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Governance and Governability of Groundwater in Arid Areas

Edwin Pino and André Steenken

Abstract

The crisis of governance and governability in the use of groundwater in coastal aquifers in arid zones is an element that contributes to the depletion and deterioration of the groundwater quality, due to processes of marine intrusion. Under the current exploration conditions, the governance crisis is characterized in the overall consumption of groundwater by humans, their animals, and by their industrials. Interpreting current national and international regulations applicable to this type of system confirms this area of investigation. This problem goes beyond the laws in all its terms regarding the management regimes and limitations on the availability of groundwater resources. If immediate actions are not taken by the government, the crisis of the system could become irreversible, with the consequent economic damage that this involves.

Keywords: governance, governability, depletion and deterioration of groundwater, arid areas

1. Introduction

The arid regions have, as their main limitation for their development, the serious shortage of water. That is the reason why established producers in these areas use groundwater, this being probably the only source of supply. Currently, most of the coastal aquifers are being over-exploited, which results in a gradual and permanent decrease in the water table, compromising their non-renewable reserves, causing the phenomenon of marine intrusion. Faced with this problem, government entities have been preparing plans for the exploitation of groundwater, with the purpose of exploiting the water resource in an efficient, organized, and sustained manner. In the same way, to evaluate the hydrogeological conditions and characteristics of the subsoil of the aquifer, which allows determining the exploitable reserve of water in quantity and quality, feasible to exploit, in a long-term sustainable way, and propose measures to improve its management and conservation.

In these aquifers, the water shortage has been exacerbated in recent decades due to the frequent presence of droughts, the expansion of the unauthorized agricultural frontier with the consequent incorporation of new wells without a license to exploit groundwater, the accelerated population growth of cities, and the multiple economic activities that this brings with it. However, these aquifers, due to the lack of an adequate exploitation program, have been overexploited, which has resulted in a gradual and permanent decrease in the water table, compromising their non-renewable reserves, which has caused the phenomenon of

marine intrusion due to the high concentration of underground water exploitation wells in the area close to the sea line. Rapid economic expansion creates serious problems with the use of groundwater in arid zones, which normally have high rates of depletion [1].

The world's main aquifers on which hundreds of millions of people depend are depleting at an alarming rate according to data obtained through Grace satellites and released by NASA of the 37 largest aquifers scattered worldwide, from India and China to the USA or France, 21 of them have exceeded their sustainability point, which means that more water has been extracted from them than has been incorporated over the 10 years of observation [2]. The NASA study confirms the suspicions that many researchers already had, especially in cases of aquifers that are not rechargeable due to rain. Likewise, a concern in the field of environmental sciences and environmental law itself is the notable deterioration and decrease of wetlands and groundwater, taking into account that one of its causes is the phenomenon of climate change [3].

Along with the natural processes that generate water deficit problems in aquifer systems, there are also problems of a social nature. Governance occurs in the sense that the State is considered as the central agent of society's leadership; thus, their concern centers on "the ability to govern," considering society as the entity to be governed and administered [4]. Thus, from the perspective of governance, the problem and its solution emanate from the capacities of the government, with some independence from society, while Governance is part of the recognition that the government lacks sufficient capacities to solve social problems.

Therefore, the objectives of this chapter are as follows: (a) we will refer to governability when it comes to the institutional part conferred on the government and its institutions, that is, its capacity and range of action; (b) we will use governance when we refer to the joint action of government and society for a common positive objective (such as development), in order to achieve a balance. (c) In order to achieve integrated water management goals, it is necessary to harmonize the conditions and environment dynamics of the populations in relation to the hydrographic basins and the hydrological cycle [5].

2. Governance and governability

Governance is denoted to have two closely related faces: the capacity to formulate adequate policies and the capacity to implement them. These capacities require the construction of consensus, the assembly of management systems, laws, national and regional public agencies, knowledge and information, practices, and the adequate administration of the system that implies social participation and the development of competences [6]. In the specific case of Chile, it has a water management system (SGA-CH) that can be considered as the only one of its kind, it considers water as a tradable commodity. This system is legally based on the National Water Code (CNA), which is at the same hierarchical level as the civil code [7].

After an exhaustive bibliographic review, seven versions of governance are identified that are highly relevant due to their degree of expression in the Colombian context and that are applicable to the South American sphere. These interpretations are shown in **Table 1** and **Figure 1** [8].

