Water governance in Brazil

The need to share water in the anthropocene

Costa de Barros, E.

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4. SHARING OF RESPONSIBILITY, RIGHTS, AND RISKS: CATEGORIES AND INSTRUMENTS

4.1. Introduction

Policies address the allocation of water through water sharing instruments. This chapter assesses the scholarly literature on water governance in addressing the question: what does the literature reveal about the instruments that deal with water-sharing, and what are the advantages and disadvantages of these instruments? This question does not address how these instruments are interpreted and implemented, but pragmatically focuses on the potential of these instruments to address water sharing. This chapter does not examine the politics of the design of such instruments, which would require a political sociology approach. Instead, it examines these instruments from a critical functionalist approach (Majoor & Schwartz, 2015). Instruments are used in a broad sense to cover all principles and mechanisms that may have an impact on water sharing.

presents an overview of the six categories of water-sharing identified (see 2.5) and related water policy instruments, which are further discussed in this chapter. These categories are: (1) sharing of responsibility between levels (see 4.2); (2) sharing of water between provinces and states (see 4.3); (3) sharing of water between uses (see 4.4); (4) sharing of water between users (see 4.5); (5) sharing of water between humans and nature (see 4.6); and (6) sharing of water-related risks and related responsibilities (see 4.7). The list of instruments associated with these categories is not comprehensive but covers most of the relevant instruments and are also those that this thesis will address. The chapter concludes with a reflection on the main advantages and disadvantages of these categories (Section 4.8), comparing them in Table 4.4.

4.2. Sharing of responsibility between levels

4.2.1. Unitary versus federal states: power relations and water management approaches

This section shows how responsibility is delegated between different levels of water governance in unitary and federal systems. Table 4.2 juxtaposes the ideal-typical characteristics of unitary and federal

Table 4.1. Water-sharing categories and instruments

Categories	Main instruments
Sharing of responsibility between levels	a. Unitary or federal system
Sharing between federal units (or provinces and states) within a federal state	a. Joint Organizations b. Sharing agreements between federal units within a federal state
Sharing of water between uses	a. Priority of Use b. Human Right to Water
Sharing of water between users	a. Water use permit for allocating water to large users b. Water pricing c. Infrastructure (irrigation and hydropower)
Sharing of water between humans and nature	a. Minimum ecological flow b. Protected area
Sharing of water-related risks	a. Disaster risk reduction b. Drought management c. Climate proofing

Source: Author's elaboration

water governance systems across four dimensions: power, governance structure, context, and scale. Power concerns whether the governance scheme is concentrated or decentralised; governance structure concerns whether the system is hierarchical and how responsibilities are delegated; context concerns the extent to which policies are generalized or local context-specific; and scale discerns whether the system operates purely at the national or both at the national and state level.

4.2.1.1. Unitary states

Generally, countries can be characterized as unitary or federal states (see 4.2.1.2). In unitary systems: power is homogenous and concentrated in the central government; policies and laws are unified throughout the country; and provincial and regional autonomy is limited to certain areas of governance, such as spatial planning (Elazar, 1997). This is the case in states like France and the United Kingdom, where power is con-

Table 4.2. Ideal-typical characterizations of unitary and federal states dealing with water

Characteristic	Unitary system	Federal system
Power	Concentrated in central government, provinces/regions have low autonomy	Decentralized; provinces/regions have more autonomy
Governance structure	Hierarchical control of the centre over the peripheries. Such control enables top-down and bottom-up interactions within democracies	Division of responsibilities between actors at multiple levels of government (many jurisdictions)
Context/ coherence	Policies are uniform; may ignore local context; can allow for contextual differentiation through participatory processes & delegation of responsibilities	Each province makes its own contextual policy; policies may be centralized in large provinces; policies differ from province to province
Scale of analysis and operation	National	National and state level
Information management	Centralized	Not centralized

Source: This table builds on Elazar (1997); Maganda & Koff (2014)

trolled at the centres rather than the peripheries (Elazar, 1997). The logic of governance in a unitary state is that the elected government can represent the views of the electorate and develop a common, harmonized strategy for the country, treating like people and situations alike. This can entail regional differentiation and delegation of authority to other levels of governance (Scholten, 2014).

Management of water resources in unitary systems tends to reflect the same nature of centralized power, with national governments having more power over water allocation (Speed et al., 2013). Normally, there is an overarching authority that adopts policies democratically (in a democratic country) and these are supposed to be uniformly implemented in different areas and regions (Speed et al., 2013). An advantage of such a system is that it can create a coherent strategy for the country which can also allow for some degree of contextual differentiation (i.e., sensitive to local circumstances). On the other hand, it is difficult to accommodate political, cultural and related local differences in the management of water resources in unitary countries (Elazar, 1997).

4.2.1.2. Federal states and distribution of water sharing responsibilities

Unlike unitary systems, in federal systems, power tends to be decentralized and political authority is distributed between national and subnational governments (Stefano & Garrick, 2018). Federal political systems have multiple jurisdictions and multi-purpose authorities (Koontz et al., 2015, p.4). Each jurisdiction is equipped with some capability to operate independently (Koontz et al., 2015, p.4). In terms of water management, authority is shared between national and sub-national governments and encompasses constitutional provisions to coordinate power-sharing and manage inter-jurisdictional disputes (Garrick, 2013; p. 2). One advantage of federal systems is that water governance characteristics tend to change across regions, following the influence of political contexts (Maganda & Koff, 2014). This means that the nature of water conflicts are recognized to be regional or local (Maganda & Koff, 2014).

Despite the advantage of contextual and dynamic policies, federal systems still struggle to ensure policies at different levels and in different states. In some countries, provincial governments do not develop relevant laws and policies (Stefano &Garrick, 2018). In others that do so, the laws conflict with the approaches of the national authority or other states, thereby creating incoherence in water policy (e.g., the US and India) (Garrick & de Stefano, 2016; Stefano & Garrick, 2018). Governance of water is very challenging in federal systems considering their complex and multi-level structures (Garrick et al., 2013; Schlager et al., 2011). Whereas unitary systems are centralized within national governments, federal systems are fragmented with some fragments being more political than others. This is especially evident in water allocation, where priorities of national governments can differ from the interests of sub-national governments (Heinmiller, 2018; Stefano & Garrick, 2018) (see also Chapter 6).

4.2.2. Sharing of responsibilities between different levels of governance within federal states

It should be noted that both in unitary and federal systems, the central government controls relations over the international aspects of transboundary rivers. In the case of national rivers, or where a part of an international river is within a country, the central government of a unitary state decides how water is shared within the country. In federal states, if water is a state subject, the central government can only mediate on conflicts between states over water. Studies on federalism often discuss how power and resources are shared between different states within the different levels of government (Conlan, 2006). Since this thesis focuses on federal states, I discuss water-sharing in federal states in more detail.

