AMU DARYA BASIN NETWORK

POLICY BRIEF

BALANCING THE USE OF WATER RESOURCES IN THE AMU DARYA BASIN

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Central Asia and Afghanistan have abundant natural resources in terms of their land, water and energy capabilities. During the Soviet era, energy and water resources in the Central Asian region were managed on a regional basis, centralized in Moscow. Upstream hydropower stations supplied irrigation water to the downstream countries, while the downstream countries supplied their upstream counterparts with fossil fuel. However, following the disintegration of the Soviet Union, the newly independent Central Asian countries decided to pursue self-sufficiency and energy security in order to reduce their dependency on other countries, including their neighbors. This has caused a split of the regional system of energy and water use, resulting in the collapse of existing water and energy management mechanisms. The Amu Darya Basin countries are still attempting to balance the management of water and energy resources through interstate organizations.

The major characteristics of the Amu Darya River include its transboundary nature, its division between hydropower use and irrigation use, and most importantly, the extent to which these two uses can be regulated to maintain a balanced supply for upstream and downstream users. These issues resulted in a reduced storage capacity.

This policy paper is a collaborative output of members of the Amu Darya Basin Network. It outlines different trends and challenges related to the balance of water use—between energy production and agriculture in the upstream and downstream of the Amu Darya Basin. The paper also addresses the inadequate water-governance policies in the basin.

The main challenges of achieving balanced water use in the Amu Darya Basin are as follows:

- **The Lack of a mutually acceptable regulatory regime on the Amu Darya:** River regulation is defined as the control of river flow through artificial structures, allowing for the use and release of a designated amount of water at particular times. Currently, the multi-year regulation capacity of the Amu Darya stands at about 76 percent of river flow.[1] However, the Amu Darya river is one of the most turbid rivers in the world, with high silt deposits in its reservoirs.[2] The average annual reservoir volume loss is estimated at

[1] *Adapted by Berdakh Utemuratov based on information from the Interstate Commission for Water Coordination of Central Asia; Amu Darya River Basin; http://www.icwc-aral.uz*

[2] *Research Action Plan Amu Darya, Maja Schluter, Prepared under contract from the European Commission, 2006*

0.5 percent in Uzbekistan[3]. With increased dead volume capacity and sedimentation, the reservoir's storage capacity continues to decline. The effectiveness of this regulatory regime is debatable, particularly in the areas of irrigation and energy production. In order to fulfill the demand of the agricultural sector, the current regulations would need to be implemented in a mutually agreed upon framework. Some experts believe that the lack of a mutually agreed upon, fair regulatory framework, which encompasses agriculture and hydropower generation, puts the region's food and energy security at risk.

- **Inter-sectoral imbalances:** Perhaps the greatest challenge for balanced water in the Amu Darya River Basin countries is the management of regional water resources in order to balance competing demands for human consumption, irrigation, industrial use and electricity generation. The basin countries are striving to develop their hydropower potential. At present, approximately **8 percent**[4] of the hydropower potential of the region has been developed, whereas about **77 percent**[5] of its water resources are being used for agriculture.

- **Afghanistan—the late developer:** About 21.5 percent[6] of the Amu Darya basin's water flow originates in Afghanistan. The existing water and agricultural infrastructure of Afghanistan is capable of utilizing only 7 to 10 percent of its water resources. Afghanistan plans to undertake large-scale irrigation and energy development projects. According to some estimates, Afghanistan's irrigated land capacity can reach 1.5 million[7] ha; however, regional forecasts estimate that, based on capacity and investment potentials, Afghanistan will increase its irrigated land capacity by 200-300 thousand ha, at a cost of $8 to 12 billion[8].

Coordinating water and energy use includes water management, but also requires sound political, economic and institutional choices. It is imperative to implement policies that will be acceptable to all countries in the region.

[3] *Rakhmatullaev et al. "Geostatical approach in estimation of sedimentation: A case study of Akdarya Reservoir"; J. Hydrotech Constr, 2008*

[4] *Regional Water Intelligence Report Central Asia, UNDP Water Governance Facility at SIWI; Stockholm, March 2010*

[5] *Information provided by the SIC-ICWC, Tashkent, Uzbekistan: Common flow of the Amudarya is 79,3 km^3 of which for 61,1 km^3 is used for irrigation, 4,1 km^3 for water supply, 5,2 km^3 use for nature, and 8,9 km losses flow^3.*

[6] *Calculated based on: Stuart Horsman, Afghanistan and Transboundary Water Management on the Amu Darya: A Political History, Foreign and Commonwealth Office, United Kingdom Water & Development Publications - Helsinki University of Technology, 2005, p64. http://water.tkk.fi/English/wr/research/global/material/CA_chapters/06-CA_Waters-Horsman.pdf*

[7] *Cooperative management of transboundary water resources in Central Asia D.C. Mckinnsey*

[8] *Information provided by the SIC-ICWC, Tashkent, Uzbekistan.*

INTRODUCTION

Water governance in the Amu Darya Basin is complicated by the absence of effective mechanisms for water management and bilateral/regional cooperation over shared water resources. The presence of institutions to facilitate effective transboundary water management and engage in preventive hydro-diplomacy to mediate disputes between countries is crucial. The history of water conflict and water cooperation, especially over the past 100 years, demonstrates that in the absence of viable institutions, shifts in water use and water availability can create tensions.[9] Experts have emphasized the benefits of regional cooperation over shared water resources.

The necessity for improved and coordinated planning regarding water resources in the Amu Darya Basin has become increasingly evident. The growing reliance on water for energy and agriculture needs is fueled by a growing population and climate change, which causes the melting of the region's glaciers that feed its rivers. This policy brief will offer major recommendations for effective planning related to water resources, in order to balance the usage of water infrastructure, particularly in agriculture and energy.

