



Adapting Public Administration to Water Challenges in Central Asia: The Case of the Kyrgyz Republic

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ABSTRACT

Climate change, increasing water scarcity, and transboundary competition are placing growing pressure on water governance in Central Asia. This study examines how institutional characteristics of public administration influence water resource management and adaptive capacity, using the Kyrgyz Republic as a case study. The research applies a qualitative case-study design based on the analysis of regulatory legal acts, national strategies, international reports, and academic studies related to water governance, climate adaptation, and transboundary cooperation. The findings indicate that the principal institutional constraints include fragmented administrative responsibilities, weak intersectoral and transboundary coordination, insufficient monitoring and evaluation mechanisms, and limited integration of digital tools into decision-making. Existing governance arrangements therefore remain predominantly reactive and are poorly equipped for long-term adaptation under conditions of climatic, geopolitical, and geoeconomic uncertainty. The study demonstrates that the effectiveness of water policy depends not only on the physical availability of water resources but also on the capacity of public institutions to coordinate actors, integrate data, and support long-term planning. The article proposes a transition toward adaptive water governance through stronger institutional coordination, integrated monitoring and evaluation systems, expanded digital infrastructure, and more stable mechanisms of regional cooperation.

Keywords: Adaptive governance, Water resources, Central Asia, Kyrgyz Republic, Public administration, Transboundary waters

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INTRODUCTION

Water resources in Central Asia have remained one of the key factors of the region's sustainable development over recent decades, determining the dynamics of agriculture, energy, and social stability. Unlike the traditional engineering and hydrological approach, within which water resource management was viewed primarily as a technical task, contemporary studies increasingly emphasize the need to analyze the water sector as an object of public administration that is sensitive to institutional constraints and the quality of coordination mechanisms (Pahl-Wostl, 2015; Xenarios *et al.*, 2019; Svensson & Lindberg, 2026).

The region is characterized by a high dependence on the transboundary water resources of the Amu Darya and Syr Darya basins, which are formed mainly in upstream countries and used in downstream countries. This structure of water use, which developed during the Soviet period, currently intensifies interstate interdependence and increases the sensitivity of water policy to changes in economic and climatic conditions (ADB & CAREC, 2014; Campins Eritja, 2019; Hao *et al.*, 2025). Climate change is increasing the pressure on the region's water resources. Rising average annual temperatures, shrinking glaciers, changes in the seasonal distribution of runoff, and the increasing frequency of extreme hydrometeorological events reduce the predictability of water resources and create a persistent risk of water scarcity (ADB & CAREC, 2014; Bissenbayeva *et al.*, 2021; Morgan *et al.*, 2025). These processes primarily affect the agricultural sector and hydropower,

thereby intensifying competition between sectors and countries in the region.

An additional pressure factor is the growth of water consumption caused by demographic dynamics and the continued inefficient structure of water use, in which a significant share of water is consumed in agriculture with high losses during transportation and irrigation (Xenarios *et al.*, 2019; GIZ, 2021; Di Fiore *et al.*, 2024; Mishra *et al.*, 2025). Taken together, climatic and socio-economic factors create a stable trend toward increasing water scarcity and rising conflict potential in the region.

Under these conditions, the ability of public administration systems to ensure the effective regulation, distribution, and use of water resources becomes critically important. Practice shows that the sustainability of water policy is determined not only by the volume of available resources but also by the quality of the institutional architecture, the level of coordination between sectors and countries, and the existence of mechanisms for adapting to changing conditions (Pahl-Wostl, 2015; Sharipova & Chemayeva, 2022; Damaševičius *et al.*, 2025; Nagesh *et al.*, 2025).

The paradigm of integrated water resources management (IWRM), which involves taking intersectoral linkages into account and balancing the interests of different water users, has become widespread in the scientific literature (Wouters *et al.*, 2007; Kowalski *et al.*, 2024; Novak & Dvorak, 2025). However, the experience of Central Asian countries shows that the implementation of IWRM faces institutional limitations, including departmental fragmentation, weak coordination mechanisms, and limited participation of stakeholders (Schlüter & Herrfahrdt-Pähle, 2011; GIZ, 2021; Huber *et al.*, 2025; Salem *et al.*, 2025).

