CENTRAL ASIA REGIONAL ECONOMIC COOPERATION (CAREC) PROGRAM:

DEVELOPING THE WATER PILLAR

SCOPING REPORT

SEPTEMBER, 2021

ADB Regional Technical Assistance TA-9977
Central Asia Regional Economic Cooperation (CAREC):
Developing the Water Pillar

Scoping Report

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Executive Summary

The scoping study for the CAREC Water Pillar presents a framework for regional cooperation on water that responds to the growing demand for water at a time of increasing climate related uncertainty. Initially it focuses on cooperation within the Aral Sea Basin region with an expectation that its scope will expand gradually to other sub-regions within CAREC. It aims to complement the role of existing regional institutions, national agencies, and development partners.

Water is integral to many sectors of CAREC cooperation either directly or indirectly, including agriculture, energy, trade and tourism. It is critical for a sustainable future and meeting commitments to many of the UN Sustainable Development Goals as well as climate adaptation and resilience measures related to the Paris Climate Agreement. The multi-sector nature of CAREC cooperation and high-level forum of the Ministerial Conference provide an opportunity for cross-sector dialogue on integrated water solutions.

The aim of the scoping study is to make recommendations for the structure of the Water Pillar and potential areas of cooperation based on an analysis of existing conditions and challenges and projections of future conditions to 2050. It involved preparation of three thematic papers on water resources and climate change, the economic value of water, and the prevailing legal and policy environment at both regional and national levels.

Water is one of the region's most precious resources that supports extensive agriculture development covering more than 10 million hectares. This development has come at a cost, raising the question of long-term sustainability, both to the environment in terms of degraded aquatic ecosystems and also financially due to the high costs for pumped irrigation and low rates of cost recovery. Hydropower development in the areas upstream generates renewable energy for both national use and export to neighbouring countries and there is scope for further expansion. Discussions between countries in the region on seasonality of hydropower production and potential consequences for water availability for irrigation during the vegetative period has intensified due to recent drought situations; occurrences that are likely to become more frequent as climate-induced variability increases.

Central Asia is a region in transition with economic advancement and population growth leading to an increase in water demand. Looking ahead to 2050, potential future demand for water is likely to rise as a result of the growth of population, higher standards of water and sanitation services, increased urbanization, expansion of industrial demand, the impact of growing hydropower use, and increased recognition of the environmental demands for water. On the supply side, climate projections based on available modelling are uncertain, particularly for rainfall. Potential evapotranspiration will increase by about 5% up to 2050 leading to higher consumptive use by crops. Higher temperatures will lead to a temporary increase in melt water from glaciers in the short term, to be replaced by lower flows as glaciers diminish. The greater variability in flow regimes is expected to continue meaning that existing planning and water management practices will need to be revised. As intermittent solar and wind power becomes a larger part of electricity generation in downstream countries, hydropower plants will increasingly be used to provide grid stability, resulting in higher levels of variability in river flows and a need for closer linkages between energy and water planning.

A large gap between potential demand and available supply will occur if the region follows its current pathway without modernization and demand management in the water and agricultural

sector. Water demand will increase which when combined with increased variability and uncertainty for supply, would lead to an estimated supply-demand gap of around 37%. In reality, as water resources in the region are already fully allocated, this would result in shortages in supply to water users. While there is scope to constrain demand under current plans for rehabilitation and modernization, it will not be sufficient and a more comprehensive climate resilient scenario involving a broad intervention portfolio of region-wide investments will be required to limit demand to available supply. Key to the climate resilient scenario is boosting prevailing low levels of water productivity across the region, while at the same time recognizing water needs for aquatic ecosystems. Consideration of the economic value of water together with climate resilience needs will be needed to influence future water allocation priorities and practices.

In recent years there has been an improving geopolitical environment for regional cooperation with extension of bilateral agreements and joint investments. Since the end of the Soviet period, inter-governmental cooperation has been facilitated by the International Fund for Saving the Aral Sea (IFAS) and its constituent organizations, including the Interstate Commission for Water Coordination (ICWC). Efforts are underway to encourage the active participation of all Central Asian countries and there is recognition of the need in the future to further involve Afghanistan as a riparian state of the Amu Darya. Further efforts will be needed to harmonize national laws with regional agreements and commitments and provide the detailed working level mechanisms for implementing high level political declarations.

Framing the Water Pillar

A series of consultations were undertaken with national focal points for the Water Pillar in each of the Central Asian states to provide background and insights on the scope and focus for the Water Pillar, involving representatives of inter-governmental organizations, development partners and knowledge management institutes. Travel restrictions due to the COVID-19 pandemic meant that these had to be undertaken virtually. A first regional consultation was held on 16 April 2021 to obtain feedback on the underlying analysis from the thematic papers and a second regional consultation was held on 14 September 2021 to review the framework and components proposed for the Water Pillar.

The proposed vision for the Water Pillar is:

> *to contribute to a sustainable, climate resilient, productive and water secure region with shared benefits among States and communities*.

With a focus on regional interventions that go beyond the benefits delivered through national projects alone, the Water Pillar will serve the following functions:

- **Investment support for water infrastructure** that has mutual benefits for two or more countries;
- **Generator of knowledge** through analysis of key issues and guidance on policy reform, including adaptation of international good practice to the local context;
- **Platform for dialogue** among countries of the region at technical and policy levels to exchange experience and build consensus on water resources management and provision of water services;

- **Facilitator of capacity development** involving peer-to-peer exchanges on topical issues, in-career professional development, and upgrading training programs.

As a new component of the CAREC Program, the Water Pillar will take an incremental approach to strengthening regional cooperation, starting with initiatives that bring technical specialists together to help build trust and confidence in close and more open working arrangements, including analysis based on shared datasets.

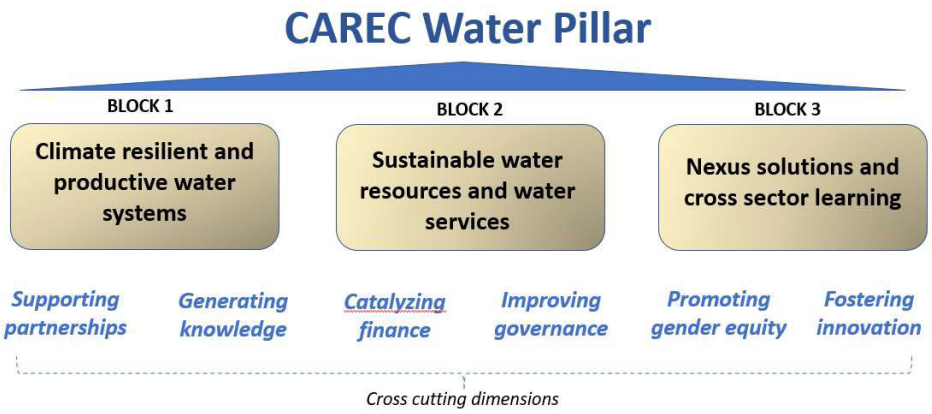
The following criteria are proposed in identifying individual CAREC Water Pillar activities:

- alignment with national strategies and support to SDGs, NDCs and climate adaptation plans,
- alignment with the mission and principles of CAREC cooperation outlined in CAREC 2030 and synergy with other relevant CAREC programs,
- involvement of two or more countries, with a clear expression of interest and ownership from the countries involved,
- potential to bring benefits of joint approaches beyond those that result from a national approach, and
- complementarity and additionality to other CAREC sector programs, work programs of other regional bodies, and programs of other development partners.

Projects under the Water Pillar will build confidence and trust in joint management approaches and comprise a combination of initiatives designed to:

- address **issues of common concern across two or more countries** that may or may not be directly linked to a shared water resource, and
- support **regional cooperation on shared water resources** (i.e., a transboundary river or groundwater system).

Water Pillar projects may involve technical assistance, (for example support to policy and regulatory, institutional strengthening, knowledge products and joint learning activities), or revolve around investment in infrastructure, including jointly owned and managed infrastructure. The proposed Water Pillar comprises three blocks, supported by a set of cross cutting dimensions that influence the design of projects.



Preliminary ideas for groups of Water Pillar project activities are summarized below and build on emerging opportunities and areas of mutual interest with the aim of stimulating greater cooperation and shared benefits:

1. ***Climate resilient and productive water systems***
   - 1.1 Strengthen regional information and analysis systems to manage uncertainty
   - 1.2 Build climate resilience and raise productivity through modernized irrigation systems
   - 1.3 Increase resilience of communities through improved water supply and sanitation
   - 1.4 Support capacity for climate adaptation and disaster risk management
   - 1.5 Climate proof regional agreements and align national legal systems

2. ***Sustainable water resources and water services***
   - 2.1 Transition to less water demanding and self-financed water services
   - 2.2 Catalyze performance gains through private sector involvement
   - 2.3 Build towards a healthy water environment

3. ***Nexus solutions and cross sector leaning***
   - 3.1 Facilitate co-ownership and joint management of shared assets
   - 3.2 Promote integrated water-energy solutions
   - 3.3 Incorporate evidence based-learning into planning decisions and management systems

There is a broad landscape of water-related regional cooperation programs initiated by Central Asian countries and development partners which the Water Pillar will complement. The Water Pillar is designed to benefit from and link to dialogue processes that focus on strengthening of regional institutional arrangements and procedures, complement ongoing regional and national programs through targeted investment and technical assistance, and strengthen existing regional knowledge institutions.

Financing and implementation mechanisms for the Water Pillar will mirror those of other CAREC programs. In addition to ADB and national contributions, co-financing arrangements will be facilitated through partnerships with other development partners on a project-by-project basis with an increasing emphasis on climate adaptation and green financing vehicles.

Acknowledgments

The authors[1] of this scoping study report would like to sincerely thank all those from national agencies including the national focal points for the CAREC Water Pillar, intergovernmental organizations, development partners, knowledge partners, researchers and consultants who contributed their insights and experience to this study. We appreciate the opportunity provided by the Asian Development Bank (ADB) to be involved in this exciting opportunity for enhancing regional cooperation on water and thank the involved Directors and project staff from ADB for their guidance. In particular, we recognize the invaluable assistance provided by ADB and CAREC support staff and the interpreters involved in the virtual meetings and in translating reports.

[1] The team comprised Jeremy Bird (Water Resources Advisor); Johannes Hunink of Future Water (Climate Change Specialist); James Winpenny (Economist); and Shaimerden Chikanayev of Grata International (Legal Specialist).

Abbreviations

ADB	Asian Development Bank
ASBP	Aral Sea Basin Programme
BaU	Business as Usual
BWO	Basin Water Organisation (of ICWC)
CAMP4ASB	Climate Adaptation and Mitigation Program for the Aral Sea Basin
CACIP	Central Asia Climate Information Platform
CAPS	Central Asian Power System
CAREC	Central Asia Regional Economic Cooperation (Program)
carec	Regional Environment Centre for Central Asia
CASA	Central Asia – South Asia
CAWEP	Central Asia Water and Energy Program (of World Bank)
CGIAR	Global research partnership for a food secure future
CMC	Coordination Meteorological Centre (of ICWC)
COP	Conference of the Parties
EC-IFAS	Executive Committee (of IFAS)
ERA5	Fifth generation of European Centre for Medium-Range Weather Forecasts
ET	Evapotranspiration
EU	European Union
FAO	Food and Agriculture Organisation (of the United Nations)
GCF	Green Climate Fund
GDP	gross domestic product
GIZ	German Development Agency
GLOF	Glacier Lake Outburst Flood
GW	Gigawatt
ICSD	Interstate Commission for Sustainable Development
ICWC	Interstate Commission for Water Coordination
IFAS	International Fund for Saving the Aral Sea
IFPRI	International Food Policy Research Institute
IHA	International Hydropower Association
IWMI	International Water Management Institute
IWRM	integrated water resources management
MEGNR	Ministry of Ecology, Geology and Natural Resources (Kazakhstan)
MEWR	Ministry of Energy and Water Resources (Tajikistan)
MOM	Management Operation and Maintenance
MW	Megawatt
MWR	Ministry of Water Resources (Uzbekistan)
NbS	nature-based solutions
NDC	Nationally Determined Contribution
NPD	National Policy Dialogues
O&M	operation and maintenance

OECD	Organisation for Economic Cooperation and Development
OP	Operational Priority (of ADB Strategy 2030)
PPP	public-private partnership
PRC	Peoples Republic of China
SAWR	State Agency for Water Resources (Kyrgyz Republic)
SCWM	State Committee for Water Management (Turkmenistan)
SDC	Swiss Development Cooperation
SDG	Sustainable Development Goal
SIC	Scientific Information Centre (of ICWC or ICSD)
SWOT	Strengths, Weaknesses, Opportunities and Threats
TA	technical assistance
TOR	terms of reference
TWh	Terawatt hours
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNRCCA	United Nations Regional Centre for Preventive Diplomacy in Central Asia
USAID	United States Agency for International Development
VAT	value added tax
WASH	Water, Sanitation and Hygiene
WWF	Worldwide Fund for Nature

1 Incorporating a Water Pillar in the CAREC Program

1.1 Introducing CAREC

1. The Central Asia Regional Economic Cooperation (CAREC) Program is a partnership of 11 member **countries**[2] and development partners working together to promote development through cooperation, leading to accelerated economic growth and poverty reduction. It is guided by the overarching vision of '*Good Neighbors, Good Partners, and Good Prospects'*. Over the past 20 years CAREC has supported economic development in the areas of transport, energy, trade facilitation and trade policy and more recently has added human development (health and education), gender, tourism and economic corridors to its Program.

2. In 2017 CAREC introduced agriculture and water as a new cluster in its strategic framework, *CAREC 2030: Connecting the Region for Shared and Sustainable Regional Development* (Asian Development Bank 2017).[3] Recognizing the complexities of the water sector and the existing landscape of cooperation activities, CAREC 2030 proposed a complementary approach that uses the strengths of the Program to further promote dialogue on water issues.

3. CAREC 2030 aligns its approach with the strategies and development plans of its member countries as well as the development agenda set by the Sustainable Development Goals (SDGs) and Paris climate agreement, COP21, including related nationally determined contributions (NDCs) on climate change. It embodies the vision of '*A regional cooperation platform to connect people, policies and projects for shared and sustainable development'*. Cutting across the five operational clusters[4] of CAREC are the use of information and communication and an emphasis on sustainable financing. Other aspects to be embraced are climate and resilient infrastructure, natural capital and the environment, sustainable urbanization, and inclusive social development.

4. Water similarly underpins all seven operational priorities of ADB's Strategy 2030 and the CAREC Water Pillar responds particularly to the call for fostering regional cooperation and integration in its Operational Priority #7 (ADB 2018).[5] The Water Pillar initiative builds on ADB's cooperation on water in the region over past decades, including support for management of shared water resources.[6]

5. Discussion on the Water Pillar within the new Agriculture and Water Cluster was taken forward in a side session of the CAREC Senior Officials Meeting in June 2019 under the banner of '*Advancing Water Cooperation and Sharing Experiences'*. It led to commissioning of this scoping study, supported by the Asian Development Bank (ADB), to develop a framework for the Water Pillar. It was agreed that the initial focus of the CAREC Water Pillar would be on the five Central

[2] CAREC countries include Afghanistan, Azerbaijan, the People's Republic of China, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

[3] Developing the CAREC Water Pillar | CAREC Program Project

[4] The five clusters are: economic and financial stability; trade, tourism and economic corridors; infrastructure and economic connectivity; agriculture and water; and human development.

[5] OP1: Addressing remaining poverty and reducing inequalities; OP2: Accelerating progress in gender equality; OP3: Tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability; OP4: Making cities more livable; OP5: Promoting rural development and food security; OP6 Strengthening governance and institutional capacity; and OP7: Fostering regional cooperation and integration.

[6] For example, Improved Management of Shared Water Resources in Central Asia (adb.org)

Asian states, in particular, the region covered by the waters of the Aral Sea Basin region (Figure 1), with consideration given to expanding to other sub-regions within CAREC over time.

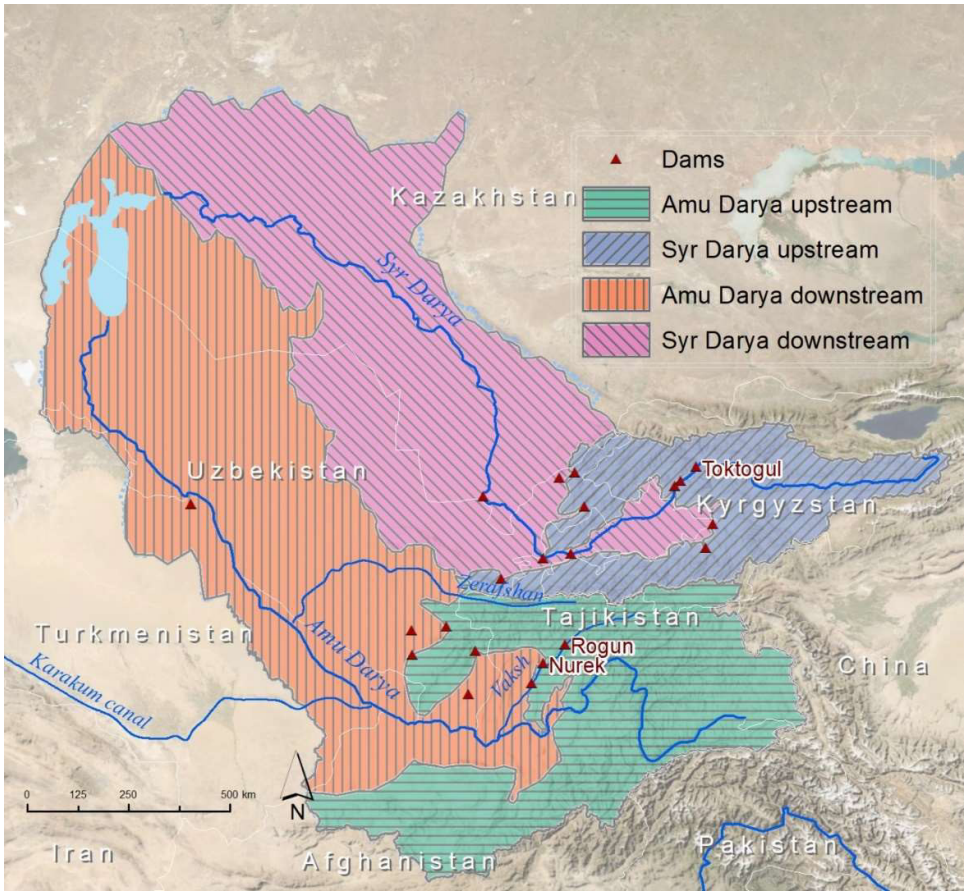
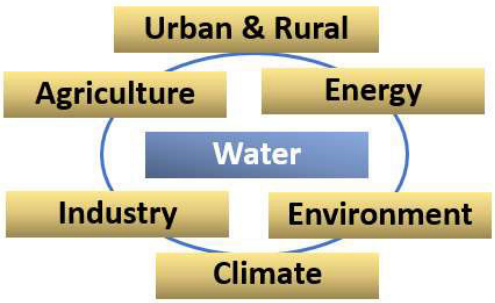


Figure 1. Map showing the Amu Darya and Syr Darya river basins with depiction of upstream and downstream areas. Turkmenistan also receives water from the Aral Sea basin through the Karakum canal. Source: authors

1.2 Expectations for the Water Pillar

6. Water is integral to many sectors of CAREC cooperation either directly or indirectly. Economic development and cooperation in the CAREC region are closely linked to water and energy resources. The importance of water in meeting countries' commitments to the SDGs goes beyond the specific water related targets of SDG6 as it is a central element in addressing so many of the development aspirations embodied in other SDGs (UN Water 2016). The highest priority for water is generally accorded to water for drinking and household uses, including sanitation. Clean and safe water for drinking underpins society and human health and development and attracts an even higher importance now as a consequence of the



COVID-19 pandemic. Water is central to agriculture in the region, with irrigation accounting for approximately 90% of water withdrawals from the major rivers of Central Asia. It also supports electricity production, both hydropower generation and for cooling of thermal plants.

7. The importance of water for aquatic ecosystems in the region has been on the international agenda for over a generation through efforts to mitigate degradation of the Aral Sea. Economic diversification and increased potential for trade, particularly of high value agricultural products and electricity, will present new challenges for managing the finite water resources of the region. In a rapidly changing climate, the focus on water intensifies further as river flows become more variable, temperatures increase, and water plays a critical role in efforts for climate adaptation. There are also linkages to tourism through an increasing emphasis on eco-tourism and the historic connections to water for many of the major tourist sites in the region.[7]

8. As States face the common challenges of climate change impacts and increasing development pressures on water resources, there is a clear rationale for closer cooperation on water through a wide range of mutually supportive and complementary programs. CAREC provides one such platform through which technical assistance and investment in water can be provided as part of a broader regional economic framework to raise the profile of water security across the region and facilitate cross-sector dialogue on mutually beneficial outcomes. Ensuring synergy with other ongoing initiatives is a key consideration for this scoping study.

1.3 Aim of the Scoping Study

9. The proposed outcome of ADB's technical assistance (TA) is to develop the scope of the CAREC Water Pillar as a contribution to improving water resources management in the Central Asian region.[8] Particular emphasis is given to climate change impacts, economic aspects and sustainable financing of water services and resource management.

10. The higher level impact supported by the TA is improved water resources management in the Central Asian region with the immediate outcome of developing the scope and framework of the CAREC Water Pillar. Three intermediate outputs were identified in the original design (i) future demand for water resources in the Central Asian region up to 2050 estimated, (ii) water resources development opportunities identified, and (iii) policy and institutional strengthening framework prepared. The main deliverable of the study is this scoping study report. It describes the evolving context of water in the region and proposes a framework for cooperation under the Water Pillar, identifying examples of projects that could be taken forward under the various elements of the framework. Some refinement to the intermediate outputs was agreed during the inception stage of the TA resulting in **three thematic papers** being prepared as supporting deliverables to the scoping study report and providing the analysis that underpins the recommendations for the Water Pillar. The thematic papers focus on:

- **Climate change:** includes projections of future availability and demand for water resources for the Central Asia region up to 2050 including implications of climate change risks and identifies opportunities for climate adaptation (Hunink 2021). It incorporates the original Output 1 of the TA.

[7] CAREC Tourism Strategy 2030 | Asian Development Bank (adb.org)

[8] 54103-001: Developing the Central Asia Regional Economic Cooperation Water Pillar | Asian Development Bank (adb.org)

- **Economics**: provides a focus on the economic value of water and how it can be used in policy making. The paper examines pricing policies and subsidies in water using sectors, the role of water demand management in policy reforms and implications for sustainable financing of water resources management (Winpenny 2021). The extent that demand management policies and practices are adopted in the region will influence the nature and scope of future water resources development needs and is a key factor in defining Output 2 of the TA.
- **Law and policy**: describes the national and regional legal and policy frameworks for water resources management in the five jurisdictions of Central Asia and related regional and bilateral agreements. It provides a comparative analysis of key topics including allocation of water, regulation and protection, institutional arrangements including river basin agencies and the framework for public-private partnerships (Chikanayev 2021). The analysis identifies constraints within the existing legal and policy frameworks thus providing a key element of Output 3 of the TA.

11. The scoping report itself provides the policy and institutional framing for the Water Pillar (i.e., the forward-looking aspects of Output 3) and a proposed list of potential areas for investment and support (related to Output 2). It delivers a basis for countries in the Aral Sea Basin region to initiate cooperation on water under the umbrella of CAREC. Over time, this cooperation may expand to other CAREC States and involve the development of a CAREC Water Strategy in a process similar to that followed by other sectors of CAREC cooperation.

1.4 Consultation process to date

12. The onset of the COVID-19 pandemic in March 2020 resulted in disruption to normal ways of working and a reorientation of priorities across the globe just at a time when the TA was starting. Despite travel restrictions due to the pandemic, a relatively broad range of virtual interviews was possible for preparing this scoping report and the underlying thematic papers. They included meetings with representatives of the five Central Asia countries, inter-governmental and international organizations, development partners and knowledge institutions (see list of people contacted in Annex 1). Internal consultations within ADB have been held with divisions responsible for regional cooperation, energy, urban development, agriculture and natural resources, and climate change. Extensive literature exists in relation to the water sector in the region and much of this body of experience has been reviewed as noted in the bibliographies of both this report and the thematic papers. An initial regional consultation on the analysis undertaken for the thematic papers and preliminary ideas for the Water Pillar was held virtually on 16 April 2021 which provided valuable feedback for drafting of the recommendations (see summary report in Annex 2). A draft of the scoping study report was circulated in late June 2021 and a second regional consultation held on 14 September to provide feedback on the proposed framework for the Water Pillar and prioritization of initial activities. Overall, general support was voiced for the need for the Water Pillar and its proposed framework and suggestions were received to strengthen the study report which have been addressed in this revised version. A summary report of the second regional consultation is being prepared.

