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Options Analysis of the Operation of the Toktogul Reservoir
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Section 1.

Background

The Central Asian republics are currently operating the water resource system of the Syr Darya basin under allocation schemes developed prior to the collapse of the Soviet Union. The allocations were designed under the assumptions that: (1) the region was a part of one country; (2) the region's hydro-technical facilities were developed to serve agricultural irrigation; (3) water deficits could be alleviated by an inter-basin transfer from Siberian rivers; (4) upstream countries would be provided with needed wintertime heating fuels; and (5) upstream hydropower developments could be facilitated through the development of the Kambarata dams.

Construction of Toktogul Dam and Reservoir was completed in 1975. Storage and hydropower capacity is listed in Table 1. Four other constant volume hydropower facilities, along with Toktogul, compose the Naryn-Syr Darya Cascade. The other dams were constructed between 1962 (Uch-Kurgan) and mid 1980's (Kurpsai, Tashkumyr, and Shamaldysai).

Table 1-1. Toktogul Reservoir Characteristics.

Annual inflow to reservoir (1951 - 96)	
Average	12.29 km^3
Maximum	18.47 km^3
Minimum	8.44 km^3
Storage Volume	
Total	19.5 km^3
Active	14 km^3
Completed in 1974	Filled in 1988
Power	
Installed capacity (Toktogul)	1200 MW
Installed capacity (Cascade)	2870 MW
Annual generation (Toktogul)	4100 GWh
Annual generation (Cascade)	9860 GWh

After the collapse of the Soviet Union, the five republics agreed to continue the water allocations adopted in 1982. However, the primary storage reservoir (Toktogul, see Table 1) is located in, and owned by, the upstream country of the Kyrgyz Republic, and the bulk of the agricultural production is located in the downstream countries of Uzbekistan and Kazakhstan. The Toktogul Reservoir operating regime was modified in 1991 to provide for wintertime power production to replace suspended fuel deliveries (See Appendix A, Figure A.1). In an attempt to secure an appropriate release regime to satisfy the downstream irrigation needs, agreements have been reached in the past three years to provide for the exchange of wintertime fuel supplies for summertime irrigation releases from Toktogul Reservoir. Table 2 and three indicates the details of those exchanges, as well as the monetized value which is given in the exchange agreements.

Table 1-2. Toktogul Reservoir Vegetative Period Release Agreement (1996-97).

Month	m^3/s	km^3/mo
April	230	0.60
May	290	0.78
June	650	1.68
July	690	1.85
August	500	1.34
September	190	0.49

Table 1-3. Exchanges in existing bilateral agreements between the Kyrgyz Republic, Kazakhstan, and Uzbekistan.

Country	Receives from		Delivers to	
Kyrgyz Rep.	**Kazakhstan** 1.1 billion kWh of power, electricity or coal Value = $\$22x10^6$	**Uzbekistan** 400 million kWh of power and 500 million m^3 of natural gas Value = $\$48.5x10^6$	**Kazakhstan** 3.25 km^3 of water from Toktogul in the monthly flows listed in Table 3	**Uzbekistan** 3.25 km^3 of water from Toktogul in the monthly flows listed in Table 3
Kazakhstan	**Kyrgyz Republic** 3.25 km^3 of water from Toktogul in the monthly flows listed in Table 3		**Kyrgyz Republic** 1.1 billion kWh of power, electricity or coal Value = $\$22x10^6$	
Uzbekistan	**Kyrgyz Republic** 3.25 km^3 of water from Toktogul in the monthly flows listed in Table 3		**Kyrgyz Republic** 400 million kWh of power and 500 million m^3 of natural gas Value = $\$48.5x10^6$	

Notes:
1. $ sigifies U.S. $
2. An exchange of 1.1 billion kWh results in a net payment from Kazakhstan to the Kyrgyz Republic of 4.45 cents/kWh in the winter peak period minus 2.5 cents/kWh in the summer off-peak or 1.95 cents/kWh, or $2.145 million. The exchange is reported as 2 cents/kWh time 1.1 billion kWh, or $22 million.
3. The value of the exchanges between Uzbekistan and the Kyrgyz Republic is $48 million using market prices of power and gas listed in the Burns and Roe (1996), that is, 2.5 cents/kWh for off-peak power, and 4.45 cents/kWh for peak power, and $80/1,000 m^3 of gas)]. The exchange is reported as 4 cent/kWh and $65/1000 m^3 of gas, or $48.5 million.

1.1 Analysis of Historical Management of the Syr Darya Basin

The historical data regarding the operation of Toktogul Reservoir indicate that the releases specified in the exchange agreements (Table 2) would have been met by natural flows in all but one month of last ten years. These data also show that the Toktogul Reservoir releases during the vegetation (April - September) and the non-vegetation (October - March) periods have changed significantly since the Soviet period (See Appendix A, Figure A.3 and Table 4). The new release regime implemented since 1991 has resulted in a decrease in the vegetation period releases from approximately 8.5 km^3 to the agreed-upon 6.5 km^3 with an increase in the non-vegetation period releases from approximately 3.5 km^3 to 8.3 km^3. The total annual release from Toktogul has increased from about 12.5 km^3 to 14.5 km^3. The effect of this increase in total releases from Toktogul has been a decrease in the total volume stored in the reservoir from approximately 18 km^3 (12.5 km^3 active vol.) in June, 1994, to 11 km^3 (5.5 km^3 active vol.) in June, 1997.

Table 1-4. Toktogul Reservoir Vegetation, Non-vegetation, Total Release, Inflow and Net Change in Volumes for 1988 - 97.

Year	Releases			Inflow	Net Change
	Vegetation Period (km^3)	Non-vegetation Period (km^3)	Total (km^3)	(km^3)	in Volume (km^3)
1988	8.80	3.44	12.24	16.52	+4.3
1989	10.97	4.02	14.99	10.13	-4.9
1990	7.09	4.50	11.60	12.99	+1.4
1991	8.51	4.66	13.16	10.75	-2.4
1992	6.55	5.64	12.19	12.05	-0.1
1993	4.41	6.22	10.63	13.64	+3.0
1994	6.72	7.81	14.52	15.24	+0.7
1995	6.33	8.30	14.62	10.89	-3.7
1996	6.18	8.37	14.55	13.70	-0.9
1997*	6.65	8.17	14.83	10.34	-4.5

*Estimated

Section 2.
Summary of Results of July 1-4, 1997, Meeting

To assist the Central Asian Republics in resolving the dilemma over the use of the Toktogul Reservoir, USAID has supported, through financing and technical assistance. The Regional Energy and Water Uses Round Table, hosted by the Interstate Commission of the Republic of Kazakstan, the Kyrgyz Republic, and the Republic of Uzbekistan (ICKKU) has met three times: October, 1996; December, 1996; and July, 1997. The July, 1997, the Round Table met at Lake Issyk-Kul in the Kyrgyz Republic. The outstanding issues which were identified for further study are:

- All parties agreed to support the operation of Toktogul Reservoir in the vegetative period release mode with compensation to the Kyrgyz Republic;
- All parties have a strong preference for monetizing the exchanges to secure Toktogul releases in the current mode;
- All parties agreed to governmental guarantors for compensation and monetary exchanges;
- All parties agreed to use the Central Asian Cooperation and Development bank as the mechanism for the guarantees;
- All parties agreed to include Tajikistan as a full member of the Water and Energy Uses Round Table at a future date;
- Parties did not agree on the method of sharing O & M costs;
- Kazakhstan proposed consideration of water quality as an issue in the determination of the appropriate operation of the Syr Darya hydro-technical facilities; and
- Options for allocating the O & M costs of the Toktogul Reservoir to the appropriate parties were requested.

Section 3.
Data Collection and Studies, July to August, 1997

Pursuant to the desires of the Water and Energy Uses Round Table, the Consultants from EPT developed a workplan, consisting of, first, the collection of relevant data on irrigated agriculture and energy resources, and second, an analysis of Syr Darya Basin management options using existing models coupled and the data collected.

3.1 Data Collection

The consultants, with the direction of the Water and Energy Uses Round Table, proceeded with data collection and analysis during the period from July 6 through August 29, 1997. Meetings with the Ministries of Water, Agriculture, and Energy, as well as other private of public entities involved in energy/water management, were scheduled in all four Republics. A data list was prepared and forwarded to the appropriate ministries (Appendix B). A review of the data collection effort is also listed in Appendix B. Once the primary data were obtained, secondary sources were consulted to complete the data requirements, and an analysis of the management options was undertaken.