If we want to make optimal use of our valuable groundwater resources and ensure their sustainability, we must manage them with care [9]. In practice, the hierarchical and centralized management scheme in force for more than four

Governance approaches	Definition
Good government	It refers to processes and institutions that deliver results that satisfy the needs of society by making good use of available resources
Governing without government	Uses the laws of nature instead of legislation and one-way communication instead of dialog
Networks	Consists of several elements that are connected to each other
Self-government	Refers to the control of an organization by people independent of the central or local government
Economic governance	Refers to the policy and regulatory settings that governments adopt to manage the economy
Corporate governance	It refers to the set of rules, practices and processes through which a productive activity is directed and controlled. Corporate governance essentially involves a balancing of the interests of users, the government and the community
New public management	Is an approach to public service organizations that is used in government and public service institutions and agencies, at both sub-national and national levels

Table 1.
Governance approaches.

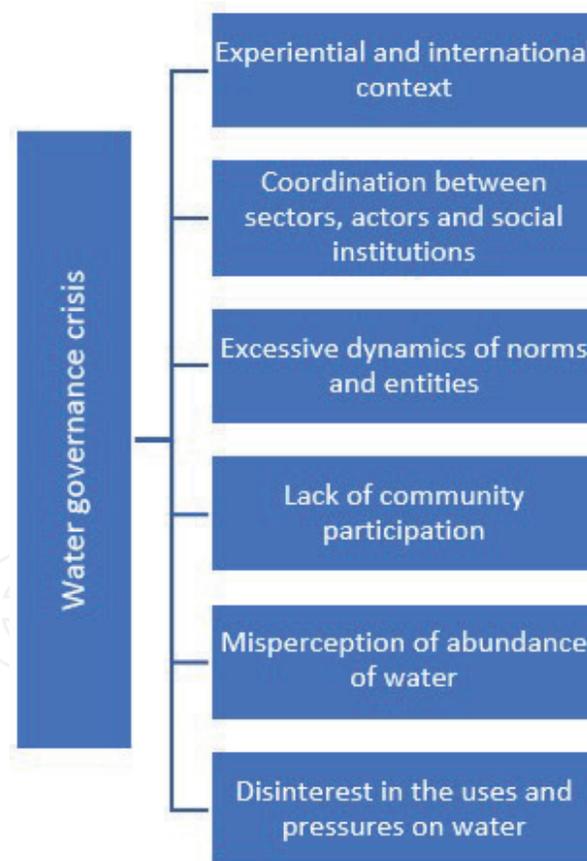


Figure 1.
Elements about the water governance crisis.

decades has been continued, and although the implementation of a water governance model from the perspective of Integrated Water Resources Management (IWRM) seems quite distant, there is the possibility of launching public actions from the territories from which networks are structured, articulate interests, and undertake collective actions [10].

3. The Dublin declaration

In the Dublin statement, according to international meetings on water resources management, it is recognized that water is essentially an economic good. Economists have insisted on the need to recognize that water is an economic good, so it should be possible to govern its distribution through the market [11]. There are a large number of approaches that explain the difficulty in improving water management systems, among them we have the lack of methods to design strategies that allow moving step by step from an existing situation to a desired situation [5].

The Dublin principles and the coherent action plans were collected at the Earth Summit held in Rio de Janeiro, in Chapter 18 of Agenda 21 [12], in the following terms: "A global ordination of fresh water as a limited and vulnerable resource and the integration of sectoral water plans and programs, within the national economic and social policy, are measures that are of the utmost importance among those adopted in the 1990s." There are controversies over the issue of the results of changes in water governance. This, we believe, can best be characterized as an effect identification problem and concerns the question of the effects of changes in governance on a wide variety of empirical phenomena and associated policy issues [13].

4. International instruments on groundwater use

It can be said that rarely, international law has taken into account groundwater, being known that there are many surface water treaties, groundwater is not nominally included in the scope of these instruments, especially if it is "related" with territorial surface waters. Some legal instruments contain specific groundwater conditions and do not address it exclusively. FAO and UNESCO provide a variety of mandatory and non-mandatory instruments of international law in this important field [14].

Likewise, there are directives on water resources and environmental treaties that contain provisions on groundwater, as is the case of the United Nations Convention to Combat Desertification in those countries that suffer severe drought and/or desertification, particularly in Africa. There is also the United Nations Convention on the law of the uses of international watercourses for purposes other than navigation. These statements are important but are generalized to resources of all kinds and in the second case to international watercourses, not being specific to the groundwater issue, being a strategic basis to address it.

There are also interstate agreements on groundwater or with groundwater provisions. United States, Idaho - Washington in the special form of the Inter-institutional Agreement on Coordinated Management Aquifer Groundwater Pullman-Moscow [14], it is agreed that management of groundwater resources in the aquifer will be in accordance with the management plan of groundwater adopted by the Pullman Moscow Water Resources Committee (PMWRC) to the extent that such plan can be implemented and administered according to the laws of each state.

