			1,180	3,250	5,400	5,400	5,400	5,400
Green Gram			130	370	600	600	600	600
Production Area (Wheat)								
Block I			90	90	90	90	90	90
Block II			-	150	150	150	150	150
Block III			-	-	160	160	160	160
Total			90	240	400	400	400	400
Production Area (Barley)								
Block I			45	45	45	45	45	45
Block II			-	75	75	75	75	75
Block III			-	-	80	80	80	80
Total			45	120	200	200	200	200
Production Area (Berseem)								
Block I			270	270	270	270	270	270
Block II			-	460	460	460	460	460
Block III			-	-	470	470	470	470
Total			270	730	1,200	1,200	1,200	1,200

Note: The parenthesized figures show green gram cropping area.

Table 25. Total Production (1986-1991)

(Unit: ton)

Crop		1986 (8th)	1987 (9th)	1988 (10th)	1989 (11th)	1990 (12th)	1991 (13th)
Paddy	Area (ha) 1/	1,180	3,250	5,400	5,400	5,400	5,400
	Yield (t/ha) 2/	2.5	2.863	3.265	4.115	4.7	5.0
	Q'tity (t) 3/	2,950	9,305	17,635	22,222	25,387	27,000
Green Gram	Area (ha)	130	370	600	600	600	600
	Yield (t/ha)	0.7	0.74	0.81	0.92	1	1
	Q'tity (t)	91	272	483	554	600	600
Wheat	Area (ha)	90	240	400	400	400	400
	Yield (t/ha)	2.4	2.5	2.6	2.88	3.0	3.0
	Q'tity (t)	216	603	1,059	1,152	1,200	1,200
Barley	Area (ha)	45	120	200	200	200	200
	Yield (t/ha)	1.8	1.9	2.03	2.2	2.3	2.3
	Q'tity (t)	81	230	406	445	461	461
Berseem	Area (ha)	270	730	1,200	1,200	1,200	1,200
	Yield (t/ha)	30	30	30	30	30	30
	Q'tity (t)	8,100	21,900	36,000	36,000	36,000	36,000
Total	Area	1,715	4,710	7,800	7,800	7,800	7,800
	Q'tity	10,848	30,331	51,849	55,714	58,571	59,861

Note: 1/ : Cropping area in hectare

2/ : Yield per hectare (ton/ha)

3/ : Quantity of the total production (ton)

Labor Requirement

	Paddy	Green Gram	Wheat	Barley	Berseem	Total
Area (ha)	5,400	600	400	200	1,200	7,800
Labor (hr/ha)	90.95	71.89	30.8	30.6	26.94	
Total Labor (man-day)	61,391	5,392	1,540	765	4,041	73,129

Farm practices to be conducted in the rice farm are categorized into two, that is, the works to be done by the permanent staff or laborers of this farm and the works to be done by temporary employees.

The works items (a) to be done by the permanent staff and laborers

- o Operation of tractors;
- o Water management;
- o Seed preparation and fertilizer mixing; and,
- o Operation of trucks (about 50 %)

The works item (b) to be done by temporary employees.

- o Weeding by man power;
- o Operation of trucks (50 %); and,
- o The other miscellaneous works.

Five officers assigned to one of the four Field Crops Department and skilled laborers will be responsible for the works items (a). The annual labor requirement will be 44,000 man-day. During the weeding season for paddy from the end of June to the end of September, the labor of 375 man-day will be required. These labor requirements will be covered by family laborers of the rice farm and farmers from neighboring villages.

Table 26 Farm Machinery for Each Operation Unit

Equipment	Operation Unit No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	Others	Total
Motorcar	-	-	-	-	-	-	-	-	4	4
Survey car	-	-	-	-	-	-	-	-	14	14
Crawler tractor	1	1	1	1	1	1	1	1	-	8
Wheel tractor	7	7	8	7	11	8	11	7	1	67
Bottom plow	3	3	4	3	5	4	5	3	1	31
Plow harrow	3	3	3	3	4	3	4	3	-	26
Disk harrow	4	4	4	4	5	4	5	4	1	35
Tooth harrow	4	4	4	4	5	4	5	4	1	35
Rotary	3	3	3	3	4	3	4	3	1	27
Culti-packer	3	3	3	3	4	3	4	3	-	26
Drill seeder	3	3	3	3	4	3	4	3	1	27
Broadcaster	1	1	1	1	1	1	1	1	1	9
Ridger	1	1	1	1	1	1	1	1	-	8
Forage harvestor	1	1	1	1	1	1	1	1	-	8
Combine	7	7	8	7	11	8	11	7	1	67
Dump truck 6 ton	10	10	12	10	17	12	17	10	-	98
Trailer	1	1	1	1	1	1	1	1	1	9
Steel tank	2	2	2	2	2	2	2	2	-	16
Motorcycle	9	10	11	9	14	11	14	9	3	90
Pick-up	-	-	-	-	-	-	-	-	10	10
Power sprayer	-	-	-	-	-	-	-	-	5	5
Grain pump	2									2
Total										622

Table 27. Mechanized System for Each Crop

Paddy:

Plowing	Fertilization	Puddling/Leveling	Seeding	Top dressing	Herbicide	Harvesting
Tractor Share plow 14" x 3	Aircraft Truck	Tractor Rotary and Board	Aircraft Truck	Aircraft Truck	Aircraft Truck Man power	Combine Tractor Trailer Truck

Drying
Rice mill Truck

Green Gram:

Plowing	Harrowing	Leveling	Seeding/Fertilizing	Pressing	Herbicide	Harvesting
Tractor Share plow 14" x 3	Tractor Disk harrow 18" x 12	Tractor Tooth harrow and Board	Tractor Drill seeder w/ fertilizing attachment Trailer	Tractor Culti-packer	Aircraft Truck Man power	Harvester Tractor Truck Trailer

Wheat & Barley:

Plowing	Harrowing	Leveling	Seeding/Fertilizing	Pressing	Herbicide	Harvesting
Tractor Share plow 14" x 3	Tractor Disk harrow 18" x 3	Tractor Tooth harrow Board	Tractor Drill seeder w/ fertilizer attachment Trailer	Tractor Culti-packer	Aircraft Truck	Combine Truck Trailer

Berseem:

Plowing	Harrowing	Leveling	Seeding/Fertilizing	Pressing	Harvesting
Tractor Share plow 14" x 3	Tractor Disk harrow 18" x 12	Tractor Drill seeder Board	Tractor Broadcaster Trailer	Tractor Culti-packer	Tractor Forage-harvester Truck

7. Agricultural Imput Requirements

(a) Agricultural Imput Materials

Fetilizers are the major agricultural imput materials. Necessary volume of fertilizers should be decided based on the target yield of each crop set up in the Project. Taking into consideration such mentioned above and based on experimental results obtained in Iraq as well as the text book "Amber Paddy Cultivation in Middle Euphrates", the agricultural imput materials per hectare for each crop has been determined and tabulated below (see Table 28).

Table 28. Agricultural Imput Materials for Crops

	1986 (1st) 1/	1987 (2nd)	1988 (3rd)	1989 (4th)
Paddy				
Seed (kg/ha)	180	180	180	180
Urea (kg/ha)	87	152	195	260
T.S.P. (kg/ha)	87	120	148	174
Stam F34 (l/ha)	10	10	10	10
Green Gram				
Seed (kg/ha)	32	32	32	32
A.S. (kg/ha)	140	160	200	200
T.S.P. (kg/ha)	61	70	87	87
Wheat				
Seed (kg/ha)	120	120	120	120
Urea (kg/ha)	209	235	260	260
T.S.P. (kg/ha)	70	78	87	87
Carbonic (l/ha)	3	3	3	3
Barley				
Seed (kg/ha)	120	120	120	120
Urea (kg/ha)	139	157	174	174
T.S.P. (kg/ha)	70	78	87	87
Carbonic (l/ha)	3	3	3	3
Berseem (Maskawy)				
Seed (kg/ha)	32	32	32	32
A.S. (kg/ha)	100	100	100	100
T.S.P. (kg/ha)	107	107	107	107

Note: 1/ The year when the first cultivation is made after completion of construction works.

Fertilizers requirement for the targe yield.

(b) Agricultural Imput Materials Supply Schedule

Taking into consideration the scale of cultivated area in each year, the agricultural imput materials supply has been scheduled until the full benefit year of 1991. (see Table 29)

The target yield of paddy will be attained in the sixth year from the commencement of cultivation in the farm, whereas full benefit from green gram, wheat and barley cultivations will be obtained in the fifth year. The agricultural imput materials required in the sixth year of 1991 and in the following years will be as follows;

Item	Area (ha)	Materials (ton)	Remarks
Paddy seed	5,400	972.0	
Green Gram seed	600	19.2	
Wheat seed	400	48.0	
Barley seed	200	24.0	
Berseem	1,200	38.4	
Urea		1,542.8	For paddy, wheat and barley
A.S.		240.0	For green gram and berseem
T.S.P.		1,172.4	For the five crops
Stam F-34		54,000.0	For paddy only
Carbonic		1.8	For wheat and barley

8. Management of State Farm

(a) Strategy for State Farm Management

In general, the agricultural development projects like Kahlaa Rice Farm Project need two stages of farm management schemes, that is, a short-term scheme for the period of 10 to 13 years after commencement of construction works when the full benefit of such projects is not yet attained, and a long-term scheme for the following period when the full benefit can be obtained every year.

Objectives of the first and second stages of farm management scheme for Kahlaa Rice Farm Project are described below. As for the "personnel/ organization in charge" in the following descriptions, brief explanation is made in the next paragraph, and the organization chart is attached also.

