Norms in multilevel groundwater governance and sustainable development

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Chapter 6. Groundwater Governance at Regional and Transboundary Level

6.1 INTRODUCTION

Groundwater governance at the regional and transboundary levels has a different character than at the other geographic levels. These two levels are analyzed together because they address geographically contiguous groups of states, but they are distinct in that the regional level focuses on geopolitical regions and the transboundary level focuses on groups of states sharing specific groundwater resources. This chapter analyses these frameworks to address: (1) How have groundwater governance frameworks evolved at the regional-transboundary level? (2) How are hydrogeology, ecosystems services and the drivers of groundwater problems taken into account at the regional-transboundary level? (3) Which groundwater governance principles have been included in these governance frameworks at the regional-transboundary level? (4) How does legal pluralism manifest itself at the regional-transboundary level? (5) How can current designs of the normative architecture become consistent with sustainable and inclusive development at the regional-transboundary level?

This chapter explains the evolution of regional and transboundary groundwater governance drawing on my previous work (Conti 2014). Section 6.2 reviews the origins of individual instruments in each regional-transboundary framework, their current legal status, relevant actors, and describes their mechanisms, scope and procedures. Section 6.3 identifies patterns in the frameworks and principles. Section 6.4 discusses the relationship between principles included at this level and the drivers of groundwater problems and ecosystems services as well as the potential to achieve sustainable and inclusive development given the pluralist context. And, finally, Section 6.5 draws inferences.

6.2 EVOLUTION OF REGIONAL AND TRANSBOUNDARY GOVERNANCE FRAMEWORKS

6.2.1 Overview of Transboundary-Regional Governance Frameworks

This section presents the chronological evolution of transboundary-regional groundwater governance frameworks. Transboundary aquifers with governance frameworks are shown in Map 6.1 for reference.

In 1856, the first framework for the Danube River Basin emerged to regulate navigation. Over 100 years later, the Lake Chad Basin states codified the 1964 Fort Lamy Convention to prevent degradation of the lake and its underlying aquifers. The African Union created the 1968 Africa Convention on Conservation of Nature and Natural Resources, updated in 2003, for the protection of environmental resources more broadly.

Simultaneously, aquifer-specific frameworks began to emerge. In 1968, the first project activities in the North-western Sahara Aquifer System began and now there is a non-binding Memorandum of Understanding (MoU) between the aquifer states. In 1972, France and Switzerland concluded the first legally-binding treaty specific to a transboundary aquifer – the Genevese Aquifer. The following year, Mexico and the US began to manage groundwater quality along the border with an amendment to their boundary waters treaty. Next, France, Switzerland, and Germany, adopted the 1975 Bonn Accord, subsequently amended to include groundwater, for the Upper Rhine Valley River Basin.

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12 This MoU is not publicly available and thus its contents could not be analyzed in this thesis.
The early 1980’s yielded two regional water agreements: one in the Southern African Development Community (SADC) and the other in the Association of South East Asian Nations (ASEAN). The next 15 years were characterized predominately by developments that have led to groundwater-specific governance frameworks. These include the beginnings of cooperation for the Iullemeden Aquifer through a 1988 protocol for the Niger river; regional and international donor activities in the early 1990’s concerning groundwater in the transboundary Guaraní Aquifer System; the 1992 establishment of an international task force for the Abbotsford-Sumas aquifer; and the 1992 legally-binding treaty which established a Joint Authority for the Study of the Development of the Nubian Sandstone Aquifer Waters. In 1993, Israel and the Palestinian Liberation Organization signed the Oslo I Peace Accord, which included provisions regarding shared water resources.

In 1995, the Oslo II agreement contained more specific provisions, including allocation of the groundwater in the Mountain (Western) Aquifer. However, there are questions surrounding the legitimacy and accountability of this agreement and its implementation. The 1995 Mekong Agreement between four of the six riparians included groundwater in its scope. Also in 1995, Hungary and Slovenia established a bilateral water management commission and now a joint project regarding geothermal energy production is underway.

Since 1995, several types of arrangements have emerged. In 1999, several countries in southeastern Europe began, in collaboration with the UNECE, researching the sustainable management of their karst aquifers. The 2000 EU Water Framework Directive was adopted as supranational legislation applicable to surface and groundwater and also spurred the establishment of the Sava River Basin Commission in 2002 to begin working in earnest on groundwater issues. Also in 2003, the Great Lakes Basin Commission developed a focus on groundwater. In 2007, Jordan and Saudi Arabia signed a technical MoU regarding monitoring and
data exchange for production wells from the Al Saq/Al Disi Aquifer, which later developed into a bi-lateral agreement. And in 2008, the Orange-Senqu River Basin began a project which included groundwater in its scope. The following sections explain these agreements in alphabetical order.

### 6.2.2 Current Status of Transboundary Frameworks

#### Abbotsford-Sumas Aquifer, 1992

The Abbotsford-Sumas Aquifer provides drinking water for approximately 110,000 people in the Canadian province of British Columbia and the US state of Washington. The aquifer’s groundwater flows from north to south and since the 1950’s, contamination originating in Canada has caused significant impacts, particularly in Washington. Nitrate concentrations are the main threat to human health (Norman and Melious 2004) and have been mapped and monitored since the 1970s (Council of Canadian Academies 2009).

The Abbotsford-Sumas Aquifer International Task Force and Abbotsford-Sumas Aquifer Stakeholder Group were established to address this problem in 1992 and 1995, respectively. The Task Force is a bi-national advisory board that supports implementation and policymaking under the 1992 Environmental Cooperation Agreement between British Columbia and Washington. It collects scientific data; coordinates its analysis and dissemination; and monitors potential threats to the aquifer. The Abbotsford-Sumas Aquifer Stakeholder Group is a consortium representing various interests from multiple levels of governance (federal, provincial, state and local), agriculture, industry, and NGOs. The group’s main objective is to protect municipal supply to the City of Abbotsford, which suffers the brunt of the contamination problem. The group was very active in the 1990’s. In the early 2000’s it was functioning with reduced activities (Council of Canadian Academies, 2009) and then became dormant until 2014 when renewed activity was reported (Personal communication with Tim Takaro and Emma Norman).

There are several other transboundary governance instruments applicable to the Abbotsford-Sumas, which will not be discussed in detail here. These include the 1909 Boundary Waters Treaty (USA & UK 1909) and its International Joint Commission, the North American Free Trade Agreement and its Commission for Environmental Cooperation, and the British Columbia-Washington Environmental Cooperation Council (Norman 2014). These agreements provide broad sets of rules regarding how Canada and the US should interact regarding trade and the environment.

This overview indicates that the governance framework in the Abbotsford-Sumas is multi-dimensional and multi-level. It includes instruments that range in codification, formality, legality, and process. The framework also includes international treaties and their associated implementation committees and task forces. There are also independently coordinated stakeholder groups. Similarly, the scopes range from boundary waters, to environment, to the aquifer itself. A volumetric allocation regime has not been established, perhaps because the primary concern is water quality. Yet despite the numerous governance instruments giving attention to the aquifer, the pollution problem remains (Zebarth et al. 2015).

#### Al-Saq/Al-Disi Aquifer, 2007

The Al Saq/Al Disi Aquifer is a confined, non-recharging aquifer split by the border of Jordan and Saudi Arabia spanning 308,000 km². It stores approximately 75 billion m³ of fossil groundwater (UN-ESCWA and BGR [United Nations Economic and Social Commission for Western Asia & Bundesanstalt für Geowissenschaften und Rohstoffe] 2013) and is the lowest layer of a larger aquifer system. Saudi Arabia began using the aquifer in the 1970’s and rapidly increased pumping in the 1980’s due to the subsidization of wheat production.

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13 This section draws heavily upon the annex of cases include in Conti, K.I. (2014), Factors Enabling Transboundary Aquifer Cooperation, IGRAC: Delft, Netherlands.
Although wheat production decreased in the 1990’s, the Al Saq/Al Disi is still heavily used. There are minimal water saving measures in place in Saudi Arabia (Al-Salamah et al. 2011). Furthermore, although most of the aquifer underlies Saudi Arabia, Jordan also relies heavily on its supplies. Specifically, it is the main source of water for the city of Aqaba. In 1965, a land transfer agreement between the two countries shifted the city of Aqaba out of Saudi territory and to Jordan. Since then, use of the aquifer has been a source of tension between the two countries. To alleviate these tensions, the Jordanian Ministry of Water and Irrigation and the Saudi Arabian Ministry of Electricity and Water signed a technical memorandum of understanding (MoU) in 2007 that enhanced monitoring and data exchange and prohibited both drilling new production wells and expanding agricultural activities within 10 km of the border. The MoU stood in juxtaposition to the simultaneous proposal for a Jordanian water transfer scheme that would move groundwater from the aquifer to the capital city of Amman. The ‘Disi Water Conveyance Project’ began in 2009 and was completed in 2013 and is designed to transfer up to 100 million m3 of water per annum. Not only does this present concerns regarding groundwater quantity but also quality, because early tests of the aquifer’s water show that it had 20 times more Radon than the international safe drinking water standard. 

This project, combined with ongoing demographic shifts, have led to projections of complete depletion of the aquifer as early as 2055 (UN-ESCWA and BGR [United Nations Economic and Social Commission for Western Asia & Bundesanstalt für Geowissenschaften und Rohstoffe] 2013). Prior to 2015, there was no formal agreement between the countries regarding the protection or use of the aquifer. However, the development of the project in conjunction with increased groundwater use likely brought such an agreement to fruition. The 2015 agreement aims to first, create a protected area for the aquifer and eliminate the potentially degrading activities within it; second, it requires the construction of monitoring wells within the protected area; third, it creates a management area in which groundwater use is limited to municipal uses (e.g. vital human needs); and fourth, it creates a joint technical committee for the implementation of the agreement. The aquifer area extends beyond these protected and management areas and thus some agricultural and industrial uses are permitted. This is the only governance instrument for the aquifer at present and it sets out a clear scope and process, but does not outline volumetric allocations or limits.

Bolsón del Hueco - Valle de Juárez Aquifer, 1973

The Bolsón del Hueco - Valle de Juárez Aquifer traverses the Mexican state of Chihuahua and the American states of New Mexico and Texas and lies beneath the eastern portion of the Rio Grande River. Its groundwater supplies 1.5 million inhabitants in Ciudad Juarez and 730,000 in El Paso (Eckstein 2011b). In 1889, Mexico and the US created the International Boundary and Waters Commission (IBWC), because of boundary disputes caused by the meandering of the Rio Grande and Colorado rivers. Subsequent water apportionment regimes in the 1906 Treaty on the Distribution of Waters of the Rio Grande and revised by the 1938 Rio Grande Compact, mandated that Mexico receive 60,000 acre-feet of water annually. However, ineffective implementation of the regime led to the river being overdrawn. Consequently, Texan and Mexican farmers began pumping the underlying groundwater, causing groundwater levels to fall over 23 meters between 1952 and 2007 (Day 1978).

In 1973, the IBWC investigated the salinity problems in the Rio Grande and aquifers. However, attempts to create a treaty that would resolve the problems were thwarted by both governments. Eventually, they signed Minute 242 in 1942, annexing it to the Boundary Waters treaty. Minute 242 is now one of two formal agreements for transboundary groundwater between the countries’ federal governments. To date, the water utilities of El Paso and the City of Juárez have taken the most action towards solving groundwater problems. They have a MoU to manage surface and groundwater via activities such as conservation and reuse measures, consumer education and technologies. Implementation of the MoU by local utilities has successfully mitigated groundwater depletion and extended the projected longevity of the aquifer by over 50 years. In 2006, the US passed the US-Mexico Transboundary Aquifer Assessment Act (190th Congress 2006), which is national legislation and does not have a Mexican counterpart. The Act requires the US government to assess the status of the aquifer; store aquifer data in a GIS database; consider expanding or modifying the
countries’ current data-sharing agreements; and designate the Bolsón del Hueco - Valle de Juárez as a ‘Priority Transboundary Aquifer’ in the US.

