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Articles

Tensions in governance from below: Independent water systems in the municipality of Huajuapán de León, Oaxaca, Mexico

Tensiones en la gobernanza desde abajo: sistemas independientes de agua en el municipio de Huajuapán de León, Oaxaca, México

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Abstract

The objective of this research is to analyze the tensions faced by the *SIAs* (Independent Water Systems) in Huajuapán de León, Oaxaca, through the Governance Analytical Framework (GAF). Using a qualitative methodology, we studied four cases through twenty in-depth interviews with representatives of citizen committees and municipal authorities in charge of water management. The results indicate that the SIAs are institutions established and managed by their own users, who have consolidated and sustained local water management. However, we detected three main tensions that the systems face: first, due to the payment of the electricity necessary for the removal and maintenance of the supply system; second, because of the coverage and expansion of infrastructure due to increasing urbanization; and third, due to the defense of water control according to the municipal operating agency. We concluded that the SIAs represent an alternative in water management within the municipality, which the law must consider in the water regulations for the protection and use of it. These experiences allow us to distinguish a type of governance from below, from the habitants of the communities, in which they developed organizational ways that, besides solving local access to water, demonstrate how they care for and defend water for the maintenance of life in their community.

Keywords: Independent water systems, governance from below, tensions, water management, supply, sanitation.

Resumen

El objetivo de esta investigación es analizar las tensiones que enfrentan los sistemas independientes de agua (SIAs) en Huajuapán de León, Oaxaca, México, a través del marco analítico de la gobernanza (MAG). Con una metodología cualitativa se estudiaron cuatro casos con un total de veinte entrevistas en profundidad a representantes de comités ciudadanos y autoridades municipales encargadas de la gestión hídrica. Los resultados señalan que los SIAs son instituciones establecidas y administradas por sus propios usuarios, que han consolidado y sostenido la gestión local del agua; no obstante, se detectaron tres tensiones principales que enfrentan: la primera, por el pago de la electricidad necesaria para la extracción y el mantenimiento del sistema de suministro; la segunda, por la cobertura y ampliación de la infraestructura a causa de la creciente urbanización; y la tercera, por la defensa del control del agua con respecto al organismo operador municipal. Se concluye que los SIAs representan una alternativa en el manejo del agua dentro del municipio que deben ser considerados en la normatividad hídrica para el resguardo y aprovechamiento del agua. Estas experiencias permiten distinguir un tipo de gobernanza desde abajo, en que se gestan formas organizativas que aparte de resolver el acceso local al agua, exponen formas en que cuidan y defienden el agua para la reproducción de la vida en su comunidad.

Palabras clave: sistemas independientes de agua, gobernanza desde abajo, tensiones, gestión del agua, suministro, saneamiento.

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Introduction

Currently, water governance in Mexico is a concept used as a political tool, which seeks to transform the relationship between government and society through the adoption of international policies such as Integrated Water Resources Management (GIRH). It, under the guise of solving water problems, may hide a perverse way of legitimizing the dispossession of water for the benefit of the market rather than society. From this perspective, governance takes a top-down approach, where the government establishes the mechanisms of action to involve citizens in political decision-making that superimposes the interests of the productive sectors and the market over water as a human right (Tagle-Zamora, Caldera-Ortega, & Fuente-Carrasco, 2019). However, there are experiences of another type of governance, from below (with the participation of the people in the community) such as the SIAs (Independent Water Systems), which are social organizations that provide water services, through a network of self-managed local water

infrastructure and they have provided themselves with internal operating management rules. Anyhow, the national water regulations do not recognize these local institutions.

SIAs operate in community schemes that are self-sufficient with water; therefore, they are a concrete social phenomenon, which helps us understand the exercise of local governance. Presently, the SIAs have a dispute over the control of water in their locality, refusing to relinquish their command and administration to the municipal government, so there are tensions that need to be analyzed in order to understand the conflicts that take place within the municipal hierarchy.

Within municipalities, SIAs are a viable alternative for water supply in urban colonies or rural communities, sometimes the only one available to access the water (Palerm-Viqueira & Martínez-Saldaña, 2013). Unlike Municipal Water Operator Systems (MWS), SIAs can provide an additional benefit, in terms of water quality and quantity, to the communities where they employ (Gumeta-Gómez, Durán, & Bray, 2016; Galindo & Palerm, 2016). Nonetheless, this type of local governance is not recognized within the official involvement with the National Water Law (LAN).

Despite the documented benefits of this type of organization, there are attritions they face in the exercising of local governance. Hence, the objective of this paper is to analyze the tensions of four SIAs, in the municipality of Huajuapán de León, Oaxaca. The presented research questions are: what are the governance processes that have initiated the SIAs? What scopes have they achieved? And, what difficulties do the SIAs face, regarding water management and control of it in their locality?

We have organized this document in four sections: the first one analyzes water management in Mexico through the LAN, under a critical perspective towards IWRM as an institutionalized instrument of a normative governance, to propose the distinction between two governance perspectives: from above and from below. This allows us to show the limits of water management by basins, and to incorporate into the debate the contributions of local governance driven by society and from below. In the second section, we present the qualitative methodological design to identify governance processes through the Governance Analytical Framework (GAF). The third section shows the results and discussions regarding three fundamental tensions that local systems face. Finally, the fourth section presents the conclusions in order to contribute to the discussion of the relevance of SIA in the defense of water.

Water management in Mexico: a Top-down approach to governance

In Mexico, the National Water Commission (Conagua) manages water resources in two geographical areas: national and regional. At the national level, the authority regulates water, in terms of quantity and quality, by different assignments, and through state and municipal disaggregation.

At the regional level, this institution administers water through concessions, and through basin organizations distributed in thirteen RHA 'Hydrological-Administrative Regions'.

According to the Official Journal of the Federation (DOF, 2010), the Conagua complies with the Territorial Circumscription Agreement of the Basin Organizations (ACTOC). This agreement establishes that each RHA must respect the territorial limits of the municipalities, in order to manage and administer water in an adequate manner between municipality and basin. Therefore, the RHAs were established according to the delimitation of the 757 water basins and the 2466 municipalities of the country (Conagua, 2018). It is important to point out that, despite this agreement, no substantial progress has been made in coordination between municipalities and basins, since, in most cases, municipalities or basin users do not abide with the provisions indicated in the LAN according to the consumptive use of water (Barkin, 2006).

To coordinate basin users, the LAN promotes a prescriptive type of governance, which seeks to include social participation in this matter through IWRM. However, the government carries out this type of governance from a top-down perspective and on a large scale (national, state and municipal), without considering social actions carried out from below and on a local scale, such as SIAs (Galindo & Palerm, 2016).

