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Notes

Model to improve the management of drinking water supply for the inhabitants of Mexico City

Modelo para mejorar la gestión del suministro de agua potable para los habitantes de la Ciudad de México

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Abstract

The objective of this research is to design a model to improve the drinking water management supply for the inhabitants of Mexico City, considering that this City is one of the cities with the largest population worldwide and has a robust economy and infrastructure. Therefore, managing the resource is a challenge due to the multiple problems that arise. The methodology used was qualitative in which the literature on the subject was reviewed and semi-structured interviews were designed to be applied to 17 directors linked to drinking water management supply in the city

located in the Water System of Mexico City (Sacmex, for its acronym in Spanish) and in the 16 mayors' offices, taking based on Hooper's model. The results and their discussion show that, of the 10 categories of the model, the lack of a budget stands out for optimal performance of management, and the necessary reforms in water regulations that allow streamlining processes and strengthening their evaluation and monitoring. Considering these two subcategories, the others could be greatly improved: coordinated decision making, response in decision making, objectives, their change and completion, organizational design, training and development, information and research, accountability, and monitoring; and the roles of the public and private sectors. However, political will is required, effective coordination between the main stakeholders and awareness on the part of the social sector. Finally, findings are offered on which future research can deepen.

Keywords: Mexico City, management, model, drinking water supply.

Resumen

El objetivo de esta investigación es diseñar un modelo para mejorar la gestión del suministro de agua potable para los habitantes de la Ciudad de México, considerando que esta urbe es una de las que cuentan con mayor número de población en el mundo y tiene una economía e infraestructura robustas. Por ello, gestionar el recurso es un reto por los múltiples problemas que se suscitan. La metodología utilizada fue de corte cualitativo, en la que se revisó literatura sobre el tema y se diseñaron entrevistas semiestrucuturadas para aplicarse a 17 directores vinculados

con la gestión del suministro de agua potable en la ciudad situados en el Sistema de Aguas de la Ciudad de México (Sacmex) y en las 16 alcaldías, tomando como base el modelo de Hooper. Los resultados y su discusión muestran que de las 10 categorías del modelo destaca la carencia presupuestal para el desempeño óptimo de la gestión, y las reformas necesarias en la normatividad hídrica que permita agilizar los procesos y fortalecer su evaluación y seguimiento. Considerando estas dos subcategorías se podrían mejorar en gran medida las demás: la toma de decisiones coordinada; la respuesta en la toma de decisiones; los objetivos, su cambio y finalización; el diseño organizacional; la formación y el desarrollo; la información e investigación; la responsabilidad y el seguimiento; y las funciones de los sectores público y privado. Sin embargo, se requiere voluntad política, una coordinación eficaz entre los principales involucrados y concientización por parte del sector social. Finalmente, se ofrecen hallazgos sobre los cuales se puede profundizar en próximas investigaciones.

Palabras clave: Ciudad de México, gestión, modelo, suministro de agua potable.

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Introduction

Fresh water is a resource of primary importance for human beings in matters of health, well-being and safety. It should be noted that the human right to water and sanitation was declared by the United Nations General Assembly in July 2010 (UNESCO, 2016). It is also necessary to indicate that the right to health is inclusive and extended to factors such as access to drinking water and sanitation, according to article 25 of the Universal Declaration of Human Rights (ONU, 1948). Likewise, it is recognized that States must guarantee the right to have access to determining factors of health, such as drinking water and sanitation, in accordance with article 12 of the International Covenant on Economic, Social and Cultural Rights (Oficina del Alto Comisionado para los Derechos Humanos, 1966). Likewise, water resources form part of one of the main axes of the 2030 Agenda, with the Sustainable Development Goal (SDG) 6, which seeks to guarantee the reserves of water resources, sustainability in their management and sanitation, and this goal is related to the remaining 16 (UN, 2017).

Globally, 2 billion people do not have securely managed services; 138 countries and five of the eight SDG regions had estimates of safely managed services, representing 45 % of the global population. Furthermore, 84 countries have achieved universal access, with coverage greater than 99 %, to at least basic services, including 30 countries that have achieved full access to safely managed services. At the current rate of progress, the world will only reach 81 % coverage by 2030, leaving 1.6 billion people without securely managed services (WHO & UNICEF, 2021).

