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Regulating groundwater use: The challenges of policy implementation in Guanajuato, Central Mexico

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ABSTRACT

Around the world it has proven very difficult to develop policies and interventions that ensure socio-environmentally sustainable groundwater use and exploitation. In the state of Guanajuato, Central Mexico, both the national government and the decentralized state government have pursued to regulate groundwater use through direct state control, groundwater markets, energy pricing, and user self-regulation. We present and analyze these regulatory mechanisms and their outcomes in the field. We argue that the close interdependencies of these regulatory mechanisms have pre-empted the effectiveness of these policy instruments as well as that of other measures aimed at reducing groundwater use in order to advance towards sustainable exploitation levels.

1. Introduction

Groundwater has become the mainstay of many societies around the world. In many regions of the world, it is the primary source of water for domestic, urban, agricultural and industrial use (Burke and Moench, 2000; Shah et al., 2003, 2007). Vast quantitates of high quality fresh water is stored in aquifers and is usually easy to access with tubewell technologies. Users located above an aquifer can by-and-large sink and operate wells autonomously of each other over a significant areal extensions (Kemper, 2007). This makes groundwater a reliable source of water. According to Shah et al. (2007: 409), groundwater is often available on site; it has an important inter-annual storage buffer that is highly reliable; and it is highly flexible, providing its users with on-demand, just-in-time water when they need it. Therefore it is not surprising that for urban and rural domestic water provision as well as for industrial uses and agriculture, when available, groundwater is the preferred source of water. This has led to intensive and unsustainable groundwater use in many areas of the world with dire socio-environmental impacts (Hoogesteger and Wester, 2015).

In most countries, despite attempts to regulate groundwater use no significant reductions in groundwater extractions have been achieved. Common mechanisms include drilling bans, regulatory control through rights systems with assigned volumes, electricity pricing, and the regulation of drilling companies. Yet, in nearly all areas of intensive groundwater use, water users continue to have nearly unconstrained control over their pumps (Shah, 2009; Giordano, 2009; De Stefano and Lopez-Gunn 2012; Frija et al., 2014).

In this context the state of Guanajuato, located in Central Mexico (see Fig. 1), offers and interesting case to analyze the challenges that groundwater regulation and governance pose. Mexico has for years been an international show model in terms of water policies; including groundwater (Mukherji and Shah, 2005). Within Mexico, Guanajuato spearheaded the decentralization policies of the 1990s and as part of it started to work with Aquifer Management Councils (Wester et al., 2009). At present in the state all industrial and 99% of urban water supply is groundwater based; and a vibrant groundwater irrigated agricultural sector that consumes 84% of all extracted groundwater occupies over 260,000 ha (CEAG, 2016). According to official data the extracted volume oscillates around 3900 Million Cubic Meters (MCM) per year and recharge is estimated at just below 2800 MCM/year; the annual deficit surpasses 1000 MCM/year (CEAG, 2016). Aquifer levels are dropping on average between 2 and 3 m a year (Wester et al., 2011), land subsidence has become a problem in many regions of the state (Hoogesteger, 2004), tubewells dry up and need to be deepened or replaced and extensive pockets of arsenic and fluoride contamination have appeared in the north and center of the state forming a threat to public health (Gevaert et al., 2012; Ortega-Guerrero, 2009).

State initiatives to regulate groundwater use have been in place since the early 1950s (Wester, 2008). In 1992 a new national water use permit system was implemented that importantly included the possibility of groundwater rights transmissions (Reis, 2014). Energy pricing mechanisms have also been used (Scott and Shah, 2004). Inspired by ideas of user self-regulation, in the 1990s the state government of Guanajuato created Aquifer Management Councils. In parallel subsidies

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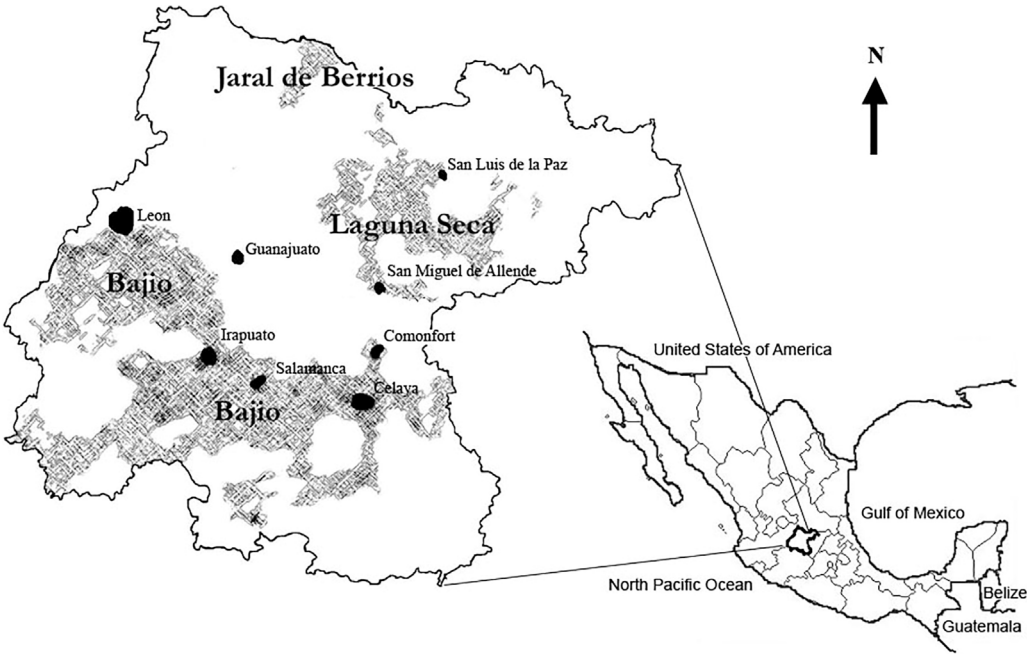

