The potential for adaptive water governance on the US–Mexico border: application of the OECD's water governance indicators to the Rio Grande/Bravo basin

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Abstract

Despite decades of political commitments, laws and agreements and significant policy effort, the governance system in the Rio Grande/Bravo basin is not able to meet the water demands generated by a growing region. Long stretches of the river are completely dry for much of the year, and water managers cannot meet full allocations to water users, let alone ensure water quality and quantity for environmental services and sustainability. Both academic scholarship and policy analysis attribute failures such as this to the inability of current water governance regimes to respond to rapidly changing circumstances – to 'adapt'. The adaptive governance literature calls for resource management regimes that are distributed yet coordinated through polycentric arrangements, as well as flexible; that promote broader engagement and that generate and disseminate knowledge as well as stimulate learning in the face of complexity and uncertainty. This paper reports on the results of qualitative empirical research which applies the OECD's water governance indicators as a diagnostic tool in order to identify the most significant adaptive governance gaps in the transboundary Rio Grande/Bravo basin.

Keywords: Adaptive governance; Rio Grande/Bravo basin; Water governance indicators; Water scarcity

Highlights

- This paper applies, for the first time, the OECD's 36 Water Governance Indicators in the transboundary Rio Grande/Bravo basin.
- Insights from the Adaptive Governance literature are used alongside the OECD WGIs to conduct a governance gap analysis.
- The methodology employs a unique blend of indicator analysis combined with interviews.

Climate change is exacerbating the problems facing governance regimes in transboundary river and lake systems around the world, even as they struggle to cope with the combined impacts of population and economic growth, as well as changing consumption patterns (IUCN & UNECE, 2017). Complex water systems located in arid regions, such as the Rio Grande/Bravo basin, are particularly challenged, and the need for better governance system performance is even more acute. The Rio Grande/Bravo basin is one of the fastest-growing regions in the US and Mexico, with the population expecting to double (or more) over 2020–2070 (Texas Water Development Board, 2016, I-4). It is widely acknowledged by officials that the region will not be able to meet the water demands generated by this growth (US Bureau of Reclamation, 2011). Long stretches of the river are completely dry for much of the year, and water managers cannot meet full allocations to water users, let alone ensure water releases for environmental services and sustainability.

Both academic scholarship and policy analysis attribute failures such as this to the inability of existing water governance regimes to respond to rapidly changing circumstances – to 'adapt'. These studies, loosely gathered under the umbrella concept of 'adaptive governance' (Karpouzoglou *et al.*, 2016), call for resource management regimes in which power is distributed yet coordinated (Pahl-Wostl & Knieper, 2014); that can link stakeholders and officials within cross-scale, collaborative networks (Pahl-Wostl, 2009); that are more flexible (McCaffrey, 2003); and that can generate and disseminate knowledge as well as stimulate learning in the face of complexity and uncertainty (Folke *et al.*, 2005). Alongside this multidisciplinary discussion, scholars, practitioners and international organizations have experimented with 'governance indicators', in an effort to create diagnostic tools that can assess the presence and operation of particular attributes linked to more effective resource management, especially those relating to adaptability.

In 2015, the OECD released 12 water governance 'principles', intended to guide the design and implementation of more effective water management regimes in a context of growing demands worldwide for this 'limited and highly variable resource' (OECD, 2015). The OECD then translated these principles into 36 water governance indicators that would provide a means for gauging the degree to which the principles were reflected in the design of governance regimes (OECD, 2018). These indicators, which have been applied within OECD jurisdictions at various scales, have been deemed helpful in terms of diagnosing gaps in water governance within countries. Given the reality that most complex water systems are shared between two or more jurisdictions, however, we push the OECD's water governance indicators one step further, in terms of their utility for examining the adaptiveness of a *transboundary* water governance system, specifically in the case of the shared US–Mexico Rio Grande/Bravo basin. The application of the OECD indicators in the Rio Grande/Bravo case highlights the ability of the indicators to shed light on adaptive governance strengths and weaknesses in the basin, as well as signal future directions for pursuing adaptive governance in water-poor regions like the RGB. However, the case findings also point to challenges of indicator application in multi-scale contexts where both surface and subsurface waters must be accounted for in governance regimes.

The Rio Grande/Bravo: a complex water system in crisis

In 2018, the Rio Grande/Bravo (RGB) was named 'one of America's most endangered rivers', an ecological system at a crossroads in terms of its ability to endure increased human demands and an impending border wall (American Rivers, 2018). The RGB is the fifth longest river in the United

States, and the 2019-km portion that forms the US–Mexico border from El Paso, Texas to the Gulf of Mexico flows through mountains and deserts. The Basin has been completely modified; in the New Mexico and Texas portion, the U.S. Bureau of Reclamation manages the large Elephant Butte and Caballo Dams, 6 diversion dams, 224 km of canals, 735 km of laterals, 748 km of drains and a hydro-electric powerplant (USBR, n.d.). This hard infrastructure on the RGB has been put in place primarily to regulate the flow of water between the US and Mexico, and to supply farmers. For over a century, water in the RGB has been discussed almost exclusively in terms of allocation totals, or how much surface water each country would receive annually from various portions of the river under the *1906 Convention Between the United States and Mexico on the Equitable Distribution of the Water of the Rio Grande* and the *1944 Water Treaty for the Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande*.

In fact, under the provisions of these treaties, the waters of the Rio Grande are fully (and actually over-) allocated to the US and to Mexico, with large amounts dammed for human use and consumption as well as withdrawn for irrigation purposes, such that 'the flow of the river in the section downstream of Ciudad Juarez/El Paso is severely depleted' (Fabiola Nava *et al.*, 2016). It is important to recognize that the binational portion of the Rio Grande (from El Paso on the Texas western border to the Gulf) actually operates as two separate segments in terms of water allocations and sharing (see Figure 1): the first, from south of Elephant Butte Dam past the water withdrawals and return flows of El Paso, TX and Ciudad Juarez, Chihuahua; and the second, from Fort Quitman through to where the Rio Conchos flows into the Rio Grande and down to the Gulf of Mexico (Carter *et al.*, 2017). Under the 1906 Convention, in the first segment, the US must deliver 60,000 acre feet (AF) per year to Mexico, but the flows may be proportionately reduced in both countries during periods of drought, without the water having to be 'repaid' later. Since 2012, deliveries have been reduced every year, by as much as 70% (Ibid).

