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Notes

Improving rural water supply in Paraguay in times of COVID-19

Mejoramiento del suministro de agua rural en Paraguay en tiempos de COVID-19

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Abstract

Water supply and access has gained widespread attention especially with the ongoing coronavirus pandemic. Summations from the documents show that the pandemic has led to investors holding out on channeling funds into water systems in Paraguay, thus leaving people in rural areas being unable to gain basic protection against the virus. The challenges faced are explored in the subsequent systematic review. Results show that Paraguay has a more than functional water system, which can, however, be improved through collaboration between private and

government entities. Recommendations drawn call on the involvement of all stakeholders in decision making to find an iron-clad solution to the issue.

Keywords: COVID-19, rural water, water supply.

Resumen

El suministro y acceso al agua han ganado una atención generalizada, especialmente con la pandemia de coronavirus en curso. Los resúmenes de los documentos muestran que la pandemia ha provocado que los inversores se retengan para canalizar fondos hacia los sistemas de agua en Paraguay, lo que deja a las personas de las zonas rurales sin poder obtener la protección básica contra el virus. Los desafíos enfrentados se exploran en la revisión sistemática posterior. Los resultados muestran que Paraguay tiene un sistema de agua más que funcional que, sin embargo, puede mejorarse mediante la colaboración entre entidades privadas y gubernamentales. Las recomendaciones formuladas exigen la participación de todas las partes interesadas en la toma de decisiones para encontrar una solución férrea al problema.

Palabras clave: COVID-19, agua rural, suministro de agua.

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Introduction

Pandemics have, for centuries, now been used by scholars and practitioners alike in the field of administration to gauge the preparedness of society. The novel coronavirus is no different with its advent and subsequent spread revealing the weakness in the systems wiring the contemporary globalized world and how destructive system disturbances can be (UNECLAC, 2020). One of the topmost systems that has been affected by the pandemic is water, which connects most if not all of society's systems.

United Nations Water (UN-Water, 2019b) highlights that natural/ built environment, water bodies, and systematic infrastructures like policy and governance have all been exposed to the negated effect of the pandemic. While human health and life are the main concerns addressed by society, the water and environmental systems have degenerated, especially with the surge in demand for people to wash their hands and practice hygiene. Anecdotal evidence postulates that the most hit populations are the ones living in rural areas located in Latin America, especially because the water systems put in place do not entirely meet the supply and demand levels.

The issue of water supply and access in rural Latin America is cited by UN-Water (2019b) to be a subject of disputatious debates, especially with the wrangles going on between the government and private institutions. Evidence from international reports back this disposition by highlighting that billions of dollars were provided to governments in Latin America with the intent of consolidating and expanding the coverage of

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water supply in the 1980s (World Bank, 2002; Bertoméu-Sánchez & Serebrisky, 2019). Despite the fact that a lot of success is recorded, there are major components of the Latin American society which do not have safe and secure access to water (UN-Water, 2019a; UN-Water, 2019b; Estache, Gomez-Lobo, & Leipziger, 2001). The substantial reason behind this is said to be the dysfunctional shelter/ land markets located in rural areas as well as the insufficient guiding principles and venture responses which leave less alternatives for the underprivileged as they are forced to access water by paying copious amounts to private institutions (World Bank, 2013; Bertoméu-Sánchez, Camós, & Estache, 2017). Specific reference is made to how Paraguay has addressed the issue of rural water supply with the government setting up infrastructure geared towards gaining and retaining the interest of private international entities/ donors (OECD, 2012; Andrés, Schwartz, & Guasch, 2013; Bell, Conant, Olivera, Pinkstaff, & Terhorst, 2009). Also, the government has created a conducive environment whereby smaller local firms can invest in the provision of water to rural areas without being subjected to intense scrutiny and business practices that undermine their investments.

The overarching objective of this study is to explore the rural water supply in Paraguay during the coronavirus pandemic. The literature is guided by the thesis that the collaborative effort of the government and private entities in the distribution of water will help improve the response, recovery, and resilience of the Paraguayan community. The thesis is substantiated by conducting a systematic literature review of conventional and contemporary works of erudition into the type of water supply systems put in place in Paraguay and how the government can tweak the systems in lieu of the raging pandemic. The rationale of the study is to

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contribute new data on the performance and sustainability of rural water systems in Paraguay. At least two queries are presented which are inclusive of:

1. Is the government prepared to handle the water demand that comes with the coronavirus pandemic?
2. Looking ahead, what infrastructure, models, or policies can the government put in place to ensure for medium- and long-term sustainability of the water distribution services?

Advertently, this study is divided into five major sections, with the first one being the methodology, which will highlight the tool and design used to collect the data. The second section is the results that will briefly highlight the type of literature identified and whether they are efficient in handling the topic and research questions. The third section is the discussion section, which will analyze the information in the articles and classify them in terms of themes. The final section is the conclusion wherein the researcher will collect and summarize all the information written in the article and provide recommendations for future research.

Methodology

The Scopus database was use with searches in others such as Microsoft Academic, CORE, World Bank, Web of Science, among others. The researcher further identified the Scimago Institutions Ranking as a major tool that could help narrow down the identification of the best-fit literature (Martín-Martín, Orduna-Malea, Thelwall, & López-Cózar, 2018).