Overall, the Bolsón del Hueco - Valle de Juárez governance framework is multi-faceted. All the instruments discussed are codified, but they range in formality/legality and legitimacy from treaties to MoU’s to unilateral legislation regarding transboundary aquifers. There are several groundwater-specific agreements, all including implementation processes. Additionally, the aquifer is partially and informally allocated through the local water utilities while the river is formally allocated by the respective federal and state governments (Eckstein 2011b, 2013).

**Canadian-American Great Lakes Basin and Châteauguay Aquifer, 2003**

The Châteauguay aquifer is located in the Canadian province of Quebec and the US state of New York, beneath the Châteauguay River (Council of Canadian Academies 2009). It is the only transboundary aquifer within the Great Lakes Basin (Great Lakes Science Advisory Board to the International Joint Commission 2010). Groundwater use on the American side is minimal. The aquifer supplies drinking water to approximately 65% of Canadians living within the aquifer boundary and it’s groundwater is abstracted by an estimated 20,000 wells (Nastev et al. n.d.). Due to industrial pollution in the 1970’s, the Châteauguay became one of Canada’s the most famous groundwater contamination cases. In addition to industry and water supply, uses include apple farming, peat mining and abstraction for water bottling. Canadians both cause and experience most of the groundwater quality problems; therefore, the impacts are not typically transboundary in nature.

Concerted research and management of the Châteauguay began in 2003. However, scientists have had concerns about the aquifer’s state for over 40 years due to increased groundwater use and intermittent droughts. As such, several large-scale Canadian initiatives have studied the aquifer’s hydrogeology, quality, vulnerability, and overall sustainability (Nastev et al. n.d.). Numerous laws and planning instruments have moved the Great Lakes Basin towards increasing the technical understanding and protection of the groundwater therein. These instruments include the 1912 International Joint Commission; 1992 Environmental Cooperation Council; 1909 Boundary Waters Treaty; 1972/2012 Great Lakes Water Quality Agreement; 1985 The Great Lakes Charter; and 2005 The Great Lakes St. Lawrence River Basin Sustainable Water Resources Agreement and Compact. Similar to the Abbotsford-Sumas, the stakeholders participating in these instruments vary from national government, state/provincial agencies, and CSOs to combinations thereof. Thus, the Châteauguay’s governance instruments are generally codified, formal, and have a high level of legality. None are groundwater specific, but rather address the environment or lake basin as a whole. Allocation is not addressed since uses are primarily Canadian. Nevertheless, nearly all of the instruments include an implementation body specifically for the Great Lakes.

**Danube River Basin Groundwater Bodies, 1856**

The 1856 Treaty of Paris was the first formal and codified governance instrument over the Danube River. At this time, the primary focus of governance was navigation. But, over time, the scope of governance broadened to include other management issues. In 1994, the countries sharing the Danube signed the Convention on Cooperation for the Protection and Sustainable Use of the Danube (Danube Convention), which also created the International Commission for the Protection of the Danube River (ICPDR) to support the Conventions’ implementation (Danube Convention 1994). The Danube Convention explicitly includes groundwater in its scope but does not allocate the waters of the basin between countries.

The Danube Convention includes several provisions directly related to groundwater such as the identification and protection of vulnerable areas and general pollution prevention especially from nitrates and pesticides. The ICPDR also integrates requirements from the EU WFD to remain consistent with the IWRM approach put forth by this supra-national law. In 2002, the ICPDR established a Groundwater Task Group to delineate groundwater bodies of basin-wide importance, namely those greater than 4,000 km$^2$ in size. The Task Group guided groundwater characterization and assessment as well as quality and quantity data collection (ICPDR
In these initiatives, all countries had to agree regarding the aquifer characteristics. The result was an identification of eleven transboundary groundwater bodies wherein all the countries agreed upon their transboundary nature and characteristics.

**Dinaric Karst Aquifers, 1999**

The Dinaric Karst Aquifers are one of the most important karst aquifer systems in the world. They are the primary source of drinking water for Albania, Bosnia & Herzegovina, Croatia, and Montenegro. In 1999, the UNECE began an inventory of transboundary water in the region, triggering the initial mapping of the Dinaric Karst Aquifers. Ten years later, the second UNECE assessment further characterized these aquifers. In the interim, UNESCO’s Internationally Shared Aquifer Resource Management (ISARM) initiative formally recognized these Dinaric Karst aquifers as a connected aquifer system. Key transboundary issues identified as a result of this assessment included the need to increase knowledge of the resources’ dynamics; to assess and balance competing user demands; to harmonize policy; and to address the negative impacts of hydraulic infrastructure.

In response to the cumulative findings from this recommendation, in 2008, country officials in collaboration with the Global Environment Facility (GEF) endorsed the Dinaric Karst Transboundary Aquifer System (DIKTAS). It was the first effort to incorporate sustainability principles into the management of a large transboundary karst aquifer. Key project objectives included enhancing scientific knowledge of the aquifer system, achieving ecosystem protection and increasing public participation. A key outcome of the project was the formal country endorsement of the Transboundary Diagnostic Analysis, which is an assessment and prioritization of transboundary groundwater issues. The document is not legally binding but does set out recommendations for the countries including increased monitoring and capacity building. It also indicates a potential to develop a Strategic Action Programme and/or to reach a political commitment to establish a legal framework or multi-country consultative body. However, a process to do so is contingent upon continued funding from the GEF.

**Franco-Swiss Genevese Aquifer, 1972**

France and Switzerland share the Franco-Swiss Genevese Aquifer. The aquifer is unconfined and hydrologically linked to the River Arve. It has been an important drinking water source since the 1940s. Currently, 20% of Geneva’s water supply originates from the Genevese aquifer. Groundwater governance for the aquifer was triggered by dramatic decreases in groundwater levels during the 1960’s and 70’s. By 1972, the Swiss Canton of Geneva and the French Prefect of Haute-Savoie began formally meeting to explore how the problem could be addressed and in 1977 they adopted the Convention on the Protection, Utilization, Recharge and Monitoring of the Franco-Swiss Genevese Aquifer with a 30-year term. This Convention was the first and so far, the only convention for transboundary groundwater resources that establishes a volumetric allocation regime. It also establishes a monitoring network and a managed aquifer recharge (MAR) scheme to prevent depletion in the Swiss portion of the aquifer. The MAR scheme was operational by 1980. The Convention’s implementation is overseen by a commission, which adopts annual joint management plans, oversees the MAR scheme, and addresses other challenges related to the aquifer’s management. The commission includes government officials and scientists from both countries and meets annually.

At the end of the 30-year term, the Convention was modified to reflect the state-of-the-art of international law as well as to become congruent with the EU WFD. The Convention was also modified from having state-level parties to local parties. As such, the parties became the communities of Annemassienne, the Genevese rural districts and the Rural District of Viry rather than the French and Swiss governments. The MAR facility was also transferred from private ownership to public ownership by Swiss community authorities.
Guarani Aquifer System, 1991

The Guarani Aquifer System (Sistema Aquífero Guaraní [SAG]) traverses Argentina, Brazil, Uruguay and Paraguay and is the world’s second-largest known freshwater reservoir. Localized depletion has been reported since the early 1970’s and quality deterioration and reduced recharge are also cited as threats to the SAG’s sustainability (Foster et al. 2006). Although many of these challenges are not considered transboundary in nature, several projects and initiatives in the early 1990’s greatly increased technical understanding of the SAG. These included a joint technical project sponsored by the International Development Research Centre; two, three-year Global Environmental Facility (GEF) Guarani Aquifer System Projects starting in 2003 and 2009 (Villar and Ribeiro 2011); as well as the MERCOSUR “Guarani Aquifer High Level Group” that began in 2004 (Sindico 2011).

Governance relevant to the SAG began with the Organization of American States (OAS) and the Common Market of the South (MERCOSUR), which have promoted transboundary and regional environmental cooperation since 1948 and 1991, respectively. Building upon this foundation, the scientific assessment from the aforementioned projects, and developments on the ‘Law of Transboundary Aquifers’ at the global level, the SAG states adopted the 2010 Guarani Aquifer Agreement. This is one of two legally-binding agreements that holistically govern a transboundary aquifer, the Genevese Convention being the other. However, the Guarani agreement stops short of allocating the SAG groundwater volumetrically.

Argentina and Uruguay ratified the agreement the same year as its adoption. The agreement still awaits ratification from Brazil and Paraguay prior to entering into force. The agreement does not provide for an implementation process. Nevertheless, the countries have already taken steps to implement the Strategic Action Programme of the GEF project under ‘Programma Marco,’ which would conjunctively manage the La Plata River Basin and the SAG under the framework of the Guarani Agreement.

Iullemeden Aquifer, 1988

The Iullemeden Aquifer crosses Mali, Niger and Nigeria. There has been bilateral cooperation between pairs of these countries since the late 1980’s. Niger and Nigeria established a Joint Commission for Cooperation on equitable sharing for development, conservation and utilization of the common water resources in 1990. The UN International Convention to Combat Desertification (UNCCD) designated the Sahel as the highest priority area. Thus, the Observatoire du Sahara et du Sahel (Sahara and Sahel Observatory - OSS) was created to oversee desertification-related issues in the region. From 1992 and 2002, OSS conducted ‘Aquifers of the Major Basins’ Program, which facilitate scientific cooperation between the three Iullemeden aquifer states. As a result of the program, they updated national water policies and prioritized transboundary issues including land use change, unregulated water used, drought and climate change (Governments of Mali, Niger, and Nigeria 2003).

From 2003-2007, the countries proposed and completed a GEF Medium Sized Project entitled ‘Managing Hydrogeological Risk in the Iullemeden Aquifer System.’ The project objectives included (1) jointly identifying transboundary risks; (2) formulating management policies; and (3) adopting a legal and institutional framework. Project outcomes included the creation of a common GIS database and the adoption of the Bamako Declaration of the Ministers in Charge of Water Resources of the Countries Sharing the Iullemeden Aquifer System in 2009 (Governments of Mali, Niger, and Nigeria 2009), which creates a ‘consultative mechanism’ for joint groundwater management. Five years later the countries made a new agreement, also including the Taoudeni/Tanezrouft and also including the countries of Algeria, Benin, Burkina Faso, and Mauritania (Governments of Algeria, Benin, Burkina Faso, Mali, Mauritania, Niger 2014).
Lake Chad Basin Aquifers, 1964

Lake Chad is the fourth largest lake on the African continent. It is located in the Sahel region and groundwater is the main source of drinking water in the basin. Lake Chad’s water levels have declined significantly over the past 40 years, due to drought, desertification and mismanagement (Adelana 2004). A massive regional drought in 1980’s significantly exacerbated these problems and over 500 boreholes were drilled to provide groundwater for basic human needs (Adelana 2004). Since the lake also supports local fishing and agricultural, poverty, malnutrition and out-migration increased (Ngatcha 2009). By 2010, large portions of Lake Chad were protected wetlands under the Ramsar Convention, emphasizing the significance of groundwater for regional ecosystems and livelihoods.

The Sahara/Sahel region has a long institutional history of water resources management. In 1964, the Fort Lamy Convention formed the Lake Chad Commission with the purpose of managing problems contributing to the lake’s degradation and its underlying aquifer. Originally, the Commission only four of the six Lake states were party to the convention: Cameroon, Chad, Niger and Nigeria. Subsequently, the Central African Republic acceded in 1994 and Sudan acceded in 2000. Recently, some of the aquifer states have inacted national legislation to manage and protect groundwater resources. The Lake Chad Basin Commission is also implementing the activities outlined in the Strategic Action Programme (SAP) of the GEF/UNDP/UNOPS Project ‘Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem’ (GEF Project). The major outcomes of this project were (1) enhanced regional policy initiatives; (2) increased stakeholder engagement; (3) a diagnostic of transboundary issues; (4) a ‘synthetic’ management framework; and (5) the creation of regional programs and initiatives.

Mekong River Basin Aquifers, 1995

The Mekong River Basin is divided between Cambodia, China, Laos, Myanmar, Thailand, and Vietnam and is linked to four major transboundary aquifers. Key groundwater uses include urban and rural drinking water supply, irrigation and industry. Cambodia, Thailand and Vietnam are the largest groundwater users. The Mekong River Delta Aquifer’s groundwater levels and groundwater quality have declined over the last 30 years (International Union for Conservation of Nature 2011). The basin’s other aquifers are facing over-extraction and contamination by agriculturalists (Foster 2008; International Union for Conservation of Nature 2011).