Table 29. Total Agricultural Imput Materials Requirement by Year

(Unit: ton & lit)

Materials	1986 (1st)	1987 (2nd)	1988 (3rd)	1989 (4th)	1990 (5th)	1991 (6th)	Remarks
Seed							
Paddy	212.4	585	972	972	972	972	180 kg/ha
Green Gram	4.16	11.84	19.2	19.2	19.2	19.2	32 kg/ha
Wheat	10.8	28.8	48	48	48	48	120 kg/ha
Barley	5.4	14.4	24	24	24	24	120 kg/ha
Berseem	8.64	23.3	38.4	38.4	38.4	38.4	32 kg/ha
Fertilizers							
Urea	127.695	429.44	854.605	1,170.69	1,403.05	1,542.8	For paddy/wheat/barley
A.S.	45.2	127.4	216.6	230.8	240	240	For green gram/berseem
T.S.P.	148.93	449.82	826.535	996.41	1,116.6	1,172.4	For five crops
Stam F-34	11,800	32,500	54,500	54,500	54,500	54,500	For paddy only
Carbonic	405	1,080	1,800	1,800	1,800	1,800	For wheat/barley

Note: The parenthesized figures show the number of a cultivated year

(i) The First State Schme

	Objectives	Personnel/Organization in charge
1.	Mobilization of officers, technicians and laborers;	D.G., Deputy D.G. and Advisors
2.	Construction of office buildings and houses for the above-mentioned staff;	D.G. and Deputy D.G.
3.	Construction of the proposed experimental farm and data collection for application of experimentations to the main farm;	Technical Advisor and the Research Department
4.	Construction of irrigation, drainage and on-farm works;	Technical Advisor
5.	Construction of farm buildings and introduction of farm machinery in paralel with the above-mentioned construction works;	Field Crops Departments and Research Department, and also Workshop
6.	Timely construction of the rice processing center;	The Grain Board
7.	Time-scheduling and practices of water control and farm operation, and planning of emergent measures agaist accidents, etc.;	Agricultural Engineering Dept. Research Dept. and Field Crops Depts.
8.	Securing of necessary quantity of agricultural imput materials;	Management Dept. with Advisor (Managerial)
9.	Estimate of irrigation water requirement for crops and control of the water source discharge with the Irrigation Office, Nissan;	Agricultural Engineering Dept and Technical Advisor
10.	Imput materials supply scheduling in consideration of cropping pattern and soil conditions, and its execution	Research Dept. and Field Crops Depts.
11.	To make efforts to attain quick benefits, and take measures againt financial unbalance during the farm construction stage;	D.G., Deputy D.G., Managerial Advisor and General Dept.

12.	Profitable selling of agricultural Products;	Management Dept.
13.	Suitable labor control;	Managerial Advisor, General Dept. and Deputy D.G.
14.	Functional Integration and coordination of departments;	Deputy D.G., Managerial Advisor
15.	Maintenance of facilities and machinery.	Management Dept. and Workshop

(ii) The Second Stage Scheme

1.	Establishment of self-supporting system of farm budget;	D.G., Deputy D.G., Managerial Advisor and General Dept.
2.	Labor control;	Deputy D.G., Managerial Advisor and General Dept.
3.	Integration and coodination of departments;	Deputy D.G. and Managerial Advisor
4.	Profitable selling of agricultural products	Management Dept.
5.	Maintenance of facilities and farm machines; and,	Management Dept. and Workshop
6.	Education of laborers.	D.G., Deputy D.G., Advisors and Management Dept.

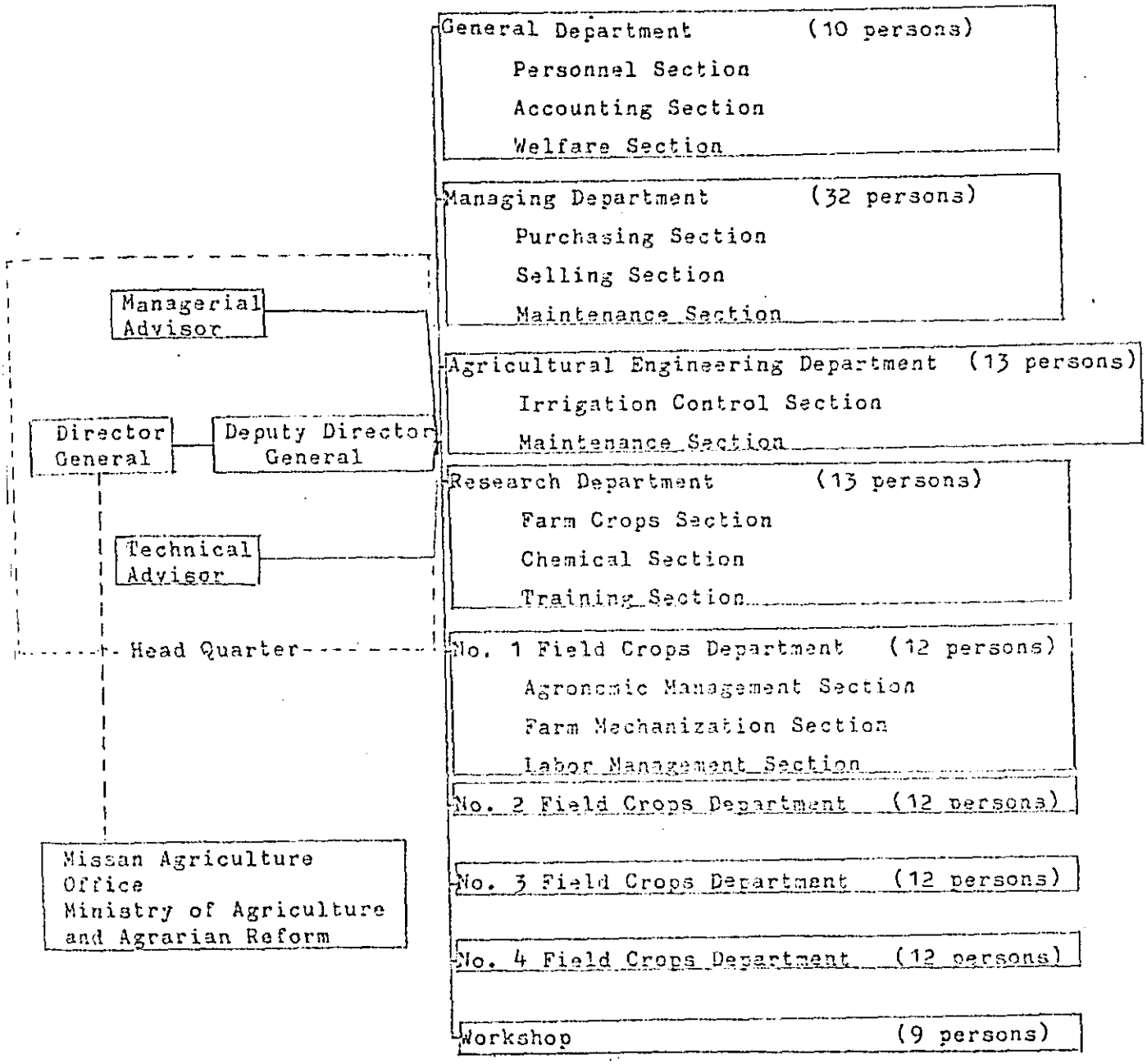
(b) Organization

The management of this rice farm will be mainly made by one Director General, one Deputy Director General and two Advisors in the fields of management and technology with support of about 130 officials of 24 sections, nine departments as shown in the Organization Chart in Figure 3.

About 300 skilled laborers and around 44,000 man-day/year of unskilled laborers will be mobilized permanently and temporarily.

The major works of each department has been already discussed in the previous paragraph setting the two stages of farm management scheme.

Figure 3 Proposed Organization for Farm Management



Total 130 persons

(c) Special Characteristics of Farm Management in the Rice Farm

The success of agricultural development projects much depends upon human factor, and the establishment of a farm management organization is the most important in successfully carrying on of this rice farm. Taking into account the irrigation system to be introduced and the operation efficiency of farm machinery, the whole farm area is divided into four farming units, and the farm management will be carried out independently in each farm unit except the operation and maintenance of farm machines. For this purpose, four field crops departments will be established, and each department has Agronomic Management Section, Farm Mechanization Section and Labor Management Section. By this way, technical level up in farm practices and management through competitive production by these departments.

It is planned that each farming unit consists of two operation units as follows;

No. 1 Field Crops Department	No. 1 Operation Unit	630 ha
	No. 2 Operation Unit	680 ha
		1,310 ha
No. 2 Field Crops Department	No. 3 Operation Unit	750 ha
	No. 4 Operation Unit	610 ha
		1,360 ha
No. 3 Field Crops Department	No. 5 Operation Unit	950 ha
	No. 6 Operation Unit	820 ha
		1,770 ha
No. 4 Field Crops Department	No. 7 Operation Unit	940 ha
	No. 8 Operation Unit	820 ha
		1,560 ha

The second special characteristics of farm management in this rice farm is that the rotational cropping of paddy, that is the major crop, and wheat, barley, green gram and berseem is adopted taking into account the weed control, economic utilization of farm machinery and labor and increase of soil fertility. Specially, berseem, green feeder crop, suits to the taste of domestic animals, and will contribute to promotion of livestock farming in Al-Kahlaa and neighborhood. At present, the number of cows raised in Al-Kahlaa and Missan is 16,000 and 218,000, respectively.

This rice farm will produce berseem to feed about 10,000 heads of cow. The berseem will be consumed in Amara area. In this connection, it is desirable that a livestock farm will be installed adjoining to the rice farm for effective utilization of feeder crop and cereals to be produced in this rice farm.

