

Efficient Irrigation and Water Conservation in Central Asia

Reports and Working
Papers 23/4

Almaty — 2023

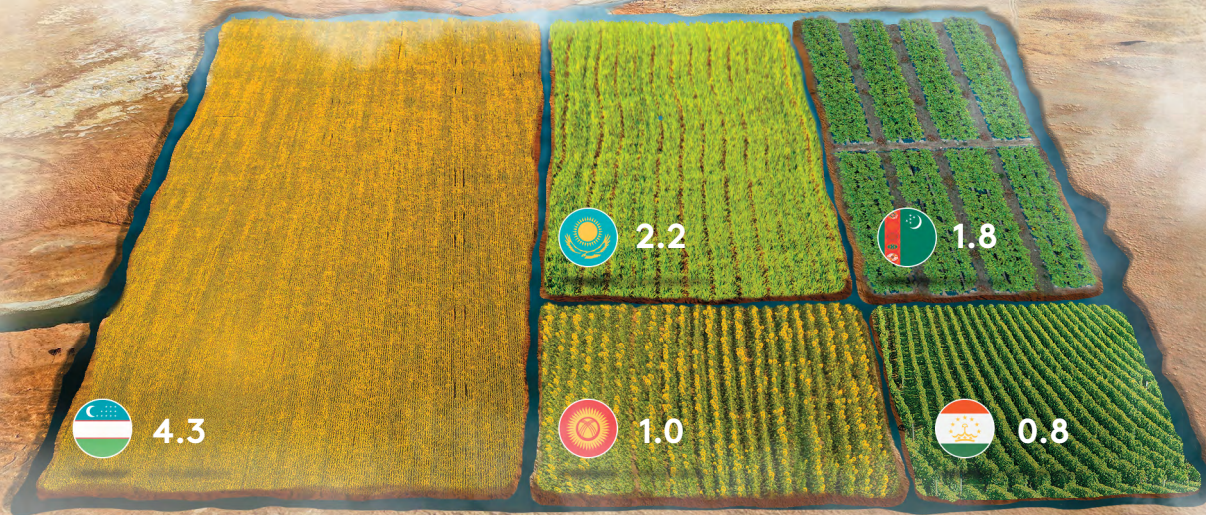
EFFICIENT IRRIGATION AND WATER CONSERVATION IN CENTRAL ASIA

FACTS AND FIGURES

ANALYTICAL REPORT '23

IRRIGATED CROP FARMING IS CRITICAL FOR AGRICULTURAL DEVELOPMENT IN CENTRAL ASIA

10.1 million ha of irrigated lands in CA, 2020



66%

gross agricultural output produced irrigated land in CA

80%

water used in CA for irrigation needs

HOWEVER, CENTRAL ASIA IS APPROACHING PERMANENT WATER DEFICIT

>50 years

the average age of irrigation infrastructure in CA

50%

irrigated land in CA exposed to salinisation

40%

water lost through filtration. 2/3 is lost in the field

10 km³

Afghanistan's expected water withdrawal from the Amu Darya River

10 PRACTICAL STEPS TO PRESERVE IRRIGATED LAND POTENTIAL, WATER AND FOOD SECURITY

STRENGTHENING REGIONAL COOPERATION

- ESTABLISH the CA International Water and Energy Consortium
- POOL MDBs' financial resources to support project construction of water infrastructure
- CREATE a regional cluster to produce irrigation equipment
- OFFER Afghanistan partnership in CA water management

SCALING UP FINANCE

- USE public-private partnership mechanisms in project construction
- ORGANISE water accounting while engaging water user associations
- Gradually INTRODUCE effective tariffs for irrigation water

PROMOTING INNOVATIVE TECHNOLOGY

- REHABILITATE on-farm irrigation infrastructure
- INTRODUCE digital technology for reliable water accounting, sustainable water allocation, and land quality monitoring
- USE modern technology in irrigation, laser land levelling, and crop farming across the region

Vinokurov, E. (ed.), Ahunbaev, A., Chuyev, S., Adakhayev, A., Sarsembekov, T. (2023) *Efficient Irrigation and Water Conservation in Central Asia*. Reports and Working Papers 23/4. Almaty: Eurasian Development Bank.

