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Notes

Rural water access and supply in Mexico and Brazil

El acceso y el suministro de agua rural en México y Brasil

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Abstract

The objective of this research is to analyze the literature on rural water access and supply in Mexico and Brazil, considering existing systems; to propose improvement recommendations in these areas. Different methodologies were used to review the literature, such as searching various scientific databases, the use of the SCIMAGO ranking, the adoption of the Newcastle Ottawa scale, the PRISMA guidelines, and the STROBE verification. The time periods spanned key remote eras ending today: 1994-2020. The results highlight that Latin American nations such

as Brazil and Mexico have water systems that need greater commitment from the public sector. It is recommended to involve the social sector in the development of community management schemes to find a solution to the changing water demand and supply. In addition, it is necessary to delve into the issue of water supply, for its improvement in the nations analyzed, in future research.

Keywords: Water supply, access to water, community management, sanitation, rural areas.

Resumen

El objetivo de esta investigación es analizar la literatura sobre el acceso y suministro de agua rural en México y Brasil considerando los sistemas existentes para proponer recomendaciones de mejora en estos rubros. Se utilizaron diferentes metodologías para la revisión de la literatura, como la búsqueda en diversas bases de datos científicas, el empleo del *ranking* SCIMAGO, la adopción de la escala Newcastle Ottawa, las pautas de PRISMA y la verificación STROBE. Los periodos de tiempo abarcaron épocas remotas clave que finalizan en la actualidad: 1994-2020. Los resultados destacan que naciones latinoamericanas como Brasil y México tienen sistemas de agua que necesitan un mayor compromiso para mejorar por parte del sector público. Se recomienda hacer partícipe al sector social en el desarrollo de esquemas de gestión comunitaria para encontrar una solución a la demanda y oferta de agua cambiantes. Además, es menester en próximas investigaciones profundizar en el tema del abastecimiento del agua para su mejora en las naciones analizadas.

Palabras clave: abastecimiento de agua, acceso al agua, gestión comunitaria, saneamiento, zonas rurales.

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Introduction

For decades, the history of humanity has been marked by decisive moments that altered its political, social, and economic structures. The 21st century is immersed in an endless number of these moments, among which the one that began in 2019 due to the COVID-19 pandemic stands out (Toledo, 2020). The disease has gone down in history as one that has caused a massive economic, social and health impact worldwide. The United Nations Environment Program (UN Environment Programme, 2020) highlights that Latin America has seen a rise in the number of deaths in recent months with governments grappling with how they can implement divergent measures aimed at mitigating its spread while maintaining the gains of peace, safeguarding human rights. and preserving the fabric of democracy (United Nations, 2020; UN Environment Programme, 2020).

A select number of Latin American countries such as Brazil and Mexico have shown some of the highest numbers of absolute and per capita cases in the international community with 3,057,470 and 485,836

respectively (Statista, 2020). Academics believe that the main reason behind the rising numbers is fragmented and unequal health systems, while others argue that it is the lack of a system and structure that can handle a major health and humanitarian crisis (Toledo, 2020).

The *modus operandi* of the coronavirus is transmission through infected surfaces, which then brings to light the importance of water and sanitation (Toledo, 2020). Sustainable development goal number 6, clean water, and sanitation for all, is seen as important in providing significant leverage for existing investments in health care and the fight against coronavirus (United Nations, 2020; UN Environment Programme, 2020). In addition to this, in Latin American society, the supply and access to water resources has decreased due to an increase in the population, as well as continuous confrontations and confusion in the organizations in charge of administering the systems (Carlsson & Berkes, 2005; Castro, 2006; Binswanger-Mkhize, De-Regt, & Spector, 2010). On the other hand, the changing climate and the increase in demand have increased the risk of problems of access and supply of water (Beall, Fiedler, Boll, & Cosens, 2011; VanDerslice, 2011). International Finance Cooperation (IFC, 2020) cites other factors, which have played a significant role in increasing demand, such as aging infrastructure and rapid urbanization.

