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Small transboundary tributaries of Ferghana Valley, Central Asia: searching for constructive pathways toward cooperation

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Introduction: Cooperation on small transboundary tributaries (STTs) in Ferghana Valley of Central Asia is key to ensuring realization of benefits such as water supply for irrigation and livelihood activities. While factors driving and constraining cooperation on the region's large rivers has received considerable focus, the dynamics surrounding cooperation at STT level is comparatively ambiguous. In particular, barriers to cooperation have not been systematically identified.

Objective: To address this gap, we implemented semi-structured interviews with regional water experts to understand drivers of and constraints to formal cooperation in a set of STTs shared between the Kyrgyz Republic and Uzbekistan in the Ferghana Valley of Central Asia.

Methods: Political stakeholder analysis tools were employed, with focus placed on water experts and a specific problem– insufficient cooperation on Ferghana Valley STTs, in particular those shared between the Kyrgyz Republic and Uzbekistan. The Kyrgyz-Uzbek STTs were selected for the case study because they account for over 70% of reported STTs in Ferghana Valley.

Results: The results suggest that expansion of irrigated lands and construction of water infrastructure served as the main drivers of formal cooperation. Main present-day barriers to cooperation relate to border demarcation, lack of political will, low cost of water, and lack of internal (intra-sectoral) coordination. Actors identified as key to enabling formal water cooperation are water and agriculture specialists. Ongoing informal cooperation constitutes a powerful foundation on which to scale up to formal cooperative agreements and should thus form a key part of strategies aimed at realizing cooperation.

Discussion: Based on these findings, we propose three concrete recommendations to strengthen cooperation in STTs within the Ferghana Valley: (1) enhance intra-sectoral coordination, planning and information exchange; (2) stimulate appreciation of the benefits of water cooperation in order to enhance political will; and (3) ensure non-water issues such as border delineation are resolved before discussions are initiated; otherwise, water cooperation efforts may be continually undermined.

KEYWORDS

Central Asia, Ferghana Valley, political stakeholder analysis, small transboundary tributaries, water cooperation

1 Introduction

Transboundary waters, and the increasingly robust institutions that apply to them, are well-documented. Worldwide, there are more than 280 transboundary river and lake basins and more than 400 shared aquifers (Lautze and Nehring, 2025). Institutional development of transboundary basins and aquifers has been considerable (Turgul et al., 2024), with major achievements realized on agreement formation, River Basin Organization establishment, as well as joint establishment and operation of infrastructure. Nonetheless, while the pathways to cooperation on shared waters can vary they can often require long gestation period (Grey et al., 2009). It is therefore critical to better diagnose pathways, and barriers to countries advancement along them, in order to motivate cooperation.

The Fergana Valley is a densely populated, intermountain depression in Central Asia, covering roughly 22,000 km^2, enclosed by the Ala-Tau, Tian Shan and Alay mountain systems with a narrow western outlet for the Syrdarya River (UNEP, UNDP, OSCE, and NATO, 2005). The valley is shared primarily among Uzbekistan (about 60% of the valley area—Andijan, Fergana, Namangan provinces), Kyrgyzstan (≈15%—Batken, Osh, Jalal-Abad provinces) and Tajikistan (≈25%—Sogd province), producing a compact but politically fragmented landscape (Kenjabaev and Frede, 2016). Hydrologically, the valley is an upstream, water-rich sub-region of the Syrdarya basin, with a network of small transboundary tributaries (STTs) those contribute about 7.8 km^3/year to the Syrdarya's flow (Wegerich et al., 2012a). Water use in the valley is overwhelmingly agricultural. Across the valley and the broader riparian countries, irrigation accounts for roughly ~90% of total water withdrawals, leaving municipal and industrial uses as relatively minor shares (Kenjabaev et al., 2020). This sectoral skew makes the valley highly sensitive to irrigation demand fluctuations, seasonal variability, and policies affecting water allocation.

The transboundary nature of the Ferghana Valley's small, shared rivers – alternatively known as STTs – present both opportunity and risk (Holmatov et al., 2016). Reflecting opportunity, joint activities have been undertaken in more than 20 transboundary sub-basins in the Ferghana Valley within the Syrdarya River Basin (Holmatov et al., 2016). These activities provide examples of constructive cooperation that has improved the security of local level water supply for critical irrigation and livelihood activities (Abdullaev, 2011; Stucker et al., 2012). For example, joint efforts on the Khoja-Bakirgan tributary have effectively prevented numerous conflict situations between the Kyrgyz Republic and Tajikistan (Wegerich et al., 2012b) and contributed to better management of water for agriculture. However, disagreements over water allocation in STTs can also pose risks, potentially escalating into interstate conflicts (Toktomushev, 2017). For instance, a conflict that occurred over a water infrastructure in Isfara STT on April 28th, 2021 led to 55 fatalities and large-scale damage to local infrastructure on both sides of the border (Arynova and Schmeier, 2021).

Unfortunately, most STTs lack formalized cooperation, and existing agreements on STTs can be outdated or un-matched to current realities of increasing demand and climate change induced fluctuations of water supply (Stucker et al., 2012). Further, clear-cut pathways and catalysts to enhance cooperation remain unclear. While cross-basin lesson sharing is certainly a positive way to promote cooperation, variation in and context-specificity of water cooperation efforts can limit replicability of experiences from one region to another (Giordano, 2003). Given the benefits of cooperation on STTs – notably that they serve as good entry points to take practical steps to address hard water management issues with fewer political complications (Holmatov et al., 2016) there is a clear need to generate guidance on how to promote such cooperation. The cost of insufficient cooperation in Central Asia is estimated at more than $4.5 billion per year (Pohl et al., 2017).

Knowledge on catalysts and barriers to cooperation can be deduced from careful understanding of basin contexts as part of investigations typically framed under a disciplinary umbrella of political economy (PE) or geography, or through a variation of such approaches in an interdisciplinary work supported by development partners (e.g., Subramanian et al., 2012). In the Syrdarya's shared tributaries, some work has been undertaken to provide guidance on how to advance cooperation but it is largely based on textual analysis of agreements and other key documents with only cursory use of informant input. Wegerich et al. (2012a) used Ferghana STTs as a case study and focused on border crossing, transboundary infrastructure and water sharing as catalysts for cooperation. Wegerich et al. (2016) explored links between expansion of the irrigated area upstream in Kyrgyzstan and potential conflict due to downstream impacts on the irrigation system in the Ferghana province of Uzbekistan. Pak et al. (2014) focused on the history of water-sharing agreements with a focus on the Isfara STT. Pak and Wegerich (2014) explored history and evolution of benefit-sharing agreements and negotiation processes with a focus on small and medium-sized reservoirs in the Ferghana Valley. Interview-based findings can fill a key gap that supports a focused, systemic identification of factors that influence efforts to jointly manage STTs in the past and in the present.

