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How do basin committees deal with water crises? Reflections for adaptive water governance from South America

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ABSTRACT. Adaptive water governance involves collaboration among multiple actors, social learning, and flexibility to deal with shocks and surprises. Crises thus become a useful context to assess how the institutional arrangements contribute to adaptation. However, an important part of the specialized literature has focused on these issues as they occur in highly institutionalized settings in the Global North. This paper, instead, analyzes basin organizations in settings with variable degrees of institutionalization in South America. The objective is to analyze the actions (or lack thereof) conducted or encouraged by basin committees in watersheds of Argentina, Brazil, and Uruguay, in the face of water crises. We analyze three case studies, involving basin committees that faced different water crises (all affecting drinking water supply) at different scales: (1) Chubut River Basin committee and a turbidity crisis in the Lower Valley in 2017 (Chubut, Argentina), (2) Piracicaba-Capivari-Jundiá (PCJ) River Basins committee and a drought that occurred in 2014–2015 (São Paulo, Brazil), and (3) Laguna del Cisne Basin commission and a crisis associated with a failure in the water treatment operation in 2019 (Canelones, Uruguay). In each case, we analyze the institutional design of the committee and the actions (or lack thereof) undertaken regarding the crisis, including the perceptions of key stakeholders of those actions. Findings showed that stakeholders tend to act and communicate through fast channels when water crises occur, referring to basin committees only for technical and additional support (Brazil), information sharing (Uruguay), or not convening the committee at all (Argentina). Our cases in South American countries with different contexts provided empirical evidence of the barriers that basin committees face as political-institutional frameworks to foster adaptive water governance (e.g., limited stability, centralization, lack of leadership).

Key Words: *adaptive governance; centralization; participation; river basin organizations; watersheds*

INTRODUCTION

One of the most pressing global challenges is to ensure water supplies in sufficient quality and quantity for human and environmental needs. This challenge becomes salient during periods of crises. Water crises can be defined in multiple ways; for instance, Taylor and Sonnenfeld (2017), based on additional literature, pointed out that “Water crises are events in social-ecological systems that are perceived as significant threats to core social values and structures and to life-sustaining systems.” Hanrahan and Dosu (2017) defined water crisis as “impaired access to adequate quantities of safe quality water, lasting at least three days.”

By definition, water crises are complex problems that usually occur due to a combination of factors (e.g., ecological, climate, economic, governance), and involve multiple actors with different perspectives, who generally are affected unequally by the water problem (Trimble et al. 2021b). Water crises may be triggered by ecological factors, material and technical infrastructure issues, changes in state policy, legal, and regulatory frameworks, asymmetrical power exercised by social actors (Taylor and Sonnenfeld 2017), governance deficits, and implementation gaps (Pahl-Wostl 2019a, b), among many others. In fact, water crises have been associated with water governance for a long time (Global Water Partnership (GWP) 2000), and the literature on

this has been growing (e.g., Srinivasan et al. 2012, Sousa et al. 2016, Taylor and Sonnenfeld 2017, Baird and Plummer 2021). Moreover, the existing and interrelated water crises, locally and globally, may be aggravated because of climate change, population growth, land-use transformations, among other drivers. In addition, regional and local dynamics may exacerbate features of a crisis, such as poor management, ineptitude, corruption, electoral dispute, militia, and narcotrafficking in watershed areas. All of these have traditionally increased the complexity of governing water in countries in the Global South (see Trimble et al. 2021b for challenges related to water governance in South America).

Given the complexity and uncertainty inherent to social-ecological systems, adaptive governance has been proposed as a suitable strategy to address the inherent interdependencies involved in the governance of natural resources (Dietz et al. 2003, Folke et al. 2005, Chaffin et al. 2014, Karpouzoglu et al. 2016). Adaptive governance of social-ecological systems has been defined as “A range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems” (Chaffin et al. 2014). These must be capable of acknowledging the social context in which environmental governance decisions are made (Karpouzoglu et al. 2016) while adjusting to uncertain and complex socio-

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environmental problems occurring at multiple scales (Cosens and Williams 2012, Chaffin et al. 2014). Paying attention to such elements requires highly contextualized knowledge of each particular case, and as such, makes it difficult to develop blueprints or practical guidelines on how to “become more adaptive.”

Very few studies have applied the adaptive governance approach to analyze water governance in South America (e.g., Berardo et al. 2013, Hurlbert and Diaz 2013). In fact, a recent literature review shows that most adaptive governance research has been conducted on water systems, and mostly focusing on the Global North (Karpouzoglou et al. 2016). This review pointed out that the building blocks of the adaptive governance theory include adaptive capacity development and flexibility (allowing actors to cope better with increased uncertainty), collaboration (networks, partnerships, responsibility sharing), knowledge integration and learning, among others (Karpouzoglou et al. 2016).

In the case of water governance, the transition from top-down (command-and-control, centralized) approaches toward participatory and integrated approaches has given rise to the creation of multiple types of river basin organizations (RBO; e.g., Huitema and Meijerink 2017, Meijerink and Huitema 2017). These forums for stakeholder participation (e.g., basin committees, basin forums, watershed councils, basin water boards), formed at multiple scales, are considered desirable tools for fostering resilience (adaptation + transformation sensu Folke 2016) (Plummer et al. 2014, Trimble et al. 2021a). They provide a bridging platform for bringing together different actors and sources of knowledge, with potential for building networks of collaboration and fostering learning at individual and social levels.

Although there has been some research on the relationship between water crises and forums for participation or basin committees (e.g., Mandarano and Mason 2013 in the USA, Berardo et al. 2015 in Argentina, Sousa et al. 2016 in Australia and Brazil, Lemos et al. 2020 in Brazil), there is still room for a comparative and systematic understanding of how these play out in contexts where the degree of institutionalization may be different than in the Global North. This is a gap that our research intends to address. Studies of this kind are also needed to understand the specific dynamics of adaptive water governance, particularly in the Global South (Karpouzoglou et al. 2016, Özerol et al. 2018), where several countries have been undergoing shifts or transitions in water governance regimes.

We focus on three South American countries, Argentina, Brazil, and Uruguay, where the authors have been developing a research project called GovernAgua¹. These neighboring countries have experienced a gradual water governance transition toward decentralized and participatory governance mechanisms (Trimble et al. 2021a). One of the signs of this shift in governance is the creation of forums such as basin committees involving government, users, and civil society. Of the three countries, Brazil shows the largest trajectory and diversity of RBO (Jacobi et al. 2009, Abers and Keck 2013). In Uruguay, regional councils for water resources and basin and aquifer commissions have been formed by the national government since 2010 (Lázaro et al. 2021, Mazzeo et al. 2021). In Argentina, in basins that are encompassed

within a single province, provincial governments decide whether to create an RBO and how (e.g., its rules, composition), resulting in a wide variety of forums and institutional designs (Pochat 2005, Organisation for Economic Co-operation and Development (OECD) 2019).

The objective of this article is to analyze the actions (or lack thereof) of basin committees in watersheds of Argentina, Brazil, and Uruguay, in the face of water crises. Doing so allows us to further our understanding of multistakeholder policy forums for adaptive water governance, and the existing limitations they face given salient social-ecological uncertainties in the region. We analyze three basin committees that faced different water crises (all affecting drinking water supply) at different scales: (1) Chubut River basin committee and a turbidity crisis in the Lower Valley in 2017 (Chubut, Argentina), (2) Piracicaba-Capivari-Jundiaí (PCJ) rivers basin committee and a drought that occurred in 2014–2015 (São Paulo, Brazil), and (3) Laguna del Cisne basin commission and a crisis associated with a failure in the water treatment operation in 2019 (Canelones, Uruguay). We highlight specific challenges that basin committees must overcome in settings with varying degrees of institutionalization, for the identification of actions and adaptive responses.

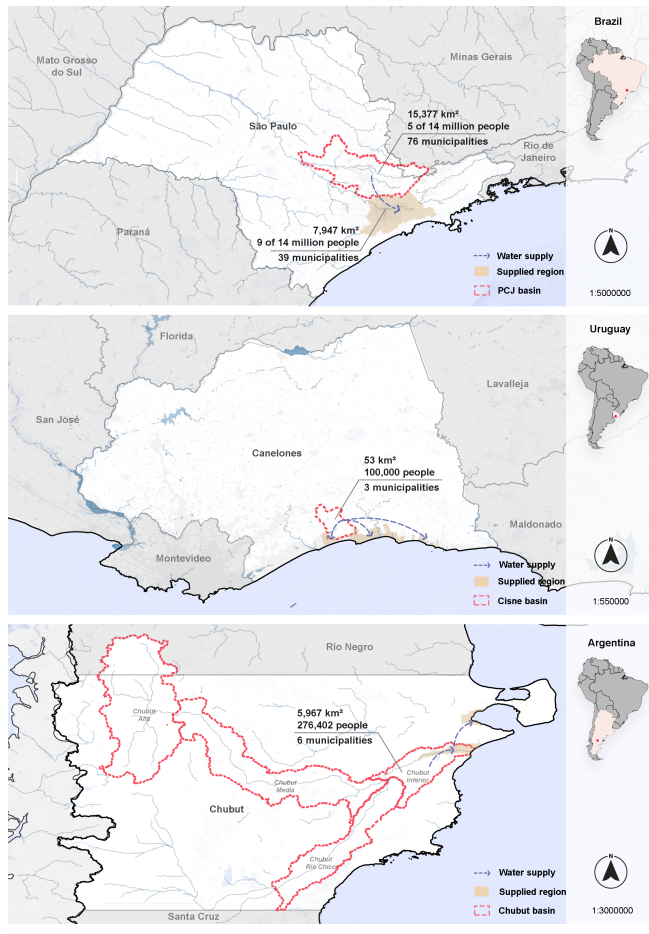
In what follows, we introduce the case studies and describe our research methods. After that, we present the findings from each case (Chubut, PCJ, Laguna del Cisne), followed by a discussion comparing our findings and drawing lessons from these, while reflecting upon limitations for adaptive water governance in the Global South.

