Legal & Institutional Frameworks
Groundwater Governance - A Global Framework for Action

Groundwater Governance - A Global Framework for Action (2011-2014) is a joint project supported by the Global Environment Facility (GEF) and implemented by the Food and Agriculture Organisation of the United Nations (FAO), jointly with UNESCO's International Hydrological Programme (UNESCO-IHP), the International Association of Hydrologists (IAH) and the World Bank.

The project is designed to raise awareness of the importance of groundwater resources for many regions of the world, and identify and promote best practices in groundwater governance as a way to achieve the sustainable management of groundwater resources.

The first phase of the project consists of a review of the global situation of groundwater governance and aims to develop of a Global Groundwater Diagnostic that integrates regional and country experiences with prospects for the future. This first phase builds on a series of case studies, thematic papers and five regional consultations.

Twelve thematic papers have thus been prepared to synthesize the current knowledge and experience concerning key economic, policy, institutional, environmental and technical aspects of groundwater management, and address emerging issues and innovative approaches. The 12 thematic papers are listed below and are available on the project website along with a Synthesis Report on Groundwater Governance that compiles the results of the case studies and the thematic papers.

The second phase of the project will develop the main project outcome, a Global Framework for Action consisting of a set of policy and institutional guidelines, recommendations and best practices designed to improve groundwater management at country/local level, and groundwater governance at local, national and transboundary levels.

Thematic Papers

No.1 - Trends in groundwater pollution; trends in loss of groundwater quality and related aquifers services
No.2 - Conjunctive use and management of groundwater and surface water
No.3 - Urban-rural tensions; opportunities for co-management
No.4 - Management of recharge / discharge processes and aquifer equilibrium states
No.5 - Groundwater policy and governance
No.6 - Legal framework for sustainable groundwater governance
No.7 - Trends in local groundwater management institutions / user partnerships
No.8 - Social adoption of groundwater pumping technology and the development of groundwater cultures: governance at the point of abstraction
No.9 - Macro-economic trends that influence demand for groundwater and related aquifer services
No.10 - Governance of the subsurface and groundwater frontier
No.11 - Political economy of groundwater governance
No.12 - Groundwater and climate change adaptation

www.groundwatergovernance.org
Thematic Paper 6: Legal and Institutional Frameworks

By

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1. Introduction

Legal frameworks play a crucial role for effective groundwater governance. They provide the basis and starting point for policy development and they turn policy decisions into rights and obligations. The legal framework for groundwater management should provide answers to key questions such as who can access groundwater, where, for which purposes and under which conditions? How are aquifers protected against depletion and pollution? According to which criteria are the finite resources of non-recharging aquifers to be allocated and protected? Which kind of monitoring and planning tools have to be used? How will private and public interest be balanced and how get stakeholders involved in decision making and management processes?

Box 1: A working definition of groundwater governance

Groundwater governance is the process by which groundwater resources are managed through the application of responsibility, participation, information availability, transparency, custom, and rule of law. It is the art of coordinating administrative actions and decision making between and among different jurisdictional levels – one of which may be global. (Adapted after Saunier and Meganck. 2007. Dictionary and Introduction to Global Environmental Governance)

Historically water legislation has focused on surface water resources, among other reasons because the state of groundwater is unseen, the resource is ubiquitous and aquifer systems respond over time creating less immediate regulatory pressures. Groundwater legislation has lagged behind. In many countries it remains fragmented, incoherent or simply ignored. Over the last decades, increasing pollution of aquifers and large-scale and intensive abstraction of groundwater caused by the advent of the energized pump have created a need for better legal responses. Specific groundwater legislation has been enacted or provisions on groundwater have been formulated in general water legislation. As for surface water the introduction of modern water legislation with permit-based systems of administrative water rights at their core has become the dominant legal paradigm for groundwater.

In countries with highly formalized water economies such as Australia, many European countries or the US such legislation tends to reach most or all groundwater users. In many developing countries it has remained ineffective. There, the implementation of groundwater legislation is even patchier as of surface water rules and can constitute a paramount administrative challenge. Typically large numbers of small-scale users individually abstract marginal amounts which collectively generate significant impacts on aquifers. Particularly in the rural areas of developing countries informal or customary rules tend to govern access to groundwater at the point of abstraction and shape users’ perceptions of their rights, instead of or in parallel to formal water rights. Limited information about the characteristics of aquifers and use patterns as well as weak institutional capacity further

\footnote{In India there are, for instance, 19 million mechanized wells and tubewells (in 2000), Shah et al. 2003, p. 130.}
complicate management processes. In such contexts user-based community approaches, the recognition of customary rules or a combination of options are highly relevant.

Whereas day to day management of groundwater resources takes place within the national sphere, and often at local level, domestic regulatory systems cannot be seen in isolation from international legal frameworks when transboundary aquifers are concerned. In that case international law determines states’ rights and obligations to which domestic law has to be made compatible. Given that there are at least 273 transboundary aquifers worldwide this is a frequent constellation (UNESCO 2009). However, at the international plane, both regulation and implementation are at an even more nascent stage than domestically: While for the 263 river basins hundreds of treaties have been concluded, only five of the 273 transboundary aquifers are covered by specific agreements and no regional or global treaty exists on transboundary aquifers (Mechlem 2011). Guidance is provided mainly by isolated provisions on groundwater in surface water treaties and by non-binding legal instruments. Among the latter, the International Law Commission’s 2008 Draft Articles on the Law of Transboundary Aquifers stand out. They were taken note of by the United Nations General Assembly and might become the basis of a future convention (Resolutions 63/124 of 11 December 2008 and 66/104 of 9 December 2011).

The discussion will develop as follows: Part 1 (Baseline) will provide an overview of the main features of legal and institutional frameworks on groundwater first with respect to domestic law, addressing both formal and customary approaches, then with respect to international law. Part 2 (Diagnostic) will discusses key challenges that have to be addressed if legal rules are to make a more effective contribution to getting a handle on aquifer depletion and degradation – again both with respect to the domestic and the international plane. Part III (Prospects) will look into the future and suggest issues whose relevance is likely to increase. The legal issues covered here focus on the use of groundwater for human consumption, agricultural, industrial and environmental purposes. They do not address the legal challenges arising from newer technologies such as those related to the use of geothermal energy, carbon dioxide capture and storage (CCS), and hydrofracturing (“fracking”) to capture shale gas, where in many cases specialized laws and regulations still have to catch up with technological developments (van der Gun, A. Merla, M. Jones and J. Burke 2012).

Part 1 Baseline

2. National legal and institutional frameworks

2.1. Water law and its context

Rules on water exist in a number of forms ranging from informal local arrangements to administrative rights created by legislation. Contemporary criteria against which water rules are measured include whether mechanisms created are accountable, transparent and participatory, and whether they deal with water resources in an integrated manner and enable sustainable management of renewable water resources.
Formal water law is part of a country’s natural resources and environmental legislation. Surface and groundwater are dealt with in a single water law or in two or more pieces of legislation, including laws and regulations, sometimes in a piecemeal fashion. Recently a trend has developed to address both resources in one water law complemented by subsidiary legislation (orders, decrees, regulations and the like), whereas historically surface and groundwater have often been addressed by different laws and regulations, compromising an integrated approach and posing greater challenges with respect to coherence and consistency. In federal states the management of water resources may be fully or partly attributed to individual states resulting in a legal framework that is not uniform nationwide. This is the case for instance in Germany, India and the US. In India the federal government has tried to influence state legislation by circulating a model groundwater bill (“Model Bill to Regulate and Control the Development of Groundwater”, 1970, revised and re-circulated in 1992, 1996 and 2005) and over the last fifteen years a number of states have enacted legislation based on the model.

Box 2: Inter-state Agreements

Some federal states, notably Australia and the US, have concluded inter-state agreements for groundwater that spans their internal boundaries. Examples are the Interagency Agreement in the Matter of the Coordinated Management of the Pullman-Moscow Ground Water Aquifer (Idaho – Washington, 1992) and the Border Groundwater Agreement (South Australia – Victoria, 1985, updated in 2005). Other agreements, sometimes also called compacts, make reference to groundwater. Interstate agreements are part of the body of national legal instruments.

Provisions on groundwater management are also contained in legislation relating to land-use planning, public works, agricultural development, the environment and mining, health and sanitary issues, among others. Land law, i.e. the law that deals with the rights to use, alienate or exclude others from land, is an area with important implications for access to groundwater and its protection and the land-water interface needs to be carefully managed (see 4.5).

In addition to formal legislation customary law and local rules play an important role in groundwater management, in particular in the rural areas of developing countries (see 2.6). Reconciling the need for formal water rights with customary traditions is one of the key challenges in groundwater governance. Legal and administrative rules set at the state level often coincide with detailed sets of informal or customary rules that govern water use and transactions at the point of abstraction.

Among the different uses of water (human, agricultural, industrial, environmental) the right of humans (and sometimes domestic animals, particularly in Africa) to quench their thirst enjoys universal priority, often together with other basic domestic needs. This approach is in line with the human right to water (see United Nations, Committee on Economic, Social and Cultural Rights, General Comment No. 15 2003).

Box 3: The right to water
The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses (United Nations Committee on Economic, Social and Cultural Rights, General Comment No. 15). It has received further support when 122 countries formally recognized it in the General Assembly (Resolution (A/64/292)) in 2010.

2.2. Ownership and control

Historically as regards the use of groundwater specific rights were often conferred on the owner of the overlying land. Four doctrines have been widely applied in western or western-influenced systems: absolute ownership, reasonable use, correlative rights or prior appropriation (Caponera 2007, p. 128, Burchi and Nanni 2003, p. 227). In Islamic law there is no right of ownership on groundwater, which is considered to be a public good, but the ownership of a well entails ownership of a certain amount of adjacent land called *harim* or forbidden area. It varies in size according to different schools (Caponera 2007, p. 64). Customary regimes in many parts of the world view groundwater resources as belonging to the community and reject the concept of individual rights over water.

While rules granting strong private rights on landowners still exist in some parts of the world such as Texas ("rule of capture") or parts of India, there is worldwide a predominant trend to make access to the use of groundwater independent of the regime of the overlying land and to vest ownership of or control over all water resources in the state or to recognize the state’s superior right to the management of water resources (Burchi and Nanni 2003, p. 227). The state becomes the guardian or trustee of groundwater resources. This step changes the status of groundwater from a private to a public good. The former owner becomes a user who must apply for a permit to obtain a right to abstract water, i.e. there is a formal separation between the two concepts of “ownership” and “right to use”. This is the first step of introducing a system of formal water rights that allows the government to manage and protect groundwater resources in the interest of the public.

