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**Institutional Design and Transboundary Water Treaty Performance Under Stress in
Central Asia.**

Student:

Alo I. Kuusik

Supervisor:

Shpend Kursani, PhD

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Abstract

This thesis examines how differences in institutional design explain variation in transboundary water treaty performance under stress in Central Asia. Three basin regimes - the Amu Darya, the Syr Darya, and the Chu-Talas - face broadly similar structural conditions: a shared Soviet institutional legacy, comparable upstream-downstream interdependencies, recurring hydrological variability, and a politically sensitive regional environment. Yet they perform differently when those conditions tighten into stress. The thesis asks why, and offers an institutionalist answer. The analysis uses a most-similar systems comparative design, with documented stress episodes as empirical windows on institutional performance. Ten episodes anchor the comparison: four on Chu-Talas (2020 COVID procedural disruption, 2021 Kirov dam safety, 2022 Aspara/Ashmara withdrawal dispute, 2023-2024 verification turn), three on Syr Darya (2000–2001 compensation failure, 2021–2022 corrective coordination, 2023–2024 partial stabilisation), and three on Amu Darya (2018 forecast shortfall, 2019-2020 lower-reach overuse, 2021-2022 severe shortfall). Institutional design is operationalised through five dimensions: monitoring and information-sharing, dispute-resolution and coordination, enforcement and compliance-supporting provisions, flexibility and adaptive capacity, and distributional or benefit-sharing arrangements, coded from treaty texts, commission statutes, and basin organisation by-laws. Performance under stress is operationalised in two components - procedural continuity and escalation containment - and assessed through ICWC bulletins, BWO reports, Water Yearbooks, and Chu–Talas Commission records. The empirical analysis supports the central argument. Stronger institutional design produces stronger procedural continuity and tighter escalation containment, with Chu–Talas (strong design) registering high performance, Syr Darya (moderate-low design) mixed performance with the 2000-2001 episode at the low end, and Amu Darya (moderate design) moderate-high performance. Once climate stress, power asymmetry, Soviet legacy, and regional political dynamics are taken into account, institutional design remains the most parsimonious explanation for the observed variation. The thesis contributes to institutional-design scholarship by applying it to transboundary water governance under conditions of stress, explains divergence within a region often discussed in uniform terms, and shows that environmental stress does not mechanically produce instability but rather that its political consequences depend on the institutional architecture through which scarcity is governed.

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Chapter 1. Introduction

1.1 Research Problem and Regional Context

Freshwater scarcity is increasingly treated as one of the major governance challenges of the twenty-first century (Koncagül and Connor, 2023). Pressures generated by climate change, population growth, and rising demand in agriculture, energy production, and urban systems are reshaping patterns of water availability across many regions of the world (Link et al., 2016: 495-496; De Stefano et al., 2012). These pressures are especially consequential in transboundary river basins, where hydrological interdependence crosses political borders and upstream decisions directly affect downstream availability, timing, and reliability of water access. Shared rivers therefore provide a particularly revealing setting for studying how states manage cooperation under conditions of anarchy, scarcity, uncertainty, ecological stress, and political complexity.

At the same time, the relationship between water scarcity and interstate conflict is not straightforward. The literature does not support a general claim that climatic change or water-related stress automatically increases the likelihood of conflict between states (Buhaug, 2015: 269; Koubi, 2019: 343). Rather, environmental pressures appear to heighten conflict risk only under specific social, economic, and political conditions and through particular pathways, including economic disruption, agricultural shocks, resource competition, and migration (Koubi, 2019: 343, 346-348, 352; Xie et al., 2024). The more analytically important question, therefore, is not whether stress exists, but how it is managed and with what consequences for institutional stability.

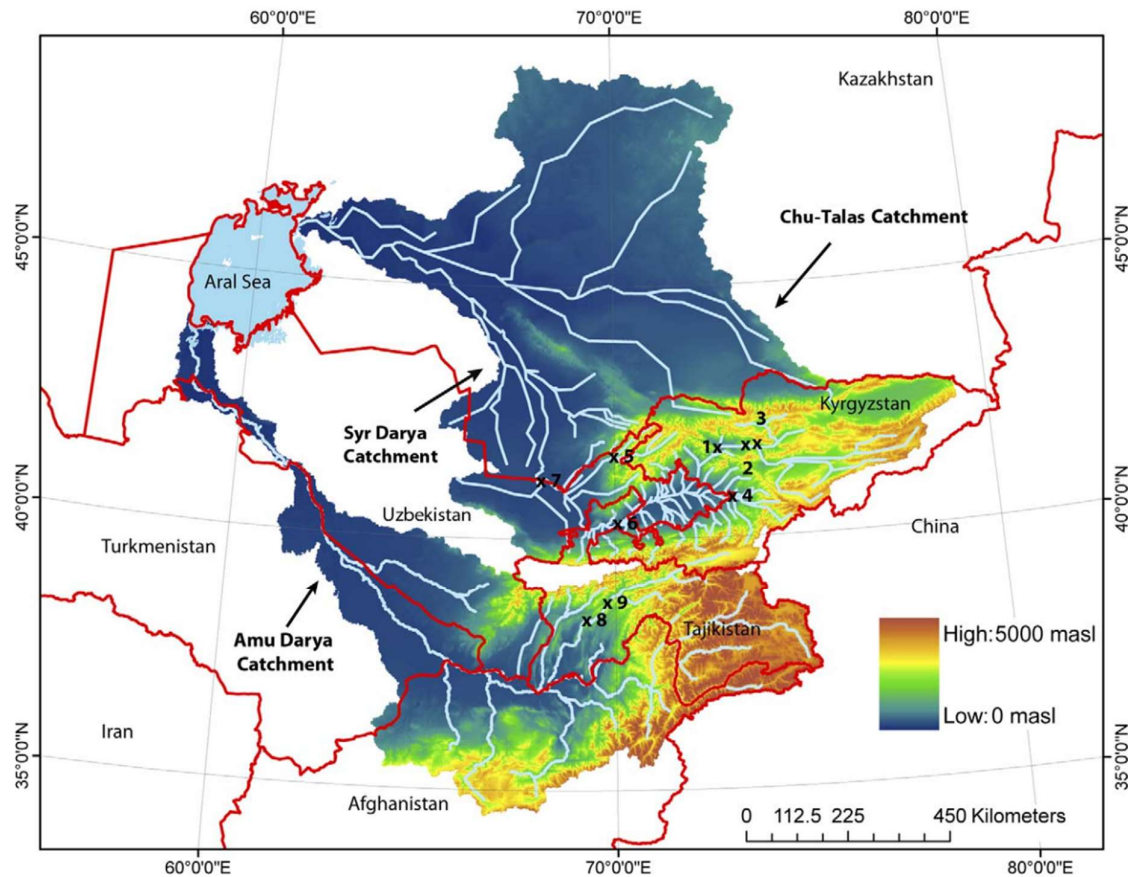
Central Asia provides a particularly useful setting in which to examine this problem. Water carries unusual political, economic, and social weight in the region. Much of Central Asia is arid or semi-arid, agriculture depends heavily on irrigation rather than rainfall, and a relatively small number of river systems sustain a disproportionately large share of agricultural production, energy management, and broader regional stability (Abdullaev and Rakhmatullaev, 2015: 849-850; Shalpykova, 2002: 10-11). The Amu Darya and Syr Darya are the two principal rivers of the wider Aral Sea basin and support extensive, highly regulated water use across multiple states. The Chu and Talas rivers form a smaller transboundary basin shared by Kazakhstan and Kyrgyzstan, but they remain regionally significant as a bounded case of interstate river management within the same broader hydro-political environment (Abdullaev and Rakhmatullaev, 2015: 849-850; Shalpykova, 2002: 10-11).

The significance of these rivers is reinforced by the region's post-Soviet inheritance. Under Soviet rule, water and energy were managed as part of an integrated inter-republican system: upstream reservoirs in Kyrgyzstan and Tajikistan stored and released water for downstream irrigation, while downstream republics supplied fossil fuels and electricity in return (Sehring, 2020: 1). After independence, these previously internal arrangements became internationalized, while the coordinated water-energy exchange system largely broke down (Sehring, 2020: 1-2). The new states were thus left with deeply interconnected infrastructure but increasingly divergent national priorities.

These structural tensions are reinforced by pronounced upstream-downstream asymmetries. Kyrgyzstan and Tajikistan control much of the upstream flow and prioritize winter releases for hydropower production, whereas downstream states depend on predictable summer flows for irrigated agriculture (Prniyazova et al., 2025: 2-3; Kanybek, 2024: 23-24). This sensitivity is amplified by the region's strong dependence on irrigated agriculture, which accounts for more than 85% of total water use (Prniyazova et al., 2025: 15). Both the Amu Darya and Syr Darya basins are heavily regulated through dams, reservoirs, and irrigation canals, making them among the most institutionally and technically complex river systems in the world (Allouche, 2007: 46-47). Climate change further intensifies these pressures by altering runoff patterns, increasing drought and flood risks, and raising uncertainty about future water availability (De Stefano et al., 2012: 194-196; Prniyazova et al., 2025: 2).

Central Asia is therefore a region in which shared rivers carry exceptional material and political importance, but also one in which common structural pressures do not automatically produce uniform institutional outcomes. This raises the central puzzle of the thesis.

Table 1. The three basin systems examined in this thesis: Amu Darya, Syr Darya, and Chu-Talas. (Bernauer and Siegfried, 2012: 229).



1.2 Research Puzzle, Argument, and Research Questions

If the structural pressures outlined above were decisive on their own, one would expect broadly similar institutional outcomes across the region. Yet this is not what we observe. The literature consistently notes that cooperation and conflict coexist in Central Asian water governance, and that cooperation has prevailed over conflict overall, even while regional institutions remain weak, unevenly implemented, and frequently contested (Sehring, 2020: 2; Zeitoun and Mirumachi, 2008).

In short: the thesis explains variation in how Central Asian transboundary water regimes continue to function or fail to function when they come under hydrological or political stress. The dependent variable is not whether conflict occurs, but how well the institutional arrangements hold up procedurally and contain dispute escalation when tested.

Stress in this region takes several recognisable forms. Hydrological stress appears most clearly in growing-season inflow shortfalls – for example, the Amu Darya inflow to Tuyamuyun

reached only 70.4% of forecast in April–September 2021, with end-of-season storage at 2,372 mcm against a planned 3,203 mcm (ICWC, 2022: 17–19), and the Syr Darya 2000–2001 episode, when Toktogul storage stood at 9.04 bcm in March 2001, 2.4 bcm below the same date a year earlier (Protocol of Experts' Joint Working Meeting, 2001: 1). Political and distributive stress appears in the breakdown of agreed compensation arrangements, as when Kyrgyzstan's planned summer releases on the Syr Darya in 2001 went uncovered by the agreed gas, fuel-oil, and diesel deliveries (Protocol of Experts' Joint Working Meeting, 2001: 1–5), or in the 2022 Chu-Talas dispute over withdrawals along the Aspara/Ashmara River (Water Yearbook 2022: 46–47). Procedural stress can also be exogenous: COVID-19 in 2020 disrupted normal Commission operations on Chu-Talas and prompted a substituted joint visual reservoir inspection at Orto-Tokoy/Kirov (Water Yearbook 2020: 48). These are the kinds of moments at which the question of whether the regime continues to function under stress becomes empirically visible.

At the same time, important differences exist across basin regimes. The Kazakh-Kyrgyz Chu-Talas Commission is often presented as a comparatively functional case of bilateral cooperation (Sehring, 2020: 2; Kanybek, 2024: 72-74, 95-96). By contrast, the 1998 Syr Darya agreement is commonly cited as having worked effectively only for a few years, while the broader Aral Sea basin framework associated with IFAS/ICWC is widely criticized for continuous disruption and weak implementation, including in the Amu Darya and Syr Darya systems (Sehring, 2020: 2; Prniyazova et al., 2025: 13, 16-17). Central Asia therefore presents a setting in which broadly similar structural pressures have produced divergent institutional trajectories.

The central puzzle of this thesis follows from that divergence: why do transboundary water regimes operating under similar constraints perform differently under stress?

Rather than asking whether treaties matter at all, this thesis asks why some transboundary water treaty regimes in Central Asia remain more resilient under hydrological and political stress while others are more vulnerable to disruption. The argument developed here is that variation in institutional design helps explain that difference. In this thesis, institutional design is treated as the main independent variable, while institutional performance under stress is treated as the main dependent variable. Defining the dependent variable as institutional performance under stress is more precise than asking only whether conflict occurs. Treaties may persist formally while becoming ineffective in practice, and disputes may remain politically serious without escalating into violence. A focus on institutional performance makes it possible to examine

procedural continuity, disruption, non-compliance, and the erosion of coordinated management rather than reducing outcomes to a simple conflict/no-conflict distinction. In practical terms, higher institutional performance under stress refers to situations in which basin actors continue to meet, exchange information, apply or adjust allocation arrangements, and manage disputes through agreed procedures even during drought, delivery shortfalls, or politically tense periods; lower performance refers to cases in which coordination stalls, agreed releases or exchanges break down, disputes bypass institutional channels, or unilateral action begins to replace negotiated management. The most extreme example of this would be interstate violent conflict.

Climate and political pressures are treated not as deterministic causes of conflict, but as contextual stressors whose effects are shaped by the institutional arrangements through which water-sharing is governed (Bandaragoda, 2000). These concepts are clarified in Chapter 2 and operationalized in Chapter 3. Differences in monitoring, information-sharing, dispute-resolution, flexibility, enforcement, and distributional arrangements are expected to influence how uncertainty is managed and whether stress remains contained within institutional frameworks.

The central research question guiding the thesis is:

How do differences in institutional design explain variation in institutional performance under stress in Central Asian transboundary water treaties?

This overarching question is complemented by three subsidiary inquiries. First, which institutional design features distinguish treaty regimes that display greater procedural continuity from those that experience breakdown under stress? Second, how do specific design features shape institutional responses during identifiable episodes of hydrological or political strain? Third, does institutional design retain explanatory power when considered alongside structural factors such as power asymmetry, Soviet institutional legacy, and wider regional political dynamics?

To make the puzzle concrete, consider two basin regimes operating under a comparable type of recurring stress: the winter reservoir release problem that arises whenever upstream and downstream riparians disagree on whether stored water should be used for winter power generation or held for spring-summer irrigation. On the Syr Darya, the annual barter arrangement for winter releases has repeatedly broken down since the early 2000s; the 1998 Syr Darya Agreement became difficult to implement, annual protocols were often not signed, and coordination drifted into ad hoc bilateral exchanges rather than treaty-based procedures

(Sehring 2020: 1-3; Wegerich 2008: 71-73). On the Chu-Talas, a much smaller shared system facing analogous seasonal tension, the bilateral commission has continued to hold its scheduled sessions, sign its annual operational protocols, and process disagreement through its working-group procedures, even as bilateral relations have been strained by unrelated issues (Sehring 2020: 2; Wegerich, 2008: 71–74). Both regimes face the same type of recurring structural pressure; only one produces the institutional outcomes this thesis calls procedural continuity and escalation containment. Explaining that difference is the task of the chapters that follow.

To answer these questions, the thesis employs a most-similar systems design comparing the Amu Darya, Syr Darya, and Chu–Talás basin regimes (Huntjens et al., 2011: 145–148). The comparative logic rests on the fact that these cases share major regional and historical conditions while differing in institutional design and observable performance. The empirical analysis draws on treaty texts, institutional documents, open-source materials, and secondary scholarship. Documented stress episodes are identified through documentary evidence while cross-referencing with open source information.

The thesis contributes to the larger literature in three ways. First, it contributes to scholarship on institutional design by applying design-based insights to transboundary water governance under conditions of stress and uncertainty. Second, it contributes to the study of Central Asian water politics by explaining divergence within a region that is often discussed in overly uniform terms. Rather than treating Central Asia as a single hydro-political setting, it shows that institutional outcomes vary meaningfully across basin regimes even where structural conditions are broadly similar. Third, it contributes to wider debates on climate and conflict by showing that environmental stress does not mechanically produce instability. Its political consequences depend in part on the institutional arrangements through which scarcity, uncertainty, and distributional tension are managed (Koubi, 2019: 343; Xie et al., 2024: 1-3, 8-9).

By focusing on the interaction between institutional design and stress, this thesis shifts attention away from scarcity alone and toward the rules, procedures, and organizational mechanisms through which scarcity is governed. In doing so, it seeks to explain why some transboundary water regimes in Central Asia remain functional under pressure while others fragment. As climate variability, water demand, and political uncertainty intensify, understanding how institutional design shapes resilience in shared river basins becomes increasingly important well beyond Central Asia.

1.3 Structure of the Thesis

The thesis is structured as follows. Chapter 2 develops the theoretical framework and explains why institutional design is treated as the central explanatory variable. It clarifies the main concepts used in the study, reviews competing structural explanations, and identifies the design dimensions and causal mechanisms expected to shape institutional performance under stress. Chapter 3 sets out the research design and methodology, including case selection, variable operationalization, temporal scope, stress-episode selection, and the evidentiary basis of the analysis. Chapter 4 applies this framework to the three selected basin regimes by first mapping their institutional design and then examining their performance during identified stress episodes. The final chapter draws the findings together, answers the main research question, and reflects on the broader implications of the study for transboundary water governance and institutional resilience under stress.

Chapter 2. Theoretical Framework

This chapter develops the theoretical framework used to explain why Central Asian transboundary water regimes perform differently under stress. Chapter 1 identified the central puzzle of the thesis: basin regimes operating under broadly similar structural pressures have not shown the same degree of institutional resilience. The argument developed here is that this variation is best explained by differences in institutional design, understood as the rules, procedures, and organizational mechanisms through which cooperation is structured and stress is managed.

The chapter proceeds in four steps. It first clarifies the main concepts used in the thesis, especially water conflict, stress, institutional performance under stress, and institutional design. It then reviews the main structural explanations in the literature and identifies what they explain well, but also what they leave unresolved. The chapter next turns to institutionalist theories of cooperation under anarchy, before specifying the design dimensions and causal mechanisms expected to shape institutional performance under stress. Together, these sections provide the theoretical basis for the empirical analysis that follows.

2.1 Conceptual Foundations

Before explaining why transboundary water regimes differ in their performance under stress, the main concepts used in this thesis must be clarified. This is necessary because terms such as water conflict, stress, and institutional performance are often used loosely or interchangeably

in both academic and policy discussions. In this thesis, they are used more precisely and for a specific analytical purpose.

This section therefore defines the core concepts that structure the argument. It first clarifies how water conflict and stress are understood in the context of transboundary river basins. It then defines institutional performance under stress as the main dependent variable of the thesis. Together, these conceptual clarifications establish the foundation for the theoretical argument developed in the following sections.

2.1.1 Water Conflict and Stress

A useful starting point is the concept of water conflict. In public and policy discourse, water conflict is often presented as a direct consequence of scarcity: as water becomes less available, competition sharpens and conflict is expected to follow. This framing has been influential in both policy and academic debates, especially in relation to environmental security and the “water wars” narrative, but it can also be misleadingly broad (Koubi, 2019: 343-344; Link et al., 2016: 495-497). In this thesis, water conflict is not understood as any disagreement over water as not every disagreement over water constitutes conflict in the same sense, and not every episode of scarcity produces the same political outcome. In transboundary river basins, bargaining, competing claims, and disputes over allocation are normal. Water conflict, in the narrower analytical sense used here, refers to the escalation of disputes beyond institutionalized channels. Conflict emerges when disagreement is no longer managed through agreed rules and procedures, but instead spills into unilateral deviation, prolonged non-compliance, or overt political confrontation.

The second concept that requires clarification is stress. In this thesis, stress refers to the pressures that test a basin regime. These pressures may be hydrological or political in nature and can include drought, water scarcity, contested seasonal releases, infrastructural strain, or intensified interstate disagreement (Fischhendler, 2004: 281-282; Mitchell and Zawahri, 2015: 188-189). Stress does not automatically amount to conflict. Rather, it describes the conditions under which institutional arrangements are tested.

This distinction is important because water scarcity is often presented in public and policy discourse as a driver of conflict. However, empirical research does not support deterministic claims linking hydrological variability to interstate violence (Link et al., 2016; Koubi, 2019: 343, 346-352; Pacillo et al., 2024). Contemporary climate-conflict scholarship instead shows that environmental stress influences conflict risk only under specific social, economic, and

political conditions, especially where climate-sensitive livelihoods intersect with political marginalization, inequality, weak adaptive capacity, and limited governance capability (Koubi, 2019; Pacillo et al., 2024; Xie et al., 2024). Climatic variability therefore functions as a stress multiplier rather than an autonomous causal driver.

This conditional understanding is particularly relevant in transboundary river basins. Shared rivers generate structural interdependence: upstream actions affect downstream availability, and seasonal variability requires coordinated management. In Central Asia, this interdependence is reinforced by pronounced seasonal asymmetry: upstream states rely heavily on winter hydropower generation, while downstream states depend on summer irrigation flows, creating recurrent coordination challenges tied to both agricultural and energy needs (Abdullaev and Rakhmatullaev, 2013; Peña-Ramos et al., 2021; Sehring, 2020). Under such conditions, uncertainty and distributional asymmetry create persistent potential for dispute. Yet most shared basins do not experience militarized interstate conflict (Link et al., 2016: 497-499; McCracken and Wolf, 2019). The persistence of cooperation suggests that stress and conflict must be analytically distinguished rather than treated as equivalent.