It should be noted that the COVID-19 pandemic has plunged the world economy into recession. The number of people who became extremely poor in 2020 was between 119 and 124 million. This has had an impact on widespread disruption in the provision and financing of essential services, such as water. In addition, it must be considered that constant hygiene is required as a preventive measure against COVID-19, which is why some governments have established emergency measures to continue providing the drinking water service. Undoubtedly, this has caused the use of more water, coupled with a scenario of water stress that already existed before the pandemic (WHO & UNICEF, 2021).

Regarding COVID-19, the Metropolitan Zone of the Valley of Mexico (ZMVM), where Mexico City is located, is the epicentre of the pandemic in the country, and whose variations of confirmed, suspected, negative cases and deaths per day they can be consulted on the website of the Gobierno de México (2020a). If the experiences that Mexico has had as a result of different epidemics such as cholera in 1992, influenza in 2009 and COVID-19 today are considered, the availability of sufficient and quality water resources is of paramount importance for the control of these epidemics, because hygiene is fundamental (Conagua, 2020a). However, hygiene is complicated when there is no or intermittent access to drinking water, resulting in water insecurity that becomes a source of disease for the marginalized population that cannot regularly access drinking water (Gobierno de México, 2020b).

On the other hand, Mexico is made up of 31 states and Mexico City (Conagua, 2018). Drinking water coverage in the country is around 94.4 %, while sewage coverage is 91.4 % (Conagua, 2020b). However, there

are multiple water problems such as overexploitation and the concession of important basins and aquifers, contamination of bodies of water in the order of 70 %, operation with obsolete infrastructure, compromised water security, conflicts over water in the three orders of government, the outdated legal framework, the lack of investment to improve the water sector and the reduction of the budget, to name a few (Arreguín-Cortés, López-Pérez, & Cervantes-Jaimes, 2020).

As for Mexico City, it is divided into 16 territorial demarcations (Conagua, 2018) and is one of the cities with the largest population in the world, has one of the largest economies in America and It has a robust infrastructure (Sedeco, 2021), so it is a challenge to manage water, since there are multiple setbacks (Torres, 2017). Water security represents a challenge to have water in quantity and quality for the inhabitants. In addition, the trend on water management envisages a negative outlook for 2050 (Martínez-Austria, 2013).

Considering the background, the research problem can be summarized in the following words: the inhabitants who live in Mexico City have suffered a deficit in the supply of drinking water with the prevailing management model. Therefore, the objective of this research is to design a model to improve this management, which is guided by the question of what elements should be considered for the design of the model.

To successfully carry out this research, a qualitative approach is used that involves the review of the literature on the subject, as well as the application of semi-structured interviews to officials involved in management. This article is structured in the following main sections:

drinking water supply in Mexico City, organization and institutional management of Mexico City, water management models, methodology, results, discussion, and conclusions.

Methodology

A review of the literature on the management of drinking water in Mexico City was carried out, as well as on the models of this management to later define which model is followed in this City. For this, various periods of time were analyzed, but paying attention to the contemporary.

The review of the literature was carried out through prestigious academic databases such as Web of Science, Scopus, Science Direct and Google Books, to point out the transcendental ones. As a complement, this review was carried out in government documents and international organizations such as the United Nations, the World Health Organization and the Organization for Economic Cooperation and Development. The main keywords used in the databases were the following, both in English and Spanish: "drinking water supply", "access to drinking water", "water administration", "water management", "water management models", "drinking water management models" with this term at the end: Mexico City.

In the next stage of the methodology, it was proposed to carry out field work, for which the semi-structured interview research technique was selected (Hernández-Sampieri & Mendoza-Torres, 2018). However,

for this it was necessary to determine a sample for the application of the interview, at the same time that the instrument was designed.

Sample determination

The guidelines of a sampling by experts were followed (Hernández-Sampieri & Mendoza-Torres, 2018) and it was considered appropriate to implement an intentional sampling. The sampling method is fundamental because it allows the researcher to rely on his or her discretion in choosing categories in a sample population (Palinkas *et al*., 2015). Therefore, the sampling process depends on the researcher's judgment and understanding of the context. In this sense, it was pointed out that the sampling method was also essential because the data was collected from a small population of interest of 17 directors. Purposive sampling ensures that qualitative responses are collected, contributing to better insights and accurate research results. In addition, it improves the analysis of the results to filter irrelevant answers that do not respond to the investigation.

