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RESEARCH ARTICLE



Mixing waters: stakeholder influence in transboundary water conflict and cooperation

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ABSTRACT

Understanding the factors that contribute to transboundary water conflict and cooperation is critical to improve governance and protect water resources. State interactions are shaped by multiple pressures and multi-scalar actors. This research assesses how local stakeholders influence the state through an analysis of power, water quality-related vulnerability and risk. Based on the findings, local stakeholders directly and indirectly support high-intensity cooperation over transboundary lakes and can foster low-intensity conflict to enable a greater representation of needs. Local actors also mutually influence state and international processes causing a multi-scalar impact and response to the states' transboundary water quality interactions.

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Transboundary lakes; water conflict; water cooperation; stakeholder influence; multi-scalar analysis

Introduction

International fresh waterbodies are a critical resource for millions of water users. More than 206 transboundary lake and reservoir basins support these global populations and provide necessary services including development and poverty reduction for basin communities (International Lake Environment Committee [ILEC] & United Nations Environment Programme [UNEP], 2016). Management of these lakes is critical to ensure that needs are met, but is complicated because they span the administrative boundaries of two or more states. As a result, shared lakes foster opportunities for cooperative and conflictive behaviour at all levels of scale that can alter the water security of basin populations.

A large body of literature has sought to understand the patterns of transboundary interactions, or the water conflict and cooperation occurring, to identify predictive indicators and enable interventions that foster positive cooperation between states. Several prevalent theories address how state dynamics affect interactions, arguing that states cooperate due to sufficient institutional capacity or positive historic relationships to absorb water stress (Wolf et al., 2003), hydro-hegemonic actors create conditions that foster cooperative or conflictive behaviour (Zeitoun & Warner, 2006), and that cooperation can be incentivized when the benefits of joint action outweigh its costs (Sadoff &

Grey, 2002). Other analyses focus on the intervening factors that can combine with other conditions to encompass elements of water use and stress, including the role of hydrologic infrastructure in exacerbating state dynamics (De Stefano et al., 2017). While the state is often the focus of these analyses, growing attention has been paid to the influence of alternate levels of scale, and in particular to the role of domestic actors (Denoon et al., 2020; Grünwald et al., 2020; Warner & Zawahri, 2012; Zawahri & Hensengerth, 2012).

Not only do domestic actors engage in transboundary interactions, but they also influence the water resource and pressure the state to act. A growing body of literature has assessed how non-state actors actively exert influence on the state. Domestic stakeholders, including non-governmental organizations and policy entrepreneurs, have been observed to hold influence as a result of their knowledge creation, perceived credibility, relationship to the government, capacity to mobilize the public and ability to build legitimacy (Denoon et al., 2020; Warner & Zawahri, 2012; Zawahri & Hensengerth, 2012). These groups can influence the state to alter its behaviour in a manner that creates cooperative conditions, ultimately achieving objectives that could not be influenced at the international level by other basin countries (Warner & Zawahri, 2012; Zawahri & Hensengerth, 2012). Other actors have deepened inter-state tensions by pressuring states to abide by environmental agreements or by attracting international attention through the domestic media (Sobol, 2006; Xie et al., 2018). Together these cases demonstrate the concrete ways in which domestic actors exhibit power; however, they do not assess the indirect and passive mechanisms of influence. Further, these studies do not fully overcome the 'territorial trap' and consider the heterogeneity of need and abilities in the domestic setting (Furlong, 2006). An assessment of distributional equity, or the benefits and costs of environmental governance amongst groups, can begin to fill these gaps by identifying the diverse experiences of water stress and the capacity of local actors to elevate concerns in the transboundary discourse. The role of domestic actors can be more comprehensively understood through this distributional lens.

Degrading water quality is a component of water stress that impacts every use of water and the health and livelihoods of basin communities (World Water Assessment Programme [WWAP], 2003). As a result, water quality impairments can challenge the ability of local actors to meet their basic needs and may motivate the desire to alter state behaviour. In transboundary lakes, water quality is often well-mixed and imparts similar impacts for all water users (ILEC & UNEP, 2016). However, although the impairments are shared, local actors experience water quality differently in their direct water security risk and ability to respond to those risks (Mancilla García, 2013; UNEP, 2006). Through analysing scalar dynamics in transboundary lake basins with water quality degradation, the varying needs of stakeholders can be more clearly identified in response to their agency, exposure and impact from degradation. Simultaneously, the complex influence of these factors can be understood to identify the role of domestic actors in the transboundary space. This research seeks to unpack the dynamics of local actor influence on state interactions by considering how the relative risk, vulnerability and power of local stakeholder groups directly and indirectly shape transboundary water conflict and cooperation over water quality. This analysis of multi-scalar relationships informs the broader understanding of state interactions that can be used to foster effective cooperation on transboundary lakes.

Materials and methods

To assess the impact of local actors on state interactions, this research evaluates the relationship between stakeholder analyses and events of state water conflict and cooperation in three transboundary lakes. The stakeholder analysis considers the distributional equity of interest and influence between local stakeholder groups leading up to each interaction, through the lenses of power (i.e., influence) and vulnerability and risk (i.e., interest). Within this framework, power represents the capacity to affect decision-making, vulnerability considers the ability to adapt to water quality impairments, and risk captures exposures and impacts, as detailed further in Appendix Tables A2–A4. The distinction between risk and vulnerability is made to separately analyse the biophysical impacts of water quality (Means, 1989) and the structural factors that influence the capacity to cope with water stress (Cardona, 2004). The transboundary water interactions are assessed between riparian states over an approximate 150-year history and are compared against stakeholder analyses to enable a temporal assessment of the evolution of state behaviour and intervening factors. The analysis is conducted as a desktop study of publicly available government documents, peer-reviewed literature, media and available datasets.

Methodology

Several transboundary interactions are assessed for each lake basin and are selected because they designate a shift in the extent of conflict and cooperation occurring, represent time periods that are relevant to water quality management or depict the current status of the basin. As a result, between five and seven transboundary interactions are assessed for each basin to provide a selection that centres on water quality and highlights events that shape inter-state relationships. Each interaction is identified and classified for its intensity of coexisting conflict and cooperation as based on the Transboundary Waters Interaction NexuS (TWINS) framework (see Table A1 in the Appendix) (Mirumachi, 2015).

In general, stakeholders are defined as any party that self-identifies as interested or impacted by the transboundary lake. Although stakeholders are diverse and can exist at multiple levels of scale, within the context of this study, five non-governmental, local stakeholder groups are considered in each basin to bound the analysis. These stakeholder groups are selected based on their representation of a large fraction of the population and frequent interactions with the lake. Stakeholder groups are then analysed for their relative power, vulnerability and risk based on specified metrics and multiple lines of evidence as outlined in Appendix Tables A2–A4. With equal weighting, the analysis of power considers the sources of influence including formal authority, resources, discursive legitimacy and state interest. Stakeholder risk broadly assesses the exposure pathways of drinking water ingestion, consumption of food (e.g., aquatic biota, crops and livestock), dermal contact and livelihood use. Finally, vulnerability incorporates elements of political ecology and environmental justice through analysis of regional development, economic, educational and political means of adaptation.

To assess the temporal distribution of stakeholder power, vulnerability and risk, each component of analysis is classified as high, medium or low based on the criteria specified in Appendix [Tables A2–A4](#). The classifications are assigned a numeric value between 1 and 3 to enable comparison between actors and across time periods. Limited resolution in values is selected to minimize any subjectivity or a false sense of accuracy that can accompany quantifying qualitative analyses. Therefore, the values are only used to identify the broad trends of stakeholder interest and influence, with inflection points at 6 and 9 to distinguish between generally low, medium and high total values.

By combining the stakeholder analysis with the TWINS framework, the complex relationships between local stakeholder distributions and state actions can be assessed, thus incorporating non-state actors without explicitly mapping their interactions (Grünwald et al., 2020). To avoid assumptions of causation, any identified patterns are compared against justifications in the reviewed literature. Alternate theories that explain motivation for state interactions are also considered for their applicability to the studied basins and the extent to which they engage in stakeholder processes. These theories highlight additional intervening factors that can engage with stakeholders to shape state interactions and include the influence of institutional capacity (Wolf et al., 2003), hydro-hegemony (Zeitoun & Warner, 2006), cost–benefit analysis (Sadoff & Grey, 2002), and international actors and ideologies. Finally, the reciprocal nature of interactions is interrogated to understand how transboundary processes affect stakeholder action. Together, these multiple perspectives provide a more comprehensive understanding of the scalar relationship between local stakeholders and state water conflict and cooperation.

Case studies

The case studies are selected from transboundary lake basins to control several factors in a most different case design and emphasize the role of domestic actors. Transboundary lakes are chosen because they minimize upstream–downstream dynamics, enabling water quality conditions to be more homogenous throughout the waterbody and removing a geographical power asymmetry in state interactions. Lakes are also selected because they have a greater physical proximity between inputs, actors and responses which supports a clearer analysis of scalar interactions that may be applied to other transboundary systems. Lake Titicaca, Lake Victoria and Lake Constance are assessed in this study because they had publicly identified water quality impacts that are well documented, are geographically diverse, have varying historic relationships and support large basin populations (greater than 1 million inhabitants). Each lake provides a unique context and history of water quality impacts that together, create a more robust analysis.

Lake Titicaca is a high-elevation lake in the Titicaca-Poopó-Desaguadero-Salar del Coipasa basin with riparian countries of Bolivia and Peru (referred to here as the Lake Titicaca basin). With approximately 3 million people living in the watershed, the lake has experienced a range of water quality impacts including eutrophic conditions, decreased fish stock, and duckweed as a result of mining activity and poorly treated wastewater effluents (Mamani-Salinas, 2013; Mancilla García, 2013; Martínez Gonzales & Zuleta Roncal, 2007; Williams, 2015; WWAP, 2003). These water quality impacts have

presented a public health risk, limited livelihoods related to the lake and decreased mobility on the water for a range of stakeholders including rural fishing and agricultural communities, urban areas, and the mining and tourism industries.