Systemic infrastructures, water bodies and the natural/built environment have been devastated by the pandemic, and governments have been forced to review their options and alternatives. In addition to this, the increased demand for drinking water and sanitation in urban areas has caused nearly 3 million people in rural areas to be negatively affected by the lack of supply and access. This, in turn, has increased

their risk levels and susceptibility to disease as they lack basic protection (SNV Netherlands Development Organisation, 2013; World Bank, 2002; Bertoméu-Sánchez & Serebrisky, 2019).

Millions of dollars have been delivered to Latin American governments with the aim of expanding and consolidating the water supply in rural areas (United Nations Water, 2019; Estache, Gomez-Lobo, & Leipziger, 2001; United Nations Water, 2012). These zones are also located in remote areas, which further undermines the execution of operations and practices focused on the creation of local water services (World Bank, 2013; Bertoméu-Sánchez, Camós, & Estache, 2017).

The objective of this article is to analyze the literature on rural water access and supply in Mexico and Brazil, considering the existing systems. The reasons why these two countries were chosen is because they have presented changes in their water systems during the last 20 years, and they are complex nations in terms of their governmental structure.

The research is divided into five key sections, the first exploring the methodology that will be used in data collection. The section explains the merits of the methodological tool and a recount of the documents that are significant to explore the main topic under analysis. The following section details the results of the data collection process. Here it is explained how the approach was narrowed and the main documents were chosen to be discussed and used when drawing conclusions and recommendations. The third section is discussion, which performs an analytical analysis on the different documents and connects the findings. This is followed by the recommendations section, which provides readers with a plan for the government on what to do to ensure the future of water supply systems.

Finally, the conclusions section summarizes the findings of the article and provides a foundation for future research with specific insights drawn from the limitations of the current research.

Methodology

The issue of water supply and access in Latin America has been the subject of numerous investigations and a large body of literature is produced annually, often with contradictory results. Schimpf and Cude (2019) highlight that most researchers develop different results due to differences in study method, flaws, or even changes in sampling variations. In addition, they often grapple with the question of which of the results are most reliable and which should be implemented as a basis for policy decisions and practice (Mallett, Hagen-Zanker, Slater, & Duvendack, 2012; Boaz, Ashby, & Young, 2002; Department for International Development, 2011).

It was considered appropriate to explore the efficacy of current water systems using a systematic review of the literature (Sorensen, Wojahn, Manske, & Calfee, 2013; Vandenbroucke, 2007). The methodology is vital, as it identifies, critically appraises, and integrates the findings of all the necessary high-quality individual studies on the topic at hand. Before beginning the systematic review of the literature, he ensured that the methodology was not only replicable and transparent, but also systematic and objective (Dixon-Woods & Fitzpatrick, 2001; Gough & Elbourne, 2002; The PLoS Medicine Editors, 2011).

The systematic review of the literature required a search of the SCOPUS database with the aim of identifying the literature on water access and supply in Mexico and Brazil. The works were identified by using the SCIMAGO ranking of institutions, which helped narrow the scope of the research (Martín-Martín, Orduña-Malea, Thelwall, & López-Cózar, 2018). The main reason for choosing this tool is that it helps to check how often other researchers have cited the article. Increased citations translate to increased impact scores, meaning the article is highly referenced in the discipline. The SCIMAGO tool explores levels of research effectiveness through the use of ratio scales, which rank the impact of the article above one or below 1.

The second step of the methodology involved the application of a production scheme that explored how percentile variations could be applied. The scheme was useful to determine when the investigations were developed (Schimpf & Cude, 2019; Dreibelbis *et al*., 2013). The research schedule was also extended to gather articles published between 2000 and 2020.

The third step of the review involved the adoption of the Newcastle Ottawa Scale, which was useful in assessing whether the studies to be used in the research had the necessary quality levels. At least three parameters were used to measure research quality, including results, content, and levels of comparison (Wells *et al*., 2019). Articles were then classified into eight key items, which were defined by their percentile scores. The main changes made to the comparative parameters were important to ensure that the necessary articles were not excluded (Martín-Martín *et al*., 2018).