For this reason, the thesis does not ask whether scarcity exists, but how basin regimes respond when scarcity and other pressures arise. The analytical focus is therefore on the relationship between stress and institutional performance: whether stress is managed within institutional channels or whether it contributes to conflict by overwhelming them.

2.1.2 Institutional Performance Under Stress

To explain variation across Central Asian basin regimes, this thesis requires an outcome concept that is more precise than the simple presence or absence of conflict. In this study, that outcome is institutional performance under stress, the dependant variable. It refers to whether a transboundary water regime continues to function when it is tested by hydrological, political, or infrastructural pressure.

This concept is necessary because formal treaty existence does not by itself show that cooperation is working. A treaty may remain in force on paper while becoming weak, contested, or ineffective in practice. Likewise, disputes may remain politically serious without escalating into militarized confrontation. If the analysis focused only on violent conflict, it would miss important forms of institutional weakness. The central question is therefore not only whether conflict occurs, but whether basin regimes continue to operate when they come under strain.

In the literature, treaty effectiveness and institutional performance are often discussed in relation to compliance, cooperation, dispute management, and regime durability (Mitchell and Zawahri, 2015: 187-189; Bandaragoda, 2000: 11-15). In transboundary water governance, this problem is especially acute because formal arrangements may persist even when coordinated management becomes weak, fragmented, or contested in practice (De Stefano et al., 2012: 195-198; Fischhendler, 2004: 1-2). For that reason, institutional performance must be assessed in terms of how institutional regimes respond under pressure, not simply whether agreements continue to exist formally.

In this thesis, institutional performance under stress is assessed through two dimensions: procedural continuity and escalation containment.

Procedural continuity refers to whether the formal mechanisms of the basin regime continue to operate during periods of strain. This includes, for example, whether commission meetings are held, whether agreed allocation procedures remain in use, and whether monitoring and reporting practices continue. The point is not that disagreement disappears, but that the institutional procedures continue to operate despite disagreement. This builds on work that treats treaty performance in terms of continued coordination, dispute management, and the ability to avoid militarized escalation rather than treaty existence alone (Mitchell and Zawahri, 2015: 187-189; De Stefano et al., 2012: 195-198).

Escalation containment refers to whether disputes remain managed within institutional channels or instead move beyond them. A regime shows stronger containment when disagreement is addressed through consultation, negotiation, or other agreed procedures. It shows weaker containment when disputes spill into unilateral deviation, prolonged non-compliance, or overt political confrontation.

This formulation is better suited to the Central Asian cases where not all institutional failures culminate in violence, yet may still matter analytically. Basin regimes may weaken through procedural disruption, contested implementation, or the repeated inability to manage stress within agreed rules. For this reason, the thesis treats institutional performance under stress as the main dependent variable for comparing why some treaty regimes remain more resilient than others. This conceptualization also clarifies what it means to claim that the Central Asian basin regimes differ in outcome. The relevant variation lies not simply in whether cooperation exists in formal terms, but in whether regimes differ in their ability to sustain procedural continuity and contain escalation during comparable episodes of hydrological or political strain.

Concretely, procedural continuity is assessed through four observable indicators: (1) whether the scheduled meetings of the basin commission or equivalent coordinating body take place during the stress episode; (2) whether joint operational protocols, such as seasonal water-release or energy-exchange agreements, are signed and implemented on time; (3) whether the secretariat or working groups continue to produce decisions and records during the episode; and (4) whether unilateral measures by any riparian replace or displace these joint procedures.

Escalation containment is assessed through three observable indicators: (1) whether disagreements are raised and processed within the formal institutional channels (commission meetings, diplomatic notes through institutions, joint working groups) rather than through broader foreign-policy channels or public media; (2) whether the language used by riparian governments in bilateral communications during the episode remains technical rather than existential or securitized; and (3) whether the episode concludes with a procedural or substantive resolution (formal agreement, renewed protocol, referral to a technical body) rather than a breakdown, silence, or unresolved impasse. Taken together, these seven indicators allow each stress episode to be scored on both dimensions and compared across basins.

The next section examines the main competing explanations used in the literature to account for variation in transboundary water cooperation before turning to institutional design as the central explanatory variable of the thesis.

2.2 Competing Explanations: Structural Accounts of Divergence

The previous section defined the main concepts used in this thesis. The next step is to consider alternative explanations for why basin regimes perform differently under stress. In the literature on transboundary water governance, variation in cooperation and conflict is often explained through structural factors such as climate variability, power asymmetry, institutional legacy, and wider political context rather than through variation in institutional design (Zeitoun and Mirumachi, 2008; Hayat et al., 2024). In the Central Asian context, the most common explanations emphasize climate variability, upstream–downstream power asymmetry, Soviet institutional inheritance, and broader regional political dynamics (Sehring 2009; Prniyazova et al., 2025; Bekmuratov, Overland, and Vakulchuk, 2025: 4-8; Kasimov, 2026: 1-4). These explanations are important because they identify the pressures and constraints within which cooperation takes place. At the same time, this thesis argues that they do not sufficiently explain why basin regimes operating under broadly similar conditions perform differently under stress.

The purpose of this section is therefore not to dismiss structural explanations, but to assess their limits. Each subsection below introduces one major explanation, explains why it matters, shows how it is used in the literature, and clarifies how it is treated in this thesis.

2.2.1 Climate Stress and Environmental Determinism

A first explanation emphasizes climate stress. In its broadest form, this argument suggests that environmental degradation, water scarcity, drought, and climatic variability can increase the risk of conflict by intensifying competition over limited resources (Buhaug, 2015; Pacillo et al., 2024; Jiang et al., 2025; Schleussner et al., 2016: 9216-9218; von Uexkull et al., 2016: 12391-12393; Marten, 2024: 4-7). This has been one of the most visible ways of framing the relationship between environment and security, especially in work that links scarcity to instability, displacement, or violence.

This explanation matters for the present thesis because hydrological variability is clearly relevant to transboundary river basins. In systems where water availability fluctuates seasonally and interannually, scarcity can place existing institutional arrangements under pressure and intensify disagreements over allocation, releases, or obligations (De Stefano et al., 2012: 196-197; Fischhendler, 2004: 1-2). In Central Asia, drought, changing runoff, and greater uncertainty about water availability are all important background pressures. Any theoretical account of basin performance that ignored these pressures would be incomplete.

In the literature, however, climate-related conflict is now generally treated in more conditional terms. Recent research does not support a simple or deterministic claim that climatic variability directly produces conflict. Rather, environmental pressures are understood as stressors whose political effects depend on the social, economic, and institutional contexts in which they unfold, often through mechanisms such as economic disruption, agricultural decline, resource competition, displacement, and pressure on already weak governance structures (Buhaug, 2015; Xie et al., 2024).

In this thesis, climate stress is therefore treated as a shared contextual condition, not as the principal explanation for divergence across cases. The Amu Darya, Syr Darya, and Chu-Talas basins are all exposed to climatic variability and hydrological uncertainty. If environmental stress alone determined institutional outcomes, one would expect more convergence across the cases. The fact that performance still differs suggests that climate stress tests institutions but does not by itself explain why some basin regimes remain more stable under pressure than others.

2.2.2 Power Asymmetry and Hydro-Hegemony

A second explanation emphasizes power asymmetry in upstream–downstream river systems. This argument holds that basin politics are shaped by unequal control over headwaters, storage infrastructure, and bargaining resources, allowing stronger riparians to exert leverage over weaker ones and to shape both the content of agreements and the distribution of benefits within a basin (Zeitoun and Warner, 2006: 449-453). This explanation is especially relevant in Central Asia, where upstream states control much of the headwater flow and key storage infrastructure, while downstream states depend heavily on timely releases for agricultural production (Prniyazova et al., 2025: 2-3). These asymmetries shape bargaining dynamics, intensify disputes over seasonal releases, and influence perceptions of fairness and obligation.

In the hydro-hegemony literature, asymmetry is not treated simply as unequal physical position, but as the unequal possession and mobilisation of material and political bargaining power. Stronger riparians may convert upstream location, control over infrastructure, superior financial or diplomatic resources, and greater agenda-setting capacity into leverage over weaker co-riparians (Zeitoun and Warner, 2006: 435-453; Zeitoun and Mirumachi, 2008: 297-301). As a result, power asymmetries can shape not only bargaining processes, but also the substantive content of agreements, the distribution of benefits, and the degree to which institutional arrangements reflect or reproduce unequal basin relations.

In this thesis, however, power asymmetry is treated as a structural feature of the environment, not as a sufficient explanation for divergence in institutional performance. All three basin regimes examined here exhibit some form of upstream–downstream asymmetry. In each case, upstream actors hold greater control over headwaters, storage, or the timing of releases, while downstream actors are more dependent on predictable flows for irrigation and agricultural production. Yet this shared structural condition does not generate uniform outcomes. The Chu-Talas regime, despite clear asymmetry between Kyrgyzstan’s upstream position and Kazakhstan’s downstream dependence, is often described as a comparatively functional case of bilateral cooperation with more stable procedural coordination (Sehring, 2020: 2; Kanybek, 2024: 49-50). By contrast, the Syr Darya regime operates under a similarly asymmetric upstream-downstream structure, but its core arrangements have been far more fragile, and prone to breaking down (Sehring, 2020: 2; Prniyazova et al., 2025: 13, 16-17). In other words, comparable asymmetry is present in both settings, but the degree of treaty continuity and dispute containment differs. This suggests that asymmetry helps explain why bargaining is difficult and why distributional tensions persist, but not why some regimes remain procedurally

more stable under stress while others experience repeated disruption. Asymmetry shapes the political and bargaining environment in which institutions operate, but it does not independently determine how well they perform under stress.

2.2.3 Soviet Institutional Legacy

A third explanation focuses on Soviet institutional legacy. Under Soviet rule, water and energy in Central Asia were coordinated through a centralized administrative system. Allocation, reservoir operations, and infrastructural management were embedded in a broader framework of technocratic planning, regional specialization, and cross-republic interdependence rather than through interstate bargaining (Sehring, 2020: 1-2). Following independence, this centralized structure fragmented into interstate arrangements, but the underlying infrastructure, operational routines, and administrative routines and hierarchical modes of coordination, common to Soviet system, remained in place (Sehring, 2009: 67, 75-76; Wegerich, 2008: 70-71).

This explanation matters because Central Asian basin regimes did not emerge on an institutional blank slate after 1991. They were built on inherited canals, reservoirs, bureaucratic routines, and allocation norms designed for a different political order. This helps explain why post-Soviet water governance has often been marked by strong path dependence, overlapping mandates, weak horizontal coordination, and the persistence of centralized or technocratic habits even after formal reforms were introduced (Sehring, 2009: 61-67, 75-76).

The literature uses Soviet legacy to explain both continuity and constraint. Abdullaev and Rakhmatullaev (2015) argue that water management in Central Asia has been shaped by a broader transformation from Soviet hydraulic administration toward more fragmented and politicized governance after independence, with inherited institutional structures proving difficult to adapt effectively. Bandaragoda (2000: 175-178) likewise show, at a more general level, that institutional change in the water sector is often constrained by the interaction of legal, policy, and administrative structures, which do not adjust easily when broader political and economic settings change.

Sehring's (2009; 2020) analysis is especially useful here because it shows that post-Soviet reform did not simply replace old institutions with new ones; rather, formal reforms were often layered onto inherited administrative cultures and informal practices. In Kyrgyzstan and Tajikistan, Soviet and pre-Soviet patterns continued to shape implementation, while new organizations and rules were frequently undermined, reinterpreted, or selectively adopted in

practice (Sehring, 2009: 61, 64-67, 75-76). This means Soviet legacy is not only a matter of infrastructure, but also of institutional logic: hierarchical administration, fragmented coordination, and weak implementation capacity remained embedded in post-Soviet water governance.

At the same time, Soviet inheritance does not by itself explain the divergence in institutional performance that this thesis seeks to explain. The Amu Darya, Syr Darya, and Chu–Talas regimes all emerged from the same broad post-Soviet transformation and inherited comparable infrastructural and administrative foundations. If Soviet legacy were sufficient on its own, one would expect greater convergence in their later institutional trajectories. Instead, important variation persists. Soviet inheritance is therefore treated in this thesis as a shared historical starting point and structural constraint, not as a principal explanation for why some basin regimes maintain greater procedural continuity and stronger escalation containment under stress than others.

2.2.4 Regional Political Dynamics

A fourth explanation highlights broader interstate relations. On this view, variation in transboundary river-basin cooperation depends not only on hydrology, asymmetry, or inherited infrastructure, but also on whether riparian states maintain cooperative or conflictual relations more generally. Hussein, Poplawsky, and Mohapatra (2023: 4) make this logic explicit by treating interstate politics as a distinct dimension of political context and arguing that improving relations should be associated with more cooperative treaty development, while deteriorating relations may produce more conflictual or less cooperative institutional outcomes.

This explanation is relevant to Central Asia because the post-Soviet transformation did not simply create new water institutions; it also transformed previously domestic rivers into international rivers and thereby made water a potential source of interstate conflict (Sehring, 2009: 235-237). Sehring further argues that early attempts at regional water cooperation achieved only limited success, suggesting that broader political constraints remained important even where formal institutions were created (Sehring, 2009: 235-237).

The logic is also visible across the basin systems examined in this thesis. In the Syr Darya, cooperation has long been strained by bargaining deadlock, repeated renegotiation, and the persistence of unresolved water–energy conflicts; more recent work still describes the basin as characterized by persistent water allocation conflicts and complex trade-offs between upstream hydropower production and downstream agricultural needs (Sehring, 2009: 234-241). In the

Amu Darya, Sehring (2009: 234-241), working from an institutional-bricolage perspective, makes a similar point: cooperation is more complicated than in Syr Darya not only because of upstream–downstream disputes, but also because of the festering conflicts between Turkmenistan and Uzbekistan. By contrast, the Chu–Talas basin has operated within a more cooperative Kazakhstan–Kyrgyzstan bilateral setting; regional reporting describes bilateral relations in terms of friendship, good-neighborliness, and strategic partnership, alongside repeated commission meetings and continuing joint water-management activity (Water Yearbook 2020: 50-51).

Taken together, this literature makes broader interstate relations a plausible competing explanation for variation in basin-regime performance: where riparians maintain more cooperative political relations, coordination and adaptation may be easier to sustain, while more conflictual relations may make basin cooperation harder to preserve. At the same time, this explanation does not eliminate the need to examine institutional design more directly. It will therefore be treated in this thesis as a plausible alternative explanation and revisited in the empirical analysis alongside the institutional argument.

2.2.5 What These Explanations Leave Unresolved

Taken together, the explanations discussed above identify important background conditions of transboundary water politics in Central Asia. Climate variability helps explain why basin regimes face recurring material stress. Power asymmetry clarifies why bargaining positions are unequal and why distributional tensions persist. Soviet institutional legacy helps account for the persistence of inherited infrastructure, administrative routines, and implementation problems. Wider regional political dynamics show why water disputes are often entangled with questions of sovereignty, mistrust, and energy security (Prniyazova et al., 2025: 1–3, 11–12; Sehring, 2009: 61–67, 75–76; Zeitoun & Warner, 2006: 449–453). In this sense, these explanations are necessary for understanding the context in which cooperation takes place.

At the same time, they do not fully resolve the central puzzle of this thesis. The Amu Darya, Syr Darya, and Chu–Talas regimes are all shaped, in different ways and to different degrees, by climatic uncertainty, upstream–downstream asymmetry, post-Soviet institutional inheritance, and wider regional political pressures. Yet their institutional trajectories have not been the same. Some arrangements have displayed greater procedural continuity and stronger containment of disputes within formal channels, while others have been more prone to weak

implementation, repeated disruption, or erosion of coordinated management. (Sehring, 2020: 2; Wegerich, 2008: 73; Prniyazova et al., 2025: 13, 16-17).

The problem, then, is not that structural explanations are wrong, but that they remain too broad to explain this variation on their own. They help explain why cooperation is difficult, why stress recurs, and why disputes are politically charged. They do not, however, explain why some basin arrangements are better able than others to preserve regular procedures, manage uncertainty, and contain escalation under pressure. To explain this variation more directly, it is necessary to examine the institutional arrangements through which stress is processed. The next section therefore turns to the core argument of this thesis: that variation in institutional design provides a more proximate explanation for divergent institutional performance under stress.

2.3 Institutional Cooperation Under Anarchy

If the structural explanations reviewed above do not fully account for divergence in basin-regime performance, the next step is to consider why institutions matter in the first place. This is important because transboundary river basins operate in an international system without a central enforcement authority, yet still require repeated coordination over allocation, infrastructure, and changing hydrological conditions.

These basin regimes are also nested within a wider international-law architecture that frames cooperation over shared waterways within the international-law architecture that frames cooperation over shared waterways. The principal codification is the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses, which entered into force in 2014 and rests on two foundational principles: equitable and reasonable utilization (Article 5) and the obligation not to cause significant transboundary harm (Article 7), supplemented by procedural duties of notification, consultation, and cooperation in Articles 8–12 (UN Watercourses Convention, 1997: Articles 5-12). Alongside this global framework, regional and bilateral treaties (in Central Asia, the 1992 Almaty Agreement, the 1998 Syr Darya Agreement, and the 1999/2000 Chu-Talas Agreement) function as the operational layer through which states translate general principles into specific commitments and procedures (Mitchell and Zawahri, 2015: 187-189; Hussein, Poplawsky, and Mohapatra, 2023: 1-3; McCracken and Wolf, 2019: 736-739; Sadoff and Grey, 2002: 389-391). This international-law layer is contextual rather than analytical for the present thesis - the analysis focuses on how the operational layer functions under stress, not on the application of UN Convention principles in

litigation, but it clarifies that the basin regimes examined here are nested within a wider normative order even when that order does not directly enforce institutional outcomes.

The institutionalist literature provides the basis for explaining how cooperation can persist under such conditions and, more importantly for this thesis, why variation among institutional arrangements may shape performance under stress.

2.3.1 Cooperation Under Anarchy in Recurrent River Relations

The institutionalist explanation developed in this thesis begins from the broader problem of cooperation under anarchy. In the absence of a central enforcement authority, states must coordinate in an environment where commitments may be uncertain, information may be incomplete, and compliance cannot be guaranteed (Koremenos et al., 2001: 790, 795-796). In such settings, cooperation is fragile because states may worry about relative gains, unequal capabilities, and incentives for opportunistic behaviour. (Keohane 1984; Hayat et al., 2024: 79-81). Institutionalism does not deny these conditions but argues that they do not make cooperation impossible. Rather, institutions emerge because repeated interaction creates incentives to reduce uncertainty, stabilize expectations, and structure behaviour over time (Koremenos et al., 2001: 762-764, 790, 795-796).

This argument is especially relevant in transboundary river basins. Shared rivers generate recurrent rather than one-off interaction: riparian states must repeatedly address allocation, infrastructure use, seasonal releases, and changing hydrological conditions (Mitchell and Zawahri, 2015: 187-188; Sadoff and Grey, 2002: 389-391). Under such circumstances, cooperation depends not only on temporary bargaining power, but also on whether durable rules and procedures exist to organize expectations and facilitate adjustment. As Keohane (1984: 85-109) argues, institutions matter because they can lower transaction costs, provide credible information, and stabilise expectations among recurrent partners; this institutional framing is complementary to the water-diplomacy perspective developed in the complex-systems literature on shared waters (Islam and Susskind, 2013: 16-22). Koremenos, Lipson, and Snidal (2001: 762-763), similarly treat institutions as purposive responses to recurrent cooperation problems rather than as incidental by-products of state interaction.

In water governance, this logic is particularly important because the relevant interactions are both repeated and materially interdependent. Institutions do not eliminate conflict, but they can make cooperation more politically manageable by regularizing contact, clarifying expectations, and creating procedures through which disagreements can be addressed (Koremenos et al.,

2001: 790, 795-796; Mitchell and Zawahri, 2015: 187-189). This is why the present thesis does not ask simply whether institutions matter in principle. It asks why some institutionalized basin regimes are better able than others to remain functional under stress.

2.3.2 Institutions as Functional but Incomplete Arrangements

If institutions help make cooperation possible, the next question is how they do so. In transboundary river basins, institutions perform a functional role by organizing repeated interaction. They formalize allocation rules, create procedures for consultation, and establish frameworks through which disagreement can be managed (De Stefano et al., 2012: 195-198; Mitchell and Zawahri, 2015: 187-189). Their importance lies less in eliminating conflict altogether than in structuring how conflict is handled.

This is particularly important because water agreements are inherently incomplete. They are negotiated under uncertainty and cannot fully anticipate all future hydrological conditions, political shifts, or changes in demand (Koremenos, et al., 2001: 762-764). Drought, infrastructural disruption, contested releases, and new sectoral priorities may all generate situations that initial agreements did not fully foresee (Fischhendler, 2004: 1-2). In that sense, basin regimes are ongoing institutional arrangements that must operate under changing conditions.

