

Groundwater governance in the Anthropocene: a close look at Costa Rica

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Abstract

The Anthropocene is an era in which humans have become the primary driver of planetary systems, not least the global hydrological cycle. This is posing significant challenges for managing the globe's water resources, and is catalyzing a shift in the focus of water law, governance and policy research. One important feature of this shift is a burgeoning focus on groundwater resources and their exploitation, particularly in developing countries. As surface water succumbs to climate pressures, groundwater use has increased rapidly as a source of food production and economic development. A fundamental question for modern water law and governance research is: what are the key challenges and opportunities for effective design and implementation of groundwater law to achieve sustainable and inclusive development. This article provides insights into this question through an empirical examination of Costa Rica. Drawing on an empirical analysis of 40 semi-structured interviews with public and private stakeholders in Costa Rica, the findings identify the following challenges and opportunities for groundwater governance: (i) recognition of water as a public good and clear ownership; (ii) insufficient definition of groundwater and embedding within the concepts of sustainable and inclusive development and participation; (iii) inadequate organization and toolbox, including implementation.

Keywords: Anthropocene; Costa Rica; Groundwater governance; Law; Participation; Sustainable and inclusive development

Introduction

The Anthropocene is characterized by the rapid change in the human–natural resource relationship to the extent that humanity could be considered as a global force itself (WWF, 2012). It is characterized by the intense use and misuse of natural resources including groundwater which has led to the decline in its

doi: 10.2166/wp.2018.158

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quantity and quality. Serious concerns have accordingly been raised about industrial waste disposal in groundwater and the quantity of supplies for future food security and production (Rockström *et al.*, 2014). Furthermore, groundwater will also be seriously affected by its use beyond low recharge rates and the impacts of climate change (Rosenzweig *et al.*, 2007).

Despite these concerns, water policy and the academic debate about water governance has traditionally focused on surface water (e.g., rivers and lakes), and mostly ignored groundwater (Naff & Dellapena, 2002; Varady *et al.*, 2013). This has disregarded the fact that of the water available for human use (including for drinking, food and energy production), groundwater constitutes approximately 95% (Morris *et al.*, 2003). This neglect is reflected in poorly identified and mapped resources (Knüppe & Paul-Wostl, 2011), historic underinvestment in monitoring (as compared to surface water), inconsistent collection standards across and even within countries (Daibes-Murad, 2005), insufficient or non-existent hydrogeological data (Wijnen *et al.*, 2012), questionable quantity and quality of scientific data (Giordano, 2009), and most relevant to the perspective of this article, poor development of groundwater law at the international level and even poorer implementation of law at the national and local levels (Knüppe & Paul-Wostl, 2011; Nelson, 2012).

At global level, the policy and law on groundwater has been influenced by the soft law provisions of diverse instruments¹ as well as by hard law provisions in the UN Watercourses Convention (1997) and the Ramsar Convention on Wetlands (1972). However, these last two deal more explicitly with surface rather than groundwater. At the same time, there have also been significant efforts to craft, reform and improve groundwater law at the supranational, national and sub-national level. This trend is evident in developed countries, such as the European Union's Water Framework Directive (2000), the Directive on the Protection of Groundwater Against Pollution and Deterioration (2006), Australia's National Water Initiative (2004) and California's Sustainable Groundwater Management Act (2014).

Nonetheless, in many non-Anglo-American geographies, groundwater laws are non-existent, underdeveloped and under-researched (Ballesteros *et al.*, 2007; Shah, 2009; Conti, 2017). This is surprising given that groundwater plays an increasingly important role in developing countries' development – for food, drinking water and climate resilience (Shah, 2009). However, groundwater use in many developing economies has often been unsustainable and comes at the expense of water table levels (Ballesteros *et al.*, 2007; Shah *et al.*, 2008). This challenge in part stems from the fact that laws regulating groundwater remain something of an afterthought within comparatively advanced surface water regimes. Certainly, there are localized and often discrete examples of co-management and conjunctive use efforts in developing economies that have successfully managed local aquifers (often in the absence of formal law) (Ostrom, 1990).