Irrigated lands in Central Asia contribute to 80% of crop production and play a pivotal role in ensuring food security in the region. In the face of significant water stress, Central Asia has nearly reached its limit for extensive expansion of irrigated agriculture. 80% of water resources are allocated to irrigation purposes. However, the efficiency of irrigated land and water use in the region remains critically low. 40% of water is lost due to filtration from irrigation canals, and over 50% of irrigated lands are afflicted by salinisation. To address these challenges, it is imperative to modernise irrigation infrastructure and attract investments for this purpose, including through Public-Private Partnerships. The implementation of effective tariffs for irrigation water, the widespread adoption of water-saving technologies, and the empowerment of water user associations in rationalising water and land resources are all essential steps. The transition to efficient water-saving methods will bolster the productivity of irrigated lands and the responsible use of irrigation water, thereby safeguarding water, food, and environmental security in the region. These measures are of utmost importance, especially in light of the anticipated reduction in the flow of the Amu Darya River.

Key words: Central Asia, water resources, food and water security, agriculture, irrigation, irrigated lands, water conservation.

JEL: F15, L66, N55, O13, Q15, Q25.

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INTRODUCTORY REMARKS BY NIKOLAI PODGUZOV



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Efficient management of water resources is a critical challenge in Central Asia, an area highly susceptible to climate change. With temperatures surging at a pace faster than the global norm and more frequent droughts and dry spells, this particular region has become increasingly fragile. A case in point was the drought experienced across the region last summer.

River hydrology and groundwater supply conditions are changing significantly. Glacial areas in the region drastically shrank by 30% over the past fifty years. Consequently, the runoff from Amu Darya and Syr Darya rivers is in decline. At the same time, the demand for water is surging, posing significant risks for agriculture and food security.

The Eurasian Development Bank is committed to enhancing sustainable economic growth among its member countries and fostering regional economic cooperation. Accordingly, it directs its loan portfolio, technical assistance, and research towards the water and energy complex in Central Asia.

Our new ground-breaking research report seeks to find comprehensive solutions to the potential water crisis in Central Asia. Agriculture accounts for an overwhelming 90% of the total water usage in the Aral Sea basin. Hence, the key part of the solution lies in facilitating efficient irrigation and enabling cooperative water resource management. This report suggests 10 practical steps, including four to be taken regionally and six nationally. This policy package should enable the region to save enough water annually to move forward sustainably. It, however, requires countries, farmers, and multilateral banks to work together.

I would like to highlight three key considerations:

1. The Central Asian countries should place revamping the irrigation system and adopting water-saving technologies high on their strategic agenda.
2. Regional cooperation is key.
3. Multilateral development banks should join forces to help the region address this issue rapidly and efficiently.

We at the Eurasian Development Bank intend to make a big difference. The global practice has demonstrated the value of the financial, technical, and research contributions from multilateral development banks in facilitating water sector projects. The Bank plans to invest at least \$400 million over the next three years in the development of the water and energy sector in Central Asia. We will also provide technical assistance when it comes to water-related matters. All in all, we will do our best to be the region's reliable partner in the water sector.

SUMMARY

Water scarcity stands out as one of the **principal structural impediments** to socio-economic development in Central Asian (CA) countries. The per capita water supply in CA has halved in comparison to the Soviet era, decreasing from 3,500 m³ to 1,712 m³ in 2020. According to international classifications, the CA countries teeter on the brink of being categorised as “insufficiently supplied” with water resources, with levels ranging from 1,000 m³ to 1,700 m³ per person per year. Looking ahead to 2050, there is a looming risk of them transitioning into a “water deficit” state.

Agriculture is a key water consumer in the CA countries: 100.4 out of 127.3 km³/year, or 79% of the water used in the region, is allocated for irrigation purposes (as of 2020). At the same time, irrigated agriculture is the backbone of agriculture and the basis for food security in CA. Irrigated land accounts for nearly **66% of the total agricultural output** in terms of value, with Turkmenistan at nearly 100%, Uzbekistan at 87%, Kyrgyzstan at 85%, Tajikistan at 82%, and Kazakhstan at 40%. In crop production, the average figure for the CA countries reaches 80%. Improving irrigation practices will help address water scarcity and inadequate water use efficiency in the region.