The objective of this paper is to understand drivers and constraints that affect the advancement of formal cooperation in STTs in Central Asia by focusing on Ferghana Valley STTs shared between Osh province of the Kyrgyz Republic and Andijan province of Uzbekistan, and Batken province of the Kyrgyz Republic and Ferghana province of Uzbekistan, respectively. A key purpose of this paper is to identify barriers to advancing cooperation, so that these barriers can be addressed. Data for this study was collected through twenty semi-structured interviews with water management specialists from the Kyrgyz Republic and Uzbekistan, conducted between September and November 2022.

2 Materials and methods

2.1 Cooperation on Ferghana STTs

STTs are important for people's livelihoods, and STT level agreements can enhance communal prosperity by securing water allocation for agricultural production (Holmatov et al., 2016). Numerous bilateral and multilateral agreements covering one or multiple Ferghana Valley STTs were concluded during the Soviet times. Holmatov et al. (2016) identified 123 agreements that covered twelve STTs or related infrastructure in the Ferghana valley although majority of them were short-lived. Nevertheless, some Soviet-era STT level agreements are still in use (Holmatov et al., 2016). For example, a *Protocol on Interstate Allocation of Ferghana Valley's Small Rivers' Flows* – from 1980 is still considered functional and valid to this day (Pak et al., 2014; Soliev et al., 2015; Stucker et al., 2012; Wegerich et al., 2012b).

The conclusion of STT level agreements has continued in the post-Soviet era (Holmatov et al., 2016). These agreements mostly focus on addressing immediate challenges, e.g., short-term water allocation, dam operation regulation, infrastructure maintenance, etc. They lack a long-term vision or strategic framework to address the evolving

complexities of water management in the Ferghana Valley. For instance, due to climate change impacts, STTs in Ferghana Valley may start facing contrasting problems like water scarcity versus flooding as is the case of shared waters between Bulgaria and Greece (Skoulikaris, 2021).

According to Holmatov et al. (2016), 2000–2009 was the decade with the greatest number of concluded agreements. While improved relations between the riparian countries can be one explanation for this acceleration of agreements, another contributing factor may be the increasing number of challenges emerging in the STTs that could not be solved within the scope of basin-wide agreements signed in the 1990s as part of *a first wave* of post-Soviet water cooperation. After collapse of the Union of Soviet Socialist Republics (USSR), the new institutional structures indeed initially placed more emphasis on large rivers (Wegerich et al., 2012b) while cooperation at the STT level was increasingly considered a local, bilateral issue (Stucker et al., 2012; Wegerich et al., 2012a), that was left outside the scope of new agreements. When regional water policies shifted toward nationalism and unilateral action between 1999 and 2006, and the cooperation became more bilateral, short-term, and informal (Dadabaev et al., 2023), the need for localized agreements also increased in order to ensure transparency and sustainability.

While formalization of growing cooperation on STTs provides benefits *in itself* (e.g., reducing conflicts; Petersen-Perlman et al., 2017), equally important is the content of such formalization reflected in the structure, scope and robustness of STT level agreements (Mitchell and Zawahri, 2015). With regards to structure, some STTs are covered by a number of agreements, and it is not clear which agreement applies to regulate water allocation (Pak et al., 2014). With regards to scope, some agreements (i.e., Protocol from 1980) cover water allocation arrangements for multiple STTs and it is not clear whether in practice it is used to decide water allocation in all covered STTs or selection thereof. With regards to robustness, the Soviet-era agreements generally had a narrow focus on water allocation that were determined considering water demand growth assumptions of that time. In the present day, many conditions that affect both water supply and demand have changed and the existing STT level agreements display some limitations in this regard such as: (a) lack of mechanisms to address demand side changes that have occurred in the last few decades (e.g., irrigation regimes, crop types, cropping area expansions); (b) limited breadth that does not cover supply side changes in water regime due to climate change; (c) lack of mechanisms to address operation and maintenance of STT river beds and infrastructure under new institutional realities like new borders and management arrangements; and (d) absence of forecasting, monitoring and exchange of information (Abdurakhmanov et al., 2024). These shortcomings may compel riparian states to conclude short-lived, ad-hoc agreements to address immediate challenges as opposed to addressing longer-term needs.

Short-term agreements have many benefits but also some shortcomings. Strengths include mitigating fears of states of binding themselves to undesirable commitment indefinitely, increasing interaction between the riparian states, adding flexibility to adjust to unexpected changes. Among their shortcomings are having a weak legal basis for long-term planning or incurring higher transaction costs (Holmatov et al., 2016). Furthermore, lack of a formal umbrella-type structure entails that the know-how and experiences of addressing different challenges through ad-hoc agreements can be linked to specific individuals, and their experiences and networks can be lost with their departure.

2.2 Designing an approach to assess opportunities and barriers to cooperation in STTs

Designing an approach to assess opportunities and barriers to cooperation can draw on political stakeholder analysis, a tool within a PE (Whaites et al., 2023). PE is defined by Serrat (2017) as "the interaction of political and economic processes in a society" and Tanner and Allouche (2011) as "processes by which ideas, power and resources are conceptualized negotiated and implemented by different groups at different scales." The main purpose of a PE analysis is to understand the underlying drivers of decision making (Fritz et al., 2014, p. 8) or in other words the focus is on finding answers to "why?" and "how?" questions (Serrat, 2017). An example would be, whether and how politics and political economy influence reforms in different countries (Fritz et al., 2009, p. viii).

Understanding the underlying drivers of decision making is valuable because it can serve as an entry point for having informed and grounded discussions although it is not a 'magic bullet' for changing complex realities (Price, 2021). Three key variables for PE analysis can be clustered as structural, institutional, and actors, that interact and impact specific changes (Fritz et al., 2009; USAID, n.d.). *Structural factors* refer to elements which local stakeholders cannot change, such as commodity prices (Fritz et al., 2009) or natural resource discoveries, demographic pressures (Whaites, 2017). *Institutions* on the other hand refer to "human-constructed constraints or opportunities within which individual choices take place and which shape the consequences of their choices" (McGinnis, 2011) or in simpler terms, to "the rules of the game" (North, 1990, p. 477). A distinction between structures and institutions is that structures are very difficult to change and they can change institutions but (usually) not the other way (Andreas et al., 2021). Stakeholders or *actors* refer to groups or individuals with shared interest (Fritz et al., 2009).

Three common variations of a PE analysis are: (a) in-depth PE analysis; (b) stakeholder PE analysis; and (c) rapid assessment PE analysis (Reich and Balarajan, 2012). An *in-depth PE analysis* is a theory-based analysis that can provide contextual analysis to assist in political strategy generation. *Stakeholder PE analysis* is more problem-oriented analysis that can help generate specific political strategies for decision-making. *Rapid assessment PE analysis* is a rapid diagnostic analysis that utilizes questionnaire to gage current political circumstances (Reich and Balarajan, 2012). There can be also different levels of PE analysis, e.g., country, sector, and problem/issue (USAID, n.d.) and different tools of PE analysis, such as the political stakeholder analysis.