GIRH in Governance from Above

GIRH has its origins in international politics, which have been promoted through different declarations, conferences, forums and world meetings about water, where they identify the water crisis as a governance issue (UNESCO, 2006). As a top-down institutionalized instrument, GIRH represents a type of governance driven from international spheres, such as the Global Water Partnership (GWP). GIRH aims to drive economic development without damaging the balance of the planet's ecosystems (WWAP, 2015). Consequently, in Mexico's water policy, they developed a process to move towards GIRH and include the governance approach, from the top down.

This transition began with the publication of the LAN in 1992 (DOF, 1992), and its reform in 2004, which sought to implement processes of liberalization and privatization of water resources (DOF, 1992). In addition, this law aimed an integrated water management through water basins by means of non-formal institutions, but recognized as basin councils, committees and commissions (Conagua, 2007). Therefore, the LAN intends that these instances function as spaces for citizen participation in decision-making. With these layouts, the LAN incorporated the governance approach; but this aspect has been highly criticized in academic research (Mussetta, 2009; Murillo, 2012).

Aboites-Aguilar (2009) and Mussetta (2009) mention that, between 1980 and almost until 2010, a transition process began in Mexico concerning water politics. The State had an exclusive power and authority over water known as "Water of the Nation" or "hydraulic Leviathan" towards a new phase in its management called water governance. Since

2004, with the reform of the LAN and through GIRH, the basin organizations are the basic units of technical, administrative and legal operation that govern water management (Conagua, 2007). With a mercantile-environmental sense, GIRH authorizes the intervention of official users and private investors, even above the political-administrative administration of the states and municipalities.

Murillo (2012) argues that water governance, through GIRH, justifies a model of "hydraulic cynicism in Mexico", as its inclusion methods are organized to override diverse political views. For these reasons, there is a growing interest in investigating true social participation in water management through real governance (Mussetta, 2009; Domínguez-Serrano, 2011; Murillo, 2012; Pacheco-Vega, 2014; Martínez & Espejel, 2015).

In this new phase, it can be seen that the incorporation of governance into water politics in Mexico takes on a clearly top-down approach, i.e., citizen participation is understood and operated through basin councils made up of the three government levels, organized society and "legally recognized users" (Figure 1). Yet, what does this legal recognition mean? Actually, this feature operates as an exclusionary device. Only the actors, who manage to register their legal personality and go through the consequent bureaucratic process, will have the prerogative of voice and participation. From this perspective, it is worth asking ourselves: What happened with the ones below? What about the citizens and common users of the public domestic water service?

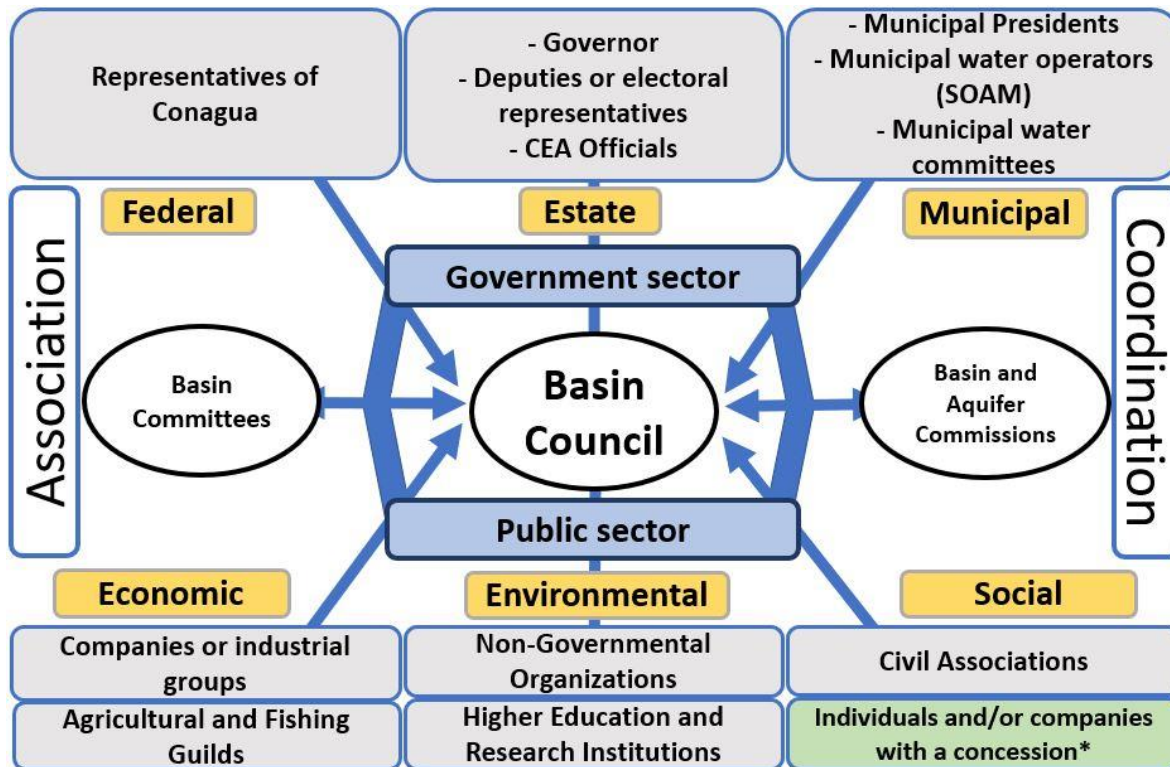


Figure 1. Members of Basin Councils and Organizations. *SIAs may fall into this category, but in reality, the Basin Council do not consider them part of them, because their operation generates tensions with the SOAMs at a municipal level.

In Mexican water policy, GIRH has implemented itself in a normative way; it prescribes how society's participation should be. Therefore, when we analyzed its application, we realize that there is a distinction in between institutional (normative) governance and actual (social) governance.

Governance in the normative sense aims to adjust a social situation that points out as in a "must be" discourse. In the case of water, GIRH

takes on the character of good water governance. It seeks to involve the government and the various social and economic actors in water management through co-responsibility in water management. Therefore, this type of governance seeks to regulate a horizontal form of government, characterized by the cooperation of non-governmental actors in the decision-making process (Aguilar-Villanueva, 2006).

According to this approach, GIRH regulates a coordinated progress of water, through three dimensions: economic, social and environmental. For this reason, as a normative political project, GIRH aims to encourage government intervention that combines social participation, with efficiency and justice, without privileges or corruption (Domínguez-Serrano, 2011).