However, the challenge of designing and implementing broader legal regimes to regulate large groundwater basins and growing groundwater use across nations is really only just beginning for most developing economies (Ballesteros *et al.*, 2007; Shah, 2009). For example, in India, despite recent policies² (Reddy *et al.*, 2014), some of the most important legal principles governing groundwater

¹ These include the International Law Association's (ILA) 1966 Helsinki Rules on the Uses of the Waters of International Rivers, the ILA 2004 Berlin Rules academic codification of customary law, and the International Law Commission's (ILC) 2008 Draft Articles on groundwater, the United Nations (UN) Conference on Environment and Development, Agenda 21: Programme of Action for Sustainable Development, the 2000 Millennium Declaration with its water targets, the UN General Assembly, the UN Human Rights Committee Resolutions on the Human Right to Water and Sanitation, and the 2015 Sustainable Development Goals.

² For example, the Model Groundwater Bill and cabinet approval of making groundwater a common resource.

originate from outdated British Common Colonial Law (which remains out of touch with the growing knowledge of the connectivity between surface and groundwater and social and ecological systems) (Hulkarni *et al.*, 2015). Pakistan's groundwater policies have successfully increased agricultural production but have contributed to massive groundwater decline. Such policies reflect the lack of scientific knowledge regarding biophysical aspects, surface and groundwater connectivity and long-term sustainability (Khair, 2015).

The palpable challenge for these and other developing nations, is how to govern groundwater effectively, and in particular, how law can play a strong and effective role in the governance mix. Surprisingly, there has been little relevant research on this issue. In response, this paper addresses the question: what are the key challenges and opportunities for effectively designing and implementing groundwater law to achieve sustainable and inclusive development? To answer this question, the paper uses the example of Costa Rica. It does so for four reasons. First, Costa Rica faces significant groundwater governance challenges as its use of groundwater is increasing due to agriculture and irrigation growth (Ballesteros *et al.*, 2007; Arias, 2012). Moreover, the North Pacific, which is the driest part of the country, relies almost completely on groundwater for all uses (Astorga, 2013). It is expected that the conditions in this region of the country will get dryer in the future due to climate change, which could severely affect groundwater (Ballesteros *et al.*, 2007; Kuzdas *et al.*, 2014).

Second, despite a reputation of being an environmental leader, it has long struggled with the design and implementation of water policy and law. There is no defined and integrated water policy: however, there have been some attempts to create one, such as the 2008 Política Nacional Hídrica [National Water Policy], the 2009 Estrategia para la Gestión Integrada del Recurso Hídrico [Strategy for Integrated Water Resources Management], and the 2013–2030 Agenda del Agua [Water Agenda]. Moreover, there is a lack of integration of goals and principles into only one piece of legislation. Although Costa Rica has made diverse attempts to design and implement a holistic water law, to date, no such law has been passed. In the past decade, due to concerns about the outdated and fragmented legal framework, various sectors of Costa Rican society, such as academics, NGOs and scientists, have submitted several water law proposals to the Congress seeking to update the current Water Law. However, none of these proposals has been approved. The Integrated Management Water Law Draft [Proyecto de Ley para el Manejo Integrado del Recurso Hídrico] (Legislative File [Expediente Legislativo] No. 17742), which has been discussed in the Congress for the past seven years, deserves a special mention. This draft was presented via the mechanism of popular initiative, which means that it was presented with the support of approximately 180,000 signatures of citizens. When first presented, there was hope that it would soon become the new water law that many in Costa Rica were agitating for; however, this has not happened yet due to conflicting interests of powerful sectors, e.g., business chambers. This draft law, among other virtues, recognizes the importance of groundwater resources and the water cycle approach³ as well as international principles such as sustainability (Article 2.d.) and participation (Article 2.c.). In the absence of a clear water policy and a holistic water law, Costa Rica, like many other emerging economies, has relied on a mix of other laws and ordinances to protect groundwater (e.g., Forestry Law, Environmental Law, Biodiversity Law and others). This makes Costa Rica a useful site to examine the effectiveness of 'legal mixes' for responding to groundwater challenges.

³ Article 23 says: 'Water planning should include the integrated water cycle in all its demonstrations including, atmospheric, surface and groundwater, and hydro-social cycle.'

Third, examining groundwater governance in Costa Rica is timely, with its Ministry of Environment and Energy (MINAE) launching a USD 1.4 million joint project with the United States Geological Survey (USGS) in July 2017 that will generate greater knowledge and precision in Costa Rica's groundwater drilling and exploitation. With the likely increase in knowledge, Costa Rica will now be in a better position to create policies and laws for the use and management of its groundwater resources, making an assessment of its current regime and areas for improvement very valuable.