The third special characteristic in farm management is that the rice farm will be equipped with a seed propagation field of about 300 ha. A seed field will be installed in the proposed experimental farm in order to obtain high quality seed, and the seed thus obtained will be propagated in the seed propagation field. By this way, the self-sufficient of paddy seed will be attained within the Project.

9. Experimental Farm

There are many subjects to be handled in farm management of this rice farm, mostly due to the following reasons;

- o Technical rice cultivation system in saline soil zone like Missan province has not yet established, and,
- o In order to manage this large-scaled farm by a limited number of officers and laborers, it is prerequisite to mechanize farming as much as possible.

The major subjects of experimentations might be as follows;

i. Methodological tests of paddy sowing to establish the most effective sowing method in order to complete this work in the vast cropping area within the limited optimum sowing season;
ii. Verification of the optimum sowing season in Amara area;
iii. Systematization of mechanized farming and education and training to cope with the mechanized farming;
iv. Tests on prevention, control and fertilizer spraying by aircraft;
v. Establishment of a labor-saving water management system; and
vi. Secure of seeds.

In order to conduct such experimentations and training, the construction of an experimental farm of 20 ha has been planned in the Project, as follows;

o Experimental field:	4.0 ha
o Training field:	2.0
o Seed propagation field:	14.0
Total	20.0 ha

This experimental farm will handle only experimental subjects directly involved in farming in this rice farm, and will not conduct the general experimentations being made by state experimental stations.

Test Items

1. The critical sowing season tests;
2. Farm mechnization tests;
3. Fertilizer application tests;

i. Basal dressing (before plowing) test in dry fields;
   a) 30 days ahead of puddling
   b) 20 days ahead of puddling
   c) 10 days ahead of puddling

ii. Basal dressing (after plowing) tests in dry fields;
   a) 30 days ahead of puddling
   b) 20 days ahead of puddling
   c) 10 days ahead of puddling

iii. Top dressing tests by different seasons;

4. Plant protection tests (herbicide tests);
5. Water management test, mainly on the intermittent irrigation;
6. Coated seeds tests;
7. Other applied-tests; and.
8. Observation:
   i. Water salinity;
   ii. Sowing density;
   iii. Fertilizer response of crops;
   iv. Agricultural chemical efficacy;
   v. Herbicide efficacy;
   vi. Others.

Training Field

This farm will be used for practical rice fariming training during summer seasons, and for machinery operation training during winter seasons. Systematic training on farm machines operation covering all the farm practices but harvesting will be conducted.

Seed Field

In order to attain the self-sufficiency of paddy seed, the seed field of 14 ha will be prepared in this experimental farm. In order to secure paddy seed of 972 tons for the main paddy fields of 5,400 ha, high quality paddy seed of 56 tons will be produced in the seed field of 14 ha in the experimental farm (14 ha x 4 ton/ha = 56 ton), and it is propagated in the propagation fields of 300 ha (300 ha x 3.5 ton/ha = 1,050 ton > 972 ton)

Production Schedule

The experimental farm does not aim to produce agricultural crops.

However, this experimental farm will have the following output of paddy;

1.	Experimental field	4 ha	9.6 ton
2.	Training field	2	4.8
3.	Seed field	14	56.0
	Total		70.4 ton

Note: The intensive farming will be made in this small seed field.

Imput Materials

Imput materials required for this experimental farm are computed, with the allowance of 30 %, as follows;

1.	Seed	4.68 ton
2.	Urea	6.78
3.	T.S.P.	4.52
4.	Stam F-34	260 lit

Equipment and Instrument

The farm machinery required for operation of this experimental farm will be as follows;

1.	Tractor	One unit
2.	Bottom plow	One
3.	Disk-harrow	One
4.	Tooth harrow	One
5.	Rotary	One
6.	Seed drill	One
7.	Broadcaster	One
8.	Trailer (3 ton)	One
9.	Ridger	One set
10.	Combine	One
11.	Power sprayer	Five sets
12.	Motorcycle	Five units
13.	Pick-up	Three units

The experimental instrument and devices required are for;

1. Soil and water analysis
2. Crops measuring (harvested crops)
3. Water requirement measuring (paddy field and upland field)
4. Others

F. Proposed Facilities

1. Pumping Facilities

(a) Irrigation Pump Facilities

Pumping facilities will be needed for irrigation in the Project. The Kahlaa river, a tributary of the Tigris is the sole water source. Based on careful studies on the proposed irrigation and drainage networks and the topography of the Project Area, the pump station site is proposed at the middle of the western Project Area boundary facing to the Kahlaa river. The Project Area has a very gentle slope towards the east, and its shape is long and narrow to that direction . Therefore, the irrigation system with single pumping station is deemed suitable in both the technical and economic aspects.

(b) Drainage Pump Facilities

In order to reform the Project Area into well-drained paddy fields for easy operation of heavy farm machines as well as for facilitate saline soil improvement by leaching, it is planned to equip all farm fields with field drains. Drainage water will be conveyed through field drains to drainage canals and pumped up to Al-Chikka marsh.

The location of this proposed drainage pump station has been decided at the northern end of the present oil company's road for eacy operation and maintenance. The other advantage of this site is its relatively low elevation.

(c) Major Dimensions of Pumps

The major dimensions of irrigation and drainage pumps are as follows;

Description	Irrigation pump	Drainage pump
Type	Vertical mixed flow pump	Vertical mixed flow pump
Bore diameter	ø 1,650 mm	ø 1,350 mm
Unit	Four (4)	Four (4)
Design discharge	360 cu.m/unit/min	210 cu.m/unit/min
Total pump head	5.5 m	2.9 m
Suction water level		
Low water level	4.0 m	2.0 m
High water level	8.0 m	3.0 m

Description	Irrigation pump	Drainage pump
Delivery water level		
Low water level	8.0 m	3.55 m
High water level	10.5 m	4.80 m
Prime mover	Motor	Motor
Power per unit	470 KW	145 KW
Generator	600 KVA	200 KVA

2. Reservoir

The major dimensions of the reservoir are as follows;

Description	Dimension
a. Reservoir	
Total volume	$1{,}400 \times 10^3$ cu.m
Reservoir area	40 ha (500 m x 800 m)
High water level	W.L. 10.5 m
Low water level	W.L. 8.0 m
b. Dam	
Dam type	Homogeneous fill-type
Dam height	4.5 to 5.5 m
Dam crest elevation	E.L. 11.50 m
Free board	1.0 m
Dam length	2,600 m
Embankment slope	
Upstream	1 : 3.5
Downstream	1 : 2.5
Crest width	4.0 m
Volume of dam	
Earth materials	239.0×10^3 cu.m
Gravel	14.5×10^3 cu.m
Filter	6.5×10^3 cu.m
Total	260.0×10^3 cu.m

3. Irrigation Canals

Concrete lining is proposed for all irrigation canals except on-farm irrigation canals (farm ditches) for effective water use, specially for reducing friction losses in canals since it is topographically difficult to secure a sufficient water head for water distribution due to very flat area. The proposed irrigation networks have been planned on the

the topographic map of 1/10,000 in consideration of the present topography and also the proposed farm management system. Specially, attentions were paid to, in planning the irrigation and drainage systems inclusive on-farm water distribution systems, the mechanized farming by heavy farm machines and aircraft.

(a) Classification of Irrigation Canals

The proposed irrigation canals are classificed into main, secondary, tertiary canals and farm ditches. The main irrigation are planned to be given the highest possible effective head in the extremely flat Project Area. The secondary and tertiary canals receive irrigation water from main irrigation canals through diversion boxes, and convey it to division boxes provided on the secondary irrigation canals or turn-outs on the tertiary canals, and farm ditches receive water from a tertiary canal and convey it to farm plots directly. As for the tertiary canals and farm ditches, reference is made in the following paragraph "On-farm Facilities".

All the irrigation canals mentioned above will be constructed along roads for their easy operation and maintenance.

(b) Typical Cross Section

The proposed irrigation canals will be paved with concrete lining with 10 cm thickness, and take a trapezoid shape. The canal side slope will be 1 : 1.5.

(c) Length of Canals

The proposed main and secondary irrigation canals have been designed as follows;

The main irrigation canals (MIC)

	Quantity of discharge	Length
MIC-1:	2.6 cu.m/sec	6,500 m
MIC-2:	8.4	4,200
MIC-3:	13.0	8,900
Total		19,600 m

The secondary irrigation canals (SIC)

SIC 1-1 to 1-4	2.0 cu.m/sec	3,800 m
SIC 2-1 to 2-8	3.3 to 2.0	17,100
SIC 3-1 to 3-11	6.2 to 2.0	19,500
Total		40,400 m

(d) Related Facilities

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 secondary irrigation canals. Some diversion boxes will be provided on secondary irrigation canals, too, where they are needed. The total number of diversion boxes will be 46.

Checks:

Checks will be used to raise water level in irrigation canals. The location of checks is determined based on canal slopes. The necessary check number is three.

Spillways:

Three spillways of the overflow type will be installed on main and secondary irrigation canals for emergent release of surplus water in these canals.

Wastways:

Three wastways will be provided, in the combination with the above-mentioned spillways, in order to drain a total discharge of main and secondary irrigation canals to drainage canals for emergency and maintenance.

Road crossings:

Concrete box culverts will be installed to convey irrigation water across roads.

4. Drainage Canals

Earth canals are proposed for drainage in the Project Area. The excavated soils in construction of drainage canals will be used for embankment of roads to be constructed along such canals.

(a) Classification of Drianage Canals

The proposed drainage canals are classified into main, secondary and tertiary canals and farm drains. The main drainage canal will be located along relatively depressed areas at the central part of the Project Area. It conveys the drainage water to the proposed drainage pump station. Secondary drainage canals will be constructed along the boundary of the Project Area. These drainage canals will collect drainage

waters from tertiary canals and farm drains, and convey it to the main drainage canal. Descriptions on tertiary canals and farm drains are made in the paragraph "On-farm Facilities".