At a global level, it is recognized that its execution has led to progress in the political-public integration of water resources, however, the UN mentions that the economic aspect has predominated in comparison with the social and environmental ones (Connor, 2015). Therefore, normative governance, through GIRH, has not been able to consolidate in the countries where they have tried to implement it. At a national level, its application in Mexican water management is questioned, given that in the LAN the economic use of water has predominated, through the opening of commercial macro-projects, where transnational companies, agro-industry and mining have monopolized water reserves (Murillo, 2012).

The Mexican academics have highlighted various tensions generated by the application of GIRH, where governance has fulfilled itself as a marker to promote the market as the one who controls the regulation

of water resources (Castro, Kloster, & Torregrosa, 2004; Mussetta, 2009; Murillo, 2012; Rivera & Aguilar, 2015). Even Aboites-Aguilar (2009) warns that governance promotes reformism, seeking for commercial interests to privatize this resource to the detriment of society and the environment.

The ambiguity of the LAN and GIRH is a factor that generates tensions, regarding the ownership of water, which according to the LAN, belongs to the nation. Following Barkin's ideas (Barkin, 2006) there is an ambivalence in the water laws, since on one hand GIRH grants concessions and allows large consumer companies to have control over water, while water from the same basin is used in agricultural or public service activities, as in the case of the SIAs. This legal indetermination is the cause of many tensions whether at the governmental or social level. Therefore, the public water service presents disputes for the domination and management of water between local, municipal and state governments.

A recent example is the release of the 10 water edicts in the DOF (2018), which lift the closures of national waters in the hydrological basins to favor the great demand for water required by the industry for productive uses, neglecting its management and social use within the municipalities. According to Tagle-Zamora, Caldera-Ortega and Fuente-Carrasco (2019), the 10 edicts represent the beginning of a process of privatization and commodification. They use this process as an argument to justify governance - from the top - under a discourse of social inclusion that does not consider at all or just a little the users and citizens of urban and rural locations that may be affected by privatizations that only benefit entrepreneurs, or powerful agro-industries.

From this perspective, the main criticism of GIRH is that it does not represent or match the real participation that exists, since its social openness is limited, with a biased distinction to formally recognized users. Participation through GIRH privileges certain types of parties, which do not ensure a plurality in social representation. Therefore, it is worth asking the following question: does water management through GIRH diminishes social participation for water within the local environment? For this reason, this study seeks to discuss what type of governance is represented by the local systems that have been shaped by citizen organization for domestic and public water use.

Currently, social participation in GIRH only remains in the discourse, because the intervention in these instances built from above is very limited for citizen integration, given that the participation bodies are only made up of representatives of the three orders of government, civil society and social guild leaders. Because of this situation, we recover the distinction between this top-down approach of governance and another from below (Tagle-Zamora *et al.*, 2019) to analyze it from the understanding of organizational processes of the SIAs. This allows for the provision of a water supply, superimpose the social aspect on the commercial and present tensions both internal to the organization and external to the public water service offered by the municipal government.

Basin councils are the ones who structure the basin organization. These councils are integrated by different actors to intervene in water management. They include government representatives registered at the federal, state or municipal level, as well as various civil or social representative organizations. The basin councils seek to coordinate water

management, as well as to reach agreements, support and advice between their guild and the Conagua (Conagua, 2007).

In this context, citizen participation in GIRH requires membership of public-private partnerships or organizations registered with a basin organization. In this way, social participation is circumscribed to a formal mechanism of cooperation, rather than participation for water. Since, officially, participation simplifies itself by being part of some of these organizations, which do not consider local actions as part of official governance (Guevara-Gil & Nuñovero-Cisneros, 2019).

A fundamental requirement for social intervention is to have some kind of concession or be part of the allocations that are given to government agencies. The Public Registry of Water Rights (REPDA) records the consumptive use of water based on the volume of water granted in concession or assigned to official users in the country. In 2017, the REPDA had 542 071 concession titles registered, which cover one or more uses or permits: 122 810 concession or assignment titles for surface water; 285 409 for groundwater; 17 439 permits for discharges, and 116 413 for extracting materials from water bodies belonging to federal zones (Conagua, 2018).

Conagua classifies these concession titles according to the four uses of water: a) in agriculture, water incorporated into the livestock and aquaculture sector, among others; b) in public water service, it includes domestic use; c) in the self-supply industry, it combines industry, commerce, and services; finally, d) in electricity, it includes thermoelectric plants (Conagua, 2018).

Governance from below

Approximately half of the 2 466 municipalities in Mexico have a local water system that manages itself independently from the municipal government (Palerm-Viqueira & Martínez-Saldaña, 2013). This means that there is a wide range of population supplied with water through various local organizational forms.

Governance from below is made by the concrete actions driven by society, which originate within the community environment, with the intention of solving public needs and problems, therefore, it is a type of governance that is born and forged from society, from below. In this sense, we can observe this in the operation of local systems established by the citizens themselves to solve the local water supply.

Local water systems are the social bodies that guarantee open participation, through social institutions formed by the users and citizens themselves, such as rural water committees, indigenous communities and SIAs. In these local systems, there is direct participation. In open assemblies, the participants discuss common problems and develop solution proposals. Therefore, the agreements are binding, built through collaborative and consensual participation, in a way that consolidates public co-ownership of water among the community's inhabitants.

From this approach, local water systems, such as the SIAs, supply water to a large number of the population within the municipalities, which the municipality itself is unable to provide (Galindo & Palerm, 2016). Nonetheless, according to Domínguez-Serrano and Castillo-Pérez (2018), there is no State policy that favors the creation and maintenance of these systems from below, since, through GIRH, the commercial use of water has been further consolidated, instead of the social use with a focus on human rights (Tagle-Zamora *et al.*, 2019).

In the social sense, the SIAs are community institutions that have managed and built their own infrastructure, and have established rules for the operation of a common water service within their locality (Gumeta-Gómez, Durán & Bray, 2016). At a national level, cases of social self-organization have been documented, where community institutions manage and handle water within their collectivity; and which, through local governance, have generated agreements and solutions to water problems in the community, mainly at the municipal and local levels (Palerm, 1973; Peña-Santana & Levi-Lattes, 1989; Galindo-Escamilla & Palerm-Viqueira, 2007; Aguilar, 2011).

According to Hufty (2011), analytical governance expresses itself in a social phenomenon that seeks solutions to public problems such as water. In this paper, we recover this analytical thought to study SIAs and their tensions, which are originated from below. The importance of this type of analysis lies in the fact that it highlights the characteristics of social participation and the limitations of the governmental order, whether local, municipal, state or federal.

