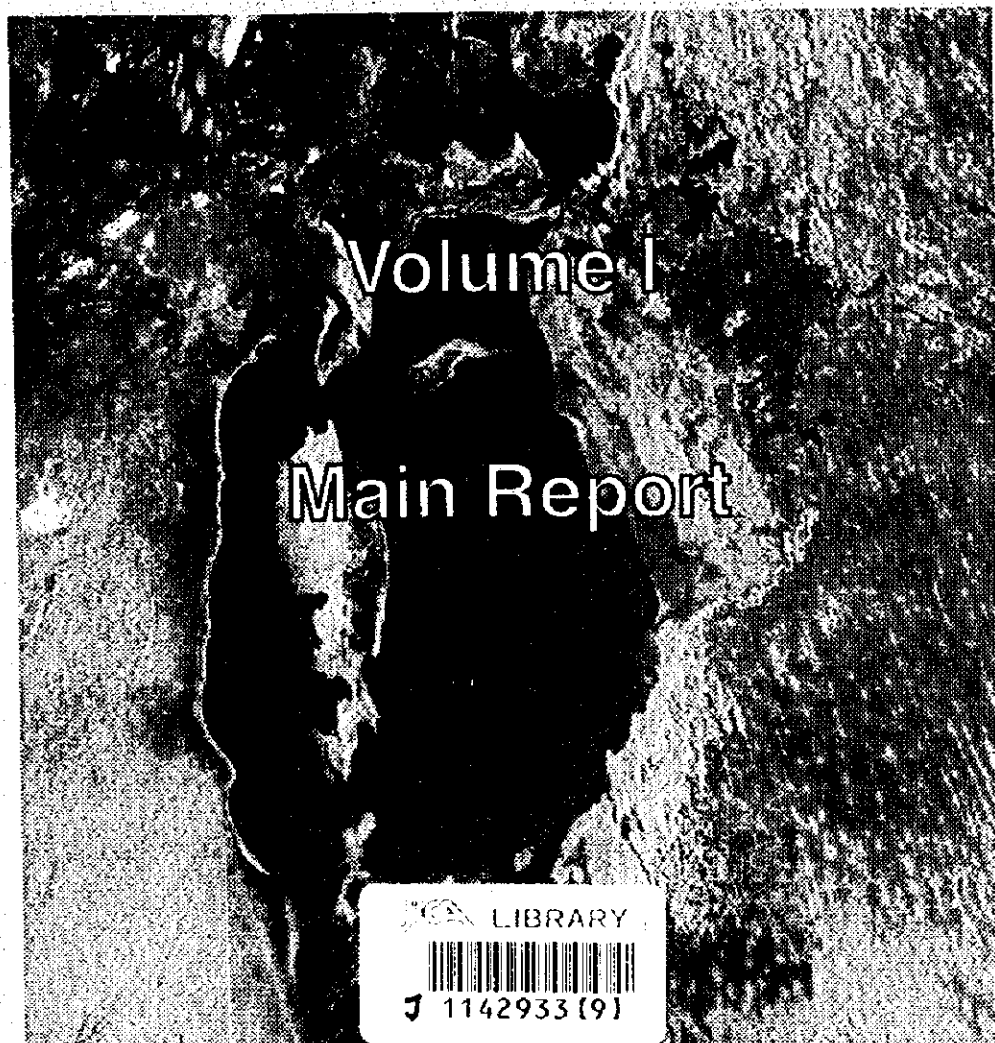


Japan International Cooperation Agency (JICA)

Ministry of Agriculture
Government of Kazakstan

THE STUDY
ON
KZYL-ORDA IRRIGATION/DRAINAGE AND WATER MANAGEMENT PROJECT
IN
THE REPUBLIC OF KAZAKSTAN



March 1998

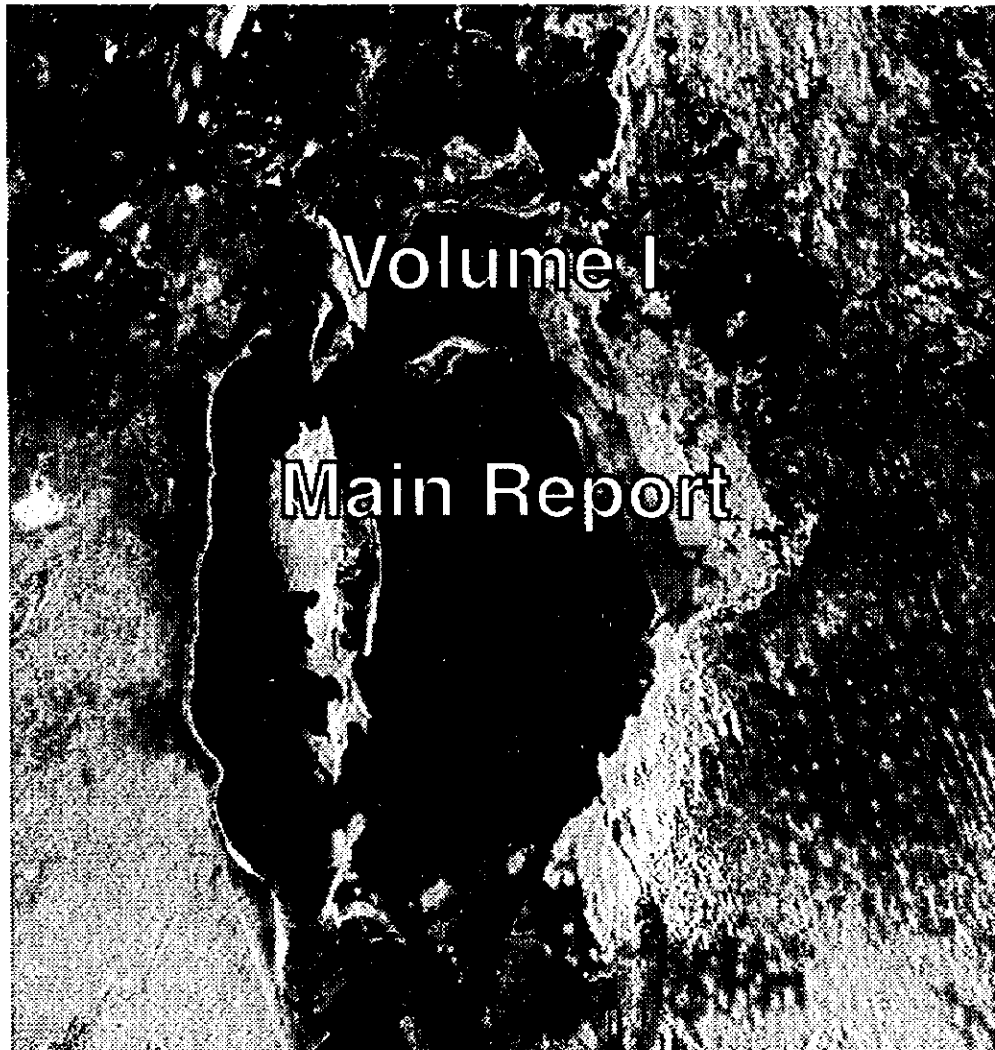
Nippon Koei Co., Ltd.
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Aero Asahi Corporation

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Japan International Cooperation Agency (JICA)

**Ministry of Agriculture
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ON
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THE REPUBLIC OF KAZAKSTAN**



March 1998

**Nippon Koei Co., Ltd.
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List of Reports

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Volume-II Annexes

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Exchange Rate

US\$ 1 = T. 68.0 = J. Yen 110.0 (As of October 1996)
US\$ 1 = T. 75.0 = J. Yen 115.0 (As of August 1997)



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PREFACE

In response to a request from the Government of the Republic of Kazakhstan, the Government of Japan decided to conduct a development study on Kзыł-Orda Irrigation/Drainage and Water Management Project and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the Republic of Kazakhstan a study team headed by Mr. Toshihiro Tomita, Nippon Koei Co.,Ltd., Japan, three times between August 1996 and December 1997.

The team held a series of discussions with the officials concerned of the Government of Kazakhstan, and conducted field surveys at the study area. After the study team returned to Japan, further studies were made and the present study report was prepared.

I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Kazakhstan for their close cooperation extended to the study team.

March, 1998



Kimio FUJITA

President

Japan International Cooperation Agency

March 1998

Mr. Kimio Fujita
The President of
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

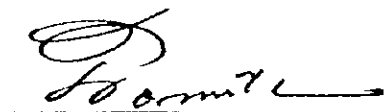
We have the pleasure of submitting herewith the study report on the Kzyl-Orda Irrigation/Drainage and Water Management Project in the Republic of Kazakstan, in accordance with the terms of reference issued by your Agency.

This study was carried out for a total period of 17 months from August 1996 to December 1997. The Project was basically formulated with the principal aim of the increase of agricultural production and the improvement of farmers' living standards in the Project Area through: (i) agricultural development; (ii) rehabilitation and improvement of irrigation and drainage system; (iii) development of rural infrastructure; (iv) improvement of water management and O&M system; (v) improvement of agricultural support services; and (vi) development of farmers' organizations.

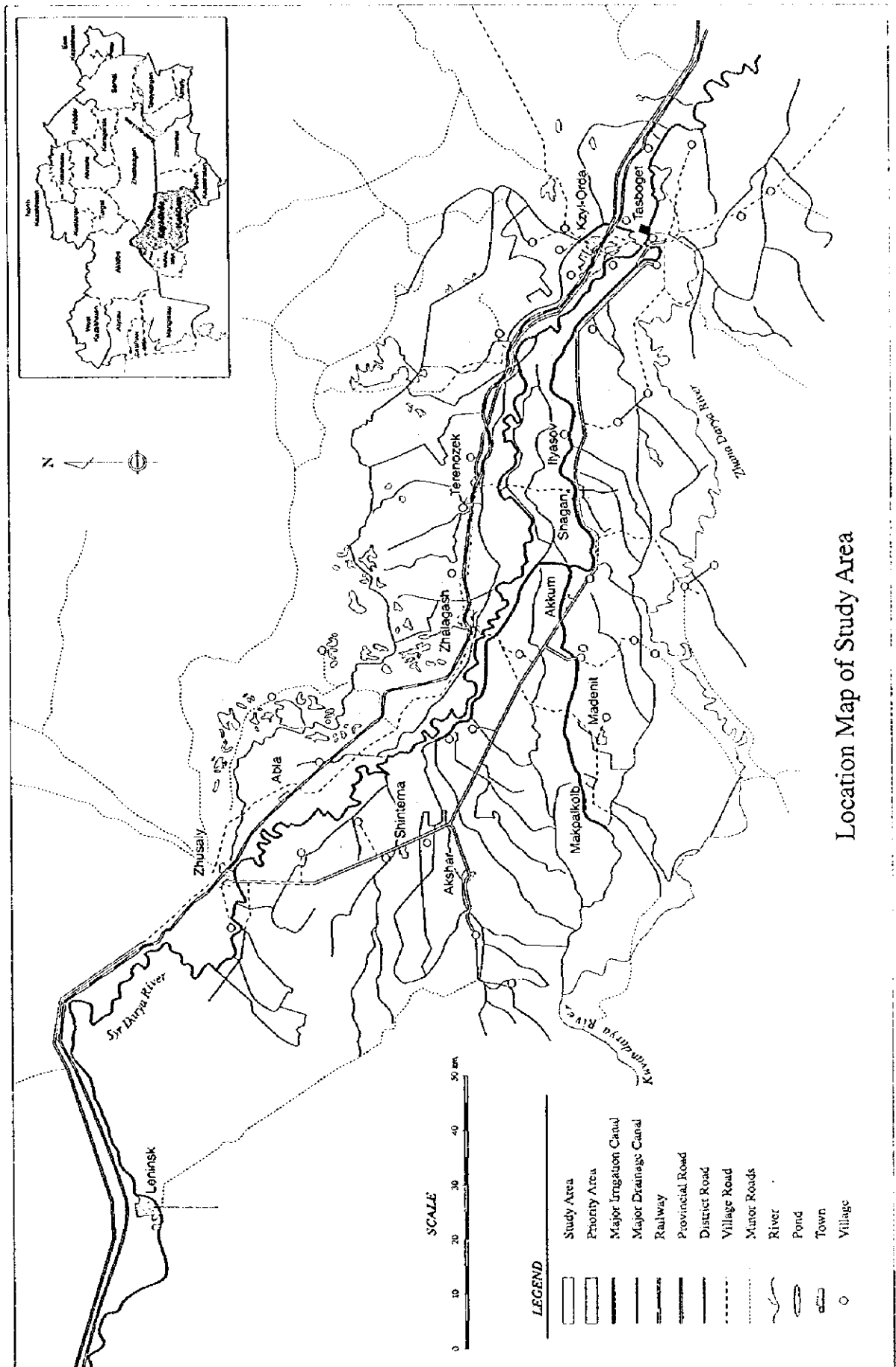
The Project is judged to be technically sound, economically feasible and financially viable. After implementation of the Project, the increase in the agricultural production would substantially contribute to the regional economy as well as the enhancement of living standard of the people in the Project Area. Moreover, the Project would also greatly contribute to the improvement of environmental conditions in the lower basin of the Syr Darya river including Aral Sea, because the river discharge will largely increase through the irrigation water saving to be realized through the project implementation. Therefore, we would like to recommend that the Project soon be implemented in line with the conclusion presented in this report.

We wish to express our deep appreciation and gratitude to the personnel concerned of your Agency, the Embassy of Japan and the Authorities concerned of the Government of Kazakstan for the courtesies and cooperation extended to us during our field survey and study.

Very truly yours,

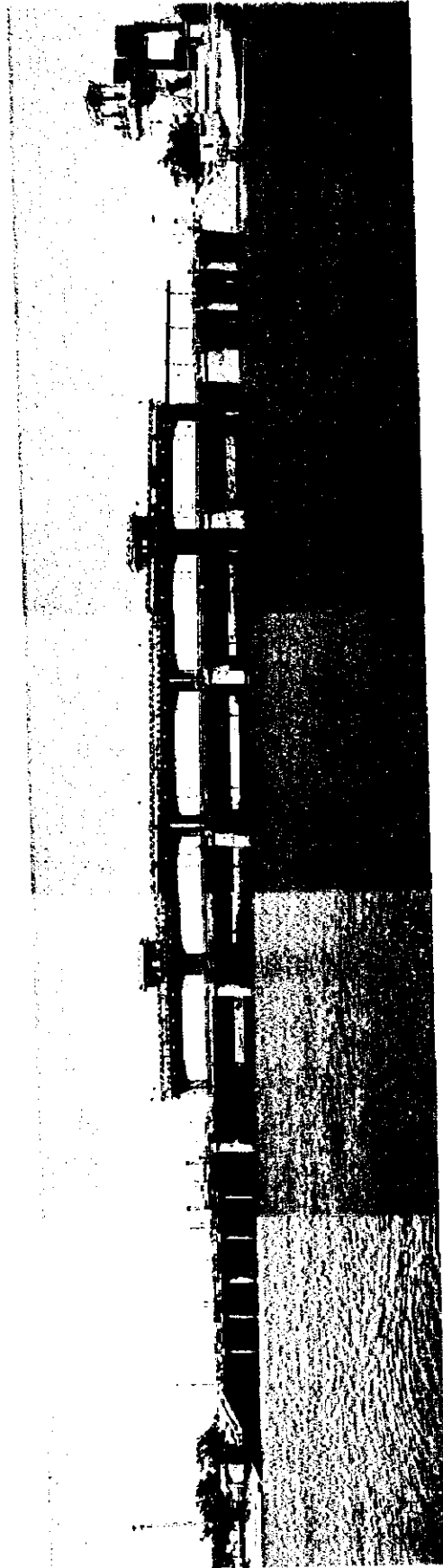


Toshihiro Tomita
Leader of Study Team for
the Kzyl-Orda Irrigation/Drainage
and Water Management Project