The 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River established the Mekong River Commission (MRC) (Cambodia et al. 1995). Although, hydrologically, China and Myanmar are basin/aquifer states, they are not MRC members. Rather, they are ‘dialogue partners’ who observe MRC activities (Mekong River Commission for Sustainable Development 2010). The agreement shifted the focus of water management from development of large-scale projects to sustainable development and natural resources management. Groundwater has not been included in MRC activities until recently.

There was an informal meeting in 2009 for organizations working in the lower Mekong Delta with in objective of increasing cooperation and capacity regarding groundwater resources (International Union for Conservation of Nature 2009). In 2011, the MRC conducted drought management studies and groundwater monitoring to establish a basin-wide monitoring network, in addition to developing a groundwater concept note. Further, the MRC planned a 2012 rapid appraisal of groundwater use in agriculture (Mekong River Commission for Sustainable Development 2012).

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14 The Chinese portion of the Mekong River Basin is mountainous and largely uninhabited. Thus, human use is considered negligible. Hence, China’s observer status in the Agreement.
Mountain (Western) Aquifer, 1995

Mountain (Western) Aquifer is located in Israel and the Palestinian Territories – which, according to international law, are a sovereign state and an occupied territory, respectively. The aquifers divided by Israel and Palestine have caused intense interactions for the past 60 years. The Israelis began rapid groundwater extraction in the 1950’s. In contrast, Palestinians only extracted groundwater sparsely prior to 1967 (Feitelson 2003). These asymmetrical usage patterns contradict the recharge and flow regime of the aquifer, since the recharge of the aquifer occurs primarily on the Palestinian side. The asymmetry resulted in tensions regarding allocation and use. Consequently, the Mountain (Western) Aquifer was a critical topic in the 1990’s Israeli/Palestinian peace talks.

The peace talks resulted in the Oslo II agreement, wherein Article 40 recognized Palestine’s right to water in the West Bank. The agreement further stated that Palestine should receive 28.6 Mm$^3$ annually to meet their immediate needs and later receive 70-80 Mm$^3$ annually for their future needs. The agreement established a Joint Water Committee (JWC) and Joint Supervision and Enforcement Teams (JSETs) to manage the aquifer’s groundwater. Additionally, the parties agreed to cooperate for protection of the aquifer (Government of the State of Israel and The Palestine Liberation Organization 1995).

The JWC oversees implementation of the Oslo II agreement and has four sub-committees: the Hydrological Committee, the Water Works Committee, the Sewage Committee and the Water Pricing Committee. The JWC regularly convenes and reviews development and construction projects of water supply and sewage (Water Authority of the State of Israel 2009). As of 2014, the committee approved 70 new water wells and 22 new observation wells in Palestine. However, the JWC also rejected hundreds of well applications, mainly in the Palestinian Territories.

Although the JWC operated through the Second Intifada, groundwater allocated from the aquifer is not in accordance with Palestine’s water right stated in Oslo II (Linton and Brooks 2011) and the legitimacy of the Oslo II agreement and its implementation have been questioned in light of the disparities in soft and hard power between Israel and Palestine (Feitelson and Fischhendler 2009).

Mura-Zala Aquifer, 1995

The Mura-Zala Aquifer underlies Hungary and Slovenia. It has three layers, the deepest of which contains groundwater sufficiently warm to generate thermal energy. The Mura-Zala is used for residential and commercial heating and air conditioning, heating of greenhouses, and balneology (Nádor and Lapanje 2010). Individual and small-scale users have abstracted the groundwater more than 100 years; yet only within the last ten years have people made efforts to upscale uses for geothermal energy. The 1856 Treaty of Paris marked the beginning of formal water governance in Central Europe. The 1995 Agreement between Hungary and Slovakia on Water Management established the Permanent Bilateral Slovenian – Hungarian Water Management Commission. The countries are also regulated by the EU WFD and part of the ICPDR.

The EU Renewable Energy Roadmap and the European Union Directive on Renewable Energy motivated Austria, Hungary, Slovakia and Slovenia to jointly manage the thermal groundwater resources (European Commission 2007; Transenergy 2014). In 2009, the countries initiated “Thermal Joint Aquifer Management: Screening of geothermal utilization, evaluation of thermal groundwater bodies and preparation of joint aquifer management plan in the Mura-Zala basin” project (T-JAM) under the Slovenia-Hungary Cross-Border Operational Programme 2007-2013 (European Commission 2008). At the time of project initiation, the Mura-Zala was not officially delineated nor were resource management practices aligned countries (Nádor and Lapanje 2010). Thus, the project aimed to identify and delineate the transboundary groundwater body; and assessed the potential risks and opportunities for exploiting its geothermal potential. The project generated an unofficial delineation of the aquifer; placed existing data collected from nearly 1,200 boreholes in a proprietary database and geothermal model; and made public the most representative data (T-JAM Project 2014). Countries’ report included “Cross-border management recommendations,” that were tailored to the Permanent Bilateral Slovenian – Hungarian Water Management Commission.
**North-western Sahara Aquifer System, 1968**

Governance frameworks for the North-western Sahara Aquifer System (the Système Aquifère du Sahara Septentrional [SASS] in French) were born out of extensive scientific cooperation between Algeria, Libya, and Tunisia. Notwithstanding that the SASS Aquifer was largely undeveloped before 1980, between 1968 and 1971, UNESCO, Algeria, and Tunisia started modeling the SASS (Sahara Sahel Observatory [OSS] 2008). The project was continued from 1982-1983 with funding from the United Nations Development Programme (UNDP) in response to Algeria and Tunisia began large-scale groundwater abstraction in 1982 (Governments of Tunisia, Algeria, and Libya n.d.). Simultaneously, Libya developed two groundwater models of the SASS to better understand the consequences of groundwater abstraction. Over the next twenty years, the aquifer states established several bilateral initiatives.

In 1998, all three countries jointly engaged in governing the SASS as part of a three-phase project. The goal was increased scientific knowledge and management capacity (Sahara Sahel Observatory and Global Environmental Facility 2008). The first phase was completed in 2002. It included a negotiated consultative mechanism, a Steering Committee, a Coordination Committee, and an Ad Hoc Scientific Committee. For the second phase, the countries with the support of OSS developed the permanent Mechanism for Concerted Action. In 2007, countries established and funded the SASS coordination unit (Sahara Sahel Observatory 2008). The third phase focused on the socio-economic and environmental aspects SASS development (Sahara Sahel Observatory and Global Environmental Facility 2008). At the conclusion of the GEF Project, the ongoing monitoring, modeling and management of the aquifer system was included in the SASS Strategic Action Programme (SAP).

**Nubian Sandstone Aquifer System, 1992**

The Nubian Sandstone Aquifer System (NSAS) crosses Egypt, Chad, Libya and Sudan and is the world’s largest identified freshwater reservoir. The NSAS is also a non-recharging aquifer system containing fossil groundwater (International Atomic Energy Agency [IAEA], 2010). Egypt and Sudan are also part of the Nile River Basin. In the 1970’s, the International Fund for Agriculture Development under the auspices of the Centre for Environment and Development for the Arab Region and Europe (CEDARE) initiated projects and management activities for the NSAS.

These activities triggered Egypt and Libya’s forming the Joint Authority for the Study of the Development of the Nubian Sandstone Aquifer Waters (Joint Authority), which was formalized in a constitution in 1992 (International Atomic Energy Agency 2012). In 1996 Sudan also signed the constitution, then Chad in 1999. In 2000, the countries signed the “Programme for the Development of a Regional Strategy for the Utilization of the Nubian Sandstone Aquifer System” (Republic of Chad et al. 2000). The Programme is composed of two legally binding agreements: one for the monitoring and exchange of NSAS groundwater information and the other establishing a data information system.

Subsequently, the Joint Authority facilitated several initiatives and partnerships with regional and international organization; significantly enhanced the technical knowledge of the NSAS; and assessed the interaction between governance of the aquifer with political, economic, environmental and humanitarian issues in the region. The IAEA/UNDP/GEF Medium Sized Project, “The Regional Formulation of an Action Programme for the Integrated Management of the Shared Nubian Aquifer” was instrumental in increasing cooperation over the aquifer. The project aimed to develop a sustainable management and use framework for the Nubian Aquifer System (International Atomic Energy Agency, 2010). It also resulted in the 2012 NSAS Regional Strategic Action Program (SAP), which guides future activities and legal agreements for NSAS management (International Atomic Energy Agency 2012).
Orange-Senqu River Basin Aquifers, 2008 (including the Stampriet Transboundary Aquifer System [STAS])

Orange-Senqu River Basin Commission (Orange-Senqu Commission) crosses Botswana, Lesotho, Namibia and South Africa. The Stampriet Transboundary Aquifer System and the Molopo Aquifer are transboundary aquifers that are hydrologically connected to the basin’s surface waters. These groundwater resources falls within the mandate of the Orange-Senqu Commission. However, the extent to which groundwater is addressed in the Orange-Senqu Commission is limited to risks assessment and identification of stress indicators. Groundwater use reduces stress on surface water resources in many parts of the catchment. There are two known instances of transboundary groundwater impacts. First, industrial contamination in the Molopo and Ramotswa aquifers (Governments of Botswana, Lesotho, Namibia, and South Africa 2009). Second, in the Stampriet Transboundary Aquifer Systems (STAS), where large-scale groundwater use by Namibia is of increasing concern (Alker 2008; see Chapter 8).

The 2008-2013 Orange-Senqu RBO, GEF, UNDP project for the Development and Adoption of a Strategic Action Program for Balancing Water Uses and Sustainable Natural Resource Management directed more attention to groundwater in the basin. Groundwater-specific project outcomes included an assessment of transboundary the resources and the launch of the Transboundary Aquifer Initiative - a task force of the Orange-Senqu Commission. In the next phase of the project, particular attention will be given to groundwater resources as well. Developments regarding the STAS are discussed in Chapter 8.

Scheldt River Basin and Carboniferous Aquifer, 1994

The Carboniferous Aquifer is situated in France and Belgium’s Walloon and Flemish regions. The aquifer is hydrologically linked to the Scheldt River, which traverses France, Belgium and the Netherlands. The riparian countries have consulted about the Scheldt since the mid 1800’s. However, tensions between Belgium and the Netherlands punctuated the 20th century, namely regarding the Moerdijk canal in the 1920’s as well as navigation (e.g. port access) and sedimentation (e.g. environmental consequences of dredging) between the mid-1960’s and late 1990’s (Meijerink 1999). The countries have since transitioned to a more cooperative and integrated governance approach (de Vries 2008). In 1994, they signed the Treaty for the Protection of the Scheldt and established the International Commission for the Protection of the Scheldt. The countries signed the International Agreement on the Scheldt in 2002 to ensure accountability at the federal level in Belgium and include provisions for coordination under the EU WFD (International Commission for the Protection of the Scheldt 2005).

As of 2015, the Carboniferous Aquifer is failing the test for good ‘quantitative status’ due to overexploitation. As a result, the International Scheldt Commission prioritized aquifer management and acquired funding through the INTERREG program. However, the INTERREG programs may have a limited effect on cross-border capacity building, in part, due to their short funding cycles (de Vries 2008). Nevertheless, the INTERREG IVB Programme facilitated the establishment of the Contribute to a Better Quality of Surface and Groundwater Bodies in the Scheldt International River Basin District (ScaldWIN) initiative. ScaldWIN aims for ‘a set of cost-effective, innovative and transactional actions aimed at attaining good water quality status of surface and groundwater bodies’ and establishing a transnational water monitoring network (Lefèbure 2012). ScaldWIN’s third work package was specifically dedicated to groundwater and would (1) enhance monitoring of the Carboniferous Aquifer and (2) assess the potential for saline intrusion due to sea level rise. In 2009, also as part of this work package, France and the Walloon and Flemish regions entered a trilateral groundwater monitoring agreement (ScaldWIN, 2009). In the future, the Scheldt Commission may develop a declaration and trilateral agreement for joint management of the aquifer (Lefèbure 2012).
Sava River Basin Groundwater Bodies, 2002

The Sava River flows through Bosnia & Herzegovina, Croatia, and Slovenia and is the third-largest tributary of the Danube. The Sava River was fully contained within the boundaries of the former Socialist Federal Republic of Yugoslavia, but became transboundary after the Republics’ dissolution. The 1992, Stability Pact for South Eastern Europe initiated regional environmental cooperation and launched the Sava River Basin Initiative (International Sava River Basin Commission 2014). Eventually, the initiative became the 2002 Framework Agreement for the Sava River Basin. When the agreement entered into force in 2004, the parties also created an interim Sava River Basin Commission. The Commission officially began its work in 2006 and has since conducted an inventory of groundwater bodies of basin-wide importance as well as laws and institutions relevant to the basin.