Materials and methods

In this research, we implemented a qualitative methodology that allowed us: a) to analyze the local water organization; b) to systematize the governance processes based on Hufty (2011); c) to understand the perception of the key entrants in such processes, and d) to account for the tensions faced by the SIAs. Therefore, we elaborated this research with an analytical and hermeneutic approach; first, we structured the governance processes in four SIAs, and then deepen in their tensions.

Research design

According to the characteristics of the analysis unit and the type of informants (Guber, 2001), we develop four cases to study, two in the urban area and two in the rural area (Figure 3). The selection criteria were the following: (1) the existence of a consolidated local water system, (2)

continuity on applying actions that seek to improve water management, (3) The presence of three agents (strategic, relevant and secondary), (4) The existence and application of formal and informal rules, which regulate the operation of water management in the area, and (5) a committee administration of the local water system.

We structured the guide questions based on the GAF, and 20 in-depth interviews we carried out with key informants, four for each analyzed case and four with public municipal servants, SAPAHUA, construction management, and communities and suburb management. In each location, informants we interviewed the following informants: (a) the current authority, (b) the previous authority, and (c) two influential actors who have participated in the governance processes. Subsequently, we did a triangulation of the information generated through interviews, institutional and government data (Guba & Lincoln, 1981; Mishler, 1990).

In order to systematize the obtained information, GAF allowed the configuration of local governance processes according to the testimony of informants and documentary data. GAF's analysis categories are: problems, parties, norms, nodal points (action scenarios) and processes (Hufty, 2011). The parties, individuals or groups, organize themselves to reach agreements through norms or rules that guide their behavior. They seek to solve water management problems through decisions and actions taken in physical or virtual spaces (nodal points). We understand that, through the interaction of these categories, governance processes are designed by means of SIAs. However, these processes generate tensions in water management (Figure 2).

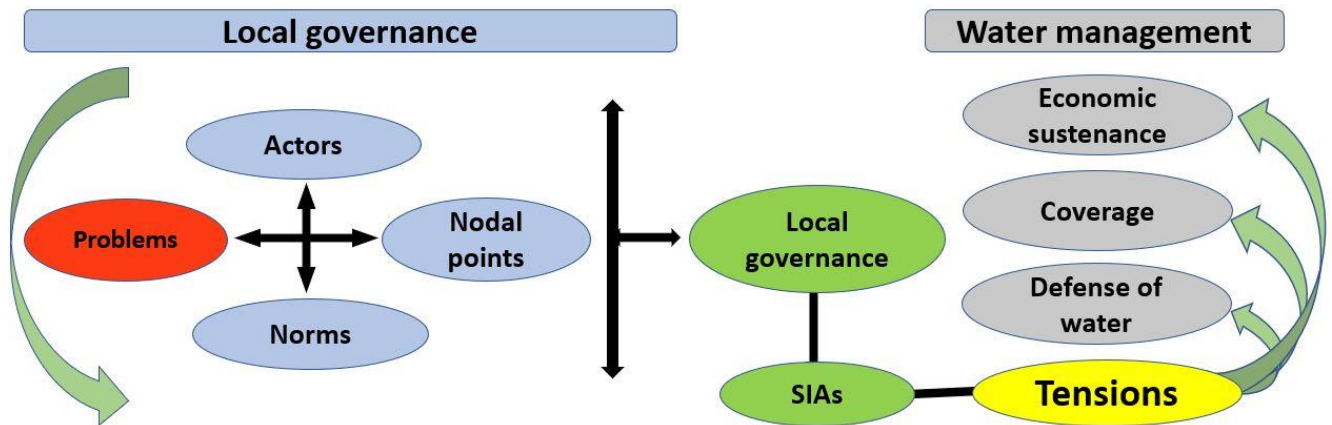


Figure 2. Organization of the information. Own elaboration based on the GAF proposed by Hufty (2011) and fieldwork.

Location of the studied area

Huajuapán de León is a municipality located in the state of Oaxaca in the northwestern part, approximately 192 km from the state capital (Figure 3). It is located at 97° 16' west longitude, 17° 48' north latitude coordinates, and at an altitude of 1 600 meters above sea level (INEGI, 2015). The municipality has 361.06 km² and a population of 77 547; distributed in 153 towns (INEGI, 2015). It is the sixth most populated municipality in the state of Oaxaca and the most important in the Oaxaca's Mixtec region.

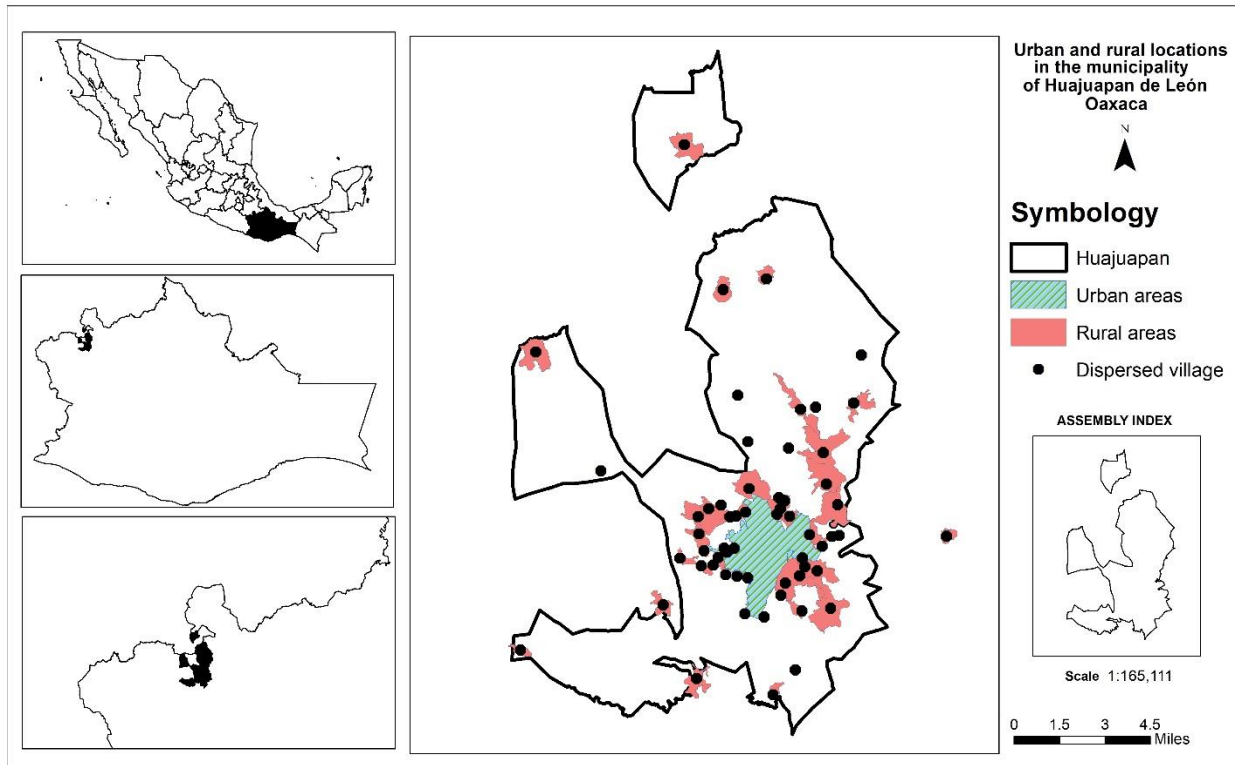


Figure 3. Location of Huajuapán de León and location of the urban area. Own elaboration based on INEGI's 2018 Geostatistical Framework.