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A percentage variation of production scheme, according to Yeung (2019), was also applied by the researcher which was vital in determining the time period for the journals. This ergo means that the timeline for the journal articles ranges between 1990 and 2020. The percentage variation between the two years would be determined through the subtraction of the normalized impact of the studies formulated in 2019 with the ones developed in the 1970s.

On top of this, the researcher deemed it fit to implement the Newcastle Ottawa Scale, which allowed for the evaluation of the divergent case study articles that focus on Paraguay. The Newcastle Ottawa scale took three quality parameters into account, which checked the selection process of the content, levels of comparison, and study outcomes (Wells *et al*., 2019). The quality parameters were then divided across 8 key items, which were different in terms of scoring percentiles (Martín-Martín *et al*., 2018).

The final tool used in the research is a checklist called STROBE. The tool contains at least 21 items that are important in the research classification. The researcher noted that at least 18 of the 21 items were vital for this research, with the remaining three somewhat undermining the efficacy of the paper.

Additionally, the researcher conducted searches on Google for government reports on the water supply systems used in rural Paraguay. The search process involved the utilization of keywords such as rural water supply, Paraguay, COVID- 19, pandemic, the impact of a pandemic, and recommendations for improving water supply.

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The inclusion criteria were tailored to identify sources that showed collaborative efforts by the government and private entities to accentuate water access to people living in rural Paraguay. The criterion also utilized three major factors, with the first being that the articles had to be quantitative by nature with the information presented being analytical. This served the main strategy used by this paper, whereby it is more analytical than descriptive.

The second factor required that the papers focus on the development of strategic initiatives that can help increase the response, recovery, and resilience efforts of the rural Paraguayan communities with regards to the novel coronavirus pandemic. The third factor was that any and all information found in the studies should explore conventional, contemporary, and future plans put in place by the stakeholders to improve water supply in the nation.

Results

The utilization of the five techniques in identifying, selecting, authenticity analysis and the inclusion of the research studies allowed the researcher to identify at least 60 papers. Out of all these, six were deemed to be ineffective as their scope was wide. Another eight were removed from the study because they did not meet half of the requirements postulated in the STROBE checklist. The remaining 45 documents were cited to be highly efficient after their results were evaluated by use of the Nelson Ottawa Scale. The Institutions Ranking system formulated by Scimago

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also showed that the 30 journals were viable for answering the topic at hand and developing recommendations for future research. The results derived are shown in Table 1.

Table 1. Literature selected.

Type of Document	Authors and date	Comments
Report	Abrams, Palmer, and Hart (1998)	It provides guidelines into water supply for rural communities
Report	Biesinger (1998)	It was important in understanding how a water and sanitation program can be put in place
Journal article	Carter, Tyrrel, and Howsam (1999)	It helped define the impact of community programs in developing nations
Report	Troyano (1999)	It explored the strategies used by independent water providers
Journal article	Loach, Melgarejo, and Lombardo (2000)	It explored the strategies used by independent water providers
Report	Mejia (2000)	It explores the issue of water access in southern America
Report	Fragano (2000)	It sheds light on the management models used in small towns in Paraguay
Report	Blagbrough (2001)	It identifies the long-term impacts of the sanitation projects
Report	Bosch, Hommann, Rubio, Sadoff and Travers (2001)	It identifies the long-term impacts of the sanitation projects

Type of Document	Authors and date	Comments
Book	Wisner and Adams (2002)	It explores the issue of water supply in the international community
Report	Lockwood, Bakalian and Wakeman (2003)	It assesses the role of community engagement in water management
Report	Jouravlev (2004)	It explores the importance of water management
Report	Kebede and Gobena (2004)	It explores the importance of water management
Report	World Health Organization and United Nations Children's Fund (2004)	It identifies the millennium development goals
Report	Drees-Gros, Schwartz, Sotomayor, and Bakalian (2005)	It explores the outcome of effective water schemes in Paraguay
Working note	Thelma, Requeno and Kariuki (2006)	The working note explores the outcome of effective water schemes in Paraguay
Report	UNDP (2009)	It offers insight into the success of water management strategies in divergent nations
Report	Inter-American Development Bank (2009)	It explores the outcome of effective water schemes in Paraguay
Report	Water and Sanitation Program (2010)	It offers insight into the success of water management strategies in divergent nations
Website	WHO (2010)	It defines pandemics and their impact on communities

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Type of Document	Authors and date	Comments
Article	Doshi (2011)	It defines pandemics and their impact on communities
Report	Pearce-Oroz (2011)	It explores the changing stature of water management in Latin America
Report	Smits *et al*. (2012)	It evaluates the governance structures put in place in Colombia for water management purposes
Book	Adank (2013)	It explores how water scarcity causes conflict between communities
Conference proceedings	Alvarez and Corrales (2014)	It explores the main issues causing water scarcity in Canada
Journal Article	Barde and Lehmann (2014)	It explores the impact of water tariffs on water access
Journal article	Smith *et al*. (2014)	It explores the growing number of disease outbreaks
Journal article	Houben, Eisenkölbl, Dose, and Vera (2015)	It defined how groundwater is impacted by high intensity agriculture
Report	Inter-American Development Bank (2016)	It analyzed how Latin American communities manage water
Journal article	Redding, Moses, Cunningham, Wood and Jones (2016)	It presented recommendations on how communities/ governments can estimate water availability
Report	UNEP (2016)	It analyzed the main issues affecting water availability