↓ Figure A. Irrigated Land in CA, 2020, ha thousand



Source: Eurasian Development Bank (EDB) estimates based on data from statistical agencies.

In 2021, **the overall food self-sufficiency in the CA countries in terms of energy value averaged 90%**. Kazakhstan achieved complete food security at 111%, though certain products experienced shortfalls. Kyrgyzstan (72%), Tajikistan (63%), and Uzbekistan (77%) fell short of ensuring sufficient production for many essential food items and relied heavily on food imports, often through mutual trade. Looking ahead to the long term, **until 2035, the situation with food self-sufficiency in the CA countries is not expected to significantly improve**. In fact, some countries may see the situation worsen.

Furthermore, water scarcity and mounting pressure on water resources **prevent CA from reaching its full irrigation development potential**. Irrigation infrastructure in the CA

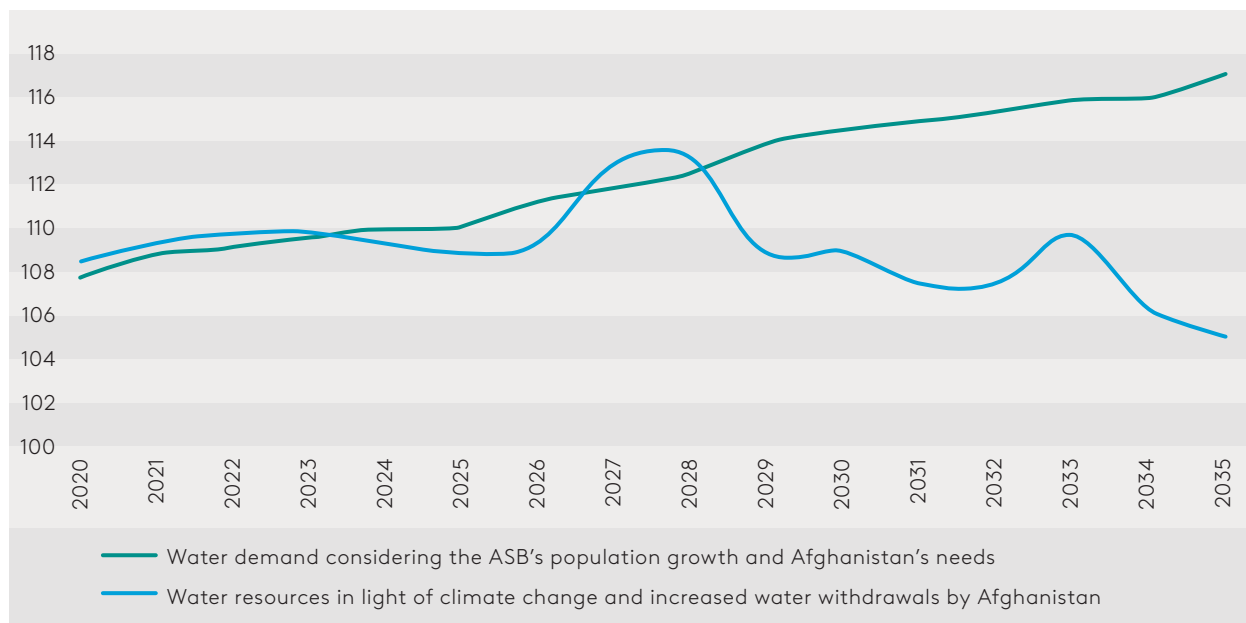
countries is burdened with extensive physical deterioration and lacks adequate technical sophistication. It is poorly equipped with devices for measuring and distributing irrigation water, as well as monitoring its usage in the fields. The average age of inter-farm and on-farm irrigation infrastructure exceeds 50 years, and this figure is even higher for large main canals.

The degradation and salinisation of irrigated lands pose a serious challenge to the CA countries. **Up to 50% of irrigated land in the region is susceptible to salinisation.** This is particularly daunting for small farms, primarily due to their limited financial resources. Many of these farms have become economically unviable, unable to maintain irrigation infrastructure or introduce reclamation measures on their irrigated lands. Consequently, the areas of irrigated land unfit for economic use are expanding, generating risks and threats to food security.