1.5 Report content

- **Chapter 2 – a region in transition**: describes the drivers of change in what is a dynamic and rapidly evolving region and reflects on pathways of change influencing

the water sector as reflected in national development strategies. It examines the political commitment to regional cooperation as it has adapted since the Soviet era and presents an analysis of the national and regional legal frameworks, identifying both supportive measures and gaps.

- **Chapter 3 – status of water resources and water demand**: presents an analysis of climate change risks facing the region and the implications for future water supply, including the consequences of increased variability and uncertainty. It projects future demands for water across water-using sectors and examines physical, environmental, and financial sustainability challenges. Emerging changes to the linkage between water and energy sectors are considered and the imperative of managing demand to ensure future water security is highlighted.
- **Chapter 4 – strengths, weaknesses, opportunities and threats:** summarizes important considerations that need to be addressed and the potential provided by the capacity in the region and reforms that are currently underway.
- **Chapter 5 – envisioning the water sector for the next generation:** looks forward to 2050 and the types of change that will define the sector by middle of the century, including living with climate variability, the consequences of economic development and higher standards of living on resource use and quality of the environment, and the transformation made possible by technological advancement. This sets the scene for determining what steps the CAREC Water Pillar can take to support achievement of shared benefits for the region.
- **Chapter 6 – framing the CAREC Water Pillar:** presents a proposal for the structure of the Water Pillar based on three themes, the principles behind its establishment and preliminary ideas at a conceptual level for populating the framework. It explores linkages and synergies with other development programs, sets out possible directions for financing pillar activities, and considers a pathway for gradual expansion of the Water Pillar beyond the Aral Sea Basin region.
- **Chapter 7 – next steps**: outlines the steps for moving forward to make the CAREC Water Pillar a reality and for preparation of initial priority activities.

13. The following documents were of particular value in providing a comprehensive background and discussion of the challenges facing the region:

- CAREC 2020, Climate Vulnerability, Infrastructure, Finance and Governance in CAREC Region – Research Report
- Project outputs of the Climate Adaptation and Mitigation Program for the Aral Sea Basin (CAMP4ASB) on climate change, energy and water
- Rethinking Water in Central Asia: The costs of inaction and benefits of water cooperation (Pohl et al. 2017)
- The Aral Sea Basin: Water for Sustainable Development in Central Asia (Xenarios et al. 2020)
- Overview of the use and management of water resources in Central Asia: A discussion document (OECD 2020)

- USAID: 2020: Water Sector Development in Central Asia and Afghanistan: Status review and development options
- World Bank (2020): Central Asia: Exposure and practical In-Roads to modernizing irrigation in Central Asia. Final Report.
- Transboundary Water Management in Central Asia (Janusz-Pawletta et al 2015)
- Overview of Regional Transboundary Water Agreements, Institutions and Relevant Legal/Policy Activities in Central Asia (Volovik 2011)

2 A region in transition

14. Water is one of Central Asia's most precious resources. In the decades to come demands on it will grow, while its supply is likely to become more uncertain and unreliable due to climate change effects. Central Asian countries are currently among the most water-intensive economies in the world in terms of water use relative to GDP and have recognized both the need for making more efficient and productive use of this vital resource and the considerable scope that exists for doing so.

2.1 Major drivers of change

15. Increasing demand for water in Central Asia will be shaped by, among other things, the growth of population, economic growth, changes in the structure of the economy between water-using sectors, climate change impacts, the evolution of inter-regional and international trade in water-intensive products, and how far commitments for environmental and ecological needs for water are implemented. The net result of these factors is likely to be a reduction of the use of water for agriculture, with implications for maintaining food security. The supply of water will be significantly influenced by climate change.

Climate change

16. The upstream regions or 'water towers' receive about 64% of the basin's **precipitation** and the vast majority falls as snow. Trend analysis over the past 30 years shows that precipitation amounts have decreased slightly (-3%) over the entire region. There is however no consensus on projections for future precipitation, with future amounts either increasing or decreasing slightly in the order of a few percent (Hunink 2021, chap. 3). There is closer agreement on **temperature changes** and analysis for this scoping study show that temperatures will increase on average by around 1.5ºC by 2050 compared to current levels. Downstream regions will be affected most in the short-term where increased heat stress and droughts are likely to have major consequences on agricultural production and health. Due to temperature increase, the evapotranspiration will increase in the same order of magnitude as the precipitation changes (around 5%), leading to lower runoff and river flows, most likely also in the same order of magnitude of a few percent.

17. The water towers of both river basins have experienced notable changes over past decades, including in glaciers and snow dynamics. Scientists indicate that climate warming in Central Asia is likely to exceed the global average when compared with pre-industrial levels. **Glacial melt** will generate additional water over the next decades in some of the tributaries with

the loss of glaciers leading to increased flows. However, at regional level, this increase will most likely be offset by reductions in other tributaries where flow decreases will be due to change in snowfall fraction, increases in evapotranspiration (reservoirs, soil and vegetation) and sublimation (vaporization of the snow surface).

18. The reduced capacity of high-mountain regions to buffer water in the water towers will have major impacts on the variability of flows within and between seasons. Indications are also that there is a detectable increasing trend in the frequency and amplitude of extreme floods and water shortages (OECD 2020).

19. Undoubtedly, the agricultural sector is the most at risk to suffer the impacts of climate change in the region, not only water-related risks, but also temperature-related ones such as pests, diseases, heatwaves, etc. This could make regional food security situation less favorable, potentially undermining progress that has been achieved to date and intensifying competition in the region. As agriculture and water resources are closely linked in Central Asia, further work is needed to enhance climate resilience of the agricultural sector at both national and regional levels. Increasing climate risks may also intensify competition for water between sectors and riparian states.

20. More detailed analysis of the implications of climate change is presented in section 3.1 and the climate change thematic paper (Hunink 2021).

Growth of Central Asian economies

21. After three years of strong growth in all five countries to 2019, (in excess of 4% per annum), they all registered a fall in GDP in 2020 due to the repercussions of COVID-19. Provisional projections, assuming the pandemic is brought under control, show a resumption of growth in 2021 and 2022, (World Bank 2020b; ADB, 2021).

22. Drawing on a broad mix of sources, the Green Action Task Force (OECD 2020) makes a forecast of the 2030 structure of GDP in the five Central Asia countries (Table 1). With the exception of Kazakhstan which already has a more varied economy, all countries are projected to diversify further out of agriculture into growth sectors which include, depending on the country, industry (including hydrocarbons, manufacturing, mining and agro-processing) and hydropower production.[9] Within agriculture, the trend to diversify the mix of crops and livestock products is likely to continue, driven largely by agricultural enterprises and small private farmers responding to market stimuli. This will be accompanied by the growth of value-addition to local produce through a higher degree of processing.[10] Table 1 presents the *relative shares* of GDP whereas *absolute levels* of activity are expected to grow in almost all cases. Agriculture provides a large share of employment in Central Asian countries, in some cases greater than its share of GDP. Agriculture's share of employment is currently (as a % of total employment): Kazakhstan 18, Kyrgyzstan 27, Tajikistan 52, Turkmenistan 8, and Uzbekistan 22 (FAO and World Bank 2019, Table 2.1 and 2.3). To give an indication of the importance of water to agriculture, it has been estimated

[9] Table 1 shows a mixed picture regarding the future share of the services sector. Depending on the country concerned, this sector includes tourism, Information Technology, financial services, public administration, health and other professional services and the wide array of activities undertaken in the "informal sector", which in the case of Uzbekistan, accounts for almost 60% of total employment. (World Bank (2019) *Uzbekistan: Toward a New Economy).*

[10] (Asian Development Bank 2019a)

that a fall of 10-20% in water availability in Uzbekistan would cause a loss of national income of 3.6%-4.3%.[11]

Table 1: Forecast of GDP structure in Central Asia by 2030 by sector (percentage) (2017 data in brackets), (OECD 2020, p85)

	Industry	Agriculture	Services	Other
Kazakhstan	35.0 (26.8)	9.0 (4.6)	45.0 (57.2)	11.0 (11.4)
Kyrgyz Republic	30.0 (18.7)	11.0 (12.5)	40.0 (51.6)	19.0 (17.2)
Tajikistan	20-21 (21.2)	17-18 (21.2)	30-30.6 (40.4)	30.4-33 (21.2)
Turkmenistan	33.8 (32.2)	8.9 (11.0)	45.8 (23.7)	11.5 (33.1)
Uzbekistan	33.3 (22.2)	20.0 (34.0)	39.3 (38.1)	7.4 (5.7)

23. Water is vital to the 60% of Central Asia's population living in rural areas as well as its growing urban populations. Irrigation accounts for 90% or more of total water withdrawals in four Central Asian countries, and 67% of the total in Kazakhstan.

24. Developments in agriculture will be the main factor determining potential growth in demand. The current water-intensive staple crops of wheat and cotton will remain predominant in downstream countries for some time but are expected to reduce in absolute terms as governments liberalize agricultural policies, thereby reducing state intervention and allowing market forces a greater role. In 2020, Uzbekistan abolished state production targets for cotton.[12] There is already growing production of more highly valued crops such as fruit and vegetables on smaller farms and examples of more commercial-scale production. Expansion of irrigation areas is also planned in several of the countries, including Kazakhstan, Kyrgyz Republic and Turkmenistan. Across the region an increase of livestock production will add further pressures on existing water resources.

25. International trade within Central Asia, and between Central Asia and Russia, collapsed following the end of the Soviet Union. New trading systems have been slow to emerge and face a number of obstacles. These are being addressed by the CAREC Trade Pillar which, through a variety of measures, aims to diversify its Member Countries' exports and expand trade both within CAREC and between its members and globally.[13] The pattern of exports and imports that will evolve from increased international trade will need to be monitored for its implications for water resources through the *water footprint* of its different components.[14]

26. Kazakhstan and the Kyrgyz Republic are members of the Eurasian Economic Union (EEU), *"..a formal trade bloc that succeeded and superseded several trade agreements among select former Soviet republics*." (Asian Development Bank 2019a). The EEU aims to restore some of the trade relationships lost since the end of the Soviet Union, particularly between Russia and other Central Asian states. The Belt and Road Initiative led by the People's Republic of China (PRC) crosses Central Asia and the infrastructure it brings will help promote trade between Central Asia, PRC and the Middle East.

[11] Bekchanov & Lamers (2016)

[12] Zorya & Babaev 2020.

[13] CAREC (2020): *Trade Sector Report and Work Plan. September 2019-September 2020. Reference Document for Virtual Senior Officials Meeting, 20 Oct 2020*

[14] Discussed further in Box 5.3 of the thematic paper on Economics.

27. Afghanistan is an upstream riparian of the Amu Darya river, and has shown an increased demand of water over recent years.[15] The Amu Darya river basin holds almost 40 percent of the country's available internal water resources and the majority of its hydropower potential is in this basin.[16] Water demand has been estimated to grow to 7km^3 demonstrating the importance of future efforts to involve Afghanistan in regional discourse on transboundary water resources (OECD 2020).

Demographic change

28. The population of the 5 Central Asian countries living within the Aral Sea Basin is projected to grow from its present level of 56.9 million (2020) to 75.9 million in 2045 (Table 2).[17] The growth in household use as a result of population growth will need to consider the absolute rise in numbers, the fact that many households in the region are under-supplied with water and sanitation at present, and the expectation that, as living standards rise, so too will expectations on the per capita use of water. There are still sizeable minorities of the population, especially in the rural areas of Tajikistan and Kyrgyzstan, without access to the improved and safe water and sanitation services mandated by the UN Sustainable Development Goals. (UNICEF 2020, CAWEP, 2020).

Table 2 Projections for Central Asian population living in the Aral Sea Basin (m)

	2018	2020	2030	2040	2045
Kazakhstan[18]	3.8	4.1	4.45	5.2	6.1
Kyrgyz Republic	3.7	3.8	4.3	4.8	5.1
Tajikistan	9.1	9.5	11.6	13.8	15.1
Turkmenistan	5.1	6.0	6.8	7.4	7.7
Uzbekistan	33.2	33.5	37.4	40.6	41.9
Total	**54.9**	**56.9**	**64.6**	**71.8**	**75.9**

Source: OECD 2020, p84

2.2 National context

29. Central Asian countries will be affected by the overriding trends in agriculture projected at a global level.[19] These will include adapting its productive processes and choice of crops to climate change as well as reducing the impact of its own greenhouse gas emissions, changes in its product mix in response to dietary shifts, and mitigating the impact of agriculture on natural resources and the environment. Commitments made through NDCs in the Paris Agreement will influence future agricultural policies. In addition to the technical advances at farm level and modernization of irrigation systems that are factored into national strategies, there will need to

[15] https://www.adb.org/countries/afghanistan/economy

[16] NEPA, 2017. Second National Communication under the United Nations Framework Convention On Climate Change (UNFCCC)

[17] These numbers relate only to the Aral Sea Basin and therefore lower than the total for the five countries, particularly as a large proportion of Kazakhstan's population lives outside the Basin.

[18] See footnote 17.

[19] FAO (2012) *The future of food and agriculture: alternative pathways to 2050*

be a redoubled efforts to intensify the use of land and water and to enhance agriculture's place in the value chain.[20]

30. National strategies embrace reforms that will affect the water sector. Some examples are given below with more detail provided in the thematic paper on legal and policy analysis (Chikanayev 2021):

- **Kazakhstan**: modernization of public utility infrastructure; harmonization of water strategy with the SDGs; improvement of the quality of water and land resources; rational use of groundwater; ensuring food security and export development; facilitating private sector involvement; and improving the quality of the environment. Kazakhstan committed to increase the share of renewable energy in domestic electricity generation from the current 3% to 6% by 2025, 10% by 2030 and 50% by 2050.[21] (Kazakhstan Strategy 2050, National Strategy Nurly Zhol, Strategic Plan 2025, Concept of Water Resources 2020-2030).

- **Kyrgyz Republic:** introduction of IWRM at all levels based on transboundary cooperation and establishment of basin water management systems in the country; water resources conservation and reuse of wastewater; adopting financial models to ensure a system's sustainability; modernization of irrigation infrastructure and expansion of new irrigated areas; and expansion of water supply and sanitation coverage. (National Development Strategy 2018-40, National Program, 40 steps to the Future 2017-2040; State Irrigation Development Program 2017-2026).

- **Tajikistan:** increasing efficiency, diversification and competitiveness of all sectors of the economy; decentralization of the management system; ensuring optimal water resources requirements for all water users; full cost recovery of water delivery and economic mechanism for water resource use; rehabilitation of existing infrastructure, water saving technologies and expansion of new areas; improved forecasting. (National Development Strategy 2030, Strategy of Water Sector Development, Program for Water Sector Reform 2016-2025, Concept for Rational Use and Protection of Water Resources).

- **Turkmenistan:** economic growth, independence and security; increased investment in construction of productive facilities including reservoirs; introducing advanced irrigation methods; incentives for stimulating rational water consumption; strengthening international cooperation (Strategy of Economic, Political and Cultural Development of Turkmenistan to 2020, National Climate Change Strategy, 2012)

- **Uzbekistan:** commitment to eliminating water scarcity, improving the rational use of water resources and reduction of negative impacts; liberalization of agricultural markets; modernization of irrigation infrastructure and reduction in electricity use; restoration and ecological rehabilitation of water bodies of water; reclamation of degraded lands; universal access to drinking water and improvement of efficiency; cooperation and private sector involvement. Uzbekistan plans to reduce natural gas consumption and increase the share of renewable energy, including solar. (National

[20] IFPRI (2019): *Agriculture development in the Central Asia Regional Economic Cooperation Program Member Countries. Review of trends, challenges and opportunities.* P.28

[21] https://www.mondaq.com/renewables/885178/renewable-energy-in-kazakhstan-what-to-expect

Development Strategy 2035, Water Sector Development Concept 2030; Agricultural Strategy 2030; Concept Note on Energy Strategy 2030)

31. There is widespread awareness in Central Asian countries that water is becoming scarce, that its supply is increasingly unreliable, its current pattern of use is inefficient and unsustainable, and that opportunities exist to obtain greater benefit from its use. This awareness is strong in the three downstream countries, each of which has extensive irrigation infrastructure dependent on water. In the two upstream countries, where although the water situation is less stressed, development plans still require consideration of potential trade-offs between irrigation, hydropower and other uses.

32. Although the vocabulary of the discourse varies by country, water scarcity evokes similar policy responses described variously as: 'incentives for rational water use', 'optimisation of water consumption patterns', 'water demand management, 'water allocation planning', 'reduction of subsidies for water and power', and other explicit and implicit acknowledgements of the principles behind the concept of the economic value of water.

33. A brief summary of agriculture in the Central Asian states is given in Box 1. Throughout Central Asia governments have moved to liberalize agricultural policies, reducing state intervention and allowing market forces and signals to have a greater role as summarized in a study undertaken for CAREC.

> "*In recent years agricultural policies have focused more on supply and value chains to counteract institutional and logistic gaps that were consequent upon the sector's transformation. Agricultural policies on supply and value chains emphasize (i) improving national food processing capacity as a means of adding value, and (ii) reducing reliance on imports of basic foodstuffs…"* (Asian Development Bank 2019a).

34. Water features prominently in the Green Economy Plans being drawn up by several countries, particularly in its potential role in energy use, and in national responses to climate change (both for mitigation and adaptation actions). All countries of the region are parties to the United Nations Framework Convention on Climate Change (UNFCCC) and joined the Paris Alignment which commits them to pursue the targets set out in their Nationally Determined Contributions (NDC). Some of the NDCs make mention of interventions in the water and energy sector although they are still fairly generic. Some countries are updating their NDCs which are expected to be available by the end of 2021 and to include more details on water-related issues.

35. More sector-specific information for some countries is available in strategies and documents that follow from the National Adaptation Plan (NAP) process promoted by the Conference of Parties (COP-17) to UNFCCC, to enhance country-led planning and preparedness for climate change adaptation in the medium and long-term.[22] These NAPs are currently being developed by some of the countries. The objectives of the NAPs are to reduce vulnerability to the impacts of climate change and to facilitate the integration of adaptation into all levels of development planning.

[22] The status of the NAP process in each country is described briefly in the Climate Change Thematic Paper.

Box 1: Agricultural situation in Central Asian Countries (Asian Development Bank 2019a)

Kazakhstan still has the potential to expand its irrigated area (currently only about 55% of its irrigable area is used) and has active plans to expand livestock production, which will add to the competition for water. The largest irrigated cereal crops, in order of acreage, are maize, rice, barley, oats and rye, followed by wheat. Its largest irrigated crop is wheat, which is now being exported. Kazakhstan's economy is more diversified than that of other Central Asian countries, and agriculture is seen as a development opportunity.

Kyrgyz Republic. About 1 million ha of irrigated area has been developed, less than half of the potential. Agriculture is diversified, with sizeable livestock (beef) production. Land reforms have taken place, but agriculture is fragmented, with many small farms, and growth depends on overcoming many challenges. Although water is plentiful, suitable land, rural infrastructure and support services are lacking.

Tajikistan. 93% of the territory is mountainous, and only 47% (0.7 mha) of potentially irrigable land has been developed. Water is plentiful but suitable arable land is scarce. Wheat is the largest crop, but a variety of horticultural items are produced, some of which (e.g. potatoes) are exported. Cotton provides major export revenue. The country is diversifying into horticulture, in which it has comparative advantage.

Turkmenistan. Almost 2 million ha of irrigated land has been developed. 75% of cultivated area is devoted to cereals, cotton and oilseeds. Livestock products (beef, milk, mutton) are the most valuable items, followed by cotton, wheat and horticulture. Its largely desert landscape is heavily dependent on irrigation, and agriculture is still under close state control. Any expansion of irrigation is constrained by the availability of water, and dependent on managing the growing volume of saline drainage water.

Uzbekistan. 4.2 million ha or 85% of irrigable land is currently developed with further expansion constrained by the availability of water. Wheat and cotton are currently the largest crops, followed by an increasing area of horticultural products (in some of which UZB is a world-leading exporter). Soil salinization has become a widespread problem. Uzbekistan's Agriculture Strategy suggests a 5% growth rate from 2022 but this is reliant on public support for increasing crop yields and animal productivity, amongst other actions (Zorya, 2019).

36. Each of the countries of the Central Asia Region have embarked on a gradual pathway of reform in the water sector since independence to adjust to the changing nature of economic activity towards market orientation and changing geopolitical relationships that are continuing to evolve. Changes in water allocation and management practices in irrigation have only recently started to gain momentum in response to liberalization of markets and relaxing controls on cropping patterns as well as a realization that, as the largest consumer of water, its use in the sector needs to become more productive.

37. In addition to expanding access to safe water services, particularly in rural areas, there is a need to improve capacity of water utilities in areas of operational efficiency, cost recovery, O&M, asset management, and non-revenue water reduction; improve sanitation coverage and

services; modernize effluent discharge standards from wastewater treatment plants; and address industrial wastewater pollution.

	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan
Population Aral Sea Basin/total (m)	4.1 / 18.9	3.8 / 6.5	9.5 / 9.5	6.0 / 6.0	33.5 / 33.9
GDP ($bn)	168	7.7	7.9	47.4	57.7
GDP agriculture (%)	4.8	13.4	22.1	9.3	28.1
Workforce in agriculture (%)	18	27	52	8	22
Total area equipped for irrigation (mha)	2.5	1.0	0.7	2.0	4.2
Irrigation (2018) withdrawal (bcm,%)	12.3 (67%)	5.2 (93%)	10.2 (91%)	22.3 (94%)	42.3 (90%)
Installed energy generation (GW)	23.6	3.8	6.4	3.3	13.9
Hydropower capacity (GW)	2.8	3.1	6.4	-	1.8
Access to safely managed water (%)	90	68	48	94	59

Source: OECD 2020 with additional data from ADB 2019a, FAO 2019, IHA 2020, ADB Key Indicators database 2021, UN Joint Monitoring Programme (2019).

Figure 2. Summary of key data

2.3 Commitment to regional cooperation on water

38. Over the past few years there has been an improving geopolitical environment for regional cooperation, for example the continued cooperation between Kazakhstan and Kyrgyz Republic on the Chu Talas river; a more supportive position by Uzbekistan on the expansion of the Rogun dam in Tajikistan; and the increased bilateral dialogue on investments, such as between Tajikistan and Uzbekistan on the Zerafshan river and Kyrgyz Republic and Uzbekistan on Kambatara 1 hydropower project. Further details are provided in para 47. However, major steps are still needed to realize the aspirations espoused in the existing declarations spanning back over three decades and to re-establish full participation of all five Central Asian countries in the existing or reformed governance arrangements of the inter-governmental organizations. For example, various attempts have been made to improve regional data sharing but with limited uptake, due to concerns by one or more countries, lack of funding or capacity constraints. Part of the issue may lie with a lack of a long-term working level vision that translates shared aspirations into a framework of guiding principles and which expands the space for negotiations to consider benefits beyond discussions on water allocation alone.

39. High level support for regional cooperation has been reflected in numerous declarations and statements of Heads of the States, most recently with the 2018 Ashgabat Joint Communique of the four active countries of the International Fund for Saving the Aral Sea (IFAS). It called for coordinated measures aimed at reducing water pollution, atmospheric air pollution, land degradation; increasing the area of forest plantations; reducing the risk of natural disasters, including floods, mudflows, droughts; and the provision of clean drinking water.

40. Despite limitations and the occurrence of localized border tensions related to land ownership and water use (including a recent dispute on the Kyrgyz-Tajik border), major conflicts over water have been avoided in the region due to the existence of cooperation mechanisms and

a commitment to defuse tensions. However, the reliance on short term negotiated arrangements in response to emerging issues inevitably leads to inefficiencies in terms of supressed production from irrigated agriculture, inequitable water distribution and sub-optimal hydropower generation. Some steps forward have been possible in bilateral agreements, for example in the Chu-Talas basin.[23]

41. The improved climate for regional cooperation opens up new opportunities to overcome constraints to more effective regional cooperation. This greater openness was reflected in 2017 through the inclusion of regional cooperation on water in CAREC 2030.

2.4 Legal frameworks influencing cooperation

2.4.1 Current framework for regional and bilateral cooperation

42. Regional agreements provide the basis of shared commitments and responsibilities in Central Asia. They were developed among the five countries of the region immediately after independence to adapt to the changes resulting from dissolution of the Soviet Union. Several agreements shaped cooperation over the past 20 years, among them:

- the **1992 Agreement on Cooperation in Joint Management of Use and Protection of Water Resources of Interstate Resources**, that established the legal framework of rights and principles and establishment of the Interstate Commission for Water Cooperation (ICWC);
- the **1993 Agreement on Joint Action to address the problem of the Aral Sea** that led to the establishment of the International Fund for Saving the Aral Sea (IFAS);
- the **1998 Agreement on the Use of Water and Energy Resources in the Syr Darya River**, creating a system for water and energy exchange between upstream and downstream States; and
- the **1999 Agreement on the Status of the International Fund for Saving the Aral Sea** (IFAS) that clarified organizational structures under IFAS, including ICWC and the Interstate Commission on Sustainable Development (ICSD).

Summaries of these and other regional agreements are given in Annex 3 with more detail provided in the thematic paper on legal and policy analysis.