The penultimate step required that the guidelines of PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) in documenting the literature review process (Vandenbroucke, 2007). Additionally, the tool was helpful in documenting an evidence base for divergent interventions based solely on quantitative research. It also helped remove any duplicate articles and exported the full reference list to Mendeley to remove redundancies. The number of remaining records was identified after this step.

The last stage of the review implemented an 18-item STROBE checklist, which allowed the classification of the research work (Vandenbroucke, 2007). The 18 items are a direct contravention of the common 21-item checklist used in research paper classification. The 18 items would be useful to shed light on previous schemes used by the governments of Brazil and Mexico to improve access and supply to water. Also, the checklist was important in determining the scope of databases to be implemented. To do this, Bing, Core, Base, Google Scholar, the World Bank, and the environmental index were identified as the most suitable databases for research. The search process involved keywords in the databases in both English and Spanish, such as "water access and supply strategies", "Brazil", "Mexico", "rural water". The authenticity of the journals was then explored using the Web of Science database.

Completion of the systematic review stages determined whether the articles met the inclusion criteria. The main condition explored whether the documents had analyzed the relationship between government agencies and communities when addressing issues of water access and supply. The subsequent requirement was that the articles had to provide

quantitative information on water access and supply to meet the established standard that the article had to be analytical, not descriptive. The third requirement was that the documents should provide recommendations on how governments can manage demand for water supply and access in the future. Lastly, the documents had to offer a pragmatic definition of stakeholder engagement and the type of strategies that would be used to engage communities in developing strategies/decisions on how water resources can be used to achieve goals. of sustainable development.

Results

The inferences drawn from the systematic review of the literature highlight that water access and supply have transformed and changed dramatically since the beginning of the 21st century. The PRISMA flowchart allowed at least more than a hundred scientific articles and grey literature articles to be evaluated in an attempt to determine their relevance. The completion of the selection phase made it possible to identify 90 articles that met the established standards of praxis.

Articles that passed the screening were found to be effective because they scored higher than one, and also contained results that could be replicated in developing the structures and strategies needed to manage water demand/supply. Then, all the results that met the inclusion criteria were grouped into two groups, the first exploring water management structures and the second analyzing policies implemented by governments.

Of the 90 articles, 20 did not meet the inclusion criteria, as they focused solely on challenges influencing access to water, without offering recommendations for future research. Eight more items were then excluded because they did not meet the checklist requirements. The remaining 62 articles were considered relevant to the final review because they offered an exploratory analysis of past and contemporary water management practices and how governments can manage water access and supply in the coming years.

Discussion

Rural water supply in Brazil

The coronavirus has brought to light systemic weaknesses in the water management systems used in Brazil. Historically, the government has been criticized for not managing the systems with increased pressure. According to the Global Water Partnership (GWP, 2017), at least a third of the rural population in Brazil lacks the necessary access to services such as clean water and sanitation. The drop in access is aggravated by the fact that only 28 % of the rural population is supplied by a water supply system, 27 % by garbage collection and 22 % by a sewage system (Aleixo, Rezende, Pena, Zapata, & Heller, 2016).

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Community based systems

In 2006, the government launched a new mandate that would see the government expand the vision of public sanitation and access to drinking water from one that focuses on building infrastructure to emphasizing the operations, maintenance, and ongoing financing of water systems access and supply of water (GWP, 2017; Jouravlev, 2004). The overarching goal of the new management system was to allow optimal distribution of water in a way that would support essential uses and growth. Global Water Partnership (GWP, 2017) cites that water in Brazil is an economic good and has to be seen as such with a regulatory system in place along with adequate institutional/legal frameworks to regulate how it is used. The framework had to be adapted with special attention to the constraints and situations faced by rural regions and its flexibility determines its general access (Mejia, 2000; Moe & Rheingans, 2006).