In federal states, the center may pass the responsibility of water governance to a state and still have control over the water in the domestic transboundary context (Garrick et al., 2013; Garrick &de Stefano, 2016). Globally, there are 319 federal rivers. Among them, 137 are international rivers, with at least one federal basin-country unit, and 182 domestic federal rivers (Garrick et al., 2013, p. 14). These numbers do not include transboundary groundwater aquifers.

Federal systems face complex administrative challenges, such as: overlapping domains of authority between national and subnational governments; diverging accountability in decision-making processes at subnational and local interests; and incoherent water policy (Stefano & Garrick, 2018). Differences between political parties in different states further aggravate fragmentation of federal systems, as governments often make decisions based on political priorities and interests of their jurisdiction rather than regional needs.

The layered structure of federal countries determines the flow of power in the water sector. This depends on whether a federal system is based on a legal or political constitution and how water resources management is integrated into its political system. Section 1.4.1 presents a list of federal countries worldwide (see Table 1.3), Table 4.3 depicts the characterisations of federal water governance systems that are based on a constitutional framework; this includes those of Australia, Brazil, Canada, India, Mexico, Pakistan, and the United States. Notably, all systems bar that of Mexico are decentralised in their power and governance structure (see middle column), in which power is concentrated at the federal level. In Brazil, meanwhile, power is decentralised and states act quasi-autonomously. Moreover, the rightmost column of Table 4.3 delves into the intricacies of the constitutional frameworks pertaining to each of the jurisdictions. For instance, the Brazilian constitution distinguishes between rivers and watersheds under federal and state contexts; here, states are responsible for governing groundwater that are entirely within their borders, even in situations in which the water subsequently flows into other rivers or basins that transgress into other states.

Table 4.3. Characterization of federal systems based on the constitution

Country	Power and governance structure
Australia	Decentralized
Brazil	Decentralized, and states have more autonomy; fragmentation of responsibilities
Canada	Decentralized; Canadian federation originated from the “coming together” of the provinces to form a federation Fragmentation of responsibilities; two orders of government which get their powers over water from a variety of constitutional headings and ranging from natural resource powers to trade and commerce powers
India	Decentralised; fragmentation of responsibilities
Mexico	Centralised responsibilities; power is concentrated at the federal level
Pakistan	Decentralised; fragmentation of responsibilities; the federal government is responsible both for international relations, including the critical Indus River Treaty, but also for the Pakistan Water and Power Development Authority; provincial governments are responsible for water and sanitation
United States	Decentralized; Fragmentation of responsibilities; 1789 US Constitution lists only 18 federal powers, most of which are concurrent with the states; and the states are assigned ‘residual’ powers that are not federal

Source: Adapted from Anderson (2014); Garrick et al.(2014); Hayat (2020)

	Constitutional framework
	Constitution (section 100) explicitly prohibits the federal government from abridging reasonable state use of rivers for conservation or irrigation
	Constitution distinguishes between rivers (or watersheds) under federal versus state competence; constitution breaks up responsibility for watershed: states are responsible for tributaries and groundwater that are entirely within their boundaries even though they may flow into larger rivers that cross states boundaries and are thus a federal responsibility; local water service is a municipal responsibility
	Constitution makes no explicit mention of ‘water’ or ‘rivers’
	Constitution gives the federal Parliament the power to assert legislative authority over some rivers. In India “water” (including supplies, irrigation, canals, storage, power) is a state responsibility, but the union government may legislate on inter-state and international rivers
	The “lands and waters” are federally owned and states have no constitutional authority over rivers or water; however, the state can own significant water rights and land use is a municipal matter so effectively there is some diffusion of power
	Water is a provincial subject according to the 18th amendment in the 1973 Constitution of Pakistan (Constitution 1973: Chap. 3, Art. 155); Water and Power Development Authority centralized water infrastructure development in 1959; formal provincial constitutional authority is largely limited to local management of the irrigation systems
	The constitution makes no explicit mention of ‘water’ or ‘rivers’, so the two orders of government get their powers over water from a variety of constitutional headings, ranging from the residual power in the US, to trade and commerce powers

4.3. Water-sharing between federal units in a federal state

4.3.1. Issues regarding domestic transboundary water

Water governance in federal countries and water-sharing across domestic transboundary river basins is challenging (see Box 4.1). Water-sharing in domestic transboundary river basins can be facilitated through joint organizations and policy. Some countries have guidelines regarding how water can be shared between provinces or federal states and many countries encourage joint organizations or sharing agreements between states.

4.3.2. Transboundary water-sharing instruments

4.3.2.1. Joint organizations

Joint organizations or councils can support negotiations and conflict resolution in water allocation on a day-to-day basis. Joint organizations such as community-based, watershed, and river basin organizations have very different formats and many different functions, approaches, mandate types, and resources (Kleemans, 2010). They can provide fair solutions to difficult problems with, for instance, allocating water through democratic decision-making processes involving a diverse group of interested participants (Kleemans, 2010). With several points of view and interests represented, they require that all perceptions, opinions, and interests be theoretically taken into account to ensure reasonable and democratic outcomes (Abers & Keck, 2004; Lemos & De Oliveira, 2004; Warner, Wester & Bolding, 2008).

With the rise of the IWRM paradigm, water management at the basin level has been stimulated since the 1990s, and basin organizations have been promoted throughout the world (Lemos & De Oliveira, 2004; Warner, Wester & Bolding, 2008). Mexico and Brazil, for example, have adopted councils to serve in negotiations on water allocation and resolve conflicts (Wester et al., 2009; Engle & Lemos, 2010; Empinotti, 2011; Rap & Wester, 2013; Brandeler 2020).

The main advantages of having a joint organization like a watershed committee are: (a) allowing representation and participation of water users and other stakeholders (Kleemans, 2010); (b) joint information management, such as having common knowledge and a common database for policy-making purposes; and (c) transparency of management and upward and downward accountability (Hulse et al., 2009; Kleemans, 2010). The main disadvantage is that participation processes can be just symbolic and very time consuming (cf. Anggraeni, Gupta & Verrest, 2019).

4.3.2.2. Sharing agreements between units within a federal state

When water becomes insufficient due to higher demand and climate variability, pre-determined water allocation rules and procedures become important mechanisms to manage competition and prevent conflicts between users and between federal units. Otherwise there is a great likelihood of disagreement over water sharing (see Box 4.1). Adequate water allocation rules ensure equitable human water uses, conservation of ecosystems, and allow for efficient use of water resources. Inspiration for water-sharing in domestic transboundary river basins can be drawn from international treaties, including the Watercourses Convention (1997).