For the stretch below Fort Quitman, under the 1944 Treaty, Mexico has the right to keep two-thirds of the flows that feed into the Rio Grande from the six tributaries flowing from Mexico but must deliver one-third of flows from these sources to the US (*1944 Water Treaty*, Articles 4A and 4B). These water
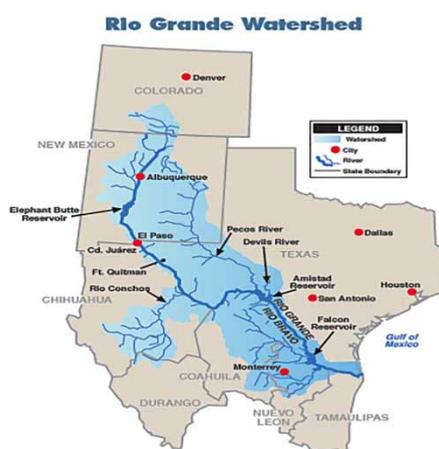

Fig. 1. Rio Grande/Bravo Basin showing major reservoirs. *Source:* Carter *et al.* (2017). US–Mexican Water Sharing: Background and Recent Developments. Congressional Research Service https://fas.org/sgp/crs/row/R43312.pdf (accessed 9 June 2020).

deliveries must average at least 350,000 AF per year, measured in 5-year cycles. If Mexico fails to meet this minimum requirement due to conditions of 'extraordinary drought' (not defined in the Treaty), as was the case over the 2010–2015 cycle, it must make this up during the course of the next 5-year cycle (Mexico delivered on its 'water debt' in 2016). Mexico is once again in debt for the 2015–2020 cycle, and officials on the US side are (at the time of writing) pressuring Mexico to release water to the US (TCEQ, 2020).

The key message here is that, in both 'management segments' on the Rio Grande/Bravo, the demands for water regularly exceed supply, which is perhaps not surprising given that the original supply assumptions embedded in treaties were based on periods of relative water abundance many decades ago. This imbalance is greatly exacerbated in periods of drought, yet stakeholders – and particularly farmers – have not lowered their allocation expectations. The RGB complex water system is thus one of scarcity, and users wait year-to-year to see whether they will get their full allocation, with little change in behaviour. If not, as is now regularly the case, they supplement by pumping groundwater.

Correspondingly, the formal transboundary governance regime is also focused on the allocation of surface water. The 1944 Treaty expanded the role of the International Boundary and Water Commission (IBWC)/la Comisión Internacional de Límites y Aguas (CILA), which has separate US and Mexican sections that work collaboratively to enforce the rules and regulations of the water-related treaties and agreements signed by the two countries. The IBWC is also tasked with monitoring the water's conditions and issuing reports on these conditions. Significantly, under the Treaty, the IBWC can issue a 'Minute', which is the official, binding documentation of decisions made by the Commission at binational meetings to respond to particular situations that may arise. The Minute process has been described by Fabiola Nava *et al.* (2016, 300) as providing a measure of flexibility in the US–Mexico water regime 'for addressing changing circumstances and support[ing] continuing and emerging issues.'

While most Minutes respond to particular problems (e.g., how water is shared during periods of drought), Minute 308, entitled 'United States Allocation of Rio Grande Waters During the Last Year of the Current Cycle' (issued in 2002) represented an initial attempt to promote a more sustainable approach to water management in the Rio Grande/Bravo basin. It outlined a course of action whereby stakeholder participation, information exchange and funding for water conservation, especially for the modernization of irrigation, were prioritized (IBWC, 2002). Several Minutes since then have included measures to promote conservation and improved water quality in river basins, as well as bring a broader range of communities into discussions about how to manage the region's water.

In the meantime, other initiatives are being undertaken by both governmental and nongovernmental actors. For example, an ambitious initiative aimed at developing and operationalizing a truly binational watershed approach to managing water on the Lower Rio Grande was in place for almost a decade and involved stakeholders from all levels of government, nongovernmental organizations, scientists and water users (Belzer n.d.). On the Mexican side, the Consejo de Cuenca del Rio Bravo[1] undertakes consultations and discussions aimed at water policy planning in the region as well as the resolution of conflicts through regular meetings of all water users and stakeholders in the basin. Further, World Wildlife Fund has led several cross-border, collaborative initiatives, including working with large water users, such as The Coca-Cola Company, to undertake water conservation and restoration efforts in the RGB.

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[1] Under Mexico's Water Law, the country is divided into water basins, each of which has a basin council with multistakeholder representation.

However, any attempts to encourage the allocation of water for ecological or conservation purposes is constrained by the hierarchy of uses established in the 1944 Water Treaty, which is as follows: (1) domestic and municipal uses; (2) agriculture and stock-raising; (3) electric power; (4) other industrial uses; (5) navigation; (6) fishing and hunting; and (7) other beneficial uses as determined by the Commission (*1944 Water Treaty*, Article 3). There is no mention of ecological water uses or water conservation, although there are provisions in the Treaty for border sanitation measures. Moreover, other than the treaty framework and legacy of Minutes, there is no other formal transboundary agreement which specifically addresses water quality or ecological degradation in the Rio Grande/Bravo.

Neither are there binational management mechanisms for the use or quality of groundwater sources that are shared between the two countries, despite the fact that users on both sides of the border are pumping large quantities of groundwater (Sanchez & Eckstein, 2017). Indeed, the incentive structure under the current governance regime encourages increasing groundwater extraction when surface waters run low, which of course impacts the hydrological cycle. Although there are significant efforts to develop a clearer scientific understanding of the state of groundwater resources through the Transboundary Aquifer Assessment Program, to facilitate binational dialogue on how to jointly manage underground resources (IBWC, 2019) and to apply international legal principles and tools for cooperative management of border aquifers (Milanes, 2020), there is at present no integrated surface water–groundwater governance mechanisms on the Rio Grande/Bravo.