Fourth, there has been little research done and published (particularly in English) discussing the challenges for Costa Rica in designing and implementing water law and policy, especially having groundwater as its focus. The following section defines the methodology and introduces two case studies used to empirically examine the application of legal mixes in Costa Rica. The next section elaborates the conceptual framework, followed by a section as it applies to Costa Rica. A discussion section follows and finally conclusions are drawn.

Methodology

This paper uses two different research methods. First, it draws on a doctrinal investigation by analysing the international literature on the elements for designing water laws to then complete a legal analysis of environmental, surface and groundwater laws at the national level in Costa Rica. After that, it develops an empirical component, through two case studies, which rely on 40 semi-structured qualitative interviews with government officials, scientists, non-governmental organizations (NGOs), community-based organizations (CBOs), businesses, water boards or communal water associations (ASADAs) and groundwater users. Such methods aim to understand not only the actual content of legal mixes but also their implementation in practice and the remaining challenges.

The article focuses on two case studies: Guácimo, located in the province of Limón in the Caribbean, and the coastal communities of Santa Cruz in Guanacaste province in the North Pacific. These case studies were selected to represent diverse problems, e.g., pollution and overexploitation, respectively, different implementation levels and different institutional responses. The interviews were analysed using adaptive theory which falls between deductive/theory-testing approaches and inductive/theory-generating approaches. It engages in a constructive dialogue with a number of approaches or paradigms that may otherwise be construed as incompatible or as competing with each other (Layder, 1998). It facilitates the development of concepts and insights by adapting and shaping existing groundwater governance literature to incoming evidence. To analyse the data of this research, the following steps were followed: (i) transcribing the interviews and storing them in electronic format; (ii) coding and data reduction by selecting, focusing, abstracting and transforming data in order to draw out the main themes; (iii) data display through the assembling of information in a form suitable for drawing conclusions and inferences; and (iv) deciding what patterns, explanations or causal flows emerge from the data analysis and thereby drawing conclusions and verifying them.

Conceptual framework – international elements for designing water law

In the context of the Anthropocene (Crutzen, 2006; Rockström *et al.*, 2014), it has been argued that there are eight elements that need to be taken into account in designing water governance and law (Gupta *et al.*, 2013). These include the following:

1. A degree of normative consensus about the discourses regarding how groundwater should be dealt with – namely what is the nature of water? Is it a public good in the sense that no one can be excluded from the use of water and the use of water by one does not mean less for another? Is it a heritage that needs to be protected? Is it an economic good that should be used in the most efficient and profitable manner? And furthermore, how does the use of water relate to discourses on development? Should water be used to optimize growth in the service of the green economy as measured by gross national product (GNP), or should water be used to promote sustainable and inclusive development (Pouw & Gupta, 2017) How does this normative consensus relate to the Sustainable Development Goals adopted in 2015?
2. How should one define water and water courses? For the purpose of this paper the focus will be on how to define groundwater. Since water flows from one physical state to another (solid, liquid, vapour), the question is what is the subject matter for groundwater governance? What is the relationship of groundwater with surface water, greenwater and waste water? Does it address the ecosystem services of the different colours of water (Hayat & Gupta, 2016)? Does it extend to the watershed? How does this relate to, or go beyond, the concepts and ideas developed within the UN Watercourses Convention (1997), the UNECE Water Convention (1992), and the Ramsar Convention on Wetlands (1972).
3. It is critical to have a good understanding about the nature of water ownership and access in a specific context, whether *de jure* or *de facto*. This can have serious impacts on the ability of governance actors to govern water.
4. What governance theory is applicable and what kind of principles have been adopted? What is the importance of including the principle of citizen's participation in water governance? Has a choice been made in favour of integrated water resource management, adaptive water governance or nexus governance? What collection of principles have been adopted for water governance and do they cover the issues of environment, development and the economy? How does this correspond to global theoretical discussions on these three key approaches to water governance? For example, is there coherence between the domestic and inter-state principles for collaboration? How are equity, environmental, economic and general principles accounted for? How do they relate to the principles of equitable sharing, no harm and priority of use principles of the Water Courses Convention (1997), the pollution principles of the UNECE Convention, the common but differentiated responsibilities and respective capabilities of the Climate Change and Biodiversity Conventions (1992) and the human right to water and sanitation as adopted by the General Assembly in 2010?
5. The level at which governance should be organized: should this be decentralized to the lowest level, or is the nature of water such that there are specific issues which should be addressed at higher levels of governance (Vörösmarty et al., 2010)? How should the principle of subsidiarity in the Rio Declaration (1992) be interpreted with respect to water issues?
6. It is also important to analyse the nature of the tool box – what instruments have been assembled, how do these instruments relate to the normative consensus underlying water, how internally coherent are they, and how are they financed, implemented, monitored and improved over time?
7. Another key issue is how to draw the boundaries of water within communities, and other administrative spaces such as provinces and states and also from one nation to another? This is both with respect to surface and groundwater. How does this relate to rules regarding boundaries in general,

