3.2.2 Delineation of Project Area

According to the present land use mentioned in Paragraph 3.1.5(2), the net irrigation areas in the Ilyasov Area and the Shagan Area were initially 6,480 hectares and 7,210 hectares respectively (so-called original rice rotation area), and these areas had been fully irrigated until 1990. Since 1991, however, Kazakstan has been economically in a difficult situation, and actually only a negligible amount of budget has been allotted to the agricultural sector. This unfavorable economic situation has seriously affected the farm management also in the Project Area: insufficient O&M of irrigation and drainage facilities, insufficient repair and no renewal of agricultural machinery and insufficient procurement of farm inputs. As a result, about 5,200 hectares; 2,950 hectares in the Ilyasov Area and 2,250 hectares in the Shagan Area, are abandoned at present. After completion of the Project, however, these abandoned areas can physically be recovered to the cultivable land, because the rehabilitation and improvement of irrigation and drainage facilities, improvement of agricultural practices, proper water management and O&M practices, and establishment of efficient agricultural support system are intended under the Project. Therefore, the irrigation area to be productive under the Project is decided to be 13,690 hectares.

3.2.3 Availability of Water Resources

(1) Kzyl-Orda Headworks

The Chardara reservoir is a main water resource for the irrigation systems in the Kzyl-Orda and South Kazakstan Oblasts. The schematic diagram of the irrigation systems in the Syr Darya river basin is shown in Figure 3.2.1. The Kzyl-Orda Headworks, located about 920 km downstream of the Chardara reservoir on the Syr Darya river, is a water source for the Project Area. The river flow at the Kzyl-Orda Headworks is affected by the operation of the Chardara reservoir. The Chardara reservoir supplies water to the Kzylkumsk Canal and the Syr Darya river. The Kzylkumsk Canal takes in the water directly from the Chardara reservoir by a separate facility. Its average annual intake from the reservoir was 1,412 MCM during the period from 1985 to 1995. Meanwhile, the annual release from the reservoir to the Syr Darya river is fixed to be 8,150 MCM at 90% guarantee according to the operation criteria of the reservoir. However, average release from the Chardara reservoir was actually 12,272 MCM during 1970-1995. The available discharge volumes at several points along the river course are shown in Table 3.2.1. The water use of the river in 1996 is shown in Table 3.2.2 for the reference.

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 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 annual total) flows during the cultivation period. The 10-day available discharge during normal and dry years at the Kzyl-Orda Headworks is shown in Table 3.2.3. The monthly and seasonal discharges at the headworks are shown in the following table.

Return Period	Drought Discharge (m^3/s)												Discharge Volume (MCM)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Apr-Sep	Oct-Mar	Total
	Kzyl-Orda Headworks														
5 Year (Dry)	56.0	55.3	95.6	110.4	321.1	338.4	278.7	175.9	55.3	43.7	52.2	63.0	3,481	1,121	4,814
2 Year (Normal)	148.5	155.7	206.3	250.3	429.3	437.8	376.6	289.6	155.5	117.4	131.6	154.7	5,124	2,488	7,760

(2) Project Area

The river discharge at the Kzyl-Orda Headworks is diverted to the Left Main Canal and the Right Main Canal, and the remaining flow is used for the downstream irrigation areas and Aral Sea. The Left Main Canal supplies irrigation water to the whole Study Area of 87,000 hectares including the Project Area of 13,690 hectares. The water available for the 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 for the Project Area is estimated at 203 MCM, the available water is sufficient to irrigate the Project Area. The 10-day available discharge during normal and dry years for the intake into the Left Main Canal is shown in Table 3.2.4. The monthly discharges available for the intake into the Left Main Canal are shown in the following table.

Return Period	Drought Discharge (m^3/s)												Discharge Volume (MCM)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Apr-Sep	Oct-Mar	Total
	Left Main Canal (Project Area)														
5 Year (Dry)	-	-	-	11.0	161.9	174.3	152.0	86.2	-	-	-	-	1,632	-	1,632
2 Year (Normal)	-	-	-	40.5	181.2	190.9	176.4	107.7	-	-	-	-	1,854	-	1,854

Note): Dash indicates no release of irrigation water from the headworks.

The irrigation area and irrigation water use in the Project Area during 1985-1996 is shown in Table 3.2.5. The irrigation water requirement in the Project Area at the headworks under "with project" condition is estimated at 203 MCM for the irrigation area of 13,690 hectares, which is 80 MCM lower than the present irrigation water requirement of 283 MCM at the headworks during the period of 1985-1996 for 12,422 hectares. Therefore, about 28% of water can be saved at the headworks after implementation of the Project. The irrigation water requirement and water saving at the headworks after implementation of the Project are shown in the following table.

Farm	Irrigation Area (ha)	Irrigation Water Requirement at the Headworks		Water Saving (MCM)
		Present (MCM)	With Project (MCM)	
Ilyasov	6,480	150	96	54
Shagan	7,210	133	107	26
Total	13,690	283	203	80

3.2.4 Agricultural Development Plan

(1) Basic Concept for Agricultural Development Plan

Although there has been a high agricultural potential in the Project Area, agricultural production has stagnated at a low level, and shown a decreasing tendency during the past

several years. For agricultural production which is the product of yield and planted area, the important factors are irrigation and drainage systems which affect the planted area. It is therefore understood that the timely supply of water and timely drainage could be prerequisite for development of sustainable agriculture in the area. Apart from the water supply and drainage systems, it could be understood that the present farming practices, supporting activities and marketing system would have some room to be improved in order to raise agricultural production and farmer's income level through the establishment of productive and advanced agriculture and a modern marketing system in the Project Area. In this regard, the agricultural development plan will be formulated based on the following concepts:

(i) to remove and/or reduce the present constraints for agricultural production,

(ii) to formulate a reasonable cropping pattern and proper crop rotation to maximize crop production,

(iii) to establish improved and practical farming practices to achieve the proposed cropping pattern and yields,

(iv) to improve the agricultural supporting system such as extension service and agricultural credit system, and

(v) to improve or establish a farmer's organization for crop production, credit and marketing.

(2) Farm Household and Agricultural Labor Force

Based on the results of the farm household survey and farm survey, the average farm size and family size as well as the labor force per household in the Project Area are estimated as follows:

Items	Ilyasov Area*2	Shagan Area*3
Average Farm Size (ha/household)	11.5	8.0
Average Farm Size*1 (ha/household)	14.3	10.4
Average Family Size (persons/household)	5.1	5.8
Average Labor Force (persons/household)	3.0	3.2

Note: *1; Including the reserve land.
*2; including Ilyasov Production Cooperative and Berlek Peasant Farm.
*3; including Shagan Production Cooperative and five peasant farms.

According to the data collected from the Oblast Statistics Office, the population in the Project Area remained steady from 1994 to 1996 due to both higher death rate and emigration. The labor requirement is expected to decrease under the future "without project" condition because of reduction of irrigated area as mentioned in Paragraph 3.2.4(3), resulting in increase of emigration. Under the future "with project" condition, however, the labor requirement would increase after implementation of the Project, though slightly, because of increase in planted area. As a result, emigration would be less to the some extent, and the present labor force mentioned above will not be much different future.

The present labor requirement in farming is very low, because completely mechanized cultivation is being practiced in the Project Area as mentioned in Paragraph 3.1.5(5). In future

also, the labor requirement under the future "with project" condition will be low as mentioned in Paragraph 3.2.4(5). Therefore, the above-mentioned average labor force per household would be enough to cover the labor requirement under both present condition and the future "with project" condition.

(3) Future Land Use

At present there are 13,690 hectares of the original rice rotation area, which includes 5,200 hectares of presently abandoned area in 1996. Under the future "with project" condition, however, all the abandoned area will be recovered to a normal cultivation area, and all the original rice rotation area will be used for crop production. On the contrary, under the future "without project" condition, the actually irrigated area will continue to decrease due to shortage of irrigation water caused by deterioration of irrigation facilities, salinization and inundation problems caused by mal-function of drainage facilities, unfavorable water mater management, worn-out agricultural machinery, less use of fertilizers due to deficit of budget, and less institutional supports. The future decrease of the irrigated area is forecast as shown in Figure 3.2.2 based on data collected from both Ilyasov and Shagan Production Cooperatives. According to the result of this forecast, the presently irrigated area will decrease from 8,490 hectares in 1996 to 2,310 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 future "without project" condition. Based on the above study result, the future land use for both future "with project" and "without project" conditions is estimated as follows:

(Unit: ha)

Farm	Without Project			With Project		
	Abandoned	Irrigated	Total	Abandoned	Irrigated	Total
Ilyasov Area*1	5,700	780	6,480	0	6,480	6,480
Shagan Area*2	5,680	1,530	7,210	0	7,210	7,210
Total	11,380	2,310	13,690	0	13,690	13,690

Note:*1; including Ilyasov Production Cooperative and Berlek Peasant Farm.
*2; including Shagan Production Cooperative and five peasant farms.

(4) Proposed Cropping Pattern

For the establishment of a profitable and sustainable cropping system, paddy, wheat, safflower (or sunflower), vegetables, melons and lucerne are selected as the proposed crops after consideration of soil and climatic conditions, growth period, profitability, demand of foodstuff, crop rotation, soil conservation and soil fertility and environmental balance. Particularly for the soil and climatic conditions, selection of crop is made in consideration of tolerance to salinity and to high temperature in summer. Then, the recommended cropping system is established as shown in Figure 3.2.3 taking into account the crop rotation, requirement of livestock feed, conservation of soil fertility, prevention of accumulation of salt in the soil surface, farmers' desire and MOA's opinion.

As shown in this cropping pattern, rice-based cropping system is employed for the rotation of crops, and paddy cultivation area is about half of the cultivated area, because paddy is the most suitable and beneficial crop under the soil and climatic conditions prevailing over the Project Area, and moreover paddy cultivation is very effective for the desalinization of

agricultural lands. In addition, rice consumption is increasing due to increase in the proportion of Kazak people who consume rice more than other ethnic groups. Lucerne is also an important crop considering soil conservation and animal food supply, and will be cultivated in about 30% of the total cropped area. Wheat is also an important crop for local consumption, and about 13% of the total cropped area is allotted for its cultivation. Other crops such as vegetables, melons and safflower are also proposed to be cropped in 7% of the total cropped area.

The following table shows the cultivation area of each crop under the future "with project" and "without project" conditions:

(Unit: ha)

Crop	Ilyasov*1		Shagan*2		Total	
	without	with	without	with	without	with
Paddy	390	3,240	770	3,610	1,160	6,850
Wheat	100	850	220	940	320	1,790
Safflower	10	130	30	140	40	270
Vegetables*3	80	320	120	360	200	680
Lucerne	200	1,940	390	2,160	590	4,100
Total	780	6,480	1,530	7,210	2,310	13,690

Note: *1; Ilyasov P.C. and Berlek P.F.
*2; Shagan P.C. and 5 peasant farms.
*3; including melons

(5) Proposed Farming Practice and Farm Inputs

The presently prevailing large-scale mechanized farming will also be employed in future, because the field plots are very large and labor forces are limited. For the establishment of profitable and sustainable agriculture under such a farming system as well as the severe natural conditions, a package of improved farming practices, which include selection of variety, certified seeds, planting period, cultural practice and farm input, needs to be introduced to the area as detailed in Annex E.

The present low yields of crops are attributed to application of low dose of fertilizer, delay in planting and harvest, poor crop husbandry, and weed damage. In addition to these reasons, particularly for paddy, its low yield is attributed to uneven crop establishment which is caused by inadequate drainage due to undulation in the field plots. In order to increase paddy yield, therefore, elaborate land preparation should be made to attain complete drainage of surface water, during the period from germination stage to crop establishment stage (7 to 14 days after seeding). Such land preparation will be made by farmers themselves by using tractors, though it will take a certain time. Before completion of such land preparation, therefore, some measures should be taken as temporary solutions. For this purpose, what the farmers in South East Asia are commonly practicing is to provide some temporary ditches in the paddy field to attain better drainage in the field. This method could be applicable to the Project Area.

Since the Project Area is salinity prone, a proper crop rotation pattern should be determined to prevent salt accumulation on the soil surface. In this regard, it is intended to

cultivate upland crops after paddy cultivation in two crop seasons, except lucerne which is cultivated continuously for 3 years in general practices as mentioned in Paragraph 3.2.4(4).

The agricultural input requirements per hectare recommended for future farming practices are shown in Table 3.2.6 and summarized below:

	Seed	Fertilizer(kg)			Pesticide	Herbicide	Labor
	(kg)	N	P2O5	K2O	(kg)	(kg)	(man-day)
Paddy	300	150	80	30	5	5	6
Wheat	200	100	50	30	2	5	4
Safflower	80	80	60	20	2	5	6
Vegetables	3	180	80	30	2	0	75
Lucerne	5	30	60	30	0	0	5

At present, one of the reasons why the planted area is decreasing and planting season and harvesting are delayed is shortage and deterioration of agricultural machinery. Almost all the existing agricultural machinery in the Project Area have been used for many years, 8 to 9 years on an average, and more than half of them should be replaced now. The following table shows the number of major agricultural machines to be required under the future "with project" condition.

	Tractor	Plough*	Seeder	Mower	Combine
Ilyasov	108	57	9	12	54
Shagan	120	63	10	14	60

Note: *; including both plough and disc harrow

(6) Anticipated Yield and Crop Production

Present yields of crops in the Project Area remain at relatively low level and fluctuate year by year, especially during the period from 1992 to 1995, due to shortage of farm inputs, irregular irrigation water supply, poor crop husbandry and inadequate cropping period. Particularly, the low yield of crops during the period from 1993 to 1995 had largely been caused by drastic reduction of farm inputs. Considering such unusual crop yields in recent years, it is not correct to estimate the crop yields based on the yields in the recent years for the future "without project" condition. Therefore, the average crop yields in and around the Project Area for the period from 1986 to 1996 are taken as the yields of crops under the future "without project" conditions.

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. The yields of crops under the future "with project" condition are estimated on the basis of the present technology level, research outcomes on the yield potential, and crop yields of developed countries which are situated in the same latitude as that of Kazakstan (Table 3.2.7). The anticipated crop yields thus estimated for the future "without project" and "with project" conditions are shown below.

(Unit: ton/ha)

Crop	Ilyasov Area*1		Shagan Area*2		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

Note: *1; including Ilyasov P.C. and Berlek P.F.
*2; including Shagan P.C. and 5 P.Fs.

The future crop productions for both future "without project" and "with project" conditions are estimated on the basis of the proposed land use, cropping pattern and anticipated yields of crops as shown below:

(Unit: ton)

Crop	Ilyasov*1		Shagan*2		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	5,010
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

Note: *1; including Ilyasov P.C. and Berlek P.F.
*2; including Shagan P.C. and 5 P.Fs.