The following (Figure 4) shows the location and extent of the colonies and rural communities where the four SIAs we analyzed are located.

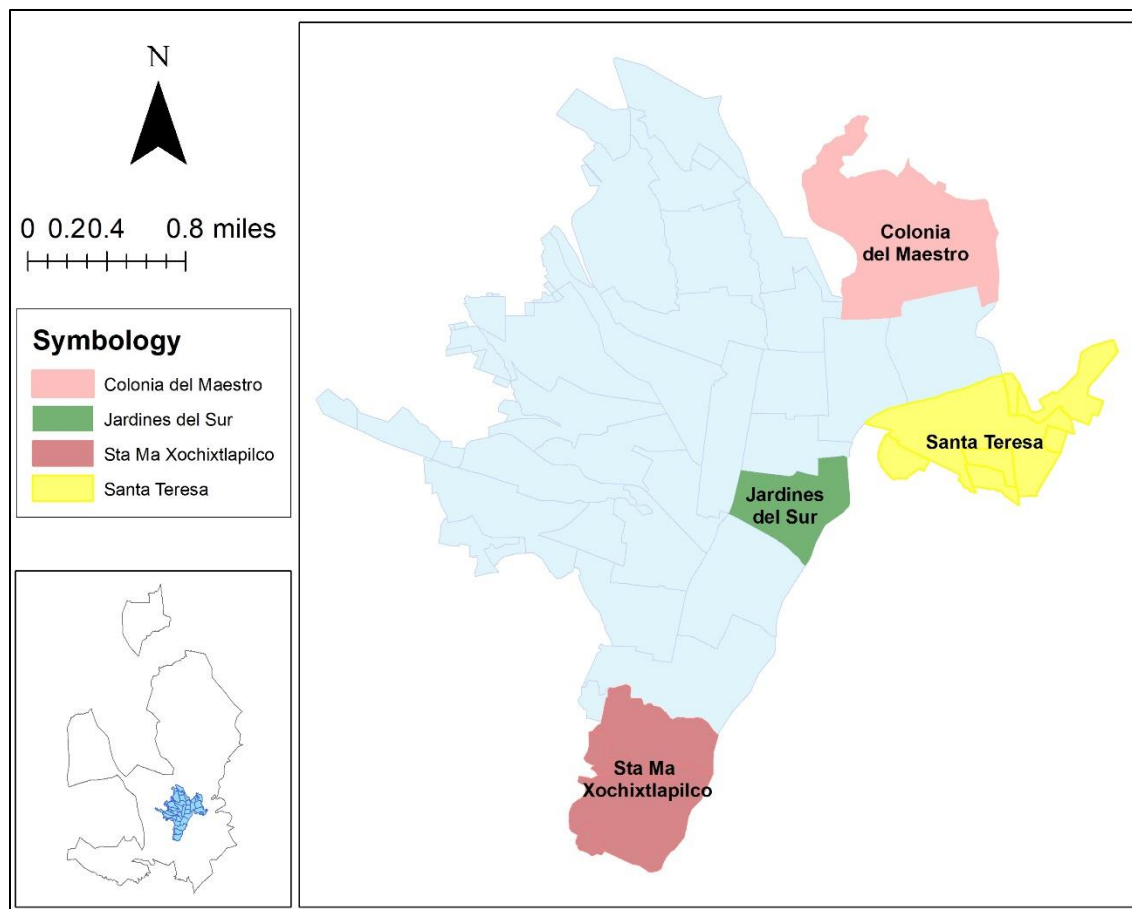


Figure 4. Location of the four studied cases in Huajuapán de León. Own elaboration based on INEGI's 2018 Geostatistical Framework.

Results and discussion

In this section, we contextualized the characteristics of the SIA in each studied case, in order to show its local governance processes. Subsequently, we analyzed and discussed the tensions generated by the economic and operational sustainability of the system, as well as the coverage and defense for water control. In Table 1, we shown the characteristics of each studied case.

Table 1. The four selected cases.

Location	Jardines del Sur	The Colonia del Maestro	Community of Santa María Xochitlapilco	Community of Santa Teresa
Zone	Urban	Urban	Rural	Rural
Population	1 200 inhabitants	5 200 inhabitants	4 100 inhabitants	4 000 inhabitants
Beginning of the SIA	1962	1960	1946	1945
Water control	Suburb committee	Water committee	Water committee	Water committee
Social property regime*	Private property	Private property	Agricultural community (areas with private property)	Agricultural community (areas with private property)
Type	Residential development	Neighborhood	Municipal agency	Municipal agency
Interviews	Four	Four	Four	Four

*We obtained the property regime at the *Directorio de Ejidos y Comunidades Agrarias* (DECA) and INEGI (2017).

Jardines del Sur is a residential area that covers 12 blocks, of which 146 homes have piped water and drainage (INEGI, 2018). This suburb is located in the interior of the urban area of Huajuapán de León, in the central-southern part of the city (see Figure 3). Jardines del Sur is located in a low altitude zone, due to this, there are filtrations in the underground water, that captures the water by a surface bodywater from which the residential is supplied. The hydraulic infrastructure is located within the "El Jagüey" Park. Through two water pumps that send the water to the elevated container with a capacity of 10 000 liters. At the same time, it supplies water to the colony homes through valves that distribute and regulate the amount of water. The SIA supply homes with water two days a week, for six hours each. Water has a rate of \$50 pesos per household and they pay monthly; for drainage, the fee is a yearly rate of \$742 pesos at SAPAHUA.