Palinkas *et al*. (2015) define expert sampling as a method used when a researcher focuses on individuals with high knowledge or perception about a specific topic. Therefore, the experts were selected based on their level of experience and specialization in water management in Mexico.

The implementation followed a series of steps, the most important being the one that highlights the need to define the research problem: the management of the supply of drinking water for the inhabitants of

Mexico City. Subsequently, the size of the sample was determined, which was made up of 17 directors, one from Sacmex and the rest from the mayors of Mexico City. The determination process was characterized by the introduction of inclusion criteria that focused on the following:

1. The power to make relevant decisions in the water sector
2. The experience
3. Knowledge
4. Capacities to influence management

After analysis, the study subjects shown in Table 1 were considered for inclusion.

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Table 1. Study subjects.

Subjects	Source
General Directors of Urban Services (mayors Álvaro Obregón, Cuajimalpa de Morelos, Gustavo A. Madero, Iztacalco, Iztapalapa, Milpa Alta, Tláhuac, Tlalpan, Venustiano Carranza and Xochimilco)	Alcaldía Álvaro Obregón (2020) Alcaldía Cuajimalpa de Morelos (2020) Alcaldía Gustavo A. Madero (2019) Alcaldía Iztacalco (2020) Alcaldía Iztapalapa (2019) Alcaldía Milpa Alta (2020) Alcaldía Tláhuac (2020) Alcaldía Tlalpan (2019) Alcaldía Venustiano Carranza (2019) Alcaldía Xochimilco (2019)
General Director of Public Works and Urban Services (Mayor's Office Coyoacán)	Alcaldía Coyoacán (2020)
General Director of Urban Services and Sustainability (Mayor's Office Cuauhtémoc)	Alcaldía Cuauhtémoc (2018)
Executive Director of Urban Services (Miguel Hidalgo Mayor's Office)	Alcaldía Miguel Hidalgo (2020)
General Director of Urban and Environmental Services (Mayor's Office La Magdalena Contreras)	Alcaldía La Magdalena Contreras (2020)
General Director of Urban Development and Urban Services (Mayor's Office Azcapotzalco)	Alcaldía Azcapotzalco (2019)
General Director of Works, Development and Urban Services (Mayor's Office Benito Juárez)	Alcaldía Benito Juárez (2019a) Alcaldía Benito Juárez (2019b)
Director of the Potable Water Service and Efficiency Improvement Project (Sacmex)	Sacmex (2024)

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Design of the research instrument

To design the instrument, the models referred to in this article were analyzed and it was decided to use the Hooper model as a basis, which has 10 categories, 37 subcategories and 115 indicators (Hooper, 2006). It was determined that the model was complete and adequate to meet the objective of this research. Although it has been formulated for several years, its elements were found to be valid, so it was only necessary to make adaptations in relation to the object of study. Hooper's model contemplates the water management cycle in a comprehensive and flexible way, which facilitates its adaptation to different contexts.

Due to the extension of the Hooper (2006) model, it was necessary to reduce it, so this was done considering the scope of the investigation and its suitability for the object of study. For this, the theoretical elements examined in the literature review of this research were analyzed and the support of six expert researchers on the subject from the National Polytechnic Institute was also requested.

Once the model had been reduced, and its elements had been clearly identified, the semi-structured question questionnaire was prepared. The final instrument was made up of 10 subcategories from which another 15 are derived with 16 indicators and 16 semi-structured questions. The main elements of the model are shown in Figure 1.