3.2 Method for Analysis of Alternative Use Scenarios for Toktogul Reservoir.

The analysis of management options was based on the Multiobjective Water Resource Allocation Model for Toktogul Reservoir (McKinney and Cai, 1997) updated with the new data. Model results were obtained for various scenarios. These results are based on certain assumptions, such as:

- the limited flow and storage data which are available to EPT;
- the constraints which have been suggested by water and power ministries (for example, a maximum of 350 cubic meters per second release from Chardara reservoir);
- a five year modeling period;
- initial volume of reservoirs at the maximum; and
- a minimum inflow to the Aral Sea of 1.35 cubic kilometers per year.[1]

Model solutions were obtained for a sequence of five normal years (30.63 km^3), and a sequence of two normal years, followed by a very dry year (21.1 km^3 of flow), followed by

[1] While the April 3, 1997, agreement specifies 6 cubic kilometers per year inflow, the model assumes a return flow of 10 percent from irrigated lands. This return percentage could be as high as 50%. Thus, the 1.35 cubic kilometers inflow represents an absolute minimum inflow.

two normal years. This very dry year flow is consistent with a probability of 95% that the annual flow is greater than or equal to it.

Deficits of water for irrigation and of power delivered to meet winter and summer energy demands in the Kyrgyz Republic were obtained for three scenarios:

(1) Toktogul Reservoir operated in the irrigation release mode, consistent with the release agreements from 1997 (Table 2); that is, maximize the satisfaction of irrigation water demands and also calculate the resulting power generation;
(2) Toktogul Reservoir operated in the energy release mode; that is, maximize power generation and satisfy winter and summer power demands for the Kyrgyz Republic, and also calculate the resulting supply of water to irrigation; and
(3) Provision of irrigation water without Toktogul Reservoir in the system. This latter solution represents a base-line from which benefits of the dam itself can be determined.

Section 4.
Model Results

4.1 Operation of the Naryn Syr Darya Cascade in Normal Year Sequence.

The model results for five normal inflow years are shown in Table 4-1. These results for operation in the *irrigation mode* with five normal inflow years show that there is little benefit from the Toktogul Reservoir to Kazakhstan or Uzbekistan above that available from the average flows of the river without the dam. There are significant losses to the Kyrgyz Republic when the dam is operated in the irrigation mode, because of reduced power production in the peak demand winter period and increased summer power production accompanying the irrigation releases when power demand is low. The results show that for operation in the *power generation mode* with five normal inflow years there is significant net benefit to the Kyrgyz Republic because of winter power generation. However, the results for this variant show little loss to Kazakhstan or Uzbekistan irrigation if downstream reservoirs are operated in careful coordination with Toktogul.

4.2 Operation of the Naryn Syr Darya Cascade in Normal and Dry Year Sequence.

The model results for inflow of two normal years, one dry year, followed by two more normal years are shown in Table 4-2. The results for operation in the *irrigation mode* show that there is significant benefit to Uzbekistan, because of releases from long-term storage. However, there is little benefit to Kazakhstan, since return flows from upstream irrigation are available and Chardara Reservoir provides significant re-regulation of the downstream river flows. There are significant losses to the Kyrgyz Republic when the dam is operated in the irrigation mode, again because of reduced winter power production and increased summer power production when power demand is low. The results also show that for operation in the *power generation mode* there is little power loss to Kyrgyz Republic, because of additional releases from long-term storage, and a significant loss to both Kazakhstan and Uzbekistan irrigation.

Table 4-1. Model Results for Three Scenarios of Toktogul Operation: Irrigation Mode With and Without the Dam, and Power Mode With the Dam (Inflows: 5 normal years).

	Operation Mode		
	Irrigation		Power
	With Dam	Without Dam	With Dam
Decrease in Toktogul Storage (km^3/yr)	1.10	N/A	1.73
Water Deficit (km^3/yr)			
Total	0.15	0.13	0.15
Naryn	0	0	0
Fergana	0	0	0
Mid-Syr	0	0	0
Chakir	0	0	0
Artur	0.15	0.13	0.15
Low-Syr	0	0	0
Power (GWh/yr)			
Deficit	4942	N/A	0
Surplus	3822	N/A	236
Supply	8937	N/A	10293

Table 4-2. Model Results for Three Scenarios of Toktogul Operation: Irrigation Mode With and Without the Dam, and Power Mode With the Dam (Inflows: 2 normal years, 1 dry year, 2 normal years).

	Operation Mode		
	Irrigation		Power
	With Dam	Without Dam	With Dam
Decrease in Toktogul Storage (km^3/yr)	2.46	N/A	2.8
Water Deficit (km^3/yr)			
Total	0.235	0.788	5.38
Naryn	0	0	0
Fergana	0	0.583	0.006
Mid-Syr	0	0	1.1304
Chakir	0	0	1.115
Artur	0.2282	0.2036	2.986
Low-Syr	0.0066	0	0.15
Power (GWh/yr)			
Deficit	4,525	N/A	140
Surplus	4,103	N/A	625
Supply	9,634	N/A	10,542

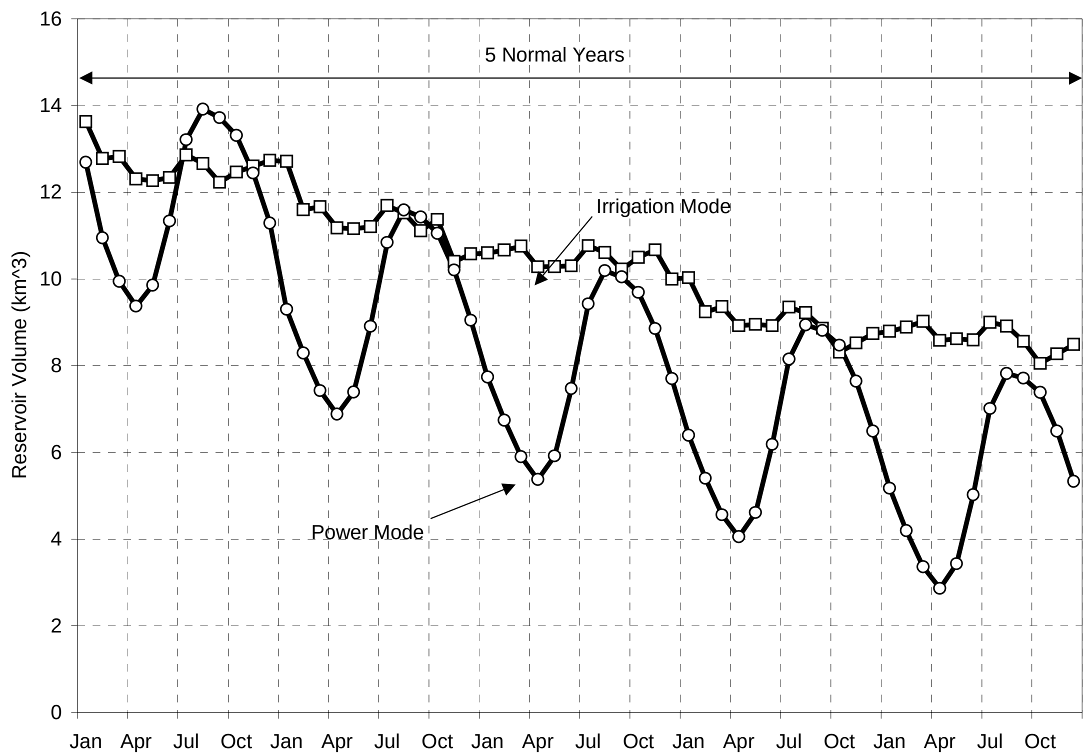

Figure 4-1. Toktogul storage under irrigation and power modes in five normal flow years.

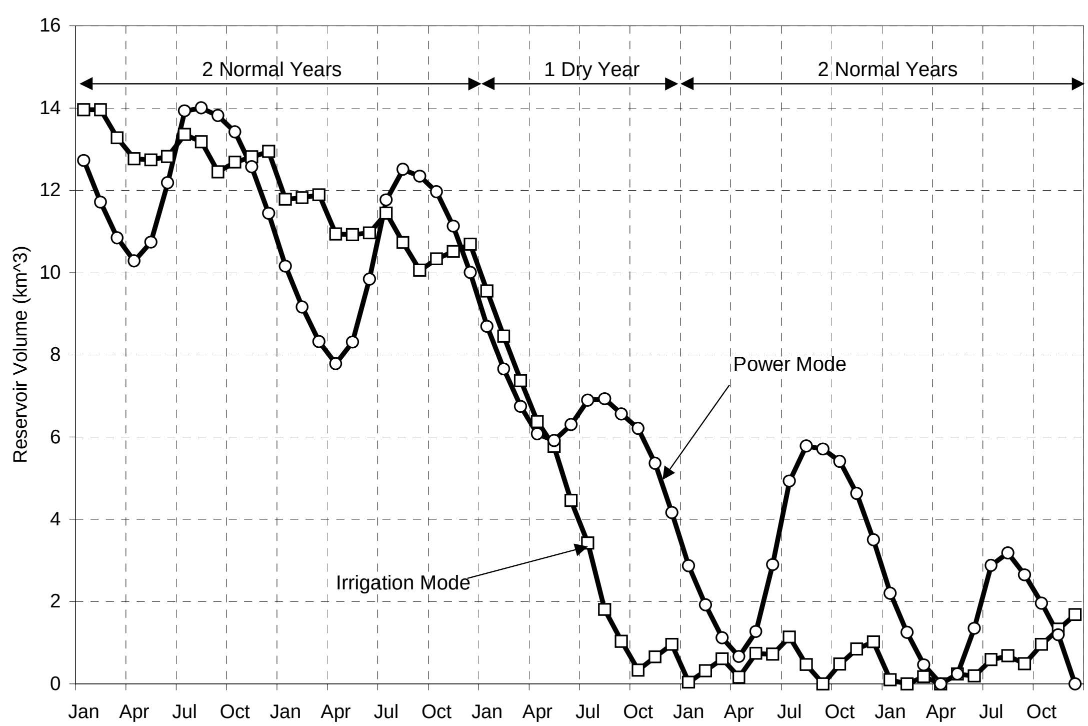

Figure 4-2. Toktogul storage under irrigation and power modes in two normal years, one dry year, and two normal years.