The Colonia del Maestro is a large area, covering 96 blocks, of which 651 homes have a piped water supply and 796 have drainage (INEGI, 2018). This suburb is located in the urban area of Huajuapán de León, in the northeastern part of the city (see Figure 3). The Colonia del Maestro is located on the hill shores of Yucunitza, in a medium altitude zone. The agrarian tenure is divided: in the northern part, the type of property is registered as an *ejido*; but, in the southern zone, the tenure is private property. This suburb has two deep wells: Angel 1 and 2, two storage tanks, two hydraulic pumps that raise the water from the wells to the storage tanks, a system of valves and a network of pipes that connect to most of the houses in the suburb. They supply water twice a week for

twelve hours. Water payments depend on consumption that the SIA calculates with gauges; on average, the monthly payment is \$75 pesos per water intake.

Santa María Xochitlapilco is a municipal agency that covers an area of about 66 hectares. The downtown population consists of 86 blocks, of which 446 homes have a piped water supply and 448 have drainage (INEGI, 2018). It is located on the limits of the urban zone, south of Huajuapán de León (see Figure 3). The hydraulic infrastructure includes three community wells, two electric water pumps and two containers. Electric power is used to operate the local water system and is distributed by gravity. Santa María is located in the lowest area of the urban surroundings; therefore, the wastewater from the city of Huajuapán de León is collected in the treatment plant located in this town. For this reason, as compensation the agency does not pay for the use of the drainage network. The SIA supplies households one day a week for twelve hours. The monthly fee is \$30 pesos. In addition, the water committee charges \$15 pesos for drainage, a resource that they use to supplement the costs of the water system maintenance.

Santa Teresa is a municipal rural community that covers an area of nearly 44 hectares. Downtown population is made up of 114 blocks, of which 847 homes have a piped water supply and 769 have drainage (INEGI, 2018); however, the water committee has 1 100 registered water supply and drainage connections. The difference is explained by the fact that many homes are unoccupied due to migration, mainly to the United States. Land tenure is classified as an agricultural community; anyhow, there are areas near the city center that are beginning to change into

private property. This community has two wells and two water boxes that supply homes through a network of pipes administered by the water committee. Water is supplied every third day for two hours, and the monthly rate is \$60 pesos.

In these four cases, we found that the communities manage the water supply, and SAPAHUA the drainage. In the neighborhoods Colonia del Maestro, Jardines del Sur and Santa Teresa, a fee is paid for municipal drainage service. This situation shows that the SIAs focuses more on access and water supply than on sanitation, since the extraction and water supply is carried out in their district under their control. Meanwhile, drainage management implies additional costs, as well as processes that take place beyond their territory.

Local governance processes

In each case, we observed that governance processes are shaped differently, although, through systematic analysis repeated patterns are in each of the studied cases. Following, Table 2 is a comparative table of this four cases according to their characteristics and the systematization based on the GAF.

Table 2. Comparative analysis of governance in SIAs.

Studied Case	Jardines del Sur	Colonia del Maestro	Santa María Xochitlapilco	Santa Teresa
Problems	1. Administration, operational and sustainability of the SIA 2. Coordination with the Municipal Council			
Actors	1. Users 2. Local representative 3. Municipal Government 4. External actors (only in Jardines del Sur)			
Norms	Institutional: Concession of the Conagua Social legitimization of the Water Committee Regulatory and Operational: Written or unwritten and customary rules 2. Water system operation rules			
Nodal points (action scenarios)	Meetings and assemblies in formal or informal settings			
	Committee offices Jagüey Park	Committee offices and auditorium	Offices and esplanade of the municipal palace	Offices and esplanade of the municipal palace
	Government scenarios			
	1. City Hall; 2. Municipal Council; 3. Offices of the Directorate of Works; 4. Offices of the Directorate of Agencies and Colonies; 5. WhatsApp Groups			
	Agreements and decision making to generate actions that give continuity to the local water system			
	1. Local water control; 2. Operation, management and maintenance, of the local water system; 3. <i>Tequios</i> (none payed work made by the			

	population in order to help the community) and economic cooperations			
Processes	1. Construction of the elevated tank that supplies the homes in Jardines del Sur 2. Rehabilitation and maintenance of the "Jagüey" Park	1. Construction of the local water system 2. Extension of the Angel 1 well 3. Maintenance of the SIA	1. Construction of the local water system 2. Construction of a second community well 3. Installation of solar panels	1. Construction of the local water system 2. Construction of a second community well 3. Continuous cleaning of the wells located in the Mixteco and Salado rivers

Source: Own preparation based on interviews with key actors and the Huajuapán de León 2016-2018 City Council.

Within their area, the SIAs manage, control and take care of water independently from the municipal water operating system. Galindo-Escamilla and Palerm-Viqueira (2007) called them "self-managing water organizations" or "rural drinking water systems" (Galindo & Palerm, 2016). From this systematization of local governance by GAF, four important scopes of the SIAs are major: (a) the reason of existence (b) the continuous operation, (c) self-regulation through norms and (d) water care.

The creation of the SIAs responds to two reasons: the first one, to the fact that their existence leads up to the conformation of the SOAMs - SAPAHUA- and LAN. This situation takes place in the rural communities of Santa Teresa and Santa María Xochixtlapilco, where their SIAs were created in 1945 and 1946 respectively. The second is that due to the lack of municipal coverage, local committees were created to help on solving the collective need for access to water. This happens in the cases of Jardines del Sur in 1962 and the Colonia del Maestro in 1960.

In the continuous operation, in this four cases, we detected the following work: (1) the maintenance of the infrastructure of the SIA, (2) the electricity payment, (3) the opening, regulation and closing of the valves, (4) conservation and rationing of the underground water or water courses, (5) extension or pipe change, (6) the annual meeting regarding the prioritization of works, where the citizens, the suburb committee and the works management of the city hall converge to agree which work will be carried out within the SIA.

Within the management of the four SIAs, there is a system of written and unwritten institutional rules, which are obtained from agreements between the residents and the water committees. These rules guide the actions of the water committee, regarding functions, structure and restrictions. The SIAs regulate themselves through rules, meetings, agreements, *tequios* and economic cooperations, therefore they are an example of governance from below that works as a local water system supported by its citizens and, consequently, recognized by the municipal council.

In the water caring, the two rural communities and Jardines del Sur have control over the distribution through the valves that close and open for different town areas; they also regulate when does the electric pump that supplies the watertanks is turned on, and they take care of the water level in the wells. In times of low water, they try to supply the minimum to ensure that it is enough for this season. The SIAs learn from experience in order to take care of the water, e.g., the president of Jardines del Sur mentioned: "if it flows constantly, the neighbors tend to waste water," so they cut off the supply as a self-regulation measure. On the other hand, the Colonia del Maestro installed gauges inside the homes where it supplies and sets a minimum rate for certain amount of water, if the user uses more, they pay more for the water supply. The use of these measuring instruments also fulfills the target where the population regulates itself regarding the water use.