CASE STUDIES AND RESEARCH METHODS

This study was based on field research conducted between 2019–2020. We used a multiple case study approach (Creswell 2013), analyzing three case studies (Table 1, Fig. 1): Chubut River basin committee (Argentina), Piracicaba-Capivari-Jundiaí Rivers basin committee (Brazil), and Laguna del Cisne basin commission (Uruguay). These cases were selected to allow a comparative analysis regarding the actions undertaken by river basin committees during water crises affecting drinking water supplies. The committees involve actors from different levels (national, provincial/state, local) and sectors (governmental and non-governmental).

Although with varying scales, all three cases showcase the actions (or lack thereof) taken by a basin committee to address a water crisis in interjurisdictional settings. The cases involved different water crises (turbidity, drought, and infrastructure operational failure), which affected the availability of drinking water to a large number of people in watersheds that cross political jurisdictions. By no means should the cases be considered representative of all water crises or of all committees in their respective countries. Nonetheless, they provide a baseline to describe how basin committees in South America act in the face of a water crisis. It is worth noting that, as Uruguay is a unitary country, most powers of government are vested at the national level, as opposed to Argentina and Brazil (federal countries), where powers are divided between the federal government and the provinces or states, respectively.

Fig. 1. Location of the study areas: Chubut River basin (Argentina), Piracicaba-Capivari-Jundiá Rivers basin (Brazil), Laguna del Cisne basin (Uruguay).



The Chubut committee is a relatively new initiative within the province of Chubut, with the goal of facilitating coordination between the provincial and local governments in the basin. The Chubut case was chosen because of an unexpected turbidity crisis that occurred in 2017 and left almost 300,000 people with no or limited access to water for over a month (Kaless et al. 2019). The basin committees of Piracicaba-Capivari-Jundiá rivers (PCJ) are among the best structured and organized cases in Brazil, due to the high degree of technical and management capacity of its municipalities, the Intermunicipal Consortium of PCJ basin (involving municipal governments and companies) and the Regulatory Agency (Pollachi 2019). They are critical in the governance of drinking water for 14 million people in the São Paulo Metropolitan Region (SPMR), that receives water through the Cantareira System in the Upper Tietê river basin. The scarcity crisis that occurred between 2014 and 2015 had severe impacts in regions with more vulnerable groups, with less capacity to react to impacts (Torres et al. 2020). Finally, the basin commission of Laguna del Cisne (the eighth of these commissions created in the country) was selected because this lake constitutes the main source of drinking water for numerous coastal towns in Uruguay (about

100,000 people in summer). The creation of this basin commission in 2014 was triggered by a crisis associated with land-use transformations in the area since 2012; through strong leadership of the subnational/local government and contributions from the basin commission, one of the first land-use plans of rural territories in Uruguay was developed. The crisis studied for this article was an operational failure that occurred in 2019 in the water treatment plant (with effects on the water supply lasting 3–7 d), which made visible other social-ecological risks in the area.

Data were obtained through document analysis (minutes and reports of basin committees, official websites, reports of management institutions, press releases published about the crises, national and subnational legislation), semi-structured interviews (conducted in 2019–2020, either face-to-face or virtually), virtual workshops with stakeholders in PCJ and Laguna del Cisne in 2020, and participant observation in 2019–2020 (only in Laguna del Cisne—three meetings of the basin commission). Interviews were conducted with stakeholders who played a relevant role during the studied crises, including governments, social organizations, farmers’ and industrial organizations, economic actors, technical/academic sector, and water and sewage companies. In total, 42 actors were interviewed in the three watersheds (averaging 1–1.5 h per interview). All interviews were recorded and transcribed. The virtual workshops occurred in August 2020 (Laguna del Cisne) and November 2020 (PCJ). Their goal was to present and discuss the relevance of the main results (for their validation), and complement the information gathered through interviews and secondary data. All the data for this article were analyzed qualitatively using a combination of deductive and inductive coding approaches, using Atlas.ti software. A common codebook was designed for the three cases, and specific codes for categorizing the data of each basin were also used.

Each case is analyzed focusing on two components: (1) institutional design of the basin committee (e.g., origin, composition, function, political impact); and (2) actions (or lack thereof) undertaken by the committee regarding the crisis, including the perceptions of key stakeholders of those actions.

RESULTS

In this section we present the findings from each case study according to the two components. In each case, we first characterize the basin committee and then analyze the actions taken by it related to the studied crises.

Case Study 1 - Chubut River Basin (Argentina)

Characterization of the Basin Committee

In 2013, to overcome the fragmentation of water governance in the province, Provincial Law XVII N° 74 (formerly Law 5.178) created a basin committee for the entire Chubut River Basin (see Table 2) and did the same for other basins in the province. In Argentina, decisions over water issues are the main responsibility of provincial governments (Pochat 2005, Berardo et al. 2013, Trimble et al. 2021a). The Chubut river basin committee is run by two provincial-level agencies, which are in charge of water quantity and water quality control, respectively: the Provincial Water Institute (IPA) and the Ministry of the Environment and Sustainable Development Control. In the province, municipalities

Table 1. Description of the three studied watersheds

	Lower Chubut River Basin - Argentina ¹	PCJ Rivers Basin - Brazil ²	Laguna del Cisne Basin - Uruguay ³
Size	5,967 km ²	15,377 km ²	53 km ²
Water users	276,402 people	14 million people	100,000 people
Main water uses (activities)	Agriculture, human consumption, industry, livestock, mining, tourism	Human consumption, industry, agriculture, tourism	Human consumption, agriculture, livestock
Administrative units involved	Province of Chubut. Six municipalities	São Paulo [†] and Minas Gerais States. Seventy-six municipalities	Canelones Department (subnational unit). Three municipalities
Main water authority (government level)	Provincial Water Institute (Instituto Provincial del Agua - IPA) (Provincial level)	National Water and Basic Sanitation Agency (Agência Nacional de Águas e Saneamento Básico - ANA) (National level)	National Water Directorate (Dirección Nacional de Aguas - DINAGUA) (National level)
Interviewed actors	15 actors: provincial and local governmental agencies (7); cooperatives in charge of drinking water provision (3); scientific and outreach organizations (3); hydroelectric power plant and irrigation company (2)	12 from PCJ and 1 from the Upper Tietê basin: representatives of the State of São Paulo (3); municipality (1); Basin Agencies (2); private users (3); NGOs and universities (4) [‡]	14 actors: governmental institutions of national and subnational levels (11); civil society organization and users (3)

[†] This article focused on the portion of the basin located in the state of São Paulo.

[‡] The interviews in Brazil required approval from the ethics committee of the Federal University of ABC (CAAE: 29854220.5.0000.5594).

¹ Profill-Rhama Consortium PCJ (2020), ² Kaless et al. (2019), ³ Comisión de Cuenca de Laguna del Cisne (CCLC) (2017), Sassano et al. (2019), Ministerio de Ambiente (MA) (2020).

oversee water intake, treatment, and distribution, as well as sewage treatment. Many municipalities, like the ones in the Lower Valley of the Chubut River (Valle Inferior del Río Chubut or VIRCh, in Spanish, a section of approximately 200 km of the larger Chubut River), delegate these duties to user cooperatives (Pascual et al. 2020). The basin committee congregates representatives from the executive and legislative sectors of each municipality, as well as representatives from the irrigation, hydropower, and human consumption sectors. The committee also incorporates representatives from research and extension agencies active in the region.

The basin committee of the Chubut River was originally created as a mechanism for coordinating water management decisions among different jurisdictions. It is supposed to meet at least twice a year, as well as any other time one of its members requests a meeting. Although tasked with the authority to enforce water legislation, in practice, the committee has served mainly as a space for occasional debate among a small group of stakeholders. A heavy dependence on the will of the Director of IPA for calling meetings² and influencing policy decisions, paired with changes in provincial administrations have curtailed the authority of the committee in recent years. This limited authority was visible in the actions of the committee during the water crisis that took place in Chubut province in 2017.