5. National instruments on groundwater use: Peruvian case

In Peru, the granting of rights to use groundwater is regulated in Title IV of the Water Resources Law (article 110). In the aforementioned law, two additional provisions are required: the first states that in case of cessation of the use, either permanently or temporarily, the holders of the rights must adopt the necessary security measures in order to avoid causing damage to the aquifer and third parties. The second indicates that it is the obligation of groundwater users to install

and maintain piezometers in the quantity and separation determined as provided by the corresponding authority, information which must be communicated to the “Autoridad Nacional del Agua (ANA)” [15].

According to Supreme Decree D.S. N ° 080-84-AG of September 6, 1984, the underground water of the pampas of La Yarada, and the D.S. N ° 020-87-AG of May 1, 1987 gives an extension for two more years. By means of Ministerial Resolution No. 0555-89-AG/DGAS of December 5, 1989, the execution of works intended to extract groundwater in the pampas of La Yarada is prohibited, later by RM No. 696-98-AG of December 16 of 1998 and based on the hydrogeological study of the Pampas de La Yarada, the closure of the increased exploitation of groundwater in the aquifer is declared. With a ruling by the Constitutional Court through a ruling issued in file No. 1290–2002-AC/TC, it ruled on the declaration of closure and the non-application of regulations for the regularization of water licenses in the area declared closed.

Regional Ordinance No. 009-2004-CR/GOB.REG.TACNA, declared of regional interest the intangibility and conservation of groundwater and rough land in the state of the pampas of La Yarada. In 2006, by means of Supreme Decree No. 065-2006-AG, the conservation and preservation of the Caplina valley water resource was declared of public necessity and national interest, extending the closure to the entire Caplina aquifer, ratifying it in the year 2009 through RJ N ° 327-2009-ANA of June 15, which declares the aquifer of the Caplina river valley closed, where the La Yarada aquifer is included, the prohibition of execution of groundwater exploitation works and the provision that the Local Water Administrators are responsible for the control and surveillance of the aquifers that are in their respective jurisdictional areas.

The R.J. N ° 201-2010-ANA, of March 22, 2010, ratifies the measures for the conservation and preservation of groundwater, based on the study “Numerical Modeling of the La Yarada Aquifer”, which concludes that there is an overexploitation of the aquifer and recommends maintaining the closure of the exploitation of the aquifer system. Finally, in 2015, the D.S. N ° 007-2015-MINAGRI, in its second complementary provision establishes that “The areas declared closed prohibit their condition, proceeding exceptionally and for the only time to formalize or regularize water use licenses, in accordance with the provisions of this Supreme Decree”.

6. The crisis of governance and governability

Governance refers to the management of collective affairs and involves the articulation of rules of conduct and the agreement of principles for the allocation of resources within the framework of a political community [16]. Likewise, governability has to do with the choice of goals and values that should guide society [17]. In Peru, we can affirm that there is no dispersion of legal provisions, nor a profusion of laws, which if we estimate is to find both conceptual and strategy and action gaps, which are really important. In most cases, the provisions are outdated and unrelated to the regional and national reality. Likewise, we currently have important instruments such as the integrating principle in water management, which is absent in the government actions taken to face the problem of the La Yarada aquifer.

The fragmentation of the actions regarding water management in the aquifer system is a relevant problem, the institutions act in isolation and without coordinating the joint actions necessary to treat the problem. This denotes that there is a governing body of water management policies in the country such as the ANA, which is perceived to have no technical and regulatory solvency to execute current water legislation on the La Yarada aquifer. The regional and local government has no participation in the management and territoriality of the water in the aquifer system.

There are limitations to the effectiveness of governance and it lies in the relationship of groundwater with society, there is a conception of water with inexhaustible resources, a culture of non-payment for water and the lack of responsibility for environmental protection. Regarding public policies and their incorporation strategies, these are practically nil, the fragmentation of policies is notorious and most importantly, there is fragility of state institutions, related to the issue of groundwater, for the control of use and its exploitation. The lack of government planning to achieve an adequate use of water is notorious. We can also identify a lack of education on the preservation and sustainable use of groundwater in the La Yarada aquifer system.