Location Map of Study Area

Photographs of the Project Area

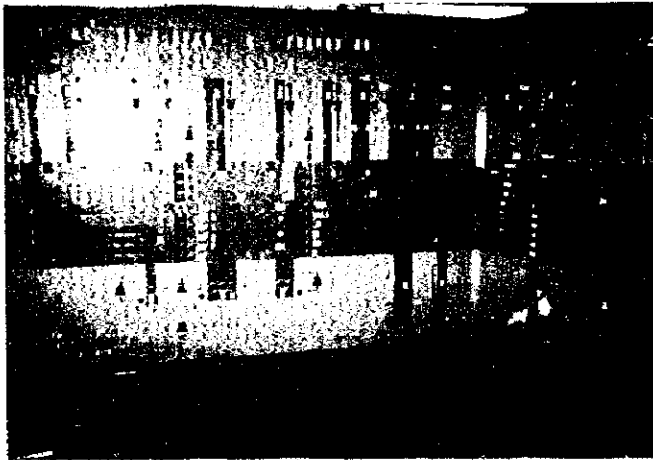


Upstream View of Kzyl-Orda Headworks

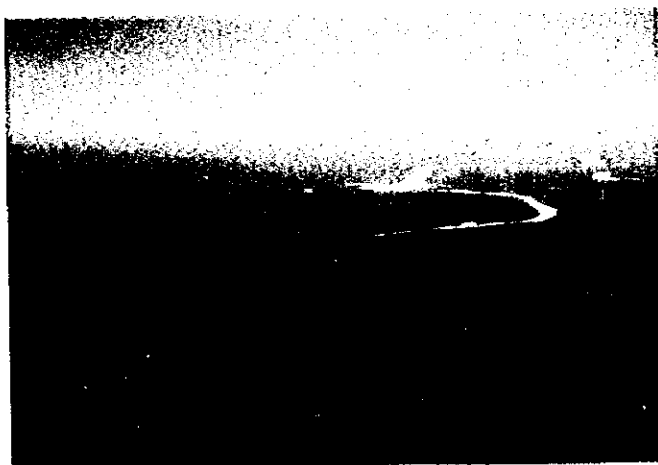
Photographs of the Project Area



Downstream View of
Chardra Dam and
Irrigation Outlet

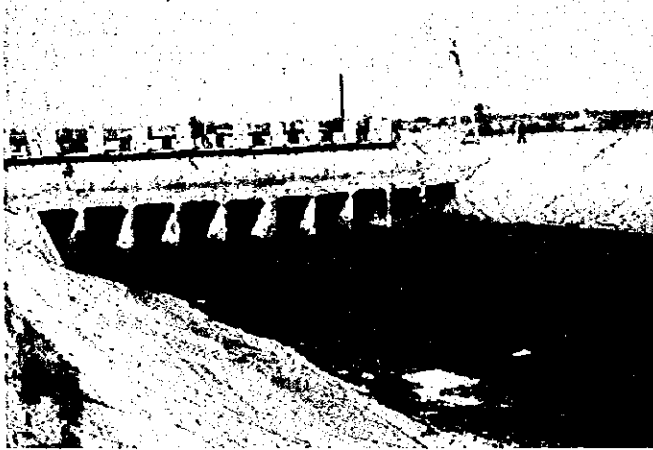


Control Panel for
Kzyl-Orda Headworks



Head Reach of
Left Main Canal

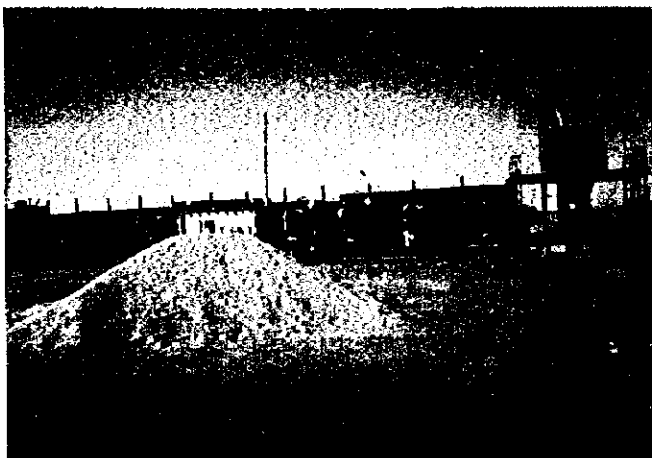
Photographs of the Project Area



Check Gate on Left
Main Canal



Growing Conditions
of Paddy in the
Project Area



Dry Yard of Rice in
Shagan Production
Cooperative

Photographs of the Project Area



South Main Collector



**The Syr Darya River in
Kzyl-Orda Oblast**



**Aral Sea and
Abandoned Ship**

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

PART - I GENERAL BACKGROUND OF THE PROJECT

Introduction

Authorities

- (01) This report is prepared in accordance with Clause VI-2 of the Scope of Work (S/W) for the Study on the Kzyl-Orda Irrigation/Drainage and Water Management Project (the Study) agreed upon between the Government of the Republic of Kazakstan and the Japan International Cooperation Agency (JICA) on March 12, 1996.
- (02) This report compiles the results of the survey and study conducted by the JICA Study Team in both Phase-I and II Study periods. The report is composed of three parts, i.e., Part-I, Part-II and Part-III. Part-I describes the general background of the Project. Part-II presents the master plan for agricultural development in the Kzyl-Orda Left Bank Area, which was established based on the data and information collected in the Phase-I Study Period. While, Part-III describes the results of the feasibility study of the priority project, which was made mainly on the basis of the data and information collected in the Phase-II Study Period.

Background of the Project

- (03) The Kzyl-Orda Irrigation/Drainage Project was taken up in the 1940's mainly for paddy cultivation and completed in the 1960's. The water source for the Project is the Syr Darya river which is an important water source for Aral Sea. After completion of this project, about 87,000 hectares of paddy field has been opened up and become the rice granary of the country producing 70% of total production of the country. Recently, however, rice production is decreasing because of deterioration of irrigation facilities, salinization and inundation problems, unfavorable water management, worn-out agricultural machinery, less use of agricultural chemicals and fertilizers, and less institutional support. In addition to these agricultural difficulties, the Syr Darya river basin is bearing the environmental problem particularly in and around Aral Sea because of the large-scale irrigation development along the Syr Darya river.

General Economic and Agricultural Background

Land and Population

- (04) Kazakstan is a land-locked country bordering Russia in the north and the north-west, Turkmenistan, Uzbekistan and Kyrgystan in the south and China in the east, and is bounded by Caspian Sea in the west. The country occupies an area of 2.72 million km². The 1996 population of Kazakstan was 16.5 million (6.1 persons/km²). The average annual growth rate for 1993-1996 in Kazakstan was -0.9%. This is due to both higher death rate than the average, and emigration of Russians, Ukrainians and Germans.

- (05) Agriculture is the second most important sector in Kazakstan following the mining sector, showing 28% of GDP and 23% of total employment. About 75% of the total land area of the country or about 200 million hectares is used for agricultural purposes such as crop production and grazing. The main crops cultivated in the country are wheat, maize and cotton, but their yields are very low; 0.97 tons/ha of wheat, 2.84 tons/ha of maize and 2.25 tons/ha of cotton, due mainly to less precipitation, 250 mm per annum on an average. Livestock breeding is also an essential economic activity in this country particularly for beef, mutton, dairy products and wool.

National Economy

- (06) The Kazakstan economy is slowly pulling out of recession after 1994, with expected GDP growth forecast at 1.5% for 1996, and 3% this year (1997).
- (07) Kazakstan has adopted and started the implementation of a comprehensive structural reform program aimed at moving the country towards a market economy since the declaration of independence in December 1991. In May 1992, the Government announced the economic development strategy aimed at the accomplishment of a free market system within 15 - 20 years.

PART - II MASTER PLAN FOR THE KZYL-ORDA LEFT BANK AREA

Present Conditions of the Kzyl-Orda Left Bank Area

Location and Administration

- (08) The Kzyl-Orda Left Bank Area consists of four districts in the agricultural area west of the capital city of Kzyl-Orda in the central and eastern region of the Kzyl-Orda Oblast. The Area encompasses 430,000 hectares: Syr Darya (37,500 hectares, 8.7%), Terenozek (78,300 hectares, 18.2%), Zhalagash (130,640 hectares, 30.4%), and Karmakshy (183,560 hectares, 42.7%).

Population and Labor Force

- (09) The present population and the number of households in the Kzyl-Orda Left Bank Area are estimated at about 53,100 persons in 8,730 households. The following table shows the present population and number of households in the Kzyl-Orda Left Bank Area involved in the respective raions.

	Syrdarya	Terenozek	Zhalagash	Karmakshy	Total/Average
Whole Raion					
Total Resident Population	47,300	29,700	38,600	42,900	158,500
Total Number of Households	8,017	4,869	6,226	7,150	25,984
Average Size of Household	5.9	6.1	6.2	6.0	6.1
Inside the Study Area					
Total Resident Population	9,426	11,149	18,026	14,508	53,109
Total Number of Households	1,597	1,828	2,907	2,402	8,734
Average Size of Household	5.9	6.1	6.2	6.0	6.1

Natural Conditions

- (10) The Kzyl-Orda Left Bank Area is affected by hot and dry summers, and cold and snowy winters, showing the mean monthly air temperature varying from -8.2 °C in January to 27.6 °C in July, and the annual mean relative humidity of 56% varying from 35% (June-August) to more than 80% (December-January).
- (11) The Syr Darya river with a drainage area of 240,000 km² is a water source in the Study Area. Shortly downstream of entering the Kazakh territory, the Syr Darya river enters the Chardara reservoir with a storage capacity of 5,220 MCM, from which the river flows down for a distance of 1,650 km to the Aral Sea. The annual river flow released from the Chardara reservoir was 388 m³/sec on an average, varying from 166 m³/sec in 1975 to 678 m³/sec in 1993. The average annual river water available at the Kzyl-Orda Headworks is 8,076 MCM, while the annual water diverted into the Kzyl-Orda Left Main Canal during the irrigation period from April to September is 1,917 MCM from the Syr Darya river.
- (12) There are two types of aquifer in the Kzyl-Orda Left Bank Area; aquifer-I and aquifer-II. The aquifer-I stratigraphically lies above the aquifer-II, and these are bounded by impermeable layers consisting of the Palaeogene deposits. The aquifer-I is composed of alternating beds of sand, clay and loam of Quaternary age. The aquifer-II is mainly composed of alternating beds of sandstone and claystone of Cretaceous age, and affected by artesian water. It occurs in the depth of 50 m to 150 m below the surface.
- (13) According to the records of groundwater quality at the existing observation wells, salt concentration of groundwater ranges from approximately 700 to 36,000 mg/lit, and the concentration exceeds 2,000 mg/lit at 70 % of the existing observation wells. The areas having a concentration of less than 2,000 mg/lit are mainly distributed in the northern and southern part of the Syrdarya Raion, Terenozek Raion and a central part of the Karmakshy Raion, and the areas with high salinity concentration are scattered in the location of the valleys and the small basins. As for the salt accumulation in the soils, about 179,580 hectares (42%) are categorized as "strong" or "very strong".
- (14) As for the irrigation suitability of the soils in the Left Bank Area, about 298,050 hectares (69%) are classified to be suitable for both paddy and upland crop cultivation and remaining 131,940 hectares are not suitable.

Agriculture

- (15) Within the Kzyl-Orda Left Bank Area, there are 21 former state farms and 165 private family farms. With the exception of one state research farm, the former state farms are now organized in 25 production cooperatives. All assets, including land, machinery, infrastructure, and buildings are jointly held and operated. Farmers own their private dwellings; other property is held in common. On the private family farms, all assets are held and administered by the family unit.

- (16) The present land use in the Kzyl-Orda Left Bank Area in 1995 is summarized below:

Land Use Category	Area (ha)	Proportion (%)
(1) Agricultural land		
- Original Rice Rotation Area	87,000	20
- Pasture	237,300	56
Sub-total	324,300	76
(2) Non agricultural land		
- Marsh and swamp	5,440	1
- Bush and forest	14,740	3
- Others*	85,520	20
Sub-total	105,700	24
Total	430,000	100

* : Including roads, rivers, residential areas and deserts

- (17) The original rice rotation area (original irrigation area) of the Kzyl-Orda Left Bank Massive Irrigation System was 87,000 hectares, but the presently irrigated area is 75,080 hectares and the remaining 11,920 hectares or 14% of the area is abandoned by such problems as water shortage due to deterioration of irrigation canal system, soil salinization and water logging caused by poor drainage system and others.
- (18) Of the presently irrigated land of 75,080 hectares, about 68,430 hectares were planted with crops in 1995, consisting of 23,590 hectares (35%) for paddy, 14,590 hectares (21%) for wheat, 21,880 hectares (32%) for lucerne, and the remaining 8,370 hectares (12%) for other crops such as industrial crops, vegetables, etc. The overall cropping intensity for the total Study Area is 79%.
- (19) The yields of major crops in the Study Area in 1995 are very low and vary from raion to raion as shown in the following table:

Raion	(Unit: ton/ha)			
	Paddy	Wheat	Vegetables	Lucerne
Syrdarya	1.70	0.55	2.33	2.23
Terenozek	2.32	0.82	6.41	1.78
Zhalagash	3.01	0.75	5.12	1.65
Karnakshy	2.94	0.52	7.70	2.38
Average	2.71	0.67	6.00	1.89

- (20) The yields of major crops mentioned above show a decreasing tendency in the period from 1993 to 1995 as shown below, which is mainly attributable to less application of agricultural inputs and delay of planting and harvesting due to insufficient irrigation water and agricultural machinery:

Year	(Unit: ton/ha)			
	Paddy	Wheat	Vegetables	Lucerne
1993	4.43	1.11	4.66	2.87
1994	3.09	0.79	6.45	2.20
1995	2.71	0.67	6.00	1.89

- (21) The amount of paddy production has drastically decreased in the period from 1993 to 1995 due to decrease of planted areas and low yields as mentioned above. The amount of paddy production in 1995 was 64,000 tons, which is less than 50% of that in 1993. The production of wheat and lucerne in 1995 was 9,800 tons and 41,000 tons respectively, which are 75% and 67% as compared to 1993 respectively. The production of vegetables (13,800 tons) has not changed much.

- (22) Animal husbandry is also one of the main agricultural activities in the Study Area. The major animals raised in the Study Area are cattle, sheep, goats and poultry. The population of these animals in 1995 are 46,810 for cattle, 150,900 for sheep and goats and 49,730 for poultry. Among them, cattle and poultry are mainly raised by family farms.

Irrigation and Drainage

- (23) The Kzyl-Orda Left Bank Massive Irrigation System was completed as a run-of-river system in 1969 to irrigate the land area extending over the left bank side of the Syr Darya river. The system integrated the intake already operated for the area of some 20,000 hectares including paddy fields of 9,000 hectares before completion of the system. The Kzyl-Orda Headworks which was constructed on the Syr Darya river for the Right Bank Area in 1957, was also used for the irrigation of the Left Bank Area.
- (24) The irrigation system consists of: (i) Left Main Canal, (ii) Right and Left Branch Canals, (iii) inter-farm/on-farm canals, (iv) field canals, and (v) field ditches, as shown in the following table:

Description	Design Discharge (m ³ /sec)	Length (km)
Left Main Canal	228.0	85.4
Right Branch Canal	93.0	70.2
Left Branch Canal	41.0	58.3
Inter-farm Canals/On-farm Canals	0.3 - 36.1	445.0

However, all these canals have been heavily eroded on the side slopes, especially at curved portions, due to poor maintenance and repair. Sedimentation and scouring on the canal bottom are also severe; 0.7 m of sedimentation and 0.5 m of scouring on an average. Other subordinate canals have also deteriorated. At the field level, all the field canals and field ditches have been irregularly shaped and thickly vegetated due to absence of regular maintenance.

- (25) The drainage system in the Study Area has been developed, but almost all the collectors (drains) have also been deteriorated by sedimentation and erosion due to poor maintenance. Sediment deposits in the collectors create poor drainage conditions. The following table shows the general features of major collectors:

Description	Design Discharge (m ³ /sec)	Length (km)
South Main Collector	74.0	148.8
North Main Collector	18.0	119.1
Koksu Collector	6.0	18.8
Eastern-Karmachinsky	3.5	42.1
Inter-farm and On-farm Collectors	-	905.4

Water Management and O&M

- (26) The water management activities at the project level are frameworked by the Kzyl-Orda Oblast Committee on Water Resources under the supervision of the Committee on Water Resources. Under the Kzyl-Orda Oblast Committee on Water Resources, the Raion

Management of Water Economy System together with the Hydro-Stations hold an important role in project level water management.

- (27) The most advanced level of engineering standards has been practised in the Study Area by employing volumetric water charge system that is common in the arid zone irrigation farming. However, this system had been effective under the planned economy system in which the Government fully supported the project in terms of technology and finance. After dissolution of the Soviet Unions in 1991, the transitional economy was proclaimed by the Government. In consequence the water fee system and the farm management system were introduced, though both systems can hardly coexist in principle.

Agricultural Support Services and Farmers' Organization

- (28) The responsibility for agricultural research is with the Kazakstan Academy of Sciences which operates the National Center of Agricultural Research. This academy has been reduced in size and budget and a number of research farms have been privatized. Before 1994, there were two research institutes in the Kzyl-Orda Oblast; the Kzyl-Orda Agriculture Research Institute and the Soil Research Institute. However, there remains the former one, which is now called the Pre-Aral Scientific Research Institute for Agro-Ecology and Agriculture. The institute undertakes research on new crop varieties, seed improvement, vegetable production, animal husbandry, soil conservation and fertility, agro-economics, land tenure, and agricultural machinery. It also is a provider of breeder seeds for paddy production.
- (29) The Ministry of Agriculture is administratively responsible for agricultural training. The agriculture extension and farmer training are not occurring in the Kzyl-Orda oblast. There are no written reports issued directly to farmers, and there are no materials being disseminated via radio or television broadcast. No on-site training is being provided to farmers by the Pre-Aral Scientific Research Institute for Agro-Ecology and Agriculture. The raion and oblast departments of agriculture are also not providing seminars or written training materials to farmers. Peasant farms and family farms are not being provided with any technical assistance or training.
- (30) The main source of credit available to the farms in the Study Area is "Agroprombank". Agroprombank is a private bank, with funds generated by deposits and returns on loans. Other than this, there are no bank sources of cash credit available to farmers in the Kzyl-Orda Oblast. Therefore, barter credits in exchange for paddy are common in the oblast. In December 1994, however, the Kazakstan Government created the State Fund of Financial Support of Agriculture to improve the economic conditions of private farms.
- (31) Farmers' organizations such as water users' associations do not exist in the Study Area. The production cooperative is the farmer group that provides the means of organization for production, marketing, water management, and worker welfare. As farms continue to evolve and more independent family farms emerge in the area, it will be necessary to organize water user associations to administer irrigation water among different users.

