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Articles

Looking for financial efficiency in small potable water systems. A methodological proposal

Buscando la eficiencia financiera en pequeños sistemas de agua potable. Una propuesta metodológica

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Abstract

A methodology is proposed to identify costs and fixed income in small potable water systems and an indicator of financial efficiency that allows comparing the number of times fixed income covers all fixed expenses. The information to build the index and the data for its empirical test were obtained directly with field work in five municipalities in the region known as Valle del Mezquital, Hidalgo, Mexico. With the methodology proposed, it was possible to document and analyze the situation of two operators agencies (OA), two municipal agencies (MA) and four user committees (UC). In the systems managed by UC it was identified that they achieve financial efficiency for two reasons, the rates charged for the service are calculated based on the specific needs of each system, and the unpaid work that users provide in the administration, operation and maintenance. For OA and MA, it is highlighted that most of their fixed income goes to the payroll of the employed personnel and the electric power, for which they require a considerable increase in the amount of their rates if they aspire to financial efficiency. It is concluded that the methodology and the proposed indicator are relevant to measure the financial performance of organizations that manage small-scale drinking water systems.

Keywords: Rural drinking water, user committees, operating agencies, municipal agencies.

Resumen

Se propone una metodología para identificar los costos e ingresos fijos en pequeños sistemas de agua potable y un indicador de eficiencia financiera que permite comparar el número de veces que los ingresos fijos cubren la totalidad de gastos fijos. La información para construir el índice y los datos para su prueba empírica se obtuvieron de manera directa con trabajo de campo en cinco municipios de la región conocida como Valle del Mezquital, Hidalgo, México. Con la metodología que se propone fue posible documentar y analizar la situación de dos organismos operadores (OO), dos direcciones municipales (DM) y cuatro comités de usuarios (CU). En los sistemas manejados por CU se identificó que alcanzan la eficiencia financiera por dos razones, las tarifas que cobran por el servicio se calculan con base en las necesidades específicas de cada sistema, y por el trabajo no remunerado que aportan los usuarios en la administración, operación y mantenimiento. Para los OO y las DM se destaca que la mayor parte de sus ingresos fijos se destina a la nómina del personal empleado y la energía eléctrica, por lo que requieren un aumento considerable en el monto de sus tarifas si aspiran a la eficiencia financiera. Se concluye que la metodología y el indicador propuesto son pertinentes para medir el desempeño financiero de las organizaciones que manejan sistemas de agua potable de pequeña escala.

Palabras clave: agua potable rural, comités de usuarios, organismos operadores, agencias municipales.

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Introduction

In Mexico, according to the criteria of the National Water Commission (Conagua), the efficiency of a drinking water system to supply large population centers is defined as the ability to capture, deliver, regularize, purify and distribute water from the natural source to the consumers (Conagua, 2012:1).

Moreover, to measure what has been called Overall Efficiency of service quality of drinking water, three components are analyzed with their

respective indicators: production and distribution engineering; trade in services; and institutional development. Thus, under these criteria, it is considered that a system loses efficiency when it starts to use excessive human, material and economic resources in any or all of these components (Conagua, 2012:1).

Such operational definition and methodological proposal are applied only to large drinking water systems, that is to say, the supply to cities. However, in the absence of an appropriate methodology on a small scale, this represents an excellent starting point in the search for the efficiency of drinking water supply in rural areas, bearing in mind that in this service type it is also possible to identify and analyze some of the indicators from these components.

Under the general framework described, the objective of this article is to propose a methodology to identify fixed costs, also the fixed income incurred by an organization to fulfill its task to provide drinking water services to small population centers, and propose an indicator that allows measuring the number of times that the fixed income is enough to cover the fixed costs.

It is relevant to clarify that both in the methodological proposal and in the efficiency index, which is here posed; only two of the components listed above are partially referenced: the trade in services and the institutional development. For the first, only two of its nine indicators were identified: tariffs and roster of users, and for the second, only one of its eight indicators: organized autonomy (Conagua, 2012:1).

The choice of the study area and the analyzed cases are justified because of the current legal framework –emanated from the constitutional article 115 of the National Water Law of 1992 and the State Water and Sewerage Law of Hidalgo of 1999– gives the Municipal Administrations of the State the faculty to handle the piped water supply systems of its administrative jurisdiction, and because the aforementioned State Law also empowers local authorities to create municipal or decentralized inter-municipal, under the assumption that such management can achieve technical efficiency and financial autonomy in the service endowment (Galindo & Palerm, 2007 and 2016; Congreso de la Unión, 2019).

Furthermore, according to the information from official sources, the State of Hidalgo is divided into 84 municipalities that, until 2010, count with 4 714 locations. Of these, 97.0% had fewer than 2 500 inhabitants,

another 2.6% with a population between 2 500 to 14 999, and only 11 locations with more than 20 000 were listed (INEGI, 2011 a).