4.3 Conclusions Regarding the Operation of Toktogul Reservoir Dam

Based on information obtained during this analysis, the projected storage volume of Toktogul Reservoir will drop below the active storage level of 5.5 km^3. This appears to be due to the operation of the Toktogul Reservoir to meet both required irrigation releases in the summer months and to additional releases in the winter months to produce heating in the Kyrgyz Republic. Since 1991, annual release from Toktogul have increased from 12.5 to 14.5 km^3. Continuing to operate the reservoir in this way could severely affect the potential benefits to both upstream and downstream republics that use the water which flows through the Naryn Syr Darya Cascade.

Although Toktogul can be operated in several different modes or regimes with different operating rules, only three have been examined in this study: irrigation mode (summer releases); current mode (summer releases to meet agreement requirements and winter releases for power production); and power mode (maximization of power production). Our examination of the current operating regimes for the Toktogul Reservoir from the data collected reveals that the volume of the reservoir continues to be depleted, and may reach dead storage (5.5 km^3) by Spring, 1998, unless natural flows are significantly above average. It is clear that, while the compensation agreements have mitigated damages to downstream irrigators, in the long term severe losses can be expected to both irrigation and hydropower as the long-term storage is depleted under the operating regimes exhibited from 1994 to 1997.

Section 5.
Economic Analysis

5.1. Introduction

Once the hydrologic model generated water and power availability under the three alternative scenarios, economic values were determined for irrigated agriculture and for hydropower. These economic values were used to examine both the value of exchanges in the current bi-lateral agreements, and the joint cost allocation for Toktogul Dam and Reservoir.

5.2 Economic Values

To determine the benefits to irrigation in the Naryn Syr Darya Basin, three data sources were used: Burns and Roe/Harza Assessment of the Export Market for Kambarata Electricity [Burns & Roe/Harza] (1996), The World Bank Irrigation and Drainage Project Report [IDIP] (1996), and Volumes II, III, IV, and V of the TACIS Phase I Report [TACIS] (1995). In addition, primary data were collected by the consultants from local water and agricultural ministries (See Trip Report for John E. Keith for the contacts and data collected). Steps to calculating the value of irrigation per hectare included :

(1) determining the typical cropping pattern for each oblast in the Syr Darya Basin;
(2) applying estimated net returns above variable costs (net margins) per crop; and,
(3) determining the weighted average of net margins for the oblasts and for each of the four countries.

The cropping patterns were obtained from the TACIS documents and from the Burns and Roe/Harza document, and verified using primary data collected by the consultants.

The three secondary sources differed substantially in the estimation of economic net margins per hectare for irrigated farming. The Burns and Roe/Harza and IDIP estimates were based on a feasibility study for irrigation improvements in Southern Kazakhstan which were reported to have been examined and verified in the field. The TACIS documents indicated that a substantial portion of the data were self-reported by local farmers and not verified by on-the-ground analysis. Thus, both alternatives were used to estimate returns to irrigated farming in the six oblasts in Uzbekistan, one in the Kyrgyz Republic, two in Kazakhstan and one in Tajikistan. These calculations may be found in Appendix C. Net margins per hectare for each oblast were calculated by summing the net margin per crop multiplied by the percentage of total irrigated hectares of that crop in a given oblast. The net margin for each republic was also the sum for a given country of the oblast net margins multiplied by the percentage of total republic hectares in a given oblast. This republic weighted average net margin was used in the analysis. These data are presented in Table 5-1.

In addition to the net margins, data concerning consumptive use and water abstraction requirements by crop were available from the same sources. These data were used to determine the weighted average crop water requirements per hectare by oblast and by country, in order to establish a basis for the analyses of alternative water management regimes. These calculations are also found in Appendix E1. It should be noted that the calculated consumptive use and abstraction requirements are somewhat less than the reported values in Burns and Roe/Harza and IDIP. This is primarily due to the exclusion of many of the minor crops in the cropping pattern (several grains, some fruits and vegetables, and tobacco) for which no net margin data were available. These data are presented in Table 5-1.

Table 5-1. Water Requirements and Net Margins by Republic

	WTD AVE WAT REQ* 1000 m^3/HA B&R	WTD AVE WAT REQ 1000 m^3/HA TACIS	WTD AVE NET MARGIN $/HA B&R	WTD AVE NET MARGIN** $/HA TACIS
UZBEKISTAN TOTAL HA:1603	11.9	11.2	448.7	132.10
KAZAKHSTAN TOTAL HA:1017	11.6	10.5	208.4	63.65
KYRGYZ REP. TOTAL HA: 548	10.7	10.9	169.2	86.37
TAJIKISTAN TOTAL HA: 260	12.0	13.4	432.0	176.09

*Water requirement per crop multiplied by the percentage of that crop in the oblast time the percentage of oblast irrigated hectares of total republic irrigated hectares.
** Net margin per crop multiplied by the percentage of that crop in the oblast time the percentage of oblast irrigated hectares of total republic irrigated hectares.

5.3 Hydropower Values

The value of hydropower was taken from two sources. First, Burns and Roe/Harza reported average wholesale transboundary market prices for power as 4.45 cents per kWh in the winter peak period and 2.5 cents per kWh in the summer off-peak period. There was little confirmation of these prices from energy ministries in the four republics, although the Power Dispatch Center in Tashkent, Uzbekistan, did confirm that these numbers were acceptable. Data were gathered regarding the cost of thermal and hydropower power the energy ministries or privatized energy companies within the republics, and these values appeared consistent with a busbar cost of 2.5 cents per kWh for thermal power. These values were used to calculate power total and net benefits and losses. Hydropower cost at Toktogul, provided by Kyrgyzenergieholding, was estimated at about 4 - 5 mils (.7 - .8 com) per kWh.

5.4. Analysis

The analysis consisted of applying the economic values to the scenario results from the hydrologic model. First, a calculation of the impacts of the two extreme alternatives for operation of Toktogul Dam were analyzed. Next, results for optimum storage management regimes for irrigation and for hydropower were compared to determine deficits and values for both normal and dry years. Finally, an analysis of benefits or losses due to the existence of Toktogul was accomplished in order to examine the allocation of operation and maintenance costs.

For irrigation, the water deficit was used to calculate the reduced hectares in irrigation in each of the consistent regions in the hydrologic model (water deficit divided by the water requirement per hectare), and then the reduced number of hectares was multiplied by the maximum (B&R/IDIP) and minimum (TACIS) net margin per hectare. These values are listed in Table 5-2.

5.4.1. Irrigation and Power Benefits and Costs.

Calculation of Benefits and Costs

Operation of Toktogul in the Power Mode. The examination of the extreme mode of reservoir operation for power was based on the assumption that there would be no releases for irrigation during the vegetation period. A loss of 6.5 km^3 of releases divided equally between Uzbekistan and Kazakhstan would affect 273 250 hectares of irrigated agriculture in Uzbekistan, with an attendant loss of net margin of $122 million, and affect 282 314 hectares in Kazakhstan, with an attendant loss of net margin of $58.85 million[2].

Operation of Toktogul in the Irrigation Mode. Operation in the irrigation mode causes significant losses to the Kyrgyz Republic due to a reduction in winter hydropower production. There is a net deficit between Kyrgyz Republic demand and supply of power, including a deficit of 4.94 billion kWh in the winter period, and a net surplus of 3.82 billion kWh in a normal year. The economic value of this loss depends on the assumptions made about power costs and/or prices. The cost of generating thermal power equivalent to the winter deficit at 2.5 cents per kWh is $123 million. The net deficit of power, 1.12 billion kWh, valued at the same 2.5 cents per kWh is $28 million. If the Burns and Roe/Harza summer and winter market values are used, 2.5 and 4.45 cents per kWh respectively, the net loss in value is $124 million. Thus, the loss to the Kyrgyz Republic is between $28 and $124 million.