GOVERNANCE:

The act of governing, which relates to decisions that define expectations, grant power, or verify performance. It consists of either a separate process or is part of management or leadership processes. These processes and systems are typically administered by a government.

WATER GOVERNANCE:

The political, social, economic and administrative systems that directly or indirectly affect the use, development and management of water resources.

[9] *Water Conlflict Chronology, World Water, 2008. http://www.worldwater.org/conflict/index.html.*

THE STATUS OF WATER USE IN THE AMU DARYA BASIN

During the Soviet era, the Aral Sea Basin River systems were used exclusively in the production of cotton, the "white gold" of Central Asian agriculture.[10] Water intakes and return flows were coordinated and limits were established for all major off takes. Dams regulated the flow of water, in order to irrigate cotton fields. Generating hydroelectricity remained a secondary priority, since a bartering system was already established: downstream Republics provided energy resources to upstream Republics; which would in turn store water primarily for downstream neighbors' irrigation needs.

Water management cooperation between riparian states has fluctuated since the Soviet period. At present, countries in the region are uncertain regarding which flows of water will be available, due to the multipurpose usage of water and the difficulties of calculating the impact of climate change. Moreover, there are concerns that the independent, uncoordinated development planning by the basin countries may impact the amount of water available throughout the region.

- **Energy:** The contribution of hydropower to general energy consumption is greatest in Tajikistan (approximately 98 percent) and Kyrgyzstan (about 75 percent), and lowest in Turkmenistan (about one percent). Any further development of hydropower is contingent on ambitious cross-border cooperation. The integration of the riparian countries into a regional energy market could feasibly allow them to meet more than 71 percent of the region's energy requirements through hydropower production, amounting to an output of approximately 150 GWh. [11]

Mirroring the water usage for hydropower production, agriculture remains the most important economic activity in the region.

- **Agriculture:** Approximately 93.4 percent of the water demand in the Amu Darya Basin is used for irrigation.[12] Agriculture is a significant component of the riparian countries' GDPs: 12 percent of gross domestic product in Turkmenistan, 20 percent in Uzbekistan, 22 percent in Tajikistan, 29 percent in the Kyrgyz Republic and 33 percent in Afghanistan.[13]

- **Institutions**: The Soviet-era bartering system was unable to serve the newly independent Republics; these states sought to reduce their dependence on their neighbors for water and energy resources. However, this approach led to the realization that neglecting the transboundary nature of common resources would not achieve the desired results. Within a year of their independence, the five post-Soviet states in the Aral Sea basin agreed to maintain and adhere to the division of the transboundary water resources as dictated by Moscow. They also established an Interstate Commission for Water Coordination (ICWC) in 1992 and designated it as the body responsible for the definition of seasonal water allocations in line with the annual agreements. Furthermore, it was agreed that the Basin Water Organizations (BWO) Sir Darya and BWO Amu Darya would be incorporated into the ICWC structure as implementation agencies. The ICWC currently sets the limits on the quantity of water to be allocated to the

[10] *EU Central Asia Monitoring; EUCAM Watch Issue No 9 «Harvesting the 'White Gold'»; September 2011*

[11] *Central Asian Water Info Portal; Aral Sea Basin Dams and Hydropower; http://www.cawater-info.net*

[12] *"Improved dam operation in the Amu Darya river basin including transboundary aspects" Froebrich et al. 2006*

[13] *Agriculture & Rural Development | Data - The World Bank, 2009 http://data.worldbank.org*

major areas of each country for both the irrigation and non-irrigation seasons; these policies are based on river flow estimates provided by the hydrological and meteorological services of the basin countries. The BWO Amu Darya, based in Urgench, Uzbekistan, is primarily responsible for overseeing the allocation of water, according to the agreed limits set by ICWC for users in the basin. It also controls the discharges to the Aral Sea and the operations of the interstate reservoir. Other tasks include measuring water levels, assessing river flows, operating canals, head gates and control facilities at interstate structures and also designing and engineering new water management equipment.

Afghanistan's irrigation practices bridge traditional and contemporary water management. The operation and maintenance of these schemes as well as water distribution are managed on a communal basis under the supervision of irrigators (*mirabs*)[14], and disputes over water rights are solved by representatives (*wakils*)[15]. The introduction of Integrated Water Resources Management is also progressing in Afghanistan with the support of international agencies.

MANAGING WATER AND ENERGY RESOURCES

There are several multilateral agreements covering water and energy sharing. However, numerous management issues inhibit states' capacities to adhere to them:

Lack of transparency in sharing hydrological data: Measurability is the most significant criterion for proper management of any resource. In the basin, the measuring systems of water energy resources are insufficient. In addition, data sharing—notably hydrological and meteorological data used to forecast water availability and develop the respective water allocation and cropping plans among riparian countries—remains very limited.

The major obstacles include:

(i) **Lack of continuity:** The transfer of hydrological and meteorological data between countries is uneven. Sharing accurate data would enable each party to monitor other party's abstractions.

(ii) **Limited resources:** Providing accurate forecast data requires sophisticated modern equipment in hydrological and meteorological agencies. This includes a means of capturing satellite images and technical and scientific equipment to analyze them, measuring the levels of snowfields, and facilitating work in the field, including remote locations. These difficulties are compounded by mediocre communication.

After the dissolution of the Soviet Union, the established network of information exchange in Central Asia on water, economy and environment related issues also collapsed and considerable knowledge was lost.

Although Central Asian states have developed regional structures such as the Interstate Commission for Water Coordination (ICWC) and the respective Basin Water Organizations (BWOs), as well as corresponding national institutions, the inadequate provision and circulation of information has been an obstacle for making appropriate short and long term decisions regarding transboundary water resource management and implementing relevant policies.