43. The framework and principles for allocating shared water resources between States in the basin was set out in two protocols dating from the mid-1980s.[24] These principles were affirmed by the five newly independent States in the 1992 Agreement. Subsequent specific

[23] Agreement on the Use of Water Management Facilities of Intergovernmental Status on the Rivers Chu and Talas, January 2000

[24] Protocol of the Scientific and Technical Council of the Ministry of Water Resources Management of the USSR on Approval of the Principles of Inter-Republican Water Allocation of the Syrdarya River Basin Resources No 413 (29 February 1984): the percentage share of actual flow is stated as Kazakhstan 42.0%; Kyrgyz Republic 0.5%; Tajikistan 7.0%; and Uzbekistan 50.5%).

Protocol of the Scientific and Technical Council of the Ministry of Water Resources Management of the USSR on Approval of the Principles of Inter-Republican Water Allocation of the Amudarya River Basin Resources No 556 (10 September 1987): the percentage share of actual flow is stated as Kyrgyz Republic 0.29%; Tajikistan 15.17%, Turkmenistan 42.27%; and Uzbekistan 42.27%).

agreements in 1998 and 2001 focused on the coordinated operation of hydropower reservoirs on the Naryn-Syr Darya cascade with irrigation needs downstream.

44. Although commitment for coordination on shared water resources existed from the early days of independence of the countries, some elements of the regional agreements have not fully met expectations for a variety of reasons. Initially this related to the withdrawal of macro-level planning decisions and financial support arrangements linked to a vacuum of regional perspective in the post-Soviet period. This exposed differing national priorities of upstream countries (Kyrgyz Republic and Tajikistan) and downstream countries (Kazakhstan, Turkmenistan and Uzbekistan), which are common to many shared river basins.

45. The post-Soviet transition has also been hindered by a lack of effective interstate institutions with the mandate to fully support implementation of the agreements and the lack of subsidiary rules and procedures to guide implementation and accommodate the changing development context and challenges. One of the constraints to building a capability for addressing such challenges and building closer working relationships is the rotation of support services every few years as the designation of Chair of the Executive Committee of IFAS changes, leading to a loss of momentum. The decision of the Kyrgyz Republic to suspend its participation in IFAS pending resolution of requested reforms and the question of a more formal relationship between IFAS and Afghanistan as a riparian state of the Amu Darya also need to be resolved and are being considered as part of discussions on institutional reforms of IFAS, including through a joint working group on legal agreements.

46. Some shortcomings in regional cooperation relate to:

- national legislation that does not sufficiently [25]prioritize regional cooperation.
- the current water allocation system in Central Asia was established during the Soviet period within the unified framework of economic relations when the water resources were allocated asymmetrically to favour the development of irrigation farming. Some make the case for concluding new long-term inter-State agreements based on new principles and economic mechanisms of water allocation and taking into account the changing context, for example expansion of hydropower and climate change impacts.
- each Central Asian country claims that water resources as its own property when only the country itself is entitled to set up a legal regime applicable to water.[26] Some

[25] National water laws of all countries in Central Asia refer to international cooperation in the area of use and protection of water to a lesser or greater degree. The Water Code of Kazakhstan provides the most explicit and clear commitment to regional cooperation.

[26] Article 8 of the Water Code of Kazakhstan, Article 4 of the Water Code of Kyrgyzstan, Article 4 of the Water Code of Tajikistan, Article 3 of the Law on Water and Water Use of Uzbekistan, Article 5 of the Water Code of Turkmenistan. Uzbekistan has accessed both major international water conventions, the 1992 UNECE Convention the 1992 UN Convention while Kazakhstan and Turkmenistan have accessed the 1997 UN Convention (see Annex 3). The principles of international water law are therefore already part of the legal system of these countries recognizing priority of provisions of these ratified international treaties over local laws. The Water Code of Uzbekistan specifically refers to such transboundary water facilities as rivers Amu Darya, Syr Darya, Zaravshan, Aral Sea and others.

provisions in national legislation are not seen as conducive to cooperation by other countries, for example, the question of payments for use of water resources.[27]

- declaratory nature of the provisions of international agreements without supporting local or bilateral regulations that set out the mechanisms for cooperation.
- limited scope of joint platforms from technical to political to discuss water related issues.
- limited commitments to sharing information or duty to inform with significant proportion of data subject to confidentiality rules and the main focus of data sharing is for historical analysis and planning rather than real time operational use.
- institutional separation of environment protection and water sectors resulting from the separate institution arrangements for ICWC and ICSD.

47. Formal agreements on cooperation between two or three countries has increased over time, for example, on the Naryn-Syr Darya cascade mentioned above; on the agreement in 2000 for establishment of a Joint Commission between Kazakhstan and the Kyrgyz Republic on joint management and financing of infrastructure on the Chu and Talas rivers;[28] the 2007 agreement between Turkmenistan and Uzbekistan on joint use of water resources in the lower Amu Darya river; the 2010 agreement between Tajikistan and Afghanistan on a framework for cooperation for the Pyanj and Amu Darya rivers; a 2017 agreement between Kyrgyz Republic and Uzbekistan on effective operation and maintenance of the Orto-Tokoi (Kasansai) reservoir; and more recently in 2020, a significant demonstration of improved relations between Tajikistan and Uzbekistan through the development of joint hydropower projects on the Zerafshan river.[29] As demonstrated above, there is a clear role for agreements between a sub-group of countries to address particular matters of joint interest with the broader framework of regional cooperation. Several joint working group between bilateral groups of countries have been established, e.g., between Kazakhstan/Uzbekistan and Tajikistan/Uzbekistan and others are planned. Although such bilateral arrangements are encouraging, it is important that there is a process for ensuring they are aligned with broader regional agreements and reflect the spirit of broader regional cooperation.

2.4.2 Influence of national law on regional cooperation

48. National legislation is a key defining factor in how individual States engage at a regional level, either constraining or encouraging cooperation depending on the framing of principles and procedural mechanisms. Water laws of the five countries are at various stages of review and reform and so to some extent this assessment is merely a snapshot of an evolving process. The following points assess the influence of national law as it currently stands. More details can be found in the thematic paper on legal and policy analysis.

- **explicit recognition of regional cooperation** - the laws of Kazakhstan, Turkmenistan and Uzbekistan include recognition of transboundary waters whereas those of upstream

[27] For example, article 3 of the Law of the Kyrgyz Republic on Interstate Use of the Water Bodies, Water Resources and Water Facilities in the Kyrgyz Republic, section 2.2 of the Concept on the Rational Management and Protection of Water Resources of Tajikistan.

[28] Including ADB support under TA-6486-REG 41316-012: Improved Management of Water Resources in Central Asia | Asian Development Bank (adb.org)

[29] Tajikistan, Uzbekistan to build two joint hydropower plants | MENAFN.COM

States, Kyrgyz Republic and Tajikistan, refer to the water as the property of the State that it can regulate. National needs appear to take priority. The water law of Kazakhstan expressly commits to joint management with neighboring States in the use and protection of transboundary waters. Only the laws of Kazakhstan and Turkmenistan recognize the importance of transboundary impact.

- **ownership of water** – all national laws incorporate the principle that water resources are the exclusive property of the state that can regulate their use at its own discretion. Whereas this makes the situation clear regarding responsibility of the state as opposed to individual or private ownership of water, it sets up a potential conflict with the principle of shared ownership with other riparian states.
- **approach to regulation of water use** and allocation of right to use – general principles for priority of water use or consideration of allocation among different uses is featured in most laws, with a priority associated with drinking water. The responsibility for allocation, setting limits and issuing licences varies depending on whether water management is organized along administrative or basin boundaries.
- **incorporation of IWRM principles**: although most recent legislation and policy embraces the principles of IWRM,[30] there remains a significant gap in application and this is also reflected in the regional and bilateral agreements.
- **protection of water**: the focus of environmental protection within the national water laws is on maintaining water quality standards and avoiding pollution. Apart from the Kazakhstan law, there is a general absence of environmental flows required to conserve aquatic ecosystems.
- **river basin management / authorities:** – Kazakhstan, Kyrgyz Republic and Tajikistan have fully embraced the concept of establishing basin agencies for water planning and management whereas in Turkmenistan and Uzbekistan there are mixed systems based on administrative and hydrological boundaries.
- **recurrent financing** - current low levels of tariffs and extent of subsidies means that revenues from water and services are insufficient to cover the recurrent management, operation and maintenance costs nor any portion of the capital costs of replacement works.
- **private sector participation** – most of the Central Asian states have public-private partnership (PPP) policies / frameworks, although they have not yet seen take up on major infrastructure projects in the water sector. There is a need to review the experiences and constraints as part of a wider process to updating PPP frameworks according to international norms. Although predominately relevant for national projects, the advent of joint infrastructure investments involving private finance and management will require a degree of harmonization across the region.

3 Status of water resources and water demand in the Region

[30] One of the more comprehensive studies on IWRM in the region was initiated in 2001 by SDC in the Ferghana valley and implemented by SIC-ICWC and IWMI, (IWRM Ferghana - Success Stories from Central AsiaOytureApr–) (iwmi.org)

3.1 Water resources – increasing variability and lower level of assured supply

49. Although all Central Asian countries are well-endowed with water, the three downstream countries (Uzbekistan, Kazakhstan and Turkmenistan) experience periodic water scarcity (potential demand relative to available supply) and water stress (the signs of scarcity) due to relatively low levels of water use efficiency and the impact of supply variations on their highly developed irrigation infrastructure. Even the two upstream countries (Kyrgyzstan and Tajikistan) need to consider the implications of future growth in water consumption, taking into account existing regional agreements on sharing water with downstream riparian states.

Precipitation

50. The high-mountain regions upstream receive most of the precipitation, predominately as snow, and several large reservoirs regulate water supply for downstream use while also being used for generating hydropower. The downstream region where most water use occurs receives less rainfall, while having favourable temperatures during part of the year to sustain extensive agricultural production.

51. Figure 3 shows the precipitation amounts each sub-region receives on average each year, based on data of the last 20 years. In total, the two major river basins receive 465 km^3 each year on average. In a very dry year the region receives in total about 15% less precipitation, while in a relatively wet year, it receives about 12% more. Upstream regions receive 64% of the average precipitation. A trend analysis indicated that the region currently receives 16 km^3 less precipitation than 30 years ago – a reduction of **3% ,** although sparsity of data in high mountain areas means some caution is needed in interpretation of the findings.

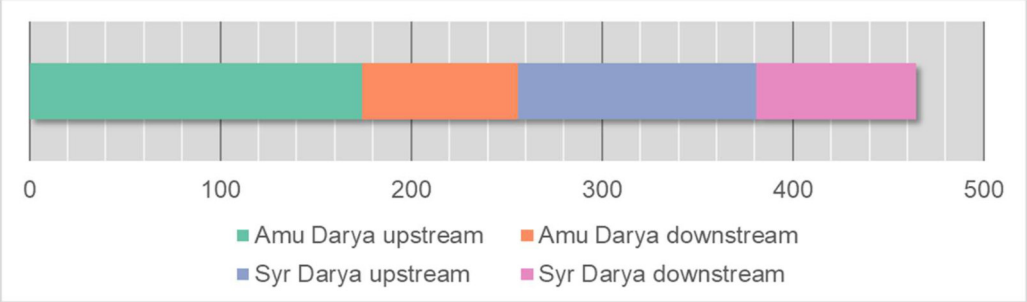


Figure 3. Mean annual precipitation per sub-region (river basins and upstream-downstream) in volumetric units (km3). Source: authors' analysis based on ERA5 dataset.

52. An estimate was produced for the likely change in precipitation over the next 30 years (Figure 4). Climate models in this region do not show much agreement on the direction of change, with some models projecting an increase in precipitation over the next 30 years, and others a decrease. In general, precipitation projections for Central Asia need to be interpreted with caution. The past and future rates of changes are in the order of a few percent and while this may appear small, given the fact that all water in these basins is already allocated, any change of this size can be very relevant, for example, annual flows to the Aral Sea are on average of 5 km^3 flow over the last decade which is in the same order of magnitude as these trends in precipitation projections.

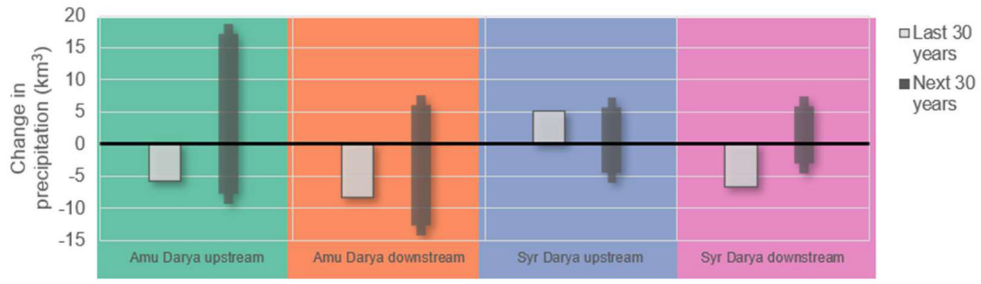


Figure 4. Changes in mean annual precipitation per sub-region based over the last 30 years and the range projected for the next 30 years (km^3) – note the large uncertainty margins in predicted change. Source: authors' analysis.

Temperatures and evapotranspiration

53. Analysis for this scoping study, also based on the ERA5 reanalysis dataset, shows that temperatures will increase in the region by around 1.5ºC by 2050 compared to current temperatures. Moreover, most previous studies focusing on Central Asia agree that the warming trend in mean annual temperatures is less pronounced in the high altitudes than in the lower elevation plains and protected intramontane valleys (Unger-Shayesteh et al. 2013). For the winter months, a stronger warming trend can be detected at higher elevations of the Tien Shan Mountains (Kriegel et al. 2013; Mannig et al. 2013; Zhang et al. 2013). Based on this approach, it is estimated that the potential evapotranspiration in the region will increase by about 5 to 7%. However, this does not necessarily convert to a similar increase in water consumption (i.e., actual evapotranspiration) as this primarily depends on other factors influencing the soil water balance, like rainfall, land use changes, etc. Still, it can be concluded that at least part of this increase will translate in increased consumptive use of water by vegetation and crops and lead to lower runoff and river flows in the same order of magnitude of a few percent.

Glacier melt

54. The impact of changes in climate and cryosphere (glaciers and snow) on river runoff is a very complex and dynamic process. Several processes act simultaneously and can have either a positive or negative effect. It is acknowledged that even in tributaries with a glacierised fraction of less than 5%, glacier melt water can be an important contributor to irrigation in the summer to compensate for scarce precipitation. Thus, even small changes can have important impacts. At the same time, a reduction in snowfall leads to changes in the seasonality of flow and could possibly also reduce the annual streamflow due to changes in evapotranspiration, as has been observed already in the region in several smaller rivers (Li et al. 2020).

55. Decrease in glacier mass results in more meltwater to be released by the glaciers over the next decades. However, this will happen only up to a certain point when the glacial mass has shrunk to such a degree that run-off will start to decline. This moment is sometimes called ***peak water***. A recent study confirmed previous calculations that this tipping point will occur around 2050 for both Syr Darya as well as Amu Darya (Khanal et al. 2021). Up to around 2050, changes to total river run-off in the region are likely to be minor (Reyer et al. 2017), however, relative contributions from glacial melt, snow melt and rainfall-runoff will already change in the next few decades (see next section). There is not yet a good picture of how much additional meltwater will

be released, due to a lack of observational data and regional cryosphere studies. Flow observations show a minor increase for inflow to the Nurek (Amu Darya) inflow over the last decades of the 20th century, but in the first decade of the 21st century again a small decrease in flows.

56. In summary, it is likely that the additional meltwater to become available over the next decades in some of the tributaries will be offset by other tributaries where a change in snowfall fraction and increases in evapotranspiration (reservoirs, soil and vegetation) and sublimation (snow surface) will lead to decreases. Also, increased evapotranspiration upstream will likely counterbalance any net increase in water resources availability. Thus, it would not be prudent to plan on the basis of additional water resources over the next decades.

57. Beyond 2050, model predictions converge more and project that the contribution of snow and glacial melt to river flow in the mountainous areas of Central Asia are very likely to decline substantially leading to a considerable decrease in the water volume of the Syr Darya: (potentially up to -47% by the end of this century (Khanal et al., 2021); other studies project less drastic but still significant reductions. Substantial increases in flow variability in the Amu Darya River due to its higher share of glacier melt water (Khanal et al. 2021) by various studies are projected (e.g. Khanal et al., 2021; White et al., 2014). Measures to address this longer term reduction in water availability and greater variability need to be considered soon as they involve complex decisions related to the future role of irrigated agriculture and land resources in the economy.

Flow variability due to climate impacts

58. Flow variability under the current climate is already substantial, e.g., peak flows into the larger reservoirs of Toktogul and Nurek are around 8 times higher than flows in the month with lowest flows. Inter-annual variability is also important and flows can deviate to up to 50% from the mean. In some years this causes low water levels in the reservoirs at the start of the vegetative season and leads to risks of water shortage when downstream demand peaks.

59. The capacity to buffer water in the water towers in the form of snow or ice will most likely reduce drastically in the future, especially in the second half of the century. This will have three major impacts on the variability of flows:

- **dry years will become drier** due to more pronounced inter-annual fluctuations in water resources, and less water security in dry and hot years.
- there will be a **seasonal shift** in water availability with peak flows happening earlier in the season.
- a **less predictable** and **more variable seasonal regime**, as the seasonal snow melt contribution will be smaller, and flows will thus depend to a larger extent on rainfall instead of snow.

60. These changes can be expected to be notable already in the coming decades but will lead to drastic changes in the second half of the century, for both river basins (Khanal et al. 2021). Figure 5 shows simulated runoff for the Naryn basin, a major tributary of the Syr Darya river, for an historic period and a future period (representative for 2050). This simulation shows that peak flows for this tributary will shift in the future from July to May-June, and that runoff (and thus reservoir inflow in this case of Toktogul) in July and August will likely be lower. In other words, the capacity of the high-mountain regions to buffer water that they receive in winter in the form

of snow and release it in spring and summer, will be reduced in the near future. This implies a severe water security risk for the region with low-flow months and drought years being drier and a higher increased seasonal variability of river flows.

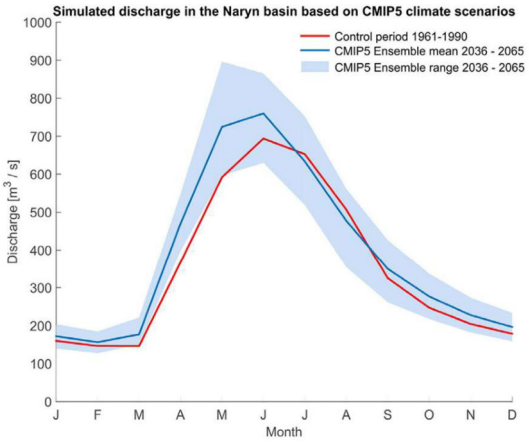


Figure 5. Projected changes in mean monthly runoff in the Naryn basin (main tributary of Syr Darya), as simulated using climate scenarios (Mannig et al. 2018).

61. To some extent, large reservoirs have the potential to buffer some of the increased variability. The three major reservoirs Nurek, future Rogun and Toktogul sum around 27 km^3 of active storage capacity which is around 81% of annual inflows into these reservoirs. The future changes in flow variability will however bring major challenges to current planning, water allocation and water allocation procedures that are not fit for such future conditions. Current tensions among different water uses around the seasonal regime of reservoir releases may increase (e.g., timing of hydropower generation versus agriculture needs). Also, increased fluctuations of river flows, particularly in tributaries, are likely to occur as a consequence of expected changes in hydropower development and operation (see section 3.4). Already today, there is significant variation in reservoir storage from year to year, as shown in Figure 6 for the Toktogul reservoir, and given the expected future trends, it is very likely that minimum water levels at the start of the growth season will occur more frequently over the next decades under business-as-usual practices.

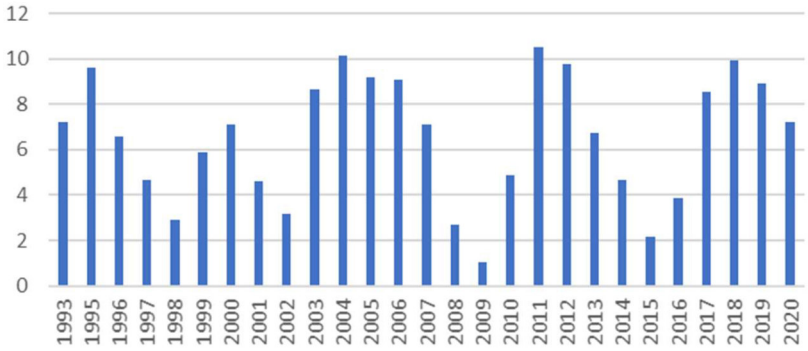


Figure 6. Average reservoir active storage of Toktogul during the first quarter (Jan-Mar) in each year in km^3 (Source: analysis based on SDSS database)

Drought and flood – recent trends

62. There are already reports of a detectable increasing trend in the frequency and amplitude of extreme floods and water shortages (OECD 2020). An increasing risk for mudflows has been reported in the region, as for example those in Tajikistan in 2021. Mudflows and landslides can be triggered by seismic events as has happened in the past on many occasions. There is a clear link between increased climate vulnerability and geophysical hazard in Central Asia. High sediment loads resulting from these events can again be a major risk for reservoirs and other water resources infrastructure.

63. 2020 and 2021 have been reported to be extremely dry. The meteorological drought of 2000-2001 caused water shortages (or hydrological drought) across the region and triggered some institutions to increase capacity to deal with disaster management planning. However, there is still a general lack of preparedness and coordination strategies as the main focus continues to be on reactive measures, predominately on emergency response and recovery, rather than proactive preparedness. The water shortages during the summer of 2020 have led to restrictions in some parts of the region.[31] Forecasts by the Minister of Water Resources of Uzbekistan predicted water shortages for the summer of 2021, similar to those in 2008.[32]

64. The potential for glacier lake outburst floods (GLOF) is expected to increase with rising temperatures as well as with a rising number and size of moraine-dammed lakes (Armstrong 2010; Bolch et al. 2011; Marzeion et al. 2012). This is associated with an increased risk of closure for road transport networks which are of high importance in the landlocked CA countries, and to inhabited areas, such as the densely populated and agriculturally productive Fergana Valley region which is particularly exposed to these geohazards.

Groundwater

65. Groundwater as a resource is essential for sustaining domestic water supply, industries, livestock and in some areas also irrigated agriculture. It has been under gradually increasing pressure in recent decades due to rapid population growth and economic development. Basic information and analytical assessments of groundwater are very limited although recently, countries have started an inventory of their groundwater stock and its use (OECD 2020). Given the nature of aquifers, it seems likely the regional stock is overestimated due to double counting of storage and yields in transboundary aquifers (Liu et al. 2020).

66. In the region, water resources used from groundwater amount to approximately 10 km^3 (about 8% of total abstracted water resources) (OECD 2020). Whether this exceeds the renewable groundwater availability is not clear, as hardly any studies have been done. The renewable groundwater resources are likely very small given the climate and physiographic conditions of the basins. More studies are needed on the renewable groundwater availability in the region.

67. It can be expected though that pressure on groundwater will change in the near future, given the trend in on-farm pumping for irrigation. Farmers have increasing access to cheap fossil-fuelled pumps to mitigate water shortages. Also trends in increasing livestock development may expand groundwater use for irrigating pasture, livestock feedcrops and stock watering.

[31] ICWC bulletin September 7-11, 2020

[32] https://kun.uz/ru/news/2021/02/21/v-etom-godu-yest-risk-uvelicheniya-defitsita-vody-do-kriticheskix-pokazateley-2008-goda-ministerstvo-vodnogo-xozyaystva

68. A more immediate concern is the deterioration of aquifer quality in the region, which results in a decrease in usable groundwater stock (OECD 2020). This is the consequence of groundwater recharge occurring from irrigated areas with water of poor quality (saline, nutrients and pollution). Experts consulted for this study have confirmed that concerns for groundwater is mainly an issue because of water quality issues, rather than quantity issues.

69. There is a need for pilot projects on conjunctive surface and groundwater management, examining the coordinated use of both resources, combined with water saving techniques that are effective at the system-level. Artificial groundwater recharge is already a practice adopted for domestic use in some areas and could be part of such a pilot.

Summary of climate change effects

70. Table 3 provides an overview of expected climate change effects on water resources across the upstream and downstream regions of the Aral Sea Basin.