Optimized Operation of the Naryn Syr Darya Cascade. The model determined the optimum

[2]Note that these values are somewhat different than those calculated in the Burns and Roe/Harza document ($141 million and no loss, respectively). Further, in earlier meetings, Kazakhstan identified approximately 119 000 hectares which would be taken out of production (or a loss of about $25 million) in the event of no releases.

management regime for an irrigation mode. The results indicate that, in normal years, storage reservoirs in the basin can be operated in a way that can provide both power requirements and almost all irrigation needs (there is no difference in the deficits generated by the model in the two alternative regimes). In a dry year, however, operating in a power mode reduces irrigated hectares by about 365 000 hectares in Kazakhstan and about 95 500 hectares in Uzbekistan, amounting to a five-year average of $73 and $43 million losses, respectively. The signle year losses are $365 million and $215 million, respectively. These scenarios assume that the operating rules for Toktogul, Andijan, Charvak, Kayrakum and Chardara Reservoirs are coordinated.

For the optimum solutions to the model, hydropower values are calculated as the net of summer deficit (losses) and winter surplus (gain) to power production under the two regimes (Table 5-2). Hydropower values are reduced dramatically between the two optimum management regimes. Under the power mode, a net surplus of 236 GWh, worth about $ 5.9 million, is obtained in normal years, and a net surplus of 485 GWh, worth $9 to $12 million is obtained in dry years (due to increased reservoir releases). However, in irrigation mode, substantial losses (net deficits) occur, as described above.

Results when the Active Storage is Reduced to 20% of Capacity in a Normal Year Sequence. The model was also used to examine the effects of reducing the active storage to 20% of storage capacity in the initial year of the 5-year normal sequence (approximately 4-5 km^3). Results indicated that in the *irrigation mode*, there was no deficit to irrigation in a normal year. However, there was an average annual deficit of 6,078 Gwh in power supply. In the *power mode*, there was an annual deficit of 3.92 km^3 of irrigation water, or approximately 332 000 hectares, divided equally between Uzbekistan and Kazakhstan, coupled with an annual power deficit of 982 GWh. Clearly, the deficits increase substantially when storage is not available and the “run of the river” must be allocated between the two uses. For the dry year sequence, the results are even more indicative of the need for the maintenance of multi-year storage.

Purchases of Storage.

The current exchange agreements are barter equivalents of the purchase of storage for irrigation by downstream republics. These are annual agreements which are similar in nature to the Columbia River storage agreement. The annual monetized values for the energy exchanges in the current bilateral agreements are shown in Table 2. Using the total compensation value of $70 million per year, for either 25 or 50 years of payments, and either 5% or 3% interest rates, the present value of the annual payment is between $1.0 billion and $1.8 billion, respectively. This may represent the long-term purchase price of storage in Toktogul implicit in the exchanges, similar to the purchase of flood control storage in the Columbia River Basin. However, for this concept to apply to the Naryn Syr Darya Cascade, existing barter arrangements would necessarily have to be monetized.

Conclusions Regarding Benefits and Costs

Results from the above analysis suggest the following conclusions:

1. The model suggests that Toktogul Dam provides: (a) protection agains a dry year for irrigation and (b) significant power production in all years.

2. The model confirms the trade-off between power and irrigation modes, which is accentuated in dry years.

3. The model indicates that releasing water to fulfill both summer and winter demands will rapidly exhaust the storage in all but very wet years.

4. The model indicates that a lack of active storage in Toktogul Reservoir causes large losses to all republics and accentuates the competition between republics in the following years.

5. Results clearly indicate the necessity for a multi-year agreement which can assure active storage and provide both predictability and security in the basin.

5.4.2. Allocation of Operation and Maintenance Costs

The allocation of costs of multi-purpose facilities generally follows a reasonably defined process. First, the costs which can be associated with a single purpose or user are allocated to that purpose, or separable costs. Next, some method of allocating the costs which cannot be associated with a single purpose or user are allocated to the purposes or users on the basis of some agreed-upon rule.

For the Toktogul Dam and Reservoir, data on annual operating and maintenance costs were obtained from Kyrgyzenergieholding Company in August, 1997 (in millions som converted to US$ at a rate of 16.5 som/$) and presented in Table 5-3. Kyrgyzenergieholding noted that these costs may be seriously underestimated.

Table 5-2. Calculated Values Based on Water Requirements and Net Margins per Hectare

Scenario	**Irr. Deficit** Km^3/yr	**HA Deficit** Ha/yr	**Net Margin** B&R $/ha	**Net Margin** TACIS $/ha	**Irrigation Value** MAX (B&R) Mln $ ha * $/ha	MIN (Tacis) Mln $ ha * $/ha	**Power Surplus** Veg GWh	**Power Deficit** Non-Veg GWh	**Net Power** Value Peak Price Mln $ pk 4.45 off 2.50	**Net Power** Value Fixed Price Mln $ Thrm 2.5
No Dam										
NNNNN*										
Kyrgyz Rep							N/A		N/A	
Kazakhstan	-0.13	-10908	208.4	63.65	-2.27	-0.69				
Uzbekistan	0.00	0	448.7	132.1	0.00	0.00				
NNDNN*										
Kyrgyz Rep							N/A		N/A	
Kazakhstan	-0.20	-17487	208.4	63.65	-3.65	-1.11				
Uzbekistan	-0.58	-49017	448.7	132.1	-22.00	-6.48				
				KZ Dry **	-6.86	-2.09				
				UZ Dry **	-109.98	-32.38				
Irrigation										
NNNNN*										
Kyrgyz Rep							3822	4942	-124.38	-28.01
Kazakhstan	-0.15	-12884	208.4	63.65	-2.69	-0.82				
Uzbekistan	0.00	0	448.7	132.1	0.00	0.00				
NNDNN*										
Kyrgyz Rep							4103	4525	-98.80	-10.56
Kazakhstan	-0.23	-20167	208.4	63.65	-4.20	-1.28				
Uzbekistan	0.00	0	448.7	132.1	0.00	0.00				
				KZ Dry **	-7.59	-2.32				
				UZ Dry **	0.00	0.00				
Power										
NNNNN*										
Kyrgyz Rep							236	0	5.89	5.89
Kazakhstan	-0.15	-12884	208.4	63.65	-2.69	-0.82				
Uzbekistan	0.00	0	448.7	132.1	0.00	0.00				
NNDNN*										
Kyrgyz Rep							625	140	9.39	12.12
Kazakhstan	-4.25	-365120	208.4	63.65	-76.11	-23.24				
Uzbekistan	-1.14	-95545	448.7	132.1	-42.87	-12.62				
				KZ Dry **	-367.11	-112.11				
				UZ Dry **	-214.37	-63.11				

*NNNNN refers to the 5 normal year scenario; NNDNN refers to the two normal, one dry, and two normal year scenario

**Indicates the calculation of the cumulative 5-year loss due to the inclusion of a dry year.

Since only the Kyrgyz Republic benefits from power production (either in providing for internal power demands or by selling or exchanging power abroad), the separable O&M costs for Toktogul Dam associated with hydropower ($1.07 million) would be borne by them under standard cost allocation procedure, as would the O&M costs for the remaining four dams in the Naryn Syr Darya Cascade.

Table 5-3. Operation and Maintenance Costs for Toktogul Dam.

Cost	**Operation Cost** Mln $	**Maintenance Cost** Mln $	**Total O&M Cost** Mln $
(A) Total O&M costs	2.72	1.03	3.75
(B) Hydropower related	0.62	0.45	1.07
(C) Joint Costs (A-B)	2.10	0.58	2.68

Joint costs have been divided in several ways in other international cases:

Entirely by one of the participating countries. This approach would be based on the assumption that the operation and maintenance costs are borne at least in part by the compensatory exchanges and the Kyrgyz Republic would pay all of the joint operation and maintenance costs.

Equally among all users. This suggests annual joint cost shares of $893,000 per Republic, with the Kyrgyz Republic also being responsible for the annual $1.07 million in O&M for the hydropower facilities.

On a physical basis. This suggests that the storage necessary for irrigation or power should be the basis of the proportional sharing of storage capacity. For the power regime, the storage is essentially for power production. Thus, in the power regime, power should bear the entire O&M costs.

For the irrigation regime, 6.5 cubic kilometers are released for irrigation. This is approximately 46 percent of the full active storage capacity (14 cubic km) of the reservoir. Thus, the downstream irrigators would bear 46 percent of the joint costs, equally as between Kazakhstan and Uzbekistan (given the equal releases of 3.25 cubic km). The result in an annual cost share of $616,400 per year for Kazakhstan and Uzbekistan, and a $2.52 million annual cost share for the Kyrgyz Republic.

On demand. This approach would allow one or more of the downstream countries to decide not to provide compensation and not receive irrigation releases. The payment of a portion of the O&M costs would be "triggered" by a request for water releases. There are two possibilities with this approach, as well. The share could either be on an equal-share basis (33% per downstream country), or on a physical basis (23% per downstream country).

On an economic basis. This approach is based on two criteria. First, no country should pay more than the benefit it derives from the facility and, second, each country should bear the cost of specific parts of the facility which are required to deliver its benefits. No irrigation-specific costs have been identified. Note that the calculations are generally based on normal water conditions.

The Separable Cost Remaining Benefit (SCRB) Method identifies a justifiable cost for a service or country as the lesser of the benefits which that service or country generates from the project and the cost of providing that service in the next best alternative method. The calculation of benefits is based on the value of irrigation and power with and without the dam.