The amount of crop production under the future "with project" condition is about ten times as compared with that for the "without project" condition. An increase in the amount of crop production is mainly attributed to an increase of cropped area.

(7) Livestock Production

As mentioned in Paragraph 3.1.5(6), the animal population decreased in 1995 and 1996 due to the drastic change in farm management in the process of farm privatization, but it again started to increase from the completion of privatization in early 1997. However, this increase will not be more than in early 1990's, because the production capacity of pasture land and marketability of the livestock will be almost same in the future as at present. In this study, therefore, it is assumed that the animal population in the Project Area will not change from the 1990's level for both future "without project" and "with project" conditions.

(8) Marketing and Price

Prices of commodities and production inputs under the future "with project" condition are expected to remain the same as at present (1997) except for vegetables. Paddy and wheat will be milled on the large production cooperative. Rice and surplus wheat flour (if any) will be sold through a marketing cooperative or individually by farmers using the service of "Tabys" Commodity Exchange. Safflower seeds will be hauled to the oil processing plant in Shimkent and the refined oil will be sold on the local market, because Kzyl-Orda is deficit in production of cooking oils. Vegetables and melons will be sold through the marketing section of the agricultural cooperative newly proposed in Paragraph 3.2.9(1), or individually by

farmers to independent truckers or "Kokonis". Livestock products will be consumed by the farm population. If there is any surplus milk or meat production, it can also be sold in the Kzyl-Orda market.

The vegetable price used in the Master Plan was US$ 220/ton as reported by the Oblast Department of Agriculture in October 1996. Subsequently, in August 1997, the Department reported an average price for vegetables received by farmers in 1996 as US$ 118/ton. The most recent price was used earlier to estimate farm income under present conditions. However, it is believed that this price is too low, and consequently the price used for vegetables under future "with project" and "without project" conditions is US$ 220/ton. The higher price seems reasonable considering the World Bank stuff appraisal report for the Kazakstan Irrigation and Drainage Improvement Project (IDIP) estimated an average vegetable price of US$ 292/ton, and onions and potatoes were valued at US$ 420/ton.[15/]

(9) Agro-processing and Post-harvest Facilities

(a) Rice Mill

Under the future "with project" condition, paddy will be the main crop and occupy 50% of the total cropped area. Accordingly rice milling will be one of the main agro-processing activities in the Project Area. At present, there are some small rice mills and a large rice mill (capacity of 700 tons/day of paddy) of JSC "Akmarzhan" in and around the Project Area. In addition to these rice mills, a new rice mill (German-made) with a capacity of 20 tons/day has recently been built and another one (Russian made) with a capacity of 50 tons/day is under construction in the Shagan Production Cooperative.

The rice mill of JSC "Akmarzhan" shows a very low recovery of rice from paddy, only 50% (12% broken) and rice quality is very low, resulting in a low value of rice compared with the international standard. On the other hand, the two new rice mills in the Shagan Production Cooperative have a recovery rate of 65% including 6% of broken rice respectively, which is acceptable, though still inferior to the world standard of the first class rice, but their capacities will not be enough for the future quantity of rice production.

Under the above-mentioned conditions, it is proposed to construct additional rice mills in the Project Area. The required capacities of the additional rice mills are estimated in the following manner:

(i) The quantities of paddy to be milled are estimated for respective areas as shown below:

Area	Cultivation Area (ha)	Yield (tons/ha)	Production (tons)	Reserve for Seeds (tons)	Quantity for Milling (tons)
Ilyasov	3,240	6	19,440	970	18,470
Shagan	3,610	6	21,660	1,080	20,580

[15/] World Bank, Kazakstan Irrigation and Drainage Project, SAR Report No. 15379 KZ, March 29,1996.

(ii) The harvesting period of paddy is assumed to be from the beginning of September to the end of September.

(iii) The operation conditions of the rice mill are assumed as follows, based on the present conditions:

Operation period in a year		7 months
Operation days in a year		180 days
Number of shift in a day		3 shifts
Operation hours	total	24 hours/day
	net	21 hours/day
	annual total	3,800 hours

Based on the above estimates and assumptions, the total required capacities of rice mills are calculated for respective areas:

Items	Unit	Ilyasov Area	Shagan Area
Total quantity of paddy to be milled	tons	18,470	20,580
Net operation days in a year	days	180	180
Net operation hours in a day	hours	21	21
Operation efficiency	%	70	70
Required milling capacity	tons/hour	7	8

According to the above calculations, the required milling capacities are 7 tons/hour for the Ilyasov Area and 8 tons/hour for the Shagan Area, while the present capacities are estimated at 0.3 tons/hour and 5 tons/hour respectively based on the above-mentioned operating conditions. Therefore, it is proposed to newly install two rice mills with each capacity of 4 tons/hour for the Ilyasov Area and one rice mill with a capacity of 4 tons/hour for the Shagan Area.

(b) Storage Facilities

According to the results of the field survey, the available storage capacity in the Project Area is 19,010 tons; 7,260 tons in the Ilyasov Area and 11,750 tons in the Shagan Area, as detailed in Paragraph 3.1.9(4). On the other hand, the storage capacities required under the future "with project" conditions, were calculated as shown below:

(Unit: tons)

Items	Ilyasov Area	Shagan Area
Raw rice	6,500	7,500
Cleaned paddy	3,300	3,800
Polished rice and seeds	1,600	1,800
Byproducts	1,300	1,500
Wheat	300	300
Miscellaneous crops	500	500
Fertilizers and agro-chemicals	900	1,080
Total	14,400	14,900

From the above-mentioned present storage capacities and the future requirements, the additionally required storage capacities are estimated as follows:

Items	Ilyasov Area		Shagan Area	
	Shortage in Weight (tons)	Shortage in Floor Area (m^2)	Shortage in Weight (tons)	Shortage in Floor Area (m^2)
Raw rice	900	290	0	0
Cleaned paddy	2,600	830	2,700	860
Polished rice and seeds	1,250	400	1,250	400
Byproducts	800	260	200	60
Wheat	190	60	0	0
Miscellaneous crops	500	160	500	160
Fertilizers and agro-chemicals	900	290	1,080	350
Total	7,140	2,290 (say: 2,300)	5,730	1,830 (say: 1900)

From the above estimates, it is proposed to construct additional storage facilities with a total floor area of 2,300 m^2 for the Ilyasov Area and 1,900 m^2 for the Shagan Area.

(c) Processing and Post Harvest Facilities for Other Crops

As for the other crops than paddy, the quantities of production are nominal in the Project Area and mostly consumed locally at present after local processing as mentioned in Paragraph 3.1.9(2). From this fact, it is judged that the existing facilities have enough capacities and any additional facilities would not need to be constructed for other crops under the Project.

(10) Crop Budgets

Crop budgets have been prepared based on the future "without project" and "with project" conditions.

The results of financial crop budgets under the future "without project" condition are summarized in the table below. This table shows that the low yields of wheat and safflower are not sufficient to cover all costs of production.

Crop	Gross Value* (US$)	Production Cost & VAT (US$)	Labor Days (days)	Net Return (US$/ha)
Rice	767	558	5.6	209
Lucerne	195	190	4.1	5
Wheat	195	304	3.3	-109
Vegetables	1,507	890	59.3	617
Safflower	162	404	5.1	-242

Note: *; including byproducts

The financial crop budget for rice under the future "with project" condition is also examined and the result is presented in Table 3.2.8. The yield of paddy has been increased to 6 tons/ha as mentioned in Section 3.2.4(6). Production input costs for fertilizers, fuel, harvest labor, and hauling have also been increased compared to the future "without project" condition (Paragraph 3.2.4(5)). According to Table 3.2.8, the net return/ha under the future "with project" condition would be US$ 565.

The results of financial crop budgets under the future "with project" condition are summarized in the following table:

Crop	Gross Value* (US$)	Production Cost & VAT (US$)	Labor Days (days)	Net Return (US$/ha)	Increase from w/o (US$/ha)
Rice	1,282	717	5.9	565	356
Lucerne	491	277	5.0	214	209
Wheat	515	385	3.6	130	239
Vegetables	3,300	1,390	75.6	214	1,910
Safflower	780	724	5.7	56	298

Note: *; including byproducts

The last column of the table shows the incremental increase in income under the future "with project" condition to the future "without project" condition. The incremental income of rice is US$356/ha. Although safflower produces a net return of only US$56/ha, it has an incremental income of US$298/ha, because under the future "without project" condition, it has a negative return (-US$242/ha).

3.2.5 Irrigation and Drainage Development Plan

(1) Irrigation Development Plan

(a) Proposed Irrigation Method

(i) Water Conveyance Plan

The irrigation water, which is diverted from the Kzyl-Orda Headworks by run-of-river system, will be distributed to the farm land through the Left Main Canal. The head gates, built on both banks of the Left Main Canal, will control the quantity of water supply to each of the inter-farm/on-farm canals. The quantity of water supplied to the inter-farm/on-farm canals will be measured at the water delivery point, so called hydro-post, which was provided immediately downstream of the head gate.

In the irrigation area of the farms, the canal network consists of the inter-farm/on-farm canals, the field canals and the field ditches. The irrigation water of the inter-farm/on-farm canals will be conveyed to the field canals through the turnouts built on them.

At the on-farm level, the field ditches principally receive the water from the supplementary field canals through the offtakes. The direct intake to the field ditch from the inter- farm/on-farm canal will not be allowed.

(ii) Field Irrigation Method

The surface irrigation method will be applied at the field, such as flooding irrigation for paddy, furrow irrigation for vegetables and flooding/corrugation irrigation for the upland crops other than vegetables, taking into account the basic intake rate observed in the course of the Study. The depth of flooding water for paddy should be 5 to 10 cm. The irrigation application

interval for the upland crops will be determined by crop water requirements and Total Readily Available Moisture (TRAM). A moderate water supply is recommended.

(b) Irrigation Water Requirement

(i) Crop Water Requirement

The reference crop evapo-transpiration (ETo) in 10-day basis for crop growing period was computed by applying Modified Penman method. Other factors for the estimate of crop water requirement, such as Oasis effect, crop coefficient(Kc) and percolation rate for paddy, are the same as explained in Paragraph 2.2.7(2). Based on the proposed cropping calendar, the water requirements for crops (ET crop) were calculated as follows (Annex F).

Crops	Cropping Period	Sowing Time	Harvest Time	Average Kc	ETcrop (mm)
Paddy	120-days	May	Sep.	1.01	1,005.4
Spring Wheat	110-days	Late-Apr.	Mid-Aug.	0.71	591.5
Winter Wheat	280-days	Late-Sep.	Early-Jul.	0.51	584.9
Vegetables	120-days	May	Sep.	0.75	569.1
Safflower	120-days	May	Sep.	0.69	560.9
Lucerne	360-days		May/Jul./Sep.	0.90	1,056.2

Note: 1 ; Periods of sowing and harvesting are 30 days starting from the above date.
2 ;ET crop for paddy includes percolation water

(ii) Net Irrigation Requirement

Net water requirement for irrigation was obtained by subtracting groundwater contribution and stored soil water from the sum of crop water requirement and pre-irrigation water on a 10-day basis. The net irrigation requirements (N.W.R.) thus calculated for the irrigation period from April 10th to September are as follows:

(Unit: mm)

Crops	ET crop	Pre-Irr.	Groundwater	Soil Stored	N.W.R.
Paddy	1,005.4	120.0	-	-	1,125.4
S.Wheat	591.5	30.0	336.2	-	285.3
W.Wheat	487.3	-	244.5	58.5	187.3
Vegetables.	569.1	30.0	100.3	-	498.8
Safflower	560.9	30.0	204.6	-	386.3
Lucerne	951.5	10.0	489.2	40.3	432.0

Note : Vegetables represent water melon

(iii) Irrigation Efficiency

Irrigation efficiency is expressed by the percentage of net irrigation requirement to the diversion water requirement including all the above-mentioned losses. The proposed irrigation efficiencies, corresponding to the said water losses, are shown below:

- Application efficiency — 95 % for paddy and 70 % for the upland crops
- Weighted average of conveyance efficiency — 73% (which is obtained based on the efficiencies of 95% for the main canal, 90% for the Inter-farm/on-farm canals and 85% for the field canals)
- Operation efficiency — 80%

- Overall efficiency 52%

(iv) Diversion Water Requirement

Diversion water requirement for the irrigation period from April 10th to September was calculated as the average water requirement weighted with cropped area based on the proposed cropping pattern for the Ilyasov and Shagan Areas, as follows:

(Unit: MCM)

Area	Irrigation Area (ha)	Apr.	May	June	July	Aug.	Sept.	Total
Ilyasov	6,480	2.77	22.22	23.79	25.22	13.97	3.05	91.02
Shagan	7,210	3.08	24.74	26.48	28.09	15.58	3.40	101.37

The design water discharge for each canal will be the maximum diversion water requirement for the service area of each canal, taking into account the crop rotational pattern. For instance, the design water discharges for the secondary and supplementary field canal will be determined by the maximum water requirement for paddy only, and that for the field ditch will be taken place in the pre-irrigation period for paddy. Thus, the unit design water discharges applied to the canals are obtained as follows:

Unit Design water Discharge (lit/sec/ha)	Application to Canals
1.556	On-farm canals down to the last brigade
1.642	On-farm canal within one brigade & main field canals
1.700	Secondary and supplementary field canals
3.520	Field ditches

(c) Proposed Irrigation System and Facilities

(i) Proposed Irrigation System

The Project Area will be irrigated by two on-farm canals and six inter/on-farm canals, respectively. Those canal systems are branched off from the Left Main Canal between the PK-272 and PK-744 regulators as shown below:

Area	Irrigation Area (ha)	Related Regulators	Canal Systems
Ilyasov Farm	671	PK-272	LMK-6
	5,809	PK-402	LMK-8
Shagan Farm	3,056	PK-634	LMK-9, 12 & 14
	4,154	PK-744	LMK-11Y-3, 11G & 16
Total for Area	13,690		

(ii) Improvement of Left Main Canal and Structures

Headworks

The intake structure of the Kzyl-Orda Headworks will be improved, in order to control the intake water discharge to the Left Main Canal properly, and prevent the canal from the

deposits of incoming river bed materials of the Syr Darya river. Major works will include: (i) replacement of six intake gates and six scouring sluice gates; (ii) remedy of intake and downstream structures; (iii) improvement of energy dissipater. All the gates will be driven by electric motors and operated by a remote control system from the operation room.

Besides the intake structures, the lifting devices of five flood sluice gates will also be replaced for proper operation and control of the water level for the intake and water discharge downstream of the headworks. Those gates will also be operated by the remote control system from the operation room.