national and international law and the rules regarding transboundary aquifers under the Draft Rules of the International Law Commission?

8. Finally, governing water also requires understanding and managing all the different types of direct and indirect drivers of water use and the way in which water is used as a sink.

From the previously discussed eight elements, this paper will focus on the first six: the nature of groundwater, what does it mean that groundwater is a public good and how to use it to promote sustainable and inclusive development; how to define groundwater; the nature of groundwater ownership; how to implement the principle of participation in groundwater governance; how the governance of groundwater is organized; and the tool box including finance and implementation. The rationale behind selecting these six criteria is that everything flows from how groundwater is defined, its nature, its ownership, who is involved in its governance, its organization and the instruments to govern it. This paper does not include discussions on the boundary of groundwater, because this follows from a better definition of groundwater. It also does not include the direct and indirect drivers of groundwater because that topic is outside the scope of this paper. As discussed in the introduction, the focus is on groundwater because it has not been studied to the same extent as surface water, not least because its use, flows and quality is more difficult to monitor. As a consequence, it is difficult to define, to draw boundaries and to understand its behaviour and connection with surface water and other natural resources.

Applying the elements at the national level – a close look at Costa Rica

In applying the above framework, this section discusses how Costa Rica has incorporated the elements of the nature of groundwater, how it has defined groundwater and groundwater ownership, how it interprets the principle of participation in its environmental and water laws, and how the governance of groundwater and its tool box, including finance and implementation is organized. [Table 1](#) outlines the development of surface and groundwater legal frameworks and shows the absence of a defined water policy.

As shown in [Table 1](#), since 1884 surface water has been seen as a public good, however groundwater was considered as a private good. It was only in 1942 that concessions or permits for groundwater use became mandatory. This meant that the legal right to groundwater usage was no longer solely determined by private land ownership. There is no clear definition of what groundwater is and the ownership is largely as a commons, but administered/regulated by the state. As with other environmental issues, the government is expected to encourage the active participation of the citizens in decision-making (Art. 6 Environmental Law). [Table 2](#) also illustrates that the legal framework is outdated and fragmented. Indeed, Costa Rica's Constitutional Tribunal has concluded that the legal framework for water resources is 'lamentably lacking in clear, accurate and complete regulations, in particular for the protection of aquifers, recharge areas and catchment areas of groundwater resources' (Constitutional Tribunal, Resolution 01923-2004).

According to some scholars, Costa Rica's privileged status in terms of a high availability of water resources has contributed to its weak and fragmented legal framework ([Guzmán-Arias & Calvo-Alvarado, 2003](#)). As Catarina de Albuquerque, the United Nations Independent Expert on the issue of human rights obligations related to the access to safe drinking water and sanitation, put it after her visit to Costa Rica in 2009, the Water Law 'no longer corresponds to the social and economic situation of the country, and

Table 1. Overview of the development of surface and groundwater legal frameworks in Costa Rica.