In accordance with the EU WFD, the Commission delineated 41 groundwater bodies of basin-wide importance, 20 of which are transboundary (International Sava River Basin Commission 2011a). There are also 18 multilateral treaties and eight bi-national agreements specifically relevant to the Sava River that date back over 60 years. Thus far, the Commission has provided water quality objectives for the groundwater bodies and countries are developing proposals for EU WFD compliant groundwater monitoring systems. The Commission also facilitates law and policy development for the states for groundwater assessment and coordinates with the Danube River Basin Commission regarding flooding and navigation. Additional plans to increase attention to groundwater in the basin are outlined in the Strategy on Implementation of Framework Agreement on the Sava River Basin Management Plan (International Sava River Basin Commission 2011b).

Upper Rhine Valley Basin and Aquifer, 1975

The Upper Rhine River flows through France, Germany and Switzerland and is underlain by the Upper Rhine Valley Aquifer. The Upper Rhine Valley Aquifer supplies drinking water to approximately 80% of the area’s residents (Region Alsace 2014). Groundwater is used mostly by industry (68%). Drinking water supply is the second largest use (20%) and the remaining water is used for agriculture (12%). Industrial pollution, especially pharmaceuticals and nitrates, moved the aquifer states to jointly protect the aquifer (Huggenberger et al. 2010). The 1975 Upper Rhine Agreement (‘Bonn Accord’) marked the beginning of formal water governance in the Upper Rhine region. The Accord has since been superseded by the 2000 Agreement between the Swiss Federal Council, the Government of the Federal Republic of Germany and the Government of the French Republic on Cross-border Co-operation in the Upper Rhine Region (Upper Rhine Agreement 2000). The objective of this agreement, as well as broader cooperation on the Upper Rhine, is to ‘provide drinking water without treatment, for present and future generations at a low cost’ (Region Alsace 2014).

This Agreement set forth implementation processes through the Upper Rhine Conference. The Conference has an environmental working group, which has established groundwater as a priority implementation area (Region Alsace 2014). Every six years, they also complete water quality assessments in compliance with the EU WFD. Since this time, EU INTERREG has co-financed three projects for the aquifer focusing on monitoring, modeling and public education (Deutsch-Französisch-Schweizerische Oberrhienkonferenz 2014). Another round of funding under INTERREG IVB supported the Transnational Organization for Groundwater Protection at the Rhine (Länderübergreifende Organisation für Grundwasserschutz am Rhein [LOGAR]) Programme. LOGAR created a groundwater expert network and continued monitoring and assessment activities to prevent depletion. Neither the agreement nor the Conference put forth a transboundary allocation regime in the Upper Rhine.
6.2.3 Current Status of Regional Frameworks

**African Convention on Conservation of Nature and Natural Resources, 1968**

Environmental protection on the African Continent dates back to treaties agreed between colonial powers. The 1968 African Convention on the Conservation of Nature and Natural Resources (African Convention) was the first multilateral governance instrument adopted by independent African states with the purpose of regulating and protecting the environment (Erinosho 2013). At the time, it was regarded as a progressive piece of international environmental law. In 2003, the African Convention was revised to align it with developments in international law as well as the rapidly changing environmental, social and economic circumstances facing the African Continent. The objectives of the revised instrument are “to enhance environmental protection; to foster the conservation and sustainable use of natural resources; and to harmonize and coordinate policies in these fields with a view to achieving ecologically rational, economically sound and socially acceptable development policies and programmes” (OAU 2003: Article II).

Of the 54 African states, 42 have signed the revised Convention but only 12 have ratified it. It has not yet entered into force because 15 ratifications are required, reducing its legitimacy and effect. The Revised African Convention’s scope covers a wide range of natural resources including, but not limited to, land and soil, water, vegetation, and biodiversity. Article VII.3 specifically requires the “rational management” and equitable utilization of groundwater and surface water resources and related ecosystems. This language in addition to requirement for states to maintain water resources at the highest qualitative and quantitative levels echoes that of the previously adopted EU WFD.

**Association of Southeast Asian Nations’ Agreement on the Conservation of Nature and Natural Resources, 1985**

The Association of Southeast Asian Nations’ Agreement on the Conservation of Nature and Natural Resources (ASEAN Agreement) is a legally binding regional treaty designed to maintain “essential ecological support systems,” preserve biodiversity, and ensure sustainable development of nature resources (Association of South East Asian Nations (ASEAN) 1985). The Convention’s scope covers a wide range of natural resources, including but not limited to biological species, vegetation cover and forest resources, soil, water, and air. Article 8 specifically mentions the need to conserve underground and surface water resources. In order to achieve this, the text encourages countries to conduct hydrological research, regulate and control water utilization, and take into account the effects of planned projects on water resources.

**European Union Water Framework Directive, 2000**

The European Union (EU) is a supranational, political-economic union with 28 member states, although UK intends to leave the Union. The EU has legislative and judicial powers and can adopt regulations, which are binding upon all member states and must be transposed into their national laws. Initially legislation relevant to water resources management was disaggregated and included the EU Bathing Waters Directive, Drinking Water Directive, Nitrates Directive and the Integrated Pollution and Prevention Control Directive. In 2000, the EU adopted Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (a.k.a. EU Water Framework Directive (EU WFD)) in an effort to consolidate the key norms for its water resource management based on the principles of Integrated Water Resources Management (see Rahaman et al. 2004 r.e. gaps and overlaps between the EU WFD and IWRM).

The EU WFD requires member states to improve the quantitative and qualitative status of rivers, lakes and groundwater bodies by 2015. In 2006, the EU adopted a follow-up directive to the EU WFD, focused specifically on Groundwater –Directive 2006/118/EC of the European Parliament and of the Council on the

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15 Not all European aquifers are classified as groundwater bodies, see Section 3.4.3.
protection of groundwater against pollution and deterioration (EU Groundwater Directive [EU GWD]) (European Parliament 2006). The EU GWD focuses on prevention and control of groundwater quality by requiring member states to limit quantities of groundwater pollution. The EU GWD also sets specific water quality standards for nitrates and pesticides. For other chemicals, states set threshold concentrations. The EU WFD and EU GWD focus on domestic groundwater bodies but also address transboundary ones.

**Southern African Development Community, 1980**

Formal cooperation within the Southern African region began with the 1980 establishment of the Southern African Development Coordination Conference (SADCC). SADCC fostered national political liberation in the region and aimed to reduce dependence on the South African apartheid regime. In 1992, the SADCC became SADC (Southern African Development Community 2015-a). Water cooperation in Southern Africa also dates back to the late 1980’s. Botswana was independent at that time; however, Namibia was under colonial rule and South Africa was in the throes of apartheid. Nevertheless, Namibia and South Africa negotiated three bilateral agreements – two of which occurred after Namibian independence (Governments of Botswana, Lesotho, Namibia, and South Africa 2009). Now SADC is instrumental in regional water management.

The Protocol on Shared Watercourses in the Southern African Development Community (SADC Protocol) was originally adopted in 1995 and revised in 2000. The Revised SADC Protocol lays the foundation for regional water cooperation based on developments in international water law, namely the UN Watercourses Convention. Thus, it emphasizes the equitable and reasonable use and integration of Integrated Water Resources Management (IWRM) principles (Southern African Development Community 2015-b). The Revised SADC Protocol does not prioritize vital human needs or acknowledge the human right to water and sanitation, but gives greater emphasis to sustainable development, and includes the sovereignty principle.

### 6.2.4 Implications of Regional-Transboundary Frameworks’ Evolution

Transboundary and regional groundwater governance is in its infancy, highly pluralistic, influenced by many actors, and geographically scattered. I draw some conclusions here regarding (1) the speed of their progress, (2) geographic coverage, and (3) scope and principles (see also 6.3).

Prior to 1970 there were relatively few governance frameworks relevant for groundwater and most were in North America and Africa. In the former, it was primarily because of concerns about groundwater quality deterioration. In the latter, it was because of nations’ transitions from colonies to sovereign nations. Between 1970 and 1990 there were only three aquifers that initiated governance frameworks. However, since 1990 there has been significant activity. Such activities led to multiple laws, policies and/or programs initiated at different levels of governance with overlapping scopes, objectives and jurisdiction. This may have been in response to the global community’s growing interest in transboundary groundwater management as well as the implementation of in-force legal instruments like the UNECE Water Convention, the EU WFD, and the SADC Revised Protocol on Shared Watercourses. Additionally, the UN Watercourses Convention and the Draft Articles on the Law of Transboundary Aquifers also place built momentum regarding the management of transboundary groundwater resources. The World Bank’s Global Environment Facility was also funding transboundary water projects since 1992.

Spatially, most frameworks are located in Sub-Saharan Africa, Europe and North America. This is disproportionate to the actual distribution of TBAs world-wide. Africa and the Americas have the fewest TBAs (72 and 73 respectively), Asia has 129 and Europe 318 (also includes groundwater bodies). Interestingly, most of the world’s largest transboundary aquifers have at least begun developing a governance framework, mainly due to international donor influence (see 6.2.2 r.e. the Guaraní, Nubian Sandstone and North Western Sahara Aquifer Systems). Also, many of the EU’s TBAs are theoretically governed under the provisions of the EU’s WFD. However, the lack of governance in groundwater dependent and groundwater
Figure 6.1 Evolution of Regional and Transboundary Groundwater Governance Frameworks

Legend and Number of Each Type of Regional-Transboundary Governance Instrument

- Boundary Waters Treaty: 3
- Multi- or Bilateral Environmental Agreement: 7
- Transboundary Aquifer Agreement: 10
- Regional Economic, Environmental or Water Agreement: 8
- Transboundary River or Lake (Basin) Agreement: 14
- Aquifer Related Projects or Initiatives: 15

