CENTRAL ASIAN JOURNAL OF WATER RESEARCH (2025) 11(1): 47-58

https://doi.org/10.29258/CAJWR/2025-R1.v11-1/47-58.eng



Central Asian Journal of Water Research

# Current challenges in Central Asian water governance and their implications for research, higher education, and science-policy interaction

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## ABSTRACT

Political tensions over water management in the Central Asia region have intensified since the Soviet era, as ecological issues like the drying Aral Sea and seasonal hydropower disruptions impact downstream countries. The paper discusses the region's water governance challenges, including climate-induced uncertainties, water resource demands, and the limited capacity of local research institutions. While Central Asia's governments have initiated reforms, including new infrastructure and agreements, resilience in water management remains underdeveloped. The paper also explores the role of higher education institutions in fostering capacity-building for sustainable governance, emphasizing the need for local expertise and regional collaboration. The proposed establishment of a Central Asian water research platform aims to enhance science-policy integration, promote sustainable water governance, and support informed regional cooperation on transboundary water issues.

## ARTICLE HISTORY

Received: November 22, 2024
Accepted: February 10, 2025
Published: February 18, 2025

## KEYWORDS

water governance, water management, Central Asia, transboundary, water cooperation

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Published by Kazakh German University, Almaty/Kazakhstan

## 1. Current challenges in Central Asian water governance

Central Asia uses water from two main rivers. The Aral Sea basin, which extends over 1,550,000 square kilometers, is fed by the Amudarya and Syrdarya rivers, originating in the Tien Shan, Hindu Kush, and Pamir-Himalayan mountains. These rivers provide a vital resource for irrigation and energy production in the region. While the Amudarya originates from the Vakhsh and Pyanj rivers, the Syrdarya is formed by the confluence of the Naryn and Karadarya rivers. Both rivers cross several national borders, including Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (figure 1).

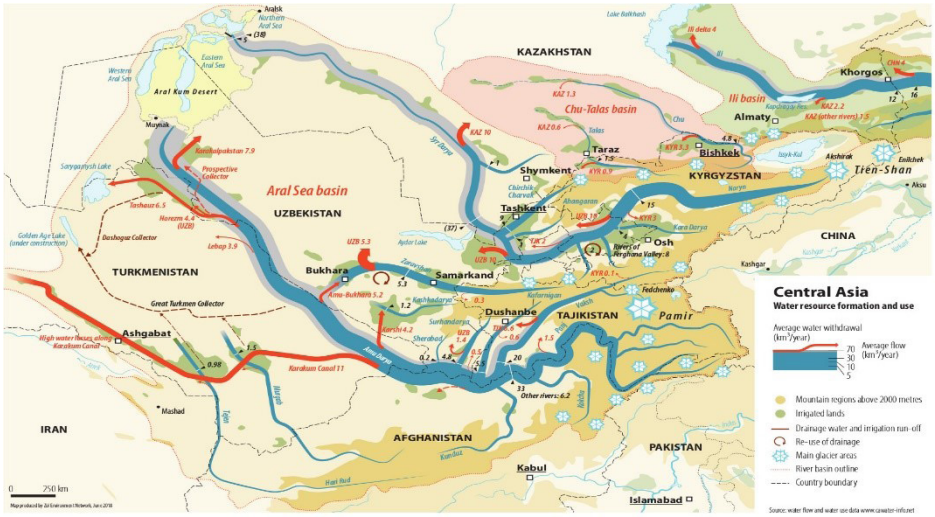


**Figure 1.** Water Resources and Systems of Central Asia (ZOI Environment Network, 2010)

The management of these water resources is a key political challenge for Central Asia, as the climate there is predominantly characterized by dry, drainless basins (Giese & Sehring 2007). This has led to fierce controversies over water distribution and the operation of reservoirs built during the Soviet era (Abdullaev and Rakhmatullaev, 2015). The drying up of the Aral Sea has provoked worldwide reactions as one of the biggest environmental disasters (Sehring 2007). Following the independence of the Central Asian states, Kyrgyzstan and Tajikistan have intensified their hydropower utilisation due to a lack of other energy sources, which has led to seasonal imbalances in water availability. This has not only reduced water availability for irrigation during the growing season but has also caused ecological changes and flooding in winter (Ziganshina and Schutter 2022).