The 1997 United Nations Watercourses Convention identifies relevant factors and circumstances for water-sharing based on equitable and reasonable utilization principles (Article 6). These factors and circumstances include:

> “(a) geographic, hydrographic, hydrological, climatic, ecological, and other factors of a natural character; (b) the social and economic needs of the watercourse States concerned; (c) the population dependent on the watercourse in each watercourse state; (d) the effects of the use or uses of the watercourses in one watercourse state on other watercourse states; (e) existing and potential uses of the watercourse; (f) conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect; and (g) the availability of alternatives of comparable value to a particular planned or existing use” (UNWC,1997,p. 236)

Parties are encouraged to democratically assign different weights to different criteria in relation to the specific river basin they are looking at (see 6.4.1).

The advantages of adopting the equitable and reasonable use principle are that it: sets an aspirational goal regarding the allocation of

Box 4.1. Water-sharing of a domestic transboundary river: the Cauvery Basin in India

The Cauvery River has been at the centre of water-sharing conflicts for the last 130 years. This is a domestic transboundary river with a length of 802 kilometres located in the southern part of India, crossing Karnataka, Tamil Nadu, Kerala, and the Union Territory of Pondicherry.

In the last twenty years, a water-sharing conflict between Karnataka and Tamil Nadu states has escalated. The state of Tamil Nadu (located downstream of the river) has historically used water for irrigation, while Karnataka state (located upstream of the river) has been increasing water use due to population growth and industrialization since the end of the 1980s. The population of Bangalore City, the capital of the state of Karnataka, increased from 150,000 in 1950 to 11.4 million in 2018. As water demand increases, so is the dispute between Karnataka and Tamil Nadu states also amplified.

In India, the central government reserves the authority to solve water disputes between federal units. The Indian Supreme Court gave directives to create a tribunal for Cauvery issues in 1991. This tribunal aimed to solve the water-sharing disputes more efficiently between the states. However, the first order from the tribunal related to the water-sharing disputes favoured Tamil Nadu state based on an established pattern, which Karnataka did not agree with. The Karnataka government approached the Supreme Court to intervene in the decision and the Supreme Court also ruled in favour of Tamil Nadu.

Over the years, the dispute has intensified even more while water demand has continuously increased along with the uncertainty of climate change (Sharma et al., 2020). Karnataka's disagreement with the tribunal's adjudication has since led to several demonstrations in both states. In 2013, through the Cauvery Water Disputes Tribunal and based on the Supreme Court's directions, the Indian government proposed the implementation of a new water policy instrument, namely a water-sharing agreement between the states within the basin. The agreement proposed that the share of Tamil Nadu's water be reduced from the 2007 verdict (from 419 thousand million cubic feet [TMC] to 404 TMC) while that of Karnataka be increased (from 270 TMC to 285 TMC). However, in 2015, Tamil Nadu accused Karnataka of not complying with the agreement and accordingly releasing the quantity of water requested, rekindling the dispute between the states.

Another water-sharing instrument – a joint water management board – was implemented for the Cauvery River in 2019. The Cauvery Management Board was constituted permanently to discuss all matters regarding water disputes.

Source: This text is based on Sharma et al. (2020)

freshwater (Conti, 2017); is seen as part of customary international law with high legitimacy; and provides clear criteria for allocating water. In practice, however, it is difficult to apply the principle due to its generality and flexibility, which render it predisposed to subjective interpretation (Kaya, 2003, p.91; Savenije & van der Zaag, 2002).

4.4. Water-sharing between uses

4.4.1. Different uses of water

Water-sharing between uses (e.g. agriculture, industry, household) means guaranteeing an adequate amount of water for different kinds of human use. Differences in water management values and priorities between national actors and their regional/local partners can lead to disputes. Water disputes among household, industrial and agricultural uses are already becoming increasingly common (OECD, 2015a). These conflicts can be observed in social-spatial exclusion processes, through which large cities push low-income populations to the margins of society where water access is low and or water pollution is high (Refinetti, 2006; Klink, 2009). In many cases, low-income populations in peri-urban and rural areas are forced to occupy watersheds and/or protected areas around the basin which puts pressure on these people while polluting the water or affecting water recharge (Refinetti, 2006; Klink, 2009; van den Brandeler, 2020). Two water-sharing instruments that can help to resolve and prevent conflicts and guarantee basic human dignity are the priority of use and the human right to water and sanitation instruments.

4.4.2. Instruments for sharing water: Priority of Use and Human Right to Water

4.4.2.1. Priority of Use

The priority of use instrument enables the state to decide which uses have priority over others especially during times of drought. The instrument originates from Islamic law, which prioritizes vital human needs for water before all other needs (Caponera &Nanni, 2019) and which came up with a list of priorities that would kick into effect when there was a water shortage. At the international level, the principle of priority of use is recognized in Article 10 of the 1997 UN Watercourses Convention (UNWC 1997). However, the UNWC does not dictate which use gets priority, rather leaving that decision to countries to make individually.

Conversations regarding priority of use should occur in "peace time", not during extreme events such as droughts and floods. This ensures an environment in which everyone understands each other's needs and the advantages and disadvantages of prioritizing some uses over others can be openly discussed. In other words, discussing priorities of use during "peace time" allows for decisions to be made in advance to balance risks, rather than in the heat of the moment.

The advantage of the priority of use instrument is that it can provide a democratically defined objective foundation for allocating a limited resource (MacDonnell, 2004). It can prioritize water allocation to vital human needs while reserving water for nature (Zheng & Spijkers, 2021), thereby having a direct impact and benefiting a greater number of people and the ecosystem. Nonetheless, the principle of priority of use requires considerable commitment from each country to set its own numbers and remains poorly debated in the literature and inadequately implemented in practice (Zheng & Spijkers, 2021).

4.4.2.2. Human Right to Water and Sanitation

Every individual, without any discrimination, is entitled to the human right to water and sanitation (HRWS), which entails sufficient, safe, acceptable, accessible, and affordable water and sanitation services for personal use. Yet, there is a long way to go to ensuring this right for everyone. An estimated 2 billion people still do not have access to safe managed drinking water services (i.e., drinking water from sources free of contamination and available and accessible in less than thirty minutes)(WHO/UNICEF, 2021); 3.6 billion people lack access to managed and safe sanitation services (i.e., access to hygienic toilets from which wastes are treated and disposed of safely) (WHO/UNICEF, 2021); and 3 billion lack basic handwashing facilities (i.e., toilets or latrines that do not have to be shared with other households and include soap and water) (WHO/UNICEF, 2019).

Appropriate sanitation services is crucial to avoid contamination of drinking water (Ellis and Feris, 2014), yet accessing clean drinking water and adequate water for sanitation services remains a complex and interlinked problem (Hurlbert, 2020). "Equitable allocation of sufficient water within and among countries is fundamental for maintaining supplies of safe and clean water for domestic consumption" (Hurlbert, 2020,p.339). International human rights law "obliges states to work towards achieving universal access to water and sanitation for all, without discrimination, while prioritizing those most in need" (UN Water, 2019,p.36).