2.3. Formal water rights systems

The next sections will discuss the central elements of a formal water rights system. Worldwide there is a clear trend to try to formalize the water sector by introducing administrative water rights. Whereas such systems work well in Australia, Canada, Europe and the US, they often fail to deliver in countries where the water sector is less formalized or even predominantly informal as in Sub-Saharan Africa.

2.3.1. Regulating drilling and drillers

Borehole digging or drilling and well construction for exploration and exploitation tend to require prior notification, a permit or registration, for instance in countries as diverse as Kenya, the Northern Territory of Australia, Oman and the Philippines, to protect groundwater, to retain control of and information over access to it and to prevent conflict among users. Obligations to sample and to file
drilling reports ensure that drillers supply groundwater data to the administration (Nanni 2005, p. 51). Drilling fees may be imposed.

In view of the skills required, legislation may subject the exercise of the profession of commercial well digging or drilling to registration or licensing requirements to ensure that the person of the driller is appropriately qualified and that borehole construction standards are maintained (Burchi and D’Andreas 2003, pp. 208 – 215). In many cases, however, the drilling industry is not regulated and opportunities for getting away with poor constructions standards abound (GEF 2012, p. 34).

2.3.2. Protecting groundwater quantity

The central element of most current water laws is the tool of water rights as the standard approach to controlling demand. The granting and denial of water rights enables the water administration to allocate water to different uses ranging from domestic, agricultural and industrial uses to environmental ones such as sustaining wetlands and the baseflow of rivers. Permit-based systems have gained prominence in particular since more powerful pumps, population growth and economic development have driven demand for groundwater, often in excess of supply.

Under a system of water rights a permit has to be acquired by a user before (ground-)water can legally be abstracted. This obligation is incumbent upon whoever the user is, including state agencies such as those involved in the development of irrigation schemes. Small-scale or de minimis uses are typically exempt. Permits are typically granted for a renewable time period, which is short enough to provide the state flexibility in the resource management, on the one hand, and a stable basis for the user for planning and investment decisions, on the other hand. The length of this time period varies considerably and depends on local context, the purpose of abstraction and the state of the aquifer. Permits provide for annual or seasonal volumetric allocations or are based on an area quota. They also state the purpose for which the water may be used, water protection measures to be taken and the obligation to pay fees or charges, among other things (on fees and charges see 2.3.4). Permits require that use be made of the water right failing which the right will lapse. The metering of wells is often imposed in order to verify compliance with the conditions attached to a permit and to measure the amount of water abstracted. Where the transaction costs of metering would be too high, estimates are sometimes used. Permit holders have the obligation to report regularly (normally on an annual basis) how much water has been abstracted. Permits are usually recorded in a registry which serves as a tool for planning purposes.

In some instances, legislation determines the overall amount of permitted withdrawals per year. An example is the Edwards Aquifer Authority Act (Texas) which precludes the Edwards Aquifer Authority

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2 In this paper the terms permit, license, authorization etc. are used interchangeably.
3 Another mechanism to promote use of a water right was chosen by Chile. Under the 1981 Water Code a water right had to be issued against no payment once a person applied for it provided that water was available and that third parties did not suffer prejudice. The Code was amended by Law No. 20.017 of 11 May 2005, which, among other, introduced a tax for non-use (patente por no uso) to be paid by those holding a water right but not using the water. The tax rate increases depending on the length of time of non-use and on the place in which the water should have been used. In the case of non-payment, the water right is revoked. This aims at preventing powerful enterprises from hoarding water to reserve for future or, or to speculate on it in times of shortage through market mechanisms.
from authorizing withdrawals from the entire aquifer exceeding 572,000 acre-feet (approximately 705,550 cubic meters) of water annually (Edwards Aquifer Authority Act 1993). The Namibian Water Resources Management Act empowers the Namibian Water Minister to determine the safe yield of aquifers for the purpose of guiding determinations concerning the abstraction and use of water from the aquifer. “Safe yield” is defined as the amount of water which may be abstracted from an aquifer at a rate that will not reduce the supply to such an extent as would render such abstraction harmful to the aquifer, quality of the water or environment (Namibia, Water Resources Management Act No. 24 of 2004, section 51).

In some countries – Australia, Chile and the US – groundwater abstraction permits may be traded, subject to some form of prior involvement of the water administration to protect both private and public interests and to mitigate negative impacts of such trades (Solanes 1999, p. 88). Other countries, especially in South Asia, have informal water trading schemes. Administering a permit system is a costly, administratively challenging and time-consuming process – and one which has failed where its introduction was not well designed and tailored to the local context and administrative capacity. Due to considerations of cost and administrative convenience small-scale or de minimis uses, which are particularly important in developing countries, usually do not require a permit. Widely accepted de minimis uses include the use of water for drinking, watering domestic animals and poultry, recreational uses, such as bathing, meeting of basic household needs, the watering of garden plots and fire fighting (FAO forthcoming, p. 26). Defining de minimis uses is a tricky task that requires taking into account local circumstances (see 4.3).

Groundwater quantity is also influenced by artificial recharge which may be used as a tool for recovering water levels. Water legislation may provide for artificial recharge with surface water, stormwater or wastewater. In this case, the legislation will require that certain conditions as to the qualifications of the operators in the sector and to water quality are met. Operators will have to register with the water administration and the process will be subject to a permit (Nanni 2006, p. 50).

2.3.3. Protecting groundwater quality

Groundwater quality protection is the second main goal of legal frameworks for groundwater and the one that poses more intractable challenges than getting a handle on abstractions.

Groundwater pollution and degradation, which is sometimes irreversible, is caused by a plethora of activities and a much wider set of actors than groundwater abstractors. Drilling and pumping mobilize naturally occurring pollutants such as arsenic or fluoride or induce saline intrusion. For instance, in many small island states such as The Bahamas and Barbados salinization from overpumping of aquifers and thus salinity intrusion into the islands’ underlying freshwater lens is a matter of great concern (IPPC 2001, p. 861). All poor quality wastewater generated on the land surface will find a pathway into an aquifer.

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4 It should be noted that the use of cap and trade schemes to address environmental problems is on the rise. Climate change in particular is the prime example of a field in which States have decided to rely on the market to address an environmental problem.
The activities causing pollution are broadly grouped into two categories, each triggering distinct legal answers. Point sources of pollution relate to pollution whose entry point into an aquifer can be established with sufficient certainty such as landfills, waste dumps and the underground storage of substances. In contrast, non-point source pollution originates from diffuse or indistinct sources whose origins, entry point into groundwater and impact are difficult or impossible to determine with accuracy. The prime example is agricultural runoff but also stormwater runoff in urban areas plays a role.

Legislative provisions on the protection of groundwater from pollution tend to be scattered among a variety of legal texts, including general environmental protection legislation. Their goal is to prevent, abate and control pollution with a view to achieving public health, social, economic and increasingly environmental objectives such as minimizing harm to dependent ecosystems. A number of instruments are used to achieve these goals, including the setting of water quality targets in relation to various water uses, the classification of water bodies into categories, and reducing and regulating abstraction. Point-source pollution is addressed by absolute prohibitions or limitations on emitting certain substances and lists of substances may be established the introduction of which into groundwater is prohibited, limited, investigated or monitored. Polluting activities may be permitted subject to wastewater discharge permits, often subject to prior treatment requirements and compliance with effluent standards (Caponera 2007). For the members of the European Union (and for accession countries) the EU Water Framework Directive provides a particularly stringent system of groundwater quality protection.

Non-point source pollution measures include the regulation of land uses giving rise to diffuse discharge (see 4.5) and the imposition of best management practices. The identification of those who cause groundwater pollution may be problematic. The whole array of actors involved in land-use and pollution management, including urban water supply utility managers and agricultural and environmental agencies seeking to regulate the application of fertilizers (e.g. nitrates) and pesticides have to be involved in groundwater quality protection and addressed by legislation.

As an accompanying measure serious groundwater pollution can be treated as a criminal law offence which is punishable with higher penalties than mere civil or administrative offences. Due to the complexities of groundwater flow and the time lag between the occurrence of pollution and the moment its effects are felt, it is often technically difficult to prove liability for pollution (Caponera 2007).

Modern technologies allow using the subsurface for a range of newer activities which may contaminate groundwater. Among them are the storage of hazardous waste such as nuclear waste, nuclear testing, the injection of fluids for soluble mineral extraction, the storage and recovery of heat and hydrocarbons, carbon capture and sequestration (CCS), hydraulic fracturing (‘fracking’) and the injection of residual geothermal fluids (on the risks of shale gas drilling for groundwater, see EPA 2011). These activities require specialized laws and regulations which overall still need to catch up with technological developments.
2.3.4. Economic mechanisms and environmental law tools

Economic mechanisms and general environmental law principles and tools play an increasingly important role in regulating groundwater law.

Resource abstraction fees as a direct pricing mechanism make a contribution to groundwater governance by trying to influence demand. They are broadly related to the “user pays” principle. Charges may be calculated on the basis of a number of different criteria including the volume of water abstracted or the area in which it is used, the kind of use to which the water is put, the type of source from which the water is abstracted or the costs of their administration. Charges may increase progressively with the volume abstracted. Non-payment may lead to the suspension or even the loss of the right. It is common for payments in arrears to be liens on the property benefitting from a water right. It is also usual that debts be collected through the procedures applied for the collection of taxes in arrears (FAO forthcoming, p. 21). Where groundwater can be abstracted for free no incentive to reduce use is provided. For producers water becomes an input at zero cost despite the substantial costs of its use for society. Consequences are inefficient groundwater use, sometimes even further promoted by subsidized energy rates as in the case of agricultural water use in India or Malta (Garduño 2011, Malta Resources Authority 2004, p. 35).

Indirect pricing incentives such as increasing energy tariffs are other measures of demand management. The goal should be to devise a system of pricing that aligns the incentives for groundwater use with the goal of sustainability without harming poor small-scale users. Policy measures such as incentives to change production patterns and subsidies for efficient use such as irrigation systems may play a further role (GEF 2012, p. 29).

Charging for wastewater discharge permits incorporates the “polluter pays” principle and is used to create an economic incentive to protect groundwater resources from pollution.

Also other environmental tools play an increasingly prominent role in water legislation. These include environmental criteria for water permits, pollution prevention and abatement standards (see 2.3.3), environmental impact assessment requirements, the relative prioritization of water allocations for environmental purposes, groundwater exploitation controls for ensuring the viability of dependant ecosystems, protected areas, and general environmental perspectives in the water legislation (Eckstein 2010, p. 86).

