

Artículos

Improving Rural Water Supply in the United States*

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Abstract:

Governments have been forced to formulate and implement demand-responsive approaches focused on curtailing the challenges faced by their denizens in terms of water access. This research evaluates the current stature of rural water supply in the United States putting emphasis on the most significant legal and institutional considerations that hinder water access. A PRISMA guideline was implemented in order conduct a systematic review from 1990 to 2019. Findings show that there is a need for the government to reorganize its existing structures and offer its municipalities the requisite flexibility required to meet their ameliorative mandates.

Keywords: privatization, rural areas, supply, water shortage.

Mejoramiento del suministro de agua en las zonas rurales de Estados Unidos

Resumen:

Los gobiernos se han visto obligados a formular y aplicar enfoques que respondan a la demanda de este servicio y que se centren en reducir los problemas de acceso al agua de sus habitantes. Esta investigación evalúa la situación actual del abastecimiento de agua en las zonas rurales de Estados Unidos haciendo hincapié en las consideraciones legales e institucionales más importantes que dificultan el acceso al agua. Se aplicó una pauta PRISMA para realizar una revisión sistemática desde 1990 hasta 2019. Los resultados muestran que es necesario que el gobierno reorganice sus estructuras actuales y ofrezca a sus municipios la flexibilidad necesaria para cumplir sus mandatos de mejora.

Palabras clave: privatización, zonas rurales, abastecimiento, escasez de agua.

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Introduction

As a basic human resource, water is vital in sustaining the existence of human beings besides its importance to ensure the economic development of a society. In addition, water resources are vital natural resources that help in the formation of strategic initiatives that allow for agricultural production. However, over half of the global population is facing water shortages (Kumawat et al., 2020; Guppy & Anderson, 2017). The organization has raised concerns on the egregious violation to Human Rights when the denizens are not guaranteed access to water.

The 21st century has been marred by a broad cornucopia of water shortage cases as a result of the imbalance between supply and demand (Overseas Development Institute, 2011). Furthermore, Abdulla (2009) shows that water conflicts and worldwide water shortages have undermined the role of water as a key factor of production and the population growth. Therefore, attention must be paid the negated impact of poverty and water shortages. The author goes further to show that the increasing demand for water resources and the lack of supply can be described in two ways:

- a) Traditional water shortage, which is defined as the lack of natural water as well as decreasing quality of water. Also, the spatial-temporal allotment of water and how the ecological systems, life, and production are highly dependent on it (Abdulla, 2009; Valkering et al., 2009).
- b) The increasing levels of human activities and how they affect people in divergent tenets of the society (Moriarty et al., 2013).

For this literature review, a primal focus is on how the government can improve their current supply frameworks to fit the increasing levels of water demand in rural United States (US). Data from census reports indicate that 61 million people reside in rural US, in areas with divergent characteristics that are impacted by the differences in the regions across the nation (Midkiff & Kennedy Jr., 2007; Shipman, 2017). People are not the same in every region, some are distinct in terms of urbanization (Midkiff & Kennedy Jr., 2007).

The Census Bureau classifies the rural and urban areas every ten years through the use of decennial census (Midkiff & Kennedy Jr., 2007). The pragmatic definition of urban area is any territory that is densely developed and contains non-residential, commercial, and residential land uses (Midkiff & Kennedy Jr., 2007; Heras & Tàbara, 2014). Rural areas encompass the housing, territory, and population that is not included in urban areas. It means that they are sparsely populated and that there is quite a distance from the urban areas.

At least 97% of the US land mass is made up of rural areas and only 3% of urban areas and urban clusters. Midkiff and Kennedy Jr (2007) indicate that even with those numbers, only 19.3% of the current population lives in the rural areas, which makes the demand to be imbalanced with the supply. This is primarily because the national programs implemented need to cater at least 80.7% of the people living in urban clusters (Haggblade et al., 2010; Trémolet & Rama, 2012).