The international legal basis of the human right to water and sanitation originates from multiple treaties. The General Comment No. 15 on the right to water, adopted in 2002 by the UN Committee on Economic, Social, and Cultural Rights, is considered the main authoritative statement for interpretations of the right to drinking water, although it is not legally binding (Grönwall & Danert, 2020). The first international declaration specifically on the human right to safe drinking water and sanitation was adopted by the UN General Assembly and the Human Rights Council in 2010 (UN, 2010). The UN Human Rights Commission and UNGA adopted two separate resolutions on this right (UN HRC 2010; UNGA 2010), both recognizing this right to be linked to other human rights, such as the right to life and human dignity. The human right to sanitation was explicitly recognized as a distinct right by the UN General Assembly in 2015 (UN, 2016).

The Human Right to Water includes five elements: availability, accessibility, affordability, quality and safety, and acceptability (OHCHR, 2020).

- Availability refers to sufficient and continuous water supply for each person for personal and domestic uses, including drinking, personal sanitation, washing of clothes, food preparation, and personal and household hygiene. One person needs between 50 and 100 litres of water per day to meet basic needs (WHO, 2003; UHCHR & WHO, 2015,p.8).

- Accessibility refers to having a water and sanitation service that is physically accessible within or near each person's household, workplace, school or health facility. According to WHO, the water source must be within 1,000 meters of the home and collection time should not exceed 30 minutes (WHO, 2003; UHCHR & WHO, 2015,p.10).

- Affordability refers to water and related facilities and services being affordable for all. The United Nations Development Programme

(UNDP, 2006) suggests that “water costs should not exceed 3 percent of household income.”(UNDP, 2006, p.66)

- Quality and safety refer to water being free from micro-organisms, chemical substances, and radiological hazards. Measurements of drinking-water safety are normally defined by national and/or local standards for drinking-water quality, which often build on WHO standards, and

- Acceptability refers to water having an acceptable colour, odour, and taste for use.

The Human Right to Water and Sanitation (HRWS) discussions have been evolving in international law through soft law instruments (e.g., “the political declarations of States, the resolutions of UN human rights organizations”) and “hard law sources like treaties” (Obani and Gupta, 2016, p. 679). More recently, the Human Right to Sanitation was recognized as an independent right by the UNGA (Resolution on the HRWS, 2016, A/RES/70/169). In practice, however, water and sanitation are difficult to separate in wet sanitation systems, and the main reason is that the sewage flows into water systems that feed the water supply (Ellis & Feris, 2014; Obani & Gupta, 2016). Therefore, the framings which combine water and sanitation rights can enrich the discussion, operationalization and implementation of the Human Right to Sanitation.

Numerous national constitutions protect the right to water or present the responsibility of the State to guarantee access to safe drinking water and sanitation for all. Courts from various legal systems have arbitrated cases regarding the right to water, including water pollution, illegal disconnections, and the lack of access to sanitation (UHCHR & WHO, 2015; Obani, 2018).

There are three main advantages to adopting the human right to water and sanitation as an instrument. First, it has direct impact as it ensures that a broad group of people have the right to access to water and sanitation, including vulnerable groups like women and children (Gupta & Lebel, 2010), the poor, and the marginalized (Obani & Gupta, 2014b; Hurlbert, 2020). Second, it ensures that individuals or groups are given legal mechanisms to ensure that their right is enforced (e.g., marginalized groups are guaranteed rights that can be enforced) (Obani, 2018). Third, it can potentially ensure access to clean water, which can significantly reduce the global burden of disease. Millions of people are affected each year by water-related diseases including cholera, hepatitis A, typhoid, and arsenic poisoning (Barry & Hughes, 2008; Qadri & Faiq, 2020).

Although the discourses and rules of HRWS theoretically apply to similar levels of freshwater governance to everybody, in practice, it operates at different levels and it does not guarantee people immediate access to water (Obani & Gupta, 2014a). Furthermore, in some cases, stakeholders and states interpret international human rights provisions in different ways affecting the actual implementation (Obani & Gupta, 2017; Alonge et al., 2019).

4.5. Water-sharing between users

4.5.1. Different users of water

Water-sharing between users can be addressed through the adoption of policy instruments such as water permits, pricing, infrastructure (e.g., hydropower and irrigation) and complemented with subsidies in different sectors such as drinking water and agriculture (see Box 4.2). This category is rooted in the notion of water being a commodity and promotes policy and market-based solutions.

4.5.2. Instruments of water-sharing: water permits, pricing, and infrastructure (irrigation and hydropower)

4.5.2.1. Water permits

Water permits (or concessions, licences, rights, authorizations) are a regulatory instrument that establish the right to use and withdraw water from rivers and aquifers and is typically allocated through administrative processes by national or state/provincial (in the case of federal systems) governments (OECD, 2011). For example, in Indonesia, every year, farmers are required to request the government for the right to use water to irrigate their crops. Requests are accorded based on water availability, seasonal period, type of crop, and farm size (Frank, 2020). The importance of granting permits and overall governance of this instrument is interlinked with the development of legitimate, equitable, and effective governance systems (Gupta, Pahl-Wostl &Zondervan, 2013).

Water permits are a way to control and change the system of water ownership that used to prevail worldwide and can be traced back 5000 years (Dellapenna & Gupta, 2009, p. 394). Through history, customary access to water was institutionalized in water access and ownership rules (Dellapenna & Gupta, 2009). Such rules normally vary by countries' political systems and dynamics around: traditional and customary properties; riparian rights linked to land ownership (e.g., in the English colonies); state ownership; private properties resulting from liberalization; and, at present, new water allocation instruments such as payments, markets, contracts, and water permits (Dellapenna & Gupta, 2008). Across the world, water access and ownership was generally tied to land ownership or first in time (prior appropriation) principles; different countries are trying to gain control over the water through changing these rules and making them subject to a system of permits. While in many European Union countries this has succeeded, in several states of the US, Spain as well as many countries in the developing world, this is more difficult. In many of these countries, the state is trying to take back control over the water but this implies expropriation of existing property rights and such expropriation implies compensation (Mann & Warner, 2019). This makes it difficult for these countries to take back the water from the original owners and redistribute through a system of permits (Gray &Lee, 2018; Bosch et al., 2020).

Assuming that states have control over the water, generally, authorities have the following options when allocating freshwater resources: a) allowing people to use water for domestic purposes or to withdraw water for a specific use without requiring a permit; b) allowing for the continuation of existing water use and rights that originated in the pre-independence period (in the case of former colonies) through a water permit system; c) allocating water through contracts, leases, and concessions; and d) allocating water through a modern permit system that uses the main instrument available in the state (Bosch & Gupta, 2021). In the modern permit system, there are five main components that states must consider when granting water use permits: (a) the right to use the allotted water for a specific purpose during a fixed period; (b) the possibility of renewing the permit when the allotted period expires; (c) the possibility of changing the permit conditions during the allotted period; (d) the possibility to transfer the permit to others; and (e) the possibility to appeal and/or be compensated by the state if the permit is withdrawn or the conditions change prematurely, leading to financial loss to the permit holder (Bosch & Gupta, 2021).