Actions of the Basin Committee during the Crisis

Between March and April of 2017, extreme rainfall in the southern part of Chubut Province activated an inactive tributary of the Chubut River. As a result, an extraordinary amount of sediment-laden water was carried to the river, causing water turbidity to remain extremely high for weeks and forcing water utilities to reduce and at times suspend water treatment. Consequently, 270,000 people had limited or no access to clean drinking water for almost 3 mos. (Kaless et al. 2019, Trimble et al. 2021b).

During the crisis, the basin committee did not play an active role. None of the interviewees recalled the committee meeting while the crisis was occurring. As one interviewee highlighted, “the

basin committee does not have authority during periods of emergency” (Representative from Scientific Organization #3). Instead, multiple informal collaborations took place among local governments, water providers, and the IPA. The epitome of the informality of these collaborations was defined by an interviewee, who stated that “we created a WhatsApp group with the agencies, with the cooperatives, the mayors, the people in charge of public works. There were 100 people [in that group] that every time we wrote something would respond or find out about it” (Representative from Provincial Government #1). This was a spontaneous decision, as one interviewee mentioned, it “was a spontaneous coordination, borne out of the same spirit of solidarity, even from the very own public officials” (Representative from Scientific Organization #3). Several interviewees also highlighted the leadership role played by water utilities (the cooperatives) in sharing information with other water utilities in the region, as well as collaborating with local governments (Representative from Scientific Organization #2; Representative from Cooperatives #3; Representative from Irrigation District).

Although created to foster collaboration among local governments in governing a shared natural resource, the Chubut River Committee lacked the ability to play such a role during a crisis. This could be due to a variety of factors: Article 5 of its statute³ establishes that the committee shall research and share information, develop plans, propose regulations to the provincial government, and enforce rules. The statute does not grant the committee joint decision-making or conflict-resolution responsibilities. Moreover, even though the event of 2017 had significant impacts on the population, it directly affected the water treatment companies, which are run mainly by cooperatives and not the local or provincial governments. Local governments aided and collaborated with the cooperatives in sorting the crisis, as mentioned above, but the nature of the event, the need for speedy technical responses, and the organizations directly affected by the crisis contributed to the committee not being the best venue to facilitate such coordination.

Table 2. Main findings of each case in the studied components

Components	Dimensions and variables	Case studies		
		VIRCH (Argentina)	PCJ (Brazil)	Laguna del Cisne (Uruguay)
Institutional design of basin committee	Name	Chubut River Basin Committee	São Paulo State PCJ Committee	Laguna del Cisne Basin Commission
	Year of formal creation	2013	1993	2014
	Composition (number of organizations per sector in brackets)	Provincial government (2); local governments (14) [†] ; user organizations (1); scientific and extension organizations (4)	State government (8), municipal government (8), civil society (9), and users (8)	National government (3), subnational-departmental government (2), municipal government (2), civil society (12), and users (3) [‡]
	Institution(s) in charge	Provincial Water Institute and Ministry of the Environment and Sustainable Development and Sustainable Development Control (Chubut Province)	Mayor of Piracicaba; National Association of Municipal Sanitation Services; São Paulo State Secretariat for Infrastructure and Environment [§]	National Water Directorate (Ministry of Environment)
	Functions and political impact	Coordination of water management decisions among different jurisdictions, and (formally) the authority to enforce legislation	Advisory and deliberative capacity (projects funded by the committee); approve the Basin Plan; support water resources management actions	Coordination among actors; participation; conflict resolution; consultative, deliberative, and advisory role contributing to and supporting water planning and management in the basin
Crisis	Year	2017	2014-2015	2019
	Description	Water supply caused by high turbidity in water after heavy rainfall, within a subsection of the basin (Lower Valley of the Chubut River)	Water supply due to reduced water availability and poor management	Water supply due to operational failure in water treatment plant
	Decision-making process during the crisis	Centralized in a small group of actors (cooperatives in charge of water provision and water authority at the provincial level)	Decentralization within the technical chambers of the basin committees, and at the same time centralization in a small group of actors (State government of São Paulo and State Water Company - SABESP)	Centralized in a small group of actors (State Water company- OSE, State Regulatory Unit for Energy and Water Services- URSEA)
	Actions and management measures by those main actors	Technical solutions (new potabilization technologies and monitoring of biophysical indicators)	Technical solutions (measures to reduce consumption, transpositions, investment in natural infrastructure), articulation between municipalities	Adoption of new potabilization technologies; water monitoring practices; normative and planning measures (e.g., OSE's Water Safety Plan)
	Response of the basin committee	No action was taken; the committee did not meet	Rapid creation of the drought working group (DWG), with frequent meetings; intensification in hydrological monitoring; dissemination of information (environmental education, municipal actions, and information on the basins)	A meeting was held 1 mo. after the crisis; discussion and information exchange among actors on the decisions made by government; workshops to prepare a communications plan (later interrupted)

[†]Local governments include 10 municipalities and four rural communities. Each of the 10 local governments sends two representatives to the Committee: one for the executive and one for the legislative. Rural communities have one representative each.

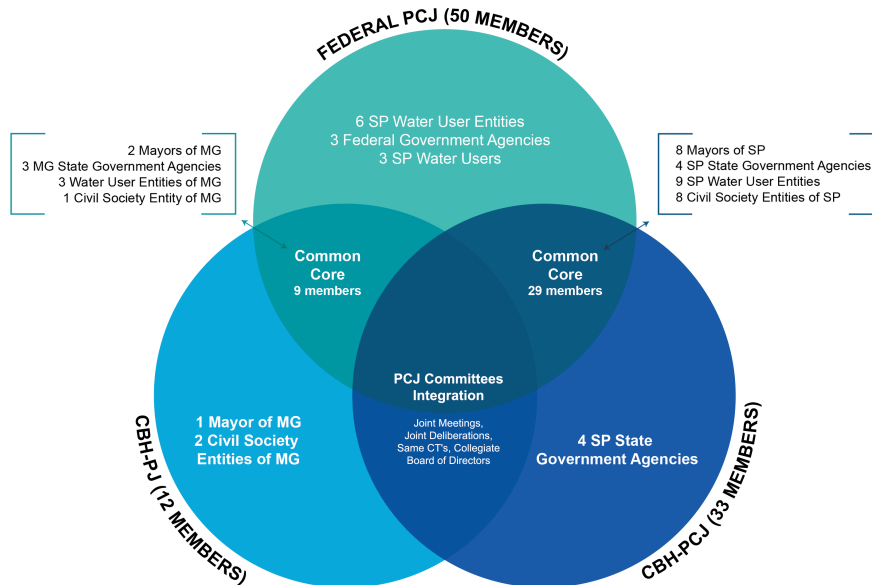
[‡]There is no rule determining a maximum number of organizations per group, and the composition varies over time.

[§]Composition of the board of directors in 2021 (elected in plenary for 2 yrs, with possible re-election).

Although the committee did not play an active role during the crisis, events like these may often leave some lessons learned to better deal with future crises. Because of its explicit role as a joint planning venue, the committee would have been an ideal setting to discuss strategies to address similar crises in the future. Interviewees, however, were critical of the role of the committee as a mechanism to share lessons learned, indicating that most of the learning occurred on the technical side, outside of the committee and within disciplinary silos. Local scientists took this opportunity to learn about river dynamics under periods of stress

(Kaless et al. 2019). As stated by a representative from an irrigation district, “after the event, there were actions of communication (from scientific organizations)”. A representative from a scientific organization (#1) reflected that “it is well established that the issue of sediments in the river is because of these alluvial basins and the area that is eroded [...] Now, if we understand learning in a broader sense, like actions that have been implemented and that will be implemented, I don't see that.” These actions seemed to have found a dead end with decision makers, who soon thereafter had to shift gears to attend to other

Fig. 2. Composition and chart of PCJ Committees: Federal, São Paulo, and Minas Gerais. (Source: Authors' elaboration based on PCJ Committees 2019.)



demands, in true “tyranny of the urgent” mode (Smith 2019), like a financial crisis that has been affecting the province since 2018. Decision makers are aware of the water problem, but no actions or planning have taken place from their end ever since; as one representative from a scientific organization (#4) mentioned, “I don’t see that this issue has reached the municipalities. [...] Or that, if the problem were to occur again, we would once again have a response based on urgency, not something well planned.”

Case Study 2 - Piracicaba-Capivari-Jundiaí Rivers Basin (Brazil)

Characterization of the Basin Committee

The São Paulo State Water Resources Policy (1991)⁴ defines river basin committees as decision-making bodies whose function is to issue opinions and assist in decision making (consultative role). They are composed of non-state actors and state actors at the federal, state, and municipal levels. The committees deliberate internally and make decisions on the issues that concern them, such as proposals for the plan for the use, conservation, protection, and recovery of water resources in the basin. According to the PCJ Committees Statute⁵, part of their objectives as articulators is “to promote the integration of defense actions against critical hydrological events that pose risks to public health and safety, as well as economic or social damage” (item XI, Art. 1°). In addition, committees can recommend changes or guidelines in policies, plans, actions, and projects.