The management of the system is a latent problem, the legislation on penalties for water use crimes without authorization or without licenses or permits is not clear. There is no reliable inventory of existing wells with and without using authorization; therefore a water balance cannot be specified by region and considering levels of vulnerability. The incorporation of municipalities, governorates, and other institutions in the management of groundwater is sought through the formation of the Caplina - Locumba Water Resources Council, created by Supreme Decree No. 019-2013-AG, as a space for agreement in which the institutions and organizations of the region, linked to the integrated management of water resources can present their needs, projects and claims, in order to plan and coordinate the sustainable use of water in the basin. In the constitution of this council, serious conformation problems have been reported, some of its members, especially the president of the council, do not meet the requirements indicated in Law No. 29338, the Water Resources Law and its regulations, this situation ends up establishing a climate of mistrust regarding non-compliance with the law from the same governing entity of the use and conservation of water in the country, that is, the ANA.

7. Governance and governance models

Improving water governance is the key to address water insecurity in developing countries. The literature does not pay attention to the study of incentive structures, interdisciplinarity and orientation with clear political implications [18]. In the Fung and Wright model [19], the governance approach is presented as a non-hierarchical form of government, characterized by cooperation with non-state actors within mixed decision-making networks between the public and the private [19].

The UNESCO model of water governance is a theoretical model that focuses on government issues. The purpose of this is the formulation of policies and their execution by the State. The model is integrated by the dimensions, social, economic, of political training, and environmental sustainability [20]. In Musetta's hydraulic leviathan model [20], emphasis is placed on a centralized State, strong in terms of state presence, a State that plans and develops, that builds large works of hydraulic infrastructure (dams, dams, irrigation systems) and in this measure the potential of your strength. It is also a State that organizes the other actors in the economy and society, and never delegates the management of this position [21].

Guhl's hard and soft line model [22] are a theoretical model, in the hard line, focuses on increasing the supply of water and making it more stable in time and space, through the construction of infrastructure works that allow us to have a greater and more stable supply of water throughout the year, or availability in areas with deficits. Its fundamental objective is the conservation of the water supply and its efficient use; it gives comprehensive consideration to the hydrological cycle based on changes in attitudes and behaviors of the users regarding the valuation of water as a finite resource and the consequent limitation of its availability and development and use of more efficient technologies [22].

8. Proposal for the adoption of a governance model: La Yarada aquifer case

As mentioned, there are several models applied in different parts of the world, each with certain peculiarities. Based on the characteristics of the La Yarada aquifer system (**Figure 2**), due to the characteristics of the state's intervention in the economic activities of the region and the country, we can establish that the Mussetta hydraulic leviathan model is the best suited to the particularities of the aquifer in question. This is a strong model in terms of state presence, plans, developments, and works of hydraulic infrastructure. It is the State that in turn organizes the other actors in the economy and society, and never delegates the management of this position. This type of action is required in a system such as the one studied where there is a general disorder, regulations and laws are not complied with, the stability of the aquifer system having been put in a chaotic situation, while the recharge is much lower than the exploitation because unauthorized users have been generated to whom no sanction has been applied.

A clear example of the weakness of the State and its institutions is registered with the grant of the D.S. N° 007-2015-MINAGRI, which establishes that “the areas declared closed prohibit their condition, proceeding exceptionally and for the only time to formalize or regularize water use licenses, in accordance with the provisions of this Supreme Decree.” This decree is totally contradictory, existing the RM N° 696-98-AG that ratifies the closure in the La Yarada aquifer, the formalization of licenses for unauthorized wells is decreed, which has generated a great imbalance in the system, which has produced not only a decrease in the water table but also deterioration of water quality due to marine intrusion processes in a large part of the aquifer, as demonstrated by studies carried out by ANA.

The post emission experience of the D.S. N° 007-2015-MINAGRI has shown that the situation worsened, in the period of time granted for the presentation of files, a massive and uncontrolled action was made to drill wells in the study area in