Midkiff and Kennedy Jr. (2007) show that the increased standards of living and education coupled with urbanization has led to an increase in the expectations of water users in the rural US even when they are not able or cannot afford the basic service levels provided by the governments. In the same vein, the trends tend to impact the cohesion of the community as people are unable to come together to mitigate the impending threat of water shortage. Challenges cited by Midkiff and Kennedy Jr. (2007) are consistent with the first description above telling that the existing water supply infrastructure has been unable to derive water from the necessary sources. This research shows that most people in US are served by sewer utilities and publicly owned water utilities, with

the latter serving about 25% of the rural population (Yates et al., 2005; Zhang et al., 2017). In addition, Kallis and March (2015) state that the functionality of the hardware used is proving to be a challenge forcing the government to recast their approach towards the supply of water to rural denizens (Kallis & March, 2015).

At least 11% of the people living in the rural US receive water from private utilities that are owned by investors (Adank et al., 2012). The cooperatives go a notch higher to provide people with drinking water as the ones from the public utilities tend to be below par. Furthermore, at least 15% of the people living in the rural US have dug their own wells, which make it easier for them to handle their demand and supply levels (Gallopín & Rijsberman, 2000; Smith Jr. et al., 2014).

Suffice to say that there is a need for a systematic review on the existing literature addressing the problem of how to improve the rural water supply. The US, despite its eminence and position in the international economy, has been unable to overcome its water management challenges over the years. This systematic review gathers, discusses and evaluates the measures implemented by the US with regards to improve the importance of water supply to the rural US.

The research primarily evaluates the current importance of rural water supply in the country by emphasizing the most significant legal and institutional considerations that hinder water access. The challenges faced by the people in the rural US are also elucidated putting special attention on how an inextricable link can be traced between the federal government and private institutions in the areas. Finally, the paper is divided into the four key tenets that include Methodology, the Results, Discussion and Conclusion sections. The noteworthy prescriptive measures will be outlined in the Discussion section as well as the recommendations on the type of policy to be designed.

Methodology

The researcher implemented the use of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) tool in order to collect the data and information from a myriad of sources (Moher et al., 2009). The guidelines in the tool were deemed as the best for this review. A 27-item checklist was developed, a significant instrument, to identify the relevant papers to be used in this research.

The research followed through a four-stage flow chart, firstly starting with the identification of the necessary research involving water access in the rural US. The second step in the flow chart focused on the screening of the research findings in a bid to determine whether they were in line with the methodologies herein. Eligibility of the research findings and authors were then checked so as to mitigate any bias that might hinder the overall evaluation. The final step in the cycle was focused on the inclusion of papers in the research.

Comparative analyses made between this research and conventional works of erudition indicate that the former is viable as it puts an emphasis on the use of the set guidelines, a 4-phase flow chart, and a 27-item checklist. It is essential to highlight that the existing dearth of data in the field of Public Administration, particularly on water management, is largely due to the lack of a uniform approach towards the utilization of the PRISMA tool.

Sources of data

The information was derived through the use of electronic databases including Web of Science, Molecular Diversity Preservation International and Multidisciplinary Digital Publishing Institute, Scopus, Water Resources Abstracts, Environment Complete, Environment Index, and Google Scholar. Also, the researcher conducted

searches on Google to identify government reports that were not classified or placed in journals. The process of searching involved keying in words that were linked with: *rural America, water access in America, quality of water, strategic initiatives implemented towards improving water access in rural America, urban and rural America.*

The searches conducted in the aforementioned databases helped in pinpointing which journals had the largest impact factors after which the researcher passed them through the Web of Science to determine their eligibility. Despite the fact that some of the sources were derived from a number of disciplines, they were only included in the study when and only if they were related to public administration and social sciences. The abstracts and data that were not related to water management in the US were discarded.

The inclusion criteria focused mainly on the sources that discussed on rural challenges to gain access to water and how the government has approached them. In addition, researches that identified the ideas on how strategies can be developed in the future were included as they could guide the American federal government on how to develop long-lasting solutions. Both empirical and non-empirical sources were chosen with the due basis being drawn on three key factors including:

- a) They had to use quantitative approaches on the issue at hand with an analytical rather than descriptive methodology,
- b) They had to pertain the development of initiatives aimed at the mitigation of water access challenges,
- c) Information presented in the paper should have been taken from the US government with respect to the development of rural-centric water access initiatives.

In addition, the scope of research was limited from 1990 through to 2019 in order to understand the dynamic efforts made by the government towards the mitigation of the water access issue. Moreover, a good deal of data published in official documents and reports use 1990 as the official year, which can help researchers in drawing comparative analyses between the two centuries. After determining the eligibility of the researches, the data records were consolidated into a single cohesive scheme whereby the abstracts, keywords, and the titles were evaluated succinctly.