Lake Victoria is one of the African Great Lakes with riparian countries of Kenya, Tanzania and Uganda, and a basin population of more than 30 million inhabitants (UNEP, 2006). In the 1980s, Lake Victoria experienced widespread eutrophic conditions and a shift in the fish community that resulted in the domination of the Nile perch, loss of endemic species and subsequent decrease in fish stocks over the last 30 years (Muyodi et al., 2010; UNEP, 2006; Zilov, 2013). The lake has also been affected by the spread of the water hyacinth that limited lake access and propagated diseases during its sporadic outbreaks, as well as loading of metals, pesticides and pathogens (Machiwa, 2003; UNEP, 2006; Zilov, 2013). Urban areas, rural farmers, fishermen, and the mining and hydropower industries have been affected by these conditions and are considered in this analysis.

Finally, Lake Constance is an oligotrophic lake shared by the riparian countries of Austria, Germany and Switzerland. The lake, with a basin population of approximately 1.5 million, experienced nutrient loading that resulted in algal growth, greater fish density and threats to the lake's use as a drinking water source in the 1950s (ILEC, 2020; Petri, 2006; Scherer & Zumbusch, 2011). Concerns of contamination and shoreline damage caused by recreational boats has also affected the lake, and although measures were taken to address nutrient loading and boat emissions, the lake is still impacted by trace heavy metals, endocrine disruptors and pesticides (Blatter, 2001; Petri, 2006; Zilov, 2013). These varying conditions have impacted a range of stakeholders including municipalities, fishermen, environmentalists, recreational boaters and the tourism industry.

Results

Throughout the study period, high levels of cooperation were observed in each basin. Of the selected interactions, most were high intensity, ranging from the 'technical' to 'risk-taking' classification, with 'risk-taking' behaviour representing the greatest commitment to cooperative action. In each basin, one conflictive interaction was experienced that was 'politicized' or 'securitized/opportunized'. However, in each situation, the conflict was addressed and the intensity reverted to 'non-politicized', or the lowest intensity conflict, by the current time period. The selected interactions of each basin are presented in the TWINS framework in Figures 1–3. These interactions are also accompanied with a brief description in Tables 1–3, respectively.

Although stakeholder groups are analysed separately for their relative power, vulnerability and risk, the average and standard deviation of stakeholders in each basin is presented leading up to each studied interaction in Figures 4–6. Relevant events are also identified to highlight the influence of local stakeholder distributions on state interactions.

In general, stakeholder power, risk and vulnerability varied at each cooperative and conflictive intensity. Although particular thresholds that may have triggered patterns of conflict and cooperation are not observed, broad correlative patterns of stakeholder influence and their relation to state interactions can be identified and compared against additional lines of evidence. Other patterns can also be observed as generally, stakeholder power increased over time as a result of institutionalized participation in governance and context-specific increases in discursive legitimacy. Vulnerability also generally decreased

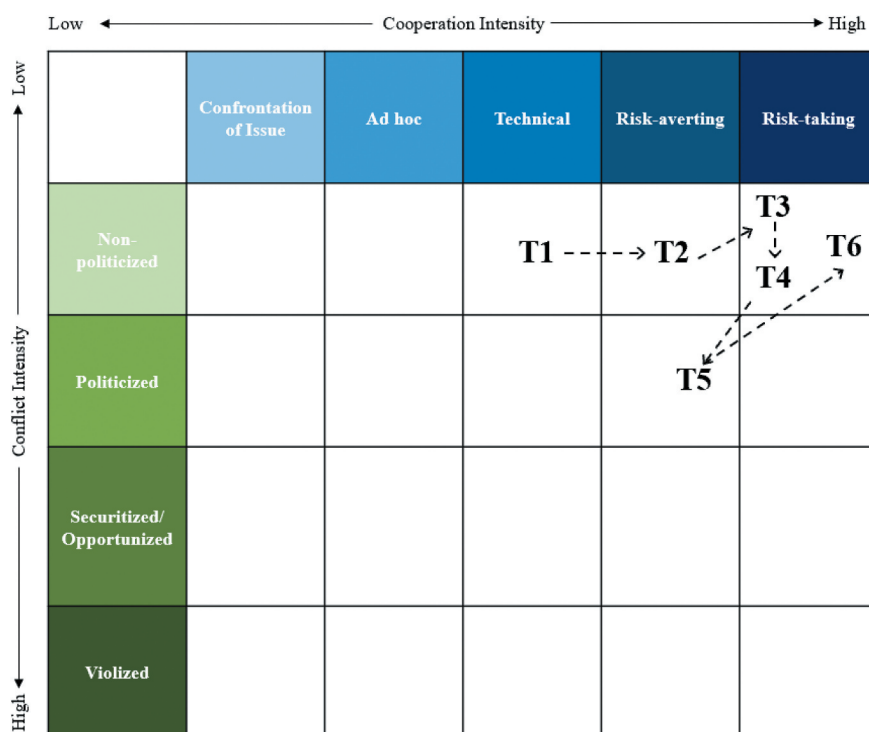


Figure 1. Transboundary water interactions of the Lake Titicaca basin.

Table 1. Description of transboundary water interactions of the Lake Titicaca basin.

Event	Description
T1	<i>1955-1957 Joint Ownership Agreement Signed</i> Bolivia and Peru signed an agreement to the 'indivisible and exclusive joint ownership' of the lake with the goal of fostering development without impacting navigation or fisheries (Priscoli & Wolf, 2010; Martínez Gonzales & Zuleta Roncal, 2007). The Peruvian government ratified the agreement in 1957, and Bolivia refrained from ratification due to 'internal criteria' (Mancilla García, 2013; Martínez Gonzales & Zuleta Roncal, 2007, p. 45).
T2	<i>1986 Ratification of the Agreement</i> Bolivia ratified the 1957 Convention in response to the severe drought and flood events; the convention came into force in 1987 (Priscoli & Wolf, 2010).
T3	<i>1996 Establishment of the ALT</i> The lake's transboundary management body, the Autonomous Binational Authority of Lake Titicaca (ALT), was established as an entity of public international law (WWAP, 2003). The ALT is autonomous in technical, administrative, and financial matters, can enforce regulations in the scope of the basin's Master Plan, and has an 'indefinite' duration (Mamani-Salinas, 2013; WWAP, 2003; Mosello, 2008; Martínez Gonzales & Zuleta Roncal, 2007, p. 62).
T4	<i>1997-1998 Ratification of RAMSAR</i> Peru and Bolivia designated their sides of the lake as Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR) sites in 1997 and 1998, respectively (Mancilla García, 2013). These acts provided a concrete commitment to environmental conservation, and as a byproduct, water quality (Mancilla García, 2013).
T5	<i>2009-2010 Withdrawal of Bolivian Support</i> Bolivian officials held concerns that the ALT was biased towards Peru at the same time that there were publicized tensions between the two countries regarding neoliberal mining policies (Mancilla García, 2013; AQ Editors, 2010). Bolivia withdrew funding from the ALT in 2009 in an attempt to force a restructuring of the organization (Mancilla García, 2013).
T6	<i>2016 Bi-national Commitment and Current Status</i> The riparian governments reformed the ALT in 2011 and committed \$500 million USD to improve the lake's biodiversity in 2016 (Varandani, 2016). Their efforts expanded their commitment to water quality, and the shared commitment to cooperation on the lake has been celebrated for preventing future conflict (Martínez Gonzales & Zuleta Roncal, 2007).

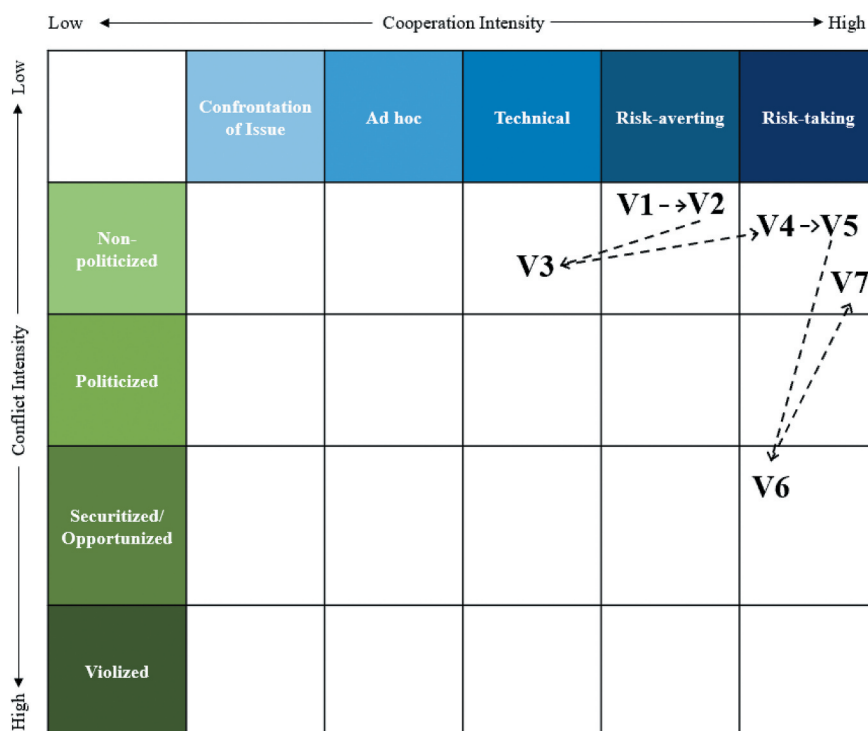


Figure 2. Transboundary water interactions of the Lake Victoria basin.

Table 2. Description of transboundary water interactions of the Lake Victoria basin.

Event	Description
V1	<i>1947 Initiation of the LVFS</i> The Lake Victoria Fisheries Service (LVFS) was established under the East African High Commission for the riparian countries to jointly collect data and manage fisheries (Muyodi et al., 2010; Kolding et al., 2014).
V2	<i>1973 Establishment of the LVFC</i> In spite of the LVFS dissolution in the 1960s, cooperation continued through the East African Fisheries Research Organization, and the Lake Victoria Fisheries Commission (LVFC) was established in 1973 to improve the standardization of fisheries data (Kolding et al., 2014; Muyodi et al., 2010).
V3	<i>1977 Collapse of the LVFC and EAC</i> Joint action between the three countries ceased with the collapse of the East African Community (EAC) in 1977, and any coordination over the lake was managed by the Food and Agriculture Organization (Muyodi et al., 2010; Lugo et al., 2014).
V4	<i>1994 Establishment of the LVFO and initiation of the LVEMP</i> The Lake Victoria Fisheries Organization (LVFO) was created through a signed convention as a legal, permanent entity with an independent budget and dispute resolution mechanisms (Wirkus & Böge, 2006; Zilov, 2013). The Lake Victoria Environmental Management Project (LVEMP) was also initiated to research and address environmental management of the lake (Wirkus & Böge, 2006; Kolding et al., 2014).
V5	<i>2003 Establishment of the LVBC</i> The EAC Council of Ministers established the Lake Victoria Basin Commission (LVBC; Lugo et al., 2014). The LVBC was established as the lead transboundary institution on the environmental governance of the lake, has binding dispute resolution with the East African Court of Justice, has a decision-making body, and is an implementing agent, thus enabling water quality to be a greater focus of joint institutions (Wirkus & Böge, 2006).
V6	<i>2008 Tensions between Uganda and Kenya</i> Tensions existed between Uganda and Kenya over territorial claims to Migingo Island (Atieno, 2014).
V7	<i>2020 Current Status</i> The states discussed Migingo Island in 2009 and were reported to have exhibited a high commitment to addressing water quality degradation in the basin (The World Bank, 2018).