(b) Typical Cross Section

The proposed cross section of drainage canals is a trapezoid in shape, and has the side slope of 1 : 1.5. Drainage canal capacity will be bigger than the capacity actually required for surface water drainage because drainage water through field drains to be provided for subsurface drainage and leaching should be drained, under free flow conditions, without being intercepted by the drainage water in such canals. The proposed depth of field drains at their outlet is two meters below ground surface at minimum. Flood discharge after rains will be, however, allow to flow within the canal capacities.

The excavated materials for canal construction will be used for embankment of roads to be constructed at the both side of such canals.

(c) Length of Canals

The proposed main and secondary drainage canals are as follows;

	Quantity of Discharge	Length
The main drainage canal (MDC)		
MDC	14.2 (6.0) cu.m/sec.	14,600 m
Secondary drainage canals (SDC)		
SDC-1	3.4 (1.6)	16,300
SDC-2	1.4 (0.6)	1,500
SDC-3	2.8 (1.3)	11,900
SDC-4	1.4 (0.6)	8,600
Total		38,300 m

(4) Related Facilities

Road crossings:

Concrete box culverts will be used to convey draiange water across roads.

5. On-farm Facilities

Soils in the Project Area are silty clay loam or silty loam, according to the soil investigation results. Having no restrictive factors, the whole cultivated land of 7,030 ha will be reclaimed in the Project.

The typical layout of on-farm facilities is shown in Figure 1 , by taking up a typical irrigation block. The following table presents the proposed on-farm facilities;

Typical Layout of On-farm Facilities

Description	Total	Per hectare
1) Area		
Gross area	212.0 ha	
Net area	180.0 ha	
Land deduction rate	15.0 %	
2) Major on-farm facilities		
Tertiary irrigation canals	1,704 m	8.0 m/gross area
Tertiary drainage canals	1,704 m	8.0
Farm ditches	6,000 m	28.3
Farm drains	6,000 m	28.3
Service roads	3,408 m	16.1
On-farm roads	12,000 m	56.6
Field drains	36,000 m	169.8
Division box	1	
Turn-outs	5	
Inlets	120	
Checks	10	
Outlets	120	
Road crossings (culverts)	10	

The average intensity of on-farm facilities in this typical irrigation block is as follows;

- o Irrigation canal: 36.3 m/ha
- o Drainage canal: 36.3 m/ha
- o Road 72.7 m/ha

6. Roads

Five types of roads are planned in the Project, namely, (a) main roads (Type A) as trunk roads, (b) service roads (Type B) to be constructed along the main and secondary canals, (c) service roads (Type C) along tertiary canals, (d) on-farm roads (Type D) along farm ditches and (e) on-farm roads (Type E) along farm drains.

The following table gives the major features of these roads;

Proposed Roads

	Type	Width (m)	Length (km)	Remarks
a)	Main road (Type A)	11.0 (9.0) 1/	21.0 2/	Asphalt pavement
b)	Service road (Type B)	9.0 (7.0)	36.0	Base coarse pavement
c)	Service road (Type C)	7.0 (5.0)	113.0	No pavement
d)	On-farm road (Type D)	7.0 (5.0)	398.1	No pavement
e)	On-farm road (Type E)	2.0	358.3	No pavement
	Total		926.4	

Note: 1/ : Parenthesized figures show the effective width of roads.
2/ : The length includes the existing oil company's road to be improved.

The road intensity in the Project is estimated at 113 m/ha.

7. Dike

The proposed site of the dike is situated at lowlying marshy land at the eastern part of the Project Area, and its foundation is considered a weak ground containing organic matters. To cope with such condition, the foundation soils of about one meter in depth will be replaced with soil materials having an adequate soil moisture ratio. Such materials could be obtained within the Project Area.

The proposed top elevation of the dike is 5.8 m above mean sea level. In determination of elevation, due attention was paid to the high water level of Al-Chikka marsh during winter seasons and the elevation of the existing oil company's road. The top width of dike is planned at seven meters, and the surface of the dike will be paved by coarse materials. The slope of dike is 1 : 1.5.

8. Farm Facilities

The required farm facilities to operate and manage the rice farm are as follows;

	Facilities	Floor space	Remarks
a)	Farm store	1,800 sq.m	Fertilizers, seeds, pesticide emergency store
b)	Equipment store	300	Experimental materials and equipment
c)	Workers' rest house	300	Skilled and unskilled workers
d)	Workshop	2,400	Building: 1,200 sq.m Concrete floor: 1,200 sq.m
e)	Agricultural machinery, car and truck garage	11,000	Tractors and their attachments, trucks and combines
f)	Aircraft runway	40,000	

9. Related Project Facilities

For the Project, the following are deemed necessary;

i) Construction of villages and housing for the Project staff and laborers;

ii) Construction of the new Kahlaa bridge crossing the Kahlaa river for transportation of agricultural production, imput materials and for communication in and around the Project Area.

iii) Installation of rice processing facilities to cope with an increased production with the Project and the other area in Missan province.

The detailed description of these related facilities are given below;

a) Construction of villages and housings:

The number of inhabitants:	2,500 persons (officers and skilled laborers)
The number of necessary houses:	About 450
Public facilities:	
o Educational facilities:	Primary school

- o Social welfare facilities: Mosque, clinic, park, post office, etc.
- o Recreation facilities: Theater, tennis court, etc.
- o Water supply and sewerage facilities:

b) Construction of the Kahlaa Bridge

Al-Bahatha locatied at the middle of the western Project Area boundary facing to the river is recommendable as construction site of this bridge.

- o The length of the bridge: 300 m (8 m wide)
- o Access road 400 m (10 m wide)

c) Establishment of the Rice Processing Facilities

Cereal processing facilities such as silo, mill and drying equipment will be needed to cope with an increased production with the Project, that is, paddy of 27,000 tons and wheat of about 1,200 tons. In case that the processing facilities to be established for the Project can have some surplus capacity, rice grown in the southern part of Amara city could be also processed here.

G. Cost Estimate

The total investment cost exclusive of the price escalation during the construction period is estimated at about 21.2 million I.D. (US$ 71.6 million). Out of this amount, 11.7 million I.D. (US$ 39.5 million) fall into the foreign currency portion, and the rest of 9.5 million I.D. (US$ 32.1 million) into the local currency portion. The following table shows the breakdown of this investment cost.

Table 30. Investment Cost of the Project

(Unit: '000 I.D.)

Item	Foreign Currency	Local Currency	Total
1. Civil works	7,130	6,840	13,970
2. Farm facilities	-	900	900
3. Farm machinery and equipment	2,390	-	2,390
4. Operation and maintenance cost	-	210	210
5. Project facilities	300	180	480
6. Project administration	390	330	720
7. Consulting services	420	200	620
Sub-total	10,630	8,660	19,290
8. Contingency (10 %)	1,060	870	1,930
Sub-total	11,690	9,530	21,220
9. Price Escalation (7 %)	3,700	4,280	7,980
Total	15,390	13,810	29,200

The project cost per hectare is computed at 3,540 I.D. (US$ 11,950) by the following ways;

i) The depreciation cost of construction equipment is involved in the unit cost of civil works; and,

ii) The price escalation is not included in this computation.

The cost estimate for each item on the above table is made as follows;

(1) Civil works

This item covers the construction cost for engineering works, construction materials 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 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.

Reservoir:

To include the cost of embankment for the dam body and the cost of spillway gate 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 leveling and construction of on-farm facilities such as tertiary irrigation and drainage canals, service roads of seven meters wide, farm ditches, farm drains, on-farm roads and field drains

Roads:

To include the cost of construction of main and service roads with nine 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 equipment and spare parts will be purchased by the Government in the lump 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 estimating. 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 store, equipment store, workers' rest houses, workshop, machinery garage and aircraft runway, etc.

(4) 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 year 1984 to 1987.

(5) Project Facilities and Project Administration

Project Facilities:

This item covers the required cost for project facilities such as buildings, furniture and equipment

Project Administration:

This item covers the overhead charge for governmental personnel to be assigned to the Project and unskilled laborers to be employed for maintenance of the Project

(6) Consulting Services

This item covers the engineering fee for final design, construction supervision and agricultural farming guidance.

(7) 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, of changes of site conditions and uncertainity of foundation conditions, etc. The adopted rate for this item is ten percent.

(8) Price Escalation

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

(9) 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.

(10) 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 component, whereas the local currency component consists of the costs for labor, operation and maintenance of equipment and local materials.

CHAPTER IV. PROJECT IMPLEMENTATION AND OPERATION AND AMINTENANCE

A. Executing Agency and Coordination

Since this Project is an integrated development scheme having the components of mechanized agriculture, irrigation, roads and housing, the Planning Council should coordinate the Project, and the Ministry of Agriculture and Agrarian Reform should function as the executing body of the Project. In order to assist the Planning Council, the Project Steering Committee shall be organized for smooth Project implementation through good coordination among the related Governmental Organizations and authorities concerned such as the Ministries of Irrigation, Planning, Housing and Construction, Trade, Industry and Oil for obtaining their assistances and cooperations directly or indirectly to the Kahlaa Agricultural Administration (KAA), which shall be newly organized under the Ministry of Agriculture and Agrarian Reform. And the Committee shall give advices and assistances to the Kahlaa Agricultural Administration in execution of the administration related to the Project.