Tensions

In the analysis of the governance processes, several situations became noticed that overflow and go beyond what the GAF's scheme could provide. We detected several tensions in each locality among the members of the SIAs and with the municipal government.

Economic and Operational System Sustainability

In the four studied cases, problems such as financing, maintenance and operation of the local water system are presented. With insufficient economic resources, it is complicated to perform optimum water system maintenance and to extend its coverage.

Regarding financing, the user's payment barely covers the costs of electricity consumed by the hydraulic pumps. In Jardines del Sur an approximate average of \$7 300 pesos is collected monthly, when they pay for electricity almost \$8 000. For Santa María Xochixtlapilco on average \$20 000 is collected and they pay \$18 000; in the Colonia del Maestro there are collected \$48 000 and payed 35 000 and Santa Teresa, despite of being the largest, it barely collects \$12 000 of the \$11 000 they pay. This situation is because there are users who do not pay for water service, some of whom are protected by the human right for water, which is why the SIAs are kept from cutting off their service.

The SIAs manage and build divers works to supply water to the community. They have available the rest of the resources that they collect, which is minimal; therefore, the SIAs appeal to extraordinary neighborhood contributions and negotiations with government institutions. Nevertheless, these resources are barely sufficient to maintain and expand coverage. Economic resources represent a tension constantly faced by the SIAs, and in order to face it, they plead to

assembly agreements to commit with extraordinary contributions as well as with the participation on government management.

Concerning the continuous operation, there are several difficulties that the SIAs have managed to solve by implementing actions in water management. The difficulties and their solutions are the following:

a) Succession of the water committee members. Generally, few people want to take up a position within the SIA, and from these ones, it is the older people who most often make this commitment. To mitigate this fact, the two communities and the Colonia del Maestro encourage youth participation by including both youth and adults within the SIA's operators.

b) Rehabilitation of infrastructure. Built since the middle of the last century, the wells, water tanks and pipes continue to operate because of the continuous renovations made by the SIAs. In the four studied cases, the wells and water tanks have been repaired and extra contributions have been made to help fulfilling the maintenance costs.

c) Lack of municipal attention to SIA requests. According to its president, the Colonia del Maestro registered the expansion of the well Angel 1, in the municipality's public works prioritization program. The work was estimated to be completed in July 2018. However, realizing that the construction management did not begin the expansion, and for seeing the burden of the lack of water supply in the following months, the Colonia del Maestro resorted to direct action such as closing streets and municipal government offices to demand the execution of the work, since the well was kept closed (Gómez, 2018). For their part, the citizens and the

Jardines del Sur committee took advantage of political connections (governance networks) to rehabilitate the Jagüey, filing the petition with state government officials to expedite the proceedings and put pressure on the municipal government.

d) Preferential rate or discount on electricity consumption. As a retired former worker, the president of Jardines del Sur has an agreement with the Federal Electricity Commission (CFE) and the Mexican Union of Electricity Workers (SUTERM), which allows him to obtain a discount on the cost of electricity supply.

e) Incorporation of technology. The Santa María Xochitlapilco community has initiated technological innovation projects to reduce electricity costs through the installation of solar panels since 2017. These actions contradict what was mentioned by Aguilar-Miranda, Rivero-Hernández and Inoue-Cervantes (2011), who upholds that the community systems resist to change in order to preserve ancestral customs; they refer to the fact that, in these institutions, the supply is barely sufficient to provide the population with what is indispensable and that this situation is due to the limited incorporation of technology, the precarious financial situation and the rusticity of the technical management of the water system.

The four studied cases show an active institution that is open to the incorporation of elements that help to solve their problems and not seeking to impose its cultural heritage, but rather to reveal in its community organizational forms, called *usos y costumbres* (traditions), the strength to coexist and resist the constant political and social changes imposed by the capitalist system (Barkin, Sánchez, Esquivel, Carcaño, &

Armenta, 2017). Therefore, SIAs in their practice integrate technology, scientific advances and their traditional knowledge to be able to adapt and restructure to the context and needs imposed by GIRH water policies (Barkin & Lemus, 2015).

These issues help to understand the great effort made by SIA to continue operating. Although, different kinds of social intervention can be observed, where most of the users are included in the solutions of water problems in the management of the local system, such as the *tequios* and the emerging economic contributions aimed at solving collective water problems.

We understand this participation by the social appropriation of water in the local environment. The SIAs allow citizens to have control over their water, and at the same time, provide a greater opening for citizens to make their demands directly to an organization composed by themselves. Therefore, they are an example of real governance that is self-regulated by means of community self-management, through the *usos y costumbres* (traditions) applied by and for water. However, there is always the tension of economic and operational sustainability of the SIA.

Coverage

The municipality of Huajuapán de León had a population increase of 31 % in the period 2005-2015 (INEGI, 2005; INEGI, 2015). This high growth is largely due to internal migration from surrounding municipalities and new inhabitants settling in the area around the city. They establish in social property territories such as *ejidos* and agricultural communities, which are located in the border areas between the rural communities and the city of Huajuapán de León. Thus, the government and communities face a growing demand for urban services, especially water.

In the communities of Santa Teresa and Xochitlapilco, there are three main problems in water service coverage. The first is the growing demand for supply by new inhabitants who settle in areas owned by the communities but are far from the water infrastructure. For this reason, the SIA cannot meet this demand; accordingly, SAPAHUA has supplied water within the community's administrative territory. In this way, the operational boundaries between the SIA and SAPAHUA become blurred. According to the water committees of Santa María Xochitlapilco and Santa Teresa, it is possible that in the future these communities will no longer have control over water, since the new citizens of these towns feel like they are part of the city and not from these areas.

The second is a high rate of uninhabited housing in the central area (of the communities) due to the migration of their original population. The water committees mention that, although they are not in use, the pipe has to have maintenance and these houses have access to a water supply that are not paid to the SIA. Finally, a third problem is the chaotic use of land; as municipal communities, land tenure is held by the agrarian

community, but the areas that are beginning to be inhabited are managed clandestinely as small properties.

Despite these problems, local water systems have a great advantage, they are present in communities where the municipal government cannot access due to lack of urbanization; they are created by the people in the community to manage the water in their territories. This agrees with Gumeta-Gómez, Durán and Bray (2016) that SIAs are community institutions that, through in charge systems, they administer and control water management in many locations in municipal territories.

