REIMAGINING SUB-NATIONAL WATER GOVERNANCE

IIHS WORKING PAPER

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Introduction

Governing water, although not a new challenge, has assumed a renewed significance globally, particularly in the context of multiple emerging crises across social, ecological, economic, and spatial systems. Water governance is a complex and ongoing process involving stakeholders across regions and time-scales, where the future of water is a critical point of discussion in the context of sustainable development in the coming decades. Humans are radically changing and modifying the water cycle: solving the challenge of water governance is critical to the success of the SDGs: water is deeply embedded across all the SDGs and addressing the challenge of water governance requires a 'systems-thinking' approach that brings together water, climate change, biodiversity loss, land use change, and urban growth (Quentin Grafton et al., 2023). Work across research and policy has focused on efforts across scale and sector and have emerged from a range of disciplinary approaches (Woodhouse & Muller, 2017). In Windhoek, Namibia for instance, local water managers were able to solve issues around water demand and water need using perspectives from water economics (by using tariff as a tool) for residents of high-income neighbourhoods and sociological perspectives to include private water vendors into the regulatory system to monitor the sale of safe water for low income neighbourhoods, resulting in the larger conservation of urban water (Magnusson & Van Der Merwe, 2005). Research has also examined a range of existing, emerging, as well as proposed institutional mechanisms to enable equitable water governance. However, the challenge around questions of water governance remains, and has in many ways been exacerbated by the pressures of a changing climate, biodiversity crisis, rapid urbanisation, growing inequality and economic development.

Governance of water has been shaped by many actors and institutions at varying scales across the last few decades, particularly at the global scale through a range of agreements and treaties and include global institutions such as the different UN agencies and the World Bank among other multilateral organisations (Gupta & Pahl-Wostl, 2013), as well as through multiple convenings/conferences at the global scale around the question of water (Quentin Grafton et al., 2023). Although member countries sign and commit to these agreements, there is limited implementation at the country level due to multiple constraints such as existing institutional arrangements and as well as the scale, number and types of stakeholders who should be involved in these processes (Gunderson, 2018). Variations in governing arrangements and systems at sub-national levels also makes implementation of global level agreements challenging. Moreover, there are a range of issues such as sharing, allocation, capacity, and administrative insufficiencies around water use, management, and conservation that emerge specifically around regional and local scales for which contextualised governance solutions are needed. Sub-national governance of water resources has not received as much attention, especially in the context of rapidly urbanising regions in the Global South.

This paper makes a case for focusing on the governance of water particularly at the sub-national scale and unpacks critical issues at this scale of governance set in the context of rapid urbanisation and growing concerns around climate change and biodiversity loss. Rising inequality and imbalance economic development across the world has led to increasingly unequal access to natural resources, water being a critical one. A re-examination of water governance is critical since water is embedded within and critical to the implementation of several of the Sustainable Development Goals (SDGs), directly (for example, SDG 6 - clean water and sanitation) or indirectly (for example, SDG 3: good health and wellbeing, SDG 9: infrastructure, SDG 11: sustainable cities and communities, and SDG 13: climate action) and will have a large impact on the way the future is shaped.

Countries in the Global South face a disproportionate burden as multiple crises converge around ecological, economic, social and spatial systems (Lobo et al., 2023). Over the past 50 years, water disasters including floods, droughts, storms, and extreme temperature changes have impacted more than two million people in the Global South (Q. Grafton et al., 2023). Water, is emerging as a critical constraint, since it is embedded within various systems and water insecurity has implications for equitable and sustainable growth. Many regions in the Global South are investing heavily in water and wastewater infrastructure systems as they grow and urbanise and

inappropriate developmental, technological and institutional choices may mean that they could get locked into unsustainable development pathways.