In order to address these shortcomings, the implementation of the Central Asia Regional Water Information Base (CAREWIB) project has been initiated by the United Nations Economic Commission for Europe (UNECE)—

[14] *"irrigator"*
[15] *"representative"*

Special Program for the Economies of Central Asia.[16]

Water use efficiency: Fifty to sixty percent of irrigation water is lost in transport.[17] Water delivery in the region is based on old norms, rather than on a system oriented around demand, which takes into account cropping patterns, field topography, soil and subsoil conditions, and rainfall levels. Some of the used water is then captured by collector drainage networks, which return it the river or desert depressions along the Amu Darya where it evaporates. This practice is not environmentally sound; however, it is an alternative to disposing used water in the stream, which would increase the mineralization of the river water. The in-land use of drainage water increases water use efficiency by reducing the disposal of pollutants in the river. It is estimated that drainage water usage can be increased to up to 25 percent of the annual drainage flow in the Aral Sea Basin, compared to the current 11 percent.[18]

infrastructure in agriculture and energy production. According to some experts, there have been major improvements in reducing water withdrawals in the basin from 114 bcm in 1990 to 109 bcm in 2010.[19] Some reductions in water withdrawals result from economic recessions, the physical fatigue of water infrastructures and the loss of agricultural lands.

Aware that increasing efficiency on a large scale is a long term process, the following needs are highlighted:

- Base water deliveries on actual demand and cropping patterns;
- Use economic mechanisms, such as basing water allocations on farming outputs, and include water users in the decision making process;
- Price water according to volumetric water charges where the volume of water available for users is specified.

Estimates of total agricultural losses due to poor management of irrigation systems (millions of $/year) [20]				
Country	Syr Darya Basin	Amu Darya Basin	Aral Sea Basin*	
Kazakhstan	206	0	206	0,7%
Kyrgyzstan	81	0	81	4,3%
Tajikistan	58	112	170	10,6%
Turkmenistan	0	378	378	6,1%
Uzbekistan	390	529	919	9,3%
Total	**735**	**1019**	**1754**	**3,6%**
Note: Annual agricultural losses are due to inadequacy in water availability, salinity, poor weed control, cultivation practices, soil compaction, leaching water, drainage problems and land abandonment.				

Increasing water use efficiency will reduce the level of stress on shared water resources and allow for better management of multipurpose

The implementation of such measures can be costly due to high transaction costs. However basin states agricultural policy reforms, such as quota systems, may lead to easing

[16] *Swiss Agency for Development and Cooperation; http://www.deza.admin.ch/en/Home*

[17] *IISD – GWSP Conference on the Water-Energy-Food Security Nexus; Amudarya River Basin; Preliminary results of the GCI II survey; Sina Marx; May 1 – 5 2012*

[18] *Drainage water management in the Aral sea basin; V. Dukhovny, K. Yakubov, A. Usmano & M. Yakubov*

[19] *Information provided by ADBN Network Member (Dinara Ziganshina)in her capacity as Deputy Director, SIC ICWC in Central Asia*

[20] *International Fund for Saving the Aral Sea 2003 and World Bank 2005e*

[*] *Percentage figures in brackets are total losses expressed as a per cent of GDP in 2003*

implementation and may contribute to better water use efficiency and planning.

Operation and maintenance of infrastructure: Since the independence of the Central Asian states and the subsequent conflict in Afghanistan, the basin countries' management capacities have been eroded and have yet to return to previous levels. In the Central Asian Republics, much of the capital accumulated by the former Soviet system has been either consumed or dissipated. As a result, important infrastructure, such as irrigation, drainage systems and roadways have been neglected. Farming and irrigation machinery are not being satisfactorily maintained or replaced in a timely manner. Throughout the basin countries, most irrigation systems are in a state of disrepair. Furthermore, the basin governments, each advancing its own national interests within a regional context, have been forced to manage the operations of systems within their own borders, while large areas of formerly irrigated land have been lost due to the breakdown of the water system.[21]

In Central Asia, management, operation and maintenance responsibilities were transferred to water users, which resulted in the creation of Water Users Associations (WUAs) who took on these responsibilities. However, many of these WUAs still do not adhere to established hydrographic principles; its members often lack the necessary knowledge, skills and experience to register or manage the organization or the infrastructure, while the objectives of WUA development are yet to be realized.

Currently the actual irrigated land area of the basin is estimated at approximately as 5.76 million ha.[22] Around 400,000- 500,000 ha of saline land is located primarily in Turkmenistan and the Khorezm and Karakalpakistan regions of Uzbekistan[23]. Often, the water runs out or develops a high concentration of saline as a result of mismanagement and a lack of finances for rehabilitation. As a result, water logging and salination problems are common, mostly in newly captured areas that required highly complex drainage methods.

In the absence of major reforms, persistent infrastructure challenges include:

- Physical problems such as poor design or state of the infrastructure;
- Institutional problems such as staff lacking the skills to operate complex systems;
- Financial problems, i.e. the lack of adequate financial resources for rehabilitation and the limited ability to recover maintenance costs.

Experts point out that structural rehabilitation of irrigation and drainage networks would promote sustainable irrigated agricultural production, increase employment and generate farm income by introducing participatory irrigation management. Meanwhile, basin countries, with the support of donors such as the United Nations Food and Agriculture Organization, the World Bank, the United Nations Development Programme, the Asian Development Bank, the Aga Khan Foundation, the European Bank for Reconstruction and Development, the Islamic Development Bank, the European Union and others, collaborating with regional and national authorities, play a vital role in trying to rehabilitate the irrigation and drainage systems. These improvements would restore dams and major pump stations. It would also increase water use efficiency in main-canal, intern-farm and on-farm areas, as well as introduce the Integrated Water Resources Management principles. These projects aim to increase overall water use efficiency.