Enéas-da-Silva, Tanya, De-Souza-Filho and Da-Silva (2013) point out that the program was developed through the use of select criteria, the first being the social dimensions and how communities can be included to improve the efficiency of the system. Fachinelli-Ferrarini, Ferreira-Filho and Horridge (2016) argue that the inclusion of local communities in the development process enables adoption and minimizes any resistance to implementation plans. Gnadlinger (2003) made a similar argument, noting that the communities involved during the planning process are likely to determine the supply options they wish to operate and maintain. On the contrary, the development process was not community-driven because it involved communities, but also governmental actors and the

private sector (Gnadlinger, 2003; Fachinelli-Ferrarini *et al*., 2016; Falk, Bock, & Kirk, 2009).

Eneas-da-Silva *et al*. (2013) cite that the merits of community participation cannot be measured in Brazil, although the success of the program has shown a ray of hope. Successful community engagement went beyond mere consultation with community members to arrive at a shared understanding of water as an economic and vital resource for community health and growth (Enéas-da-Silva *et al*., 2013). In addition, the project included a dialogue between the government and community members, which aimed to explore the main ideas about infrastructure options and determine whether people preferred or were enslaved by different levels of service. Eneas-da-Silva *et al*. (2013) believe that clarifying community preferences and responsibilities for the maintenance and financing of the water management system helped resolve conflicts and facilitate decision-making processes.

The social criteria also explored the issue of social capital, which Tucci (2004) defines as a shared set of norms, expectations, and patterns of interaction in a community. Social capital is important in a community because it helps them formulate and deploy their own financial and managerial capital in running a system (Ostrom, 2000). Rural communities in Brazil are cited by Enéas-da-Silva *et al.* (2013) and have differing degrees of social capital, which depends on their previous experience working together on other community projects and water infrastructure. Ostrom (2000) explains that social capital is more likely to exist in communities that have established their own practices and rules regarding water use. Furthermore, rural communities in Brazil are

distinguished by the ability of community leaders to communicate with members when it comes to the planning and operation of water systems (Solanes & Gonzales-Villarreal, 1999; Norman, Dunn, Bakker, Allen, & De-Albuquerque, 2013). This helps build the trust that is important for building social capital.

The second criterion after social is technical capacity, which explored the availability of equipment for system management. In addition, the technical criterion is supported by administrative and financial capacities, all of them dependent on social factors. Enéas-da-Silva *et al*. (2013) highlight that the existence of social capital in rural areas of Brazil meant that communities could formulate rules that would help in collecting the necessary revenues for the maintenance of water projects. Community participation in the planning process is identified by Enéas-da-Silva *et al*. (2013), as important as it contributes to the training and development of necessary skills on the technical front. In contrast, some rural communities in Brazil lack the necessary expertise to operate their own systems, requiring external technical support to be provided (Silva, Sales, Lanza, Heller, & Rezende, 20202020; Porto & Kelman, 2000).

The third and last criterion is the environment, which analyzed the capacity of the rural environment to generate enough water to satisfy the levels of demand and supply. The system is shown by Enéas-da-Silva *et al*. (2013) has been suitable for the environmental and climatic conditions of the rural region. Furthermore, it was established in a way that would limit the degradation of the quantity and quality of the water sources and the ecosystems that surround it (Silva *et al*., 2020; Willaarts, De-Stefano,

& Garrido, 2014). Enéas-da-Silva *et al*. (2013) highlight that infrastructure options guided the development process by balancing technical and social criteria with environmental factors. However, the concerns raised by the authors showed that the system was not applicable in the semi-arid rural areas of northeastern Brazil due to the limited availability of fresh water.

Heller (2006) also presents the public consortium model as one that has enabled the government to improve access and supply of water in rural areas of Brazil. The model implies the implementation of plans in which state and municipal participation is encouraged. The plans are legally based on the consortium law, which regulates how services between federated entities will be managed. In addition, the law is important because it grants public consortiums the necessary administrative and financial autonomy to govern and manage water access and supply systems (Heller, 2006; OECDt, 2020; Uytewaal, 2016).