Table 3. Overview of climate change effects and their impact on upstream and downstream water resources, horizon 2050 (Source: authors analysis)

Expected future changes	Expected dominant impact on water tower region upstream	Expected dominant impact on water users downstream
Changes in precipitation amounts and extremes	⊖⊕ Either positive or negative, depending on the region and climate scenario. Risks of extreme precipitation will likely be mitigated largely by reservoirs	⊖○ Even under a climate scenario with increasing rainfall amounts, increased extremes will likely have negative consequences
Increased evapotranspiration due to increased temperatures	⊖ Reduced runoff and thus reduced flows and inflows into reservoirs	⊖ Less water supplies from upstream and increased water demands
Lower snowfall fraction	⊖ Reduced runoff	⊖ Reduced river flows and seasonality shifts in tributaries without reservoirs
Permafrost degradation	⊖ Infrastructure stability and permafrost-related hazards (landslides, etc)	○ None
Glacier shrinkage	⊕ Up to around 2050 likely more water from glacier melt ⊖ After 2050 significant decrease, especially for Amu Darya	⊕ Up to 2050 likely more water from glacier melt ⊖ Increased inter-annual flow variability, so more severe droughts, and reduced flows after 2050

71. In spite of work done so far, especially at the regional level, there are still important knowledge gaps in terms of the magnitude and the spatio-temporal patterns of changes in the Central Asia high-mountain regions, and thus the impacts on water resources. These gaps are related principally to the scarcity of reliable and appropriate data sets of these regions and a consequent lack of full understanding of the impacts on the hydrological response changes in snow and glacier dynamics in the headwater catchments.

Information systems

72. The Regional Information System on Water and Land Resources in the Aral Sea Basin (CAWater-IS) is an important and actively used resource of information on water resources in the region. Basin Water Organizations (BWOs) provide data on actual water withdrawals every ten days, which are posted online on the CAWater-Info portal. National authorized agencies have open access to data on this portal and SIC-ICWC analyzes ten-day data and publishes it online. Access is restricted but open for ICWC members. SIC-ICWC also analyzes data on water use and the report is published in the ICWC bulletin and posted online.[33]

73. Currently some regional water information systems are available or being developed which provide public information, all based on public domain data rather than data collated by SIC. These are product from donor-sponsored projects like CAWa and CAMP4ASB. Further details are provided in Annex 2 of the thematic paper on climate change.

3.2 Future demand for water requires a change of approach

74. During the first decade of Independence, water withdrawals in the Aral Sea Basin as a whole were reported to be around 120 km^3 per year on average. Over the whole period 2000-2018 annual water withdrawals varied from around 100 km^3 to around 120 km^3, with no clear trend (OECD 2020 p. 25). In 2018, a relatively dry year, total withdrawals amounted to 113.5 km^3 and this can be regarded as typical. Table 4 summarises water withdrawals by country and sector in 2018.

[33] http://sic.icwc-aral.uz/reports.htm

Table 4: Water withdrawals by sector in the Aral Sea Basin (2018) in km3.

	Total	Irrigation	Household	Industry
Kazakhstan	18.7	12.3	0.9	5.5
Kyrgyz Republic	5.5	5.2	0.2	0.08
Tajikistan	12.3	10.2	0.7	0.3
Turkmenistan	25.3	22.3	0.5	1.5
Uzbekistan	51.6	42.3	2.2	5.4
Total	**113.5**	**92.4**	**4.6**	**12.9**

Data for energy is not included

Source: (OECD 2020) *p.24 adjusted following revised data received from the authors*

75. Although withdrawals have remained more or less stable, or even reduced slightly according to the FAO Aquastat database,[34] consumptive water use has most likely increased in the recent decades, as suggested by the negative trend in Aral Sea inflow. This demonstrates that it is not sufficient to look only into data for withdrawals, but also obtain indicators on actual consumptive water uses. Consumptive water use typically increases when demands exceed supplies. The concept of 'real water savings' becomes important in that case, which is discussed in para 120.

76. Changes in water withdrawals are not necessarily reflective of changes in the demand for water – but are more likely to be the result of changes in its availability. In normal years, water in the Aral Sea Basin is fully allocated, allowing for losses in transit and flows into wetlands. There is some evidence that in recent dry years water demand, in terms of use by the main sectors, has shown signs of being *constrained* by supply. The largest user, irrigated agriculture, has expanded or contracted from year to year depending on the amount of water available for distribution. Flows to the Aral Sea tend to be residual, diminishing significantly in dry years, (Figure 7).

77. Looking forward to 2050, the demand for water in Central Asia will be shaped by a number of factors:

- growth of population and rate of urbanization
- economic growth and changes in the structure of the economy between water-using sectors
- evolution of trade between countries in the region and between Central Asia and its neighboring countries
- the extent to which environmental and ecological claims to water are recognized
- impact of hydropower development and operational modes
- developments in agriculture, the largest water user by far, which will be the main factor driving changes in demand.

78. As the basin is fully allocated, demand projections based on the assumption that sufficient water is likely to be available are, in practice, theoretical constructs. The projections do though have value in indicating the size of water risk confronting users and the scale of adjustment likely to be required of them (see section 3.5). On this basis, future scenarios of demand have been prepared for the study and are summarized in Table 5.

[34] http://www.fao.org/aquastat/en/databases/

79. Over recent decades demands have changed among sectors, and the pressure on the resource has even further increased. This has led to shifts between uses, for example more water withdrawals for households and industry compared to agriculture, and higher vulnerability to water shortages. It is reported that in dry years the withdrawals can drop by about 20%, leading to significant reduction in production and additional environmental impacts (OECD 2020).

80. A comprehensive study of irrigation in Central Asia identifies likely trends listed below, which will affect the sector's demand for water (FAO and World Bank 2019):

- the nature of inter-sectoral water allocation rules, including allocations to higher value uses, and environmental protection
- irrigation management moving towards on-demand supply for both bulk water and for individual farmers or groups
- more emphasis on modernization rather than rehabilitation of infrastructure, and a willingness to identify alternative development opportunities for the least viable irrigation areas
- full financial sustainability of irrigation services in order to provide adequate funds for operating and maintaining the infrastructure and services
- exploration of the scope for engaging private operators, e.g., using performance-based contracts.

81. Several studies have performed water demand projections that are specific to the region. The two most relevant are: (i) a study comissioned by OECD (OECD 2020), (ii) a study for the World Bank by COWI, not published or reviewed but of which the estimates were provided by the consultants (COWI, 2020). Comparing the projected demands of the two cited studies it can be concluded that they are reasonably consistent. Table 5 shows sectoral demand estimates for 2050 based on these studies, but adjusted by the authors to include environmental demand and adjustments to industrial demand figures. Two scenarios are presented:

- a **Business-as-Usual (BaU) scenario** that assumes little rehabilitation over the next decades, and
- an '**adequate rehabilitation' projection**, that is mainly based on the assumption of a 10% drop in water demand due to reduced leaking and seepage in the water conveyance system.

82. Irrigation currently accounts for 84% of the use of water in Central Asia and in some countries this is currently over 90%, but expected to reduce in relative terms due to expansion in water use by other sectors. In the BaU scenario, irrigation demand is assumed to increase by 5% (as a result of increased potential evapotranspiration, irrigation expansion and a business-as-usual rehabilitation). Industrial demand increases by 1.5% annually, in a similar pace as previous decades. Future water demand for irrigation in Afghanistan (not included in this water balance) have been estimated to be 7 km^3, which is 6% of the supply (OECD, 2020). This would further increase the potential gap between the region's demand and available supply.

83. The 2017 UN Joint Monitoring Programme indicates relatively high levels of access to basic water supply and sanitation services[35] (with 68-98% having access to basic drinking water services, with the higher values in urban areas, and over 95% having access to at least basic

[35] Water, Sanitation and Hygiene – also used here to include wastewater.

sanitation services).[36] However, these data mask many who lack access to 'safely managed' drinking water, especially in Tajikistan and rural Kyrgyz Republic. Overall, service delivery is considered generally low with old, poorly maintained infrastructure and a lack of financial sustainability, (CAWEP 2020). Urban and rural water demand projections are taken from the COWI study and reflect further migration to cities and an increase in the per capita rural consumption figures, bringing them closer to urban levels.

Table 5:. Projections of Central Asia demands[37] (unpublished estimates provided to the consultants) in km^3

Water demand	Now	2050: Business-as-Usual (BaU)	2050: Rehabilitation
Irrigation water	107	113	101
Rural water	1	6	6
Urban water	4	8	8
Industrial water	9	14	12
Environmental	12	12	12
Total water	**134**	**153**	**139**

84. **Hydropower** demand is typically not included in this projection as most of its demand is non-consumptive. It is important to note however that hydropower projects with reservoirs do lose water through evaporation from the water surfaces of the reservoir (about 2 km^3/annually, which is about 2% of the water resources available). Evaporation losses from irrigation reservoirs are included in the irrigation water demand estimate.

85. A growing trend in the region with potential to affect water resources is **livestock** in the more arid regions. Water for livestock and pasture is often supplied by groundwater. Experience from other countries shows that as the livestock sector grows, so does the demand for fodder crops that are grown on irrigated land. If not properly managed, over-abstraction of groundwater can affect baseflow to rivers and thus water users downstream, as well as other users of the same aquifers, including for domestic purposes. Further work is needed to quantify the scale of water demand increase from a growing livestock sector and to promote efforts towards improved groundwater management and solutions, including the conjunctive management of surface water and artificial recharge.

86. The **environmental demand for water**, through in-stream functions such as flushing silt, waste assimilation, recreation, fisheries, and sustaining aquatic ecosystems, is likely to grow from a situation where already many of the existing demands are not yet met. The main environmental demand in these two river basins is the Aral Sea and its aquatic ecosystem. A study conducted in 1998 considered the environmental demand to be 12 km^3/year.[38] The agreed environmental flow

[36] Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. Geneva: World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), 2017. Licence: CC BY-NC-SA 3.0 IGO.

[37] Note that further analysis would be required to disaggregate data for the Aral Sea Basin region from Central Asia, but the relative magnitudes for the ASB region of supply and demand between now and the future remain valid.

[38] "Fundamental provisions of the regional water strategy" (1998) considered a demand of at least, 8.5 km3 for the Amu Darya basin and 3.5 km3 for the Syr Darya basin (item 42). These values were subsequently reduced in ICWC decisions to 4.5 km3 and 3.0 km3, respectively.

rates were subsequently agreed under ICWC to be 4.5 km^3 and 3.0 km^3 for the Amu Darya and Syr Darya respectively. Figure 7 shows a declining trend for flows from the Amu Darya into the Aral Sea with an average of about 5 km^3, but considerable annual variability from year to year and several years in the past 25 years when the agreed flow rate has not been met. Such variability compromises the planning and implementation of restoration programs. The discussion on future environmental flows will need to take place within the broader context of economic water security, more variable flow regimes resulting from climate change, and the opportunities provided by introducing real water savings (para 120).

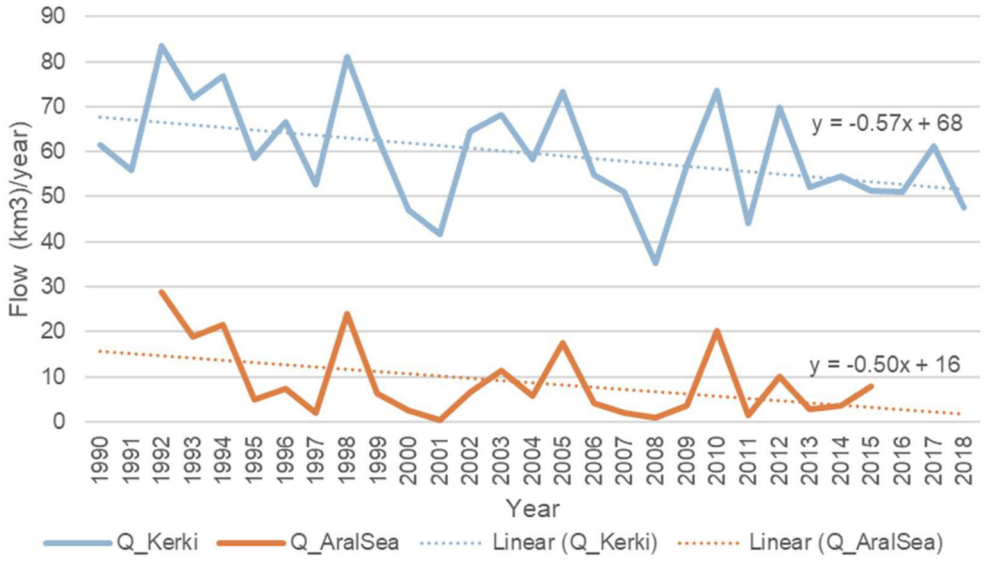


Figure 7. Annual flow volumes for two points in the Amu Darya river (Kerki, located in Turkmenistan downstream of the border with Afghanistan, and the inflow into Aral Sea) (Source: Amu Darya River Basin Authority)

87. What happens to irrigation is the key to Central Asia's future water status. This rests on a number of factors, including:

- the outcome of current reforms in agriculture aimed at liberalizing state control, reducing subsidies and increasing the role of market forces
- growing opportunities for trade in agricultural products within and outside Central Asia
- trends in global commodity prices which is a major influence on the production of crops for export
- the spread of more efficient on-demand irrigation services
- reduction in the area devoted to cotton as the least productive and most saline areas are abandoned and other areas adapt to more profitable and less water-intensive crops
- plans to expand the irrigated area by countries with untapped irrigation potential.

3.3 Sustainability challenges

88. Long-term trends are rarely considered in current agricultural development and irrigation planning. As discussed earlier, beyond 2050 climate change impacts in the high mountain areas will reduce available water resources notably. Anticipating these changes will require a transformational change to the role of irrigated agriculture in regional economies. More near- and medium-term sustainability challenges are addressed below.

Environmental sustainability

89. Water quality and salinity are the origin of several key environmental issues in Central Asia, affecting all countries, but mostly the downstream areas. There are a number of opportunities to mitigate these issues, both at source as well as their impacts, including adoption of the principles of a circular economy, in particular the reuse of domestic and industrial wastewater. Over the past decades, there has been an increasing trend in salinization and pollution (Bekturganov et al. 2016). About 50% of the irrigated area in the Aral Sea basin are experiencing increased salinization, affecting agricultural productivity. The risk for water quality deterioration depends on the location in the river basin and on the local biophysical and socio-economic conditions. Agricultural pollution is affecting downstream areas of Amu Darya and Syr Darya and more than 70% of the area within the Amu Darya Basin in Uzbekistan has water quality levels that pose health risks. Copper, zinc, and chromium concentrations exceed maximum permissible concentration and more than 10% of the waters have been reported to suffer from extreme pollution levels (Bekturganov et al. 2016). Consulted experts have also highlighted that livestock is an increasing source of pollution for the region.

90. Water supply and sanitation infrastructure is highly deteriorated in many parts of the region with consequent risks of pollution and contamination of water supplies. About 40-50% needs complete rehabilitation, in some cities the need is up to 70%.

91. In-stream water plays a vital role in sustaining aquatic ecosystems, flushing sediment, assimilating effluent and wastewater, navigation, fisheries, and recreation. In some countries, proposals have been made to recognize ecological use as a legitimate water user with rights established in legislation.[39] The proposed project for the creation of small local water bodies in the Amu Darya Delta of Uzbekistan would involve the creation of a complex of engineering structures and artificially irrigated landscape ecosystems in the former bed of the Aral Sea. This project would require minimum water flows from the main river equivalent to 6 km^3 per year, (Sokolov 2020). No comprehensive study has yet been done to assess environmental demand outside of the Aral Sea. Apart from a few exceptions, environmental use is not yet included as an allocation commitment to such wetland areas in regional agreements and national water laws.[40]

92. The water-related impacts of climate change are even more acute when environmental water requirements are taken into account. Natural ecosystems are often the 'residual' claimant of water resources, receiving only as much water as is left over from agricultural and other human uses and much of this is polluted.

[39] Reported to consultants in private discussions

[40] National laws of Kazakhstan and Turkmenistan law provide explicit and clear commitment to environmental use of transboundary water (see thematic paper on legal and policy analysis).

Physical sustainability of resources

93. Central Asia is subject to several land degradation processes, the major ones being (i) changes in vegetation state and biodiversity, (ii) wind and water erosion, (iii) desertification caused by human activities such as construction and quarrying, and (iv) salinization of irrigated lands. Past achievements in agricultural development have been accompanied by negative side-effects or externalities on land and water resources, both on-farm and downstream. FAO has adopted a new framework to assess land degradation in which its definition goes beyond simply soil erosion or loss of soil fertility, extending it to the deterioration of a balanced ecosystem and the loss of the services that ecosystem provides.

94. Tackling 'land degradation' thus goes beyond reducing soil erosion, risk for sedimentation of infrastructure (some reservoirs in the region are already out-of-service due to siltation) or water pollution costs. It includes the inter-related components of the ecosystem where several trade-offs exist, for example related to biodiversity conservation and intensive farming practices. Increasingly, nature-based solutions are promoted worldwide to tackle some of the challenges related to land degradation.

95. Restoration of saline land and the maintenance of acceptable salinity levels in the Basin involves using significant amounts of water during the non-vegetation (winter) period for leaching. This practice has significant costs (energy for pumping and water losses through evaporation) but is needed to keep the lands productive. At the basin-scale, it has negative side effects, including return flows that are more saline, in turn causing higher salinity concentrations in rivers receiving drainage which compromises downstream use. In some areas, a positive effect of leaching practices is a consequence of the water being effectively stored in the soil during winter and released during spring, thus increasing water availability during the spring period for downstream users.

Financial sustainability of assets and services

96. The general practice in all countries is for state budgets to fund the costs of O&M in irrigation at basin (provincial) and upper levels, while funding the costs of O&M at system (district) levels is split between state budgets and revenues collected from farm users. Allocations from State budgets are generally too low to ensure the physical sustainability of infrastructure and irrigation service fees collected from farmers are insufficient to cover the O&M costs at the system level (OECD 2020 53). FAO estimated that payments received from water user associations and other users in the region covered only about 30% of MOM costs across four of the Central Asian states (FAO and World Bank 2019, 8). Recent analyses of irrigation in Central Asia point to the damaging consequences of under-funding recurrent O&M costs, which result in a 'vicious circle' of unreliable service, premature obsolescence of assets, users' dissatisfaction and unwillingness to pay for water, a further weakening of cost recovery, and the need for major rehabilitation. The main obstacles to raising tariffs have been considered to be the low level of farm incomes and a lack of political will, although new initiatives are being taken, for example in Uzbekistan with the separation of land and water taxes (OECD 2020).

97. The most recent estimate is that the cost of the irrigation water subsidy in Uzbekistan amounts to 1.3% of GDP, plus the cost of subsidized credit and other direct payments to cotton producers amounting to a further 0.2% (World Bank 2020c). Electricity used in irrigation water supply represents 16% of national power generation, and its subsidy costs USD 350 million annually (World Bank 2020a, 7).

98. A similar situation can be seen in urban water services that have not been able to make adequate financial provision for their operations. Across Central Asia, charges for household drinking water and sanitation are inadequate to recover the costs of operating and maintaining the infrastructure, while capital investment costs are met by central governments. Tariffs are low, only a minority of households are metered and thus most charging is not on a volumetric basis, and collection rates are low (USAID, 2020). Some key data are contained in Table 6.

Table 6. Key data on drinking and household water supply in Central Asia (2016)

	Access to safely managed water supply (national) %	Tariff US$/m3	Fee collection rate %
Kazakhstan	90	0.10-0.58	85
Kyrgyz Republic	68	0.07-0.11	65
Tajikistan	48	0.4-0.8	75
Turkmenistan	94	0.5	70
Uzbekistan	59	0.11-0.25	85

Source: OECD 2020, p.27

99. Water supplies are particularly poor in rural areas. In Kyrgyzstan only one quarter of rural households had piped connections of their own , and three-quarters of rural households only had intermittent supplies. Community Drinking Water Users' Unions are nominally responsible for providing rural water services, but only one quarter of these are currently operational due to a lack of revenues and technical resources.[41]

Carbon emissions

100. Central Asia is home to less than 1% of the global population and produces less than 0.5% of the world's GDP. Nonetheless, the region generates more than 120 million tons of carbon emissions or approximately 1.2% of the global carbon emissions (Wang et al. 2020), reflecting the high energy and carbon intensity of the region. Especially in the downstream region, many irrigation systems rely on pumping water considerable heights from the river to the command area and as the current source of the electricity is mostly from fossil fuels (natural gas and coal), resulting in a significant carbon footprint from irrigation.

3.4 Water-energy linkages

Water in energy

101. Electricity generation across the basin is influenced by topography and endowment of fossil fuels. Hydropower is the predominant source in the upstream countries of Kyrgyz Republic (installed capacity of 3,070 MW) and Tajikistan (6,400MW) whereas mainly thermal generation (predominately from natural gas and coal) provides capacities in Kazakhstan of (23,600MW - of which about 12% is hydropower),[42] in Turkmenistan (of 3,300MW) and in Uzbekistan (of 13,900MW - of which approximately 13% is hydropower), (IHA 2020). Upstream countries have major expansion plans for hydropower development including an increase to 10TW in Tajikistan by 2030, involving subsequent phases of the Rogun dam in Tajikistan and Kambarata projects in

[41] Kyrgyz Republic: Country Partnership Strategy 2013-2017 - Sector Assessment (Summary): Water Supply and Other Municipal Infrastructure and Services (adb.org)

[42] Kazakhstan Electric Power Industry Key Factors | KEGOC

the Kyrgyz Republic. Downstream countries have plans to expand the use of intermittent renewables, particularly solar and wind energy, in response to their climate commitments; for example in Kazakhstan to 10% of supply by 2030 and 50% by 2050 and in Uzbekistan to 5,000MW of solar power and 1,700MW of wind power by 2030[43].

102. Although not a major consumptive user of water, the timing and seasonality of hydropower withdrawals and releases can pose significant opportunity costs for other users, especially irrigation downstream. Arrangements to synchronize upstream hydropower generation with downstream summer irrigation supply during the Soviet period is well documented (Xenarios et al. 2020). Since independence, hydropower releases have increasingly responded to peak domestic demand, which for the upstream countries occurs in winter due to demand for heating. This causes a change in the seasonality of the flows with peak flows downstream of the reservoirs shifting from summer towards winter. Figure 8 shows for Toktogul (Syr Darya) and Nurek (Amu Darya) the mean inflows and releases based on data from 2000-2010, complemented with data from the latest ICWC Bulletin available for last year.[44] The seasonal shift is very clearly observed for Toktogul reservoir. The reservoir operations also reduce the amplitude of the flows and flatten out the peaks (inflow peaks being higher than outflow peaks both for the high flows as well as the low flows), as can be seen for Nurek reservoir. Climate change will change the seasonality of energy demand (e.g., less demand for heating in winter, more demand for cooling in summer) and will also change the seasonality and variability of the reservoir inflows, especially in the long-term (i.e., beyond 2050). These changes are expected to significantly influence negotiations in the water-energy space.

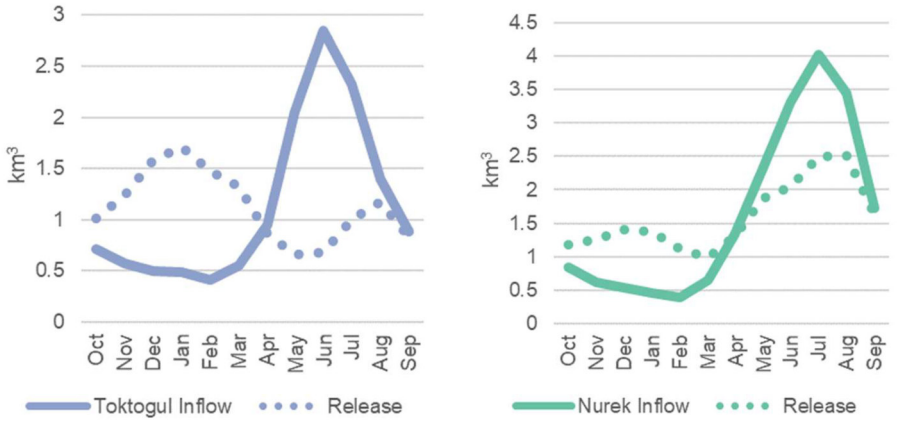


Figure 8. Mean monthly inflows and releases from Toktogul (left) and Nurek (right) reservoir. Source: SIC

103. Management of competing interests of hydropower generation and irrigation water supply is currently based on a combination of historic agreements on water allocation shares and status of reservoir storage volumes at the beginning of the irrigation season and bilateral negotiations, both long and short term. Energy generation and trading is already having a significant influence on the river flow regime and this is likely to increase significantly in the coming years as grid interconnection between neighboring countries develops further. Energy trading between the Central Asian countries reached a low of 2,080 million kWh in 2016 resulting

[43] Data provide in presentation of consultants dated 5 May 2021 for ADB TA9717 and TA9823
[44] http://www.icwc-aral.uz/icwc_bulletins.htm

in widespread power outages in Tajikistan and increased use of fossil fuels in Kazakhstan, Turkmenistan and Uzbekistan in the summer months.

104. Under CAREC, ADB is supporting a regional technical assistance project for increasing cross-border energy trading within the Central Asian Power System (CAPS) which includes reconnecting Turkmenistan to CAPS and expansion to Afghanistan and other potential markets.[45] In a parallel initiative, the governments of Kyrgyzstan, Tajikistan, Afghanistan and Pakistan are cooperating to establish the Central Asia – South Asia (CASA) transmission line, CASA-1000, to transmit electricity from the two Central Asian countries to power-short countries in South Asia.[46] In the absence of a market for their output, some existing hydropower plants end up idling and spilling water which, although has a benefit to downstream irrigators through maintenance of river flows, means that the full potential benefit is not realized.