The obligation to carry out environmental impact assessments is becoming a prerequisite for the granting of abstraction or discharge permits above a certain quantity of water or before allowing projects of industrial, agricultural or other type with potentially negative impact on aquifers. Provisions on environmental impact assessments can be found, for instance in the water legislation of a large number of countries among them as diverse jurisdictions as Cameroon, Mexico, Kenya and Paraguay (Eckstein 2010, p. 95). The allocation of water to an “environmental reserve” as in South Africa aims at promoting sustainable use of water resources and preserving dependent ecosystems such as wetlands. Finally, environmental objectives in legislation support the allocation of groundwater to groundwater dependent ecosystems and the baseflow of rivers.
2.4. Monitoring

Groundwater quantity and quality monitoring provides the basis for planning, allocation and conservation decisions.

Information from modeling and monitoring enables scientifically based management decisions to ensure that in case of aquifers under pressure water remains safe and water rights secure and not threatened by falling water tables putting water out of reach or deteriorating quality attributes. Once baseline data of the characteristics of an aquifer system is available regular monitoring of changes in flow, storage and water quality informs about the impact of abstraction and pollution activities. Together with inventories of wells (sometimes limited to certain locations or to wells showing specific characteristics) and registers of abstraction and wastewater discharge permits, the data made available through monitoring enables the water administration to recognize critical situations and to intervene accordingly. Monitoring also helps to establish liability, for instance for polluting incidents, although the concealed and inaccessible nature of groundwater and the slow changes in quantity and quality cause difficulties in practice.

The main piece of water legislation usually contains obligations to monitor groundwater use and status while detailed parameters are often contained in subsidiary legislation or technical guidelines. Legislation may (and should) also require groundwater-related institutions to coordinate data-gathering, interpretation and storing. Monitoring by the water administration is complemented by information provided by well owners on their abstractions. Monitoring aquifers is a technically demanding and costly exercise so that information about many aquifers is very incomplete. The costs for setting up a monitoring network, collecting data regularly, processing, interpreting and storing it in databases, including unified databases at the national level, are one of the reasons why in developing countries water rights and monitoring obligations, especially with respect to groundwater, remain unimplemented.

2.5. Planning

Although some degree of uncertainty is no impediment to planning, scientific research and the information gathered by data collection provide the basis for the preparation and periodic revision of water resources management plans which are required by legislation, for instance, in Morocco, South Africa, Uganda, South Australia and Texas and by the European Water Framework Directive (Hodgson 2006, p. 52). Water management plans may have a legally binding nature and are developed to promote rational, effective and fair water management and decision-making.

Depending on the hydrogeological setting, the degree of surface-groundwater linkage, the significance of the aquifer and the limitations of the legal and institutional framework in place different types of plans have proved to be useful. For significant aquifers or fossil aquifers management plans can be developed which can be complementary to integrated water resource planning at the national level. Alternatively, as all recharging aquifers occur within river basin management units, groundwater can be integrated into river basin planning, which, however, often faces a range of constraints and might be premature for some countries (Garduño 2006). An example
of the former option is the Groundwater Management Plan for the important Edwards Aquifer in Texas, which guides the activities of the Edwards Aquifer Authority.

Where the water legislation does not establish development and management priorities, such may be included in a management plan. In addition, management plans typically contain the characteristics of a river basin or aquifer, a review of the impact of human activity, objectives with respect to quantity and quality of the resource and measures to meet the objectives. In the case of non-renewable aquifers or of aquifers for which a policy choice in favour of mining has been made the plan may need to address depletion. Typically a range of stakeholders is involved in plan preparation and revision (see 4.6). Participation in planning processes under the EU Water Framework Directive is a case in point: Under Art. 14 of the EU Water Framework Directive Member States shall encourage the active involvement of all interested parties in the implementation of the EU Water Framework Directive and in particular in the production, review and updating of river basin management plans which are mandatory for all basins under the directive. Where groundwater does not follow a particular river basin it is assigned to the nearest or most appropriate river basin (Article 3 EU Water Framework Directive).

2.6. Customary and community-based approaches

In many jurisdictions formal law does not exist or, particularly in Africa, the formal law may recognize specified areas as being subject to customary rules. Customary law or informal arrangements may also be the de facto dominant legal paradigm despite formal law being in place. The latter may be rejected or simply not be implemented and thereby replaced by other rules. The relationship between customary and formal law invariably tends to be complicated and unclear.

Customary water law practices and rights and informal arrangements hold sway in much of the rural areas of the developing world. They govern the use of water by large proportions, if not the majority of the world’s citizen’s (van Koppen et al. 2007, p. 2). Community-based water law is often but not necessarily local. It may cross even international boundaries as the example of pastoralists in sub-Saharan Africa shows whose water use agreements with each other and settled farmers cover large areas.

Customary water law regimes are often complicated. Water tenure may form part of a broader customary legal framework that regulates access to other natural resources such as land and forest. Different customary law regimes or customary rules may only apply within particular societies or groups such as pastoralists. Within a national context a range of diverse and heterogeneous customary rules may exist and conflict may arise between users of water under different customary tenure arrangements (e.g. between pastoralists and settled farmers). Also, the extent of water resources may exceed the territorial application of local rules (FAO forthcoming, p. 29). Groups or communities rather than individual users have rights. All these factors pose challenges when attempts are made to align customary and formal law. As most customary uses are also de minimis uses the challenges posed by the latter also apply to most customary uses (see 4.3).

Many countries have attempted to replace customary and community-based rules with a formal administrative rights based permit system, often with only limited success. Research has shown that
the extent to which water policy, law and administration are able to bring into their ambit all or most water transactions depends on the degree of formalization of the water economy which is in turn determined by the overall development of the national economy (Shah 2007, p. 65). In developing countries the water sector is predominantly informal and although water legislation may exist it is often implemented only in urban areas and rapidly industrializing regions. In such contexts customary, local and informal approaches dominate.

The penetration of the state to the local level varies around the world. In places like China there is substantially more connection between local and national political bodies than elsewhere (van Koppen et al. 2007, p. 6). In sub-Saharan Africa traditional tribal authorities command land, water and other natural resources and exist often side by side with the elected local government (van Koppen et al. 2007, p. 6). Research on India has revealed that most users rely on self-provision of water (through private wells, streams, ponds), on local, informal exchange institutions and on community-managed water sources (Shah 2007, p. 65). In many contexts attempts to enforce a modern permit-based water law may thus prove very difficult and not the most suitable way forward. Alternative as well as supplementary approaches might have to be considered (see 4.4 and 4.6).

2.7. Institutional aspects

Institutional set-ups to manage aquifers and to administer water rights vary highly across countries. In most countries a plethora of multi-level water resources administration institutions tends to exist. A systematic discussion of such institutions according to their powers, functions, uses, territorial level of jurisdiction or legal regime is beyond the scope of this thematic paper. As intensive development of groundwater is recent, institutional responses tend to lag behind the tasks created by new legislation. Traditionally, geological surveys or agencies have informed water resource and environmental regulators. Only a few countries have attempted to set up dedicated groundwater management agencies such as India with the Central Groundwater Authority and the Central Groundwater Board (Garduño 2011). In federal countries federal, state and local institutions may be vested with functions and powers in respect of groundwater institutions.

The highest and ultimate responsibility for water management is often conferred upon one or more ministers, usually acting through a statutory Director or Director-General of water resources, such as the Department of Water Affairs and Forestry in South Africa, or some other statutory body such as an authority (e.g., the Jamaica Water Authority) or agency (e.g., the Environment Agency in England) or Directorate of Waters (e.g., the Dirección General de Aguas in Chile) (Hodgson 2006, p. 39). Ideally, the entire range of groundwater management issues would be placed in the hands of a single water resources institution, which would also be in charge of surface water (Nanni et al 2006, p. 52). This is, however, the exception rather than the rule. An interministerial/interagency mechanism such as a council, commission or committee usually has the task of coordinating those ministries and agencies that also have a stake in aquifer management (Nanni et al 2006, p. 52).

5 For such an analysis of national water resources administration institutions see Caponera 2007, p. 171.
There is an increasing trend to complement the water resources institution which bears overall responsibility throughout the jurisdiction with coordinating/decision-making institutions at the drainage basin level. Groundwater management is either included in the scope of institutions set up at the river basin, even where aquifer boundaries do not follow the boundaries of the river basin or, still more rarely, a mechanism is set up specifically at the aquifer level.

The main tasks of a water authority comprise planning and modeling future demands and impacts on water resources, organizing stakeholder fora, monitoring of water quality and quantity, issuing and administrating water rights, including the maintenance of registers, and implementing and enforcing the water law and water rights regimes, e.g. by meting out administrative fines in cases of non-respect for legal obligations or the terms and conditions of a permit (FAO forthcoming, p. 43, Hodgson 2006, p. 43). Water authorities often fall short of delivery on these tasks due to institutional weaknesses, lack of empowerment, gaps in mandate and a number of other factors. For instance, the countries of the former Soviet Union only gradually introduce resources monitoring reflecting the principles enshrined in the EU Water Framework Directive. Institutional deficits inevitably result in implementation deficits which erode the contribution a legal framework can make to aquifer governance (see 4.7).

In federal countries large aquifers spanning several states may call for inter-state institutional mechanisms. This is the case of the Great Artesian Basin (GAB) shared by Queensland, New South Wales, South Australia and the Northern Territory, one of the largest basins in the world covering 22 percent of Australia, for which the Great Artesian Basin (GAB) Consultative Council has been established (Caponera 2007, 98).

3. International legal and institutional frameworks for transboundary aquifers

3.1. Agreements for specific transboundary aquifers

Only five agreements have been concluded for specific transboundary aquifers (Mechlem 2011). These are the Genevese Aquifer, the Nubian Sandstone Aquifer, the North Western Sahara Aquifer, the Iullemeden Aquifer and the Guaraní Aquifer. In other international treaties groundwater is addressed among other issues or as a side aspect of surface water management.

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6 For instance Art. 3 of the EU Water Framework Directive requires that where groundwaters do not fully follow a particular river basin, they shall be identified and assigned to the nearest or most appropriate river basin district.

7 See also Article VI(2) of the UN ECE Groundwater Management Charter which states that “the territorial competence of [water authorities or co-coordinating bodies] with respect to groundwater management should not necessarily be limited to . . . catchment areas, but should allow for encompassing, as appropriate, management of aquifers in their entirety.”
In 1977 the first aquifer specific agreement was concluded between two local authorities, the Franco-Swiss Arrangement on the Genevese Aquifer. It covers a relatively small local aquifer of only 19 km in length and 1–3 km in width whose characteristics were well known compared with what is known about most other transboundary systems, especially in developing countries (Walter forthcoming). The Arrangement was concluded to address a clearly defined problem, namely over-pumping resulting in falling water tables. Under the Arrangement the Swiss constructed and have operated an artificial recharge installation. Both parties agreed to share the costs of construction and operation. A management commission was created that proposes yearly aquifer utilization programmes to ensure that abstraction is matched by sufficient artificial recharge. The French were allowed to abstract up to 5 million m³ per year of which 2 million m³ are free of charge. This is the only specific allocation clause in any of the few aquifer agreements. The Arrangement is devoid of any abstract principles and of a highly technical nature. In 2008, when it expired, it was replaced by a Convention. The agreement on the Genevese Aquifer was an exception at the time and its successor convention has remained so in many respects. They stand out because of the level of detail they provide, the degree of joint management of the shared aquifer, the active commission and the tangible impact they have had on the sound management of the aquifer.