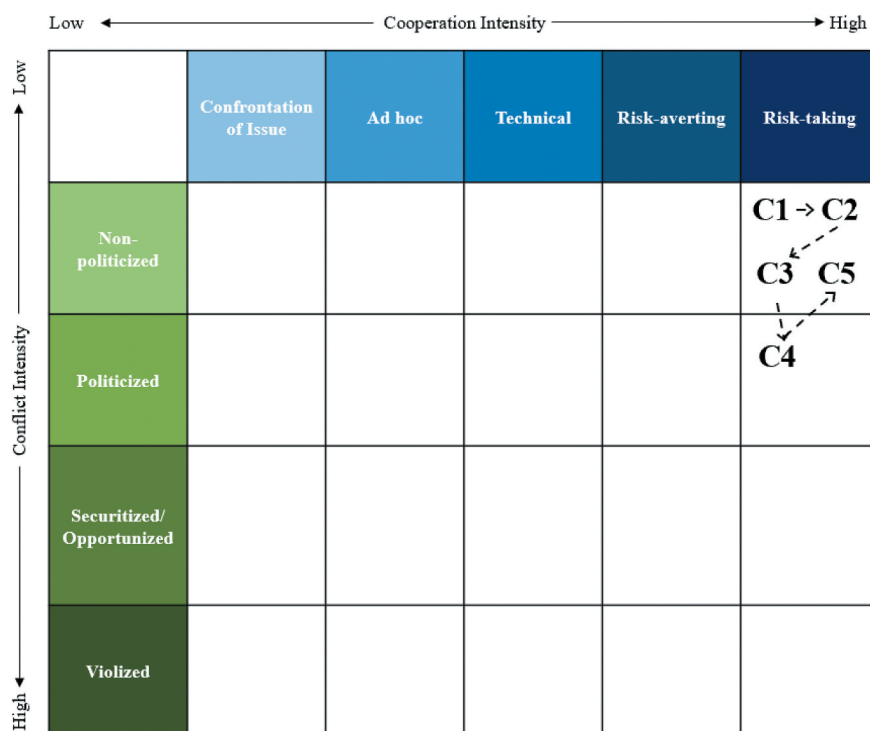


Figure 3. Transboundary water interactions of the Lake Constance basin.

Table 3. Description of transboundary water interactions of the Lake Constance basin.

Event	Description
C1	<i>1893 Establishment of the IBKF</i> The International Conference for Fishing at Lake Constance (IBKF) was established to promote sustainable fisheries development by the riparian countries (Scherer & Zumbusch, 2011; Schröder, 2005; Blatter, 2001). The participating countries are obliged to transform IBKF decisions into national law (Schröder, 2005).
C2	<i>1959 Formation of the IGKB</i> The International Commission for the Protection of Lake Constance (IGKB) was established to protect the lake from contamination and is considered to be the 'central authority' for the lake (Schröder, 2005; Blatter, 2001, p. 103).
C3	<i>1967 Establishment of Environmental Regulations</i> The IGKB published the first transboundary guidelines for pollution prevention (Schröder, 2005).
C4	<i>1991 Establishment of Emissions Regulations</i> After contentious negotiations were managed by different regulatory authorities, the three countries agreed on recreational boat exhaust regulations (Blatter, 2001). Before an agreement was reached, initial consensus on the rules was halted by a veto of a Swiss canton in 1984 (Blatter, 2001).
C5	<i>2020 Current Status</i> The IGKB is described as an amicable and increasingly informal transboundary organization due to high levels of trust (Blatter, 2001).

over time as a result of implementation of policies for environmental protection and increased development in the basins. Finally, risk generally increased in each basin until effective interventions were implemented. Although each event presents a range of distributions, variability of power and risk was greatest amongst stakeholder groups.

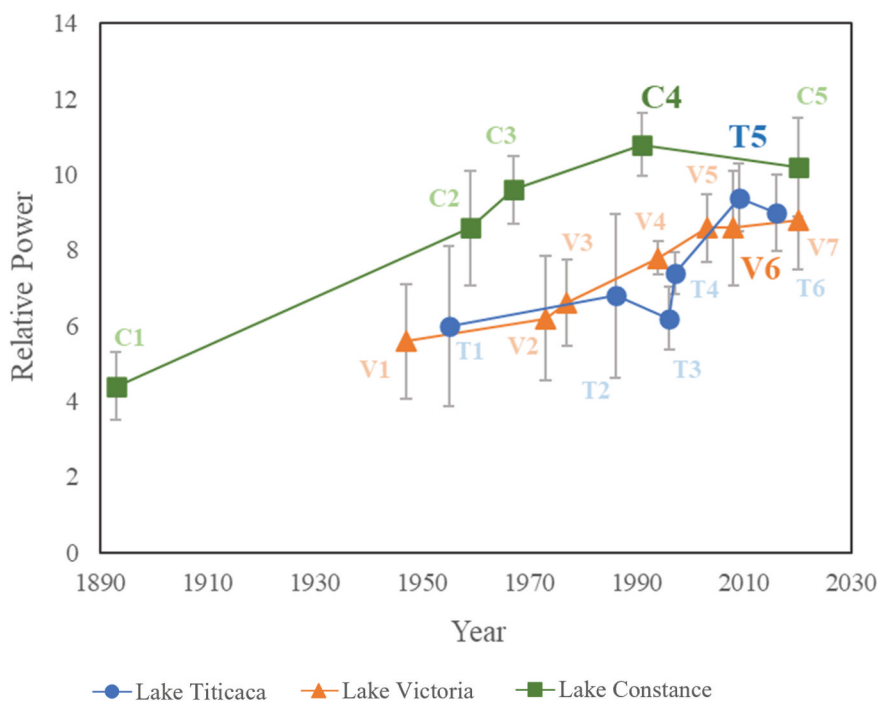


Figure 4. Relative average and standard deviations of stakeholder power in the lake basins leading up to each studied interaction. Note: Interactions with a conflict intensity greater than 'non-politicized' (T5, V6 and C4) are highlighted.

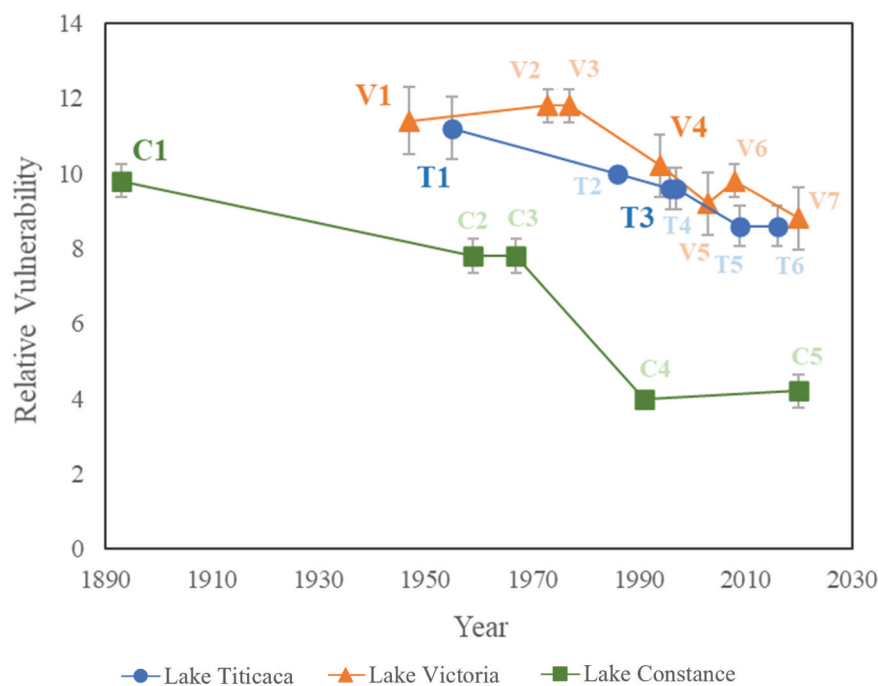


Figure 5. Relative average and standard deviations of stakeholder vulnerability in the lake basins leading up to each studied interaction. Note: The initiation of cooperation (T1, V1 and C1) and instances in which cooperation intensity first became 'risk-taking' (T1, T3 and T4) are highlighted.

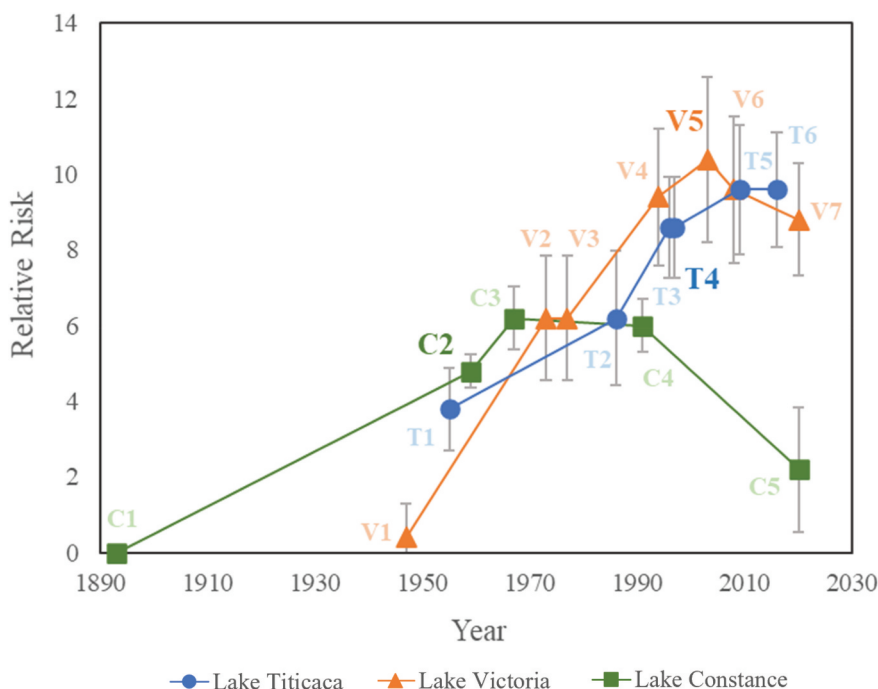


Figure 6. Relative average and standard deviations of stakeholder risk in the lake basins leading up to each studied interaction. Note: The events where ‘risk-taking’ cooperation over water quality were initiated (T4, V5 and C2) are highlighted.