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[21] *Sustainability Analysis for Irrigation Water Management in the Aral Sea Region; D. C. McKinney et al. 2003*

[22] *Transboundary Water and Related Energy Cooperation for the Aral Sea Basin Region of CA; USAID, 2002*

[23] *Figures provided by ADBN Network Member (Dr. Iskandar Abdullaev) in his capacity as Regional Advisor for Transboundary Water Management in Central Asia Programme, GIZ*

Systematic regulation of river reservoirs: More than 35 water reservoirs were constructed in the Amu Darya basin, each with a storage capacity of over 10 million m^3. The aggregate capacity of these water reservoirs exceeds 29.8 km^3.[24] The Amu Darya cascade of reservoirs operates according to a specific scheme, allowing regulation by two main rivers on stream reservoirs (Nurek and Tuyamuyun) and several on-system reservoirs on the Karakum, Karshi and Amu-Bukhara canals and small rivers. The total storage capacity of the reservoirs on the main river is estimated at 17 km^3.

Now the multi-year regulation capacity of the Amu Darya is about 76 percent of the river flow. At existing reservoir capacities, the guaranteed yield in low-water years may reach up to 62 km^3 ofwater available for use. However, during past years, the irrigation-and-hydropower mode of operation for which the reservoirs were designed has drastically shifted, which needs to be a subject for discussion and an eventual agreement on changes in flow regime.[25]

Experts highlight the importance of finding mutually acceptable solutions, including

- The construction of small dams;
- The diversification of energy sources through the introduction of wind energy, bio-fuel and solar power;
- Institutional reforms of the agriculture and energy sectors, with the support of the international community, to enhance cooperation between the basin countries.

However, this does not negate the potential benefits of large dams and their reservoirs for the economies of the countries in the region. Large dams contribute to seasonal and long-term regulation of river flow in the interests of irrigation, hydropower generation and water supply. They also serve as an efficient means to prevent floods, mudslides and droughts.[26] On the other hand, these large dams pose a significant potential threat, because their breach or destruction could have cause disastrous effects, including loss of life.

[24] *Interstate Commission for Water Coordination of Central Asia; Amu Darya River Basin; http://www.icwc-aral.uz and WaterWiki, Amu Darya: http://waterwiki.net/index.php/Amu_Darya*

[25] *Interstate Commission for Water Coordination of Central Asia; Amudarya River Basin; http://www.icwc-aral.uz*

[26] *Dam safety in Central Asia: Capacity-building and regional cooperation, UNECE, 2007*

Large Dams[27]	Small Dams[28]
Advantages	
• Irrigation—regions with poor or unpredictable rainfall can be turned into fertile farmland. • Water supply—providing dependable water supply for urban or industrial use. • Flood control—holding back and channeling potentially dangerous water flow. • River regulation—allows for the release of water in dry times or when otherwise needed.	• Non-consuming generator of electrical energy, utilizing a renewable resource through the hydrologic cycle by solar energy. • Plants can be designed and built within one or two years. • Characterized by reliability and flexibility of operation, including fast start-up and shut-down times in response to rapid changes in demand. • Requires few operating personnel. Some small-scale installations are operated entirely by remote control.
Disadvantages	
• Risk of failure—dam failure can be catastrophic. It is a major concern in civil engineering to ensure that dams are safe from hazards such as landslides and earthquakes. • Environmental—dams may destroy wildlife habitats, drain wetlands, and cause river pollution by reducing the river flow to a level where the river can no longer self-cleanse. Farmland can be ruined by salt produced by the irrigation process. • Cost—dams are very expensive to build and may not provide economically sufficient electrical power generation, water supply, or irrigation. • Limited life span—dams, particularly in areas of strong erosion where there is a lack of maintenance, will have short life spans.	• Limited natural flow during the summer—water becomes stratified, with warmer water collecting at the surface and cooler water lying at the bottom, which is detrimental for fish. • Silt—which would have naturally traveled to the mouth of the river and out to sea, builds up steadily at the wall of the dam; tree clearing from the development of hydroelectric dams can result in soil erosion and landslides. • Hydrology—of a river is changed through a hydroelectric project, major habitat changes can occur. • Short lived—due to silting, cannot serve the said purpose, rapidly lose storage water due to evaporation and seepage; unable to control super floods to avoid devastation.

[27] *Hydropower: electricity from moving water, Whitney Baker, Laura Livesay; http://dnrc.mt.gov*
[28] *Small Hydropower Schemes as an Important & Renewable Energy Source, H. Ramos & a. Betamio de Almeida*

WEAK WATER GOVERNANCE

Water usage for economic growth remains the core interest for each of the Central Asian Republics, as well as Afghanistan. The Amu Darya Basin is not suffering from a shortage of water resources, yet the lack of effective national and regional management frameworks stokes tensions between the countries over the usage of water resources.

Each of the riparian countries promotes unilateral economic development tracks that depend on different uses of water, which puts more stress on shared resources. Drought and low levels of reservoir storage have created shocks and setbacks for the basin economies. Water demand is growing to meet national, economic growth plans and planned water usage for energy exports to new regional markets. Basin countries must engage in open dialogue on the need for reform that acknowledges the energy-food-environment nexus of water resources.

Despite a number of regional organizations that deal with the transboundary nature of the basin resources, there are discrepancies between mandates and current practices. Decisions are often country or sector oriented. For instance, water quality and environmental considerations are not part of the water allocation procedure that benefits irrigation.[29]

A transition of the water sector to a governance system based on IWRM principles is in progress in the basin. Some countries are already on the way toward practical implementation of more integrated approaches to water resources development, management and use; whereas others have only taken the initial steps in this direction.

Despite the current level of progress, there are number of governance issues that remain problematic:

- Despite water codes that provide adequate management frameworks, basin countries lack financial resources, qualified skills and modern equipment that would allow for their implementation;
- The lack of transparency and monitoring of the water-resources withdrawal poses a serious challenge;
- Weak rules of law and corruption burden the effectiveness of projects undertaken by governmental institutions or initiatives funded by international aid and development agencies;
- Limited inter-institutional coordination of decision making and monitoring of water resources management;
- Information derived from field monitoring is not reliable and is rarely used for planning and decision-making;
- Inadequate mechanisms for joint water and energy resource management between basin stakeholders, including mechanisms for prevention and resolution of conflict in dry years.