Left Bank Main Canal

The Left Main Canal with a length of 85.35 km will be improved by providing side-slope protection works on both banks of the canal for the entire length of canal, in addition to reshaping of the canal section by excavation and embankment. For the mitigation of seepage water from the canal, adequate measures will be provided. The concave section of the curved canal may be required to be provided with the bed protection works for the scouring.

The Left Main Canal runs through the old river course of the Syr Darya river for its upstream most reaches, which is circuitous for the distance of 9.0 km (Figure 3.2.4). The canal section of these reaches is very erosive and supplies much eroded materials to the downstream portion of the main canal, resulting in high maintenance and repair costs for the canal system. Considering this situation, a comparative study was made between the following two alternatives:

Alternative-1	Reshaping and concrete panel lining on both inside slopes of the canal section for the present canal reach of 9.0 km.
Alternative-2	Short-cut of the circuitous portion in a direct alignment and provision of concrete panel lining on both inside slopes of the canal section.

Since there would be no technical difference in construction between Alternative-1 and Alternative-2, the comparative study was made only from the economic viewpoint between them. The following table shows the result of comparison:

(Unit : US$'000)

Description	Alternative-1	Alternative-2
(1) Construction Cost		
(a) Civil work	6,813	3,293
(b) Land acquisition	0	9
Total, (a) + (b)	6,813	3,302
(2) Annual Equivalent Total Cost		
(a) Annual Equivalent Construction Cost*	687	333
(b) Annual Operation and Maintenance Cost	46	17
Total, (a) + (b)	733	350

Note : *; at the discount rate of 10% in the project life of 50 years

From the above comparative study, it can be concluded that Alternative-2 will be much more attractive from the economical viewpoint. After construction of the short-cut channel, the length of the Left Main Canal will be shortened by 5.97 km.

Canal Structures

The structure on the Left Main Canal are three bridges, five regulators, one hydro- knot to divert the water to the Right and Left Branch Canals with a head gate for one on-farm canal, one spillway, 38 head gates and others including currently unused head gates and unauthorized inlets. Those structures will need remedy and/or reconstruction depending on the respective conditions. In either case, all gates of the regulators and head gates will be replaced with new ones to control the water discharge properly. Other unused and unauthorized inlets will be disregarded or demolished under the Project. In addition to these structures, two road bridge will be required across the short cut channel for the crossing of existing roads.

The inlet of the spillway at PK-827+50 will be improved from the sluice way type to the over-flow type. In addition, 16 spillways of over-flow type without gates will be provided in front of all regulators and at certain places where spill-out facilities are required from hydraulic viewpoint.

(iii) Improvement of Irrigation Facilities in the Farms

Canals

All inter-farm/on-farm canals with a total length of 108,030 m will be lined, of which the LMK-9 inter-farm canal will be improved up to the turnout for the LMK-9EI, which is the last turnout along the LMK-9, to divert the water to the Shagan Area. The main and secondary field canals will be unlined in principle, except some sections of the canals in which much seepage water is expected due to high embankment. The discharge capacity and total length of canals proposed for the rehabilitation and improvement for each grouped irrigation area are shown as follows:

Grouped Area	Inter/On-farm Canals		Main Field Canals		Secondary Field Canals	
	Discharge	Length	Discharge	Length	Discharge	Length
	(m^3/sec)	(m)	(m^3/sec)	(m)	(m^3/sec)	(m)
LMK-6 & 8	6.36 - 0.30	44,000	1.70 - 0.07	26,490	0.53 - 0.14	10,500
LMK-12, 14 & 16	2.58 - 0.21	45,380	0.66 - 0.07	25,780	0.12 - 0.02	3,290
LMK-9	4.04 - 0.86	11,900	0.88 - 0.07	23,380	0.03	7,180
LMK-11Y-3 & 11G	1.49 - 0.21	6,750	0.79 - 0.10	7,610	0.23 - 0.07	950
Total Canal Length		108,030		83,260		21,920

Canal Structures

The canal structures, such as the turnouts, check structures, bridges, pipe road crossings and aqueducts, will be rehabilitated and improved, depending on the respective conditions. All gates for the turnouts and check structures will be replaced with new ones for proper water operation and management. The turnouts, which divert the water directly from the inter-farm/on-farm canals and main and secondary field canals to the field ditches, will be

integrated into the adequate numbers of new ones, taking into account the efficient field water management. The water measurement structures may be additionally required when the present brigade of farms are reorganized into the independent cooperatives. The total numbers of each structures for the rehabilitation and improvement, together with construction of new turnouts for integration of turnouts, are summarized for each grouped irrigation area, as follows:

Grouped Area	Turnouts		Check Gate	Road Clos'ng	Aqueduct
	Reh.	New	Reh.	Reh.	Reh.
LMK-6 & 8	65	68	29	12	-
LMK-12, 14 & 16	61	46	19	13	1
LMK-9	46	14	6	11	1
LMK-11y-3 & 11G	23	8	7	1	-
Total	195	136	61	37	2

(iv) O&M Roads

The Project will provide rehabilitation of the existing O&M roads for operation and maintenance of irrigation canals. The O&M roads for the Left Main Canal will be provided on both sides of the canal, which will have a width of 6 meters. If there is no existing road, the top of the bank will be used as O&M road. The inter-farm/on-farm canal and the field canals will be provided with O&M road on one side of the canals. All O&M roads for inter-farm/on-farm canals will be paved with gravel, and have a width of 6 meters for the inter/on-farm canals and 5.0 meters for field canals. If the farm roads are provided along the canals, the roads will be improved as a farm roads.

(2) Drainage Development Plan

(a) Proposed Drainage Method

(i) Field Drainage Method

For the sub-surface drainage, three types of drainage method, i.e., the open drain method, the lateral under-drainage method, and the vertical under-drainage methods are practiced in Kazakstan. The open drain method is cheaper in the construction cost (US$100/ha) but needs a wide area for its right of way. The lateral under-drainage method is most common for heavy clay soil but requires high construction cost (US$16,840/ha) as compared to the open drain method. The vertical under-drainage method is very effective to control the groundwater table but needs a big amount of investment cost (US$14,725/ha) and O&M cost (US$217/ha/year). In addition, the frequency of pump operation for the vertical under-drainage method will be very low, because the proposed cropping pattern is a rotational cropping with paddy as a leading crop combined with the upland crops, such as lucerne, wheat and vegetables for the home consumption in the farms.

From the above view, the field drainage method was studied for the Project and it is concluded that the open drain method would be applied for the sub-surface drainage because of cheaper costs, clay loam in most soils in the Project Area, lowering of ground water table by 50 cm below the ground surface and no constraint in land acquisition of the right of way. The field ditches will be excavated to the depth of 1.5 meters below the ground surface at minimum,

taking into account the permeability of soils, spacing of the field drains and depth of the groundwater tables.

(ii) Drainage Canal System

The open channels will be provided with adequate water level to collect the percolated water along the channel. The drainage water at the farms will be discharged to the inter-farm/on-farm collectors though the field drains and field collectors. The collected water into the inter-farm/on-farm collectors will be basically discharged to the main collectors. To discharge the drainage water rapidly, the depth of drainage canal should be enough to flow down to the downstream.

(b) Drainage Module

(i) Design Drainage Module

The design drainage modules were estimated for the farm land and other land as mentioned in Paragraph 2.2.8 (2) and shown below (Annex F):

Land Category	Drainage Module (lit/sec/ha)
Farm land	0.398
Other lands than farm land	0.174

(ii) Design Discharge

The design drainage discharge was computed by applying the land area and drainage module for each land category. Among others, the design drainage discharges of the canals at the selected stations are presented below:

Drainage System	Station	Drainage area (ha)	Discharge (m^3/sec)
North Collector	At boundary of Ilyasov and Shagan Areas	19,217	4.85
	At ending boundary of Shagan Area	32,674	7.96
	At confluence with South Main Collector	33,840	29.82
South Collector	At mouth of Yuk-8 On-farm collector	2,145	0.66
	At Mouth of Yuk-12 inter-farm collector	18,405	4.63
	At confluence with North Main Collector	155,710	34.39

(c) Proposed Drainage System and Facilities

(i) Proposed Drainage System

The existing drainage system is proposed to be rehabilitated under the Project, which largely consists of the drainage system of the North Main Collector included in the Ilyasov Area and the northern part of the Shagan Area, and the drainage system consisting of tributaries of the South Main Collector; YuK-8 and YuK-12, in the Shagan Area. All the collectors to be rehabilitated under the Project will deal with only the farm land but not other land.

The Project will basically follow the existing drainage system. However, the drainage water in the upstream of the North Main Collector will be directly conveyed to the existing

North Main Collector in the downstream area by providing a drainage culvert across the Right Branch Canal. The existing diversion drainage channel will be no longer used.

(ii) Rehabilitation of Drainage Canals

Inter-farm/on-farm Collectors and Field Collectors

The Project will provide rehabilitation and improvement of the existing inter-farm/on-farm collectors and the field collectors in the Project Area. In addition to those collectors, the Y_UK-12 inter-farm collector will also be rehabilitated for about 20 km from the project boundary in the Shagan Area down to the confluence with the South Main Collector. All the collectors will be trapezoid earth canals and have enough depth to drain the water effectively. The lengths of inter-farm/on-farm collectors, the main field collectors and the secondary field collectors to be improved are referred to Paragraph 3.1.6(2).

Main Collectors

The North and South Main Collectors will be rehabilitated under the Project. These collectors will be unlined and have trapezoidal sections. Total lengths of the collectors to be rehabilitated are shown below:

Collectors	Length within Project Area	Length outside Project Area	Total
North Main Collector	39.8 km	79.9 km	119.7 km
South Main Collector	-	149.6 km	149.6 km
Total	39.8 km	229.5 km	269.3 km

(iii) Rehabilitation of Drainage Canal Structures

Structures on Inter-farm/on-farm Collectors and Field Collectors

The drainage canal structures on the inter-farm/on-farm collectors and the main and secondary field collectors consist of mainly drain inlets, bridges, road crossings and cross drains. The following table shows the number of structures to be improved under the Project.

Drainage System	Area	Canal Outlet		Bridge		Pipe R.Crossing	
		I/O-FDC	FDC	I/O-FDC	FDC	I/O-FDC	FDC
North Collector	Ilyasov	23	14	-	-	4	3
	Shagan	14	10	1	-	4	4
Sub-total		37	24	1	-	8	7
South Collector	Shagan	-	14	4	-	9	2
Total		22	38	5	0	17	9

Note: I/O-FCD; Inter-farm/on-farm Collector
FCD; Field Collector

Structures on the Main Collectors

For the North Main Collector, two crossing conduits and two bridges out of 14 existing ones will be improved, and one conduit will be newly constructed across the Right Branch

Canal. Three bridges out of 12 existing ones on the South Main Collector will also be improved under the Project.

(iv) O&M Road

For proper maintenance of the collectors, the banks of the North and South Main Collectors and the on-farm collectors will be used as O&M road. The roads will have a width of 6 meters on one side bank and 4.5 meters on the other side bank of the North and South Main Collectors and 3.0 meters on one side bank of inter-farm/on-farm collectors.

(3) On-farm Development Plan

(a) Improvement of Irrigation System

The irrigation rotation area will be equipped with one turnout and supplementary field canal, field ditches with the average number of 5 and offtake structures for farm ditches. A field inlet on the field ditch will be provided for each farm plot. The field ditch will be provided along the long side of the land unit. One irrigation rotation area will be irrigated by rotation on the basis of the irrigation farm unit. The proposed water distribution system is so designed as to irrigate the highest farm plot with enough water head.

The Project will provide the rehabilitation and improvement of existing supplementary field canals, field ditches and related structures, such as offtake and field inlet for each farm plot. In addition, new supplementary field canals will be required for the integration of turnouts which were provided for the field ditches to divert the water directly from the on-farm canals and main field canals as stated previously. The length and canal density of on-farm system to be improved and constructed are summarized below:

Grouped System	Supplementary Field Canals			Field Ditches	Canal Density	
	Reh.	New	Total	Reh.	F.C.	F.D.
	(m)	(m)	(m)	(m)	(m/ha)	(m/ha)
LMK-6 & 8	53,800	20,570	73,370	226,700	11.5	35.0
LMK-12, 14 & 16	40,590	19,640	60,230	155,660	14.5	37.5
LMK-9	17,250	9,000	26,250	75,080	13.4	38.3
LMK-11Y -3& 11G	10,600	2,300	12,900	41,480	10.8	37.9
Total	122,240	51,510	173,750	498,920	12.7	36.7

(b) Improvement of Drainage System

As the on-farm facilities for drainage, the farm lands are equipped with field drains, supplementary field collectors and drainage outlets to the main field collectors, the on-farm collectors and/or the main collectors. The outlets are mostly of natural flow type but some are sluice way type. On the other hand, since the dual-purpose canals of irrigation and drainage, so called Karta Chek, still exist in some farm lands, the new field drains are proposed to separate the drainage function from the dual-purpose canals. The following table shows the length of supplementary field collectors and the field drains to be rehabilitated and/or constructed under the Project together with the canal density (Annex F).

Grouped System	SFDC	Field Drains			Canal Density	
	Reh.	Reh.	New	Total	SFDC	FDD
	(m)	(m)	(m)	(m)	(m/ha)	(m/ha)
LMK-6 & 8	43,090	244,950	2,130	244,950	6.7	37.8
LMK-12, 14 & 16	35,660	161,910	2,230	164,160	8.6	39.5
LMK-9	17,000	80,350	-	80,350	8.7	41.0
LMK-11_V -3& 11_G	10,060	45,810	-	45,810	9.2	35.0
Total	105,810	533,020	4,360	535,270	7.7	38.9

Note: SFDC; Supplementary Field Collectors
FDD; Field Drain

3.2.6 Development Plan of Rural Infrastructure

(1) Farm Road

(a) Classification of Farm Roads

According to the standard of Kazakstan, farm roads are classified into three categories; (i) inter-farm road, (ii) on-farm road and (iii) operation and maintenance road for canal (canal O&M road). The inter-farm road which is given a function to connect a farm to other farms is maintained by the Oblast Administration. The on-farm road, of which role is mainly to support farm activities, is maintained by a concerned farm, while the canal O&M road is maintained by the Oblast Committee on Water Resources or a concerned farm depending on the canal category.

The on-farm road is further 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 (sometimes national road or provincial road) and important facilities in the village for the villagers' social activities and transportation of agricultural inputs and products outside the village. 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 the above-mentioned roads, the village roads and the main farm roads are dealt with as the rural infrastructure under the Project. The salient feature of the existing farm roads is already mentioned in Paragraph 3.1.4(1), and their network is shown in Figure 3.2.5.