It is also worth noting that differences in domestic water management approaches add an additional layer of complexity to the transboundary relationship. Interestingly, NAFTA has done little to harmonize actual policies or regulations, and thus considerable differences remain between the American and Mexican water management approaches (Healy *et al.*, 2014). Mexico manages the Rio Grande/Bravo from the national level with some engagement by states, while the US manages the basin primarily at the state and irrigation district levels, with some national engagement (Mumme, 2016, 703). These varying arrangements make transboundary governance difficult, even in terms of who should be involved and how. Mexico's federal and regulatory system – particularly for water policy-making – is highly centralized. The federal water agency, CONAGUA, controls water allocations and water quality standards, even at the state and regional levels. By contrast, the American system is quite decentralized; water use (after the broader allocations have been made by the IBWC) is managed through state and district agencies, which allows Colorado, New Mexico and Texas to have differing legislation, water uses and water rights structures (Mumme & Ibanez, 2013). The US does have a national set of environmental water quality standards that apply across the individual states through the *Clean Water Act*, but even these standards are implemented via state programming.

The political reality, then, is one where state-based rules for water rights – and entrenched local interests focused on preserving their current allocation rights – cast a long shadow over binational attempts to manage shared water resources, or to pursue conservation measures. This reality, which is replicated across the American West (Hundley 2001), cannot be overstated. The largest user in the Rio Grande/Bravo is – overwhelmingly – agriculture (Dagnino & Ward, 2012); more than 85% of water on the US side (Kort, 2013) and 76% of water on the Mexican side (Comisión Nacional del Agua 2018) is diverted for the purposes of irrigation. Consistent access to water is critical for a $1 billion agricultural sector (TWRI, 2012) that is particularly water-thirsty; popular crops in Texas and New Mexico such as alfalfa and pecans require larger quantities of irrigation water when compared to other, more water-efficient crops. Agricultural water use represents 82% of water withdrawals in New Mexico; the comparable Texas data show that agricultural water withdrawals as a percentage of total withdrawals

are much smaller for the state as a whole (US Geological Survey 2015, 10–17), though irrigation withdrawals are concentrated in the border region. The Mexican state of Chihuahua is also a dairy industry centre, which uses large quantities of water; indeed, water concessions for agriculture in Chihuahua constitute a whopping 89% of total concessions (Comision National del Agua 2018, 82). Other border states such as Coahuila and Tamaulipas look similar in this regard (80 and 88%, respectively).

Moreover, growing urban areas on both sides of the border are demanding an ever-increasing proportion of water (TCEQ n.d.). Along the Rio Grande/Bravo transboundary mainstem, there are seven 'sister-cities' which have been growing at high rates since 2000 (Kort, 2013). On the Mexican side of the southern border, the population has increased more quickly, as the region draws economic migrants from poorer parts of Mexico and, increasingly, Central America. In addition, the US–Mexico cross-border region is a centre of industrial activity; there are thousands of manufacturing plants in the Rio Grande region, most of them located around the basin's largest cities that require significant quantities of water (Ibid). The Rio Grande region is essential to the US–Mexico cross-border economic partnership, acting as the hub of binational trade. In fact, the signing of the USMCA, the successor to NAFTA, has led to accelerated industrial development planning (Businesswire, 2020), despite the scarcity of water resources.

Given the current demands on the Basin's water as a result of intensive agricultural operations, growing urban populations and industrial activities, not to mention a rigid binational water-allocation regime with firmly entrenched local water users (especially agriculture), the RGB is clearly facing serious management challenges. This narrative is replicated throughout the American Southwest, where competing values and concerns about deepening water scarcity and impaired ecosystem services confront a legacy of hard engineering to carry water to those with long-established water rights (Feldman, 2016). And, predictions for the future are even more dire for this region. According to the US Bureau of Reclamation, climate change is likely to strain water availability even further. With temperatures increasing in the region 'by roughly 5–6°F during the 21st century', various impacts are expected, including a decline in snowpack river sources and decreased early-season run-off impacting all users (USBR, 2011). Warmer conditions are also likely to lessen natural groundwater recharge, yet further incentivize increased groundwater pumping. Given such a challenging and constrained context, what is the capacity of the transboundary water governance architecture to adapt and respond?

Adaptive governance and the OECD water governance initiative

The term 'adaptive governance' (AG) is perhaps most accurately described as an umbrella concept under which scholars from a variety of disciplines and using different analytical approaches attempt to puzzle through the challenge of shifting current management regimes to governance modes that more fully recognize the interdependence of human and ecological systems (Folke *et al*., 2005). Dietz *et al*. (2003), in an early formulation, refer to the need for 'a system of resource governance that … allows rules to evolve from feedbacks originating both in the human and biophysical realms.' In this case, how do we get to a governance regime that is more adept at responding to feedbacks and balancing human needs for water with ecosystem needs?

Certainly, a key adaptive feature is the ability of the system to generate and apply knowledge, or to 'learn' (Pahl-Wostl *et al*., 2010; Hill & Engel, 2013). This, in turn, requires monitoring key drivers of change and scenario planning, yet also efforts to take into account past experiences (Peterson *et al*.,

2003). Relatedly, Karpouzoglou *et al.* (2016) note the importance of critically assessing broader political, economic and social variables which may underlie repeated patterns of governance failure. In the RGB case, the difficulties posed by the entrenched political and economic interests of agriculture would figure predominantly. In addition, social networks, rooted in personal interactions focused on shared interests, 'can be key mechanisms for drawing on social memory at critical times and enhancing information flow and collaboration across scales' (Folke *et al.*, 2005, 453).

Another critical attribute of adaptive governance, one which builds on several decades of insights and experience with integrated water resources management, is the ability to engage a broad range of decision-makers, water users and stakeholders meaningfully in governance (Pahl-Wostl, 2009; VanNijnatten *et al.*, 2016). There is clear evidence that governance and policy systems which promote interactions within and across state, private sector and civil society are more successful in terms of increasing both the legitimacy of decision-making within these governance systems as well as the quality of decisions made, particularly at local and watershed scales (Ostrom, 2007; Huitema *et al.*, 2009). 'Co-management' or partnership mechanisms which involve the sharing of power across multiple institutions, networks and groups, are seen as particularly useful (Folke *et al.*, 2005). Meaningful engagement requires the inclusion of 'all types of stakeholders' (Hargrove & Hayman, 2020) and the building of social relationships and a common vision (Milman *et al.*, 2013). Analysts further highlight the importance of trust and reciprocity as providing the 'glue' for collaborative systems (Adger, 2003; Edelbos & vanMeerkerk, 2015).