The literature addresses this in two related ways. First, institutionalist and rational design approaches suggest that agreements are deliberately crafted under conditions of uncertainty and therefore cannot specify every future contingency in advance (Koremenos, et al., 2001: 762-764). Second, the water-governance literature shows that treaty performance under variability depends on whether agreements include provisions that allow adjustment, consultation, and continued coordination when conditions change. De Stefano et al., (2012: 195-198) argue that treaties are more resilient where they provide institutionalized environments for negotiation, monitoring, and adaptation during periods of variability and extreme events. Fischhendler (2004: 1-2) similarly shows that water treaties often require legal and institutional adaptation to cope with changing supply conditions and that rigid arrangements can become politically fragile when hydrological reality shifts. De Bruyne and Fischhendler (2013: 1-3) add that the institutional means for handling future disagreement are themselves often incomplete or difficult to negotiate, which further reinforces the importance of design under uncertainty.

This matters for the present thesis because it clarifies why institutional performance should not be judged only by formal treaty existence. A treaty may persist while functioning poorly in practice, especially when stress exposes the limits of incomplete arrangements. The relevant question is therefore not whether an agreement exists, but whether it contains and activates mechanisms that allow it to remain procedurally functional when tested.

2.3.3 Why Institutional Variation Matters

Once institutions are treated as functionally important but incomplete arrangements, a further question follows: why do some institutionalized basin regimes maintain stronger institutional performance under stress than others? This question is central to the thesis because the three cases examined here are all governed by some form of institutional arrangement, yet they do not display the same level of performance under stress.

In the literature, this move from the existence of institutions to variation among them is closely associated with rational design perspectives. These approaches focus on how agreements differ in the features they include and how those features respond to recurring cooperation problems such as uncertainty, enforcement problems, incomplete contracting, and distributional conflict (Koremenos, et al., 2001: 762-764, 773-775). In the transboundary water literature, a similar move appears in work showing that treaty provisions such as river basin organizations, information exchange, enforcement, and conflict-management mechanisms influence how water disputes are handled in practice (Mitchell and Zawahri, 2015: 187-189).

In this thesis, institutional variation is therefore treated as the key theoretical lever for explaining divergence across cases. The argument is that institutions do not matter only by existing. They matter through the design features they formalize and through the ways those features shape information-sharing, dispute handling, adaptation, compliance, and incentive alignment. The next section develops this argument by identifying the principal dimensions of institutional design relevant to transboundary water governance.

Two causal propositions follow from this institutionalist reading and structure the empirical analysis. Proposition 1 (procedural): treaty regimes whose design features include regular institutionalized contact - scheduled meetings, standing secretariats, embedded information-sharing protocols - are more likely to maintain procedural continuity under stress, because these features lower the transaction cost of communication precisely when political friction would otherwise reduce it. Proposition 2 (containment): treaty regimes whose design features include pre-specified dispute-handling mechanisms, separation between technical coordination and

high political channels, and benefit-sharing or distributional rules, are more likely to contain dispute escalation under stress, because these features create institutional landing points for disagreement and raise the political cost of defection to unilateral measures. These propositions do not predict that institutions eliminate stress; they predict how institutional design mediates the translation of stress into observable performance outcomes.

2.4 Institutional Design as the Central Explanatory Variable

The previous section explained why institutions matter in transboundary river basins and why variation among institutional arrangements is analytically important. The next step is to specify what institutional design means in this thesis. This is necessary because the argument does not treat basin regimes as undifferentiated entities. It treats them as arrangements that vary in the rules and procedures they include for managing recurring cooperation problems such as uncertainty, dispute, compliance, adaptation, and uneven gains.

In the literature, rational design approaches start from the idea that institutional features are not random. Agreements are shaped by the cooperation problems states face, including uncertainty, enforcement difficulties, and distributional conflict (Koremenos et al., 2001: 773-778). The intellectual lineage of this approach traces back to Ostrom's (1990: 88-102) foundational work on institutional design principles for common-pool resources, which established that durable cooperative arrangements depend on rules-in-use that specify monitoring, sanctions, conflict resolution, and adaptive provisions. Building on that foundation, more recent transboundary-water scholarship has refined the analytical inventory of design features and tested it against treaty practice. In the transboundary water literature, this general insight is developed through more issue-specific attention to treaty provisions and formations of river basin organizations/regimes with elements such as **information exchange, conflict-resolution mechanisms, enforcement clauses, adaptive clauses, and benefit-sharing arrangements** (Mitchell and Zawahri, 2015: 187-189; De Bruyne and Fischhendler, 2013: 1-3; Fischhendler, 2004: 1-2; Sadoff and Grey, 2002: 389-391; Schmeier et al., 2013; Hussein, Poplawsky, and Mohapatra, 2023: 1-3).

This thesis builds on that literature by treating institutional design as a composite of five dimensions: 1) monitoring and information-sharing provisions, 2) dispute-resolution mechanisms, 3) enforcement and compliance clauses, 4) flexibility and adaptive provisions, and 5) distributional or benefit-sharing arrangements. Rather than treating these dimensions as

universally required in every case, the thesis presents them as a theoretically grounded synthesis of the main cooperation problems that recur in transboundary water governance

2.4.1 Monitoring and Information-Sharing Provisions

The first dimension of institutional design concerns monitoring and information-sharing provisions. This dimension addresses the problem of uncertainty. In transboundary river basins, cooperative management is widely understood to require credible and reliable data and information about flows, availability, and use of the shared water resource, and access to such information is considered especially important where waters are shared across borders (Gerlak, et al., 2011: 179-180).

In the transboundary water literature, information-sharing is treated as part of the broader institutionalization of basin governance. Gerlak, Lautze, and Giordano (2011) argue explicitly that water resources data and information exchange can be understood as one element of the wider institutionalization framework in shared waters, and their analysis highlights the elements comprising this as hydrologic data exchange, hydrologic information exchange, research and assessment provisions, prior notification, and formalized communication mechanisms (Gerlak, et al., 2011: 181-183, 186-187).

These provisions matter because they help make cooperation more operational and more durable. Gerlak, Lautze, and Giordano (2011: 181, 183) also link data and information exchange to agreement formation, implementation, and effectiveness, and note that exchange can provide a basis for coordinated management, transparency, trust, and joint compliance. Mitchell and Zawahri (2015: 187-188) similarly find that information exchange provisions in river treaties reduce the likelihood of militarized conflict and increase the chances that negotiations over river claims successfully resolve the issues at stake.

In this thesis, monitoring and information-sharing provisions are therefore understood as design features through which basin regimes formalize the collection, exchange, and communication of relevant information. Their significance lies in reducing uncertainty, improving coordination, and making it easier for states to manage recurring disputes within an institutional framework rather than through competing unilateral interpretations.

2.4.2 Dispute-Resolution Mechanisms

A second dimension of institutional design concerns dispute-resolution mechanisms. In transboundary river basins, disagreement is not exceptional but recurrent, because shared rivers generate ongoing interdependence and expose riparian states to continuous conflicts of interest

over use, management, and the interpretation of obligations (Mitchell and Zawahri, 2015: 188-189). The key question is therefore not whether disagreement occurs, but whether basin regimes provide recognized procedures through which it can be addressed (Mitchell and Zawahri, 2015: 188-189).

In the water treaty literature, conflict-resolution mechanisms are treated as important constituting elements of international water agreements because they provide recognized procedures for handling disagreement under conditions of uncertainty (De Bruyne and Fischhendler, 2013: 1-2). De Bruyne and Fischhendler (2013) further link them to treaty flexibility and dispute mitigation when conditions change, while Fischhendler (2004) shows that the exclusion of crisis-mitigating mechanisms can weaken treaty performance under stress. Mitchell and Zawahri (2015: 190-191), meanwhile, treat conflict-resolution mechanisms as institutional features that can guide riparians through periods of tension and help them maintain cooperation.

This dimension matters because institutions do not remove disagreement; they structure how it is handled. Where such procedures are absent, incomplete, or vague, disputes are less likely to be managed through clearly institutionalized channels. De Bruyne and Fischhendler (2013: 1-3) show precisely that many transboundary water agreements either omit conflict-resolution mechanisms altogether or include only weakly developed provisions, despite their potential importance for coping with future disputes.

The broader treaty-design literature reinforces the same general point. Mitchell and Zawahri (2015: 187-188) include conflict-resolution mechanisms among the key institutional features through which riparians attempt to manage river disputes within an organized framework, even if their empirical results suggest that other provisions, especially information exchange and enforcement, more consistently shape dispute outcomes. The significance of dispute-resolution mechanisms thus lies less in eliminating conflict than in providing recognized procedures for contesting claims and handling grievance without immediately stepping outside the regime.

In this thesis, dispute-resolution mechanisms are understood as design features that structure how disagreement is processed once cooperation comes under strain. Their importance lies in helping determine whether disputes remain procedurally contained within the institutional framework or become harder to manage through established rules and forums.

2.4.3 Enforcement and Compliance Provisions

A third dimension of institutional design concerns enforcement and compliance provisions. In transboundary river basins, agreements matter not only because they define rules, but also because they shape whether those rules remain credible once cooperation comes under pressure. This dimension addresses the problem of compliance: whether commitments are likely to be carried out, and what institutional response exists when they are not.

In the water treaty literature, enforcement is treated as one of the key design features through which riparians seek to manage disputes more effectively. Mitchell and Zawahri (2015: 188, 194-199) explicitly include enforcement among the principal institutional mechanisms embedded in river treaties, alongside information exchange, monitoring, and conflict-resolution procedures, and their empirical analysis suggests that enforcement provisions are among the most consequential in practice. They find that enforcement provisions reduce the likelihood of militarized conflict, increase the chances that negotiations successfully resolve river claims, promote third-party dispute settlement attempts, and increase compliance with agreements reached (Mitchell and Zawahri, 2015: 194-197, 199).

The broader institutional design literature supports the same logic. Koremenos, et al. (2001: 779) argue that cooperation problems persist after agreements are signed, especially where incentives to defect and gain remain strong. Under such conditions, states may adopt more centralized arrangements that monitor behaviour, exclude shirkers from subsequent benefits, or delegate authority to third parties to adjudicate and enforce mutually beneficial agreements (Koremenos, et al., 2001: 789-790). Even where coercive enforcement is weak, institutional arrangements may still strengthen compliance by increasing the reputational and political costs of breakdown (Koremenos, et al., 2001: 789-790).

Enforcement and compliance provisions therefore refer, in this thesis, to design features that connect agreed rules to institutional consequences or leverage when obligations are not met. These may include explicit sanctions for non-compliance, adjudicative or third-party procedures that strengthen compliance, or institutional arrangements that raise the costs of defection by linking continued participation to rule observance. Their significance lies in helping determine whether commitments remain actionable once cooperation becomes politically or materially strained.

2.4.4 Flexibility and Adaptive Provisions

A fourth dimension of institutional design concerns flexibility and adaptive provisions. This dimension addresses the problem of (in)flexibility: transboundary water agreements are negotiated under conditions of uncertainty, where the hydrological, political, and economic conditions under which they operate can change substantially over time

The broader institutional design literature provides the general logic for this claim. Koremenos, et al. (2001: 773, 777-778, 784, 792-793) argue that states design agreements under uncertainty and cannot fully anticipate future contingencies, which means that institutional arrangements must often cope with changing conditions after signature rather than simply implement a fixed bargain. In the water-specific literature, flexibility is discussed more concretely through provisions that allow agreements to adjust when water availability changes. Fischhendler (2004) shows that treaties often exclude climate-uncertainty mechanisms even though variation in water availability and drought can make fixed allocations difficult to sustain; among the mechanisms he identifies are escape clauses, percentage-based allocation rules, and balancing arrangements that help riparians adapt obligations during periods of shortage. De Stefano et al. (2012) likewise treat flow variation management provisions as one of the treaty design elements relevant to institutional resilience under hydrological variability.

What matters here is not flexibility in an abstract sense, but whether agreements contain provisions that allow adjustment without institutional breakdown. As highlighted above, these may include review clauses, drought or emergency provisions, escape clauses, procedures for revising allocations, or institutional forums through which changing conditions can be addressed without abandoning the cooperative framework. Where such provisions are absent, regimes may find it more difficult to absorb stress because disagreement over changed conditions must be managed through rules that were designed for a different context.

In this thesis, flexibility and adaptive provisions are therefore understood as design features that allow basin regimes to respond to changing hydrological or political conditions without requiring outright institutional rupture. Their significance lies in helping explain whether cooperation remains operational under stress or becomes more vulnerable to breakdown when the original terms of agreement come under pressure.

2.4.5 Distributional and Benefit-Sharing Arrangements

A fifth dimension of institutional design concerns distributional or benefit-sharing arrangements. This dimension addresses the problem of uneven gains. In transboundary river

basins, cooperation is often difficult not because states cannot identify technically preferable solutions, but because they expect the costs and benefits of cooperation to be distributed asymmetrically. Agreements must therefore do more than allocate water physically; they must also make cooperation politically acceptable to actors whose interests and vulnerabilities differ.

The broader institutional design literature provides the general logic for this claim. Koremenos et al. (2001: 775-776, 780-782) argue that distribution problems are central to institutional bargaining because states are concerned not only with joint gains but also with how those gains are divided. Where expected benefits are distributed unevenly, institutional design becomes a way of making cooperation more acceptable by structuring who receives what, when, and under what conditions.

In the water-specific literature, this problem is most clearly developed through the concept of benefit-sharing. Sadoff and Grey (2002: 390-391, 394-395) argue that cooperation over international rivers can generate several categories of benefits, not only direct benefits from the river such as irrigation or hydropower, but also reduced costs because of the river through lower tensions and broader benefits beyond the river through wider regional cooperation. Their central point is that cooperative arrangements become more viable when riparians focus on sharing the broader benefits generated by cooperation rather than only dividing a fixed volume of water (Sadoff and Grey 2002).

This matters because disputes in transboundary basins are often distributional as much as hydrological. Upstream and downstream states typically value water differently across sectors and seasons, and this makes purely volumetric allocation politically fragile (Kanybek 2024: 23-24). Benefit-sharing arrangements can help address this problem by linking water cooperation to side payments, infrastructure cost-sharing, energy exchanges, or other compensatory arrangements that make cooperation more acceptable to parties who might otherwise see themselves as losing from it (Kanybek 2024: 64). In this sense, distributional design does not eliminate asymmetry, but it can make asymmetry more governable by embedding it in a package that offers reciprocal advantages.

In this thesis, distributional or benefit-sharing arrangements are understood as design features that seek to align incentives by addressing how the gains, costs, and burdens of cooperation are distributed across riparians. Their significance lies in helping explain whether cooperation remains politically acceptable under stress or weakens when parties no longer view the institutional bargain as sufficiently balanced.

2.4.6 How Institutional Design is Understood in this Thesis

Taken together, these five dimensions define institutional design in this thesis as a composite explanatory variable rather than a single treaty attribute. The argument is not that every agreement must contain all five dimensions in equal measure, nor that one provision automatically guarantees effective cooperation. Rather, the claim is that variation in how agreements address uncertainty, contestation, compliance, changing conditions, and uneven gains helps explain why some basin regimes remain more functional under stress than others.

The five dimensions are analytically separable, but in practice they often interact. Monitoring and information-sharing provisions reduce uncertainty and make deviations more visible; dispute-resolution and enforcement provisions shape how disagreement and non-compliance are handled once they arise; flexibility provisions affect whether changing hydrological conditions can be absorbed without institutional rupture; and distributional arrangements influence whether cooperation remains politically acceptable when pressures increase. The significance of institutional design therefore lies not only in the presence of individual clauses, but in the extent to which these provisions together make cooperation more structured, credible, and adaptable. This compound reading is consistent with recent transboundary-water scholarship that emphasises how the political context surrounding treaty change shapes whether design features remain operative over time (Hussein, Poplawsky, and Mohapatra, 2023: 7-10), and with the polycentric-governance literature that examines how multi-level institutional configurations interact under environmental pressure (Thiel, Blomquist, and Garrick, 2019: 1–5).

On this basis, the thesis treats institutional design not as a background characteristic of treaties, but as the central explanatory variable through which basin regimes differ in their capacity to preserve procedural continuity and contain escalation under stress. The next section specifies the mechanisms through which these design features are expected to shape institutional performance.

2.5 Causal Mechanisms Linking Design to Performance

Specifying the principal dimensions of institutional design for our transboundary water systems is only the first step in the argument. To explain variation in institutional performance under stress, it is also necessary to clarify how those design features are expected to shape outcomes once cooperation comes under pressure. The central claim of this thesis is that institutional design matters because it structures how basin regimes process stress. Under conditions of

hydrological shortfall, political tension, or infrastructural strain, institutions may either preserve procedural continuity and contain escalation or fail to do so. The difference is expected to depend on the causal mechanisms through which particular design features operate in practice. This expectation builds on a broader literature in environmental governance that emphasises how institutional rules mediate the link between resource pressure and cooperative outcomes and on the polycentric-governance literature that examines how multi-level institutional arrangements adapt to environmental change. The following subsections therefore shift from the level of institutional attributes to that of causal process, specifying how the design features identified above are expected to shape institutional performance under stress and what consequences are likely to follow. At this stage, these expectations are formulated in comparative and relative terms; the specific criteria through which they will be identified and assessed in the empirical analysis are clarified in Chapter 3.

2.5.1 Informational Stabilization

The first mechanism is informational stabilization. As highlighted, stress episodes increase uncertainty by making it harder for riparian states to determine whether shortfall reflects unavoidable environmental pressure, technical disruption, or politically motivated deviation. When flows decline, release schedules change, or delivery obligations are only partially met, contestation can quickly shift from the allocation problem itself to disagreement over what has actually happened. Monitoring and information-sharing provisions are expected to matter here because they reduce this ambiguity. Where these provisions are institutionalized and regularly used, actors should have a more credible basis for interpreting basin conditions and assessing whether departures from agreed expectations reflect genuine stress or strategic behaviour. This should make it easier to preserve procedural continuity and less likely that disputes escalate because parties cannot agree on the factual basis of the problem. Where such provisions are weak, irregular, or politically contested, ambiguity should be greater and disagreements more likely to intensify (Gerlak, et al. 2011; Mitchell and Zawahri 2015). The expectation, therefore, is that stronger monitoring and information-sharing provisions should make stress episodes more likely to remain institutionally manageable and less likely to produce escalation driven by uncertainty.

2.5.2 Procedural Containment

The second mechanism is procedural containment. Dispute-resolution mechanisms are expected to matter because they provide institutionalized procedures through which disagreement can be addressed once cooperation comes under strain. In the transboundary

water literature, such mechanisms are treated as important constituting elements of water agreements because they help absorb dispute under conditions of scarcity and climate change and provide a forum for handling conflicting interpretations and unanticipated change (De Bruyne and Fischhendler, 2013: 1-2, 9; De Stefano et al., 2012: 195). Where such mechanisms are clearly defined and practically accessible, dissatisfied parties should be more likely to raise grievances, seek clarification, or renegotiate within the institutional framework rather than bypassing it altogether (De Stefano et al., 2012: 195; De Bruyne and Fischhendler, 2013: 1-2, 9). This should make it easier to keep disputes within recognized forums and less likely that temporary disagreements spill over into sustained non-compliance or overt political confrontation. On the other end, where such procedures are weak, vague, or absent, contestation should be harder to channel institutionally, increasing the likelihood that disputes move beyond established rules and forums (De Stefano et al., 2012: 195; De Bruyne and Fischhendler, 2013: 1-2, 9). The expectation, therefore, is that stronger dispute-resolution mechanisms should make stress episodes more likely to remain procedurally contained and less likely to escalate beyond the regime itself.

2.5.3 Compliance Reinforcement

The third mechanism is compliance reinforcement. Stress episodes may increase the likelihood that riparian states will depart from agreed rules, because it is assumed and found that compliance becomes more politically and materially costly when water is scarce or domestic demands intensify (Sehring 2009: 234-241). Under such conditions, the key issue is whether deviation remains institutionally visible and answerable. Enforcement and compliance provisions are expected to matter because they ensure that non-compliance does not pass as routine or consequence-free. Where such provisions are more clearly institutionalized, missed obligations should be more likely to trigger some recognizable response such as formal review, justification, third-party involvement, or another procedure that marks deviation as a matter requiring institutional attention. This should raise the procedural and political cost of ignoring agreed rules and help preserve the practical credibility of commitments under strain. Where such provisions are weak, vague, or absent, departures from agreed procedures are more likely to accumulate without meaningful response, making it easier for institutional rules to lose practical force during stress episodes. The expectation, therefore, is that stronger enforcement and compliance provisions should make temporary deviation less likely to turn into sustained erosion of rule-based cooperation.

2.5.4 Institutional Adaptation

The fourth mechanism is institutional adaptation. Stress episodes expose the limits of fixed bargains by confronting basin regimes with conditions that differ from those under which their original commitments were negotiated. When water availability changes, seasonal pressures intensify, or previously accepted allocation schedules become harder to sustain, rigid rules may become increasingly difficult to apply without generating dispute or non-compliance. Flexibility and adaptive provisions are expected to matter because they provide institutionalized ways of adjusting commitments without abandoning the cooperative framework altogether. Where such provisions are present and usable, changing conditions should be more likely to trigger review, recalibration, or temporary adjustment within the regime rather than ad hoc bargaining outside it. This should make it easier for basin regimes to absorb stress while preserving procedural continuity. Where adaptive provisions are absent, weak, or too vague to activate, changing conditions are more likely to place fixed obligations under strain without offering a recognized institutional route for adjustment, increasing the risk of procedural disruption or informal deviation. The expectation, therefore, is that stronger flexibility and adaptive provisions should make stress episodes more likely to produce managed institutional adjustment and less likely to result in breakdown of the original cooperative framework.