Market and Prices

- (32) Farmers did not benefit fully from the unregulated market prices in 1996, because much of their paddy production was committed to repay loans from the food production corporation, and the fuel supply company at prices ranging from US\$249/ton to US\$195/ton for paddy of first to third quality. Most trade in melons and vegetables is by private commission dealers who load up direct in the fields and haul the produce to urban markets. No livestock or livestock products are exported from Kzyl-Orda except for hides. The former state meat factory was closed two years ago for lack of supply. Farms slaughter their own animals and sell meat in the urban markets.
- (33) For the first time since independence, the Government did not regulate market prices in 1996. As a consequence, prices of livestock products and paddy were sharply higher based on a comparison at US\$ exchange rates. Free market prices were generally higher in 1996 than in 1995, as reflected by the unregulated commodities, vegetables, melons and potatoes. This is a result of reduced supply, as well as possibly higher incomes in some segments of the urban population. The following table presents the comparison of prices between 1995 and 1996 for major crops and livestock production, which shows much differences of prices for respective products between 1995 and 1996:

Commodity	1995		October 1996		Percent Change
	tenge/ton	US\$/ton	tenge/ton	US\$/ton	
Paddy	928.45	151.29	2,000	294.12	94.4
Vegetables	626.98	102.16	1,500	220.59	115.9
Potatoes	1,302.68	212.27	1,700	250.00	17.8
Melons	301.99	49.21	500	73.53	49.4
Beef, lv.wt.	1,821.04	296.73	6,000	882.35	197.4
Mutton, lv.wt.	1,686.85	274.87	6,000	882.35	221.0
Milk	945.98	154.14	3,000	441.18	186.2

Farm Economy

- (34) The farm budget for the typical farm of 5,000 hectares with the cropping pattern consisting of 27% of paddy, 26% of lucerne, 16% of wheat, 4% of maize silage, 2% of safflower, 2% of vegetables, 1% of melons, 14% of abandoned area and 8% of fallow is examined. According to the result of examination, the most of gross income (US\$1,222,000) is spent as the farming cost, water charge and taxes, and net income is only US\$12,000 or US\$2.4/hectare as shown in the following table:

(Unit: US\$ '000)	
Item	Farm Budget Summary
1. Gross Value of Production	1,221.50
2. Crop Production Costs	1,134.59
3. Water Charges, US\$17/ha	66.30
4. Land Tax (US\$1.47/ha)	7.35
5. Total Outflow	1,208.24
6. Net Return before Income Tax	13.26
7. Income Tax (10%)	1.33
8. Net Return after Tax	11.93
Net Return after Tax (per ha)	(US\$2.4/ha)

Environment

- (35) According to the Guideline on Assessment of Water Quality Used for Kazakhstan Irrigation Lands, the quality of river water at Kzyl-Orda is categorized in Class II or Class III in terms of salinity, which is within the limit of the standard in terms of heavy metals. Therefore, it is judged that the surface water of the Syr Darya river at Kzyl-Orda can be used for irrigation of most crops except some salt-sensitive ones. On the other hand, most of the groundwater samples contain more than 2,000 mg/l of salt and are categorized in Class IV.
- (36) According to the data collected through the flora and fauna survey, the number of fauna tends to be less in and around the Syr Darya river due to decrease of river discharge, while the fauna including rare species maintains the same situation in desert area.

Constraints to Agricultural Development

- (37) Major constraints to proper agricultural development in the Study Area are mentioned below, all of which should be taken into consideration in the formulation of the agricultural development plan for the Project:
- (i) Physical Constraints
 - Scarce precipitation,
 - Poor drainage,
 - Unfavorable geological characteristics, and
 - Salinity hazard.
 - (ii) Socio-economic Constraints
 - Lack of knowledge for marketing under the market-oriented economy,
 - Lower than reasonable commodity prices for agricultural products,
 - Lack of O&M for agricultural facilities and equipment caused by cultural tradition, and
 - High cost of credit from the Agroprombank.
 - (iii) Agricultural Constraints
 - Shortage of farm machinery and farm inputs,
 - Low recovery rate and quality control in the rice mills,
 - Less coordination between research institutes and training activities, and
 - Lack of proper extension system.
 - (iv) Constraints in Irrigation Practices
 - Absence of proper maintenance works,
 - Over-supply of water,
 - Poor land leveling in paddy fields, and
 - Insufficient cost for O&M.

Development Plan of the Kzyl-Orda Left Bank Area

Project Concept

- (38) The main subjects included in the Study are: (i) enhancement of irrigation efficiency through rehabilitation and improvement of the irrigation system; (ii) assurances of proper operation and maintenance (O&M) of project facilities by farms and independent family farms themselves in the process of privatization of the agricultural production system; (iii) prevention of salinization through proper management of irrigation and drainage and proper land use and cropping system; (iv) mitigation of negative environmental impact caused by the agricultural development; and (v) enhancement of farmers' incentive towards agriculture through improvement of the agricultural production environment.

Delineation of Irrigation Area under the Study

- (39) Through rehabilitation and improvement of irrigation and drainage facilities, proper water management and O&M practices and establishment of efficient agricultural supporting system, the presently abandoned area of 11,920 hectares will be recovered to the normal agricultural land. Adding this abandoned area to the presently irrigated land of 75,080 hectares, therefore, the irrigation area to be dealt with under the project is 87,000 hectares.

Availability of Water Resources

- (40) Based on the record of discharge measurement (1985 - 1996) at the intake structure of the headworks for the Left Main Canal, the water available for diversion to the Left Main Canal is estimated at 1,632 MCM in a dry year (1 in 5 years return period), while the future water demand under the "with project" condition would amount to 1,206 MCM. Therefore, the available water will be sufficient to irrigate the whole Study Area of 87,000 hectares.
- (41) A water balance study was also made for the total basin of the Syr Darya river in the Kazakstan territory, and it shows that under the "with project" condition, the annual irrigation water demand is estimated at 5,000 MCM for 343,000 hectares of the total irrigation area along the Sir Darya river, if the same irrigation practices as proposed for this project are applied to all the irrigation area in the basin. This means that the future irrigation demand in the basin can be saved by 1,801 MCM as compared with the present irrigation demand. Thus, there will be 26.5% of water saving under the "with project" condition for Aral Sea. Then, the annual inflow to Aral Sea will increase from present 3,568 MCM to 5,369 MCM under "with project" condition.

Agricultural Development Plan

- (42) According to the result of forecast on the future increase of the abandoned area, the presently irrigated land will decrease from 75,080 hectares in 1995 to 31,900 hectares which is the average of the area to be irrigated during the project life of 50 years and deemed to be the irrigation area under the "without project" condition.

- (43) For the proposed agricultural development in the Study Area, the rice-based cropping system: 50% of paddy, 25% of lucerne, 15% of wheat, and 10% of other crops such as safflower, vegetables and maize, is employed considering the soil and climatic conditions, profitability, crop rotation, environmental balance, farmers' desire, and opinion of MOA.
- (44) The anticipated crop yield and production under both "with project" and "without project" conditions are estimated as shown in the following tables. The yield under the future "with project" condition will be attained 5 years after completion of the Project.

Crops	Crop Yield										(Unit: ton/ha)	
	Syrdarya		Terenozeq		Zhalagash		Karmakshy		Total		without	with
	without	with	without	with	without	with	without	with	without	with		
Paddy	3.51	6.00	3.76	6.00	3.84	6.00	3.72	6.00	3.76	6.00	3.76	6.00
Wheat	1.07	2.50	1.16	2.50	1.19	2.50	1.14	2.50	1.16	2.50	1.16	2.50
Safflower	0.20	1.20	0.24	1.20	0.26	1.20	0.17	1.20	0.22	1.20	0.22	1.20
Vegetables	3.04	10.00	3.76	10.00	3.08	10.00	3.74	10.00	3.45	10.00	3.45	10.00
Lucerne	3.07	6.24	3.42	6.24	3.42	6.24	3.20	6.24	3.34	6.24	3.34	6.24

Crops	Crop Production										(Unit: '000ton)	
	Syrdarya		Terenozeq		Zhalagash		Karmakshy		Total		without	with
	without	with	without	with	without	with	without	with	without	with		
Paddy	1,370	8,940	14,020	70,980	14,480	103,200	15,700	76,800	45,570	259,920	45,570	259,920
Wheat	310	1,700	1,990	9,000	2,380	13,070	2,560	6,150	7,240	33,460	7,240	33,460
Safflower	0	80	40	850	20	1,220	20	930	80	3,080	80	3,080
Vegetables	40	500	760	4,700	650	6,900	510	5,150	1,960	17,250	1,960	17,250
Lucerne	1,260	5,140	8,250	37,000	13,580	53,700	9,420	40,030	32,510	135,870	32,510	135,870

Improvement Plan of Agricultural Supporting Services

- (45) For the successful achievement of agricultural development, the following agricultural supporting services need to be improved and strengthened by Government's own effort.

(Agricultural Research)

- (46) The government's tight budgetary condition seriously and adversely affects the activities of all of the agricultural research institutes and their activity has become quite limited. Given this condition, research activities should, within a limited budget, selectively focus on not only the development of technologies to resolve the agricultural restraints faced by farms, but also the improvement of the social and agro-economic situation of farms and farmers. The recommended research activities include the breeding of high yield and high quality varieties, production of high quality seeds, improvement of farming practices and soil fertility, post harvest techniques, and improved water management. In addition, a strong linkage among the agricultural research institutes' agricultural policy and extension divisions needs to be established for the distribution and transfer of newly developed technologies.

(Agricultural Extension Services and Farmers' Training)

- (47) Under a command economy, agricultural extension was non-existent. Thus, one key challenge in the Project Area is to create an agricultural extension system which is matched to the needs of a market economy. In market agriculture, accurate and timely information as well as relevant and current training are crucial to competitiveness and

profitability. Farm workers and peasant farmers have none of the skills in management, marketing, agriculture economics, water management, business planning, accounting, or the legal environment. As farms continue to evolve into different organizational forms of various sizes, it will be crucial to conceptualize agricultural extension as something which is extended to individuals rather than to farms.

(Agricultural Credit)

- (48) The agricultural development plan includes funding for an agriculture credit program to make short term farm operating loans and mid-term loans to project farms for the purchase of tractors and farm machinery. The credit program could be managed by established commercial banks in the Kzyl-Orda Oblast. However, there may be a problem finding a suitable bank to carry out the project credit program. Therefore, performance of these banks should be improved prior to the implementation of the project, so that it will be possible to manage the farm credit component.

Improvement Plan of Farms and Farmers' Organization

- (49) All of the individual farmers in the Study Area belong to either a production cooperative or a peasant farmer's association. The appraisal of these organizations indicates that each of them is functioning adequately in the fields of farm management, crop production, and animal husbandry. However, they are not functioning adequately in the fields of marketing of products, procurement of agricultural inputs and consumer goods, and financing. In order to improve productivity and output in the Study Area, it is intended to: (i) strengthen these existing organizations through training; (ii) create an agricultural cooperative that provides all of the project farms with marketing, input procurement and financing services; and (iii) organize a water user association (on-farm level).

Irrigation and Drainage Development Plan

- (50) A basic concept of irrigation for this project is to supply the farm land with an adequate quantity of the water required for crops when it is needed. The current over supply of irrigation water and seepage water through the Kzyl-Orda Left Bank Massive Irrigation System, which causes salt injury to upland crops due to the rising groundwater table, should be controlled. In order to attain this objective, measures should be taken to provide the Study Area with an adequate quantity of water effectively for crop cultivation, to distribute the water with less conveyance and operation losses through improvement of the irrigation water supply system, and ultimately to restore the natural environment of the Aral Sea in the future by applying such water saving irrigation methods to other irrigation projects in the Syr Darya basin.
- (51) The direct objective of drainage is to drain sub-surface water to control soil moisture rather than surface water in the Study Area, because precipitation in the area is very small. From the above standpoint, drainage control will be pursued to remove excess soil moisture and to lower the presently high groundwater table. By this drainage control, it is expected to improve farming operations and to accelerate leaching of salt in the top soil.

Development Plan of Rural Infrastructure

- (52) In the Study Area, there are 574 km of farm roads. Of these roads, about 92.5 % need to be re-paved to facilitate the marketing and farming activities in the Study Area. In addition to the improvement of the farm road network, it is also necessary to improve or newly construct rural water supply systems including 7 deep wells and 270 km of pipelines.

Improvement Plan of Water Management and O&M

- (53) For the proper water management and O&M practices, it is proposed to establish a well organized water management system through improvement of: (i) facilities management; (ii) information management; and (iii) institutional management. The facilities management is identical to the operation and maintenance (O&M) of project facilities. The maintenance refers to the activities to keep the facilities as original state as possible. While, the operation means the activities to take out the originally intended function of facilities. The facilities management can be materialized through the information management. The information management occupies a pivotal role in the water management and consists of monitoring system, communication system, data management system and control system. The institutional management will be made by the water supplier side and the water user side. The Water Committee on Water Resources represents the former and the Farm /Water User Association (WUA) stands for the latter.
- (54) The current on-farm level water management issues seem to be non-technical but financial matters originated from water pricing mechanism or farm products marketing system. Nevertheless, there would be considerable room to improve the current institutional structure in water user side.

Environmental Consideration

- (55) The preliminary result of initial environmental assessment is summarized below:
- (i) Deterioration of water quality and agro-chemicals
According to the results of the salt balance study, the water quality in most drainage canals will deteriorate due to increase of the total salt volume from irrigation water in future.
 - (ii) Application of chemical fertilizers and agro-chemicals
The application of chemical fertilizers and agro-chemicals in the irrigation area will affect the water quality of both surface water and groundwater.
 - (iii) Conservation of Tugai Vegetation
According to the result of the flora and fauna survey, the Tugai vegetation distributed along the Syr Darya river is the most important ecosystem in the Kzyl-Orda Left Bank Area because of not only water conservation, but also natural habitat for wildlife and birds including significant species.

(iv) Positive Impact to be caused by the project

As the positive impacts of the project, increase of inflow to Aral Sea due to water saving irrigation, and decrease of salinity hazard due to drainage improvement will be expected after implementation of the project.

Project Works and Services

(56) In order to attain the final target of the project, the following works would be needed under the project:

Description	Quantity
Irrigation and Drainage Facilities	
Headworks	1 lot
Irrigation System	
- Left Main Canal	85 km
- Right Branch Canal	70 km
- Left Branch Canal	49 km
- Inter-farm/On-farm Canals	473 km
Drainage System	
- North Main Collector	120 km
- South Main Collector	150 km
- Inter-farm/On-farm Collectors	911 km
On-Farm Facilities	8,700 ha
Buildings	
- Project Office building	1 No.
- Branch Offices	4 Nos.
- Hydro-Post Buildings	14 Nos.
Post-harvest Facilities	
- Rice Mills	25 Nos.
Rural Infrastructure	
- Farm Roads	40 km
- Water Supply System	270 km
O&M Equipment	Lump Sum
Farm Machinery	
- Tractor	670 Nos.
- Combine Harvester	250 Nos.

(57) In addition to the above construction and procurement works, the project services will be needed, which include: (i) the training of farmers and project office staff, (ii) strengthening agricultural support; (iii) establishment of demonstration farm; and (iv) technical support to the project office.

Development Cost

(58) The project cost comprises: (i) direct construction cost; (ii) cost for procurement of O&M and office equipment; (iii) cost for procurement of farm machinery; (iv) project administration cost; (v) cost for technical support; (vi) land acquisition cost; (vii) cost for fishery compensation; and (viii) physical contingency, which would amount to US\$ 661 million.

- (59) The annual operation and maintenance cost of the project facilities includes the salaries of the staff for the Project Office, staff of the WUAs, the materials and labor costs for repair and maintenance of the project facilities, the cost for operation, and repair and maintenance of O&M equipment, which would amount to US\$ 5.66 million per annum for the total project area, or US\$ 65/ha per annum.

Project Evaluation

- (60) The average net return per hectare is US\$86 under the "without project" condition, compared to US\$696 under the "with project" condition. The incremental benefit per hectare is US\$610, and the total benefit from the combination of higher yields and more intensive cropping is US\$53 million annually at full development of 87,000 hectares. The economic internal rate of return (EIRR) of the project is 11%. The EIRR(s) of individual farms range from 7.5% to 13.8%. Of the four raions in the Study Area, the farms of Terenozek Raion have the highest average EIRR, 11.8%, followed by Zhalagash Raion (11.0%), Karmakshy Raion (10.2%) and Syrdarya Raion (9.4%).

Development Priority and Implementation Program

- (61) The assessment of development priority is made from the technical, economical and socio-economical viewpoints, and the first development priority is given to the following works:
- (i) Rehabilitation of the intake structure of the Kzyl-Orda Headworks for the Left Main Canal,
 - (ii) Rehabilitation and improvement of the Left Main Canal of 85 km
 - (iii) Rehabilitation and improvement of North Collector (120 km) and South Collector (150 km), and
 - (iv) Rehabilitation and improvement of Ilyasov Farm with an irrigation area of 6,480 hectares and Shagan Farm with an irrigation area of 7,210 hectares.
- (62) Based on the result of the above study and further considering the economic viability of the work, the development packages and their priority rankings are decided as follows:

Stage-I Development

- Rehabilitation of the Kzyl-Orda Headworks including the intake structure,
- Rehabilitation of the Left Main Canal,
- Rehabilitation and improvement of the North and South Collectors, and
- Rehabilitation and improvement of Ilyasov Farm and Shagan Farm including inter-farm/on-farm canals.