Other AG studies (Pahl-Wostl, 2009; Pahl-Wostl *et al.*, 2012; Hill & Engel, 2013) embrace the concept of 'polycentricity' (Ostrom, 2010), whereby multiple arenas of policy actors are coordinated under an overarching set of formal and informal institutional rules and arrangements. Several features of polycentricity have been emphasized by AG scholars: first, the presence of multiple centres of decision-making; second, discovering whether these centres are self-organized (as opposed to being imposed by one powerful actor); and, third, the degree to which coordination of these centres is achieved through a uniform set of rules that act as 'connective tissue' supporting and linking these arrangements across scales (Pahl-Wostl & Knieper, 2014). Polycentricity is a way of organizing decision systems that can allow for innovation in multiple decision centres, yet ensure that all centres are 'rowing in the same direction', e.g., towards sustainability.

In a dynamic context, flexibility is critical. Flexibility can be built into adaptive governance institutions through, for example, review mechanisms or yearly planning cycles which allow different actors operating within the regime the opportunity to take stock of existing conditions and shift priorities (McCaffrey, 2003). In addition, the ability of governance institutions to provide opportunities for experimentation and innovation, especially from the bottom-up, is key (Peat *et al.*, 2017). In a direct reference to polycentric structure, Peat *et al.* (2017) highlight the ways in which 'distributed leadership' can drive innovation from multiple centres. Indeed, as Feldman *et al.* (2015) note, it is participatory/collaborative engagement that powers the innovation potential of polycentric arrangements and fosters both flexible responses and long-term legitimacy for policy decisions adopted. The key point here is that the attributes of knowledge/learning, stakeholder engagement, polycentricity and flexibility are linked in critical ways (see Table 1).

But how do we determine the presence and/or strength of these governance attributes? Alongside the multidisciplinary discussion of adaptability, scholars, practitioners and international organizations have experimented with the use of 'governance indicators', in an effort to create diagnostic tools that can isolate and assess particular attributes linked to more effective resource management, especially those relating to adaptability (Garrick & De Stefano, 2016). Governance indicators are understood as

Table 1. Major attributes of adaptive governance.

Knowledge and learning		Stakeholder engagement		Polycentricity		Flexibility
Generate new information via monitoring, scenario planning, social memory	⬌	Broad range of stakeholders involved (state-private sector-civil society)	⬌	Multiple centres for decision-making, distributed leadership	⬌	Presence of review mechanisms or planning cycles
Information integrated into public decision systems		Collaboration through co-management		Centres are self-organized		Evidence of experimentation, esp. bottom-up
Situates knowledge critically in broader context		Building common vision through trust and reciprocity		Discernible 'connective tissue' among centres		Distributed leadership

comprising 'a variable or some aggregation of variables' describing 'a system or process such that it has significance beyond the face value of its components' (Lorenz *et al*., 2001).

Governance indicators are different from 'outcome' indicators (which focus on measuring the state of ecosystem/water quality) as they can provide us with 'horizontal' knowledge about the transboundary capacity to support the aims and objectives for a shared water basin. They are a powerful way to focus data collection and connect scholarly research to real-world governance challenges, as they can contribute to continuous diagnosis, reflection and improvement, when designed and used appropriately (Langhans *et al*., 2014; Muriithi *et al*., 2015). Although there are certainly challenges associated with operationalizing indicators (Milman *et al*., 2013), they provide a way of isolating and assessing specific aspects of institutional and network architecture. One cannot assume, however, a causal relationship between government attributes and environmental outcomes; this requires empirical investigation (VanNijnatten & Johns, 2020).

The Organisation for Economic Co-operation and Development (OECD) Water Governance Programme[2] has waded into these waters, creating tools for water managers to self-diagnose their governance system's strengths and weaknesses. The OECD (2015) developed 12 water governance principles (see Figure 2) focused on the three dimensions of effectiveness, efficiency and trust & engagement, through a collaborative process involving a consortium of experts from the public, private and not-for-profit sections. The principles do not refer to a specific scale or specific water functions and are intended to be adaptable to different contexts. To support the implementation of the Principles, the OECD then developed 36 indicators over 2016–2017, three per principle, assessing the dimensions of policy framework, institutions and instruments (OECD, 2018). In 2017–2018, the OECD pilot-tested the 36 indicators in 12 OECD and non-OECD jurisdictions at the city, basin and national scales within countries.

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[2] The OECD considers 'water governance' to be the range of political, institutional and administrative rules, practices and processes (formal and informal) through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision-makers are held accountable for water management (OECD, 2011).
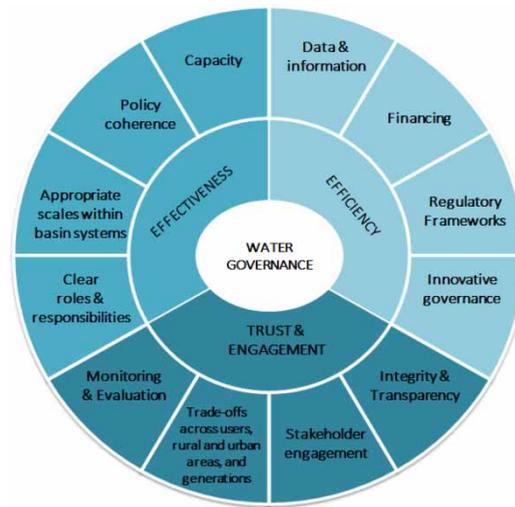
Fig. 2. OECD Principles on Water Governance. *Source*: Organization for Economic Cooperation & Development (2015). https://www.oecd.org/cfe/regionaldevelopment/OECD-Principles-on-Water-Governance-en.pdf.

First and foremost, the 36 OECD indicators emphasize the 'nuts and bolts' aspects of water management by determining the presence (or not) of independent and properly resourced institutional and regulatory mechanisms for managing water, specifically with the following indicators:

1. existence of water agreement/law
2. designated lead agencies
3. formal review mechanisms
4. merit-based independent implementers
5. mechanisms to identify capacity gaps
6. education and training programs for water professionals
7. frameworks to collect necessary revenues
8. domestic revenues and allocations related to water
9. mechanisms to assess medium- and long-term investment needs
10. sound water management regulatory framework
11. dedicated public institutions with key regulatory functions
12. regulatory tools for both water quality and quantity
13. mechanisms to identify corruption

However, when we relate the OECD indicators to the attributes for AG, we get a more nuanced picture (see Table 2).