Finally, it is noteworthy that Article 30 of the State Law for Water and Sewerage of Hidalgo points out that it will promote the creation of Municipal Water Utilities (OO in Spanish) in those municipals where the main community is greater than 2 500 inhabitants (POEH, 1999). However, until the year 2015, in the referred state, a total of 33 water utilities were counted (CVIA, 2015). That is to say, while the official provisions on the subject have been fulfilled, it is also notorious that there are a considerable number of municipalities where this organizational figure for water management is not present.

Another peculiarity is that according to Article 25 of the same law, it is up to the local congress to approve the fees to be charged for drinking water systems (POEH, 1999). One might, therefore, wonder what the role of the users and the private sector is in those cases where the municipality is not responsible for the service.

Water as a public service and dominant management models in the light of the Mexican case

A discussion, with specific cases, on the issue of drinking water in general, and the small scale in particular is justified since it has been said that water supply for human consumption is a public service. And that this, by its nature, has the capacity to generate economies of scale the same for economies of agglomeration or scope (Solanes, 1999; Jouravlev, 2004).

With such assuming theorists, in practice, five globally dominant models have been made to provide the service: direct public management; corporate services company; private management concession; direct private management with no concession; and public company (Blokland, Braadbaar & Schwarts, 2000).

In accordance with the search and review of published materials between 1990 to 2010, it can be said that during those two decades it was notorious the diffusion and impulse of the five models mentioned

above; the little discussion about its viability; in the specific case regarding the supply of small-scale drinking water, it was rare to raise the direct participation of the users in the construction and management of the infrastructure, as well as in the decision making to establish fees, hiring employees, fixing agreements and establishing sanctions (Ávila, 1996 and 2002; Pineda, 1998; Burguete, 2000; Barreda 2006; Barkin, 2006; Caldera, 2006; Dávila, 2006; Galindo & Palerm, 2007; Jiménez & Palerm, 2007; Rodríguez, 2007; Romero, 2007; Saldivar, 2007; Mejía & Kauffer, 2008; Galindo & Palerm 2012; Palerm 2014 a).

Such a situation changed in the current decade, and regarding the management of small-scale piped water service, we can say that the debate has become more acute, hence, there are two very influential contradictory positions. On one side are the studies that show the management efficiency by users and their contribution to both the local self-government and alternative governance (Ostrom, 2011), and, on the other, the ones that show that community management is not an effective framework for providing the service because it is somewhat inefficient (Chowns, 2015).

In other words, there is a debate between a management with some state participation, either directly through the municipalities or partially by decentralized operators, against a management by users with defined institutional and organizational designs by self-government and self-management (Aguilar, 2011; Vagliente, 2011; Sandoval, 2011; Galindo & Palerm, 2012; Villareal 2012; Bustos-Cara, Sartor, & Cifuentes 2013; Kreimann, 2013; Vargas, 2015; Galindo & Palerm, 2016; Nicolás-Arteo, 2016).

Concerning the Mexican case, it can be said that its particularity lies in that this type of management was promoted from the central government at the beginning of the twentieth century, specifically from 1930, implemented in the first Six-year Plan term (SPP, 1985). It can also be affirmed that during the remainder of this century there were a series of policies and programs aimed at building new systems or upgrading of existing ones under the form of piping network, with the uniqueness that in all of them the participation of users with manpower and materials from the region was included (SSA, 1965; COPLAMAR, 1970; Aboites, 1999; Birrichaga, 2007).

According to the above, it can be said that it has been nearly a century that the Mexican State included the rural drinking water among its policies, and despite this long learning process, the relevance of self-

government and self-management is now being debated under that kind of service.

Another special feature of the Mexican case is in the search for financial efficiency of drinking water systems. Concerning this point in particular, it stands out that it has been four decades since the central government initiated actions in this matter, and that an official response to this was the transfer of systems, which were managed by the Federal Drinking Water Boards, to the federation and municipalities entities (SAHOP, 1981; Martínez, 1998; Pineda, 1998; Dávila, 2006; Aboites, 2009).

However, for thirty years, the municipalities have also made legal and administrative actions to, in turn, delegate such constitutional attribution either to decentralized utilities of the municipal administration or, if applicable, to private companies with any experience in the field (CNA, 1994; CONAGUA, 2001; Pineda, 2002; Soares, 2007; Romero, 2007; Lutz & Salazar, 2011).

It is relevant to highlight that from the beginning of the transfer process to the federal entities, they issued their own legal systems in the field, and although the differences are marked from one state to the another, in general the municipalities have chosen one of the following four options: to provide service in a direct way, decentralize it in Water Utilities managed by government boards; cede it to the private sector; or confer it to users grouped in some legal figure (CONAGUA, 2001 & 2004; Aguilar, 2011; Palerm 2014 B; Galindo & Palerm, 2016).