The main advantages of the water permit system include direct impact, clarity, and applicability to a broad group of actors. A disadvantage is that it requires adequate information about water availability, quantity and quality (i.e., considerable knowledge and expertise) and the ability to make an appropriate water budget. Moreover, it requires the administrative authority to have a clear idea about how water should be shared between the different users. This is a challenge especially for many developing countries that lack adequate information about how much water is available for human uses, which uses should be prioritized and under what conditions and where water governance systems tend to not allocate water to the environment. Another problem is that such permits and contracts may de facto allocate water ownership for a long period of time and may thus limit the flexibility of the state for redistribution (Bosch & Gupta, 2021). A key question is whether such permits allocate water in such a way that some users are prioritized over other users.

4.5.2.2. Water pricing

Water pricing is a policy instrument for valuing water at opportunity cost according to potential possibilities and limitations related to supply and demand (Varela-Ortega et al., 1998). This is based on the notion that water is a commodity, a scarce resource, that should be priced. The instrument focuses on enhancing economic efficiency[5] where water productivity is measured by the limits and opportunities of the best water price (Molle, 2009b).

As challenges to allocating water among users increase, this leads to the evolution of water markets and allocation policy reforms (Wheeler et al., 2021). In the 1990s, economists argued that treating water as an economic good and thereby instituting water pricing would offer economic incentives to ensure that users would not waste water (Hellegers& Perry, 2004; Molle & Berkoff, 2007; Molle, 2009b). Water pricing is closely related to the IWRM paradigm in terms of giving particular

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5 Economic efficiency is a cornerstone of neoliberal ideology. “Neoliberal ideology holds that social functions are best managed through the free market, and that economic development should be undertaken by the private sector, with the state playing a facilitating and regulatory role where the economy dictate the rules to society rather than the other way around” (*Budds, 2004, p. 2*).

Box 4.2. Subsidies in drinking water and agriculture sector

Subsidies are also a well-known complementary instrument of the country's drinking water and agriculture sector. The subsidies can be an integral component to enable beneficiaries to access enough water, food security of individual households and credit (Naik, 2022).

Some recent studies have explored the role of subsidies in water access and allocation, taking into account the equity and inclusiveness aspects (Bosch et al., 2020; Naik, 2022). For instance, Naik (2022) conducted research to investigate the impacts of subsidies on groundwater access and regulation in India. The investigation pointed out that the Indian state interventions, such as water-related subsidies, are intended to address the inequitable water access and water allocations to ensure equity and inclusiveness in accessing groundwater drinking water supply. However, inequality in water access is increasing because the land rights, social discrimination, economic disparities, political choices, and bureaucratic interventions. More than that, the land-water nexus combined with the extreme use of subsidies is causing the aquifers' exhaustion and deterioration. According to him, it is important to reconceptualise the Indian current legal framework addressing subsidies and indirect addressing water allocation between uses and users taking into account the ecological impacts and groundwater exploration (Naik, 2022).

Source: This text is based on Naik (2022)

attention to economic instruments as a way to influence water demand and improve the efficiency and productivity of water use (Finney, 2013). Moreover this enables cost recovery and enables the water supply system to become financially viable.

Water pricing uses prices and charges to motivate certain types of decision-making by water users. Among the charges are those referred to as direct water abstraction charges, such as irrigation service charges and water supply tariffs. Others are indirect water resource charges, which are made for the use of water in itself and the provision of services that exploit the resource (e.g., hydroelectricity) (Finney, 2013). Water pricing addresses water-sharing in terms of the market, which has some advantages (Wheeler et al., 2021). First, market pricing influences actors' behaviours through market signals, using prices and charges to motivate certain types of decision-making by water users (Wheeler et al., 2021). Second, such charges (e.g., budget) can be used for financing specific purposes, including irrigation system operation and maintenance and water resource management (Wheeler et al., 2021).

The disadvantages of water pricing are that as water supply exceeds water demand, the price of water goes up and poor people and small holders may no longer be able to afford the water (Smets, 2009; Martínez-Santos, 2017) and thus become poorer and water may be reallocated from lower- to higher-value activities (Bjornlund & Rossini, 2005). The design and enforcement of water pricing instruments also often face difficulties including strong political pressure from dominant users such as irrigators (Varela-Ortega et al., 1998).

4.5.2.3. Infrastructure

Infrastructure enables the allocation of water to different users through distribution and division of the resource by small and large scale hard engineering systems (Allan, 2003). With small and large scale hydropower, irrigation systems and storages, and inter basin water transfer (see Box 4.3) infrastructure has often been promoted as a means for increasing welfare, flood protection, energy production, food augmentation, water security enhancement, and expansion of supplies of drinking water (Molle, Mollinga & Wester, 2009; Merme, Ahlers & Gupta, 2014; Rusca et al., 2019). Throughout the 20th century, particularly large dams were a sign of economic development and technological progress (Ahlers, 2020). As mentioned earlier, water infrastructure has traditionally been part of water sector development, and strongly embedded in the hydraulic engineering paradigm and the establishment of large international hydraulic bureaucracies (see 3.2.2).

An advantage of infrastructure as an instrument of water-sharing is that it has direct performance impact in influencing certain behaviours of water users (Majoor & Schwartz, 2015). Hydropower multipurpose development schemes can also improve living standards through electricity supply, irrigation for food production, and flood control (Kaygusuz, 2010). Furthermore, groundwater can only be accessed using infrastructure, which thereby determines the use of groundwater (Cosgrove & Cosgrove, 2012; Gupta & Pahl-Wostl, 2013).

Box 4.3. Inter basin water transfer (IBWT)

Inter Basin Water Transfer (IBWT) refers to a situation where "water transfers connect hydraulically two or more river basins that hitherto were unconnected" (Gupta & van der Zaag, 2008, p. 29). It enables the allocation of water to different users through engineering systems. Usually, an IBWT project focuses on transferring water from a water-abundant specific area to a water-deficient area (e.g., donor and recipient reservoirs, water transportation and distribution tunnels, and mass water pumping) (Zhang et al., 2015; Ma et al., 2020).

One advantage of IBWT as an instrument of water-sharing is that it has direct performance impact in improving flood control for the exporting basin and improving water quality in the importing basin, as IBWT can accelerate water exchange and upgrade water self-purification capacity (Zhuang, 2016; Khadem, Dawson & Walsh, 2021). Disadvantages include energy intensiveness, high implementation costs, harmful social and environmental impacts (Khadem, Dawson &Walsh, 2021), and can cause aridification of the exporting basin (Zhuang, 2016).

Among its disadvantages are a high tendency to be inflexible and have irreversible consequences (Majoor & Schwartz, 2015). For instance, when a dam is built, a lot of changes, particularly social and environmental disturbances (e.g., submergence of land and property including human settlements) occur, which cannot be undone (Awakul & Ogunlana, 2002). Second, infrastructure entails high costs of implementation (Merme, Ahlers & Gupta, 2014; Rusca et al., 2019). Third, infrastructure can move water from those who owned and/or had access to it to others (Hailu, Osorio & Tsukada, 2012).