To calculate the with/without conditions for irrigation, results from Table 5-2 are used. The difference between the No Dam and Irrigation Mode scenarios is used to determine the benefits of the existence of the dam. Under normal year conditions, the maximum estimated irrigation value is zero for Uzbekistan and for Kazakhstan We have been unable to identify a "next best alternative method" of providing the 6.5 cubic kilometers of irrigation water from Toktogul, but given that the benefits to irrigation are small, those data are probably not necessary.

The gain in hydropower production is, of course, significant. Toktogul Dam produces approximately 4 billion kWh per year, depending upon the release regime and flow scenarios used. The value of that hydropower in replacing thermal power (the next best alternative) at a cost of 2.5 cents per kWh would be about $101.75 million per year. The present value of this annual benefit stream calculated using a 50 year life and a 3% interest rate is $2.168 billion. If one considers that the entire Cascade would not exist without the presence of Toktogul, then the total hydropower production would be approximately 9 billion kWh in the irrigation mode or 10.3 billion kWh in the power mode, or about $225 million to $257 million per year in normal years. The present values of those annual streams are $5.79 and $6.61 billion, respectively. During dry years, increasing amounts of hydropower are generated as increasing water releases occur.

Table 5-4. Separable Cost Remaining Benefit Allocation.

	Hydropower Mln $	Irrigation Mln $
(D) Benefits	2618.0	0.0
(E) Separable Costs	27.50	0.0
(F) Remaining Benefits	2590.5	0.0
(G) Share of Remaining Benefits (F/ Sum F)	1.00	0.0
(H) Share of Joint Cost	2.68	0.0
(I) Total Allocated Cost	3.75	0.0

Thus, using economic approaches, neither Kazakhstan nor Uzbekistan would be assessed any cost sharing, and the Kyrgyz Republic would be assessed the entire $3.75 million per year.

APPENDIX A.
FLOWS, RELEASES AND VOLUME: TOKTOGUL RESERVOIR

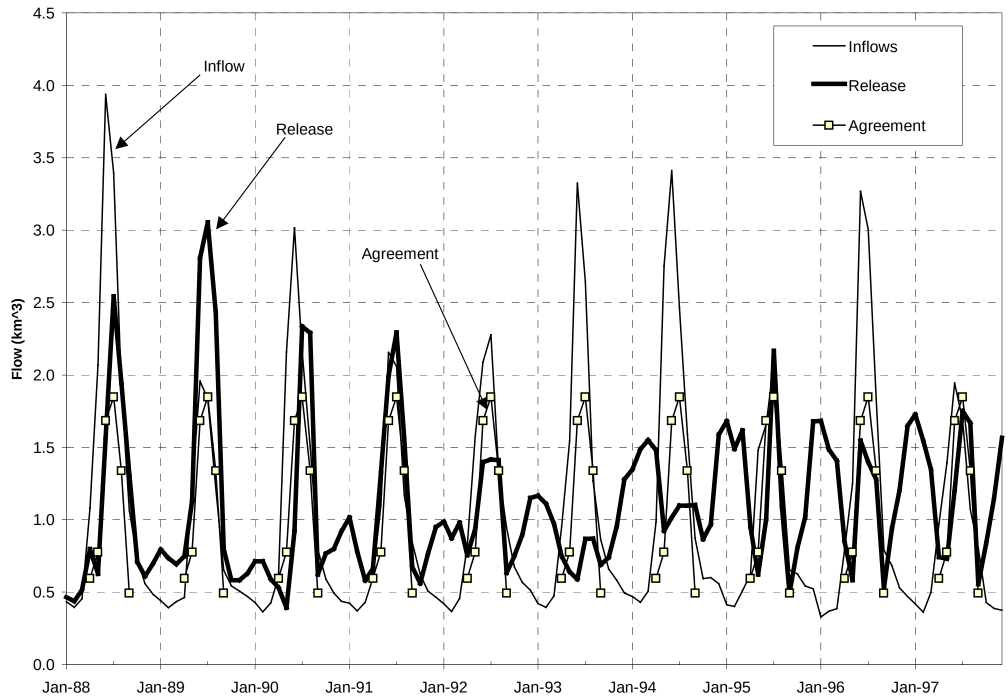

Figure A.1. Toktogul Reservoir inflow, release and agreement flows (m^3/s) for 1988-97.

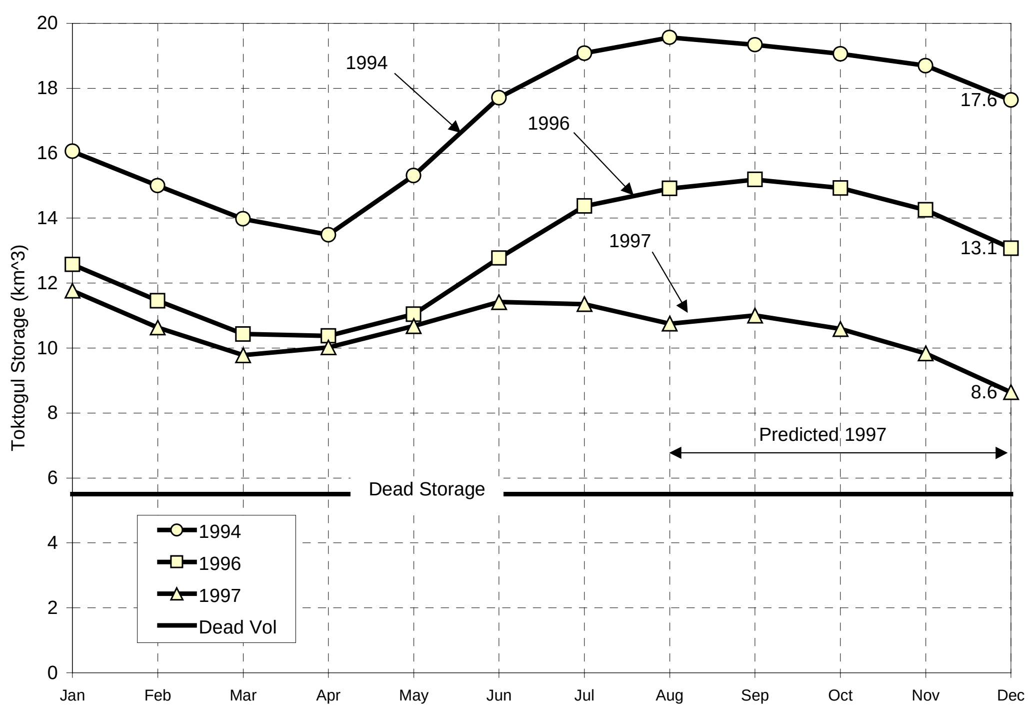

Figure A.2. Toktogul Reservoir storage volumes (km^3) for 1994, 96, and 97.

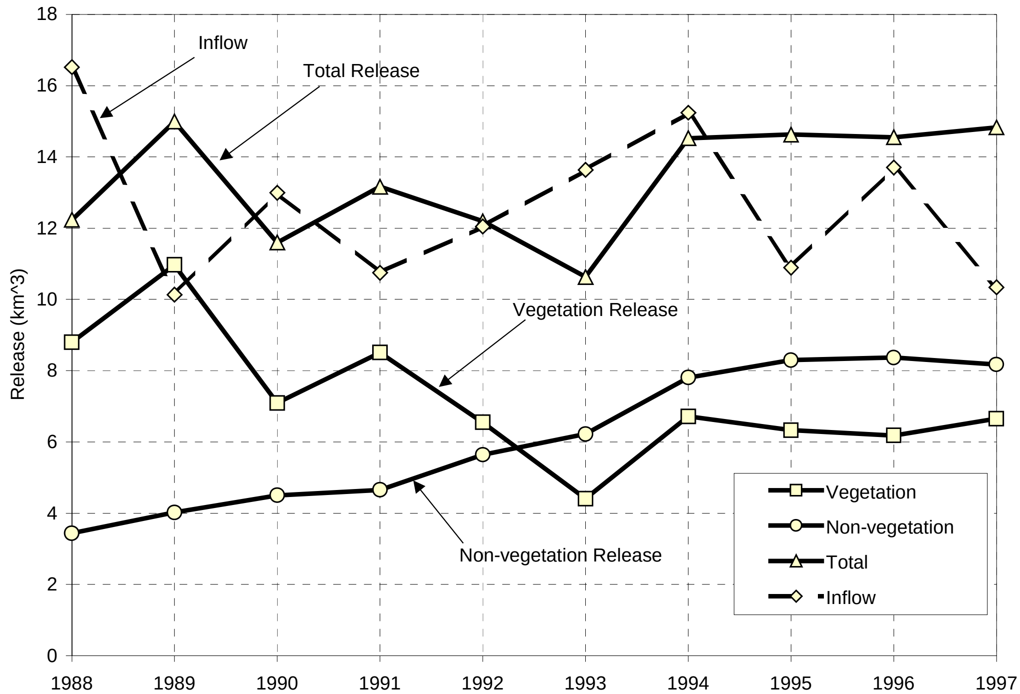

Figure A.3. Toktogul Reservoir vegetation, non-vegetation, total release and inflow volumes for 1988 - 97(km^3).