This is the panorama of drinking water management in Mexico. At the end of the first decade of this century, an official publication on utilities documented that they had 2 517 units that are dedicated to this service throughout the country and that such units employed a total of 110 038 people (INEGI, 2011 b).

Another data from the same source indicates that the registered water utilities reported expenses for an amount of 17 670 000 pesos, which were allocated to five major items in the following order of importance: electricity bill payment; bulk water bill payment; the purchase of physicochemical agents; payments for repairs and replacement parts; payment for fuels and lubricants; and the payment for personnel, advertising, stationery, communication services, professional services and insurance premiums, among others (INEGI, 2011 b).

In the light of this information there is also a doubt about the number of community organizations for the supply of drinking water in rural and

peri-urban areas of Mexico, as well as the people's profile that is responsible for operation and administration of such systems, and especially what their regular expenses and financial standing are to cover them. The latter, as already stated, is the central theme of this article.

Tariff as an element for financial efficiency

In terms of water for human consumption, the discussion on the role of tariffs and their collection is not new in Mexico and has not been free from controversy (Solis, 2005, Pineda, 2006 and 2008; Saldivar 2007; Romero, 2007; Salazar, 2016).

Some scholars of the topic point out that water is regarded as a commodity for which the rights of access and property should be guaranteed to incentivize the water markets who allocate efficiently what is considered as a scarce resource (Roemer, 1997). Others debate whether water should be treated as a commodity, as its nature has no value, and the discussion focuses on the so-called hydro-useful procedures that human beings perform to pump, deliver, store or distribute (Boltvinik, 2006; Veraza, 2007). From another perspective, that of common pool resources, there are those who believe that community management of small-scale drinking water is an efficient response against market or state failures (Galindo and Palerm, 2007; Guzmán, 2013; López, Martínez, & Palerm, 2013; Domínguez & Castillo, 2018).

With regard to tariffs and methods, to determine them, it is worth mentioning that since the beginning of this century the National Commission of Water pronounced three minimum criteria for determining tariffs providing such public service: economic efficiency; financial viability; and equity. The same unit also recognized that the organizations, providers of these services, had the challenge of establishing efficient, equitable and sustainable tariffs systems since, by that time, in many agencies short-term political and financial criteria prevailed aimed to minimize, or in extreme cases, avoid the increase in tariffs (Conagua, 2001:143-145).

Almost twenty years from this official stance on the importance of tariff in the institutional development of service providers, Briseño (2018) states that at present, the water utilities that supply to large urban centers of Mexico apply different tariff models according to the objectives pursued, the main ones being flat tariff, uniform single block tariff, increased block, decreasing block and increased tariff. However, the same author states that, generally, tariffs are insufficient to cover the costs for service; therefore, local governments must save the service providers through transfers of economic resources.

In a different scenario, other scholars have documented specific cases of small drinking water systems, and their results show that decision-making by users significantly contributes to establishing tariffs close to financial efficiency (Galindo & Palerm, 2012; Pimentel, Velázquez, & Palerm, 2012; Rivera, Hernández, Ocampo, & María, 2017).

Thus, as in previous paragraphs, it is relevant to ask about the tariff schemes on small scale, particularly with regard to the criteria for establishing the amounts of charges for service, the same for billing efficiency, and if the amounts are sufficient to ensure the sustainability of the organizations that manage them.

Methodology

The methodology to obtain the information consisted in choosing a random study area, which was formed by five municipalities of a total of twenty that integrate the region known as the Valle del Mezquital in the State of Hidalgo, México.

The main selection criterion was that the municipalities had less than 20 000 inhabitants and that the systems with which they supply water for human consumption to the population centers remained within the 5 000 home outlets, that is to say, the rural drinking water was privileged.

The existing drinking water systems were then identified in each of the municipalities, the same as for the organizations that are in charge of administration and operation.

Thus, from a representative sample of 12 water systems, the information was analyzed and compared under the criteria to estimate the financial efficiency indicator, which mathematically is expressed as follows:

$$IEF = \frac{\mathrm{IF}}{\mathrm{GF}}$$

Where:

IEF = financial efficiency index.

IF = fixed income.

GF = fixed expenses.

As illustrated, the IEF is obtained by dividing the IF by the GF; the product of that division indicates the number of times the total fixed income covers the total fixed costs.

To calculate the index, IF was taken as the amount of money that the organization perceives every month when charging piped water service for each outlet served by the system or systems it manages, that is, the data is obtained by multiplying the number of outlets served by the fee that is charged to each of them. The amount of money that the organization distributes each month for the concepts of personnel employed in the administration and operation was taken as GF, power consumption to extract and distribute water to the outlet served, and office rent and telephone service when it is the case.

Given that in the analyzed systems the administrative staff differentiates from the operation, it is necessary to define the respective functions.

The administration includes activities such as tariff collection for piped water service as well as fines for failures to established rules; the issuance and collection of new contracts; issuing the installation order of new piped water outlets; perform the payments for employees, energy consumption and the rental of offices and telephone service, when applicable; also, system accounting or piped water systems that a particular organization manages.