This method was significant in the establishment of the possible literature that can help inform the comprehensive view of this research. A number of denotations were made including the author affiliations, publication date, names of the journals, and their impact factors.

The thematic tenets were also explored after the identification, selection as well as synthesis of the materials to be used. The organization of the material in a thematic manner was vital in offering an understanding of the conventional and contemporary issues faced by the American government in the provision of water access to denizens living in the rural US. Reviews were conducted concomitantly to ensure that the arrangement of the documents thematically was accurate by nature. Table I shows the documents used in the research.

TABLE 1
LITERATURE ANALYZED

Title	Type of Document	Authors and Date	Comments
The Uses of the Practicably Irrigable Acreage Standard in the Quantification of Reserved Water Rights	Research paper	Franks (1991)	The paper explores the continued challenges facing rural Americans in getting water rights and why congress needs to understand the Practicably Irrigable Acreage prior to formulating policies
Science and decision making	Research paper	Rykiel Jr. et al. (2002)	This paper denotes that governments are forced to formulate environmental conservation schemes whenever their economy is at risk of degradation
Holistic Risk-Based Environmental Decision Making: A Native Perspective	Research paper	Arquette et al. (2002)	The paper determines the manner through which rural American populations are affected by the decisions made by urban populations into water conservation and access to facilities
The Struggle to Govern the Common	Article	Dietz et al. (2003)	The article analyzes the impact of human activities on natural resources and how this affects water access in rural areas
Water Resources of North America	Book	Biswas (2003)	The book evaluates the Spatio-temporal distribution of water resources in the US and how the government can tap into them to mitigate the issue of decreased access
Humans Transforming the Global Water System	Article	Vörösmarty et al. (2004)	The article presents strategies that can be used in increasing water conservation in the US
Urban Water Management with Artificial Societies of Agents: The FIRMABAR Simulator	Research paper	López-Paredes et al. (2005)	The research paper evaluates how urban agents can be used in the provision of water to rural areas
Democracy, Participation, and Native American Tribes in Collaborative Watershed Management	Research paper	Cronin and Ostergren (2007)	This research analyzes how the government can use a collaborative conservation model to mitigate the issues facing its people
The Influence Of Major Dams On Hydrology Through The Drainage Network Of The Sacramento River Basin, California	Research Paper	Singer (2007)	The research implements the use of hydrograph alteration to determine how water conservation has been an issue for the California state government

Title	Type of Document	Authors and Date	Comments
Linking Traditional Ecological Knowledge And Western Science: Aboriginal Perspectives From The 2000 State Of The Lakes Ecosystem Conference	Article	McGregor (2008)	The article analyzes the manner through which the government can draw recommendations from the rural population into the type of systems they can use to ensure for water conservation
The Growing Importance of Social Learning in Water Resources Management and Sustainability Science	Research paper	Pahl-Wostl et al. (2008)	The paper evaluates the significance of understanding social perceptions to develop the necessary tools that can be used in the management of water resources
Modelling Cultural and Behavioural change in Water Management: An integrated, agent-based, gaming approach	Research paper	Valkering et al. (2009)	The paper develops new modeling schemes that can help in water management for the federal and local governments
Adaptive Water Governance: Assessing the Institutional Prescriptions of Adaptive (Co-)Management from a Governance Perspective and Defining a Research Agenda	Research paper	Huitema et al. (2009)	The research analyses previous works developed into water governance
The Climate Learning Ladder. A Pragmatic Procedure to Support Climate Adaptation	Research paper	Tàbara et al. (2010)	The authors introduce a scheme that can be helpful for the federal government in terms of developing strategic initiatives to curb the ensuring issue of water scarcity and lack of access to rural denizens
Sustainability in Austerity: How Local Government Can Deliver During Times of Crisis	Research paper	Boyce (2011)	The author highlights the divergent schemes that can be implemented by governments in ensuring sustainability for locals
An Assessment of Agriculture and Natural Resource Extension Program Needs on American Indian Reservations in Idaho, Nevada, Oregon, and Washington	Research paper	Loretta et al. (2011)	The paper evaluates the challenges faced by American Indians living in Rural America. Emphasis is created in the areas of Washington, Oregon, Nevada and Idaho with queries being drawn