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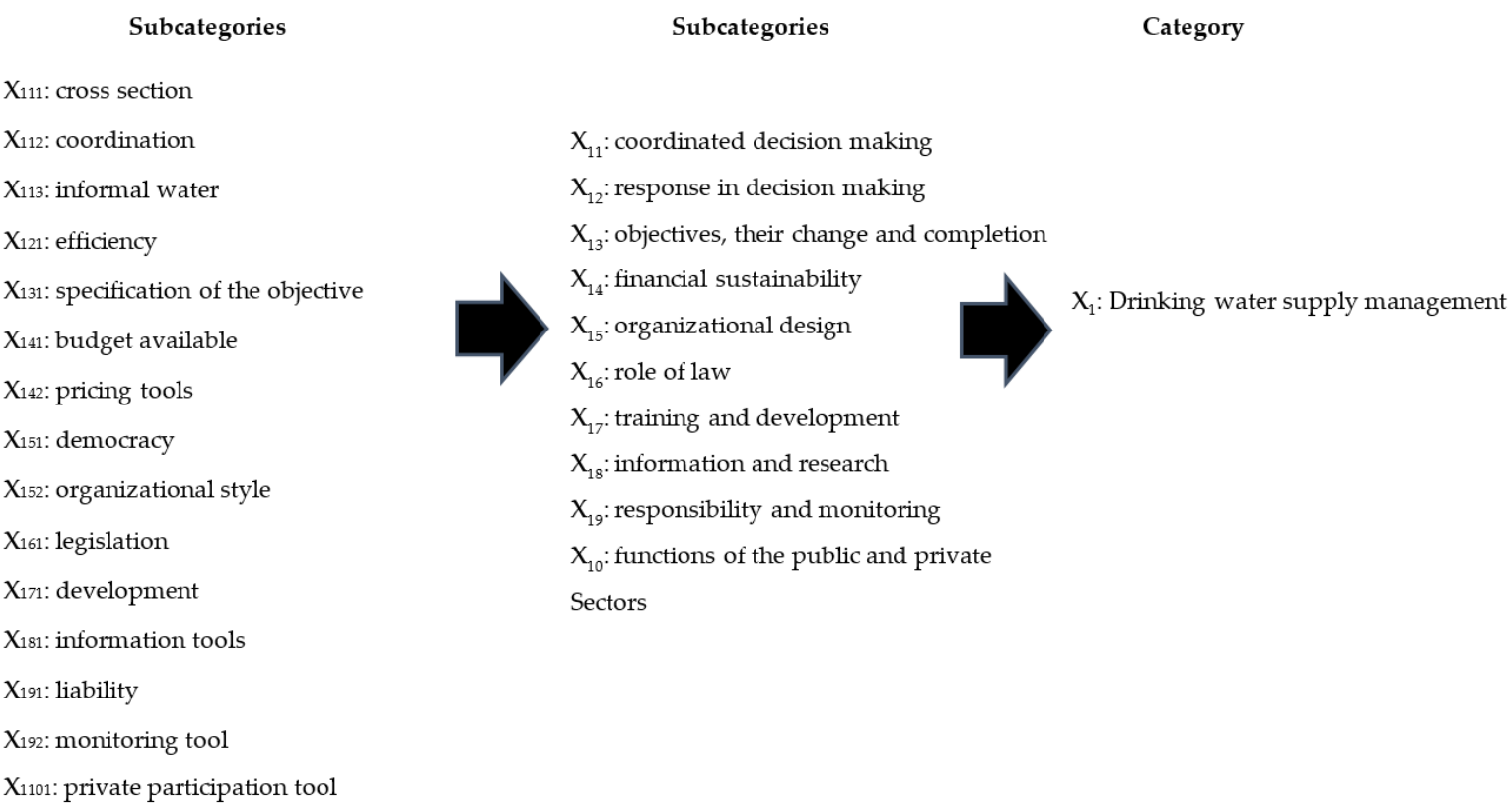

Figure 1. Model to improve the management of drinking water supply for the inhabitants of Mexico City. Source: Own elaboration based on Hooper (2006).

Results

The theoretical review of the literature on the supply of drinking water in Mexico City served as the basis for the design of the research instrument that was applied to 17 directors linked to the management of drinking water supply in Mexico City (Table 1).

In particular, the results derived from the semi-structured interviews showed disparities and challenges in the drinking water supply system. The first section of the semi-structured interview focused on subcategory X_{11}: coordinated decision making. Here the interviewees were prompted with questions about the cross section, coordination, and informal water. One of the directors pointed out the need to introduce transversal water policies that would strengthen the supply of drinking water among the residents of Mexico City. Reviewing the response, the researcher noted that a cross-cutting water supply system is used between multiple locations to reduce the risk of shortages and increase availability.

The second question explored coordination between agencies and departments with a primary emphasis on control mechanisms. The response obtained was that it was necessary to strengthen coordination because it was at a low point, which increased the supervisory bias in public and private organizations. In addition, there was a risk of bureaucracy influencing coordination and misaligned priorities between organizations.

It was recommended that the municipalities develop a coordination framework to curb this problem. Specifically, it was pointed out that the reason behind the shortcomings is that each mayor's office has its own vision and objectives, which undermines coordinated approaches and decision-making processes. Therefore, the mayor's offices should unite and strike agreements with society and Sacmex to improve the supply of drinking water to citizens.