Heller (2006) cites that investments are made in all rural water supply units, with the government taking control of hiring and assigning the staff needed to monitor the systems. The community consortium is largely responsible for activities that offer economies of scale:

- Follow-up of fee collection.
- Non-compliance follow-up.
- Water quality monitoring.
- Supervision of the acquisition of construction projects.
- Billing to customers.
- Follow-up of the coordination of community institutions.

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SISAR model

The Integrated Rural Water and Sanitation System (SISAR) model is a well-known tool used in managing water access and supply in rural areas of Brazil. The advent of the model dates back to the Kreditanstalt für Wiederaufbau program (KfW) launched by Germany between 1992 and 1998. In the program, the German government offered financial support in the form of a loan and donation to at least 63 communities in rural areas (GWP, 2017; Batista-Vieira *et al*., 2020). Global Water Partnership (GWP, 2017) considers that the model is one of sustainable self-management with the same bank supporting it over time. Despite its success in the northern states, the application of the SISAR model can only be limited to the Central Jacobina and Central Seabra areas, with no growth prospects identified.

A deductive analysis of the model shows that it consists of a select number of community associations whose mandate is the self-management of local rural water supply and sanitation systems. Each unit is constituted using a legal strategy with a non-profit organization that must manage the systems while working in conjunction with affiliated community associations (World Bank, 2013; Water.org, 2020). In addition, the units manage their own funds after receiving them from the government and other private donors. The SISAR water supply and access management system is made up of four components including:

1. General assembly containing a member of the affiliated community association.

2. Board of directors in charge of the execution of the decisions of the assembly, planning of activities and administration of units.
3. Financial council composed of members of the affiliated associations.
4. Audit.
5. Community associations that are created with the aim of building, operating and maintaining rural water supply and access systems.

It is vitally important to point out that the SISAR implementation process is carried out at the state level, with the state company coordinating the entire process. The model was used once in the rural areas of Ceará, where it saw the formulation of a parallel structure called Coordination of Water Supply and Rural Sanitation. The structure was important to distribute the SISAR units and respond to the demands of the state's hydrographic basins. In addition, the parallel structure allowed for the formulation of a sustainable link between the government and the people living in the communities (GWP, 2017; OECD, 2017; World Health Organization and United Nations Children's Fund, 2000; Charles, Pond, Pedley, Hossain, & Jacot-Guillarmod, 2010). This was important in achieving technical standards and raising the revenue needed to manage the systems.

The Rural Water Supply and Sanitation Coordination structure also guides communities on how they can establish their own water access and supply systems. The construction process often begins with the application of a formal application to the structure after receiving the necessary terms of agreement from the municipality. Applications that pass for being economically stable have to connect water to a minimum of 50 houses in rural communities (Machado, Dos-Santos, Quindeler, &

Alves, 2019; Barnes & Ashbolt, 2010). The projects are then drawn up by the firm, which sets up meetings aimed at the bidding process for the construction of the system. Global Water Partnership (GWP, 2017) indicates that only 10 % of community participation is required when it comes to financing the project. In the event that the community cannot provide the economic resources, then it has to participate by offering labor (Akhmouch, 2012; Akhmouch & Clavreul, 2016). At least two people from rural communities are trained on how to maintain the pump, bill customers and account for profits and losses.

Water policies in Brazil

Historical approaches to water access and supply have proven important in determining whether government mandates and strategies have been successful. The current state of Brazilian water services dates back to 1934 when the Brazilian Water Law was enacted. The Act focused on helping the nation transition from an agricultural society to one that is urban and industrial in nature. Porto and Kelman (2000) argue that the policy also focused on disciplining the economic uses of water to provide rural communities with a secure return. Despite being a vital Law at the time, it was never enforced and was largely implemented in regulating the uses of hydropower.

During the 1980s, the government and professionals noted that specific legislation was required for water management. This was followed by the reform of the constitution in 1998 and the definition of water management systems in section 21 of the constitution. Porto and Kelman

(2000) argue that the section made it clear that water supply was important to the nation's future and placed responsibility for managing water use on the state and federal governments, as noted above. To mitigate any confusion over responsibilities, the constitution stated that the federal government would be responsible for rivers flowing through various states, while state governments would manage tributaries within their geographical boundary (Porto & Kelman, 2000). This legal arrangement helped improve coordinated action between the two forms of government.