Stage-II Development

- Rehabilitation of Right and Left Branch Canals,
- Rehabilitation and improvement of the remaining 2 farms in Terenozek Raion including inter-farm/on-farm canals, and
- Rehabilitation and improvement of all 10 farms in Zhalagash Raion including inter-farm/on-farm canals.

Stage-III Development

- Rehabilitation and improvement of all 7 farms in Karmakshy Raion including inter-farm/on-farm canals, and
- Rehabilitation and improvement of all 4 farms in Syrdarya Raion including inter-farm/on-farm canals.

According to the cost estimate for each stage, the cost for Stage-I is extremely high as compared with those of Stage-II and III. This is mainly due to the reason that Stage-I work includes the rehabilitation and improvement of the main irrigation and drainage facilities such as the Kzyl-Orda Headworks, Left Main Canal, North and South Main Collectors, which will serve not only the Stage-I area but also the whole area of 87,000 hectares. Therefore, it should be understood that the cost for Stage-I includes the pre-investment cost for Stages-II and III.

Conclusions and Recommendations

Conclusions

- (63) The Phase-I Study clarified that the main components for achieving sustainable agricultural development in the Kzyl-Orda Left Bank Area are:
- (i) enhancement of irrigation efficiency through rehabilitation and improvement of the existing irrigation system;
 - (ii) assurances of proper operation and maintenance (O&M) of project facilities by farmers' organizations and beneficiaries themselves in the process of privatization of the agricultural production system;
 - (iii) prevention of salinization through proper management of irrigation and drainage and proper land use and cropping system;
 - (iv) mitigation of negative environmental impact caused by agricultural development; and
 - (v) enhancement of farmers' incentive towards agriculture through improvement of the agricultural production environment.
- (64) Through implementation of the above-mentioned project components, the following benefits would be expected:
- (i) Agricultural production would largely increase and accordingly the farmers' income would largely increase; US\$86/ha to US\$696/ha in economic value.
 - (ii) Improvement of a potable water supply system in farms will improve farmers' health and reduce the inconvenience, time and drudgery of obtaining water.
 - (iii) Rehabilitation and improvement of the existing irrigation and drainage facilities will save irrigation water, which will increase the inflow to Aral Sea by 21% and contribute to environmental conditions in the lower basin of the Syr Darya river including Aral Sea.

- (65) According to the result of the project evaluation, the agricultural development in the Kzyl-Orda Left Bank Area including 25 farms in 4 raions is technically sound, and economically feasible, showing the economic internal rate of return (EIRR) of 11% ranging from 7.5% to 13.8%.

Recommendations

- (66) As mentioned in the above, the implementation of the project is technically sound and economically feasible. Furthermore, the project will bring about various kinds of indirect social and economic benefits to the residents of the area. Thus, it is recommended that the project be implemented as early as possible following the priority sequence mentioned in Item (62) hereof.
- (67) In order to attain the projected target, it is recommended that the following agricultural supporting services be improved and strengthened by the GOK's own efforts.
- (i) The activities of agricultural research should, within a limited budget, selectively focus on not only the development of technologies to resolve the agricultural restraints faced by farmers, but also the improvement of the social, managerial and agro-economic situation of farms and farmers.
 - (ii) Agricultural extension and farmer training should be reinforced by MOA to improve farm management, agricultural techniques, irrigation practices, business planning, marketing, water management and legal issues. Moreover, it is necessary to tighten the linkage between the agricultural research and extension wings at the oblast level.
 - (iii) The agricultural credit system should be strengthened through improving poor earnings, weak financial health, weak management and an excessively high rate of default on its loans.
- (68) In order to improve productivity and output in the Kzyl-Orda Left Bank Area, it is recommended to strengthen and improve the present farm organizations by creating an agricultural cooperative that provides all of the project farms with marketing, input procurement and financing services, and by organizing a water users association.
- (69) For successful implementation and O&M of such a large-scaled irrigation project as this project, it is recommended to establish an inter-ministerial coordination committee, which will consist of the representatives from the Ministry of Agriculture, the Ministry of Finance, Ministry of Economy, Ministry of Ecology and Bioresources, Ministry of Construction, Architecture and Housing, Ministry of Geology and the Project Manager of the Kzyl-Orda Irrigation and Drainage Project Office proposed in the following section.
- (70) Following the priority sequence mentioned above, it is recommended that the Feasibility Study be conducted for the Stage-I Development in the Phase-II Study period.

PART - III FEASIBILITY STUDY ON THE PRIORITY PROJECT

Present Condition of the Priority Project Area

Location, Administration and Population

- (71) The Priority Development Project Area (the Project Area) with a net irrigation area of 13,690 hectares includes the Ilyasov Area (6,480 hectares) and the Shagan Area (7,210 hectares), both of which have been selected as the priority development areas through the Master Plan study conducted in the Phase-I Study. The Ilyasov Area administratively consists of the Ilyasov Production Cooperative and the Berlek Peasant Farm, while the Shagan Area includes the Shagan Production Cooperative, the Abuov Zhakhsylyk Peasant Farm and four family peasant farms.
- (72) The Project Area has a total population of 6,078, of which 3,236 (53%) are male, and 1,149 households. The household density is 5.3 persons per households. There are 2,155 children in the Project Area, comprising 35% of the total population.

Agriculture

- (73) According to the study result on irrigation suitability of the soils in the Project Area with a total area of 40,230 hectares, about 30,310 hectares (75%) are classified as suitable or marginally suitable land for both paddy and upland crop cultivation, and remaining 9,920 hectares include solonchaks, roads, canals and built-up areas, which are classified as unsuitable land.
- (74) The Project Area encompasses a total area of 40,230 hectares of which 13,690 hectares (original rice rotation area) are arable and 13,450 hectares are pasture. A portion of the total area (14%) is held in reserve for inheritance by the children of current shareholders (5,680 hectares). There are 11,830 hectares of village land. The remainder consists of wetland, built-up area and roads.
- (75) Of the original rice rotation area of 13,690 hectares, 8,490 hectares were used for crop production, and 5,200 hectares were abandoned in 1996 by such problems as water shortage due to deterioration of irrigation canal system, soil salinization and water logging caused by poor drainage system and poor management of irrigation, and other reasons such as late arrival of irrigation water to the field, worn-out agricultural machinery and shortage of agricultural inputs.
- (76) In the Project Area, paddy, wheat and lucerne are major crops, followed by vegetables (including potato and melons). Other crops are cultivated in very limited or negligibly small areas. The planted area of paddy occupies 3,500 hectares or more than 40 % of the total planted area. Wheat and lucerne areas occupy 2,140 hectares and 2,400 hectares or approximately 25 % and 28% of total planted area respectively. Vegetables are mainly cultivated in kitchen gardens and their area is 360 hectares in total. The cropping intensities in the Ilyasov and Shagan Areas are 0.56 and 0.70 respectively.
- (77) The yields of wheat, lucerne and vegetables are very low but the paddy yield in the Project Area is rather high as shown in the following table:

(Unit: ton/ha)

Crops	Ilyasov Area	Shagan Area	Average	Terenzek Raion	Kzyl-Orda Oblast
Paddy	3.83	5.02	4.51	3.39	3.08
Wheat	1.64	0.36	0.62	0.47	0.25
Lucerne	1.54	1.81	1.65	1.99	1.40
Vegetables	8.00	9.00	8.49	10.87	9.15

Note: Vegetables include potato and melons.

- (78) The 1996 productions of paddy and wheat in the Project Area are 15,800 tons and 1,300 tons respectively, which are equivalent to 46% and 75% of total production in Terenzek Raion. From these figures, it is understood that the Project Area is important area for the production of cereals in the raion.
- (79) In the Project Area, cattle, sheep and goats are important animals. Forty percent of cattle (9,800 heads) are fed in the production cooperatives, while almost all sheep/goats (6,400 heads) and poultry (9,000 heads) are fed by individual farmers. From this fact, it can be said that individual farmers play an important role in animal husbandry in the area.

Irrigation and Drainage

- (80) The Project Area is included in the Kzyl-Orda Left Bank Massive Irrigation System. The irrigation water is supplied to the farms by the inter-farm/on-farm canal systems through the head gates built on both banks of the Left Main Canal. Five on-farm canals in the right bank side area and three inter-farm/on-farm canals in the left bank side area are provided in the Project Area. The service area of each inter-farm/on-farm canal is estimated as follows:

(Unit: ha)

Inter/On-farm Canal	Ilyasov	Shagan	Shirkeli*	Akzharina*	Total
LMK-6 & 8	6,480	-	-	-	6,480
LMK-12, 14 & 16	-	4,154	-	-	4,154
LMK-9	-	1,961	230	462	2,653
LMK-11v-3 & 11G	-	1,095	-	-	1,095
Total	6,480	7,210	230	462	14,382

Note: * ; These areas are located outside the Project Area.

- (81) All the irrigation canals are irregularly shaped, due to deposits of silt materials, erosion and/or side-slope failures, passage of farm machinery and so on. The canals with small flow capacities, particularly in the downstream area, have been thickly vegetated, due to absence of maintenance. In addition, the seepage from these canals, which is estimated at about 15% of the canal discharge, is another major problem, which causes the high groundwater table in the Project Area.
- (82) The drainage area to be considered under the Project is situated within the drainage area of the North Main Collector and the South Main Collector in the Kuvan Darya drainage area, and covers a gross area of some 40,230 hectares. The drainage water in the right bank side area of the Left Main Canal is drained to the North Main Collector through the inter-farm/on-farm collectors or directly. In the left bank side area of the Left Main Canal, the drainage water flows down through two inter-farm/on-farm canals connecting

to the South Main Collector. The drainage area for both North and South Main Collectors are shown below:

Drainage Channel	(Unit : ha)					
	Ilyasov Area		Shagan Area		Total	
	Drain. A	(Irr. A)	Drain. A.	(Irr. A)	Drain. A.	(Irr. A)
North Main Collector	15,930	(6,480)	14,620	(4,154)	30,550	(10,634)
South Main Collector			9,680	(3,056)	9680	(3,056)
Total	15,930	(6,480)	24,300	(7,210)	40,230	(13,690)

Note : The parenthesized irrigation areas are already included in the drainage areas.

- (83) All collectors including two Main Collectors, inter-farm/on-farm collectors and the field collectors have become shallow due to sediment deposits in the canals. No recurrent excavation work has been made for remedy of the canal shape since early 1970s, so that such drainage canal conditions bring about water logging, high groundwater table, and salt injury to the crops, resulting in lower yields and abandonment of cultivated lands.

Water Management and O&M of Project Facilities

- (84) The water management activities at the project level are frameworked by the Kzyl-Orda Oblast Committee on Water Resources under the supervision of the Committee on Water Resources of MOA. Under the Kzyl-Orda Oblast Committee on Water Resources, the Raion Management of Water Economy System together with the Hydro-Stations hold a pivotal role in the practical project level water management. The on-farm O&M operations are currently undertaken by the Farm Hydro-Engineer under the instruction of the Agronomist.
- (85) There are two lines of institutions on the project water management. The Committee on Water Resources represents the "Water Supplier" side, while the farm represents the "Water User" side. Both parties are independent self-financing bodies confronting each other at the water delivery point customarily called hydro-post in aspects of water quantity and water price.
- (86) Field survey revealed that the water charge in 1995 was 5.63 tiyn/m³ and estimated O&M cost comes up to US\$17/ha.

Agricultural Support Services and Farmers' Organizations

- (87) There is an institute for agricultural research in the Kzyl-Orda Oblast; the Pre-Aral Scientific Research Institute for Agro-Ecology and Agriculture. This institute undertakes research on new crop varieties, seed improvement, vegetable production, animal husbandry, soil conservation and fertility, agro-economics, land tenure, and agricultural machinery. It also is a provider of breeder seeds for paddy production.
- (88) The Ministry of Agriculture is administratively responsible for agricultural training. It has the mandate to arrange demonstrations or seminars for specialists from collective farms. The link between research and training is absent because the Kazakstan Academy of Sciences, which is responsible for agricultural research, is completely independent of the Ministry of Agriculture. In addition, such training as was provided was for large collective farms and cooperatives. The ministry provides no training for private family farms or peasant farmers.

- (89) Agroprombank is the only source of agriculture cash loans for farmers in the Kzyl-Orda Oblast except for the State Fund for Financial Support of Agriculture administered by MOA, which was started in 1995 to improve the economic conditions of private farms. There are no other bank sources of cash credit available to farmers in the Kzyl-Orda Oblast. Therefore, the use of barter credits in exchange for paddy are common.
- (90) The Project Area includes three different types of farms: the Production Cooperative and two types of Peasant Farms. A Production Cooperative is the result of the privatization of a former state farm (sovkhoz). The same administration as before is usually in place, including the same manager and the same specialists (agronomist, animal husbandry specialist, economist and engineer). The organization of the farm continues under central management with all major decisions being made at the top managerial level with little farmer input. The second type of farm is called a Peasant Farm. This category includes two sub-types: those with single household and those with multiple households. In this farm type, the unit has been registered as a private farm under the control of the household or households, and it is operated separately and independently from a Production Cooperative.

Market and Prices

- (91) Market and price conditions have improved remarkably in the Kzyl Orda Oblast less than one year after the survey for the Master Plan study. The supply of inputs has improved, interest rates on farm loans have gone down, and farmers can get a fair price for their products, if they have some to sell. Even though these very significant changes have occurred, there still remain some problems:
- (i) Farmers still lack cash to purchase production inputs and lack product to sell for cash, because most of their production is committed to repay barter debts for inputs and consumption goods.
 - (ii) Farmers still lack experience (knowledge) of marketing under a private enterprise system, and self-financing or arranging credit sufficient to cover operating costs for the next year's crop.
 - (iii) The physical infrastructure and equipment are deteriorated or worn out.
- (92) Average prices received by Kzyl Orda farmers in 1996 as determined by the Oblast Department of Agriculture are summarized in the following table, based on which the economic evaluation of the Project is made.

Commodity	Tenge/kg	US\$/ton
Paddy	10.8	159
Vegetables	8.0	118
Potatoes	13.0	191
Melons	3.0	44
Beef, live weight	32.0	470
Mutton, live weight	28.0	412
Milk	23.0	338
Lucerne	2.0	27

Farm Economy

- (93) The farm budget for the typical production cooperative of 6,800 hectares with the cropping pattern consisting of 28.4% of paddy, 19.2% of lucerne, 13.7% of wheat, 3% of vegetables, 2% of other crops and 33.7% of abandoned area was examined, and its result is summarized in the following table:

Item	Value (US\$ '000)
1. Gross Value of Production	1,948.21
2. Crop Production Costs	1,732.68
3. Water charges, US\$17/ha for 4,508 ha	76.64
4. Land Tax (US\$1.33/ha)	9.04
5. Total Outflow	1,818.36
6. Net Return Before Income Tax	129.85
7. Income Tax, @10%	12.98
8. Net Return After Taxes	116.86
8. Net Return After Taxes (per ha)	17.18

The results of the above analysis indicate that the two large production farms in the Project Area are not producing enough income under present conditions to sustain the workers and their families living on them.

Environment

- (94) According to the Guidelines on Assessment of Water Quality Used for Kazakstan Irrigation Lands, the quality of river water at Kzyl-Orda is categorized in Class II or III in terms of salinity, it is judged that the surface water of the Syr Darya river at Kzyl-Orda can be used for the irrigation of most crops except some salt-sensitive ones. On the other hand, drainage water and groundwater contains more than 2,000 mg/lit of salt and are categorized in Class IV.
- (95) According to the result of bacterial analysis on the Syr Darya river water and groundwater in deep wells in the Ilyasov and Shagan Areas, number of micro-organisms and coli index showed high values. For the domestic use of this water, the water quality should be interpreted with caution, and independent tests and purification are recommended.

Development Plan for the Priority Project

Objectives and Scope of Project

- (96) The main objectives of the Project are: (i) to improve agricultural infrastructures including irrigation and drainage system and farm road network; (ii) to establish a well-defined water management system; and (iii) to improve the present farming system including the farming practices and agricultural supporting system. Through these improvement and establishment, it is expected that presently abandoned agricultural land would be recovered to the cultivable land, and sustainable agricultural development would be realized in the Project Area. Moreover, due to improvement of irrigation facilities, irrigation efficiency would be much increased, and water saving would be

realized at the intake structure of the headworks, which will result in increase of river flow downstream of the headworks and contribute to the improvement of environmental conditions in the lower basin of the Syr Darya river including Aral Sea for the long term.

Delineation of Project Area

- (97) Through rehabilitation and improvement of irrigation and drainage facilities, improvement of agricultural practices, proper water management and O&M practices and establishment of efficient agricultural supporting system, the presently abandoned area of 5,200 hectares; 2,950 hectares in the Ilyasov Area and 2,250 hectares in the Shagan Area, will be recovered to the normal agricultural land. Adding this abandoned area to the presently irrigated land of 8,490 hectares, therefore, the irrigation area to be dealt with under the Project is decided to be 13,690 hectares, 6,480 hectares in the Ilyasov Area and 7,210 hectares in the Shagan Area.