APPENDIX B.
DATA COLLECTION LIST

Data Requirements

The meeting of the Water and Energy Uses Round Table of the ICKKU concluded its negotiations on the questions of the operation of Toktogul Reservoir recognizing agreements in principle regarding timing of releases and compensation, and on methods of enforcement of those agreements. The topic of sharing of operations and maintenance costs was addressed, but no agreement was reached. Instead, it was determined that further study was needed and the Consultant to EPT, Dr. John Keith, would visit each of the Republics to provide technical assistance in determining an appropriate cost sharing agreement as the subject of a negotiation scheduled for September, 1997. Other items, such as similar agreements for other joint facilities in the Naryn SyrDarya Basin and the discussion of damages, were identified for discussion at a future date.

In order to determine an equitable division of the costs of operation, maintenance, and rehabilitation a set of data are required from each Republic. These data should serve to clarify each Republic's position in the coming negotiation: its benefits and costs related the provision of, or lack of provision of, operation, maintenance and rehabilitation. It is anticipated that the experts of each country, in cooperation with the Consultant, will be able to clearly establish these costs and benefits and begin a negotiation on the basis of an appropriate analysis.

The Consultant has prepared the list below as the minimum data necessary to the negotiations. It is probably not exhaustive relative to all the data which might be useful, and it may include data which are not now readily available. However, it is essential to a negotiated agreement that, in so far as possible, these data be collected and examined. Since the focus of the negotiations has been agreed by the participants from each Republic as the Toktogul Dam and Reservoir, the data are focused on this reservoir. Data for other facilities may be supplied if readily available, but the data for Toktogul are absolutely essential.

The two basic release regimes are (1) irrigation regime in which the releases specified in the 1995, 1996 and 1997 bilateral agreements (6.5 km^3 during the vegetation period); and (2) the power regime, in which Kyrgyz Republic releases water in winter sufficient to provide for its power needs.

Facility(ies) operation:
- Costs of operation and maintenance of the facility
  - Normal operations costs
    - Energy facilities (turbines, penstocks, transformer stations, etc.)
    - Irrigation facilities (headgates, canals)
    - General costs (flood control, debris removal, etc.)
    - Other
  - Normal maintenance costs
    - Energy facilities (turbines, penstocks, etc.)
    - Irrigation facilities (headgates, canals)
    - General costs (flood control, debris removal, etc.)
    - Other
  - Rehabilitation costs
    - Dam
    - Energy facilities
    - Irrigation facilities
    - Other
  - Direct Costs of operation which result from alternative operating regimes
    - Flooding costs
    - Structural damages
    - Other

Benefits to "normal" regime and to alternative regime (with summer releases; with winter releases). Note that for some Republics, there may be no benefits under one or the other regime.
- Returns to irrigation releases
  - Production of crops
  - Values of crops
    - Prices paid to farmers
    - Values retained by State
  - Costs of all inputs but water
    - Seeds, fertilizer, pesticides, herbicides, planting and harvest labor
  - Costs of local water distribution facilities
    - Investment repayment
    - Operation and Maintenance
    - Rehabilitation
    - Other
- Returns to agricultural production <u>without</u> releases
  - Production of crops
  - Values of crops
    - Prices paid to farmers
    - Values retained by State
  - Costs of inputs
    - Seeds, fertilizer, pesticides, herbicides, planting and harvest labor
    - Water costs exclusive of releases

- Returns to hydropower releases
  - Values of hydropower locally
  - Prices of hydropower in the power pool
    - Peak load
    - Off-peak
    - Variations
- Avoided costs of flooding
- Other

Costs of alternative resources/production (if feasible)

- Irrigation water
- Electric power
- Flood control
- Other

Table B1. Data Collection in the Central Asian Republics of the Syr Darya Basin: 7 July through 24 August, 1994

REPUBLIC	MINISTRY	DATA REQUESTED	DATA RECEIVED
Kazakhstan	Agriculture and Water	Cropping patterns	No
		Values of crops	No
		Production by crop	No
		Price to farmer	No
		Retained by State	No
		Costs of inputs	No
		Water requirements by crop	No
		Costs of local water	No
		Costs of flood control	No
		Flows/Release for Chardara	No
	Energy	Costs of thermal power	Yes
		Prices of power to consumers	Yes
		Cost of fuel	Yes
Kygryz Republic	Water and Agriculture	Cropping patterns	Yes
		Values of crops	No
		Production by crop	Yes
		Price to farmer	No
		Retained by State	No
		Costs of inputs	No
		Water requirements by crop	Yes
		Costs of local water	No
		Costs of flood control	No
	Energy and Kyrgyzenergie-holding	Toktogul Costs	Yes
		Operation	Yes
		Maintenance	Yes
		Rehabilitation	No
		Specific costs of hydropower	Yes
		Specific costs of irrigation	N/A
		Flows/releases for Toktogul	Yes
		Costs of thermal power	Yes
		Prices of power to consumers	Yes
		Cost of fuel	Yes
Tajikistan NOTE: Due to cancellation of travel authorization, Tajikistan was not visited for the data collection. A fax of the data request was sent.	Water and Agriculture	Cropping patterns	No
		Values of crops	No
		Production by crop	No
		Price to farmer	No
		Retained by State	No
		Costs of inputs	No
		Water requirements by crop	No
		Costs of local water	No
		Costs of flood control	No
	Energy	Costs of thermal power	No
		Prices of power to consumers	No
		Cost of fuel	No
		Cost of Hydropower	No
		Flows/releases for Kayrakum	No
Uzbekistan	Water and Agriculture	Cropping patterns	No
		Values of crops	No
		Production by crop	No
		Price to farmer	No
		Retained by State	No
		Costs of inputs	No
		Water requirements by crop	No
		Costs of local water	No
		Costs of flood control	No
	Energy	Costs of thermal power	No
		Prices of power to consumers	Yes
		Cost of fuel	No
		Cost of Hydropower	No

APPENDIX C:
WATER REQUIREMENTS AND NET MARGINS BY OBLAST

Uzbekistan

	Area HA	%	AGGRE-GATE	WAT REQ/HA BR	WAT REQ/HA TAC	WAT REQ TOT B&R	WAT REQ TOT TAC	MARG /HA B&R	MARG TOT B&R	MARG /HA TACIS	MARG TOT TACIS
ANDIJAN	239										
Cotton	114.5	0.48		14.15	13.21	1620175	1512545	799	91485.5	204	23358
Winter wht	37.4	0.16	0.1677	7.07	6.96	264418	260304	120	4488	60	2244
Wint rye	0.3	0.001				0	0		0		0
Wint barl	2.3	0.009				0	0		0		0
Spr wht	0.1	0.0004	0.0004	7.07	7.85	707	785	120	12	60	6
Spr barl	0	0				0	0		0		0
Spr rye	0	0				0	0		0		0
Maiz gr	13.7	0.0573		11.285	11.285	154604.5	154604.5	418	5726.6	418	5726.6
Rice	4.8	0.0200		42.94	38.518	206112	184886.4	94	451.2	-254	-1219.2
Oats	0	0				0	0	120	0		0
Potato	2.5	0.0105		10.61	8.714	26525	21785	374	935	2479	6197.5
Melon	1.5	0.0062		13.017	13.017	19525.5	19525.5	283	424.5	722	1083
Tomat	1.9	0.0079		11.107	11.107	21103.3	21103.3	869	1651.1	869	1651.1
Grnd nut	1.5	0.0062				0	0		0		0
Peas	0	0				0	0		0		0
Beans	0.1	0.0004				0	0		0		0
Sunflr	0.2	0.0008				0	0		0		0
Maiz frg	11.1	0.0464		7.25	7.25	80475	80475	175	1942.5	175	1942.5
Root frg	1	0.0041				0	0		0		0
Alf yng	1.9	0.0079		17.392	17.392	33044.8	33044.8		0		0
Alf mat	21.8	0.0912		17.392	17.392	379145.6	379145.6	175	3815	175	3815
Tobacco	0	0				0	0		0		0
Fruit tree	0	0				0	0		0		0
Vines	0	0				0	0		0		0
											0
TOTAL						2805835.7	2668204.1		110931.4		41365