As the Piracicaba, Capivari, and Jundiaí (PCJ) Rivers are on the border between the states of São Paulo and Minas Gerais, there are three basin committees (PCJ committees), which are integrated (Fig. 2). The committee related to the portion in the state of São Paulo (CBH-PCJ), which is the focus of this study, was created in 1993, expanding its composition with the formation

of the federal (Federal PCJ) and Minas Gerais (CBH-PJ) committees, in 2002 and 2008, respectively. The PCJ committees act in a participatory manner through their 12 Technical Chambers (TCs). The TCs are consultative and assist in decision making by supporting the PCJ committees in selecting projects that promote improvements and protect water bodies, in addition to focusing on issues relevant to each TC. The allocation of financial resources from water use charges to these projects is decided in plenary sessions (Comitês das Bacias Hidrográficas dos Rios Piracicaba, Capivari e Jundiaí (PCJ Committees) 2019). In the CBH-PCJ, half of the non-state actors are private users (companies), and the other half are NGOs and academic institutions. Since a 2019 sentence issued by the State Court of Justice to comply with federal legislation, the CBH-PCJ has been composed of 33 members: 8 representing the State, 8 representing municipalities, 9 for civil organizations, and 8 for water user associations. The executive powers of the State and municipalities are now in the minority compared with the total number of civil society and users in the CBH-PCJ plenary.

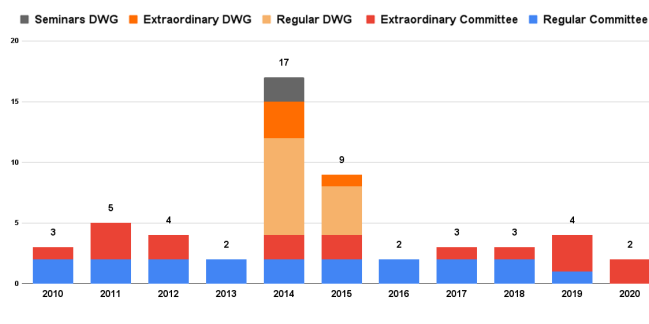
Actions of the Basin Committee during the Crisis

From 2014 to 2015, the southeastern region of Brazil experienced one of its worst ever recorded droughts (Jacobi et al. 2018). The PCJ rivers basin faces the challenge of supplying water to 14 million inhabitants: 5.8 million locally and 9 million in the SPMR through the transposition of water to the Cantareira System⁶, consisting of five reservoirs, covering 2,000 km² (Profill-Rhama Consortium 2020: 57, 193). In a prompt response to the drought, at the beginning of 2014, the CBH-PCJ Committee created a new and temporary technical group to implement water crisis actions (PCJ Committees 2014). The Drought Working Group⁷ (DWG) acted as an advisory nucleus of the Executive Branch of the

committee during the drought season, operating in 2014 and 2015. The actions developed by the DWG included the development of public advertising campaigns about the drought; dissemination of municipal laws created to encourage the reduction of water consumption; knowledge sharing among actors and on social networks about municipal experiences in dealing with water scarcity; monitoring of the Cantareira System with the incorporation of data from public and private users; and guidance to municipalities on preparing contingency plans (PCJ Committees 2021a, 2021b). According to one of the interviewees (São Paulo State representative #05), the DWG “tried to raise and integrate all the demands of each municipality and promoted mutual help between them, mainly from public supply services.”

Figure 3 shows the frequency of plenary meetings involving the CBH-PCJ committee, held from 2010 to 2020. The average annual pattern appears to consist of two regular meetings of the committee to deal with general matters and one extraordinary meeting. During the years of the crisis (2014–2015), however, the DWG mobilized more significant interaction in the basin; 49% of the meetings held in the last 11 yrs took place in those years.

Fig. 3. Number of meetings of the CBH-PCJ Watershed Plenary Session from 2010 to 2020 (DWG: Drought Working Group.) (Authors’ elaboration based on: CBH-PCJ Committee’s minutes.)



Interviewees perceived the involvement of the CBH-PCJ committee during the water crisis differently. Almost half of the interviewees considered that there was little openness for discussions, and many highlighted that the State government of São Paulo seemed to have centralized decision making, reducing the role of the basin committee. On the other hand, other stakeholders had a more positive view of the committee: a civil society representative (#8) pointed out that during the crisis the actions “were integrated at all levels of the committees,” providing a better dialog between the various actors of the Technical Chambers, which has been perpetuated and continues to grow constantly. One water user representative described the vital role of the PCJ committee beyond the committee’s sphere and their members, creating the DWG, intensification in hydrological monitoring, and “a greater alignment, a closer approach with the population,” presenting “a much clearer and more accessible language, as to involve the common citizen and public authorities” (#02). In addition, according to some interviewees (including one state and two non-state actors), the committee now has greater autonomy over the water transposed to the Cantareira System due to the water crisis.

Regarding the lessons learned from the crisis, a small portion of the interviewees pointed out that there were improvements regarding management and governance of the basin committee. According to the representative of the civil society in the Upper Tietê basin (#AT), there have been advances in search of a better technical structure to face future crises and “articulation of the support instances of the basin committees, such as the Technical Chambers.” Advances were also cited in the processes of planning and anticipation actions, within the PCJ Basin Plan, a management instrument driven by the PCJ Committees. This plan includes projections of water demand, as well as the construction of scenarios, which assist in the definition of action plans, objectives, and recommendations to public managers. A representative of the State of São Paulo (#10) reported that there were advances in governance; however, they claimed that “participatory instances have been, at least discussed, but they need to be better implemented, this is an improvement that still needs to happen. I consider that we have to admit that there has been a setback in various situations in relation to social participation.” This issue appears as a key element evoked by more than one respondent. However, as in this quotation, it is not discussed which participatory alternatives should be implemented, or whether the committee’s institutional design must be reformed.

Case Study 3 - Laguna del Cisne Basin (Uruguay)

Characterization of the Basin Committee

The basin commission of Laguna del Cisne in Canelones Department (one of Uruguay’s 19 administrative units) is a forum that brings together government actors at the national, departmental (subnational), and municipal level, as well as civil society organizations (including academia), and users (such as farmers’ organizations) (Table 2). The National Water Directorate (DINAGUA), the highest authority in charge of water management (within the Ministry of Environment), presides over the basin commission (e.g., it is in charge of convening the meetings, although there is no set frequency for that). The operating regulations established that the commission may determine the formation of working groups when needed.

The Laguna del Cisne commission was formed in 2014, at the request of the subnational government (Canelones), and the interest of social organizations, mainly because of an environmental conflict associated with land-use changes (related to soybean plantations in the basin and use of pesticides). There were also concerns about water quality in the lake and in the provision of drinking water. The commission is a consultative, deliberative, and advisory board. It advises DINAGUA and the Regional Council for Water Resources (with tripartite composition like basin commissions), supporting water management and planning (Decree N° 258). The formal responsibilities or duties of the commission include coordination among actors; contributing to the creation and implementation of the water management plan for the basin; strengthening citizen participation; working as a conflict resolution venue; application of management measures or rules; and advising on water use projects and initiatives that could impact the territory.

Actions of the Basin Committee during the Crisis

In 2019, the State water company (OSE, in Spanish) distributed non-potable water with high pH and high turbidity, after an erroneous and unauthorized action by an operator, which

triggered a failure in the water treatment procedures. This “event” (as it was described by some interviewees, who preferred not to call it “a crisis”) started on 3 February 2019, and the effects on the water supply lasted between 3 d and 1 wk. The main impacts were the lack of potable water in 15 locations of coastal Canelones Department (involving about 100,000 people), and some human health issues. Even though only five cases of minor health effects were officially reported, in a letter that was publicly disseminated in early February (addressed also to government organizations), neighborhood associations stated that more cases existed and requested an investigation into this. Moreover, these social organizations emphasized the access to drinking water as a human right, and claimed the right to transparency, access to information (regarding water quality and the reasons behind the event), as well as active participation in water planning, management, and control (as determined in the country’s Constitution, after a referendum in 2004, when a reform was approved).

Approximately 18 mos after the previous session, and 45 d after the event, DINAGUA convened the basin commission. One neighborhood organization (Commission of Neighbors in Defense of Laguna del Cisne - CVDLC), which also signed the above-mentioned letter, dissatisfied with the way in which the government organizations dealt with the event, had expressed their desire to have a meeting of the commission in relation to the crisis. During the session, OSE gave a presentation on the event, followed by presentations from the Regulatory Unit for Energy and Water Services (URSEA) and CVDLC. The meeting allowed for a tense dialog between users, social organizations, and decision makers to make sense of the event and the responses to it (e.g., CVDLC expressed that the Water Safety Plan developed by OSE was produced without social participation).