Availability of Water Resources

- (98) The annual river discharge at the Kzyl-Orda Headworks (upstream) is estimated at 4,814 MCM in a dry year (1 in 5 years return period), of which 3,481 MCM (72% of the annual total) flows during the cultivation period (April-September). While, the annual discharge during the normal year (1 in 2 years return period) is estimated at 7,760 MCM, of which 5,124 MCM (66% of the annual total) flows during the cultivation period. The water available for diversion to the Left Main Canal is estimated at 1,632 MCM in a dry year and 1,854 MCM in a normal year. Since the future water demand in the Project Area is estimated at 203 MCM, the available water is sufficient to irrigate the Project Area.

Agricultural Development Plan

- (99) According to the result of forecast on the future increase of the abandoned area, the presently irrigated land will decrease from 8,490 hectares in 1996 to 2,310 hectares which is the average area to be irrigated during the project life of 50 years and deemed to be the irrigation area under the future "without project" condition.
- (100) The anticipated crop yield and production under both future "with project" and "without project" conditions are estimated as shown in the following tables. After completion of the project work, the yield of each crop will be increased through timely supply of irrigation water, adequate drainage and employing improved farming practices. In addition to the increase of crop yields, the crop cultivation area will also increase under the future "with project" condition and as a result the crop production will largely increase as compared with that under the future "without project" condition. The crop yields under the future "with project" conditions will be attained 5 years after completion of the project implementation.

Crop	Crop Yield				(Unit: ton/ha)	
	Ilyasov Area		Shagan Area		Total	
	without	with	without	with	without	with
Paddy	3.39	6.00	3.69	6.00	3.59	6.00
Wheat	1.08	2.80	1.04	2.80	1.06	2.80
Safflower	0.25	1.20	0.25	1.20	0.25	1.20
Vegetables	6.36	15.00	7.14	15.00	6.85	15.00
Lucerne	3.09	7.20	2.74	7.20	2.86	7.20

Crop	Crop Production				(Unit: ton)	
	Ilyasov		Shagan		Total	
	without	with	without	with	without	with
Paddy	1,320	19,440	2,840	21,660	4,160	41,100
Wheat	110	2,380	230	2,630	340	5,050
Safflower	3	160	7	170	10	330
Vegetables	510	4,800	860	5,400	1,370	10,280
Lucerne	620	13,970	1,070	15,550	1,690	29,520

Irrigation and Drainage Development Plan

- (101) The current over-supply of irrigation water caused by a large volume of seepage water and the uncontrolled water supply brings about water logging and salt injury to the crops. In order to overcome these present irrigation conditions in the Ilyasov and Shagan Areas, it is intended under the Project to rehabilitate and improve the present irrigation system, aiming to restore the function of existing canals and structures, to minimize water losses especially seepage water, and to enhance the irrigation efficiency with the help of proper water management. The project will also provide the rehabilitation and improvement of the Left Main Canal including the intake structures of the Kzyl-Orda Headworks to minimize seepage water losses, to control the intake discharge properly and to distribute water to the inter-farm/on-farm canals precisely.
- (102) Sub-surface drainage will be planned to lower the groundwater table. The groundwater table will be lowered by at least 50 cm below the ground surface in order to accelerate salt leaching by paddy irrigation and to improve the field working condition for agricultural machinery, and concurrently to reduce salt on the soil surface. In order to lower the groundwater table, it is intended to rehabilitate and improve the drainage canals and structures in the farms and the entire length of the North and South Main Collectors.

Development Plan of Rural Infrastructure

- (103) The farm roads in the Project Area are classified into three categories: (i) village road; (ii) main farm road; and (iii) farm spur road. The village roads connect the village center to the inter-farm road and important facilities in the village for the villagers' social activities and transportation of agricultural inputs and products. The main farm roads connect the village to important facilities in the village area, such as brigade offices and agro-processing and post-harvest facilities. While, the farm spur roads are mainly provided along the corners of the irrigation land blocks and used for the transportation of farm machinery, farm inputs and products in the farm. Among these roads, the

village roads and the main farm roads are dealt with as the rural infrastructure under the Project.

- (104) The constraints for the rural water supply in both Ilyasov and Shagan Areas are insufficient water supply volume and poor water quality caused by the lack of proper maintenance. Under the Project, therefore, it is intended to improve the water supply systems in both areas to meet the demand quantity and quality conforming to the standard of Kazakhstan.

Improvement Plan for Water Management and O&M

- (105) The water management stands for water operations through the institutional activities to the project facilities with aid of the information management system such as monitoring system, communication system and data management system. Among these systems, there is a considerable room for the improvement of current data management system relevant to the water management, because it is now managed manually. Therefore, it is proposed to introduce a data processing unit with graphic panel at the Hydro-Department for Kzyl-Orda Headworks.
- (106) The Kzyl-Orda Headworks and the Left Main Canal up to PK 420 will be directly managed by the Hydro-Department for Kzyl-Orda Headworks because of its structural importance and technical requirement. Meantime, the hydro-post at the head of the inter-farm canal will be managed by the Telenozek Raion Management of Water Economy System. Most on-farm canals will be managed by the Ilyasov Production Cooperative or Shagan Production Cooperatives. The present farm management in terms of the water management and O&M of the project facilities is proposed to be reorganized into the water users association.
- (107) The measured flow discharges at the hydro-posts will be converted into volumetric unit for the water charge collection from the farms, since the water charge is an indispensable income source to sustain the Raion Management of Water Economy System under the self-financing account. For the water pricing, the Harvard Institute for International Development (HIID) is providing technical assistance to the Committee on Water Resources to develop water pricing methodology under the legislative and institutional framework of water policy reform in Kazakhstan.

Development Plan for Agricultural Support Services

- (108) For the successful achievement of agricultural development, the following agricultural supporting services need to be improved and strengthened by Government's own effort:

(Agricultural Research)

- (109) Presently there is one research institute in Kzyl-Orda, the Pre-Aral Scientific Institute for Agro-Ecology and Agriculture. It is primarily now involved in the production of paddy breeder seed and it is disseminating minimal research materials for farmer consumption. In addition to this work, the institute is proposed to fill the gap by selectively focusing not only on the development of technologies to resolve agricultural constraints faced by farms, but also improvement of the social and agro-economic situation of the farmers.

(Agricultural Extension Services and Farmers' Training)

- (110) The agricultural extension component is proposed to confront the challenge of providing training which is matched to the needs of a market economy. In market agriculture, accurate and timely information as well as relevant and current training are crucial to competitiveness and profitability. Such information and training are non-existent in the Project Area. Farm workers and peasant farmers have none of the skills in management, marketing, agriculture economics, water management, business planning, accounting, or the legal environment with which to compete effectively. As farms continue to evolve into different organizational forms of various sizes, it will be crucial to conceptualize agricultural extension as something which is extended to individuals rather than to farms.

(Agricultural Credit)

- (111) The Project includes a line of credit to finance farm operating loans and purchase of tractors and farm machinery. The program includes a revolving fund for one year term farm operating loans of US\$ 2.7 million to cover purchase of commercial fertilizers, chemicals, fuel and seeds. The Project will also establish a mid-term credit line of US\$ 2 million annually for five years to finance the purchase of tractors and farm machinery. For the management of the farm operating loans, however, there are no commercial banks which are presently capable of administering the agriculture credit program, as mentioned in Item (48) hereof. If this is the case when the credit program component of the Project is implemented, it will be necessary to manage it through direct loans from the Project Implementation Unit (PIU) to project farms.

Improvement Plan of Farmers' Organization

- (112) Under the Project, the agricultural cooperative is proposed to be established in the Ilyasov and Shagan Areas respectively. This agricultural cooperative will differ from existing joint stock company, because this agricultural cooperative will newly include Agro-Processing Section, Marketing and Procurement Section, and Financing Information Section. Another important difference from existing organizations in the area is that all farmers in the Project Area would be eligible to join the cooperative, including family "peasant" farmers.
- (113) The current system of water management at the farm level does not assure the representation of the minor farms in irrigation water management nor does it guarantee timely and adequate delivery of water in requisite amounts and irrigation infrastructure is in disrepair. In addition, peasant farms must pay the larger production cooperatives for water; a commodity the larger farms do not have legal right to administer. The proposed WUA is designed to resolve each of these issues.

Environmental Consideration

- (114) The environmental impact assessment (EIA) was conducted on the items of: (i) impact to be caused during construction stage; (ii) impact of application of fertilizer and agro-chemicals on water quality; (iii) salinization of land resources and water resources; (iv) conservation of Tugai vegetation and marsh area; and (v) change of inflow to Aral Sea

from the Syr Darya river. As a result, it is judged that there will be no significant negative impacts to be caused by the project implementation for items (ii), (iii) and (iv). Item (i) will need proper construction management during the construction period. As for item (v), a positive impact can be expected, because about 80 MCM or about 28% of water presently diverted can be saved at the Headworks after implementation of the Project, resulting in the increase of the Syr Darya river discharge to Aral Sea from the present 3,568 MCM to 3,648 MCM or 2.2 % under the future "with project" condition.

Project Works

Project Facilities

(115) In order to attain the final target of the Project, the following works need to be implemented under the Project:

Description	Total	Phase - I	Phase - II
Irrigation and Drainage Facilities			
Kzyl-Orda Headworks	1 No.	1 No.	
Irrigation System			
- Left Main Canal	79.4 km	33.7 km	45.7 km
- Inter-Farm/On-Farm Canals	108.3 km	44.2 km	64.1 km
- Main and Secondary Field Canals	105.2 km	37 km	68.2 km
Drainage System			
- North Main Collector	119.7 km	119.7 km	
- South Main Collector	269.3 km		269.3 km
- Inter-Farm/On-Farm Collectors	101.8 km	26.5 km	75.3 km
- Main and Secondary Field Collectors	49.4 km	32.4 km	17 km
On-Farm Facilities	13,690 ha	6,480 ha	7,210 ha
Buildings			
Project Main Office	1 No.	1 No.	
Hydro-Post Buildings	5 Nos.	2 Nos.	3 Nos.
Brigade Offices	14 Nos.	6 Nos.	8 Nos.
Store House	2 Nos.	1 No.	1 No.
Rice Mills	3 Nos.	2 Nos.	1 No.
Rural Infrastructure			
Farm Roads	63.5 km	24.4 km	39.1 km
Village Water Supply System	16.2 km	6.7 km	9.5 km
O&M Equipment	2 lots	1 lot	1 lot
Farm Machinery			
Tracto	121 Nos.	56 Nos.	65 Nos.
Combine Harvester	92 Nos.	42 Nos.	50 Nos.

Project Services

(116) In addition to the above construction and procurement works, the project services will be needed, which include: (i) the training of farmers and project office staff, (ii) strengthening agricultural support; (iii) establishment of a demonstration farm; and (iv) technical support to the project office.

Implementation Schedule

(117) According to the result of the project cost estimate mentioned in Item (118), a huge amount of construction cost will be required for the implementation of the total project

work, and it would be difficult for the Government to arrange a sufficient budget for the construction of all the works at the same time. It is therefore proposed to implement the Project in two phases. The time required for implementation of the total project work is estimated at about 8 years consisting of 2 years for design, 3 years for Phase-I implementation and 3 years for Phase-II implementation.

Cost Estimate

(118) The project cost includes: (i) direct construction cost; (ii) cost for procurement of rice mills, farm machinery, office equipment, O&M equipment and water management equipment; (iii) project administration cost; (iv) cost for technical support; (v) land acquisition cost; (vi) cost for fishery compensation; (vii) physical contingency; and (viii) price contingency. The total cost thus estimated will amount to US\$291.2 million consisting of US\$185.1 million for the local currency portion and US\$106.1 million for the foreign currency portion as shown in the following table:

(Unit: US\$'000)			
Phase	Local Currency Portion	Foreign Currency Portion	Amount
I	79,700	50,978	130,678
II	105,386	55,110	160,496
Total	185,084	106,088	291,174

Project Organization and Management

(119) The Ministry of Agriculture will have an overall responsibility for project implementation. For successful implementation and O&M of such a large-scaled irrigation project as the Kzyl-Orda Irrigation and Drainage Project, however, it is proposed to establish an inter-ministerial coordination committee, which will be called Project Coordination Committee. Under this committee, it is proposed to establish Project Implementation Unit (PIU), which differs from the existing PIU and will deal with the MOA management, administration and coordination exclusively for the Project.

(120) The Kzyl-Orda Irrigation and Drainage Project Office is proposed to be established at the site and operated under the custody of the PIU. The Project Office will function as a construction office during the construction period of the project works. After completion of the construction work, however, this office will be re-organized by including the existing Hydro-department of Kzyl-Orda Headworks in the office, and will function as the Project O&M Office. The Kzyl-Orda Irrigation and Drainage Project Office in the construction stage will be organized by four divisions and one unit, i.e., Engineering Division, Agriculture Division, Administrative Division, Financial Division, and Monitoring and Evaluation Unit.

Project Evaluation

Economic Evaluation

(121) The average net return per hectare under the future "without project" conditions is US\$49.0, compared to US\$682.0 under the future "with project" conditions. The incremental benefit per hectare is US\$633.0, and the total benefit from the combination

of higher yields and more intensive cropping is US\$8.7 million annually at full development of 13,690 hectares. The economic internal rate of return (EIRR) of the Project is 11.3%. Also, the Ilyasov Area and Shagan Area were evaluated separately based on an allocation of total project costs. The result was EIRR of 13.4% for the Ilyasov Area of 6,480 hectares, and 10.6% for the Shagan Area of 7,210 hectares.

Financial Evaluation

(122) The financial internal rate of return (FIRR) is calculated to be 16.8% for the Ilyasov Area and 15.9% for the Shagan Area. Meanwhile, the net income per household in the Ilyasov Area increases from US\$251 before the Project to US\$2,857 in the third year when farms begin to increase production as a result of project investment. During the fourth through seventh years, net income per household increases to US\$3,790 at full production as the rice mill loan is repaid. After the rice mill loan is repaid, net income per household is US\$5,195. As for the Shagan Area, the net income per household in the first two years is \$294 without project benefit, rising to US\$2,311 in the third year, US\$3,354 in the fourth through 7th years, and US\$3,698 thereafter.

Indirect Benefit

(123) After the implementation of the Project, the following indirect benefits are expected:

- (i) Increase of employment opportunity,
- (ii) Activation of marketing system,
- (iii) Increase of government revenue,
- (iv) Enhancement of living conditions,
- (v) Demonstration effect of improved farming practices,
- (vi) Foreign currency earnings, and
- (vii) Improvement of natural environmental conditions.

Conclusions and Recommendations

Conclusions

(124) Based on the recommendation made in Item (70), the feasibility study was made for the Priority Development Project in the Phase-II Study period and clarified that rehabilitation of irrigation and drainage systems and rural infrastructure including farm roads and domestic water supply system, improvement and strengthening of agricultural support system, and establishment of farmers' organizations including the agricultural cooperative and WUA would be needed for the successful agricultural development in the area.

(125) Through the implementation of the above-mentioned project components, the following benefits would be expected:

- (i) The agricultural production would largely increase and the farmers' income would accordingly increase; from US\$49/ha to US\$633/ha in economic value.

- (ii) Improvement of a portable water supply to farm household will improve their health and reduce the inconvenience time and drudgery of obtaining water.
- (iii) Rehabilitation and improvement of the existing irrigation and drainage facilities would realize irrigation water saving by about 2.4%, which would contribute to environmental conditions in the lower basin of the Syr Darya river including Aral Sea to some extent.

(126) According to the result of the project evaluation, the agricultural development in the Project Area is technically sound, economically feasible and financially viable.