Our approach in this paper draws on political stakeholder analysis tools, with focus placed on water experts and a specific problem–insufficient cooperation on Ferghana Valley STTs, in particular those shared between the Kyrgyz Republic and Uzbekistan. The Kyrgyz-Uzbek STTs were selected for the case study because they account for over 70% of reported STTs in Ferghana Valley (Holmatov et al., 2016), and given their prominence, were considered the most logical focus for this study (Figure 1). We utilized a case study research strategy, which involves examining one or several cases of the focal topic in real-life setting (Van Thiel, 2014). As with the other potential methods, the case study research strategy has its own strengths and limitations. After careful contemplation, its strengths such as combined data collection (qualitative and quantitative), the capacity to reveal dynamics within a limited setting, and ability to use gathered evidence to generate theory (Eisenhardt, 1989) were assessed to outweigh potential limitations such as the small sample size.

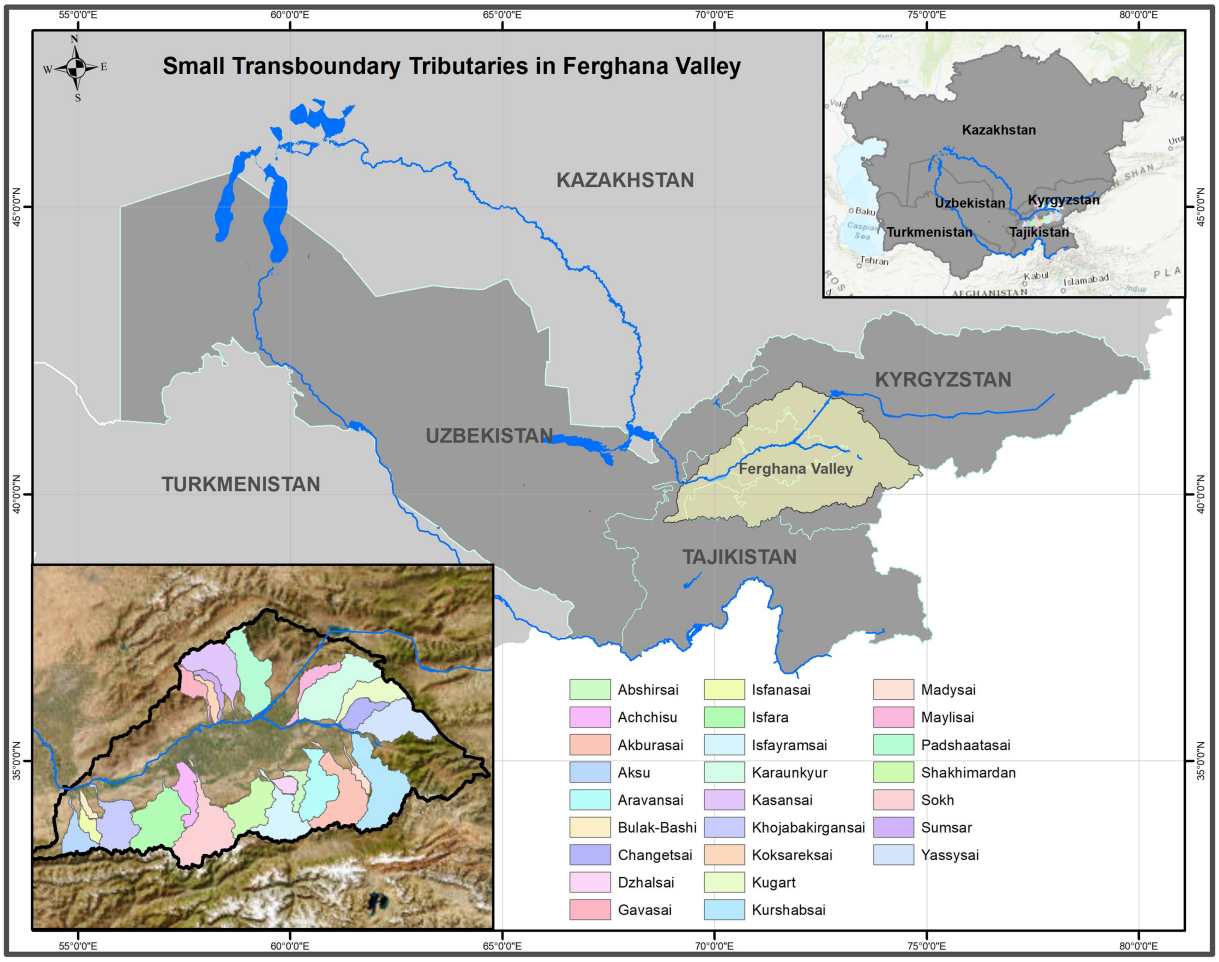

FIGURE 1
Map of the Ferghana Valley showing focus STTs within Central Asia. Source: Authors compilation.

To populate the framework, we drew on qualitative and quantitative data generation approaches used in the field of social-ecological systems (de Vos et al., 2021), namely, empirical field data, textual and archival data. For empirical data we use results from semi-structured interviews. The textual and archival data were obtained from publications and IWMI's collection of STT water agreements (Holmatov et al., 2016).

2.3 Data collection and analysis

2.3.1 Data collection and handling

We conducted a total of twenty semi-structured interviews with key water management specialists familiar with the STTs, ten from the Kyrgyz Republic and ten from Uzbekistan, between September and November 2022. All but one interview[1] was conducted in-person at the offices of water management specialists or at locations of their choice. The main aim of interviews was to identify factors that influence decision making in Ferghana Valley STTs using a set of 10 guiding questions[2] (Table 1). Use of similar questionnaires are common in explorative studies (Reich and Balarajan, 2012; van Langen et al., 2021), where questions can be grouped into different themes. Following similar structure, we grouped questions into three themes: (a) actor's background; (b) focus on the topic; and (c) a way forward.

Two questions were related to information about the respondent's background and degree of involvement in transboundary water management. These questions were aimed at understanding how respondents know what they say they know and whether they have a working knowledge of the decision-making processes, i.e., whether they were directly involved in the process of negotiations.

Four questions were related to gaging the presence of formal or informal cooperation as well as the underlying drivers for their creation. These questions were aimed at identifying and mapping key legal documents serving as the basis for transboundary water

1 Due to a scheduling conflict, one water management specialist from Uzbekistan was interviewed by phone following an in-person meeting.

2 Since some questions built on previous ones, when no answer was provided to the earlier one the follow up questions became irrelevant.

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TABLE 1 Interview questions.