According to the perception of those interviewed, the SIAs provide good quality water and are more cost efficient than SAPAHUA. They represent an alternative in the coverage of water services in the localities of the municipality (Galindo-Escamilla, 2007), and a community institution that provides social environmental justice to mitigate the negative effects of globalization and the neoliberal market, which they have created through GIRH (Altvater & Mahnkopf, 2002).

The defence of water

Through the Municipal Gazette of Huajuapán de León (Gaceta Municipal de Huajuapán de León, 2017) and the catalogue of localities of INEGI's (INEGI, 2018) National Geostatistical Framework, we identified the

existence of 153 urban and rural localities. According to field research and data from the Water and Sewerage Management System of the City of Huajuapán de León (SAPAHUA, 2018), the municipal government supplies 88 localities, the SIAs 38, so there are 27 localities without continuous water supply. The supplied population of SAPAHUA is estimated at 70 %, which is equivalent to 58 524 inhabitants; while the coverage of the SIAs is estimated at 23 %, which is equivalent to 19 229 inhabitants.

Currently, there is a high demand for water in order to satisfy the needs of the 88 localities supplied by the municipal government, where 70 % of the municipal population is concentrated. To supply water, the municipal government has the Yosocuta dam that supplies 66 localities; while the other 22 do so through six deep wells and three filtering galleries located in different rural locations near the city. For sanitation, the SAPAHUA has both, a water and a wastewater treatment plant located in the agency of Santa María Xochitlapilco.

The main tension between the municipal government and the towns it administers is the serious problem of water quality. The dam presents issues in terms of its operation and infrastructure. The UTM (Instituto de Hidrogeología de la UTM, 2016) Institute of Hydrogeology of pointed out that, in 2015 and 2016, there were serious problems of contamination due to three factors: 1) direct discharge of sewage waste that arrives from the city of Huajuapán de León and is not adequately treated by the treatment plant; 2) supply of large quantities of water to irrigation systems; 3) high level of azolve due to deforestation in the Mixteco River basin, which reached 40 percent of the dam level.

Because of this situation, there is a conflict over water control with localities that have their own SIAs. The municipal government wants the wells controlled by the SIAs to supply more localities. The SIAs do not give up control of the water because they know that the water, they would receive, would come from the Yosocuta dam and not necessarily from their own wells. In interviews with former members of the San Mateo and San Diego water committees, it became clear that this situation has already happened in their localities, where they handed over control of their SIA to the municipal government, and the quantity and quality of water they now receive is less than what their own system supplied.

In three of the four studied cases, we found that there is pressure from the municipal government to gain control of their waterbodies. The three communities have refused to relinquish it because they agree that SAPAHUA will supply them with very poor-quality water like the one coming from Yosocuta. Each of the cases has particular arguments: the water committee of Jardines del Sur is not willing to see the volume of water in the Yagüey reduced, which has also become a symbol of care for the environment that makes them proud. The Colonia del Maestro does not want to lose control of the water, because it would affect their level of organization, which is a distinctive feature of this town. For the Santa Teresa rural community, water represents the pride of belonging to this territory.

In general, and according to the information compared between the interviews made to the SIAs and SAPAHUA, it is confirmed that the municipal government has an interest in appropriating the management of water in the localities according to the following reasons: (a) the quality

of the water, (b) the geographical situation, (c) the infrastructure, and (d) the quantity of water available to provide water to nearby localities. With the justification of public interest, the municipality wants to obtain control of the resources and infrastructure built and managed by the SIAs.

Natera-Peral (2005) and Paz (2008) have documented this situation that causes several tensions where community systems seek to avoid the appropriation of their resources. The SIAs represent a way that allows citizens to have control over their water, because they have worked for it and taken care of it, therefore, they defend their water bodies because they see water as their own, as a necessary resource for life.

Conclusions

In this article, we made a criticism of water management in Mexico based on the governance of water through GIRH, as a way of distinguishing governance from above, where the LAN does not contemplate -in an official way- the existence of local governance institutions, which allows visualizing governance from below, organized from local bodies such as SIAs.

The main criticism towards GIRH is for using selective criteria, which limit the inclusion of actors in basin management. This mechanism

operates as an exclusionary device. Decision-making comes from political and economic elites, who restrict social participation to build collective water governance. At this point, local governance represents an alternative for better water management, by enabling direct interaction between citizens and their representatives -the local authority elected by them-, to solve problems by generating agreements, with the purpose of making them responsible for carrying them out, thanks to a governance from below.

Governance from below is mainly made up of two factors that balance each other out. First, their participation allows having a social organization consolidated by water. Second, this consolidation materializes in the built infrastructure and the operability of the local system thanks to community self-management. From this point, the SIAs are a turning point in governance in an official way; they represent a process of social organization that influences the functioning of municipal water management; therefore, water regulations are incomplete because they do not consider their functioning and social importance in the rural and urban areas where they operate.

In relation to the difficulties faced by localities with SIAs, the results showed the existence of three important tensions regarding water management and control. The first showed that the sense of social appropriation of water represented by the SIAs allows a practical solution for the difficulties that arise regarding the economic and operational sustainability of the SIA.

In the second tension, we speculate that the coverage and extension of the SIA's supply is limited to the local scale. In Santa María

Xochitlapilco and Santa Teresa, there is a demographic growth, where these systems are not able to cover the demand of the new population that settles in the periphery of their territory. Thus, and in spite of the fact that the SIAs are an extraordinary alternative in the local water supply (Gumeta-Gómez *et al.*, 2016), they have a growth limit due to their built infrastructure, the participating population, and the territorial extension of the locality.

Regarding the third tension, the localities with SIAs do not give in control of their water management, since the autonomy and availability of water would be left in the hands of administrative personnel who do not meet the communities' needs. From the analysis of the four studied cases, we concluded that the main difficulty of the local systems is the defense of water. For SAPAHUA, the SIAs must share water and infrastructure with the other suburbs in order to have a common benefit. However, the independent systems resist, since they defend their right to enjoy the water, thanks to their organization and infrastructure for the material and symbolic reproduction of life.

In the four studied cases, SIAs emerged from the collective need for access to water supply. From governance from below, a local system materialized with its own infrastructure and rules, which, through community self-management, maintains its operability regardless of the change in municipal administration. Its importance is such, that almost a quarter of the localities in Huajuapán de León operate a SIA independently from the municipal government.

Currently, the SIAs have many obstacles to operate; anyhow, they exist because they are necessary for the reproduction of life, in diverse

communities with no access to the municipal water service, or not wanting the government supply. For this reason, they refuse to give up what they have built in a communal and vernacular way (Méndez-García & Fuente-Carrasco, 2020); their self-regulation rules motivate them to continue with their operation, since as we found in the four cases, the SIAs supply water in better quantity and quality than the municipal government itself.

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