The operation includes water extraction and its distribution to the served outlets; the maintenance and rehabilitation of the hydraulic infrastructure; the installation of new outlets served as well as the suspension of those for failing to pay the fees and, when it is the case,

the periodic measurement of consumption that is made in each outlet served to calculate the amount to be charged for.

According to the latter, when reference is made to administrative or operational personnel, in both cases, they refer to full-time recruits. Otherwise, the set of tasks mentioned are made by the users of the system in question, and such work, in many of the analyzed cases, is not remunerated.

It is relevant to clarify that to estimate the IEF variable revenues and expenses were excluded. The variable revenue is the amount of money the particular organization gets each month by the concept of fines and contract charging that is issued to each user. The variable expenses are the monthly amount of money the particular organization disburses for preventative and corrective maintenance of the hydraulic infrastructure that makes up the system or systems it manages. This type of income and expenses were excluded as the aim is, as mentioned before, to know how many times the fixed income is enough to cover the fixed expenses.

It is also necessary to clarify that when talking about the type of organization for the management of drinking water systems; it is made reference to the technical administrative design established by three different decision makers: users, the town hall of a specific municipality, or the governing board of utilities decentralized from the municipal administration. For the latter, it is relevant to point out that the same organization can manage two or more systems without the need for them to be interconnected, and may even be distant from each other.

Thus, for the study area, it was considered that in cases where an organization manages two or more systems, the fixed costs of each system is calculated in the following way: the total amount of salary paid to the operating personnel assigned to the system in question, the proportional amounts of salary paid to the director was added and the vice-principals, respectively, the same for the payment of electrical energy consumed in each system, and the proportional amount of office rental and telephone service, when it was the case.

Results and discussion

With the criteria indicated in the methodological part, the study area was formed with the municipalities of Ajacuba, El Arenal, El Cardonal, Santiago de Anaya and San Salvador, belonging to the State of Hidalgo, México, whose generalizations are indicated in Table 1 and Figure 1.

Table 1. Total population and type of human settlements. Source: own elaboration with data from the XIII Population and Housing Census (INEGI, 2011 c).

Municipality	**Total of population**	**Number of locations**	**Less than 250 inhabitants**	**Between 250 and 2 499 inhabitants**	**More than 2 500 inhabitants**
Ajacuba	17055	15	8	5	2
EL Cardonal	18427	81	54	27	0
El Arenal	17374	25	11	13	1
San Salvador	32773	48	12	34	2
Santiago de Anaya	16014	28	11	17	0
Total	**101643**	**197**	**96**	**76**	**5**

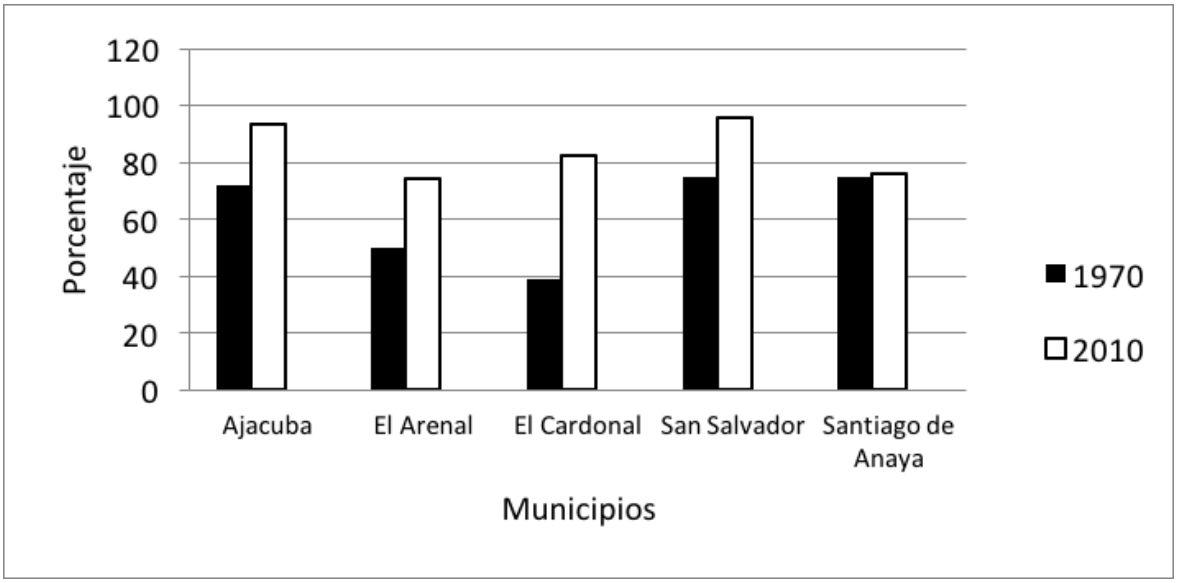

Figure 1. Coverage of piped water service per municipality (1970-2010). Source: own elaboration with data from the IX and XIII censuses of Population and Housing (SIC, 1971; INEGI, 2011 c).