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Type of Document	Authors and date	Comments
Journal Article	Barde (2017)	It explored how people move and the telltale factors behind international migration
Report	FAO and WWC (2018)	It provides an overview of the main drivers behind increased water availability
Book	Browder, Ozment, Rehberger-Bescos, Todd, and Glenn-Marie (2019)	It provides an assessment of the green and gray infrastructure to be used for water management
Journal article	Houben (2019)	The author focuses on how knowledge on groundwater can be instilled into Paraguayans from a young age
Report	Aquastat (2020)	It focuses on the number of water sources in the case nation
Journal article	Soldi, Aparicio-Meza, Guareschi, Donati and Insfrán-Ortiz (2019)	It offers recommendations on how to improve water access and management
Policy brief	UN-Water (2019a)	It analyzes the various methods to be used to improve water management
Report	UN-Water (2019b)	It offers recommendations on how to improve water access and management
Report	World Health Organization and United Nations Children's Fund (2019)	It analyzes the importance of improving WASH procedures

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Type of Document	Authors and date	Comments
Report	Cooper (2020)	It explores the impact of coronavirus on water security
Report	International Finance Corporation (2020)	It explores the impact of coronavirus on water security
Report	Kumar *et al*. (2020)	It explores the impact of coronavirus on water security
Journal article	Lee *et al*. (2020)	It explores the impact of coronavirus on water security
Article	Sadoff and Smith (2020)	It explores the impact of coronavirus on water security

Discussion

Definition of a pandemic and its impact on water supply to rural areas

The concept and meaning of pandemics have been the same ever since the advent of the World Health Organization with its modus operandi being different from that of an epidemic. The World Health Organization (WHO, 2010) defines a pandemic as any disease which has spread all over the world affecting the day to day livelihoods of societies (WHO, 2010; De-Albuquerque & Coates, 2020). An epidemic, on the other hand is

defined as a disease which occurs and spreads in a specific community at a set time period (Doshi, 2011).

Now, the coronavirus is deemed to be a pandemic due to the fact that it initially started as an epidemic in China after which it started spreading to other parts of the world. The disease movement has been exacerbated by the fact that it is transmitted through coming into contact with an infected surface or being close to an infected person. Its attack rates have been quite high as well as its level of explosiveness. The disease contains an epidemiologic feature which typifies common source acquisition and a short incubation period which is similar to that of the Black Plague (Smith *et al*., 2014; Kumar *et al*., 2020). Cooper (2020) opines that the disease is quite novel due to the fact that the doctors have been unable to find a cure for it which has stopped the global operations with succinct measures such as hygiene and sanitation being put in place to curb its spread.

Cooper (2020) presents an alternative perspective into the pandemic by noting that COVID-19 has the features of a zoonotic disease. In most instances, the zoonotic diseases are passed from animals to humans and vice versa (Redding *et al*., 2016). Some of the most notable and devastating zoonotic diseases are inclusive of the Middle East Respiratory Syndrome, Ebola, Zika virus and the sudden acute respiratory syndrome (UNEP, 2016). Smith *et al*. (2014) and UNEP (2016) exposit that the richness of such diseases is that they increase with approximately one new infections disease being apparent in human beings after every four months.

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Cooper (2020) adumbrates that a number of human drivers are linked to the emergence of COVID-19 as a zoonotic disease which include wildlife trade, extractive activities, habitat destruction, intensified agriculture, deforestation and changes in land usage. The human drivers can lead to the reduction of the barriers between the host animals and the humans in the rural areas with increased interaction altering the distribution of the diseases' reservoirs and vectors thus accentuating the manner through which they are passed from the host animals to humans and livestock (Lee *et al*., 2020; UNEP, 2016; Prado, 2015).

A substantial link is drawn between climate change and the spreading of zoonotic diseases like coronavirus in the form of increased landscape suitability for contact rates between humans and the host animals (Lee *et al*., 2020). Redding *et al*. (2016) opine that the climate change increases flooding with failed sanitation and safe water creating a viable environment for the spread of the diseases.

The International Finance Corporation (2020) cites that prior to the occurrence of the pandemic, the global water sector was influenced largely by the aging infrastructure, rapid urbanization, increased number of people living in areas facing water stress and global warming. There were specific frameworks and strategies in place which were geared towards handling these issues although those plans have been scuttled by the pandemic due to the fact that the demand and supply levels of water have increased (International Finance Corporation, 2020; Redding *et al*., 2016).

International Finance Corporation (2020) further explains that the plans initially depended on private and government investment into

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facilities with the novel pandemic forcing the stakeholders to direct their funds towards other areas such as healthcare or even hold out on relaying the funds out of fear of economic downturn. The coronavirus is criticized for increasing the significance of operational reliability as a result of the cost of disruption with the operational needs being derived from shifts in the supply and demand patterns as well as the emergency measures put in place by the governments to deal with the pandemic (International Finance Corporation, 2020). The author opines that the people living in rural areas have been most hard hit due to the fact that the government has down scaled the provision of water into the areas.