Years	Legal framework	Key aspect
1821–1883	No formal legislation	Roman legal tradition recognized surface and groundwater resources as common good
1884–1941	First Water Law (1884)	Introduced the concept of water as a public good; however, this does not include groundwater. The owner of the land where groundwater was found was considered as its owner and could use it infinitely
1942–1972	Second Water Law (1942) (still in force) Law No. 2726 (1969) created the Institute of Aqueducts and Sewage (AyA – its Spanish acronym)	Introduced permits or ‘concessions’ to use groundwater. However, this law does not define groundwater Article 2.g established that AyA may administer water services in collaboration with local communities. This led to the legal birth of the Communal Administrative Associations of Aqueducts and Sewage (ASADAs – its Spanish acronym)
1973–1990	Law No. 5438 (1973) Law No. 6877 (1983) Mining Code, Law No. 6797(1982)	Established the National Groundwater Service to regulate and control groundwater use for agriculture Reformed the National Groundwater Service and created the National Service for Groundwater, Irrigation and Drainage (SENARA – its Spanish acronym). This law does not define groundwater Mining Code established that groundwater is reserved for the state and reaffirmed the need of concessions to use it. However, this law does not define groundwater
1991–1999	Wildlife Conservation Law (1992) Environmental Law (1995)	Recognized the principle of protection of water (where groundwater is implicit) Confirmed the public good nature of water as well as the importance of its sustainable use (where groundwater is also implicit). This law also recognizes the importance of active participation of the inhabitants in decision-making in relation to the protection of the environment
2000–2017	Forestry Law (1996) Ordinance for Environmental Fee for Discharges, Executive Degree No. 31176-MINAE (2003) Ordinance for Water Use, Executive Degree No. 32868-MINAE (2006) Ordinance for Drilling the Subsurface for the Exploitation and Utilisation of Groundwater, Executive Degree No. 35884-MINAET (2010)	Established protected areas of springs and rivers Established fees in order to discharge waste water Established fees in order to use water. There is a clear mention here about groundwater use (art. 4) Regulated wells and the procedures to obtain groundwater concessions (permits) from the Water Directorate of MINAE. However, this ordinance does not define groundwater

Table 2. Synopsis of the case studies.

Case study	Guácimo, Limón	Coastal communities of Santa Cruz
Location	Guácimo in Limón province is in the Caribbean. It has adequate rainfall and covers 576.48 sq-km and has approximately 40,000 people	Santa Cruz in Guanacaste province in the North Pacific is very dry. Coastal communities include Flaming, Potrero, Brasilito, Tamarindo and Playa Grande; neighbouring communities include Huacas, Lorena and Villarreal. The population is about 40,000
Background and context	Unplanned expansion of pineapple plantations becoming the world's foremost exporter. Problems: deforestation, erosion and surface/groundwater pollution due to intensive use of agrochemicals. Public institutions have not solved existing problems. ASADAS, development associations and environmental associations have sued pineapple plantations for violating water and environmental laws	Coastal areas are a popular tourism destination and tourism has grown in the absence of any integrated sustainability plans taking local vulnerabilities into account. Public agencies have not solved existing problems. ASADAS actively engage in groundwater governance
Key challenges	Coordinated actions by public institutions. Enforcement of environmental and water laws. Overcoming lack of government funding and/or support	Coordinated actions by public institutions. Enforcement of environmental and water laws. Overcoming lack of government funding and/or support. Enhancing the figure of the ASADAs

needs to be urgently revised and updated'. Thus, it is not strange that Costa Rica faces considerable challenges in regard to water governance, in particular to groundwater governance. The paper now turns to analyse groundwater governance in practice in Costa Rica with two case studies to draw insights on when and how groundwater law can be designed and implemented to best confront the challenges of the Anthropocene.

The case studies

This section uses two case studies from Costa Rica to explore how and when it has taken into account the design elements discussed in the conceptual framework. Table 2 shows an overview of the case studies.

As shown in Table 2, the case studies of Guácimo and the coastal communities elucidate various groundwater governance challenges such as weak institutions and lack of enforcement of existing legislation. It illustrates that in order to find solutions to pressing problems, concerned citizens used environmental litigation and organized themselves in environmental associations and in ASADAs.

The article now discusses the six elements presented in the section Conceptual framework – international elements for designing water law – namely, the nature of groundwater; the definition of groundwater; groundwater ownership; the operationalization of participation in groundwater governance; the level at which groundwater is organized; and financing and implementation mechanisms.

These issues are considered across three main sections: (i) recognition of water as a public good and clear ownership; (ii) insufficient definition of groundwater, and embedding within the concepts of

sustainable and inclusive development and participation; and (iii) inadequate organization and toolbox, including implementation.