Note: Several instruments are relevant to multiple regional/transboundary aquifers. These are only counted once in the table, but may appear multiple times in the diagram.
<table>
<thead>
<tr>
<th>Transboundary Aquifer Name</th>
<th>Aquifer States</th>
<th>Storage (MM³)</th>
<th>Area (Km²)</th>
<th>Major Uses</th>
<th>Threats/Risks</th>
<th>Catalyst for Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbotsford-Sumas Aquifer</td>
<td>Canada, United States of America</td>
<td>3,700</td>
<td>200</td>
<td>Agricultural, Domestic,</td>
<td>Localized overexploitation, Agricultural pollution</td>
<td>Health impacts due to pollution</td>
</tr>
<tr>
<td>Bolsón del Hueco-Valle de Juárez Aquifer</td>
<td>Mexico, United States of America</td>
<td>23,683</td>
<td>8,000</td>
<td>Domestic, Industrial, Irrigation, Military</td>
<td>Pollution, Overexploitation, Salinization from irrigation</td>
<td>Overexploitation due to agricultural production</td>
</tr>
<tr>
<td>Carboniferous Aquifer (part of Scheldt River Basin)</td>
<td>Belgium, France</td>
<td>Unknown</td>
<td>4,500</td>
<td>Agricultural, Domestic, Industrial</td>
<td>Sanitary, industrial, and agricultural pollution, Overexploitation</td>
<td>Implementation of the EU Water Framework Directive</td>
</tr>
<tr>
<td>Canadian-American Great Lakes Basin and Châteauguay Aquifer</td>
<td>Canada, United States of America</td>
<td>1,287.5</td>
<td>2,500</td>
<td>Agricultural, Bottled water production, Domestic, Industrial</td>
<td>Agricultural and industrial pollution, Overexploitation</td>
<td>Reduction in groundwater quality and quantity</td>
</tr>
<tr>
<td>Danube River Basin</td>
<td>Austria, Bosnia &amp; Herzegovina, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Montenegro, Romania, Serbia, Slovakia, Slovenia, Ukraine</td>
<td>Unknown</td>
<td>100,082</td>
<td>Agricultural, Balneology, Caloric energy, Domestic, Industry</td>
<td>Agricultural, industrial, and sanitary pollution, Localized overexploitation</td>
<td>Implementation of Danube Convention</td>
</tr>
<tr>
<td>Dinaric Karst Aquifers</td>
<td>Albania, Bosnia &amp; Herzegovina, Croatia, Greece, Italy, Macedonia, Montenegro, Serbia, Slovenia</td>
<td>Unknown</td>
<td>19,700</td>
<td>Agriculture, Domestic, Fishing, Industry, Livestock</td>
<td>Reduced spring flow, Solid waste and sanitary pollution, Saline intrusion, Ecosystem degradation</td>
<td>UNECE inventory of transboundary waters</td>
</tr>
<tr>
<td>Franco-Swiss Genevese Aquifer</td>
<td>France, Switzerland</td>
<td>74</td>
<td>19</td>
<td>Domestic</td>
<td>Overexploitation</td>
<td>Overexploitation</td>
</tr>
<tr>
<td>Guarani Aquifer System</td>
<td>Argentina, Brazil, Paraguay, Uruguay</td>
<td>40,000,000</td>
<td>1,200,000</td>
<td>Domestic, Geothermal energy, Industrial</td>
<td>Localized overexploitation, Localized pollution</td>
<td>New scientific information about hydrogeology</td>
</tr>
<tr>
<td>Lake Chad Aquifer System</td>
<td>Cameroon, Central African Republic, Chad, Niger, Nigeria</td>
<td>170,000-360,000</td>
<td>1,917,000</td>
<td>Agriculture, Domestic</td>
<td>Drought, Desertification</td>
<td>Drought and rapid environmental degradation</td>
</tr>
<tr>
<td>Mekong River Plain Aquifers</td>
<td>Cambodia, Laos, Thailand, Vietnam</td>
<td>Unknown</td>
<td>369,124</td>
<td>Aquaculture, Domestic, Irrigation</td>
<td>Agricultural and sanitary pollution, Localized overexploitation</td>
<td>Third-party projects' partnerships with Sweden, the Netherlands, IUCN</td>
</tr>
<tr>
<td>Transboundary Aquifer Name</td>
<td>Aquifer States</td>
<td>Storage (MM$^3$)</td>
<td>Area (KM$^2$)</td>
<td>Major Uses</td>
<td>Threats/Risks</td>
<td>Catalyst for Governance</td>
</tr>
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</tr>
<tr>
<td>Mura Zala Aquifer</td>
<td>Hungary, Slovenia</td>
<td>Unknown</td>
<td>4,974</td>
<td>Balneology, Geothermal Energy</td>
<td>Overexploitation</td>
<td>Geothermal energy exploration</td>
</tr>
<tr>
<td>Northwestern Sahara Aquifer System</td>
<td>Algeria, Libya, Tunisia</td>
<td>Unknown</td>
<td>1,019,000</td>
<td>Agricultural, Domestic</td>
<td>Overexploitation, Salinization, Loss of artesian flow, Reduced discharge</td>
<td>Third party funding for hydrogeological research</td>
</tr>
<tr>
<td>Nubian Sandstone Aquifer System</td>
<td>Chad, Egypt, Libya, Sudan</td>
<td>375,000,000</td>
<td>2,199,000</td>
<td>Agriculture, Domestic, Industrial, Mining</td>
<td>Increasing abstraction, Hyper-salinity (northern portion only), Loss of ecosystems</td>
<td>Third party funding for hydrogeological research</td>
</tr>
<tr>
<td>Orange-Senqu River Basin Aquifers including the STAS</td>
<td>Botswana, Namibia, South Africa</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Domestic, Livestock, Mining</td>
<td>Contamination due to diffuse pollution, Drought, Diminished recharge due to surface water diversion</td>
<td>Localized pollution and/or third party funding for hydrogeological research</td>
</tr>
<tr>
<td>Iullemeden Aquifer</td>
<td>Algeria, Benin, Mali, Niger, Nigeria, Mauritania</td>
<td>5,000,000</td>
<td>1,000,000</td>
<td>Agricultural, Domestic, Mining</td>
<td>Land use changes, Drought, Salinization</td>
<td>Drought and rapid environmental degradation</td>
</tr>
<tr>
<td>Sava River Basin Groundwater Bodies</td>
<td>Croatia, Slovenia, Bosnia &amp; Herzegovina</td>
<td>Unknown</td>
<td>20,518</td>
<td>Domestic</td>
<td>Agricultural, industrial and sanitary pollution</td>
<td>Dissolution of former Yugoslavia Implementation of EU Water Framework Directive</td>
</tr>
<tr>
<td>Western Aquifer</td>
<td>Israel, Palestine</td>
<td>Unknown</td>
<td>9,000-14,167</td>
<td>Agricultural, Domestic, Industrial</td>
<td>Overexploitation</td>
<td>Oslo II Peace Agreement</td>
</tr>
<tr>
<td>Al-Saq/Al-Disi Aquifer</td>
<td>Jordan, Saudi Arabia</td>
<td>750,000</td>
<td>308,000</td>
<td>Agricultural, Municipal</td>
<td>Overexploitation</td>
<td>Large-scale groundwater transfers</td>
</tr>
<tr>
<td>Upper Rhine Aquifer</td>
<td>France, Germany, Switzerland</td>
<td>80,000</td>
<td>13,693</td>
<td>Agricultural, Domestic, Industrial</td>
<td>Agricultural and industrial pollution, Reduced recharge due to urbanization</td>
<td>Contamination of drinking water supply</td>
</tr>
</tbody>
</table>
stressed regions is startling (see Figure 6.1); notwithstanding that all recharging transboundary aquifers are vulnerable to exhaustion and pollution, at least to some extent. The lack of groundwater frameworks in these particularly vulnerable regions implies: (1) that countries are not yet using and/or polluting groundwater from transboundary aquifers and thus have not been motivated to govern it; (2) that countries are over-abstracting and/or polluting groundwater from these aquifers but do not realize it, as was initially the case for the Genevese and Guarani aquifers; (3) countries are consciously over-abstracting and/or polluting groundwater resources but have not developed the political will (possibly because of other high priority issues), financial resources, or public pressure necessary to initiate a groundwater governance framework.

6.3 Patterns and Legal Pluralism in Regional-Transboundary Groundwater Governance

This section assesses patterns and pluralism in the global groundwater governance framework examining scope, content, procedures and actor participation. The additional characteristics of codification, legality, legitimacy and formality are discussed where relevant.

6.3.1 Groundwater in the Scopes of Regional-Transboundary Governance Texts

In terms of scope, groundwater governance frameworks incorporate groundwater in three different ways:

(a) Some define a TBA using ‘groundwater’ or ‘aquifers’ as the primary unit of governance (e.g. the Franco-Swiss Genevese Aquifer, NSAS, NWSAS, Guarani), but mostly of these are not holistic - focusing on either groundwater quality or quantity. Examples include the Abbotsford-Sumas’ focus on pollution and the Nubian Sandstone aquifer’s focus on data exchange and information systems. Only a few aquifers have expanded their early frameworks to be holistic, addressing the full range of groundwater governance challenges, for example, the Bolsón del Hueco - Valle de Juárez moving from a focus on quality to integrated management of the aquifer by the public water utilities.

(b) Others define groundwater as part of a river or lake basin without fully delineating the groundwater resources, possibly because of limited capacity in hydrogeology (e.g. the Danube, Lake Chad, Orange-Senqu). Without proper identification or assessment of groundwater resources, RBOs tend to exclude groundwater resources from their activities. For example, the IRBOs discussed above were generally operational for 10 years or more, prior to implementing their mandates with respect to groundwater, even in highly groundwater dependent regions such as in the Lake Chad and Orange-Senqu River Basins.

(c) The EU merges groundwater resources and administrative boundaries in order to fit the administrative and aquifer scales together and promote norm coherence. However, the DIKTAS project in the Dinaric Karst region, where only some aquifer states are EU members, could present challenges for norm coherence.

6.3.2 Patterns in Use of Principles

The content analysis of the regional-transboundary groundwater governance instruments reveals some patterns. These patterns are illustrated in Table 6.2, which shows the principles included in each of the regional-transboundary frameworks. Most of these frameworks include multiple laws, policies, and/or programs. Thus, if a principle is included in any of these laws, policies, and/or programs, it is considered as part of the framework.

Political Principles

At the regional-transboundary level, three of the seven principles are used in more than half of the frameworks. These include exchange of information (19 frameworks), notification of emergencies (14 frameworks), and peaceful resolution of disputes (16 frameworks) (see Table 6.3). Notification of planned measures is included in nearly half the frameworks, while obligation to cooperate and sovereignty are included in 35% and 30% of frameworks respectively. No frameworks include the CBDR principle.
<table>
<thead>
<tr>
<th>POLITICAL PRINCIPLES</th>
<th>ENVIRONMENTAL PRINCIPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBDR</td>
<td>Aquifer/basin as the Unit of Management</td>
</tr>
<tr>
<td>Exchange of Information</td>
<td>Notification of Planned Measures</td>
</tr>
<tr>
<td>Notification of Emergency Situations</td>
<td>Peaceful Resolution of Disputes</td>
</tr>
<tr>
<td>Obligation to Cooperate</td>
<td>Sovereignty</td>
</tr>
</tbody>
</table>

**Africa Convention on Conservation of Nature**

**ASEAN Agreement on the Conservation of Nature**

**European Water Framework and Groundwater Directives**

**SADC Revised Water Protocol**

- Abbotsford-Summas Aquifer
- Bolson del Huexco-Valle de Jaruez Aquifer
- Canadian-American Great Lakes Basin / Châteauguay Aquifer
- Danube River Basin Aquifers
- Dinaric Karst Aquifers
- Al Saq/Al Disi Aquifer
- Franco-Swiss Genevese Aquifer
- Guarani Aquifer System
- Iullemeden Aquifer
- Lake Chad Basin Aquifers
- Mekong River Basin Aquifers
- Mountain (Western) Aquifer Basin
- Mura Zala Aquifer
- North-western Sahara Aquifer System
- Nubian Sandstone Aquifer System
- Orange-Senqu River Basin Aquifers
- Sava River Basin Aquifers
- Scheldt River Basin and Carboniferous Aquifer
- Upper Rhine Valley Basin Aquifer
<table>
<thead>
<tr>
<th>Pollution Prevention</th>
<th>Precautionary Principle</th>
<th>Protected Areas for (Ground)water</th>
<th>Protected Recharge and Discharge Zones</th>
<th>Protection and Preservation of Ecosystems</th>
<th>Subsidiarity</th>
<th>Water as a Finite Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOCIAL PRINCIPLES</strong></td>
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<td>Equitable and Reasonable Use</td>
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<td>Human Right to Sanitation</td>
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<td>Human Right to Water</td>
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<td>Intergenerational Equity</td>
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<td>Poverty Eradication</td>
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<td>Prior Informed Consent</td>
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<td>Priority of Use</td>
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<td>Public Access to Information</td>
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<td>Public Awareness and Education</td>
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<td>Public Participation</td>
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<td>Rights of Women, Youth, and Indigenous Peoples</td>
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<tr>
<td><strong>ECONOMIC PRINCIPLES</strong></td>
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<tr>
<td>Open International Economic System</td>
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<td>Polluter Pays</td>
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<td>Water as an Economic Good</td>
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<tr>
<td>Bold/Grey = Regional Agreements</td>
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</table>
Looking at each region provides additional insights. African frameworks prefer notification, exchange, and cooperation, but do not significantly include the other principles. All of the Americas’ frameworks include the principles of information exchange and notification, indicating consensus in this area. Three of their four frameworks include dispute resolution and sovereignty but only one includes the obligation to cooperate. Additionally, this is the region with the strongest emphasis on sovereignty. Asia includes the fewest political principles overall, and only information exchange is included in at least half of them. The remaining principles are included in only one framework. In Europe, all frameworks include information exchange and peaceful resolution of disputes. Notification of emergency situations is in seven of the eight frameworks and both notification of planned measures and obligation to cooperate are in half of the frameworks. The only principle in less than one-fourth of European frameworks is sovereignty where it is included in the Scheldt River framework. Interestingly, the Scheldt is one area that has ebbed and flowed between surface water conflict and cooperation in Europe (Meijerink 1999).