(b) Present Condition of Village Roads and Main Farm Roads

(i) Village Road

There are three village roads with a total length of 4.5 km in the Ilyasov Area and also three roads with a total length of 2.4 km in the Shagan Area. All these roads are asphalt-paved because of their importance. Among these roads, 0.6 km of road connecting the village center of Shagan to the rice mill is seriously damaged, while the other roads are maintained in fair condition.

(ii) Main Farm Road

In the Ilyasov Area, there are eight main farm roads with a total length of 41.5 km, while there are seven roads with a total length of 38.5 km in the Shagan Area. Among these, 19.0 km in the Ilyasov Area and 12.3 km in the Shagan Area are asphalt-paved, and the remaining are gravel-metalled. At present, however, almost all these roads have been heavily deteriorated without proper maintenance and repair work.

(c) Rehabilitation of Farm Roads

Judging from the present conditions of village roads and the main farm roads as mentioned above, 0.6 km of the village road in the Shagan Area and all the main farm roads in both areas need rehabilitation to enhance farming activities. Considering future activation of the villagers' social activities and increase of agricultural inputs and production, all these roads will be designed to have a 8.0 m width both for asphalt-paved and gravel-metalled roads.

The rehabilitation plan of farm road network under the Project is shown in Figure 3.2.5, and specifically mentioned as follows:

(i) Ilyasov Area:

- Rehabilitation of the main farm road for 19.0 km with asphalt pavement and 22.5 km with gravel pavement.

(ii) Shagan Area:

- Rehabilitation of the village road for 0.6 km with asphalt pavement.
- Rehabilitation of the main farm road for 38.5 km with gravel pavement.

(2) Rural Water Supply

(a) General

As described in Paragraph 3.1.4(2), 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 works. 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 Kazakstan.

(b) Water Source

Water sources for the rural water supply in both areas are groundwater at the depth of 300 m to 460 m. There are four deep wells which are being used in the Project Area, one for the Ilyasov Area and other three are in the Shagan Area. The following table shows results of pumping tests conducted when they were constructed:

(Unit: lit/min)

	Ilyasov No.1	Shagan No. 1	Shagan No. 2	Shagan No. 3
Discharge Capacity	468.3	516.7	378.3	NA

Source: Kzyl-Orda Department of Hydrogeology

As mentioned in Paragraph 3.1.4(2), the quality of groundwater in the deep aquifers where water is taken is fair, but this water is contaminated, because the casing pipes in wells are damaged and allow groundwater leakage from shallow depths.

(c) Water Demand

Water demands are estimated based on projected population and estimated daily water consumption per capita. The projected population in the target year of 2007 is forecast based on an annual population growth rate of 0.3% during the period from 1989 to 1996 in the Terenozek Raion. The daily water consumption per capita is estimated at 75 lit/day referring to the Akkoshkar Water Supply Project near the Project Area. The water demand thus estimated is as follows:

	Projected Population	Water Demand (m^3/day)
Ilyasov Area	2,385	178.9
Shagan Area	3,850	288.8

(d) Water Supply Network

The water distribution network in the Shagan Area is well developed having enough capacity for the future increase of population, while that of the Ilyasov Area will not be enough in future. Moreover, in case of the Ilyasov Area, the density of the distribution network is low particularly in the central part of the settlement area where the population density has increased.

Taking into account the existing water supply conditions mentioned above, and further considering the settlement programs of respective areas, the water supply networks planned for both areas are shown in Figures 3.2.6 and 3.2.7.

(e) Water Supply Facilities

In order to achieve the proposed water supply plan, it is proposed to provide (i) new deep wells near the existing wells, (ii) rehabilitation and construction of delivery pipelines, (iii) rehabilitation and construction of standing pipe outlets, (iv) rehabilitation of water reservoir tanks, (v) provision of purification pits, and (vi) replacement of well pumps. The followings are the features of required water supply systems in the Ilyasov and Shagan Areas:

(i) Ilyasov Area:

- Construction of one deep well with a depth of 300 m.
- Rehabilitation of 4,600-m long delivery pipelines.
- Extension of 1,900-m long delivery pipelines,
- Rehabilitation and construction of 42 standing pipe outlets,
- Provision of one water reservoir tank with a capacity of 50 m^3.

- Provision of one purification pit with a capacity of 80 m^3.
- Replacement of one electric-driven pump.

(ii) Shagan Area:

- Construction of three deep wells: one for 300-m deep and two for 460-m deep.
- Rehabilitation of 9,000-m long delivery pipelines.
- Rehabilitation of 70 standing pipe outlets.
- Provision of three water reservoir tanks with a capacity of 50 m^3 for each.
- Replacement of three electric-driven pumps.

3.2.7 Improvement Plan for Water Management and O&M

(1) Proposed Water Management System

(a) Schema of Water Management

In due consideration of the current water management situations and the proposed development plans under the Project, an improvement plan for the water management and O&M of Project facilities was formulated as described below.

Water management in general stands for water operations through the institutional activities to the project facilities with an aid of the information management system such as monitoring system, communication system and data management system as depicted in Figure 3.2.8.

(b) Monitoring System

The monitoring system means the water level observation and discharge measurements at the stations called hydro-posts. The hydro-posts are furnished at each regulator site along the Left Main Canal and also each distributor head point which corresponds with the outlet point (or sometimes called delivery point) of the main irrigation canal as illustrated in Figure 3.2.9.

The discharge measurement with ten-day interval and the water level observation with 7 times per day have been carried out during the irrigation period at the hydro-posts of the Left Main Canal by the staff of the Hydro-Department of Kzyl-Orda Headworks, and those of the distributor canals by the staff of the Raion Management of Water Economy System.

The monitoring operations after implementation of the Project will be significantly improved by the installation of up-to-date devices to newly lined canals. Flume type discharge measuring devices are proposed to facilitate the measurement activities.

(c) Communication System

The monitored hydraulic data at the regulator sites along the Left Main Canal are directly sent via PK899 local station or Terenozek Raion Management of Water Economy System to the

Hydro-Department for Kzyl-Orda Headworks through the Angara radio communication system with a range of around 200 km.

Meantime, the monitored hydraulic data at the heads of distributors are transmitted to the Terenozek Raion Management of Water Economy System through the Len radio communication system with a range of around 50 km as indicated in Figure 3.1.10.

This information is integrated at the Oblast Committee on Water Resources for cross reference in context of the water delivery schedule and the amount of water actually released .

The local means of communication between the hydro-posts and the Len stations currently used are motor cycles, tractors and horses as the case may be. Wagon type patrol cars and motor cycles are proposed for local communication after the Project. The communication instruments will be modernized after implementation of the civil works. The communication system with O&M manuals will be specified during the final design stage.

(d) Data Management System

There is considerable room for improvement of the current data management system relevant to 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. Integrated operation with the communication system will enhance the overall performance in the data management system. The importance of a training program for the system engineers/operators should be stressed for the successful operation of the new data management system. The training program will be arranged by the manufacturers or vendors prior to the installation of the system.

(2) Proposed O&M System

(a) Facilities by Management Body

Major items of facility inventory by management body are presented in Table 3.2.9. The Kzyl-Orda Headworks and the Left Main Canal up to PK420 are directly managed by the Hydro-Department for Kzyl-Orda Headworks due to its structural importance and technical requirement. The North and South Main Collectors are managed by the Department of Zhana Darya Canal Management under the Kzyl-Orda Oblast Committee on Water Resources.

Meantime, the hydro-posts at the heads of the distributors and the inter-farm canal are managed by the Terenozek Raion Management of Water Economy System. The distributor canals refer to the on-farm canals in most cases and are managed by the Ilyasov Production Cooperative or Shagan Production Cooperative as shown in Figure 3.2.9 and Table 3.2.10. The present farm management in terms of water management and O&M of the project facilities is proposed to be reorganized into a water users association as described in Paragraph 3.2.9(2).

(b) Management Technology

The site survey and interviews with O&M staff of the relevant organizations clarified that as far as the O&M management technology is concerned, no serious drawback was

identified despite the facts that current O&M situations are seriously suffering from shortage of staff, scarcity in supply of spare parts, rusted metal works, silting of canal section and so on.

It should be taken into account that current O&M conditions originate from the financial deficit but not technical expertise. It means that the financial matters are able to be overcome through an arrangement of sufficient funds. An incremental revenue to the project account from a foreign loan has to link to starting up the monetary circulation of the project account in association with duly collected water charge from the water users.

(3) Proposed Institutional Structure

(a) Oblast Committee on Water Resources

The institutional structure of the current water management practices is shown in Figure 2.1.17. There are two lines of institutional systems comprising the Committee on Water Resources and farm management. The Committee on Water Resources plays a role of the water supplier and the farm management takes in position of the water user.

Current personnel arrangement of the Committee on Water Resources is tabulated in Table 3.2.10. The Terenozek Raion Management of Water Economy System is involved in the Project which proposes to rehabilitate ten hydro-posts and corresponding number of distributors (one inter-farm canal and nine on-farm canals).

Sufficient number of personnel seems to be assigned to the water management activities, but actually most of the personnel are engaged in the projects located in the right bank side. It is reported that only one hydro-engineer is engaged in the water management/O&M in the Left Main Canal. Therefore, it is recommended to improve this situation along with the matters described in the following paragraphs.

(b) Proposed Organization during Project Implementation

A Project Office as organized in Figure 3.2.10 is contemplated to set up during the project implementation period. The shaded box in Figure 3.2.10 represents the existing organizations relevant to the water management/Project O&M which are planned to incorporate with the project office according to the progress of works.

Thus, well qualified O&M staff will be ensured to conduct O&M activities during and after project implementation. The vocational training of the O&M staff is prerequisite for recruitment due to an introduction of new O&M technology entailed by project implementation.

(c) Formation of Water Users Association

The on-farm level water management has been practiced within the framework of the farm management under the initiative of the specialist (agronomist) based upon the top-down decision making system as presented in Figures 3.1.7, 3.1.8 and 3.1.9. This system involves no serious technical problem but there is considerable room for improvement from financial or social standpoints originating from the transitional economy and subsequent water pricing mechanism.

Under the circumstances, the water users association has been advocated as an improvement to the current farm-based water management despite the fact that eligible peasant farms as members of the water users association are still in an emerging stage and few in number. Taking into account the above-mentioned situation in the Project Area, it is proposed to reorganize the farm water management groups into four tiers as explained in Paragraph 3.2.9(2). The first step starts from the improvement of the current farm water management system into on-farm canal level water user associations corresponding to ten distributors as illustrated in Figure 3.2.9. The second step proceeds to the brigade level and finally reaches the individual farmer level as shown in Figure 3.2.11. This step-by-step approach basically conforms with the proposed irrigation canal system.

(d) Water Pricing Mechanism

The hydro-posts are placed at each head gate of the distributor canals and stand for the delivery point of irrigation water to the farms. The measured flow discharges are 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.

The original water cost is estimated by the Committee on Water Resources on the basis of the Water Cost Estimate Criteria stipulated in the Cabinet Decree. It comes to 12 tiyns/m^3 in the 1995 fiscal year. However, the farm side can hardly accept the estimated water cost which suppresses the farm finance. The water charge issues are finally settled by the Governor's arbitration which resulted in 5.63 tiyns/m^3 in 1995. The delivered water amount and water charge collected in 1997 are shown in Table 3.1.12.

Meanwhile, the Harvard Institute for International Development (HIID) is now 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 Kazakstan. Coordination with HIID may be required to scrutinize the subject matter.

(e) Annual O&M Cost

The annual O&M cost for the Project was estimated taking into account the necessary costs for heavy equipment, water management instruments, buildings and administration. The estimated O&M cost comes up to US$0.9 million per annum for the total Left Bank Area or US$65/ha per annum. Current O&M cost is US$17/ha per annum which is the sustaining level. Further details on O&M cost estimate are presented in Paragraph 3.3.4(5).

3.2.8 Improvement Plan for Agricultural Support Services

(1) Agricultural Research

During the reform era, there has been a dramatic decline in the funding and output of agricultural research entities. As noted in Paragraph 3.1.8(1), agricultural research is primarily the responsibility of the Kazakstan Academy of Sciences. In the past, the academy administered research farms and branch institutes for agricultural research throughout the

country. Many of these have been privatized. Within the Kzyl-Orda Oblast, there were three research institutes which administered state research farms. Presently there is one research institute in Kzyl-Orda Oblast; the Pre-Aral Scientific Research Institute for Agro-Ecology and Agriculture. It is primarily now involved in the production of paddy breeder seed and is disseminating minimal research materials for farmer consumption. Thus, the Project Area is not receiving current and relevant information on crop and animal production nor on marketing and water management.

An agricultural research component 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 the improvement of the social and agro-economic situation of the farmers.

The Ilyasov Area will have the site of a research and demonstration farm of approximately 100 hectares which will be used for: (i) breeding of high yield and high quality seeds; (ii) improvement of farming practices and soil fertility; (iii) post-harvest techniques; and (iv) improved water management. Research on environmentally sound farming practices would also be necessary to improve the present environmental conditions in the Project Area including the deterioration of water quality, soil salinization, and desertification. With regard to the improvement of the social and economic situation, research priority should be given to the improvement of marketing systems, land tenure and land holding, credit, and farm economy.

In addition, a strong linkage among the agricultural research institute's agricultural policy and extension divisions needs to be established for the distribution and transfer of newly developed technologies. The research activities of the Project would be carried out by the Agricultural Extension Office detailed in the following section.

(2) Agricultural Extension

The agriculture extension component of the project is summarized in Paragraph 2.2.5(2). It 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: that is to say, that training and information must be directed not toward large farm units and their managers and specialists, but toward all of those involved in the rapidly changing agricultural enterprise.

In the Project Area, it is important to assist in the privatization and commercialization process by including a Farmer's Participatory Training and Information Services Pilot component. This entails:

(i) Training specific target groups in farm management, agricultural techniques, irrigation practices, business planning, management, marketing, water user associations, and legal issues.

(ii) Demonstrations of improved and modern technologies for profitable crop production, efficient water management, operation and maintenance, and reduced environmental degradation.

(iii) Agricultural Extension Office which provides regular information on issues and techniques related to production and marketing through the production of pamphlets and other materials; and acts as a liaison office for the Project with respect to questions regarding agriculture in a market economy.

The Training Component entails the production of on-site expertise in market-based agronomy, water management, marketing, irrigation operation and maintenance, business planning, agricultural marketing, water user association and management, animal husbandry, business management, farm mechanization, and the legal environment of agriculture. Currently, agricultural expertise is disproportionately held by leaders and technical experts. Not only is the expertise inequitably distributed at the top, such knowledge expertise as is present is based on large scale crop and livestock production under state command agriculture. The purposes of training are to distribute agricultural expertise more broadly among the many constituents of the Project Area's agricultural system and to provide training that is fitted to a market economy. Those skills which are most demanded in competitive agriculture, such a business management and marketing, are those least evident among farm personnel. Moreover, as the farming system becomes more diversified and evolves to new economies of scale, it is crucial that such skills be imparted widely so as to facilitate a smoother and more rapid transition to market agriculture.