Category	Question sets
Actors background and degree of involvement in transboundary issues	How long have you been working in water management? (We requested to exclude breaks, military service, and working in other jobs).
	How do you know the process of decision-making in STTs in Ferghana Valley (i.e., direct involvement; indirect interaction with those who are involved; research; other).
Focus on the topic: existence of formal and informal cooperation	Do you know of any formal agreements that cover STTs in Ferghana Valley? Can you list them starting from the earliest?
	When did the first agreement commence and why or what factors/circumstances triggered the need to conclude the first agreements? Who were involved?
	What factors contributed to conclusion of consecutive agreements (e.g., did something change)?
	Are you aware of any informal co-operations happening in STTs in Ferghana Valley (e.g., phone calls, meetings)? Why is informal cooperation happening in STTs in Ferghana Valley and why aren't they converted to formal cooperation?
Way forward: ways to improve cooperation	Do you think there is a need to conclude formal agreements on STTs in Ferghana Valley? Why or why not?
	Who do you think should be involved and why? Who should not be involved and why?
	What type of political and/or economic factors need to change to remove barriers for cooperation?[1]
	Your frank outlook on improving cooperation in STTs. What is achievable under current conditions/constraints?

[1]When the question was not clear to interviewees we provided examples of political (e.g., Kambarata hydropower plant construction, border demarcation, land swapping) and economic (e.g., financing water infrastructure rehabilitation, water pricing) factors.

cooperation, factors that enabled their creation, and their status (i.e., can they still solve present-day issues or is there informal cooperation happening in parallel with formal cooperation or in its absence).

Four questions were related to respondent's perception of a way forward. These questions were aimed at assessing whether there is a need for concluding or renewing existing STT level agreements, who needs to be involved and what are the main hindering factors to cooperation. Interview responses were contextualized, validated or supported with information from literature (both published and grey, including IWMI's collection of STT water agreements in Central Asia) (Holmatov et al., 2016).

At the time of interviews, interviewees were affiliated with one of the following types of organizations: Water Ministry/Department[3], basin/provincial level water management organization, local/district/canal level water management organization, and academic institution. We interviewed at least one specialist from each of the mentioned organizations in the Kyrgyz Republic and Uzbekistan. Although there is no agreed standard to the minimum number of interviews that should be undertaken to saturate a topic, twelve is believed to reflect a suitable number for analysis (Andreas et al., 2021). To increase credibility, we conducted a total of twenty interviews in this study. Three respondents (15% of respondents) had a national level mandate and were familiar with the situation in all STTs shared between the Kyrgyz Republic and Uzbekistan. Similarly, three respondents (15%) were affiliated with academia and understood situations in all STTs shared between the two countries. Eleven respondents (55%) had a provincial level mandate and had good understanding of STTs crossing their respective provincial borders, i.e., Andijan and Ferghana in Uzbekistan and Batken and Osh in Kyrgyzstan (Figure 2). Three respondents (15%) worked at the local level and were only familiar with the situation in individual STTs that they worked on. The actual positions and names of the interviewees are withheld to protect their identities.

All interviews were conducted by two researchers (authors of this paper) to validate oral consent of interviewees and to confirm notes. The Russian language version of the protocol was shared with the interviewees at their request. Interview notes were digitized and saved as a master spreadsheet file immediately upon returning from the field. Respondents' names and affiliations were replaced by assigning random, five-digit numeric numbers generated using www.random.org. A file containing keys that allows linking random numeric numbers to respondent identities was saved and stored separately.

2.3.2 Data analysis

Collected data and information was used to conduct the following analyses stratified by country:

1 Length of respondent's service in water management and type of their involvement in the decision making in STTs (directly, indirectly): to understand how respondents know what they tell us they know and confirm through their experience that they have a working knowledge of decision-making processes at the STTs level;
2 Spread and date of key legal documents presently used in formal cooperation on STTs and evidence of informal cooperation: to understand the basis for formal cooperation on STTs and whether there is evidence of informal cooperation;
3 Extent and frequency of key factors that contributed to the conclusion of formal cooperation on STTs: to understand what main and recurrent factors contributed to emergence of formal cooperation on STTs;
4 List of actors that are crucial for formal cooperation on STTs: to identify actors who are key for initiating and sustaining formal cooperation on STTs;
5 Factors hindering cooperation on STTs: to comprehend key factors that are perceived as barriers for cooperation stratified by country.

3 Results

3.1 Length of respondent's employment in the field of water management and type of their involvement in the decision making in STTs (directly, indirectly)

Interviewed experts possessed lengthy experience in water management. The average work experience of interviewed

3 The highest level in Uzbekistan is the Water Ministry while in the Kyrgyz Republic it is the Water Department.

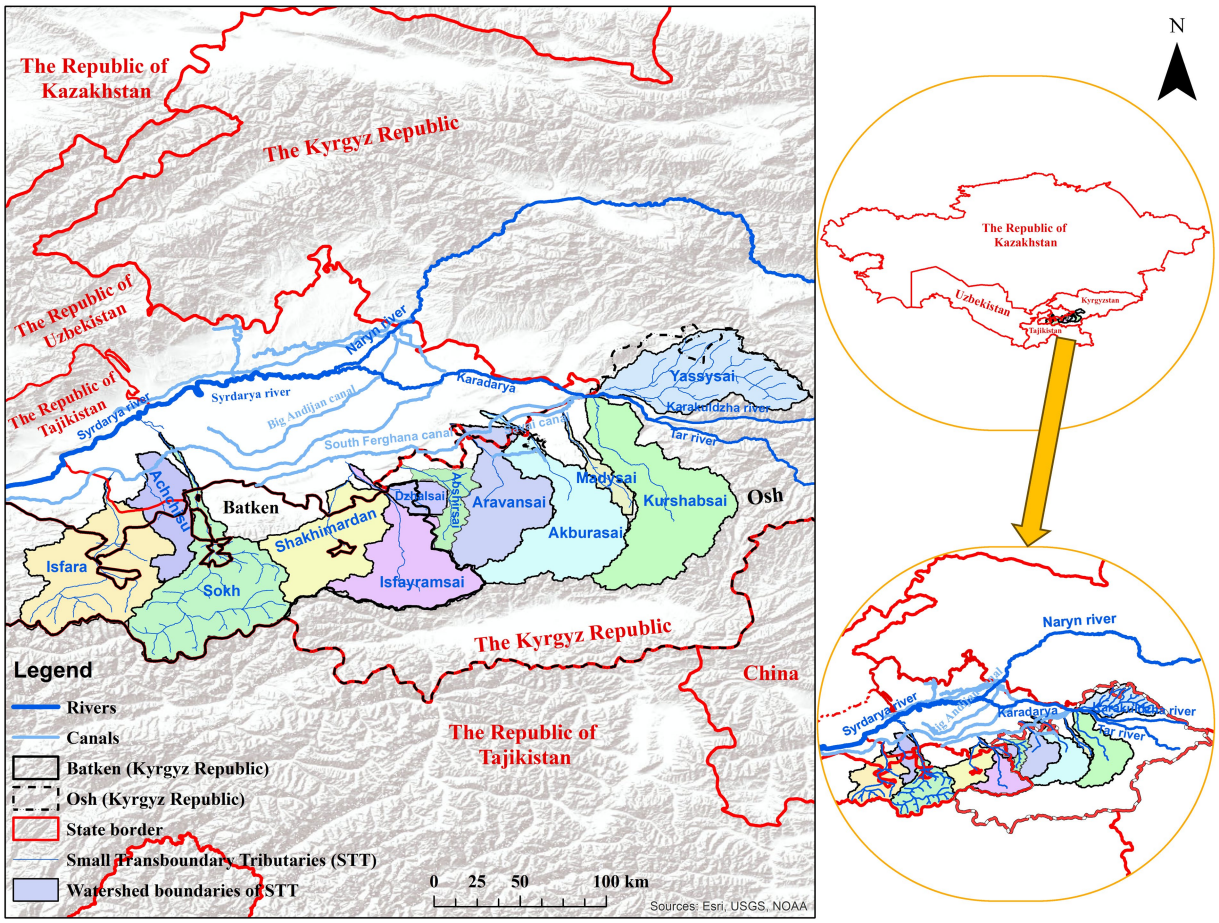

FIGURE 2
Map of STTs shared between Batken and Osh provinces of Kyrgyzstan and Andijan and Ferghana provinces of Uzbekistan. STTs located outside the four selected provinces are not shown for better visualization. Source: Authors compilation.