Title	Type of Document	Authors and Date	Comments
Historical Legacies, Information, and Contemporary Water Science and Management	Research paper	Bain et al. (2011)	The paper evaluates the importance of understanding water demand through the use of hydrologic science
Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy	Research paper	Dilling and Lemos (2011)	The research paper focused on the importance of collecting data and information which can be used in informing decisions on the type of strategies that can be used in mitigating water scarcity, climate change and the lack of equilibrium between water demand and supply
Everyday Environmentalism: Creating an Urban Political Ecology	Book	Loftus (2012)	The author evaluates the divergent opinions launched by various scholars on everyday environmentalism
Water futures: Reviewing water-scenario analyses through an original interpretative framework	Survey article	March et al. (2012)	The authors use a framework to determine how the governments can mitigate impending threats of water scarcity
Adaptive basin governance and the prospects for meeting Indigenous water claims	Research paper	Bark et al. (2012)	The paper presents a comparative overview of the challenges facing people in Rural America and Australia
Traditional Knowledge: Considerations for Protecting Water in Ontario	Research paper	Mcgregor (2012)	The paper evaluates the impact of the water crisis in Ontario and how it affects the indigenous people living in rural America
Water Conservation: Theory and Evidence in Urban Areas of the Developed World	Review article	Sauri (2013)	The article determines the manner through which different nations have implemented schemes aimed at water conservation
Climate change in arid lands and Native American socioeconomic vulnerability: The case of the Pyramid Lake Paiute Tribe	Research paper	Gautam et al. (2013)	The paper evaluates the vulnerabilities of the rural people living in America to water scarcity due to climate changes
Opening up knowledge systems for better responses to global environmental change	Research paper	Cornell et al. (2013)	The research evaluates the link between knowledge and action and how the two can work towards the development of open systems

Title	Type of Document	Authors and Date	Comments
Coupling Human Information and Knowledge Systems with social-ecological systems change Reframing research, education, and policy for sustainability	Research Paper	Tàbara and Chabay (2013)	The research highlights the efficiency of creating knowledge systems which will help the government on understanding the importance of sustainability and water conservation for future generations
Let's play transformations! Performative methods for sustainability	Review Article	Heras et al. (2014)	The article presents various reformative methods that can be included to manage natural resources and improve access to water resources for every denizen
Climate change perception, observation and policy support in rural Nevada: A comparative analysis of Native Americans, non-native ranchers and farmers, and mainstream America	Research paper	Smith Jr. et al. (2014)	The paper discusses how people in rural America have taken up the initiative of safeguarding their water resources in lieu of failing government initiatives
Adaptive governance, ecosystem management, and natural capital	Research Paper	Schultz et al. (2015)	The research highlights the impact of adaptive governance and how the US government can change its strategies to fit the increasing user demands for water
Conservation Theatre. Mirroring experiences and performing stories in community management of Natural Resources	Research article	Heras (2016)	This article analyzes how governments can develop community-based resource management programs to boost the conservation efforts of locals
Constructed Wetlands for Agricultural Wastewater Treatment in Northeastern North America: A Review	Review article	Rozema et al. (2016)	This article analyzes the divergent tools implemented by the regime in water conservation in rural America
Improving the management of water multi-functionality through stakeholder involvement in decision-making processes	Research paper	Ricart Casadevall (2016)	The author focuses on the importance of drawing a link between the decision-making process and multi-functionality in order to improve water management

Title	Type of Document	Authors and Date	Comments
Adaptive Governance of Water Resources Shared with Indigenous Peoples: The Role of Law	Article	Cosens and Chaffin (2016)	The article analyses the impact of adaptive governance and how it can help increase access to water resources for Native Americans living in rural America
Potential of Rainwater Harvesting and Greywater Reuse for Water Consumption Reduction and Wastewater Minimization	Article	López Zavala et al. (2016)	The article presents recommendations on the type of schemes that can be used in sustaining demand for water consumption
Accounts from Tribal Elders: Increasing Vulnerability of the Navajo People to Drought and Climate Change in the Southwestern United States	Book chapter	Redsteer et al. (2018)	The research analyses the divergent attitudes of the populace living in the rural US in terms of water access and how the government has helped in curtailing climate changes
Payment for Ecosystem Services and the Water-Energy-Food Nexus: Securing Resource Flows for the Affluent?	Article	Rodríguez-de-Francisco et al. (2019)	The article analyses the importance of fostering nature conservation, which will help in alleviating poverty in rural areas as well as increasing the level of security for energy, food, and water

Source: own elaboration

Results

By implementing the flowchart in the identification, selection, determination of eligibility, and inclusion of the research, the author found at least 65 documents that fit the criteria on water management. Out of the 65 documents, however, at least ten were found to be duplicates and were removed from the review process. In addition, 19 of the 65 papers were screened and excluded due to the fact that their eligibility did not meet the overall standards. All in all, 36 documents were identified as suitable for inclusion considering the inclusion criteria defined by the researcher.