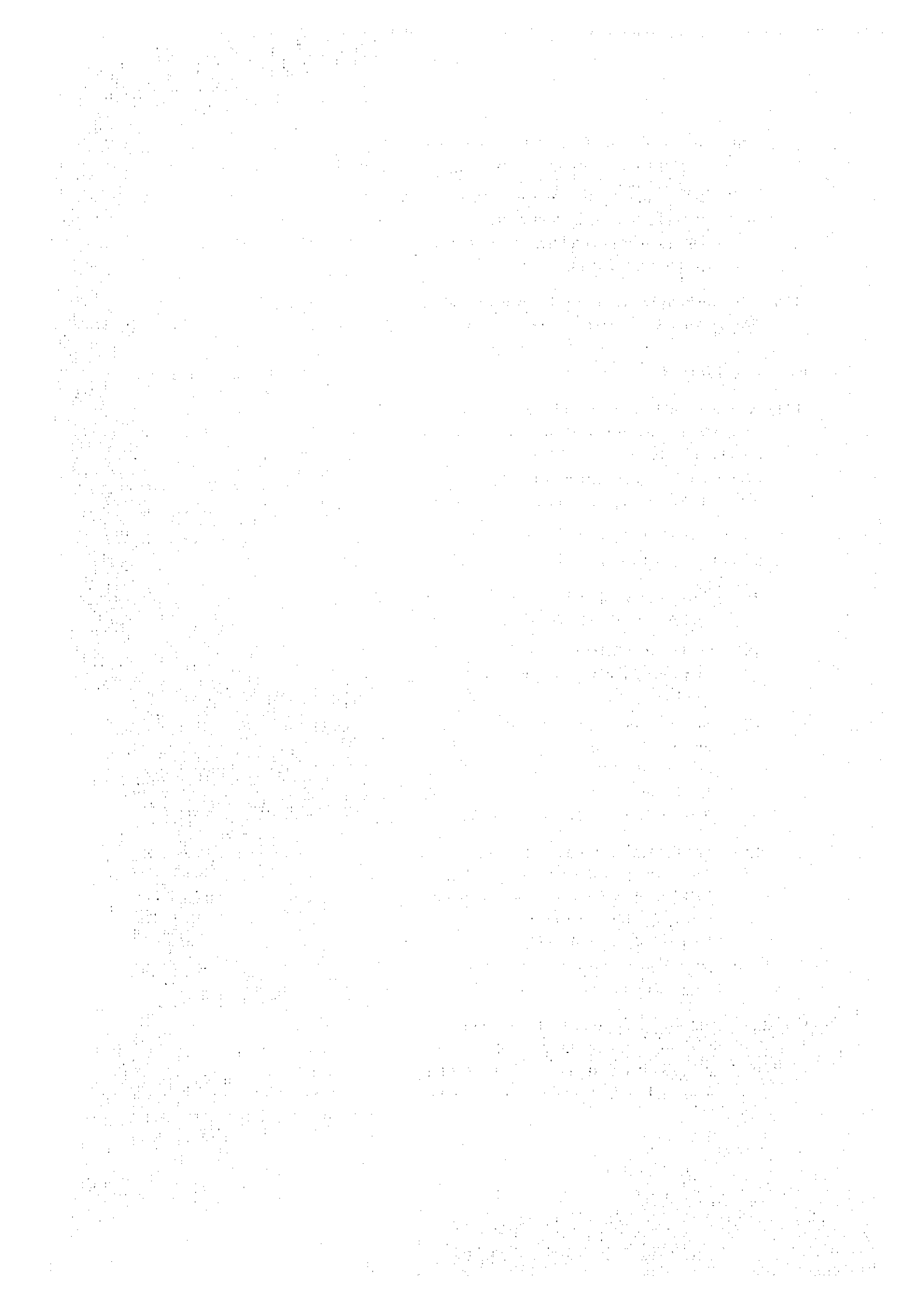
Recommendation

(127) As mentioned in the above, the implementation of the Project is technically sound, economically feasible and financially viable. Moreover, the Project will have many direct and indirect social and economic benefits to the residents of the area. Thus, it is recommended that the Project be implemented in two phases. The project components included in the respective phases are detailed in Item (115) hereof.

(128) For the sustainable agricultural development in the Project Area, it is recommended that the following activities be taken by the GOK:

- (i) The existing organization of the Pre-Aral Scientific Institute for Agro-Ecology and Agriculture should be reinforced for effective agricultural research.
- (ii) In the Project Area, MOA should assist in the privatization and commercialization process by including a Farmer's Participatory Training and Information Services Pilot component.
- (iii) Since the Project is intended to include a line of credit to finance operating loans and purchase of tractors and agricultural machinery, for which management concept is to make a "two-step" loan through some bank, possibly Narodny Bank and Agroprombank, the Government should assist them in strengthening their organization and management.
- (iv) For the successful and smooth achievement of the project implementation, it is necessary to establish the Project Implementation Unit (PIU) for dealing with the MOA management, administration and coordination exclusively for the Project, and to establish the Project Office at the site under the custody of PIU. The Project Office will function as a construction office during the construction period of the project works, and as the O&M office after completion of the construction work.

(129) In order to improve productivity and output in the Project Area, it is recommended to strengthen and improve the present farm organizations by creating an agricultural cooperative which will have the areas of product processing, marketing, inputs procurement and credit that current organization are unable to assist farmers.



KZYL-ORDA IRRIGATION/DRAINAGE AND WATER MANAGEMENT PROJECT

- Final Report -

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Abbreviations

ADB	Asian Development Bank
BVOs	River Basin Organizations (Union)
CCF	Construction Conversion Factor
CWR	Committee for Water Resources
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of United Nations
GOJ	Government of Japan
GOK	Government of Kazakstan
IBRD	International Bank for Reconstruction and Development, World Bank
ICB	International Competitive Bidding
IDIP	Irrigation & Drainage Improvement Project
IEE	Internal Environmental Examination
IPLR	Integrated Program for the Development of Land Reclamation
JICA	Japan International Cooperation Agency
JSC	Joint Stock Company
LMC	Left Main Canal
MOA	Ministry of Agriculture
MOEB	Ministry of Ecology & Bioresources
O&M	Operation & Maintenance
OECF	Overseas Economic Cooperation Fund
PIU	Project Implementation Unit
RDB	Red Data Book
RMC	Right Main Canal
SCF	Standard Conversion Factor
VAT	Value Added Tax
WARMAP	Water Resources Management and Agricultural Production in the Central Asian Republics
WUA	Water Users' Association
WUG	Water Users' Group

Local Organizations

AGROPROMTEKHNIKA	JSC dealer in tractors and farm machinery
AKBULAK	Small dairy in Kzyl-Orda city
AKMARZHAN	Large rice mill in Kzyl-Orda city
HURRICANE	Company supplying diesel and gasoline fuel
KAZGIPROVODHOZ	Collective enterprise design institute
KAZSELHOZTECHNICA	JSC dealer in tractors and farm machinery
KOKONIS	JSC purchasing vegetables and melons
KUNARLYLYK	JSC supplier of fertilizers and chemicals
TABYS	Commodity exchange in Kzyl-Orda city

Abbreviations of Measurements

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer

Area

cm ²	=	square centimeter
m ²	=	square meter
km ²	=	square kilometer
ha	=	hectare (10,000 m ²)

Electric Measures

kW	=	kilowatt	=	1,000 watt
MW	=	megawatt	=	1,000 kW
GW	=	gigawatt	=	1,000 MW
kV	=	kilovolt	=	1,000 Volt

Other Measures

%	=	percent
°	=	degree
'	=	minute
''	=	second
°C	=	degree in Celsius
PS	=	Horse Power (or Hp)

Volume

lit.	=	litter
cm ³	=	cubic centimeter
m ³	=	cubic meter
	=	1,000 lit.
MCM	=	million m ³
	=	1x10 ⁶ m ³

Weight

g	=	gram
kg	=	kilogram
t (ton)	=	metric ton = 1,000 kg

Time

sec	=	second
min	=	minute = 60 second
hr	=	hour = 60 minutes
	=	3,600 seconds
yr	=	year

Derived Measures

m ³ /sec	=	cubic meter per second
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Monetary

US\$	=	US dollar
J.Yen(¥)	=	Japanese yen
T.	=	Kazakstan Tenge (=100 Tyn)

Exchange Rate

US\$ 1 = T. 68.0 = J. Yen 110.0	(As of October 1996)
US\$ 1 = T. 75.0 = J. Yen 115.0	(As of August 1997)

PART - I

GENERAL BACKGROUND OF THE PROJECT

1.1 Introduction

1.1.1 Authorities

This report is prepared in accordance with Clause VI-2 of the Scope of Work (S/W) for the Study on the Kzyl-Orda Irrigation/Drainage and Water Management Project (the Study) agreed upon between the Government of the Republic of Kazakstan (GOK), through the Ministry of Agriculture (MOA), and the Japan International Cooperation Agency (JICA) on March 12, 1996. The S/W is attached to this report as Attachment I.

This report compiles the results of the survey and study conducted by the JICA Study Team in both Phase-I and II Study periods. The report is composed of three parts, i.e., Part-I, Part-II and Part-III. Part-I describes the general background of the Project. Part-II presents the master plan for agricultural development in the Kzyl-Orda Left Bank Area, which was established based on the data and information collected in the Phase-I Study Period. Part-III describes the result of the feasibility study of the priority project, which was made on the basis of the data and information collected mainly in the Phase-II Study Period. In the studies, the main emphasis was put on the present conditions of socio-economy, agriculture, irrigation, agro-economy, environment in and around the Study Area, the prospective agricultural development plan, the environmental conservation program, a preliminary cost estimate of the priority project, the project evaluations and the proposed development and implementation program of the priority project.

1.1.2 Background of the Project

Agriculture is the second most important sector in Kazakstan following the mining sector, showing 28% of GDP and 23% of total employment. About 75% of the total land area of the country, or about 200 million hectares, is used for agricultural purposes such as crop production and grazing. Kazakstan is broadly divided into three agricultural regions: the north region where rain-fed crop and livestock production are predominant; the central region where extensive grazing is being practised; and the south region where irrigated agriculture prevails. The main crops cultivated in the country are wheat, maize and cotton, but their yields are very low; 0.97 tons/ha of wheat, 2.84 tons/ha of maize and 2.25 tons/ha of cotton, mainly due to less precipitation; 250 mm per annum on an average. Livestock breeding is also an essential economic activity in this country particularly for beef, mutton, dairy products and wool.

In order to develop agriculture even under such conditions of less precipitation as mentioned above, the Government has been promoting an irrigation development program particularly in the southern part of the country, where water resources of the Syr Darya river are available. Under this program, the Kzyl-Orda Irrigation/Drainage Project was taken up in the 1940's mainly for paddy cultivation and completed in the 1960's. The water source for the

Project is the Syr Darya river which is also an important water source together with the Amu Darya river for Aral Sea. After completion of this project, about 87,000 hectares of paddy field has been opened up and become the rice granary of the country producing 70% of total production of the country. Recently, however, rice production is decreasing because of shortage of irrigation water caused by deterioration of irrigation facilities, salinization and inundation problems caused by mal-function of drainage facilities, unfavorable water management, worn-out agricultural machinery, less use of agricultural chemicals and fertilizers due to deficit of budget, and less institutional support.

In addition to the above-mentioned agricultural difficulties, the Syr Darya river basin is bearing the environmental problem particularly in and around Aral Sea. This environmental problem has been caused by large-scale irrigation development of 380,000 hectares along the Syr Darya river, including the Kzyl-Kum Project (73,600 hectares), the Kelintube Project (31,940 hectares), the Novochilisky Project (38,630 hectares), the Kzyl-Orda Project (103,500 hectares), the Kazalinsk Project (33,660 hectares) and others (98,670 hectares) which need a large amount of water intake from the Syr Darya river, resulting in decrease of inflow to Aral Sea, and as a result causes destruction of the ecosystem in and around the sea.

GOK, taking the above-mentioned adverse situation seriously, requested the Government of Japan (GOJ) for technical assistance to conduct the study on the Kzyl-Orda Irrigation/Drainage and Water Management Project in November 1994. In response to this request, GOJ sent a Preparatory Study Team to Kazakstan and concluded the S/W for the Study with GOK on March 12, 1996.

Based on this S/W, the JICA Study Team was first dispatched by JICA to the Study Area in August 1996. The study team completed the Phase I Study in March 1997 and recommended to take up the rehabilitation of the Kzyl-Orda Headworks, the Left Main Canal, the North and South Main Collectors and rehabilitation and improvement of the Ilyasov and Shagan Farms as the Priority Project. Following this study, the field survey for the Priority Project was started from May 24, 1997 in the frame work of the Phase II Study.

1.1.3 Objective of the Study

The objectives of the Study are:

- (i) to prepare an overall Master Plan of the Study Area for the improvement of agricultural productivity considering the efficiency of water use, and contribution to the environmental condition of the lower basin of the Syr Darya river including Aral Sea for the long term,
- (ii) to conduct a Feasibility Study for the Priority Project identified through the Master Plan, and
- (iii) to carry out technology transfer to Kazakstan counterpart personnel through on-the-job training in the course of the Study.

1.1.4 Study Area

The Study covers approximately 87,000 hectares which have been irrigated by the Kzyl-Orda Left Bank Massive Irrigation System starting from the existing Kzyl-Orda Headworks constructed on the Syr Darya river (called "the Study Area" in this report). However, about 430,000 hectares encompassing the Study Area (called "Kzyl-Orda Left Bank Area" in this report), is taken for the aerial photo shooting, soil survey, land use survey and environmental study.

1.1.5 Activities of the Study Team

The Study consists of two phases: the Phase-I Study, which was mainly for the formulation of a master plan by reviewing the previous studies and design and analyzing data and information; and the Phase-II Study, which was for a feasibility study of the priority project. The Phase-I Study was carried out from August 18, 1996 to January 29, 1997, and the Phase-II Study was carried out from May 24, 1997 to March 20, 1998, as shown in Figure 1.1.1. The experts of the Study Team and their counterparts dispatched by GOK are listed in Table 1.1.1. The minutes of meetings held with MOA during these study periods are attached hereto as Attachment III through Attachment VIII.

1.2 General Economic and Agricultural Background

1.2.1 Land and Population

Kazakstan is a land-locked country in Central Asia bordering Russia to the north and northwest, Turkmenistan, Uzbekistan and Kyrgyzstan to the south, and China to the east, and is bounded by Caspian Sea in the west. The national territory is 2.72 million km² and extends 3,200 km east to west and 1,800 km north to south.

Kazakstan has a semi-arid continental climate with cold snowy winters and hot dry summers. Annual precipitation ranges from less than 150 mm in the north to 450 mm in the southern foothills. Kazakstan's land ranges from semi-arid steppes in the northern and central regions to desert and mountains along the southern borders with Uzbekistan and Kyrgyzstan. Most irrigated agriculture occurs in the south along the Syr Darya river. Crop land includes about 34 million hectares, of which about 32 million hectares is rain-fed and about 2.4 million hectares is irrigated. Soils are moderately fertile.

The National Statistical Agency estimated the 1996 population of Kazakstan at 16.5 million (6.1 persons/km²). Population peaked at 17.0 million in 1993 and since then it has been declining. The average annual growth rate for 1993-1996 in Kazakstan was -0.9%. This is due to both higher death rate than the average and emigration. The percentage of the population residing in urban areas is 59% with 41% residing in the rural sector.

The population of Kazakstan is comprised of eight major nationalities or ethnic groups. The largest is Kazak which presently accounts for 46% of the population. The nation was a multi-ethnic pluralist, secular society during the Soviet Period. With independence in 1991, the population's ethnic structure began to change with the emigration of Russians, Ukrainians and Germans.

During the 3 years; 1993 to 1995, about 1,124,000 Kazakstan citizens emigrated abroad in large numbers. The largest groups were Russians, Ukrainians and Germans as shown below.

Nationality	1993	1994	1995
Russian	170,129	283,154	160,883
German	88,212	92,586	82,657
Ukrainian	23,278	36,899	22,204

Source: National Statistical Agency

1.2.2 National Economy

(1) General

The Kazakstan economy is slowly pulling out of recession, with expected GDP growth forecast at 1.5% for 1996, and 3% for 1997 as shown in the following table:

Economic Indicator	1994 ^{*1}	1995 ^{*1}	1996 ^{*2}	1997 ^{*2}
Real GDP (%)	-25.4	-8.9	1.5	3.0
Industrial Production (%)	-28.5	-7.9	0.7	2.0
Consumer Prices (%)	1,900	175	45	30
Trade Balance ^{*3} (US\$ million)	-330.5	1,193.5	1,969.1	-
Average exchange rate ^{*3} (tenge : \$)	36	61	67	75 (Aug.)

Note: ^{*1}; Actual,

^{*2}; EIU forecasts,

^{*3}; 1994-96 data source is the National Statistical Agency, Statistical Bulletin No.4 1996, Almaty, 1997,

Source: EIU, Country Report, 2nd Quarter, 1996

Fiscal and monetary policies have been held tight, with the result that the rate of inflation has been decreasing, and interest rates have declined. The oil and gas sector has recorded strong expansion and will continue to increase production, as foreign investment is spurred in response to conclusion of a new pipeline deal. Energy arrears have continued to rise as has inter-enterprise debt^{1/}.

Per capita GDP was US\$699 in 1994, US\$1,003 in 1995, and US\$1,276 in 1996. By the end of March 1996, 206,000 people were registered as unemployed; 4.2% of the work force (Annex E). However, taking into consideration people who are on unpaid leave, working without pay, or otherwise not registered, the real unemployment rate is probably 15% ^{2/}.

The budget deficit was 6.5% of GDP in 1994, and 2.8% in 1995. The IMF forecast of the 1996 deficit is 3.3% of GDP. Expected revenues and expenditures of the 1996 State budget are compared to 1995 in the following table:

State Budget	1995 Actual		1996 Budget	
	Tenge (billion)	% of GDP	Tenge (billion)	% of GDP
Revenue	188.0	18.9	241.7	18.6
Expenditure	215.3	21.7	285.7	22.0
Balance	- 27.3	2.8	- 44.0	3.4

Source: EIU, Country Report, 2nd Quarter, 1996

The grain harvest in 1995 was the worst since 1965; 9.5 million tons, compared to 18.5 million tons in the previous year. The target harvest for 1996 was 18 million tons. According to the Ministry of Agriculture, the estimated actual harvest as of October 1996 was 13 million tons, well below target because of very low yields caused by low precipitation. Livestock numbers have been dwindling since 1990. As of December 1996, the number of cattle was 5.4 million heads, including 2.5 million heads of cows. The number of sheep and goats was 13.8 million. Since 1994, the cattle herd has declined 31%, and there are only half as many sheep and goats ^{3/}.