specialists was 30 years. Comparatively speaking, interviewed water management specialists from the Kyrgyz Republic worked in the field longer, on average 34 years while those in Uzbekistan worked on average 27 years (Figure 3). The longest serving water management specialist interviewed in this work was from the Kyrgyz Republic had 48 years of experience. In contrast, a water management specialist with the least number of years working in water management from Uzbekistan brought 12 years of experience at the time of interview.

The majority of interviewed experts were involved in decision-making. Twelve interviewees (60%) stated that they were directly involved in STT level water management negotiations or decision-making. This ratio stayed the same for the Kyrgyz Republic (6 interviewees) and Uzbekistan (6 interviewees). Even some junior water management specialists indicated that they have been directly involved in STT level water management negotiations, suggesting that the negotiation process is very much alive and ongoing. Eight respondents (40%) who were not directly involved in STT level decision-making stated that they either participate in internal discussions and advise peers as necessary (four respondents), did not provide further clarification (two respondents) or stated that they are more of a technician (one respondent).

3.2 Spread and date of key legal documents presently used in formal cooperation on STTs and evidence of informal cooperation

Formal cooperation exists in nine tributaries. Three legal documents, applying up to nine tributaries, are used in formal cooperation. Although five respondents stated that they are aware of other documents, they only provided years and names of STTs as opposed to the actual titles of documents and locating them proved to be ambiguous or impossible. The most mentioned protocol was the *Protocol on the Interstate Allocation of Ferghana Valley's Small Rivers' Flows*. The latter protocol specifies volumetric as well as proportional water allocations for 9 Ferghana Valley STTs for irrigation (Table 2). It was mentioned by seven (35%) respondents, two from the Kyrgyz Republic and five from Uzbekistan.

The second most mentioned protocol was from 1981 "*Protocol on decadal water allocation in Sokh, Shakhimardan, and Isfayram between the Uzbek and Kyrgyz SSR*." This document was referenced by 3 (15%) interviewees, two from the Kyrgyz Republic and one from Uzbekistan. This protocol specifically focuses on three STTs and specifies decadal, percentage-based (proportional) water allocation for the vegetation period. The preamble states "In accordance with the Protocol on the

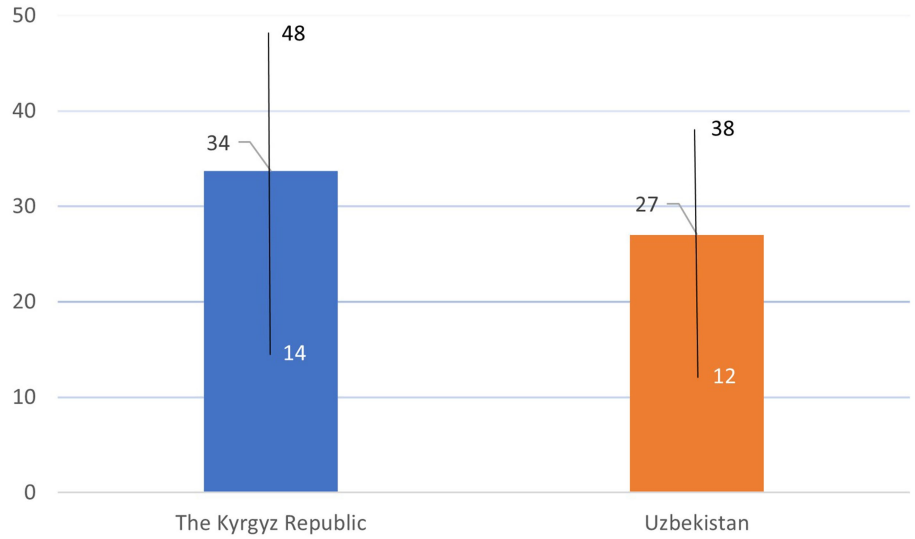

FIGURE 3
Average length respondents worked in water management. The error bars indicate the upper and lower range of respondents who worked the longest and shortest. Source: Authors compilation.

TABLE 2 Key legal documents used in formal cooperation in STTs.

Date	Title	Referenced STTs	Times referenced
April 10–11, 1980	Protocol on the Interstate Allocation of Ferghana Valley's Small Rivers' Flows	Akbura, Aravansai, Isfayramsai, Shakhimardansai, Sokh, Isfara, Maylisai, Padsha-ata, Kasansai	7
June 14, 1981	Protocol on decadal water allocation in Sokh, Shakhimardan, and Isfayram between the Uzbek and Kyrgyz SSR	Sokh, Shakhimardansai, Isfayramsai	3
August 28, 1989	Protocol of a technical meeting on solving water management issues between the State Committee for Water Resources of the Uzbek SSR and the Ministry of Water Resources of Kyrgyz SSR	Sokh, Padsha-ata, Kasansai, Maylisai	2

Interstate Allocation of Ferghana Valley's Small Rivers' Flows from 10 April 1980, approved by the Water Resources Ministry of USSR on 11 April 1980, the meeting considered proposals presented by the Water Resources Ministries of the Kyrgyz and Uzbek republics on decadal, percentage-based allocation of river flows from Sokh, Shakhimardan and Isfayramsai." This shows that the 1981 protocol further fine-tuned water allocation for three out of nine original STTs mentioned in the 1980 protocol. The three STTs singled out in the 1981 protocol are shared between the Batken province of the Kyrgyz Republic and Ferghana province of Uzbekistan.

The third document that was referenced by more than one respondent was a protocol from 1989. When requested to clarify, respondents mentioned "a protocol from 1989 that covers Sokh and others." A protocol from 22 August, 1989 titled "*Protocol of a technical meeting on solving water management issues between the State Committee for Water Resources of the Uzbek SSR and the Ministry of Water Resources of Kyrgyz SSR*" mentions Sokh, Kasansai, Padsha-ata, and Maylisai STTs, but the supplement to the protocol only specifies decadal water allocation for the Sokh STT for the vegetation period.