2.5.5 Incentive Alignment

The fifth mechanism is incentive alignment. Stress episodes sharpen distributional tensions by increasing the likelihood that one or more riparians will view continued cooperation as disproportionately costly. Where water becomes scarcer, seasonal demands diverge more sharply, or existing allocation arrangements impose visible losses on one side, the political acceptability of the institutional bargain may weaken. Distributional and benefit-sharing arrangements are expected to matter because they reduce the likelihood that cooperation is experienced as a purely zero-sum exchange. Where such arrangements are more clearly institutionalized, stress should be more likely to be managed through compensatory or linked benefits such as cost-sharing, energy-for-water exchange, or other reciprocal arrangements that make continued cooperation more acceptable despite asymmetric pressures. This should help preserve the willingness of parties to remain within the regime even when hydrological conditions worsen. Where such arrangements are weak or absent, stress is more likely to intensify perceptions that the burdens of cooperation are unfairly distributed, making institutional commitments harder to sustain politically. The expectation, therefore, is that

stronger distributional and benefit-sharing arrangements should make basin regimes more capable of maintaining cooperation under asymmetric stress and less vulnerable to destabilization driven by perceived imbalance in gains and burdens.

2.5.6 How the Mechanisms Work Together

These mechanisms are analytically distinct, but their effects are unlikely to be independent in practice. Monitoring and information-sharing can reduce ambiguity, but this matters more when disagreement can also be processed through recognized dispute procedures. Adaptive provisions may make adjustment possible, but adjustment is more likely to remain politically sustainable where distributional arrangements reduce the perception that changing conditions simply redistribute burdens unfairly. In this sense, institutional performance under stress is unlikely to depend on any single provision alone. It is more plausibly shaped by the extent to which different design features work together to make cooperation more structured, credible, and adaptable.

Basin regimes that combine stronger and more coherent design features should be better able to preserve procedural continuity and contain escalation under comparable stress than regimes in which those features are weak, sparse, or poorly integrated. The next section draws these expectations together and clarifies the broader analytical framework that guides the empirical analysis.

2.6 Implications for Analysis

This chapter has established the theoretical framework of the thesis. It began by clarifying the core concepts of water conflict and institutional performance under stress, then reviewed the main structural explanations commonly used to account for variation in transboundary water cooperation. While climatic variability, asymmetry, Soviet institutional legacy, and wider regional politics shape the context in which basin regimes operate, they do not sufficiently explain why structurally similar regimes diverge in their performance under stress. The chapter therefore advanced institutional design as the central explanatory variable and specified its principal dimensions: monitoring and information-sharing provisions, dispute-resolution mechanisms, enforcement and compliance provisions, flexibility and adaptive provisions, and distributional or benefit-sharing arrangements.

The chapter also moved beyond identifying these dimensions by explaining the mechanisms through which they are expected to matter. Institutional design is expected to influence whether hydrological or political strain is absorbed through continued procedural operation and

managed contestation, or instead contributes to disruption, unilateral deviation, and escalation beyond the regime itself.

Chapter 3 translates this theoretical framework into an empirical strategy by specifying the comparative design, case selection, operationalization of the key variables, and the evidentiary basis through which these expectations are assessed.

Chapter 3. Research Design and Methodology

The previous chapter argued that variation in institutional design helps explain why Central Asian transboundary water regimes do not perform equally under stress. It defined institutional performance under stress as the main dependent variable of the thesis and identified the principal dimensions of institutional design examined in the analysis: monitoring and information-sharing, dispute-resolution and coordination mechanisms, enforcement and compliance-supporting provisions, flexibility and adaptive capacity, and distributional or benefit-sharing arrangements. Chapter 3 translates that theoretical framework into an empirical strategy.

The chapter proceeds in six steps. It first outlines the comparative research design and explains why a most-similar systems approach is appropriate for this study. It then justifies the selection of the Amu Darya, Syr Darya, and Chu–Talas regimes and briefly establishes the institutional baseline of each case, including the principal agreements, bodies, and governance structures through which cooperation is organized. The chapter next operationalizes the independent variable, institutional design, and the dependent variable, institutional performance under stress. It then explains how the temporal scope of the study is defined and how stress episodes are identified and selected for analysis. Finally, it sets out the evidence base on which the thesis relies, including treaty texts, commission documents, annual bulletins, yearbooks, donor and intergovernmental reports, and secondary scholarship.

The purpose of the chapter is to establish the analytical and methodological foundations that make structured comparison possible. By specifying how the cases are selected, how the key variables are observed, and how stress episodes are traced, the chapter provides the framework for the empirical chapters that follow.

3.1 Research Design

The research design follows directly from the theoretical framework developed in the previous chapter. If institutional design is expected to shape variation in institutional performance under

stress, then the empirical strategy must be able to compare basin regimes operating under broadly similar structural conditions while examining whether differences in institutional design correspond to differences in performance. For that reason, this study adopts a comparative qualitative case study design using a most-similar systems design (MSSD).

A most-similar systems design is therefore appropriate because it allows the analysis to hold major contextual factors relatively constant while focusing on the explanatory role of institutional design. The purpose is to help explain divergence within a bounded and structurally comparable regional setting. This design is especially well suited to the present study because the thesis is interested in why cases exposed to many of the same structural pressures do not produce the same institutional outcomes.

The study is qualitative in method and comparative in logic. It does not rely on large-N comparison or statistical inference. Instead, it examines a small number of carefully selected basin regimes in depth and evaluates them against common analytical criteria derived from Chapter 2. The comparison is organized around two questions: first, how institutional design differs across the cases; and second, whether those differences correspond to variation in institutional performance under stress.

Within this comparative design, the analysis focuses on documented stress episodes as empirical windows through which institutional performance becomes visible. Stress episodes are not treated as isolated anecdotes, but as bounded periods in which hydrological, political, or infrastructural pressures test the operation of basin regimes. Examining such episodes makes it possible to assess whether formal procedures continue to operate, whether disputes remain contained within institutional channels, and how specific design features appear to matter in practice. The identification and selection of these episodes is explained in a later section of this chapter.

For transparency, the stress episodes that anchor the analysis in Chapter 4 are summarised below. They are drawn from primary documentary materials: ICWC bulletins, Water Yearbooks, the bilateral Chu-Talas Commission record, and the underlying treaty texts and examined in detail in the case chapters.

Chu-Talas. Four episodes are examined: the COVID-period procedural disruption of 2020, when in-person commission sessions were not feasible and the parties substituted a joint visual reservoir inspection at Orto-Tokoy/Kirov (Water Yearbook 2020: 48); the 2021 Kirov dam safety episode, processed through routine commission discussion and expert inspection (Water

Yearbook 2021: 50-51; Chu-Talas II Project Report, 2014: 18-22); the 2022 mixed hydrological, infrastructural, and financial stress, including the Aspara/Ashmara withdrawal dispute (Water Yearbook 2022: 46-47); and the 2023-2024 verification turn, characterised by sensor automation and resumed hydrological observation (Water Yearbook 2023: 55).

Syr Darya. Three episodes are examined: the 2000-2001 low-storage episode, when the bilateral Kyrgyz–Uzbek compensation arrangement broke down despite documentation in the 52nd ICWC meeting record (Protocol of Experts' Joint Working Meeting, 2001: 1–5; ICWC, 2001a; ICWC, 2001b); the 2021-2022 corrective-coordination cycle, when the 80th and 81st ICWC meetings convened on schedule and produced documented water-allocation outcomes (ICWC, 2021; ICWC, 2022); and the 2023-2024 partial-stabilisation episodes, characterised by persistent stress and imperfect implementation alongside maintained procedural continuity.

Amu Darya. Three episodes are examined: the 2018 growing-season shortage forecast, when BWO Amu Darya submitted alternative withdrawal options to the 73rd ICWC meeting (ICWC, 2018); the 2019-2020 lower-reach overuse, when actual withdrawals reached 115.6% of the approved limit even as delta and Aral deliveries remained at 96.9% of plan (ICWC, 2020: 18-21); and the 2021-2022 severe shortfall, when actual inflow reached only 70.4% of forecast and the 80th ICWC meeting nonetheless approved country withdrawal limits and reservoir-operation regimes (ICWC, 2022: 17–19; 80th ICWC Meeting, 2021: 5–8).

The primary level of analysis is therefore the institutionalized basin regime, while the main empirical observations are made through stress episodes occurring within each regime. This nested structure allows the study to connect relatively stable institutional design features to more dynamic moments of strain and response. In this way, the research design is structured to test the central proposition of the thesis: that variation in institutional design helps explain why structurally similar basin regimes perform differently under stress.

3.2 Case Selection

The selection of cases follows from the scope and comparative logic of the study. The thesis examines three Central Asian transboundary basin regimes: the Chu-Talas regime, the Syr Darya regime, and the Amu Darya regime. These cases were chosen because they fall within the same post-Soviet regional setting, but represent different institutional arrangements through which transboundary water coordination has been organized since independence.

The cases are comparable in several important respects. All three emerged from the dissolution of the Soviet hydraulic system and the transformation of previously internal allocation and

infrastructure-management arrangements into interstate governance among newly sovereign states (Sehring, 2020: 1-2; Abdullaev and Rakhmatullaev, 2015: 849-850). All three are also embedded in a regional context marked by inherited cross-border infrastructure, unequal spatial distribution of water resources, and upstream-downstream interdependence, which has long made some form of inter-state coordination necessary in Central Asia (Abdullaev and Rakhmatullaev, 2015: 849; Shalpykova, 2002: 10-11).

At the same time, the three cases are not defined simply by river basins as geographical units, but by the principal treaty-based or institutionally organized frameworks through which transboundary coordination in those basins has been carried out. In the Chu–Talas case, this refers to the 2000 Agreement between Kazakhstan and Kyrgyzstan on the use of water management facilities of intergovernmental status on the Chu and Talas Rivers, which in Article 5 provides for the creation of permanent commissions to determine operating regimes and the necessary costs of operation and maintenance (Agreement between Kazakhstan and Kyrgyzstan, 2000). In the Syr Darya case, the relevant framework is the 1998 interstate agreement on the use of water and energy resources in the basin, together with the related arrangements governing the Naryn-Syr Darya cascade (Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, 1998). In the Amu Darya case, the relevant regime is the broader regional framework carried forward after independence through the 1992 Almaty Agreement, the ICWC, and the basin water organizations, including BWO Amu Darya (Agreement on Cooperation in the Joint Management, Use and Protection of Interstate Water Resources, 1992: 1-3; ICWC By-Law, 1992: 1-3; ICWC Statute, 2008/2009).

These three cases were selected because they also provide meaningful institutional variation within that shared regional setting (McCracken and Wolf, 2019: 736-739). Chu-Talas is a comparatively bounded bilateral regime organized around a specific agreement and bilateral commission structure (Agreement between Kazakhstan and Kyrgyzstan, 2000: Art. 5; Commission on the Chu and Talas Rivers, 2010: 2). Syr Darya represents a more politically burdened and issue-linked regime in which basin coordination has repeatedly been tied to water-energy bargaining and recurring renegotiation over cascade operation (Agreement on Cooperation, 1992: 1-3; ICWC Statute, 2008/2009). Amu Darya represents a broader regional allocation framework in which procedural continuity has remained visible through recurring ICWC decisions and basin-wide quota-setting, even while substantive outcomes have often been uneven, especially in the lower reaches and in delta and Aral deliveries (Water Yearbook, 2021: 13-14; Water Yearbook, 2023: 15).

For these reasons, the Amu Darya, Syr Darya, and Chu-Talas regimes are appropriate cases for a most-similar comparative design. They share major historical and regional background conditions, including post-Soviet institutional transition, inherited hydraulic interdependence, and persistent upstream-downstream coordination problems, but differ in the treaty-based and institutional arrangements through which transboundary coordination has been organized. This combination of common structural conditions and meaningful institutional variation makes the three cases suitable for examining whether differences in institutional design correspond to differences in institutional performance under stress. The next section therefore specifies how the institutional design dimensions identified in Chapter 2 will be observed in the empirical material

3.3 Operationalization of the Independent Variable: Institutional Design

As mentioned in Chapter 2, this thesis treats institutional design as the central independent variable. The operationalisation strategy that follows builds on the broader literature on institutional analysis of water-resources management in river-basin, which provides the closest established framework for coding basin-level institutional features against treaty texts and statutes. The purpose of this section is not to restate why particular design dimensions are theoretically important, but to specify how they will be observed in the empirical material. The analysis focuses on five dimensions: monitoring and information-sharing, dispute-resolution and coordination mechanisms, enforcement and compliance-supporting mechanisms, flexibility and adaptive capacity, and distributional or benefit-sharing arrangements.

The empirical task is therefore to identify whether, and in what form, these design dimensions are present in the three cases. The elements of which are found primarily in treaty texts, statutes, protocols, commission reports, ICWC bulletins, yearbooks, and related institutional documents. A design feature is treated as stronger where it is formalized more clearly, assigned to a specific body or procedure, and linked to a recurring institutional practice. It is treated as weaker where it is vague, informal, absent, or only episodically activated. In this sense, the section operationalizes institutional design through observable legal and organizational features rather than through abstract institutional labels alone.

3.3.1 Monitoring and information-sharing

Monitoring and information-sharing are observed through provisions and practices requiring data exchange, hydrological reporting, reservoir-operation reporting, forecasting, joint measurement, or monitoring programmes. In the present study, evidence of this dimension

includes explicit clauses on exchange of hydrological data, monitoring mandates assigned to basin organizations or commissions, and documentary evidence that such reporting continued during periods of strain. Relevant indicators therefore include requirements for regular reporting, hydrometeorological coordination, monitoring of reservoir regimes, joint data systems, and formal requests to clarify disputed inflow or withdrawal figures (Mitchell and Zawahri, 2015: 187-188; ICWC Statute, 2008/2009; Water Yearbook, 2023: 6-7; ICWC Statute, 2008/2009; Water Yearbook, 2023: 5-6).

3.3.2 Dispute-resolution and coordination mechanisms

Dispute-resolution and coordination mechanisms are observed through clauses or institutional procedures that specify how disagreement is to be managed once cooperation comes under strain. This includes formal consultation procedures, permanent commissions, working groups, arbitration or adjudication clauses, as well as structured technical coordination bodies that channel disagreement into recurrent institutional forums. In this study, stronger performance on this design dimension is indicated where treaties or statutes identify a standing body, a procedure for convening and discussion, and some formal route for managing disagreement. Weaker performance is indicated where disputes depend largely on *ad hoc* political bargaining outside established procedures. Relevant evidence includes commission statutes, meeting rules, provisions for negotiation or third-party involvement, and documented reliance on repeated side protocols because existing arrangements were insufficiently self-executing (De Bruyne and Fischhendler, 2013: 1-2; Agreement on Cooperation in the Joint Management, Use and Protection of Interstate Water Resources, 1992: 1-4; Agreement on Cooperation, 1992: 1-3). Secondary academic resources or reports are used as well to provide commentary on the efficacy of these methods or indicators where parties have preferred informal channels.

3.3.3 Enforcement and compliance-supporting mechanisms

Enforcement and compliance-supporting mechanisms are observed through provisions that increase the likelihood that agreed rules will be followed or that deviations will be detected and corrected. In the present study, this dimension is not limited to hard sanctions. It also includes softer compliance-supporting mechanisms such as mandatory reporting, implementation review, formal obligations tied to compensation or reciprocal exchange, and institutional procedures for identifying deviations from agreed quotas or operating modes. Relevant indicators therefore include compensation clauses, deficit carry-over rules, explicit implementation obligations, quota-compliance reporting, and documentary evidence of how

departures from agreed releases or withdrawals were handled institutionally (Mitchell and Zawahri, 2015: 194-195; ICWC By-Law, 1992: 4-6; ICWC By-Law, 1992: 5-7).

3.3.4 Flexibility and adaptive capacity

Flexibility and adaptive capacity are observed through design features that allow regimes to respond to changing hydrological or political conditions without immediate institutional breakdown. This includes review clauses, amendment provisions, escape clauses, variable allocation rules, balance mechanisms, and formal possibilities for revising operating modes under drought or other stress. In this study, evidence of flexibility is therefore sought both in formal legal design and in documented institutional practice. Relevant indicators include provisions for revising seasonal limits, changing operating rules, amending agreements, or creating supplementary protocols during stress episodes (Fischhendler, 2004: 1-2; ICWC Statute, 2008/2009; Commission on the Chu and Talas Rivers, 2010: 2). A regime is treated as more adaptive where such adjustments occur through recognized institutional channels rather than solely through emergency improvisation or prolonged deadlock.

3.3.5 Distributional and benefit-sharing arrangements

Distributional and benefit-sharing arrangements are observed through clauses and practices that address how the gains, costs, and burdens of cooperation are allocated across parties. In transboundary river governance, this may include cost-sharing for infrastructure, water-energy exchange arrangements, compensation mechanisms, or reciprocal commitments linking water allocation to other sectoral benefits. This dimension is observed through provisions on cost-sharing, operation and maintenance expenditures, energy compensation, linked exchange obligations, and documentary evidence of whether those arrangements remained functional in practice (Sadoff and Grey, 2002: 396–398; Koremenos et al., 2001). Stronger performance on this dimension is indicated where such burdens and benefits are clearly structured and institutionally processed; weaker performance is indicated where allocation disputes repeatedly reappear because compensatory arrangements are unclear, unstable, or politically contested.

Taken together, these five dimensions provide the analytical template through which institutional design will be examined across the three cases. Chapter 4 does not revisit the theoretical rationale for selecting these dimensions. Instead, it applies this operationalization to the documentary record in order to assess how the relevant design features are configured in each regime and how they relate to performance under stress.

3.4 Operationalization of the Dependent Variable: Institutional Performance Under Stress

The dependent variable in this thesis is institutional performance under stress. The task of this section is not to redefine that concept, but to specify how it will be identified in the empirical analysis. Institutional performance in this thesis is assessed in terms of how basin regimes function under pressure, not simply whether agreements continue to exist formally. The relevant variation therefore lies not only in whether cooperation exists in formal terms, but in whether regimes differ in their capacity to sustain institutional procedures and keep disputes within institutional channels during comparable episodes of hydrological, political, or infrastructural stress.

3.4.1 Procedural continuity

Procedural continuity refers to the continued operation of the formal mechanisms of a basin regime during periods of strain. It does not require the disappearance of disagreement. Rather, it asks whether stress is still processed through existing institutional procedures. In this thesis, procedural continuity is observed through whether commission meetings, technical consultations, and coordination forums continue to function; whether allocation decisions and reservoir-operation regimes continue to be made through established institutional procedures rather than by unilateral determination; and whether agreed monitoring, reporting, and information-sharing practices remain active during the episode (Mitchell and Zawahri, 2015: 187-189; De Stefano et al., 2012: 195-198).

More specifically, higher procedural continuity is indicated where at least three types of evidence are present in the documentary record: first, evidence that the relevant bodies continued to meet or were formally convened during the stress episode; second, evidence that decisions, limits, or protocols continued to be adopted through recognized procedures; and third, evidence that reporting, monitoring, or technical exchange remained institutionally active. Lower procedural continuity is indicated where meetings are suspended for a sustained period, agreed procedures cease to be the main channel for allocation or coordination, or monitoring and reporting mechanisms break down or lose practical relevance during the episode. Temporary delay, contestation, or bargaining difficulty is not treated as breakdown unless it results in sustained interruption of institutional procedure.

3.4.2 Escalation Containment

Escalation containment refers to whether disputes remain managed within institutional channels or instead move beyond them. A regime shows stronger containment where

disagreement is addressed through consultation, negotiation, technical review, side protocols linked to existing institutional structures, or other recognized procedures; it shows weaker containment where disputes spill into unilateral deviation, prolonged non-compliance, or overt political confrontation (Mitchell and Zawahri, 2015; De Bruyne and Fischhendler, 2013).

Escalation containment is therefore assessed through 1) whether formal dispute-handling or coordination mechanisms are actually used 2) whether parties continue to seek adjustment within the regime rather than outside it 3) whether sustained unilateral deviation occurs and 4) whether stress episodes generate suspension of cooperation, explicit repudiation of commitments, or durable movement of the dispute beyond basin procedures. Stronger containment is indicated where contestation remains embedded in consultation, technical bargaining, or other institutionalized pathways. Weaker containment is indicated where disputes bypass these channels, where non-compliance becomes prolonged and unresolved, or where high-level confrontation displaces institutional management as the main mode of response.

3.4.3 Unit of Observation and Mode of Assessment

The unit of observation is the basin regime during identified episodes of stress. Institutional performance is therefore assessed dynamically rather than under routine conditions alone. This is necessary because institutional robustness often becomes most visible when allocation rules are strained, delivery shortfalls emerge, infrastructure becomes contested, or political tensions disrupt ordinary coordination. Stress episodes are used as bounded empirical windows within which procedural continuity and escalation containment can be observed comparatively across cases.

Performance is assessed qualitatively rather than through a numerical index. The analysis does not reduce institutional performance to a single score. Instead, it compares the documentary record across cases and episodes using the common criteria set out above. This allows the thesis to preserve analytical transparency while remaining sensitive to the institutional nuance of the Central Asian cases.