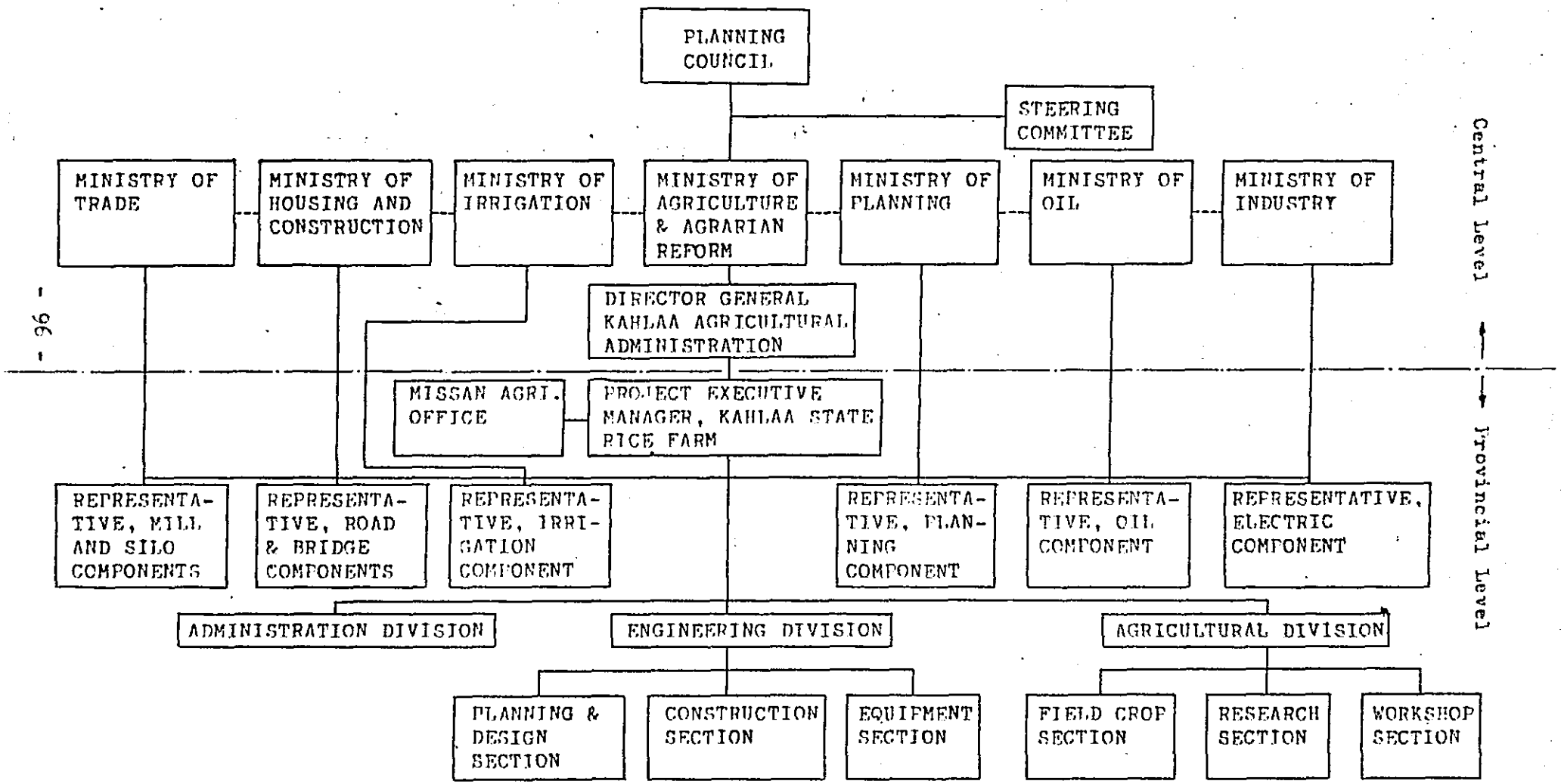
With these oordinations, the Kahlaa Agricultural Administration headed by specifically nominated Director General will be the direct executing body. The Director General is fully responsible in executing the Project works, to coordinate the related Governmental Organizations and to direct the Project Manager to be assigned to carry out, with full responsibility, the works in the job site.

Under the control of the Project Manager, the Administration, Engineering and Agriculture Divisions will be organized. (see Figure 4)

Out of the proposed divisions, the Engineering Divsion will be responsible for planning, programming, design and cost estimate of facilities as well as revisions/amendment dictated by field conditions involved in these works. The Administration Division will be in charge of personnel and record management, accounting, property management, procurement and other services. The agricultural phase of the Project will be handled by the Agriculture Division.

Furthermore, the Project Manager should keep close contact with the Governmental branch offices in Amara so that the Project will be smoothly implemented with their cooperation.

FIGURE 4.: PROPOSED ORGANIZATION CHART FOR PROJECT IMPLEMENTATION



B. Construction

1. Construction Method

There are two ways in executing the Project construction, that is, the force account and contract bases. The contract basis will be adopted for the Project. Consequently, contractors will execute the construction works, and to the contractors the equipment and materials to be imported or purchased by the Government will be supplied.

2. Construction Schedule

The Project Area having the total acreage of 8,160 ha will be divided into eight blocks in the aspect of water and farm management based on the proposed irrigation and drainage systems. The earth works occupy the major part of the Project construction. The seven years of the construction period has been scheduled including the final design in the fiscal year 1981, and the construction of facilities will be started in the fiscal year 1982, and completed in the fiscal year 1987.

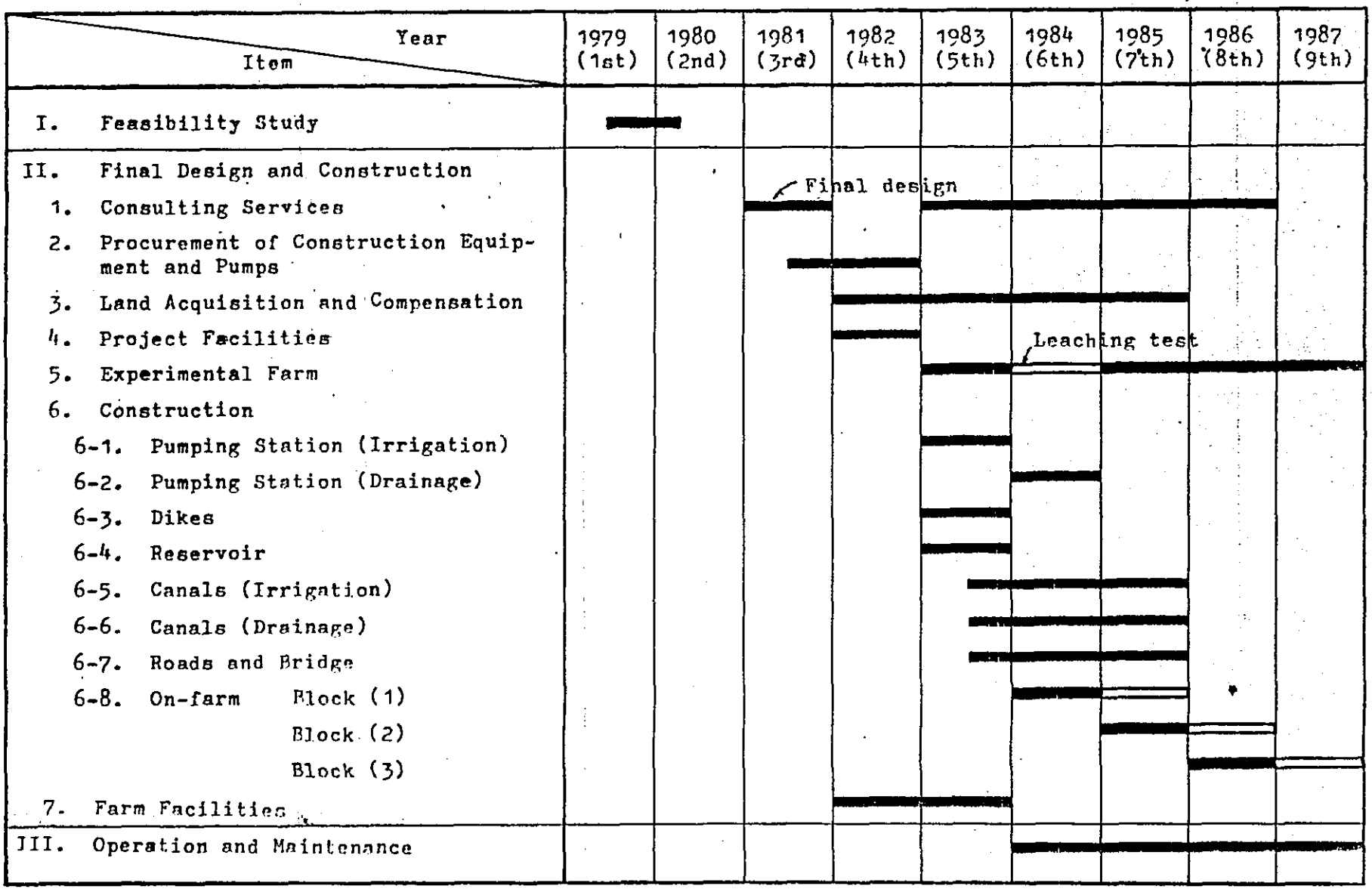
In construction scheduling, the following considerations were made;

- o The major facilities such as pump stations, main and secondary canals, reservoir and dike should be constructed prior to on-farm development; and,
- o The land reclamation for on-farm development shall be completed during the fiscal years of 1984 to 1986.

The reclamation area will be, therefore, 1,310 ha in the fiscal year (FY) 1984, 2,310 ha in the FY 1985 and 2,380 ha in the FY 1986, respectively. After the completion of land reclamation, each construction block will be equipped with on-farm facilities. Leaching will be conducted for one year.