In total, 17 respondents (85%) confirmed presence and practice of informal cooperation, all respondents from Uzbekistan and seven respondents from the Kyrgyz Republic. Specifically, two respondents, one from the Kyrgyz Republic and one from Uzbekistan, mentioned existence of oral agreements from 1991, 2001 and from 2003 to 2004 but could not describe the scope and breadth of such oral agreements. The main reason for informal cooperation presented by the respondents was to solve operational issues. Some of the examples were the need to solve ad-hoc issues, such as cooperation during extreme events, water allocation discussions during low flows in the early irrigation period (or in hot weather/low flow years), need to cross border, etc. According to respondents, informal cooperation is common, but it is to solve small deviations or issues. Converting it into a formal cooperation is not easy because water specialists involved in informal cooperation are low in the hierarchy and do not have power to formalize informal cooperation practices.

3.3 Extent and frequency of key factors that contributed to the conclusion of formal cooperation on STTs

Nine respondents (45%) suggested that increased water demand due to expansion of irrigated areas (e.g., new land reclamation) as the main reason for commencement of formal cooperation on STTs (Figure 4). When providing context one

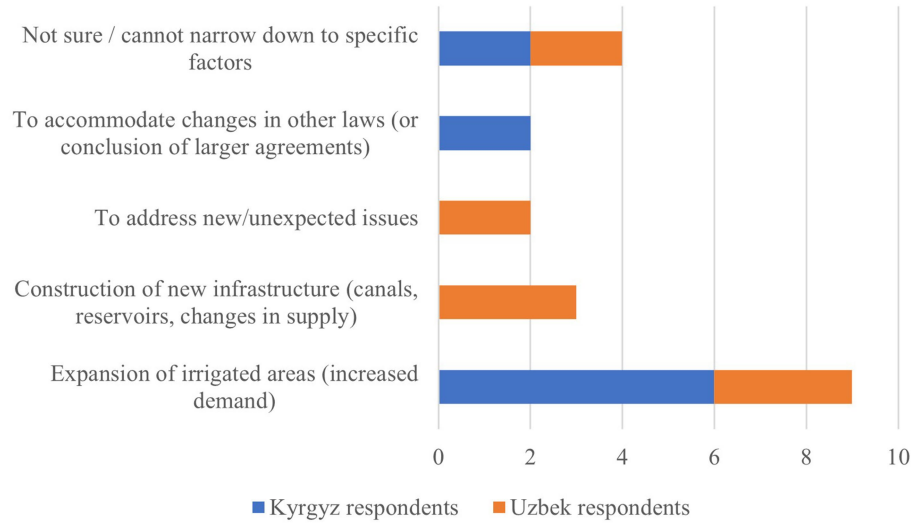

FIGURE 4
List of factors, identified by the respondents, that drove the conclusion of the first and subsequent agreements.

respondent from the Kyrgyz Republic explained that from about 1949 corn lands changed to cotton & tobacco in the Kyrgyz Republic while Uzbekistan saw expansion of cotton lands which affected water demand. Another respondent from Uzbekistan explained "1980 was a water shortage year, so the main factor was to have enough water for irrigation…" because "expansion of new lands led to higher water demand." Another respondent from the Kyrgyz Republic explained that protocols were agreed on to ensure that the state plan of the Soviet Union (*Gosplan*) for important crops (e.g., cotton) would be met. It was a result of the top-down intervention by the Soviet state to ensure that the government's interests are satisfied rather than a good-willed agreement.

The second main factor mentioned by the respondents was *construction of new infrastructure* (canals, reservoirs). It was mentioned by 3 (15%) respondents, all from Uzbekistan. For instance, one respondent from Uzbekistan stated that emergence of the protocol from 1980 was linked to the construction of the Andijan reservoir that changed water allocation arrangements. Indeed, the preamble of the 1980 protocol explicitly states: "*water allocation of rivers in the Ferghana Valley is currently being carried out without taking into account the water management measures implemented in recent years, with the most significant being the commissioning of the Toktogul and Andijan reservoirs*."

The next two factors that were mentioned by more than one respondent were: *to address new or unexpected challenges*, and *to accommodate changes in other laws*. According to one respondent, new or unexpected challenges do not mean that the challenges had to be necessarily on rivers themselves but did not elaborate on specific examples. With regards to accommodating changes in other laws, a respondent from the Kyrgyz Republic clarified that as cooperation became easier, older agreements could be expanded by concluding larger and more comprehensive agreements (i.e., covering more STTs) because the two sides built up experience. Four respondents (20%) could not narrow down their responses to a list of specific factors or simply did not know because the process occurred before their time.

3.4 List of actors that are crucial for formal cooperation on STTs

Regarding the list of key actors, water management specialists were mentioned as the most crucial actors for formalizing cooperation on STTs by all respondents (Table 3). Representatives from the Ministry of Agriculture were identified as the next tier of crucial actors, mentioned by seven (35%) respondents, four from the Kyrgyz Republic and three from Uzbekistan. Local government representatives (mayors, governors) were mentioned by four (20%) respondents, two of the respondents were from the Kyrgyz Republic and two from Uzbekistan. Interestingly, local government representatives were also identified, by two responders (10%), as actors who should be excluded from the cooperation. Two respondents (10%) one from the Kyrgyz Republic and one from Uzbekistan mentioned a representative from the presidential administration as an important player.

Analysis of the responses suggests a country-line divide on who else is viewed as important with some actors being viewed as important but exclusively by the representatives of one country. For instance, importance of involving a prime minister was mentioned by four respondents (20%) but all from Uzbekistan. Other key players exclusively mentioned by respondents from Uzbekistan were ministry of energy, ministry of emergency situation, basin authority, security forces, and standing working group members. The list of crucial players exclusively mentioned by respondents from the Kyrgyz Republic were ministry of foreign affairs, Interstate Commission for Water Coordination (ICWC), academia, civil society, and representatives of other relevant (unspecified) ministries.

3.5 Factors hindering cooperation on STTs

Although *border demarcation* was identified as the main factor hindering cooperation on STTs mentioned by seven (35%) respondents, five of the responses came from the Uzbek

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TABLE 3 Actors identified as critical for concluding formal agreements.

Key actor (affiliations)	According to		Total mentions
	Kyrgyz	Uzbek	
Water	10	10	20 (100%)
Agriculture	4	3	7 (35%)
Local government	2	2	4 (20%)
Nature/Ecology	1	2	3 (15%)
Presidential administration	1	1	2 (10%)
Ministry of Foreign Affairs	1	–	1 (5%)
International Center for Water Cooperation	1	–	1 (5%)
Academia	1	–	1 (5%)
Civil society	1	–	1 (5%)
Other relevant ministries	1	–	1 (5%)
Prime Minister	–	4	4 (20%)
Ministry of Energy	–	1	1 (5%)
Ministry of Emergency Situations	–	1	1 (5%)
Security forces (i.e., border control)	–	1	1 (5%)
Basin authority	–	1	1 (5%)
Standing working group members	–	1	1 (5%)

The total adds up to more than 100% because respondents mentioned more than one key actor.