3.5 Temporal Scope and Stress-Episode Selection

Because institutional performance is assessed dynamically rather than under routine conditions alone, the identification and selection of stress episodes is central to the research design. In this thesis, stress episodes are treated as bounded periods during which hydrological, infrastructural, or political pressures materially test the operation of basin regimes. The purpose

of this section is to specify the temporal scope of the analysis, the criteria by which episodes are included, and the rules used to delimit their onset and resolution.

The broader temporal scope of the study is post-1991. This boundary is analytically significant because 1991 marks the transformation of previously internal Soviet hydraulic management into interstate governance among newly sovereign states. In Central Asia, independence converted earlier inter-republican arrangements into transboundary governance problems and disrupted the operation of the integrated water–energy system inherited from the Soviet period (Sehring, 2020: 1-2; Abdullaev and Rakhmatullaev, 2015: 849-850). Stress episodes are therefore identified only within the contemporary basin regimes examined in this thesis, so that institutional performance is evaluated within the institutional architectures actually under investigation.

Within that broader post-1991 frame, the analysis gives particular attention to periods occurring after the consolidation of the main post-Soviet agreements and institutional arrangements. This is necessary because the thesis is concerned not simply with crisis in a broad regional sense, but with the performance of institutionalized coordination mechanisms once treaty-based or formally organized regimes were in place. For that reason, episodes are selected only where the relevant basin regime had already acquired a minimally identifiable institutional framework through agreements, commissions, basin organizations, or related procedural structures.

Stress episodes are identified according to predefined inclusion criteria rather than outcome-based selection. An episode is included when it satisfies two conditions. First, it must involve documented pressure that plausibly tests institutional coordination. In this thesis, such pressure may take one of three forms: hydrological stress, such as drought, major flow reduction, or extreme seasonal variability affecting agreed allocation schedules; infrastructural stress, such as reservoir malfunction, safety incidents, maintenance disputes, or operational disruptions affecting coordinated releases; or political stress, where interstate tension, policy shifts, or issue-linkage disputes directly intersect with water allocation or water-energy arrangements. Second, the episode must generate observable institutional engagement, such as commission meetings, technical consultations, allocation negotiations, activation of monitoring systems, side protocols, or documented procedural responses. Without such institutional trace, the episode may be important contextually, but it cannot be used to assess institutional performance in a disciplined way.

To avoid selection based on the dependent variable, episodes are not chosen because they ended in breakdown, confrontation, or visible failure. The analysis includes periods associated with both more resilient institutional handling and more contested implementation. This allows comparison across a broader spectrum of institutional response and reduces the risk that the study simply reproduces its own conclusion through selective episode choice. In practice, episode identification is grounded and justified in a combination of hydrological evidence, official commission reports, basin bulletins (institutional meetings), regional water yearbooks, open source articles and peer-reviewed scholarly accounts. This ensures that inclusion is based on documented stress conditions rather than retrospective interpretation alone.

Each stress episode is treated as a bounded temporal sequence with identifiable onset and resolution points. Onset is marked by documented recognition of strain, such as official drought language, recorded shortages, contested reservoir operation, infrastructure-related disruption, or explicit institutional acknowledgment that agreed procedures were under pressure. Resolution is defined by either restoration of procedural stability, adoption of a revised institutional arrangement, or transition into a new equilibrium in which the immediate phase of intensified strain has ended. The purpose of defining such boundaries is not to suggest that every episode has a perfectly clear beginning and end, but to ensure that the analysis examines complete sequences of stress and institutional response rather than isolated incidents.

This bounded approach is particularly important for the logic of the thesis. The aim is not to collect illustrative anecdotes, but to identify analytically usable tests of institutional design under strain. By applying consistent inclusion criteria across basins, the study strengthens comparability and reduces the risk that observed variation in performance is driven by selective construction of the empirical material. Stress episodes thus function as the principal empirical windows through which procedural continuity and escalation containment can be assessed across the three cases.

3.6 Data Sources and Evidence Base

The empirical analysis relies on a structured combination of primary institutional documents, official reporting, hydrological and operational data, donor and technical documentation, and secondary academic literature along with open source reporting of the region. Because the thesis examines both institutional design and institutional performance under stress, it is necessary to use sources that capture not only the formal architecture of cooperation, but also its practical operation during periods of strain. Treaty texts and institutional statutes are

therefore used to identify the formal rules of cooperation, while commission reports, basin bulletins, water yearbooks, and related operational materials are used to assess whether those rules remained active and how they were applied in practice during identified stress episodes

The first component of the evidence base consists of treaty texts, statutes, and formal institutional rules. These documents are the empirical objects from which the institutional-design features defined in Section 3.3 are observed and coded. The documents themselves are read as primary sources; the institutional rules of interest - monitoring provisions, dispute-resolution and coordination procedures, enforcement and compliance-supporting rules, flexibility and adaptive provisions, and distributional and benefit-sharing arrangements, are not directly visible but are reconstructed from the texts using the indicators specified in Section 3.3. The texts are therefore not used as direct measures of institutional performance, but as the documentary basis from which the formal architecture of each regime can be characterised in comparable terms. In the Chu-Talas case, this includes the 2000 bilateral agreement, the statute of the bilateral commission, and associated project and commission documents on operation, maintenance, monitoring, and emergency coordination (Agreement between Kazakhstan and Kyrgyzstan, 2000; Statute of the Chu-Talas Commission, 2006; OSCE Chu-Talas Final Report, 2002). In the Syr Darya and Amu Darya cases, the same function is served by the 1998 Syr Darya water-energy agreement, the 1992 Almaty framework, the ICWC by-law, and the statutes of the basin water organizations (Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, 1998; Agreement on Cooperation in the Joint Management, Use and Protection of Interstate Water Resources, 1992; ICWC Statute, 2008/2009; BWO Syrdarya Statute).

A second component consists of official reports and commission records, which are central for assessing the dependent variable. These include Chu-Talas Commission reports, ICWC bulletins, basin-level reports by BWO Amu Darya and BWO Syr Darya, and regional water yearbooks. Such documents provide evidence of whether coordination bodies continued to meet, whether withdrawal limits and operating regimes continued to be adopted, whether parties requested recalculations or clarifications, whether working groups were activated, and whether additional protocols or corrective measures were introduced during stress episodes. In the Syr Darya case, for example, ICWC bulletins record repeated negotiation over operating regimes, discrepancies in inflow calculations, and additional trilateral protocols concerning the Bakhri Tojik reservoir and Shardara inflow accounting (ICWC, 2021: 5-6; ICWC, 2022: 5-6; ICWC Statute, 2008/2009; Water Yearbook, 2023: 5-6; ICWC, 2024: 6-8). In the Amu Darya

case, the same archive records recurring approval of water-withdrawal limits, reservoir operation regimes, and lower-reach allocations, including delivery commitments to the delta and the Aral Sea (ICWC, 2019: 6-10; ICWC, 2024: 11-12). In the Chu–Talas case, commission reports and yearbooks provide evidence on joint inspections, repair works, financing plans, and commission meetings, though the episode record is less complete and often more summary-based than in the ICWC cases.

A third component consists of hydrological and operational data embedded in official basin documentation. These materials are used to determine whether a period qualifies as a stress episode and to align institutional responses with observable environmental or operational strain. In practice, this includes reported inflow deviations, withdrawal volumes, reservoir levels, quota reductions, projected and actual release schedules, and formal statements that water availability diverged from expectations. The ICWC bulletins are especially useful here because they often combine meeting minutes with annexed tables on country withdrawal limits, reservoir operation regimes, and basin hydrological conditions for both the Amu Darya and Syr Darya systems. In the Chu-Talas case, comparable information is available more unevenly, often through commission reports, yearbooks, and donor or technical project materials rather than through a similarly regular basin bulletin series.

A fourth component consists of donor, technical, and evaluation reports, which are used selectively and with caution; representative examples include the CAWEP Annual Reports (2020; 2022-2023) and the Chu-Talas evaluation materials cited above. These sources are particularly valuable where they preserve information on institutional practice that is not easily accessible in treaty texts or official interstate protocols, for example in relation to dam safety, joint surveys, repair financing, monitoring systems, or project-supported institutional reforms. This is especially important for the Chu-Talas case, where donor-backed institutionalization and technical cooperation played a larger visible role in the accessible record than in the other two basins. Later project reports, and UNECE-linked climate-resilience documentation therefore help identify concrete instances of joint inspections, operation-and-maintenance planning, emergency coordination, and safety-related institutional activity around facilities such as the Kirov dam and Orto-Tokoy reservoir (OSCE Chu-Talas Final Report, 2002: 57-67; UNECE Chu-Talas Brochure, 2014: 7-8; Evaluation Report, 2019). These materials are not treated as substitutes for primary interstate documentation, but as supplementary evidence used to reconstruct episodes and institutional practice where direct minutes or protocols are unavailable.

A fifth component consists of secondary scholarly literature, which serves a corroborative and interpretive role rather than forming the empirical core of the analysis. Academic sources are used to situate the basin regimes in their broader post-Soviet and regional context, to identify episodes or institutional dynamics that are then be checked against official records, and to qualify or complicate policy narratives that may otherwise overstate institutional success. This is particularly relevant in the Chu–Talas case, where parts of the policy literature have presented the regime as a model of cooperation, while more critical scholarship has pointed to persistent asymmetries, continued off-season release issues, and the limits of cost-sharing as a fully stabilizing mechanism (Wegerich, 2008). Secondary literature is therefore used to cross-check primary documentation and to prevent official institutional narratives from being accepted uncritically.

Taken together, the evidence base is designed to support validation through multiple intakes, rather than reliance on any single source type. Treaty texts identify formal institutional design. Commission records and bulletins indicate whether procedures continued to operate. Hydrological and operational data identify whether the river regime was under strain. Donor and technical reports provide additional detail where the primary record is incomplete. Academic literature helps contextualize and interrogate the documentary record. This layered strategy is necessary because the source base is not equally dense across all three cases. The Syr Darya and Amu Darya regimes are documented comparatively well through the ICWC and BWO record, whereas the Chu–Talas regime is documented more unevenly and often through a combination of commission reporting, donor-supported material, and bilateral water yearbooks. The study therefore gives priority to the most direct and contemporaneous sources available in each case, while making source limitations explicit where evidentiary density is lower.

They are not treated as the main basis for identifying stress episodes, nor as a substitute for documentary evidence. Their function is narrower: to clarify ambiguous institutional sequences, explain procedural practice that is only partially visible in written sources, and help interpret why certain mechanisms were activated, delayed, or bypassed in specific episodes.

3.7 Limitations

This study faces several evidentiary limitations that affect the scope and certainty of the comparative analysis. The first is uneven documentary density across cases. The Syr Darya and Amu Darya regimes are documented comparatively well through the ICWC bulletin series,

BWO reporting, and annexed materials on water-withdrawal limits, reservoir operation regimes, and basin hydrological conditions. By contrast, the Chu–Talas regime is documented more unevenly and often through a combination of bilateral commission reports, donor-supported project materials, and yearbook summaries rather than a comparably continuous basin-wide bulletin record. This asymmetry does not prevent comparison, but it does mean that some cases can be reconstructed more precisely than others, especially at the level of bounded stress episodes.

A second limitation concerns the nature of official institutional sources. Commission minutes, bulletins, statutes, and yearbooks are highly valuable for identifying formal procedures, organizational mandates, agreed limits, and documented institutional responses. They are therefore especially useful for assessing procedural continuity. At the same time, such sources are less well suited to capturing informal bargaining, politically sensitive disagreement, or unsuccessful negotiations that do not result in formal written decisions. In other words, the archival record is generally better at showing that institutional procedures continued than at fully revealing the informal politics surrounding them. This creates a risk of underestimating contestation where official documents record outcomes more readily than disagreement.

Third, the reconstruction of stress episodes is not equally straightforward across all cases. In the Syr Darya basin, the documentary record frequently links hydrological strain, operating disputes, and corrective institutional action in a way that makes episode boundaries relatively visible. The bulletins, for example, record discrepancies in Shardara inflow calculations, requests for detailed recalculation, additional working arrangements, and later moves toward joint gauging and coordinated data management. In the Amu Darya case, the record more often documents recurring quota-setting, lower-reach deliveries, reservoir-operation planning, and adaptation to changing availability, but is somewhat less explicit about overt political contestation between the states. In the Chu-Talas case, the available evidence is stronger on institutional architecture, repair works, monitoring, and commission activity than on a dense sequence of clearly bounded crises. As a result, the comparative analysis is stronger for some kinds of performance variation than for others.

A fourth limitation concerns source mediation in the Chu-Talas case. Some of the most informative materials for this basin are donor, project, and evaluation documents that preserve evidence about joint inspections, operation-and-maintenance planning, dam safety, repair financing, and institutional strengthening. These are valuable because they document concrete

institutional practice that is otherwise difficult to recover. However, they do not carry the same status as original intergovernmental protocols or full commission minutes. Where claims about Chu-Talas practice rely primarily on donor or project documentation rather than on original bilateral records, they must therefore be treated with greater caution.

A fifth limitation is that the study does not claim to measure institutional performance through a single exhaustive indicator. Instead, it assesses performance through procedural continuity and escalation containment during identified stress episodes. This improves analytical precision, but it also means that the thesis does not attempt to capture all possible dimensions of regime performance, such as long-term ecological sustainability, distributive justice, or full welfare effects across all basin users. The framework is therefore intentionally narrower: it is designed to explain variation in how regimes function under strain, not to provide a complete evaluation of basin governance in all respects.

Taken together, these limitations do not invalidate the comparison, but they do shape the level of confidence that can be attached to different parts of it. The Syr Darya and Amu Darya cases can be reconstructed more densely through the ICWC documentary record, whereas the Chu-Talas case requires greater reliance on a mixed source base and therefore somewhat more cautious inference. The comparative conclusions that follow should be read in that light.

Chapter 4. Empirical Analysis

Chapter 3 set out the research design of the thesis by defining the comparative logic of the study, operationalizing institutional design as the independent variable and institutional performance under stress as the dependent variable, specifying the criteria for identifying stress episodes, and clarifying the evidentiary basis of the analysis. The purpose of the present chapter is to apply that framework to the three selected basin regimes: Chu-Talas, Syr Darya, and Amu Darya. In other words, the chapter moves from methodological specification to empirical assessment.

The chapter proceeds in two stages. It first maps the institutional design of the three regimes by examining how the five dimensions identified in Chapter 2 and operationalized in Chapter 3 are configured in each case: monitoring and information-sharing, dispute-resolution and coordination mechanisms, enforcement and compliance-supporting provisions, flexibility and adaptive capacity, and distributional or benefit-sharing arrangements. It then examines how these institutional arrangements functioned during identified episodes of hydrological,

infrastructural, or political stress. This sequence is important because the explanatory argument of the thesis depends not only on whether the three regimes performed differently under pressure, but also on whether they differed in the institutional features that were expected to shape such performance.

The analytical aim of the chapter is therefore not simply descriptive. It is to determine whether the three basin regimes display meaningful variation both in institutional design and in institutional performance under stress, and whether those two forms of variation plausibly relate to one another. The chapter does not treat the cases as binary opposites of success and failure. Instead, it compares different configurations of institutionalized cooperation within a broadly shared post-Soviet regional setting, and assesses how those configurations shaped procedural continuity and escalation containment when cooperation came under strain.

The chapter is organized as follows. Section 4.1 maps the institutional design of the three regimes and establishes the empirical profile of the independent variable in each case. Sections 4.2, 4.3, and 4.4 then examine Chu-Talas, Syr Darya, and Amu Darya respectively through the stress-episode framework set out in Chapter 3. Each case section first identifies the relevant institutional setting and stress episodes and then assesses the regime's performance in terms of procedural continuity and escalation containment. The final section draws the cases together in a structured comparison and evaluates the extent to which differences in institutional design help explain divergent institutional performance under stress.

4.1 Mapping Institutional Design Across the Three Regimes

4.1.1 Chu-Talas

The Chu-Talas regime is the most clearly bounded and formally bilateral of the three cases. Its legal basis is the Agreement between the Government of the Kyrgyz Republic and the Government of Kazakhstan on the Use of Water Management Facilities of Intergovernmental Status on the Rivers Chu and Talas of 2000, which links the interstate use of specific facilities to obligations concerning operation, maintenance, repair, financing, emergency notification, and dispute settlement. Article 5 of the agreement provides for the creation of permanent commissions to determine facility operating regimes and the costs necessary for their operation and maintenance, while other provisions address proportional cost-sharing, joint protection of facilities against floods and mudflows, restoration works, and negotiated settlement of disputes (Agreement between Kazakhstan and Kyrgyzstan, 2000).

The regime was further institutionalized through the 2006 Statute of the Commission, which operationalized the bilateral framework in more detailed procedural terms. The Statute provides that the Commission shall operate on a parity basis with equal representation from both sides and that its main form of activity shall be sessions held at least twice a year. It also defines the Commission's scope as covering six interstate water-management facilities: Orto-Tokoyskoye Water Reservoir, By-Pass Ferroconcrete Chu Canals, Western Bolshoi Chu Canal, Eastern Bolshoi Chu Canal, Chumysh Hydrosystem, and Kirovskoye Water Reservoir (Statute of the Chu–Talas Commission, 2006: 1-2). At the level of formal architecture, this gives the Chu–Talas regime a more tightly specified institutional scope than either the Syr Darya or Amu Darya cases.

In terms of monitoring and information-sharing, the Chu-Talas regime is comparatively explicit. The Statute assigns the Commission responsibilities for the exchange of hydrological forecasts and current water-management information, agreement on water assessment and measurement indicators, and coordination of monitoring programmes for water bodies, water facilities, and hydrotechnical structures (Statute of the Chu-Talas Commission, 2006: 2). This formal picture is reinforced by the ADB pilot-basin report, which translates these institutional commitments into concrete operational categories such as monitoring systems, technical surveys, information systems, and data-related support for interstate water allocation and facility management (Chu-Talas Commission Report 2006-2007: 8-12; OSCE Chu-Talas Final Report, 2002: 14-16).

The regime also contains relatively well-developed dispute-resolution and coordination mechanisms, although these are structured primarily through consultation and joint administration rather than through formal third-party adjudication. The Commission operates on the basis of consensus, may establish temporary or permanent working groups, and is supported by a permanent Secretariat that prepares sessions, coordinates working-group activity, and facilitates implementation (Chu–Talas Commission Report, 2006–2007: 5-8). The 2006-2007 Commission report further states that where disagreements arise, the parties are to undertake additional consultations and reconsider the issue at a subsequent session, indicating that dispute handling is institutionalized through recurrent bilateral procedure rather than left wholly to ad hoc diplomacy (Chu–Talas Commission Report, 2006–2007: 5-8).

With respect to enforcement and compliance-supporting provisions, the Chu-Talas regime is more modest. The agreement and associated institutional materials provide for control over

compliance with agreed plans, annual schedules, and operation-and-maintenance arrangements, but they do not establish a strongly formalized sanctioning system. The ADB-supported operational framework is especially clear in this regard: it refers to agreed annual plans, endorsed annual schedules for water intake and supply, and “control of the Parties’ compliance” with the 2000 agreement and approved joint activities (Chu-Talas Commission Report 2006-2007: 14-15). The result is a regime that appears comparatively strong in managerial oversight, joint planning, and implementation control, but less strong in coercive or sanction-based enforcement.

The Chu-Talas regime is stronger on flexibility and adaptive capacity than a narrow reading of the 2000 agreement might suggest. The Commission is mandated to agree on operational reservoir regimes, revise limits and operating procedures in line with actual water availability and water-user needs, and establish joint procedures for extraordinary situations, flood control, mudflow response, and other natural-hazard-related measures (Statute of the Chu-Talas Commission, 2006: 2). The ADB report similarly identifies prevention and liquidation of extraordinary situations, technical surveys, and adjustment of operational practice as part of the institutional repertoire of the basin regime (Chu-Talas Commission Report 2006-2007: 8-12). This indicates that the regime was designed not only for routine allocation, but also for adaptation under changing hydrological or infrastructural conditions.

Finally, the regime is unusually explicit on distributional and benefit-sharing arrangements. The 2000 agreement recognizes the right of the owning state to compensation for operation and maintenance expenditures and obliges the parties to share such costs in proportion to the volume of water received (Agreement between Kazakhstan and Kyrgyzstan, 2000). The ADB report shows that this principle was elaborated into detailed categories of cost-sharing, including administration, maintenance, repairs, emergency prevention, monitoring, planning, protection measures, technical diagnostics, and information systems, and that these categories were linked to annual basin planning and investment in shared infrastructure (Chu-Talas Commission Report 2008-2009: 6-10). Among the three cases, Chu-Talas therefore appears to have the clearest formalization of cost-sharing as a mechanism for addressing distributional asymmetry, even if that should not be taken to mean that broader distributive tension disappeared entirely.

Taken together, the Chu-Talas regime combines a clearly bounded legal framework, a parity-based bilateral commission, comparatively explicit monitoring and emergency provisions, and

unusually well-developed cost-sharing arrangements. At the level of formal institutional design, it is therefore the most focused and internally specified of the three regimes.