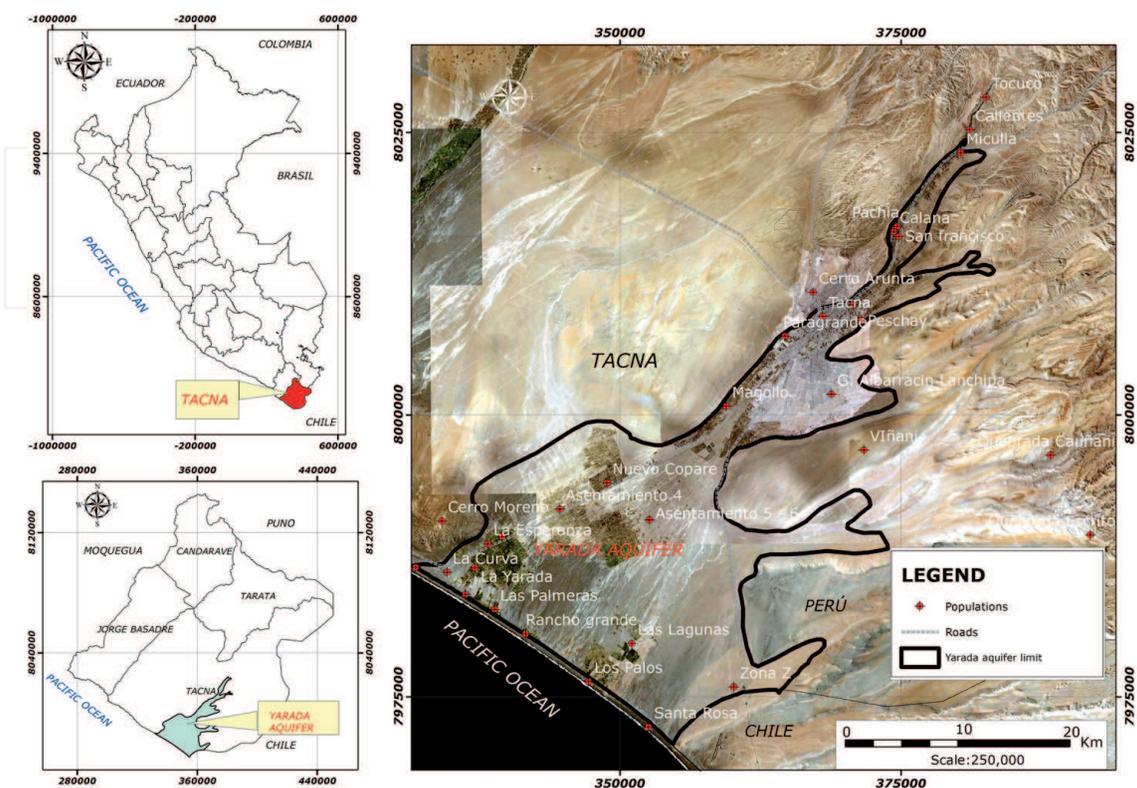


Figure 2.
 La Yarada aquifer location map.

order to achieve the regularization of the groundwater exploitation infrastructure. Likewise, after the regularization process carried out, well drilling continues indiscriminately, with which it is demonstrated that the effect, more than a palliative to the problem, was a trigger for the drilling of wells without control, ignoring the regulations current and most worrying, an attempt was made to implement an action without the required control and security mechanisms.

According to the particularity of the La Yarada aquifer system and water management in Peru, it is observed, from the perspective of water governance, the presence and actions of social groups have increased over the years, exerting strong pressure on the aquifer. Thus, we can establish that the transition from governance to governance presents indicators that the institutions have not adequately managed their tasks and responsibilities and that the social agents have gained a presence in the excessive extraction of water from the aquifer, without the authority being able to intervene in concrete form. No sanctions are applied for violators of the laws and restrictive devices for the use of aquifer water, generating an increase in extraction wells that have grown geometrically in recent years with the consequent deterioration of the quality of the water in the aquifer.

9. Conclusions

Government policy in many countries of the world generates a serious collision between closed regulations on coastal aquifers and, on the other hand, decrees authorizing the formalization or regularization of water use licenses. This situation generates negative antecedents of government policy in the administration and management of water and in general of all-natural resources.

Governance and governance are altered and exceeded, the laws regarding the regimes of management and limitation of groundwater resources, both have qualities that could provide a relevant benefit for the sustainable use of water resources, if no immediate action is taken. On the part of the government apparatus, the crisis of the system could become irreversible with the consequent economic damage that this entails. In the area, there are large extensions of plantations that are the support of economic activity.

In the Peruvian case, it is necessary to have a specific regulatory framework for groundwater that recognizes its particularity. Institutions in the field of Water Law must be consolidated and strengthened, not being a unique need in the case of groundwater, but in general for water resources in all its forms. Therefore, the efficient and transparent participation of the public administration that allows adequate water management for sustainable use is urgent. In the Peruvian case, it would be advisable to adopt the Mussetta hydraulic leviathan model, strong in terms of state presence, planning, developing, and building hydraulic infrastructure works. In turn, the State is the one that organizes the other actors of the economy and society, and does not delegate functions. This type of action is required in a system such as the one studied, where there is a general disorder, regulations, and laws are not complied with, the stability of the aquifer system being put in a chaotic situation, while the recharge is much less than exploitation because unauthorized users have been generated to whom no sanction has been applied.

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