The downscaling has been geared towards minimizing the cost incurred by the government and private entities when pumping water. Take for instance; factories have closed down their facilities in order to exercise social distancing with this decreasing the amount of funds paid to the government to direct water into the facilities (International Finance Corporation, 2020). Losing their biggest customers means that the revenue collected by the government will be hard hit due to the fact that citizens pay less. The International Finance Corporation (2020) indicates that the industrial water demand has fallen by at least 27 % due to the COVID-19 with deeper revenue loss being projected across the supply chain including consultants, chemical suppliers, contractors, technology companies and operators (International Finance Corporation, 2020).

To make matters worse, wastewater utilities around the world expect to see reductions in the revenue collections by 15 % with well governed markets compensating for the losses through the use of tariff adjustments, government transfers and deferred amounts (International Finance Corporation, 2020). Sadoff and Smith (2020) argue that the

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measures will most likely impact the governance levels of the utilities with the user payment culture being usurped especially if the pandemic ranges on for extended periods.

Another estimate provided by the International Finance Corporation (2020) is that the capital expenditures from the government and public entities will decline in the short-term period with municipalities prioritizing emergency response and operational expenditure. There will be a downward adjustment of 7 % in the water sectors capital expenditures (International Finance Corporation, 2020). It is however unclear how much the water and sanitation capital expenditures will decline and how long it will take for the society to return to investment levels recorded before the crisis (International Finance Corporation, 2020).

Sadoff and Smith (2020) highlight that the coronavirus has shed a harsh spotlight on the global health risks, hardships and inequalities which are brought forth by the collective failure of the society to uphold the human right to water and sanitation. The article shows that many communities in the world are deprived of their most basic protections due to a lack of water supply and sanitation. In order to better understand the administrative and social impact of the virus, the authors' use the recovery ideology whereby they argue that society will only get back to where it was through effective water management (Sadoff & Smith, 2020).

The recovery ideology further postulates that the water management is important in reinforcing the stability of food systems that have been disrupted. Rural areas have been affected the most due to the fact that lockdowns have impacted their agricultural cycles through the

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depression of demand and interruption of input supply (Sadoff & Smith, 2020).

The resumption of farming in rural activities is cited by Sadoff and Smith (2020) to be quite risky because it will cause a demand for irrigation water in the case that dry season cropping will expand to counter the deficits in food supply. This conflicts with the deductions drawn by International Finance Corporation (2020) whereby increased demand will be affected by no supply because the investments have been channeled to other areas so as to manage operational expenditure and improve on emergency response efforts. Recommendations drawn by Sadoff and Smith (2020) highlight that a critical priority is to prepare for unplanned withdrawals in irrigation with governments having to ensure that they do not undermine the basic domestic water needs.

Sadoff and Smith (2020) also cite that the risk of natural disasters like flooding, extreme weather and drought occurring during the COVID-19 pandemic is another major issue as this threatens water security and the long-term recovery efforts of people in rural Paraguay. The authors cite that the people displaced by the prevalence of the pandemic have been forced to move to areas where they are densely populated thus increasing the demand for water which can meet their basic hygiene and sanitation requirements. This has in turn increased the risk from water crises and placed it above the infectious or food crises (Sadoff & Smith, 2020).

Rural water supply in Latin America

Latin American governments have exploited measures that can be summed up in the following main categories (Silva-Rodríguez-de-San-Miguel, 2021).

Ensuring water quality, access, and continuity

Fighting coronavirus warrants access to water source, the continuity of services, and ensuring the water people access is of good quality (Serrano & Gutierrez-Torres, 2020). Governments in Latin America are keen to repurpose water meant for irrigation. Getting water to underserved rural areas within a short time frame if extremely difficult. Prolonged disenfranchisement means that there are vast areas that are not only inaccessible but also lack the type of systems needed to facilitate prompt provision of adequate volumes of water. This is where approaches like providing bottled water and the transportation of water to rural Latin America is applicable. In a nutshell, this step involves ferrying water from areas that have surplus to those that experience water scarcity (UNICEF & Somalia WASH Cluster, 2019; Sikder, Mirindi, String, & Lantagne, 2020a).

Smets (2009) notes that "water should be available to all at an affordable price". Now more than ever, this statement holds true given the centrality of water in stemming the spread of coronavirus. The full realization of water rights means ensuring that the resource is affordable and accessible to everyone (Smets, 2009). Equity requires that vulnerable

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groups should not be unduly burdened with water expenses vis-à-vis richer households (Smets, 2009). The gist of water subsidies and the suspension of restrictions lies in ensuring that there are no burdens or obstacles that hinder immediate access to quality and sufficient water.

Direct support to cover water services fees

Latin American governments have been keen to offer direct support as well Central to facilitating access to quality water is the necessity to lower obstacles like price and the need to pay bills. The restrictions occasioned by coronavirus present insurmountable economic barriers, as communities cannot engage in meaningful economic activities. The pandemic has brought entire industries to a standstill and threatens to plunge the global economy into a crippling crisis. Economic headwinds witnessed in the global arena have a direct impact on the livelihoods of the rural populace in Latin America. Job losses and income crunches hurt people's ability to meet financial obligations like paying water bills. This situation calls for measures that can shield households. Suitable steps range from lowering price points to lifting any suspension of water services because of the inability to pay bills. Besides suspending disconnections to those who have stopped payment, certain administrations have pursued measures to lift water bills altogether for certain durations, cover up to 50 % of qualifying users' bills, waiving late payment tolls, suspending tariff adjustments, and blanket service reconnection for defaulters. These steps seek to ensure that those who

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can access piped water do not experience any disruption until things resume normalcy.