There are also plans for large hydropower projects in the upper part of the Aral Sea basin, such as the Rogun hydropower plant in Tajikistan and new facilities

statements reflect the outcomes of a networking workshop on water governance research in Central Asia that was held at Justus Liebig University Giessen on 14 and 15 May 2024.

## 2. Research on Central Asian water governance: Resilience or resistance?

Since the dissolution of the Soviet Union, Central Asia has undergone profound changes in both its social and ecological systems, necessitating the adaptation of its water governance regimes to increase flexibility and resilience. The region faces heightened challenges from climate change, which impacts the water sector with extreme events like droughts and floods. Although the reality of climate change is well-acknowledged, predicting its specific effects on the timescales and spatial dimensions required for sustainable development planning remains difficult. Current water management practices—often focused on planning, prediction, and control—struggle to address the uncertainties posed by climate change, which complicates the development and implementation of effective adaptation strategies (Bilalova et al., 2023). To address these challenges, resilient and flexible policies and institutions must be developed, capable of managing uncertainties and supporting sustainable development. However, water sector reforms in Central Asia have largely prioritized technical solutions and market-driven approaches aimed at enhancing water use efficiency, with limited attention to resilience (Rodina, 2018).

Reframing water governance as a complex adaptive system—characterized by unpredictable behaviour and emergent properties—would entail a shift from a focus on efficiency and optimization to one emphasizing resilience through the management of change and uncertainty. This approach aligns with resilience theory, which offers a valuable framework for examining water governance reforms in Central Asia, particularly with regard to how these reforms may contribute to strengthening the resilience of the social-ecological system (SES) in the face of climate change (Rodina, 2018). Key research questions in this context include whether and how these reforms enhance the SES's ability to withstand and adapt to climate challenges, especially in rural areas (Hermans et al., 2024).

Initial post-Soviet water governance reforms primarily sought to preserve existing structures, a persistence that ultimately decreased resilience and increased susceptibility to crises (Schlüter & Herrfahrdt-Pähle, 2011; Herrfahrdt-Pähle et al., 2020). Effective adaptation and transformation require overcoming structural barriers to change, including dependence on cotton production, the interdependence of the water and agricultural sectors, and entrenched clientelism and vested interests. At the local level, reforms have primarily focused on establishing Water User Associations (WUAs) as community-based water management institutions. While scholars agree on

along the Naryn River in Kyrgyzstan. However, these projects have been met with resistance as they could affect water availability downstream and raise safety concerns due to seismic activity. At the same time, the Central Asian countries (excluding Afghanistan) have concluded a large number of agreements in recent decades and established regional institutions such as the International Fund to Save the Aral Sea (IFAS) to promote transboundary cooperation (Sehring et al. 2020).

Beyond these ongoing challenges, the demand for scientific policy advice on water governance has risen sharply in Central Asia in recent years for several reasons:

- The Uzbek government is focusing on regional cooperation and is calling on scientific expertise to a much greater extent than the previous government (IFAS 2020). Since 2017, Uzbekistan has begun discussing the possible joint construction of hydropower plants with the neighbouring countries. In spring 2024, the energy ministers of Kazakhstan, Kyrgyzstan and Uzbekistan reached an agreement on the joint construction of the Kambarata I power plant on the Naryn River in Kyrgyzstan (Gazeta.uz 2024).
- In 2022, the Taliban government in Afghanistan began realising the construction of an irrigation canal, which has been planned for decades and would divert up to 30% of the water from the Amudarya (Gafurov et al. 2023). Irrigated agriculture in Uzbekistan and Turkmenistan in particular would be massively affected by this measure, so the governments of both countries are following this development with great concern and are looking for political solutions.
- Recurring environmental crises such as severe drought or flooding are putting increasing pressure on Central Asian governments. Examples include the effects of the Sardoba dam burst in Uzbekistan in May 2020, the ongoing drought in large parts of Kazakhstan in summer 2021 and the floods during the snowmelt in spring 2024. At the same time, Central Asian citizens are also showing an increasing willingness to publicly demand political measures from their governments to protect them (Kłyszcz 2022).