Recognition of water as a public good and clear ownership

Costa Rica's first Water Law of 1884 introduced the concept of water as a public good. This implied that no one could be excluded from the use of water. It also saw water as a heritage that needs to be protected by the government in order to guarantee its use by everyone. In order to achieve these goals there was the need to regulate its use, thus water use was subject to prior authorization from the state (1884 Water Law, Article 4). However, this applied only to surface water. This lack of regulation on groundwater clearly shows an inconsistency in the goal of water as a public good. Such an approach in regard to groundwater remains common in many developed and developing economies, although they have often been replaced by state laws that seek to limit harm.

Sixty-two years later the new 1942 Water Law included for the first time regulations for groundwater use, through calling for permits or 'concessions' to use it, although there were so many exemptions left, e.g., domestic uses, that still groundwater was not sufficiently protected.

Groundwater ownership and access is based on groundwater being available for *common use* but *reserved* for the state. The Mining Code of 1982 reiterated that groundwater use is conditional on state concessions (although there are some exceptions). Later on, Article 50 of the 1995 Organic Environmental Law reconfirmed this. For example, in the case study of the coastal communities, the ASADAs are the administrators of water services (see Table 1), thus they are responsible for authorizing new services, connections and reconnections for water supply. Therefore, the ASADAs can deny new connections if they know that groundwater resources are being used beyond their sustainable limits and this has been done by some ASADAs in the coastal communities. For example, as one interviewee commented:

'Here in the ASADA of Tamarindo we have said, we cannot give you a water connection because there is no more water ... the studies of our aquifers show that we cannot use more water ... we are committed not to push the water beyond its recharge limits ...' (Interview No. 4, ASADAs, July 2013)

Even though this is only one quote, statements like this where water permits were denied, were mentioned repeatedly by the ASADAs' representatives during the interviews. Thus, this quote shows that when laws are effectively designed and implemented some problems such as overexploitation can be tackled. It also illustrates the important role that community groups such as the ASADAs have in effectively implementing water legislation.

Insufficient definition of groundwater and embedding within the concepts of sustainable and inclusive development and participation

Despite the above progress in the nature of groundwater ownership and access, the 1942 Water Law faces multiple shortcomings (albeit several reforms). This section discusses the main three. First, there is a failure to define groundwater in the Water Law (or in any other environmental law). As it is unclear what exactly encompasses the term groundwater – e.g., does it include saline water or only freshwater, is there a depth limit – governing the resource becomes highly complex. There is also ambiguity regarding

whether associated structures, like the aquifer structure, are included in the term groundwater. These aspects make the difficult task of drawing boundaries almost impossible, causing even more problems which can reach the international level.

Second, this Water Law does not have any provisions for sustainable and inclusive development. However, the 1995 Organic Environmental Law requires that:

‘The State shall ensure the rational use of the elements of the environment, in order to protect and improve the quality of life of the inhabitants of the country. It is also required to promote an economic and environmentally sustainable development, defined as the development that meets basic human needs without compromising the options of future generations.’

But the findings demonstrated that this provision is constantly violated. For example, in Guácimo, the pineapple plantations have caused severe environmental damage (Ruepert et al., 2005) and communities had to pressure the municipality and other public institutions (e.g., MINAE and MAG), with lawsuits and demonstrations. The municipality successfully established a moratorium on future pineapple plantations in 2008 as a way to protect vulnerable areas, and reduce pollution from agrochemicals. More importantly, the municipality was committed to enforcing compliance. As argued by an interviewee, ‘we knew we were facing groundwater problems ... we felt that the municipality had to do something, people were angry, they wanted actions’ (Interview No. 3, Government agency, July 2013). Although the moratorium was an essential legal planning tool in Guácimo and helped the canton to protect its aquifers, it is no longer in force. The National Chamber of Pineapple Producers and Exporters⁴ successfully litigated (*Amparo*) against the municipality’s violation of their right to free trade and private property. They won the case on 18 October 2013 and the Constitutional Tribunal ruled that:

‘there is a clear violation of the reasonable motivation of any administrative action ..., since it is not a sufficient, adequate, necessary and reasonable motivation, since the sine die suspension of the business and productive activity was based on technical reports drawn up years ago with a different purpose. ... on the other hand, it is a limitation of a fundamental right – exercise of freedom of trade and agro-industry ...’ (Constitutional Tribunal, Resolution 2013-0013939)

This ruling shows that even though the municipality was implementing an important planning tool to avoid further groundwater pollution and guarantee sustainable and inclusive development, the Constitutional Tribunal favoured trade law principles over environmental protection.