Throughout the study periods, conflictive interactions are also observed at alternate levels of scale in all three basins. These conflicts ranged from ‘politicized’ to ‘violized’ and existed between stakeholder groups within the state and across state boundaries, between national divisions of the same stakeholder group, between stakeholders and the state, and within state governance.

Discussion

Influence on inter-state cooperation

High-intensity cooperation was observed between many of the states throughout the study period. Although not all states experienced institutionalized cooperation throughout the full study duration, the lowest-intensity cooperation observed was ‘technical’, or working towards the same goals without collaborative action. Based on the narrative of actions and corresponding distributions, local stakeholders likely influenced these patterns of cooperation in its initiation and evolution by their vulnerability, risk, power to drive a narrative and influence on alternate processes.

In all three case studies, cooperation was initiated based on the narrative of development (T1, V1 and C1). The countries expressed that cooperation was necessary to jointly develop the basin and largely, address economic vulnerability in the region (Lugo et al., 2014; Mancilla García, 2013; Orlove, 2002; Priscoli & Wolf, 2010; Schröder, 2005). These

time periods correspond with high average vulnerability of all stakeholders in the Lake Titicaca, Lake Victoria and Lake Constance basins. Additionally, in all three basins, the initiation of cooperation centred around fisheries. In the Lake Constance basin, this cooperation was in direct response to the economic vulnerability of fishermen in the 19th century (Schröder, 2005). In the Lake Titicaca and Lake Victoria basins, fisheries were likely the entry point of cooperation because they can renewably yield economic and social benefits for the broader population, including food security, without being bound by property rights (Bailey, 1988; Lugo et al., 2014). Thus, fisheries provided an opportunity to jointly broaden the benefits reaped from the waterbody without perceived losses when fish are abundant. Although these conditions make fisheries an ‘easy’ entry point of cooperation, the primary benefits of these early fisheries supported the domestic population, and thus presumably, states engaged in cooperation to directly address the vulnerability of local stakeholders.

Stakeholder vulnerability and risk may have further influenced the evolution of cooperation. High maintained stakeholder vulnerability in the Lake Titicaca and Lake Victoria basins likely encouraged states to engage in higher intensities of cooperation. Bolivia and Peru had made a commitment to joint development but had not fully ratified the agreement until natural disasters caused an economic downturn in the basin (Priscoli & Wolf, 2010). This economic impact was believed to have led Bolivia to ratify the agreement and initiate ‘risk-averting’ cooperation (T3), and thus respond to the economic vulnerability of basin stakeholders. In the Lake Victoria basin, the states had ceased collaborative action with the collapse of the East African Community (EAC) in 1977. However, high maintained vulnerability and its connection to the benefits of ‘sustainable development’ that were emphasized at the Rio Earth Summit in 1992, were believed to inspire the re-initiation of joint efforts (V4) (Muyodi et al., 2010). Based on these interpretations, the states in both instances responded to high maintained stakeholder vulnerability with a greater cooperation intensity, and as a result, stakeholders drove the states to commit to the institutionalization of cooperation through treaties and joint organizations.

High stakeholder risk also likely influenced the form of cooperation that occurred. In all three basins, increases in stakeholder risk corresponded with the institutionalization of cooperation over water quality through the establishment of joint organizations and expansion of mandates (T4, C2 and V5 for ‘risk-taking’ cooperation). Therefore, although high-intensity cooperation was already occurring in the basins, the states responded to high average stakeholder risk by engaging in ‘risk-taking’ cooperation over water quality, which expanded and created redundancy in the state interactions. Through this action, the states demonstrated their interest in addressing water quality concerns and decreasing risk for the basin communities. Notably, not every increase in risk yielded high-intensity cooperation over water quality. In the Lake Titicaca and Lake Victoria basins, cooperation over water quality did not occur until after the 1980s. This gap in response can be attributed to the manifestation of risk. In both basins, water quality degradation was not physically manifested through sight or odours until after a threshold of contamination had been reached. Therefore, risk awareness was required to enable states to respond to stakeholders’ needs.

Although the state responses to stakeholder distributions represent a passive influence of local actors, stakeholders also exerted voice and power to influence the state throughout the study period. Through active protests, participation in formal channels and generation and dissemination of data, stakeholders actively engaged in defining the narratives of cooperation that occurred. In the Lake Titicaca basin, protests over organic pollution spurred the binational authority to focus on addressing wastewater effluents (Mancilla García, 2013). Because protests were initiated by a powerful group during a politically sensitive time, these actions directed the narrative of cooperative projects at the exclusion of other contaminants in the basin. In the Lake Constance basin, powerful stakeholder groups disseminated information with regards to pollution from recreational boats, which ultimately led to the establishment of joint regulations (Blatter, 2001). While neither of these narratives altered the patterns of cooperation that were occurring, they bounded the way that the state viewed stakeholder concerns and shifted the implementation of cooperation. Therefore, beyond exhibiting power to foster cooperative acts, as observed in previous studies, local actors also framed how cooperation occurs (Warner & Zawahri, 2012).

While stakeholders played passive and active roles in encouraging state cooperation, alternate theories are also assessed for their applicability as potential intervening factors. Several well-known theories can supplement justification for the cooperative behaviour between states and apply to the studied basins to varying extents. Wolf et al. argue that states will cooperate when they have the institutional capacity or significant positive historic relationships to absorb stressors or changes to the system (Wolf et al., 2003). Most of the basins had positive historic relationships and pre-existing cooperation over fisheries prior to the initiation of cooperation over water quality. Sadoff and Grey suggest that states will cooperate when the benefits of cooperation outweigh the costs. In all basins, financial and diplomatic gains of cooperation can be reaped from addressing water quality, in part, because water quality is not an inherently a distributive issue (Sadoff & Grey, 2002). Other theories address the influence of international actors including global pressure, international donors and ideologies such as ‘sustainable development’ and the ‘Euroregion’ (Blatter, 2001; Furlong, 2006; Petersen-Perlman et al., 2017; Warner & Zawahri, 2012; Xie et al., 2018). These international ideologies were perceived to motivate greater engagement in cooperative activities in the Lake Constance and Lake Victoria basins, and international donors supported the continuation of cooperative activities in the Lake Victoria basin (Blatter, 2001; Godsäter, 2013; Muyodi et al., 2010). Therefore, pressures at the state and international scales also likely promoted the observed transboundary cooperation.

However, although these theories are valid and relevant to the case studies, they cannot be divorced from stakeholders. Positive historic relationships are often tied to a shared identity that derives from the local basin population, and stakeholder vulnerability likely supported the initiation of institutional capacity in the basins. Financial and diplomatic benefits also constitute benefits for local stakeholders in the reduction of vulnerability, and international actors similarly respond to local power, vulnerability and risk, such as through the perpetuation of the ‘sustainable development’ narrative. As a result, stakeholders not only influence the state through their own distributional

equity and actions, but also through how those elements tie to other factors of influence, creating a multi-scalar pressure on transboundary interactions to encourage cooperation.

Influence on inter-state conflict

In addition to shaping cooperation in the basin, local stakeholder distributions are also closely tied to the inter-state conflict observed. Although most of the studied interactions had limited, ‘non-politicized’ conflict, elevated conflict ranging from ‘politicized’ to ‘securitized/opportunized’ occurred at one instance in each of the three basins (T5, V6 and C4). These events coincided with high average power of basin stakeholders, and local actors were believed to play an important role in invoking and framing this state conflict through various pathways.

In the Lake Constance basin, sectoral conflict between stakeholder groups was elevated to the transboundary discourse. Concern over the environmental impacts of recreational boats caused the states to engage in low-intensity conflict over the establishment of emissions regulations, with Austria and Germany focusing on the lake’s use as a drinking water reservoir and Switzerland seeking to protect recreational boaters (Blatter, 2001; Scherer & Zumbusch, 2011). These positions closely aligned with the dominant interest of stakeholders in their respective states and corresponded with high stakeholder power, as most actors had access to the state through formal channels of lobbying and representation. Thus, stakeholders influenced sectoral representation in the decision-making process. In the case of the Lake Constance basin, stakeholders also framed the need to address the issue in the first place. The Syndicate of Waterworks in the Lake Constance-Rhine Region (AWBR) is a stakeholder organization that represents 77 municipalities in the basin area and had high power from both formal participation in the transboundary commission and its ability to distribute information that was perceived as legitimate (Blatter, 2001). With this power, the AWBR was able to frame and draw widespread attention to the chemical contamination from boats, in spite of limited evidence (Blatter, 2001). Therefore, high stakeholder power of individual groups was able to elevate an issue that was then addressed with low-intensity conflict as a result of high average stakeholder influence.

In the Lake Titicaca basin, local distrust appeared to be internalized at the level of the state. Stakeholders on both sides of the lake had experienced tension with the Autonomous Binational Authority of Lake Titicaca (ALT) attributed largely to a lack of transparency and limited participation. This distrust led to stakeholder resistance of the binational authority’s projects, especially within the Cohana region of Bolivia where local stakeholders had high power due to their status as focal points of the Bolivian presidential campaign. These acts added to concerns that the ALT focused primarily on Peru, leading the Bolivian government to temporarily limit funding and discuss restructuring (Mancilla García, 2013). Other stakeholder groups may also have contributed to the willingness to engage in conflict because at the same time, stakeholders were protesting in Peru over the state’s mining practices which were further criticized in public statements made by Bolivian head of state, President Evo Morales, and may have contributed to inter-state tensions (AQ Editors, 2010, January 5; Williams, 2015).