According to Table 1, all the communities of the study area are within the rural category, given that a considerable percentage is under the range of fewer than 2 500 inhabitants. Therefore, strictly speaking, only three out of five municipalities meet the requirement for the formation of water utilities established by the State Law for Drinking Water and Sewerage.

Regarding the service coverage under the modality of piped water, Figure 1 shows that 100% has not been reached in all municipalities. And, that while in the last 40 years in some the progress has been considerable in others it is not very significant.

When analyzing the information in Table 1 and Figure 1, the dispersion of human settlements can be one of the possible explanations in order to not reach 100% in service coverage at all population centers of the municipalities that make up the study area. Precisely the latter also opens up the possibility of questioning the relevance of Water Utilities versus Users Committees; the same applies to the system network, which has already been mentioned that since the last century it is presented as a synonym of modernity in the service endowment.

Table 2 presents the information collected for the five municipalities mentioned and, as it was stated, it was possible to identify three types of organizations for management of small drinking water systems: Water Utilities, Municipal Boards and Users Committees.

Table 2. Organizations and drinking water systems studied. Source: elaborated with field data.

Municipality	Organization	Employees	System (s)	Outlets
San Salvador	Water and Sewerage Commission, Municipality of San Salvador Hidalgo (CAAMSSH in Spanish)	23	San Salvador Santa María	560 3,080
El Cardonal	Water Utilities of Cardonal (OOC in Spanish)	8	Cardonal	650
Ajacuba	Municipal office of drinking water in Ajacuba (DMAPA in Spanish)	17	Ajacuba Tezontlale Tecomatlan	2,286 1,242 1,097
El Arenal	Municipal office of drinking water in El Arenal (DAPMA in Spanish)	6	20 de Noviembre Bocja- Chimilpa	1,479 454
El Arenal	Users Committee of El Rincon (CUR in Spanish)	1	Outlet No. 2	144
Santiago de Anaya	Users Committee of Santiago de Anaya (CUSA in Spanish)	2	Santiago de Anaya	980
Santiago de Anaya	Users Committee of Yolotepec (CUY in Spanish)	2	Yolotepec	700
El Cardonal	Users Committee of San Miguel Tlazintla System (CUSMT in Spanish)	0	San Miguel Tlazintla	1,697

As shown in Table 3, the water utility of El Cardonal and San Salvador, respectively, have fixed expenses for the rental of offices and telephone service. On the contrary, neither the municipal directorates nor user

committees reflect those expenses. The first, because their offices are located in the building that houses the municipal presidency, and because the telephone service is one more of the expenses paid by the corresponding municipal treasury. The latter, because their offices occupy public buildings owned by the beneficiary locality, and because they do not use telephone service.

Table 3. Income and expenses. Average month in thousands of pesos. Source: Elaborated with data obtained in the field.

Organization Systems	Fixed Income (IF)	Personal Administrative	Personal Operating	Electrical Energy	Phone Offices	Fixed Expenses (GF)
CAAMSSH	181,617	73,754	25,728	120,000	3,600	223,082
San Salvador	23,537	35,184	12,864	40,000	1,800	89,848
Santa María	158,080	38,570	12,864	80,000	1,800	133,234
OOC	33,400	19,600	19,800	60,000	6,000	105,400
El Cardonal						
DMAPA	231,250	21,399	46,300	221,800	0	289,499
Ajacuba	114,300	8,333	14,800	120,800	0	143,933
Tezontlale	62,100	6,533	9,500	6,000	0	22,033
Tecomatlán	54,850	6,533	22,000	95,000	0	123,533
DAPMA	77,320	8,000	20,800	50,000	0	78,800
20 de Noviembre	59,160	4,000	17,800	35,000	0	56,800
Bocja-Chimilpa	18,160	4,000	3,000	15,000	0	22,000
CUR	6,480	0	1,200	4,000	0	5,200
El Rincón						
CUSA	53,077	0	10,000	20,000	0	30,000
Santiago de Anaya						
CUY	31,500	0	3,600	12,000	0	15,600
Yolotepec						
CUST	18,360	0	0	0	0	0

San Miguel Tlazintla						

Within the same Table 3, it is indicated that the San Miguel Tlazintla system does not incur in fixed expenses; for the reason that users perform the administration and operation tasks, therefore, there is no personnel employed. Nor does it have electrical energy costs since the source of water supplying the system is a spring and no pumping equipment is required to extract or distribute water.

As shown in Table 4, only one of the three systems managed by the Ajacuba Municipal Board is self-sufficient: the Tezontlale, as its financial efficiency index indicates that its IF covers 2.82 times the total of its GF. By contrast, the estimated indicator for Ajacuba indicates that the IF only covers 79.0% of its GF; while in Tecomatlán it hardly covers 44.0%.