[29] *Water Governance in Central Asia. The European Union's TACIS programme; October 2008*

CHALLENGES TO EQUITABLE WATER GOVERNANCE

NEED FOR STRATEGY FOR REGIONAL COOPERATION IN THE ENERGY SECTOR

The integrated power system of Central Asia was designed during the Soviet time to balance the unequal geographical and seasonal spread of hydro and thermal fuel resources within Central Asia. During the Soviet era it was technically and operationally optimal, and it adequately catered for fluctuating demand requirements, in addition to frequency needs and water/energy balances. This entire borderless power system with approximately 70 percent of thermal power plant (HPP) and 30 percent of hydro power plant was controlled from a center in Tashkent. The HPP reservoirs were utilized to optimize the irrigation flow requirements of the downstream countries.

To achieve this balance, the Unified Energy System of Central Asia (UESCA) was built based on a 500 kV transmission system that connects Kyrgyzstan, Uzbekistan and southern Kazakhstan and includes interconnecting lines into Tajikistan and Turkmenistan.[31]

This scheme helped maintain stable operations of power grids for each of the member countries as much as possible, by regulating peak loads and power interchanges, and using water from hydropower plant reservoirs for irrigation. By 1997, after the collapse of the USSR and its entire system of energy management the power ring was restored through a special agreement. However, despite numerous declarations, a substantive, advantageous integration has yet to be implemented in the energy sphere. Uzbekistan and Turkmenistan withdrew from the regional power grid, and regional power trade decreased from 25 TWh in 2000 to 3.7 TWh in 2008. Thus, Kyrgyzstan and Tajikistan's dependence on hydro resources for their energy needs has increased with 90 percent of their electricity production based on hydropower.[32]

TStructure of the Production of Primary Fuel and Energy in Central Asia (%)[30]

Countries	Gas	Oil	Coal	Hydro	Total
Kazakhstan	16	50	33	1	100
Kyrgyzstan	2	5	11	82	100
Tajikistan	2	1	1	96	100
Turkmenistan	83	17	0	0	100
Uzbekistan	84	13	2	1	100

[30] *Water and Energy Resources in Central Asia: Utilization and Development Issues; Eursaian Development Bank Industry Report April 24, 2008*

[31] *Energy Demand/Supply Balance and Infrastructure Constraints Diagnostics Study, J. Omorov & T. Lynch; CAREC Energy Sector Action Plan; October 2010*

[32] *Strategy for Regional Cooperation in the Energy Sector of CAREC Countries. Endorsed by the Seventh Ministerial Conference on Central Asia Regional Economic Cooperation, 19-21 November 2008, Baku, Azerbaijan*

Meanwhile, according to many experts, new contradictions prove that the one unified energy system of Central Asia is still in a functional crisis, due to independence in the use of regional water and power resources. Experts argue that the unauthorized power intake from the unified energy system, which provoked new conflicts, was caused by an unadjusted agreement compiled by member countries.

Furthermore, at the regional level, Tajikistan, Afghanistan, the Kyrgyz Republic and Pakistan have been pursuing the development of electricity trade arrangements and the establishment of a Central Asia—South Asia Regional Electricity Market (CASAREM). Since 2005, these four countries have intensified their level of cooperation both amongst themselves and with international financial institutions comprising the Asian Development Bank, the European Bank for Reconstruction and Development, the International Finance Corporation, the Islamic Development Bank, and the World Bank.

One of the key components of this initiative is the development of cross-border electricity transmission capabilities, which would link the four countries for the purposes of transferring surplus power. Under this plan, 4 billion kwh would be made available in the Kyrgyz Republic and 2 billion kwh from Tajikistan; the total would then be distributed to Pakistan and Afghanistan. The first phase of CASAREM aims to establish the necessary transmission and trading infrastructure and systems to enable a trade of 1000 to 1300 MW of electricity between Central Asia and South Asia; it is referred to as "CASA-1000."

Meanwhile, it should be noted that the energy shortages within Central Asian states are becoming serious, especially during the winter. During these cold months, some 20 to 30 percent of the basin countries' land is disconnected from electricity. This issue needs to be addressed before promoting regional energy exports from Central Asian states.

Hydro Energy Potential of the Central Asian Rivers[33]

Countries	HPP Installed capacity (MWt)	Electricity production and HPP (2005) (billion kWh)	Economic hydro potential (billion kWh/yr)	Utilization of hydro potential (%)	% the Hydro Potential of the CAR
Tajikistan	4037	17.1	317	5	69
Kyrgyzstan	2910	14	99	14	22
Kazakhstan	2248	7.9	27	29	6
Uzbekistan	1420	6	15	49	3
Turkmenistan	1	0	2	0	0
Total	**10616**	**45**	**460**	**97**	**100**

[33] *Water and Energy Resources in Central Asia: Utilization and Development Issues; Eurasian Development Bank Industry Report April 24, 2008*

THE BASIN POPULATION'S DEPENDENCE ON WATER FOR AGRICULTURE

Since their independence, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan have undertaken a significant economic transition towards more market-oriented systems. Despite these efforts for policy reform, agricultural productivity and performance has been declining, and food insecurity and malnutrition remain a challenge to the development of livelihoods of local populations.

About 20 to 30 million people depend directly or indirectly on irrigated agriculture in basin countries, which is the main food supplying sector; over 90 percent of the basin-surface water flow is used for irrigation.

According to the World Bank, agricultural output supported by irrigation in 2009 accounted for 12 percent of the gross domestic product in Turkmenistan, 20 percent in Uzbekistan, 22 percent in Tajikistan, 29 percent in the Kyrgyz Republic, and 33 percent in Afghanistan.[34]

In general, the overall macroeconomic situation in Central Asian countries has significantly improved since 2000. However, economic growth and improved economic stability have not contributed to a great extent to improving food security, which is continuously impacted by the tension between hydropower generation and irrigated agriculture.