In 1992, a joint authority for the study and development of the Nubian Sandstone Aquifer System was created to enhance cooperation in managing the aquifer system’s water resources. In 2000, the Nubian Sandstone Aquifer System States concluded two further short and limited agreements. The first is on monitoring and exchange of groundwater information. It foresees the sharing of data consolidated during an international externally funded programme for a regional strategy on the aquifer and included in an information system, the Nubian Aquifer Regional Information System (NARIS). The second agreement is on monitoring and data sharing. It establishes obligations of continuous monitoring of the aquifer and sets out detailed parameters of the aquifer to be monitored, including yearly extractions, number of wells, electrical conductivity measurements and water levels. Together the three agreements provide a legal framework for data and information exchange as a step towards sustainable management of the Nubian Sandstone Aquifer System.

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9 This limitation of the French use is balanced by the fact the installation is owned by the Swiss and that the Swiss are responsible for its construction and operation (Wohlwend 2002).
Cooperation efforts are also ongoing with respect to the North-Western Sahara Aquifer System, better known by its French acronym SASS, which is shared by Algeria, Libya and Tunisia and extends across more than 1,000,000 km². A short and bare-bones agreement established a technical consultation structure at the end of 2002, which became a standing consultation mechanism in 2007 hosted by the Observatoire du Sahara et du Sahel in Tunis (Reprinted in Burchi and Mechlem (eds.) 2005, p. 6). Its objective is to coordinate, promote and facilitate the rational management of the SASS aquifers water resources. Its main functions are to manage a hydrogeological database and simulation model, to develop a reference observation network, to process, analyse and validate data and information about the aquifer and its use, and develop indicators on the aquifer and its use. Like the Nubian Sandstone Aquifer agreements the SASS agreement is silent on general principles and reflects a rather cautious and reserved approach to cooperation. In contrast to the Nubian Aquifer Sandstone System case effective cooperation has been initiated with respect to the joint data base and joint model.

In 2009 the three states sharing principally the Iullemeden Aquifer System, which covers 500,000 km², Niger, Nigeria and Mali, signed a Memorandum of Understanding relating to the Setting up of a Consultative Mechanism (on file with author, not yet in force). Its objective is to promote integrated management of the aquifer, cooperation and joint identification and management of risks as well as sustainable development. Among the 14 functions of the consultative mechanism are to provide opinions on policies and projects, to coordinate programmes, to make recommendations to harmonize legislation and to settle disputes. The parties also commit to take into consideration a range of general principles relating to equitable and reasonable utilization, public participation, non-detrimental use, precautionary measures, the polluter pays and the user pays principles. A chapter on general obligations emphasizes sustainability and protection of the aquifer. A chapter on planned measures sets out procedural obligations, including obligations to exchange data and information, and a detailed notification procedure. Finally provision is made for dispute settlement. The Iullemeden Memorandum of Understanding is the first comprehensive treaty for the management of a transboundary aquifer. It is very different in nature to the much more limited commitments made for the Nubian Sandstone Aquifer System and the SASS and the technical approach to the Genovesa Aquifer and provides a basis for the joint management of the risks to which the shared aquifer is exposed.

Finally, in 2010 the Guaraní Aquifer System, with 1,200,000 km² one of the world’s largest aquifer systems, located beneath Argentina, Brazil, Uruguay and Paraguay became the fifth aquifer for which an agreement was concluded, the Agreement on the Guaraní Aquifer (del Castillo Laborde forthcoming, Sindicó 2011). It is a framework agreement that emphasizes strongly the sovereignty of the states involved over their respective portions of the aquifer (on the issue of sovereignty see 5.1) and only subsequently mentions rational and sustainable use, the obligation not to cause significant harm, conservation and protection. It contains useful clauses on notification and exchange of technical information, cooperation, the identification of critical areas and dispute resolution. A commission is to be established under the La Plata River Treaty to coordinate cooperation. The

Guaraní Aquifer Agreement is the first agreement that refers explicitly to the ILC Draft Articles on Transboundary Aquifers in its preamble (see 3.4). Its impact in practice will depend to a large extent on the role its commission will assume.

3.2. Groundwater in bi- and multilateral surface water treaties

Bilateral treaties that specifically address groundwater among other subject matters include the 1973 Agreement on a Permanent and Definitive Solution to the Salinity of the Colorado River (known as Minute No. 242), which limits groundwater pumping by both Mexico and the United States close to the Arizona–Sonora boundary near San Luis. Other examples are the 1994 Israel–Jordan Peace Treaty and the 1995 Israeli–Palestinian Interim Agreement. The conventions on the Carpathians, the Danube, the Rhine and Lake Tanganyika as well as the Agreements on the Sava River Basin and on the Incomati and Maputo, and the Protocol for the Lake Victoria Basin, inter alia, apply to surface as well as groundwater. The mentioned treaties are generally based upon the areal limits of surface water management, primarily the river basin. The substantive provisions often reflect only negligible concern with groundwater. In other cases even the application of a treaty to groundwater remains open to interpretation, for instance, if a treaty refers to the “water resources” of a particular basin without defining any further its scope.

3.3. The regional level, especially the case of Europe

In Africa, the 2000 Revised SADC Revised Protocol on Shared Watercourses applies to groundwater associated to watercourses but suffers from the same shortcoming with respect to groundwater as the United Nations Convention on the Non-navigational Uses of International Watercourses (UN

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14 International Boundary and Water Commission United States and Mexico, Minute No. 242 of 30 August 1973, Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River, 12 I.L.M. 1105 (1973) (Minute No. 242).
Watercourses Convention, see 3.4) on which it was modeled.\textsuperscript{18} Also the African Convention on the Conservation of Nature and Natural Resources contains provisions on groundwater.\textsuperscript{19}

The most advanced legal regime with respect to groundwater resources, transboundary and also domestic, exists in Europe. An earlier non-binding instrument is the 1989 UNECE Charter on Groundwater Management.\textsuperscript{20} The 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE Water Convention, “Helsinki Convention”) covers, in contrast to the UN Watercourses Convention, all types of transboundary groundwater (1936 UNTS 269). The parties have an obligation to prevent, control and reduce transboundary impact and to take additional specific measures to prevent the pollution of groundwater. Furthermore, the Convention states that water-quality objectives and criteria shall take into account specific requirements regarding sensitive and specially protected waters and their environment such as groundwater resources. In 1999 the Protocol on Water and Health to the UNECE Water Convention was adopted to ensure the adequate supply of safe drinking water and adequate sanitation (2331 UNTS 202). It obliges parties, inter alia, to develop water-management plans on the basis of aquifers to promote the achievement of water quality targets and the protection of public health. It applies to transboundary and, remarkably, also to domestic groundwater resources. Starting from this legal basis currently model provisions on transboundary groundwater are being developed by the UNECE to enhance the organization’s work these resources. In 2000, the UN ECE also developed detailed Groundwater Monitoring Guidelines (UNECE Task Force on Monitoring and Assessment 2000).

For the members of the European Union (and candidate countries) the Water Framework Directive provides for a detailed, encompassing and ambitious regime of quantity and quality protection of all waters—rivers, lakes, coastal waters, and groundwater, domestic and transboundary—and sets the parameters for the water policy of each Member State.\textsuperscript{21}

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**Box 4 EU Directives**

EU directives are supranational law which is unique in nature. Supranational law is neither international law, which is binding only between and among states, nor domestic law. EU directives are developed in legislative processes at the EU level but then have to be transposed into domestic law, i.e. the content of EU directives becomes part of the domestic legal system. In case members states fail to transpose EU directives the European Commission can initiate an infringement procedure before the European Court of Justice which may impose financial penalties. Under certain circumstances, EU directives may also be directly effective in member states’ national legal orders.

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\textsuperscript{19} http://faolex.fao.org/.

\textsuperscript{20} Charter on Groundwater Management, adopted by the UN ECE at its forty-fourth session (1989) by Decision E (44), UN Doc. E/ECE/1197 ECE/ENVWA/12 [hereinafter Groundwater Management Charter].

The Water Framework Directive is based on the concept of integrated management of the water resources of a river basin. It provides for the recovery of costs, including environmental and resources costs, for water services in accordance with the polluter pays principle, and for public participation in water management. All waters in the European Union have to achieve ‘good status’ by 2015. ‘Good groundwater status’ is defined in terms of both quantity and chemical status. With regard to groundwater, the Water Framework Directive aims particularly to reduce significantly the pollution of groundwater. Member States have to prevent or limit the input of pollutants into groundwater, to prevent the deterioration of the status of all bodies of groundwater; and to protect, enhance, and restore groundwater. Direct discharges of all pollutants into groundwater are prohibited (to be made operational by 2012). To cover indirect discharges they have to monitor groundwater bodies so as to detect changes in chemical composition and to reverse any significant and sustained upward trend in the concentration of pollutants. With regard to quantity, Members have to ensure a balance between abstraction and recharge. They have to control and authorize all water abstractions as well as the artificial recharge or augmentation of groundwater bodies.

Currently the second main instrument on groundwater is a groundwater directive which is to be repealed in 2013.\[22] It prohibits the direct discharge of certain toxic, persistent, and bioaccumulative substances such as mercury or cadmium into groundwater and makes indirect discharges subject to prior authorization. The discharge of a number of other substances has also to be limited and be made subject to prior authorization. The current groundwater directive will be replaced fully by the Water Framework Directive and a daughter directive of the Water Framework Directive on groundwater quality.\[23] The latter provides for criteria for the assessment of groundwater quality, for the identification and reversal of significant and sustained upward trends, and for the definition of starting points for trend reversals. It also complements the Water Framework Directive provisions on preventing or limiting inputs of pollutants into groundwater and aims to prevent the deterioration of all bodies of groundwater. The protection of groundwater has become a key concern and target in the EC context. The Water Framework Directive and its daughter directive provide the most advanced legal regime for domestic and transboundary groundwater resources. They have initiated an important process of improving the status of water resources within the EU. When assessing the success of the Water Framework Directive and evaluating the extent to which it can provide guidance to other regions, the unique legal nature of the EU, including its implementation and sanctions system, must be fully appreciated. It should also be noted that while the environmental protection is now a self-standing goal of the EU, EU environmental law was initially based on economic considerations, namely on the idea of promoting comparable production conditions in the internal market by posing the same environmental obligations on each member.