Table 4. IEF, GF and employee cost per outlet. Average month. Source: elaborated with field data.

Organización Sistemas	**IEF (IF/GF)**	**GF/ Outlets ($)**	**Employees/ Outlets ($)**
CAAMSSH	0.81	61.28	27.33
San Salvador	0.26	160.44	85.80
Santa María	1.19	43.26	16.70
OOC El Cardonal	0.32	162.15	60.62
DMAPA	0.79	62.59	14.63
Ajacuba	0.79	62.96	10.12
Tezontlale	2.82	17.74	12.91
Tecomatlán	0.44	112.61	26.01
DAPMA	0.98	40.76	14.89
20 de Noviembre	1.04	38.40	14.74
Bocja-Chimilpa	0.83	48.46	15.42
CUR El Rincón	1.25	36.11	8.33
CUSA	1.77	30.61	10.20

Santiago de Anaya			
CUY Yolotepec	2.02	22.29	5.14
CUST San Miguel Tlazintla	ND	0.00	0.00

The expenses incurred by each of these systems are counted in aggregate form in the municipal treasury. Thus, salary expenses for the administrative staff are divided equally between the three systems, and the Municipal Treasury absorbs the budget deficits with which the two systems that do not reach their financial efficiency are operated.

Therefore, the fact of having a joint accounting hides the situation of each system in particular. Thus, the aggregated data indicate that a served home water outlet costs $62.59 to the Municipal direction of Ajacuba, when in practice, the supply of a home water outlet in the Tecomatlán system has a cost of $112.61 and in the Tezontlale $17.74. The same applies to the staff employed, since the aggregate data indicates that its cost is $14.63 for each outlet served, but the actual cost is $10.12 in the system Ajacuba, $12.91 in the Tezontlale and $26.01 in the Tecomatlán, respectively.

The Municipal Office of Drinking Water in El Arenal is in similar conditions and the aggregate data also does not reflect the situation of each particular system.

Its IEF indicates that in that organization the fixed incomes cover 98.0% of its fixed expenses, but when disaggregating the corresponding data of each one of the two systems the result is that the Bocja-Chimilpa only covers 83.0% of its GF with its IF, and that the 20 de November covers 100.0% of its GF with its own income. Hence, the aggregated accounting masks the low efficiency of the Bocja-Chimilpa system.

With regard to the cost of an outlet served, the aggregate data indicate that the municipal office of El Arenal costs $40.76, but the disaggregated data indicate that in the system Bocja-Chimilpa it is $48.46 and $38.40 at the 20 de November.

Another type of organization that manages two systems of piped water is the utility of San Salvador, the aggregate data show an IEF of 0.81, which means that the water utility reaches to cover the 81.0% of its fixed expenses with what it obtains the monthly fee collection. The

situation is different for the San Salvador system because the IF only covers 26.0% of their GF, while in the Santa Maria system it reaches to cover 1.19 times their GF.

Thus, the cost of a home water outlet is $160.44 for the San Salvador system and $43.26 in Santa Maria. However, the aggregate data indicates that it costs the water utility $61.28 for an outlet served; the same applies to the staff employed because the joint accounting indicates that it costs the water utilities $27.33, and when disaggregating the data, it turns out that for each home water outlet served the staff employed has a cost of $85.80 in the system San Salvador and $16.70 in the Santa Maria.

The so marked difference between the San Salvador and Santa Maria Systems is because the costs of the employed staff are divided equally between the two, but with the caveat that the first only supplies 560 home water outlets compared to the 3 080 of the second.

As it turns out, the users of the San Salvador system subsidize the Santa Maria system in order to cover the whole payroll. In addition, the respective municipal treasury absorbs the cost of the electrical energy consumed by the two systems; thus, the users pay the personnel employed and the electrical energy the City Hall. That is why the water utility persists.

The water utility of El Cardonal manages a single system, as the city council decided to, and it is the most expensive of all those who were chosen as case studies.

In this water utility the GF per home water outlet served rises to $162.15 and the expenditure of staff employed at $60.62, therefore, their financial efficiency index is 0.32, which means that it only covers 32.0% of their GF with their own income. The missing money is obtained in the form of subsidies from the municipal treasury of El Cardonal.

In this system, as in the one managed by the water utility of San Salvador, the tariff the users pay is used to cover the amount of the monthly payroll and the Municipal Presidency contributes the total amount for electrical energy.

By making a comparison among the 12 systems that were studied, it turns out that those managed by user committees are financially more efficient than those managed by municipal offices or water utilities.

According to the financial efficiency index that was calculated for each one of the systems managed by the users, it is deduced that in the El Rincón system, the IF cover 1.25 times the total of its GF; in the Santiago de Anaya 1.77, and in the Yolotepec 2.02, respectively.