Some reflections were found to be articles on this theme and were analyzed through the use of different metrics. Findings from the review process showed that they were effective and could be included in the final summarized information. Some of the articles were official documents from scholars and practitioners that were shown to be vital in understanding the measures taken by the US government to struggle against the water access issues in the rural US

Discussion

The review of the 36 documents showed that the rural water supply infrastructure in the US is below par the increasing urbanization upsetting the equilibrium. At least 70% of the documents focused on the issue of water rights in the rural areas with recommendations by the authors showing that there is a need for community management-oriented approaches to be implemented. The findings from the review process duly stated that even though the current government programs have been effective, they have not yet addressed the issue of demand increase and how to manage it. The research results efficiency were hindered by the fact that there is a general lack of knowledge into community management initiatives which could have helped inform decision making processes. In summary, the main reason for analyzing the 36 documents is that they helped in gaining an understanding into the various challenges facing the people in the rural US. In addition, the review also allowed the researcher to effectively identify the current infrastructural setups and whether they have met the needs and demands of the country.

Definition of rural areas, water sources and current supply systems used

Loretta et al. (2011) offer a pragmatic definition of rural areas as communities that live away from the urban settings with their climate, tradition, and language being dependent on the natural environment around them. The authors go further to show that most people living in rural areas, presumably in the US, have low and middle income with agriculture being their main source of food. Summarized information by Dilling and Lemos (2011) state that the urban population is increasing at a rapid rate as compared to the national population that creates a strain on the resources, thus hindering the provision of services to every denizen in the nation.

Development-expert opinions by Loretta et al. (2011) state that rural people play a noteworthy role in managing national food production, which means that they are also responsible for safeguarding the national environment. Rural people source their water from surface water bodies or by drilling into the ground for water (Dilling & Lemos, 2011).

In addition, the people are dependent on the collection of rainwater, which is then treated so as to mitigate any health issues that might result thereof. Biswas (2003) shows that the water quality is reliant on its supply from the rivers, streams, reservoirs, and lakes that may have a poor quality water. Then it means that the people have to wait for the government to set up the necessary treatment plants to get sufficient water.

Compared to the surface water sources, groundwater has a high level of quality, although it is said to be contaminated by materials derived from human activities. Heras and Tàbara (2016) indicated that most of the residents in the rural US are reliant on the wells that have been drilled into aquifers, which then help in the provision of groundwater. By definition, an aquifer is described as a natural formation which leads to the pooling of water deep in the ground (Heras & Tàbara, 2016).

Most of the aquifers in the country are found in rural areas, as most of them have not been disrupted by human activities (Heras & Tàbara, 2016; March et al., 2012). This makes it easier for the people living in the areas to drill and penetrate through the aquifer, thus meeting their supply needs and demand rates. Now, Cornell et al. (2013) show that the supply systems in the rural US can be divided into two key tenets.

The first tenet provides that public water systems use 15 connections to serve 25 people for two months annually (Heras & Tàbara, 2016). The public water systems are often owned by the local government, investor-owned firms and/or homeowner associations (Cornell et al., 2013; Fuller, 2006). The second tenet focuses on private water suppliers, i.e., people in the rural US drill wells and pump water into their complexes and facilities without having to worry about the challenges that come when being served by the national government (Cornell et al., 2013; Smith Jr. et al., 2014). Comparative analyses go further and indicate that the rural US use over 100 daily gallons water per capita as compared to the 50 daily gallons per capita from the 20th century.