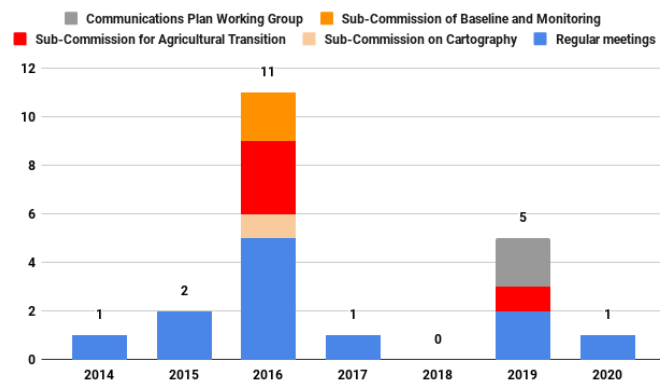
Most interviewees considered that the basin commission acted as a space for dialog and information sharing after the crisis. A representative of the national Ministry of Livestock and Agriculture stated that at this commission session “the hierarchical levels that needed to be present came and talked (...); everyone who had to say something said it; it was democratic, everybody listened to everybody.” An interviewee of the municipal government valued the dialog and debate, adding that the commission should be prepared to inform the population regularly and anticipate events related to water quality. Finally, an interviewee from a farmers’ organization valued the presence of OSE, DINAGUA, and URSEA at the meeting; “the person from URSEA explained how they would start working in the basin to ensure water quality. Maybe that was the good thing about this: what happened (referring to the 2019 event) provides tools so that it doesn’t happen again in the future, hopefully!” However, some interviewees (like OSE members) considered that there had been communication among the parties before the meeting.

The basin commission showed potential for promoting learning, which may lead to institutional and policy changes. A DINAGUA representative stated, “we realized the need to work on the communication theme (...); we had that in mind before, but this (event) was the straw that broke the camel’s back.” During June and August 2019, DINAGUA organized two well-attended workshops to work on the creation of a Communications Plan for the basin commission, although this initiative was later

discontinued (for unknown reasons). The OSE, for example, created new protocols and plans, such as the Water Safety Plan (a change in the institutional settings), which was triggered mainly by three related drivers: the context of the crisis; social pressure brought by CVDLC and neighborhood associations of several locations; and the existing institutional structure, because the regulatory organization (URSEA) called for the acceleration of the adoption of certain plans and measures.

Figure 4 shows the frequency of meetings of the basin commission. After the communications workshops in mid-2019, the next meeting took place virtually in late 2020. The meeting was convened at the request of academic and social actors in relation to an infrastructure project by OSE that would impact the basin. This suggests that the basin commission tends to meet reactively, mainly when emergencies or threats are identified by its members, rather than proactively to plan and anticipate problems or actions. At the same time, a rigid and centralized scheme (at the national level) prevails in the organization of the meetings (e.g., definition of the agendas).

Fig. 4. Frequency of meetings of the Basin Commission of Laguna del Cisne since its creation in 2014. (Authors’ elaboration based on the Committee’s minutes.)



Considering its formal responsibilities, the commission acted partly as expected in response to the 2019 crisis, by facilitating communication and information sharing. This was a partial role because most decisions and coordination had already taken place before the session, mainly through informal interactions between government actors. Moreover, the actions carried out by the committee did not result in a significant change in governance practices, or at least there was no indication that the debates held after the crisis led to any form of institutional change, besides the Water Safety Plan at OSE (which is expected to decrease the chances of future problems in the water treatment plant). In fact, social organizations are still demanding the fulfillment of their right to participate actively in water issues. As stated by a member of CVDLC (at a meeting of the Regional Council for Water Resources in 2021), “We all need to have clarity about the importance of participation in water resources planning because this is mandated by the Constitution; but sometimes when we’re going to give our opinion about a number of projects, they are already ongoing!”

DISCUSSION

The three case studies allowed us to identify the actions (or lack thereof) undertaken by basin committees in Argentina, Brazil, and Uruguay during and after water crises. Findings showed that government actors tend to act and communicate through fast and informal channels when water crises occur, referring to basin committees only for technical and additional support (Brazil), information sharing (Uruguay), or not convening the committee at all (Argentina). Centralized decision making during water crises is common (e.g., Head 2014) as it can allow for quick responses and emergency actions. However, engaging a broader range of coordination mechanisms and involving users and society have also proven to be effective during such occurrences (Sousa et al. 2016, Dieperink et al. 2018). This section discusses the main findings on the role of each basin committee during their corresponding crises, focusing on whether and how each committee facilitated three dimensions of adaptive governance, namely flexibility, collaboration, and learning among stakeholders (Table 3).

Table 3. Summary of key findings on three dimensions of adaptive water governance

	VIRCh (Argentina)	PCJ (Brazil)	Laguna del Cisne (Uruguay)
Flexibility	Basin committee shows no stability and flexibility	Basin committee shows high stability and flexibility	Basin committee shows limited stability and flexibility
Collaboration	Committee was not involved during crisis. Few actors collaborated informally outside the committee	Committee facilitated some debates among a few stakeholders; provided policy recommendations for future crises	Committee facilitated information sharing after crisis. Some government organizations started collaborating before the committee meeting
Learning	Focused on the short-term and limited to academic and technical sectors. Single-loop learning prevailed	Advances in planning and anticipation to future crises. Improvements in operation of basin committee. Double-loop learning prevailed	Focused on the short-term. Some discussions about role of the committee as governance tool. Single-loop learning prevailed

Adaptive water governance can be fostered by legal frameworks (Craig et al. 2017, DeCaro et al. 2017, Cosens and Gunderson 2018). However, because of the need to cope with change, legal frameworks in adaptive governance systems must successfully balance stability and flexibility to be effective and legitimate (i.e., increased flexibility is needed while maintaining certain governance stability) (Craig et al. 2017). Our case studies suggest that the better the balance between stability and flexibility, the better prepared the committees might be for addressing water crises. This is exemplified by the CBH-PCJ committee in Brazil, with nearly three decades of continuous operation (stability), and which, in the face of a crisis, quickly formed the Drought Working Group (flexibility). Also, flexibility and uncertainty are partly recognized in the statutes of this committee, as its objectives

include the promotion of actions against critical events posing risks.

In the case of Laguna del Cisne, the committee shows some indications of stability, such as the occurrence of meetings (mainly when there are conflicts or threats in the basin) and some basic formal rules about how to conduct its business. However, the observed rules could be further developed, for instance, by the inclusion of more explicit formal guidelines on minimum number of annual meetings, which would provide continuity to the committee's work and would also help in relationship building among its members. The actions undertaken by the committee after the 2019 crisis (even though important for information sharing, transparency, and claims for meaningful participation), did not show signs of flexibility. For instance, no working group tasked with follow-up activities related to the crisis was formed. Moreover, there is a risk of rigidity (too much stability) given that the operation of the committee depends almost exclusively on the National Water Directorate.

The Chubut basin committee appears to be a case of an unstable committee (given the absence of regular meetings) with no apparent flexibility. This committee, which has not been active over the past few years and has limited commitment from the provincial government (Olivier and Berardo 2021), neither met nor took action during the crisis. Concentrating the power to call for meetings within the provincial agency, a lack of leadership, and structural aspects (like the over-representation of the government sector compared with users and scientific organizations) may explain this lack of flexibility in the committee, and ultimately its peripheral role in coordinating behavior following a crisis.

Collaboration among multiple actors (networks, partnerships, responsibility sharing) is another building block of adaptive governance (Karpouzoglou et al. 2016). Basin committees and other multistakeholder forums or platforms can foster adaptation and resilience, as they bring together multiple actors and sources of knowledge (Pahl-Wostl et al. 2007, Plummer et al. 2014, Trimble et al. 2021a) within polycentric decision-making settings. Nevertheless, our research showed that the mere existence of these basin committees is not enough to foster collaborative and adaptive actions in the South American context and that sometimes collaboration occurred through other less-formal channels (as shown in Chubut and to some extent in Laguna del Cisne). The three cases studied showed varying degrees of stakeholder collaboration spurred by the basin committees. In two of these settings, the committees served as an after-the-fact space for debate among stakeholders (Laguna del Cisne) or did not channel collaborations at all (Chubut). The reason for this absence of formal collaborations is, in part, due to the historical trajectories followed by the committees studied. The PCJ, and the Brazilian case in general, have a much longer and established history of developed basin committees (with support for these institutions from the federal and state levels—see, for instance Abers 2007, Abers and Keck 2013, for a discussion on the emergence of these institutions). Uruguay and Argentina, on the other hand, show a more recent and haphazard development of basin committees. In the Argentine case, for instance, the design and implementation of such organizations presents a wide degree of variation depending on the province in which it takes place (for

provincial rivers) (Pochat 2005, OECD 2019). A similar picture emerges from Uruguay, where basin committees have operational and performance differences despite their common legal framework (Mazzeo et al. 2021).