Moreover, as we have seen in the case of multi-level climate governance, sub-national governance processes and mechanisms do not always align with national and international goals and policies (Jörgensen et al., 2015). Water governance mechanisms particularly need to be aligned with local and regional developmental aims and growth agendas, since global treaties and agreements often fail to be implemented at the sub-national scale due to incompatible internal governance and policy structures (Gupta et al., 2013). Developing multi-level governance processes for water at the sub-national scale is also an important point of investigation since it allows us to study how policies disseminate and devolve within an existing governance structure in a riparian state. The success of global initiatives such as the Sustainable Development Goals (SDGs), depends on how these are interpreted and implemented at local scales. This is particularly relevant to water since it is directly or indirectly embedded in the SDGs. SDG 3 (good health and wellbeing) is directly linked to the availability and access to safe water and at a larger scale to infrastructures of water and sanitation that would come under the purview of SDG 6. Access and availability of water, sanitation and health are in turn connected to SDG 10 (reduced inequalities) bringing into the picture the socio-economic indicators that determine access to water (Balakrishnan & Anand, 2015; Mehta et al., 2014).

In this paper, we attempt to make a case for focusing on sub-national governance arrangements across three key aspects: types or colours of water; different types of uses of water; and across a range of settlement patterns ranging from the rural to the urban. We focus on blue and green water that constitute the major freshwater sources used for human and non-human activities at the household level for domestic consumption, economic development and ecosystem services at the larger regional scale. We investigate current governance practices in the larger context of increasing urbanisation, particularly in countries of the Global South where most urban growth will take place (UN, 2018). Understanding water governance is key to addressing the current fragmentation of water governance as we describe further in the paper.

Setting the context

The issue of water governance has been examined across multiple sectors and from different disciplinary perspectives and geographies. At the global scale, collective agreements and actions such as the Millennium Development Goals (MDGs), multilateral transboundary river sharing agreements and more recently the Sustainable Development Goals (SDGs) have seen some success in implementation at respective national levels. Most multilateral agreements and resolutions on the issues of water have been at the global scale, mobilised by the UN and global institutions such as the World Bank and the OECD, where representatives of riparian states have agreed towards collective action and goals. Initiatives like the Global Water Partnership (GWP) have been instrumental in advocating for strategies such as the Integrated Water Resources Management (IWRM) to improve coherence at the global but also at the national scales. Challenges around water values, pricing, privatisation, justice and equity have been discussed extensively across multiple geographies citing gaps in the way global water governance is imagined and therefore designed (Quentin Grafton et al., 2023).

While global conventions are important as they bring together a collective agreement towards an issue particularly around shared resources like water, there is little downstream implementation at the sub-national scale. The subnational scale is a heterogeneous territory since historical trajectories of policy, legislation and governance of individual riparian states are not uniform, and can vary significantly. Thus, when global agreements are to be implemented at the subnational scale through legacy institutions and policies, they fail due to incompatibilities between the objectives and visions of water governance, the political economy of local institutions, policy instruments and incentives. For instance, the vision around IWRM requires an inter-connected governmental structure that allows for a collective vision to be implemented across ministries and sectors.

However, this is not possible in many countries, with their current fragmented governmental setup that has strict silos in the way they govern different types of water use (Biswas, 2013). The intrinsic relationship between land and property rights and water management also has a large bearing on the way countries govern green water (Bosch & Gupta, 2023)

The lack of implementation of global agreements at the sub-national scale is due to multiple factors including unfavourable institutional lock-in, infrastructural lock-in, technology barriers, mismatch between the stakeholders involved and their interests along with issues of a scale-mismatch in the larger governance framework (Q. Grafton et al., 2023). Institutional hierarchies and structures at the national level are a result of their policy histories that are difficult to adapt to new policy objectives, particularly those made at a global scale. Further water governance systems and frameworks tend to be fragmented across ministries, sectors, and jurisdictions as well as along use, type and source leading to siloed planning and governance of water within a geographical jurisdiction(OECD, 2011). This makes it particularly challenging to implement strategies such as the IWRM (Biswas, 2013). The OECD report on the 'Water governance challenges in African cities' (OECD, 2021) states that weak institutional structure particularly around IWRM, in addition to poor integration between sectoral policies contribute to overall poor water governance.