DJIZAK	257										0
Cotton	134.6	0.5237354		14.15	17.553	1904590	2362633.8	799	107545.4	-87	-11710.2
Winter wht	24.9	0.0968872	0.163035	7.07	5.25	176043	130725	120	2988	-122	-3037.8
Wint rye	0	0				0	0		0		0
Wint barl	4.3	0.0167315				0	0		0		0
Spr wht	12.7	0.0494163	0.0712062	7.07	9.25	89789	117475	120	1524	-122	-1549.4
Spr barl	5.6	0.0217899				0	0		0		0
Spr rye	0	0				0	0		0		0
Maiz gr	6.3	0.0245136		13.803	13.803	86958.9	86958.9	418	2633.4	194	1222.2
Rice	0.2	0.0007782		42.94	43	8588	8600	94	18.8	-601	-120.2
Oats	0	0				0	0	120	0		0
Potato	1.7	0.0066148		10.61	9.41	18037	15997	374	635.8	2479	4214.3
Melon	6.3	0.0245136		17	17	107100	107100	283	1782.9	772	4863.6
Tomat	0.7	0.0027237		13.267	13.267	9286.9	9286.9	869	608.3	869	608.3
Grnd nut	4.1	0.0159533				0	0		0		0
Peas	0	0				0	0		0		0
Beans	0.2	0.0007782				0	0		0		0
Sunflr	1.6	0.0062257				0	0		0		0
Maiz frg	5.6	0.0217899		10.982	10.982	61499.2	61499.2	175	980	175	980
Root frg	1	0.0038911				0	0		0		0
Alf yng	1.7	0.0066148		21.071	21.071	35820.7	35820.7		0		0
Alf mat	29.1	0.1132296		21.071	21.071	613166.1	613166.1	175	5092.5	175	5092.5
Tobacco		0				0	0		0		0
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
											0
TOTAL							3549262.6		123809.1		563

NAMNGN	222		BR	TAC	B&R	TAC	B&R	B&R	TACIS	TACIS	20522.4
Winter wht	39.4	0.1774775	0.2103604	7.07	6.892	278558	271544.8	120	4728	60	2364
Wint rye	0.8	0.0036036				0	0		0		0
Wint barl	5.9	0.0265766				0	0		0		0
Spr wht	0.6	0.0027027	0.0027027	7.07	7.897	4242	4738.2	120	72	60	36
Spr barl	0	0				0	0		0		0
Spr rye	0	0				0	0		0		0
Maiz gr	3.6	0.0162162		11.286	11.286	40629.6	40629.6	418	1504.8	418	1504.8
Rice	4.6	0.0207207		42.94	38.518	197524	177182.8	94	432.4	-254	-1168.4
Oats	0	0				0	0	120	0		0
Potato	4.7	0.0211712		10.61	8.714	49867	40955.8	374	1757.8	2479	11651.3
Melon	2.6	0.0117117		13.017	13.017	33844.2	33844.2	283	735.8	722	1877.2
Tomat	1	0.0045045		11.107	11.107	11107	11107	869	869	869	869
Grnd nut	0.4	0.0018018				0	0		0		0
Peas	0.1	0.0004505				0	0		0		0
Beans	0	0				0	0		0		0
Sunflr	0	0				0	0		0		0
Maiz frg	14.9	0.0671171		7.25	7.25	108025	108025	175	2607.5	175	2607.5
Root frg	1	0.0045045				0	0	175	175		0
Alf yng	3.2	0.0144144		17.393	17.393	55657.6	55657.6		0		0
Alf mat	24.4	0.1099099		17.393	17.393	424389.2	424389.2	175	4270	175	4270
Tobacco		0				0	0		0		0
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
						0					0
TOTAL							2497402.6		97531.7		44533.8

SYRDAR	268										0
Cotton	141.6	0.5283582		14.15	11.788	2003640	1669180.8	799	113138.4	35	4956
Winter wht	28.9	0.1078358	0.1313433	7.07	4.357	204323	125917.3	120	3468	-77	-2225.3
Wint rye	0	0				0	0		0		0
Wint barl	6.2	0.0231343				0	0		0		0
Spr wht	0.1	0.0003731	0.0108209	7.07	7.161	707	716.1	120	12	-77	-7.7
Spr barl	2.7	0.0100746				0	0		0		0
Spr rye	0.1	0.0003731				0	0		0		0
Maiz gr	10.4	0.038806		9.768	9.768	101587.2	101587.2	418	4347.2	-23	-239.2
Rice	8	0.0298507		42.94	37.446	343520	299568	94	752	-159	-1272
Oats	0	0				0	0	120	0		0
Potato	1.4	0.0052239		10.61	7.036	14854	9850.4	374	523.6	2479	3470.6
Melon	4.8	0.0179104		11.535	11.535	55368	55368	283	1358.4	772	3705.6
Tomat	0.5	0.0018657		9.571	9.571	4785.5	4785.5	869	434.5	869	434.5
Grnd nut	1.6	0.0059701				0	0		0		0
Peas	0	0				0	0		0		0
Beans	0	0				0	0		0		0
Sunflr	0.4	0.0014925				0	0		0		0
Maiz frg	11.5	0.0429104		6.91	6.91	79465	79465	175	2012.5	175	2012.5
Root frg	1.2	0.0044776				0	0	175	210	175	210
Alf yng	2.2	0.008209		14.571	14.571	32056.2	32056.2		0		0
Alf mat	31.4	0.1171642		14.571	14.571	457529.4	457529.4	175	5495	175	5495
Tobacco		0				0	0		0		0
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
											0
TOTAL							2836023.9		131751.6		16540

TSHKNT	315										0
Cotton	108.2	0.3434921		14.15	11.786	1531030	1275245.2	799	86451.8	35	3787
Winter wht	22.6	0.071746	0.1307937	7.07	4.357	159782	98468.2	120	2712	-77	-1740.2
Wint rye	0.4	0.0012698				0	0		0		0
Wint barl	2.1	0.0066667				0	0		0		0
Spr wht	16.1	0.0511111	0.0730159	7.07	7.161	113827	115292.1	120	1932	-77	-1239.7
Spr barl	6.9	0.0219048				0	0		0		0
Spr rye	0	0				0	0		0		0
Maiz gr	10.2	0.032381		9.767	9.767	99623.4	99623.4	418	4263.6	-23	-234.6
Rice	12.6	0.04		42.94	37.446	541044	471819.6	94	1184.4	-159	-2003.4
Oats	0.1	0.0003175				0	0	120	12		0
Potato	10.1	0.0320635		10.61	7.035	107161	71053.5	374	3777.4	2479	25037.9
Melon	2.8	0.0088889		11.536	11.536	32300.8	32300.8	283	792.4	772	2161.6
Tomat	3.9	0.012381		9.571	9.571	37326.9	37326.9	869	3389.1	869	3389.1
Grnd nut	2.2	0.0069841				0	0		0		0
Peas	0.1	0.0003175				0	0		0		0
Beans	0.1	0.0003175				0	0		0		0
Sunflr	0.3	0.0009524				0	0		0		0
Maiz frg	19.4	0.0615873		6.91	6.91	134054	134054	175	3395	175	3395
Root frg	3.2	0.0101587				0	0	175	560	175	560
Alf yng	4.1	0.0130159		14.571	14.571	59741.1	59741.1		0		0
Alf mat	45.6	0.1447619		14.571	14.571	664437.6	664437.6	175	7980	175	7980
Tobacco		0				0	0		0		0
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
											0
TOTAL							3059362.4		116449.7		41092.7

FRGANA	302										0
Cotton	131.2	0.4344371		14.15	11.911	1856480	1562723.2	799	104828.8	204	26764.8
Winter wht	47.8	0.1582781	0.2009934	7.07	6.071	337946	290193.8	120	5736	60	2868
Wint rye	3.8	0.0125828				0	0		0		0
Wint barl	8.6	0.0284768				0	0		0		0
Spr wht	0.5	0.0016556	0.0019868	7.07	7.893	3535	3946.5	120	60	60	30
Spr barl	0.1	0.0003311				0	0		0		0
Spr rye	0	0				0	0		0		0
Maiz gr	7.3	0.0241722		10.089	10.089	73649.7	73649.7	418	3051.4	418	3051.4
Rice	1.2	0.0039735		42.94	37.179	51528	44614.8	94	112.8	-254	-304.8
Oats	0	0				0	0	120	0		0
Potato	7.6	0.0251656		10.61	7.732	80636	58763.2	374	2842.4	2479	18840.4
Melon	1.6	0.005298		11.714	11.714	18742.4	18742.4	283	452.8	722	1155.2
Tomat	1	0.0033113		9.946	9.946	9946	9946	869	869	869	869
Grnd nut	0.2	0.0006623				0	0		0		0
Peas	0.1	0.0003311				0	0		0		0
Beans	0.1	0.0003311				0	0		0		0
Sunflr	0	0				0	0		0		0
Maiz frg	30.6	0.1013245		6.5	6.5	198900	198900	175	5355	175	5355
Root frg	1.8	0.0059603				0	0	175	315		0
Alf yng	2.2	0.0072848		15.946	15.946	35081.2	35081.2		0		0
Tobacco	32	0.1059603		15.946	15.946	510272	510272	175	5600	175	5600
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
Vines		0				0	0		0		0
											0
TOTAL							2806832.8		129223.2		64199