In this regard, an approach focused on adaptive water resource management is becoming increasingly relevant. This approach involves the use of long-term planning and monitoring and evaluation mechanisms, as well as flexible forms of coordination under conditions of high uncertainty (Pahl-Wostl, 2015; Sharipova & Chemayeva, 2022; Kajanova & Badrov, 2024; Novak & Jelic, 2025). Unlike reactive models based on responses to emerging crises, the adaptive approach is aimed at anticipating risks and forming sustainable institutional solutions.

The Kyrgyz Republic represents an illustrative case for analyzing these processes. On the one hand, the country possesses significant water potential and plays a key role in forming the river runoff of the region. On the other hand, its water resource management system is characterized by institutional complexity, intersectoral dependence, and limited coordination capacity, which makes it sensitive to external and internal challenges (Musabaeva, 2007; Imanalieva, 2014; Kwatra *et al.*, 2024).

This research paper investigates how institutional frameworks within Central Asian public administration, specifically focusing on the Kyrgyz Republic, shape water resource governance and determine systemic resilience against evolving climatic, geopolitical, and geoeconomic pressures that currently threaten regional stability and natural resource sustainability.

To achieve this purpose, the following objectives are addressed:

1. to identify the key pressure factors affecting the region's water resources;

2. to analyze the specific features of transboundary water use;
3. to assess the institutional characteristics of national water resource management systems;
4. to determine the limitations and opportunities for the transition to an adaptive governance model.

MATERIALS AND METHODS

The study was conducted as a qualitative analysis of the water sector in Central Asia, with a focus on the Kyrgyz Republic as an upstream country that plays a key role in shaping the region's water balance. The choice of this case is determined by the combination of significant water potential and a complex institutional governance structure, which makes it possible to consider the Kyrgyz Republic as an illustrative example of the interaction between natural and administrative factors (ADB & CAREC, 2014; Imanalieva, 2014).

The methodological basis of the study includes elements of comparative and institutional analysis. The focus is on the water resource management system as a set of formal institutions, coordination mechanisms, and regulatory instruments that determine the allocation and use of water in national and transboundary contexts (Wouters *et al.*, 2007; Pahl-Wostl, 2015; Abdoul-Latif *et al.*, 2025).

The empirical base consists of:

1. regulatory legal acts and strategic documents of Central Asian countries in the field of water management;
2. national programs and strategies of the Kyrgyz Republic in the sectors of water management, energy, and agriculture;
3. regional and international reports devoted to water resource management and climate adaptation (Punkari *et al.*, 2012; ADB & CAREC, 2014; GIZ, 2021; Green Central Asia, 2024);
4. academic studies on water governance, transboundary resources, and institutional models of regulation (Pahl-Wostl, 2015; Xenarios *et al.*, 2019; Sharipova & Chemayeva, 2022; Zairkhanova *et al.*, 2024).

The document analysis was carried out according to a unified framework that included:

- identifying the goals and priorities of water policy;
- determining the institutional governance structure and distribution of powers;
- assessing mechanisms of intersectoral and transboundary coordination;
- analyzing instruments of monitoring, evaluation, and digitalization.

At the next stage, formally established mechanisms were compared with actual governance practices reflected in international reports and studies, which made it possible to identify gaps between strategic objectives and their implementation (GIZ, 2021; Green Central Asia, 2024; Nguyen *et al.*, 2025).

The comparative component of the study was implemented through an analysis of Central Asian countries according to a number of key parameters:

- the institutional organization of water resource management;
- the degree of development of coordination mechanisms;
- the level of implementation of monitoring and evaluation (M&E) tools;
- the integration of climate factors into water policy.

To interpret the results obtained, the study uses an approach based on distinguishing between reactive and adaptive models of water resource management. The reactive model is characterized by a short-term planning horizon, fragmented coordination, and limited use of data, whereas the adaptive model implies long-term planning, systematic monitoring, and the integration of different levels of governance (Pahl-Wostl, 2015; Sharipova & Chemayeva, 2022; Aksoy & Akaydin, 2024). This methodological approach makes it possible to link the physical and economic characteristics of water resources with the institutional conditions of their management and to assess the capacity of existing public administration systems to ensure sustainable and balanced water use under conditions of increasing challenges.

RESULTS AND DISCUSSION

Institutional fragmentation

The analysis of national documents and expert reviews shows that the water governance system in the Kyrgyz Republic is characterized by a high degree of institutional fragmentation.