Further, the fragmentation of water governance along the types of water is a pertinent issue since most governance frameworks focus on blue water without its integration with the other colours (grey, black and green) of water. A stark issue in the future would be the integration of green and blue water governance, since it has a strong relationship with the way land is owned, planned and governed. In addition to this is the difference in governing water used for different purposes such as industrial, domestic, irrigational and ecosystem services, as well as across space across the rural-urban continuum. Scattered governance across multiple institutions and scales reiterates the different values of water which guides the eventual governance of the water in their respective jurisdictions. Differing institutional values creates a dissonance in the way water is imagined and therefore governed. Many countries have established river-basin governance arrangements that bring together multiple stakeholders to address a water sharing and governance.

Stakeholders on the urban-rural gradient will need be mobilised to create more coherence in the way blue and green water is governed across that continuum. Participatory governance and planning as well as devolution of decision making around water are can create conducive spaces to implement larger SDGs and IWRM-linked strategies. Long term solutions guided by a holistic vision around an integrated water governance framework is the need of the hour. Towards this end, we offer a few perspectives through the course of this paper.

Approaches to subnational water governance

Water governance at the national and subnational scales are typically driven by hydro-hierarchies, with unequal power wielded by key actors who have the authority to make decisions around water (Q. Grafton et al., 2023). To move away from legacy based institutional decision making and policies, new perspectives to value water will need to be imbibed. A part of this transition would be to account for the different colours of water and their unique governance requirements. For instance, the governance of green water (soil moisture) is inexplicably linked to the governance of land-related institutions related to green water.

Centring water in the governance of other sectors is fundamental towards building a resilient and sustainable future. In order to achieve this, there is an urgent need to build coherence in policies and objectives within the water sector as well as across sectors (Gupta et al., 2024a). Presently, the different colours of water are governed within narrow context due to narrow objectives of institutions in charge of them.

Blue water governance includes addressing challenges around freshwater across different sources such as rivers, aquifers and other surface water bodies between subnational institutions. Besides governing for their use, the framework must also include the downstream impacts of using the freshwater. Post-use, blue water from urban regions are often transformed into grey and black waters which are dense in organic matter and inorganic pollutants. Leaving these pollutants in the water affects human and non-human health and well-being, not to mention compromises the quality of water. Aligning sanitation infrastructures with water supply infrastructures is critical in developing more efficient and equitable water consumption systems, particularly in rapidly urbanising countries of the Global South. Coordinated actions like this will automatically allow countries to successfully implement interconnected SDGs. These actions, would for instance, address objectives of SDG 6 (Clean Water and Sanitation), SDG 3 (Health and Wellbeing) as well as SDG 14 (Life Below Water).

Similarly, green water (soil moisture) is tied closely to property rights and soil health. The use of land for different purposes therefore has deep implications for the conservation of green water. In rural settings, this has implications in the way agriculture is practised, often resulting in nitrate-polluted green water that is unsuitable for the microbial soil biome which further impacts agricultural productivity in the long term (Gupta et al., 2024c; Singh et al., 2024). The fundamentally unsustainable agricultural practice that is dependent on chemical fertilisers and pesticides to grow water intensive crops, impacts the quality of green water (Gupta et al., 2024a). At the national scale, the governance of green water is tied to the vision and practice of agriculture and global trade, strengthening the water-energy-food and environment nexus. Further, in countries of the Global South, where tenure and ownership status of land is often a contested, implementation of blanket policies and regulations around the conservation of green water is neither useful or equitable. Modernising land records and updating local revenue records, on the other hand, would significantly aid the process of creating evidence-based policies around green water governance. Here, for example, we see the potential of achieving goals of SDG 10 (reduced inequalities) and SDG13 (climate action) through integrating water governance mechanisms, which may allow us to address the overuse of the fossil fuel and chemical fertilisers in modern agriculture. Moving away from agricultural practices like monoculture of water-intensive crops, that consume fossil fuel-based fertilisers and pesticides, towards diversified local crops would significantly reduce water and carbon footprint of countries (Singh et al., 2024).