Support given to utilities

There have also been notable measures to support water utilities, including private ones. Identifiable steps undertaken in this regard include suspending taxes imposed on potabilization products to facilitate water treatment, donating sodium hypochlorite, and facilitating the procurement of chlorine to foster safe water standards. Scholarly literature suggests that running chlorination programs that cover both providers and households during emergencies can be useful during emergencies (Wilner *et al*., 2017; Rajasingham *et al*., 2019; Sikder *et al*., 2020b). The state is often the dominant actor in water services and resource management. Even so, there is a strong case to depart from the focus on government-driven strategies alone. State owned utilities have been implicated for inefficiency, the lack of quality, and poor coverage of water service (Rogers, 2002). They are also encumbered by serious financial constraints especially because the health crisis was completely unprecedented. There is great promise in expanding utility sector liberalization policies that will lead to the growth of private sector participation (Rogers, 2002). Measures like donations, lifting taxes, and facilitating access to inputs shore up the capacity to provide water services. This kind of support strengthens private actors who step in with the funding and capabilities that is lacking in governments and expand existing infrastructure to penetrate underserved rural areas. An elemental

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concern regarding privatization is that they import welfare losses that will have an adverse impact on the most vulnerable groups (Rogers, 2002). Care must be taken to ensure that privatization does not actually produce the same disenfranchisement it is purported to resolve. Collaboration can be helpful in sealing the inadequacies that plague water management.

Rural water supply in Paraguay

Water supply is termed to be vital in rural areas as it helps in the establishment of an environment which is not only clean but also sanitary (Kebede & Gobena, 2004; World Health Organization and United Nations Children's Fund, 2004). The government of Paraguay has for years now viewed water access in rural areas as a millennium development goal with its objective being to achieve coverage of 65 % by 2015 (Inter-American Development Bank, 2016).

Thus far, it goes without saying that the government has surpassed the goal with coverage in rural areas being set at 69.3 % as per the Inter-American Development Bank (2016). Alvarez and Corrales (2014) cite that Paraguay has in the last two decades put up infrastructure which has boosted water access with at least 88 % of the people having continued supply. Paraguay leads the globe with 53 percentage points which signify how it has been able to ensure that the government and private entities collaborate for the sake of the people (Alvarez & Corrales, 2014; Howell, 2019; Mejia, 2000).

Alvarez and Corrales (2014) opine that the water sector in Paraguay is characterized by a select number of features. The first is that the nation

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is one of the many that have more water resources available although the distribution is unequal (Alvarez & Corrales, 2014; Aquastat, 2020). The second feature is that the water supply and access in rural areas is decentralized with community-based operators being prevalent. Furthermore, the classification of the supply operators proves to be an issue in terms of supervision and regulation (Pearce-Oroz, 2011).

The topmost opportunity which changed the water supply levels of the communities can be traced to the separation of the formal public water and sanitations sector prior to 2000. Loach *et al*. (2000) opine that the government divided the sector into two groups which include:

- Rural communities with over 4 000 people.
- Rural settlements with less than 4 000 people.

Now, the first group was serviced and provided with water access by the Corporation for Sanitary Works (CORPOSANA) which is state run while the second group is managed by the National Environmental Sanitation Service (SENASA) (Loach *et al*., 2000). The CORPOSANA is tasked with maintaining close to 300,000 connections while its counterpart manages only 120,000 connections through the use of water committees (Loach *et al*., 2000; Drees-Gros *et al*., 2005). Loach *et al*. (2000) cite that both institutions have divergent managerial, legal, organizational and institutional characteristics. The SENASA mandates focuses highly on the community participation with cost recovery being top on its agenda. The SENASA largely deals with most of the rural communities that are small, and it relies exclusively on the generation of

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water from groundwater sources which have low unit costs (Loach *et al*., 2000).

Furthermore, SENASA is known for its ability to put in place Juntas or local sanitation committees in the rural areas to improve access and monitor usage. The Juntas are provided with assets that are managed by the ministry of health that aid in the setting up of water usage projects (Loach *et al*., 2000). The Juntas work in tandem with the ministry to guide SENASA on how they can complete the system design and cost structure (Loach *et al*., 2000; Houben *et al*., 2015). Out of the investment costs incurred, Loach *et al*. (2000) note that SENASA is required to donate between 40 to 60 %. The investment costs are often financed by multilateral loans to the central government with Juntas borrowing between 15 to 30 % in soft terms from the regulatory agency.

The effective environment created by SENASA has allowed for the propping up of independent and small-scale entities who provide water to the people living in the rural areas. Loach *et al*. (2000) explain that most of the communities in the Eastern Region get their water from acquirers and shallow wells. In the case of any water issues, the communities depend on the small-scale entities to pump water using cheap electricity supplied by the Itaipu hydroelectric project. Loach *et al*. (2000) opine that there are between 350 and 600 independent small-scale entities in the outskirts of Asunción and Ciudad del Este with their services meeting the needs and demands of 600 000 people using only 115 000 connections.