The IEF of the San Miguel Tlazintla system remains undetermined for the reason that there are no fixed costs for electrical power or payment of staff employed; but the fact that its respective index has not been calculated does not mean that this system is inefficient in the collection of the annual fee for piped water service.

Organizations that manage self-governing systems have healthy finances, because the GF per home outlet as well as the cost of staff employed per outlet served are low since the administration and operation tasks are performed by the same users.

Thus, according to the data in table 4, the fixed cost of a home outlet served in the Yolotepec system is $22.29; in Santiago de Anaya $30.61 and in the El Rincon $36.11. The cost of the staff employed per home outlet served is $5.14, $8.33 and $10.20, respectively.

With the data obtained and shown here, we proceeded to make a division of the GF between the total of home outlet served, with this the value closest to the amount of the tariff to be charged by each of the organizations was obtained, as a case study to reach the financial self-sufficiency. Figure 2 resulted from the comparison between the amounts of the estimated tariff with what was charged at the moment of the interviews.

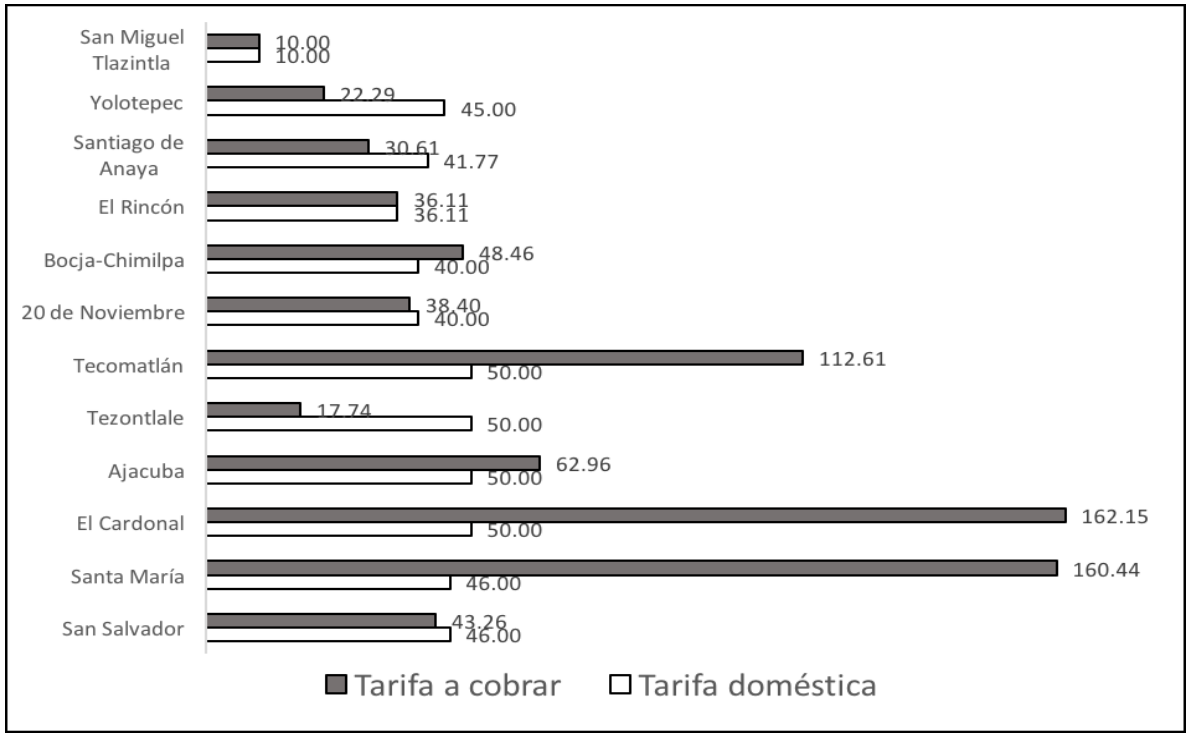

Figure 2. The minimum tariff that guarantees to cover the GF. Source: elaborated with field data.

As shown in Figure 2, the domestic tariff that the Congress of the State of Hidalgo approved for the OO of El Cardonal barely covers a third of the fixed costs involved to ensure the extraction and distribution of water.

The one that was approved for the OO of San Salvador is enough to cover the expenses in the San Salvador system; but in the case of the Santa Maria, it is only possible to cover a quarter of the total fixed expenses; therefore, the logic indicates that the tariffs should be increased in that system, however, that is not possible since the approved tariff should be applied to the two systems that the organization manages.

The Yolotepec and Santiago de Anaya systems, which are managed by the same users, apply a fee which amount is above the minimum necessary to cover their fixed expenses; this translates into financial efficiency and flexibility at the moment of charging fees for piped water service.