Recently, countries in Central Asia have initiated further reforms. Tajikistan has been implementing water sector reforms for the last nine years. Kazakhstan has established a new water ministry and announced plans to construct 50 reservoirs. Uzbekistan plans extending the area under the drip irrigation and lining of the irrigation canals. Uzbekistan has also recently separated the water ministry from agriculture. Afghanistan has started building a large canal, which may withdraw up to 15% of the Amu Darya River flow. All these are new developments in Central Asia's current status quo on water resources systems.

Against this background, the remainder of this paper discusses current challenges of water governance in Central Asia and how they affect the three key areas of (1) research, (2) higher education, and (3) science-policy interaction. The

the necessity of WUAs, opinions vary on their operational principles. Some research emphasizes WUAs as critical institutions replacing collective farming structures (Hirsch, 2007; Moss & Hamidov, 2016), while others focus on the representative role these associations play in community governance (Abdullaev et al., 2010) also in a historical context of community-based water governance (Amirova et al., 2022).

At the transboundary level, research has traditionally centered on conflict and security concerns; however, cooperation and institutional development issues have also been examined (Ziganshina& Janusz-Pawletta, 2020). Recently, scholarship on regional water relations has introduced the concept of "brotherly" relations, describing the long-standing resilience of Central Asian water cooperation, which has, so far, defied predictions of inevitable conflict over water resources (Dadabaev et al., 2023).

Western donor initiatives, such as Integrated Water Resource Management (IWRM), have significantly shaped water governance discourse in the region since independence. However, domestic political dynamics have often hindered the implementation of these governance principles. The objectives and scope of development partners on water projects in Central Asia have also changed over time (Assubayeva & Sehring, 2024). Research on implementation specifics—what succeeded, what failed, and why—remains limited, particularly at the national level. This knowledge gap likely stems from the historically limited academic focus on social and political sciences in Central Asia, compounded by restrictions on political research in authoritarian contexts (Sehring, 2020).

Current studies indicate that the region's water situation continues to deteriorate due to the compounded impacts of climate change, as well as increased water withdrawals from the Amu Darya River by Afghanistan (The Diplomat 2023). Nevertheless, regional integration among Central Asian states has accelerated, partly in response to security challenges and global instability. Regular summits among Central Asian leaders have emerged as key platforms for discussing and addressing shared concerns around climate change and water management.

## 3. The role of higher education institutions in Central Asian water governance

The United Nations' 2030 Agenda for Sustainable Development recognizes capacity building as an essential element in achieving the Sustainable Development Goals (SDG), particularly under Target 17.9. Target 6.a of the SDGs calls for enhanced international cooperation, knowledge generation, and capacity-building support in water-related activities and programs in developing countries. Effective solutions for water-related challenges are critical for ensuring sustainable development, particularly in regions like Central Asia, where water governance faces unique national and transboundary complexities.

Central Asia's regional and national scientific organizations hold valuable potential for addressing water governance challenges, yet they require substantial support. Since gaining independence, Central Asian states and their academic institutions have experienced significant shifts, with many facing persistent issues in higher education and research. Research institutions have mainly remained unreformed, and limited funding has constrained universities and research centers, hindering their efforts to develop regionally and internationally recognized academic communities. These institutions are essential for providing evidence-based national and transboundary water governance solutions. A modern higher education system rooted in rigorous, applied research is vital to achieving effective water governance. Such a system would also serve as a foundation for long-term, evidence-driven, cooperative water management across Central Asia and neighbouring states that share transboundary water resources (Ziganshina & de Schutter, 2022). Achieving this requires strengthening local research capacities and integrating research as a core component of national water policy (Sehring, 2020).