Table 6.3 Patterns in political principles included in regional-transboundary groundwater governance instruments

<table>
<thead>
<tr>
<th></th>
<th>All Regions (n=23)</th>
<th>Africa (n=7)</th>
<th>Americas (n=4)</th>
<th>Asia (n=4)</th>
<th>Europe (n=8)</th>
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<td>count</td>
<td>%</td>
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<tr>
<td>CBDR</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
</tbody>
</table>
| Exchange of Information   | 19     | 83        | 5      | 4            | 2      | 1      | 8      | 10.50%
| Notification of Emergency Situations | 14     | 61        | 2      | 4            | 1      | 7      |
| Notification of Planned Measures | 11     | 48        | 3      | 4            | 0      | 4      |
| Obligation to Cooperate   | 8      | 35        | 2      | 1            | 1      | 4      |
| Peaceful Resolution of Disputes | 16     | 70        | 4      | 3            | 1      | 8      |
| Sovereignty               | 7      | 30        | 2      | 3            | 1      | 1      |

Environmental Principles

Five of the thirteen environmental principles at the regional transboundary level are utilized in over half of the frameworks analyzed: aquifer/basin as the unit of management, EIA, monitoring, pollution prevention, and protection and preservation of ecosystems (see Table 6.4). The principles of BAT, the precautionary principle, establishing protected areas for (ground)water, protecting recharge and discharge zones, and subsidiarity are used in less than half of the frameworks and present interesting regional trends. Attention to conjunctive use, invasive species or explicit acknowledgement of water as a finite resource is absent from the regional-transboundary frameworks. The absence of the principle of conjunctive use is notable since eight of the frameworks govern groundwater within the scope of a river or lake basin organization.

In Africa, monitoring is the only principle included in more than half the frameworks. Pollution prevention and protection of ecosystems are in 15 of the frameworks. The remaining principles are scarcely included or absent. In the Americas, the protection and preservation of ecosystems is included in three of the four frameworks, only being absent in the Abbotsford-Sumas. Using the aquifer/basin as the unit of management, EIA, and protected areas for (ground)water are included in half of the frameworks and the remaining principles are only used in one framework or are absent. The Asian frameworks only include five of the thirteen environmental principles: aquifer/basin as the unit of management, monitoring, pollution prevention, protected areas for (ground)water, and protection and preservation of ecosystems. However, there is a relative consensus around these chosen principles at this level since all of them except using the aquifer/basin as the unit of management are included in 13 of the 23 frameworks. Still Europe indicates a higher level of consensus around its selected principles because all the principles included in the EU WFD are applicable to the frameworks in the region. Further, review of these frameworks indicates that many have updated their governance frameworks specifically to comply with the provisions of the EU WFD and EU.
GWD. Fifty percent of European frameworks protect groundwater recharge and discharge zones but conjunctive use, invasive species, and water as a finite resource are absent from all European frameworks. This indicates that groundwater-specific principles are not fully integrated in this region, despite the EU GWD.

Table 6.4 Patterns in environmental principles included in regional-transboundary groundwater governance instruments

<table>
<thead>
<tr>
<th>Princi...</th>
<th>All Regions (n=23)</th>
<th>Africa (n=7)</th>
<th>Americas (n=4)</th>
<th>Asia (n=4)</th>
<th>Europe (n=8)</th>
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<td>count</td>
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</tr>
<tr>
<td>Aquifer/basin as the Unit of Management</td>
<td>13 57</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>BATT</td>
<td>9 39</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Conjunctive Use</td>
<td>0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>EIA</td>
<td>12 52</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Invasive Species</td>
<td>0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Monitoring</td>
<td>16 70</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Pollution Prevention</td>
<td>15 65</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Precautionary Principle</td>
<td>10 43</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Protected Areas for (Ground)water</td>
<td>10 43</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Protected Recharge and Discharge Zones</td>
<td>4 17</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Protection and Preservation of Ecosystems</td>
<td>15 65</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Subsidiarity</td>
<td>8 35</td>
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<td>0</td>
<td>0</td>
<td>8</td>
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<tr>
<td>Water as a Finite Resource</td>
<td>0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Social Principles**

Three of the twelve social principles are included in more than five of the regional-transboundary frameworks (see Table 6.5). Equitable and reasonable use is included most frequently (14 frameworks). Public participation and public access to information are included in 11 and 9 frameworks, respectively. None of the frameworks include the human right to water and sanitation nor intergenerational equity. The remaining social principles are used sporadically.

Africa and the Americas use the broadest range of social principles. African frameworks emphasize equitable and reasonable use, poverty eradication, prior informed consent, and priority of use. However, participation, awareness and education of the public as well as capacity building are barely included. Further, rights-based principles (e.g. HRWS and rights of marginalized groups) are absent from the frameworks entirely. In contrast, the Americas emphasizes public awareness and participation (although not access to information). It is also the only region to include the rights of indigenous peoples through the framework for the Great Lakes Basin. Capacity building is included in the Guaraní framework, equitable and reasonable use in the Abbotsford-Sumas framework, and prior informed consent in the Great Lakes Basin framework.

Asia and Europe include a narrower range of principles, but contrast sharply in the degree to which these principles are included. Equitable and reasonable use and public awareness and education are each included in the Asian frameworks - once in the Mekong river basin framework and the ASEAN environmental agreement respectively. In Europe, equitable and reasonable use, public access to information and public participation are each included in all the frameworks because of their inclusion in the EU WFD.16

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16 In Article 1(e), the EU WFD refers to this as sustainable, balanced, and equitable use.
Table 6.5 Patterns in social principles included in regional-transboundary groundwater governance instruments

<table>
<thead>
<tr>
<th></th>
<th>All Regions (n=23)</th>
<th>Africa (n=7)</th>
<th>Americas (n=4)</th>
<th>Asia (n=4)</th>
<th>Europe (n=8)</th>
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<td>Count %</td>
<td>count</td>
<td>count</td>
<td>count</td>
<td>count</td>
</tr>
<tr>
<td>Capacity Building</td>
<td>3 13</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Equitable and Reasonable Use</td>
<td>14 61</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Human Right to Sanitation</td>
<td>0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Human Right to Water</td>
<td>0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Intergenerational Equity</td>
<td>0 0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Poverty Eradication</td>
<td>3 13</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Prior Informed Consent</td>
<td>4 17</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Priority of Use</td>
<td>3 13</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Public Access to Information</td>
<td>9 39</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Public Awareness and Education</td>
<td>3 13</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Public Participation</td>
<td>11 48</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Rights of Women, Youth, and Indigenous Peoples</td>
<td>2 9</td>
<td>0</td>
<td>2</td>
<td>0</td>
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</tbody>
</table>

Economic Principles

All economic principles are included in 10 or fewer regional-transboundary frameworks (see Table 6.6). The polluter pays principle is most common, being included in 10 of 23 frameworks. While all European frameworks include it, the polluter pays principle is absent in the Asian frameworks. Further, the principle is only included once in the other regions, namely the Great Lakes basin and Iullemeden frameworks.

Water as an economic good is in 43% of the frameworks. It is used in all European frameworks, in one American and one Asian framework, but is absent from African frameworks. The Guaraní is the only framework including an open international economic system by way of the MERCOSUR environmental agreement.

Table 6.6 Patterns in economic principles included in regional-transboundary groundwater governance instruments

<table>
<thead>
<tr>
<th></th>
<th>All Regions (n=23)</th>
<th>Africa (n=7)</th>
<th>Americas (n=4)</th>
<th>Asia (n=4)</th>
<th>Europe (n=8)</th>
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<tbody>
<tr>
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<td>count %</td>
<td>count</td>
<td>count</td>
<td>count</td>
<td>count</td>
</tr>
<tr>
<td>Open International Economic System</td>
<td>1 4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Polluter Pays</td>
<td>10 43</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Water as an Economic Good</td>
<td>10 43</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
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</tbody>
</table>

17 Article 9 of the EU WFD discusses “cost recovery for water services” and consequently, this provision is applicable to all EU states and the groundwater bodies therein. Nevertheless, only 63% of the frameworks explicitly mention water as an economic good or cost recovery in the instruments outside the EU WFD.
Map 6.2: Groundwater depletion in transboundary aquifers with governance frameworks.
Map 6.3 Groundwater Contamination in TBAs with Governance Frameworks

Legend:
- No Data Reported*
- Waste/Wastewater
- Agricultural and Waste/Wastewater
- Industrial* and Waste/wastewater
- All Types of Pollution
- No Pollution Reported
- No Data Requested*

* No data reported means countries did not provide data as part of the TWAP project. No data request means country did not participate in the TWAP project.

* In this map industrial pollution includes heavy metals and organic compounds as well as pollutants generated from mining and mineral exploration activities.
6.3.3 Pluralism in Process and Participation

There are myriad combinations of procedures, modes of implementation, and actor participation within and across regional-transboundary frameworks. The most common situation is a commission or committee that functions under the auspices of an aquifer, river or lake basin agreement that includes all relevant actors.

This is the case for the Al Saq-Al Disi Aquifer, Canadian-America Great Lakes, Danube River Basin, Franco-Swiss Genevese Aquifer, Lake Chad Basin, Mekong River Basin, Nubian Sandstone Aquifer System, Orange-Senqu River Basin, Scheldt River Basin, Sava River Basin and Upper Rhine River Basin. There are also some slight variations, wherein the agreement also falls under supranational law (e.g. the EU), the agreement operates parallel to a regional agreement (e.g. SADC) or there are additional environmental or water agreements including subsets of the actors (e.g. Great Lakes Basin). The content analysis indicates that such a structure improves coherence in content. However, it does not always successfully address the scale issue, wherein not all countries sharing a surface water resource will share all the related groundwater resources.

In another set of cases, the status of actors and/or their participation varies, creating issues of legitimacy. For example, neither the DIKTAS project nor the Mekong agreement include all the countries sharing the groundwater resources. The former was because not all countries were eligible for GEF funding (Governments of Albania, Bosnia & Herzegovina, Croatia, and Montenegro 2011) and the latter due to China and Myanmar having observer status, namely being ‘dialogue partners’ (Mekong River Commission for Sustainable Development 2016). In both cases, it is unclear what consequences this has for groundwater governance. In the Mountain (Western) aquifer case, the legitimacy of the Oslo Accords is debated since Palestine is considered an occupied territory, not a sovereign state (Kittrie 2003). The Guarani agreement awaits ratification and lacks a procedural mechanism, so it is stalled with respect to implementation. In US and Mexican transboundary aquifers, the US unilaterally adopted legislation regarding the assessment, monitoring and management of transboundary aquifers. While the bill has spurred cooperation with the Mexican government, it does not constitute a bilateral governance instrument. Also in the Mura-Zala, there is no aquifer-specific instrument that includes all the countries; however, there are several bilateral agreements and EU directives that form the basis for cooperation.

A final set of cases are those where sub-national or non-state actors are the primary implementing actors. The Abbotsford-Sumas aquifer is subject to multiple bilateral treaties between Canada and the US. Nevertheless, governance activities have primarily occurred through local-level stakeholder groups. The Genevese agreement delegates governance to the local level authorities, particularly for the management of the artificial recharge facility. In the Bolsón del Hueco - Valle de Juárez, the Mexican and US municipal water providers took on governance functions in the face of inadequate state-level action. In the latter two cases, focusing on local-level actors and procedures had highly beneficial results with regard to groundwater resources sustainability, but not necessarily norm cohesion (see 6.4.2).

6.4 DISCUSSION: CONTRIBUTING TO SUSTAINABLE AND INCLUSIVE DEVELOPMENT AT THE REGIONAL-TRANSBOUNDARY LEVEL

6.4.1 Principles’ Relationship to Drivers

There are numerous drivers of groundwater problems at the regional-transboundary level. This discussion focuses on the regional-transboundary drivers (see 3.2 and Table 3.1) which includes drivers identified in the cases as well as through literature that is not case specific.

