

INTRODUCTION

Joint use of water resources in the Aral Sea basin is one of key problems in interrelations between Central Asian countries. This problem is especially acute in the Syrdarya basin (see Figure 1), where flow regulation amounts to 93 %, and all water resources are utilized. With long-term average river flow of 37.5 cu km (in recent years the flow was 34 cu km, which has led to a gradual depletion of reservoir storage). Up to 52 cu km of water are used in the basin, indicating that almost 50% reuse of water resources takes place.

The major water consumer in the basin is irrigated agriculture, and the major water users are hydroelectric power plants (HPPs). In the region, all reservoirs of both long-term and seasonal regulation have HPPs. In addition, many HPPs are located on diversion canals and “minor” watercourses.

Previously, within the united state of the USSR, regulation of water use in all sectors of the economy (especially regulation of water use for irrigation and electric power generation) was centralized; formation of independent countries in Central Asia made these issues more complicated. National interests joined the already arisen regional problem, the crisis of the Aral Sea and Pre-Aral zone. Consequently, these problems have disrupted the coordinated operation the Naryn-Syrdarya Cascade of reservoirs from the previous single schedule and orientation primarily for water supply to irrigated areas of the basin.

At present, to settle interstate water and energy relations in the region, a series of organizations of different levels has been established. These are the Central Asian Economic Community (CAEC), the Interstate Coordination Water Commission (ICWC), the Energy Council of Central Asian countries, etc. These institutions play an important role in solving current and long-range problems. For example, in 1992, within the ICWC an agreement on joint water use in the Aral Sea basin was concluded. This agreement made a considerable contribution in establishing water relations in the region. However, the following high water years smoothed many acute problems of interrelations, but once low water years (1995 and 1997) came, problems were exacerbated and many provisions of the agreement were no longer in force and ceased being applied.

Under these circumstances, the need for a new agreement on a higher level became more apparent. Such an agreement was developed under the aegis of the Executive Committee (EC) of the CAEC with financial and technical assistance of USAID. On March 17, 1998, Prime Ministers of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan signed the agreement on the use of water and energy resources of the Syrdarya basin between governments of these countries. Later (in 1999), the Republic of Tajikistan joined this agreement.

This agreement provides for mutual supplies of electric power, fuel and energy resources to settle water and energy relations between the basin countries. The agreement also defines areas of future joint activities concerning rational use of water, fuel and energy resources in the region.

Concurrent with the Syrdarya agreement, the countries signed an agreement on the parallel operation of the energy systems of Central Asia, the agreement on cooperation in the area of environment and rational nature use, and other interstate acts. These agreements complement each other and open up opportunities for closer cooperation.