3.4. The global level and the Draft Articles on the Law of Transboundary Aquifers

A binding legal instrument at the global level on shared groundwater resources is still outstanding. The most authoritative treaty on international water law, the 1997 United Nations Watercourses Convention (not yet in force), formally applies to most shared aquifers but its provisions exclude certain types of aquifers, most importantly non-recharging aquifers (Mechlem 2003, pp. 54 -57; Eckstein 2005). In addition, its substantive provisions are exclusively geared towards surface water and completely ignore the specific management challenges posed by groundwater (Mechlem 2003, pp. 57 -62).

Box 4 The International Law Commission

The International Law Commission is the body of the United Nations system mandated to codify and progressively develop international law. It is composed of 34 independent experts in international law. The International Law Commission has authored a number of documents central to international law today, a number of which have become international treaties.

Between 2002 and 2008 the International Law Commission developed a set of 19 draft articles on the law of transboundary aquifers. The Draft Articles apply the general principles of international surface water law – equitable utilization, no significant harm and cooperation – to transboundary aquifers. They develop the content of these principles with respect to transboundary aquifers and add new (and partly controversial) issues like sovereignty. They also deal with protection, preservation and management, and procedural issues (Mechlem, 2009 Stephan 2011). The United Nations General Assembly took note of the draft articles and encouraged States to make appropriate bilateral and regional aquifer arrangements taking them into account. Their final form, i.e., whether to take them as a basis of a convention on transboundary aquifers, will be discussed in 2013.

Although of a non-binding nature the draft articles are the most authoritative statement on the law of shared groundwater resources.

Supplementary, sometimes detailed, guidance at the global level is provided by further non-binding instruments both of an official nature and developed by experts, starting with the 1977 Mar del Plata Action Plan that focused primarily on the utilization of aquifers and on increasing aquifer-related

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28 Their content is binding to the extent that it reflects customary international law.
knowledge.\textsuperscript{29} Fifteen years later, in 1992 the Dublin Statement and Chapter 18 of Agenda 21, in response to increasing water problems, emphasized sustainable use, integrated water resources management, and the protection of water resources and ecosystems.\textsuperscript{30} This focus has been maintained in the 2002 Johannesburg Plan of Implementation.\textsuperscript{31} The Conference of the Contracting Parties to the Convention on Wetlands of International Importance Especially as Waterfowl Habitat adopted in Resolution VIII.40 Guidelines for Rendering the Use of Groundwater Compatible with the Conservation of Wetlands.\textsuperscript{32}


A range of other international treaties has implications for aquifer governance, e.g., the United Nations Convention to Combat Desertification and the United Nations climate change regime. Under the latter carbon dioxide capture and storage in geological formations can be a project activity under the Clean Development Mechanism, one of the flexibility mechanism allowed in Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change.\textsuperscript{34}

\textbf{Part 2 Diagnostic}

\textbf{4. Constraints and opportunities at the national level}

Part I provided a snapshot of common approaches to regulating access and management of domestic groundwater resources and of legal initiatives taken with respect to transboundary aquifers. The experience of many countries shows that legislative frameworks for water often have less impact

\textsuperscript{31} Resolution VIII.40 Guidelines for Rendering the Use of Groundwater Compatible with the Conservation of Wetlands adopted at the 8th Meeting of the Conference of the Contracting Parties, 18–26 November 2002.
than desired on the de facto use and abuse of groundwater resources. Indeed, in many countries the potential of legislation to shape the governance of aquifers with a view to better use and protection of groundwater resources remains untapped due to a number of reasons. This section will discuss some of these reasons and suggest a number of challenges that have to be addressed if water legislation is to make a more meaningful contribution to improving groundwater governance.

4.1. Groundwater as a public good

Despite the trend to vest groundwater in the state groundwater continues to be perceived as an intensely “private” good in important countries. For instance, in Texas, the Indian state of Gujarat or the Pakistani Punjab the rule of capture is still dominant, allowing landowners to extract groundwater freely on their land (Burchi and Nanni 2003, p. 227). As a result, regulation of access to and extraction of groundwater in the interest of the public is very weak in those countries.

More importantly, even where groundwater is formally a public good and users have only usufructuary rights, perceptions of it being “private” often linger on. They interfere with compliance with government regulation or generate transition problems from an unregulated to a regulated regime. The legal notion or the perception of groundwater being private property can be a strong driver for overexploitation. In order to ensure socially more equitable access to groundwater and sustainable management the link between land ownership and control over groundwater should be severed. To achieve changes of perception requires, however, legal as much as educational and awareness raising measures.

In some instances, changing the status of groundwater from a private to a public good has been challenged in courts of law on grounds of expropriation of constitutionally protected private property rights and compensation has been claimed. Such claims have usually been rejected on grounds that regulating groundwater abstraction arises from the need to safeguard the public interest (Burchi and Nanni 2003, p. 227).

4.2. Appropriate and coherent legal frameworks

In many jurisdictions groundwater is still regulated inadequately: the water legislation does not apply to groundwater, or does not address it in a technically and comprehensive manner, or is outdated, or contains gaps and inconsistencies.

A recent review of the water legislation of SADC member states revealed that almost all possess some form of water law but that many of these laws make no specific reference to groundwater (Vidal 2010). In addition, inconsistencies between surface and groundwater law or between water, land and environmental law may undermine the effectiveness of legislation. For instance, if for surface water abstraction a permit is required but not for groundwater abstraction perverse

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35 See also the recent (24 February 2012) Edwards Aquifer Authority v. Day Case ruling of the Texas Supreme Court.
incentives are created, i.e. the unintended consequence is that users will favour groundwater abstraction over surface water abstraction to avoid administrative hassle and fees.

In many situations introducing a new comprehensive law dealing with all water resources of a country in one piece, enshrining principles of integrated water management and creating secure water rights might seem like an attractive course of action to address such shortcomings. Introducing an implementable system of water rights, where such does not yet exist, yields a number of benefits provided that it is well tailored to the specific local context. It allows managing water resources in a planned way that takes account of the needs of different sectors and the environment, recognizes the economic value of water, supports or entrenches wider economic reforms, promotes social goals and helps to ease pressure on aquifers (Hodgson 2006, p. 21). It also allows subjecting all water resources to a single regime in terms of both legislation and institutional arrangements for the implementation of such legislation, which is one element of an integrated water resources management approach.

**Box 6 Integrated Water Resources Management (IWRM)**

IWRM is a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Global Water Partnership).

To introduce a system of formal water rights is, however, a complex task that may take years and is usually part of a more substantive water sector reform. It may fail if is not well designed, implemented and embedded in wider cross-sectoral policies or if it is not politically viable. In some contexts other approaches such as incorporating customary rules or relying more on community management than on permits alone stand higher chances of being successful.

**Box 7 Malta**

From the early 1980s an agrarian boom prompted by advances in drilling technology and sustained by EU-accession land-based subsidies resulted in deep boreholes unsustainably exploiting the sea-level aquifer and causing high-levels of pollution. Despite strong pressures on the resource and EU Water Framework Directive obligations to achieve “good groundwater” status, attempts to introduce modern groundwater legislation within the framework of a larger water policy reform failed due to lack of interest on behalf of the government and the public as well as other political priorities (FAO 2006).

Introducing a system of modern water rights requires careful managing of the transition process, involving stakeholders in designing the new regime and dealing with *de minimis* uses, customary rights and practices (see 4.3 and 4.4) and existing rights. Rights are typically granted to existing users on the basis of their declared historical use before new rights are allocated, whereas *de minimis* uses,
defined according to local conditions, are exempt from permit requirements (Hodgson 2006, p. 98). Where existing uses are restricted issues of compensation may arise and be dealt with in legislation such as in Art. 22 (6) of the South African Water Act. In legislative reform processes it may also be necessary to introduce amnesties on illegal boreholes in order to shed light on abstractions and to set the basis for acceptable solutions.

Staged approaches with respect to planning or the issuance of water rights for particularly stressed aquifers are an option provided that concerns over unequal treatment of different users can be addressed. Success depends both on the degree of acceptance of the new system and on the security of the rights provided; the latter in turn depends on the extent to which the law is implemented. To maintain or improve the quality of groundwater is usually a bigger challenge than getting a handle on quantity because a larger and more diverse group of actors is involved which has to be addressed by legal rules in primary and subsidiary water and related legislation.

In many situations it might be preferable for the sake of swift action to improve the implementation of existing legislation or to strengthen the capacity of existing institutions, e.g. by broadening their mandate and providing more staff, before embarking on lengthy new legislative projects.

4.3. De minimis abstractions

The degree of complexity of water legislation and in particular of a permit system must be commensurate with the available institutional, planning and administrative capacity. It must be carefully thought through where groundwater regulation should start and which uses should be excluded from permit requirements. For administrative convenience and cost it is standard practice to exclude small-scale users from permit requirements. Such de minimis uses can be defined with regard to volumes, or area, purpose and need to take into account local conditions. While for instance in the Murray–Darling basin small users are allowed to extract water for domestic or livestock needs, or for irrigating small plots of 2 ha or less, without a permit, the same rule would exempt over 95% of current groundwater irrigators if applied in South Asia or on the North China plains (Shah 2003, p. 135).

Exempting de minimis uses spares users the trouble and costs of obtaining a permit and the administration the burden of administrating them. The accumulated effects of such unregulated small-scale uses can generate significant negative environmental impacts where water demand outstrips supply. These can be felt both on groundwater through dropping water tables, eventual depletion, migration of low quality water or salinization in coastal areas and on springs, seepage zones and the baseflow of rivers. In terms of water tenure users face the disadvantage that even where de minimis use is described in terms of a right to abstract water and use it for specific purposes it will be very difficult to assert an un-quantified right against the state or other users, i.e. individual de minimis rights lack security and often also equitable mechanisms for allocation even where de minimis uses as a category are legally protected (FAO forthcoming, pp. 27 and 29; van Koppen 2007, p. 56). It has been stated that they are rights only for as long as there is water available.

Beyond recognizing de minimis rights as legal, the protection of the significant social and public health benefits derived from small-scale uses requires effective aquifer protection measures to prevent de minimis sources from running dry or becoming unfit for use. As information about de minimis abstraction is scarce requiring well drilling to take place only on the basis of a permit provides at least information about the location of wells. A reporting regime whereby users are required to periodically provide details of their abstraction and use of groundwater also helps to keep the scope of de minimis uses under review (FAO forthcoming, p. 29). Community management approaches may provide further options for groundwater allocation and protection for de minimis uses (see 4.6).

4.4. Customary rights

In many parts of the world customary or local water rules function very well and are perceived as the legitimate rules in place that effectively guide the way individuals use groundwater.