Supply challenges

Boyce (2011) gained insights from nationwide analyses stating that there is an apparent disconnect between the supplies of water in rural areas and the water demand (Boyce, 2011; Foushee & Gurneau, 2010). The findings were backed by Sankarasubramanian et al. (2017) who cited that the rural areas of Mississippi, South Carolina and Oklahoma have gotten worse in the past years as compared to urban areas like Pennsylvania, Wyoming, and Washington.

An analysis presented by the latter found that the rural areas are becoming less efficient in terms of water management with recommendations on the importance of retrofitting the existing water infrastructure and implementing new water-efficient technologies (Sankarasubramanian et al., 2017). Sankarasubramanian et al. (2017) state that the primal reason as to why there is a lack of equilibrium is based on the political will or the inability of the rural people to keep the pace.

March et al. (2012) gave dissenting opinions on the equilibrium alteration in the water supply by indicating that the proportion of rural people in the US with access to water supply rose from 16 to 29% from 2000 to 2010. The authors show that this impact is primarily caused by a series of divergent drivers at the national extent. Reports also indicate that there are positive and negative drivers that affect the water supply and demand in the rural US. The first driver is shown to be urbanization, which directly affects the provision of water as discussed above.

Redsteer et al. (2018) state that the rapid growth of smaller towns in the rural US has led to congestion, thus leading to an increase in the demand and a setback in the water supply. The second driver is the rise in lifestyle and expectations, which is inextricably linked to the urbanization of rural areas. Cosens and Chaffin (2016) state that with urbanization, the government is forced to meet the new demands and expectations of water users.

The change in demand rates often leads people to adopt self-supply options so as to cater for their own needs and those of the people around them (Cosens & Chaffin, 2016; Dietz et al., 2003). The adoption of higher service levels by governments in the form of piped supplies is seen to be a move away from the use of hand pumps. This initiative is focused on serving the increasing demands for water supply to rural areas in the US. As the clusters grow into bigger towns, the government finds it hard to offer piped suppliers, and they are forced to upgrade their technical and financial structures (Cosens & Chaffin, 2016; Dietz et al., 2003).

Gautam et al. (2013) state that the gaps between the detailed metrics used in understanding service delivery, the non-functionality of water systems and coverage are large. Therefore, these facts provide scholars and practitioners with a basis to interpret the failure and success of the supply systems used by the US governments when meeting the needs of the users (Gautam et al., 2013; Danert & Flowers, 2012). However, the key point made by the authors is in the analysis of the expectations of the water service in terms of rural supply and whether it is consistent with demand rates.

Williams James (2014) argues that demand is therefore complex and not uniform in the rural areas with the increasing levels of education in the areas leading to people to implement new forms of self-supply so as to meet their overarching service levels. In addition, the demand for water and supply in poorer areas of the rural US is insufficient and the people there cannot afford the basic hardware that would help them to satisfy their demands (Smith Jr. et al., 2014; McGregor, 2008). This context poses a dilemma for the community-based providers and governments in the rural US as they have to achieve a balance between meeting the national standards that require them to provide safe water services against supplying water services to those who can [cannot??] pay (Smith Jr. et al., 2014).

Current governmental programs

Loretta et al. (2011) show that the government had previously implemented the use of a demand-responsive approach, which was at first effective in the short-term. The overarching aim of this approach was to ensure that rural communities were able to gain the services they required with the financial demands brought about by the operations (Loretta et al., 2011). There is also the presumption that the communities were well aware of the challenges faced to satisfy their basic services with an increase in demand for safe water, thus leading them to the use of government-provided services (Loretta et al., 2011; Rosegrant & Cai, 2002; Bhatti & Church, 2001).

However, opinions by McGregor (2012) show that the demand responsiveness cannot exist when the suppliers are expected to accomplish the millennium development goals. Furthermore, the Realpolitik that comes with government institutions makes it hard that communities can develop a sense of ownership regarding the water systems.

The last four decades have seen the US government focusing on the development of infrastructure, which can help them in effectively providing their denizens with the required service levels in a sustainable way. March et al. (2012) show that the government has, however, found it challenging to build and maintain supply services. At least 31% of the expenditure incurred by state governments is mainly due to operational maintenance of the supply systems (World Health Organization, 2012).

It is imperative to make clear that the data obtained on the supply infrastructure in the US are not well consolidated and a good deal of them are really scant. Rodríguez-de-Francisco et al. (2019), however, identified the Conservation Stewardship Program as the first government-based initiative focused on helping people in the rural US. The authors state that the program has been significant in helping people to understand their role in meeting the supply and demand levels, thus strengthening the overall operational stature of the government (Rodríguez-de-Francisco et al., 2019).