4.1.2 Syr Darya

The Syr Darya regime is institutionally more complex and more strongly shaped by intersectoral bargaining than Chu-Talas. Its key legal reference point is the 1998 Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, which linked water releases, electricity supplies, and fuel compensation across the participating states and distinguished explicitly between growing-season and non-growing-season operating regimes (Shalpykova, 2002: 54-55). In practice, the regime has also remained embedded in the wider ICWC system and in the technical role of BWO Syr Darya, which continued to prepare basin operating schedules, coordinate water withdrawals, and manage reservoir-cascade information in consultation with the riparians (Water Yearbook 2023: 47; BWO Syrdarya Statute.: 1-3).

In terms of monitoring and information-sharing, the Syr Darya regime has substantial technical infrastructure, but its documentary record also suggests recurring problems of trust and accounting. ICWC materials repeatedly show concern with improving water accounting, automation, data exchange, and forecasting. In 2013, for example, BWO Syr Darya was tasked with providing monthly information on water limits, withdrawals, and reservoir-cascade operation, while SIC ICWC was instructed to complete a concept for developing information exchange mechanisms and regional databases (ICWC, 2013: 6-7). Later materials continue this emphasis, including repeated requests to analyze discrepancies in gauging-station data and inflow calculations, especially in relation to the Shardara reservoir (Water Yearbook 2022: 36-37; ICWC, 2024: 6-7). The regime therefore contains significant monitoring structures, but also recurrent evidence that such structures remain contested in practice.

The Syr Darya regime also possesses developed dispute-resolution and coordination mechanisms, but these are institutionally layered and politically burdened. Coordination occurs not only through ICWC and BWO Syr Darya, but also through working meetings of representatives of the water and energy sectors, protocol-based seasonal arrangements, and repeated negotiation over the operation regime of the connected reservoir systems of Naryn-Syr Darya cascade (Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, 1998: 1-4; Water Yearbook 2023: 48; ICWC, 2024: 28-29). This gives the regime many coordination channels, but it also means that the core bargain is not fully self-executing through one stable institutional forum. The 1998 agreement and related documents are better

understood as a framework for repeated coordination than as a definitive settlement of allocation and compensation issues (Shalpykova, 2002: 54-56; Water Yearbook 2018: 56).

On enforcement and compliance-supporting provisions, the Syr Darya regime is weaker and more dependent on reciprocal exchange obligations than on autonomous compliance mechanisms. The 1998 agreement did not rely primarily on hard sanctioning, but instead tied implementation to specified obligations of release, compensation, and annual coordination. This meant that compliance support depended less on an independent enforcement architecture than on whether the parties actually carried out their reciprocal commitments and whether deviations could be managed through continuing institutional coordination (Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, 1998: Arts. III–V; World Bank, 2004: 17, 21–22). This suggests a structure in which compliance was politically supported by exchange arrangements rather than strongly guaranteed through institutional enforcement as such (Shalpykova, 2002: 54-55; Sorg et al., 2014: 6). This makes the regime highly sensitive to bargaining failure.

The Syr Darya regime has meaningful flexibility and adaptive capacity, but often through ad hoc or supplementary arrangements rather than through stable and transparent revision procedures alone. ICWC records show repeated approval and correction of seasonal water-withdrawal limits and reservoir-operation modes, as well as later decisions to gather updated data and agree additionally on operating regimes when forecasts changed. Yet this adaptive capacity is double-edged: it allows the regime to respond to changing hydrological conditions, but it also reflects the fact that existing arrangements often require continuing renegotiation (ICWC Statute, 2008/2009; Water Yearbook 2022: 36-37).

The regime's strongest and most distinctive dimension is distributional and benefit-sharing arrangements, but this is also the source of much of its fragility. Unlike Chu-Talas, Syr Darya does not centre on cost-sharing for a defined set of facilities; instead, it is built around a broader water-energy bargain in which summer irrigation releases are tied to winter energy compensation. The regime therefore institutionalizes distributional management through intersectoral linkage rather than through a narrow infrastructure-sharing formula. This makes it analytically distinctive, but also more vulnerable to broader political and economic disruption (Shalpykova, 2002: 54-56).

Overall, the Syr Darya regime appears institutionally dense but structurally burdened. It contains substantial monitoring, repeated coordination mechanisms, and built-in issue linkage,

yet its compliance and containment capacity depend heavily on continuing political agreement over water–energy exchanges. At the level of design, it is therefore more complex and more fragile than the more focused Chu-Talas regime.

4.1.3 Amu Darya

The Amu Darya regime is the most explicitly embedded in the broader post-Soviet regional governance framework. Its legal basis lies not in one narrowly basin-specific bilateral treaty, but in the 1992 Almaty Agreement on cooperation in the joint management, use and protection of interstate water resources, which preserved earlier regional allocation rules and established the ICWC as the central coordinating body (Almaty Agreement 1992). Later ICWC statutes and yearbook materials show that this framework continued to rely on the executive role of BWO Amu Darya, annual quota-setting, and basin-wide reservoir-operation planning (ICWC Statute, 2008/2009; Water Yearbook 2019: 62-65).

In terms of monitoring and information-sharing, the Amu Darya regime possesses strong formal technical routines. The ICWC by-law provides for annual planning, control of water withdrawals, reservoir-operation planning under actual flow probability, and releases for environmental protection and the Aral Sea. The yearbooks and BWO reporting also describe real-time control over observance of established water-withdrawal limits, participation in lower-reach allocation meetings, and ongoing coordination with hydrometeorological services and regional partners (ICWC Statute, 2008/2009: 2-3; Water Yearbook 2020: 41; Water Yearbook 2023: 47). This indicates a comparatively dense technical-management infrastructure.

The regime also contains substantial dispute-resolution and coordination mechanisms, though these are organized through regional administrative structures rather than through a focused bilateral commission. The ICWC by-law frames the Commission as the regional body for joint water management in the Aral Sea basin, while the yearbooks show that BWO Amu Darya and related lower-reach organizations meet repeatedly to address water allocation, technical operation, and reservoir-management issues (ICWC Statute, 2008/2009: 1–3; Water Yearbook 2019: 65). Coordination is therefore highly institutionalized, but it is embedded in a broad regional architecture rather than in a narrowly basin-bounded commission.

On enforcement and compliance-supporting provisions, the Amu Darya regime resembles Chu-Talas in relying more on planning, supervision, and routine technical control than on hard sanctions. The ICWC by-law explicitly provides for annual limits, supervision over

observance, and management under actual hydrological conditions. BWO Amu Darya reporting further shows continuous work on interstate water allocation and real-time control over observance of limits approved at ICWC meetings (ICWC Statute, 2008/2009: 2-3; Water Yearbook 2020: 41). This amounts to a significant compliance-supporting system, but one rooted in administrative supervision rather than coercive enforcement.

The regime also shows meaningful flexibility and adaptive capacity, though again in a technical rather than highly legalized form. Annual withdrawals are set with reference to actual flow probability and water-economic situation, reservoir-operation regimes are planned and controlled accordingly, and the basin framework also provides for annual releases for environmental protection and the Aral Sea, including sanitary releases along canals (ICWC Statute, 2008/2009: 48-49). This gives the regime significant room for seasonal adaptation, but within a largely technocratic allocation system rather than through a strongly articulated amendment culture (ICWC Statute, 2008/2009: 2-3).

Finally, the Amu Darya regime contains distributional arrangements, but these are structured differently from both Chu-Talas and Syr Darya. It does not rely on a clearly bilateral cost-sharing formula like Chu-Talas, nor on a narrow water–energy barter architecture like Syr Darya. Instead, the distributional problem is managed through annual water-withdrawal limits, technical allocation procedures that extend into the lower reaches, and explicit provisions for environmental and Aral-related releases (ICWC Statute, 2008/2009: 48-49; Water Yearbook 2019: 65; Water Yearbook 2020: 41). The by-law also authorizes preparation of recommendations on pricing and compensation mechanisms related to shared water and energy use, although these appear less central in the empirical record than quota-setting and delivery management (ICWC Statute, 2008/2009: 2-3).

At the level of formal design, the Amu Darya regime therefore appears as a broad regional management framework with substantial technical capacity, dense allocation routines, and strong procedural continuity, but a less sharply bounded institutional profile than Chu-Talas and a less specifically issue-linked structure than Syr Darya.

4.1.4 Comparative Summary of Institutional Design

Taken together, the three regimes differ in ways that are directly relevant to the independent variable. Chu–Talas is the most tightly bounded and formally bilateral regime, with especially clear cost-sharing provisions, explicit monitoring and emergency clauses, and a parity-based commission supported by a secretariat and working groups (Statute of the Chu-Talas

Commission, 2006: 1-2; OSCE Chu-Talas Final Report, 2002: 12-13, 29-30). Syr Darya is the most issue-linked regime: its institutional design combines ICWC-based basin coordination with a politically sensitive water-energy bargain that creates significant coordination density but also repeated implementation strain (Shalpykova, 2002: 54-56). Amu Darya is the broadest and most regionally embedded regime, characterized by extensive technical allocation routines, annual quota-setting, and strong procedural continuity, but less sharply bounded institutional design and less explicit bilateral burden-sharing than Chu–Talas (ICWC Statute, 2008/2009: 2-3; Water Yearbook 2020: 41).

The following Tables summarize the independent variable across the three cases in comparative form. The next sections therefore turn from the independent variable to the dependent variable by examining how each regime functioned during identified episodes of hydrological, infrastructural, and political strain. The analysis begins with Chu–Talas, the most narrowly bounded of the three cases and the regime most often presented in the literature as a comparatively successful example of water cooperation in Central Asia.

Table 2. Comparative Overview of Institutional-Design Dimensions Across the Three Basin Regimes

Institutional-design dimension	Chu-Talas	Syr Darya	Amu Darya
Monitoring and information-sharing	Strong: explicitly specified in the Statute; assigned to the bilateral Commission; linked to hydrological exchange, joint surveys, and coordinated monitoring practice	Moderate: clearly embedded in basin management through ICWC/BWO reporting and forecasting, but less sharply bounded institutionally than in Chu-Talas	Strong: clearly embedded in ICWC/BWO routines through annual planning, quota control, and basin-wide technical reporting
Dispute-resolution mechanisms	Strong: clearly structured through a standing bilateral commission, consensus rule, secretariat, working groups, and additional consultations	Moderate: multiple coordination channels exist, but they are institutionally layered and less tightly specified as one self-contained dispute-processing framework	Moderate: coordination is strongly embedded in regional bodies and recurring allocation procedures, but less narrowly focused and procedurally bounded than in Chu-Talas
Enforcement / compliance-supporting provisions	Moderate: compliance support is built into agreed schedules, implementation control, monitoring, and joint planning, but not strongly formalized through sanctions	Weaker: reciprocal obligations are formalized, but compliance support depends heavily on continued political agreement and follow-up arrangements rather than autonomous enforcement architecture	Moderate: compliance support is embedded in annual limits, observance control, and routine technical oversight, but remains managerial rather than coercive
Flexibility/adaptive capacity	Strong: explicitly specified through reservoir-regime revision, extraordinary-situation procedures, and flood/mudflow response mechanisms	Moderate: adaptation is present through seasonal adjustment and supplementary arrangements, but often relies on repeated renegotiation rather than more tightly specified built-in procedures	Moderate: adaptive capacity is built into annual flow-based planning and reservoir-operation adjustment, though within a broad technocratic framework rather than a sharply articulated revision mechanism

Distributional/ benefit-sharing arrangements	Strong: clearly formalized through proportional cost-sharing for operation, maintenance, and repair of shared facilities	Strong: clearly built into the regime through formalized water–energy exchange obligations, even if politically burdened in practice	Moderate: distributional management is built primarily through annual withdrawal limits, lower-reach allocation, and environmental/Aral-related releases rather than a sharply specified compensatory formula
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Reading the disaggregated dimensions of Table 2 in aggregate yields a clear ordering of institutional-design strength: Chu-Talas occupies the strong end of the comparison, with four of five design dimensions assessed as strong; Amu Darya is moderate, with strong monitoring and information-sharing routines but more managerial provisions on enforcement, dispute resolution, and distribution; Syr Darya is moderate-low, distinguished by formalized water-energy burden-sharing on the distributional dimension but weakened by less autonomous enforcement and less tightly bounded dispute-resolution architecture.

Table 3. Aggregate Comparative Scoring of Institutional Design and Performance Under Stress

Basin regime	IV: Institutional-design strength (overall)	DV: Performance under stress (overall)	Anchoring stress episodes
Chu-Talas	Strong (4 of 5 design dimensions strong; 1 moderate)	High (procedural continuity high; escalation containment high)	2020 COVID-period procedural substitution (joint visual inspection at Orto-Tokoy/Kirov); 2022 integration of Aspara/Ashmara withdrawal points within the bilateral commission framework
Syr Darya	Moderate-low (3 dimensions moderate; 1 strong; 1 weaker)	Mixed (low in 2000-2001 compensation failure; moderate in 2021-2024 corrective cycle)	2000-2001 Toktogul low-storage and compensation-failure episode; 2021-2022 corrective-coordination cycle (80th and 81st ICWC meetings); 2023-2024 partial-stabilization episodes
Amu Darya	Moderate (1 dimension strong; 4 moderate)	Moderate-high (procedural continuity high; escalation containment partial)	2018 growing-season shortage forecast (73rd ICWC meeting); 2019-2020 lower-reach overuse without institutional breakdown; 2021-2022 severe shortfall

and adaptive procedural
response (80th and 81st
meetings)

Table 3 maps these aggregate IV scores against an aggregate reading of performance under stress drawn from the documented case-chapter episodes (Sections 4.2-4.4). The pattern is consistent with the thesis's two propositions: stronger institutional design corresponds to stronger procedural continuity and tighter escalation containment, with the variation across cases largest where the design itself varies most sharply. The match is not deterministic - Amu Darya's moderate IV nonetheless produces moderate-high DV performance, suggesting that strong information-sharing and recurring allocation routines can partly substitute for less developed enforcement architecture - but the broader IV-DV alignment is the analytical point the rest of Section 4.5 develops in detail.

4.2 Chu–Talas: Institutional Performance Under Stress

The Chu-Talas regime is often presented as one of the more successful examples of transboundary water cooperation in Central Asia. The available evidence supports a comparatively positive assessment, but with limitations. Chu-Talas appears strongest where stress can be processed through joint technical and administrative procedures, especially in relation to operation and maintenance, repair planning, monitoring, and reservoir safety. The evidence is weaker for any stronger claim that underlying distributive tensions were fully resolved. The analytical question, therefore, is not whether Chu–Talas was conflict-free, but whether the regime continued to function when cooperation came under strain and whether stress remained contained within institutional channels.

4.2.1 Stress-Episode Overview

The most useful Chu-Talas episodes fall into two broad groups. The first is a brief early corrective to the standard success narrative: the years after the 2000 agreement show that cost-sharing and formal institutionalization did not immediately eliminate disputes over release timing and downstream expectations (Wegerich, 2008: 8-11). The second, and more important for the present analysis, is the better-documented recent period from 2020 to 2024, when the regime was tested by pandemic disruption, reservoir-safety concerns, hydrological disagreement over withdrawals, repair and rehabilitation needs, and recurring financing questions (Water Yearbook 2020: 48; Water Yearbook 2021: 50-51; Water Yearbook 2022: 46-47; Water Yearbook 2023: 55; Water Yearbook 2024). These later episodes provide the clearest evidence of how the regime responded to stress in practice. Examples below are best highlights and examples of stress episodes.

4.2.2 The 1992-2000 Episode: Early Institutionalization and Foundation-Building Under Routine Stress

The main reason not to overstate Chu-Talas as a simple success case lies in the early post-agreement record. Wegerich's (2008) analysis suggests that the 2000 agreement did not immediately restore stable downstream operating conditions. Off-season releases and variable timing remained visible, and Kazakhstan's increasing contribution to infrastructure costs did not produce a clear return to earlier release patterns Wegerich's (2008: 10-11). This matters because it shows that institutional form and distributive settlement did not advance at the same pace. The regime acquired a clearer bilateral structure, but that did not automatically remove upstream leverage or downstream concern over water timing. Chu-Talas should therefore be treated as a comparatively institutionalized regime, not as a frictionless one.

4.2.3 Recent Mixed Stress and Institutional Response, 2020-2024

The clearest evidence of institutional performance comes from the recent period, when the regime faced several distinct but connected forms of stress.

The first was pandemic and safety-related stress in 2020. COVID disrupted normal governance conditions, while the Sardoba dam disaster elsewhere in the region heightened concern over reservoir safety. What matters analytically is not simply that the Commission met, but that the regime converted an exogenous shock into a joint institutional response. Instead of suspending cooperation, the parties used Commission procedures to continue seasonal coordination and to initiate a joint safety check of the Orto-Tokoy and Kirov reservoirs (Water Yearbook 2020: 48). This is strong evidence of procedural continuity under stress: the institutional channel remained active even when normal operating conditions were disrupted (UNECE Chu-Talas Brochure, 2014: 7-10; EN ClimateProofing Chu-Talas, 2018: 12-15). It is also evidence of escalation containment, since a potentially sensitive transboundary safety issue was handled through joint procedures rather than blame or unilateral reaction.

The second was infrastructural and safety stress around the Kirov dam in 2021. Here the test facing the regime was whether reservoir-safety concerns would be absorbed institutionally or become politically destabilizing. The available record suggests the former. The issue was processed through regular Commission discussion, expert inspection, and follow-up technical recommendations, including further inspection, a safety declaration, and discussion of gate replacement (Water Yearbook 2021: 50-51; Chu-Talas II Project Report, 2014: 18-22). The key analytical point is that the regime responded to infrastructural risk by deepening technical coordination. This suggests that Chu-Talas had a functioning institutional pathway for managing safety-related strain without interrupting cooperation.

The third, and most revealing, was the mixed hydrological, infrastructural, and financial stress of 2022. This episode is especially useful because it captures both tension and institutional response in the same sequence. On the stress side, the Kyrgyz side raised difficulties caused by Kazakhstan's withdrawals from the Aspara/Ashmara River, while the parties also faced ongoing Kirov safety issues, cone-valve replacement needs, and repair financing questions (Water Yearbook 2022: 46-47). In other words, the regime was simultaneously tested by contested withdrawals, infrastructure vulnerability, and distributive burdens. On the response side, however, the documentary record shows continued use of institutional procedures: water-delivery schedules were still adopted, repair and rehabilitation programmes were still approved,

operation and maintenance financing was still negotiated, and monitoring work continued (Water Yearbook 2022: 46-47). This is the strongest recent evidence that Chu-Talas maintained procedural continuity under mixed stress. It is also the clearest example of qualified escalation containment: tension was visible, but it remained inside the regime's working procedures rather than spilling into open institutional breakdown.

The follow-up in 2023-2024 is analytically important because it shows the type of institutional response the regime prefers when strain persists. The record does not show a decisive political settlement of the underlying disagreement. Instead, it shows a turn toward tighter verification: continued repair planning and co-financing, joint measurements, sensor automation, and resumed hydrological observation (Water Yearbook 2023: 55). The significance of this pattern is that the regime answered uncertainty with more monitoring and more joint technical activity. That does not mean the underlying distributive issue disappeared. It does suggest, however, that the regime retained the capacity to keep stress within a cooperative procedural framework.

4.2.4 Interim Assessment

Taken together, the Chu-Talas case supports a restrained but comparatively positive assessment. The regime appears to perform best under infrastructural, operational, and safety-related stress, where it can mobilize joint inspections, repair planning, monitoring, and technical follow-up. In this domain, the evidence for procedural continuity is relatively strong. Meetings, working procedures, repair programmes, financing discussions, and monitoring activities continued across the best-documented recent episodes (Water Yearbook 2020: 48; Water Yearbook 2021: 50-51; Water Yearbook 2022: 46-47; Water Yearbook 2023: 55; Water Yearbook 2024; Evaluation Report Chu-Talas, 2019: 14-19).

The evidence for escalation containment is also positive, but more qualified. Early operational strain and the 2022 Aspara/Ashmara dispute both indicate that distributive friction remained present (Wegerich, 2008: 1011; Water Yearbook 2022: 46-47). Yet the available record suggests that these pressures were generally processed through Commission meetings, repair and financing arrangements, joint measurement, and monitoring structures rather than through overt institutional breakdown. The safest conclusion, therefore, is that Chu-Talas exhibits relatively strong procedural continuity and comparatively robust, though not absolute, escalation containment under stress.

Procedural Continuity: High. Across all three episodes, the regime maintained scheduled meetings, signed bilateral protocols on timelines, produced joint operational decisions, and

avoided unilateral substitution. The 1992-2000 foundational period established regular bilateral operations. The 2020-2021 pandemic and infrastructure episodes adapted to safety constraints while maintaining formal coordination. The 2022-2024 hydrological stress saw continued protocol-signing and joint measurement.

Escalation Containment: High, with qualified acknowledgment of distributive friction. The regime processes disagreements through formal Commission channels rather than public securitization. Language remains technical and managerial. Early 1990s and 2022 Aspara/Ashmara disputes revealed distributive tensions, yet both were addressed within institutional procedures rather than through unilateral action.

Conclusion: Chu–Talas exemplifies how a clearly bounded bilateral regime with strong monitoring, explicit dispute-resolution, and parity-based decision-making can preserve institutional performance under operational, safety, and hydrological stress. The dominant causal mechanism is procedural containment: formal decision-making structures prevent pressure from escaping into extrajudicial channels.