Several observations can be made on the basis of this matching exercise. First, there is a cluster of OECD indicators that fit nicely within the Knowledge & Learning attribute, as they are aimed at gathering information, sharing knowledge and also promoting reflection on policies and practices. Likewise, another cluster of indicators focuses on promoting engagement and supporting cooperation among stakeholders; as well as encouraging transparency and equity, which aids in fostering trust and reciprocity. On the Polycentricity attribute, there is an indicator which asks about the presence of basin-wide

Table 2. Adaptive governance attributes and OECD indicators.

Knowledge and learning	Stakeholder engagement	Polycentricity	Flexibility
5a. TB water info systems	2a. Cooperative mechanisms	2b. Institutions at basin-wide scale	8a. TB policy frameworks/incentives to foster innovation
5b. Standardized, harmonized, official, basin-wide water-related statistics	2c. Cooperation across all water users	3a. Cross-sector approaches/policies	8b. TB institutions encouraging bottom-up initiatives, dialogue
5c. Mechanisms to identify data gaps	9a. Legal and institutional frameworks on integrity and transparency	3b. TB horizontal coordination	
8c. TB knowledge and experience sharing mechanisms	10a. TB legal frameworks to engage stakeholders	3c. Mechanisms to review cross-sectoral barriers and policy coherence	
12a. Regular TB monitoring and evaluation of water policy/governance	10b. Structures to engage stakeholders		
12b. TB monitoring and evaluation to assess practices and help adjust	10c. Mechanisms to diagnose/review engagement		
12c. TB monitoring and evaluation to assess whether water policy achieves intended outcomes	11a. Formal provisions fostering equity across water users		
	11b. TB ombuds institution to protect water users, included vulnerable groups		
	11c. Mechanisms to manage trade-offs among users		

Note: TB, transboundary.

institutions and several which focus on cross-sectoral coordination, which might get at the 'connective tissue' within the regime. Flexibility might be seen to be embodied in indicators aimed at discovering incentives for innovation or bottom-up dialogue, but little else. The Polycentricity and Flexibility attributes appear to be less well captured in the OECD indicators.

Below, we review the OECD water governance indicator methodology and then apply the indicators in the case of the transboundary Rio Grande/Bravo region. We then reflect on both the basin-level findings and on the utility of the OECD water governance indicators as a tool for signalling transboundary governance gaps.

Methods for OECD indicator application to the Rio Grande/Bravo case

The OECD water governance indicators are intended as a tool to 'stimulate a transparent, neutral, open, inclusive and forward-looking dialogue across stakeholders on what works, what does not, what should be improved and who can do what' (OECD, 2018, 5). The WGI Framework is aimed at 'triggering actions to bridge water governance gaps' (Ibid). Voluntary self-assessment is used along with multistakeholder dialogue to assess how water governance systems are performing at a given moment or are expected to perform over time (through comparison of results with a baseline scenario, after 3 years). The OECD's water governance indicators are thus *perception-based*, involving the view of experts and key stakeholders, but also *fact-based*, involving analysis of available data. In applying the OECD's water governance indicators, both approaches are to be used and data collected through a 10-step methodology using a mix of methods including questionnaires, interviews, workshops and available data sources to build consensus over subjective judgments within multistakeholder settings (OECD, 2018).

We adopted several features of the OECD's approach to applying the indicators, including the 'traffic light' baseline system and colour-coded response categories, as well as the iterative approach, though with modifications. In terms of the data collection instruments, a worksheet was designed containing all 36 of the OECD's water governance indicators (see Table 3), although the indicators were adapted to make it clear that they were referring to water governance at the transboundary scale. A short questionnaire with open-ended questions was also developed which allowed participants to provide qualitative assessments of the indicators as well as their applicability and value vis-à-vis their region (Appendix A). A backgrounder was created on the OECD water governance principles, which accompanied the materials given to respondents. All materials were translated into both English and Spanish, allowing participants to choose their preferred language. Before launching data collection, a pre-test was conducted with six experts, after which some clarifications were made to the materials.

The OECD methodology is not intended as a tool to reach large numbers of respondents but rather to focus on 'deeper' engagement of those who are engaged in water management activities. While we were not able to organize a focus group discussion among respondents (due to resource limitations and the difficulty of organizing cross-border dialogues), we did attempt to incorporate an iterative component whereby respondents were asked whether they wished to provide additional feedback or comments in

Table 3. Aggregated indicator worksheet responses.

OECD Water Governance Indicators Worksheet: Rio Grande/Bravo Summary of Submissions

Indicator	In place, functioning	In place, partly implemented	In place, not implemented	Under development	Not in place	Not applicable	No Response Don't Know
1a. existence of water agreement/law	green						
1b. designated lead agencies	green						
1c. formal review mechanisms	green						
2a. cooperative mechanisms	green	yellow					
2b. institutions at basin-wide scale					red		
2c. cooperation across all water users	purple						
3a. cross-sector approach/policies	purple						
3b. transboundary horizontal coordination		yellow					
3c. mechanisms to review cross-sector barriers and policy coherence		yellow			red		
4a. merit based independent implementers		yellow			red		
4b. mechanisms to identify and address capacity gaps	purple						
4c. transboundary/domestic education and training programmes for water professionals	purple				red		
5a. transboundary water information systems	purple						
5b. standardized, harmonized, official, basin-wide water-related statistics	purple						
5c. mechanisms to identify data gaps				orange			
6a. frameworks to collect necessary revenues to meet mandates	purple				red		
6b. domestic revenues and allocations related to water	purple						
6c. mechanisms to assess short, medium and long-term investment needs		yellow			red		
7a. sound water management regulatory frameworks	purple						
7b. dedicated public institutions with key regulatory functions	green						
7c. regulatory tools for both water quality and quantity	purple						
8a. transboundary policy framework/incentives to foster innovation	purple						
8b. transboundary institutions encouraging bottom up initiatives, dialogue and learning	purple						
8c. transboundary knowledge and experience sharing mechanisms	purple						
9a. legal and institutional frameworks on integrity and transparency	purple						
9b. independent audit/adjudication to investigate and safeguard public interest		yellow			red		
9c. mechanisms to identify corruption					red		
10a. transboundary legal frameworks to engage stakeholders	purple						
10b. structures to engage stakeholders	green	yellow					
10c. mechanisms to diagnose/review stakeholder engagement	purple						
11a. formal provisions/legal frameworks fostering equity across water users	purple						
11b. transboundary ombuds/institution to protect water users including vulnerable groups	purple				red		
11c. mechanisms to manage trade-offs across users		yellow					
12a. regular transboundary monitoring and evaluation of water policy/governance	purple						
12b. transboundary monitoring and evaluation to assess policies/practices and help adjust	purple						
12c. transboundary monitoring and evaluation mechanisms to measure extent to which water policy fulfils intended outcomes and water governance framework fits is purpose		yellow			red		