Therefore, in both instances, stakeholder power was exerted through protests on the state, which was likely internalized and supported the escalation of conflict between Bolivia and Peru.

Finally, in the Lake Victoria basin, conflict can be interpreted as a means to 'solve problems' for powerful actors. In the basin, there were concerns of the available fish stock, causing an uptick in violent conflict between fishermen and local authorities (UNEP, 2006). While overfishing is a component of the decrease in fish stock, it was compounded by degraded water quality. However, in spite of these multiple stressors, many institutions focused on overfishing as the dominant narrative of what was affecting fishermen during this time period (Ntiba et al., 2001). Fishermen were also powerful actors in the basin which elevated their concerns of fish stock and likely motivated Uganda to address concerns outside of the existing institutions. When Uganda moved to claim Migingo Island, this act would also claim territorial waters for fishing and alleviate some Ugandan fishermen's concerns (Atieno, 2014). Therefore, although stakeholders did not drive the narrative of the problem, the state appeared to respond with conflict to address the perceived needs of powerful stakeholders.

Other factors may also have also contributed to the conflict experienced in the studied basins including perceptions of power asymmetries in Lake Titicaca (Mancilla García, 2013; Zeitoun et al., 2014), a history of past conflict in Lake Victoria and the international ideology of the 'Euroregion' which encouraged states to address a contentious topic in Lake Constance (Blatter, 2001). These factors likely established conditions in which stakeholder power could influence states to engage in conflict. Additionally, high average levels of stakeholder risk corresponded with these conflict events, suggesting that risk may have also provided motivation for both domestic actors to exert influence and for the state to respond.

Influence on multi-scalar interactions

Stakeholder distributions influenced state interactions while mutually receiving influence from the patterns of transboundary conflict and cooperation that occurred. In general, stakeholder vulnerability likely led to basin development through inter-state cooperation. Development then caused increased anthropogenic inputs into the lake and eventually, increased risk. As risk increased, the states engaged in high-intensity cooperation over water quality, and the institutionalization of this cooperation created spaces for formal authority that increased stakeholder power. Thus, the stakeholder distributions of power, vulnerability and risk were not only determined by the actions of the states but were also indirectly compounded by the stakeholders themselves. While this evolution of distributions ultimately empowered stakeholders and enabled some elevation of needs, it did not inherently address these needs, maintaining prolonged periods of high stakeholder vulnerability that suggest that institutionalized actions were not effective at addressing water quality objectives.

Because needs were not met, stakeholders chose to participate in and react to governance. Thus, in spite of high-intensity state cooperation, conflict was displaced to and between multiple levels of scale. Conflict ranging from 'politicized' to 'violized' intensity was experienced by local actors to contest how water quality was managed and as a result of degradation. In response to existing management, stakeholders

participated in formal channels of representation and lobbying, shared information to sway public opinion and engaged in demonstrations and protests. Through these mechanisms, they highlighted concerns over water quality to both pressure the state to address the topic and to contest the management authority. Although not every method of intervention was successful in altering the behaviour of the state, these findings illustrate the multi-scalar patterns of conflict and ultimately suggest that when water quality is not effectively addressed by the state, conflict is experienced elsewhere. Furthermore, the displaced conflict was observed to be of higher intensity where formal channels of communication with the state did not exist. These conflicts occasionally led to violence and restricted stakeholders' capacity to meet their basic needs as exemplified in the violent confrontation between fishermen in Lake Victoria that was aggravated by water quality impacts (Atieno, 2014). Together these findings underscore the need for transboundary systems to be responsive to stakeholders and to create spaces for communication in order to decrease the intensity of conflict and resulting cost of participation for basin communities.

While the empowerment of stakeholders was observed to address these concerns in the case studies, it did have ramifications for the state. However, although high stakeholder power was correlated with inter-state conflict, high power neither necessitates that conflict will occur nor that the conflict is inherently negative. In all three basins, elevated conflict occurred only once in the studied interactions, was accompanied by high-intensity cooperation, and reverted to 'non-politicized' conflict in spite of maintained high levels of stakeholder power. This pattern suggests that stakeholders passively and actively elevate conflict to address their specific needs and following, participate in a more sustained cooperation. In the Migingo Island example, it could be argued that the elevation of tensions caused unnecessary harm; however, the course of action appeared to be shaped by the state's interpretation of the problem. Because the problem of fish stock was framed as distributive, the state likely chose to act in a distributive and conflictive manner. However, had the problem of fish stock been perceived as related to water quality, the state may have chosen to act collaboratively, thus enabling stakeholders' needs to be met in a more cooperative manner. Furthermore, ongoing stakeholder power can pressure the state to actively engage in the implementation of cooperation. For instance, in the Lake Titicaca basin, stakeholders have continued to exert high average power through protests. These events have not yielded conflict and instead encouraged the states to commit funding to address lake contamination (teleSUR/lgc-TP, 2016, January 10). As a result, high power of stakeholders can support commitments to transboundary cooperation.

These findings suggest that the empowerment of stakeholders through formal channels can decrease the intensity of conflict for local stakeholders and enable the states to address concerns through a structured and more cooperative manner. By empowering stakeholders, the states can be held accountable to address needs and enable a more sustained transboundary cooperation at all scales.

Applicability of the research

The analysis of the role of stakeholders in transboundary water interactions not only supports an understanding of factors that shape state interactions but also addresses the effectiveness of these interactions in addressing water quality through the lens of stakeholder risk and vulnerability. This dual relationship informs the exchange between levels of scale while also interrogating the implementation of transboundary institutions for how they affect domestic actors.

Through understanding this complex role of stakeholders in transboundary interactions, targeted interventions and management strategies to foster sustainable cooperation can be informed (De Stefano et al., 2017). For instance, by understanding transboundary elevation of stakeholder conflict and the top-down displacement of conflict, basins at risk can be identified and addressed to decrease conflict intensity and resolve tensions, such as through narrative framing and stakeholder empowerment. Additionally, states can use mechanisms of stakeholders' influence to foster greater intensity cooperation that can generate a wider range of benefits for both the stakeholders and the state. The acknowledgement of the multi-tiered stakeholders' influence on state actions underscores the need to pay greater attention to domestic communities when analysing and managing transboundary basins. By centring stakeholders in these processes, professionals can more effectively promote and predict fruitful interactions that serve the populations that they represent.

The stakeholder analysis further informs decision-making by emphasizing the needs of stakeholders. Through the consideration of power, vulnerability and risk, the framework enables a critical, multidisciplinary understanding of how stakeholders experience water quality. In doing so, the analysis serves as a mechanism to assess the local effectiveness of transboundary institutions in reducing vulnerability and risk for various stakeholders and highlights deficiencies to address in future interactions. The framework also demonstrates the extent that equity underlies state interactions. In understanding that cooperation cannot be sustained without equity, this tool can identify groups that are not being served by the current strategies and encourage states to engage with a broader diversity of needs (Zeitoun et al., 2014). Incorporation of these processes can help to reduce the amount of displaced conflict that occurs at local scales and minimize the domestic pressures that escalate conflict to the transboundary level.

The findings of this research can also support the prediction and understanding of ongoing local-transboundary dynamics in other lake basins. The common themes identified between the three case studies demonstrate the multifaceted influence that stakeholders exert on state interactions although influence may be limited based on status and systems of government. These findings are also useful for transboundary river and aquifer systems, given the mechanisms of influence and utility of a stakeholder-centred framework. However, analysis of transboundary rivers and aquifers must consider additional factors of interpretation as they may introduce greater diversity in the stakeholder groups and public awareness. Within the case studies, stakeholders in each group were assumed to have similar water quality experiences given the consistency of degradation, similarity of cultures and livelihoods, and similar geographically derived water use, independent of the state. These elements can vary substantially in river and aquifer basins that have a greater spatial extent and upstream–downstream dynamics that affect

water quality. Physical manifestations of water quality impacts may also be limited, given river flow and a lack of visibility in aquifers, preventing widespread risk awareness. Additionally, the location of states along rivers and aquifers introduce power dynamics that also pressure state action. Therefore, while the methods and findings may apply to transboundary rivers and aquifers, these nuances of context must be considered, and stakeholder groups must be defined with greater resolution to comprehensively understand the research implications.

Overall, the analysis of the role of local stakeholders in state interactions highlights the indirect and direct ways in which stakeholders influence the state and its engagement in transboundary water conflict and cooperation. By paying greater attention to stakeholders' needs through the analysis of power, vulnerability and risk, professionals can improve the states' ability to cooperate and effectively address water quality in transboundary systems while also minimizing the burdens of water degradation and conflict on the local community.

Conclusions

Local stakeholders have a vast array of channels through which they indirectly and directly influence the state. Their distributions of vulnerability and risk have likely prompted cooperation and the institutionalization of cooperation over water quality in transboundary lakes. High empowerment of stakeholders is also believed to have elevated local concerns to the transboundary discourse, initiating low levels of state conflict. Stakeholders have directly shaped these processes through driving narratives that bound interactions, active participation to elevate stakeholder voices, and the exercises of conflict that accompany needs not being addressed. Their influence has extended through their ties with simultaneous processes of institutional capacity, historic relationships, cost–benefit analyses and international actors. Stakeholder actions and experiences are similarly shaped by state and international actors that drive equity and reactions in positive feedback loops. Together these relationships create a fluidity of scale that pressures states to engage in high-intensity cooperation over transboundary water quality. This mixing of influence mimics water in the lakes, themselves, creating a blended context that overcomes notions of scalar actors to understand the multifaceted and interconnected nature of stakeholders' influence in transboundary processes.

By understanding the complex dynamics that tie local stakeholders to transboundary systems, patterns of transboundary water conflict and cooperation can be informed. The pathways of influence and role of distributional equity can provide predictive measures for other basins that enable interventions or improved decision-making. By centring stakeholders' experiences within these processes, states can better understand the effectiveness and equity of their interactions and can harness the local population to promote sustained cooperation over water resources. An active acknowledgement of the importance of stakeholders in transboundary interactions enables states to more comprehensively address shared water management challenges that benefit the state and reduce the vulnerability, risk and cost of contestation for its domestic populations.