The small-scale independent entities are referred to as aguateros and they have little legal footing due to the fact that most of their connections are unregulated and informal. Loach *et al*. (2000) highlight

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that the entities are developed with the objective of serving a third of the population thus the government does not see them as a threat. The main logic behind this line of thought can be traced back to the end of Alfredo Stroessner's 35-year rule with Paraguay shifting from a dictatorial nation towards one which is more democratic (Weisskoff, 1992). The end of the rule came with it a new environment with the business environment gaining space as well as the growth of the investor confidence (Houben, 2019).

The government removed restrictions placed on the private sector with businessmen working towards opportunities that are independent. As opined prior, Paraguay has a lot of water resources with this observation being used by the independent businesses to set up their new ventures. Loach *et al*. (2000) cite that it did not take long for international and domestic investors to develop small scale water supply systems that were based on a small distribution network reliant on a small well. The shift was lauded as dynamic because it caused a move from the use of water carts and trucks towards the setting up of pipes served by 200-meter-deep wells (Fragano, 2000). Furthermore, the wells were proven to be insulated from contamination with water meters being added to them so as to rationalize the consumption rates (Loach *et al*., 2000; Water and Sanitation Program, 2010). Loach *et al*. (2000) cite that the cost regime started becoming unitary with new connections being made at prices that were affordable.

The customers shifted from depending on government supplied water towards family wells in their communities. There was a surge in the number of small-scale independent water systems with aguateros serving Paraguay for generations. Water and Sanitation Program (2010)

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highlights that the aguateros shifted the attention of the market with high quality services being channeled towards rural areas while entities like CORPOSANA were left to dominate the urban areas (Soldi *et al*., 2019).

The CORPOSANA is said quite reserved and it does not involve the rural communities in the identification, expansion, function and management of the water supply systems. The organization's principal water sources come from the Paraguay and Parana rivers to serve the Ciudad del Este and the Asunción where most people live in (Loach *et al*., 2000).

Calculations provided by Loach *et al*. (2000) show that the initial cost of setting up a new connection when the entity was formed is set at $1800 to $2800. This has in turn caused clashes with the users preferring to set up illegal connections. Loach *et al*. (2000) argue that the operational indicators of CORPOSANA show that the firm has weak cost recovery with its administration levels being poor. Furthermore, it has high rates of commercial and physical loss of water at 40 % compared to SENASA. The high losses have caused financial instability in the public utility with its heavy reliance on the infusions of finances from the central government loans undermining its objective to serve the rural communities (Loach *et al*., 2000).

The moment the government realized the failure of the CORPOSANA, they started setting up policies which favored private operator models. The policies would however be implemented under the careful eye of the government (Loach *et al*., 2000). The Juntas would work with the government to monitor compliance which further cut on the cost incurred by the central government when establishing a regulatory

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body. Troyano (1999) explains that the aguatero offered a better price compared to others. The SENASA subsidizes at least 100 % of the construction costs incurred by the cooperatives which ensures for the growth of the options (Troyano, 1999; Thelma *et al*., 2006).

The success of SENASA in rural Paraguay is explored by Inter-American Development Bank (2016) which denotes that the nation has made significant progress in the expansion of the low levels of water access in the rural areas. From 1990 to 2015, the entity has accentuated the supply of water to the areas by 83 % (Inter-American Development Bank, 2016). Whereas there was no water coverage in the rural area in 1990, by 2015, the number increased to 68 % from the 30 %. A period of heavy investment between 2008 and 2014 saw significant improvements in rural coverage reaching more than a million Paraguayans (Inter-American Development Bank, 2016).

Inter-American Development Bank (2016) further shows that a good chunk of the investments is overseen by SENASA with at least 67 % of the projects coming to fruition (Inter-American Development Bank, 2016). At least 90 % of SENA investments have been financed by:

- Spanish Cooperation Fund.
- MERCOSUR Structural convergence fund.
- World Bank.
- Inter-American Development Bank.

Ever since the first project approved in 2001, the Inter-American Development Bank has supported over 600 rural water systems which have benefitted close to 30 000 people the majority of the systems are in

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constant review and are in working order (Inter-American Development Bank, 2016). At the time of the Inter-American Development Bank (2016) survey, only four of the systems installed by SENASA and the Inter-American Development Bank were not working effectively. Furthermore, the Inter-American Development Bank projects are lauded for having high water quality by the sanitation boards and the independent users.

Inter-American Development Bank (2016) explains that the high rate of performance and perception of quality is linked intermittently to the fact that the systems are examined physically by representatives from the entity. The tank and distribution systems are cited to be in pristine condition. Furthermore, the operational performance levels are deemed to be consistently high since the systems were installed with their performance index being set at an average of 0.9 at a scale which has a minimum score of 0 and a maximums core of 1 (Inter-American Development Bank, 2016). There are however issues related with contamination whereby 12 % of the water sources have been found to have issues which might cause diseases (Inter-American Development Bank, 2016).

Along with the progress comes with it the challenge of ensuring that the existing water systems are performing well. Despite the fact that information on performance of the water systems in Paraguay is hard to locate, summative dispositions presented by government critics show that an estimated 40 % of the water supply systems in rural Paraguay are not functional (Inter-American Development Bank, 2016). The low service rate has generated quantitative research which explains sustainability so that more effective schemes can be formulated. As a matter of fact, sustainability concerns have caused a change in the intervention

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paradigm from one which focuses on infrastructure to one which is geared towards the delivery of services (Inter-American Development Bank, 2016).