Almost immediately, states began formulating their own systems with the aim of managing tributaries (SNV Netherlands Development Organisation, 2013; World Bank, 2002; Bertoméu-Sánchez & Serebrisky, 2019). The Brazilian water resources association formulated formal declarations that helped insert novel concepts in the discussion and prompted communities to come together to address the problem of water scarcity that undermines their success in the short and long term (Porto and Kelman, 2000). The association also established a set of principles citing that:

1. The quality and quantity of water cannot be dissociated.
2. Water must be considered an economic good whose rational use is achieved through pricing mechanisms.
3. The use of water must be disciplined.
4. The decision-making process must be decentralized with the participation of the local community.
5. The watershed has the necessary unity for actionable management.

The Dublin Declaration of 1992 helped reinforce the principles with the state of Sao Paulo, being the first to formulate a water management system geared towards helping rural communities (Porto & Kelman, 2000). The system also played a role in the formulation of the São Paulo Water Law of 1991, with several workshops highlighting the need to decentralize water management systems to improve community participation.

A key issue identified in the decentralization process was the promotion of rational use through the implementation of prices. Porto and Kelman (2000) outline that the price affected the agricultural industry due to the intensive use of the product. Increasing conflicts between the US and Brazil had further exacerbated the problem with no revenue being collected from agricultural activities (Porto & Kelman, 2000).

The issue gave rise to an extensive debate and the subsequent formulation of the National Water Law in 1997 (Porto & Kelman, 2000; Tucci, 2004). The Law has been renewed in the 21st century with the aim of guiding future decision-making and ensuring that rural communities have the necessary levels of water supply and sustainable prices. In addition, the Law classifies water bodies into divergent use classes, and water standards are applied based on the number of people in rural communities (Porto & Kelman, 2000).

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Rural water supply in Mexico

Water supply systems

Mexico has been identified as a nation with an armored water supply system. Lang, Kaser, Reygadas, Nelson and Kammen (2006), argue that current success is related to past failures. Inferences from the results show that prior to 2010, most people living in rural areas received sewage, which increased their susceptibility to waterborne diseases and organisms. The lack of tap water has been further demonstrated by the coronavirus, which requires people to wash their hands to avoid contracting the disease. Statistics highlight that at least 8.9 million people in rural areas of Mexico have a sewage system, and 16.4 million use piped water (Lang *et al*., 2006). The disparity was due in large part to the costs and location of the water systems. Over time, the Mexican Ministry of Health upgraded the water systems to curb rising health spending, which at the time fell to $3.6 billion (Hidalgo & Peña, 2009; OECD, 2013; IFC, 2011).

The Food and Agriculture Organization of the United Nations Organization (FAO, 2007) outlines that food production increased with the influx of rural population, which meant that more communities would need water to grow their food. The population caused an increase in demand with the dietary change, which also influenced the change in dynamics (Schweitzer, 2009; Ortega-Gaucin, López-Pérez, & Arreguín-Cortés, 2016; Richter, 2014). The strain placed on water supply and access systems led to a change in consumption patterns, with

communities being forced to eat or grow healthier foods, which also required a constant supply of water (FAO, 2007).

With the imbalance in natural resources came the formulation of government managed water systems after extensive review and debate. Silva-Rodríguez-de-San-Miguel, Trujillo-Flores, Lámbarry-Vilchis, Rivas-Tovar y Bernal-Pedraza (2015) cite that the Mexican government was criticized for its inability to identify the complexities and ins and outs of rural water management. Deductions made by the Organisation for Economic Co-operation and Development (OECD, 2013) cite that government funding management was less than average, which in turn undermined government-managed water systems. This created a new opportunity whereby community participation would be used in the development and implementation of water management systems or strategies (Silva-Rodríguez-de-San-Miguel *et al*., 2015; OECD, 2020).