Kazakhstan						0	0				0
S KAZAK	757					0	0				0
Cotton	120	0.1585205		14.15	11.788	1698000	1414560	799	95880	101	12120
Winter wht	0	0.0792602	7.07	4.357	0	0	120	0	-397	0	
Wint rye		0				0	0		0		0
Wint barl	60	0.0792602				0	0		0		0
Spr wht		0	0	7.07	7.161	0	0	120	0	-486	0
Spr barl		0				0	0		0		0
Spr rye		0				0	0		0		0
Maiz gr	20	0.0264201		9.678	9.678	193560	193560	418	8360	-292	-5840
Rice	20	0.0264201		42.94	37.446	858800	748920	94	1880	-699	-13980
Oats		0				0	0	120	0		0
Potato	4	0.005284		10.61	7.036	42440	28144	374	1496	2479	9916
Melon	10	0.01321		11.535	11.535	115350	115350	283	2830	772	7720
Tomat	25	0.0330251		9.571	9.571	239275	239275	869	21725	869	21725
Grnd nut		0				0	0		0		0
Peas	10	0.01321				0	0		0		0
Beans	10	0.01321				0	0		0		0
Sunflr		0				0	0		0		0
Maiz frg	34	0.0449141		6.91	6.91	234940	234940	175	5950	175	5950
Root frg	1	0.001321				0	0	175	175	175	175
Alf yng	16	0.0211361		14.571	14.571	233136	233136				0
Alf mat	154	0.2034346		14.571	14.571	2243934	2243934	175	26950	175	26950
Tobacco		0							0		0
Fruit tree	16	0.0211361					5451819		0		0
Vines	10	0.01321							0		0
											0
TOTAL									165246		64736

KZYL-ORD	260										0
Cotton	0	0		14.15	11.788	0	0	799	0	0	0
Winter wht	0	0	0.1346154	7.07	4.357	0	0	120	0	-470	0
Wint rye		0				0	0		0		0
Wint barl	35	0.1346154				0	0		0		0
Spr wht		0	0	7.07	7.161	0	0	120	0	-395	0
Spr barl		0				0	0		0		0
Spr rye		0				0	0		0		0
Maiz gr	11	0.0423077		9.678	9.678	106458	106458	418	4598	-465	-5115
Rice	87	0.3346154		42.94	37.446	3735780	3257802	94	8178	-549	-47763
Oats		0				0	0	120	0		0
Potato	2	0.0076923		10.61	7.036	21220	14072	374	748	2479	4958
Melon	3	0.0115385		11.535	11.535	34605	34605	283	849	772	2316
Tomat	5	0.0192308		9.571	9.571	47855	47855	869	4345	869	4345
Grnd nut		0				0	0		0		0
Peas	4	0.0153846				0	0		0		0
Beans	4	0.0153846				0	0		0		0
Sunflr		0				0	0		0		0
Maiz frg	16	0.0615385		6.91	6.91	110560	110560	175	2800	175	2800
Root frg	1	0.0038462				0	0	175	175	175	175
Alf yng	8	0.0307692		14.571	14.571	116568	116568		0		0
Alf mat	78	0.3		14.571	14.571	1136538	1136538	175	13650	175	13650
Tobacco		0				0	0		0		0
Fruit tree	1	0.0038462				0	0		0		0
Vines	7	0.0269231				0	0		0		0
											0
TOTAL							4824458		35343		-24634

Kyrgyz Rep											0
											0
OSH	244										0
Cotton	7	0.0286885		14.15	11.911	99050	83377	799	5593	204	1428
Winter wht	4	0.0163934	0.0163934	7.07	6.071	28280	24284	120	480	60	240
Wint rye		0				0	0		0		0
Wint barl		0				0	0		0		0
Spr wht		0	0.4713115	7.07	7.893	0	0	120	0	60	0
Spr barl	115	0.4713115				0	0		0		0
Spr rye		0				0	0		0		0
Maiz gr	0	0		10.089	10.089	0	0	418	0	418	0
Rice	1	0.0040984		42.94	37.179	42940	37179	94	94	-254	-254
Oats		0				0	0	120	0		0
Potato		0		10.61	7.732	0	0	374	0	2479	0
Melon		0		11.714	11.714	0	0	283	0	722	0
Tomat	8	0.0327869		9.946	9.946	79568	79568	869	6952	869	6952
Grnd nut		0				0	0		0		0
Peas		0				0	0		0		0
Beans		0				0	0		0		0
Sunflr		0				0	0		0		0
Maiz frg		0		6.5	6.5	0	0	175	0	175	0
Root frg	6	0.0245902				0	0	175	1050		0
Alf yng	9	0.0368852		15.946	15.946	143514	143514		0		0
Alf mat	81	0.3319672		15.946	15.946	1291626	1291626	175	14175	175	14175
Tobacco	14	0.057377				0	0		0		0
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
											0
TOTAL							1659548		28344		22541

DJLELBD	151										0
Cotton	13	0.0860927		14.15	11.911	183950	154843	799	10387	204	2652
Winter wht	2	0.013245	0.013245	7.07	6.071	14140	12142	120	240	60	120
Wint rye		0				0	0		0		0
Wint barl		0				0	0		0		0
Spr wht		0	0.4834437	7.07	7.893	0	0	120	0	60	0
Spr barl	73	0.4834437				0	0		0		0
Spr rye		0				0	0		0		0
Maiz gr		0		10.089	10.089	0	0	418	0	418	0
Rice	1	0.0066225		42.94	37.179	42940	37179	94	94	-254	-254
Oats		0				0	0	120	0		0
Potato		0		10.61	7.732	0	0	374	0	2479	0
Melon		0		11.714	11.714	0	0	283	0	722	0
Tomat		0		9.946	9.946	0	0	869	0	869	0
Grnd nut	4	0.0264901				0	0		0		0
Peas		0				0	0		0		0
Beans		0				0	0		0		0
Sunflr		0				0	0		0		0
Maiz frg		0		6.5	6.5	0	0	175	0	175	0
Root frg	1	0.0066225				0	0	175	175		0
Alf yng	5	0.0331126		15.946	15.946	79730	79730		0		0
Alf mat	45	0.2980132		15.946	15.946	717570	717570	175	7875	175	7875
Tobacco	6	0.0397351				0	0		0		0
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
											0
TOTAL							1001464		18771		

NARYN	153										0
Cotton	0	0		14.15	11.911	0	0	799	0	204	0
Winter wht	1	0.0065359	0.0065359	7.07	6.071	7070	6071	120	120	60	60
Wint rye		0				0	0		0		0
Wint barl		0				0	0		0		0
Spr wht		0	0.4575163	7.07	7.893	0	0	120	0	60	0
Spr barl	70	0.4575163				0	0		0		0
Spr rye		0				0	0		0		0
Maiz gr		0		10.089	10.089	0	0	418	0	418	0
Rice		0		42.94	37.179	0	0	94	0	-254	0
Oats		0				0	0	120	0		0
Potato		0		10.61	7.732	0	0	374	0	2479	0
Melon		0		11.714	11.714	0	0	283	0	722	0
Tomat	2	0.0130719		9.946	9.946	19892	19892	869	1738	869	1738
Grnd nut		0				0	0		0		0
Peas		0				0	0		0		0
Beans		0				0	0		0		0
Sunflr		0				0	0		0		0
Maiz frg		0		6.5	6.5	0	0	175	0	175	0
Root frg	1	0.0065359				0	0	175	175		0
Alf yng	8	0.0522876		15.946	15.946	127568	127568		0		0
Alf mat	72	0.4705882		15.946	15.946	1148112	1148112	175	12600	175	12600
Tobacco		0				0	0		0		0
Fruit tree		0				0	0		0		0
Vines		0				0	0		0		0
											0
TOTAL							1301643		14633		0

Tajikistan											0
LENINBD	260										0
Cotton	112	0.4307692		14.15	11.911	1584800	1334032	799	89488	204	22848
Winter wht	38	0.1461538	0.1461538	7.07	6.071	268660	230698	120	4560	60	2280
Wint rye		0				0	0		0		0
Wint barl		0				0	0		0		0
Spr wht		0	0.0307692	7.07	7.893	0	0	120	0	60	0
Spr barl	8	0.0307692				0	0		0		0
Spr rye		0				0	0		0		0
Maiz gr	2	0.0076923		10.089	10.089	20178	20178	418	836	418	836
Rice	2	0.0076923		42.94	37.179	85880	74358	94	188	-254	-508
Oats		0				0	0	120	0		0
Potato	2	0.0076923		10.61	7.732	21220	15464	374	748	2479	4958
Melon		0		11.714	11.714	0	0	283	0	722	0
Tomat	5	0.0192308		9.946	9.946	49730	49730	869	4345	869	4345
Grnd nut		0				0	0		0		0
Peas		0				0	0		0		0
Beans		0				0	0		0		0
Sunflr		0				0	0		0		0
Maiz frg	8	0.0307692		6.5	6.5	52000	52000	175	1400	175	1400
Root frg	1	0.0038462				0	0		0		0
Alf yng	6	0.0230769		15.946	15.946	95676	95676		0		0
Alf mat	55	0.2115385		15.946	15.946	877030	877030	175	9625	175	9625
Tobacco	10	0.0384615				0	0		0		0
Fruit tree	5	0.0192308				0	0		0		0
Vines	6	0.0230769				0	0		0		0
											0
							2749166		111190		0