At the global level, there have been a few approaches to water governance that have been advocated such as the Integrated Water Resources Management (IWRM) through the Global Water Partnership (GWP). Many countries have adopted the principles of IWRM into their existing governance systems to allow for a more collaborative and participatory system of water management. It includes user groups at the community scale to increase accountability and build a network to promote inclusion of tacit knowledge along with modern technology (Rahaman & Varis, 2005). Another approach that has origins in the Spanish social movement is the New Culture of Water (NCW) that hinges on the key principle of power distribution, not allowing administrators complete control of the resource (Barkin, 2011). Another important element of this approach is the culture of water use, taking into account the social dimensions around water management. Besides a holistic governance and a political system, participation from members of society is critical to its success.

In order to fruitfully implement these visions, it is important to address institutional challenges at subnational scales, like states, provinces, cities and regions. Institutional challenges stemming from fragmented governance structures are passed down the governmental system and get reproduced across times. Besides having a fragmented structure, institutions are also burdened due to financial limitations and insufficient capacity among others (Q. Grafton et al., 2023). Addressing these challenges at their respective scales is important to address governance dysfunctions at a larger scale.

This is closely linked to the way different types of water use including economic/industrial, domestic and ecosystem services are governed. Institutions across scales typically have narrow mandates over a fixed

jurisdiction. While this is helpful in creating accountability, it often hinders the implementation of larger system-wide goals such as the SDGs. Relevant state and non-state stakeholders participating in the water governance process is important to create more equitable and inclusive governing arrangements. This would also be useful in allowing a bottom-up approaches to respond more adaptively to diverse local policy environment. Creating adaptive governance is crucial to designing evidence-based and context-driven water management systems, strengthened by traditional and tacit knowledge of water, embedded in local context. We elucidate a few of these approaches and challenges in the next section and present case studies to illustrate them.

In this paper we focus on blue water or freshwater and its interlinkages with green water, given its inherent relationship to land and property rights. We begin by illustrating how the sub-national space plays an important role in the governance of water particularly in the context of future urbanisation. A critical requirement to create resilient and robust governance frameworks, is a reliable, granular and consistent data architecture across sectors. Capturing timely data is important not only to understand current circumstances but also to project future trajectories. Data around different types of water uses integrated with data from different ministries has the potential to create a robust planning mechanism.

Creating a robust data architecture around water

A recurring issue across multiple sectors is the lack of reliable and consistent data, a vital requirement to create robust policy and regulatory frameworks. Data when available, represents large populations and does not have the granularity required to illustrate an accurate picture of reality. In the specific context of water, data around water extraction, consumption, replenishment and treatment is rather poor making it challenging to project future consumption patterns. This issue leaks into other administrative challenges around underinvestment in water infrastructure, under delivery of services, inaccurate projection of future resource use (Tiwale, 2021). Balakrishnan & Anand (2015) elucidate issues around data through a case study of Bengaluru, analysing data across 9 parameters. They argue that administrative boundaries are too large resulting in data being homogenised, therefore not giving an accurate picture of urban inequality. The lack of granularity of data therefore allows 'shadow areas' to exist in master plans, where there is very low access to basic social infrastructures like health, education, water and sanitation. As an extension, data around different types of water use across different sources, and institutional and sectoral jurisdictions would allow stakeholders to design a more inclusive society. Understanding water consumption from a socio-ecological perspective will allow stakeholders to address issues around equity, sustainability and conservation (Mehta et al., 2014). Analysing material flows will contribute to creating more efficient systems and contribute to the larger goal of sustainable resource management while prioritising just allocation and access to water (Gupta et al., 2022; Hodson et al., 2012). Using modern technologies to capture more accurate real-time data is a seemingly easy solution on paper, however, the reality of implementing these solutions is slightly different. Often, the lack of consistent finance to install the technology and maintain skilled staff to operate and analyse the data to inform policy processes can be a serious constraint. Bridging the financing gap across the governmental hierarchy is necessary but may not be the only solution to addressing key issues around water. In the next section, we offer possible approaches that align interests around water governance with those with national and global traction, such as climate and heat action.