Ideally, the political principles would address drivers such as political dynamics between states and also create linkages to non-groundwater policies. Political dynamics between states are in part addressed through CBDR, information exchange, notification of planned measures, and sovereignty. While, exchange of information is widely used at this level and planned measures is present in nearly half of the frameworks,
CBDR is absent and may prevent the driver from being fully addressed. Limited sovereignty is in nearly one-third of the frameworks, but none of them explicitly address the ownership status of the resources as shared by countries, divided by countries’ share of groundwater underlying their territory or otherwise. The Guarani agreement comes closest by stating that each country has sovereignty over its portion of the aquifer. Non-groundwater policies are not addressed through specific principles in the framework. In some cases, such as the EU WFD or the Nubian and Iullemeden SAPs, a need for linkages to other regulatory fields is discussed.

The social principles, if included robustly, could deal with drivers such as pumping and pollution by individuals, and local authorities, commercial agriculture and industries by ensuring equitable distribution of and access to groundwater resources as well as preventing degradation of transboundary groundwater dependent ecosystems upon which populations rely. Regrettably, most social principles are rarely used in the regional-transboundary frameworks with the exception of equitable and reasonable use (in 61% of frameworks) and the principles governing interactions with the public, all of which are used in less than half of the frameworks. Consequently, there are no clear agreed upon principles through which to establish allocation regimes nor is there a mechanism through which the public can learn and influence decision-making in this regard.

The included environmental principles are insufficient to counter drivers such as naturally-occurring shifts in available water quantity and climate change, but might counter changes due to land use strategies. The regional-transboundary frameworks also do not deal with the natural changes in available water quality and quantity (e.g. as a result of invasive species or geogenic contamination) even though such changes may bring about questions regarding equitable allocation between countries. Climate change adaptation was not included in any of the legal or policy documents at this level. It was only addressed to a limited extent in the Strategic Action Programme of the Nubian Sandstone Aquifer. Further, ecosystems services such as groundwater storage via managed aquifer recharge, carbon sequestration and geothermal energy production, which are considered climate change adaptation and mitigation techniques respectively, are not explicitly addressed in any transboundary framework. Clean energy production that exploits thermal groundwater is only addressed in the Mura-Zala framework but not in (ground)water-specific legal or policy texts. Although land use strategies are not specifically addressed in the frameworks, principles such as monitoring, pollution prevention and establishing protected areas can counter this driver, if implemented collectively.

Due to a lack of economic principles, drivers such as pumping and pollution from industry, trade and shifts in economic conditions are not explicitly addressed. However, frameworks targeted at preventing pumping and pollution from commercial agriculture (e.g. the Al-Saq/Al-Disi) and to sustain urbanization (e.g. groundwater transfers from the Nubian to Libyan cities) are emerging. Yet, the analysis indicates that regional-transboundary frameworks address these issues through principles such as data exchange and monitoring, rather than through economic incentives/disincentives or through explicit allocation and land use planning principles. Countries governing TBAs rarely control volumetric allocation, licensing or economic approaches; exceptions include the Franco-Swiss Genevese and the Bolsón del Hueco -Valle de Juárez frameworks.

6.4.2 Incoherence and Contradictions on Principles

There is a high level of pluralism with respect to how regional and transboundary groundwater governance frameworks suggest coordinating political interaction, protecting groundwater resources, organizing and legitimizing rights, allocating groundwater resources, and governing within a neo-liberal paradigm. This Section highlights key areas of incoherence and contradictions.

The regional-transboundary frameworks indicate some level of agreement around information exchange, notification of emergencies, and dispute resolution. However, each region expresses different preferences with regard to which political principles are emphasized. Africa and Europe both emphasize notification, exchange and cooperation. In contrast, the Americas emphasizes sovereignty and Asia does not substantially include political principles. Further, CBDR is absent from regional-transboundary frameworks even though it
has clear implications for allocation of rights and responsibilities at this level. Nevertheless, the most convergence occurs with regard to the political principles.

One would anticipate that at the regional-transboundary level, states would try to assert their sovereignty in transboundary groundwater governance frameworks. However, only six of the twenty-three frameworks explicitly include sovereignty. Only three of the six frameworks that include the sovereignty principle is directly related to groundwater: the Iullemeden Aquifer System (1964 Niamey Act Concerning the River Niger Commission and the 1990 Niger-Nigeria Joint Commission for Cooperation), the 1995 Mekong Agreement, and the 2000 Revised SADC Protocol. In the remaining frameworks, the principle is in texts indirectly applicable to water: 1906 Canadian-US boundary waters treaty in the frameworks of the Abbotsford-Summas aquifers and the aquifers of the Great Lakes and the 1991 regional economic agreement establishing MERCOSUR in the Guarani framework. This indicates that the explicit inclusion of the sovereignty principle at the regional-transboundary level is neither a significant trend nor a source of incoherence.

More environmental principles are less-included in Asia (four principles) than in Africa, the Americas and Europe (between seven and ten principles). However, the degree to which the chosen principles are included in the frameworks is higher in Asia and Europe (the selected principles are included in 3 of the 4 Asian frameworks and nearly all of European frameworks, respectively) than in Africa and the Americas (roughly half of frameworks on average). Thus, coherence varies across regions, both with regard to which principles are included and the frequency of their inclusion. There is a high level of coherence across all regions regarding monitoring (70%), pollution prevention (65%) and ecosystem protection (65%) and a moderate level of coherence regarding using the aquifer/basin as the unit of management (57%) and EIA (52%).

When focusing on principles related to gathering groundwater data (EIA, precautionary principle, monitoring; see Map 6.5) and groundwater-specific principles (conjunctive use, protected areas for groundwater, and protecting recharge and discharge zones; see Map 6.6), some clear patterns arise. On groundwater data, the EU and all European TBA frameworks include all three principles. The Iullemeneden framework also includes all three. The Africa Convention on the Conservation of Nature, the Bolsón del Hueco-Valle de Juárez and Lake Chad framework do not include any of the three and the other frameworks include some of the three in varying combinations. No framework includes conjunctive use, despite nearly half of them being centered around river basin agreements. Only the Danube framework both established protected areas and protects recharge and discharge zones. The other frameworks strongly prefer including general protected areas rather than specific protections for recharge and discharge zone. These patterns imply that there is some coherence around the issue of data gathering but not around the specific approach and that there is little to no coherence around including groundwater-specific principles. Thus, the analysis also indicates that frameworks at this level are most likely to include well-established environmental principles and less likely to integrate emerging or groundwater-specific principles.

There is little attention to social principles at this level. Only, the principle of equitable and reasonable use is included in more than half of the frameworks. There is a conspicuous absence of rights-based principles with only the Americas giving attention to the rights of indigenous peoples in the Great Lakes Basin (see Map 6.6). Although principles regarding public engagement are somewhat integrated into most regions’ frameworks, attention to the issues of capacity building and intergenerational equity are lacking. However, these two principles are highly relevant to groundwater given the limited capacity for groundwater resource management in other areas of the world. Further, several of the aquifers at this level are non-recharging indicating that intergenerational equity is a key concern.

The economic principles were barely included at this level, with the exception of the polluter pays principle. Water as an economic good was present in Europe, but had minimal traction in Asia and the Americas and was absent in Africa.
Map 6.4 Inclusion of Data Gathering Principles in TBAs
Inclusion of Groundwater-specific Principles in TBAs

Map 6.5 Inclusion of Groundwater-specific Principles in TBAs
Map 6.6 Inclusion of Allocation-related Principles in TBAs
Overall, instruments at the regional-transboundary level mostly focus on political and environmental aspects. Regional instruments as in the EU and SADC have a noticeable effect on the content of aquifer/basin-level agreements. There are theoretical debates regarding the tension between the human right to water and sanitation and water as an economic good as well as between sovereignty and equitable and reasonable use (see 4.7). The legal pluralism analysis shows that these tensions manifest in two key ways at the regional-transboundary level.

First, there is a clear paradox with regard to the principles of sovereignty, equitable and reasonable use, and intergenerational equity. Overall, equitable and reasonable use is included by twice the number of frameworks as sovereignty. Intergenerational equity is entirely absent, despite the presence of large, non-recharging aquifers in North Africa and West Asia. However, the geographical distribution of these principles indicates regional preferences. African and European frameworks emphasize equitable and reasonable use over sovereignty. The SADC Water Protocol even goes as far as requiring water licensing in transboundary river basins. American frameworks emphasize sovereignty over equitable and reasonable use, except in the case of the Guarani which includes both principles. Similarly, in Asia, the Mekong agreement includes both principles as well. Other Asian frameworks do not include all three principles.

Additionally, in all cases, these principles are not included in all of the laws, policies, and programs relevant to a particular region and/or transboundary aquifer, but rather only a few. As such, there is little agreement regarding these principles across and within the regional-transboundary frameworks.

Second, the principles relevant to human rights, priority of use, and water as an economic good are either absent or hardly included in the frameworks. Water as an economic good is most emphasized within Europe via the EU WFD and is included once each in the Americas (MERCOSUR agreement) and Asia (Oslo II agreement) (see Map 6.3). In contrast, three of the seven African frameworks include priority of use, but the principle is not included in any other region. None of the frameworks include the human right to water and sanitation. Percentage-wise, considering water as an economic good is included in twice as many frameworks as the human right to water and sanitation and priority of use combined. Together, these findings show a high level of incoherence between regional approaches to water services provision in a transboundary context.

This variation is likely attributable, so some extent, to differences in the types of groundwater problems facing these regions.

### 6.4.3 Principles’ Relationship to Sustainability and Inclusive Development

This section assesses how the principles at this level contribute to sustainable and inclusive development. Figure 6.2 shows the relative distribution of principles in the governance frameworks at this level.

The African region has the most emphasis on the social principles of all the regions. All but the NSAS have frameworks consisting of at least 20% of the social principles. There is very little use of economic principles in the frameworks. The political and environmental principles nearly equally share the remaining proportion of principles. The groundwater governance frameworks in the region indicate that key drivers include asymmetrical access to groundwater (across space and time), lack of clarification on ownership regimes, natural changes in groundwater quality and quantity, as well as the full range of indirect drivers (e.g. climate change, trade, economics, demography). The robust inclusion of social principles could increase access for basic human needs but has the potential to be undermined in the absence of clear political principles regarding groundwater ownership and CBDR for groundwater protection. Similarly, environmental principles may protect groundwater and related environmental resources under the status quo, but without accounting for time scale through linkages to climate change, including intergenerational equity, and accounting for potential changes in groundwater quality the existing principles are not likely to be sufficient. Further, the absence of economic principles indicates limited opportunity to counter drivers such as trade. This indicates the potential for inclusivity along the environmental and social dimensions but little opportunity for sustainability overall.
Figure 6.2 Frequency distribution of Principles across All Regional-Transboundary Governance Instruments

The Americas has the strongest emphasis on political principles (all frameworks include >30% political principles). The high-level of political interaction between American states may explain the relatively high number of political principles present. Compared to the other regions, the Americas is the least focused on the environment. Key drivers in the cases presented include quality degradation and depletion due to industry (particularly agriculture), economy and non-groundwater policies and political dynamics between states. This region had very pronounced environmental challenges that are hardly addressed by the frameworks’ principles – half establish protected areas for groundwater, 25% explicitly include pollution prevention or polluter pays, and none protect groundwater recharge and discharge zones. And while, there is support for the principles of public engagement, rights-based principles are nearly absent. There is very little use of economic principles and moderate use of the other types. Thus, the role of industry, the economy, and the underlying policies are unaddressed. Given the mismatch between the key drivers of groundwater problems and the frameworks’ principles, the prospect for sustainable or inclusive development in the Americas is narrow.

Asia is the region with the least balanced distribution of principles, with social and economic principles being nearly absent. And despite a greater presence of environment principles than the other types, there are still myriad issues related to over-abstraction and pollution throughout the region (see Map 6.2 and Map 6.3). Given that groundwater composes a large portion of water abstraction in this region, especially West Asia, key drivers are supply for human activities. Additionally, political dynamics and non-groundwater policies play a major role since pushes for food security in water scarce areas are common. The absence of economic principles in the frameworks as well as principles designed to facilitate water-smart trade politics undercuts sustainable development in the region. Political instability in these areas is also centered to some extent around water resources, yet there are few principles regarding cooperation and dispute resolution. Further, no social principles are designed to address the role of groundwater in providing emergency supplies, coping with sudden demographic shifts, nor is there support for equitable and/or rights based allocation in general.
As such, there are little prospects for sustainable development and even less potential for inclusive development.