The water deficit closes the door on sustainable agriculture and the profitability growth of farms in CA. Climate change exacerbates water scarcity and brings about devastating consequences for agricultural producers, including salinisation, waterlogging, soil fertility loss, desertification, and abandoned lands.

Water conservation in CA appears to be the only viable solution to effective use of irrigated lands and food and water security in the region. Climate change and growing water demands are fast-tracking the switch to water conservation, along with **the expected reduction of the Amu Darya River flow from Afghanistan** (annually up to 10 km³ out of 22 km³ formed in the territory of Afghanistan and out of 80 km³ of the average annual river flow). Afghanistan's hydrotechnical projects **critically and dangerously reduce access to water in the middle and lower reaches of the Amu Darya.** These risks are particularly high in dry years: the Amu Darya flow during the growing season can potentially decrease by up to 50% or more in the lower reaches of the river.

↓ **Figure B. Forecast of Runoff and Water Withdrawal in the Aral Sea Basin (ASB) by 2035, km³**



Source: EDB estimates based on data from SIC ICWC.

CA is highly likely to face an acute chronic water deficit of 5–12 km³ in 2028–2029. The Afghan factor will have the same strong impact on the water balance in the region as the hydrological regime of low water, climate change, and high demographic growth. The region will potentially experience agriculture, industry, and energy crises. Shortages of food, drinking water, and electricity will cause a mass exodus of people from rural areas to cities and abroad. In his speech in Dushanbe at the meeting of the Council of Heads

of States that are founders of the International Fund for Saving the Aral Sea, Kazakhstan's President Kassym-Jomart Tokayev mentioned this issue, estimating the possible number of migrants at 5 million people by 2050.

The socio-economic development of Central Asia requires international cooperation and an integrated approach to water, land, and energy resource management. **The EDB has analysed numerous recommendations for supporting CA and proposes to focus on ten key practical steps.** They will help prepare for the significant changes in water flow in the Aral Sea basin expected in 2028 and compensate for the potential increase in water deficit. These steps can be classified into three major sets of solutions.

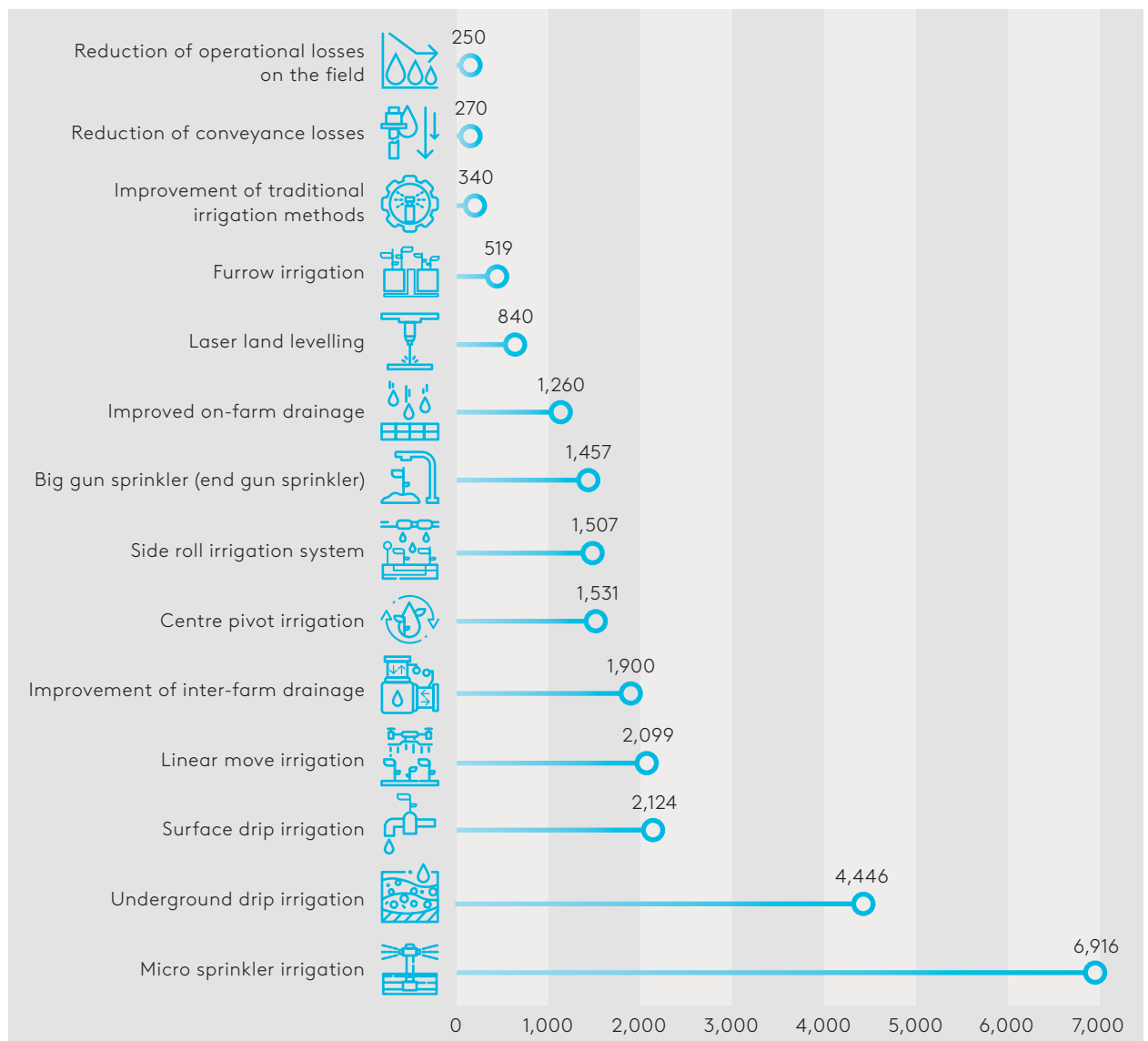
First, the causes of institutional water scarcity in CA agriculture should be eliminated internationally and nationally. The CA countries will require a consolidated regional response.