*all responses may not total to the total 'n' as some participants did not respond to all 36 indicators indicating a 'don't know' or unsure '?' response

NOTES
Corresponding colour indicates clear majority of responses (51% and above = 8 and above)
Two colours indicate split in responses (two cells representing values of between 4 and 7)
Purple indicates distribution of responses across more than two response categories (cells representing value of 1-7);
In a few cases respondents included checked two cells in a particular indicator - we have included both

a short follow-up interview, after filling out the worksheet and completing the questionnaire. In addition, respondents were given the option of commenting on the draft findings and providing additional insights, either to the researchers individually or to all respondents online. The lack of focus group results – and the consensus-building function that this activity can produce – is a limitation of this study, however, and our results thus do not reflect the outcomes of a multistakeholder process. However, it is important to note that our questionnaire specifically asked respondents their opinions on the utility of the Water Governance Indicators themselves, which is unique to our study.

Application of the OECD water governance indicators to the Rio Grande/Bravo case was carried out in early 2019. A total of 33 key water managers and stakeholders (water users, non-governmental organizations or academics who were actively engaged in water governance in the region) were invited to participate, and 16 responses were received. Two-thirds of responses were from US participants, one-third from Mexican respondents. Follow-up interviews were conducted with eight of the respondents, also in their language of choice (five interviewees were American, three were Mexican). The next section of the paper provides an analysis of the aggregated findings for the worksheets submitted in the Rio Grande/Bravo case, as well as discussion arising from both the open-ended questions and the follow-up interviews.

Results and discussion

OECD indicator worksheet

The worksheet containing all 36 of the OECD's water governance indicators asks respondents to choose whether each indicator is 'in place, functioning', 'in place, partly implemented', 'in place, not implemented', 'under development', 'not in place' or 'not applicable', as per the OECD response categories (see Table 3).

What is striking about the results in the RGB case is the lack of consensus reflected across the responses and the high number of split responses on most indicators. Responses on 11 out of the 36 indicators are split largely between two options and an additional 16 responses are split between three or more options. This means that responses on fully 27 out of the 36 indicators show a clear lack of agreement on the existence/implementation/functioning of the attributes described in the indicators on the part of respondents. On only nine indicators were there a clear majority of responses favouring a specific option. In terms of where these majorities appear, there is consensus on the *presence* of agreements and institutions in place for water management and cooperation, along with designated lead agencies, agencies with regulatory functions and cooperative mechanisms more generally, as 'in place and functioning'. Consensus also exists in the *absence* ('not in place') of transboundary education/training, frameworks for revenue collection, mechanisms to identify corruption and ombuds-institutions. In addition, a strong majority of respondents also agreed that the transboundary incentives for innovation are 'not in place'.

But there the agreement ends. There is a diversity of opinion on whether the transboundary institutions, agreements and associated mechanisms actually foster cooperation across water users (2c.), address capacity gaps (4b.), encourage bottom-up initiatives/dialogue/learning (8b.), foster knowledge and experience sharing (8c.) or promote cross-sectoral (horizontal) coordination and policy coherence (3a., 3b.). Further, no agreement exists on whether the governance regime possesses domestic revenues and allocations for water (6b.), sound water management regulatory frameworks (7a.), regulatory tools for both water quality and quantity (7c.), legal and institutional frameworks to promote integrity and

transparency (9a.), transboundary legal frameworks to engage stakeholders (10a.), mechanisms to diagnose/review stakeholder agreement (10c.), formal provisions/legal frameworks for fostering equity across water users (11a.), regular transboundary monitoring and evaluation of water policy and governance (12a.) or transboundary monitoring and evaluation to assess water policies and practices (12b.).

Notable in this regard is that responses tend not to cluster at one side of the spectrum among more closely related options (e.g., 'in place, functioning' and 'in place, partly implemented'). There are arguably only three cases of clustering: 2a. where respondents agree that cooperative mechanisms are in place, but disagree on whether they are functioning or partly implemented; 10b. where respondents agree that structures for engaging stakeholders are in place, but disagree on whether they are functioning or partly implemented; and 5c. where respondents believe that mechanisms to identify data gaps are either 'not in place' or 'under development'. In all other cases of split responses, respondents were very likely to disagree on whether particular attributes were 'in place, functioning', 'under development' or 'not in place' at all. To provide one illustration of this tendency, respondents were just as likely to believe that transboundary legal frameworks for engaging stakeholders were in place (whether 'functioning' or 'partly implemented') as to believe such frameworks were 'not in place'. Interesting also is the observation that some responses seem to indicate an awareness that some of the mechanisms to address these gaps are 'under development', while others did not.

It is important to reflect on what might explain the lack of agreement among respondents on the presence of the 36 OECD indicators. While the number of respondents (16) is too small to provide any definitive answers to this and follow-up interviews would be needed to get more detail as to the roots of this disconnect, there are two hypotheses that might be worth pursuing in future work on water governance in the Rio Grande/Bravo. First, it may be that answers are influenced by the respondent's location in the basin. The basin is managed as separate segments in terms of water allocations and sharing, under two separate treaties. As was noted by more than one respondent, the segments 'are really two separate rivers, that are managed in different ways,' due to varying ecological and river conditions, different stakeholder composition, networks and power structures, and diverse modes of interaction across the border.' Secondly, responses may differ based on respondents' status as water user, i.e., where they are positioned in the hierarchy of water allocations, if at all. Indeed, positionality as a feature of context figured into respondents' comments; as one explained, 'I see two different categories of respondents: (i) those who have water rights or concessions …; and (ii) those with insufficient water rights. …Those in the first category may respond more positively than those in the second …'

Findings – open-ended questions

Written responses to the open-ended questions yielded further insights into perceptions of the water governance regime in the Rio Grande/Bravo. Respondents were asked for their general assessment of the value and applicability of the OECD water governance indicators to water governance in their region (VanNijnatten & Johns, 2019). The quotes provided below are taken from the written remarks.

