

Review

Review of Community-Managed Water Supply—Factors Affecting Its Long-Term Sustainability

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Abstract: Although water is considered a human right, rural communities in many countries face challenges related to the lack of a safe water supply. In rural areas, where there is no access to public or private water supply, populations have no other choice than to rely on other unsafe sources of water. Community-managed water supply (CMWS) has emerged as an alternative to address the lack of access to safe water. Nonetheless, this alternative has several critical characteristics that harm the sustainability of water supplies. Studies on sustainability and the long-term impact of the CMWS were explored through a review of recent literature using Scopus and Web of Science databases, which analyzed 86 papers reporting on research into the sustainability and efficiency of water supply systems managed and operated by local communities, as well as the long-term critical factors that can interfere with the functionality of these systems. Based on the critical factors most cited in the literature, we proposed a framework of strategies that interrelate and integrate the critical factors into levels of responsibility. The most critical factors are related to the community level, such as inadequate capacity and ineffective systems. This demonstrates the relevance of local characteristics in the implementation of water management systems. The most cited sustainability strategies refer to the local level as the one requiring action to promote effective community involvement and post-construction support. The framework helps to conceptualize what we called an enabling environment for decision-making, and thus, the achievement of the long-term sustainability of water supply.

Keywords: rural community; rural water supply; community-based water; system efficiency; management strategies



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1. Introduction

Water is a critical resource for human communities. From 1948 onwards, the UN implicitly recognized the human right to water [1], and in 2010, access to clean water was officially established as a human right [2]. However, many countries face challenges related to a lack of safe water supplies for rural communities [3–5]. In these regions, precarious drinking water infrastructure, combined with cultural and environmental particularities, forces communities to seek alternative sources of water [6,7]

In some countries, citizens' access to water also faces environmental and political challenges. According to the IPCC (2013) [8], the African continent is most sensitive to climate change, which affects the region's water availability. In South Africa, water availability, accessibility, and quality are based on climatic conditions [9]. This condition makes the human right to water even more challenging. This indicates the need for efficient natural resource management at a local level where risks and impacts are most felt [10]. On the other hand, Brazil faces unique challenges. Urban areas are largely covered by water services, but rural areas remain poorly covered, with approximately 34.5% of rural households not connected to any type of reliable water source [11], indicative of weak institutional and political support regarding safe water access [12].

The water supply commonly used in developed urbanized regions is piped water operated and maintained by the government or private concessionaires. In rural areas, however, where the government or its concessionaires are unable to improve access to water, the population is vulnerable and must develop other water sources, such as manual pumping, rainwater harvesting, or well water [13]. In this context, community-managed water supply (CMWS) has emerged as an alternative to government or private management. The CMWS structure is based on the population being responsible for the operation, management, and water supply of a local association. The construction of water facilities, as well as the provision of technical, institutional, and political assistance, is delegated to external agents [14–16]. However, there is no specific framework for its initiation, as its sustainability depends on adaptation to local specificities concerning economic, social, and political aspects [17].

Despite the significant number of CMWS success stories, several studies list critical sustainability factors that negatively influence the efficiency of their operation and management over time. Each study considers the particularities of its study region and presents the critical factors that require development; however, there is a gap in the literature [12,18–21]. A synthesis that brings common factors requiring improvement and strategies that can serve as an example for other regions has yet to be produced.

Consequently, the main objective of this article is to present a review of recent literature on the sustainability of CMWS in several areas of study. In particular, we discuss the most cited long-term critical factors affecting the success of CMWS and sustainability strategies that can improve water management in rural communities. Furthermore, we propose a framework that interrelates and integrates the most important critical factors organized into levels of responsibility.

2. Methods

This non-systematic review was based on case study literature (e.g., [22]), and adopted an explicit search protocol to investigate the development of trends in case research on CMWS. This study used keywords to find international papers through the Scopus and Web of Science databases. The search was limited to the last five years of publications.

Article selection began with the determination of keywords, that is, the possible combinations that would meet the research objective. The terms used in the search were: “water supply” in combination “and” with the terms “rural” and “community-based water”. A total of 345 articles were identified in the databases and another 13 studies on the subject were manually added. After reading the titles and abstracts, 86 articles were filtered for content analysis to enable framing according to the proposed objective.

The next step in data collection was to select articles according to the established inclusion and exclusion criteria.

- (I) Inclusion criteria for content: Articles that presented the central theme correlated with CMWS were included.
- (II) Inclusion criteria for the type of article: articles with qualitative and quantitative methodologies from various areas of knowledge were considered. Articles in Portuguese, English, and Spanish were considered.
- (III) Exclusion criteria: Articles that diverged from the theme proposed in this study were excluded; those that did not specifically address the subject of this article were also excluded.