Third, there is a lack of recognition of the importance of having public participation in decision-making regarding groundwater permits/concessions, planning or other management tools. For example, there is no specific requirement for public participation in order to decide how groundwater should be allocated and used in the water or environmental laws. However, there are some legal requirements in regard to participation in environmental matters, which can be extrapolated to groundwater. An illustration of this is Article 6 of the Environmental Law, which says that ‘It is the responsibility of the state and the municipalities to encourage the active participation of the inhabitants of Costa Rica in decision-making in relation to the protection of the environment.’ Claiming this principle, community

⁴ The Spanish name is Cámara Nacional de Productores y Exportadores de Piña (CANAPEP).

leaders in Guácimo organized in the environmental association Pro-Defence of the Natural Resources of the Caribbean⁵, presented an administrative procedure to the National Technical Environmental Secretary against a pineapple plantation. They argued that the plantation was violating the right to participation as established by the Environmental Law because no one in the communities had heard of the development of a new plantation, and that the company's Environmental Impact Assessment (EIA) was inaccurate and misleading. As stated by a participant, 'there were a lot of lies in the EIA ... they said that they had a consultation but it was a lie ... they did not involve the communities ...' (Interview No. 35, *Community-based organisation*, June 2014). The SETENA ultimately did not grant the environmental approval. The plantation could have performed a new EIA for obtaining environmental approval, but it did not, possibly because the company realized that this community was organized and well-informed and that they probably would not get approval.

Inadequate organization and toolbox, including implementation

From an environmental point of view, Costa Rica is organized into 11 conservation areas, which are administered by the National System of Conservation Areas (SINAC), which belongs to the MINAE. This Ministry is the lead public agency governing natural resources including surface and groundwater. However, policies and laws clearly separate surface and groundwater, creating overlapping responsibilities and institutional confusion. For example, when defining policies regarding groundwater, the leading institution is not MINAE and its entities but SENARA (see Table 1) which is an autonomous institution, subject politically to the guidelines of the Ministry of Agriculture and Livestock (due to its initial focus on irrigation when first created in 1973). Currently, SENARA is mandated to promote hydrological studies on the aquifers in Costa Rica and design policies to protect groundwater resources such as the *Water Matrix*⁶. In fact, the Constitutional Tribunal has highlighted that its opinions and recommendations are fully binding for all government institutions (Constitutional Tribunal, Resolution No. 2009-00262). However, in practice, that is not normally the case.

The two case studies reveal that there is an inadequate organization along with limited capacity and lack of enforcement when it comes to groundwater governance. As explained by a participant in Guácimo: 'when the problems started here, we went to MINAE for help but they send us to MAG, so we went ... once there, they sent us to the Municipality ..., the Municipality send us to SETENA ... it was really frustrating ...' (Interview No. 11, *Community-based organisation*, July 2013). In Guácimo too, the interviews reveal that there is considerable lack of enforcement. For example an interviewee mentioned that: 'We see lack of enforcement here ... first it was the deforestation ... then the application of agrochemicals ... you can really smell it when they are pouring the agrochemicals ... of course that provoked the river's pollution, the death of most of our fish ... and also groundwater pollution ...' (Interview No. 14, *ASADAs*, July 2013).

Additionally, the coastal communities' case study shows that even though mangroves are Protected Areas according to Article 58 of the Biodiversity Law and it is prohibited to change land use in forests according to Article 19 of the Forestry Law, such situations happen with regularity. In the words of an

⁵ The Spanish name is: Asociación Ambientalista Pro-defensa de los Recursos Naturales del Caribe.

⁶ For more information about the Water Matrix see Arias, 2012 'Vulnerabilidad y Protección del Agua Subterráneas: Valor de la Matriz del Uso del Suelo de SENARA' *Ambientico*, 228, 9–13.

interviewee: ‘We are worried because we feel that government institutions here in Santa Cruz ... are incompetent ... they do not implement proper controls ...’ (Interview No. 15, ASADAs, July 2013).