Training would be offered in on-site short course offered evenings and weekends to facilitate participation and would include workshops in:

(i) Agricultural business management,

(ii) Preparation of farm business plans,

(iii) Acquiring and managing farm credit,

(iv) Fundamentals of market agriculture,

(v) Basic agricultural marketing,

(vi) Water user association management,

(vii) Irrigation operation and maintenance,

(viii) Environmental aspects of irrigated agriculture, and

(ix) The legal environment of private agriculture in Kazakstan.

Classroom training would be supplemented with written materials and pamphlets published in the Kazak language and site visits to the Demonstration Farm.

The Demonstration component will be carried out on an easily-accessible 100 hectares area of rehabilitated land that is to be provided by the Ilyasov Production Cooperative. This land will be cultivated with rice and other crops including wheat, lucerne, melon, and vegetables. Its purpose would be to demonstrate effective land preparation, sowing and cultivation, on-farm water management, use of inputs, soils management, irrigation and drainage techniques, farm safety, water conservation, erosion control, and related topics.

The Agricultural Extension Office would function as an on-going office which would provide the basis and physical center for agricultural extension. Its functions would be to:

(i) Disseminate printed and other media materials to farmers (posters, pamphlets, newspaper articles, etc.),

(ii) Establish a library of relevant extension materials and media from various national and international sources,

(iii) Carry out demonstrations on the farm demonstration plot,

(iv) Serve as a liaison center for farmer questions and technical assistance, and

(v) Function as the office for training staff.

Training staff would be developed by expatriates who would "train the trainers" from the farm and the Project Office which would carry out demonstrations and training with consultant assistance.

(3) Agricultural Credit

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$ 2.1 million annually for five years to finance the purchase of tractors and farm machinery. This will cover replacement of approximately 20% each year of the total tractor and farm machinery investment needed for the Project of US$ 10.6 million at 1997 prices. The management concept is to make a "two-step" loan, meaning that the Project would make a loan to a commercial bank such as Agroprombank, and then the commercial bank would make loans to project farmers and manage and supervise the loans.

As discussed in Paragraph 2.2.5(3), it appears that neither Agroprombank nor Narodny Bank are presently capable of administering the agriculture credit program. 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 to project farms.

3.2.9 Development Plan for Farmers' Organizations

(1) Agricultural Cooperative

All farmers in the Project Area belong to either a production cooperative or a peasant farmer's association as described in Paragraph 3.1.8(5). Rural appraisal of these organizations

indicates that they are functioning adequately in the fields of farm management, crop production, and animal husbandry, but they are not functioning satisfactorily in the marketing of products, procurement of agricultural inputs and consumer goods, and financing. In order to improve productivity and output in the Project Area, it is intended to: (i) strengthen these existing organizations through training; (ii) create agricultural cooperatives that provides all of the project farms with marketing, input procurement and financing services; and (iii) organize water user associations (on-farm level). The organizational structure of the proposed cooperative is as shown in Figure 3.2.12.

All project area farms would participate in agricultural cooperative and benefit from the collective strength of cooperative marketing, financing, and participation in a water user association. The smaller peasant family farms do not presently have access to cooperative assistance in marketing and finance. Peasant farmers indicate that their most difficult challenges are in obtaining credits, accessing markets, and obtaining a reliable supply of irrigation water. They would benefit from participation in the agricultural cooperative.

The agricultural cooperative would differ from a Joint Stock Company or any existing collective organizations in that it would include three sections that are not now present in the Project Area. These would include Agro-Processing Section, Marketing and Procurement Section, and Financing Information Section as detailed in Figure 3.2.12 and the functions of these sections are explained in Table 3.2.11. It is in the areas of product processing, marketing, inputs procurement, and credit that current organizations are unable to assist farmers. 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. The cooperative would serve as a means for joint interaction with external constituencies including the Department of Agriculture, Committee on Water Resources, banks, private traders, marketing firms, and the Project Office, thereby increasing efficiency and improving the economies of scale.

(2) Water User's Association (WUA)

To assure equitable delivery of water to all the farms in the Project Area, WUAs are need especially for the new peasant family farms, which do not have adequate water supply or representation in water management. Currently, the hydraulic system serves multiple users and farms. Water is delivered to the head gates of the two former state farms, Ilyasov and Shagan, and then is centrally administered by those two units at the farm level. However, there are six peasant farms which function independently of the Ilyasov and Shagan Production Cooperatives, but they must rely on the larger farms for irrigation water.

The current system 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 WUA is designed to resolve each of these issues.

The Committee on Water Resources administers inter-farm systems and has resolved to develop water user associations to manage water at the local on-farm level. Additionally, the

farming system is constantly evolving within the new market context and it can be expected that during the project period, the farming system will continue to develop into smaller units of scale including more peasant farms and additional smaller production cooperatives. Formation of WUA's will provide the organizational mechanism for on-farm irrigation management. This proposal is fully supported by national, oblast, and raion officials as well as farmers themselves.

In an on-farm system serving multiple plots regardless of their size or type, the WUA administers water distribution, fee payment, and O&M while assuring equity through the WUGs. The WUA would be consulted at each stage of the Project, including feasibility, construction, and acceptance. For consistency, this project will use the WUA development model similar to the one developed by the World Bank Irrigation and Drainage Improvement Project. The organizational structure of the proposed WUA is as shown in Figure 3.2.11.

The steps in developing the WUA in the project area include:

(i) Site Selection: Identifying farms for initial trials. Criteria include evidence of poor water management, irrigation infrastructure decay, fee non-payment, and poor compliance with O&M plans. This stage is complete and includes the identified project area summarized in this report.

(ii) Initial Field Work: Conducting focus group discussions with farmers to assess the feasibility of forming a WUA in the pilot area. This stage has been completed as a part of the JICA Study Team's activities.

(iii) Public Consultation with Stakeholders: At a special session of the general assembly, the membership consents to establish a water user association. Benefits and costs are explained. Independent peasant farms within the Project Area would be included in the discussions and have the option to join the association. This consultation meeting was conducted on July 29, 1997 at two general assemblies in the Ilyasov and Shagan Areas.

(iv) Corporatization: The general assembly elects a board of directors which appoints a manager. In production cooperatives, the group may chose to use its existing board of directors. Representation from peasant farms must be assured.

(v) Development of by-laws: With technical assistance from the Project, the WUA leadership develops by-laws appropriate to their circumstances. These by-laws are ratified by the general assembly. A draft set of by-laws for the project area is appended in Annex D.

(vi) Design Review: WUA and WUG leadership are consulted in the design of the system's rehabilitation and construction. Project design is explained to the general membership and accepted. This stage would be carried out at the final design stage of the Project.

(vii) Construction: Members of the WUA participate in construction supervision. During construction, WUG leaders and WUA leaders are involved in monitoring construction.

(viii) Testing and Acceptance: Members of the WUA participate in final testing and formally accept the system and terms of loan.

(ix) Training: The O&M Plan is explained and farmers and hydro-technicians are trained in its implementation. Farmers are trained in the formation and administration of the WUA. This training is administered through the agricultural extension component of the project discussed in Paragraph 3.2.8(2).

The farmer surveys conducted in the step of initial field work indicates strong support for agricultural reform in the Project Area. All of the farmers interviewed support the privatization of agriculture and 66% support the privatization of irrigation. Over 80% said their situation had improved as a result of privatization. One hundred percent said they would be willing to join a water user association, if it would improve local water management. Over 80% said that they would engage in regular maintenance activities and would be willing to pay more for water, if it would improve supply and reliability. In the public consultation with stakeholders conducted for the Study, all the participants consented to implement the Project.

3.2.10 Environmental Consideration

(1) General

Based on the result of IEE as mentioned in Sub-section 2.2.11, the following environmental items are considered to be the significant impacts to be caused by the Project and therefore the Environmental Impact Assessment (EIA) is made for these items as mentioned in the following sub-sections:

(i) Negative impact to be caused during the construction stage,

(ii) Application of chemical fertilizer and agro-chemicals,

(iii) Salinization of land and water resources,

(iv) Impact on Tugai vegetation and marsh area,

(v) Change of inflow to Aral Sea, and

(vi) Fish loss.

(2) Environmental Impact Assessment (EIA)

(a) Negative Impact Caused during the Construction Stage

The relatively high magnitude of negative impact will be expected during the construction stage. The negative impact will mainly be caused by construction waste, increase of turbidity in the surface water and waste water from workers' camps. The main construction wastes are disposal of dredged and excavated materials from canal rehabilitation and construction under the Project. The quantity of materials for disposal is estimated as follows:

Item	Length (m)	Excavation (m^3)	Embankment(m^3)
Canal			
Left Main	79,300	2,974,000	4,112,000
Inter-farm/On-farm	108,000	180,000	2,548,000
Field	277,500	427,600	1,478,000
Collector			
North and South Main	269,500	16,700,000	97,100
Inter-farm/On-farm	121,100	1,023,500	46,100
Field	149,800	391,700	2,600
Total		21,696,800	8,283,800

According to the above estimate, the quantity of excavation would be 21.7 million m^3, of which 16.7 million m^3 or 77 % are in the North and South Main Collectors. Although most of these excavated materials can be used as the embankment materials for canal rehabilitation, the balance of 13.4 million m^3 between the excavation and embankment is necessary to be disposed of at some areas. It is judged that the high magnitude of negative impacts will be expected, if the selection of appropriate disposal area and proper construction management are not conducted during the construction stage.

According to the proposed construction plan, most of the earthworks on the irrigation canals will be implemented during the non-irrigation period so as not to disturb the irrigation water supply to agricultural land. As a result, the impact of water turbidity caused by earthworks will be almost nil.

During construction stage, around 2,000 workers per day will be employed in the Project. It means that 60 kg per day of BOD load (30 g/person/day x 2,000 persons) will be discharged from workers' camps without any proper treatment. These discharges will cause the deterioration of surface water and groundwater in and around the Project Area, and the high magnitude of the negative impacts will be caused, if the proper sanitation facilities are not installed in the workers' camps during the construction stage.

(b) Application of Chemical Fertilizer and Agro-chemicals

The application of chemical fertilizer and agro-chemicals in the Project Area would affect the water quality of both surface water and groundwater. The possibility of the impacts is examined on the basis of the difference of farm inputs between the present condition and the future "with project" condition as shown below:

(Unit : ton)

	N	P	K	Ca	S	Pesticide	Herbicides
Present Condition	450	160	80	130	520	10	10
With Project Condition	1,430	470	520	380	1,780	360	30
Balance	980	310	440	250	1,260	350	20

The above calculated result shows the large increase of load by inputs of chemical fertilizer and agro-chemicals as compared with the present condition in the Project Area. Based on these calculated results, the future change of surface water quality of Kuvan Darya river, which connects with the North and South Main Collectors, is estimated as follows:

(Unit : ppm)

Description	NH_4	NO_3	P_2O_4	K	Ca	SO_4	Pesticide	Herbicides
Present Condition	0.10	-	n.a.	7.6	120.2	960.7	-	-
"With Project" Condition	0.33	1.57	0.26	8.6	120.4	963.4	0.13	0.01
Standard								
- Domestic	2	45	3.5	50	180	100	-	-
- Fish	0.39	9	0.25	10	180	500	-	-
- Irrigation	-	-	-	-	160	600	-	-

Note : n.a. means that no data are available.

The above table shows that only a small impact is expected to the surface water of the Kuvan Darya river under the future "with project" condition. As for the groundwater, most of the drainage water flows into the field drain under the future "with project" condition. Therefore, it is judged that the elements of chemical fertilizer and agro-chemicals will not be accumulated in the groundwater, and accordingly the impact of chemical fertilizer and agro-chemicals would be small.

(c) Salinization of Land Resources and Water Resources

(i) Salinization in Agricultural Land

Based on the existing data and the result of soil survey and water quality analysis conducted under sub-let contract in the Study, a salt balance calculation is made employing the proposed cropping pattern described in Paragraph 3.2.4(4). The results are shown in the following table.

Year	Crop	Soil Salinity in Root Zone (ECe in mS/cm)	
		Ilyasov Area	Shagan Area
Present		3.88	4.61
1	Paddy	3.28	3.52
2	Wheat	4.49	4.82
3	Paddy	3.48	3.59
4	Lucerne	4.96	5.09
5	Lucerne	6.03	6.18
6	Lucerne	6.89	7.05
7	Paddy	4.26	4.32
8	Paddy	3.40	3.42
9	Wheat	4.73	4.76
10	Paddy	3.56	3.57

The above result shows the decrease of salinity content in the root zone after paddy cultivation and the increase after upland crops cultivation in both Ilyasov and Shagan Areas. After the completion of one cycle of 10 years, the salinity content in the root zone in both areas is about 3.60 mS/cm, which is lower than the present EC value. The decrease in salinity is attributed to proper drainage system and increase in the cropping intensity of paddy.

(ii) Salinity in the Collectors and the Kuvan Darya River

Based on the result of impact assessment for the chemical fertilizer and agro-chemicals, and salt balance, it is estimated that the salt outflow from the Project Area will increase by

39,800 tons in a year under the future "with project" condition. The increment of the salt outflow consists of 38,700 tons from soil and 1,100 tons from chemical fertilizer. At present, the discharge of the Kuvan Darya river is around 309 MCM at its head; the meeting point of the North and South Main Collectors, during irrigation period. Therefore, the increment of salt concentration in the river water from the present level to that of the future "with project" condition is estimated at 129 ppm. Since the present salt concentration in the Kuvan Darya river is 2,500 ppm, it is judged that this impact is very small.

(d) Tugai Vegetation and Marsh Area

According to the result of the EIA survey, the northeastern boundary of the Project Area is close to the Tugai vegetation area which is the most important ecosystem distributed along the Syr Darya river in the Kzyl-Orda Left Bank Area because of not only water conservation but also natural habitat for wildlife and birds including significant species. According to the result of field survey, however, the Tugai vegetation area is not involved directly in the area to be influenced by the irrigation and drainage systems, and also in the original rice rotation area. Therefore, it can be judged that the project impact is almost nil, if special attention is paid to conserve the area.

According to the result of land use survey, around 2,230 hectares of marsh area exists in the Project Area. This marsh area, which is occupied mainly by reeds along canals or around agricultural land, is also natural habitat for wildlife and birds. The area may disappear due to the improvement of drainage condition after the completion of the Project, if no action is taken to protect the area. In order to avoid this crucial situation in future, ecological maintenance water is included in the estimated irrigation water requirements.