Scholars indicate that the rural population is growing with the maintenance of the 65 % of the coverage goal being quite hard as it requires investment from the government and private entities (Inter-American Development Bank, 2016). Estimates derived by UNDP (2009) highlighted that at least US $81 million was needed in setting new systems back at the time. Additionally, $330 million was required to ensure that the 65 % rate is continuing with future financial commitments in water studies and projects being set at $97 million (UNDP, 2009).

UNDP (2009) draws specific reference to a 2004 financial policy which noted that uptake is low in rural areas due to the fact that users have to pay 100 % of the loan in order to set up water systems in their homes. The unit costs of a borehole with a fitted pump are set at $2525 with the per capita for water supply being $200 (UNDP, 2009). Most of these tariffs are defined by politics and they do not in any way reflect the real service costs (UNDP, 2009). The rural users thus resort to the option of using the services provided by the Juntas with the community boards only requiring them to pay for maintenance and operation. UNDP (2009) cites that even this is an issue as most incomes are not efficient to cover the expansion and replacement costs thus undermining the operational stature of the systems.

Water and Sanitation Program (2010) informs the growing concern and move towards service delivery by noting that the shift is reliant on a number of factors with the topmost being that increased demand for

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quality services in rural areas. This has led to the current rural water supply paradigm utilizing a project-based funding dubbed the feast or famine (Water and Sanitation Program, 2010). This paradigm is criticized by the Water and Sanitation Program (2010) for having issues like unpredictable funding, exclusion of poor communities, minimal follow up after construction and increased capital expenditures (CAPEX) or operational expenditures (OPEX). There have been cases of practitioners arguing that the recuperation of investment costs into the water supply systems stops completely once an upfront payment has been made which in turn strains the relationship that they hold with the governments (Water and Sanitation Program, 2010). This minimizes the ability of the entities to implement their plans as required thereby causing a breakdown in infrastructure and the stopping of water flow (Water and Sanitation Program, 2010).

Recommendations

Troyano (1999) presented a research paper which argued that the best fit strategy to improve water access in times of pandemics such as the coronavirus is to privatize public water companies and organizations like the CORPOSANA. The logic behind the privatization is cited by the author to be that the operating expenses and the capital expenditures will shift from the public entities to private hands (Troyano, 1999). Furthermore, there is a high probability that both social equity and economic efficiency will be improved more in the case that privatization allows for the creation

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of an open market whereby suppliers will offer alternative types of services (Smits *et al*., 2012; Lockwood *et al*., 2003).

A select number of guidelines are offered by Troyano (1999) with the topmost being the privatizing of the commercial supply units one at a time. The privatization will begin with the small and medium sized systems of service with the local small-scale operators being promoted to meet the demand for water during the pandemic. The second guideline is that the privatization will take the form of an operational contract which is similar to the one used by water companies and aguateros (Carter *et al*., 1999; Bosch *et al*., 2001). The entities have to adopt a competitive bidding approach with the bid documents being doled out to the available small-scale operators. Owing to the below par economy in lieu of the coronavirus, no entry requirements or conditions should be put in place. This will allow for the effective competition from small scale operators including those from other nations.

The third guideline is that the government has to put in place a conscious framework which will promote the experiences of the competitive bidding (Troyano, 1999). The framework will be modified to ensure that information is disseminated through national and international channels. Additionally, focus groups of small-scale operators have to be brought on board with cheaper and more effective methods to produce a rapid and effective answer to the issue being formulated (Barde, 2017; Barde & Lehmann, 2014). After the round of competitive bids is finished, a reminder will be implemented which will assimilate the experiences of the entities. SENASA is required to control the small-scale private operators more using the Juntas which will work as separate entities.

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Water and Sanitation Program (2010) argues that the only way to address the issue of rural water supply during the coronavirus pandemic period is to adopt the FRUGAL Model which represents a potential response to the changing patterns of demand and supply. The model is conceived with the objective of improving sustainability and coverage through the improvement of cost recover. In addition, it addresses the problems that SENASA's community management model has experienced over the past decade or so. Water and Sanitation Program (2010) denotes that the FRUGAL model should have select characteristics with the first being that it should contain an aggregate service liberation area that will allow for the stipulation and preservation of water supplies (Bartram *et al*., 2014; UN-Water, 2019a). The second characteristics is that the infrastructure will require legal ownership which will be maintained by communities or the government (Water and Sanitation Program, 2010).

The third characteristic is that a local operator at the service area will be tasked with the management of the state investment funds. The local operator will monitor how the finances are used to set up new infrastructure or even rehabilitate the pre-existing infrastructure in rural Paraguay (Biesinger, 1998; Blagbrough, 2001; Bardhan & Mookherjee, 2006). The local operator, read Junta, will also ensure that the users regularly pay for the services. The payment structure has to however be formulated with specific reference being drawn to the income levels of the denizens (FAO & WWC, 2018). The finances collected will then be used to develop the operational stature of the water supply systems and ensure for significant cost recovery over time. Water and Sanitation Program (2010) highlights that there is a need for the local operator(s) to better react to the needs and desires of the customers during the pandemic.