Fig. 1. State of Guanajuato, Mexico with areas of intensive groundwater use (Bajío, Laguna Seca and Jaral de Berrios) (adapted from Wester et al., 2011).

were put in place to stimulate the modernization of irrigation systems. These aimed to reduce groundwater use in the agricultural sector. In this contribution we analyze these policy interventions through the analytical lens of normative structures (Reimer et al., 2008). Based on our analysis we show the interrelatedness of these measures and discuss the challenges there are for achieving equity and sustainability in groundwater use in Guanajuato as elsewhere.

This article is based on fieldwork of both authors over the past 20 years. Data collection consisted of literature review, grey literature collection, structured and semi-structured interviews with farmers, staff of non-governmental organizations, state agencies, the Aquifer Management Councils, agro-export companies, drilling companies and policy makers. Several meetings and events which brought these actors together were attended and observed. Data collected from these different sources was triangulated to ensure their validity (Mason, 2002).

2. Normative structures and groundwater regulation

Groundwater is very often characterized by the basic resource features identified by Ostrom (1990) as Common Pool Resources (CPR) (see also Knegt and Vincent, 2001). Common pool problems or dilemmas arise when individually rational resource decisions bring about a result that is not optimal when considered from the perspective of the group; thus CPR are public goods with finite, or subtractive benefits (Ostrom, 1990). In the case of groundwater, when one user uses more, less remains for the others. When no regulatory frameworks exist users have neither carrot nor stick that incentivizes them to restrain or reduce their resource use; the self-interest of the individual users then easily leads to over-exploitation.

According to Ostrom (1990), the policy solutions that emerge mostly fall under: state control; market regulation or the creation of institutions for self-regulation (see also Agrawal, 2014; Araral, 2014; Lejano et al., 2014; Lejano and Fernandez de Castro, 2014). The basis for these different policy instruments is the creation of a normative framework that regulates the behavior of individuals for the benefit of the collective interest. A normative framework establishes a set of rules about rights, obligations and sanctions that create reciprocal expectations about the behavior in and amongst the resource users and the institutions responsible for its implementation; that is social capital.

The term social capital was developed as a way to better understand how and why individuals benefit from social relations (Bourdieu, 1977; Coleman, 1990). Today social capital has become a framework for 'analysing the functional value of social relations and organizational networks, as well as their influence on economic outcomes and state accountability' (Perreault, 2004:329). The term has been widely used in the analysis of natural resources management arrangements including groundwater (López-Gunn, 2012; Nenadovic and Epstein, 2016; Rica et al., 2012).

Social capital is engrained in the structure of relationships and can be defined as 'the ability of actors to secure benefits by virtue of membership in social networks or other social structures' (Portes 1998:6). The presence of reciprocity in networks (which often goes paired with trust) forms the basis for people to engage in actions that are of mutual benefit. Normative structures maintain and organize the connections in these networks by establishing 'reasonable' expectations concerning what others will do through 'systems of sanctions and incentives that ensure consistency in those actions' (Reimer et al., 2008: 259). These same authors identify four different kinds of normative structures that organize and guide the social relations through which people accomplish tasks, legitimize their actions, structure their institutions and distribute resources. These are (p. 261–263):

- Bureaucratic relations: These are legal relationships established by nation states at different levels. They are based on generally applied laws and legal decrees that are implemented through state based institutions and administrative systems to guarantee 'order' within society. The granting of entitlements, the protection of the rights that are imbued in these entitlements and the control over the fulfilment of the responsibilities that accompany this grant to groups and individuals is the responsibility of designated state agencies.
- Market relations: These revolve around the exchange of goods and services among people that relate to each other as free actors. For these relations to function trust among the engaged actors must exist with regards to the agreed upon exchanges as well as its terms and conditions.
- Associative relations: Associative relations emerge among people that come together for achieving a shared goal for which collaboration is required. Associative relations build on a set of normative frameworks (formal or intensely socialized) that establishe what people are expected to contribute and with what benefits to them