105. The linkage between energy generation and river flows will become more complex as hydropower has the capability to provide stability in the power grid as increasing amounts of intermittent renewables such as grid-connected solar and wind are added to the generation mix. ADB has supported a study under CAREC to identify regional capacity reserve sharing mechanisms grid reinforcement measures that will allow large scale intermittent renewable integration at a lower cost compared to a no-cooperation scenario.[47] The consultant's report refers to the intra-day trading arrangements for providing grid stability (RTE International 2020, 14). Although this can result in neutral daily balance of energy exchange between countries, it could lead to significant diurnal fluctuations in river flows and associated opportunity costs for downstream water users.

[45] RETA 52112-002, ADB Grant to Support Increased Cross-Border Energy Trading in Central Asia | Asian Development Bank

[46] About CASA-1000 – CASA-1000 (casa-1000.org)

[47] RETA 51148-001 Regional Cooperation on Renewable Energy Integration to the Grid

Box 2: Regional Cooperation on Energy Trading within the Central Asian Power System

ADB sponsored technical assistance within the CAREC Energy Pillar includes an assessment of the potential to 2030 for increasing energy trading within the Central Asia region, including links to Afghanistan and Pakistan, and for determining the savings of a more regionally integrated system. Preliminary results presented to a CAREC meeting of experts on 1 June 2021 suggest that extending regional trade would bring additional benefit in the order of $595 m by 2023 and $735 m by 2030. The scope of investments in future electricity interconnection projects depends upon whether Turkmenistan joins the Central Asian Power System. Modelling of future scenarios includes the historic constraint that reservoir storage at the beginning of the irrigation season is at a minimum of 50%. This limits the potential output of hydropower, but is considered a critical condition to meet seasonal irrigation demand. Combined modelling of water and energy systems in the future could explore optimizing outcomes for both energy and water sectors.

52112-003: Regional Cooperation on Increasing Cross-Border Energy Trading within the Central Asian Power System - Provision of Solutions to Bottlenecks to the Regional Power Trade (Subproject 2) | Asian Development Bank (adb.org) and 52112-004: Regional Cooperation on Increasing Cross-Border Energy Trading within the Central Asian Power System - Expansion of Membership in Central Asian Power System (Subproject 3) | Asian Development Bank (adb.org)

106. Given the high costs of irrigation pumping in downstream states, there may also be significant potential for use of renewable energy as part of the modernization of large pumping stations, either where a country is increasing the mix of renewables in their on-grid systems, or by introducing decentralized off-grid solutions particularly in remote areas where the cost of connecting to the grid is high.

Energy in water

107. Beyond the energy efficiency benefits of reducing water losses in irrigation and municipal water supply systems, many opportunities exist to introduce energy saving technology in the provision of water and wastewater services, including for the pumping and treating of raw water, more efficient pressurized distribution systems, and improved network management. The replacement of outdated and inefficient electro-mechanical equipment in water and wastewater treatment plants can have significant savings in energy consumption as well as improving reliability. Groundwater abstraction for irrigation is a high user of energy and is inefficient when electricity or fuel subsidies are present. Embracing the circular economy principle also opens up options for recovering energy from wastewater including biogas.

3.5 Managing demand within available supply

Bridging the supply-demand gap

108. From the analyses of future supply and demand in sections 3.1 and 3.2, it can be seen that a major gap will occur under the 'business-as-usual' (BaU) scenario if the region were to follow its current development trajectory without modernization and demand management

investments in the water and agricultural sector (Figure 9).[48] Potential water demand would increase by about 15%, which combined with increased variability and uncertainty for supply, would lead to a supply-demand gap of around 37%.[49] A 'moderate rehabilitation' scenario, assuming a 10% reduction in irrigation demand through water productivity measures and 20% increase in industrial water use efficiency, would reduce this gap, but it would still remain at about 24%. Note that the 90% reliable supply figure from now to 2050 reduces by 10% due to more severe climate related extremes of low flows. The grey band on the supply estimate denotes a level of uncertainty in the climate projections.

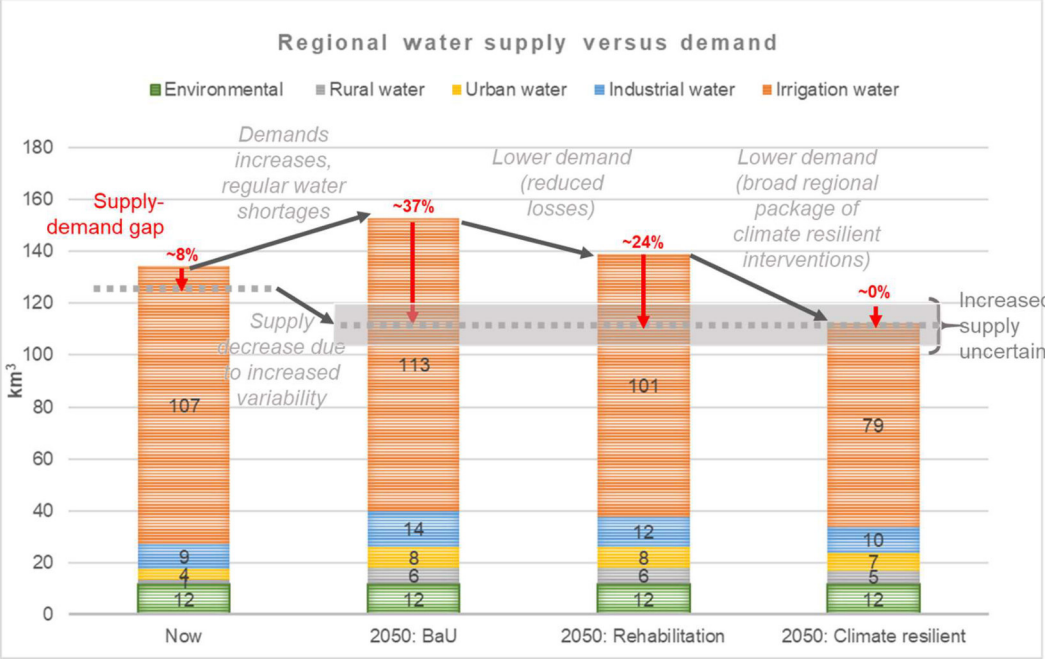


Figure 9. Gap between regional water demand and reliable supply – Aral Sea Basin. The bars indicate the forecast demand for the five sectors; grey dotted line the projected supply

109. In a situation where water supply in the basin is fully allocated, future water use will be constrained by available supply. In the many years when the agreed water allocation to the Aral Sea is not met, the basin can in fact be considered over-allocated and, as noted in para 78, projecting future 'potential' demand is theoretical. It does though point to the scale of the challenge faced in the basin, and the risk for water-related conflicts. When also viewed with increased inter-annual and intra-seasonal variability, the scale of the potential gap makes a strong case for strengthening regional cooperation and updating the tools, mechanisms and procedures for basin water management. Although some additional storage can be considered through landscape and nature-based solutions as well as infrastructure solutions, this would effectively only smooth out some of the interannual variability rather than provide additional water.

[48] Note that these numbers refer to supply and demands from the main river systems – as is typically done for regional water balances in Central Asia, for example in the ICWC bulletins, other regional studies and for the regional agreements in place. In other words, this is gross demand - it includes water that is reused through the main river system (i.e., return flows used by downstream users)

[49] The figure for environmental demand for this analysis has been taken as 12km^3, as estimated by the OECD 2020 study rather than the prevailing ICWC agreement of 7km^3. The overall findings and conclusions do not materially change whichever figure is used and the case for a climate resilient and more productive future scenario remains valid for both cases.

110. The scale of the apparent gap indicates the urgency of demand management policies and technological improvements, including reduction in on-farm and transmission losses, to enable the amounts of available water to satisfy the growing calls on its use. In this context, the growth of unauthorized groundwater extraction to supplement surface irrigation water supplies is an indication of the emerging supply-demand imbalance in surface water supplies.

111. A more comprehensive 'climate resilient' scenario will therefore be required to close the demand-supply gap. It assumes a broad intervention portfolio of region-wide investments to reduce the gap to minimum, although there will still be some residual uncertainty related to climate change. The climate change scenario in Figure 9 assumes a reduction in BaU demand of 30%. Key elements of this scenario include enhanced regional cooperation; a system- and basin-level approach to water resources interventions and water productivity technologies; demand management interventions; and widespread adoption of risk-managed climate adaptation interventions.

112. The gap between supply and demand differs according to region, basin and sub-basin. For example, it has been estimated that about one third of the gap between demand and supply corresponds to the Syr Darya, and two thirds to the Amu Darya basin (Lutz, Droogers, and Immerzeel 2012). To assess the spatial differences of water stress, another commonly used water stress indicator can be applied based on freshwater withdrawal as a proportion of available freshwater resources.[50] This indicator is also known as water withdrawal intensity, or 'level of water stress' and will measure progress towards SDG Target 6.4. Figure 10 shows a map of this indicator that was extracted from a global assessment by WWF. As can be seen, the downstream areas in Amu Darya have the highest level of water stress according to this SDG indicator as denoted by the deeper red colours. It can be expected that the regional differences over the next decades have the potential to be intensified, as climate change will impact the upstream countries differently to the downstream countries.

[50] More specifically the ratio between total freshwater withdrawn by major economic sectors and total renewable freshwater resources, after taking into account environmental water requirements

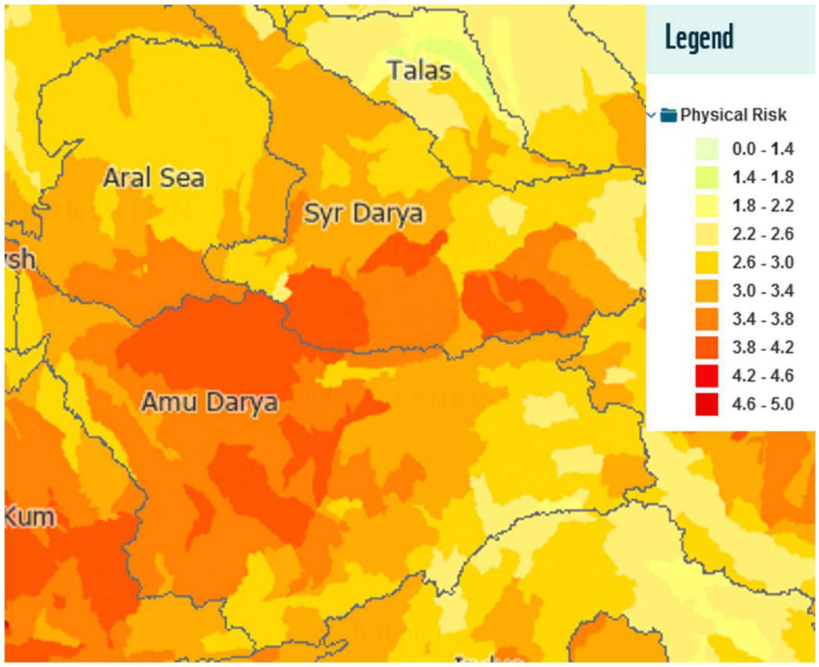


Figure 10. Map of water scarcity risk (source: WWF Water Risk Filter)

Real irrigation savings

113. There is a growing consensus in Central Asia around the need for greater water *productivity.* Productivity measures the impact on output from the contribution of a specific factor of production – in this case water. Where water is scarce, or unreliable, or where there is competition for its use from several sectors, it is important that water is deployed to where it is most productive, in broad economic terms taking into account social and climate resilience considerations.

114. There are various concepts of efficiency and productivity, each with its own performance measures. Box 3 includes measures applying mainly to irrigation, the predominant water user. This is discussed in more detail in the thematic paper on Economic Value of Water.

Box 3. Different concepts of water productivity

Concept	Definition	Measurement
crop productivity (kg/ha)	physical yield obtained in crops grown under irrigation	physical yield (e.g., in kg) of crop per hectare
physical water productivity (kg/m^3)	impact of water on the physical yield of irrigated crops	yield of crop (kg) per cubic meter of water beneficially consumed in a specified domain
economic water productivity ($/m^3)	net value that water adds to production	in irrigation, net value of product ($) per cubic meter of water beneficially consumed (after deduction of all non-water costs and with product and inputs valued at economic prices).

115. Economic water productivity provides a universal indicator by including value and is valid across all crop types and can correct for subsidies and pricing distortions. However, it is data-intensive and unlike physical water productivity, cannot be estimated on a mass-scale through satellite imagery. It can though be used selectively in policy oriented research to supplement analysis of physical water productivity.

116. There is considerable variation across the region in physical water productivity. Recent work by IWMI covering two irrigation districts in Uzbekistan showed a large gap between well and low-performing areas with a factor of four between the lowest and highest values (0.25 kg/m3 and 0.99 kg/m3) (IWMI 2020). Potential explanations for this large range include differences in water reliability and access to inputs. An ongoing remote sensing-based study on water productivity in the entire Syr Darya basin carried out by IrriWatch shows an even higher range in water productivity in the region (between 0.25 and 2.5 kg/m3 (based on dry matter production).[51] Maps from this study show that areas at the tail end of irrigation systems and salinized areas typically have lower water productivity, while other areas perform reasonably well. Such spatial analysis can provide insight on which factors (drainage, capacity, extension service) explain the performance of these systems.

117. There is significant scope to increase overall water productivity through improved irrigation practices and technologies and close the gap between low and high values of water productivity. Introducing modern irrigation techniques and technology (such as drip irrigation, sprinkler, pressurized systems and improved agronomic practices for surface irrigation) are being encouraged across the region with expectations that 'saved water' can be used for other purposes (such as increased domestic and industrial demand, the environment, recovery of degraded lands and expansion of irrigated areas). Reducing water diverted for irrigation also has a benefits of reducing pumping costs.

118. However, a growing body of evidence shows that in many cases, apparent water 'savings' at field scale can translate into an increase in water consumption when assessed at larger scales (for example the irrigation district or basin), as these 'savings' are often used locally for increased cropping intensities or irrigation expansion on-farm. This can lead to unintended side-effects, as water saving interventions finally increase consumption, reduce return flows and thus increase water stress elsewhere in the basin. This is well documented in reports by FAO (Perry, Pasquale, and Fawzi 2017) and recently further refined by (Opstal et al. 2020) as well as research done by the World Bank (Scheierling and Tréguer 2018). This does not undermine the case for more intensive irrigation systems, but does demonstrate the need for its introduction to be accompanied by revised systems of water regulation and licensing that adjusts water allocation to ensure potential 'saved' water is available for use by others, either through new water entitlements administered by the regulator (as in the case of Israel) or through an incentive based water trading system (as in the case of Australia).[52]

119. It is increasingly recognized that any project investing in irrigation modernization should not only consider possible local irrigation efficiency gains, but also assess other positive or

[51] Personal communication regarding ongoing study

[52] The Australia Water Partnership sponsored preparation of a discussion paper (2021, unpublished) entitled 'Formulating a strategy for water allocation in Uzbekistan' as a contribution to development of the new national Water Resource Development and Irrigation Sector Strategy. It reviewed international experience and made proposals on a pathway for change of allocation systems. Many of the recommendations are relevant to managing water scarcity in the region more broadly.

negative impacts, related to return flows, impact of water remaining in the system, water quality and energy costs, i.e., looking at the local and the basin perspective. Projects can have a positive impact if they reduce the salinity of the river that receives saline return flows, but can at the same time have a negative impact if these return flows are for example essential to sustain the ecosystem of the Aral Sea. The mainly unplanned and uncoordinated reuse of water in Central Asia is a significant volume both at the basin-level and also within single irrigation districts. This needs to be taken into account in the overall water quantity and quality balance when introducing incentives for more efficient irrigation technology.

120. FAO has recently launched the concept of 'Real Water Savings', making a distinction between 'real' water savings in contrast to 'apparent' water savings (FAO 2021). Figure 11 shows the consequence of a well-regulated system for introducing water saving measures. The climate resilient scenario aims to reduce non-beneficial consumption and increase beneficial or productive consumption. [53] Return flows are reduced and the saved water is allocated to other uses. More explanation is provided in the thematic paper on climate change impacts.

121. Another complexity to the water saving and upstream-downstream links relates to the practice of using significant amounts of water during the non-vegetation (winter) period for leaching of salts which can also have benefits of increasing soil moisture for the beginning of the growing season, (see para 95).

122. In summary, a system-wide approach is needed for irrigation investment planning in the region, that assesses how the investments can lead to real water savings, generating local benefits by reducing energy consumption and land productivity, and off-site benefits in terms of water availability and water quality. Similar interventions are needed in other sectors to reduce losses in water supply systems and introduce efficient processes in industry, including greater reuse of treated wastewater. These actions to increase physical water productivity can be complemented by interventions to raise the economic productivity of water, by stimulating production of higher-value crops, reducing production costs, or by retiring irrigation systems with excessive pumping costs.

[53] The consumed fraction (essentially ET), comprising: (i) beneficial consumption (for the purpose intended or other beneficial use such as environmental purposes) and (ii) non-beneficial consumption (such as weeds; evaporation from wetted surfaces; or capillary rise during a fallow period). The non-consumed fraction, comprising: (i) recoverable flows (water flowing to drains and back into the river system for possible diversion downstream, and percolation to freshwater aquifers) and (ii) non-recoverable flows (percolations to saline aquifers, outflow to drains that have no downstream diversions or direct outflow to the sea). There is an economic dimension to this component - salinized or polluted water can be physically recoverable but can become too costly to recover for re-use.

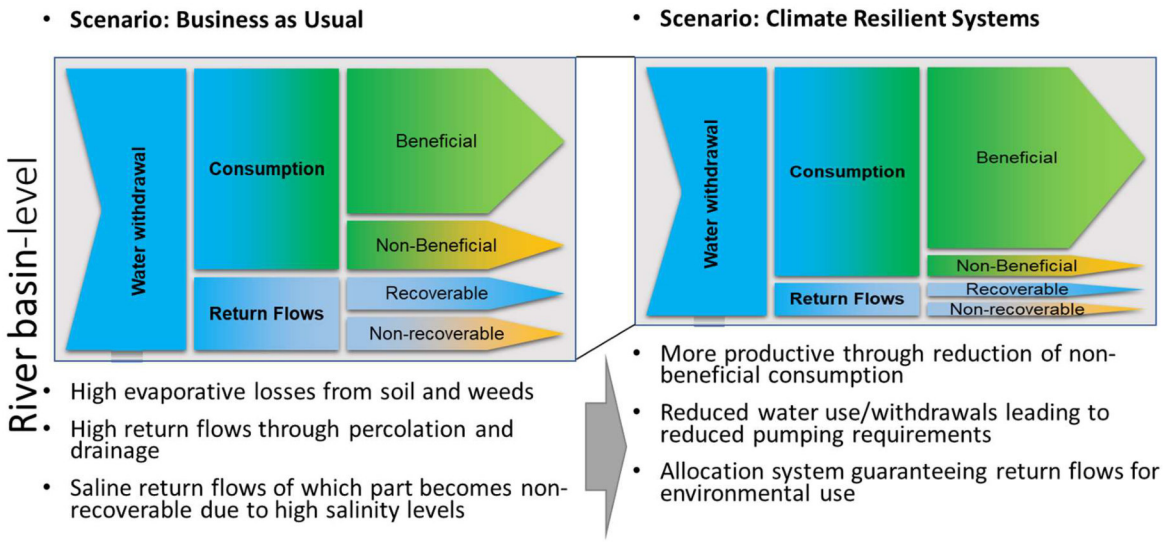


Figure 11. Impacts of real water savings measures on the water flows at the river basin-level, illustrated using the Follow the Water concept.

4 Strengths, Weaknesses, Opportunities and Threats (SWOT)

123. A SWOT analysis is given in Table *7* as a summary of points that in one way or another could influence the establishment, content and outcomes of the Water Pillar.

- The **strengths** are areas on which to build and demonstrate there is a foundation of regional cooperation on water.
- The **weaknesses** provide an indication of shortcomings that might impede closer cooperation and need to be considered.
- The **opportunities** suggest there is potential for greater cooperation.
- The **threats** present risks that need to be taken into account during the design and implementation of Water Pillar activities

Table 7: Preliminary SWOT analysis for the CAREC Water Pillar

Strengths	**Weaknesses**
○ Long history and high-level commitments to regional cooperation on water – regional agencies and institutes exist ○ Recognition of the need for economic reforms including in agricultural sector ○ Rich endowment of land and water resources as a region ○ High human resource potential ○ Established CAREC cooperation platform in other sectors ○ Extensive network of irrigation assets ○ Extensive knowledge base on water in C Asia ○ Shared concerns on environmental degradation, and impacts of extreme weather events (droughts, floods, etc) ○ Well-developed portfolio of ADB support to national water projects / programs	○ Limited skills in modern management systems and low representation of women in senior positions ○ Sparse data collection and limited information sharing ○ National water laws have limited recognition of regional commitments ○ Outdated regulatory frameworks, institutional structures, operational procedures and management tools, (including water allocation policies, cost recovery and pricing structures) ○ Uncoordinated sector strategies at national and regional levels ○ Degraded water infrastructure, low water productivity and high levels of water loss ○ Low levels of cost recovery for MOM of water infrastructure and local resistance to increased water charges in all sectors ○ Degraded natural environment and aquatic ecosystems including high levels of salinity ○ Limited experience with private sector engagement in system management ○ Language barriers for accessing knowledge on international practice
Opportunities	**Threats**
○ Improved geo-political relations ○ Numerous issues of common concern in the region bring people together ○ Potential for water as part of wider regional benefit sharing dialogue - taking a wider perspective beyond water allocation ○ Global emphasis on climate adaptation, including funding for resilience and green economy projects ○ Large potential for increasing both physical and economic water productivity ○ Extensive opportunities for export of high value agricultural produce ○ Linkage with CAREC Energy Pillar and complementary water-energy benefits as a result of regional integration ○ Application of modern technology (equipment and ICT), systems and management approaches ○ Potential for energy saving and renewable energy - cost reductions and lower CO_2 emissions ○ Emerging involvement of private enterprise in some countries	○ Negotiating positions can take a narrow water-centric perspective ○ Legacy of past disagreements slows trust building ○ Lack of commitment to regional cooperation constrains project design and implementation ○ Possible escalation of local bilateral disputes on land and water ○ Institutional barriers to cross-sectoral coordination ○ Increasing levels of water stress constrains regional cooperation and further impacts the environment ○ Growing upstream abstractions, including in Afghanistan ○ Climate change impacts are more extreme for some countries than others which may alter the basis upon which earlier regional agreements were founded ○ Increased variability of river flows as a result of energy trading for grid stability ○ Incompatible timing of upstream energy demand and downstream irrigation requirements ○ Water quality deteriorates as economies grow

124. By its nature, the SWOT analysis is generic and there is a diversity of situations and perspectives in each of the countries influenced by the nature of their economies; their geographic position, upstream or downstream; their endowment of natural resources; and their development aspirations. A key entry point for the CAREC Water Pillar will be to identify interventions that bridge these differences, are mutually beneficial, and address embedded concerns.

Moving from policy commitment to action

125. There is a cost of inaction as indicated in the recent report on *Rethinking Water Management* (Pohl et al. 2017). Much has been researched and written on the challenges of water resources in the Central Asian region and the scoping study has identified a number of situations where, although policy measures or political commitment have been articulated, progress on measures for implementation is limited. Some of these policy-implementation gaps include:

- A high level of regional interdependence on water, *but* limited operational mechanisms and capacity for joint working (e.g., on monitoring, modelling, planning and forecasting).
- High levels of water stress as measured by global indicators of water availability per capita, *but* low levels of water productivity.
- Universal commitment by States to the principles of IWRM under SDG 6.5 and in some national policies, *but* limited evidence of integration and coordination between sectors and regionally.
- A recognition that climate change impacts are already being experienced, *but* limited incorporation of climate adaptation measures in regional protocols and agreements.
- Awareness of the environmental implications of over-allocating a basin's water resources (e.g., the Aral Sea disaster), *but* limited measures to prevent similar outcomes in other aquatic ecosystems.
- A realization that short-term, ad-hoc arrangements to resolve water shortages within the agricultural season can lead to inefficiencies and low productivity, *but* a lack of effective procedures for managing river flows in times of uncertainty and increasing variability.
- The importance of sustaining groundwater resources to meet rising demand for drinking water in urban and rural settings in the future, *but* competing uses from informal exploitation for irrigation and livestock is unregulated.
- Recognition that water quality deteriorates as economies develop, *but* limited capacity and preparatory measures are in place to manage and reduce pollution.
- High levels of ambition for regional hydropower trading *but* limited platforms for coordinating planning and management between energy and water sectors.
- High potential for solar power generation as a complementary source to hydropower generation and a carbon free source of energy to power irrigation pumps, *but* limited uptake of this renewable resource.