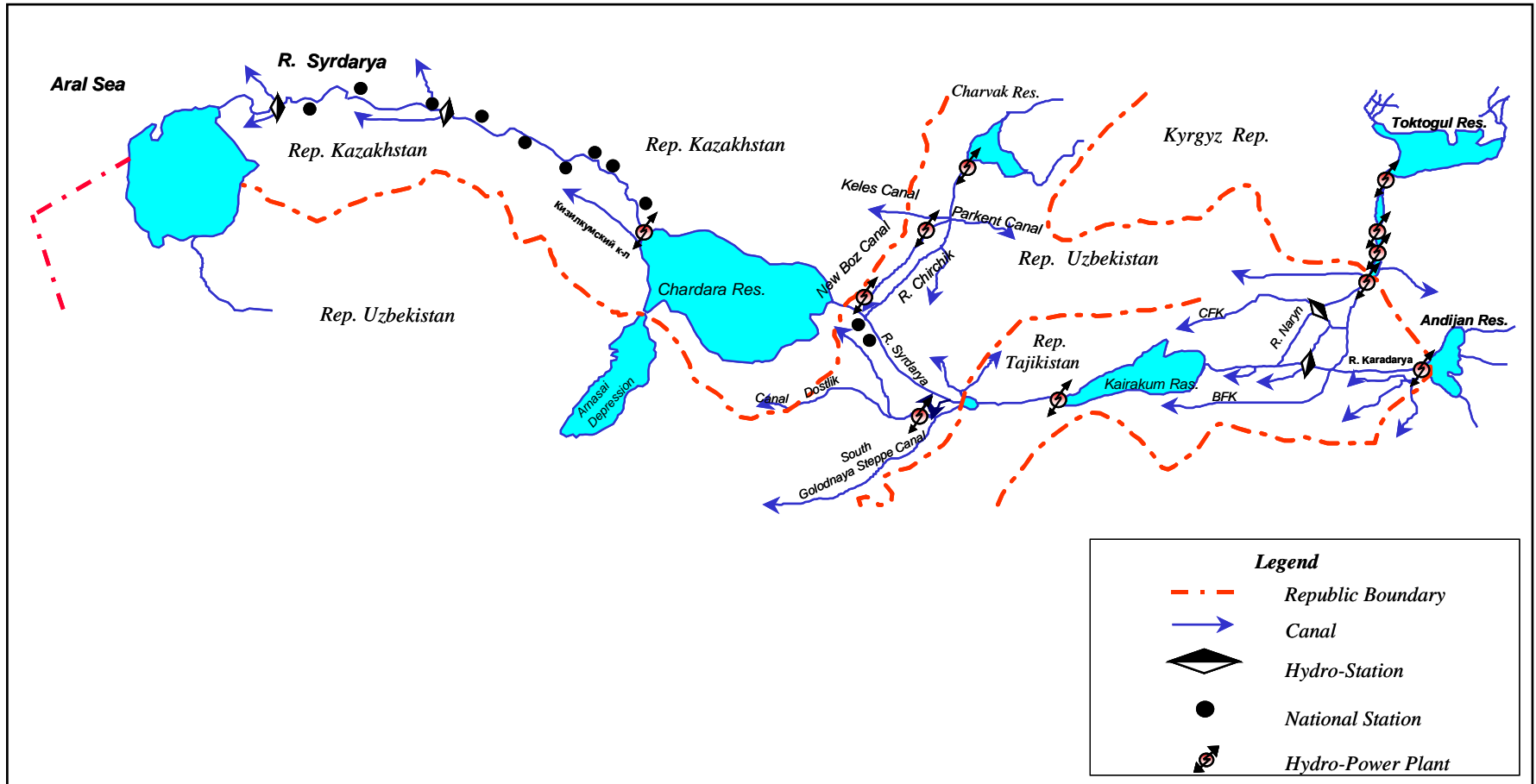


Figure 1.1. Scheme of the Syrdarya basin.

It became apparent that the Syrdarya water and energy agreement, being a framework agreement, required implementation mechanisms. The meetings of the Water and Energy Uses Round Table under the EC CAEC of July 20-25, 1998 and August 10-14, 1999 addressed these issues. At these meetings heads of water and energy sectors and representatives of governmental agencies of the countries participating in the agreement took part. The meeting participants noted the importance of developing a model to optimize operation modes for the major reservoirs of the Syrdarya basin that form the Naryn-Syrdarya Cascade. The participants of the 1998 Round Table included this work in the action plan and applied to USAID for support in solving this problem.

Thereupon, the USAID Environmental Policies and Institutions for Central Asia (EPIC) Program initiated development of a model to optimize operation modes of major reservoirs of the Naryn-Syrdarya Cascade. The Round Table requested the five Central Asian governments and the regional organizations to appoint a group of specialists (the Working Group on Modeling) from the water and energy sectors of their countries and organizations to participate in the model development work. The main organizations for water management participating in the work included the Ministries comprising the ICWC from the riparian countries (Kyrgyzstan, Tajikistan, Uzbekistan, and Kazakhstan), the Basin Management Organization of the Syrdarya river (BVO Syrdarya), and the Scientific Information Center (SIC) of the ICWC. The energy management organizations participating in the work included the Ministries comprising the Energy Council of Central Asia and the Unified Dispatch Center for Energy (UDC Energia). A group of about 25 specialists (both policy and technical level) was identified through this process.

This Working Group was split into a policy level group (the Coordination Group; see Appendix 4 for a list of the members) to oversee and direct the work and a technical level group (the Technical Group; see Appendix 5 for a list of the members) to carry out the actual programming and testing of computer models.

The Coordination Group decided that the primary objective of the work was to develop model components that are useful for the regional cooperation of the riparian countries of the Syrdarya basin and to the organizations carrying out the day-to-day work of implementing the 1998 Syrdarya agreement, that is, BVO Syrdarya and UDC Energia. The decision was made to concentrate on developing models of the river and energy systems as the primary goal. The need to develop a model of the use of water in irrigation (the so called Planning Zone model) was also agreed, but it was given lower priority and recognized as primarily of interest to the national Ministries of Agriculture and Water Management. The Coordination Group developed Term of Reference (TOR) for three components comprising the Syrdarya modeling system:

- (1) **River Component:** This component is a model of the main river and canal system of the Syrdarya basin developed at the BVO Syrdarya with assistance from the EPIC Program and national representatives in the Technical Group;
- (2) **Energy Component:** This component is a model of the electricity grid of Central Asia developed at the UDC Energia with assistance from the EPIC Program and the national representatives in the Technical Group; and
- (3) **Planning Zone Component:** This component is a model of the irrigation planning zones of the basin developed at the SIC ICWC with assistance from the EPIC Program.