The creation of new organizational forms like a basin committee in a country like Argentina, Brazil, or Uruguay, is difficult to carry out without buy-in from stakeholders at different levels (Abers and Keck 2013). As the literature on collaborative governance has shown, obtaining that buy-in requires trust both in the new institution and among the stakeholders involved, and is a process that unfolds over time (Imperial et al. 2016, Trimble and Plummer 2019, Ulibarri et al. 2020). Comparative studies of RBO have shown that time really matters. Basin organizations struggle over their institutional design and their performance after being established, “new organizations that are layered on top of existing ones can eventually transform an institutional regime” (Meijerink and Huitema 2017). Our findings clearly show that PCJ, as a collaborative institution, is in a different stage than its Argentine or Uruguayan counterparts. Most importantly, at least in Chubut and Laguna del Cisne, our findings show that basin committees that have not reached a level of maturity like PCJ’s are unlikely to serve as formal spaces that foster collaboration among stakeholders during crises. When critical events occur, stakeholders in both cases preferred to address them via more informal mechanisms than resorting to convening the basin committee. In order to become the go-to spaces that foster collaboration during crises, these basin committees may benefit from stronger and explicit government support (Huitema et al. 2009), paired with efforts for including diverse sectors among its members (Olivier and Berardo 2021), as well as effective communication mechanisms.

Although the basin committees were perhaps not impactful in the overall governance outcomes, some of them opened up opportunities for learning, by facilitating information exchange and dissemination as well as intensification in hydrological and limnological monitoring. Collecting and processing information about water quality/availability and about climate events and their impacts is an important dimension of adaptive capacity (Hurlbert and Diaz 2013), which can potentially improve how organizations address future crises. For example, the PCJ case included projections of water demand and the construction of scenarios, and in PCJ and Laguna del Cisne fostered advances in monitoring programs, management, and action plans. In Chubut, it is important to stress the active participation of the water cooperatives in the development of a platform for turbidity measurement since the crisis. Despite such promising learning processes, in the three cases, there was a prevalence of decisions and solutions oriented to addressing problems in the short term and focused on technical aspects (i.e., infrastructure), dealing with uncertainty with the goal to foster predictive capabilities, typical of single-loop learning (Pahl-Wostl 2009). We found no evidence of the crises triggering deeper policy discussions regarding, for instance, setting decision-making mechanisms that would facilitate fast collaboration between key stakeholders during crises, which would be a sign of transformative triple-loop learning. This learning implies a change in paradigm, reframing resources governance and involving additional actors, among others (Pahl-Wostl 2009). Higher levels of learning are an indicator of higher adaptive capacity for management (see

Huntjens et al. 2010 for empirical cases on learning and adaptive and integrated water management). However, the three cases show some initial signs of double-loop learning, such as the increased informal knowledge exchange between levels and the creation of informal coordination groups to address the crises.

In sum, our cases provided empirical evidence of the barriers that basin committees face as institutions to foster adaptive water governance (e.g., limited stability and flexibility, centralization, lack of leadership). The dynamics of the studied basin committees during the water crises are partly associated with their institutional design, which appears to impose some limitations. The institutional histories, structures, aims, and agendas of basin committees depend greatly on the biophysical and socio-political context in which they are set (Meijerink and Huitema 2017, Mancilla Garcia and Bodin 2019). Moreover, the broader socio-economic and political context at the national level, such as financial crises (Argentina) and changes in government coalitions (Brazil and Uruguay), also influence the operation and actions of local basin committees.

Analyzing the actions of basin committees during important water crises raises a more fundamental question: what is the extent of decision making, enforcement, and overall authority that should be granted to these interjurisdictional venues to properly deal with water crises? As shown by the Chubut and to some extent by the Laguna del Cisne cases, basin committees are rendered powerless when they are not granted the institutional tools to effectively foster collaboration among decision makers and other actors. When this happens, the existence of a basin committee may become a hindrance in situations of crisis where fast and effective coordination is required.

It is important to recognize that the nature and triggering factors of the three crises were quite different: the crises in Chubut (Argentina) and PCJ (Brazil) had their origin in climatic events (extraordinary rainfall and intense drought, respectively) that were exacerbated by poor management, whereas the crisis in Laguna del Cisne (Uruguay) was caused by wrong actions taken at the water treatment plant associated with communication flaws with social actors and resource users. Huntjens et al. (2010) found that the response/adaptation to droughts seems to be slower than the one related to floods, indicating that this finding could be explained by differences in risk perceptions and solutions available, but also by the nature of the problem itself. Future work should address whether fast-occurring crises (i.e., floods, an unexpected turbidity event, or a human error in water treatment) ought to require the same level of coordination as slow-onset crises (such as drought or saltwater intrusion). For instance, the Laguna del Cisne case (triggered by human errors) may lead to different policy learnings from those that we would expect in Chubut or PCJ, where the crises were triggered by environmental (albeit human-caused, i.e., climate change) variables. In addition, the Chubut case showcases a fast-occurring crisis triggered by excess rainfall, whereas in Brazil the crisis has been years in the making. In both cases, we would have expected lessons learned that allow bolstering policy and decision-making mechanisms to reduce the impacts of similar crises. This learning, however, should not lead to the same policy recommendations: in Chubut, we would have expected mechanisms that facilitate deploying fast collaboration and resources among key actors during such

punctuated events, whereas in Brazil, we would have expected the development of mechanisms that facilitate broad involvement of affected sectors over sustained periods of time.⁸ Finally, adaptive governance requires mechanisms for monitoring and evaluation of agreed plans and actions, instances for a periodic adjustments or definitions of new actions or strategies.

CONCLUSIONS

The cases analyzed in this article illustrate the challenges faced by governments and stakeholders in the Southern Cone as new participatory approaches to governing shared water resources are adopted. In the cases studied, the capacities for adaptation and anticipation in the face of shocks or crises (anticipated or not) appear to be limited. Although all three cases show considerable progress in fostering interactions between technical–governmental and academic actors as a result of crises, challenges remain regarding how to translate these interactions into effective policies to adapt to emerging and reoccurring problems.

Most research on adaptive governance has been carried out in the Global North. Even though there have been claims for comparative studies in countries in the Global South (Karpouzoglou et al. 2016, Özerol et al. 2018), the literature still has not provided enough examples of it. This article contributes to this field of study by conducting a comparative analysis of the actions undertaken by basin committees during water crises in three South American countries (Argentina, Brazil, and Uruguay).

Our analysis in different contexts (e.g., institutional structures, water management, basin committee design), and the consideration of different administrative levels and geographical scales allowed for a deeper understanding of some of the challenges faced in South American countries for incorporating components of adaptive water governance. Concentration of power in upper government levels (a trait of centralized and hierarchical governance) hinders the potential that basin committees could have in fostering participatory water governance.

Our research suggests that basin committees with a balance between stability and flexibility, with a record of sustained activities (i.e., meetings and participation in those meetings by members), an explicit and formalized role in decision making (even though advisory), and stakeholders that recognize the committee as the main venue to address collective action problems regarding water governance issues are better prepared for addressing or responding to water crises, by taking quick actions when these occur.

This work, of course, is not devoid of limitations. Our analysis explored three different crises in three countries, each with their own institutional, political, and cultural dynamics. Doing so allowed us to identify common trends that occur in the Global South that may not be common or expected in the Global North. Future work should further explore within-case comparisons to assess the performance of basin committees in addressing similar problems within the same sociopolitical context.

Although climate change is already introducing long-term trends on the quantity and quality of water resources across many watersheds in the world (Intergovernmental Panel on Climate Change (IPCC) 2014), including some of those studied here

(Pessacq et al. 2020), its actual effects on the water supply of cities are still mediated by multiple variables that blur this signal. Specifically, the face of extreme events with their stochastic nature mounted on top of the long-term effects of climate change, along with governance deficits, is what triggers most climate-related crises. If our goal is to better prepare for new climate-related crises, we must therefore continue to expand our understanding of what works, when, and how.

¹<http://saras-institute.org/governagua-transforming-water-governance-in-south-america-from-reaction-to-adaptation-and-anticipation/>

² At the time of the writing of this article, the last meeting of the committee took place in April 2018.

³ Available in Spanish here: <http://institutodelagua.chubut.gov.ar/documentos/estatuto-comite-de-cuenca/5/estatuto-para-el-comite-de-cuenca-de-rio-chubut>

⁴ Law of São Paulo State, n.º 7.663, 30 of December 1991. Establish norms to guide the State Policy for Water Resources and the Integrated System for Water Resources Management.

⁵ Available in: https://www.comitespcj.org.br/index.php?option=com_content&view=article&id=214&Itemid=219.

⁶ The Cantareira System is responsible for supplying 46% of the SPMR; 94% of the water demand in the Cantareira system relies on the water availability of the PCJ basin (ANA 2021).

⁷ The DWG was composed of executive secretaries of the PCJ, representatives of the PCJ Basin Agency, one member of each Technical Chamber, representatives of regulatory agencies for sanitation and energy and representatives of institutions in the water user sectors (PCJ Committees 2014).

⁸ The State of São Paulo has been facing a new water shortage in 2021. It is worth highlighting that in the face of this potential new crisis, in June 2021, the PCJ Committee has created the “2021 Drought Working Group”.

Responses to this article can be read online at:
<https://www.ecologyandsociety.org/issues/responses.php/13356>

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Data Availability:

The data that support the findings of this study are available on request from the corresponding author, MT. None of the data are publicly available because they contain information that could compromise the privacy of research participants. Ethical approval for this research study was granted by the Federal University of the ABC (CAAE: 29854220.5.0000.5594).