126. Each of these issues are well understood. Assessing the economic and financial implications of these constraints and moving the discussion beyond 'sharing water volumes' to

'*sharing the benefits that derive from water'* may open up new avenues for discussion at regional level.

5 Envisioning the water sector in 2050

127. Given the rapid development trajectory in the region, the scoping study has attempted to articulate elements of a '2050 scenario'. It serves as a 'vision' or 'target', helping to identify what measures need to be put in place in the short-term for that vision to materialize. Creating such a long term perspective aims to open new avenues for dialogue. By 2050, some of the following situations will have become the 'new normal'. Inevitably there are uncertainties in any projections as demonstrated by the recent COVID-19 pandemic, but the scenario provides a basis on which to plan. The following statements are written from the standpoint of life in 2050.

Living with climate change

By 2050, society will have adapted to increasing water stress and changes in seasonality, and water management systems will be responsive to greater frequency of extreme events and increased variability. Water allocation and water resources planning will place less reliance on historic data and greater emphasis on adaptive management including forecasts and projections. Regional cooperation around water issues is a reality due to the shared challenges to deal with uncertainty. Coordinated climate-resilient international strategies are implemented coherently across all agencies and stakeholders.

Climate adaptation measures have occurred through a wide range of interventions where regional cooperation was required for the mutual benefits to be achieved. Information, knowledge and experience have been shared at different management levels and on water use, water quality, environmental variables, among others. Competent technical capacity exists within the region to support decision-making using real time data, remote sensing data and forecasts. Early warning systems for floods and droughts are in place and allow the countries to act in time to prevent impacts. An effectively sized and climate-responsive infrastructure is in place, realizing synergy from the public and private sectors. Central Asia is world-leading in the adoption of innovative technology and climate adaptation measures for efficient management of water resources and nexus solutions for renewable energy. The carbon emissions in the water sector will have dropped considerably compared to 30 years earlier (2020).

Economic development

Urbanization, industrial development and market liberalization has led to higher living standards. The share of water allocated to agriculture in 2050 remains dominant, but there have been transfers to industrial, domestic and environmental uses as their demands increased and more value has been given to the services provided by the environment.

Central Asian economies have diversified into sectors with greater productivity and value-added such as agricultural processing, manufacturing and services, reducing their former relative reliance on highly energy- carbon-and water-intensive activities. NDC commitments increasingly influence and constrain economic strategies. Investment decisions by both private and public agents factor in climate risk. Long term public investment projects take

account of climate change and give preference to 'no regret' choices that are robust in the face of different climate scenarios.

- *Regional trade integration and economic integration: the integrated trade agenda, supported by CAREC,*[54] *has led to increased market access, economic diversification, and stronger institutions. Water cooperation is viewed within a broader regional cooperation agenda and based on the benefits that are derived from it. There are increased exports of high value agricultural products from a mature agri-food sector instead of primary products. Some water intensive crops are produced where decisions on cropping patterns are taken by farmers within a strengthened regulatory framework for water entitlements that integrate environmental demands, and emerging opportunities for water trading.*
- *Agriculture intensification and irrigation modernization: the success of irrigation development responded to changes in agriculture sector water security challenges. Liberalization of agricultural policies, more commercial enterprises, trade opportunities for high value horticultural produce coupled with incentives for irrigation modernization, technological advances and secure land tenure led to more water productive irrigation systems. A growth in on-demand irrigation services provided farmers greater control to produce high quality products and enabled a mature value chain for manufactured products. Nowadays, farmers have increased income and the ability to pay for environmental and water resources services provided. Expansion of livestock production prompted greater regulation and coordinated use of groundwater resources.*
- *Wider involvement of private sector in delivering services: adoption of a conducive enabling framework of policy, institutions and regulations has encouraged expansion of private sector involvement and led to more efficient and financially sustainable irrigation and water supply systems in parallel with increasing returns for farmers.*
- *Regional energy integration and shift to renewables: the power systems of Central and South Asia are more integrated, creating synergies between energy production and water distribution. A transition from fossil fuel to renewable technologies provided significant carbon emissions reductions but required a closely coordinated management approach between the water and energy sectors. Reservoir water release operations account for the constraints of downstream water resources infrastructure and demands.*

Universal access to water supply and sanitation services

24/7 water supply and safe sanitation has become a reality in urban and rural areas with increased reliability, better quality water, reduced losses, improved cost recovery, widespread reuse of wastewater (circular economy). The COVID-19 pandemic emphasized the importance of access to safely managed water and led to an impetus to 'build back better'. Improved hygiene provision particularly for women and girls has been provided. Consumer expectations for improved levels of service delivery have led to improved governance and efficiency in the management of water systems.

Technological advancement

There has been widespread adoption of technologies available in developed economies for improving water productivity and strengthening the use of real-time information in

[54] CAREC Integrated Trade Agenda and Rolling Strategic Action Plan 2018–2020 (adb.org)

management decisions. In parallel there was uptake of new applications involving artificial intelligence and earth observations for controlling water applications and improving short- and long-term forecasting.

Improved state of the environment

Water quality has improved with reductions in salinity, controlled pollution from point and non-point sources, improved wastewater treatment and adoption of recovery, recycling and reuse principles of the circular economy. Aquatic systems are recognized as a legitimate water user and allocations are made according to defined needs.

128. Transition pathways towards a climate resilient 2050 scenario projected above will need to be identified and planned. Reconciling the demand trends with likely future water availability and avoiding serious water stress and economic losses while also restoring environmental degradation, will require actions to manage water demand and supply and encourage its use in more productive purposes. As argued in a recent USAID report, this requires a shift towards more long term planning. (Abdullaev and Strikeleva 2020, p5). This will be particularly important in the post-2050 period when climate impacts result in more acute water shortages (para 57) particularly for the Syr Darya basin.

129. CAREC 2030 provides the stimulus for establishing the Water Pillar, but the aspiration is for it to be a longer-term component of regional cooperation beyond 2030. It aims to play an important role in reaching a 2050 climate resilient scenario and preparing for the post-2050 situation through supporting a wide range of activities across the region. The initiatives proposed are intended as 'no-regrets' interventions that will deliver both short-term and longer-term benefits. The next section provides preliminary suggestions as a framework for the Water Pillar.

6 Framing the CAREC Water Pillar

130. The Water Pillar will be aligned with CAREC's overall vision of *Good Neighbors, Good Partners, and Good Prospects* and consistent with its mission of *A Regional Cooperation Platform to Connect People, Policies, and Projects for Shared and Sustainable Development.*

131. A proposed **vision** for the Water Pillar is to contribute to:

> '**a sustainable, climate resilient, productive and water secure region with shared benefits among States and communities.'**[55]

6.1 Role of the Water Pillar

132. With a focus on regional interventions that go beyond the benefits delivered through national projects alone, the Water Pillar will serve the following functions:

- **Investment support for water infrastructure** that has mutual benefits for two or more countries;
- **Generator of knowledge** through analysis of key issues and guidance on policy reform, including adaptation of international good practice to the local context;
- **Platform for dialogue** among countries of the region at technical and policy levels that complements other regional initiatives to exchange experience and build consensus on water resources management and the provision of water services;
- **Facilitator of capacity development** involving peer-to-peer exchanges on topical issues, in-career professional development, and upgrading training programs.

6.2 Principles and approach for establishing a Water Pillar

133. While focussing initially on the Aral Sea Basin region within the five Central Asian Republics, the framing of the Water Pillar is also designed to meet the medium- to long-term ambition of expansion to the wider CAREC region. Initially for Central Asia, it involves recognition of the influences and economic drivers related to the region's relationships with its neighbouring countries. In particular, it needs to involve dialogue with the Afghanistan as a riparian state of the Amu Darya river. Over time, the Water Pillar will grow gradually with involvement of other sub-regions within CAREC on a project by project basis.

134. The Water Pillar aims to build on initiatives taken by other regional cooperation mechanisms while benefiting from the comparative advantages of the CAREC platform, including its high level connectivity through ministries of finance and economic development and the potential for linking across sectors and themes, particularly agriculture, energy and gender[56] (Asian Development Bank 2019b; 2021; 2019a).

[55] The term sustainable incorporates physical, financial and environmental sustainability including healthy ecosystems.

[56] The CAREC Gender Strategy comprises four objectives that can be integrated into many of the proposals, namely promote women's access to economic opportunities; contribute to women's social empowerment; support women's regional networks and policy reform for women's empowerment; and enhance women's access to information and communication technology. Specific entry points on water identified in the Strategy include '*increased representation in regional emergency responses to address impacts on food and water*

135. As a new component of the CAREC Program, the Water Pillar will take an incremental approach to strengthening regional cooperation, starting with initiatives that bring technical specialists together to help build trust and confidence in close and more open working arrangements, including analysis based on shared datasets. There are several examples from other shared basins across the world, each with their own objectives and characteristics and each with their own history of successes and setbacks. A common thread though is that joint long-term approaches to working on shared issues can bring improved understanding, stability, benefits and efficiencies that otherwise prove elusive.[57] The Pillar will respond to the 'honest broker' role foreseen in *CAREC 2030.*

136. The following criteria are proposed in identifying individual CAREC Water Pillar activities:

- alignment with national strategies and support to SDGs, NDCs and climate adaptation plans,
- alignment with the mission and principles of CAREC cooperation outlined in CAREC 2030 and synergy with other relevant CAREC programs,
- involvement of two or more countries, with a clear expression of interest and ownership from countries involved,
- potential to bring benefits of joint approaches beyond those that result from a national approach, and
- complementarity and additionality to other CAREC sector programs, work programs of other regional bodies, and programs of other development partners.

137. Projects under the Water Pillar will build confidence and trust in joint management approaches and comprise a combination of initiatives designed to

- address **issues of common concern across two or more countries** that may or may not be directly linked to a shared water resource, and
- support **regional cooperation on shared water resources** (i.e., a transboundary river or groundwater system).

  These two categories of project are depicted in the top and bottom rows of Figure 12. In the first column, projects are of a technical assistance type (for example support to policy and regulatory, institutional strengthening, knowledge products and joint learning activities). In the second column, projects revolve around investment in infrastructure (including jointly owned and managed infrastructure). Individual projects may have components that cover more than one of the boxes of the typology.

security and on water and sanitation infrastructure…and providing support to establish mechanisms to recruit women into technical and managerial roles in the water sector and to provide on-the-job trainings for them to participate more effectively in regional water projects'.

[57] For example, the formal 1995 agreement for the Mekong River Commission was built on a foundation of years of joint working groups, data collection, modelling and analysis.

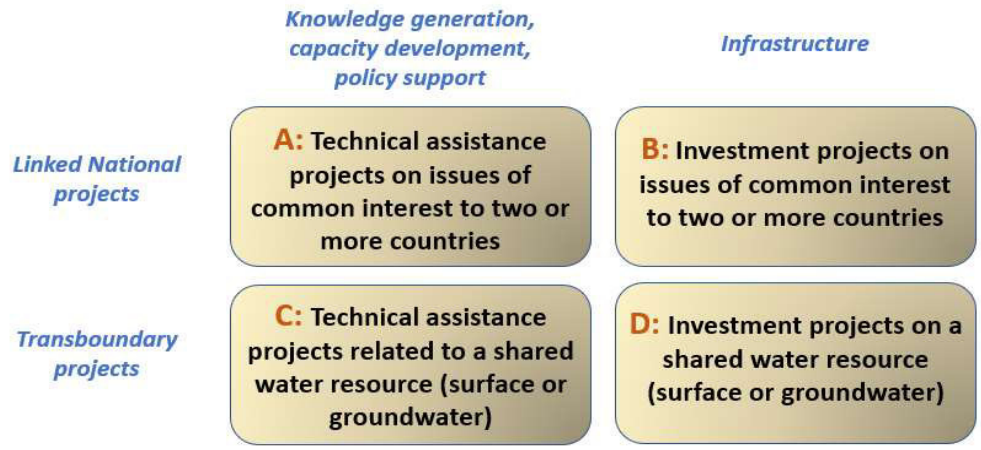


Figure 12 Typology of projects under the CAREC Water Pillar

6.3 Framework for the Water Pillar

138. The proposed Water Pillar comprises three main blocks, supported by a set of cross cutting dimensions that influence the design of activities, see Figure 13. The three blocks are not mutually exclusive and some projects may have dimensions associated with two or more blocks.

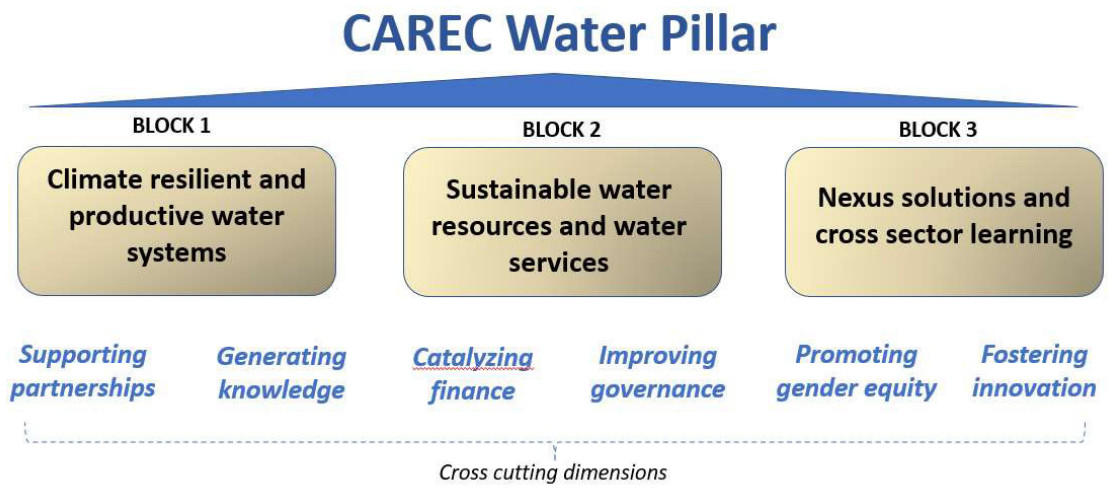


Figure 13 Framework for the CAREC Water Pillar

139. Preliminary ideas for groups of Water Pillar activities are outlined in the following sections with a summary mapping given in Figure 14. They build on emerging opportunities and areas of mutual interest with the aim of stimulating greater cooperation and shared benefits. As the Pillar will be built on the premise of demand from countries of the region, the ideas are presented as initial concepts for discussion. They will be refined as the consultation process moves forward to ensure synergy with other national and regional cooperation initiatives (section

6.4). They are also illustrative and the list will expand as the Pillar matures. Capacity development opportunities feature in each of the activities through joint working of professionals from each of the involve member countries and relevant regional and national institutes.

140. Concepts for individual activities will move forward at their own pace depending on level of commitment and availability of resources. The typology of activities (A, B, C, D) provided in Figure 12 is referenced in the titles of each proposal. The use of the terms 'regional' denotes activities related to more than one country, ranging from bilateral activities[58] to those involving all riparian states of the Aral Sea Basin. The list of potential activities for the Pillar are indicative and not intended to be exhaustive or constraining. Ohers can be added over time. The longer-term focus denotes those where the time needed to attain benefits is greater, but even for these, actions are required in the shorter term for supporting preparatory activities and establishing the enabling environment.

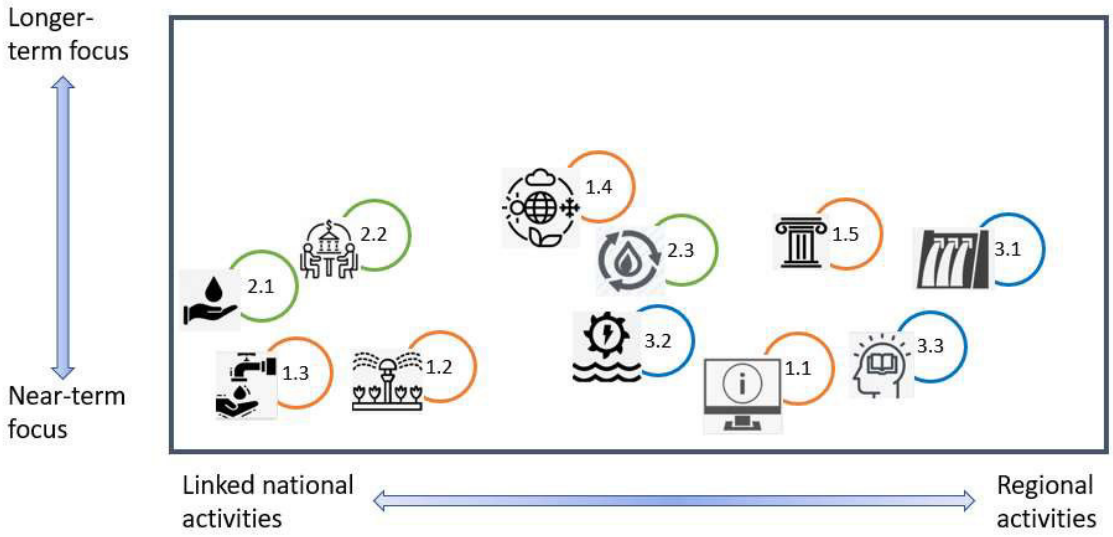
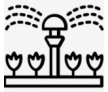


Figure 14: Mapping of potential groups of Water Pillar activities (indicative representation)

[58] For example, similar to earlier ADB supported project between Kazakhstan and Kyrgyz Republic on the Chu Talas basin.

Block 1: Climate resilient and productive systems

Activity Title	Examples of possible Sub-components	➢ Links with other programs (illustrative)
1.1 Strengthen regional information and analysis systems to manage uncertainty 	• Upgrade regional and national information and monitoring systems (A) • Align regional information systems with management processes for manging uncertainty (C) • Improve methodologies for undertaking basin water balance and water accounting, forecasting, pre-season planning and real time operations (A/C) • Improve data and analysis systems for snow and glacier dynamics and develop capacity for cryosphere and climate impact modelling (A/C)	• Existing regional information systems, e.g., SIC • ASBP4: links to 2 proposals • Regional information systems supported by UNESCO-IHP • Cryosphere monitoring supported by SDC • GEF/UNDP-funded regional project on cryosphere and water management by UNESCO • Work at national levels on information systems supported by GIZ, SDC and S. Korea • World Bank Hydromet Modernization Project
1.2 Build climate resilience and raise productivity through modernized irrigation systems. 	• Develop guidance for embedding climate resilience in project planning, design and operational procedures including drought planning (A/C) • Support investment in climate resilient irrigation and drainage modernization projects (B/D) • Introduce water productivity metrics and the concept of real water savings (A/C)	• ADB climate resilient irrigation projects in Tajikistan and Uzbekistan • IWMI applied research on irrigation water management
1.3 Increase resilience of communities through improved water supply and sanitation 	• Support expansion of coverage of urban and rural water supply and sanitation services (B)	• Multiple national WASH initiatives and COVID-19 programs

1.4 Support capacity for climate adaptation and disaster risk management 	• Strengthen forecasting and capability for disaster preparedness (A/C) • Promote an integrated approach to disaster risk management including nature based solutions and risk insurance (A/B/C/D) • Provide knowledge support for climate adaptation planning and preparing projects for climate finance (A/C)	• CAREC initiative on disaster risk financing • ADB TA 9414 pilot in Uzbekistan for climate and disaster risk screening tool • UNDP support for National Adaptation Plans • UNESCO project on GLOF early warning funded by Adaptation Fund
1.5 Climate proof regional agreements and align national legal systems 	• Develop guidance and support for climate proofing regional and bilateral agreements (C) • Provide a platform for sharing experiences on aligning national legislation to regional cooperation. (A/C)	• ADB /SDC support to Uzbekistan water legislation • WB support to Kazakhstan water legislation • Programs of UNECE / UNRCCA • GIZ Green Central Asia • EBRD Water efficiency – Green Economy Transition Approach

Block 2: Sustainable water resources and water services

Activity Title	Sub-components	Links with other programs (illustrative)
2.1 Transition to less water demanding and self-financed water services 	• Support for a program of demand management for irrigation and water supply systems including technological improvements and policy interventions (A) • Guidance on pathways for increased cost recovery and improved governance of water services including water user organizations, agricultural clusters etc. (A) • Support for introducing principles of economic value of water to water allocation and investment decision-making (A/C) • Build capacity for sustainable asset management procedures (A)	• ADB and World Bank support for irrigation modernization and WASH • Links to ongoing initiatives on asset management • IWMI applied research on water productivity • FAO projects – to be identified
2.2 Catalyze performance gains through private sector involvement 	• Develop guidance and share experiences on a balanced risk framework and enabling policy framework for private sector involvement including PPPs (A) • Develop appropriate contractual and financial options including support for non-sovereign financing for attracting private sector ventures (B)	• ADB, World Bank/PPIAF initiatives
2.3 Build towards a healthy water environment 	• Build capacity and invest in wetland restoration, nature based solutions (A/B/C/D) • Invest in circular economy solutions including wastewater reuse and waste-to-energy (A/B) • Develop guidance for preparation of improved salinity management plans and related investments (A/B/C)	• Links to ongoing initiatives on the Aral Sea • Links to work coordinated by ICSD

Block 3: Nexus solutions and cross sector learning

Activity Title	Sub-components	Links with other programs (illustrative)
3.1 Facilitate co-ownership and joint management of shared assets 	• Analysis and promotion of financing options and modalities for multi-purpose and transboundary water infrastructure. • Support identification and preparation of joint projects based on agreed cost-sharing and benefit sharing arrangements (A/C) • Invest in joint projects including application of green financing instruments (D)	• Links to ongoing bilateral and regional dialogue and planning initiatives on joint infrastructure • SDC funded projects on shared aquifers in Syr Darya in collaboration with UNESCO • FAO/GEF project in preparation on transboundary water management Panj river basin
3.2 Promote integrated water-energy solutions 	• Establish regional capacity for integrated water-energy planning models (A/C) • Incorporate benefits of the water-energy-food-climate nexus into planning systems (A/B/C/D)	• CAREC Energy Pillar • CAWEP
3.3 Incorporate evidence based-learning into planning decisions and management systems 	• Build capacity of regional training and knowledge hubs for integrated water management (A/C) • Support for applied research, monitoring and evaluation programs as a basis for a more integrated approach to water management (A/C)	• National and regional support programs to national and regional institutes • UNESCO-IHP programme

6.3.1 Block 1: Climate resilient and productive systems

141. Climate resilience involves managing uncertainty and increased variability as an essential component of future water resources management and service delivery. This first block of the Pillar supports improved knowledge and capacity for responsive management of climate change impacts and embedding resilience measures into planning design and operational procedures.

1.1 Strengthen regional information and analysis systems to manage uncertainty

142. **Align regional information systems (C):** [59] Several countries have started working on improved national water information systems based on SMART technology at key monitoring and control stations (e.g., the Uzbekistan Water Cadastre and National Water Information System of Tajikistan). This provides a basis for strengthened integrated regional information systems, building on existing and previous regional initiatives of SIC-ICWC and development partners (Hunink 2021, Annex 2). The Aral Sea Basin Program-4 (ASBP4) has identified two potential projects in this area. The CAREC Water Pillar could provide knowledge support for aligning the regional information system with improved procedures for addressing uncertainty and variability, including methodologies for improving water balance assessments, forecasting, pre-season planning, and real-time operations, and joint working groups on climate scenario modelling. Joint learning and development of mutually compatible systems would be significant benefits of a regional approach.

143. **Expand capacity for climate impact modelling (A/C):** There are still important knowledge gaps in terms of the magnitude and the spatial and temporal patterns of changes in the Central Asian high-mountain regions and thus the impacts on water resources, specifically for the next few decades up to 2050. These gaps relate principally to the scarcity of reliable and appropriate data sets and consequent gaps in understanding of the impacts on the hydrological response changes in snow and glacier dynamics in the headwater catchments. The Aral Sea Basin Program-4 proposes a similar project specific to the glaciers within the territory of Tajikistan. The CAREC Water Pillar could support efforts of other development partners to build the necessary data and analysis systems, develop capacity for cryosphere and climate impact modelling and facilitate a change in planning protocols to incorporate uncertainty and greater variability.

1.2 Build climate resilience and raise productivity through modernized irrigation systems

144. **Build climate resilience into project design and operation (B/D).** Guidance for planning, design and operation of water infrastructure is based on conventional systems that have not kept pace with the needs of a changing climate, the liberalization of agriculture, or contemporary practice for water supply and sanitation. New approaches are being piloted in several development projects in the region to modernize irrigation systems and municipal water services and introduce planning and design procedures that pay more attention to uncertainty in hydrological records and need for adaptive management. The CAREC Water Pillar could support the embedding of climate resilience in planning processes, design guidance and operational procedures resulting in climate proofing of infrastructure and services, adoption of climate smart agriculture, and preparation of drought management plans.