Powers are distributed among several ministries responsible for agriculture, energy, and natural resources, as well as specialized agencies and local authorities. Formally, this implies a functional division of responsibilities; however, in practice, it leads to blurred boundaries of competence, duplication of tasks, and the emergence of “gray areas” of responsibility (Musabaeva, 2007; Imanalieva, 2014; Jannath *et al.*, 2024; Elango & Govindaraju, 2025). A number of reforms based on IWRM principles supplemented the existing architecture with new structures without dismantling outdated ones, which increased institutional complexity (Wouters *et al.*, 2007; Schlüter & Herrfahrdt-Pähle, 2011; Benhmida & Trabelsi, 2024; Chandrasekhar *et al.*, 2025).

At the regional level, coordination relies on basin commissions and interstate agreements; however, their mandates are limited, and mechanisms for ensuring the implementation of decisions remain weakly institutionalized (Campins Eritja, 2019; GIZ, 2021; Liedekerke *et al.*, 2025). Given differences in the economic models, energy strategies, and political regimes of the countries in the region, this leads to recurring conflicts over runoff allocation and to agreements whose stability depends largely on the current political situation (ADB & CAREC, 2014; Xenarios *et al.*, 2019; Dobrzynski *et al.*, 2024).

To clarify the position of the Kyrgyz Republic between reactive and adaptive governance models, **Table 1** compares the key characteristics of these two approaches to water resource management.

Table 1. Reactive and adaptive models of water resource management

Parameter	Reactive model (prevailing practice)	Adaptive model (target orientation)
Logic of action	Response to crises and emergencies	Proactive management of risks and scenarios (Pahl-Wostl, 2015)
Planning horizon	Short-term, within budgetary/political cycles	Long-term, taking into account climatic and hydrological scenarios (ADB & CAREC, 2014)
Coordination	Ad hoc interdepartmental coordination	Stable intersectoral platforms and centers for coordinating change (GIZ, 2021)
Role of data and M&E	Fragmented reporting and weak feedback	A unified system of indicators, regular monitoring, and policy iteration (Green Central Asia, 2024)
Stakeholder participation	Predominantly government bodies	Inclusion of local communities, business, academic, and expert institutions (Sharipova & Chemayeva, 2022)
Transboundary dimension	Occasional agreements with an emphasis on sovereignty	Hybrid architecture with stable supranational mechanisms (Campins Eritja, 2019)

In practice, water governance in Kyrgyzstan and in the countries of the region as a whole remains closer to the reactive pole: decisions are often made in response to crisis events, coordination is episodic, and data are used mainly for reporting purposes. At the same time, certain elements of the adaptive approach, including scenario studies, pilot digitalization projects, and climate strategies, are already present in policy, but they remain fragmented.

Limitations to the sustainability of water resource management

The long-term viability of water governance in the Kyrgyz Republic is constrained by systemic institutional challenges rooted in the current resource management framework. Primary among these is the persistent disconnect between strategic policy formulation and operational execution; while

national modernization agendas exist, their application remains disjointed, hindered by interdepartmental friction and fiscal limitations (ADB & CAREC, 2014; Xenarios *et al.*, 2019). Furthermore, ambitious water sector initiatives, such as irrigation upgrades and hydropower expansion, necessitate robust execution structures. In practice, the lack of cohesive cross-sectoral integration frequently leads to project delays and suboptimal outcomes. Finally, restricted institutional accountability mechanisms mean that water allocation decisions are often driven by isolated departmental priorities rather than a comprehensive, unified resource management strategy. Consequently, the absence of centralized oversight significantly impedes the development of an efficient, sustainable water regime capable of addressing the nation's evolving environmental and socio-economic requirements over the coming decades.

Deficit of monitoring, evaluation, and digitalization

Monitoring and evaluation systems and digital infrastructure are key elements of adaptive governance; however, in Kyrgyzstan's water policy, they are still developed in a fragmented manner. International reports emphasize the need for standardized indicators, regular data collection and analysis, and the use of M&E results to adjust policy decisions (Punkari *et al.*, 2012; ADB & CAREC, 2014; Green Central Asia, 2024). In practice, however, departmental statistical systems are disconnected, and data are used mainly to meet reporting requirements rather than to support management decisions (Musabaeva, 2007).