Reaching this objective can be supported by setting strategic goals for Higher Educational Institutions (HEIs) and fostering robust partnerships among academic and scientific organizations in Central Asia while maintaining consistent exchanges with the global scientific community and water policy networks. To assess how to strengthen scientific contributions to water governance, examining the current academic and scientific landscape within Central Asia is essential. During the Soviet period, the academic system was divided between humanitarian universities, technical institutes, and research institutions. The humanitarian universities were focused on educating scholars in social sciences, history, and other relevant areas. The technical institutes were training in engineering areas, and the research institutes focused on natural science research. The water sector has been one of the priority areas of the Soviet economic system, receiving high shares of funding from the centralized budget (Abdullaev & Rakhamtullaev, 2016). However, during the Soviet period, the Central Asian countries started to reform their education and research systems, and the water sector was relegated to secondary importance in comparison to other economic sectors. This analysis enables the identification of HEIs' academic and scientific needs and provides recommendations to enhance their role in water governance across the region.

A key challenge in Central Asia is the limited availability of water-related academic materials in national languages, as most resources used are in Russian, as was the case during the Soviet Union. Developing resources in native languages is crucial to facilitating more accessible and effective learning. Since much of the recent literature is in English, proficiency in English is also increasingly important for accessing current knowledge. Locally adapted materials can address regional water management challenges and promote lifelong learning. Building the knowledge

capacity of local academic staff is essential to achieve these goals. Educators need better access to global knowledge and methodologies, as well as ongoing professional development opportunities that support research and practical connections to water management practices. These improvements in faculty capabilities will enhance teaching quality and further develop water research in Central Asia.

The systemic weaknesses in water science (water policy, water planning and water economy, hydrology, GIS/RS in water sector) across Central Asia are largely due to inadequate financial support. Compared to the Soviet era, when water science received robust funding, financial backing has significantly declined over the past three decades. Reduced state budgets have weakened institutional and research capacities across the region, creating a dependency on external funding, primarily from Europe, the USA, and China. Although external funding has its benefits, it should not replace the strategic role of the state in developing a regional and national research agenda. Research frameworks should be independently shaped according to each state's needs, with only supplemental support from external donors, who often prioritize short-term goals. Long-term government investments are necessary to ensure that research addresses the specific challenges and priorities of Central Asian countries, both individually and in a basin-wide context.

The educational programs at Central Asian universities must better align with the practical demands of local, national, regional, and global contexts. Insufficient collaboration between HEIs, research entities, and the water industry and governance sectors has led to limited knowledge exchange, thus hindering innovation and the advancement of evidence-driven water cooperation across all levels. Strengthened collaboration will enable more innovative and effective water management solutions, particularly for complex regional water issues. The major issues of water science, education, and research are the need for more interdisciplinary thinking and the integration of social sciences, law and economics with water sciences to tackle complex water challenges. Improved interaction among academia, industry, and governance bodies will also foster practical, customized solutions to water management challenges beyond the traditional agricultural and energy sectors. This coordination is critical for addressing transboundary water challenges, promoting regional cooperation, and advancing goal-oriented water governance in Central Asia.

## 4. Science-policy interaction in regional water governance

Robust research and policy integration significantly enhance transboundary water governance in Central Asia. Recognizing this potential, the Interstate Commission for Water Coordination in Central Asia (ICWC) was established in 1992, along with its Scientific Information Center (SIC), to support decision-making in water policy,

improve water management and usage, and address environmental challenges in the Aral Sea basin. The ICWC functions under the International Fund for Saving the Aral Sea (IFAS) as the primary regional institution tasked with regulating, managing, and protecting interstate water resources.