Although customary rules tend to be robust and dynamic they may on their own not be sufficient to achieve higher standards of welfare or to cope with growing pressures on water resources induced by technical innovation, socio-economic drivers or environmental changes (van Koppen et al. 2007, p. 6). Large investments or planning purposes require the increased legal security offered by formal rights. And, the livelihoods of existing users may have to be protected against new uses and users by formalizing their rights. Customary law may also not be fair or non-discriminatory, particularly as far as women and non-dominant religious or ethnic groups are concerned. It entrenches gender, age, ethnicity and class differences and frequently reflects unequal power relationships in local communities.

In many instances water reform processes have therefore attempted to replace customary rules with permit-based systems, often creating conflict between the two. Reforms that ignore or even erode community-based water law risk disenfranchising rights holders and dispossessing them of their customary water rights (van Koppen 2007, p. 46). The introduction of permits that stipulate individual use rights to a resource that may be perceived as a common property resource that is to be shared may pose particular challenges. In most African customary water laws, water is considered as a community property and private ownership of such water is not recognized even though some shallow wells may be considered private (Meinzen-Dick and Nkonya, 2007, p. 17). In contrast, private water rights are widely observed for groundwater in Asia. Problematic are also transition provisions such as time limits within which existing customary rights may be registered as formal rights. They do not achieve their purpose if the holders of customary rights are not properly informed of the new legal requirements or if the time provided is too short as in the case of Ghana where twelve months were granted. This period was so short that many users in rural areas did not even become aware of the new legislation and therefore officially lost their customary rights (Sarpong 2004). Among the harshest criticisms is that water rights permits destroy social capital, create a tragedy of the commons and favour the administration-proficient at the expense of all others, most of all poor women (van Koppen et al. 2007, p. 8). Viewed together with the weakness of the administration in

37 Increasingly customary rights are also threatened by foreign agri-business investments based on concession agreements backed by foreign investment treaties (FAO forthcoming, p. 30 and 48).
many countries and the high costs involved in implementing a permit system for high numbers of groundwater users, this criticism raises important concerns.

It is a key question how customary water uses can be incorporated within a formal water management framework in a way that respects and protects existing rights, avoids disenfranchising customary rights holders and takes into account existing perceptions, values and structures but also enables groundwater management decisions beyond the local level and requires permits for certain types of uses. Many open questions remain how the interface of community-based water law and public intervention could be designed so that more appropriate and effective legislative measures can build upon communities’ strengths, while overcoming their weaknesses.38

4.5. The land-water interface

Whereas water resources are typically under state ownership or control, the right of private land ownership is a key feature in many jurisdictions. While historically water rights were essentially a subsidiary component of land tenure rights, with the introduction of administrative water rights regimes few formal links remain between land tenure and water rights regimes, except in a few jurisdictions and where customary rights prevail (Hodgson 2004). In much of Africa and Asia customary water rights are intrinsically linked to land and embedded in land tenure (Meinzen-Dick and Nkonya 2007, p. 17).

Groundwater quantity and quality protection are affected by land management. Natural groundwater recharge processes have to be protected from land-based interference and land management offers scope to regulate recharge to improve groundwater quality and quantity. Also the problem of land-based diffuse pollution underscores the importance of looking at the land-water interface when regulating groundwater. It is increasingly important to both develop and coordinate land use plans, in both urban and rural areas, with river basin or aquifer development plans.

A number of legal measures have been used to ensure that land uses do not adversely affect groundwater. Among them are: prohibition or limitation of certain polluting activities; limitations of the use of fertilizers and pesticides as diffuse sources of pollution; prohibition or limitation of certain water-using activities; restrictions of certain cropping patterns; reduction of animal-grazing intensity; land reclamation and drainage (Nanni et al. 2006, p. 51).

Special zoning mechanisms have become a major feature of recent legal regimes. Land surface zoning is often applied to recharge areas. It is also used for other critical areas of high vulnerability where prohibitions or restrictions to groundwater abstraction or to activities with adverse impact on groundwater, such as industrial chemical handling or effluent discharge to the ground, mining, or certain agricultural land use practices, are introduced. The protection of drinking water sources is a particularly important case in point: the capture zones of the main areas of potable water-supply abstraction require to be designated as protected areas. Zones may also be established in discharge areas, for instance to protect wetlands.

38 See for a discussion of these issues and further references van Koppen, Giordano and Butterworth (eds.) 2007.
Successful zoning depends on sufficient knowledge about the characteristics of the aquifer, on land-use planning processes that take groundwater issues appropriately into account and on a set of accompanying measures that support the restrictions brought about by zoning. E.g., if a “critical area” is defined where water well drilling would be banned to prevent land subsidence, possibly combined with powers to seal water wells in areas with mains water-supply coverage, this should be combined with economic measures such as charging for groundwater abstraction according to metered (or estimated) abstraction for the remaining wells. Such measures have, for instance, successfully been taken in the Greater Bangkok Area to control urban private abstraction since the mid-1980s. They have resulted in reversing a trend of groundwater resource decline and environmental degradation (Buapeng & S. Foster 2008).

4.6. Stakeholder participation and (ground-)water user groups

Stakeholder participation involving a wide range of stakeholders in processes leading to new legislation or planning or in day-to-day aquifer management, can contribute significantly to effective governance outcomes. It can take the form of user self-organization with a view to managing groundwater resources at the local level.

Participation has shown to yield a number of benefits ranging from more informed decisions to outcomes that are better complied with, to mobilizing self-regulatory capacity, where appropriate (Hodgson 2006, p. 32; Garduño, van Steenbergen and Foster 2010, p. 2). It raises public awareness, familiarizes with the reform, planning effort or administrative task, increases the information available to governments and, ideally, helps to generate general social consensus that fosters respect for the law and facilitates implementation through user cooperation, even in case of unpopular decisions which result in some stakeholders losing benefits (Hodgson, 2006, pp. 31-35, also providing examples from South Africa and Kyrgyzstan). It is particularly important in situations where the sheer number of groundwater users makes monitoring and enforcing groundwater rights cumbersome.

Legislation has to set out where participation will take place, how representatives are chosen and what roles they play and make sure that all stakeholders are properly represented, which may be a challenge with respect to disadvantaged groups and non-articulate small-scale users. NGOs have a potentially important role to play here and may help to keep participatory approaches alive beyond the time of externally funded pilot projects, which may be an issue (FAO forthcoming, pp. 29 and 44).

In many instances the scale of groundwater issues may be quite small and local solutions be the most appropriate given the localized nature of groundwater access and use. In such circumstances local level groundwater management by self-organized user groups may be a promising and appropriate approach. For instance, the Expert Group on Ground Water Management and Ownership of the Indian National Planning Commission suggested a shift in focus from state control to community management by user groups because of difficulties of implementing a permit-based system. It recommended that user groups be responsible for planning the use of groundwater within groundwater management units and based on the goal of sustainable-yield management meaning that withdrawal should not exceed long-term recharge. The Central Ground Water Board and the
State Ground Water Board would be responsible for scientific monitoring of groundwater levels and for estimating a sustainable level of groundwater use. In case water levels fell below the replenishable level the Central government could declare an area as “environmentally threatened” and in consultation with stakeholders and strategy for addressing this problem would be developed (Expert Group on Ground Water Management and Ownership of the National Planning Commission of the Government of India 2007, p. 47).

Stakeholder self-organization can occur based on strong community values and norms, particularly if embedded in and facilitated by a conducive larger regime (Ostrom 2002, p. 5). A well-informed community of groundwater users may agree on maximum acceptable drawdowns in pumped wells or ban the application of pesticides across an aquifer that furnishes potable water supplies (GEF 2012, p. 34). Local self-management will need technical support when problems occur, and preferably before, for realistic appreciations of the state of the resource. Management of groundwater resources by user groups also does not replace state regulation, implementation and enforcement, and economic mechanisms, rather the three work as a tripod on which to base aquifer governance (Meinzen-Dick 2007). It should also be noted that there are relatively few examples of self-organization in relation to the scale and intensity of groundwater development (Moench, Burke and Kulkarni forthcoming).

It is important that the legal framework provides options how of users can organize and clearly defines the role and responsibilities of groundwater user groups on the one hand and the water administration and other public institutions on the other. For large-scale groundwater users such as Coca Cola in the case of India a permit and registration approach with clear indications of conditions to be met should exist in parallel to community approaches (Nanni, no date). Among the organizational forms according to which stakeholder groups can be established are water users associations, groundwater user groups, village water supply groups, aquifer management organizations (AMORs) or NGOs. AMORs have been suggested for larger high-yielding aquifers and should include all local water user associations, groundwater user groups, village water-supply councils etc., and also representatives of national and/or local groundwater resource agencies and of the corresponding local government (Garduño, van Steenbergen and Foster 2010, p. 3). The governance arrangements that may work across a small aquifer may not work in large aquifers supplying water to a range of different activities in larger urban, agricultural, industrial and mining areas (GEF 2012, p. 21).

Box 8 Groundwater User Associations in Spain, the US and Mexico (COTAS)

The legislation of a number of countries provides for the establishment of (ground-)water user associations or aquifer management organizations, for instance in Spain (Lopez-Gunn and Cortina 2006), Mexico, Australia and the western states of the US. They have been established especially where aquifers are at risk of being degraded or depleted. For instance, the Spanish Water Law of 1985 makes the establishment of groundwater user organizations compulsory in overexploited aquifers (Hodgson 2006, p. 41). In a number of western states of the US groundwater management or conservation districts, a form of water users association, have been established in respect of about 89 percent of groundwater resources. They are controlled by local users and may set limits on
pumping and wells, adopt groundwater management and development policies and programmes, and propose water allocations criteria. In Mexico, where groundwater resources are severely overexploited, COTAS (Comités técnicos de aguas subterráneas – technical groundwater committees) have been created. They are civil society organizations, whose set up has been carefully facilitated by the National Water Commission and who are supported financially by the public hand. Inter alia, the COTAS support the implementation of groundwater management plans, support the government in groundwater rights administration, provide services to groundwater user, support consensus-building for future integrated water resources management and establish dialogue with and improving data on groundwater users (e.g. by helping the water administration to validate, update and correct databases on wells) (Foster, Garduño and Kemper 2004).

4.7. Implementation and enforcement

Implementation is the key for any working water law regime and the biggest stumbling block. Without consistent implementation access to water becomes insecure. Falling water tables put livelihoods at risk and the absence of effective quality protection may render groundwater dangerous for human consumption. Water rights lose their value and cannot be used for planning purposes.

Implementing groundwater legislation is particularly challenging because of the sheer number of users involved, the difficulties of monitoring and the high financial implications. Particularly agricultural abstraction has proved impossible to regulate in countries such as China, India, Mexico and India. Due to insufficient implementation, particularly in developing countries, many recent water laws fail wholly or partly to work in practice thus making no or an insufficient contribution to aquifer governance. This applies even to progressive and sophisticated water laws like the 1998 South African Water Act.