4.6. Water-sharing between humans and nature

4.6.1. Issue in water-sharing between humans and nature

Water-sharing between humans and nature means guaranteeing an adequate amount of water to accommodate not only human needs but also vital ecosystem functions and freshwater biodiversity. Nature has its own right to water, which is recognized by several countries as a motive for sharing the resource between humans and nature (Miranda Sara, 2021).

A more anthropocentric motive is that human well-being depends on nature, from which it receives multiple benefits from ecosystem services (MEA, 2005) (see 1.2.1). Millions of people worldwide, particularly in poor communities, are directly dependent on natural resources such as fish and timber (Wallace, Acreman & Sullivan, 2003). There is therefore an urgent need to reconsider how we use the shrinking 'ecospace'[6] that we have, and this requires mechanisms that favour sustainability and inclusivity (Gupta, 2016). This section focuses on two instruments of water-sharing between humans and nature: minimum ecological flow and protected areas.

4.6.2. Instruments of water-sharing between humans and nature: minimum ecological flow and protected areas

4.6.2.1. Minimum ecological flow

Minimum ecological flow refers to the partial reservation of water resources for ecosystems. This instrument specifically focuses on water quantity (and sometimes, water quality) and ensures adequate volumes of water in rivers to maintain ecosystem services even during seasonal low periods (Arthington et al., 2006).

The concept of ecological flow (EF) entered water management discussions in the middle of the 20th century (Poff, Tharme & Arthington, 2017). This occurred as a result of the construction of immense dams that obstructed the large-scale flow of free-flowing rivers, causing a perceptible loss of ecosystem services, natural habitats, and biodiversity (Dickens et al., 2019). Initially, concerns were closely related to the impact of dams on supporting fish species (e.g., salmon) and thus the concept of minimum flow (or minimum instream flow) in rivers was adapted to not only account for navigation but also for ecological reasons (Dickens et al., 2019). Over the decades, the concept of EF has evolved through the 2007 Australia Declaration (Arthington, Kennen, et al., 2018) and the 2018 Brisbane Declaration (2018 Brisbane Declaration and Global Action

6 "Ecospace or environmental utilization space is a concept used to denote the total amount of resources available for use or the total amount of the sink available for the disposal of wastes"(*Gupta and Lebel, 2010, p. 378*)

Box 4.4. Ecological flow: the Australian experience

The ecological flow of Australia's Murray–Darling Basin is a well-known case of water-sharing between humans and nature in an arid climate. Over the last decades, agricultural diversification has increased pressure on water resources (Baumgartner et al., 2020). The main problem has been the over-allocation of available water to irrigated agriculture to the detriment of riverine ecosystems (Pittock & Finlayson, 2011). In 2012, Australia introduced a water recovery programme to restore the Murray–Darling Basin and support the riverine ecosystems (Crase, O'Keefe & Dollery, 2013). This expensive programme resulted in the implementation of the Basin Plan in 2012 (Baumgartner et al., 2020), which included the long-term goal of a sustainable diversion limit that determined the maximum water that could be extracted from the basin, and the amount of water that should be left in the basin to achieve an environmentally sustainable level (Authority Murray-Darling Basin, 2011). Several additional measures have been implemented to generate environmental outcomes and water recovery, including irrigators being able to voluntarily sell their entitlements back to the government (Horne, 2014) and the Commonwealth Environmental Water Holder's management of a portfolio of water entitlements for protecting and restoring aquatic ecosystems of the basin (Stewardson and Guarino, 2018). Consequently, water availability in riverine ecosystems in Australia's Murray–Darling Basin has increased (Williams & Grafton, 2019).

Agenda on Environmental Flows), both of which pointed out the importance of water allocation for humans and nature and made an urgent call to action to protect and restore freshwater-dependent ecosystems (Arthington, Bhaduri, et al., 2018).

One advantage of adopting the minimum ecological flow instrument includes its direct impact on ecosystems. However, implementation of this instrument is costly in the short-term and requires considerable knowledge and expertise. It involves measurement of historic flow variability (Richter et al., 2012) and grounding in scientific studies and socially acceptable limits for river development, which are not always easily negotiated (Dickens et al., 2019).

4.6.2.2. Protected Areas

A protected area is a clearly defined "geographical space that is recognized and managed through legal or other means to achieve the long term conservation of nature and related ecosystem services and cultural values" (Dudley, 2008, p. 60; Dudley et al., 2010). This definition, adopted by the International Union for Conservation of Nature (IUCN), embraces plurality and recognizes the high value of biodiversity conservation, particularly within areas of importance for biodiversity and ecosystem services (Vimal et al., 2021). Hence, Protected Areas (PAs) are part of main conservation strategies around the world (Hermoso et al., 2016).

The concept of a PA is not new (Watson et al., 2014). Protected Areas have existed for millennia in different cultures (e.g., sacred sites guarded by indigenous communities and 'tapu' areas for communal resource use in the Pacific island region) (Chape et al., 2005; Watson et al., 2014). In the 1970s, there was growing acceptance of the importance of in-situ conservation, which led to sharp expansions of PAs (Watson et al., 2014). Accordingly, the IUCN proposed a classification of the PAs in order to establish a common nomenclature to assess and compare PAs within and across regions (Vimal et al., 2021).

The IUCN proposed six categories of PAs, which differ from each other by management focus, type of human activity allowed within the area (e.g., tourism), and degree of intervention allowed to re-establish or maintain habitats within the area (Chape et al., 2005; Dudley, 2008; Vimal et al., 2021). The six categories are: (I) Strict Nature Reserves (the most restrictive type of PA regarding human activities) and Wilderness Areas (substantial restrictions for humans); (II) National Parks (typically large areas established to protect natural biodiversity and underlying ecological structures, support environmental processes, and promote education and recreation); (III) Natural Monuments (often small areas with a large number of visitors); (IV) Habitat/Species Management Areas (protection of specific species or habitats); (V) Protected Land/Seascape (areas with significant value due to exceptional interaction between humans and nature); and (VI) Protected Areas with sustainable use of natural resources (biodiversity conservation targets are not the primary focus) (Jones, McGinlay and Dimitrakopoulos, 2017). Furthermore, the IUCN identifies four different types of management frameworks: (a) Public (managed by the state); (b) Private (managed by a private owner or non-profit organization); (c) shared management (mostly collaborative management frameworks), and (d) PAs administered by indigenous people and local communities (Jones, McGinlay & Dimitrakopoulos, 2017).