(e) Inflow to Aral Sea

According to the result of the water balance study as mentioned in Paragraph 3.2.3(2), 80 MCM or about 28% water can be saved at the headworks after implementation of the Project. As a result, the discharge of the Syr Darya river to Aral Sea will increase from present 3,568 MCM to 3,648 MCM or 2.2% under the future "with project" condition. If the same irrigation development system as proposed in the Project is applied to other irrigation areas in the Study Area of 87,000 hectares, the discharge of the Syr Darya river to Aral Sea would increase from present 3,568 MCM to 4,076 MCM or 14.2% under the future "with project" condition. As a result, reduction of surface area of Aral Sea is expected to be restrained to some extent. In addition, the vegetation along the Syr Darya river would be recovered because of increase of river flow.

(f) Fish Loss

Due to improvement of the intake facilities of the Kzyl-Orda Headworks, and water saving mentioned above, the fish loss would be decreased to some extent. According to the estimate of Scientific Research Institute of Fish, the annual fish loss will decrease from the present 200 - 300 tons to 140 - 200 tons. In addition to this positive impact, the construction cost for the fish breeding pond needs to be included in the project cost following the Ordinance on "Protection of Fish Resource and Management of Inland Fishery" (Attachment VI).

(3) Environmental Monitoring Plan and Management Program

The Monitoring and Evaluation (M&E) Unit is proposed to be established in the Project Office as mentioned in Paragraph 3.4.1(3). The main duties concerning environmental monitoring and management of M&E Unit are as follows:

- To prepare a concrete monitoring plan and management programs.
- To conduct and supervise the actual monitoring.
- To analyze the data obtained through the monitoring.
- To propose and evaluate the management program.
- To conduct a special study for the environment, if necessary.

The monitoring items include the condition of disposal area, water quality and discharge of surface water, water quality and groundwater table, condition of farm inputs, condition of ecosystem and salinization of agricultural land. In addition, it is necessary to monitor the socio-economic condition of local people through result of baseline survey and setting of benchmark to be carried out in the design stage in order to clarify the project effect and complaints of local people. The summary of the environmental monitoring plan is as shown in Table 3.2.12.

Based on the result of monitoring, the M&E Unit will conduct the environmental management program. The environmental management program includes the evaluation of monitoring result, the preparation of annual or general work plan for the environmental protection such as the above conservation plan including budget allocation, the implementation and follow-up of the work plan and implementation of training related to environmental protection.

Based on the preliminary conservation plan presented in Paragraph 2.2.11 (2), and the result of the EIA mentioned above, the environmental conservation plan is prepared for a future reference. The plan thus prepared is shown in Table 3.2.13. This plan is recommended to be managed by the M&E Unit proposed in Paragraph 3.4.1(3), in cooperation with MOA, MOEB and the local government.

3.3 Project Works

3.3.1 Project Facilities

(1) Irrigation Facilities

In order to attain the final target of the Project, the rehabilitation and improvement work for the existing irrigation facilities is one of the major components of the Project. The work consists of: (i) rehabilitation of the Kzyl-Orda Headworks, (ii) rehabilitation and improvement of the Left Main Canal, (iii) rehabilitation and improvement of inter/on-farm canals and main and secondary field canals in the Ilyasov and Shagan Area. All the irrigation facilities to be rehabilitated and improved under the Project are summarized below:

Description	Quantity		
	Common	Ilyasov	Shagan
1 Headworks			
Left Bank Intake Facilities			
- Rehabilitation of Intake Structure	1 lot		
- Hydro-mechanical and Electrical Works	1 lot		
- Rehabilitation of Gate Remote Control system	1 lot		
Flood Way Facilities			
- Rehabilitation of down stream protection	1 lot		
- Replacement of Electrical Devices	1 lot		
Provision of Temporary Diversion Works	1 lot		
2 Left Main Canal			
Canal Length			
- Construction of New Canal	3.5 km		
- Rehabilitation of Existing Canal	75.9 km		
Related Structures	59 nos		
3 Inter-farm/On-farm Canals			
Numbers of Canal		4 nos	6 nos
Canal Length		44.2 km	63.8 km
Related Structures		74 nos	97 nos
4 Main and Secondary Field Canals			
Numbers of Canal		73 nos	69 nos
Canal Length		37.0 km	68.2 km
Related Structures		120 nos	177 nos

(2) Drainage Facilities

Taking into consideration the present flow capacities of the existing canals and topography in the Project Area, rehabilitation and improvement of existing collectors will be needed for enhancement of land productivity in the Project Area. The following table shows the drainage facilities to be rehabilitated and improved under the Project:

Description	Quantity		
	Common	Ilyasov	Shagan
1 North Collector			
Canal Length	119. km		
Related Structures	5 nos		
2 South Collector	149. km		
Canal Length	3 nos		
Related Structures			
3 Inter-farm/On-farm Collectors			
Numbers of Canal		7 nos	10 nos
Canal Length		26.5 km	75.3 km
Related Structures		27 nos	29 nos
4 Main and Secondary Field Collectors			
Numbers of Canal		24 nos	18 nos
Canal Length		32.4 km	17.0 km
Related Structures		17 nos	30 nos

(3) On-farm Works

In order to convey required irrigation water smoothly and effectively and to drain excess water from the farm lands properly, on-farm facilities such as supplemental field canals, supplemental field collectors, field ditches and field drains will be rehabilitated and improved as the on-farm works. The works to be carried out under the Project are as follows:

Description	Quantity	
	Ilyasov	Shagan
1 Supplemental Field Canal		
Numbers of Canal	91 nos	108 nos
Canal Length	74.4 km	99.4 km
Related Structures	328 nos	487 nos
2 Supplemental Field Collector		
Numbers of Canal	42 nos	66 nos
Canal Length	38.9 km	61.4 km
Related Structures	304 nos	306 nos
3 Field Ditch		
Numbers of Canal	314 nos	454 nos
Canal Length	226.7 km	272.2 km
Related Structures	2,290 nos	3,420 nos
4 Field Drain		
Numbers of Canal		
Rehabilitation	304 nos	450 nos
New	4 nos	4 nos
Canal Length		
Rehabilitation	244.9 km	290.3 km
New	2.1 km	2.2 km
Related Structures	2,860 nos	4,270 nos

(4) Farm Roads

In order to activate the transportation and communication in the Project Area, the improvement of farm road network connecting the centers of settlement areas to rice mills and brigade offices is essential. The following list shows the farm roads to be rehabilitated and improved under the Project.

Description	Quantity	
	Ilyasov	Shagan
1 Asphalt-Paved Road		
Number of Roads	1 no	1 no
Road Length	1.9 km	0.6 km
2 Gravel-Paved Road (20 cm thickness)		
Number of Roads	7 nos	6 nos
Road Length	22.5 km	38.5 km

(5) Village Water Supply Scheme

The water supply systems in the settlement areas both for Ilyasov and Shagan are seriously damaged and people are facing unfavorable conditions. For the improvement of rural life in the area by providing clean water, the following rehabilitation and improvement of water supply system will be needed under the Project:

Description	Quantity	
	Ilyasov	Shagan
Rehabilitation of Deep Well	1 no	3 nos
Water Supply Pipe Length	6.7 km	9.5 km
Water Supply Stand	42 nos	70 nos
Water Supply Tank	1 no	3 nos

(6) Buildings

For the management of construction and O&M of the project facilities, it is proposed to establish the Project Office at Kzyl-Orda city, which comprises an office building and a storage for the O&M equipment. Other than this office, five buildings will be needed at respective hydro-posts along the main canal. Since two buildings are available at present, though some repairing is needed, three buildings will be newly constructed under the Project. In addition to these offices, 14 brigade offices each consisting of an office building and a shade, and two store houses for raw rice and fertilizer storage will be rehabilitated or newly constructed.

The following table shows the number of buildings and their approximate sizes to be rehabilitated or newly constructed under the Project:

Description	Quantity		
	Common	Ilyasov Area	Shagan Area
1. Project Main Office			
(a) Office Building	600 m²		
(b) O&M Equipment Storage	1,200 m²		
2. Hydro-post Building			
(a) New Construction, 3 nos.	300 m²		
(b) Rehabilitation, 2 nos.	200 m²		
3. Brigade Office			
(a) Office Building			
- Number of buildings (new construction)		3 nos.	1 no.
- Floor area		1,200 m²	400 m²
- Number of buildings (rehabilitation)		3 nos.	7 nos.
- Floor area		1,200 m²	2,800 m²
(b) Shade		3,000 m²	4,000 m²
4. Store House		2,300 m²	1,900 m²

(7) Rice Mill

Almost all rice mills in and around the Project Area, except newly constructed rice plant in the Shagan Production Cooperative, are decrepit at present. Compared to the international standard, the performance of these mills is poor showing around 50% average recovery rate of the first class rice (12% broken rice). Therefore, rice mills need to be renewed for improving rice quality and recovery of rice from paddy taking into account the anticipated paddy production. The following table shows the required rice mill plants to be constructed under the Project.

Description	Quantity	
	Ilyasov Area	Shagan Area
Rice Mill Plant		
Plant Capacity	4 t/hr	4 t/hr
Required Number	2 nos	1 no
Rice Mill Building	1,500 m²	-

(8) Procurement of Farm Machinery and O&M Equipment

(a) Farm Machinery

In the Project Area, almost all the farm management is carried out by machinery to handle large-scale farming. Taking into consideration the working condition of the existing machinery in the Ilyasov and Shagan Areas, the following major farm machinery with attachments will be required and will be procured under the Project:

Description	Quantity	
	Ilyasov	Shagan
Tractor with attachment	56 nos	65 nos
Combine Harvester	42 nos	50 nos

(b) O&M Equipment

In order to carry out proper and efficient O&M and water management, it is proposed to procure the O&M equipment including heavy equipment and vehicles, communication system, meteo-hydrological observation equipment, survey instrument and some office equipment. The following table shows the required equipment to be procured under the Project:

Description	Quantity
Heavy Equipment	52 units
Vehicle	10 nos
Motor Cycle	60 nos
Communication System	7 lots
Data Processing System	1 lot
Meteo-hydro Observation Equipment	2 lots
Survey Instrument	3 lots
Office Equipment	1 lot

3.3.2 Project Services

(1) Training

(a) Training to Farmers

In order to develop farmers' skill and capacity to manage the irrigation system and farm management, training will be organized for target groups of water users' association (WUA) members as mentioned in Paragraph 3.2.8(2). The training will be provided in the fields of: (i) operation and maintenance of the project facilities; (ii) agricultural extension; (iii) cooperative and marketing; and (iv) water management. The training will be organized by the Agricultural Division in collaboration with O&M Division of the Project Office proposed in Paragraph 3.4.1(3) hereof.

Agricultural extension and water management training to farmers will include special short term training at the Demonstration Farm to be established in the Ilyasov Farm, organizing meetings with farmers of WUAs, farm walks to demonstrate practices on existing irrigation projects to the farmers, and field demonstration on the farmer's land.

There would be the following two types of training within a period of 2 years for each phase of the Project:

(i) The first type of training will deal with orientation. This will also include training on the attitudinal/behavior change of the farmers.

(ii) The second type of training will include formal, in depth training which will provide the main theoretical aspect of the operation and maintenance of the irrigation canal system, water management, agricultural extension and marketing. It will also provide them with practical training, such as farmers- to farmers training on the transfer of technical skills and management skills.

The role of trainers of the Project Office would be to assist WUA in identifying and selecting trainees. Local consultants will organize and conduct the training with assistance from foreign consultants. The trainers of the Project Office will provide day-to-day specific problem solving training to WUA members.

(b) Training for Project Office Staff

The Project Office will also organize training/seminars for its staff to develop their project implementation capacity. The staff training seminars will basically focus on: (i) orienting the staff towards the objectives and process of the Project to enable them to efficiently implement the Project; (ii) building a team approach among the staff to skillfully handle their team relations; (iii) reviewing project outcomes and suggesting improvement measures to collectively promote their project implementation capability. In the early stage of the Project, the Project Office will focus on (i) and (ii) types of training/seminars. In the subsequent year of the Project, the Project Office will focus on (iii) type of training/seminars. Local consultants, with assistance from foreign consultants, will conduct the training/seminars in close collaboration with the Project Office trainers. The Project Office trainers will prepare and organize the training/seminars with the help of the project consultants.

(2) Agricultural Strengthening Support

Under the agricultural strengthening program, the Project Office is proposed to provide the agricultural support fund under a technical assistance arrangement. The fund will be utilized by the Oblast Department of Agriculture, Kzyl-Orda, and the Prearal Scientific Research Institute for Agro-Ecology and Agriculture. The Project Office will be in charge of coordinating and monitoring the agricultural activities of the said two organizations with assistance of the project consultants. The Oblast Department of Agriculture and the Prearal Scientific Research Institute for Agro-Ecology and Agriculture will prepare an action plan in collaboration with the project consultants to utilize the agricultural support fund.

(3) Establishment of Demonstration Farm

In order to exhibit the results of agricultural research made by the Research Institute and to demonstrate the modern cultural practices, new varieties and new crops and efficient irrigation farming to the farmers, it is proposed to establish a demonstration farm in the Project Area. The site of the demonstration farm will have the area of 100 hectares to be selected in the Ilyasov Production Cooperative.

The roles of this demonstration farm would be:

- to establish optimum on-farm water management by crops,
- to evaluate the cropping season of each crops,
- to evaluate the newly introduced varieties and crops,
- to establish effective utilization of agricultural machinery,
- to establish most effective cultural practices including farm input application, and
- to establish effective soil management system.

In order to disseminate efficiently the irrigated farming techniques confirmed in this demonstration farm to the farmers in the Project Area, the demonstration plot will be arranged in the farmland of advanced farmers in each command area of the inter-farm canal of the Project.

This demonstration farm will be managed by an agronomist and an agricultural engineer to be dispatched from the Agricultural Division of the Project Office and some workers.

(4) Technical Support

(a) Consulting Services

Consulting services will be required to advise and assist the Project Office in: (i) designing the irrigation canal system and associated works of the drainage system and on-farm works; (ii) preparing bid documents and bid evaluation; (iii) providing construction techniques; (iv) providing construction quality control; (v) monitoring of progress of work; (vi) establishing operation and maintenance, and water management criteria, and training the farmers in the field applying these criteria; (vii) providing agricultural and farmers organization support; (viii) operating the demonstration farm; (ix) monitoring and evaluating the water resources and water supply; (x) planning work programs and budgets; and (xi) designing the project training program.

(b) Survey and Study

(i) Canal Route Survey

A canal route survey will be required for a length of about 840 km, consisting of 300 km for the irrigation canal system, and 540 km for the drainage system. This canal route survey will be conducted by local survey companies under the supervision of the project consultants.

(ii) Groundwater Monitoring

In the Phase I Study, 30 observation wells were newly constructed and 20 existing wells were rehabilitated in the Project Area for observation of the groundwater table and water quality. By using these wells, the water table and quality will be monitored at the interval of one month. This monitoring will be conducted by the Monitoring and Evaluation Division of the Project Office.