This underscores the need for basin countries to cooperate in distributing water and energy resources and reducing the region's dependence on water for agriculture. More specifically, this can be achieved by reducing the amount of water required for crops, implementing advanced technologies and introducing integrated water resources management. IWRM is partially promoted throughout the Amu Darya Basin and has demonstrated proven results. Finally, it is necessary to improve market functions and avoid market distortions by facilitating regional trade and better integration with global commodity markets for farmers and national economies.

[34] *Agriculture & Rural Development | Data - The World Bank, 2009 http://data.worldbank.org*

AFGHANISTAN'S CHALLENGE AS A LATE DEVELOPER

Twenty five percent of the Afghan population depends on the Amu Darya for their livelihoods and economic activity[35]. The future reconstruction and development goals detailed in the Afghanistan National Development Strategy will depend largely on the country's water resources.

Around 21 percent (between 13 and 19 bcm[36]) of the Amu Darya's flow is generated in Afghan territory. Afghanistan currently diverts only about 2 bcm (about 3 percent) of the Amu Darya and its tributaries to feed irrigation networks in its part of the basin. It is conceivable that the country could divert as much as 10 bcm in the future if development plans are realized. It is important that efficient water-use technologies and sound-water management practices are introduced in Afghanistan, along with improvements in information and data exchange on water flows originating in the country.[37]

Afghanistan plans to increase its infrastructure and storage capacity to manage its water resources and offset climate shocks. New dams will also be necessary to improve its energy

[35] *Masood Ahmad and Mahwash Wasiq, Water Resource Development in Northern Afghanistan and Its Implications for Amu Darya Basin, World Bank Working Paper No.36, World Bank, 2004.*

36 Data retrieved from: Scheme on Complex use and protection of water resources of in the Amu Darya, Sredazgiprovodhlopok Design Institute, Tashkent, 1971.

[37] *I.S. Zonn, Water Resources of Northern Afghanistan and Their Future Use, presented at Informal Planning Meeting: Water, Climate, and Development Issues in the Amudarya Basin, Philadelphia, June 18-19, 2002.*

security. Afghanistan has identified at least 31 major infrastructure projects, including the construction of 15 storage dams at an estimated total of almost $10 billion.[38]

These projects would serve multiple purposes, leading to the use water for domestic needs, irrigation, power, flood control, industry, recreation, groundwater recharge and environmental rehabilitation. However, in most cases, new infrastructure will require agreements with neighboring countries and the donor community to determine the best ways to manage shared water resources.

POTENTIAL CONSEQUENCES OF CLIMATE CHANGE, LOW RESILIENCE AND MITIGATION

Water availability in the Amu Darya may decrease by up to 40 percent due to the effects of climate change.[39] Many experts believe that the Central Asian region will undergo significant warming, resulting in major environmental, economic and social disruptions[40]. Currently, 46 glaciers are shrinking, which may eventually decrease water flows. From the 1950s to the 1990s, the Pamir-Alai glaciers lost 19 percent of their ice; the process is now intensifying[41]. For several decades, the area of glaciers in different regions of Tien Shan, Gissaro-Alai, Pamirs and Dzhungarskiy and Zailiyskiy Alatau has decreased at an average rate of about 1 percent per year. Despite a limited available natural supply, the demand for water continues to grow unabated. Increasing instances of droughts and floods and decreased grain productivity are widely anticipated.

Most livelihoods in Central Asia depend on irrigated agriculture, which in turn depends on the quantity of winter precipitation in the Amu Darya's headwaters. The abundance of melted snow in the river flow results in peak water supplies being available in mid-summer when evaporation peaks.

Should more of the precipitation in the headwaters fall as rain, runoff characteristics will change, possibly resulting in greater river flows in winter and spring at the expense of summer flows. Notably, in some unregulated sub-catchments, this phenomenon can only be mitigated by targeted construction of new storage and conveyance infrastructure and better management.

Climate variations will also impact grain productivity and the success of yields. In the mountain ecosystems, climate variations seriously affect water quantities. Environmental pollution reduces water quality, often making it unsuitable for irrigation, drinking or commercial purposes, thereby reducing agricultural output.[42]

Climate change could limit energy production capacities in the long run. The rapid melting of glaciers would lead to diminished glacier reserves, which will eventually limit snow melt and the capacity of dams to generate hydropower.

Greater flexibility, however, comes with increased complexity for transboundary management; the riparian countries need to incorporate the two major dams in effective water and energy sharing regimes. Current water-sharing institutions should be modernized and existing inefficiencies eliminated by deliberately targeting mismanagement and partisanship.

[38] *Afghanistan Human Development Report, 2011*
[39] *predictions made following various GHG emissions scenarios proposed by Intergovernmental Expert Group on Climate Change (IEG),*
[40] *Human Development Report 2007/2008*
[41] *Central Asia: Background Paper on Climate Change*
[42] *Central Asia Human Development Report, 2005*

THE WAY FORWARD: TOWARDS BALANCED WATER USE IN THE AMU DARYA BASIN

RECOGNIZING THE ENERGY-AGRICULTURE-FOOD NEXUS OF WATER RESOURCES

It is crucial that basin countries recognize the intertwined nature of energy production, agricultural production and food security when addressing water management.[43] Experts highlighted the importance of:

- Preventing the deepening and expansion of the energy, food, and water insecurity crisis;
- Making national water management frameworks more sustainable;
- Helping Central Asia respond to climate change threats by capturing the benefits of renewable energy and carbon finance;
- Addressing security risks posed by environmental hot spots, such as industrial pollution and uranium tailings) Environmental hotspots that directly impact water sources can cause extreme damage to local food production and livelihoods, particularly in disaster or flood-prone areas.