Financing

Constraints in finance is a considerable roadblock for many institutional activities, particularly at the sub-national scales. At the same time, many nations are now investing actively in climate funds and green funds to address climate change at the national level, devolving responsibilities to the lower levels of government. Climate action funds at the national scale is an opportunity to bring together different stakeholders, towards creating an inclusive regulatory framework. Inculcating water goals through initiatives such as these allows stakeholders from

across the board to work together. The Green Fund of South Africa for instance is an initiative that promotes the transition to a greener economy. The fund is a collaborative effort between the Development Bank of Southern Africa and the Department of Forest, Fisheries and Environment, and funds private enterprises as well as subnational governments like municipalities allowing state and non-state actors to participate. Another collaborative initiative is the National Adaptation Fund for Climate Change (NAFCC) in India funded through the National Bank for Agricultural and Rural Development (NABARD). The bank aids the implementation of projects identified by State Action Plans on Climate Change prepared by individual subnational states and includes capacity building as an identified area requiring upgradation. Innovative financing mechanisms are critical in tackling complex interconnected issues particularly around climate change and natural resource management. It facilitates small scale solutions and cohesion across existing funding frameworks, allowing water to be integrated into the larger goals (Koop et al., 2017). Financial security is a crucial element the absence of which triggers a sequence of related barriers particularly around capacity as we discuss further.

Capacity

The complexity of water governance challenges requires specific types of capacity building within governing institutions: existing governing institutions are not only deeply understaffed; they also lack the technical knowledge as well as access to cutting edge science. Capacity building needs to focus not only on building the ability of state institutions to manage complex issues around water, but also to develop structures that draw on technical experts, community knowledge and multi-scalar and multi-sectoral approaches. Issues around capacity do not pertain only to the skill set of state actors but also to the way capacity systems are imagined. This is particularly important since there is no organisation at the global and national level dedicated to governing the water cycle (Q. Grafton et al., 2023). Horizontal and vertical linkages across different scales of government and concerned agencies is crucial in building adaptive capacity particularly in the face of accelerating climate change (R. Q. Grafton et al., 2011; Gupta et al., 2024b).

In addition to training and building skill sets of state cadres, it is equally important to design a system that is able to adjust policies and practices in changing circumstances. A system that anticipates change and responds proactively through an interactive network of information, capacity and finance (Koop et al., 2017). Keeping water justice and equity at the centre of multi scalar urban governance systems, deliberate attempts must be made to ensure that spatial inequalities are not reproduced (Bharathi et al., 2022)or neighbourhood residential sorting within a ward (the elementary administrative and political unit in urban India. Parallel mechanisms in the realm of climate action, can be appropriately borrowed to enable a better cohesion across the organisational, network and government levels (Willems, 2004). Subnational government institutions such as cities, states and provinces in America, have been able to work together by implementing climate action strategies in their administrative jurisdictions (Osofsky, 2010).

Reimagining the role of state and non-state stakeholders in water governance

An important observation across different federal water governance systems is the shift away from state-led hierarchical governance models to more participatory frameworks of governance that include non-state stakeholders. While this is an important step towards creating a more democratic model of water governance, there is a need to integrate these processes across scale and across sectors. The inclusion of non-state stakeholders like individual water users, private sector players and civil society groups have played important roles in water advocacy and infrastructure creation that have enabled hybrid models of governance (Gupta et al., 2013).These non-state actors have played crucial roles in supplying alternative water supply systems and off-grid solutions at the neighbourhood scale in many Global South cities, supplementing the larger state supplied water network. However, appropriate regulation is a necessary to protect against monopolies over land and water resources, that will contribute to increasing urban inequality. The inclusion of non-state actors in governance

arrangements and negotiations, have been inconsistent, contextual and dependent on power hierarchies. It has often restricted the creation of a level playing ground, as differential power, grounded in economic, political and social identities and the limited clout of these non-state stakeholders has a bigger impact on the decision-making process (Adams et al., 2020).