The third question asked if any available control mechanism could help prevent clandestine intakes of drinking water. Given this losses, and leaks of water in the pipeline can cause shortages in the short and long term. It highlights that it is necessary to strengthen water programs, which can increase availability and minimize the probability of clandestine intakes. In addition, it is necessary to exercise control over natural water resources (aquifers) to improve availability. One of the directors indicated that the government should allocate more resources through annual budgets, which will improve infrastructure management and the implementation of water supply and conservation projects throughout the city.

After completing the first section, we moved on to the second subcategory, which focused on the decision-making response (X_{12}). The subcategory contained questions about the efficiency of decision-making processes and programs in general. The initial question explored what needs to be improved in decision-making to effectively combat drinking water scarcity. Most directors pointed to the issue of resource allocation and budget constraints as an impediment to the provision of drinking water. Therefore, they recommended improving budgets to manage infrastructure effectively. The subsequent consultation focused on current water harvesting programmes, which have so far been touted as ineffective in addressing water scarcity. Directors agree that increased budget allocations will help expand the number of rainwater harvesting programs, thereby improving availability and minimizing shortage problems.

The X_{13} subcategory was substantial in understanding objectives, changes, and completion levels in water supply agencies. It was also intended to determine whether the water agencies had clear objectives to improve the management of the drinking water supply in the long term. Respondents noted that most of the goals were coined at the turn of the century, thus focusing on long-term goals.

However, the main problem was the apparent lack of effective mechanisms that could help water agencies achieve their goals. To alleviate this problem, it was mentioned that each administration must evaluate the projects that gave positive results to give them continuity and implement improvements in the processes to face any challenge.

Financial sustainability is at the core of any water management system, as it determines the availability of resources that can improve supply and service delivery (Hooper, 2006). The concept was explored in subcategory X_{14}, and the researcher asked what needs to be improved so that the budget would be sufficient to improve the management of drinking water supply. At least 10 of the respondents mentioned that their mandates to deliver water safely and effectively are undermined by budget constraints. Therefore, the national and local governments must expand budget allocations to increase the infrastructure that serves the inhabitants of Mexico City.

Consequently, the respondents indicated that ineffective pricing policies contributed to the scarcity of budgetary resources. Torres (2017) supports this provision by pointing out that the costs of public water in Mexico City are quite high. In addition, the quality of tap water is not good, which encourages citizens to buy bottled water. The directors

agreed with this assertion when pointing out that the prices of drinking water supply have been detrimental to recovering the operating costs incurred in its management. The responses indicated the need to introduce a transparent and affordable pricing scheme, thus increasing dependence on public drinking water supply systems. Affordability will inadvertently increase the money collected, allowing water agencies to recoup investments in the supply system.

The X_{15} subcategory explored organizational designs with democracy and organizational styles at the centre of the questions. Directors noted that hydrological policies were constantly changing, undermining consistency in the management of drinking water supplies. Furthermore, each government was riddled with bureaucracy, with officials gradually undoing the gains made by previous administrations. Regarding the organizational style, the directors pointed out the need to carry out periodic updates that respond to the current reality, thus improving the organizational structure of the water agencies.

The researcher went to subcategory X_{16} on the role of the law. The questions focused on the changes needed in the legal system. All Directors' responses pointed to the fact that constant updates are essential for water agencies to respond to current challenges. Therefore, it is the mandate of the executive and the legislature to enact laws that expand the mandate of the water agencies and allow them to respond to the problems of scarcity in the city.

Torres (2017) alludes that the continuity and efficiency of water services are based on the skills, knowledge, and competencies of public servants. Therefore, training programs enable the staff of a water agency

to manage the supply systems. The researcher asked what should be improved in development programs according to subcategory X_{17} (training and development). Directors mentioned that increasing staff training on the job and throughout their tenure would inform them about changing environmental conditions. Training programs are important to ensure that staff respond effectively to drinking water supply issues, thereby improving customer satisfaction.

Respondents were also asked about information tools based on the subcategory X_{18} (information and research). Directors agreed that communication was a major challenge in improving drinking water supply systems. Therefore, an upward communication channel must be introduced, including all stakeholders in decision-making processes (Pavic, Cosic-Flajsig, Petricec, & Blazevic, 2012). The model not only improves data collection but allows for the clear flow of information between utility agencies, allowing adaptation to change in supply and demand.