The advantages to establishing PAs include: allocation of water to ecosystems, thereby preserving biological diversity; focus on maintaining native habitats; and provision of ecosystem services, such as community access to natural resources (Hermoso et al., 2016; Jones, McGinlay &Dimitrakopoulos, 2017). The disadvantages include that PAs are costly and few resources are currently allocated to their management (Hermoso et al., 2016); they are often situated where poor people and indigenous people live and can cause significant social impact including displacement (Jones, McGinlay & Dimitrakopoulos, 2017); and they are often located in areas where the biodiversity is low or encroachment is low such as mountain tops.

4.7. Sharing of risks related to floods, droughts and climate change

4.7.1. Explaining the issue

Globally, climate variation has been exacerbated by increasing occurrences, magnitude, and intensity of natural disasters (IPCC, 2022). Some areas are more vulnerable than others to natural disasters depending on geographic location, geology, and capacity of the area to cope with extreme conditions. Sharing of risks related to events like flooding, drought and climate change can be addressed, respectively, through the instruments of disaster risk reduction, drought management, and climate-proofing. The following section elaborates on these three risk-sharing instruments. However, we note that unlike the previous description of individual instruments, instruments here have been clustered in relation to their purpose.

4.7.2. Disaster Risk Reduction, drought management and climate-proofing

4.7.2.1. Disaster Risk Reduction

With the severity of floods and droughts increasing throughout the world, Disaster Risk Reduction (DRR) aims to address the causal factors of disasters through systematic and comprehensive efforts for reducing risks thereof (Hurlbert, 2016; Triyanti, 2019; Islam et al., 2020; IPCC, 2021). This normally focuses on short-term, single responses towards local vulnerabilities and risks of specific areas, hazards, and communities potentially or actually affected (Birkmann &von Teichman, 2010; Thomalla et al., 2006). Currently, DRR is at the top of political agendas, following the adoption of the first and only global framework, the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters (HFA, 2005). In 2015, 187 states adopted the Framework for Disaster Risk Reduction 2015–2030 during the third UN World Conference on Disaster Risk Reduction in Sendai, Japan (Zimmermann & Keiler, 2015). Alongside these efforts, DRR was integrated into the Sustainable Development Goals, specifically mentioned in goals 1, 2, 11, and 13. Most recently, the main UN organization responsible for disasters was retitled as the UN Office for Disaster Risk Reduction (UNDRR) (Mena & Hilhorst, 2021).

The main components of DRR include: "systematic risk assessments, land use legislation, flood control policy, building plans and implementation", disaster monitoring, warning systems, and public awareness (Birkmann & von Teichman, 2010; Aitsi-Selmi et al., 2015; Orimoloye, Belle & Ololade, 2021, p.673). Therefore, DRR can be considered a policy mix of instruments.

Its advantages include direct impact through regular monitoring with available infrastructure and time-saving and cost-effective responses. DRR ensures "well-informed and prepared communities and good leadership to reduce the loss of life and property to risks" (Orimoloye, Belle & Ololade, 2021, p. 674). In China, for example, since the implementation of national and regional DRR plans based on scientific knowledge and risk variability, lives lost has been less than 2,000 per year (Orimoloye, Belle & Ololade, 2021) compared to previous years when more than three million and two million lives were lost during the floods of 1931 and 1959, respectively (Basher, 2013; Innocenti, 2014; Orimoloye, Belle & Ololade, 2021).

Flood warning networks quickly advise on responses such as evacuation, food and water planning, and protection of households and properties (Orimoloye, Belle & Ololade, 2021). In Bangladesh, the global high-tech precipitation predictions of 10 days in advance combined with information organized by the National Flood Forecast & Warning Center have been distributed as forecasts to district offices and relevant organizations (Basher, 2013; Orimoloye, Belle & Ololade, 2021). The combination of disaster monitoring, warning systems, and public awareness has resulted in not only time-saving but also the protection of millions of residents from flood hazards (Basher, 2013).

Cost-effective responses through infrastructure can be seen in The Netherlands' protection of agricultural systems and towns against flood risks and other pressing issues (Orimoloye, Belle and Ololade, 2021). Recently, The Netherlands changed its strategy from relying only on dikes to a more resilient approach that combines traditional engineering behaviour with other risk-reducing technologies, such as allowing room for rivers (Van Alphen et al. 2003; Orimoloye, Belle &Ololade, 2021).

A disadvantage of this approach is that it requires considerable commitment and investment from the national government to strengthen local capacities to implement disaster risk management and local risk assessments (UNISDR, 2014). Sustainable and inclusive cities can only be achieved if the implementation practices of DRR initiatives take into account the long-term inequities (Fuentealba, Verrest & Gupta, 2020).

4.7.2.2. Drought management

Droughts often have significant economic, social, and environmental impacts in both developing and industrialized countries (Wilhite, 2012; Hurlbert, 2016; FAO, 2019). These impacts vary considering where and when they occur and the approach adopted to respond to them (FAO, 2019). Environmental degradation tends to increase drought vulnerability and continuing droughts can produce different effects at different times depending on human activities such as deforestation and land degradation (FAO, 2019).

An increasing number of international initiatives have been proposed to reduce the global risk of droughts. The Convention to Combat Desertification of 1994 focuses on reducing the risk of drought related desertification. The Hyogo Framework for Action (HFA) 2005–2015, was also fundamental in establishing global drought management measures (Djalante et al., 2012). The 'High-level Meeting on National Drought Policy organized by several UN agencies in 2013 presented important recommendations to decision-makers (Tánago et al., 2016). The meeting focused on the lack of preparedness for droughts and the absence of drought management policies in most countries, which is generally due to the lack of a national policy and/or adoption of any reactive responses against droughts (Sivakumar et al. 2014). Many countries have adopted measures to address drought (Mwinjaka, Gupta & Bresser, 2010; Li, Gupta & Van Dijk, 2013). There is still need for drought mitigation and preparedness strategies to reduce social vulnerability.

Drought management entails reactive and proactive responses. The main goal of a reactive drought response (Hayes et al., 2004; Svoboda et al., 2015; Wilhite et al., 2007, 2014), is to provide relief (e.g., water, food, and health care) to the affected population (Carrão, Naumann & Barbosa, 2016; FAO, 2019). Proactive responses include planning, monitoring, and implementation of planned measures to avoid the most severe impacts of droughts (Rossi & Cancelliere, 2016), recognizing that drought planning is permanent and therefore actions must be continuous (FAO, 2019). Drought management itself consists of a range of instruments that have been assessed (Hurlbert, Gupta & Verrest, 2019).

The advantages of adopting the drought management instrument include direct impacts such as guaranteeing food security and accessible food prices (Carrão, Naumann & Barbosa, 2016). However, it is costly, requires extensive climatic data records and accuracy of measurements of precipitation data and is often difficult to implement (De Stefano et al., 2015).

4.7.2.3. Climate-proofing

Climate-proofing is defined as an adjusted response to reduce adverse impacts or exploit beneficial opportunities of climate change (IPCC, 2014; Islam et al., 2020). This instrument is linked to disaster risk reduction and drought management.