Europe has the most balanced distribution of principles of all the regions, including all four types. Yet, there is still a clear emphasis on the environmental dimension. Given that groundwater governance in Europe is typically a subsidiary activity to river basin governance, there is not much information about the presence of groundwater-specific drivers in the cases discussed. This is reflected in the fact that the groundwater-specific principles are the least included environmental principles. The lack of attention to conjunctive use is particularly notable, although it may be taken as an assumption within the IWRM approach of the EU WFD. Nevertheless, it is clear that industrial activities and population growth have caused groundwater pollution and depletion in some of the cases reviewed. The Mura-Zala aquifer case also indicates the potential emergence of groundwater governance primarily related to energy development. The European frameworks would likely make a reasonable contribution to sustainable development. However, the lack of groundwater-specific principles may be an obstacle to integrating groundwater into implementation. Further, this region has the strongest emphasis on water as an economic good, but an absence of a human rights approach. Having said this, the EU countries have one of the best records in meeting the human right to water and sanitation services with approximately only 2.4% of the population (12 million people) without regular access to water or sanitation services (EUROSTAT 2016). But the World Health Organization Europe Region, which includes many non-EU European Countries claimed that as of 2015 Europe had 912 million people with 6.7% (62 million people) lacking access (World Health Organization 2016). Further, the refugees in refugee camps in and on the borders of Europe may not be accurately included in these numbers and may face increasing difficulties attaining access and rights to water.

Taken together, the groundwater governance frameworks at the regional transboundary level indicate that regional political priorities and dynamics in combination with global development discourses influence the distribution of principles. Africa focuses on poverty eradication and public engagement; the Americas focuses on political dynamics rather than the environment; Asia uses very few principles; and Europe, having benefitted from iterations of transboundary water policy making, demonstrates a balanced but conservative approach. This also implies that although various norm dispersion mechanisms, such as projects from international donors and IWRM have impacted the framework at this level (cf. Scheumann 2008). Context specific-factors have a visible influence on the selection of principles. While this can be beneficial, the analysis indicates that regional customization has, in many cases, led to a mismatch between the key drivers of groundwater problems and the selection and creation of principles. Undoubtedly, this will limit groundwater governance’s contribution to sustainable development at this level.

With regard to the sub-dimensions of inclusive development, there is moderate potential for relational inclusiveness given that 39-61% of the frameworks include the political and social principles addressing state interaction. However, the principles neither support social inclusiveness, nor environmental inclusiveness as they lack groundwater-specific principles that would protect ecosystems.

6.5 INFERENCES

This chapter leads to the following conclusions. First, there are currently 23 regional-transboundary frameworks, each made up between one and eight individual laws, policies, and/or programs that include various combinations of the 35 governance principles. Of these frameworks two are limited to the general environment, seven are focused on surface water (including boundary waters), one on all waters equally, and thirteen are groundwater-specific. The roots of these laws, policies and programs can be traced to more than 100 years ago. Over the last 100 years, there has been a slow evolution of frameworks followed by rapid development between 1970 and 2000, with 14 of the 23 frameworks emerging during this time (see Figure 6.1). However, within the last 15 years, progress has slowed down significantly, with only the Guarani and Al-Saq/Al-Disi Aquifer’s frameworks being developed. Furthermore, groundwater governance at this level is not typically streamlined into a single instrument, but is rather an agglomeration of multiple instruments that
govern various environmental and water resources. Moreover, the recently developed frameworks required either a clear internal or external catalyst to begin governing groundwater, as opposed to it developing as a result of consistent advancements in water knowledge and governance.

Given that 97% of the world’s known transboundary aquifers and groundwater bodies do not have groundwater-specific governance frameworks, the slow rate at which frameworks are being adopted is counter-intuitive. However, it could potentially be explained by: (i) countries focusing on the implementation of existing bilateral and multilateral surface water agreements and/or IWRM approaches, most of which do not explicitly include or exclude groundwater; (ii) water scarce countries being less willing to discuss or conduct research on transboundary groundwater resources challenges due to concerns about allocation and thus leaning back towards an absolute territorial sovereignty approach (Eckstein 2007); (iii) countries feel that they lack the necessary information and capacity to address groundwater problems (see 1.3, 8.2.2, 10.2.2) (iv) a lack of political will and/or pressure to address issues regarding transboundary groundwater resources; and (v) countries are experiencing treaty exhaustion within the area of global environmental governance (e.g. as interviewees in my case study stated, see 8.3.3).

Second, most of the regional-transboundary governance texts define groundwater in one of three ways: as part of the environment, as hydrologically connected to a river or lake basin, or as an aquifer. The most recent governance laws policies and initiatives from the Abbostford-Summas, Bolsón del Hueco -Valle de Juárez, Dinaric Karst, Al-Saq-Al-Disi, Franco-Swiss Genevese, Guaraní, Iullemeden, Mountain, Mura-Zala, North-West Saharan and Nubian Sandstone Aquifers explicitly use the aquifer as the unit to be governed. Further, because of the EU WFD and EU GWD, each of the European river basins has explicitly incorporated groundwater into their scope. The transboundary river and lake basins analyzed have also taken a similar approach with the exception of the Orange-Senqu River Basin, which does not explicitly include groundwater in the legally-binding agreement but does include it in the agreement’s implementation. The African Convention on the Conservation of Nature and the ASEAN Environmental Agreement are the only two frameworks that only include groundwater as part of the environment.

The analysis shows that the scope and definition of groundwater in regional-transboundary governance texts impacts the level of attention groundwater is likely to receive during implementation. Instruments with broader scopes often neglect groundwater in implementation. For example, 70% of frameworks include the monitoring principle, but this is hardly extended to groundwater in practice since few countries have established monitoring networks. Notable progress is only made when the frameworks include a process in which a groundwater-specific mechanism is established, such as the Danube Groundwater Task Force, the groundwater expert network in the Upper Rhine Basin, and the groundwater technical group in the Orange-Senqu (see 8.3.3).

Lastly, in analyzing whether the principles individually and jointly contribute to sustainable and inclusive development, I would first argue that the principles at regional-transboundary level do not address the indirect drivers of groundwater problems, namely climate change, regional pressures for economic growth, international trade, and non-groundwater policies. Political dynamics between states is addressed to a limited extent. Only the framework of the Nubian Sandstone Aquifer System addresses climate change directly in the text of its Strategic Action Programme, which unfortunately is not being implemented at present. With respect to regional economy and international trade, only one framework explicitly calls for supporting an open economic system, but possibly all implicitly do so; however, 43% of frameworks consider water as an economic good. None of the frameworks specifically address non-groundwater policies, although the EU WFD or the Nubian and Iullemeden SAPs discuss the need for linkages to other fields. Political dynamics between states, from a legal perspective are countered by the customary principles of international law: obligation to cooperate, peaceful dispute resolution and limited sovereignty. However, only one of these three (dispute resolution) is included in more than 50% of frameworks. From an institutional perspective, there is a need for clear agreements around sovereignty, groundwater ownership and allocation, information sharing, and the responsibilities therein. While one-third of frameworks include limited sovereignty and none
explicitly address the ownership status or include CBDR, 61% include equitable and reasonable use and 83% include some form for data exchange or notification. This indicates that there is no consensus on the principles that would address the political dynamics between states.

Direct drivers at the transboundary level include pumping and pollution by individuals, local authorities, commercial agricultural and industry, land use strategies, and natural changes in groundwater quality and quantity. The principles addressing pumping and pollution are moderately included in the frameworks. For example, equitable and reasonable use is in 61%, pollution prevention in 65%, and protection and preservation of ecosystems in 65% of the frameworks. Yet none of the frameworks directly address agriculture, industry and land use through the principles. Both the Abbotsford-Sumas and Bolsón del Hueco - Valle de Juárez do so through local activities stemming from civil society organizations and local authorities, respectively. In general, there is a stronger preference to rely on data sharing (83%) and monitoring (70%) than on principles directly addressing over-abstraction and contamination. Principles dealing with natural changes to groundwater quality and quantity are also absent from all the frameworks. Thus, the lack of attention to direct and indirect drivers at the regional- transboundary level will affect the ability of the principles to counter the key causes of unsustainable water management.

Second, in terms of addressing the dimensions of sustainable and inclusive development, I find that political aspects are dealt with through a regional preference in terms of the treatment of sovereignty – 75% of frameworks in the Americas include it while it is in less than 30% of frameworks in other regions (see Table 6.3). This implies that expressly including sovereignty is not a paramount concern for most countries – even at the transboundary level. Also noteworthy is the complete absence of CBDR, indicating that countries sharing transboundary resources may not feel it is necessary to differentiate responsibility and capabilities, even when there are hegemonic power differentials between riparian states (e.g. between Egypt and the other Nubian Sandstone Aquifer states), economic differences between states (e.g. Brazil and other Guaraní aquifer states), or when some states contain a much larger portion of the aquifer than others (e.g. Namibia’s large share of the Stampriet transboundary aquifer). Alternatively, they feel that these aspects can be captured by the social principle of equitable and reasonable use. There is also a clear emphasis on information exchange and dispute resolution, which indicates that states feel that these are critical principles for regional- transboundary groundwater governance.

In terms of environmental issues, groundwater specific principles range widely in how they are included in the frameworks: e.g. conjunctive use is absent; establishing protected areas for groundwater is in 43%, and protection of recharge and discharge areas is in 17% (see Table 6.4). Although five of the twelve environmental principles appear in more than half of the frameworks (i.e. aquifer/basin as the unit of management, EIA, monitoring, pollution prevention, and ecosystem protection), there are also two principles (i.e. conjunctive use and water as a finite resources) that are absent from all frameworks. Although, it is the dimension with the highest degree of consensus at the regional-transboundary level, the treatment of environmental principles varies greatly across continents. In Europe, eight of the twelve principles are included in 100% of the frameworks due to their inclusion in the EU WFD and GWD. African frameworks also include eight of the twelve principles, but indicate a lesser degree of consensus. Asia and the Americas include significantly less principles, only five and six principles respectively.

In terms of social principles, there is some consensus around equitable and reasonable use (61%), public participation (48%), and public access to information (39%), mostly in Africa and Europe. However, the remaining principles are in less than 20% of frameworks. Critical social principles such as capacity building, intergenerational equity (for the use of non-renewable groundwater), and all the human rights principles are nearly absent in the frameworks (see Table 6.5).

In terms of economic principles, only the Guaraní frameworks actually include the need to protect an open international economic system via the regional MERCOSUR agreement (see Table 6.5) indicating a potential emphasis on trade at this level. Water as an economic good is in the EU WFD and thus is prominent in the
EU frameworks but is nearly absent elsewhere, indicating a general preference not to make this principle explicit, even though groundwater governance is occurring in the context of a neo-liberal market economy.

The combination of political, environmental, social and economic principles also reveals that actors typically choose between equitable and reasonable use and sovereignty, with more frameworks focusing on equitable use. It also shows a stronger preference for water as an economic good (in seven frameworks) over water as a human right (absent from frameworks).

Hence, the inability of these principles to structurally address the regional and transboundary drivers (except perhaps in the context of the SDGs), and to address political, environmental, social and economic aspects in a coherent manner means that states to not have the necessary framework to ensure equitable, reasonable and sustainable groundwater allocation over time. Further, the absence of mechanisms through which states can deal with multiple laws, policies and programs in a coherent way opens up these frameworks for potential for error and/or negligence in implementation or even conflict between actors. It also seems that states prefer to focus on data gathering and exchange rather than issues of allocation and resource protection, which may delay taking action on these critical issues. This could hamper the ability of the regional-transboundary framework for groundwater governance to achieve sustainable and inclusive development. However, although not explicitly discussed in this Chapter, the overarching concept of IWRM, adopted in many parts of the world in response to global level declarations and donor persuasion may provide room for promoting sustainable and inclusive development.