Often efforts to decentralise have not been successful as they lead to local territorial competition and conflict rather than conservation, making the exercise counterproductive (Pinel et al., 2018).For instance, the failed devolution of water management to local governments in Mexico led to the re-centralisation of federal power (see Box 1). Multi Stakeholder Platforms (MSPs) are often offered as a solution to issues around participatory planning to encourage and inculcate public participation. However, they may not always be a solution to this complex challenge. MSPs have a tendency to "homogenise the problem" where perspectives are antagonistic leaving little room for a collaborative decision-making process. In such a situation, technocratic models of water governance, that have been the norm, take over as a default method of water regulation and governance (Batchelor, 2007).

Box 1: Recentralisation of power in Mexico

Water reforms in Mexico brought about the creation of a 1983 Constitutional amendment that made it the legal responsibility of local governments to manage and treat water in their jurisdictions, under the supervision of the National Water Commission (CONAGUA). These local agencies face many constraints including financial and capacity deficits to respond to an overwhelming demand to meet international water management.

At the same time, federal authorities created incentives to involve private participation in the water sector to help modernise infrastructure. Public-private participatory models such as the BOT (build, operate and transfer), often placed the burden of cost-recovery on local agencies, many of whom are not equipped for the task. The quality of the privately constructed infrastructure, caused an overall loss of revenue. In a lax regulatory environment where local agencies are unable to enforce environmental regulations and standards, unchecked extraction of groundwater, and pollution, could well ensue.

Financially insecure local agencies became heavily dependent on federal funds even for operations. As a result, the CONAGUA which was originally imagined to be an advisory and supervisory body, took on the core responsibilities of modernising water sector technology, "intensifying its efforts to promote the international private sector for the modernization and management of the infrastructure" (Barkin, 2011). A growing market of industrial and commercial users supported by local power groups caused an increase in local water extraction. Local governments are typically not equipped to monitor or regulate a diverse set of water arrangements leading to a situation where CONAGUA has eventually (re) centralised powers over the country's water resources (Barkin, 2011).

Box 2: River Chief System in China: a collaborative governance model

The River Chief System in China is an example of collaborative governance established within a hierarchical institutional framework. Instituted in 2016, this system operates through hierarchical representation at the provincial, urban, county, and township levels. At each scale, the River Chief is responsible for coordinating concerned departments to solve intersectional water issues. The cadre of River Chiefs, at different scales, are in-turn tasked with coordinating and managing water resources both horizontally and vertically within the institutional framework. This system has enabled greater inter-departmental collaboration and cross-scale collaboration, creating a more holistic approach to water governance. (Wang & Chen, 2020)

Governing for water security and equitable access to water

Current water governance systems do not prioritise just and equitable access to water. The lack of a uniform understanding of water security and justice has led to a situation where objectives of institutions vary significantly based on the metrics and values of water, they consider more important. There is often a deep dissonance in the way access to water is understood across ministries and agencies in a typical urban, regional and national system. Adding to this is the disjuncture between water security and water access where water security of a country does not translate to equitable access to water within it (Hordijk et al., 2013). Rapid urbanisation exercises have resulted in urban jurisdictions being expanded beyond gridded infrastructure of institutions in charge of water supply. Peripheral urban neighbourhoods relying on off-grid solutions often tap into water sources from neighbouring agricultural and rural jurisdictions, negatively impacting the aquifer in question. Water running in gridded infrastructures is also sourced from outside the urban hydrological boundary, severely impacting the source environment. Additionally, is the increasing virtual water footprints across urban areas, agriculture and economic activity. Irrigational water is also a supplied gridded infrastructure that depends on water sources distant from the point of use. The invisible use of water through commodities and services imported into a settlement has adverse impacts on the larger hydrological system and the Global Water Cycle.