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References

- AQ Editors. (2010, January 5). Bolivia launches harsh accusations against Peru. *Americas Quarterly*. <https://www.americasquarterly.org/blog/bolivia-launches-harsh-accusations-against-peru/>
- Arnstein, S. (1969). A Ladder of Citizen Participation. *Journal of American Institute of Planners*, 35 (4), 216–224. <https://doi.org/10.1080/01944366908977225>
- Atieno, O. E. (2014). *Environmental Scarcity and Trans-boundary Conflicts: The Case of Lake Victoria, 1994–2011* (R50/75459/2009) [Master’s thesis, University of Nairobi]. University of Nairobi Research Archive.
- Bailey, C. (1988). The political economy of fisheries development in the third world. *Agriculture and Human Values*, 5(1–2), 35–48. <https://doi.org/10.1007/BF02217175>
- Blatter, J. (2001). Lessons from Lake Constance: Ideas, institutions, and advocacy coalitions. In J. Blatter & H. Ingram (Eds.), *Reflections on water: New approaches to transboundary conflicts and cooperation* (pp. 89–122). Massachusetts Institute of Technology.
- Cardona, O. (2004). The need for rethinking the concepts of vulnerability and risk from a holistic perspective: A necessary review and criticism for effective risk management. In G. Bankoff, G. Frerks, & D. Hilhorst (Eds.), *Mapping vulnerability: Disasters, development and people* (pp. 37–51). Earthscan Publishers.
- Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003). Social Vulnerability to Environmental Hazards. *Social Sciences Quarterly*, 84(2), 242–261. <https://doi.org/10.1111/1540-6237.8402002>
- De Stefano, L., Petersen-Perlman, J. D., Sproles, E. A., Eynard, J., & Wolf, A. T. (2017). Assessment of transboundary river basins for potential hydro-political tensions. *Global Environmental Change*, 45, 35–46. <https://doi.org/10.1016/j.gloenvcha.2017.04.008>
- Denoon, R. T. P., Paisley, R. K., de Chaisemartin, M., & Henshaw, T. W. (2020). Engaging non-state actors in the negotiation and implementation of international watercourse agreements: Experiences and lessons learned from Canada. *Water International*, 45(4), 311–328. <https://doi.org/10.1080/02508060.2020.1734757>

- French, M., Alem, N., Edwards, S. J., Blanco Coariti, E., Cauthin, H., Hudson-Edwards, K. A., Luyckx, K., Quintanilla, J., & Sánchez Miranda, O. (2017). Community exposure and vulnerability to water quality and availability: A case study in the mining-affected Pazña Municipality, Lake Poopó Basin, Bolivian Altiplano. *Environmental Management*, 60(4), 555–573. <https://doi.org/10.1007/s00267-017-0893-5>
- Furlong, K. (2006). Hidden theories, troubled waters: International relations, the ‘territorial trap’, and the Southern African Development Community’s transboundary waters. *Political Geography*, 25(4), 438–458. <https://doi.org/10.1016/j.polgeo.2005.12.008>
- Godsäter, A. (2013). Regional environmental governance in the Lake Victoria region: The role of civil society. *African Studies*, 72(1), 64–85. <https://doi.org/10.1080/00020184.2013.776198>
- Grünwald, R., Feng, Y., & Wang, W. (2020). Reconceptualization of the Transboundary Water Interaction Nexus (TWINS): Approaches, opportunities and challenges. *Water International*, 45(5), 458–478. <https://doi.org/10.1080/02508060.2020.1780854>
- ILEC. (2020). *Lake Constance: EUR-33*. <https://wldb.ilec.or.jp/Lake/EUR-33>
- ILEC & UNEP. (2016). *Transboundary waters assessment programme: Transboundary lakes and reservoirs: Status and trends, summary for policy makers*. 16-03589/500.
- Kolding, J., Medard, M., Mkumbo, O., van Zwieten, P. (2014). Status, trends, and management of the Lake Victoria Fisheries. In R. L. Welcomme, J. Valbo-Jørgensen, & A. S. Halls (Eds.), *Inland fisheries evolution and management – Case studies from four continents* (pp. 49–62). FAO Fisheries and Aquaculture Technical Paper 579.
- Lugo, C., Jordan, A., & Benson, D. (2014). The role of problem and process factors in creating effective transboundary water regimes: The case of the Lake Victoria basin, East Africa. *International Journal of Water*, 8(2), 219–240. <https://doi.org/10.1504/IJW.2014.060969>
- Machiwa, P. K. (2003). Water quality management and sustainability: The experience of Lake Victoria Environmental Management Project (LVEMP)—Tanzania. *Physics and Chemistry of the Earth*, 28(20–27), 1111–1115. <https://doi.org/10.1016/j.pce.2003.08.032>
- Mamani-Salinas, A. (2013). PowerPoint presentation at First Workshop “River Basin Commissions and other joint bodies for Transboundary Water Cooperation: Legal and Institutional Aspects”. <https://unece.org/environmental-policy/events/first-workshop-river-basin-commissions-and-other-joint-bodies>
- Mancilla García, M. (2013). *Pollution, Interests and Everyday Life in Lake Titicaca: Negotiating Change and Continuity in Social–Ecological Systems* [Doctoral dissertation, University of Oxford]. Oxford University Research Archive.
- Martínez Gonzales, I., & Zuleta Roncal, R. (2007). *Co-operation on the Lake Titicaca*. SC/2007/PI/H/2. UNESCO, IHP, WWAP.
- Means, B. (1989). *Risk-assessment guidance for Superfund. Volume 1. Human Health Evaluation Manual. Part A, Interim report* (PB-90-155581/XAB; EPA-540/1-89/002). USEPA
- Mirumachi, N. (2015). *Transboundary water politics in the developing world*, 1st ed. Routledge.
- Mosello, B. (2008). Water in Central Asia: A Prospect of Conflict or Cooperation? *Journal of Public and International Affairs*, 19, 151–174. <https://jpia.princeton.edu/sites/g/files/toruqf1661/files/2008-9.pdf>
- Muyodi, F. J., Bugenyi, F. W. B., & Hecky, R. E. (2010). Experiences and lessons learned from interventions in the Lake Victoria Basin: The Lake Victoria Environmental Management Project. *Lakes & Reservoirs: Science, Policy and Management for Sustainable Use*, 15(2), 77–88. <https://doi.org/10.1111/j.1440-1770.2010.00425.x>
- Ntiba, M. J., Kudoja, W. M., & Mukasa, C. T. (2001). Management issues in the Lake Victoria watershed. *Lakes & Reservoirs: Science, Policy and Management for Sustainable Use*, 6(3), 211–216. <https://doi.org/10.1046/j.1440-1770.2001.00149.x>
- Orlove, B. S. (2002). *Lines in the Water: Nature and Culture at Lake Titicaca*. University of California Press.
- Pearce, J. R., Richardson, E. A., Mitchell, R. J., & Shortt, N. K. (2010). Environmental justice and health: The implications of the socio-spatial distribution of multiple environmental deprivation for health inequalities in the United Kingdom: Environmental justice and health. *Transactions of the Institute of British Geographers*, 35(4), 522–539. <https://doi.org/10.1111/j.1475-5661.2010.00399.x>

- Perles Roselló, M. J., Vías Martínez, J. M., & Andreo Navarro, B. (2009). Vulnerability of human environment to risk: Case of groundwater contamination risk. *Environment International*, 35 (2), 325–335. <https://doi.org/10.1016/j.envint.2008.08.005>
- Petersen-Perlman, J. D., Veilleux, J. C., & Wolf, A. T. (2017). International water conflict and cooperation: Challenges and opportunities. *Water International*, 42(2), 105–120. <https://doi.org/10.1080/02508060.2017.1276041>
- Petri, M. (2006). Water Quality of Lake Constance. In T. P. Knepper (Ed.), *The Handbook of Environmental Chemistry* (Vol. 5L, pp. 127–138). Springer. https://doi.org/10.1007/698_5_018
- Phi, H. L., Hermans, L. M., Douven, W. J., Van Halsema, G. E., & Khan, M. F. (2015). A framework to assess plan implementation maturity with an application to flood management in Vietnam. *Water International*, 40(7), 984–1003. <https://doi.org/10.1080/02508060.2015.1101528>
- Prescott-Allen, R. (2001). *The wellbeing of nations: A country-by-country index of quality of life and the environment*. Island Press.
- Priscoli, J. D., & Wolf, A. T. (2010). *Managing and Transforming Water Conflicts*. Cambridge University Press.
- Purdy, J. & Jones, R. (2012). A Framework for Assessing Power in Collaborative Governance Processes. *Public Administrative Review*, 72(3), 409–418. <https://doi.org/10.1111/j.1540-6210.2011.02525.x>
- Sabatier, P. A., & Weible, C. M. (2007). The advocacy coalition framework – Innovations and Clarifications. In P. A. Sabatier (Ed.) *Theories of the policy process, Second Edition* (pp. 189–220). Westview Press.
- Sadoff, C. W., & Grey, D. (2002). Beyond the river: The benefits of cooperation on international rivers. *Water Policy*, 4(5), 389–403. [https://doi.org/10.1016/S1366-7017\(02\)00035-1](https://doi.org/10.1016/S1366-7017(02)00035-1)
- Scherer, R., & Zumbusch, K. (2011). Limits for successful cross-border governance of environmental (and spatial) development: The Lake Constance Region. *Procedia – Social and Behavioral Sciences*, 14, 101–120. <https://doi.org/10.1016/j.sbspro.2011.03.028>
- Schröder, H. G. (2005). Transboundary water management in Lake Constance: From tradition to co-operation. In U. N. E. S. C. O. IHP & W. M. O. Hwrp (Eds.), *Value of Water – Different Approaches in Transboundary Water Management* (pp. 49–56). International Workshop of UNESCO IHP and WMO HWRP. https://waterandchange.org/wp-content/uploads/2017/04/Heft3_en.pdf#page=56
- Sobol, T. (2006). An NGO's Fight to Save Ukraine's Danube Delta: The Case for Granting Nongovernmental Organizations Formal Powers of Enforcement. *Colorado Journal of International Environmental Law and Policy*, 17(1), 147–149. [https://heinonline.org/HOL/Page?handle=hein.journals/colenvlp17&div=9&g_sent=1&casa_token=teleSUR/lgc-TP.](https://heinonline.org/HOL/Page?handle=hein.journals/colenvlp17&div=9&g_sent=1&casa_token=teleSUR/lgc-TP.(2016,January10).BoliviaandPeruinvestUS$400milliontorestoreLakeTiticaca.telesurtv.net.https://www.telesurenglish.net/news/Bolivia-and-Peru-Invest-US400-Million-to-Restore-Lake-Titicaca-20160110-0007.html)
- teleSUR/lgc-TP. (2016, January 10). Bolivia and Peru invest US\$400 million to restore Lake Titicaca. *telesurtv.net*. <https://www.telesurenglish.net/news/Bolivia-and-Peru-Invest-US400-Million-to-Restore-Lake-Titicaca-20160110-0007.html>
- UNDP (2009). *Human Development Report 2009: Overcoming barriers: Human mobility and development*. UNDP & Palgrave Macmillan, New York.
- UNEP. (2006). *Lake Victoria Basin Environment Outlook: Environment and Development*.
- Varandani, S. (2016, January 8). Lake Titicaca cleanup: Bolivia, Peru sign \$500M deal to improve Lake's biodiversity through 2025. *International Business Times*. <https://www.ibtimes.com/lake-titicaca-cleanup-bolivia-peru-sign-500m-deal-improve-lakes-biodiversity-through-2256195>
- Warner, J., & Zawahri, N. (2012). Hegemony and asymmetry: Multiple-chessboard games on transboundary rivers. *International Environmental Agreements: Politics, Law and Economics*, 12 (3), 215–229. <https://doi.org/10.1007/s10784-012-9177-y>
- Williams, H. (2015). What lies beneath: An eco-historical view of high Andes water pollution. *Ambiente & Sociedade*, 18(1), 175–192. <https://doi.org/10.1590/1809-4422ASOC872V1812015en>
- Wirkus, L., & Böge, V. (2006). Transboundary water management on Africa's international rivers and lakes: Current state and experiences. In W. Scheumann & S. Neubert (Eds.), *Transboundary Water Management in Africa: Challenges for Development Cooperation* (pp. 11–102). German Development Institute.
- Wolf, A. T., Yoffe, S. B., & Giordano, M. (2003). International waters: Identifying basins at risk. *Water Policy*, 5(1), 29–60. <https://doi.org/10.2166/wp.2003.0002>