LITERATURE CITED

- Abers, R. N. 2007. Organizing for governance: building collaboration in Brazilian river basins. *World Development* 35 (8):1450-1463. <https://doi.org/10.1016/j.worlddev.2007.04.008>
- Abers, R. N., and M. E. Keck. 2013. Practical authority: agency and institutional change in Brazilian water politics. Oxford University Press, New York, New York, USA.
- Agencia Nacional de Águas e Saneamento Básico (ANA). 2021. Sistema Cantareira. Ministério do Desenvolvimento Regional. URL: <https://www.gov.br/ana/pt-br/sala-de-situacao/sistema-cantareira/sistema-cantareira-saiba-mais>
- Baird, J., and R. Plummer. 2021. The emergence of water resilience: an introduction. Pages 3-19 in J. Baird and R. Plummer, editors. *Water resilience: management and governance in times of change*. Springer International Publishing, Cham, Switzerland.
- Berardo, R., M. Meyer, and T. Olivier. 2013. Adaptive governance and integrated water resources management in Argentina. *International Journal of Water Governance* 1(3):219-236. <https://doi.org/10.7564/13-IJWG9>
- Berardo, R., T. Olivier, and A. Lavers. 2015. Focusing events and changes in ecologies of policy games: evidence from the Paraná River Delta: focusing events in ecologies of policy games. *Review of Policy Research* 32(4):443-464. <https://doi.org/10.1111/ropr.12128>
- Chaffin, B. C., H. Gosnell, and B. A. Cosens. 2014. A decade of adaptive governance scholarship: synthesis and future directions. *Ecology and Society* 19(3):56. <https://doi.org/10.5751/ES-06824-190356>
- Comisión de Cuenca de Laguna del Cisne (CCLC). 2017. Comisión de Cuenca Laguna del Cisne. Asistencia a la transición agroecológica de sistemas productivos en la Cuenca de la Laguna del Cisne (CLC). 8ª Sesión de la Comisión de Cuenca de la Laguna del Cisne, 4 de agosto de 2017. URL: https://www.gub.uy/ministerio-ambiente/sites/ministerio-ambiente/files/2020-12/Anexo_III_Presentacion_ADR-IDC.pdf
- Comitês das Bacias Hidrográficas dos Rios Piracicaba, Capivari e Jundiá (PJC Committees). 2014. Deliberação dos Comitês PCJ nº 197, de 27 de março de 2014. Creates the Working Group for the institution of the "Operation of PCJ Estiagem - 2014." URL: <https://www.comitespcj.org.br/images/Download/DelibComitesPCJ197-14.pdf>
- Comitês das Bacias Hidrográficas dos Rios Piracicaba, Capivari e Jundiá (PJC Committees). 2019. Relatório de Atividades dos Comitês PCJ - Exercício 2019. PCJ Committees Annual report. Piracicaba, São Paulo, Brazil. URL: <http://www.agencia.baciaspcj.org.br/docs/relatorios/relatorio-atividades-comites-pcj-2019.pdf>
- Comitês das Bacias Hidrográficas dos Rios Piracicaba, Capivari e Jundiá (PJC Committees). 2021a. GT Estiagem - 2014. Comitês PCJ. URL: http://www.comitespcj.org.br/index.php?option=com_content&view=article&id=439:gt-estiagem-atividades&catid=163
- Comitês das Bacias Hidrográficas dos Rios Piracicaba, Capivari e Jundiá (PJC Committees). 2021b. GT Estiagem - 2015. Comitês PCJ. URL: http://www.comitespcj.org.br/index.php?option=com_content&view=article&id=526:gt-estiagem-apresentacao&catid=38:ct-pl-planejamento
- Cosens, B., and L. Gunderson. 2018. Practical panarchy for adaptive water governance: linking law to social-ecological resilience. Springer International Publishing, Cham, Switzerland.
- Cosens, B. A., and M. K. Williams. 2012. Resilience and water governance: adaptive governance in the Columbia River Basin. *Ecology and Society* 17(4):3. <http://dx.doi.org/10.5751/ES-04986-170403>
- Craig, R. K., A. S. Garmestani, C. R. Allen, C. A. T. Arnold, H. Birgé, D. A. DeCaro, A. K. Fremier, H. Gosnell, and E. Schlager. 2017. Balancing stability and flexibility in adaptive governance: an analysis of tools available in U.S. environmental law. *Ecology and Society* 22(2):3. <https://doi.org/10.5751/ES-08983-220203>
- Creswell, J. W. 2013. *Qualitative inquiry and research design: choosing among five approaches*. SAGE Publications, Thousand Oaks, California, USA.
- DeCaro, D. A., B. C. Chaffin, E. Schlager, A. S. Garmestani, and J. B. Ruhl. 2017. Legal and institutional foundations of adaptive environmental governance. *Ecology and Society* 22(1):32. <https://doi.org/10.5751/ES-09036-220132>
- Dieperink, C., H. Mees, S. Priest, K. Ek, S. Bruzzone, C. Larrue, and P. Matczak. 2018. Managing urban flood resilience as a multilevel governance challenge: an analysis of required multilevel coordination mechanisms. *Ecology and Society* 23(1):31. <https://doi.org/10.5751/ES-09962-230131>
- Dietz, T., E. Ostrom, and P. C. Stern. 2003. The struggle to govern the commons. *Science* 302(5652):1907-1912. <https://doi.org/10.1126/science.1091015>
- Folke, C. 2016. Resilience (republished). *Ecology and Society* 21 (4): 44. <https://doi.org/10.5751/ES-09088-210444>
- Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30:441-473. <https://doi.org/10.1146/annurev.energy.30.050504.144511>
- Global Water Partnership (GWP). 2000. *Towards water security: a framework for action*. GWP, Stockholm, Sweden and London, UK.
- Hanrahan, M., and B. Dosu. 2017. The rocky path to source water protection: a cross-case analysis of drinking water crises in small communities in Canada. *Water* 9(6):388. <https://doi.org/10.3390/w9060388>
- Head, B. 2014. Managing urban water crises: adaptive policy responses to drought and flood in Southeast Queensland, Australia. *Ecology and Society* 19(2): 33. <http://dx.doi.org/10.5751/ES-06414-190233>
- Huitema, D., and S. Meijerink. 2017. The politics of river basin organizations: institutional design choices, coalitions, and consequences. *Ecology and Society* 22(2): 42. <https://doi.org/10.5751/ES-09409-220242>