Scientific collaboration under ICWC's framework has enabled evidence-based dialogue, regional knowledge-sharing, and improved data accessibility among Central Asian countries. However, challenges remain, partly due to resource constraints. Key barriers to effective science-policy integration for transboundary water governance in Central Asia include inadequate baseline data, countries' reluctance to share information, and disputes over data usage and interpretation. These issues are further complicated in a transboundary context, where data can sometimes be misinterpreted as attributing blame to specific actors. Additionally, under IFAS/ICWC, the integration of science and policy has focused primarily on regional water management, without fully addressing the broader, interconnected goals of sustainable development and water security (Ziganshina & de Schutter, 2022).

To improve the alignment of regional water research with policymaking, establishing a long-term research agenda that identifies priority research areas and facilitates the implementation of findings is essential. A centralized repository for scientific information and datasets focused on mutual research interests would further support the joint utilization of research outputs. Often, the limited duration of international and national projects impedes the establishment of trust and sustainable regional capacity-building.

Maximizing the use of existing water-related research in Central Asia is essential. The region possesses extensive technical and institutional knowledge on irrigation, drainage, and integrated water resources management, yet this knowledge remains underutilized. Central Asia's rich legacy of traditional irrigation knowledge and its ex-Soviet expertise in hydrology, hydrometeorology, irrigated agriculture, drainage, agricultural mechanization, land reclamation, hydropower, and riverbed processes could greatly benefit current water governance efforts. Supported by the Russian Federation and UNECE, the SIC ICWC has developed a "Scientific Heritage on Water" repository containing over 1,000 digitized publications across various water-related fields (http://cawater-info.net/library/history.htm), but more efforts are needed. Integrating this legacy knowledge into research agendas and educational curricula alongside contemporary approaches and practices is crucial.

A sustainable water sector and effective transboundary water cooperation are unattainable without long-term investments in research. An increase in governmental funding for science, technology, and innovation—particularly for water-related research—is crucial for all Central Asian nations. Investments from international partners should support coordinated, long-term research programs and collaborative

initiatives that align with regionally developed policies, rather than imposing external priorities (Conrad et al., 2023). Additionally, it is vital to educate a new generation of water and environmental experts and policymakers, reforming curricula to offer students a comprehensive, interdisciplinary understanding of water challenges and the skills needed to address them.

International experiences demonstrate that independent, strategic, interdisciplinary, and network-based research can offer new perspectives on transboundary water governance. Currently, most research institutions in the region lack a critical and independent mandate, which limits their role in questioning existing policies. Consequently, a proposal has been made to establish an independent "Central Asian Expert Platform on Water Security, Sustainable Development, and Future Studies." This think tank would foster collaboration among diverse research institutions, universities, and independent researchers across Central Asia, creating a space for projects and programs that align with regional priorities. The platform's primary objectives would be to unite research teams on shared regional topics, facilitate knowledge exchange through regular meetings, and produce joint publications and policy briefs to advance science-based policy dialogue in Central Asia. Informal expressions of interests for partnerships and cooperation could be directed to one of the co-authors of this paper, Dr. Dinara Ziganshina, Director of Scientific information Centre of Interstate Coordination Water Commission (SIC ICWC)

## 5. Conclusions

The aim of this paper was to reflect on the challenges and reforms in water governance in Central Asia, focusing on resilience and adaptability in a region characterized by socio-political tensions, transboundary conflicts, and climate-induced uncertainties, their implications for research, higher education and science-policy interaction. Water governance reforms in Central Asia have historically prioritized efficiency and technical solutions, often neglecting the need for systemic resilience. Initial post-Soviet reforms aimed to preserve existing structures, inadvertently increasing vulnerabilities to crises rather than fostering flexibility and adaptability. It is important to reframe governance as a complex adaptive system that emphasizes managing uncertainties rather than solely optimizing resource use.

At the local level, the role of WUAs has been central to reform efforts to enhance community-based water management. However, these organizations have faced operational challenges and diverse interpretations of their roles. At the transboundary level, while regional cooperation has defied predictions of inevitable conflict, significant gaps remain in implementing and sustaining effective governance structures. The concept of "brotherly" relations highlights long-standing resilience in regional cooperation. However, further institutional development is necessary.