- 1. The establishment of the International Water and Energy Consortium of CA (IWEC CA)** will promote sustainable water management and irrigation development in the CA countries. It is one of the most effective solutions, as this consortium could prioritise integrated irrigation projects along with energy projects. It would facilitate collaboration and dialogue between multilateral development banks (MDBs) and the countries in the region.
- 2.** A coalition of the International Fund for Saving the Aral Sea (IFAS), IWEC CA, and MDBs could effectively **attract investments in irrigation**, guided by the regional and national water and energy development strategies of the CA countries. It is a challenging issue, and MDBs operating in the region would serve as financial operators, jointly executing complex projects and attracting additional financial resources from other donors.
- 3. The countries could create a regional cluster specialising in the production of modern irrigation equipment**, tailored to the unique requirements of each CA country. It is essential to establish regional manufacturing facilities for agricultural machinery, specialised reclamation equipment, canal maintenance, repair machinery, and water metering devices. Equipment to be produced would depend on the specific needs and characteristics of each country in the region: sprinkler equipment, sprinklers, pumps, pipe products, attachments, electronic water control, metering devices, and equipment for irrigation system maintenance and repair. CA ranks 5th in the world (in aggregate) after China, India, the USA, and Pakistan in terms of irrigated area. The region represents a capacious irrigation equipment market of \$140–320 million (4%–8% of the world market).
- 4. The CA countries should consolidate their efforts to strengthen cooperation with Afghanistan and involve the IFAS** and other regional organisations in managing transboundary water resources. The CA countries could benefit from entering into an ongoing dialogue with Afghanistan on water-related issues, as well as Afghanistan's full membership in the IFAS.

The transition to water conservation expects substantial financial resources. The future development of agriculture in CA may face significant constraints due to limited investment opportunities, including the water and irrigation sectors. The maintenance and modernisation of irrigation infrastructure requires financial resources and state-of-the-art technology.

Irrigation is one of the most capital-intensive aspects of agriculture. It is therefore important to fully involve and engage development banks, including multilateral institutions, and it is advisable to focus on expanding the resource base for financing irrigation infrastructure.

↓ Figure C. Cost of Irrigation Technology in Agriculture, USD per 1 ha of land



Source: EDB estimates based on data from CRS Report (Stubbs, 2016) and Royal Haskoning, 2003.