- Huitema, D., E. Mostert, W. Egas, S. Moellenkamp, C. Pahl-Wostl, and R. Yalcin. 2009. Adaptive water governance: assessing the institutional prescriptions of adaptive (co-)management from a governance perspective and defining a research agenda. *Ecology and Society* 14(1): 26. <http://www.ecologyandsociety.org/vol14/iss1/art26/>
- Huntjens, P., C. Pahl-Wostl, and J. Grin. 2010. Climate change adaptation in European river basins. *Regional Environmental Change* 10:263-284.
- Hurlbert, M. A., and H. Diaz. 2013. Water governance in Chile and Canada: a comparison of adaptive characteristics. *Ecology and Society* 18(4): 61. <http://dx.doi.org/10.5751/ES-06148-180461>
- Imperial, M. T., E. Johnston, M. Pruett-Jones, K. Leong, and J. Thomsen. 2016. Sustaining the useful life of network governance: life cycles and developmental challenges. *Frontiers in Ecology and the Environment* 14(3):135-144. <https://doi.org/10.1002/fee.1249>
- Intergovernmental Panel on Climate Change (IPCC). 2014. Climate change 2014: impacts, adaptation, and vulnerability. Part B: regional aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, New York, USA.
- Jacobi, P. R., N. Bujak, and A. N. Souza. 2018. Pénurie hydrique et crise de gouvernance dans la Région métropolitaine de São Paulo. *Bresil(s)* 13. <https://doi.org/10.4000/bresils.2506>
- Jacobi, P. R., P. Sinisgalli, Y. Medeiros, and A. Romeiro. 2009. Governança da Água no Brasil - Dinâmica da política nacional e desafios para o futuro. In P. R. Jacobi and P. Sinisgalli, editors. *Governança da água e políticas públicas na América Latina e Europa*. Anablume, São Paulo, Brazil.
- Kaless, G., M. A. Pascual, S. Flaherty, A. Liberoff, M. I. García Asorey, L. Brandizi, and N. Pessacg. 2019. Ecos de la tormenta de Comodoro Rivadavia en el valle inferior del Río Chubut. Aporte de sedimentos al Río Chubut desde la cuenca del Río Chico. In J. M. Paredes, editor. *Comodoro Rivadavia y la Catástrofe de 2017: Visiones múltiples para una ciudad en riesgo*. Universidad Nacional de la Patagonia San Juan Bosco, Argentina. URL: <https://ri.conicet.gov.ar/handle/11336/107426>
- Karpouzoglou, T., A. Dewulf, and J. Clark. 2016. Advancing adaptive governance of social-ecological systems through theoretical multiplicity. *Environmental Science and Policy* 57:1-9. <https://doi.org/10.1016/j.envsci.2015.11.011>
- Lázaro, M., I. Bortagaray, M. Trimble, and C. Zurbriggen. 2021. Citizen deliberation in the context of Uruguay's first National Water Plan. *Water Policy* 23(3):487-502.
- Lemos, M. C., B. P. Puga, R. M. Formiga-Johnsson, and C. K. Seigerman. 2020. Building on adaptive capacity to extreme events in Brazil: water reform, participation, and climate information across four river basins. *Regional Environmental Change* 20: 53. <https://doi.org/10.1007/s10113-020-01636-3>
- Mancilla García, M., and Ö. Bodin. 2019. Participatory water basin councils in Peru and Brazil: expert discourses as means and barriers to inclusion. *Global Environmental Change* 55:139-148. <https://doi.org/10.1016/j.gloenvcha.2019.02.005>
- Mandarano, L. A., and R. J. Mason. 2013. Adaptive management and governance of Delaware River water resources. *Water Policy* 15(3):364-385. <https://doi.org/10.2166/wp.2012.077>
- Mazzeo, N., C. Zurbriggen, C. J. Sciandro, M. Trimble, I. Gadino, and D. Pérez. 2021. Agua, ambiente y territorio: avances, barreras y desafíos en la gobernanza de los recursos hídricos. In G. Bidegain, M. Freigedo, and C. Zurbriggen Fin de un ciclo: balance del Estado y las políticas públicas tras 15 años de gobiernos de izquierda en Uruguay. Instituto de Ciencia Política, Facultad de Ciencias Sociales, Montevideo, Uruguay.
- Meijerink, S., and D. Huitema. 2017. The institutional design, politics, and effects of a bioregional approach: observations and lessons from 11 case studies of river basin organizations. *Ecology and Society* 22(2): 41. <https://doi.org/10.5751/ES-09388-220241>
- Ministerio de Ambiente (MA). 2020. Comisión de Cuenca de la Laguna del Cisne, 4 de diciembre de 2020. URL: <https://www.gub.uy/ministerio-ambiente/politicas-y-gestion/comision-cuenca-laguna-del-cisne#:~:text=Es%20un%20%C3%A1mbito%20tripartito%2C%20integrado,agua%20y%20la%20sociedad%20civil>
- Olivier, T, and R. Berardo. 2021. Birds of a feather fight together: forum involvement in a weakly institutionalized ecology of policy games. *Policy Studies Journal* 50(1):176-198. <https://doi.org/10.1111/psj.12418>
- Organisation for Economic Co-operation and Development (OECD). 2019. Water governance in Argentina. OECD Publishing, Paris, France. <https://doi.org/10.1787/bc9ccb6f-en>
- Özerol, G., J. Vinke-de Kruijf, M. C. Brisbois, C. Casiano Flores, P. Deekshit, C. Girard, and S. Barbara. 2018. Comparative studies of water governance: a systematic review. *Ecology and Society* 23 (4): 43. <https://doi.org/10.5751/ES-10548-230443>
- Pahl-Wostl, C. 2009. A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global Environmental Change* 19 (3):354-365.
- Pahl-Wostl, C. 2019a. Governance of the water-energy-food security nexus: a multi-level coordination challenge. *Environmental Science and Policy* 92:356-367. <https://doi.org/10.1016/j.envsci.2017.07.017>
- Pahl-Wostl, C. 2019b. The role of governance modes and meta-governance in the transformation towards sustainable water governance. *Environmental Science and Policy* 91:6-16.
- Pahl-Wostl, C., M. Craps, A. Dewulf, E. Mostert, D. Tabara, and T. Taillieu. 2007. Social learning and water resources management. *Ecology and Society* 12: 5.
- Pascual, M. A., T. Olivier, L. Brandizi, P. Rimoldi, H. A. Malnero, and G. Kaless. 2020. Análisis de Factibilidad de Fondo Agua Cuenca del Río Chubut, Argentina (p. 197). Alianza Latinoamericana de Fondos de Agua. URL: http://www.repositorio.cenpat-conicet.gov.ar/bitstream/handle/123456789/1271/Reporte_Pascual_Olivier_etal_2020.pdf?sequence=1&isAllowed=y
- Pessacg, N., S. Flaherty, S. Solman, and M. Pascual. 2020. Climate change in northern Patagonia: critical decrease in water resources.

Theoretical and Applied Climatology 140:807-822. URL: <https://doi.org/10.1007/s00704-020-03104-8>

Plummer, R., J. Baird, M. L. Moore, O. Brandes, J. Imhof, and K. Krievins. 2014. Governance of aquatic systems: what attributes and practices promote resilience? *International Journal of Water Governance* 2(4):1-18.

Pochat, V. 2005. Entidades de gestión del agua a nivel de cuencas: Experiencia de Argentina. Naciones Unidas, CEPAL, Santiago, Chile. <https://archivo.cepal.org/pdfs/Waterguide/LC12375S.PDF>

Pollachi, A. 2019. Aplicação do Fundo Estadual de Recursos Hídricos nas áreas de mananciais da Bacia do Alto Tietê. Thesis, Universidade Federal do ABC, São Paulo, Brazil.

Profill-Rhama Consortium. 2020. Relatório Final - Plano de Recursos Hídricos das Bacias Hidrográficas dos Rios Piracicaba, Capivari e Jundiá, 2020 a 2035. Piracicaba, São Paulo, Brazil. URL: <https://plano.agencia.baciaspcj.org.br/o-plano/documentos/relat%C3%B3rio-final>

Sassano, K., P. Iccardi, G. Giordano, R. García, G. Parrilla, A. Reyes, and P. García. 2019. Análisis del conflicto ambiental de la Cuenca de la Laguna del Cisne: territorio en disputa. IV Congreso ciencias sociales agrarias. Facultad de Agronomía, Montevideo, Uruguay. URL: http://www.fagro.edu.uy/images/stories/DptoCCSS/doc/resumenes/trabajos_completos/An%C3%A1lisis_del_conflicto_ambiental_de_la_Cuenca_de_la_Laguna_del_Cisne_agua_y_agriculturas_en_disputa.pdf

Smith, J. 2019. Overcoming the 'tyranny of the urgent': integrating gender into disease outbreak preparedness and response. *Gender and Development*, 27(2):355-369. <https://doi.org/10.1080/13552074.2019.1615288>

Sousa, W. Jr., C. Baldwin, J. Camkin, P. Fidelman, O. Silva, S. Neto, and T. F. Smith. 2016. Water: drought, crisis and governance in Australia and Brazil. *Water* 8: 493. <https://doi.org/10.3390/w8110493>

Srinivasan, V., E. F. Lambin, S. M. Gorelick, B. H. Thompson, and S. Rozelle. 2012. The nature and causes of the global water crisis: syndromes from a meta-analysis of coupled human-water studies. *Water Resources Research* 48(10): W10516. <https://doi.org/10.1029/2011WR011087>

Taylor, P. L., and D. A. Sonnenfeld. 2017. Water crises and institutions: inventing and reinventing governance in an era of uncertainty. *Society and Natural Resources* 30(4):395-403. <https://doi.org/10.1080/08941920.2017.1274208>

Torres, P. H. C., P. L. Cortes, and P. R. Jacobi. 2020. Governing complexity and environmental justice: lessons from the water crisis in metropolitan São Paulo (2013–2015). *Revista Desenvolvimento e Meio Ambiente* 53:61-77.

Trimble, M., P. R. Jacobi, T. Olivier, M. A. Pascual, C. Zurbriggen, L. Garrido, and N. Mazzeo. 2021a. Reconfiguring water governance for resilient social-ecological systems in South America. Pages 113-135 in J. Baird and R. Plummer, editors. *Water resilience: management and governance in times of change*. Springer International Publishing, Cham, Switzerland.

Trimble, M., and R. Plummer. 2019. Participatory evaluation for adaptive co-management of social-ecological systems: a transdisciplinary research approach. *Sustainability Science* 14:1091-1103.

Trimble, M., P. H. C. Torres, P. R. Jacobi, N. D. Tadeu, F. Salvadores, L. Mac Donnell, T. Olivier, G. Giordano, L. A. P. dos Anjos, I. M. Santana-Chaves, M. Pascual, Mazzeo, N., and E. Jobbágy. 2021b. Towards adaptive water governance in South America: lessons from water crises in Argentina, Brazil, and Uruguay. Pages 31-46 in W. Leal Filho, U. Miranda Azeiteiros and A. F. Freitas Setti, editors. *Sustainability in natural resources management and land planning*. World Sustainability Series, Springer, Cham, Switzerland.

Ulibarri, N., K. Emerson, M. T. Imperial, N. W. Jager, J. Newig, and E. Weber. 2020. How does collaborative governance evolve? Insights from a medium-n case comparison. *Policy and Society* 39(4):617-637. <https://doi.org/10.1080/14494035.2020.1769288>