Improved community participation gave rise to the Program for the Construction and Rehabilitation of Potable Water and Sanitation Systems in Rural Areas (PROSSAPYS), which would oversee the development of new water treatment plans and the expansion of water networks in rural areas. Before the program, only 30 % of the rural population in Mexico had access to drinking water and sanitation facilities. Large investments in the programs, however, helped improve the figures, which increased to at least 70 % (Fewtrell & Bartam, 2001; Scott & Banister, 2013).

Scott and Banister (2013) also highlight that the new systems were decentralized, similar to those used in Brazil, with local communities or Boards in charge of regulating the water supply to all households in rural areas. The mode of operation of the Boards involved the implementation

of community organization initiatives and sustainable development processes. The initiatives would also be guided by goals defined by PROSSAPYS (Gortari & González, 1994).

The provision of support for community management was important to improve service delivery, according to Silva-Rodríguez-de-San-Miguel *et al*. (2015). However, the implementation process would require public community partnerships, community participation, and private partnerships. This confirms the ideology presented above that the success of any community program is threefold and requires the cooperation of divergent stakeholders. Research shows that specific agreements must be established to ensure the flow of technical and financial resources to stakeholders and alliances (Akhmouch & Clavreul, 2016; Netherlands Enterprise Agency, 2020). The flow will be useful in monitoring how rural areas are supplied with water during the coronavirus.

The allocation of resources is carried out in accordance with the triple S model developed by Lockwood and Smits (2011), which describes how this allocation should be carried out considering the different orders of government: local, regional, and national), as well as the infrastructure and systems or means to achieve it. The model cites that water supply to rural areas should be decentralized, with each person at all levels having specific responsibilities that need to be fulfilled, especially at times of high demand, such as when pandemics are at their peak. The lower level of the model deals with the implementation of policies developed by the regional and national levels (Lockwood & Smits, 2011). However, the application of this model requires that organizations detail the terms and adapt them to the needs of the community.

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Water supply and access policies

Spring (2014) introduces an integrated water management model and how existing water resources can be distributed in a sustainable manner in each basin and aquifer through a new National Water Law. The author points out that this model can comply with the legal and regulatory instruments necessary to protect the poor from being neglected by the government. In addition, it protects and recovers the natural conditions of water bodies in order to improve the supply and access of water to communities.

The Library of Congress (Library of Congress, 2020) outlines that the National Water Law is the main policy used to address any issues related to water supply and access in rural Mexico. The law highlights that all water bodies are property of the national government, and their use and administration is the responsibility of the National Water Commission. Library of Congress (2020) explains that rural community water concessions need to highlight the amount of water withdrawn and used. Concessions will only be granted to the Boards of rural communities for a period of between 5 to 50 years, the extension request being valid when and only if it is made six months before the expiration of the concession.

The Law also states that the water can be used freely for domestic purposes as long as its quality and the stream bed are not altered in any way by the user. In addition, the user must ensure that the quality does not decrease significantly assuming a decrease if the extraction is carried out through the implementation of pumping equipment. The

environmental standard NOM-001-SEMARNAT-1996 establishes a limit on the amount of pollutants allowed for agricultural purposes. Furthermore, all persons and entities with water concessions are required to comply with established environmental standards when supplying water to rural communities (Library of Congress, 2020).

Library of Congress (2020) recommends that the water policy be changed due to the coronavirus. The framework must address the existing mismanagement of water and control its use from a business-as-usual perspective. This means that regulatory authorities must charge the actual costs of water use, including the management, reuse, and recycling of wastewater.

Recommendations for Mexico and Brazil

In both Mexico and Brazil, it is necessary to continue searching for new systems to improve the conditions of the population in rural areas that lack access to and supply of water. For this, it is important that an appropriate budget be assigned that achieves an adequate allocation and supervision of financial resources that are reflected in investments to improve federal, state, and municipal programs in the long term. In particular, it is necessary to ensure that the costs incurred in the operation of water systems are recovered.

In terms of access, in addition to seeking new water sources for supply in rural areas, new alternatives should be sought for water

collection. In this sense, investment in desalination plants and rainwater harvesting facilities play a determining role.