- The World Bank (2018). *Project Information Document/Integrated Safeguards Data Sheet (PID/ISDS): Lake Victoria Environmental Management Project III* (Report No. PIDISDSC23414).
- WWAP (2003). *The UN World Water Development Report 2003: Water for People Water for Life* (UWWDR1). UNESCO & Berghahn Books.
- Xie, L., Zhang, Y., & Panda, J. P. (2018). Mismatched Diplomacy: China–India Water Relations Over the Ganges–Brahmaputra–Meghna River Basin. *Journal of Contemporary China*, 27(109), 32–46. <https://doi.org/10.1080/10670564.2017.1363014>
- Zawahri, N. A., & Hensengerth, O. (2012). Domestic environmental activists and the governance of the Ganges and Mekong Rivers in India and China. *International Environmental Agreements: Politics, Law and Economics*, 12(3), 269–298. <https://doi.org/10.1007/s10784-012-9179-9>
- Zeitoun, M., & Warner, J. (2006). Hydro-hegemony – A framework for analysis of trans-boundary water conflicts. *Water Policy*, 8(5), 435–460. <https://doi.org/10.2166/wp.2006.054>
- Zeitoun, M., Warner, J., Mirumachi, N., Matthews, N., McLaughlin, K., Woodhouse, M., Cascão, A., & Allan, T. (2014). Transboundary water justice: A combined reading of literature on critical transboundary water interaction and ‘justice’, for analysis and diplomacy. *Water Policy*, 16(S2), 174–193. <https://doi.org/10.2166/wp.2014.111>
- Zilov, E. A. (2013). Water resources and the sustainable development of humankind: International cooperation in the rational use of freshwater-lake resources: Conclusions from materials of foreign studies. *Water Resources*, 40(1), 84–95. <https://doi.org/10.1134/S0097807812030116>

Appendix

Criteria for the classification of conflict and cooperation and the stakeholder analysis of power, vulnerability, and risk.

Table A1. Classification of conflictive and cooperative interactions as based on the TWINS framework.

Intensity	Criteria
<i>Conflictive interactions</i>	
Non-politicized	The issue is minimal to the state or not within the public domain
Politicized	The issue is on the political agenda and some resources are being reallocated to address the issue
Securitized/ opportunized	The issue is seen as a threat or opportunity that is sufficient enough to justify emergency action outside of the bounds of political procedure
Violized	The issue justifies violent confrontation
<i>Cooperative interactions</i>	
Confrontation of issue	There is acknowledgement that the issue exists, but states are not participating in joint action and do not have shared goals
Ad hoc	States are participating in joint action but do not share goals
Technical	States have shared goals but are not participating in joint action
Risk-averting	States are participating in joint action and have shared goals but are unwilling to commit to future constraints (i.e., will not commit to unforeseen future costs)
Risk-taking	States are participating in joint action, have shared goals, and have committed to future constraints (i.e., unforeseen costs and risks)

Source: Mirumachi (2015).

Table A2. Criteria for analyses and ranking of stakeholder power.

Power source		Ranking
Formal authority	High (3)	(a) There is a transboundary government institution that has formalized participation of stakeholders with influence over decisions (i.e., delegated power, partnership, placation or consultation) (Arnstein, 1969)
	Medium (2)	(a) There is a transboundary government institution that has formalized participation of stakeholders with <ul style="list-style-type: none"> (i) limited influence over decisions through information supply (i.e., informing, therapy or manipulation) (Arnstein, 1969) (ii) inconsistent involvement of the entire stakeholder group (i.e., participation on a case-by-case base), or (iii) involvement contingent on state conditions (b) There is a national, regional or local government institution that has formal or informal participation of stakeholders with influence over decisions (i.e., delegated power, partnership, placation or consultation) (Arnstein, 1969)
	Low (1)	(c) There is informal governance with strong influence over decisions (i.e., delegated power) (Arnstein, 1969)
		(a) There is a transboundary government institution with little to no participation of stakeholders
		(b) Stakeholders are involved in national, regional or local government institutions and have limited influence over decisions through information supply (i.e., informing, therapy or manipulation) (Arnstein, 1969)
		(c) Stakeholders are not engaged in governance
Resources	High (3)	(a) There is an organization that specifically represents the stakeholder and <ul style="list-style-type: none"> (i) is transboundary with broad participation in all countries, or (ii) has the capacity to implement projects or produce and distribute information (b) There is an organization that represents the stakeholder in one country and the stakeholder group represents a majority fraction of the basin
		(c) The stakeholder has a strong coalition with <ul style="list-style-type: none"> (i) sufficient stakeholder groups to constitute a majority, or (ii) an actor that has high formal authority, the capacity to implement projects, or the capacity produce and distribute information
	Medium (2)	(a) There is an organization that specifically represents the stakeholder group and <ul style="list-style-type: none"> (i) is transboundary without broad participation in all countries, or (ii) does not have the capacity to implement projects or produce and distribute information (b) There is an organization that represents a broad range of stakeholders and <ul style="list-style-type: none"> (i) is transboundary with broad participation in all countries, or (ii) has the capacity to implement projects or produce and distribute information (c) There is no organization, but the stakeholder group demonstrates an ad hoc capacity to organize
		(d) There is no organization, but the stakeholder group represents a majority fraction of the basin or a specific country
		(e) The stakeholder group has a strong coalition with other stakeholder groups but together, constitute a minority fraction of the basin population
		(f) The stakeholder group has weak or loose coalition with other stakeholder groups
	Low (1)	(a) There is no organization that represents the stakeholder and <ul style="list-style-type: none"> (i) the group represents a minor fraction of the basin or a specific country, and (ii) the group has not demonstrated an ad hoc capacity to organize

(Continued)

Table A2. (Continued).

Discursive legitimacy	High (3)	(a) The stakeholder group's position is prioritized in political processes and/or the stakeholder group has framed the dominant narrative that is addressed
		(b) The stakeholder group frequently exerts their voice in public spaces or in direct connection to the state and the state reacts to this expression
		(c) There is broad public support of the stakeholder group's position
		(d) The stakeholder group is viewed as credible when presenting information in public spaces
	Medium (2)	(a) The stakeholder group frequently exerts their voice in public spaces or in direct connection to the state but <ul style="list-style-type: none"> (i) the government does not react to this expression, or (ii) the group or representation of the group is not perceived as credible
		(b) There is some public support for the stakeholder group or the perspective of the stakeholder group
		(c) The public voice of the group is perceived as credible or representative of the stakeholders but rarely presents information or opinion in public spaces
		(d) The stakeholder's perspective has been considered in transboundary management and there is freedom of the press (considered 'good' or 'very good')
	Low (1)	(a) The stakeholder group does not exert their voice in public spaces
		(b) There is no clear public support for the perspective of the stakeholder group
		(c) The stakeholder's perspective has not been considered or is discredited in transboundary management
		(d) Freedom of the press is inadequate (considered 'bad,' 'problematic,' or 'non-existent')
State interest	High (3)	(a) The states have demonstrated interest in the stakeholder group or group's interests as a result of transboundary studies, projects or cooperation
		(b) The stakeholder group contributes a large percentage to the state GDP for at least one riparian country <ul style="list-style-type: none"> (i) The percentage of GDP is > 30% (ii) The sector is one of the top five GDP earners in the state, or (iii) The sector is expressed as a major contributor to the GDP
		(c) The stakeholder group holds a political interest to the government of at least one riparian country
		(d) The stakeholder group contributes economically through the region in alternate manners (i.e., exports or foreign investments) in a manner that is expressed as important to the state
		(e) The stakeholder group is perceived to be prioritized by the state
	Medium (2)	(a) The states have expressed interest in the stakeholder group or group's interests but have not demonstrated interest through transboundary studies, projects or cooperation
		(b) The states have expressed interest in the region but not a specific stakeholder and have demonstrated this interest through transboundary studies, projects or cooperation
		(c) The stakeholders hold some political interest to the government of at least one riparian country but have not been perceived to be prioritized
		(d) International actors have expressed interest in the stakeholder group as a result of studies or projects although the states have not expressed interest
		(e) The stakeholder group contributes to the GDP of at least one riparian country
	Low (1)	(a) The states have expressed interest in the region but have not demonstrated that interest through transboundary studies, projects or cooperation
		(b) The stakeholder group is largely ignored by the state
		(c) The stakeholder group has been disadvantaged by prioritization of another stakeholder group
		(d) The stakeholder group does not contribute to the GDP of the region

Note: Quantitative values assigned to the rankings are shown in parentheses. GDP: gross domestic product.