TABLE 4 Factors hindering cooperation according to respondents.

Factors	Stated by		Total mentions
	Kyrgyz	Uzbek	
Border demarcation	2	5	7 (35%)
Lack of funds (e.g., cost of water)	4	2	6 (30%)
Lack of political will	5	1	6 (30%)
Lack of internal coordination	1	0	1 (5%)
Lack of specialists	1	0	1 (5%)
No response		3	3 (15%)

The total adds up to more than 20 (100%) because some respondents identified two or more factors.

representatives (Table 4). As one of the respondents from Uzbekistan put it, "we simply struggle to cross our equipment to the Kyrgyz side to help with the maintenance of water infrastructure" while another one clarified that the STTs "pass through remote areas close to the border and working in those areas is very challenging." The main factor hindering cooperation on STTs according to the greatest number of respondents from the Kyrgyz Republic is *lack of political will*, mentioned by five Kyrgyz respondents and only one Uzbek respondent. According to respondents, lack of political will is manifested as the issue not being perceived as important. As one respondent from the Kyrgyz Republic put it, "leaders need to agree to make compromises instead of winning." Another large issue appears to be the *perceived value of water*, which is basically free in the region and prevents generating funds to support infrastructure exploitation and maintenance. This was mentioned by a total of six respondents (30%), four from the Kyrgyz Republic and two from Uzbekistan. Two respondents (one from the Kyrgyz Republic and one from Uzbekistan) mentioned that the cost of water is cheaper in Uzbekistan, which leads to mismanagement of the resource.

Two responses mentioned by respondents from the Kyrgyz Republic were relatively unique. One of them stated the *lack of internal coordination*, explained as a situation where water needs and supply issues within countries are unresolved. For instance, when water managers do not have information on how much land will be used for agriculture or what will be sowed, they cannot properly plan ahead. A reactive rather than a proactive approach to managing water resources has become more habitual in the region. So, coordination between water managers and largest users like agriculture is lacking. Another respondent from the Kyrgyz Republic mentioned lack of new-generation water experts. According to him, in most cases, local water managers across borders know each other well, are friendly and cooperating. However, if the situation changes like retirement or relocation of water managers then the situation may deteriorate. Three respondents from Uzbekistan struggled to identify any hindering factors.

4 Discussion

Despite substantial effort to expand tributary-level cooperation in Syr Darya sub-basins, completion of agreements has often proved elusive. Moreover, identification of factors that can drive or constrain efforts to advance cooperation, a key tool to address the issue, is scantly explored. This paper sought to identify factors that can be used to accelerate progress, to realize more cooperation and reap its benefits.

The main findings from this paper to understand lack of cooperation in Ferghana Valley STTs are: (1) the main drivers of formal cooperation in the STTs were the expansion of irrigated lands & construction of infrastructure; (2) factors hindering present-day cooperation are the border demarcation issues, lack of political will, (low) cost of water, and lack of internal coordination; (3) the key actors for formal cooperation are the water and agriculture specialists; (4) cooperation in many STTs involves and interplay of formal and informal processes, and this interplay should be harnessed to advance cooperation; (5) existing formal cooperation agreements are not adequate to address present-day challenges because they do not account for changes in supply and demand conditions.

4.1 Construction of infrastructure to support irrigation expansion was a key driver of cooperation—in the past

In previous decades, a key driver for formal cooperation in the STTs was the expansion of irrigated lands & construction of infrastructure. This is consistent with the findings of Pak and Wegerich (2014) and Pak et al. (2014), who describe how construction of several

reservoirs in the 1970s changed water allocations within some STTs necessitating Uzbek and Tajik SSRs to build pump stations to transfer water between different sources (canal to river, reservoir to canal, etc.) The resulting competition necessitated Kyrgyzstan to request Moscow's help in mediating water-sharing negotiations which resulted in water sharing agreements like the protocol of 1980. Even recently, the observed land swap between the Kyrgyz Republic and Uzbekistan in 2022, confirms that water infrastructure and the need to irrigate new lands can still motivate agreements between countries. That said, given the growing water scarcity in water for irrigation, it is also fair to question whether infrastructure for other sectors—such as energy—may increasingly drive cooperation going forward. For example, there is increasing attention to integrating small-scale hydropower in water management that help generate additional benefits for the local communities around the STTs (Hydro4U, 2024). Likewise, given climate changes and increasing variability in water availability, the role of storage in shared tributaries may be an increasing driver of cooperative agreements. An integrated water storage framework that combines built and natural storage may indeed encourage countries to work together and help alleviate tensions in the STTs covered in this study (Holmatov et al., 2023).

4.2 Factors hindering regional level cooperation are also applicable to the STTs

Factors hindering present-day cooperation at the STT level identified in this study are (1) the border demarcation issues, (2) lack of political will, (3) low cost of water, and (4) lack of internal coordination. These factors are not surprising and were mentioned previously in other studies examining cooperation at various scales in Central Asia., e.g., link between border demarcation issues and STT level cooperation (Pak et al., 2014; Soliev et al., 2015; Wegerich et al., 2012a), lack of political will for the cooperation at the regional level (Khasanova, 2017; McKinney, 2004), link between (low) cost of water as in compensation for water releases by the upstream countries during the vegetation period, and lack of internal coordination as in lack of inter-sectoral policy coherence (Pohl et al., 2017). However, the relevance of these factors (except for the border demarcation) to the limited STT level cooperation was not always clearly established.[4]

Part of the reason for unclear linkages between cooperative barriers to the STT scale, in turn, is the sheer complexity of underlying issues. For example, cost of water in Central Asia is closely linked to (a) cost of water services at the country scale (Orazaliev et al., 2024) and (b) cost of hydropower production at the regional scale, e.g., downstream compensating upstream countries for foregone electricity production opportunity (Pohl et al., 2017, p. 8). Thus, addressing the low cost of water issue would entail thinking bigger and tackling interlinked (nexus) challenges across different sectors, a process that will likely take some time, although the new Water Code of Kyrgyzstan (comes into force on January 1, 2026) aims to tackle perceived low cost of water by recognizing it as a commodity and seek payments for its use from the neighboring countries (Frank.uz, 2025) which worries the downstream countries like Uzbekistan. Similarly, lack of internal coordination between sectors is a major hurdle for proper planning linked to lack of an internal mechanism for using proper foresight tools, planning, and exchange of information between sectors. The available socio-economic data within the administrative boundaries do not align with the hydrographic boundaries. The informational gap creates conditions that complicate the work of water specialists who must negotiate water allocation without having good baseline data on the water requirements in their respective countries.