The penultimate subcategory: explored responsibility and follow-up (X_{19}) in relation to accountability and data network management. All 17 directors mentioned the need to improve public access to information that emphasizes accountability and calls to action. One of the directors indicated that the use of updated technology and databases could improve the operational structure of the supply system because the agencies will collect information on the behaviour of water during supply.

The final section explored subcategory X_{110} on the functions of the public and private sectors. The researcher asked the respondents what needs to be improved regarding the link between the public and private

sectors. At least 50 % of directors mentioned that introducing a joint vision and policy among stakeholders can streamline operations. Furthermore, the joint vision would ensure that each stakeholder understood what is required of them in the provision of drinking water, thus minimizing dissatisfaction and shortages.

Discussion

The review of the literature on water management models was necessary to select one as a reference to develop the drinking water supply management model for Mexico City. During this review some contemporary models were analysed, but also some older ones. This is the case of the model by Hooper (2006), which was considered ideal for this research due to its robustness and flexibility to adapt to different contexts. Considering the model referred to in the previous paragraph, we proceeded to reduce it with the support of experts about water and from these semi-structured questions were formulated. These questions were applied to 17 directors involved in the management of drinking water supply in the city located in Sacmex and the mayor's offices. All the questions helped to determine the efficiency of the drinking water supply system in Mexico City.

The efficiency of a drinking water supply system is defined by the total sum of components that work together with each other. A decrease in the operating effectiveness of one component can contribute to the failure of the entire system. In the results section, each component was identified and categorized into subcategories.

Regarding category X_{11}: coordinated decision-making, the research by Arreguín-Cortés *et al*. (2020) agrees with the findings that it is necessary to strengthen mainstreaming because water policy is centralized in the Comisión Nacional del Agua (Conagua). It is necessary to strengthen coordination between government agencies themselves and later abroad, considering clear mechanisms for its assurance. Achieving this also requires political will.

In relation to clandestine, despite the efforts made to cancel clandestine water intakes, there are still extractions in clandestine wells, which is why it is necessary to design a surveillance system that allows inspection and control of water extraction. For this, it is necessary to allocate greater economic resources to promote programs that address the problem.

Additionally, category X_{12}: response in decision making shows that there is still inefficiency in the use of water in different sectors (Arreguín-Cortés *et al*., 2020) despite having invested for years in the construction of different works aimed at improving water efficiency that helps to eliminate water losses (Sacmex, 2012). Therefore, a larger budget is needed to improve infrastructure and improve water efficiency. To control these losses, it is necessary to implement technology that detects them and enables a rapid response. The technologies would determine where there are leaks with constant data collection to improve future maintenance processes.

On the other hand, it is necessary to look for new alternative sources of sustainable water, so that not everything falls on the extraction and supply of sources located outside of Mexico City. Instead, rainwater

harvesting could be used as an alternative. Although there are no convincing results with the implemented programs (Sacmex, 2012, it is necessary to continue promoting and supporting them so that domestic users are provided with another source of water that would complement the main one. C40 (2019) anticipates that the natural availability of water in Mexico City is likely to reduce by 17 % from 2050. This requires the introduction of rainwater harvesting that will manage water scarcity and improve water availability. availability. Furthermore, the methods would reduce excessive reliance on natural aquifers, thereby improving water management.

Category X_{13}: objectives, their change and completion shows that there is an *Integrated Water Resources Management Program* (PGIRH) that contains more than 2,200 actions, and includes the financial part, with a 20-year vision (Sacmex, 2012). However, it is important to give it continuity and make the pertinent adjustments to be able to build new projects on an established basis, and not make drastic changes every time a new administration governs, since one of the problems with management is related to temporality linked to the directors in turn.

To explain category X_{14}: financial sustainability, it is important to return to some arguments from Sacmex (2018), where the persistence of a lack of planning that affects budgeting is raised. For this reason, priority should be given to budgetary allocations of water resources for the achievement of projects that improve the supply of drinking water. The provision of budgetary resources would ensure that each water utility could effectively fulfil its mandate.

On the other hand, the approval of tariffs for water supply rights is attributed to the legislative body of Mexico City indicated in the Fiscal Code; Therefore, these rates comply with political-administrative principles, instead of a technical-operational analysis. In addition, it is through the Ministry of Finance that the proposals for modifying the rates are made, so that through them they are presented to the legislative body (Sacmex, 2018).