4.3 Syr Darya: Institutional Performance Under Stress

The Syr Darya regime is the strongest test in this thesis of whether an institutionally dense but politically burdened framework can remain functional under stress. Its central vulnerability lies in the fact that water allocation is tied to a wider water-energy exchange: irrigation-season releases from upstream reservoirs depend on reciprocal deliveries of electricity, coal, gas, fuel oil, or monetary compensation. The 1998 Agreement codified that structure, but it did not create a fully self-executing regime. Instead, it left reservoir operation, compensation, and seasonal scheduling dependent on continued intergovernmental agreement. (Agreement on the Use of Water and Energy Resources of the Syr Darya Basin, 1998)

For that reason, the relevant analytical question is not whether institutions existed, but whether they were able to keep hydrological and distributive stress within routine basin-management procedures. The bulletin and protocol record suggests a mixed answer. Across the record, stress is repeatedly recognized, institutions do respond, and cooperation does not collapse outright. But the response is repeatedly corrective and supplementary, not routine. The regime remains active under stress, yet often only through additional protocols, revised schedules, and renewed bargaining.

4.3.1 Stress-Episode Overview

Three clusters of episodes are especially important. The first is the 2000-2001 low-storage and non-fulfilment episode, when Toktogul drawdown, shortfalls in fuel and gas deliveries, and disagreement over summer releases exposed the fragility of the post-1998 framework (Protocol of Experts' Joint Working Meeting, 2001: 1–5; ICWC, 2001a; ICWC, 2001b). The second is the 2021-2022 corrective coordination period, when lower storage and expected scarcity again triggered additional protocols around Uchkurgan and Bakhri Tojik (ICWC, 2021: 5–6; ICWC, 2022: 5–6). The third is the 2023-2024 implementation and adjustment period, when scarcity indicators remained serious, some protocol targets were only partly met, and yet additional releases and revised schedules still helped stabilize supply in the middle reaches (ICWC, 2023: 41–43; ICWC, 2024: 28–29).

These episodes allow a direct assessment of the dependent variable. They show when stress became visible, what institutional procedures were activated, and whether the outcome was routine management, partial stabilization, or failure to contain the dispute within ordinary basin channels.

4.3.2 The 2000-2001 Episode: Low Storage, Unmet Compensation, and Failure to Reach Agreement

The clearest early stress episode appears in the March 2001 Protocol of Experts' Joint Working Meeting. The document records that Toktogul storage on 15 March 2001 stood at 9.04 bcm, 2.4 bcm lower than at the same time in 2000, and was expected to decline further to 8.5 bcm by 1 April. It also records concrete non-fulfilment of exchange obligations: Kazakhstan had under-supplied coal, while Uzbekistan had delivered only 113 million m³ of gas instead of 230 million m³, had not supplied the agreed 32.6 thousand tons of fuel oil, and had not yet started diesel deliveries.

This was not only hydrological stress. It was mixed hydrological and distributive stress, because low storage coincided with failure of the compensation mechanism that was supposed to make additional releases politically and economically acceptable. The protocol (2001) further notes that the volume of water proposed by the Kyrgyz side was judged insufficient by Kazakhstan, Tajikistan, and Uzbekistan for downstream irrigation needs. Most importantly, it states that the parties did not reach agreement on the key questions of summer 2001 releases and the following fall-winter period, and that these questions were pushed upward for further governmental decision.

The institutional response in this episode was real but limited. Experts from Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan met in Bishkek on 16 March 2001 to draft an agreement on use of the Naryn–Syr Darya cascade’s water and energy resources; in doing so, they recorded Toktogul storage levels, quantified shortfalls in coal, gas, and fuel deliveries under earlier intergovernmental arrangements, and debated alternative summer release and compensation schedules before failing to reach agreement on the key seasonal terms (Protocol of Experts’ Joint Working Meeting on Use of Naryn–Syr Darya Cascade Water and Energy Resources in 2001, 2001: 1-5). That is evidence of procedural continuity in a minimal sense: the regime remained active and attempted to process stress institutionally. But the outcome was weak. The dispute was not contained within routine basin-management procedures and had to be elevated into broader intergovernmental bargaining (Protocol of Experts’ Joint Working Meeting on Use of Naryn–Syr Darya Cascade Water and Energy Resources in 2001, 2001: 5). In analytical terms, this episode shows that the regime did not collapse under stress, but it did experience a clear slippage of the core water-energy bargain when hydrological shortage and non-fulfilment of exchange obligations coincided. ICWC, 2001b records the subsequent Kyrgyz-Uzbek bilateral protocol that the parties adopted in May 2001 - Toktogul at 8.7 bcm on 1 May, planned summer releases of 1,250 mcm of water against agreed deliveries of 700 mcm of natural gas, 10,365 tonnes of diesel, and 20,000 tonnes of fuel oil to the Osh region (ICWC, 2001b), a corrective intergovernmental settlement that followed, rather than substituted for, the March 2001 institutional breakdown.

The bilateral Kyrgyz-Uzbek protocol (2000: 1-4; Annual Protocol 1999; Annual Protocol 2001) reinforces the same point. It tied excess summer Toktogul releases to specified deliveries of electricity, natural gas, and fuel oil, and explicitly deferred unresolved fall-winter matters to another intergovernmental meeting in July. That is important because it shows that even before the March 2001 breakdown, the regime was already operating through ongoing repair and follow-up bargaining, not through a stable automatic settlement.

4.3.3 The 2021-2022 Episodes: Corrective Coordination Under Scarcity

The growing-season response in 2021 took the form of corrective protocolization. According to the basin bulletins (2021-2022), expected low water availability and reduced storage prompted bilateral and trilateral protocols on electricity-for-water arrangements, including additional Uchkurgan releases and additional releases from Bakhri Tojik. The bulletin reports that these measures, together with repeated working meetings, made it possible to deliver water to irrigated lands in the middle reaches of the Syr Darya during the growing season.

This is analytically important because it shows a stronger outcome than the 2001 episode. Stress again emerged through low water availability, but the institutional response was sufficient to produce a partially stabilizing outcome. Yet the episode still did not demonstrate a self-executing regime. The response depended on additional arrangements layered onto the existing framework. Procedural continuity therefore existed, but it was continuity through correction, not through routine automatic operation.

The same pattern appears even more clearly in 2022. The bulletin shows that the 2022 growing season began under substantial forecast stress: total inflow was forecast at only 86% of norm. In response, a water-energy cooperation protocol was signed on 7 March 2022 in order to prevent Toktogul from being emptied to a critical level, sustain inflow to Bakhri Tojik, and improve water availability in the upper and middle reaches (ICWC, 2022: 5–8). The growing-season data then show that actual total inflow reached 91% of norm, while actual Uchkurgan-Bakhri Tojik inflow remained only 78% of norm (ICWC, 2022: 12–15). A separate protocol on Bakhri Tojik releases was also signed in June (ICWC, 2022: 9–11).

The outcome in 2022 was mixed but stabilizing. Some targets were not met, but the bulletins (2022A;2022B) records that the supplementary arrangements were implemented and that the basin was managed through the season without outright institutional breakdown. This again supports the same inference: the regime worked under stress, but only through additional protocolization and renewed bargaining.

4.3.4 The 2023-2024 Episodes: Persistent Stress, Imperfect Implementation, and Partial Stabilization

In ICWC, 2023, the forecast for the non-growing season 2023-2024 put total inflow in the Syr Darya basin at 14,483 mcm (88% of norm) and lateral inflow at 9,538 mcm (85% of norm); the same bulletin reported that, as of 1 October 2023, total water storage in the Naryn-Syr Darya cascade stood at 16,756 mcm, compared to 19,151 mcm a year earlier, while Toktogul alone was down by 1,872 mcm (ICWC, 2023: 41–43). That is a clear hydrological stress indicator. But the 2023 growing-season record also shows how the institutions reacted. Total inflow in the basin during the growing season ended at only 77% of norm, and actual releases from the reservoirs were 4,451 mcm lower than the forecast schedule, with total water releases amounting to only 82% of the forecast schedule. Water supply to all four basin states also fell below quota, including Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan.

This is one of the strongest pieces of evidence in the chapter because it reveals that institutional response did not eliminate implementation shortfalls. The regime remained procedurally active, but its outputs were clearly weaker than planned. At the same time, the bulletin also records that supplementary releases from Bakhri Tojik helped improve water supply in the middle reaches during the peak of the growing season. That means the outcome was neither institutional collapse nor routine success. It was partial stabilization under imperfect implementation.

The 2024 growing season strengthens this interpretation. The bulletin states explicitly that, given expected water availability and the need to prevent Toktogul from reaching a critical level, ensure inflow to Bakhri Tojik, and improve water availability in the upper and middle reaches, a protocol on water and energy cooperation was signed on 11 April 2024 among Kyrgyzstan, Kazakhstan, and Uzbekistan (ICWC, 2024: 6–9). A further ministerial meeting in Cholpon-Ata on 29 June 2024 produced another protocol adjusting the Uchkurgan discharge schedule (ICWC, 2024: 10–12). In parallel, Uzbekistan, Kazakhstan, and Tajikistan signed a separate trilateral protocol on Bakhri Tojik for June–August 2024 (ICWC, 2024: 13–15).

The stress indicators remained serious. For the 2024 growing season, forecast total inflow was only 89% of norm, and forecast Uchkurgan–Bakhri Tojik inflow only 80% of norm. Yet actual outcomes improved significantly relative to forecast: actual total inflow reached 97% of norm, actual Uchkurgan–Bakhri Tojik inflow reached 101% of norm, and actual Bakhri Tojik–Shardara inflow reached 103% of norm (ICWC, 2024: 28–29). The bulletin further states that Tajikistan fully fulfilled its obligations under the trilateral protocol and that water requirements in the middle reaches of the Syr Darya were effectively met during the peak growing season (ICWC, 2024: 30–32).

This is the strongest recent example of successful institutional response under stress. But it still does not demonstrate a self-sustaining regime in the stronger sense. The positive outcome depended on new corrective protocols, revised schedules, and extra intergovernmental coordination, not on the straightforward operation of an already stabilized standing framework. The institutions managed the crisis, but through additional repair rather than through ordinary routine execution.

4.3.5 Interim Assessment

Taken together, the Syr Darya case shows medium procedural continuity and weaker escalation containment than Chu-Talas. The regime does not disappear under stress. Meetings are held,

deficits are quantified, protocols are signed, discharge schedules are revised, and seasonal management continues. This is true in both the early and recent record.

But the evidence also shows that this continuity is conditional and corrective. In 2001, low storage and non-fulfilment of exchange obligations led to an outright failure to reach agreement within the working process, with the dispute pushed upward to governments. In 2021-2024, the regime performed better, but only because the parties repeatedly assembled additional protocols and emergency operating adjustments. Even in 2023, when corrective action continued, releases and deliveries still fell substantially short of planned schedules.

The central analytical conclusion is therefore not that Syr Darya lacks institutions, but that it experiences recurrent slippage of its core water–energy bargain under stress. The regime retains real coordinating capacity, and in recent years that capacity has sometimes produced meaningful stabilization. Yet the bulletin record shows that it still relies on repeated supplementary bargaining to remain functional. Its institutional performance under stress is therefore best described as persisting but not deeply stabilized: procedures endure, but the regime continues to require ad hoc repair whenever hydrological and distributive pressure intensifies.

Procedural Continuity: Medium. The regime does not collapse: meetings are convened, data shared, protocols drafted, discharge schedules revised. However, continuity is conditional on repeated supplementary bargaining. In 2000-2001, failure to agree within standing procedures required bilateral side-negotiations (Kyrgyz-Uzbek protocol) to circumvent deadlock. In 2021-2024, continuity required repeated extraordinary protocols and emergency adjustments, suggesting the standing framework is insufficient for persistent stress.

Escalation Containment: Medium. Disagreements remain inside formal coordination channels and do not escalate to public security rhetoric. However, the 2000-2001 failure followed by bilateral bypass suggests that when formal channels are insufficient, parties circumvent rather than escalate-containment through workaround rather than robust design. In recent years, escalation has been contained but at cost of eroding confidence in the standing regime.

Conclusion: Syr Darya exemplifies an institutionally dense but politically burdened regime. Its five design dimensions are substantially developed, particularly in monitoring. Yet the underlying water-energy bargain linking Tajik and Kyrgyz hydropower to Uzbek and Kazakhstani irrigation remains fundamentally in tension. When stress emerges, the regime

retains coordinating capacity but repeatedly requires supplementary bargaining. Long-term stability requires either renegotiation of benefit-sharing or deeper enforcement mechanisms.

4.4 Amu Darya: Institutional Performance Under Stress

The Amu Darya case differs from both Chu-Talas and Syr Darya because stress appears less as a visible bargaining breakdown and more as chronic allocation strain managed through a broad regional administrative framework. In this case, the key analytical issue is not whether the regime eliminated tension, but whether it continued to function procedurally under low-water conditions, lower-reach pressure, and uncertainty over seasonal availability. The record suggests that the Amu Darya regime was strongest where stress could be absorbed through quota-setting, reservoir-operation planning, and repeated technical coordination, rather than through sharply bounded dispute-settlement procedures.

4.4.1 Stress-Episode Overview

Three episodes are especially useful for assessing institutional performance. The first is the 2018 growing-season shortage, when BWO Amu Darya forecast below-normal water availability and warned that the lower reaches could only be supplied at 83.7% under the main operating regime, prompting submission of a second option with reduced withdrawal limits (73rd ICWC Meeting materials, 2018: 1-3). The second is the 2019-2020 non-growing season, when actual withdrawals in the lower reaches exceeded approved limits, even though the formal quota and environmental-flow system remained in place (ICWC, 2020: 18-21). The third is the 2021-2022 low-inflow cycle, when inflow to Tuyamuyun and actual basin withdrawals fell sharply below plan, but the ICWC still responded through formal approvals of revised seasonal limits and reservoir-operation regimes (ICWC, 2022: 17-20; 80th ICWC Meeting, 2021: 5-8).

4.4.2 The 2018 Shortage Episode: Forecast Stress and Planned Lower-Reach Under-Delivery

The 2018 materials provide one of the clearest Amu Darya stress episodes because the stress and the expected institutional response are visible in the same document. BWO Amu Darya forecast that water content in the basin during the growing season would be only 80–85% of average annual levels at the nominal Kerki gauging station (73rd ICWC Meeting materials, 2018: 1). On that basis, it proposed preliminary country withdrawal limits and 2,100 mcm for the river delta and Aral Sea, but also stated that under the main operation regime of the Nurek and Tuyamuyun reservoirs, withdrawals would be 100% provided in the middle reaches and only 83.7% provided in the lower reaches. BWO Amu Darya therefore submitted a second

option involving a 15% decrease in withdrawal limits (73rd ICWC Meeting materials, 2018: 1-3).

This episode matters analytically because it shows that the regime did not deny scarcity or collapse under it. Instead, stress was processed through formal planning: alternative reservoir-operation regimes were prepared, reduced quota options were tabled, and lower-reach vulnerability was recognized explicitly inside the institutional process. This is evidence of procedural continuity under anticipated stress, even if the expected distributional outcome remained unequal.

4.4.3 The 2019-2020 Episode: Lower-Reach Overuse Without Institutional Breakdown

A second stress episode appears in the non-growing season 2019–2020. Here, the problem was not only scarcity in the abstract, but implementation strain in the lower reaches. The bulletin records that actual withdrawals in the lower reaches reached 115.6% of the approved limit, including 108.0% in Uzbekistan and 130.4% in Turkmenistan. At the same time, planned water supply to the Amu Darya delta and the Aral Sea was 2,100 mcm, while actual supply reached 2,034 mcm, or 96.9% of plan (ICWC, 2020: 18-21).

The analytical significance of this episode is that it shows stress inside a still-functioning quota system. The regime was clearly under pressure, especially in the lower reaches, but the deviation remained legible within the institutional framework: limits existed, actual withdrawals were measured against them, and delta/Aral obligations remained embedded in the same formal allocation structure. In other words, this was not institutional breakdown. It was a case of overuse under strain, managed inside the regime's reporting and allocation procedures.

4.4.4 The 2021-2022 Episode: Severe Shortfall and Adaptive Procedural Response

The 2021 growing season provides the strongest modern stress episode. Forecast inflow to Tuyamuyun for April–September 2021 was 18,324 mcm, but actual inflow reached only 12,900 mcm, or 70.4% of forecast. Planned releases were 17,774 mcm, while actual releases were 13,180 mcm, or 74.1% of plan. End-of-season storage also remained well below forecast, at 2,372 mcm against a planned 3,203 mcm (ICWC, 2022: 17-19). Actual withdrawals across the basin showed the same strain: total growing-season withdrawal reached only 79.1% of plan, and in the lower reaches only 64.6% of the approved limit was achieved (ICWC, 2022: 18-19).

Yet the institutional response remained intact. At the 80th ICWC meeting, members approved country withdrawal limits in the Amu Darya and Syr Darya basins for the growing season 2021

and took into account forecast reservoir-operation regimes; they also agreed that, on the basis of more accurate water-availability data, reservoir operation could be considered further inside the formal process (80th ICWC Meeting, 2021: 5-8). The approved Amu Darya appendix continued to include not only country withdrawal limits but also water supply to the river delta and Aral Sea (80th ICWC Meeting, 2021: Appendix 1).

This is the clearest evidence in the Amu Darya case of strong procedural continuity under substantial hydrological stress. The outcome was not perfect implementation; on the contrary, actual inflow and deliveries fell sharply below plan. But the regime still responded through ordinary ICWC/BWO procedures - measurement, approval, reservoir planning, and updated technical consideration, rather than through overt institutional slippage.

4.4.5 Interim Assessment

Taken together, the Amu Darya case supports a comparatively strong assessment of procedural continuity. Across the episode record, the regime repeatedly responded to stress by revising or reaffirming withdrawal limits, tabling alternative operation regimes, maintaining delta and Aral Sea commitments inside the formal allocation system, and managing deviations through reporting and seasonal planning (73rd ICWC Meeting materials, 2018: 1-3; ICWC, 2020: 18-21; ICWC, 2022: 17-20; 80th ICWC Meeting, 2021: 5-8).

The evidence for escalation containment is also comparatively positive, though less dramatic than in Chu-Talas because the regime manages stress in a more technocratic form. The lower reaches experienced overuse, and in 2021 actual inflow and withdrawals fell well below forecast and plan. But these pressures remained largely inside the regional administrative framework rather than spilling into visible institutional rupture. The safest conclusion is therefore that the Amu Darya regime exhibits strong procedural continuity and relatively strong escalation containment, but in a specifically managerial form: it manages recurring allocation stress through quotas, reservoir planning, and technical adjustment rather than through a narrowly bounded dispute-resolution process.

Procedural Continuity: High. Across all three episodes (2018 shortage forecast, 2019–2020 lower-reach overuse, 2021-2022 severe shortfall), the regime maintained formal ICWC meetings, revised or reaffirmed water-withdrawal quotas, tabled alternative operation regimes, maintained Aral Sea and delta commitments, and managed deviations through seasonal planning. The regime used core procedures adaptively rather than suspending them. The 2021 episode with the most severe hydrological stress, saw the ICWC formally approve revised

withdrawal targets and adaptive management protocols, demonstrating that extraordinary response remained within procedural channels.

Escalation Containment: High, achieved through managerial rather than adversarial mechanisms. Disagreements remained inside the regional ICWC framework rather than escalating to extrajudicial dispute or public conflict. Language in official bulletins remained technical and administrative; no securitization is evident. Episodes consistently resolved through formal adjustment of quotas, seasonal management amendments, or technical planning rather than through standoffs or confrontation.

Conclusion: Amu Darya exemplifies how a broad, technically sophisticated regional framework embedded in Soviet-legacy coordination structures can absorb acute hydrological stress and distributional pressure through adaptive quota and planning systems. The regime operates as a collective administrative body coordinating withdrawal limits among technically comparable actors. Dominant mechanisms: informational stabilization (strong monitoring and data-sharing enable rapid deviation detection) and incentive alignment (the formal quota system provides a standing reference point). Long-term sustainability depends on whether underlying water scarcity permits continued quota-system operation or climate-driven reductions force redistributive renegotiation (as in Syr Darya).

4.5 Cross-Case Synthesis

The three case studies demonstrate variation in institutional responses to stress. This section tests the two propositions and examines competing explanations.

4.5.1 Summary of Performance Across Cases

Comparing the three regimes reveals distinct patterns in procedural continuity and escalation containment.

On the procedural continuity dimension, the evidence shows clear differentiation across the documented case-chapter episodes. Chu-Talas sustained scheduled bilateral coordination through the 2020-2024 stress sequence: when in-person sessions could not be held under COVID-19 conditions in 2020, the parties substituted a joint visual reservoir inspection at Orto-Tokoy/Kirov to preserve oversight, and the 2022 entry of new transboundary withdrawal points along the Aspara and Ashmara rivers was processed within the existing commission framework (Water Yearbook 2020; Water Yearbook 2022: 46-47). The Syr Darya regime experienced its sharpest discontinuity during the 2000-2001 low-storage episode: the May 2001 Kyrgyz-Uzbek bilateral protocol on Toktogul releases failed in implementation and the compensation

arrangements lapsed despite documentation in the 52nd ICWC meeting record (ICWC, 2001a; ICWC, 2001b); procedural continuity recovered in the 2021-2022 corrective-coordination cycle, when the 80th and 81st ICWC meetings convened on schedule and produced documented water-allocation outcomes (ICWC, 2021; ICWC, 2022). The Amu Darya regime maintained scheduled plenaries and BWO submissions throughout its 2018, 2019-2020, and 2021-2022 stress episodes, with the 73rd, 80th, and 81st ICWC meetings each producing documented allocation protocols even as inflow shortfalls of up to roughly 30% of forecast strained the system (ICWC, 2018; ICWC, 2021; ICWC, 2022).