A critical re-examination of stakeholders, water values and jurisdictional boundaries is crucial to build an integrated cross-scale water governance system. The convergence and regulation of state and non-state stakeholders from state- provided municipal water utilities, private utilities, informal markets among others is necessary to create an equitable water governance system. A reassessment of governance of water from different and types for different uses is urgent to recalibrate the fundamental fragmentation between blue and green waters for the coming decades. (Hordijk et al., 2014).

Box 3: Governing water sharing between regions: the Cauvery River basin in India

Flowing through India's southern peninsula, the Cauvery River marks the basin boundaries across four south Indian states: Tamil Nadu, Karnataka, Kerala, and the Union Territory of Pondicherry. The water sharing dispute in the Cauvery River basin in southern India illustrates the challenges around sub-national water governance. The Indian states of Tamil Nadu (downstream) and Karnataka (upstream) have shared water from the Cauvery for over a century, in spite of many altercations around water sharing, since the late 1800s.

The dispute primarily focuses on the sharing of water between the two states, especially in times of water scarcity. Both states have been trying to get a larger share of the river water to cater to the needs and demands of growing populations and economic activity. This conflict is exacerbated by growing water demands by increasing urbanisation in Karnataka (where Cauvery water caters to the megacity of Bengaluru's water supply), growing population as well as irrigation and other economic developments.

While several attempts have been made over the years to negotiate use terms of the river water across the century, there has been no permanent long-term solution. India has implemented Integrated River Basin Management for decades. Yet, Cauvery River water sharing remains an ongoing conflict that is currently being mediated through the courts. In the late 1990s, the Cauvery Water Disputes Tribunal (CWDT) was established to resolve the issue. After two decades, the CWDT issued its ruling on water sharing between all four riparian states. This ruling remains contested and the conflict tends to resurface, during times of water scarcity.

The dispute between the states represents a classic upstream-downstream water sharing conflict. With increasing pressure on the Cauvery, the river is increasingly viewed as a mechanistic resource rather than a dynamic ecosystem, impacted by local and global processes, including climate change. There is an urgent need to rewrite the narrative around water sharing that not only prioritises the sustainable use of water, but also minimises ecological harm and is responsive to challenges posed by climate change. (Bhave et al., 2018; Garg & Azad, 2019)

Potential ways forward

As we have discussed through the course of this paper, the path forward must involve a critical rethinking in the approaches towards a holistic water governance system. One that involves diverse sets of stakeholders, knowledge areas and methods. This is possible only with a review of current processes and mechanisms to one cantered around water security, water justice and sustainability. A cross-sectoral effort including non-state stakeholders could streamline these processes and governance arrangements considerably. This requires governance mechanisms to transcend ministerial and departmental mandates to create a larger vision of water security that includes blue, green, grey and black waters. Integrating different forms of knowledge, technology and financing arrangements will also enable a more context specific water governance framework, as we describe using the case of Ahmedabad in Box 4.

Integrating multiple forms of knowledge into the water governance framework

Water governance is a complex ongoing process involving many stakeholders of varying power and influence. In order to achieve an equitable water governance system, in a particular context, all values of water must be considered including cultural and traditional values. Part of this endeavour would be bridging the current tacit and traditional knowledge with modern scientific knowledge. By default, this means the inclusion of citizens, residents and local community members in any governance arrangement. A collaborative process must include "diversity and debate" (Batchelor, 2007) without which integration is not possible.

Box 4: Integrating tacit knowledge with public participation in the mitigation of urban floods in Ahmedabad, India

A successful instance of integrating tacit knowledge with modern systems is that of Ahmedabad's disaster resilience plan for urban floodings. Based on cycles of rain fed urban floods, the local corporator (representative of the urban local body) and the local community members have developed a communication system. When there is a risk of urban flooding, the corporator sounds the alarm and relays the information to the community residents who then turn off valves to avoid backflow of the rainwater into the sewage system. This system was built organically based on vernacular knowledge of the urban flood phenomenon in their neighbourhood, allowing the women in the community to organise themselves to seek help. The alarm was a prototype designed by the Mahila Housing Trust, Ahmedabad and has been crucial in keeping the community safe from flood risks. (Brahmbhatt & Jhabvala, 2020).

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