3.3.3 Implementation Schedule

(1) General

According to the result of the project cost estimate made in the following section, a huge amount of construction cost; US$ 291 million, would be required for the implementation of the Project, and it would be difficult for the Government to arrange sufficient funds for the construction of all the works at the same time. It is therefore proposed to implement the Project in two phases. Phase-I will include: (i) project office building; (ii) rehabilitation and

improvement of headworks, Left Main Canal (PK0 - PK402), North Main Collector, inter-farm/on-farm canals, on-farm facilities and rural infrastructure for the Ilyasov Area; and (iii) procurement of O&M equipment, water management equipment, rice mills and farm machinery also for the Ilyasov Area. While, Phase-II will include: (i) rehabilitation and improvement of Left Main Canal (PK402 - PK899), South Main Collector, inter-farm/on-farm canals, on-farm facilities and rural infrastructure for the Shagan Area; and (ii) procurement of O&M equipment, water management equipment, rice mill and farm machinery also for the Shagan Area.

The time required for implementation of the Stage-I Project 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. A tentative implementation schedule is prepared and graphically shown in Figure 3.3.1. Provided that the financial arrangements for the Phase-I and the Phase-II implementation are concluded by the end of 1998 and by the end of 2003 respectively, the construction of the work would be completed by early 2004 for the Phase-I and early 2007 for the Phase-II.

(2) Survey and Design

Immediately after the selection of the project consultant, irrigation and drainage planning and field survey including geotechnical survey and topographical survey will commence simultaneously. Following the completion of the survey work, detailed design for the rehabilitation and improvement of civil work and preparation of tender documents will be started and completed by the end of the third project year after spending about 2.0 years. The survey and design for both Phase-I and Phase-II works will be completed within this period in order to expedite the design of the Phase-II work.

(3) Phase-I Implementation

(a) Construction

(i) Office Building

The construction of the office building will be started from the beginning of the second project year and completed by the middle of the third project year, so that the office building will readily be available when the main construction work is started. The contractor for this construction work will be selected under local competitive bidding (LCB).

(ii) Rehabilitation of Project Works

Immediately after completion of the design work, an international tender will be made for selection of the contractor for rehabilitation and improvement of the project works spending about 6 months. Before start of this tendering, the pre-qualification of the tenders should be completed.

Rehabilitation of the Kzyl-Orda Headworks will be started first and completed by the middle of the fourth project year. The rehabilitation work for the Left Main Canal and inter-farm/on-farm canals and the North Main Collector will simultaneously be started from

September, in the third project year, and completed before the start of irrigation season in the sixth project year, spending about 2.5 years. Rehabilitation and improvement of the on-farm facilities in the Ilyasov Farm will be completed within about 1.5 years from the start of the off-season of irrigation in the fourth project year to the start of irrigation season in the sixth project year.

The rehabilitation and improvement of the rural infrastructure including farm roads and domestic water supply in the Ilyasov Farm will be implemented in the fifth project year, spending 9 months.

(b) Procurement

For the use of field survey, construction supervision, and other movement of the project office staff and project consultants, vehicles and office equipment will be needed from the commencement of the Project. For this immediate use, the procurement of these vehicles and office equipment will be completed before start of the construction work at the latest. All these equipment will be procured under international competitive bidding (ICB).

The procurement of O&M equipment and water management equipment will be completed before start of the full-swing operation of the irrigation system; by the start of the irrigation period in the sixth year. All this equipment will also be procured under the ICB system.

The rice mill and farm machinery for the Ilyasov Area will be procured under the ICB system in the fourth project year and the fifth project year respectively considering their present working capacities and the quantities of agricultural production which will gradually increase according to the progress of rehabilitation of the project facilities.

(4) Phase-II Implementation

The construction work and procurement included in Phase-II will be started from 2004, provided that the financial arrangement for the Phase-II work is completed by the end of 2003. All the construction work and the procurement will be conducted almost in the same duration and manner as those of the Phase-I work as shown in Figure 3.3.1.

3.3.4 Cost Estimate

(1) Basic Consideration and Assumptions for Cost Estimate

The costs for the project works and their relevant works and services are estimated based on the following conditions and assumptions:

(i) Conversion rate among Kazakstan Tenge (T.), US dollar (US $) and Japanese Yen (JPY) is assumed to be US$ 1.0 = T. 75.0 = JPY 115.0, referring to the current exchange rate as of August 1997.

(ii) All costs are estimated based on unit prices in July 1997. The unit prices comprise the foreign currency and local currency portions. The ratios of local

currency and foreign currency portions of the construction materials used in the unit price are determined through market survey in Kazakstan and shown below.

Items	Local C. (%)	Foreign C. (%)
Cement	20%	80%
Aggregate	90%	10%
Reinforcement Bar	20%	80%
Structural Steel	20%	80%
Precast Concrete Block	90%	10%
Timber	95%	5%
Concrete Pipe	90%	10%
Fuel	90%	10%

(iii) All the construction works for the irrigation and drainage canal systems as well as procurement of rice mill, farm machinery, O&M equipment and water management equipment will be carried out by the contractors selected through international competitive bidding (ICB).

(iv) Machinery and equipment required for construction work will be provided by the contractors themselves. The depreciation costs of machinery and equipment are therefore counted in the unit prices of the construction works instead of the procurement cost.

(v) The project administration cost including the staff salaries and operation and maintenance costs for the PIU-Kzylorda and project office is estimated at 5 % of the direct construction cost.

(vi) The cost for fishery compensation is included in the cost for the phase-II Work based on the Ordinance on "Protection of Fish Resources and Management of Inland Fishery" (Attachment VI).

(vii) A physical contingency of 10 % of the direct construction cost is included in the project cost.

(viii) The price contingencies are estimated on the basis of 3.0% per annum for the local currency portion after conversion to the US$ and 2.0% per annum for the foreign currency portion..

(2) Project Cost

The project cost comprises: (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 project cost estimate is divided into two portions, Phase-I and Phase-II, following the recommendation made in Sub-section 3.3.3.

The following table shows the summary of total project cost, of which details are shown in Table 3.3.1.

(Unit: US$ '000)

Description	Local Currency	Foreign Currency	Amount
Phase-I	79,700	50,978	130,678
Phase-II	105,386	55,110	160,496
Total	185,086	106,088	291,174

(3) Annual Disbursement Schedule of Project Cost

The annual disbursement schedule is worked out based on the project implementation program shown in Figure 3.3.1. The following table shows the summary of the annual disbursement schedule and the details are shown in Table 3.3.2.

(Unit: US$ '000)

Phase	Year	Local Currency	Foreign Currency	Amount
Phase-I	1999	2,094	1,138	3,232
	2000	1,555	2,075	3,630
	2001	12,205	8,179	20,384
	2002	26,496	14,243	40,739
	2003	27,807	19,404	47,211
	2004	9,543	5,939	15,482
	Total	79,700	50,978	130,678
Phase-II	2004	14,149	5,334	19,483
	2005	35,175	14,340	49,515
	2006	38,744	24,299	63,043
	2007	15,150	9,600	24,750
	2008	2,168	1,537	3,705
	Total	105,386	55,110	160,496
Total		185,086	106,088	291,174

(4) Replacement Cost for Project Facilities

Some project facilities, especially hydromechanical and electrical works, have a shorter economic life time than project life and will require replacement during the proposed 50 years of the project life. The following table shows the economic life times and replacement costs of the works to be replaced.

(Unit: US$'000)

Description	Economic Life Time	Replacement Cost
- Hydromechanical Works	25 years	4,592.0
- O&M Equipment	10 years	2,247,9
- Water Management Equipment	10 years	1,993.4
- Pump for Water Supply	10 years	66.6
- Pipe and Valves for Water Supply	25 years	574.9
- Wooden Stoplog	5 years	23.3

(5) Annual Operation and Maintenance Cost

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. The estimated cost is US$ 890,000 per annum for the total project area, which corresponds to US$ 65/ha per annum.

3.4 Project Organizatin and Management

3.4.1 Project Organization

(1) Project Coordination Committee

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 the Project Coordination Committee. The members of the committee will consist of 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.

(2) Project Implementation Unit

At present, the existing Project Implementation Unit (PIU) overseas all international lending activities within the Ministry of Agriculture (MOA). For the Kzyl-Orda Irrigation and Drainage Project, however, it is proposed to establish another project implementation unit (PIU-Kzylorda) which will deal with the MOA management, administration and coordination exclusively for this Project, because of limited staff of the existing PIU and large size of the project. PIU-Kzylorda will have an office in Almaty, taking into account the convenience of access to the project site.

(3) Project Office

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 for the Kzyl-Orda Headworks in the office, and will function as the Project O&M Office.

During the construction stage, the Kzyl-Orda Irrigation and Drainage Project Office will be organized by four divisions and one unit as shown in Figure 3.2.9. The Engineering Division will be responsible for planning, survey, design, bid documentation and assessment, and supervision of construction of alt project works; and for providing technical assistance to farms and farmers for on-farm development works. This division will be phased out by the completion of the construction work. The Agriculture Division will be responsible for the facilitation of the agricultural extension and training, guidance to farm and farmers in marketing of agricultural products and farm inputs and agricultural credit, and coordination to the agricultural research institute. In addition to these activities, this Division will be in charge of collection of technical data and demonstration activities at the demonstration farm to be established in the Ilyasov area. The Administrative Division will be responsible for personnel, contract procurement, land acquisition and general administration of the Project Office. The Financial Division will be responsible for the project budgeting, finance, internal audit, stores

and inventory control of equipment and supplies. The Monitoring and Evaluation Unit being under direct control of the Project Manager will be responsible for collecting and analyzing data on project planning, implementation and performance.

3.4.2 Project Management and Staffing

The chief executive officer for the Kzyl-Orda Irrigation and Drainage Project will be the Project Manager, who will be responsible for day-to-day project administration and management, work programming and supervision, budgeting, and financial control. He will be appointed by the Minister of Agriculture and will be based at the Project Office in Kzyl-Orda. He will: (i) ensure the design and implementation of the Project in accordance with the time schedule; (ii) prepare annual implementation programs and progress reports; (iii) prepare the project's annual budget proposal; (iv) manage all project staff and consultants; (v) supervise preparation of tender documents, issuance of calls for tender, and evaluation of bids for procurement of works, goods, and services; and (vi) ensure coordination of all project activities at the project and raion levels. The Project Manager will be assisted in these functions by the project consultants.

The number of key staff, including Project Manager, engineers, administrators, accountants, technicians and assistant officers, who will be required to implement the Project, is shown in Table 3.4.1 and summarized below.

Division and Staff Category	Project Year									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
A. Kzyl-Orda Irrigation and Drainage Project Office										
1. Project Head Office	1	1	1	1	1	1	1	1	1	1
2. Engineering Division	8	8	9	16	16	16	16	16	7	3
3. Agricultural Division	3	3	9	9	9	9	9	9	9	9
4. Administration Division	7	7	7	7	7	7	7	7	7	7
5. Finance Division	6	6	6	6	6	6	6	6	6	6
6. Monitoring and Evaluation Unit	7	7	7	7	7	7	7	7	7	7
Sub-total	32	32	39	46	46	46	46	46	37	33
B. Hydro-department for Kzyl-Orda Headworks*	77	77	77	77	77	77	77	77	77	77
Total	109	109	116	123	123	123	123	123	114	110

Note: * ; Existing O&M Office under the Committee on Water Resources

3.5 Project Evaluation

3.5.1 General

The project evaluation is made from economic and financial viewpoints. The economic analysis is from the perspective of the social welfare of the country as a whole, while financial analysis is from the standpoint of the farm and the project. The difference between the two analyses is in terms of the prices at which resources used by the Project and outputs of the Project are valued.

The economic feasibility of the Project is determined by the economic internal rate of return (EIRR), net present value (NPV), and the benefit/cost ratio (BCR). As part of the economic evaluation, a sensitivity analysis is made of increased construction cost, decreased benefit, or delay of implementation.

Financial feasibility of the Project is judged in terms of the financial internal rate of return (FIRR), increase of income to farmers and workers, and ability of the farmers to pay for annual project operation, maintenance and replacement costs and a share of the project construction investment.

3.5.2 Economic Evaluation

(1) Basic Considerations

The economic evaluation is made on the basis of the following assumptions:

(i) The economic useful life of the Project is 50 years.

(ii) All prices are expressed in constant US$ at the mid-1997 level with an exchange rate of T.75 = US$1.

(iii) A standard conversion factor (SCF) of 0.9 is used to convert local currency financial prices to economic prices.

(iv) Transfer payments such as taxes, duties, and interest are not included in economic prices.

(v) A shadow wage rate factor of 0.50 is applied to the unskilled labor component of project cost.

(vi) Farmgate prices of traded commodities are estimated on the basis of international market prices for 1997.

(vii) The implementation schedule spans a period of 10 years, 1999 - 2008. Actual construction of irrigation and drainage works for each phase of the Project is four years, covering a span of seven years beginning in 2001 and ending in 2007.

(viii) The estimated rate of buildup of benefits is that 75% of the Phase-I benefits accrue in the year 2003 with full benefits thereafter. The Phase-II benefits begin at the 75% rate in the year 2007, and full benefits accrue thereafter.

(2) Economic Cost

The project cost estimate was presented earlier in Sub-section 3.3.4. Project financial costs were adjusted to economic costs by making the following changes:

(i) Price contingencies for inflation were deleted.

(ii) Duties and taxes were deleted.

(iii) A standard conversion factor (SCF) was applied to the local cost component to adjust for distortions in local costs because of the government trade restrictions.

(iv) Unskilled labor was shadow-priced based on opportunity cost.

The economic analysis is in constant US$ at the 1997 price level.

The following table summarizes the economic cost allocated to the 13,690 hectares of the Project Area:

(Unit: US$ '000)

Description	Phase-I		Phase-II	
	Financial Cost	Economic Cost	Financial Cost	Economic Cost
(1) Construction Cost				
- Rural Infrastructure	2,184.6	0.0	1,984.3	0.0
- All Remaining Construction	26,976.4	22,741.1	34,740.6	29,629.0
Sub-total of (1)	29,161.0	22,741.1	36,724.9	29,629.0
(2) Procurement Works				
- Rice Mill	2,080.0	0.0	780.0	0.0
- Farm Machinery	6,118.4	0.0	7,158.9	0.0
- All Remaining Procurement	453.1	450.9	458.0	455.8
Sub-total of (2)	8,651.5	450.9	8,396.9	455.8
(3) Administration Cost	1,194.7	1,075.2	1,140.9	1,026.8
(4) Technical Support	3,073.7	3,004.3	3,271.5	3,160.1
(5) Land Acquisition	1.4	0.0	0.0	0.0
(6) Fishery Compensation	0.0	0.0	160.0	0.0
Sub-total of (1)-(6)	42,082.3	27,271.5	49,694.1	34,271.6
(7) Physical Contingency	4,208.1	2,727.1	4,969.5	3,427.2
Total of (1)-(7)	46,290.4	29,998.6	54,663.6	37,698.8
(8) Price Contingency	6,287.9	0.0	12,457.0	0.0
Total Cost	52,578.3	29,998.6	67,120.6	37,698.8

The total economic cost allocated to the Phase-I of the Project is US$30.0 million, US$4,629/ha and the economic cost of Phase-II is US$37.7 million, US$5,229/ha. The combined economic cost allocated to the Ilyasov and Shagan Areas for Phase-I and II of the Project is US$67.7 million, US$4,945/ha for the 13,690 hectares of the Project Area.