Sources: Adapted from Purdy and Jones (2012); Phi et al. (2015); Sabatier and Weible (2007); and French et al. (2017).

Table A3. Criteria for analyses and ranking of stakeholder vulnerability.

Vulnerability Category		Ranking
Regional Development	High (3)	<ul style="list-style-type: none"> (a) Less than 50% of the population has basic or improved drinking water access (b) Less than 50% of the population has access to high quality drinking water (c) Greater than 50% of the population has basic or improved drinking water access but large population growth (relative to the rest of the respective countries) has occurred in the region exceeding the capacity of existing infrastructure and has caused substantial decreases in water access
	Medium (2)	<ul style="list-style-type: none"> (a) Between 50% and 80% of the population has basic or improved drinking water access (b) Greater than 80% of the population has basic or improved drinking water access but large population growth (relative to the rest of the respective countries) has occurred in the region exceeding the capacity of existing infrastructure and has caused substantial decreases in water access
	Low (1)	<ul style="list-style-type: none"> (a) Greater than 80% of the population has basic or improved drinking water access (b) There are alternate water resources that are likely affiliated with improved water access and are not at risk for contamination related to the lake
Economic	High (3)	<ul style="list-style-type: none"> (a) Greater than 50% of the population is living below the poverty line, and/or (b) The employment opportunities are subsistence and <ul style="list-style-type: none"> (i) There is low diversity of production in the region or (ii) There is a high dependence on water resources (c) The employment generates a financial income but <ul style="list-style-type: none"> (i) There have been large losses in the sector or (d) Income is assumed to be consistent with the remainder of the country and the income parameter is low (<0.5) or the GNI per capita is considered low based on the World Bank annual thresholds (e) The income parameter is low (<0.5) or the GNI per capita is considered low development based on the World Bank annual thresholds (f) The sector has not yet been established in the region
	Medium (2)	<ul style="list-style-type: none"> (a) The employment generates a financial income, poverty in the region is medium (> 20% and <50%), and <ul style="list-style-type: none"> (i) There is diversity of production in the region, (ii) There is low dependence on water resources, or (iii) The industry is growing or thriving generating substantial financial resources for participants (b) The employment generates a financial income, poverty in the region is high (>50%), and <ul style="list-style-type: none"> (i) The industry is growing or thriving generating substantial financial resources for participants that are anticipated to exceed income of the average stakeholders within the basin (c) Poverty is medium (> 20% and <50%) and <ul style="list-style-type: none"> (i) The income parameter is medium (<0.8 and >0.5) or (ii) The GNI per capita is considered medium (e.g., lower-middle or upper-middle income) based on the World bank annual thresholds (d) Poverty is low (<20%) and <ul style="list-style-type: none"> (i) There is limited diversity of production in the region and (ii) There is high dependence on water resources (e) In the absence of alternate data sources, the income parameter is medium (<0.8 and >0.5) or the GNI per capita is considered medium (e.g., lower-middle or upper-middle income) based on the World bank annual thresholds
	Low (1)	<ul style="list-style-type: none"> (a) The employment generates a financial income, poverty in the region is low (<20%) and <ul style="list-style-type: none"> (i) There is diversity of production in the region, (ii) There is low dependence on water resources, or (iii) The industry is growing or thriving generating substantial financial resources for participants (b) Poverty is low (<20%) and <ul style="list-style-type: none"> (i) The income parameter is high (>0.8) or (ii) The GNI per capita is considered high (e.g., high income based on the World bank annual thresholds (c) In the absence of alternate data sources, the income parameter is high (>0.8) or the GNI per capita is considered high (e.g., high income) based on the World Bank annual thresholds

(Continued)

Table A3. (Continued).

Vulnerability Category		Ranking
Education	High (3)	<p>(a) The population has limited to no risk awareness and</p> <p>(i) Literacy is considered low (<50%) or</p> <p>(ii) When the literacy percentage is not available, the literacy calculation is low (<0.5)</p> <p>(b) There is a low rate of literacy with the literacy percentage (<50%) or in the absence of the literacy percentage, the literacy calculation is low (<0.5)</p> <p>(c) There is a medium rate of literacy with the literacy percentage (>50% and <80%) or in the absence of literacy percentage, the literacy calculation is medium (>0.5 and <0.8) and</p> <p>(i) The average years of education are considered low (<8.25 years)</p> <p>(d) In the absence of alternate data, the average years of education are considered low (<8.25 years)</p>
	Medium (2)	<p>(a) The population has some risk awareness and/or some access to data and</p> <p>(i) Literacy in the region is considered medium or high or</p> <p>1. Based on a literacy percentage of medium or high (>50% or 80%, respectively) or</p> <p>2. When literacy percentage is not available, the literacy calculation is medium or high (>0.5 or >0.8, respectively)</p> <p>(ii) The average years education are considered medium or low (<10.49 years or <8.25 years, respectively)</p> <p>(b) There is a medium rate of literacy with the literacy percentage (>50% and <80%) or in the absence of literacy percentage, the literacy calculation is medium (>0.5 and <0.8) and</p> <p>(i) The average years of education are considered medium (>8.25 years or >10.49 years, respectively)</p> <p>(c) There is a very high rate of literacy (>90%) and</p> <p>(i) The average years of education are considered low (<8.25 years)</p>
	Low (1)	<p>(a) The population has a high risk awareness and access to data and</p> <p>(i) Literacy in the region is considered medium or high or</p> <p>1. Based on a literacy percentage of medium or high (>50% or 80%, respectively) or</p> <p>2. When literacy percentage is not available, the literacy calculation is medium or high (>0.5 or >0.8, respectively)</p> <p>(ii) The average years education are considered medium or high (>8.25 years or >10.49 years, respectively)</p> <p>(b) There is a high or very high rate of literacy with the literacy percentage (>80% or >90%, respectively) or in the absence of literacy percentage, the literacy calculation is high (>0.8) and</p> <p>(i) The average years of education are considered high (>10.49 years, respectively)</p> <p>(c) There is a very high rate of literacy (>90%) and</p> <p>(i) The average years of education are considered medium (>8.25 years and <10.49 years)</p> <p>(d) There is a medium rate of literacy (<80% and >50%) or in the absence of literacy percentage, the literacy calculation is medium (>0.5 and <0.8) and</p> <p>(i) The average years of education are considered high (>10.49 years)</p>

(Continued)

Table A3. (Continued).

Vulnerability Category		Ranking
Political	High (3)	<ul style="list-style-type: none"> (a) There are not water regulations in a majority of the countries (b) There are water regulations in all countries but they do not all address pollution controls and <ul style="list-style-type: none"> (i) Laws are not enforced, (ii) There are high rates of non-compliance, or (iii) There is a medium-high level of corruption in public officials which implies lack of enforcement (corruption index <66% and <33%, respectively) (c) There are regulations in a majority of countries that address pollution controls and <ul style="list-style-type: none"> (i) Laws are not enforced, (ii) There are high rates of non-compliance, or (iii) There is a medium-high level of corruption in public officials which implies lack of enforcement (corruption index <66% and <33%, respectively)
	Medium (2)	<ul style="list-style-type: none"> (a) There are regulations in all countries that address pollution controls and <ul style="list-style-type: none"> (i) Laws are not enforced, (ii) There are high rates of non-compliance, or (iii) There is a medium-high level of corruption in public officials which implies lack of enforcement (corruption index <66% and <33%, respectively) (b) There are water regulations in all three countries but they do not all address pollution controls and <ul style="list-style-type: none"> (i) Laws are enforced, (ii) There is a low level of corruption in public officials which can imply greater enforcement (corruption index >66%), or (iii) Enforcement of regulations is implied based on a lack of reporting of non-compliance (c) There are regulations in a majority of countries that address pollution controls and <ul style="list-style-type: none"> (i) Laws are enforced, (ii) There is a low level of corruption in public officials which can imply greater enforcement (corruption index >66%), or (iii) Enforcement of regulations is implied based on a lack of reporting of non-compliance
	Low (1)	<ul style="list-style-type: none"> (a) There is harmonized legislation in all riparian countries that are enforced (b) There are regulations in all three countries that address pollution controls and <ul style="list-style-type: none"> (i) Laws are enforced, (ii) There is a low level of corruption in public officials which can imply greater enforcement (corruption index >66%), or (iii) Enforcement of regulations is implied based on a lack of reporting of non-compliance

Note: Quantitative values assigned to the rankings are shown in parentheses. GNI: gross national income.

Source: Adapted from French et al. (2017); Cutter et al. (2003); Pearce et al. (2010); Prescott-Allen (2001); Perles Roselló et al. (2009); and United Nations Development Programme (UNDP) (2009).

Table A4. Criteria for analyses and ranking of stakeholder risk.

Risk component		Ranking
Water quality impact	Yes (1)	(a) The water quality impacts or has reached a sufficient level to negatively impact the given exposure pathway. These negative impacts can include human health risk through consumption (directly or via bioaccumulation), contribution of water quality impact to food insecurity, impaired mobility through dermal exposure, or effect on functioning of livelihood (e.g., clogged pipes), livelihood supply (e.g., fish stocks) or the market in general (e.g., water quality impacts on the tourism industry)
	No (0)	(a) The water quality does not negatively impact the exposure pathway (b) There are some negative impacts from the water quality, but these are outweighed by positive impacts from the water quality (c) There are some water quality impacts but they have not reached a sufficient level to negatively impact the given exposure pathway
Frequency of exposure	High (3)	(a) There is a daily exposure to the stakeholder
	Medium (2)	(a) There is some exposure to the stakeholder or (b) There is daily exposure to the stakeholder, but the impact is likely minimal
	Low (1)	(a) There is limited or no exposure to the stakeholder or (b) There is some exposure to the stakeholder, but the impact is likely minimal
Approximate risk		Water quality impact * Frequency of exposure

Note: Quantitative values assigned to the rankings are shown in parentheses.

Source: Adapted from Means (1989); French et al. (2017); and Perles Roselló et al. (2009).