Staedter (2017) argues that the government program allows the people living in rural areas to take up the conservation practices that mitigates the challenge faced by the government, that is, trying to balance between meeting the set Millennium Development Goals (MDGs) and providing water to people who are willing to pay. Staedter (2017) shows that the conservation program covers over 70 million acres of land in the rural US with aquifers identified that can be drilled to allow people to supply themselves with water (Schultz et al., 2015). The second program identified by Staedter (2017) is an improvement to the previous one.

Named as the Conservation Stewardship Program (CSP), a grasslands conservation initiative, it provides people living in the rural US with the necessary financial and technical assistance focused on the development of supply schemes for the people (Schultz et al., 2015). The program also helps in addressing any concerns raised by the communities with regards to natural resources as well as improving the quality of water provided (Schultz et al., 2015). Schultz et al. (2015) show that the initiative has thus far helped to reach a balance between demand and supply with the ground and surface waters in the rural areas being conserved concomitantly.

The third government program implemented by the US government regarding supplying water to people in rural areas is the Environmental Quality Incentives Program. This program was activated with the 2018 farm bill, which required people living in the rural US to take up conservation practices that will help them to protect their watersheds and alleviate the government from pressure of supplying water (Rodríguez-de-Francisco et al., 2019; American Ground Water Trust, 2019). The EQIP initiative also focused on providing the farmers with insurance subsidies and federal income to help the farmers in setting up their own supply systems by drilling aquifers (University of Oxford, 2019).

What needs to be done

Vörösmarty et al. (2004) presented a paper with recommendations. The first idea for the government is to keep an eye on the way how the water systems are being managed (Vörösmarty et al., 2004). The development of personal water systems and a balancing of the supply and demand requires users able to treat the water, protect the catchment and continuously audit the finances provided by the government (Vörösmarty et al., 2004; Askew & McGuirk, 2004). This goal can be attained through the implementation of community management initiatives whereby relatively full-piped systems are used to provide the people with water. In addition, the formulation of community management regulations will help the government to hire paid staff who will be certified by training institutions (McGregor, 2008).

The second recommendation is for the government to identify community-based service providers who will retain their non-profit status through the promotion of good business practices while meeting their business objectives. In the case that the community-based providers are unable to provide the members of the society with the supplies, then they will be allowed to outsource the services from other private operators (McGregor, 2008).

The local governments in the rural areas will also ensure that they maintain assets ownership and functional authority over the privatized systems. The Rural Community Assistance Partnership has to work towards ensuring that the service providers uphold the predefined performance indicators (Franks, 1991). This will be enabled by

the formulation and implementation of regulations by the federal and state governments (Alcamo, 2008; Allon & Sofoulis, 2006).

The imminent challenge of lacking regulators in the rural areas will be mitigated by the involvement of the Rural Community Assistance Partnership who will work in tandem with the local government towards meeting the regulatory functions commissioned to them (Ricart Casadevall, 2016). The third recommendation is drawn by Saurí (2013), who states that there is a need to count on support agents in the process of developing supply systems that will serve the demands of the people in the rural US. López-Paredes et al. (2005) back this proposal by stating that the agents can be able to anticipate any problems inextricably linked to the development of personal supply systems. The provision of structured support also has to involve divergent entities including (López-Paredes et al., 2005):

- a) Support from the local governments working under the auspice of the water service authority;
- b) Support from private companies;
- c) Support from national government agencies; and
- d) Support from community-based service provider conglomerates.

Ricart Casadevall (2016) highlights that evidence on the impact of service provision has become scarce, with direct support being subject to threshold effects. The author indicates that in the case that the impact can only be seen when the support is below a particular threshold (Ricart Casadevall, 2016; De Albuquerque, 2012). The only way the threshold can be met is when there is a link between the finances and the efforts carried out to improve the services.

The fourth recommendation focuses how the government can collect the funds needed to keep the operations going. A lack of balance between demand and supply as well as the increasing need for the government to reach the MDG goals often leads the authorities to incur in extra expenses, which can be mitigated only if they are able to develop the optimal financial structures (Loftus, 2012). This can involve the local governments implementing a new policy that will be used in determining the necessary water pricing levels (Loftus, 2012; Bark et al. 2012). Cost recovery has long been an issue for the municipalities as most of the water connections in the city are not registered and consumption is really high. The funds collected from the plan will help in the construction of treatment plants for wastewater, which in turn, treat the aquifer's wastewater (Loftus, 2012; Llausàs & Saurí, 2017).