The government representatives in both case studies admitted to the numerous gaps in enforcing environmental and water laws. As expressed by a government interviewee in the coastal communities case study:

‘There is a lot of non-enforcement of environmental legislation here ... for example, we cannot supervise and control that everyone is using their groundwater concessions only for the amount of groundwater allocated ... we know that there are over 15.000 illegal wells too ... but we do not have enough personnel to come and close all illegal wells ...’ (Interview No. 34, Governmental agency, June 2014)

In order to complement government actions, the ASADAs in the coastal communities’ case study are actively engaged in groundwater protection. For example, the ASADAs in Tamarindo and Huacas have established protection zones for their groundwater sources. The Ordinance of the ASADAs includes clauses about delimitation of the protection zones of their water catchment; therefore, the ASADAs are legally authorized to implement them. The ASADAs have first purchased those lands and then implemented reforestation activities. As expressed by a participant:

‘We have bought a few hectares around our water catchment in order to protect that area, so nobody can come and buy them later and put at risk our water ... after we buy the land we are reforesting those areas ... we are doing that in the community of El Llanito ... and some organisations are donating trees, such as Coopeguanacaste’ (Interview No. 36, ASADAs, June 2014)

Buying these lands to guarantee water protection suggests that the ASADAs represent a good level (local) to address some prominent problems. However, all the members of the ASADAs who were interviewed said that the AyA is not providing them with enough support and training. As highlighted by an interviewee ‘The government hardly ever provides us with support and funding for monitoring ... it seems that the government has forgotten all the positive things that we provide to our communities ...’ (Interview No. 25, ASADAs, June 2014). Thus, this lack of support has prevented the ASADAs from working to their full potential.

Conclusion – towards inclusive and sustainable development

This article has investigated the challenges and opportunities for designing and implementing groundwater laws, in the Anthropocene, to achieve sustainable and inclusive development looking at the particular case of Costa Rica. It was demonstrated that despite the existence of normative internationally agreed elements such as the recognition of its public good nature and ownership rules, the laws lacked a number of key elements, namely, promoting sustainable and inclusive development, a proper definition, the principle of participation, the need of proper organization – at all levels – and supported toolbox, including implementation. It has also shown that, in general, groundwater regulations have been less well developed than other natural resources and surface water (Varady et al., 2013). This is because of the newness of large-scale groundwater development and limited awareness of groundwater issues.

The article has also demonstrated that even when there are provisions to regulate groundwater use, such as in Costa Rica (albeit in a limited fashion, disorderly and without a clear definition of groundwater), their implementation remains a major challenge mainly due to an inadequate organization and limited funding. The findings of this research demonstrated that in Costa Rica, as in many developing countries – and even in some developed ones (Varady et al., 2013) – government institutions perform poorly with imprecise mandates, inadequate staff and human capacity, limited political support or institutional authority, and inadequate budgets. This lessens the likelihood of goals such as public good, common ownership, citizen participation and ultimately sustainable and inclusive development.

Such problems have motivated community groups to get involved in groundwater governance in many diverse ways. For example, in Guácimo, presenting lawsuits against water lawbreakers and to pressure local governments through demonstrations to improve control on economic activities which are polluting groundwater. It also showed how organized local groups in the coastal communities such as the ASADAs have been actively involved in improving the governance of groundwater on the ground, e.g., denying new permits when aquifers are overexploited.

The actions taken by organized groups demonstrated that groundwater governance in practice in Costa Rica has been dominated by ad hoc responses to particular and urgent problems but not in a holistic and planned manner. Therefore, the main challenges are: (i) to approve a new, holistic water law which recognizes groundwater challenges and that includes the international design elements, which will help to have clear definitions, mandates, rules and overarching goals; (ii) public organizations dealing with surface and groundwater need to be restructured in order to have only one organization with clear responsibilities as well as more specialized public servants, e.g., hydrologists, adequate and ongoing funding for this Herculean task; (iii) there needs to be government support for research to raise awareness of the current groundwater situation and for the development of strategies to deal with avoidable groundwater problems (such as the ones discussed with the case studies). Additionally, funding (from government and non-government actors) must be made available to support leaders who are involved in groundwater governance, e.g., ASADAs.

The overall reflection of this article on groundwater governance in the Anthropocene in practice and the literature is that effective design and implementation of laws in developing countries are far from perfect and there is still a great deal of work to do in order to achieve the ultimate goal of sustainable and inclusive development. It is essential to reflect on and learn from existing challenges as well as opportunities so that it will be possible to create a more effective approach to design and implement laws for the challenges of the Anthropocene.

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Received 20 September 2017; accepted in revised form 16 December 2017. Available online 7 February 2018