The El Rincón system is the most efficient in this case, because its fee is variable month by month. To establish it, the total amount of electrical energy consumed in the well plus the operator's payment and an extra for unforeseen expenditure is divided by the total of outlets served. It should be clarified that, for this specific case, Figure 2 shows an average data obtained according to the maximum and minimum amounts consumed in one year.

As already mentioned, the San Miguel Tlazintla system does not incur GF; therefore, the data presented in the graph was obtained by dividing the twelve months of the year by the annual fee of $120.00 charged to the user in the category of a domestic outlet. The estimated data is considered correct since the annual fee that the users set is enough to cover the variable and unexpected expenses.

The two systems that the Municipal Office of Drinking Water of El Arenal manages, almost achieve a global balance, because at the 20 de November the approved tariff exceeds with two pesos the minimum tariff to cover their fixed expenses, while for Bocja-Chimilpa there is an eight pesos shortfall to reach the tariff that would allow them to deal with its GF.

The drawback to this municipal office, as said in the interviews, is the lack of payment by the users and the inability to control the water consumption, conditions said by the Municipal Director of water, have led to the City Council to consider the possibility of ceding the operation of these two systems to an inter-municipal water utility, based in Pachuca, Hidalgo.

In the three systems managed by the Municipal Board of Drinking Water of Ajacuba, there is also no homogeneity. Thus, the approved tariff represents half of the minimum tariff that allows the Tecomatlán system to cover its GF; and on the contrary, with the same tariff, the users of the Tezontlale system pay 290.0% more than the minimum necessary to cover the GF. Finally, the Ajacuba system is thirteen pesos below the minimum tariff that would allow it to be self-sufficient in its GF.

So far, there is an overall view of the condition that the financial situations of small water systems in the rural areas of the state of Hidalgo have, where it is common to find three well-defined management models: water utilities, Municipal offices, and users committees. So far, with the submitted arguments, it is possible to affirm that, at small scale, the users' participation is fundamental to

establish a tariff system closer to the requirements of the organizations, in order to solve their fixed expenses.

In addition, it could be identified that the strategy of adding small dispersed systems to a central administration does not necessarily lead to economies of agglomeration or scope, as proposed by theorists that define the supply of water for human consumption as a Public service which by its nature generates monopolies.

It was also documented that the fact of increasing the number of home outlets served in those organizations of a monopoly nature and administering a single system, is far from reaching economies of scale and requires a considerable amount of subsidies to keep running.

Finally, the information presented is decisive to say that the organizational performance of DM and OO is limited because they lack autonomy to fix their tariff, and in the hypothetical case that the legal framework allows them to, the users' availability to pay the minimum tariffs, guaranteeing to cover the fixed expenses in the respective systems that they use, would yet to be evaluated.

Conclusions

The results obtained and their comparative analysis, it is possible to affirm that the proposed index, as well as the methodology for its construction and empirical testing, it is applicable to analyze the financial situation of the organizations that manage small systems of drinking water.

It can also be concluded that in all the cases analyzed there are minimum indicators to compare the different organizational arrangements found in field for two of the efficiency components in drinking water systems: the commercialization services and institutional development.

With regard to commercialization services, it is clear that all of the organizations analyzed have tariff systems to determine the cost of the

service, as well as a list of users to whom they are endowed with piped water.

Regarding collection, there are elements to indicate that all the organizations have the capacity to charge for the service, however, their tariff structures with which they operate prevent them from determining a differentiated fee for each system and thus cope with their fixed expenses for each one of them.

In reference to institutional development, two situations can be identified, the total organizational autonomy of CU, in comparison with the high dependency on part of the OO, and the DM of the municipal public budget to cover their respective budget deficits.

It is also noteworthy that the OO and DM have some autonomy with respect to the current City Council to elect administrative and operational staff, not in the case of tariffs, because, as stated above, this is the exclusive attribution of the local Congress.

It can, therefore, be concluded, from the data presented, that the lack of autonomy to fix tariffs by the OO and DM affects negatively the institutional development of the organizations studied.

With regard to the implementation of DM and then OO as official responses to achieve financial autonomy in the management of piped water systems, it can be concluded that in the small scale these two strategies are not feasible, especially because of the lack of autonomy in the institutional development.

In other words, 40 years of national policy have been implemented and the expected target has not been achieved. In the specific case of the small scale, it is relevant to consider the management by the users as a viable option, as well as to recognize its technical and financial advantages over other two organizational arrangements analyzed here.

In addition to the above, the data found in the field give rise to discuss the absence of the private initiative in the delivery of water service for human consumption on a small scale. It is also pending to investigate the optimal size or limits of private companies to access a management scheme that until now has only been of direct intervention from the municipalities. In the absence of these, the answer is the community organized through self-government and self-management.

Finally, with the intention of making the budget more efficient that municipalities assign to the supply of water for human consumption, in

the light of the evidence presented here, the option to create municipal funds to support unforeseen CUs arises, wherewith a little distributive justice of public resources is included, given the constant financial bailouts of DM or OO.

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