[43] *Summary of Renewable Energy in Central Asia: Enhancing Food Security and Improving Social and Economic Conditions in Remote Locations.*

MAKING WATER AND ENERGY USE A HIGH PRIORITY IN NATIONAL SECTOR STRATEGIES AND INTERSTATE ORGANIZATIONS' AGENDAS

It is of the utmost necessity to conserve water through the improvement of outdated irrigation systems and updated water application methods. An estimated 60 percent[44] of water is lost en route to crops via flooding, seepage or evaporation. Improvements in irrigation techniques and water conservation would not only have positive impacts on agriculture in the region, but would also reduce the amount of water being diverted from rivers, thus increasing the amount of runoff left for environmental purpose. Identifying this as a common, regional problem will push basin countries to collaborate. Furthermore, encouraging local populations should conserve water at the grassroots level and keep water sources clean. Raising public awareness is equally important, particularly given that it is a complementary change to infrastructure reform.

While energy loss is not as visible to end users as water loss, at least 20-30 percent of energy is wasted.[45] Unlike water losses, energy losses are non-returnable. For example in Tajikistan alone, by improving energy efficiency and conservation measures, the country can reduce energy losses by 30-40 percent in industry, up to 15-30 percent in electrical networks and up to 50 percent in public and private buildings.[46]

[44] *Improvement of the efficiency of water use in the region, EC IFAS, http://www.ec-ifas.org*

[45] *Information provided by ADBN Network Member (Dr. Iskandar Abdullaev)in his capacity as Regional Advisor for Transboundary Water Management in Central Asia Programme, GIZ*

[46] *Rio +20 Sub Regional Meeting, Asia Pacific, 2011, Subregion: Central Asia, http://www.unep.org/roap/Portals/96/CA%20SubregionalMeeting%20Reporting,%20Kaisha-Dima,%20eng.pdf*

ENCOURAGING GOVERNMENT-CORPORATE-CIVIL SOCIETY PARTNERSHIPS

Government-corporate-civil society partnerships are a key element to promoting water use efficiency, supported by financial instruments. Experience across developing economies in all regions has demonstrated that, with a better understanding of the issues and possible solutions, coalitions of partners can be mobilized to make transformational changes. For the necessary changes to be lasting, a new generation of financial instruments will be needed to value water resources, charge for water services and used water emissions, and help manage the risks associated with increasing floods and droughts. To make this happen, governments are encouraged to mobilize inclusive government–corporate sector–civil society partnerships as coalitions.[47]

IMPROVEMENT OF INTER-STATE COOPERATION ON INTEGRATED WATER RESOURCES MANAGEMENT

The need to maintain and broaden cooperation remains paramount, despite disagreements over its forms and methods. The introduction of new cooperation patterns requires thorough work in developing legal, administrative and financial mechanisms. Under these conditions, while not yet undertaking far-reaching reforms of the existing systems, experts advise that countries begin coordinating activities of all relevant institutions and improve their operations. Accordingly, it is necessary to begin gradually developing an interstate cooperation system in the area of water resource management. In this regard, effective coordination of SPECA, IFAS and other initiatives should be pursued and all countries of the regions should be engaged in active cooperation. [48]

WATER, ENERGY AND FOOD INSECURITY

Central Asia's developing countries are particularly vulnerable to water, energy, and food insecurities. For example, Tajikistan experienced a "compound crisis" during the winter of 2008, when exceptionally cold weather, followed by severe drought, caused breakdowns in the country's energy infrastructure, damaged winter crops and reduced livestock herds. The resulting water, food and energy insecurities were subsequently exacerbated by higher global food prices and the onset of drought conditions during the spring and summer. The drought particularly affected Central Asia's southern and eastern regions, as well as parts of the Fergana Valley and the Aral Sea Delta in Uzbekistan. Regionally, food insecurities worsened across Central Asia over the course of 2008

Source: Central Asia Regional Risk Assessment, UNDP, 2009

COOPERATION ON DEVELOPING OF SMALL AND MEDIUM HYDROPOWER PROJECTS IN THE REGION FOR MUTUAL BENEFIT

Many potential locations to place these plants were identified during the Soviet era; these plants could be financed easily, be built, and come online quickly. It would allow for multiple stages in the construction process with the installation of one or two turbines at the initial stage, with the possibility of installing more facilities designed to host several turbines late in the process.[49]

[47] *The Water, Energy and Food Security Nexus: Understanding the Nexus Contribution from: The Global Water Partnership; Bonn 2011*

[48] *Strengthening cooperation for rational and efficient use of water and energy resources in Central Asia*

[49] *The Hydropower Solution in Central Asia: yes but…;, London, April 2010, http://www.commodities-now.com*

DEVELOPING MORE SUSTAINABLE AND ALTERNATIVE WAYS OF ENERGY PROVISION SUCH AS WIND AND SOLAR ENERGY DEVELOPMENT PROJECTS

It is urgent to identify and promote cost-effective energy efficiency improvements, expand the use of renewable energy, facilitate the introduction of new clean energy technologies, and create incentives for public and private sectors investments. Central Asian countries are blessed with sun and lots of light during a large part of the year. The costs and benefits of using solar energy need to be compared with the creation of hydropower plants. This could be a separate research project, with more detailed cost-benefit analyses.[50] For instance, Tajikistan can provide 20 percent of energy consumption through the use of solar energy.[51]

CALCULATION OF THE REGION'S WATER RESERVOIRS' ACTIVE STORAGE CAPACITY UNDER SEDIMENTATION AND CLIMATE CHANGE THREATS

Today in Uzbekistan alone the total volume capacities of major reservoirs have decreased by about 20 percent and the nation's dams' dead-storage capacities have decreased by 55 percent. For example, the dead-volume capacities of seven reservoirs decreased by more than 75 percent.[52] This is an alarming signal that in the future, sedimentation rates will be unprecedented, leading to several operational and maintenance problems.