Community systems have been a fundamental part, so it is necessary to continue promoting programs aimed at improving them. The trend of these systems indicates that greater flexibility should be granted to community members in terms of the operation of their systems, providing them, above all, infrastructure, and training (including, among other points, topics on water saving). In other words, the public or private sector should not rigidly control the community groups, because their effective forms of operation would be lost.

Regarding regulations, Mexico and Brazil should strengthen their legislation, and that it should have specific criteria regarding the incursion of community members in water management. In this way, the gaps that exist around the operation of community water systems in rural areas would be eliminated. For this, there must be adequate coordination between the different levels of government. Likewise, regulatory reforms should be reoriented to population growth, production, and agricultural activities. The abandoned regions of the countries should be tied to the discussion about the best way to control natural resources. Development processes must be promoted taking into account the principles of sustainability. In addition, the regulations should guide how to plan and invest with the government in the future, avoiding the transfer of water between basins.

Immediate actions —due to the COVID-19 pandemic— must include joint work, particularly between government agencies, so that access to a water supply is guaranteed. In this sense, it is necessary to focus on

emergency provision, guaranteeing the availability to make use of a water supply greater than what is commonly available, for rural areas. For this it is important that local governments have continuous support from state governments and the federal government. Due to the limitations that may exist in the water networks in rural areas, the operation of water pipes in continuous schedules is important.

Conclusions

In Brazil, at least a third of the rural population lacks the necessary access to services such as drinking water and sanitation. In addition, in the last three decades no significant progress has been made in rural water supply and sanitation due to lack of funds and their inadequate allocation, insufficient regulations and the lack of long-term planning strategies.

Some community systems have been established to remedy the problem, with relative success, in which communities have been involved, along with government and private sector actors. In these systems, social, technical and environmental criteria have been proposed. It also highlights the public consortium that encourages state and municipal participation through administrative and financial autonomy. In this sense, there is a participation between the government and the communities, the main function of the government being that of providing the necessary elements for the management systems; while the community ones focus more on managing.

Another system to highlight is the SISAR focused on sustainable self-management through economic support from foreign banks. In this system a non-profit organization works together with affiliated community associations.

In terms of water policy, in Brazil it dates back to the promulgation of the Water Law in 1934, which helped the nation in the transition from an agricultural society to an urban and industrial one and in disciplining the economic uses of water to provide rural communities a secure return. However, due to the gaps in terms of water management, it was necessary to establish specific legislation, for which the constitution was reformed in 1998 and the definition of water management systems. This gave the responsibility for managing water use to the state and federal governments, helping to improve coordination between the two: the federal government would be responsible for the rivers that flow through several states, while the state governments would manage the tributaries in its geographical limit. It also highlights that the National Water Law in 1997 has been renewed in the 21st century with the aim of guiding future decision-making and ensuring that rural communities have the necessary levels of water supply and sustainable prices.

Regarding Mexico, at least 8.9 million people in rural areas have a sewage system, and 16.4 million use piped water. PROSSAPYS stands out as support for the inhabitants of rural areas in water matters, since before the implementation of the program only 30 % of the rural population had access to drinking water and sanitation facilities; and with the execution of this figure increased by more than 70 %.

It also highlights that the new systems were decentralized, similar to those used in Brazil, with local communities or Boards in charge of regulating the water supply to all homes in rural areas. However, the implementation process would require public community partnerships, community participation, and private partnerships.

Regarding water supply and access policies, the National Water Law was a vital scheme necessary in the management of rural water supply/access. It has enforced the necessary legal and regulatory instruments to protect rural communities. However, the policy must resolve the management that prevails around the non-recovery of water income as a consequence of not charging the real costs incurred in the supply and supply of water, to mention the main elements of interest for the present article.

Finally, both Mexico and Brazil have implemented systems to improve access and water supply with similar results. However, there is still a long way to go because the rural population continues to be the focus of attention in terms of water problems, which has been aggravated by the COVID-19 pandemic. The recommendations made provide a general overview of how the two analyzed nations can improve, but further research is required.

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