Furthermore, there is a need for the government to shift its perspective from viewing the water as public goods to an economic good. This will go a long way in ensuring that they set up the necessary structures that are focused on the provision of water to the people in the rural US (Rozema et al., 2016; Rykiel Jr. et al., 2002; Bain et al., 2011).

The fifth recommendation focuses on the development of community management schemes that will allow for the provision of formal models of delegated supply from investment entities (Pahl-Wostl et al., 2008). The absence of the delegated supply will be addressed by the development of self-supply schemes by the users who will opt-out the community systems. The national government has to ensure also that it sets up supply-side management initiatives (López Zavala et al., 2016).

Reports indicate that rural California has only 21 desalination plants that are aimed to addressing the issue of water scarcity in the area. The plants were initially expected to have a total capacity of over 450 million gallons, which would help to balance the demand by 70% (Tàbara & Chabay, 2013). By building more desalination plants in the area, the US government will be able to increase the total capacity from 450 million to 600 million gallons per day (Tàbara et al., 2013; Tàbara et al., 2010).

However, the success of the supply management initiative is dependent on demand-side management whereby the government will work to reduce leakages from the distribution network (Arquette et al., 2002; Cronin & Ostergren, 2007; Huitema et al, 2009). The implementation of water conservation programs like educating the

locals, implementing rules, formulating new pricing policies as well as the use of rebates for appliances needed for water-saving is expected to help the government in reducing the per capita water use.

Focus should be on meeting the levels of demand for outdoor water, which takes up at least 60% of the residential water use in the rural US (Huitema et al., 2009). This can be attained by reducing the water flow in the grass areas in addition to the implementation of rain sensors, pool covers, and irrigation controlling schemes. The government can roll out water-efficient appliances, which will help in managing the supply and conservation of water in the areas (Singer, 2007).

Ricart Casadevall (2016) shows that the distributional losses of water in the US are between 11 and 14% of the overall loss with the total water use exceeding 25% of the conventional systems. These numbers are high as compared to those in Germany, which only reaches 7 to 9% and France, which ranges 5-7% (Ricart Casadevall, 2016). The local governments have to understand that the use of low water rates in no way encourage water conservation efforts, thus meaning that they have to dismantle the existing systems and implement new ones (Adank et al., 2012). The water recovered from the water-efficient appliances will be directed towards nonportable uses in the rural areas such as fire protection, wetlands creation, and restoration as well as the irrigation of agricultural lands (Rozema et al., 2016).

Heras (2014) found that expanding the reuse of wastewater can go a long way in increasing the available water resources in the rural US. The author indicates, however, that rural Florida denizens have to avoid overloading their receiving water with nutrients. This can be done by reusing and reclaiming water in a more feasible manner that is aimed at meeting the surface water disposal standards. The sanitization and water centralization infrastructure will be financed through the collection of revenue by the utility companies with loans provided in the form of state revolving funds (Heras & Tàbara, 2016).

Conclusion

The preceding systemic review shows that even though the US government and all stakeholders have implemented a myriad of solutions aimed at mitigating supply issues in the country, the problem still remains. However, the main recommendation is that the government can educate people on how they can develop their own supply systems. In addition, the government has to identify new ways through which they can collect the revenues from private suppliers based on a cost-effective strategy. The paper clearly explains that the lack of regulatory bodies to control the supply in the areas will be alleviated by the development of Rural Community Assistance Partnership who will work in tandem with the local governments in order to meet the regulatory functions commissioned to them.

The theoretical implications of this research paper may be impactful because it presents a summary of relevant published works on how to improve the rural water supply in the United States, which can be taken for future research on this subject-matter. In addition to the usefulness for decision makers, for practical implications, it may serve as a reference for changing water supply in the country. In the case of political implications, this research can be useful to raise awareness in the government about the main water deficiencies in the rural sector, to develop public policies to improve the water system. It is expected that this paper be beneficial to understand the topic and the measures that are needed to address it.

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Notes

* Artículo de revisión

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