The life of the Project is 50 years commencing from the fifth year when construction of the Phase-I irrigation works is completed. Capital components with a 10 year life are replaced at an economic cost of US$922,000, and components with a 25 year life are replaced at an economic cost of US$964,000.

The estimated O&M cost under the future "with project" condition is US$65/ha and the estimated O&M cost under the future "without project" condition is based on the 1996 water

charge, US$17/ha for the area irrigated under the future "without project" condition as mentioned in Paragraph 3.1.7(2). After shadow pricing the local cost component (80%), the O&M cost is US$60/ha under the future "with project" condition and $15/ha under the future "without project" condition.

(3) Economic Benefit

Financial and economic crop budgets, and the budget supporting data for prices, yields, and inputs are provided in Annex E and the detailed economic rice crop budget is in Table 3.5.1. The net returns/ha from the economic crop budgets are summarized in the following table for the future "without project" and the future "with project" conditions:

(Unit: US$/ha)

Crop	"with Project" Condition	"without Project" Condition	Increase with Project
Rice	859	399	460
Luceme	325	66	259
Wheat	226	-25	201
Vegetables	2,420	931	1,489
Safflower	271	-138	409

Note: Based on economic prices, no taxes are included.

The benefits of the project result from: (i) restoration of abandoned land; (ii) increased yields; and (iii) conversion to a more intensive cropping pattern. Under the future "without project" condition, 83% of the crop area will be abandoned. This cropland will be restored to production under the future "with project" condition. The yield of the major crop; paddy, is projected to increase from 3.59 tons/ha under the future "without project" condition to 6.0 tons/ha under the future "with project" condition. Under the future "with project" condition, the cropped area is expected to include 50% paddy, as compared to 8.5% under the future "without project" condition.

The average net return per hectare under the future "without project condition is US$49, compared to US$682 under the future "with project" condition. The incremental benefit per hectare is US$633, and the total benefit from the combination of higher yields and more intensive cropping is US$8.7 million annually at full development of 13,960 hectares.

(4) Economic Evaluation

The EIRR of the Project is 11.3%. Using a 10% discount rate, the NPV of the Project is US$5.2 million and the BCR is 1.1. The detailed cash flow of benefits and costs is in Table 3.5.2.

The full economic cost of the Phase-I, US$88.9 million (US$13,717/ha), was evaluated against the economic benefit from only the Ilyasov Area of 6,480 hectares. The result of course was a very low EIRR, 3.2%. Also, the Ilyasov Area and the Shagan Area were evaluated separately based on an allocation of total project costs. The result was an EIRR of 13.4% for the Ilyasov Area of 6,480 hectares, and 10.6% for the Shagan Area of 7,210 hectares.

Sensitivity Analysis: The EIRR of the proposed project is 11.3% under normal conditions. If the construction cost is increased by 10%, the EIRR becomes 10.2%. If the benefit is 10% less, the EIRR becomes 10.0%. If both events occur, the EIRR falls to 9.0%. If there is a one year delay in construction implementation of Phase-I, which delays Phase-II by one year, and delays benefits by one year, the EIRR becomes 10.9%. To calculate the latter figure, it was assumed that only 70% of scheduled construction was completed in the 4th and 5th years of Phase-I and the carryover work was completed in the 6th year. The work scheduled for the 6th year was postponed to a year later and the beginning of Phase-II was delayed one year.

3.5.3 Financial Analysis

(1) General

The purpose of this section is to examine the financial condition of the project farms and determine whether they will have sufficient income to pay for O&M costs, and their share of project construction costs.

Under terms of the Government Resolution specifying conditions for implementing the Kazakstan Irrigation and Drainage Improvement Project (KIDIP) financed partly through a World Bank loan to the Government, the farms/beneficiaries are required to repay 70% of the "amount invested for improvement of irrigation and drainage system on the land of the farm/beneficiary"[16/]. Local budgets (raion and oblast) must repay 10% of the construction cost, and the Republic Budget covers the remaining 20% of the cost. Although the Government must repay the World Bank loan within 20 years, the farmers are allowed a 30 year repayment period.

In the following analysis, it is assumed that the same terms will apply to the Kzyl Orda Irrigation/Drainage and Water Management Project. In other words, the project farms will be required to repay 70% of on-farm development costs over a 30 year repayment period with interest. The interest rate at which these costs are repaid is assumed to be 2.5%.

This project differs from the KIDIP in that nearly all of the construction investment of KIDIP is for on-farm development. Most of the construction investment for this project is for the Left Main Canal and Inter-farm canals.

The financial analysis is conducted in two parts. The first part examines the financial condition of the project farms, assuming they repay 70% of the on-farm construction cost. The second part is a payment capacity analysis to see how much of the construction investment farmers could repay and still have a reasonable household income.

16/ Resolution of the Government of Kazakstan No.1237 dated October 7, 1996, Attachment 2, Note No.10

(2) Farm Budget Analysis

Farmers will also receive loans under the Project for rice mills, farm machinery, and annual operating loans for purchase of production inputs. In the farm budget analysis, it was assumed that rice mill loans are repaid over five years at 4.5% interest, with only interest repayment required in the first year. The repayment period is similar to the four year term allowed for the Shagan Production Cooperative to repay the rice mill loan it received under the Asian Development Bank Mid-term Credit loan.

Annual farm operating loans for purchase of production inputs are assumed to be repaid in seven months at an annual 4.5% interest rate.

With respect to the farm machinery loans, interest is charged in the farm budgets at 4.5% on 55% of the loan. The crop budgets include depreciation costs by the straight line method on 90% of farm machinery costs. The combination of the interest charge and the depreciation cost is sufficient to replace the entire inventory of machinery every seven years in perpetuity.

The results of the farm budget analysis for the Ilyasov Area of 6,480 hectares are summarized in the following table and the complete budgets for both areas are in Tables 3.5.3 and 3.5.4.

(Unit: US$ '000)

Item	Yr 1 - 2	Yr 3	Yr 4	Yr 5 - 7	Yr 8 - 30
Gross Value of Production	425	4,535	5,905	5,905	5,905
Total Outflow*1	3,233	9,432	5,041	3,359	3,359
Net Benefit Before Financing	-2,808	-4,897	864	2,546	2,546
Net Benefit After Financing	85	1,073	1,497	1,587	2,135
Net Income/Household*2	251	2,857	3,989	3,790	5,195
Financial Internal Rate of Return = 18.3%					

Note: *1; Year 1 figures shown. Total outflow in Year 2 was US$3,838 and net benefit before financing was -US$3,413. The rest of the figures are the same for Year 2.
*2; Includes wages paid as crop production costs.

The financial internal rate of return to all resources engaged (FIRR) which is calculated from the incremental cash flow before financing is 16.8% for the Ilyasov Area. Net income per household, including wages from crop production labor, increases from only 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.

The results of the Shagan Area analysis indicate a FIRR of 15.9%. Net income per household in the first two years is US$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.

(3) Capacity to Pay

Payment capacity is defined as the ability of the farm family to pay for project water charges, both O&M and construction repayment. Making a determination of payment capacity requires making a judgment as to what constitutes an adequate level of income to the farm family. Any residual profit above that amount is called payment capacity which may be allocated to pay annual O&M costs and part or all of project construction costs. After subtracting the annual O&M costs, the remaining payment capacity is called amortization capacity, which is the ability of the farm to repay project construction charges.

The farm survey reported that there are 1,149 households in the Project Area as mentioned in Sub-section 3.1.2. Thus the average area of the Project is 11.9 hectares of irrigated land per household. In determining whether project farms have payment capacity, it is necessary to specify what is considered to be an adequate return for labor, management, and living expenses to these households. This is a subjective judgment, but, the following background provides perspective on the current levels of income in Kazakstan.

The national average monthly salary in Kazakstan was T.6,851 (US$101.83) in 1996. The average monthly salary of workers in agriculture was T.3,558 (US$52.88) and the average monthly salary of workers in education was T.5,003 (US$74.35).[17/]

The Household Survey in the Project Area found with respect to family food expenditures that the average expenditure for food in 1995 was T.62,538 (US$1,019) or US$85/month.[18/] Adjusting for about 4% inflation in the US$ since then, the equivalent amount in October 1997 is about US$88.40/month or T.6,630/month. The wage charge for skilled tractor drivers in the crop budgets is US$0.70/hour, which converts to a monthly income of US$122.50 (T.9,188/month).

Based on the above review of wages and incomes, it was decided that for the purpose of estimating payment capacity, farm households in the Project Area should have an after tax income of at least T.135,000 (US$1,800). In order to arrive at this level of income per household in the Shagan Area, it was necessary to add a family living allowance of US$1,000/household to the household income from labor and management on the farm. A lower allowance around US$800 per household would have been sufficient in the Ilyasov Area, but, the same figure was used for both areas, resulting in somewhat higher average income to households in the Ilyasov Area compared to the households in the Shagan Area.

The detailed payment capacity budgets in Tables 3.5.5 and 3.5.6 deduct the following costs from gross value of production: (i) crop production costs; (ii) all debt service costs for farm machinery, rice mills, and operating loan; (iii) all taxes; and (iv) the returns to farm households for labor, management, and living allowance. The residual payment capacity is then allocated first to pay annual O&M cost, and the balance remaining is amortization capacity

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17/ National Statistical Agency of Republic of Kazakstan, Statistical Bulletin 1996, No.4, Almaty 1997.

18/ JICA Study Team, The Study of Kzyl-Orda Irrigation /Drainage and Water Management Projkect in the Republic of Kazakstan, Interim Report, March 1997.

for repaying project construction costs. Results of the payment capacity budget for the Ilyasov Area are summarized in the following table:

(Unit: US$)

Component	Yr 1 - 2	Yr 3	Yr 4 - 7	Yr 8 - 30
Net Income/Household	217	2,172	2,188	2,441
Payment Capacity	0	580	1,249	1,759
less O,M&R Cost, 65$/ha		421	421	421
Amortization Capacity	0	159	828	1,338
less repayment of on-farm development			245	245
Remaining Amortization Capacity			583	1,093
Per Hectare			90	169

Household incomes were somewhat less for the Shagan Area of 7,210 hectares. Income per household is US$1,779 in Year 3, US$1,958 in Years 4 through 7, and US$2,020 thereafter. Amortization capacity is US$154/ha. After deducting US$45 for repayment of 70% of the on-farm development cost, the remaining amortization capacity is US$109/ha. If the average of the remaining amortization capacity is taken from the two farm areas, US$100, this is sufficient to repay another US$2,093/ha or US$2,807 million total of project construction costs over 30 years at 2.5% interest. Also, it should be noted that after the rice mill loans are paid off, there is considerable more income available to households, or this income can be used to pay for more of the construction costs.

(4) Loan Repayment

The allocation of costs for repayment and the terms of repayment are yet to be negotiated. An example of the apportionment of construction costs for repayment and the schedule and cash flow of funds is shown in Table 3.5.7. This example is based on the following assumptions:

(i) Farmers repay all of the rice mill and farm machinery costs and 70% of the cost of on-farm irrigation and drainage facilities.

(ii) Local governments (raion and oblast) pay 10% of project costs excluding rice mills and farm machinery.

(iii) The Republic Government repays the remainder of the construction cost (loan) after deducting the shares paid by farmers and local governments.

(iv) The interest rate charged on the loan is 2.5%.

(v) Interest during construction (IDC) is charged at 2.5% of the loan balance at the beginning of the year (the sum of construction expenditures and interest from previous years), plus 2.5% of one half of the construction expenditure during the current year.

(vi) The term of the loan is 40 years consisting of the 10 year construction period and 30 year repayment period thereafter.

(vii) The repayment period for local governments and the Republic Government is 30 years, commencing in 2009, the year after project construction is completed.

(viii) The repayment period for farmers is 30 years, commencing the year after the construction of on-farm facilities is completed for each phase of construction. Thus the farmers served by Phase I construction begin repayment of on-farm facilities in the year 2005 and farmers served by Phase II begin repayment in the year 2008.

Repayment of the loans for the rice mills and farm machinery are shown separately in the analysis under the special terms of these loans as follows:

(i) Repayment of the rice mill cost begins the year after the expenditures are completed for each phase.

(ii) Only interest is paid in the first year of repayment for the rice mills.

(iii) The principal of the rice mill loans is paid over a period of four years at an interest charge of 4.5% of which 2.5% is credited to the project repayment and 2% is for loan administrative fees.

(iv) The farm machinery costs are repaid as five consecutive seven year term loans, each loan consisting of 20% of the total project cost for farm machinery.

(v) Repayment of the first farm machinery loan under each phase of construction begins in the first year of expenditure of funds for farm machinery, 2003 for the Phase I farmers, and 2006 for the Phase II farmers.

(vi) As with the rice mills, interest is charged to farmers at 4.5% of the farm machinery loans, of which 2.5% is credited to the project loan repayment.

(vii) IDC is not charged on the rice mill and farm machinery loans.

As shown in the following table, the total project construction cost including physical and price contingency allowances is US$291.2 million of which US$3.5 million is for rice mills, US$16.9 million for farm machinery, and US$20.6 million for on-farm facilities. IDC is US$31.3 million, making a loan balance of US$322.5 million at the end of the construction period.

Item	Farmers	Local Governments	Republic Government
Total Loan and IDC			322,450
Repayment of Principal and Interest @2.5%			
Rice Mills	3,847		
Farm Machinery	18,648		
Remaining Project Costs	20,644	43,295	368,868
% Repayment exc. rice mills & farm machinery	4.8	10.0	85.2
Total Repayment	43,139	43,295	368,868
% of Total Repayment	9.5	9.5	81.0

Total project repayment from all sources is US$455.3 million, of which US$164.1 million is interest. Excluding rice mill and farm machinery loans, the average annual payments over the 30 year repayment period are $688,000 for farmers, US$1,443,000 for the local Government and US$12,248,000 for the Republic Government. The detailed loan repayment schedule is shown in Table 3.5.7.