In practice, climate-related risks can be managed through mitigation and adaptation. Mitigation can reduce climate-related risks in the longer term and has been the primary response to reducing greenhouse gas emissions (Arnold et al., 2014). Currently, mitigation entails policy, action, and other initiatives towards the reduction of greenhouse gas emissions (Asian Development Bank, 2005). Adaptation deals with: training and raising awareness to understand and carry out adaptative measures; developing tools for adaptation risk assessment; integration of adaptative measures into development policies, strategies, and plans based on the results of evaluations and adaptation priorities; ensuring adequate internal and external sources of funding; and implementing adaptation plans, programmes, and projects (Asian Development Bank, 2005).

The advantages of adopting climate-proofing are direct impacts and socio-economic benefits. Climate-proofing avoids damage repair costs and postponing drastic actions (Kabat et al., 2005). The Netherlands, for instance, has been climate-proofing through implementing protective dikes and surge barriers (Kabat et al., 2005). In terms of disadvantages, climate-proofing is expensive to build and maintain (Renaud et al., 2013) and requires specialized knowledge and expertise on climate change and trust in, and legitimacy, of precautionary policies (Vogel & Henstra, 2015). This is also evident in the Netherlands considering the country's high dependency on specialized knowledge and expertise on climate change to deal with higher risks of river and water drainage flooding due to intense precipitation (Edelenbos et al., 2017).

4.8. Comparing the instruments

This chapter assessed water governance in terms of policy instruments dealing with water-sharing. Table 4.4 compares the advantages (middle column) and disadvantages (rightmost column) of the 14 analysed instruments (leftmost column), showing how they can be organized within the six categories of sharing: (1) sharing of responsibility between levels; (2) water-sharing between states; (3) water-sharing between uses; (4) water-sharing between users; (5) sharing between humans and nature; and (6) sharing of water-related risks. Several instruments can have direct impacts on and yield improvements in water governance, like water permits, disaster risk reduction, drought management and climate proofing, which are considered major advantages. Conversely, several disadvantages potentially threaten the success of numerous instruments: agreements between states, priority of use and joint organizations require considerable commitments and willingness to cooperate between all relevant parties; unitary systems are often lacklustre in accommodating political and cultural differences and local and regional levels; and water permits require considerable knowledge of water budgets and expertise, else the permits may be deemed ineffective or inequitable and therefore exclusive in their design.

4.9. Inferences

I draw a number of conclusions from this Chapter. First, I have identified an existing menu of water-sharing instruments, clustered into 6 approaches for water sharing, for the forthcoming discussions in this thesis.

Second, these instruments can theoretically address many of the social, ecological and relational dimensions of inclusive development. However, the design and implementation of these instruments determines whether and how they, in fact, address water sharing issues.

Third, while participation in the design of such instruments is an important factor in determining how fair these instruments are; participation alone may not imply water-sharing outputs and outcomes. The participatory processes may be symbolic; poor and vulnerable people may self-exclude because of the lack of resources to support such participation and the decision-making processes of such participation may be skewed in favour of more powerful actors. Thus, it is also important to ensure that participatory processes are fair and equitable. Hence, in the following empirical chapters I examine some of the above issues.

Table 4.4. Advantages and disadvantages of various water policy instruments dealing with water-sharing

Instruments	Advantages
Unitary system	Creates coherent strategy at country level which can also be contextually sensitive, if designed well; may be easier to develop water-sharing strategies
Federal system	Power diffusion can accommodate political, cultural and related differences that are locally specific
Joint organizations	Allow representation and participation of water users to address water sharing; transparency of management; upward and downward accountability
Agreements between states	Can in theory provide an objective agreement for allocating water resources
Priority of Use	Can in theory provide an objective foundation for allocating a limited resource; each country can make its own priorities and translate into its own quantitative divisions (locally specific); can prioritize water allocation to vital human needs and reserve water for nature; Direct impact and benefit for a greater number of people and animals, depending on whether they are prioritised
Human Right to water and sanitation	Recognizes rights to potable water and improved sanitation resources (direct impact); applicable to a broad group of actors
Water permit	Direct impact, clear and can be made applicable to a broad group of actors
Water pricing	Steers actors' behaviour through market signals; resources acquired can be used to finance specific purposes
Infrastructure	Relatively direct impact in their performance by making supplies available
Ecological flow	Allocates water to ecosystems; focuses on maintaining native and intact habitats (direct impact)
Protected area	Allocates water to ecosystems; focuses on maintaining native and intact habitats (direct impact)
Disaster risk reduction	Direct impact; in the case of using early warning system such as flood warning can be time-saving
Drought management	Direct impact as it can lead to a proactive response to guarantee food security and accessible food prices; costs of action are (usually) lower than the costs of inaction
Climate proofing	Direct impact, socio-economic benefits (avoids damage and repair costs)

Source: This table builds on Majoor & Schwartz (2015), Renaud et al. (2013), Thomalla et al. (2006)

	Disadvantages
	Difficult to accommodate political, cultural, and related differences that are locally specific;
	Problems with coordination between federal, state, and local governments; many jurisdictions can lead to fragmentated responsibilities between actors at multiple levels of government; water sharing strategies cannot be dictated from above as control over water is delegated to provinces/ states
	Requires considerable commitment among all the participants and very time consuming; poorer and vulnerable communities may not be able to participate
	Requires considerable commitment and willingness to share among all the participants; upstream states may be unwilling to share
	Requires considerable commitment from each country to make its own priorities and allocate quantitative divisions (including water allocation to vital human demands and nature); the instrument if often poorly elaborated and implemented; suggestions made by the central government may not be adopted, or adopted differently in different states leading to incoherent policy
	The rights are not self-enforcing and requires considerable administration to ensure implementation; such rights may not be enforceable for those who have no formal legal rights to their housing
	Requires considerable knowledge of water budget and expertise; limited flexibility; and often does not allocate water to the environment; reallocating permits can be challenging; unclear how permits are allocated between different users within the system
	Pricing can be beyond the reach of the poor; assumes rational behaviour, difficulties to design and enforce a water pricing system; rich water users may not conserve water; water may be allocated to the most profitable uses
	Relatively inflexible, requires considerable underlying knowledge and expertise, costly; can have significant social and environmental costs; hydropower has a high risk due to climate change and low water availability
	Costly because it requires knowledge and expertise; and negotiations to prioritize nature
	Costly; requires considerable knowledge and expertise; and PA implementation can have negative social impacts
	Requires considerable commitment and investment from governments to strengthen local capacities and local mechanisms (e.g., risk assessments); requires sufficient levels of implementation for each monitored DRM activity (e.g., risk information, public awareness raising campaigns)
	Requires a long climatic data record and requires accuracy of measurements of the precipitation data
	Costly (expensive to build and maintain); requires specialized knowledge and expertise on climate change, trust and legitimacy of policies