145. **Reduce vulnerability by modernizing irrigated agriculture (B):** Improving the productivity of irrigation systems provides a range of benefits including contributing to water

[59] The letters A, B, C, D refer to the typology of projects in Figure 12

security through reducing demand, increasing farmer incomes to allow them to invest in resilience measures and providing water savings that frees up water for allocation to other users. The CAREC Water Pillar could support a program of climate resilient irrigation modernization projects across the region including a platform for exchanging experiences and building capacity. It would include a series of linked measures, for example reform of regulatory approaches to water allocation to ensure water savings are 'real' (see para 120), expansion of water saving technology for main and on-farm systems including pressurized systems, adaptation to the trends of changing agriculture in the medium to long term, institutional strengthening of water users associations, assessment of the scope for including decentralized renewable energy technologies, and support for the growth of indigenous private sector industry for irrigation equipment.

146. **Introduce performance assessment metrics on water productivity (A/C):** The benefits of assessing physical and economic water productivity over conventional irrigation efficiency are outlined in section 3.5. Utilizing the new capabilities for assessing physical water productivity from remote sensing information provides an improved capability for using performance data to target improvements on the ground aimed at closing the yield gap and provides a feedback loop for system managers. The CAREC Water Pillar could support establishment of a regional working group to explore joint learning activities and experience sharing on the new performance metrics. The scope includes applying the more data-intensive economic water productivity measure as a policy research tool to inform decisions on agricultural futures. Water productivity criteria, and the metrics used to operationalise these, would need to be assimilated into the overriding imperative for climate resilience (e.g., for the choice of the most economically productive use of water in drought-resilient crops, or by incorporating climate risk into expected economic returns).

1.3 Increase resilience of communities through improved water supply and sanitation

147. **Build regional networks and share experiences in water services:** Although project investment in water supply sanitation and health is predominately a national and sub-national undertaking, the potential benefits from shared learning and mentoring with utilities outside of the region are considerable. Areas of water sector reform, cooperation and joint learning include cost recovery and non-revenue water management, internal processes related to operating efficiency, customer orientation, O&M and asset management, PPPs, use of high level technology and SMART ICT, introduction of modern effluent discharge standards and safe wastewater recovery and reuse. Water operators' partnerships could be supported under CAREC to assist integration of resilience principles into water services and assist in addressing many of the common issues faced across the region.

1.4 Support capacity for climate adaptation and disaster risk management

148. **Promote an integrated approach to disaster risk management (A/C):** With an increased frequency of extreme climate events, there will be an increasing need for cooperation to forecast, warn and mitigate disasters including floods, droughts and mudslides. Strengthening regional information systems, the sharing of real time data and notification procedures are critical. There are several initiatives underway in this area including that supported by UNESCO (see section 6.4). The CAREC Water Pillar could provide technical assistance and investment support for an integrated approach to disaster risk management including incorporation of nature-based solutions (NbS), and introduction of parametric risk insurance. It would link with the work of CAREC on disaster risk financing facility. NbS mimic natural processes to protect and sustainably manage natural or modified ecosystems and can reduce flood risks in riverine, urban and agriculture areas and recharge groundwater. Strengthening systems for dam safety similarly

require improvements in regional cooperation on emergency preparedness, information exchange and warning systems.

149. **Build capacity for financing climate adaptation (A):** The increased emphasis on NDCs in preparation for the COP26 meeting in 2021 is providing renewed focus on water as a core component of national adaptation planning. The CAREC Water Pillar could provide assistance for cross-sector engagement in detailed climate adaptation planning including coordinated regional approaches, guidance and briefing materials on mechanisms and approaches for accessing climate and green finance opportunities, and a platform for dialogue and exchange of experiences across countries of the region. It is necessary to understand how climate risks interact with the lives and livelihoods of affected communities. This will differ depending on the region and economic activity and needs to be understood as a pre-requisite of project design. A pipeline of climate adaptation projects could be developed to the level needed for submission for climate funding.

1.5 Climate proof regional agreements and align national legal systems

150. **Climate proof regional agreements and procedures (C):** The analysis of regional agreements and policies for this scoping study revealed that the context and basis for them date back to a period prior to the current recognition of climate change impacts. The challenges facing countries of the region are now more complex than they were a generation ago. The CAREC Water Pillar could promote support for climate proofing regional and bilateral agreements and related capacity development, to ensure that institutional arrangements, mechanisms and procedures are fit for purpose, support adaptation pathways to reach a sustainable 2050 scenario and address other development challenges and opportunities, including those related to a more integrated water and energy system. This includes incorporating the principle of sustainable development and procedures for the use and protection of inter-State water resources and closer coordination between water and environmental regulatory frameworks and institutions that oversee them.

151. **Align national and regional legal provisions (A/C):** Reforms in the water sector are being reflected in the national legislative systems of Central Asian states, either through recently approved or revised water codes and laws or ongoing processes. There is much to learn from the experiences of implementing the new provisions and, like any reform process, adaptions will be needed as the process progresses. The analysis for this scoping study identified several aspects where the commitment and support for regional cooperation is not fully reflected in national legislation. The CAREC Water Pillar could provide a platform for dialogue and technical assistance on harmonizing national water legislation with commitments on regional cooperation as a means of better aligning development and management processes at national and regional scales.

6.3.2 Block 2: Sustainable water resources and water services

152. The poor physical condition of water infrastructure across Central Asia and degraded environment are partly a consequence of subsidies that distort water allocation decisions and result from an inability to generate financial resources from the services provided. The second

block of the Water Pillar focuses on interventions to improve financial sustainability and hence physical sustainability of water assets, together with environmental sustainability of the resource.

2.1 Transition to less water demanding and self-financed water services

153. **Manage demand, improve services and increase cost recovery (A):** This scoping analysis has confirmed projections of other studies that a major emphasis on demand management is needed to assure future water security in the face of economic development pressure and climate change. It applies to all water services and is part of a comprehensive approach needed for improving governance, raising levels of service to the consumer, and working towards self-financing of water systems.[60] Particular progress is needed in irrigation as it is the major water user. Irrigation water and power are subsidized in all the Central Asian countries and although several countries aim to reduce these subsidies, the trajectory and timeframe for reducing subsidies will depend upon local economic and social contexts and needs to be part of a broader package of policy measures to assist farmers'. The CAREC Water Pillar can assist in preparing pathways for demand management and cost recovery, joint learning by mobilizing and exchanging experience from beyond and within the region, assembling examples of good practice, and providing a platform for implementation on associated modernization projects. It would involve guidance on structures for sustainable finance for water resources management and service provision, including transitional processes for subsidy removal. Developing detailed recommendations will require a more comprehensive analysis of the current status and recent trends in costs, financing modalities and subsidy levels. Demand management practices in irrigated agriculture also include climate smart agriculture, scheduling and soil moisture management, and other agronomic practices.

154. **Build capacity for asset management (A):** Breaking the cycle of deteriorating water infrastructure is essential for future water security. Rehabilitation and modernization projects alone are insufficient. In addition to the measures for cost recovery and financial sustainability, there is a need for more effective asset management systems that prioritizes maintenance activities according to an objective assessment of needs and is linked to reforms in budget planning procedures. Some countries in the region have embarked upon such systems (e.g., Kyrgyz Republic and Tajikistan) and others have committed to them in recent strategy documents (e.g., Uzbekistan). The CAREC Water Pillar could provide a regional platform for disseminating knowledge and exchanging experiences on asset management, including with agencies outside the region, and incorporate good practices into modernization projects.

155. **Apply principles of economics value to water allocation and investment decisions (A/C):** Systems of water allocation both regionally and nationally have their origins in the Soviet system. As competition for water grows, the influence of other sectors like energy expands and appreciation of the environmental needs for water grows, there is a need to revisit basic principles underpinning national allocation systems. The priority accorded to providing adequate and safe domestic water is universal agreement across the region. Allocation decisions will increasingly need to consider the economic value of water use and its contribution to overall national development goals and ensuring sufficient water is available for environmental needs.

[60] The ADB supported Dushanbe Water Supply and Sanitation Project in Tajikistan typifies a "holistic" approach to reform, which "..includes a behaviour change and communication plan, aimed at demand side management, to promote the new service level and its impact on health, efficient water usage, and awareness of the benefits of metering and billing among stakeholders." (ADB, 2018, p. 4)

The CAREC Water Pillar could raise awareness and examine options for incorporating the economic value of water into policy considerations and water allocation and investment decisions. In the short term, this could include the development of an evidence base, metrics and analysis of appropriate policy tools, drawing on relevant international experience and the evolving state-of-the-art. In the medium term, the feasibility of applying these principles to policy reform in Central Asia countries could be tested, selecting the 'low hanging fruit' in order to create momentum. Certain policy innovations (e.g., water markets) could be piloted on a local scale. In the longer term the full assimilation of the principle of the economic value of water would call for its systematic use across the spectrum of policies and the creation of a coherent incentive structure for water users. The formation of a forum of water economists, drawn from CAREC member states and regional institutions, would assist policy dialogue with governments on the application of economic principles to the water sector, and support efforts to broaden the financing of its development and operation.

2.2 Catalyze performance gains through private sector investment

156. **Provide guidance on private sector investment in irrigation and water services (A):** Other sectors have successfully encouraged greater involvement of the private sector and public-private partnerships and yet this has been elusive in the water sector. Improving the value proposition for private sector engagement requires creating a pipeline of projects with the required balance of risk and reward, and a clear and balanced enabling environment. The CAREC Water Pillar can facilitate dialogue in the region on key elements of policies, institutions and regulations for encouraging private sector involvement based on adapted experience from other regions, including the apportionment of risk, and provide advice and financial support for project implementation.

2.3 Build towards a healthy water environment

157. **Improve the water environment (A/B/C):** Recognition of the importance of a healthy water environment has grown in recent decades, yet practical measures to redress degradation are still limited compared to the scale of the existing problems. A 'business as usual' scenario would threaten further environmental assets and the economies that depend upon them requiring costly restoration campaigns in the future. The CAREC Water Pillar could use regional dialogues and investment support to stimulate a coordinated and integrated approach across a range of measures to improve water quality; encourage the circular economy principle through reuse of treated wastewater and recovery of waste as an energy source; restore aquatic ecosystems including through recognized water allocations; adopt drainage, salinity management and land reclamation plans; and adopt nature-based solutions for flood risk management. A pilot project could be supported to demonstrate the potential for conjunctive surface and groundwater management and various water saving technologies, considering an integrated system-approach to the water balance (consumptive use, return flows) and pollution and salinity management.

6.3.3 Block 3: Nexus solutions and cross-sector learning

158. Strengthening regional cooperation on water requires joint investments of human, technical and financial resources as well as coordination with the changing context of energy sector development. The third block of the Pillar focuses on building joint planning and

management capacity, processes for addressing the water-energy-climate nexus and encouraging joint management of shared assets.

3.1 Facilitate co-ownership and joint management of shared assets

159. **Develop mutually beneficial joint projects (C/D):** Considerable progress has been made in recent years on proposals for joint development and financing of shared assets, particularly on tributary rivers. It reflects successful practices from other international river basins. The CAREC Water Pillar could assist in developing guidelines on principles and procedures for the implementation of joint water projects including on cost and benefit sharing, and in project preparation and investment support for individual projects where there is express demand from two or more countries. This could be linked to catalyzing support for sourcing green finance where applicable.

3.2 Promote integrated water-energy solutions

160. **Establish a capability for integrated water-energy planning (A/C):** The inter-connectivity of hydropower operation and river management has grown and become more complex as hydropower generation capacity increases, regional transmission grids expand and the role for hydropower in providing grid stability develops. This provides potential opportunities and challenges and the increased variability of the flow regime requires closer engagement between the sectors starting with a clearer joint understanding of the potential implications and responses. The CAREC Water Pillar could support the establishment of a regional capability for integrated water-energy modelling systems through adaption of the type of systems recently applied to other major river basins.[61] A joint regional water-energy working group could oversee scoping of the issues and application of a suitable model, thereby building consensus on the implications for the two sectors and exploring options for future plans and operational modalities. Emphasis in application of the models will be placed on building regional capacity and it would need to be linked to climate modelling activities.

161. **Incorporate the water-energy-food-climate nexus (A/B/C/D):** The close relationship between water and other sectors of the economy and environment has been stressed in many of the consultations for this scoping study. A strategic dialogue between key actors in the water and other sectors is largely absent in the region. The CAREC Water could facilitate a range of knowledge generation and dialogue processes focus on the practical dimensions of integrating nexus thinking into current planning and management processes and portfolio development. This would emphasize the importance of addressing the water-energy nexus in achieving water security. Applied inter-sectoral research could be undertaken on the economic benefits of green infrastructure solutions and of environmental flow allocations to critical wetlands; managing reservoir storage to minimize the consequences of increased flow variability (linked to energy-water modelling; the potential and practical guidance for renewable energy, e.g., through floating solar systems on reservoirs, canal-top solar, or decentralized solar supply for irrigation pumping

[61] Normally water and energy planning models are run separately and do not interact. Under the FutureDAMS research project, a new approach to integrated water and energy modelling has been developed that allows short time step analysis of multiple possible development scenarios providing implications across a range of pre-determined water and energy indicators. The model has been piloted in a number of countries including Ghana in West Africa where the complex interaction between hydropower generation and releases for irrigation downstream were analyzed. For more details see River basins and energy systems - what synergies are possible and how can they be discovered? - The FutureDAMS Research Consortium

stations in remote areas, or mini-hydropower; and studies on the potential implications on water security of the expected increased regional trade in agricultural products (virtual water).

3.3 Incorporate evidence-based learning into decisions and management systems

162. **Build regional capacity in knowledge management (C):** Considerable capacity already exists in the region for policy and technical research on water resources management, irrigation management and the water environment, including but not limited to agencies such as SIC-ICWC, CAREC Institute, *carec* regional environment centre, the International Water Management Institute, and national universities and institutes, many of which operate on a regional agenda.[62] In implementing its programs, the CAREC Water Pillar will prioritize the involvement of regional and national institutes where relevant experience exists in order to further strengthen the network of knowledge hubs and local capacity for policy and thematic analysis, skills development, and in-career professional development. The scope of knowledge services covers all topics identified in the above proposals with particular emphasis on climate resilience and supporting the career advancement of women in the water sector.

6.4 Synergy with other development programs

163. There is a broad landscape of water-related regional cooperation programs initiated by Central Asian countries and development partners alongside which the CAREC Water Pillar will operate and complement. These will continue to evolve over time. The most prominent of these is the **Aral Sea Basin Program** coordinated by the Executive Committee of IFAS. Now in its fourth iteration, (ASBP4), it brings together a range of activities proposed by IFAS member countries and developed into concepts for funding support. ASBP4 was approved by IFAS in June 2021 and comprises 34 project concepts along the four categories of integrated water resources management; environmental direction; socio-economics; and improving the organizational and legal framework of IFAS. Many of the topics in ASBP4 are closely linked to the proposals presented in section 6.3.

164. A significant strength of the ASBP process is the level of ownership and engagement of IFAS member states in its formulation and determination of project concepts. A weakness in the past has been difficulty in attracting donor funding, which in part may be attributable to their lack of involvement at an early stage or donor concerns regarding the extent proposals have undergone an inclusive regional process. This leads to a mismatch with development partner programs which tend to be planned on a different timeframe, typically with 2-3 year lead times. One potential measure to more closely align the processes so as to increase the uptake of ASBP projects for funding, reduce delays and enhance continuity of approaches, would be to hold a development partner conference at an earlier point in the process, once preliminary ideas have been generated by member states. Care is needed to ensure that it remains the agenda of the member states and at the same time that project concepts are fashioned in a way that is considered 'bankable' by development partners, including incorporation of measures to incorporate social and environmental safeguards. For ASBP4, a development partner conference is being organized for October 2021.

165. Other major programs with which the Water Pillar could build links include:

[62] An expert platform for interdisciplinary research water security and sustainable development has been created (http://cawater-info.net/expert-platform/index_e.htm)

- **Central Asia Water and Energy Program** (CAWEP)[63] - a multi-donor fund implemented by the **World Bank** and which evolved from the former Central Asia Water Development Program (CAEWDP)[64] that supported the Central Asia Hydromet Modernization Project (CAHMP), the Climate Adaptation and Mitigation Program for the Aral Sea Basin (CAMP4ASB) and the Central Asia South Asia Electricity Transmission and Trade Project CASA-1000). CAWEP is structured around three action areas for water security, energy security and water-energy linkages (data and diagnostic analysis; institutions, capacity and dialogue; and supporting investments), two national areas of investing in water supply and sanitation; and reform of water resources governance and irrigation management; and a combined national and regional action area on adaptation measures to build economic and social resilience.
- **Blue Peace Central Asia Initiative**[65] of the government of **Switzerland** focusing on fostering dialogue related to the increasing competition for water resources in the region. Launched in 2014, it comprises three pillars on (i) diplomatic and sector policy to support dialogue between states; (ii) operations to bring knowledge and evidence based dialogue to priority areas of data management (including disaster risk reduction), joint management of infrastructure, and water quality; and (iii) youth to raise awareness and build capacity of the next generation on the social, economic and political interlinkages of IWRM.
- **Green Central Asia –** a joint initiative between **Germany**, the Central Asian states and Afghanistan[66] for support 'in tackling the challenges of climate change and in strengthening regional cooperation'. The program involves a series of political dialogues on climate security underpinned by projects, including early detection of climate-induced security and development risks, the analysis of climate-related security risks, training on adaptation to climate change and strengthening of resilience, including through the use of renewable energy sources. It builds on a major program of the German government on transboundary water management implemented from 2009 to 2019.[67]
- **European Union** programs include support for CAWEP; the Central Asia Water, Environment and Climate Change Cooperation (WECOOP) that aims to enhance environment, climate change and water policies in Central Asia through approximation to EU standards and to promote green investments; the EU Water Initiative National Policy Dialogues (NPDs) implemented by UNECE (see below) ; the Central Asia Nexus Dialogue Project: Fostering Water, Energy and Food Security Nexus and Multi-Sector Investment; and the Regional Water Monitoring System in Central Asia which provides regional capacity of water monitoring system and laboratory capacities related to uranium legacy sites.
- **USAID support includes the** Contribution to High Asia Runoff from Ice and Snow (CHARIS) a USAID regional project in the five countries focussing on the role of glaciers and seasonal snow cover in the hydrology of the mountains of High Asia; [68] and the Regional Water and Vulnerable Environment Activity (WAVE) that aims to develop human capital

[63] Central Asia Water & Energy Program (worldbank.org)
[64] See Promoting Pathways to Energy and Water Security 2009 2017 Impact Report
[65] Regional Initiatives - Central Asia (thebluepeace.org)
[66] Joint Declaration of Intent of the high-level Green Central Asia conference held in Berlin on 28 January 2020.
[67] Transboundary water management in Central Asia (giz.de)
[68] http://nsidc.org/charis/

on IWRM and nexus issues, support the capacity and sustainability of sub-basin councils, support inter-sectoral transboundary coordination and respond to emerging environmental challenges and opportunities.

- **Central Asia Climate Information Platform (CACIP)** is currently being developed and aims at giving stakeholders access to public-domain climate and climate-relevant data, linking with high-quality datasets from global, regional, and local sources. It is developed within the framework of the World Bank funded CAMP4ASB initiative and led by the Central Asia Regional Environmental Center (*carec*).
- The **Regional Information System on Water and Land Resources in the Aral Sea Basin** (CAWater-IS) of SIC-ICWC is an actively used resource of information on water resources in the region, publishing data on flows, and reservoir water balances. Some of the data is public and published in bi-annual reports.
- **United Nations. UNESCO-IHP** (International Hydrological Programme) has been implementing numerous water related activities in the region, at various level with focus on advocacy, capacity building and policy support. Specific focus is on climate change and glaciers melting in the region, as well as transboundary groundwater management. Currently a regional project is launched on reducing vulnerabilities from glacier lake outburst floods, funded by the Adaptation Fund and focusing on DRR and climate change adaptation. They are also involved in a larger regional project (5 Central Asian countries participating), funded by the GEF through **UNDP** focusing on cryosphere and water, tackling upstream and downstream water management issues. The IHP Programme will start its new 8 year phase/cycle in 2022 focusing on capacity building activities including the Central Asian region. **UNECE** is involved with several National Policy Dialogues on IWRM in Central Asia, technical support to the Chu Talas Water Management Commission, support for improving safety of mine tailings operations and early phase of a project to reduce pollution of the Syr Darya river as a result of emergency situations (see program links in Annex 4). It is part of a UN proposal for a Special Programme for the Economies of Central Asia (SPECA) that focuses on regional water-energy strategy, increased private sector involvement for nexus-related investments and climate resilient transformation of agribusiness.
- **Chinese Academy of Sciences** (CAS) is actively involved in various applied research projects in the Aral Sea region. The CAREC Institute and the CAS organized an international symposium on 'Ecological Restoration and Management of the Aral Sea' in November 2020) in which many of their research and development projects were presented.
- **Knowledge institutes** – extensive analysis and research work is being undertaken by a range of regional institutes referred to in this report including, but not limited to, SIC-ICWC,[69] the CAREC Institute, *carec* Regional Environment Centre and IWMI. Collectively they provide a valuable regional resource to support the proposals for the Water Pillar. The Strategic Knowledge Framework of the CAREC Institute focuses on knowledge

[69] Some of the initiatives proposed by SIC-ICWC include: measures of Regional Hydromet for development and application of the long-term flow forecast; long-term planning of multiyear operation of water-management system for Amu Darya and Syr Darya; operational model for planning of river water management; improvement of river flow management accuracy through SCADA system; development of the regional program of rational water use in the basin; and development of a program on return water use.

generation including research on regional water and energy cooperation and on climate vulnerability; knowledge services including capacity building on climate and water scarcity and WASH; and knowledge management including work on sustainable water and sanitation systems. Specific initiatives on water related to the CAREC Institute program for 2021-22 are given in Annex 4.

166. In addition, there is a wide range of regional and national projects funded by multilateral agencies (ADB, World Bank, EU, IsDB etc) and bilateral agencies. A preliminary list appears in Annex 4).

167. The agenda set by Central Asian states for achieving water security in the region is broad and ambitious. The framework for the CAREC Water Pillar is being designed to work alongside other initiatives and will:

- benefit from and link to dialogue processes that focus on strengthening of regional institutional arrangements and procedures (e.g., IFAS reforms, Blue Peace, Green Central Asia)
- complement ongoing regional and national programs through targeted investment and technical assistance
- strengthen existing regional knowledge institutions.

6.5 Financing the Pillar

168. Financing mechanisms for the Water Pillar will mirror those of other CAREC programs with a combination of sovereign and nonsovereign lending and grant resources. In addition to ADB and national contributions, co-financing arrangements will be possible through partnerships with other development partners on a project-by-project basis with an increasing emphasis on climate adaptation and green financing vehicles. A network of 'friends' of the CAREC Water Pillar could be established to attract a broad range of resources, skills and perspectives to the program. ADB will provide initial coordination support for the establishment and early implementation stages of the Water Pillar.

6.6 Implementation arrangements

169. Procedures and processes for identifying and appraising potential activities under the CAREC Water Pillar will follow those of other CAREC sector activities including the roles of national focal points for the Water Pillar, expert working groups and sector committees with representatives from relevant countries. Consideration will be given to establishment of a Water Pillar steering committee similar to those of other CAREC sectors. Oversight and coordination of complex projects will be provided through the Senior Officials' Meeting. The CAREC Secretariat and ADB thematic divisions will provide organizational and technical support. Activities under the Water Pillar will involve two or more countries from the region depending on the focus and scope.

7 Next steps

170. Following on from finalization of the scoping study report, the next steps in the process of establishing the Water Pillar are:

- briefing to CAREC National Focal Points Meeting (12 October 2021).
- Presentation of draft CAREC Water Pillar to a possible side session of the CAREC Ministerial Conference (tbd)
- development of concept papers for selected priority projects (end 2021-early 2022)
- initiation of discussions to undertake similar scoping studies in other sub-regions of CAREC.

Annexes

1. List of people contacted
2. Summary of regional consultations – 16 April 2021 and 14 September 2021 (to be added)
3. List of regional agreements
4. List of related development partner projects in Central Asia

Supplementary Appendices – thematic papers prepared for the study

(available on request – full papers in English, executive summaries in English and Russian)

- **Climate resilience through regional cooperation**
- **Realising the economic value of water in Central Asia countries**
- **Legal aspects to strengthen water resources management in Central Asia**

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Annex 1: List of people met through virtual consultations

Lists of participants of the regional consultations held on 16 April 2021 and 14 September 2021 are given in Annex 2.