Due to the natural high turbidity of the watercourses, reservoir sedimentation is an acute issue in Central Asia. In fact, most of the reservoirs have been silted to a great extent. Sedimentation impacts the guaranteed water supply for the different water users (irrigation, industry and hydropower) at the national and regional levels.

With regard to current water-sharing mismanagement and partisanship, more innovative approaches should be explored in light of research findings.[53] For example, instead of the current compensation of direct water releases with hydrocarbon energy equivalents, upstream countries could be compensated for winter-water savings and summer releases in a mixed incentive scheme. Compensation levels could, furthermore, be tied to expected future climate variability, with water savings in the non-vegetation period preceding an expected below-average hydrological year (as determined by probabilistic forecasts) carrying a higher value for compensation than water-savings in normal or above-normal periods.

[50] *Expanding the Use of Clean Energy, ADB, http://www.adb.org/themes/climate-change/clean-energy*

[51] *Rio +20 Sub Regional Meeting, Asia Pacific, 2011, Subregion: Central Asia, http://www.unep.org/roap/Portals/96/CA%20SubregionalMeeting%20Reporting,%20Kaisha-Dima,%20eng.pdf*

[52] *Facts and perspectives of water reservoirs in CA: A special focus on Uzbekistan. Sh. Rahmatullaev et al, 2010*

[53] *Will climate change exacerbate water stress in Central Asia? Tobias Siegfried et al, September 2011*

Possible policy interventions for balancing water use in the Amu Darya Basin							
	Water	**Data**	**Environment**	**Agriculture**	**Energy**	**Finance / Economy**	**Education**
International	Facilitate high-level dialogue between officials of the Central Asian countries and Afghanistan. Initiate integrated and joint studies of transboundary water management Adopt policies that promote integration and efficiency across the water, agricultural and energy sectors.	Support the efforts of IFAS, other water policy institutions and donor organizations (i.e., the World Bank) in Central Asia in improving the legal and institutional set up for water information management. Strengthen strategic water communication in Central Asia by supporting UNRCCA and IFAS in their communication efforts and maximizing the role and potential of SIC ICWC information sharing, analysis and modeling	Encourage regional programs on environmental security. Build cooperative relationships over environmental hotspots.	Fund projects that encourage innovative approaches to agricultural development. Support capacity development projects and promote best practices and water efficiency. Provide financial and institutional support and long term commitment to the rehabilitation of agricultural schemes in Central Asia and Afghanistan. Promote the role of the private sector in providing efficient solutions to water saving and agriculture.	Enhance capacities to generate alternative energy supplies, including wind and solar. Implement pilot projects for alternative energy solutions. Promote the role of the private sector in providing alternative energy solutions and energy saving practices.	Advance on the achievements in the water sector. Fund projects that encourage innovative approaches to agricultural development and promote water and energy efficiency. Fund projects that develop resilience in Central Asia and Afghanistan, particularly in water and food security.	Encourage trainings, and mobility programs with basin countries' professionals on common issues of water, energy, food and climate change and the cooperation required to overcome them.

	Water	Data	Environment	Agriculture	Energy	Finance / Economy	Education
National	Invest in irrigation infrastructure and efficiency. Enhance domestic water pricing schemes. Develop national water use policies, taking into account agreed national and regional interests.	Reform and further develop an impartial CAREWIB system as a regional host of water-related data and information, a platform for the exchange and analysis of such information and a decision-support system with extended capacities for modeling and near-real-time data exchange.	Pursue modern approaches to benefits-sharing to enable an ecologically sound exploitation and protection of transboundary water courses in a manner that safeguards not only the regular irrigation, power and drinking water interests but also the economic, environmental, cultural and social interests of all riparian states along the river basin.	Fund of projects that encourage innovative approaches to agricultural development . Encourage farming projects that shift to water consumptive crops instead of highly dependent crops on water.	Develop legal frameworks under which alternative energy development activities could be initiated. Develop commercial as well as industrial production of the solar and wind panels.	Support the water users' organizations in implementation of effective pricing systems that permit sufficient cost recovery to support capital, operation and maintenance costs, informed by sustainable development principles. Incentivize water use efficiency.	Encourage trainings, and interstate mobility programs between the riparian countries.
Regional/Basin wide	Encourage further support for IWRM in all basin countries and address IWRM from a nexus approach that accounts for energy and industrial needs, in addition to agriculture.	Create a joint system to monitor the status and quality of water resources.	Further the efforts on IWRM to introduce river basin management for water resources. Establish and agree upon a set of environmental requirements relating to the protection of aquatic ecosystems.	Fund of projects that encourage innovative approaches to agricultural development. Support capacity development projects and promote best practices.	Develop a regional dialogue and coordinate on a regional energy market. Prioritize energy efficiency.	Encourage impact investment in the areas of water and energy efficiency.	Build national capacities and readiness for a more integrated and transboundary approach to water management.

	Water	Data	Environment	Agriculture	Energy	Finance / Economy	Education
Local/Community	Organize local meetings to spread awareness of national and regional policies.	Identify specific water managers to participate in data collection trainings and explain to water users the importance of data collecting measurement infrastructure, thus improving the local maintenance of infrastructure.	Encourage programs that raise awareness on environmental risks, impacts of non-efficient and unsustainable uses of water and energy resources, pollution, positive impacts of ecological integrity of basin, climate change mitigation and adaptation.	Introduce water efficient cropping technologies. Encourage training and knowledge expansion activities among water users by other farmers, promoted in-training schools or pilot projects.	Raise awareness of the local communities on the efficient use of energy resources (electricity) and on the benefits of affordable alternative energy sources.	Market studies to support business investment plans in areas of agriculture, water development and alternative energy.	Organize national and local working groups to internalize IWRM implementation processes on trans-boundary streams.