A number of factors have emerged as key constraints to implementation. Among them are legal requirements that exceed the available technical, human and financial resources; formal legislation that is not well aligned with customary or local rules and thus rejected (see 4.4); legal frameworks that do not clearly delineate responsibilities and assign well defined tasks; and insufficient information on groundwater resources that impede informed decisions about allocation and protection measures (see 2.4 and 2.5).

Implementation requires human, administrative and financial resources. The extent to which such resources are available should be assessed before legislative steps are taken. The outcome should help to determine feasible approaches, i.e. legislative burdens that are commensurate with existing capacity. For reasons of equity and justice implementation should be uniform across a country, unless implementation in priority areas is legally allowed for specific reasons. There are examples that improving implementation of groundwater management measures in objectively-defined
priority areas and not across a whole jurisdiction (which would have high administrative overhead) can be a useful approach.\(^{39}\)

An effective organizational framework depends on a clear delineation of responsibilities among the institutions involved in one way or another in groundwater management and coordination among the ministries, departments or other authorities responsible for specific or sectorial aspects of water resources. Gaps and overlaps in competence as well as lack of coordination horizontally among different ministries or vertically cross different levels e.g. from the federal to the state level, render the implementation of legislation cumbersome or ineffective. In many countries there is still a fragmented structure of governmental institutions entrusted with various water management roles, often with one ministry or authority being in charge of surface water and another (often less well staffed and financed) of groundwater. Unless roles and responsibilities are clearly defined groundwater management, let alone integrated water resources management, suffers.

Setting up accountable and transparent institutional arrangements, staffing them with skilled personnel and financing them appropriately takes time. It is important to stage the steps of introducing new rights and obligations appropriately in order to avoid signals of non-implementation and to ensure that non-compliance incurs sanctions, ranging from offences punishable by modest fines to severe offences of a criminal law nature depending on the offence, its severity and persistence and the damage caused. With patchy enforcement those who do not respect the law are often not sanctioned, thus deterring the rest of the user community from complying as well.

4.8. Water law and macro-level policies

If water law is to make an effective contribution to good groundwater governance water law and policy and social, economic, agricultural and environmental policies need to be aligned. Where economic triggers to overexploit groundwater and technological innovation meet weak water law enforcement, the result is aquifer degradation. The already mentioned example of Guanajuato demonstrates that where energy, agricultural and other policy fields provide incentives in favor of overexploitation of groundwater resources a weakly enforced water law has little influence on this process (Foster, Garduño and Kemper 2004).

Typical examples of policies on a collision course with legal limitations include subsidies on energy tariffs (the prime example being groundwater energy tariffs in peninsular India, Garduño et al. 2011) or flat-rates encouraging increased water well pumping or incentives to intensify agriculture, including fertilizer and pesticide subsidies and guaranteed prices for certain crops, which have resulted in groundwater contamination. In situations where economic reasons nudge users not to comply with legal obligations and the water authority has no operational capacity to enforce the law, the law cannot cope by itself with the effects of counter-running economic stimuli. Rather than relying solely on enforcement in such situations it is more promising to provide incentives for user to comply with the law by aligning policy areas. Direct and indirect resource and energy pricing policies and other demand management measures can support the legal regulation of demand for water.

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\(^{39}\) See the example provided in Buapeng and Foster 2008.
groundwater and its protection through a water rights system, in particular in situations where the implementation of water permits appears unrealistic because of multitudes of users.

5. Constraints and opportunities at the international level

Remarkably few agreements have been concluded for specific transboundary aquifers and on shared groundwater resources in general. A range of factors may explain this dearth of legal instruments among them ignorance in some cases that an aquifer is transboundary, apprehension to undertake commitments with respect to resources whose characteristics may not be well known and strong perceptions of sovereignty over transboundary groundwater quite different to the generally well recognized shared nature of transboundary rivers and lakes.

5.1. Sovereignty

The paucity of international instruments addressing transboundary aquifers reflects longstanding disregard and partly ignorance of the shared nature of these resources which has changed only recently.\textsuperscript{40} Sometimes only groundwater in the boundary area is recognized as belonging to a shared resource. In the absence of clearly defined rules and obligations international law has so far only marginally shaped the way in which states manage their transboundary groundwater systems. The vacuum has fostered an ill-founded view of almost unrestricted sovereignty over shared groundwater resources, which still looms very strongly.

This view has also influenced the ILC Draft Articles on Transboundary Aquifers. Criticized sharply by many, the principle of sovereignty is placed prominently as the first principle in the Draft Articles section on principles (McCaffrey 2009, McIntyre 2011). According to Article 3 each aquifer state has sovereignty over the portion of a transboundary aquifer located within its territory. Although Article 3 continues stating that the sovereignty shall be exercised in accordance with international law and the draft articles, the emphasis on sovereignty is atypical for a legal instrument on transboundary freshwater resources. It reflects an approach that seemed overcome since the infamous Harmon Doctrine\textsuperscript{41} and replaced by the notion that states share a “community of interest” in a shared water resource to which they have a right to equitable and reasonable use.\textsuperscript{42} Most likely the indiscriminate focus on aquifers without distinguishing rock and water together with the invisible and ubiquitous nature of groundwater whose transboundary and often very slow flow remains hidden to the eye has been conducive to the unfortunate resurrection of claims of sovereignty. It is noteworthy that the first aquifer agreement following the draft articles, the Guaraní Aquifer Agreement, places strong

\textsuperscript{40} A UNECE map of a survey of European transboundary aquifers shows that a number of aquifers had only been indicated by one country as being transboundary. UNESCO (2001), p. 12.


\textsuperscript{42} The principle of community of interest was introduced by the Permanent Court of International Justice in the River Oder case and reaffirmed by the International Court of Justice in the Gabčíkovo-Nagymaros Project case. Territorial Jurisdiction of the International Commission of the River Oder, 1929 PCIJ, Series A, No. 23, p 27; Gabčíkovo-Nagymaros Project (Hungary/Slovakia), Judgement, I.C.J. Reports 1997, p. 7, 56.
emphasis on the notion of sovereignty in reflection of some deeply rooted convictions prevailing in the region. At the same time, it recognises that a transboundary aquifer requires cooperation among the states sharing it and serves as an example how such cooperation may be styled.

### 5.2. Formats of cooperation

It is at the level of specific transboundary aquifers that cooperation can generate the most tangible and short-term positive impacts on groundwater governance. The ILC draft articles provide a general framework that needs to be fleshed out considerably in the application to specific local conditions and challenges.

Where a treaty seems one step too far or too cumbersome an incremental approach or more informal arrangements not (yet) backed by formal legal instruments or priority action along the border region can be useful options. An evolutionary process for arriving at an aquifer cooperation mechanism was taken in the cases of the SASS and the Iullemeden aquifer system. Cooperation can also grow at the more local or even municipal level. Arrangements have been crafted on the Hueco Bolson between the City of El Paso and Ciudad Juarez on the border between Mexico and the USA, and on the Abbotsford-Sumas Aquifer between the US State of Washington and Canadian Provence of British Columbia. For the Hueco Bolson aquifer the memorandum of Understanding has been concluded between the municipal water utilities on each side of the border (for a discussion see Eckstein 2011, pp. 576-577). For the Abbotsford-Sumas aquifer the memorandum of understanding was signed at state/provincial level and it is made explicit in the text that it is a non-binding agreement. Also within the framework of the Guaraní Aquifer project local transboundary cooperation was established in four pilot areas (Proyecto Sistema Aquífero Guarani, 2009). Such arrangements can serve to initiate communication, cooperation, implementation of projects of joint interest, and data and information sharing.

Instead of embarking on a self-standing agreement in many circumstances it may be more feasible to increase cooperation on groundwater issues under the umbrella of an existing treaty, possibly supplemented by a protocol on groundwater or technical guidelines, and to incorporate groundwater in the mandate and work of already established basin institutions.

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43 See Article 2 and Articles 1 and 3.
5.3. Benefit sharing and other lessons learned

Lack of real or perceived cross-border issues to be tackled or lack of perceived benefits to be gained from cooperation provide disincentives to transboundary cooperation. Only if cooperation is likely to yield more tangible benefits than individual country action is there an incentive to cooperate, to make (legally binding) commitments and to honor them. The Genevese Aquifer Agreement is a good example of a benefit-generating undertaking: both sides benefit from the capacity of the aquifer to purify artificially recharged water.

There are also other lessons to be learned from the rich corpus of surface water treaties (Paisley 2002, Fox and Le Marquand 1978). A review of the experience of a large number of GEF transboundary freshwater and marine legal and institutional frameworks has distilled the following key factors for working treaty arrangements in addition to benefit sharing: information and data exchange, the existence of a dispute resolution mechanism, sustainable financing, good institutional design at the technical and political level, the adaptability or flexibility of the treaty and public participation (Paisley et al. 2011, p. 5).

5.4. External support

It is noteworthy that with the exception of the Genevese Aquifer treaties, all agreements for specific aquifers concluded until present were preceded by large externally funded projects which had a substantial component of knowledge generation and study of the shared resource and which aimed at data and information collection and exchange. As only what can be measured can be managed, the emphasis on knowledge generation and data sharing seems sound. The importance of monitoring is underscored by the 2000 UNECE Guidelines on Monitoring and Assessment of Transboundary Groundwaters (UNECE, Task Force on Monitoring and Assessment 2000). An initial phase with emphasis on technical issues is a good prerequisite to establishing a basis for further cooperation and to building trust before moving towards a more formal agreement. Where needs are pressing, the call for more data and information should, however, not turn into an alibi for inaction.

For developing countries cooperation over transboundary aquifers will often require external financing and support by international agencies as the experiences of the Nubian Sandstone Aquifer System, the SASS, the Iullemeden Aquifer System and the Guarani Aquifer System show. As these developments are still fairly recent an assessment of the degree to which project-support agreements will be implemented and retain long-term viability remains to be undertaken in the future.

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47 The characteristics of the Genevese aquifer were already well known when the parties entered into the 1977 Arrangement.
5.5. Guidance from global and regional legal frameworks

Where no treaty exists for an aquifer, regional and global legal frameworks come into play. For the time being the Draft Articles on the Law of Transboundary Aquifers are the most important document containing rules of a general nature for shared groundwaters. Potentially, the draft articles may become the starting point for the development of a globally binding convention. Whether such is feasible and desirable in the coming years is still open. On the one hand, given the immature state of international groundwater law generally, rushing towards a convention might be premature. One the other hand, a well crafted convention supported by a number of important aquifer states would provide impetus to the development of further agreements for specific aquifers. The same can to some degree already be said of the Draft Articles as the reference to the Draft Articles in the Guaraní Aquifer Agreement demonstrates. For the time being the draft articles are the most authoritative codification of international groundwater law and recommended by the General Assembly. They make it very clear that transboundary aquifers are shared resources that have to be managed as such.