CAREC Member Countries

Kazakhstan (25 March 2021)

- Ministry of Ecology, Geology and Natural Resources
- Mr. Arsen Zhakanbaev Armanovich, Head, Division for Regulation of the Use of Water Resources, Committee for Water Resources
- Mr. Murat Beisenov Ukeevich, Head, Division for Operation and Development of Water Management Facilities, Committee for Water Resources
- Mr. Erdos Kulzhanbekov Tursynbekovich, Head, Division of Hydro-Reclamation and Implementation of the State Program, Committee for Water Resources
- Mr. Marat Imanaliev Ualikhanovich, Head, Division of State Control over the Use and Protection of Water Resources, Committee for Water Resources
- Ms. Aigul Sultanova Kairatovna, Head, Tariff Setting Department of the RSE "Kazvodkhoz"
- Mr.Daniyar Sagadiev Gabitovich, Head, Transboundary Rivers Division of the Transboundary Rivers Department

Kyrgyz Republic (5 March 2021)

Ministry of Agriculture Water Resources and Regional Development

- Mr. Abdybai Djailobaev, Deputy Director, Dept. of Water Resources
  CAREC Water Focal Point

Tajikistan (26 March 2021)

Ministry of Energy and Water Resources

- Mr. Daler Abdurazokzoda, Head, Water and Energy Policy, Development of Science and Technology Department/ TA 9977 Focal Point
- Mr. Gul Sharifov, Deputy Head, Water Resources Management Department/TA 9977 Focal Point

Turkmenistan (10 March 2021)

Ministry of Foreign Affairs

- Mr. Makhtumkuli Akmyradov, Advsior, Dept. of International Organizations*ter Management*
- Mr. Georgiy Kurtovezov, Head, Laboratory for Water Supply Engineering, "Turkmensuwylymtaslama" Institute/ TA 9977 Focal Point
- Mr. Jumamuhammet Geldiyev, Engineer-in-Chief, "Turkmensuwylymtaslama" Institute/ TA 9977 Focal Point

Uzbekistan (6 March 2021)

Ministry of Water Resources

- Mr. Zokirjon Ishpulatov, Head, Division for Water Resources/TA 9977 Focal Point
- Mr. Shamsiddin Kurbonov, Acting Director, Information and Analytical Resource Center, TA Coordination Unit
- Mr. Farkhod Akhmatov, IARC

Inter-governmental organizations

Executive Committee of IFAS

- Mr. Sulton Rahimzoda, Executive Chairman
- Mr. Husniddin Sharofiddinov
- Serik Bekmaganbetov

Scientific Information Centre, Interstate Commission for Water Coordination of Central Asia (ICWC)

- Prof. Viktor Dukhovny, Director, Scientific Information Centre[70]
- Dr. Dinara Ziganshina, Deputy Director, Scientific Information Centre
- Dr Shavkat

International Fund for saving the Aral Sea (IFAS)

- Dr. Vadim Sokolov, Head, Agency of IFAS for Aral Sea Program and GEF Projects

ADB

Environment, Natural Resources & Agriculture Division (CWER), Central and West Asia Department (CWRD)

- Ms. Yasmin Siddiqi, Director
- Mr. Kazuhiro Yoshida, Senior Water Resources Specialist/ Team Leader
- Mr Frank Radstake, Principal Water Resources Specialist
- Mr. Yaozhou Zhou, Principal Water Resources Specialist
- Mr Nathan Rive, Climate Change Specalist
- Mr. Malte Maass, Climate Change Specialist
- Mr Akihiiro Shimasaki, Senior Water Resources Specialist
- Ms. Marie Stephani Igaya, Project Officer

Energy Division (CWEN), Central and West Asia Department (CWRD)

- Mr Joonho Hwang, Director
- Ms Sarin Abado, Energy Specialist

Urban and Water Division (CWUW), Central and West Asia Department (CWRD)

- Ms Ramola Singru, Senior Urban Development Specialist

Regional Cooperation and Operations Coordination Division (CWRC), CWRD

- Mr. Safdar Parvez, Director
- Mr. Saad Paracha, Senior Regional Cooperation Specialist
- Ms. Carmen Perez, Regional Cooperation Specialist
- Mr. Vishal Potluri, Young Professional

Kazakhstan Resident Mission (KARM)

- Mr Kenzhekhan Abuov, Project Officer
- Regional Cooperation Coordinator

Kyrgyz Resident Mission (KYRM)

- Ms. Ainagul Amanova, Senior Project Officer
- Ms Aidana Berdybekova, Regional Cooperation Coordinator

Tajikistan Resident Mission (TJRM)

[70] The team of consultants was saddened to hear of the passing of Prof. Dukhovny prior to the finalization of this report.

- Mr Shavkhat, Vosiev Senior Project Officer
- Ms Ganjina Fazilova, Regional Cooperation Coordinator

Turkmenistan Resident Mission (TKRM)
- Mr Chang Ching Yu, Country Director
- Ms Jennet Hojanazarova, Sr. Economics Officer and Regional Cooperation Coordinator

Uzbekistan Resident Mission (URM)
- Mr Talat Nasirov, Senior Project Officer
- Mr Rovshan Mamurov, Regional Cooperation Coordinator

Development Partners and Bilateral Agencies

Deusche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH
- Dr. Caroline Milow, Programme Manager of the Green Central Asia Initiative, German Federal Foreign Office
- Mr. Alexandr Nikolayenko, Senior Regional Advisor

European Union (EU)
- Mr. Robert Brudzynski, Project Manager, Cooperation Section, European Union Delegation to Kazakhstan
- Ms Suzanna

Islamic Development Bank (IsDB)
- Mr Nizar Zaied
- Mr Bekzod, Parmanov

Swiss Agency for Development and Cooperation (SDC)
- Mr. André Wehrli, Coordinator, Regional Blue Peace Program

UN Educational, Scientific and Cultural Organization (UNESCO), Almaty Cluster Office for Kazakhstan Kyrgyz Republic, Tajikistan, Uzbekistan
- Dr. Kristine Tovmasyan, Programme Specialist for Natural Services

United States Agency for International Development (USAID) Central Asia Economic Development Office
- Ms. Rabab Shamayleh, Water and Environment Team Leader
- Ms Gulzada

World Bank
- Dr William Young, Program Manager, CAWEP

International/Regional Institutes

CAREC Institute
- Dr. Iskandar Abdullaev, Deputy Director Two
- Qaisar Abbas, Chief of Research Division
- Shakboz Akhmedov, Research Division

Regional Environmental Centre for Central Asia (*carec*)
- Mr Zafar Makhmudov, Executive Director
- Ms. Tais Reznikova, acting Manager, Water Initiatives Support Programme

International Water Management Institute, Regional Representative Office for Central Asia (IWMI-CA)

- Mr. Oyture Anarbekov, Country Management/Researcher
- Mr Kakhramon Djumaboev, Country Management/Researcher
- Dr Akmal Karimov (former head of IWMI, now with Tashkent Institute of Irrigation)

Consultants

- Dr Pascal Bertolini, Team Leader ADB TA 9717 & 9823
- M. Anes Dallagi, Team member, ADB TA 9717 & 9823

Annex 2: Summary of regional consultations – 16 April 2021 and 14 September 2021 (*under preparation – to be inserted later*)

CAREC Water Pillar - Summary of Initial Re

Annex 3: Summary of regional agreements

Title of Regional Agreement	Main provisions
Agreement on Cooperation in **Joint Management of Use and Protection of Water Resources of Interstate Sources**, 1992 (all Central Asian countries)	○ aimed to set up the legal framework for joint use of water resources of Central Asian countries after the dissolution of the USSR; ○ equal rights to use and liability to procure rational use and protection of water resources of the region of each country which is party to the agreement; ○ obligation to respect the agreed procedure and rues for the use and protection of water resources; ○ not to allow actions which may affect interests of the other parties, change of agreed use level of water and pollution of water sources; ○ joint works to settle environmental problems related to shrinking of the Aral Sea; ○ establishment of the Interstate Commission for Water Coordination (ICWC);
Agreement on **joint action to address the problem of the Aral Sea and surrounding areas, environmental improvement and socio-economic development of the Aral Sea region** 1993 (all Central Asian countries)	○ aimed to define the common tasks of regional water and environmental cooperation in Central Asia; ○ establishment of the Inter-State Council for the Aral Sea Basin and the Commission on Socio-Economic Development, Scientific, Technical, and Environmental Cooperation (the predecessor of ICSD), and the Commission on Socio-Economic Development;
Agreement on the **use of fuel and water resources, construction, operation of gas pipelines of the Central Asian region** 1996 (Kazakhstan, Kyrgyzstan, Uzbekistan)	○ aimed to set up the legal basis for joint use of fuel and water resources: ○ parties to develop and execute separate documents given the most efficient use of the water resources of the Syrdarya river basin for irrigation purposes; ○ parties to develop principles and procedure for share participation in financing the costs of operation and repair of inter-republican water facilities; ○ suggestion to the Inter-State Council for the Aral Sea Basin Problems to annually consider the issues of joint use of water and energy resources of the Syrdarya River Basin;
Agreement on the **Use of Water and Energy Resources in the Syr-Darya River Basin** 1998 (Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan):	○ aimed to set up the legal framework to annually coordinate and decide on water discharges and joint discussion of issues of, *inter alia*, construction of new hydropower facilities and reservoirs or alternative sources in the region, ensuring the safe operation of hydraulic structures, located in the Syrdarya river basin, economical and rational use of water resources using water-saving technologies and technical means of irrigation and reducing and stopping the discharge of polluted water into water sources basin of the Syrdarya river; ○ establishment of the regime of use of electric energy additionally produced by Naryn-Syrdarya cascade connected with the water discharges regime in the vegetation and long-term regulation of water in the Toktogul reservoir, over the needs of Kyrgyzstan to Kazakhstan and Uzbekistan
Agreement between Belarus, Russia, Kazakhstan and Tajikistan on the **Main Principles of Interaction in the Field of**	○ aimed at ensuring conservation, rational use and protection of transboundary water bodies of joint use;

Rational Use and Protection of the Transboundary Water Bodies of the CIS 1998	○ regular information and forecast exchange, joint development of complex schemes of protection of water facilities from pollution and depletion, aim to agree and bring together legal, administrative and technical measures, normative documents regulating use and protection of water facilities; ○ creation of joint system of monitoring of water facilities
Agreement on the **Status of the International Fund for Saving the Aral Sea and its Organizations** 1999 (all Central Asian countries)	○ aimed to set up the legal basis, for the existing regional institutions - the International Fund, the ICWC and its subsidiary bodies and the ICSD and its subsidiary
Protocol on **Use of Water-Power Resources of Naryn-Syrdarya Cascade of Reservoirs** 2001 (Kazakhstan, Kyrgyzstan, Uzbekistan)	○ aimed to establish a coordinated regulation regime, implementing coordinated releases, rational use of water and fuel and energy resources; ○ establishment of water discharges regime from the Toktogul reservoir, Kayrakum reservoir, including in the vegetation period
Framework Convention for the **protection of the environment for sustainable development in Central Asia** 2006 (all Central Asian countries)	○ aimed to set up the legal framework for efficient protection of environment for sustainable development of the Central Asia including for the purposes of protection of water and prevention of water pollution and depletion of water resources; ○ implementation of the objectives of the Convention requires adoption of protocols, regional projects and other bilateral and multilateral schemes and mechanisms for cooperation – in relation to, *inter alia*, water pollution and depletion of water resources, regional monitoring, drinking water supply.

Summary of accessions to international agreements

	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Convention on **Wetlands** of International Importance (or Ramsar Convention) 1971	✔	✔	✔	✔	✔
Convention on **Environmental Impact Assessment** in a Transboundary Context (or EIA or Espoo Convention) and its Protocol on Strategic Environmental Assessment (or SEA Protocol) 1991	✔	✔			
Convention on the Protection and Use of **Transboundary Waters and International Lakes** and its Protocol on Water and Health 1992					✔
UN Convention on the Law of the **Non-Navigational Uses of International Watercourses** 1997	✔			✔	✔
Convention on **Access to Information, Public Participation in Decision-making and Access to Justice** in Environmental Matters (or Aarhus Convention) 1998	✔	✔	✔	✔	

Annex 4: List of related development partners projects in Central Asia

(as of May 2021)

Asian Development Bank

Country	Project Name – Water Resources & Irrigation	FY
TAJ	Irrigation and Drainage Modernization in the Vaksh River Basin Project	2021
UZB	Climate Adaptive Water Resources Management in the Aral Sea Basin Sector Project	2022
UZB	Agriculture and Water Resources Management Projects Readiness Facility	2022
UZB	Climate Adaptive Water Resources Management in the Aral Sea Basin Sector Project (Additional financing)	2024
UZB	Water Resources Management Modernization Project	2024

Country	Project Name – Water Supply and Sanitation	FY
TAJ	Dushanbe Water Supply and Sanitation Project (Additional Financing)	2022
UZB	Water Supply and Sanitation Sector Development Program (SDP)	2022
KAZ	Kazakhstan Urban Infrastructure Modernization Program (KUIMP) - Construction and Rehabilitation of Wastewater Treatment Facilities 1	2022
UZB	Fergana Water Supply and Sanitation Project	2024
	Project Name – Energy	
TAJ	Renewable Energy Support Project	2022
UZB	Solar PPP Program (Phase II - Sherabad Solar Partial Credit Guarantee)	2022
KGZ	Energy Sector Project	2023
UZB	Solar PPP Program (Phase IV-Partial Credit Guarantee)	2024

European Commission

Regional

- **Central Asia Water and Energy Program** (CAWEP, EU contribution of EUR 7 million)
- **Central Asia Water, Environment and Climate Change Cooperation** (WECOOP, EUR 3 million) aims to enhance environment, climate change and water policies in Central Asia through approximation to EU standards and to promote green investments
- **European Union Water Initiative National Policy Dialogues** (NPDs) in Central Asia (implemented by UNECE, EUR 600 thousand)
- **Central Asia Nexus Dialogue Project: Fostering Water, Energy and Food Security Nexus and Multi-Sector Investment** (implemented by CARECO where EU contributes EUR 1 million,) This project aims at institutionalizing the Nexus approach in national and regional governance structures and investment decisions for water, energy and food security.

- **Regional Water Monitoring System in Central Asia** (ISTC, EUR 3 million) provides regional capacity of water monitoring system and laboratory capacities related to uranium legacy sites.

Kyrgyz Republic

- work through the Investment Facility for Central Asia, blending EU grants with EBRD/EIB loans to: provide the population with sustainable and affordable service for safe and high quality drinking water and sanitation; upgrade operations and maintenance equipment; establish proper institutional and operational reforms for effective and rational use of water resources.

Tajikistan

- Provision of Technical Assistance to the Government of Tajikistan to build institutional capacity in IWRM and contribute to sustainable management and protection of water and land resources
- Zarafshon Irrigation Rehabilitation and River Basin Management Project (ZIRRB) with EU contribution of EUR 15.6 million to the WB Trust Fund to (i) strengthen the institutional base for irrigation planning and management and (ii) improve the condition and management of irrigation and drainage infrastructure in the Zarafshon sub-basin.
- Kulob Water and Wastewater Project with EUR 8.5 million EU contribution to IFCA blending with EBRD. The project works on water supply and sanitation, addressing all the elements of the WASH sector in Kulob city.
- Rural Development Program II. Contribution Agreement with GIZ for EUR 20,5 million was signed in late 2020, EUR 5 million are dedicated to support to water resources management.
- Negotiating an Administration Agreement with the World Bank for a 'Tajikistan Resilient Irrigation project'

Uzbekistan

- Water Resource Management Programme with 3 components supporting national policy framework for water governance and integrated water management; strengthening technical capacities of the stakeholders and raising awareness and partnership for sustainable water development. The components are implemented by GIZ, UNDP and CARECO.
- Fergana Valley Water Resources Management Project (EUR 14.5 M; 2018-2025): Implemented by the World Bank aims to improve the quality of irrigation and drainage service delivery to agricultural users and boost diversification of sustainable high productive agriculture.
- Water Services and Institutional Support Programme in Uzbekistan. IFCA blending action with the EU grant of EUR 11 M that will be blended with EIB loan of over EUR 290 M. The Programme's main objectives are to: (i) improve coverage, quality and efficiency of Water Supply and Sanitation services (ii) and strengthen the capacity of institutions for improved water service delivery.
- Sanitation Development Project in Uzbekistan with AFD. IFCA blending action where EU grant of EUR 9.4 M is blended with AFD loan of over EUR 109 M. Objective is to improve

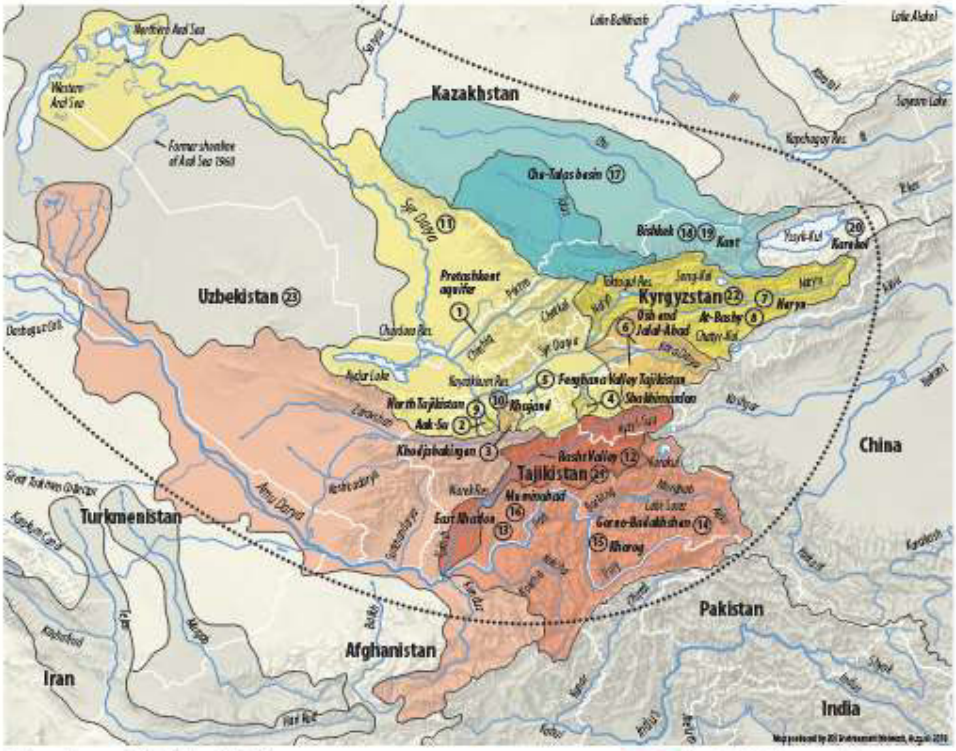
coverage, quality and efficiency of urban sewerage systems in in two urban centres of Uzbekistan: Karmana and Kitab-Shakhrisabz.

Germany

to be added

Switzerland

https://www.shareweb.ch/site/Water/Documents/Central%20Asia%20Watersheds%20Map%202018.pdf



Swiss water portfolio in Central Asia

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC
State Secretariat for Economic Affairs SECO

Transboundary watersheds and selected sub-basins

- Amu Darya
- Syr Darya
- Chu-Talas

Projects

■ SDC △ SECO

1. Pretashkent Aquifer
   - ■ *Groundwater resources governance in transboundary aquifers*
2. Aak-Sa
   - ■ *National Water Resources Management Project in Tajikistan (NWRM – Tajikistan)*
3. Khodjabakligan
   - ■ *National Water Resources Management Project in Tajikistan*
4. Shakhimardanskaya I
   - ■ *Regional Rural Water Supply Project Uzbekistan (RWSP)*
5. Fergana Valley Tajikistan
   - ■ *Rural Water Supply and Sanitation Tajikistan Fergana Valley*
6. Osh and Jalal-Abad
   - △ *Osh and Jalal-Abad Water Rehabilitation project*
7. Naryn
   - △ *Naryn water and wastewater project*
8. At-Bashy
   - △ *At-Bashy Hydro Power Plant Rehabilitation Project*
9. North Tajikistan
   - △ *North Tajik Water Rehabilitation Project*
10. Khujand
    - △ *Khujand wastewater rehabilitation project II*
11. Syr Darya
    - △ *Syr Darya water supply project*
12. Rasht Valley
    - ■ *Integrated Health and Habitat Improvement (IHHI) Rasht Valley IV*
    - △ *Rehabilitation Water and Wastewater project*
13. East Khatlon
    - ■ *Tajikistan Water Supply and Sanitation (TajWSS) III*
    - ■ *Safe Drinking Water and Sanitation Management in Tajikistan Project (SWSMT)*
14. Gorno-Badakhshan
    - ■ *Safe Drinking Water and Sanitation Management in Tajikistan Project (SWSMT)*
15. Kharog
    - △ *Pipeline Kharog Urban Rehilitation*
    - △ *North Tajik Water Rehabilitation Project*
    - △ *Tajik Water Phase II (Water Supply and Sanitation in Kharog)*
16. Mamlakat
    - ■ *IFAS Natural disaster DRR and IWSN Mamlakat*
17. Chu-Talas basin
    - ■ *Water Accountability in Transboundary Chu and Talas River Basins*
18. Bishkek
    - △ *Bishkek water and waste water rehabilitation project*
19. Kant
    - △ *Kant Water and Wastewater Project*
20. Karakol
    - △ *Karakol Water supply Project*
21. Tajikistan
    - △ *Tajik (national level) Water Phase II*
    - ■ *Focus Remote geohazards capacity building*
    - ■ *Improved DRR Policy making*
    - ■ *National Water Resources Management Project in Tajikistan (NWRM – Tajikistan)*
22. Kyrgyzstan
    - ■ *National Water Resources Management Project in Kyrgyzstan (NWRM – Kyrgyzstan)*
23. Uzbekistan
    - ■ *National Water Resources Management Uzbekistan*

Central Asia
Blue Peace Central Asia
△ *Central Asia Energy and Water Dev. CAEWDP*

United Nations

UNCCD 2021: Climate Change, Land Degradation and Migration nexus in Central Asia

UNESCO:

- Current: Regional project on reducing vulnerabilities from glacier lake outburst floods, funded by the Adaptation Fund (4 CA countries participating) and focusing on DRR and climate change adaptation.
- Project under processing involving 5 CA countries to be funded by GEF through UNDP focusing on cryosphere and water, tackling upstream and downstream water management issues and looking more in depth at cryosphere with its three components- glaciers, snow and permafrost
- International Hydrological Programme will stat an 8 year phase in 2022 focusing on strengthening IHP national committee, water education and regional water information systems.

UNECE: Links to the work of the 1992 Convention relevant to Central Asia include:

- The Water Convention and the Protocol on Water and Health: https://unece.org/environment-policy/water
- National Policy Dialogues as a multisector platform for water related reforms and transboundary cooperation: https://unece.org/environment-policy/water/areas-work-convention/npds-central-asia
- Adaptation to climate change: https://unece.org/environment-policy/water/areas-work-convention/water-and-adaptation-climate-change
- Water-food-energy-ecosystem nexus: https://unece.org/environment-policy/water/areas-work-convention/water-food-energy-ecosystem-nexus
- Financing of transboundary water cooperation: https://unece.org/environment-policy/water/areas-work-convention/financing-transboundary-water-cooperation
- Water allocation and the new Transboundary Water Allocation Handbook: https://unece.org/environment-policy/water/areas-work-convention/water-allocation-transboundary-context

United States

- The Contribution to High Asia Runoff from Ice and Snow, or CHARIS, project is systematically assessing the role that glaciers and seasonal snow play in the freshwater resources of High Asia.

World Bank – CAWEP Projects

CAREC Institute

	ROP 2021	**ROP 2022**	**TA 2021**
Capacity Building	Blended Workshop on CAREC Regional Water Management: Climate Change and Water Scarcity	Agricultural Trade in the CAREC: Tapping East Asian Market potential focusing on PRC's Greater Bay Area initiative (Guangdong-Hong Kong-Macau regions)	Workshop on Water, Sanitation and Hygiene in CAREC region (CI-UNICEF)
	Blended Workshop on International Symposium on Ecological Restoration and Management of the Aral Sea Region	Technology Application for Disaster Risk Reduction (DRR) in Central Asia	Workshop on CAREC Climate Change Vulnerability Index
Research	Sustainable Policy framework for Energy Transitions pathways of the CAREC member countries	Implications on economy of regional water and energy cooperation in Central Asia	
	Regional Climate Vulnerability in CAREC and		

	Perspectives for Regional Cooperation		
Knowledge Management	Development of sustainable water and sanitation systems in rural areas of CAREC region – April 2021	Public webinar on Key impacts of behavior change in WASH for building health resilience and a more dynamic economy	
	Public webinar on Finance sustainable for the WASH in CAREC region - 2021		

The CAREC Institute identified the following synergies between their program and the Water Pillar:

Investment support:

- Water infrastructure Investment Forums/Dialogues of CAREC countries – based on water infrastructure investment of CAREC Institute/ADBI (Economist's dialogue)
- Water Sector Infrastructure financing priority map -selecting most important priority areas (expert group work)

Generator of knowledge:

- Research projects and activities, research partnerships, Visiting Fellowships, CAREC Institute Think Tank grants, Annual Research Conference - knowledge generation and intellectual (research to research cooperation)

Platform for dialogue:

- Policy dialogues, policy discussions and priority setting and regional working groups (policy makers dialogue)
- Regular CAERC Water Dialogues series to discuss economic cooperation options (water professionals dialogue)

Facilitator of capacity development:

- Capacity Building interventions, professional development, Leadership Trainings, targeted group, on-job trainings (www.elearning.carecinstitute.org)
- Knowledge Sharing, dissemination, publication and knowledge platform (www.carecinstitute.org/publications