The construction schedule of major civil works is shown in Figure 5. Immediately after the commencement of the civil works for main facilities, the construction of experimental farm shall be started to attain the quick yield of agricultural products as well as to conduct experimentations and trainings required in the Project.

CONSTRUCTION SCHEDULE



C. Operation and Maintenance

The proper operation and maintenance (O/M) of farm machines, equipment and buildings will be one of the most important works in farm management specially for this large-scaled rice farm.

The essential work items involved in the O/M are;

1. To execute appropriate O/M and management of farm machines, equipment and facilities including their timely renovation;
2. To operate carefully machines and facilities for saving repair cost;
3. To allot the O/M cost of machines and facilities to the field crops departments in order to make clear their responsibility in bearing such expenses;
4. To keep clear record on the annual expenditures for O/M; and,
5. To conduct the training of O/M staff for level-up of their techniques.

The O/M cost, after the completion of construction, would be estimated as follows;

Operation:

1. Salaries of management and administration officers inclusive of those in charge of cropping;

   100 I.D. x 10^3

2. Wages of skilled laborers such as mechanics, assistant mechanics, fitters, assistant fitters, drivers and watchmen;

   175 I.D. x 10^3

3. Operation cost of infrastructural facilities including fuel cost;

   107 I.D. x 10^3

Maintenance:

1. Salaries and wages of officers and laborers directly in charge of maintenance;

   9 I.D. x 10^3

2. Maintenance cost of infrastructural facilities including materials cost, etc.;

   87 I.D. x 10^3

3. Maintenance cost of buildings and houses; $20 \text{ I.D.} \times 10^3$

Total $498 \text{ I.D.} \times 10^3$

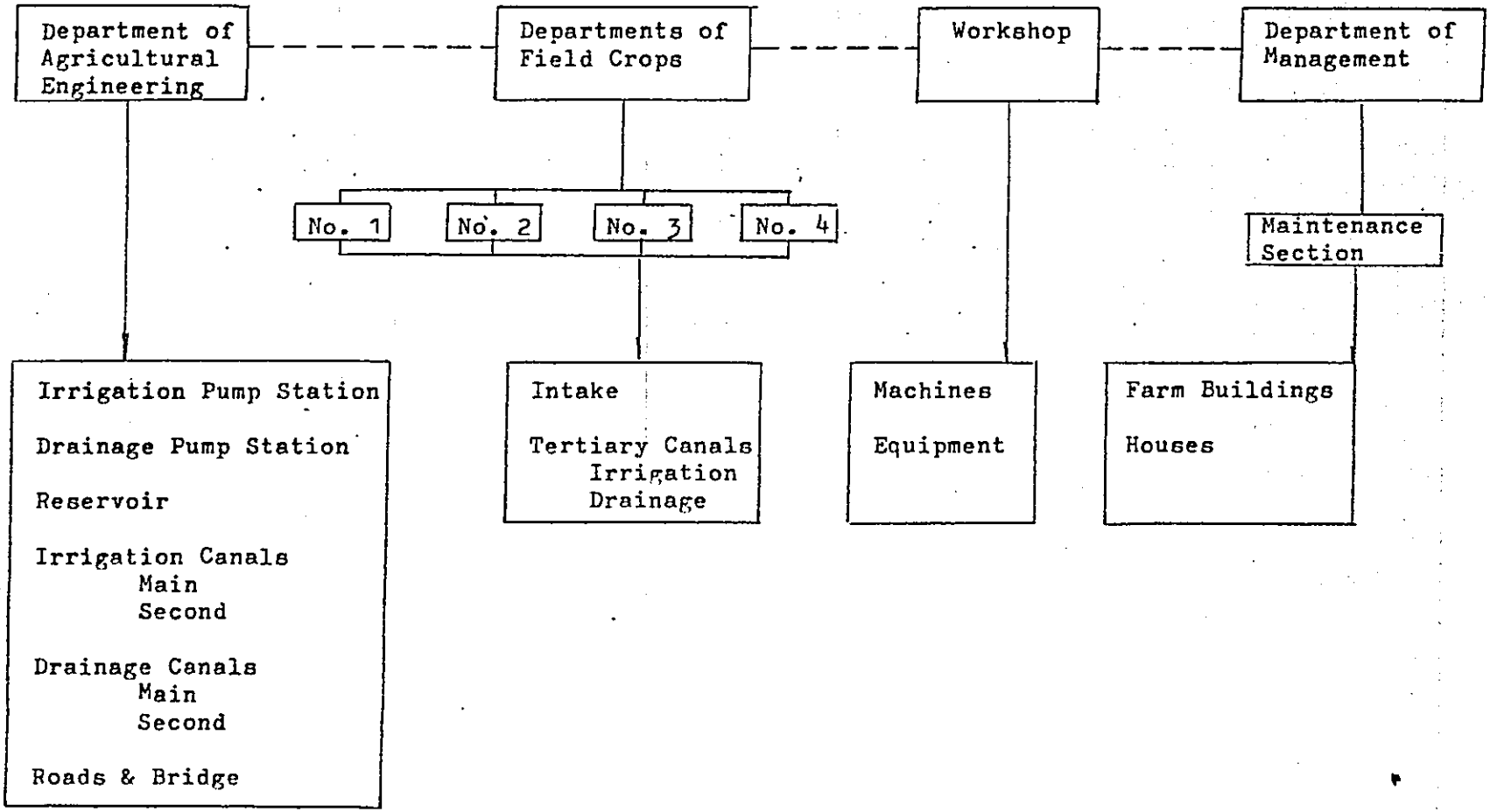
The total O/M cost excluding the salaries and wages in the categorized item of "operation" is as follows;

$$498 \text{ I.D.} \times 10^3 - 275 \text{ I.D.} \times 10^3 = 223 \text{ I.D.} \times 10^3$$

Therefore, the O/M cost per hectare is computed at 37.2 I.D., which is equivalent to US$ 125.

Figure 6 indicates the proposed Organization Chart for operation and maintenance of the Project.

Figure 6. Organization for Operation and Maintenance



CHAPTER V. PROJECT ECONOMIC EVALUATION

A. General

This Project has been taken up to fill the national economic needs to establish a large-scaled state rice farm, to extend a large-scaled-rice-cultivation technics and to increase the paddy rice production, a staple food in Iraq.

In general, project should be planned to obtain the maximum benefit with the minimum investment, or with an economical project cost. The Project should be evaluated based on its contribution extent to the national economy.

B. Method of Economic Evaluation

The measurable economic benefits and costs are expressed in monetary terms, and both streams of benefit and cost, in annual form, over an evaluation period are converted to the present values, respectively. Under the prevailing evaluation standards, a fifty-year limit of evaluation period might be well justifiable. The internal rate of return (IRR) is used as the main indicator in economic evaluation of projects. The project evaluation deals with incremental benefits and costs to clarify a difference between the "with the project" case and the "without the project" case.

C. Economic Evaluation

1. Economic Evaluation of Commodities and Labor Prices

The traded goods to be re-evaluated from the domestic price to the shadow price are rice and wheat. The foreign exchange rate of one Iraqi Dinar equal to 3.377778 US Dollars is applied as official rate.

Judging from the recent balance of demand and supply of rice, Iraq would be an importer of rice in future, too. Table 31 shows the estimated balance these days. On the assumption that the annual growth rate of population and annual consumption per person are 2.8 % and 25 kg, the demand of rice in 1985 is computed at about 366,000 tons. This rice is converted to paddy of about 610,000 tons. Assuming, again, that the unit yield of paddy is 3.5 ton per hectare or 4.0 ton per hectare, the cropping area necessary to produce such quantity of paddy is 179,000 ha or 152,000 ha.

Table 31. Demand and Supply Balance of Rice

Year	Supply of Rice: Cropped Area (10^3 ha)	Supply of Rice: Paddy Yield (ton/ha)	Supply of Rice: Paddy Volume (10^3 ton)	Supply of Rice: Rice Volume (10^3 ton)	Estimated Demand: Population (10^3 person)	Estimated Demand: Per Capita Rice Consumption 25kg (10^3 ton)	Estimated Demand: Per Capita Rice Consumption 20kg (10^3 ton)	Estimated Demand: Per Capita Rice Consumption 15kg (10^3 ton)	Balance: Per Capita Rice Consumption 25kg (10^3 ton)	Balance: Per Capita Rice Consumption 20kg (10^3 ton)	Balance: Per Capita Rice Consumption 15kg (10^3 ton)	Imported Rice (Statistics) (10^3 ton)
1971	109.1	2.817	307	169	9,750	244	195	146	- 75	- 26	23	97
1972	94.1	2.848	268	147	10,070	252	201	151	- 105	- 54	4	33
1973	64.0	2.448	157	86	10,410	260	208	156	- 174	- 122	- 70	16
1974	31.4	2.204	69	38	10,760	269	215	161	- 231	- 177	- 123	198
1975	30.0	2.024	61	34	11,120	278	222	167	- 244	- 188	- 133	120
1976	52.4	3.116	163	90	11,430	286	229	171	- 196	- 139	- 81	na
1977	63.5	3.156	199	109	11,750	294	235	176	- 185	- 126	- 67	na

If one of the cropped area and yield per hectare is smaller than the above-mentioned figures, the import of rice will be still necessary.

The farm gate price of paddy may be evaluated at the export price of Thai 25 to 35 % borken rice, F.O.B., Bangkok, forcast by the World Bank, that is, 258 US$/ton in 1979 and 315 US$/ton in 1985. As indicated in the following table, the financial farm gate price of paddy (domestic price) is higher than the economic farm gate price (shadow price).