4.3 Soviet-era institutional memory still guides current expectations

The list of actors identified as key for formal cooperation shows the strong influence of participants institutional memory. In the absence of alternative experiences, the list of key actors identified by the respondents skew toward actors that were key in negotiations in the Soviet period. For instance, the protocol from 1980 involved only representatives from the water ministries, water specialist from "Soyuzvodproyekt" (Soviet water project), and a representative from the "Sredazgiprovodhlopok" institute. In protocols from 1981 and 1989 water and agriculture specialists were key. Our results indicate that the water specialists are still considered key actors by all respondents, followed by the agriculture specialists identified by more than a third of respondents. A fifth or less of respondents identify other actors as important or relevant and interestingly only one respondent identified the energy ministry as a key actor despite the complex water-food-energy nexus arrangement at the full Syrdarya river basin scale. Protocols from the 1980s listed only a small group of like-minded specialists, without the involvement of foreign ministry or other ministries who may think of larger state's interests. In this sense, unlike today, decisions regarding water cooperation during the Soviet period were made by a smaller group of people who had the data and information on the topic and whose work was directly impacted by their decisions. However, the interests and approaches in STTs changed from monocentric to polycentric (Wegerich et al., 2012b), meaning that Moscow's role in prioritizing and ensuring sufficient water supply for irrigation is replaced by pursuit of multiple self-interests (Pohl et al., 2017). Even so, choice of actors considered key for cooperation and recorded persistence of water cooperation at the STT level even during challenging political times suggests strong Soviet path dependence.

4.4 Informal cooperation can be built on

Confirming previous findings (Pak et al., 2014; Wegerich et al., 2012a), both formal and informal cooperation in some STTs appears to be alive. Formal cooperation or agreements identified in this study explicitly reference six (i.e., Akburasai, Aranvansai, Isfayramsai, Shakhimardansai, Sokh, and Isfara) out of twelve STTs shared between the four focused provinces, meaning that the state of formal cooperation on the remaining six STTs is ambiguous. This also has implications for informal cooperation. Some previous studies

4 The first two factors were recently addressed by an agreement between the Kyrgyz Republic and Uzbekistan on joint management of the Andijan (Kempirabat) reservoir (FAOLEX, 2023) which involved swapping lands between the two countries. The agreement demonstrated the political will of the countries to solve water issues.

mentioned existence of oral agreements (Soliev et al., 2015; Wegerich et al., 2012b), for instance, Wegerich et al. (2012b) writes that in 2001, "the ministries of Uzbekistan and Kyrgyzstan met and agreed orally to share equally all the STTs on the left side the Ferghana Valley (including Shakhimardan River)." As stated by the interviewees, such informal cooperation is not expansive enough and is used to solve operational, ad-hoc issues and is not a replacement for formal cooperation. Nonetheless, this informal cooperation can be strengthened and codified into formal cooperation—building on these experiences may be far more efficient than starting from zero.

4.5 Past cooperation catalysts need to be adapted to motivate cooperation that responds to emerging issues

Ferghana valley is changing rapidly. The population in the Ferghana Valley, the most densely populated region in Central Asia, increased by more than 30% in the first decade of the 21st century alone (CGIAR, 2013). Between the 1980s and 2010s, sown area increased from circa 1.5 million ha in 1985 to 1.7 million ha in 2010s (Kenjabaev and Frede, 2016). From the supply side, glaciers in Central Asia are melting at a rate of 0.2–1% per year (Stucker et al., 2012) and the projected decrease in summer river runoff in small tributaries of Ferghana Valley is expected to reach 12–42% for the period 2071–2,100 (Radchenko et al., 2017). As the precipitation patterns change, the likelihood and severity of extreme events will likely increase as well. Moreover, importance of addressing transboundary water pollution is increasing in the region. Ultimately, the region will need new or updated agreements that respond to these new realities. Just as the potential to share the increased benefits from irrigation and infrastructure motivated cooperation in the past, it may motivate countries to secure the increased benefits that emerge from joint management of increasingly variable water supplies—unlike the benefits of irrigation which can be directly visible however, there may be need to sensitize decision-makers on the less visible benefits of joint management of shared resources.

4.6 Future work

In this study, we limited our focus to political stakeholder analysis with a very limited consideration of structural factors that also influence cooperation in STTs. A first avenue of further investigation would be to conduct a full PE analysis covering structural elements to understand the state and practice of cooperation in all STTs, even when not covered by formal agreements that can reveal additional clues, lessons and challenges that are not captured by the current study. Second, we only focused on STTs shared between the Kyrgyz Republic and Uzbekistan and identified that the existing formal cooperation only covers some STTs. Future investigation could expand focus to STTs involving Tajikistan or STTs where the circumstance may be very different from those identified in the current study. Third, key to application of our approach were stakeholder interviews and the water management specialists were selected as key stakeholders because they directly manage STT resources (with some interviewees also being specialists in irrigation/agriculture). Future efforts may build on this assessment by broadening the sectoral backgrounds of those interviewed, involving specialists from un-represented groups, and capturing interviewee features that may have influenced their responses.

5 Conclusion

Ferghana Valley is the most densely populated area in Central Asia where dozens of STTs, shared between two or more countries, are considered crucial for local livelihoods. We identified drivers and constraints that affect the advancement of formal cooperation in select number of STTs shared between Osh province of the Kyrgyz Republic and Andijan province of Uzbekistan, and Batken province of the Kyrgyz Republic and Ferghana province of Uzbekistan. Through a combination of semi-structured interviews and document investigation we identified that expansion of irrigated lands and construction of water infrastructure served as the main drivers of formal cooperation while barriers to cooperation relate to border demarcation, lack of political will, low cost of water, and lack of internal (intra-sectoral) coordination. Actors identified as key to enabling formal water cooperation are water and agriculture specialists. Informal cooperation is expansive enough to replace formal agreements. And last, existing formal cooperation agreements are not fit to address present-day challenges.

Based on these findings, we propose three concrete recommendations to strengthen cooperation in STTs within the Ferghana Valley: (1) enhance intra-sectoral coordination, planning and information exchange; (2) stimulate appreciation of the benefits of water cooperation in order to enhance political will; (3) ensure non-water issues such as border delineation are resolved before discussions are initiated; otherwise, water cooperation efforts may be continually undermined. The recent warming of relations between the Kyrgyz Republic and Uzbekistan demonstrate that the political will is growing and with sufficient support to demonstrate benefits from intersectoral cooperation (e.g., data exchange platforms, foresight tools), integrated water storage, and exchange of experiences of cooperation from other regions can improve participation of countries in joint projects, an important step for cooperation. For instance, integrated water storage projects can help drive cooperation by helping build trust, addressing practical issues on the STTs, while expanding access to a limited resource.

Data availability statement

The datasets presented in this article are not readily available because of privacy concerns for the interviewees. Requests to access the datasets should be directed to Bunyod Holmatov, b.holmatov@cgiar.org.

Ethics statement

The studies involving humans were approved by International Water Management Institute's (IWMI) Research Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because the study opted for oral informed consent.

Author contributions

BH: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. JL: Conceptualization, Funding acquisition, Methodology, Supervision, Writing – original draft, Writing – review & editing. KD: Conceptualization, Project administration, Writing – original draft, Writing – review & editing. SK: Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declared that Generative AI was not used in the creation of this manuscript.

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