In terms of the first question asking for respondents' general assessment of the applicability of the OECD indicators to the Rio Grande/Bravo basin, a majority of all respondents noted that the water governance indicators were applicable. For example, one respondent noted with regard to the indicators that 'most are applicable to the Rio Grande/Bravo region', while another stated that 'the indicators make sense' and a third provided a similar assessment: 'they are common sense indicators of the effectiveness,

efficiency and transparency of the institutional arrangements designed to safeguard the sustainability of the basin.' It should also be noted, however, that one respondent believed that the water governance indicators were 'not very relevant' to the Rio Grande/Bravo, while a second indicated that 'most are related, some are not quite related or not applicable' and a third noted that '[t]he indicators reflect the general aspects of the governance of the Rio Grande/Bravo Basin. They do not demonstrate specific characteristics.'[3]

A recurring theme in the open-ended responses was that the OECD water governance indicators were a useful toolset, in a theoretical sense, for thinking about how to better manage the shared water basin, as well as for highlighting gaps in the governance regime – regardless of whether indicators were deemed to be in place and functioning in the basin at the present time, or not. One respondent commented that 'these indicators are a weather vane for sustainability of any water resource' while another noted that 'they are helpful tools to assess the current state, but also a good way to see what may still be needed. … These indicators are a great way to track what's being done, who's doing it, what's needed, etc.' Another believed that the water governance indicators 'do a good job of capturing strengths and weakness' (in the water governance regime), while yet another respondent felt that 'these indicators could be a tool to better manage the basin. It provides all the elements necessary for smart planning and operations.' Similarly, a majority of respondents also agreed on the value of the water governance indicators for charting future directions. As noted by one respondent, the exercise 'shows the heavy weight of past institutions and directions that we need to innovate to be adaptable in the future.' Another commented that '[t]here is value in applying the OECD water governance indicators in identifying current settings and exploring opportunities for improvement/innovation in water operations with new frameworks.'

However, there were two significant weaknesses with respect to the indicators that were noted across respondents. Perhaps most significantly, it was felt by many of the respondents that the application of the OECD indicators does not allow for proper consideration of surface–groundwater interactions. Respondents noted the difficulty of applying the Water Governance Indicators as it was not clear to them how such interactions could be taken into account given the nature of the indicators. Several respondents echoed the view of one who explained that 'my answers are limited only to surface water, since basically all my answers would have been 'not in place' for groundwater.' In fact, a number of respondents sought counsel from the investigator when completing the worksheet and questionnaire, asking whether they should view the exercise as being primarily about surface water or subsurface, implying that there are two different regimes. Two respondents even filled out the sheet with separate answers for the surface and subsurface regimes. One respondent was quite direct in their assessment of this challenge in approaching the water governance indicators: 'The indicators are only capable of reflecting the topic concerning superficial water and nothing else.'[4] As another respondent concluded, '[w]e need to make sure that (1) water quality (esp. salinity) and (2) subsurface water also are considered matters of governance,' implying that they are not, at present.

Second, respondents felt that the indicators were not likely to apply equally well across scales and jurisdictions. As one respondent noted '[t]he multi-jurisdictional issue on a regional, state and country basis makes a few of the indicators difficult to address – policy coherence, data and information, regulatory frameworks, monitoring and evaluation all seem like areas that would be extremely challenging to implement on such a large scale.' Another noted that, in filling out the worksheet, 'the indicators labelled as 'not

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[3] Response translated from original in Spanish.
[4] Response translated from the original in Spanish.

applicable' were labelled as such because at a national level there is no regulatory framework that applies to water issues. Likewise, the indicators of equity, ombudsman and compensation do not exist within the laws of water and the treaty, much less in the political constitution as an obligation to observe.'[5]

In fact, several respondents noted feeling overwhelmed by the myriad activities at different scales, the sheer complexity of water management in the basin and the lack of coordination among them. One explained that '[m]any people are doing really good things in their respective areas but have capacity and scale issues in thinking and reaching out beyond their areas.' Another noted that '[s]everal NGOs and planning groups are actively engaged and there are so many levels of projects/planning activities underway that many agencies are feeling overwhelmed and unable to commit to additional efforts.' The impression given by such sentiments is of a multi-scalar yet fragmented reality, complicating how the water governance indicators can be applied.

Observations on the application of the OECD water governance indicators at the transboundary scale in Rio Grande/Bravo Basin

This paper began with a discussion of the challenges facing those managing water in the Rio Grande/Bravo basin; the RGB is portrayed as an important test of a water governance system, whose management provisions and stakeholder relationships were established many decades ago, to respond to multi-faceted conditions and rapidly changing circumstances. If we reflect on the preliminary findings from the application of the OECD water governance indicators to the Rio Grande/Bravo case, what does this exercise tell us with respect to where the gaps are and where energy might be focused in terms of moving the governance system toward higher levels of adaptability? Further, in the process of actually using the OECD indicators, what lessons have we learned in terms of their usefulness as a tool for assessing the adaptability of water governance regimes in a transboundary context?

To begin, it is helpful to look at the findings of this study alongside the advice provided by the adaptive governance literature – namely, that resource management regimes which generate and disseminate knowledge as well as stimulate learning; promote broader engagement; and are distributed yet coordinated through polycentric arrangements, as well as flexible, are more likely to be able to adapt in the face of complexity and uncertainty. In these regards, the application of the OECD water governance indicators by respondents revealed concerns on all four attributes, yet also provided some direction for moving forward.

First, the tools that might be regarded as critical to the knowledge and learning function of an adaptive governance system – such as transboundary water information systems and standardized water statistics, as well as transboundary monitoring and evaluation to assess policies and practices and mechanisms to identify and address capacity and data gaps – are all the subject of disagreement among respondents as to whether they are in place, let alone how they are functioning. One might question, then, whether the transboundary Rio Grande/Bravo system can properly support the basic elements of knowledge production, dissemination and discussion, given current structures. Additional resources and energy should be directed to these areas immediately.