Developments at the global level should be supported by progress at the regional level, where especially the ongoing initiative of the UNECE to develop model provisions on transboundary groundwaters to supplement the 1992 UNECE Water Convention might result in concrete outcomes. The members of the European Union already have committed to a very stringent approach to groundwater protection.

Compared with the regime available for the protection of other natural resources where conventions with clear and detailed rights and obligations, regular meeting of parties and well-working secretariats are in place and have shaped domestic laws and policies, the potential of international law to contribute to the governance of transboundary aquifers remains still to be developed.

Part 3 Prospects

This last part will look towards the future and suggest some issues whose relevance is likely to increase.

6. The domestic level

A need for appropriate legal frameworks to govern groundwater is sharply felt. More and more, the assumption that permit systems are the best way forward in all circumstances to address issues of groundwater scarcity and degradation is challenged. More creative approaches have to be to get a handle on the de facto open access nature of groundwater in many countries. Nuanced and sophisticated discussions about the respective roles of permit systems, customary rules and community approaches are likely to gain in importance if the challenge of groundwater abstraction by multitudes of small-scale users in many developing countries is to be addressed.

To the extent that groundwater resources are becoming overly used and polluted environmental concerns are likely to take a more and more prominent role in groundwater legislation, something
that could already be observed with respect to water law in general over recent decades. In particular developments in the European Union tendency bear out such a tendency.

The effects of climate change might require new regulatory answers to the challenges arising from it, domestically and with respect to transboundary resources. It will have to be explored what role the law will be able to play in enhancing adaption strategies and mitigation actions.

Since the adoption of General Comment No. 15 by the United Nations Committee on Economic, Social and Cultural Rights the debate about the human right to water has been growing. It has received further support when the United Nations General Assembly affirmed the right to water in Resolution 64/292 in 2010. The discussion about the rights to water might have more and more repercussions for water policy and legislation as experience gained from the right to food shows. Water will increasingly be looked at from a human rights perspective and policies and laws be measured against human rights criteria, particularly with respect to non-discrimination.

Use of the subsurface is growing aided by new technologies and often with implications for aquifers. Examples are tapping deep seated aquifers that until present have been used only sparsely for abstracting freshwater but also extracting minerals, oil and gas; developing geothermal energy; hazardous waste disposal; storage and recovery of substances and heat; and accommodating technical infrastructure. These activities are likely to result in new requirements for legal regulation, domestic and international as far as transboundary aquifers are implicated (van der Gun, Merla, Jones and Burke, 2012).

7. The international level

With growing pressure on groundwater resources, the extent of cooperation with respect to specific transboundary aquifers is likely to increase as is the number of treaties or other legal arrangements. It is at the level of bi- and multilateral international legal cooperation that tangible outcomes can best be achieved. Cross-country cooperation may take a number of forms from informal cooperative approaches to joint activities following the adoption of a fully fledged treaty. Timely cooperation will offer opportunities to mitigate harm early and to avoid crisis situations. Developing countries are likely to require donor assistance when embarking upon such an endeavor.

The adoption of the draft articles on transboundary aquifers and their endorsement by the United Nations General Assembly has created a momentum of attention to transboundary aquifers that might lead to further initiatives trying to craft legal tools to meet the challenges of groundwater governance. The UNECE initiative to develop Model provisions on transboundary aquifers can be seen in this context. As there are only few legal examples to seek guidance from, progress in this field is, however, likely to remain incremental.

At the global level, the Draft Articles on the Law of Transboundary Aquifers might in time lead to the adoption of a framework convention on transboundary aquifers as has been the case with legal instruments developed by the International Law Commission in other fields. The fate of the Draft Articles will be influenced by progress made at regional and aquifer level. If a convention is negotiated its effectiveness will depend on a range of factors. Arguably, it could be greatly enhanced
by a regular meeting of parties and the existence of a secretariat which have become common features of environmental treaties.

8. Conclusions

Legal frameworks that are well tailored to the specific local context are indispensable for groundwater governance. Worldwide there is a tendency to modernize water laws and to pay more attention to groundwater management and protection in domestic legislation.

With the exception of a few jurisdictions groundwater resources now tend to be vested in the state or put under state control although this may not be felt at all at the local level. Government administered legislation tends to replace property minded doctrines and permit-based access to groundwater resources has become a standard approach. Such administrative water rights systems work very well in high-income countries with highly formalized water economies where also registration, metering, charging and other obligations are easy to implement. Yet, highly complex requirements such as those of the EU Water Framework Directive and its daughter directive on groundwater remain challenging even for EU member states.

Approaches that work in circumstances such as in the United States and in Australia which are characterized by small numbers of large users and low population density have often failed in other regions such as Asia with high population density, de facto open access to groundwater, little information about the characteristics of aquifers and multitudes of tiny private users. In much of Asia and Africa local and customary rules shape individuals’ approaches to groundwater. It is a key question how to incorporate _de minimis_ abstractions, customary water uses and local level institutional arrangements within a formal water management framework. Such incorporation should respect and protect existing rights, avoid disenfranchising customary rights holders and take into account existing perceptions, values and structures. At the same time it should enable groundwater protection and management decisions beyond the local level and the use of permits for certain types of uses. In addition, less complex provisions, staged implementation, implementation in priority areas and community-based management by user groups may be explored. All water governance mechanisms should be accountable, transparent, participatory and non-discriminatory and function in an integrated manner taking into account the implications of the land-water interface.

Trite as it may sound, it also has to be remembered that what has worked in one place, often fails in another place where resource systems, governance systems, resource units, and users are different (Meinzen-Dick 2007). General key factors for laws that work in practice are high quality of the legal provisions, which address all relevant issues and are fair, equitable, coherent and enforceable; well-sequenced and planned processes of transition and change; operational capacity of the water administration to implement the law; social consensus that supports compliance; stakeholder participation in legislative, planning and management processes, including user groups; and coherent and supportive wider socio-economic trends and policies. Ample experience from around the world has made it abundantly clear that water law only works if it is flanked by supporting policies, awareness raising, technical solutions and, very importantly, the human, administrative and financial
structures for its implementation. For many countries and situations this is a tall order with important socio-economic and financial implications. These costs need, however, to be offset against the costs of inaction that will often still be higher – and most likely be borne by those who are already disadvantaged.

For the governance of transboundary aquifers the development of International law has only lately picked up pace. While until a few years ago it offered very little guidance on how to manage and protect transboundary aquifers, recently developments at the global, regional and transboundary aquifer level have marked the beginning of a phase in which international law might begin to play a bigger role in governing these resources. Nonetheless a shift at the transboundary level from notions of sovereignty to the notion of a shared resource is yet to take hold in many regions. Important inroads are being made with regard to specific transboundary aquifers and also at the regional and global level. These developments seem to herald acceptance of the shared nature of problems, whether they be of overdraft or of pollution or both, or the mere anticipated threat of them, across the borders. States have geared up to deal with them in cooperative or coordinated fashion in a number of ways from informal arrangements to a few bi- and multilateral treaties for specific aquifers. With respect to tangible governance outcomes and immediate benefits to be realized cooperation at the aquifer level is most desirable, ideally guided by regional and global instruments, including most notably the landmark draft 2008 Articles on the Law of Transboundary Aquifers developed by the International Law Commission.

9. References

9.1. Books and articles


Foster S., H. Garduño and K. Kemper, *The “COTAS”: Progress with Stakeholder Participation in Groundwater Management in Guanajuato*, Mexico. GW-Mate Case Profile Collection, April 2004


Garduño H., F. van Steenbergen and S. Foster, *Stakeholder Participation in Groundwater Management*, GW Mate Briefing Note Series, Note 6, 2010


Meinzen-Dick R., Beyond Panaceas in Water Institutions, Proceedings of the National Academy of Science USA. 2007 September 25; 104(39): 15200


Proyecto Sistema Aquífero Guarani, Programa Estratégico de Acción, 2009


Vidal A., Overview of the Status of Policy and Legislative Framework within SADC and the SADC Member States for Ensuring the Effective and Sustainable Development and Management of Groundwater Resources, GW Mate, World Bank, April 2010


9.2. Documents


Edwards Aquifer Authority Act of 30 May 1993, 73rd Legislature, Regular Session, Chapter 626, 1193 Tex Gen. Laws 2350, as amended

FAO, Guidelines on Water Tenure, (forthcoming)

Framework Agreement on the Sava River Basin (Kranjska Gora, 3 December 2002), http://faolex.fao.org/

Framework Convention on the Protection and Sustainable Development of the Carpathians (Kiev, 22 May 2003), UN Doc. ECE/CEP/104


India, Model Bill to Regulate and Control the Development of Groundwater, http://www.indiawaterportal.org/sites/indiawaterportal.org/files/e0506_0.pdf


International Boundary and Water Commission United States and Mexico, Minute No. 242 of 30 August 1973, Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River, 12 I.L.M. 1105 (1973) (Minute No. 242)


International Court of Justice, Gabčíkovo–Nagymaros Project (Hungary/Slovakia), Judgement, I.C.J. Reports 1997, p. 7


Memorandum of Understanding relating to the setting up of a Consultative Mechanism for the management of the Iullemeden Aquifer System (IAS), Mali, Niger, Nigeria, 20 June 2009 (on file with author)


Resolution VIII.40 Guidelines for Rendering the Use of Groundwater Compatible with the Conservation of Wetlands adopted at the 8th Meeting of the Conference of the Contracting Parties, 18–26 November 2002


SADC Revised Protocol on Shared Watercourses, 2000, 40 ILM 321 (2001)


Supreme Court of Texas, *Edwards Aquifer Authority v. Day*


Tripartite Interim Agreement Between the Republic of Mozambique, the Republic of South Africa and the Kingdom of Swaziland for Co-operation on the Protection and Sustainable Utilisation of the Water Resources of the Incomati and Maputo Watercourses (Johannesburg, 29 August 2002); http://faolex.fao.org/


United Nations General Assembly Resolution 63/124 of 11 December 2008 - The law of transboundary aquifers
United Nations General Assembly Resolution 64/292 of 28 July 2010 - The Human Right to Water and Sanitation

United Nations General Assembly Resolution 66/104 of 9 December 2011 - The law of transboundary aquifers

UNECE, Charter on Groundwater Management, adopted by the UN ECE at its forty-fourth session (1989) by Decision E (44), UN Doc. E/ECE/1197 ECE/ENVWA/12

UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, 1992, 1936 UNTS 269

UNECE Protocol on Water and Health to the UNECE Water Convention, 1999, 2331 UNTS 202