As of 1995, private sector output accounted for 25% of Kazakhstan's GDP, compared to 7% in 1990. On an index scale of ten, progress in economic liberalization in Kazakhstan is rated

^{1/} The Economist Intelligence Unit, Country Report Kazakhstan, 2nd Quarter, 1996.

^{2/} Ibid.

^{3/} National Statistical Agency, Statistical Bulletin No.4 1996, Almaty, 1997.

as six by the World Bank as of 1995. For comparison, the Czech Republic scored above nine on the index, seven for Russia, and three for Turkmenistan ^{4/}.

(2) Foreign Trade

The annual trade balances for the period from 1993 to 1996 are shown in the following table:

(Unit: US million)			
Year	Imports	Exports	Balance
1993	471.6	1,485.5	1,013.9
1994	3,561.2	3,230.7	-330.5
1995	3,781.0	4,974.5	1,193.5
1996	4,261.3	6,230.4	1,969.1

Source: National Statistical Agency, Statistical Bulletin No.4
1996, Almaty 1997

The major exports of Kazakhstan are minerals, base metals, and vegetable products. Major imports are also minerals and base metals along with machinery and appliances. Kazakhstan's major trading partner is the Russian Federation which accounted for 48.9% of external trade in 1996^{5/}. Other CIS countries are next in importance as trading partners.

(3) National Economic Development Plan

Kazakhstan has adopted and started the implementation of a comprehensive structural reform program aimed at moving the country towards a market economy since the declaration of independence in December 1991. In May 1992, the Government announced the economic development strategy aimed at achieving a free market system within 15 - 20 years, which consists of: (i) establishment of laws and regulations for the promotion of a market economy including the privatization of state enterprises and implementation of restructuring of government organization; (ii) control of inflation; (iii) reconstruction of petroleum industry; (iv) liberalization of foreign trade; (v) improvement of unbalanced government budget through tax reform and reduction of government subsidies; and (vi) promotion of economic reform through tightening of money supply and reorganization of the financial sector.

Meanwhile, the World Bank^{6/} has established a strategy to assist the Government placing main emphasis on: (i) macroeconomics stabilization and price reform; (ii) transformation of the economy to a competitive, market-based system through privatization of state enterprises and encouraging competition from new market participants; (iii) strengthened capacity for social protection; and (iv) rehabilitation and improved management capacity for public infrastructure. Particularly for the agricultural sector, the World Bank, identifying low output prices in the country compared to world market prices, suggested a number of reforms

^{4/} IBRD, From Plan to Market, World Development Report 1996.

^{5/} National Statistical Agency, Statistical Bulletin No. 4, 1996, Almaty 1997.

^{6/} World Bank, Staff Appraisal Report, Irrigation and Drainage Improvement Project, Republic of Kazakhstan, May 1996.

in pricing, government procurement of agricultural commodities and trade policy designed to bring agricultural prices in line with world market levels.

1.2.3. Agriculture

(1) Present Situation of Agriculture

Agriculture has long been a significant sector in Kazakhstan's economy. In 1994, it counted for 28% of Gross Domestic Product (GDP) and provided employment to over 23% of total employment. About 200 million hectares, or 75 percent of Kazakhstan's total area, is used for cropping and grazing. Cropped land covers 34 million hectares, of which 32 million hectares is rainfed and about 2.4 million hectares is irrigated. Cereals cover about 62% of total cropped area with fodder crops, vegetables and industrial crops accounting for most of the rest.

Since dissolution of the former Soviet Union, the financial position of most farms has deteriorated markedly in the past five years, with a sharp increase in the number of farms reporting losses. The losses have been largely due to official pricing and marketing policy that depressed producer prices well below world market levels, while the prices of inputs were liberalized and increased. Under this condition, fertilizer application has dropped year by year, fuel shortages have disrupted planting and harvesting activities, and worn-out farm machinery has not been replaced. As a result, planting area has decreased and the yields of crops have dropped, causing sharply decreased production as shown below.

Crop	(Unit: '000 tons)						
	1986-90*1	1991	1992	1993	1994	1995	1996
Wheat	13,663	6,889	18,285	11,585	10,033	6,490	7,678
Barley	6,737	3,085	8,510	7,148	5,871	2,208	2,695
Paddy	590	521	467	403	282	183	226
Maize	493	330	367	355	233	136	122
Sugar beat	1,431	726	1,160	843	433	341	371
Sunflower	117	108	122	86	97	99	64
Cotton	321	291	252	200	160	223	183
Vegetables*2	3,676	3,401	3,842	3,286	2,967	2,498	2,436

Note: *1; Average value in the period from 1986 to 1990.

*2; Including potato and melons

Source: National Statistical Agency

The above table shows that the production of paddy; the most important crop in the Study Area, heavily decreased particularly from 1993 till 1996. While, according to Trade Year Book, FAO, Kazakhstan imported about 100,000 tons of rice in 1992 and 1993 respectively. Although no data are available for the import of rice since then, it is estimated that 200,000 to 300,000 tons of rice are being imported at present judging from the above-mentioned total production and import amount.

(2) Agricultural Development Policy and Strategy

As mentioned above, performance in agriculture has been declining heavily since dissolution of the former Soviet Union, particularly in the recent five years. The Government, recognizing this crucial situation of the sector, has been emphasizing: (i) price and trade policy;

(ii) marketing reform; (iii) farm privatization and restructuring of the state enterprises; and (iv) improvement of agricultural productivity.

The establishment of price and trade policy is urgently needed to solve the cost-price squeeze caused by the fact that the prices for agricultural commodities have not been liberalized, but the prices for industrial products and agricultural inputs have been liberalized. Meanwhile, the market reform is aimed at privatizing the state enterprises that were formerly responsible for all the aspects of marketing of agricultural inputs and products and processing of agricultural commodities, establishing a free market system, and encouraging the entrance of new trading, input supply and processing firms into the sector.

Privatization of the state agriculture enterprises has been almost completed by early 1996. New entrants to the sector are being encouraged by the gradual development of a legal and regulatory environment conducive to commerce. Already many old structures for marketing and processing of livestock products, fruits and vegetables have been bypassed by private sector marketing channels. Less progress has been made in the development of alternative channels for grain trade though the private traders and exporters are offering increasing competition to former state owned firms.

Concerning the improvement of agricultural productivity, the agricultural research and extension service are of great importance for profitable agriculture. At present, there is no agricultural extension service system. Since fast progress of privatization in the agricultural sector and an increase of the number of private family farms are expected in the near future, the extension system and farmers' training program need to be established. Government has started setting up an extension service system in MOA for farmer's education and training. At the same time, the agricultural research institutes are being reorganized under the National Academy of Sciences at the national and oblast levels.

1.2.4 Irrigation Development

(1) Past Achievements in Irrigation Development

Water is a major factor for agriculture in Kazakstan, because annual precipitation is about 250 mm on an average, and therefore the successful development and management of irrigation infrastructure is of great importance for future development of Kazakstan's agriculture. In 1990, the total area equipped with irrigation facilities implemented by the Government was estimated 2.4 million hectares, of which about 70% is located in the five southern oblasts. The main water sources for irrigation are surface water which irrigates about 2,290,000 hectares (96%), groundwater for about 90,000 hectares and sewage water for 20,000 hectares.

(2) Irrigation Development Policy

A ten year investment plan for irrigated agriculture was prepared under supervision of the World Bank for the Ministry of Agriculture in 1994. The basis for development of the Ten-Year Plan was the report "An Integrated Program for Development of Land Reclamation (IPLR)" commissioned by the State Committee on Water Resources, prepared under the

direction of the Water Management Design Institute (Kazgiprovodkhoz) in 1991 and approved by the Kazakstan Cabinet. The IPLR covered the period 1991 to 2010. The first five years of the Plan included over 1,300 potential projects with a total of 562,000 hectares, including 160,000 hectares of new irrigation, 340,000 hectares of reconstruction and drainage in existing irrigation systems, and 62,000 hectares of estuary irrigation. The 1996 cost of this five year program would be about US\$4.0 billion. Economic feasibility and environmental impacts were not considered in the selection of projects.

Comments on the IPLR by the Cabinet and the State Economic Committee stressed that construction of new large irrigation projects will decrease because of limited water and financial resources. A subsequent report by the National Academy of Sciences (1993) on the effects of the break up of the Soviet Union confirmed the lack of funds for development of irrigated agriculture and placed priority on reconstruction of old irrigation systems. Construction was started on some projects in the IPLR five-year program, but most were not completed because of lack of funds.

Over 1,300 projects listed in the IPLR were screened according to economic, environmental and political criteria in preparation of the 1994 Ten-Year Plan of the MOA which identified 58 main projects costing US\$ 651 million (1994 price level). The Plan emphasized reconstruction of irrigation and drainage on existing and previously irrigated land, with only incidental irrigation of new land. In the Plan, the rehabilitation and improvement of the Kzyl-Orda Left Bank Massive Irrigation System is included as one of the highest priority projects aiming at the improvement of rice farming, for which about 1,100 hectares was selected in Akkumski Farm in Zhalagash Raion as a demonstration and training farm.

1.2.5 Institutional and Legal Framework Related to the Project

All the development activity in the agricultural sector is overseen by the Ministry of Agriculture (MOA), which is responsible for the development of agricultural policy, agricultural investment policy, new project development, management of the Land Fund, and development of the agro-industrial complex (Figure 1.2.1). A primary responsibility of the MOA is the coordination of all international development activity in relation to agriculture.

The Kzyl-Orda Left Bank Project is administered in collaboration with the Project Implementation Unit (PIU) of MOA; a unit which oversees all international lending and donor activities within MOA (Figure 1.2.2).

The project necessarily must collaborate with other legal and institutional units including the Committee on Water Resources (CWR), which operates and maintains the main irrigation system, including river basin management, reservoirs, international river treaties, dams and diversion structures, major pumping stations, and main canal inter-farm systems up to the farm head gates under the jurisdiction of MOA (Figure 1.2.3). The CWR oversees Oblast and Raion Water Resource Committees that carry out its programs at the local and district levels. The Committee on Land Relations and Organization of Land Use is carrying out the program of agricultural land reform and privatization also under the jurisdiction of MOA.

The research arm of the MOA, the Kazakstan Academy of Agricultural Sciences has been recently relocated to the Kazakstan Academy of Sciences, within which it is the research unit for agriculture, forestry, fisheries, water management, and agricultural economics.

The Ministry of Ecology and Biological Resources is the environmental policy, planning, and management agency of national government, which is responsible for the protection of natural resources (Figure 1.2.4). The ministry enforces limits on natural resource use and regulates pollution of water, soils and air. River water quality and drainage water are within the purview of the agency. The ministry also conducts environmental impact assessments of all new projects.

Other agencies with related mandates include: the Ministry of Geology which oversees groundwater resources; the Water Management Design Institutes (Kazgiprovodkhoz) which design irrigation and drainage systems; the Ministry of Construction, Architecture and Housing, which enforces norms and standards related to construction quality; the Ministry of Health, which is responsible for preventing and reducing the effects of the environment on health; and the Ministry of Economy, which approves new projects which involve government funding.

The World Bank has been conducting the study on the "Irrigation and Drainage Improvement Project (IDIP)" since January 1994 with the support of a Japanese PHRD Grant. Through this study, the World Bank identified 24 priority sub-projects over the country and intends to implement all these sub-projects in three phases within 5 years from 1997. In these priority sub-projects, there are no inclusion of any part of the Study Area.

PART - II

MASTER PLAN FOR THE KZYL-ORDA LEFT BANK AREA

2.1 Present Conditions of the Kzyl-Orda Left Bank Area

2.1.1 Location and Administration

The Kzyl-Orda Left Bank Area consists of four districts in the agricultural area west of the capital city of Kzyl-Orda in the central and eastern region of the Kzyl-Orda Oblast (Region). This oblast is an administrative unit located in south central Kazakstan bordering Uzbekistan to the south, Aral Sea to the west, South Kazakstan Oblast to the east and the Zhezkagan and Aktobe Oblast to the north. The Kzyl-Orda Oblast is comprised of 228,100 km² encompassing 8 raions (districts), 3 towns, 11 town type settlements, and 97 rural settlements. The Kzyl-Orda Left Bank Area includes agricultural and non-agricultural land on the left bank of the Syr Darya river. The Area encompasses 430,000 hectares: Syrdarya (37,500 hectares, 8.7%) with four farms, Terenozek^U (78,300 hectares, 18.2%) with four farms, Zhalagash (130,640 hectares, 30.4%) with ten farms, and Karmakshy (183,560 hectares, 42.7%) with seven farms as shown in Table 2.1.1 and Figure 2.1.1.

2.1.2 Population and Labor Force

The Kazakstan Census Bureau estimates the population of the Kzyl-Orda Oblast at 676,800 for October 1996. The population of the Kzyl-Orda Oblast is more urban than the national average; 429,900 (63%) reside in urban settings, of which 160,700 are living in Kzyl-Orda City, and 246,900 (37%) live in rural communities. Although the population of the Kzyl-Orda Oblast is remaining steady, there is an out-migration process underway, which is attributed to limited employment opportunities, showing the excess of out-migration by 13,700 in 1994, 8,900 in 1995 and 2,300 in 1996 (1st quarter) respectively.

The present population and the number of households in the Kzyl-Orda Left Bank Area is estimated at about 53,100 persons in 8,730 households based on the results of the farm survey in the Phase-I Study period, and the family sizes in the respective raions shown in the 1989 national census. The following table shows the present population and number of households in the Kzyl-Orda Left Bank Area in the respective raions.

	Syrdarya	Terenozek	Zhalagash	Karmakshy	Total/Average
Whole Raion					
Total Resident Population	47,300	29,700	38,600	42,900	158,500
Total Number of Households	8,017	4,869	6,226	7,150	25,984
Average Size of Household	5.9	6.1	6.2	6.0	6.1
Inside the Study Area					
Total Resident Population	9,426	11,149	18,026	14,508	53,109
Total Number of Households	1,597	1,828	2,907	2,402	8,734
Average Size of Household	5.9	6.1	6.2	6.0	6.1

^U The Terenozek Raion was included in the Syrdarya Raion on September 10, 1997 in accordance with the Presidential Decree of the Republic of Kazakstan, but the old names of these raions are used in this report.

The Kzyl-Orda Oblast is located within the Kazak region of the country and the ethnic structure reflects a profile quite different from that of the nation. Fully 93% of the population of the Kzyl-Orda Oblast is Kazak, only 4.3% is Russian and no other ethnic nationality comprises more than 1.0% of the total.

The following table identifies the economically active population in the Study Area.

Raion	Population in Kzyl-Orda Left Bank Area	Percentage of Economically Active Population	Economically Active Population in the Kzyl-Orda Left Bank Area
Syrdarya	9,426	45.2	4,261
Terenozek	11,149	45.4	5,062
Zhalagash	18,026	47.1	8,490
Karmakshy	14,508	46.0	6,674
Total	53,109	46.2	24,487

2.1.3 Natural Conditions

(1) Topography

The Kzyl-Orda Left Bank Area of 430,000 hectares, in which the Study Area of 87,000 hectares exists, extends over the alluvial plain lying in the left bank area along the lower reaches of the Syr Darya river. The plain extends almost in east-west direction having a length of 130 km and an average width of 33 km ranging from 25 km to 60 km. The plain is dissected in many drainage compartments by criss-crossing small streams and man-made drains. The elevation of the plain is EL.150 m at the east end and EL.120 m at the west end of the plain, which form a slope of 0.02%, while the land slope in north-south direction is almost nil. This flat topography has created many poorly drained areas forming swamps in the plains.

(2) Climate

The Kzyl-Orda Left Bank Area is located in the transition area of semi-desert and desert agro-climatic zone. It has a continental climate with hot and dry summers, and cold and snowy winters. The annual precipitation is scarce and decreasing towards west in the Kzyl-Orda Left Bank Area. The monthly and annual precipitation observed at 12 stations in the river basin are shown in Annex A. The mean annual precipitation in the area is estimated at 155 mm. The rainy season is from November to May and about 80% of precipitation has been recorded in this period. The average annual precipitation during the crop growing period (April-September) is only 40 mm, or 25% of the annual precipitation.

Mean monthly air temperature varies from -8.2 °C in January to 27.6 °C in July at the Kzyl-Orda Meteorological Station (Latitude 44° 51' North, Longitude 65° 30' East, and Altitude 128 m above the Baltic mean sea level). April to September are warmer months, when the temperature is generally above 20°C. The coldest period is from December to February with average temperatures below 0°C, which decreases to -8.2°C in January. The average duration of the period with the average daily temperature above 0°C is about 220-250 days, and the non-frost period is 175-185 days. The relative humidity is 56% on an average, varying

from 35% (June-August) to more than 80% (December-January) in terms of monthly average. North-east winds with average velocity of 3-4 m/sec prevail in the area. The strong winds take place in spring and at the beginning of summer. Sunny months are generally from May to September with a duration from 10 to 12 hours/day; whereas the sunshine duration in winter season decreases to around 5 to 6 hours/day.