In Central Asia, there is an increasing demand for scientific policy advice, for guiding current water policy reforms and attempts of regional integration in terms of water (e.g. brotherly water relations). The implications of climate change further necessitate the adaptation of the Central Asian water governance regimes as well as to increase their flexibility and resilience.

The current scientific and research architecture is, however, not well prepared to meet this demand and needs to be reformed. The educational programs at Central Asian universities must better align with the practical demands at local, national, regional, and global contexts. What is needed is government investment in a long-term research agenda as well as improved collaboration between HEIs, research entities, the water industry and water governance organisations with the aim to foster knowledge exchange and innovation as well as improved interdisciplinary thinking and the integration of the social sciences, law and economics with the water sciences.

HEIs can play a crucial role in advancing water governance by fostering local expertise and integrating evidence-based research into policy but their potential is not yet fully used. Systemic weaknesses in funding, interdisciplinary collaboration, and access to updated resources limit their impact. There is urgent need for aligning educational programs with regional governance demands and strengthening the capacity of HEIs to address practical challenges through applied research.

Finally, science-policy integration remains constrained by inadequate data sharing, limited collaboration, and insufficient alignment of research agendas with policy priorities. There is a need for a centralized research agenda to address these barriers, ensuring that research findings are effectively translated into actionable policies. The proposed Central Asian Expert Platform on Water Security, Sustainable Development, and Future Studies represents an initiative to align research with policy priorities and foster sustainable governance.

## Acknowledgments

The authors acknowledge financial support by the German Academic Exchange Service (DAAD) from funds of the Federal Ministry for Economic Cooperation (Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung), SDGnexus Network [grant number 57526248], program “exceed – Hochschulexzellenz in der Entwicklungszusammenarbeit.”

## References


Abdullaev, I., Kazbekov, J.S., Manthritilake, H., & Jumaboev, K. (2010). Water User Groups in Central Asia: Emerging Form of Collective Action in Irrigation Water Management. *Water Resources Management*, 24, 1029-1043.

Abdullaev, I. und S. Rakhmatullaev (2015), Transformation of water management in Central Asia: from State-centric, hydraulic mission to socio-political control, *Environmental Earth Sciences* 73, pp. 849–61.

Amirova, I., Petrick, M., & Djanibekov, N. (2022). Community, state and market: Understanding historical water governance evolution in Central Asia. *IAMO Discussion Paper*: Vol. 200. IAMO. https://doi.org/10.22004/ag.econ.327298

Assubayeva, A. and Sehring, J. (2024). Water Management. In The EU as an Actor in Central Asia: External Impacts, Regional Responses. *Palgrave Macmillan Cham*

Bilalova, S.; Newig, J.; Tremblay-Lévesque, L.-C.; Roux, J.; Herron, C. and Crane, S. 2023. Pathways to water sustainability? A global study assessing the benefits of integrated water resources management. *Journal of Environmental Management* 343: 118179.

Conrad, Christopher; Guggenberger, Georg; Klein, Igor; Kress, Hannelore; Schaich, Christian; Stroink, Ludwig (2023): Zentralasien - den regionalen und globalen Herausforderungen begegnen. Positionspapier deutscher Forschungs-, Mittler- und Förderorganisationen mit Empfehlungen für die zukünftige Zusammenarbeit zwischen Deutschland und Zentralasien in Wissenschaft, Forschung und Bildung.

Dadabaev, T.; Sehring, J. and Djalilova, N. 2023. Central Asian water neighbourhood: A constructivist reconceptualisation of hydropolitics in Central Asia. *Water Alternatives* 16(3): 930-948

Gafurov, A., I. Bobojonov, M. Bekchanhov and C. Busch (2023), Impact of the Qush-Tepa canal on the agricultural sector in Uzbekistan, Berlin, *Berlin Economics GmbH*.