Table 32. Paddy Rice Price Structure, 1979 and 1985

(Unit: I.D./ton)

	Description	1979	1985
1)	Export price of Thai 25 to 30 % broken rice, F.O.B., Bangkok	75 1/	95 2/
2)	Price of rice, Basra	90	115
3)	Price of milled rice, Project Area	85	110
4)	Paddy equivalent price, Project Area	50	70
5)	Farm gate price of paddy	50	70
	Financial farm gate price (Amber, the second class)	(85)	(85)

Note: 1/ : equivalent to 258 US$
2/ : equivalent to 315 US$

Iraq imported wheat of 672,000 tons in 1974 and 512,000 tons in 1975. These quantities correnspond to about 50 % and 60 % of the total domestic production. The annual production of wheat in Iraq is not stabilized as seen in the production down in every other year. The major reasons of it might be the shortage of irrigation water, low yield per unit area and saline soils. If the yield of wheat per hectare increases from 0.8 tons at present to about 1.5 tons in 1985, Iraq needs no more imported wheat even if the cropping area of 1,400,000 ha in 1975 is not expanded. In consideration of this balance, wheat has been dealt as the traded good.

The following table shows the price structure of wheat in 1979 and 1985. The estimation procedure is just the same as mentioned for paddy.

Table 33. Wheat Price Structure in 1979 and 1985

(Unit: I.D./ton)

Description	1979	1985
1) Export price of Canadian No. 1 Western Red Spring	60 1/	60 2/
2) Price of wheat, Basra	75	80
3) Farm gate wheat price	65	70
4) Financial farm gate price (Saber beh)	(51)	(51)

Note: 1/ : equivalent to US$ 200.
2/ : equivalent to US$ 206.

The economic farm gate price is higher than the financial farm gate price (domestic price). This means that the Government has subsidized to that extent in the wheat price system.

Barley, berseem, green garm, fertilizers and agricultural chemicals have been evaluated by means of applying the domestic prices. Fertilizers are mostly produced in Basra area in Iraq. Iraq has a sufficient production capacity of N and P_2O_5 fertilizers. Reportedly, one-third of the fertilizer production in this country has been domestically consumed, and the rest of two-third is exported to the other Arabic countries. The agricultural chemicals in Iraq are subsidized. Therefore, the shadow price of them is used in the economic evaluation. The price of berseem has been estimated to cover the production cost and obtain a benefit at the same net income rate of the other crops.

The Governmental farm labor wage rate is 1.0 I.D. The real price of unskilled labor should be interpreted.

One farm family might live on their head's earning, that is, 1.0 I.D. The farm management survey in the Project Area revealed that the farm income per person per day is about 200 fils. So, the farm income of six family is calculated at 1.2 I.D. per day. On the other hand, the theoretical living cost per person per day is estimated at 280 fils. Then, the living cost of six family amount to 1.7 I.D.

The shadow rate of the above-mentioned official wage of 1.0 I.D. could be stimated in the range of 1.2 to 1.7 I.D. at present.

Since the personal income increases in future, the shadow price of unskilled labor will also get high. On the assumption that the annual growth rate of personal income is 10 % during the period of 1979 to 1985, the shadow wage rate would increase to 2.0 or 3.0 I.D.

2. Evaluation of Benefit

The incremental benefit should be estimated in the economic evaluation. The following table shows the cropped areas in the summer of 1977 and in the winter of 1977/78.

. Cropped Area at Present

(Unit: ha)

Summer Crops		Winter Crops	
Crop	Area	Crop	Area
Paddy	38	Wheat	750
Sorghum	225	Barley	1,000
Vegetables	14	Broad Beans	125
(Sub-total)	(277)		(1,875)
	Total	2,152 ha	

In this study, the cropped areas and yields mentioned in the above-table have been assumed to continue in future, too, for convenience.

The actual benefited area should be decided based on the proposed construction schedule. According to the proposed construction schedule, on-farm development of 6,000 ha will be executed in three-year period. The full benefit would be attained in the sixth year after the commencement of cultivation. Since it is scheduled to start the construction in 1981, the full benefit will be attained in the 11th year of 1991.

Table 34 indicates the cropped area by crops during the period of 1986 to 1991 in case of the "with the Project."

The production cost of crops has been estimated based on imput material prices such as seeds, fertilizers and chemicals, etc. The operation cost items of machines consist of fuel, repair, depreciation and driver costs. This machinery cost is counted, in general, in the benefit flow, and the purchasing cost of farm machines is not counted in the cost flow. In this study, the depreciation cost is, however,

not counted in the production cost.

Table 34 . Cropped Area in case of "With the Project"

(Unit: ha)

Crop	1986	1987	1988	1989	1990	1991
Paddy	1,180	3,250	5,400	5,400	5,400	5,400
Green gram	130	370	600	600	600	600
(Summer, total)	1,310	3,620	6,000	6,000	6,000	6,000
Wheat	90	240	400	400	400	400
Barley	45	120	200	200	200	200
Berseem	270	730	1,200	1,200	1,200	1,200
(Winter, total)	405	1,090	1,800	1,800	1,800	1,800
Total	1,715	4,710	7,800	7,800	7,800	7,800
Gross production (ton)	10,848	30,331	51,849	55,714	58,571	59,861

The unskilled labor cost has been counted in the production cost by applying the shadow price. The salaries of administration officers and skilled laborers have been counted in the cost flow. The following table shows the annual incremental net production value.

Table 35 . Incremental Net Production Value (Paddy Target Yield 5 ton)

(Unit: '000 I.D.)

Item	1986 */	1987	1988	1989	1990	1991
With the Project						
Gross Production Value	300	900	1,660	2,010	2,260	2,370
Production Cost	57	170	295	314	328	336
Net Production Value	243	730	1,365	1,696	1,932	2,034
Without the Project						
Gross Production Value	134	134	134	134	134	134
Production Cost	43	43	43	43	43	43
Net Production Value	91	91	91	91	91	91
Incremental Net Production Value 1/	152	639	1,274	1,605	1,841	1,943
Unskilled Labor Cost	20	55	90	90	90	90
Incremental Net Production Value	132	584	1,184	1,515	1,751	1,853

Note: */ : The first cultivation year

3. Evaluation of Project Cost

The cost flows are categorized into the Project cost, operation and maintenance cost and replacement cost. The Project cost consists of the cost items of civil works, facilities, machinery and equipment, project administration and consulting services. The civil works include all works items required for civil works. The construction cost does not include the interest during the construction period. The land acquisition cost is not considered because this Project aims to develop a state rice farm. The escalation factor of seven percent has been applied in the Project cost evaluation based on the price index of construction materials and labor wages in recent year. The depreciation cost of construction machines was computed based on operation hours, and then, re-estimated economically. The unskilled labor cost has been re-evaluated by applying the shadow wage rate.

The operation costs have been estimated based on officer's salaries and skilled laborer's wages as well as the other costs required for operation of irrigation and drainage facilities, etc.

The maintenance costs have been estimated based on salaries and wages as well as the other costs required for maintenance of irrigation and drainage facilities, buildings and houses.

Some officers and skilled laborers will be mobilized to this rice farm from existing organizations, etc. Therefore, salaries and wages of such persons are not regarded as an incremental cost in the view point of the national economy.

The replacement cost has been estimated for farm machines and maintenance equipment. The following table shows the cost flow;

Table 36. Project Economic Cost

(Unit: '000 I.D.)

Item	1981	1982	1983	1984	1985	1986	1987	Total
Project cost								
Financial cost	230	1,090	4,370	4,980	5,180	4,250	890	20,990
Ecnomic cost	230	1,060	3,970	4,590	4,930	1,180	1,440	20,360
O & M cost	1	2	2	59	119	197	279	
Replacement cost								
	1992	1995/98	2002	2006/09	2012	2016/2020	2024	2027/30
	20	2,070	20	2,370	20	2,270	20	1,380

4. Economic Internal Rate of Return

The present worth values of the economic cost and benefit shown in the above table have been estimated with the discount rates of 3 %, 3 %, 8 % and 10 %. The following table indicates the present worth values thus estimated and the economic internal rate of return.

Table 37. Economic Internal Rate of Return

Discount Rate	3 %	5 %	8 %	10 %
Benefit I.D. x 10^6	35.84	22.78	12.84	9.26
Cost I.D. x 10^6	27.61	22.50	18.00	15.95
B/C	1.30	1.01	0.71	0.58
Economic Internal Rate of Return: 5.3 %				