From the TORs, the Technical Group prepared the three component models in the General Algebraic Modeling System (GAMS) programming language. The three components (river, energy and planning zone) have been developed separately and each stand-alone component provides useful information and interim results for the counterpart organizations (BVO Syrdarya, UDC Energia, SIC ICWC, and the national water, energy and irrigation planning agencies). In the recommended second phase of work, the tighter integration of the initial blocks is envisioned. To date the planned first stage of work is over, and this report reflects its results.

This Report is a two-volume document. Volume 1 is dedicated to retrospective and current analysis, and the assessment of the current situation regarding Syrdarya water and energy resources use. Volume 1 also describes the program complexes developed for the regional organizations BVO Syrdarya, UDC Energia, and the SIC ICWC. Volume 2 includes models, developed by national specialists to back up the regional models, or model developments that use approaches and principles programmed in the regional models. Generally, the models developed by the national specialists consider national interests and are compatible with the regional models.

The models were developed using the GAMS optimization modeling language. The GAMS language was specially developed by an international group of scientists to solve complex resource management problems.

On the whole it should be noted that the first-step modeling goal has been attained (see also Coordination Group Protocol 7):

- BVO Syrdarya, with assistance from the USAID/EPIC Program and other specialists, developed and is using a reliable model for day-to-day management of water resources and optimal decisions related to reservoir operation of the Naryn-Syrdarya Cascade. The output forms comply with ICWC requirements and are intended to promote ICWC substantiation and decisions.
- UDC Energia renovated and updated its main computation complex “OPTIMUM” with a core computation module written in the GAMS language for operational management of the Electric Power Pool of Central Asia (EPP CA) energy regimes. Production testing has started in UDC Energia.
- The Kazakhstan Electric Grid Operating Company (KEGOC), the State Energy Company of Tajikistan (Barki Tochik), and the Uzbek Ministry of Energy created a daily mode optimization model for national energy systems that promotes HPP load optimization.
- Kyrgyz Republic Energy Company (Kyrgyzenergo), using the BVO Syrdarya model, developed a complex energy model for the Toktogul-Naryn Cascade of HPPs, which includes the interactions of the Kyrgyz Republic and the other Syrdarya basin countries through water supplies and mutual fuel (energy carrier) deliveries.
- Uzbek and Tajik experts developed optimization models for reservoirs. In the Uzbek Ministry of Agriculture and Water Management the BVO Syrdarya model was attached to the Ministry’s internal database. Production testing has started there. In Tajikistan, representatives of TajikNIGMI and Barki Tochik developed a model of Kayrakum reservoir.

- Specialists of the Kazakh Branch of SIC ICWC and the Kyrgyz Ministry of Agriculture and Water Management tested the BVO Syrdarya model on the Chu River transboundary water system. The results allow the conclusion that the BVO Syrdarya model may have a broader use versus the earlier plans.

This report is a product of work of the Coordination Group (members listed in Appendix 4), the Technical Group (members listed in Appendix 5), and the EPIC Program staff (members listed in Appendix 6). The implementers of the various Chapters and Sections of the report are:

VOLUME I:

BVO Syrdarya

Chapter 1	Sections 1.1.1, 1.1.5, 1.2.1–2, 1.2.5, 1.3.1, 1.3.4
Chapter 2	Sections 2.1.1.1–2, 2.1.3.1, 2.2.1–2, 2.3.1–2
Chapter 3	Sections 3.1.1, 3.1.3, 3.3.2
Chapter 4	Section 4.1

UDC Energia

Chapter 1	Sections 1.3.2, 1.3.3
Chapter 2	Sections 2.1.2, 2.1.3.2, 2.3.2
Chapter 3	Sections 3.1.2, 3.3.3
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SIC ICWC

Chapter 1	Sections 1.1.1–5, 1.2.1–6
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EPIC

Introduction	
Chapter 3	Sections 3.2, 3.3.1,
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Appendix 1	

VOLUME II:

National Groups

Volume 2

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