Gazeta.uz (2024), Uzbekistan, Kazakhstan and Kyrgyzstan to establish joint company for Kambarata HPP-1 construction. Online verfügbar unter: https://www.gazeta.uz/en/2024/04/16/hpp-1/

Giese, E. and J. Sehring (2007), Konflikte ums Wasser: Nutzungskonkurrenz in Zentralasien, *Osteuropa* 57(8-9), pp. 483–96.

Hermans, K., Djanibekov, N., Abdullaev, I., Abduvalieva, N., Assubayeva, A., Blondin, S., ... & Umirbekov, A. (2024). Future research directions for understanding the interconnections between climate change, water scarcity, and mobility in rural Central Asia. *Climate and Development*, 1-10.

Herrfahrdt-Pähle, E.; Schlüter, M.; Olsson, P.; Folke, C.; Gelcich, S. and Pahl-Wostl, C. 2020. Sustainability transformations: socio-political shocks as opportunities for governance transitions. *Global Environmental Change* 63: 102097.

Hirsh,, D. 2007. Water Users Associations in Uzbekistan: Theory and practice. Thesis for: PhD

IFAS (2020), Decree of the President No UP-6024 on approval of the water sector development concept of Uzbekistan for 2020-2030. Online verfügbar unter: https://aral.uz/en/blog/2020/07/23/decree-of-the-president-no-up-6024-on-approval-the-water-sector-development-concept-of-uzbekistan-for-2020-2030/

Kłyszcz, I. (2022), Zwischen Autonomie und Nationaler Integration – Steht die finale Krise Karakalpakstans noch bevor?, *Zentralasien-Analysen*(154), pp. 2–7.

Moss, T., Hamidov, A. (2016). Where Water Meets Agriculture: The Ambivalent Role of Water Users Associations. In: Hüttl, R., Bens, O., Bismuth, C., Hoechstetter, S. (eds) Society - Water - Technology. *Water Resources Development and Management*. Springer, Cham. https://doi.org/10.1007/978-3-319-18971-0_11

Rodina, L. 2018. Defining "water resilience": Debates, concepts, approaches, and gaps. *WIREs Water* 6(2).

Schlüter, M. and Herrfahrdt-Pähle, E. 2011. Exploring resilience and transformability of a river basin in the face of socio-economic and ecological crisis – an example from the Amudarya River Basin, Central Asia. *Ecology and Society* 16(1 (32)).

Sehring, J. (2007), Die Aralsee-Katastrophe: Ein Nachruf auf das multilaterale Krisenmanagement, *Osteuropa* 57, pp. 497–510.

Sehring, J. "Unequal distribution: Academic knowledge production on water governance in Central Asia." *Water Security* 9 (2020): 100057

Sehring, J., D. Ziganshina, M. Krasznai and T. Stoffelen (2020), International actors and initiatives for sustainable water management, in S. Xenarios et al. (eds.), *The Aral Sea Basin: Water for Sustainable Development in Central Asia,* London, Routledge, S. 155–75.

The Diplomat (2023), The Taliban's New Canal Threatens Water Security in Uzbekistan and Turkmenistan. As the Taliban rush to complete the Qosh Tepa canal, Central Asia's water security is at risk. 5 July 2023, https://thediplomat.com/2023/07/the-talibans-new-canal-threatens-water-security-in-uzbekistan-and-turkmenistan/

Ziganshina, Dinara & Janusz-Pawletta, Barbara. (2020). The principle of no significant harm in the Central Asian context. *International Environmental Agreements: Politics, Law and Economics*. 20. 713-730. 10.1007/s10784-020-09509-0

Ziganshina, D. and J. de Schutter (2022), Paving the Way for Evidence-Driven Transboundary Water Cooperation in Central Asia, *Journal of the American Water Resources Association* 58(6), pp. 1149–61.

ZOI Environmental Network. 2010. Map of irrigation systems of Central Asia. https://zoinet.org/product/climate-cryosphere-water-ca/