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They have to try and create synergies over time so as to work together towards economic recovery.

Cooper (2020) adopts a different approach to the administration of water supply in the rural areas with the main recommendation being the implementation of nature-based solutions as they increase water storage and availability. The nature-based solutions have to utilize and or impersonate natural processes which in turn improve management of water (Cooper, 2020; UN-Water, 2019a). This will be attained through the protection, management and restoration of natural processes in ecosystems that are both natural and modified (Water and Sanitation Program, 2010; Browder *et al*., 2019). Examples might include the enhancement of groundwater recharge, restoration of Paraguayan forests as well as conservation of the watersheds (Jouravlev, 2004).

Cooper (2020) also highlights that the nature-based solutions can aid with trade-offs between divergent water users. Take of example, enhancing the storage of aquifers, harvesting of rainwater and conservation agriculture will generate constructive merits for water supply, thus reducing antagonism between communities which cause water conflicts. The author draws insight into the management of groundwater especially because most wells in Paraguay are at risk of short-term water shortages. The soil in the rural areas can further be improved to ensure that they store water during the rainy season which will be used in the dry season (Abrams *et al*., 1998).

An initial priority identified by Cooper (2020) is improving the information base with regards to the extent and availability of ground water (UNEP, 2016). Data collection networks will be established that will

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facilitate the assessment of available ground water resources. An accurate evaluation of the groundwater will inform decision making and plans on how to recover post COVID-19 (World Health Organization and United Nations Children's Fund, 2019). There is a need for gray infrastructure solutions to be put in place as they will lock Paraguay into efficient water solutions (Smith *et al*., 2014).

The next recommendation provided by Cooper (2020) is for the government to improve its water governance metrics. The governance has to be fragmented with interventions such as regulatory frameworks or policies being put in place to allow for the adoption of green infrastructure (Andrés *et al*., 2013; Adank, 2013). In response to the coronavirus, the policy responses should address a solution which is more inclusive and holistic. Through inclusivity, UNDP (2009) cites that the main stakeholders like the Ministry of Public Works and Communications, Empresa de Servicios Sanitarios del Paraguay (ESSAP), SENASA, Sanitary Services Regulatory Entity (ERSSAN), sanitation boards and aguaterías will be involved.

The ongoing public health crisis have caused myriad people to suffer serious losses because of quarantines and other restrictions, possibly on a far-reaching scale. It is tempting to give up in the face of the ongoing crises. Even so, the ongoing crisis actually presents valuable opportunities for change and lessons that can inform policy going forward. It is important to seize this chance to quicken the pace of meaningful changes that can increase access to quality water. Urgent solutions are necessary to save lives. The conundrum now is how to quickly resolve water access issues caused by longstanding systemic factors. As the preceding analysis shows, there is no single panacea to the complex and interconnected

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issues surrounding water stress and shortages in rural areas. The solutions that Latin America, and in this case Paraguay, needs to implement include:

1. Streamlining bureaucratic processes.
2. Improving storage infrastructure.
3. Promoting efficiency in water usage.
4. Finding new sources of water (including rainwater collection, desalination, and enhancing reuse).
5. Protecting the environment.
6. Supporting optimal water treatment.
7. Ensuring pricing and bills do not impede access to water.
8. Leverage steps that ensure prompt water availability like delivery and repurposing water.

In Paraguay it has worked over the years the support of the government to provide the necessary conditions to make rural water supply possible through various efficient mechanisms of public-private collaboration. Likewise, community organizations have played a decisive role, locally. However, support and joint work between the different sectors involved in rural water supply should be strengthened.

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Conclusions

In due summation, the raging coronavirus has caused more harm than ever predicted with its subsequent spread causing bottlenecks in every facet of society. This paper explores how the virus has disrupted water supply in one of the top nations lauded for their water supply systems. The systematic review shows that the demand for water has affected supply entities because of the operational costs and capital expenditure incurred. On the contrary, however, the growth of the independent small-scale entities is shown to be vital in handling the demand and supply rates.

The 45 documents explored in the discussion section have presented a novel insight into pandemics and water supply. They have further shown how private and public entities can work together to improve sustainability. But the private sector particularly needs more support from the government. Paraguay has water resources available although the distribution is unequal, and the water supply and access in rural areas is decentralized with community-based operators being prevalent.

In general, rural Latin America faces the risk of receiving scant state attention and support as the region grapples with the pandemic. The coronavirus pandemic introduces unique pressures and underscores the nexus between access to water and health.

Recommendations drawn call for the adoption of the FRUGAL Model which will solve or better handle the issues affecting the current structural frameworks. Also, the collaborative effort of the government and private

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entities in the distribution of water will help improve the response, recovery, and resilience of the Paraguayan community.

In the short term, according to Sadoff and Smith (2020), governments and international organizations should work to ensure access to safe and reliable water supply and sanitation. This includes emergency provision for underserved communities and care to protect women and girls responsible for fetching water from exposure. To address potential supply disruptions, a clear understanding of where and how municipal or rural water infrastructure is dealing with spikes in demand related to the pandemic is also needed.

The results derived from the study will contribute to quantitative analysis of the sustainability and performance of Paraguayan and Latin America water systems. Furthermore, the insight provided by the researcher will set forth the foundation for future research on pandemics and how their impact can be mitigated effectively.

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