Digital initiatives, including the automation of water accounting in selected areas, the introduction of geographic information systems, and the creation of national and regional data platforms, are developing, but they have not yet formed a unified framework embedded in the everyday management cycle (Central Asia Program, 2020; Green Central Asia, 2024). This limits opportunities for scenario planning and reduces the quality of feedback on the results of implemented reforms.

Table 2 summarizes the main institutional limitations identified in the water governance system of the Kyrgyz Republic and presents corresponding directions for institutional reform.

Table 2. Institutional limitations and reform directions in water governance in the Kyrgyz Republic

Institutional problem	How it manifests itself in the water sector of the Kyrgyz Republic	Possible reform direction
Departmental fragmentation	Overlapping mandates of ministries and agencies; absence of a clear coordination center; complex structure of subordinate organizations (Imanalieva, 2014; Musabaeva, 2007).	Creation of a specialized state body or coordination center for change management in the water sector; institutionalization of interdepartmental "water-energy-agriculture" platforms fixed in regulatory legal acts (Schlüter & Herrfahrdt-Pähle, 2011).
Weak M&E and data standards	Fragmented accounting and reporting systems; limited access to information; absence of a unified data platform (Musabaeva, 2007).	Development of a unified national M&E framework, including standardized indicators for water, energy, and agriculture; creation of a digital water data platform with open access for key users (ADB & CAREC, 2014; Green Central Asia, 2024).
Limited integration of strategic and water governance	Revision of priorities when leadership changes, dependence of reforms on personal initiatives, and high sensitivity to the electoral cycle (Central Asia Program, 2020; ENERPO Journal, 2026).	Consolidation of long-term water strategies through institutional implementation mechanisms; development of program-targeted management and interdepartmental coordination.
Insufficient transboundary coordination	Low binding force of agreements, recurring disputes over runoff regimes, and weak use of existing regional institutions (Campins Eritja, 2019; GIZ, 2021).	Deepening regional mechanisms with clearly defined obligations, integrated M&E systems, and dispute resolution procedures; strengthening the role of regional organizations based on the principles of adaptive governance (Green Central Asia, 2024).

The table shows that institutional problems are systemic in nature and extend beyond the boundaries of the water sector itself. Many of the identified problems are connected with the general architecture of public administration and require a more comprehensive approach to their solution.

The findings demonstrate that Central Asian water resources are far more than mere economic or natural assets; they serve as intricate focal points for public administration, encapsulating the region's primary institutional constraints. Diverging from conventional perspectives that primarily emphasize ecological or infrastructural dimensions, this research illustrates that the sustainability of water management is heavily contingent upon the efficacy of governance frameworks. Ultimately, the capacity for governance systems to facilitate seamless coordination and foster resilient adaptation remains the decisive factor for long-term regional water security (Pahl-Wostl, 2015; Xenarios *et al.*, 2019).

The identified water stress, caused by the combination of climate change, demographic pressure, and worn-out infrastructure, increases the requirements for institutional resilience. However, the existing governance models in Central Asian countries largely retain a reactive character, which limits their effectiveness under conditions of high uncertainty (ADB & CAREC, 2014; GIZ, 2021).

Institutional fragmentation, observed in most countries of the region, hinders the formation of an integrated approach to water resource management. The division of powers among

sectors, including agriculture, energy, and ecology, in the absence of stable coordination mechanisms, leads to a conflict of objectives and reduces the effectiveness of decisions. Similar limitations are widely noted in studies on the implementation of integrated water resources management (IWRM) principles, where intersectoral coordination remains one of the key problems (Wouters *et al.*, 2007; Schlüter & Herrfahrdt-Pähle, 2011).

An additional limitation is the weakness of monitoring and evaluation systems, as well as the limited integration of digital tools. The absence of a unified information base and standardized indicators makes it difficult to develop long-term forecasts and scenarios, which reduces the adaptability of governance decisions. International studies emphasize that the development of M&E systems and digital platforms is a necessary condition for the transition to adaptive water resource management (Punkari *et al.*, 2012; Green Central Asia, 2024).

The transboundary nature of water resources intensifies these problems. The management of water flows in the Amu Darya and Syr Darya basins requires coordinated action by the states of the region; however, existing coordination mechanisms remain insufficiently institutionalized. Despite the presence of formal agreements, their implementation is limited by the absence of enforcement mechanisms and unified monitoring systems, which reduces the effectiveness of regional governance (Campins Eritja, 2019; GIZ, 2021).