In addition, the concern expressed through the worksheet responses about the lack of legal frameworks and structures for engaging stakeholders and bringing about equity among water users is of

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[5] Response translated from the original in Spanish.

concern and should be noted by those who manage basin waters. We know from academic scholarship and case study analysis that broadening the range of voices included can change the nature of discourse, heighten levels of reciprocity and trust in a governance regime, leading to a greater likelihood of constructive trade-offs (critical to water governance in the region), as well as promote more sustainable outcomes. We need to look no farther than the Colorado River for an example; here, stakeholder engagement has been critical in developing more sustainable water management practices – including the development of a drought management plan (Dikeman, 2017). In this respect, it is important to note that very few respondents considered frameworks and structures for engaging stakeholders to be 'under development', which might be regarded as a surprising finding given the initiatives which our respondents indicated are being undertaken at various locations around the basin, and which seem to be engaging additional communities and organizations. Given the size of the basin, it may be that these initiatives are not being communicated widely.

As regards polycentricity, the picture that respondents shared with us was of a governance architecture that is coordinated and connected only in the most basic sense of water allocations under the treaty by institutions, agreements and cooperative mechanisms. At the same time, secondary research and respondents' comments in the open-ended questions suggest that there are initiatives being undertaken in the basin, outside of formal structures and with the intent to shift the focus of the regime in more sustainable directions. Self-organized social networks have been/are being developed, some led by government agencies, others by NGOs. This activity, however, is not firmly connected to the formal regime. The problem here is that any successful experiments by agencies or other groups, for example, with respect to joint knowledge-gathering and assessment or bringing additional interests into deliberations on water governance, are also likely to be unconnected, or at least not well connected, to the formal transboundary regime (and this would support the hypothesis about lack of communication, above). In sum, the connective tissue necessary for effective polycentric governance is not in place, and this appears to be a critical weakness in fostering and broadening innovative governance practices in the RGB.

One of the most striking findings was that the indicator with the highest level of agreement among respondents as being 'not in place' was transboundary policy frameworks/incentives to encourage innovation. When paired with the open-ended responses, it is clear that the system is seen as rigid and inflexible. Here, we might return to the insight made earlier in the paper, namely that one cannot ignore the ways in which the four attributes of knowledge/learning, stakeholder engagement, polycentricity and flexibility are linked. For policy-makers that are seeking new ways forward, broadening engagement to the *full range of stakeholders* (see, again, Hargrove & Hayman, 2020), and ensuring that the best information is available to support their dialogue on shared problems, are important first steps in unleashing innovative decision-making potential. However, innovative solutions need to feed upward and across through the system – and it is here that the most significant blockage occurs, given the difficulties associated with countering the influence of entrenched water users backed by a rigid legal regime at the state level and binational allocation regime at the transboundary level. However, it is worth emphasizing the high level of consensus among our respondents on the need for broader and deeper participation, and the implied/explicit assumption that this could help to change dynamics.

Interestingly, current efforts to engage different communities in groundwater management in the basin – for which there is no established binational architecture – offer an important testing ground for these arguments. These efforts have started with very collaborative and truly binational data-gathering processes so that stakeholders can better understand aquifer water resources. While these processes are still ongoing,

early results are attracting attention and fostering learning across managers, use communities and other interests, and concerns about the lack of appropriate governance structures are also attracting attention. Given the way in which the scientific and modelling efforts are focused on specific aquifers along the border, this may pave the way for instituting distributed management centres along the border which are able to pursue innovative strategies for more holistic and integrated water governance. In other words, a new groundwater regime may push the existing surface water regime in new directions.

The above discussion highlights the contributing role of the OECD water governance indicators in providing key insights into the water governance regime in the RGB, particularly when the results are considered in conjunction with advice from the adaptive governance literature on the kind of institutions and mechanisms we need most. As our respondents made clear, the water governance indicators serve as a useful toolkit for looking across governance regimes at performance with respect to particular functions or mechanisms.

Yet, the OECD water governance indicators are limited in some respects. Our respondents made it clear that applying the OECD water governance indicators to a transboundary context with a multi-scalar reality is challenging. Attempts to apply the OECD water governance indicators to the transboundary context run up against a reality whereby some functions in the basin are carried out by binational authorities, other functions by national or subfederal authorities, or at the local level. In the Rio Grande/Bravo basin case, respondents made it clear that it was difficult to fill out the indicator worksheet, given that functions such as water regulation might be carried out at the state level while water allocation was implemented by binational authorities along with local irrigation districts. In this context, the analytical problem of what constitutes 'the transboundary governance regime,' which we encouraged respondents to focus on, almost certainly limits what the OECD indicators can tell us. However, it must be noted that the water governance indicators do highlight those instances where no authority (any scale) is performing a particular function; this is useful information for governance gap analysis.

Another very significant challenge is that the OECD indicators do not provide an easy way to account for both the surface and subsurface governance regimes, or the interactions between the two. One solution to this, suggested by one of our respondents, is that the water governance indicators be applied twice – to the surface and subsurface regimes. We suggest a further step might be to map out those governance functions across the two regimes that are proximate (and easier to coordinate) and those which are not (where the lack of coordination is most serious). This would help to isolate those points in the governance regime where concerted coordination efforts can be directed.

A final concern with the water governance indicators is that they are ill-suited to addressing the most intangible determinant of governance success: political will and leadership. In fact, one reading of the application of the water governance indicators to the RGB case is that indicators showing the presence/functioning of regime components, such as 'existence of water agreement/law' (1a.), 'designated lead agencies' (1b.) and 'sound water management regulatory framework', may actually be demonstrating the rigidity of a governance framework attached to status quo management practices. By contrast, innovating in response to changing conditions requires that there are leaders willing to confront such rigidities. This is difficult, uphill work that needs to be undertaken over time. The OECD water governance indicators do not provide an easy way for analysts to ascertain incentives or facilitators of this kind of leadership.

The need for more adaptive governance in the case of the Rio Grande/Bravo, where the system's rigidities are legion and users are closely tied to outdated and uncertain surface water allocations,

while at the same time, ecological conditions worsen rapidly, is obvious. The analysis here provides some suggestions, based on the application of the OECD water governance indicators, as to where one might focus efforts to improve the adaptability of the governance regimes, namely with knowledge-gathering mechanisms, tools for learning and engaging stakeholders and connective infrastructure to draw together the disparate parts of the water governance regime. The exercise also provides insights into pitfalls that need to be approached carefully, such as sorting out multi-scalar interactions. Critically, these reflections have a direct bearing on how to address the almost complete lack of governance with regard to shared subsurface water resources, as our respondents have pointed out. In this case, insights into weaknesses in the transboundary surface water regime can chart future directions for shared governance in the Rio Grande/Bravo.

Acknowledgements

Data availability statement

All relevant data are included in the paper or its Supplementary Information.

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