5. The attraction of investment is vital to the development of irrigation infrastructure in the CA countries, **including as a public-private partnership (PPP)**. This report analyses the global PPP experience using multiple case studies and concludes that such form of financing is acceptable. State budgets and financial resources of MDBs can equally encourage such projects. MDBs act as integrators of solutions, supporting dialogues with all stakeholders, including water policy makers, government agencies, and organisations, and facilitating multilateral agreements. For instance, MDBs use grants or sovereign lending at subsidised interest rates to fund irrigation projects in CA. The applicable interest rate for financing water sector projects in the region typically averages 1% during the grace period and either 1.5% or a fixed 1% thereafter. The grace period usually spans five to eight years, with loan terms ranging from 20 to 32 years. These terms constrain financing within the sector.

6. It is extremely important to organise **proper water accounting at inter-farm canals and farms** with the participation of Water User Associations (WUAs). In Central Asia, about 40% of water withdrawn from rivers is lost through filtration in the canal system; one-third is lost in the main and inter-farm canal systems, and two-thirds of losses occur in on-farm canals. The key is to strengthen the organisational and legal status of WUAs. This will increase the responsibility and obligations of WUAs regarding water resource use and allow creating legal and economic conditions for the cooperation and partnership of WUAs with state and economic management bodies, as well as farms. These measures will further help switch to the system of paid water supply services for farms.

7. **An optimal and economically justified tariff for water supply services should be introduced in CA stage-by-stage as a crucial reform.** Current tariffs in CA are significantly lower than the economically justified rates, often by a factor of 4 to 15. Gradually incorporating investment charges into the tariff structure will empower water management organisations to invest in the construction, modernisation, and renovation of irrigation systems. Individual farmers cannot afford the required investment, so globally, governments continue to provide subsidies and compensations to irrigated agriculture despite a paid water supply mechanism in place. This is food for thought when it comes to introducing paid water usage in CA and developing sustainable and efficient irrigation models and mechanisms.

Central Asia lacks enough water resources and is reaching the limit of extensive irrigated farming; the region will now have to prioritise **industrial agricultural technology focused on water and energy conservation**. The CA countries should strive to adopt water-saving technology across the region and improve the technical and engineering aspects of irrigation systems, as well as cultivate high-yielding crops.

8. To combat the widespread salinisation of irrigated lands and the decline in soil fertility, **we believe that the countries need to improve their meliorative condition by reconfiguring irrigation and drainage systems.** This will reduce filtration losses by a factor of 3 or 4 and lower groundwater levels by 2–3 metres, depending on the hydrogeological characteristics of the area. For instance, on-farm earthen canals can be transformed into flume canals, and existing systems can be replaced with pipelines for efficient water supply to the fields. Reducing crop water consumption and increasing crop yields will undoubtedly help achieve this objective. The resulting water should be allocated to maintaining the ecological balance of rivers and the natural environment.

9. **We also recommend introducing digital technology in the water sector everywhere** for rational water allocation, accurate water accounting, and an easier transition to the system of paid water supply services for farms. **The introduction of digital water-metering technology is expected to save 12%–15% of water per year.** The countries would also benefit from setting up a long-term system to monitor the ameliorative condition of irrigated lands and soil salinisation using remote satellite diagnostics.

10. The CA countries continue to favour surface irrigation methods. They should be encouraged to turn to **modern technical tools, such as laser levelling of irrigated fields**. This technology facilitates optimised crop management, ensuring even water distribution without losses, accelerating plant growth, and boosting yields. Precise levelling involves new mechanised and water-saving surface irrigation techniques along furrows. On fields levelled with slopes under furrow irrigation, grain and other crop yields can increase by a factor of 1.3–2.3, while saving from 20% to 30% of water per year.

The economies of the CA countries are developing under extreme exhaustion of land and water resources. Water use issues require **new mechanisms and instruments of cooperation in transboundary river basins, with deepening economic integration of the region's countries as the underlying factor**. Only partnerships and mutually beneficial economic cooperation can help address and overcome the long-term socio-economic and environmental consequences of ambiguous natural-geographical and geopolitical factors and high transboundary water dependence in the CA countries.