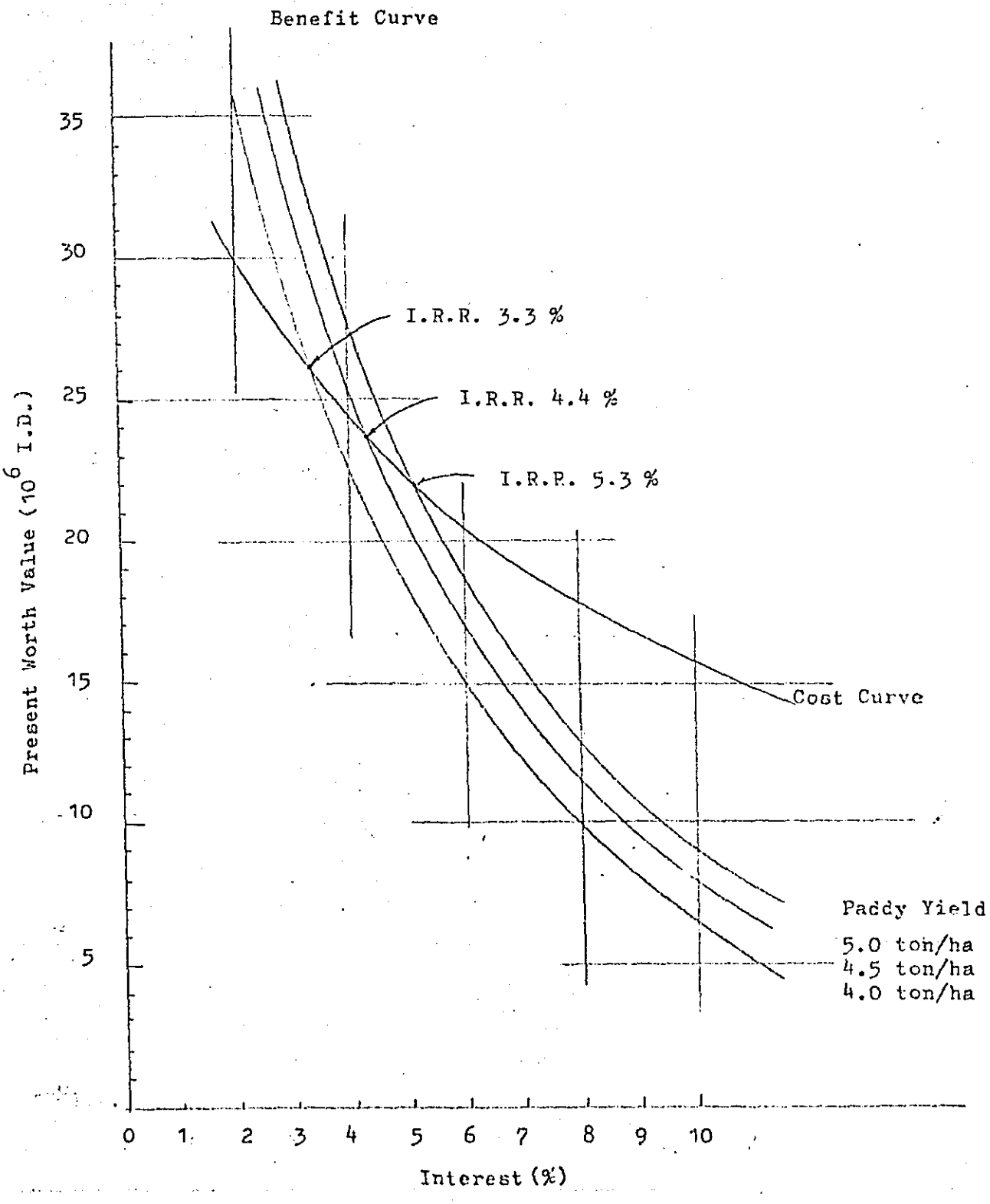
When internation financing agencies such as the World Bank and Asian Development Bank loan to a project in the south east Asian developing countries, they apply the appraisal standard of the economic internal rate of return ranging in 12 to 14 % with the cost-benefit ratio of 1 or less. It means that, if the cost-benefit ratio of that project is more than 1, the loan with an interest rate of 12 to 14 % is already risky for such financing agencies. In this point of view, the economic internal rate of return of this Project (5.3 %) is too low to obtain a loan from financing agencies.

But Iraq has rich oil dollar, and does not need loans to the Project from outside. Under the situations, it is not economically rational to apply the internal rate of return of such high percent as mentioned above to this Project.

The appraisal standard of the Ministry of Irrigation in investment is the cost-benefit ratio with the interest of 5.0 %. Therefore, this Project is feasible under the prevailing domestic appraisal standard on the premise that the rice farm can produce paddy of 5.0 ton per hectare (1.25 ton per donum).

In case that the rice farm cannot attain the paddy yield of 5.0 ton per hectare, for instance, the yield of 4.5 ton per hectare will lower the internal rate of return to 4.4 %, and that of 4.0 ton per hectare to 3.3 %. The Figure 7 shows the relation between production and internal rate of return.

Figure 7. Economic Internal Rate of Return



In this economic evaluation, the rice processing center (silo and mill) is not taken into consideration in computation of the Project cost since data on ex-mill prices and operation and management cost are not available in spite that this cost should be included from the view point of national economy.

5. Financial Aspects

This rice farm requires for its establishment the capital investment of 20,990 thousand of Iraqi Dinar exclusive of the price escalation but inclusive of the contingency of 10 %.

The farm economy in the full benefit stage will be as follows;

Table 38. State Farm Economy in the Full Benefit Stage

(Unit: '000 I.D.)

Items	Value
Gross farm income	2,695
Production cost	
Imput materials	287
Operation cost of machines	270 1/
Salaries and wages	341
O & M cost for facilities and buildings	223
Sub-total	1,121
Net farm income	1,574

Note: 1/ : The operation cost of machines includes their depreciation cost.

The annual net farm income of 1,574 thousand Iraqi Dinar corresponds to the return of 7.5 % to the capital investment.

It is expected that this rice farm will be operated as a commercial enterprise with the self-financing account operation. The profit accrued should, therefore, cover the following requirements.

i. Re-investment for development of further profitability and efficiency improvement of the farm;
ii. Replacement of farm machinery and equipment;
iii. Repayment of a part of the capital cost to be recovered;
iv. Payment of some charges like cooperation tax, etc.; and,
v. Payment of bonus or higherwages to stimulate laborers' willingness for production.

The analysis of annual net cash balance is shown in Table 40. The negative balance will continue until the seventh year, and from the eighth year, the balance will convert to be positive with the annual net farm income of 1,769 thousand Iraqi Dinar. However, in order to let the accumulation balance convert from the negative to the positive, it takes 19 years even if the interest is not taken into account. The figures in Table 40 have been estimated on the assumption that the all capital expenditure inclusive of that for civil works (13,970 thousand Iraqi Dinar) but exclusive of the contingency will be recovered by this rice farm itself. On the assumption that the on-farm cost of 6,190 thousand Iraqi Dinar and other capital are recovered by this rice farm, the accumulation balance will convert to the positive in the 15th year.

The financial internal rate of return is estimated as follows;

Table 39. Financial Internal Rate of Return

Discount Rate	5 %	10 %	15 %
o In case that the total capital cost is recovered by the rice farm			
Inflow I.D. x 10^6	33.6	13.7	6.8
Outflow I.D. x 10^6	28.3	18.3	13.6
B/C	1.19	0.75	0.5
Finacial internal rate of return		6.6 %	
o In case that on-farm works and the other capital costs are recovered by the rice farm			
Inflow I.D. x 10^6	33.6	13.7	6.8
Outflow I.D. x 10^6	22.3	13.3	9.6
B/C	1.50	1.03	0.73
Financial internal rate of return		10.1 %	

Table 40. Rice State Farm Financial Projections

(Constant 1979 Prices in '000 I.D.)

- In case that the total cost of civil works is recovered by the rice farm -

Project Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Outflow																			
(1) Capital Expenditure																			
Civil Works	—	—	2,320	3830	4,000	2,820	—	—	—	—	—	—	—			—	—	—	—
Machinery & Equipment	—	—	—	420	430	760	790	—	—	—	—	—	—			—	—	—	—
Housing & Buildings	—	930	450	—	—	—	—	—	—	—	—	—	—						
Project Administration	—	40	160	180	180	140	20	—	—	—	—	—	—						
Consulting Services	210	40	40	100	100	150	—	—	—	—	—	—	—						
Contingency (10 %)	20	100	400	450	470	390	80	—	—	—	—	—	—						
Sub-total(A)	230	1,020	3870	4530	4710	4250	880	—	—	—	—	—	—						
(2) Operation Expenditure																			
Salaries & Wages 1/	12	15	16	32	64	146	239	341	341	341	341	341	341			[illegible]	[illegible]	[illegible]	
Machinery Operation Cost 2/	—	—	—	—	—	17	43	75	75	75	75	75	75			[illegible]	[illegible]		
Infrastructure & Facilities	—	—	—	26	52	80	107	107	107	107	107	107	107			[illegible]	[illegible]		
Sub-total(B)	12	15	16	58	116	243	389	523	523	523	523	523	523				[illegible]	[illegible]	
(3) Maintenance Expenditure																			
Salaries & Wages	—	—	—	3	7	9	9	9	9	9	9	9	9			[illegible]	9	9	[illegible]
Infrastructure & Facilities	—	—	—	22	44	65	87	87	87	87	87	87	87	[illegible]	[illegible]	87	87	87	87
Housing & Buildings	—	—	—	5	10	15	20	20	20	20	20	20	20	20	20	20	20	20	20
Sub-total (C)	—	—	—	30	61	89	116	116	116	116	116	116	116	116	116	116	116	116	116
(4) Farm Production Cost (D) 3/	—	—	—	—	—	45	143	245	264	279	287	287	287	287	287	287	287	287	287
(5) Total Outflow (E) (A + B + C + D)	242	1105	3886	4618	4887	4,627	1538	884	903	918	926	926	926	926	926	926	926	926	926
Inflow																			
Gross Income of Crops (F)	—	—	—	—	—	324	898	1,855	2,272	2,558	2,695	2,695	2,695	2,695	2,695	2,695	2,695	2,695	2,695
(6) Net Cash Balance (F - E)	(242)	(1,105)	(3886)	(4,618)	(4887)	(4,303)	(560)	971	1,368	1,640	1,769	1,769	1,769	1,769	1,769	1,769	1,769	1,769	1,769
(7) Accumulation Balance	(242)	(1,347)	(5,333)	(9,951)	(14,838)	(19,141)	(19,681)	(18,710)	(17,341)	(15,701)	(13,932)	(12,163)	(10,394)	(8,625)	(6,856)	(5,087)	(3,318)	(1,549)	220

Note: 1/ Wages are those for skilled and unskilled laborers.

2/ This cost does not include the depreciation cost because of the cash flow.

3/ This cost consists of imput materials costs.