The pattern on joint operational protocols is similarly revealing across the same episodes. Chu-Talas continued to produce annual operational arrangements through its commission framework, including under the 2020 procedural-substitution and the 2022 withdrawal-point integration (Water Yearbook 2020; Water Yearbook 2022: 46-47). Syr Darya protocols were uneven across the period: the May 2001 bilateral protocol failed in implementation despite being formally adopted, while the 2021–2022 cycle produced complete water-balance protocols at the 80th and 81st ICWC meetings (ICWC, 2021; ICWC, 2022). Amu Darya protocols continued on schedule across all three episodes, with growing-season and non-vegetation limits each adopted at the corresponding ICWC meeting (ICWC, 2018; ICWC, 2021; ICWC, 2022).

On escalation containment, the differences are sharper still. Chu-Talas confined disagreement to the bilateral commission across all three observed episodes, with the dispute-handling architecture of the 1999 Agreement (Article 7) channeling both the COVID-period adjustments and the 2022 Aspara/Ashmara integration (Water Yearbook 2020; Water Yearbook 2022: 46-47). The Syr Darya regime showed its weakest containment in 2000–2001, when the failed compensation arrangement spilled into bilateral political channels outside the ICWC (ICWC, 2001b; Shalpykova, 2002: 18–24); containment was tighter in 2021-2024, with disputes processed within ICWC plenary and working-group channels (ICWC, 2021; ICWC, 2022). Amu Darya showed partial containment across all three episodes: lower-reach overuse in 2019-2020 and severe shortfalls in 2021-2022 produced bilateral and ministerial signalling outside the commission, but the disputes were reintegrated into the technical framework at the next plenary (ICWC, 2021; ICWC, 2022).

4.5.2 Testing the Two Propositions

These performance patterns directly engage the two propositions developed in Chapter 2.

Proposition 1 (procedural continuity) posits that regimes with regular institutionalized contact - scheduled meetings, standing secretariats, and embedded information-sharing protocols - are more likely to maintain procedural continuity under stress. The evidence supports this proposition. Chu-Talas, which combines a bilateral commission meeting twice annually with explicit monitoring protocols, demonstrated unbroken procedural continuity across the 2020-2024 stress sequence. Even when in-person sessions were not feasible under COVID-19 conditions, the parties substituted a joint visual reservoir inspection at Orto-Tokoy/Kirov to preserve oversight, and the 2022 Aspara/Ashmara withdrawal-point entry was integrated through the standing commission framework (Water Yearbook 2020; Water Yearbook 2022: 46-47). The Syr Darya regime's weaker performance during the 2000-2001 low-storage episode is similarly illuminating: although the regime possesses substantial institutional infrastructure (the ICWC plenary, the BWO, and the standing secretariat), its procedural continuity was disrupted when the May 2001 bilateral protocol on Toktogul releases failed in implementation and the compensation arrangement lapsed (ICWC, 2001a; ICWC, 2001b; Shalpykova, 2002: 12-18). Continuity recovered in the 2021-2022 corrective cycle, but with the qualification that procedural continuity depends not just on the existence of scheduled contact, but on its insulation from high-level political override and on the resilience of the implementation architecture that follows formal adoption.

Proposition 2 (escalation containment) posits that regimes with pre-specified dispute-handling mechanisms, separation of technical and high-political channels, and benefit-sharing rules are more likely to contain dispute escalation. The evidence again supports the proposition, but with variation. Chu-Talas's clearly bounded dispute-resolution procedure (Article 7 of the 1999 Agreement), combined with its parity-based bilateral structure and explicit cost-sharing formula, contained both the 2020 COVID-period procedural adjustments and the 2022 Aspara/Ashmara withdrawal-point integration within formal channels. Neither party escalated beyond the bilateral commission (Chu-Talas Agreement 1999: Article 7; Water Yearbook 2020; Water Yearbook 2022: 46-47). Syr Darya's failure to contain escalation during 2000-2001 reflects, in part, the absence of sharp separation between technical and high-political channels: water-energy linkages allow energy and gas-supply terms to override ICWC technical schedules, and the regime lacks a clearly bounded dispute-resolution mechanism analogous to Chu-Talas's Article 7 (ICWC, 2001b; Shalpykova, 2002: 18-24); in the 2021-2024 corrective cycle, containment improved but remained dependent on the broader political willingness to honour negotiated compensation. Amu Darya achieved partial containment across its 2018,

2019-2020, and 2021-2022 episodes: disagreements over reservoir operation and lower-reach withdrawals were ultimately negotiated within the technical and commission structures, though some unilateral actions occurred. The regime's broad distributional framework and regional scope allowed disputes to be reintegrated without escalation beyond the ICWC (ICWC, 2018; ICWC, 2021; ICWC, 2022). Proposition 2 is thus supported most strongly by Chu-Talas and least by Syr Darya in 2000-2001, with Amu Darya occupying an intermediate position and Syr Darya itself moving toward partial containment in the more recent cycle.

4.5.3 Alternative Explanations Revisited

The propositions foreground institutional design as the primary driver of performance variation. Chapter 2.2 identified four competing structural explanations: climate stress, power asymmetry, Soviet institutional legacy, and regional political dynamics. The cross-case analysis allows these to be revisited in light of the evidence.

Climate stress does not explain the variation. Amu Darya faced repeated growing-season inflow shortfalls of up to roughly 30% of forecast across 2018–2022, yet maintained scheduled plenary cycles and produced complete allocation protocols at each ICWC meeting; the Syr Darya 2000-2001 episode unfolded under comparable but not more severe hydrological stress, yet produced a failed compensation arrangement. Conversely, the 2020 COVID period and the 2022 Aspara/Ashmara integration on Chu-Talas involved minimal hydrological stress, yet the regime maintained the strongest procedural containment of any case in the comparison. Climate severity alone does not determine institutional performance.

Power asymmetry likewise fails to explain the pattern. Syr Darya's upstream-downstream asymmetry favouring Kyrgyzstan and Tajikistan did not prevent earlier periods of cooperation and does not fully explain the 2000-2001 compensation-failure breakdown. Chu-Talas, with more balanced riparian power, showed stronger containment, but so did Amu Darya, which also features significant power imbalances between upstream Tajikistan and downstream Uzbekistan and yet maintained procedural continuity through the 2018-2022 episodes (Sehring, 2009: 234-241). Power asymmetry is a conditioning factor, not a primary driver (Fischhendler 2004: 287).

Soviet institutional legacy is shared across all three basins, yet performance variation remains. This suggests that the Soviet legacy itself is neither necessary nor sufficient to explain performance differences. What matters is how successor states have adapted this legacy—through the Chu-Talas bilateral agreement (1999), the ICWC statute revisions, and differing

compliance strategies - which better accounts for the performance patterns observed (Sehring 2009: 234-241). Regional political dynamics shape opportunity structures but do not fully determine institutional response: the 2020 COVID disruption affected all three basins comparably, yet only Chu-Talas substituted a joint visual inspection regime to preserve oversight, while the 2022 Aspara/Ashmara integration was processed without external escalation despite ongoing regional political tension. Syr Darya's regional position created constraints during the 2000-2001 episode, but regime design failures compounded these constraints rather than being determined by them (Zeitoun and Warner 2006: 438-441). Institutional design emerges as the most parsimonious explanation for cross-case variation, addressing the residual variation left unexplained by structural factors alone.

4.5.4 Scope and Limits

The analysis also reveals boundary conditions on when institutional design matters most and least.

Institutional design matters most when political disagreement is acute but the underlying interdependence remains stable. In the Chu-Talas case, political tensions over borders were real and enduring, yet both riparian states continued to depend on the shared river for irrigation. The institutional design - bilateral commission, dispute-resolution procedure - provided a mechanism through which that underlying dependence could be managed despite political tension. In the Syr Darya case, by contrast, political disagreement was compounded by fundamental uncertainty over whether cooperation remained mutually beneficial given energy-water trade-offs. When the underlying interdependence is questioned or the distribution of benefits is perceived as fundamentally illegitimate, institutional design is less able to contain escalation.

Institutional design matters least when one or more riparian states faces existential resource scarcity, when external political alignments radically shift, or when enforcement capacity is absent and compliance depends entirely on voluntary cooperation. All three regimes face the voluntary-compliance problem, but Chu-Talas has addressed it more effectively through explicit bilateral verification and cost-sharing mechanisms that create reciprocal accountability. Syr Darya's broader structure provides less clear verification and accountability, making sustained voluntary compliance more difficult during periods of stress. Within these scope conditions, the thesis finds that institutional design—specifically, the features identified in Chapter 2 (regular institutionalized contact, dispute-resolution mechanisms, technical-political

separation, and benefit-sharing rules) explains the variation in procedural continuity and escalation containment observed across the three Central Asian basins.

Chapter 5. Conclusion

This thesis asked how differences in institutional design explain variation in institutional performance under stress in Central Asian transboundary water treaties. The puzzle that motivated the inquiry is straightforward: three basin regimes - the Amu Darya, the Syr Darya, and the Chu-Talas - face broadly similar structural conditions, yet they perform differently when those conditions tighten into stress. Some maintain their meeting cycles, sign their annual protocols, and process disagreement through institutional channels even under acute strain; others see their procedures slip, their compensation arrangements lapse, and their disputes escalate beyond the institutions designed to contain them. Explaining that divergence within a structurally comparable region was the analytical task.

The existing literature offered partial purchase but left the residual variation unaccounted for. Climate-stress accounts predict that hydrological severity should drive outcomes, yet Amu Darya maintained scheduled plenary cycles through inflow shortfalls of roughly 30% of forecast in 2018–2022 while Syr Darya broke down in 2000–2001 under no greater hydrological pressure. Power-asymmetry accounts predict that upstream-downstream imbalance should determine performance, yet basins with similar asymmetries diverged sharply. Soviet-legacy accounts apply equally to all three cases. Regional-political-dynamics accounts capture opportunity structure but cannot explain why only Chu-Talas substituted a joint visual reservoir inspection regime to preserve oversight under COVID-19. What was missing was an explanatory variable located within the regimes themselves and capable of varying systematically across them. Institutional-design scholarship outside Central Asia supplied the conceptual handle but had not been applied to these regimes under stress.

To address that gap, the thesis used a most-similar systems comparative design across the three basin regimes, with documented stress episodes serving as empirical windows on institutional performance. Ten episodes anchored the analysis: four on Chu–Talas (the 2020 COVID disruption, the 2021 Kirov dam safety episode, the 2022 Aspara/Ashmara dispute, the 2023–2024 verification turn), three on Syr Darya (the 2000–2001 compensation failure, the 2021–2022 corrective cycle, the 2023–2024 partial-stabilisation period), and three on Amu Darya (the 2018 forecast shortfall, the 2019–2020 lower-reach overuse, the 2021–2022 severe shortfall). Institutional design was operationalised through five dimensions: monitoring and

information-sharing, dispute resolution, enforcement, flexibility, and distributional arrangements, coded from treaty texts, statutes, and basin-organisation by-laws. Performance under stress was operationalised in two components: procedural continuity and escalation containment, and assessed through ICWC bulletins, BWO reports, water yearbooks, and Chu-Talas Commission records.

The empirical analysis supports the central argument and closes the three sub-questions posed in Section 1.2 in turn. On the first sub-question — which design features distinguish regimes that maintain procedural continuity from those that experience breakdown — stronger institutional design produces stronger procedural continuity and tighter escalation containment, with Chu-Talas (strong design) registering high performance, Syr Darya (moderate-low design) registering mixed performance with the 2000–2001 episode at the low end, and Amu Darya (moderate design) registering moderate-high performance. On the second sub-question — how specific design features shape institutional responses during identifiable episodes — the episode-level evidence shows each design dimension at work in concrete institutional behaviour: monitoring routines explain why Amu Darya could continue producing allocation protocols at the 73rd, 80th, and 81st ICWC meetings under shortfall; dispute-resolution architecture explains why the Aspara/Ashmara dispute stayed inside the Chu-Talas commission; flexibility procedures explain why the COVID-period substitution at Orto-Tokoy/Kirov was institutionally legible rather than improvised; distributional arrangements explain why the failed Toktogul compensation in May 2001 produced sharper escalation than equivalent shortfalls did on Amu Darya. On the third sub-question — whether institutional design retains explanatory power once structural factors are considered — the cross-case analysis in Section 4.5.3 shows that climate stress, power asymmetry, Soviet legacy, and regional political dynamics each remain conditioning factors but none is sufficient to explain the observed variation. Institutional design remains the most parsimonious explanation for the observed variation, while structural factors operate as conditioning rather than determining variables.

One feature of the comparison deserves particular reflection. The mapping from institutional design to performance under stress holds across the cases, but it is not deterministic: Amu Darya occupies a moderate position on institutional design and yet registers moderate-high performance under stress, somewhat above what a strict reading of the framework would predict. Rather than treating this as a vulnerability of the argument, the case is best read as informative about how institutional design works in practice. Strong monitoring and

information-sharing routines, combined with recurring allocation procedures embedded in annual planning, can partly substitute for less developed enforcement architecture and less sharply bounded dispute-resolution channels. The implication is that the five design dimensions are not equally weighted in all settings, and that institutional design effects operate cumulatively rather than additively across dimensions. This is a finding of the comparison rather than a limitation of the framework: it shows that the relationship between design and performance is mediated by the specific configuration of strengths within each regime.

The thesis contributes to three literatures: it applies institutional-design scholarship to transboundary water governance under stress; it explains divergence within a region too often discussed in uniform terms; and it shows that environmental stress does not mechanically produce instability - its political consequences depend on the institutional architecture through which scarcity is governed. Several limitations qualify but do not undermine the argument: documentary materials make formal procedure more visible than informal motivation; the Chu-Talas record is less dense than the ICWC bulletin archive; the five-dimension operationalisation is a reasoned simplification of a more complex institutional reality; and the analysis stops at 2024, leaving the most recent climate cycle as an open empirical question. Within those limits, the central finding holds: where institutions are well-designed, regimes function under stress; where design is weaker, regimes slip. Institutional architecture is doing analytical work that climate, power, and political environment alone cannot explain.

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APPENDIXES

Table 1. The three basin systems examined in this thesis: Amu Darya, Syr Darya, and Chu–Talas. (Bernauer and Siegfried, 2012: 229).

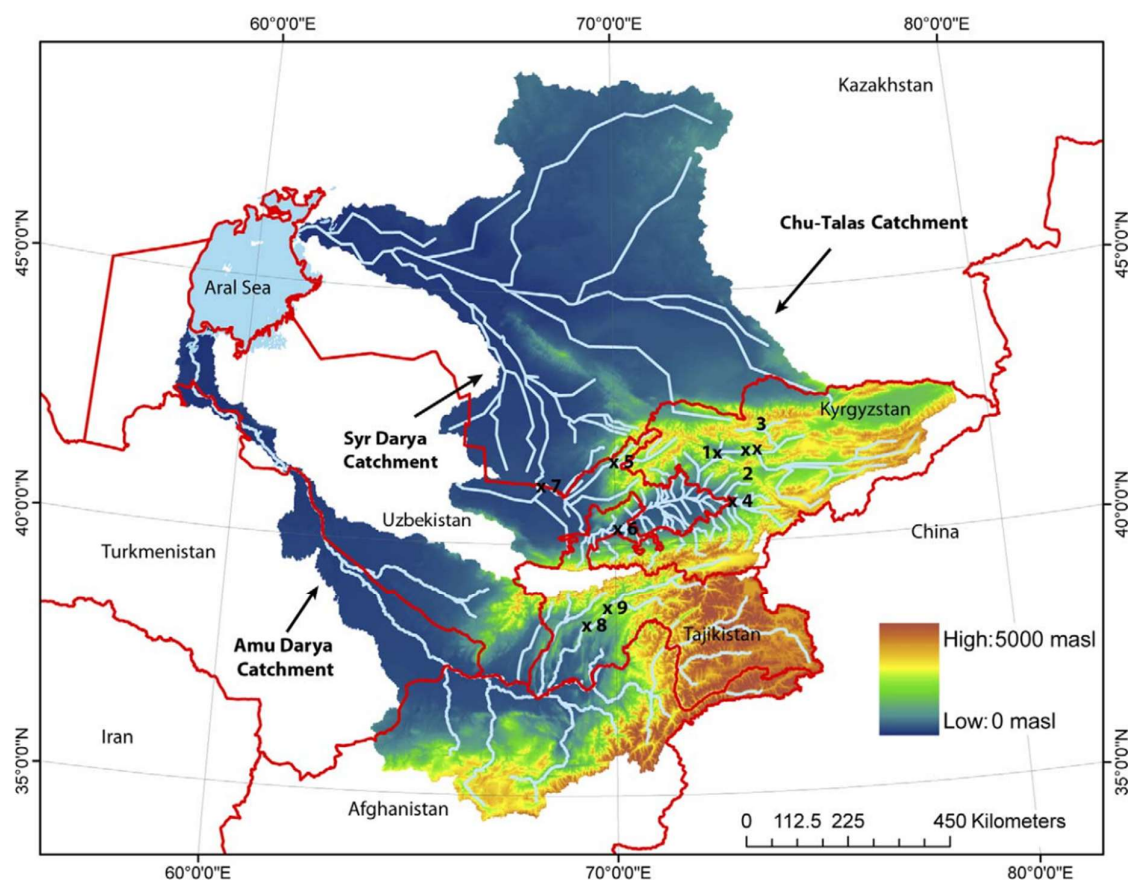


Table 2. Comparative Overview of Institutional-Design Dimensions Across the Three Basin Regimes

Institutional-design dimension	Chu–Talas	Syr Darya	Amu Darya
Monitoring and information-sharing	Strong: explicitly specified in the Statute; assigned to the bilateral Commission; linked to hydrological exchange, joint surveys, and coordinated monitoring practice	Moderate: clearly embedded in basin management through ICWC/BWO reporting and forecasting, but less sharply bounded institutionally than in Chu–Talas	Strong: clearly embedded in ICWC/BWO routines through annual planning, quota control, and basin-wide technical reporting

Dispute-resolution mechanisms	Strong: clearly structured through a standing bilateral commission, consensus rule, secretariat, working groups, and additional consultations	Moderate: multiple coordination channels exist, but they are institutionally layered and less tightly specified as one self-contained dispute-processing framework	Moderate: coordination is strongly embedded in regional bodies and recurring allocation procedures, but less narrowly focused and procedurally bounded than in Chu–Talas
Enforcement / compliance-supporting provisions	Moderate: compliance support is built into agreed schedules, implementation control, monitoring, and joint planning, but not strongly formalized through sanctions	Weaker: reciprocal obligations are formalized, but compliance support depends heavily on continued political agreement and follow-up arrangements rather than autonomous enforcement architecture	Moderate: compliance support is embedded in annual limits, observance control, and routine technical oversight, but remains managerial rather than coercive
Flexibility/adaptive capacity	Strong: explicitly specified through reservoir-regime revision, extraordinary-situation procedures, and flood/mudflow response mechanisms	Moderate: adaptation is present through seasonal adjustment and supplementary arrangements, but often relies on repeated renegotiation rather than more tightly specified built-in procedures	Moderate: adaptive capacity is built into annual flow-based planning and reservoir-operation adjustment, though within a broad technocratic framework rather than a sharply articulated revision mechanism
Distributional/benefit-sharing arrangements	Strong: clearly formalized through proportional cost-sharing for operation, maintenance, and repair of shared facilities	Strong: clearly built into the regime through formalized water–energy exchange obligations, even if politically burdened in practice	Moderate: distributional management is built primarily through annual withdrawal limits, lower-reach allocation, and environmental/Aral-related releases rather than a sharply specified compensatory formula

Table 3. Aggregate Comparative Scoring of Institutional Design and Performance Under Stress

Basin regime	IV: Institutional-design strength (overall)	DV: Performance under stress (overall)	Anchoring stress episodes
Chu-Talas	Strong (4 of 5 design dimensions strong; 1 moderate)	High (procedural continuity high; escalation containment high)	2020 COVID-period procedural substitution (joint visual inspection at Orto Tokoy/Kirov); 2022 integration of Aspara/Ashmara withdrawal points within the bilateral commission framework
Syr Darya	Moderate-low (3 dimensions moderate; 1 strong; 1 weaker)	Mixed (low in 2000-2001 compensation failure; moderate in 2021-2024 corrective cycle)	2000-2001 Toktogul low-storage and compensation-failure episode; 2021-2022 corrective-coordination cycle (80th and 81st ICWC meetings); 2023-2024 partial-stabilization episodes
Amu Darya	Moderate (1 dimension strong; 4 moderate)	Moderate-high (procedural continuity high; escalation containment partial)	2018 growing-season shortage forecast (73rd ICWC meeting); 2019-2020 lower-reach overuse without institutional breakdown; 2021-2022 severe shortfall and adaptive procedural response (80th and 81st meetings)