Meteorological data at 5 stations located in the Syr Darya river basin are summarized in Table 2.1.2, and those at the Kzyl-Orda station are as shown in the following table:

Climatic Parameter	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Air Temperature	°C	-8.2	-7.3	0.8	12.9	19.7	25.5	27.6	24.5	17.9	9.1	1.1	-4.8	9.9
Air R. Humidity	%	79.2	77.3	71.7	50.1	41.0	35.4	35.3	35.7	40.4	53.5	72.1	80.3	56.0
Wind Speed	m/s	3.2	3.6	3.9	4.2	3.6	3.0	2.9	3.2	3.1	4.0	2.8	2.9	3.4
Sunshine	hrs	5.3	6.4	7.2	8.2	10.7	12.2	12.4	11.8	10.0	7.9	5.9	4.6	8.5
Precipitation	mm	16.3	13.9	18.7	18.7	19.1	8.5	5.0	3.4	3.6	12.5	16.9	18.3	155.0*

Note: *, Annual total

The location of the meteorological stations used in the Study is shown in Figure 2.1.2 and their observation periods are as shown in Annex A.

(3) Hydrology

(a) Syr Darya River Basin

The Syr Darya river with a drainage area of 240,000 km² is a water source in the Study Area. The Syr Darya river originates from Tien Shan ranges in Kyrgyzstan, where the river is called Naryn, then it flows down through Uzbekistan joining a right-side tributary called Chirchick and takes the name of the Syr Darya till Aral Sea. The annual precipitation varies from around 750 mm in the uppermost catchment area down to 100 mm near Aral Sea.

In the upstream basin, there are several large reservoirs, of which the most important one is the Toktogul in the Kyrgyz territory as shown below.

S.N.	Reservoir & Hydroplant	River Basin	Year of Operation	Effective Storage (BCM)	Installed Capacity (MW)	Yearly Ave Evaporation (BCM)
1	Toktogul	Naryn	1974	14.07	1,200	0.086
2	Chardara	Syr Darya	1965	4.24	100	0.719
3	Kayrakkum	Syr Darya	1956	2.57		0.333
4	Charvac	Chirchick	1970	1.60	600	0.024
5	Andghigian	Kara Darya	1980	1.60	100	0.035
6	Bugun	Bugun	1970	0.36		0.041
7	Chakir System	Chakir		2.08		0.038
Total				26.52	2,000	1.276

Toktogul reservoir regulates the river flow on a multi-annual basis. Shortly downstream of the inlet into the Kazak territory, the Syr Darya river enters the Chardara reservoir with a storage capacity of 5,220 MCM, from which its flow is regulated and released to feed a hydro-power plant, an irrigation canal and the downstream river course. The flow in

excess is spilled into the Arnasai depression in the Uzbek territory through a separate outlet controlled by gates. In the territory of Kazakstan, it flows in the South Kazakstan and Kzyl-Orda Oblasts. The river flows down for a distance of 1,650 km from the Chardara reservoir till Aral Sea. The river bifurcates into two channels, i.e., the Syr Darya and Karaozek, about 35 km downstream of Kzyl-Orda, and rejoins some 190 km downstream of the bifurcation point. Only two tributaries join the Syr Darya river from the right side; the Keles river, just before the Chardara reservoir inlet, and the Ariys river, some 250 km downstream of the reservoir. The contribution of these rivers to the Syr Darya river is minimal, since their flows are mostly diverted for irrigation along their upstream reaches.

(b) Chardara Reservoir

The Chardara reservoir, which is located at the boundary with Uzbekistan and started operation in 1965, is a multi-purpose reservoir; irrigation, hydropower and flood protection. The main purpose of the reservoir is to provide irrigation to the South Kazakstan and Kzyl-Orda Oblasts. The reservoir has a gross storage of 5,220 MCM, a dead storage of 980 MCM and an effective storage of 4,240 MCM. It is a very shallow storage with an average depth of only 6.5 m, and has a surface area of 890 km². The power house is located just at the dam toe in the Syr Darya river bed and has a total power generation capacity of 100 MW. The overall discharge capacity of the Chardara complex is 3,975 m³/sec (power house and outlet gates; 1700 m³/sec, Kzylkumsk canal; 200 m³/sec, and Arnasay outlets; 2075 m³/sec).

Monthly inflows of the Syr Darya into the Chardara reservoir are affected by the water uses in the upstream Republics (Kyrgyzstan, Tajikistan, Uzbekistan) and by the natural discharges regulated by the upstream reservoirs. The interstate agreement between Republics of Kazakstan, Kyrgyzstan, Uzbekistan, Tajikistan and Turkmenistan for the Syr Darya water use has been signed on February 18, 1992 at Almaty. According to this agreement, the annual share of Kazakstan is 10,000 MCM at 75% guarantee and 8,700 MCM at 95% guarantee. Average annual inflow of the Syr Darya river into the Chardara reservoir was 13,668 MCM during the period 1970-1996, which is higher than the internationally agreed volume.

The water share of the Chardara water release for the Kzyl-Orda and South Kazakstan Oblast is according to the criteria shown in the following table.

Oblast	Water Share (MCM)	
	75% guarantee	95% guarantee
Kzyl-Orda Oblast	7,200	6,050
South Kazakstan	2,800	2,750

(c) Aral Sea

The Syr Darya river flows into Aral Sea, forming a wide delta. In the last 33 years, the surface area of Aral Sea has decreased from 65,580 km² to 32,500 km², which has been caused by lowering of its water surface for some 16 m during the same period. Due to the lowering of the water surface, Aral Sea is at present divided into two portions; Large Aral Sea in the south and Small Aral Sea in the north. The Small Aral Sea, laying totally in Kazak territory, is fed by the Syr Darya river, whereas the Large Aral Sea is fed by the Amu Darya river, which flows in the Uzbek territory. Both portions of Aral Sea have no outlet. The Small Aral Sea (North Aral

Sea), pertinent to the present study, has lost 55% of its original surface as compared with that in 1963 (from 6,500 km² to 2,900 km²) and 70% of original volume (from 75 km³ to 22 km³).

(d) River Discharge

As mentioned above, the natural flow of the Syr Darya river is regulated by the Chardara reservoir and other reservoirs located in the drainage basin upstream. The monthly river discharge data are collected at 12 gauging stations, of which observation periods are shown in Annex-A. Of these stations, 9 stations are scattered along the Syr Darya river course and 3 stations on its tributaries as shown in Figure 2.1.2. Table 2.1.3 shows the average monthly and annual river discharge records at the said 12 gauging stations. The release of river flow from the Chardara reservoir is concentrated during the growing season from April to August, with about 70% of the annual total (Annex A).

The average annual river flow released from the Chardara reservoir during a 26-year period (1970-1995) was 12,272 MCM (388 m³/sec), varying from 5,266 MCM (166 m³/sec) in 1975 to 21,453 MCM (678 m³/sec) in 1993. The average annual volume of water available at the Kzyl-Orda Headworks is 8,076 MCM, and the annual volume diverted into the Kzyl-Orda Left Main Canal is 1,917 MCM (1985-1996) from the Syr Darya as shown in Table 2.1.4. The following table shows the average monthly discharge of the Syr Darya river and annual discharge volume at three observation stations.

Station	River Discharge (m ³ /s)												Annual Volume (MCM)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		Year
- Chardara	190	203	292	591	855	745	676	359	182	171	189	202	388	12,272
- K-Orda Headworks	169	183	216	266	459	453	392	310	169	133	149	165	255	8,076
- Kazalinsk	134	145	162	150	108	95	74	97	132	116	111	121	121	3,795

(e) Sediment Loads

The average annual suspended load in the Syr Darya river was 153 mg/lit varying from 37 mg/lit in January to 390 mg/lit in May during the period from 1970 to 1989 at the Kergelmes gauging station located 85-km upstream of the Kzyl-Orda Headworks. The average monthly suspended load at the Tomenariyk and Kergelmes stations is shown in Table 2.1.5. In the present study, the measurements of suspended loads were conducted at the 3 points between Kzyl-Orda and Zhalagash during September-October 1996, and the result showed that the average suspended load at the three points was 104 mg/lit. In addition, measurements were also conducted at 8 points in the irrigation canals and 8 points in the drainage canals at the end of the irrigation period, which showed 91 mg/lit and 112 mg/lit of average sediment loads respectively.

(4) Geology

The geology of the Kzyl-Orda Left Bank Area can broadly be divided into three types of sedimentary faces, which are Cretaceous, Palaeogene and Quaternary in ascending order. The Palaeogene deposits overlying the Cretaceous occur in the western part of the area. Generally,

the beds dip south to southeast in the area, and therefore the Quaternary deposits become thin westward along the Syr Darya river and thick toward the southeast.

The unconsolidated deposits, which widely extend over the area, can be divided into four units which are aQI, aQII, aQIII and aQIV members of the Quaternary age. The aQIV member exists along the Syr Darya river, while the aQIII member, which belongs to the alluvium age, occurs in the southern and western parts of the area. The total thickness exceeds 20 m, and the thickness of each layer largely varies. These deposits are mainly composed of sand, loam, and irregularly interbedded with lenticular deposition clay. The features of these deposits are as follows (Annex B):

Sand : composed of fine to medium-grained sand.

Loam : with frequent intercalations of thin sandy layers.

Clay : divided into clay and heavy clay with organic substance.

Geological structure of this area is characterized by the prevalence of folded structures of bedrock. The Cretaceous deposits are completely folded, while the Quaternary deposits lie in layers which are parallel or nearly parallel to the surface. Because of this, the thickness of the Palaeogene deposits is extremely variable. For instance, it ranges in thickness from about 10 - 100 m near the Syr Darya river to more than 250 m in the southern part of the Syrdarya Raion.

Figure 2.1.3 shows the geological map, the geological sections and the geological stratigraphy in the Kzyl-Orda Left Bank Area.

(5) Hydrogeology

(a) General Hydrogeological Conditions

There are two types of aquifer in the Kzyl-Orda Left Bank Area ; aquifer-I and aquifer-II. The aquifer-I stratigraphically lies above the aquifer-II, and these are bounded by impermeable layers consisting of the Palaeogene deposits.

The aquifer-I is composed of alternating beds of sand, clay and loam of Quaternary age. Clay of greenish gray or gray occurs isolated at the surface in some places, of which beds are of impervious strata. This material of aquifer is grains with varying size of sand and sandy layer. This aquifer may be divided into small units by interbedded clay.

The aquifer-II is mainly composed of alternating beds of sandstone and claystone of Cretaceous age, and affected by artesian water. It occurs in the depth of 50 m to 150 m below the surface. Many wells with 100 - 400 m depths have been dug down to this aquifer to get water for domestic and industrial use.

The surface dips from southeast to northwest, but this area is completely folded, and impermeable layers form a syncline in the central part of the area. Due to this, the aquifer-I

forms a small basin in the Terenozek and Zhalagash Raions. The groundwater in the aquifer-I appears to have accumulated owing to the geological structure in the area.

(b) Distribution of Groundwater

According to the records of groundwater level at 372 existing observation wells, the groundwater table stays at relatively shallow subsurface (2 - 5 m) over the area. Generally, the depth of the groundwater table tends to be deep in the central part of the area. The uppermost unconfined aquifer is subject to rapid fluctuations according to the seasons of the year and irrigation practices. The depth of groundwater ascends from 2 - 3 m to about 1 m in the Syrdarya and Karmakshy Raions, and 3 - 5 m to 0.5 m in the Terenozek and Zhalagash Raions during the period from June to September. The depth of the groundwater table below the surface generally tends to be deep in the Syrdarya and Karmakshy Raions between October to May, and shallow in irrigation seasons. Figure 2.1.4 shows a contour map of the groundwater table (Annex B).

(c) Salinity Hazard of Groundwater

According to the records of groundwater quality at the existing observation wells, the salinity concentration of groundwater ranges from approximately 700 to 36,000 mg/lit, and the concentration exceeds 2,000 mg/lit at 70% of the existing observation wells. The following table shows salinity concentration at the existing wells. The areas having a concentration of less than 2,000 mg/lit are mainly distributed in the northern and southern part of the Syrdarya and Terenozek Raions and a central part of the Karmakshy Raion, and the areas with high salinity concentration are scattered in the location of the valleys and the small basins, in which the groundwater table appears. Figure 2.1.5 shows the present condition of salinity concentration in the Kzyl- Orda Left Bank Area.

Salinity Concentration (mg/lit)	(Unit: Nos of well)		
	March	June	October
S<1,200	30 (7)	10 (4)	18 (6)
1,200≤S<2,000	77 (19)	56 (20)	43 (13)
2,000≤S<3,500	128 (32)	82 (30)	116 (37)
3,500≤S<6,500	121 (30)	74 (27)	78 (25)
6,500≤S<8,000	19 (5)	12 (4)	20 (6)
8,000≤S	30 (7)	42 (15)	41 (13)
Total	405 (100)	277 (100)	316 (100)

Note: The figure in parenthesis shows the percent against the total number of wells.

(6) Soils

(a) Soil Classification

Based on the result of the soil survey in the Phase-I Study period, the soil classification map on a scale of 1:100,000 was prepared for the Kzyl-Orda Left Bank Area of 430,000 hectares (Figure 2.1.6). This soil classification was assessed based on the soil texture, salt composition, soil depth, erosion and influence of surface water or groundwater. According to

this soil classification map, the following seven soil classes are identified in the area (Annex C).

(i) Alluvial-meadow Soils

These soils were formed by the alluvial deposit of loam brought in by the Syr Darya river. The soils are commonly covered with shrubs, grass and reeds. The surface layer of 0 - 10 cm depth shows spot salinization, while the layers below this are affected by non to strong salinization. The groundwater level is at 2.5-5.0 m below the ground surface.

(ii) Old Alluvial-meadow Soils

These soils were also formed by the alluvial deposit of loam brought in by the Syr Darya river. They are still under or after the desertification process. Therefore, they are covered with weeds and tamarisk trees. The soils are affected by spot to strong salinization. The groundwater level stays at 3.0-5.0 m below the ground surface.

(iii) Meadow-boggy Soils

These are the major soils in the flood plains of the Kzyl-Orda Left Bank Area. The soils are common in irrigated paddy fields and grazing land. They are black colored weakly structured sandy loam to silty loam soils which are characterized as typical paddy soil. Some of the soils show salt on the surface. The groundwater level stays at 1.0-10.0 m below the ground surface.

(iv) Takyrlike-Solnecheck Soils

These soils are affected by slight to strong saline or alkaline concentrations due to high water evaporation under the desertification process and they become muddy in the upper layer when they get rain. They occur in grazing land or covered with grass and bush. The groundwater level is at 5.0-10.0 m below the ground surface.

(v) Takyr and Takyrlike-Solnecheck Soils

These soils are characterized by medium to strong saline or alkaline concentrations due to high water evaporation after the desertification process, and they become muddy in the upper layer when they get rain. They are covered with weeds and bush. The groundwater level is at 5.0-15.0 m below the ground surface.

(vi) Solnechecks

These soils are characterized by very strong saline or alkaline conditions generated by high content of salt in the groundwater or high evaporation. They show severe salinization in the surface layer. They are not suitable for crop cultivation and, no vegetation is found in these areas. The groundwater level stays 2.0-10.0 m below the ground surface.

(vii) Sandy desertified soils

These soils, which are composed of sand to sandy loam influenced by high erosion rate, are developed in the hilly or hilly edge area. The soils are characterized by the low cation exchange capacity and the low content of organic matter. The groundwater level is at 1.0-15.0 m below the ground surface.

Based on the soil classification map mentioned above, the area extent of each soil class is estimated as follows:

Soil Class	(Unit : ha)					Total	(%)
	Syrdarya	Terenozek	Zhalagash	Karmakshy			
1. Alluvial-meadow Soils	2,240	680	500	2,200	5,620	(1.3)	
2. Old Alluvial-meadow Soils	15,420	19,810	22,510	35,980	93,720	(21.8)	
3. Meadow-boggy Soils	14,260	46,620	64,720	47,790	167,390	(38.9)	
4. Takyrlike-Solnecheck Soils	0	0	0	22,330	22,330	(5.2)	
5. Takyrs and Takyrlike-Solnecheck Soils	0	0	0	9,000	9,000	(2.1)	
6. Solnechecks	2,450	17,190	26,560	47,110	93,310	(21.7)	
7. Sandy Desertified Soils	3,130	0	16,350	19,150	38,630	(9.0)	
Total	37,500	78,300	130,640	183,560	430,000	(100.0)	

(b) Irrigation Suitability and Soil Salinization

Judging from the present land use in relation with the above soil classification, most of the Solnechecks are not suitable for agriculture due to high content of salt in the soils, while most of the Meadow-boggy Soils are suitable for irrigated paddy crop due to less permeable soil texture. Most of the Alluvial-meadow Soils are suitable for irrigated upland crops. The other soil classes are marginally suitable for irrigated agriculture, because they require some improvement of drainage condition to solve salinity or alkalinity problem. Thus, the area of each irrigation suitability classification is estimated as follows (Figure 2.1.7):

Irrigation Suitability	(Unit : ha)	
	For Paddy	For Upland Crops
Highly or Moderately Suitable	176,390	5,620
Marginally Suitable	121,670	292,440
Not Suitable	131,940	131,940
	430,000	430,000

Based on the above soil classification and in accordance with the Salinity Classification of Kazakstan, the salinity hazard of soil in the Kzyl-Orda Left Bank Area is evaluated as follows:

Salinity Hazard	Area (ha)	Proportion(%)
Slight	168,550	39.2
Medium	81,870	19.0
Strong	86,270	20.1
Very Strong	93,310	21.7
Total	430,000	100