It is also important to emphasize that the hydraulic system is archaic, the subsidized rates do not make it possible to cover the expenses incurred in operation and maintenance (Sacmex, 2018). For this reason, it is necessary to continue presenting tariff proposals to the Ministry of Finance that allow the aforementioned expenses to be covered, and the amount allocated to investment in infrastructure can be increased.

Category X_{15}: Organizational design shows that water planning and its evaluation have not been fully executed and tend to be repetitive, which can be observed in the last three water programs (Arreguín-Cortés *et al*., 2020). Due to the above, it is necessary to carry out regular updates that respond to current changes.

Another point to consider has to do with the bureaucratization of drinking water agencies, which has been going on for decades (Sacmex, 2018), so the implementation of new, less rigid organizational structures could allow information to flow efficiently. relevant for decision-making and rapid actions can be taken to improve the management of the drinking water supply.

Regarding category X_{16}: role of the law, it is a very broad topic, but it requires updating (Arreguín-Cortés *et al*., 2020). In general, regarding the operator of the drinking water and sanitation service, it has already been proposed that it should be a decentralized body. This would make it possible to improve management by simplifying activities that would not require going through certain administrative instances that would slow down the achievement of objectives (Sacmex, 2018).

Continuing with what was proposed by Sacmex (2018), it is necessary to formulate a new water law that enables the creation of the aforementioned decentralized body, but also the design of a sustainable and comprehensive water policy according to the current reality that also benefits the operation. of the water supply that is carried out from the 16 territorial demarcations of Mexico City. Well, according to Sandoval-Minero (2017), not even with the reform of the National Water Law in 2004 has it been possible to solve the problem of the supply-based management approach through structural measures, centralized decision-making, and the lack of transparent mechanisms.

Regarding category X_{17}: training and development, regardless of the reinforcement made to personnel with training and continuous performance evaluation, a mechanism should be sought that discourages placing personnel in strategic positions who do not have the profile to perform it, by margin that you can learn it over time. This is because, according to Arreguín-Cortés *et al*. (2020), it is common for the directors of urban drinking water systems not to be appointed based on their merits; but because of the personal relationship they have with their immediate boss on duty.

In relation to category X_{18}: information and research, in order to improve communication channels between areas involved in the management of drinking water supply, it is necessary to implement new computer systems that simplify processes. In addition to this, according to Zambrano (2017), coordination between the various political entities is needed. For example, the installation of a metropolitan water commission would enable the different water agencies to reach an agreement regarding the amount of water necessary to distribute in each entity that encompasses different political entities, considering the sharing of a hydrological basin. in common.

In category X_{19}: responsibility and follow-up, it is important that transparency and accountability be improved, so that it is truly in the public domain and is available and updated on the official pages of the agencies involved in supply management. of drinking water. On the other hand, it is necessary increase investments for infrastructure projects that involve the use of state-of-the-art technology to automate information and have updated databases that allow monitoring the behaviour of the drinking water supply in real time in order to intervene in the event of any problem that arises.

Finally, category X_{110}: functions of the public and private sectors show that, according to Sacmex (2018), it is useful to seek a public-private association for social benefit, particularly because the public sector can obtain advantages in obtaining financing.

It is important to emphasize that, despite the associations between the public and private sectors, the State must assume responsibility for

the management of the drinking water supply and must only delegate certain functions to the private sector as a form of support.

Conclusions

The drinking water supply system in Mexico City is far from being effective according to national and international standards. This article indicates that system efficiency is undermined by a number of factors covered in Hooper's model (Hooper, 2006).

Among the findings found, the lack of budget to better operate the drinking water supply stands out, as well as changes to water regulations that could streamline processes and strengthen their evaluation and monitoring. Considering these two subcategories, the others could be improved: coordinated decision-making, response in decision-making, objectives, their change and compliance, organizational design, training and development, information and research, accountability, and follow-up; and the roles of the public and private sectors. However, political will, effective coordination between the main actors and awareness on the part of the social sector are required.

This research offers a validated model, with general results, which can have a positive impact on the categories analysed. Although they are not the only categories that can be analysed in a model with the characteristics presented, they are of great importance for the context in which the research was developed. In addition, the discussion of the results offers a general guideline of how the government should proceed

to continue improving, but also provides the researchers with findings on which they can deepen.

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