In this context, the concept of adaptive water resource management becomes particularly important. Unlike the reactive model, which focuses on eliminating the consequences of crises, the adaptive approach involves long-term planning, regular monitoring, and flexible forms of coordination that make it possible to account for uncertainty and changing conditions (Pahl-Wostl, 2015; Sharipova & Chemayeva, 2022). However, the analysis shows that the implementation of such mechanisms in Central Asian countries remains fragmented and does not form an integrated institutional model.

A comparison of national governance systems demonstrates that differences in institutional maturity and reform priorities create additional barriers to the formation of a regional water resource management model. The divergence of approaches, ranging from digitalization to centralized models of control, complicates the development of unified mechanisms of interaction and reduces the predictability of transboundary water use (ADB & CAREC, 2014; Xenarios et al., 2019).

In a broader context, the results of the study make it possible to consider the water sector as an indicator of the condition of public administration systems. The nature of water policy reflects the ability of institutions to ensure coordination, integration, and long-term planning under conditions of uncertainty, which corresponds to adaptive governance approaches applied in international practice (Pahl-Wostl, 2015).

The transition to a sustainable model of water resource management requires not only infrastructure modernization but, above all, institutional transformation aimed at strengthening coordination, developing data systems, and forming stable transboundary mechanisms. Without this, water scarcity will continue to intensify economic and social risks in the region.

CONCLUSION

The analysis conducted shows that water resources in Central Asia are a key factor in the region's sustainability; however, their condition and dynamics are determined not only by natural characteristics but also by the quality of public administration systems. Under conditions of increasing water scarcity caused by climate change, demographic growth, and structural features of water use, institutional limitations become the main barrier to ensuring sustainable development. The results of the study demonstrate that existing water resource management models in Central Asian countries largely retain a reactive character. Fragmentation of authority, weak intersectoral coordination, insufficient development of monitoring and evaluation systems, and limited digitalization hinder the formation of an integrated and adaptive governance model. In the transboundary dimension, these limitations are intensified by the absence of effective mechanisms for implementing agreements, which reduces the predictability of water use and increases conflict potential.

Based on the analysis, the following key conclusion can be drawn:

the sustainability of water resources in Central Asia is determined not so much by their physical availability as by the ability of state institutions to ensure coordinated, long-term, and adaptive governance.

In this regard, the transition to a sustainable water governance model requires systemic institutional changes. Practical recommendations can be grouped as follows.

1. *Institutionalization of change management*: It is advisable to establish change management in the water sector as a permanent function of public authorities. This implies the creation of stable coordination structures responsible for the development, implementation, and regular revision of comprehensive reforms, as well as the formalization of policy adjustment cycles based on data.
2. *Development of M&E and digital infrastructure*: It is necessary to move from departmental reporting to a unified M&E framework covering the water, energy, and agricultural sectors and based on an agreed set of indicators. Digital data platforms should become one of the central tools for monitoring, scenario analysis, and decision-making.
3. *Deepening regional cooperation*: The transboundary nature of water resources requires the formation of more firmly institutionalized regional regimes with clearly defined obligations, M&E procedures, dispute resolution mechanisms, and developed data exchange procedures. At the same time, adaptive logic can serve as a basis for designing hybrid institutions that combine national sovereignty with supranational coordination.
4. *Integration of climate adaptation*: Long-term climate scenarios should be taken into account in water policy and infrastructure planning.

The implementation of these directions requires coordinated action at the national and regional levels, since the transboundary nature of water resources makes it impossible to achieve sustainability within individual states alone.

The study has several limitations. First, it is based mainly on document analysis and secondary data; the absence of original field research and interviews limits the depth of reconstruction of informal governance practices. Second, the focus on the Kyrgyz Republic as an upstream case may not fully reflect the specific features of downstream countries. Third, the comparative component is limited to Central Asian countries; including other regions with comparable challenges, such as the Middle East or South Asia, would make it possible to better assess the universality of the conclusions drawn.

Further research may focus on the quantitative assessment of the effectiveness of water governance models, the analysis of specific transboundary mechanisms, and the study of the role of digital solutions in improving the sustainability of water policy. Overall, the water sector in Central Asia represents a space in which the ability of states to adapt under conditions of complex and interconnected challenges is most clearly manifested. It is precisely in water resource management that the practical basis is formed for the transition from reactive models to sustainable and adaptive systems of public administration.

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