Based on the arguments of the reviewed studies and the authors’ expertise in the area of water supply in rural communities, was separated the critical factors and the long-term sustainability strategies cited in the literature into three levels at which they should be addressed: community, local/regional, and national (Figure 1).

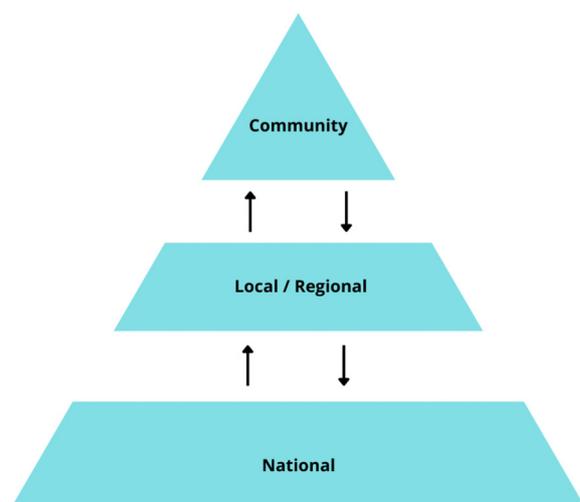


Figure 1. Proposed structure of levels that favor accountability for critical sustainability factors.

The community level applies when critical factors are specifically related to a single community or community association. At this level, strategies for achieving sustainability are limited to the system, community, or management unit. The local/regional level represents the critical factors that can be addressed by a set of communities, or within the geopolitical unit (municipal, regional, or state), and that embrace an action external to the communities. The national level refers to the legal security of community associations and the recognition of management as an effective alternative for water supply. In addition, practices and programs that strengthen and support CMWS are included.

The levels suggest specific strategies to offer access to safe water as a human right. The national level supports the establishment of institutional programs, legal frameworks, and NGOs and reinforces this alternative to water management. The local/regional level is related to the community, and can offer technical and administrative support and training.

3. Results

Community management of water has been indicated as an alternative pathway to achieving the human rights to water in several countries [23]. As the research area addresses real challenges faced by various rural communities, there is a growing number of studies on the development of CMWS. The willingness and participation of the community in the operation and maintenance of water supply systems are widely discussed from several points of view. These are influenced by the realities of the community and water management effectiveness, and the need for a strategy to fill the gap that the local government cannot reach.

Most recent studies have focused on countries in the African continent, such as Ghana (12), Uganda (12), Ethiopia (7), Brazil (7), Cameroon (6), and Zimbabwe (6). The concentration of publications in this region indicates greater regional interest in exploring community participation in water management. Globally, in 2017, of the estimated 785 million people with limited services or unimproved sources of surface water, 51% lived in Sub-Saharan Africa (SSA), 20% in Southeast Asia, and 18% in Central and South Asia, where the rural population is the most affected [24]. The rural gap in safely managed water services means that most rural residents who do have access to improved water services in SSA are among those served by alternative sources [25]. This highlights the need for these regions to find safe access, such as that provided by CMWS.

Despite the international nature of the issue, there is a lack of studies focusing on the effectiveness and functionality of systems managed by the community. There is an increase in the number of studies on the subject in recent literature, but there is a deficit of publications in regions where community management is already a reality, as in the case of Latin America.

3.1. Performance of Community-Managed Water Supply

Around the world, CMWS presents itself as an alternative to achieving a water supply that meets the needs promised by the universal right to water. However, the efficiency of community management for the effective delivery of safe water warrants discussion. The elements requiring improvement are identified, potentially allowing these solutions to become more sustainable. Table 1 presents the opinions of the authors regarding international efforts to implement CMWS.

Table 1. Authors' position on the performance of CMWS internationally.

Authors' Position	Countries	Source
Community management systems prevailed due to the huge contributions of local inhabitants and community networks. According to the author, a better engagement of the government is necessary for effective development of these administrations.		[26]
Effective community engagement is a way to respond to government negligence within the community.	Cameroon	
Low community involvement in community management issues as water resources management in the country is dominated by a centralized management system.		[27]
The country's water resources management is dominated by a centralized management system that largely ignores rural households; water consumption remains inadequate.		
Eliminating the community contribution runs the risk of reintroducing paternalism in the water sector.		[28]
Limited capacity and weak management characterize water systems with an inadequate mechanism to deal with Capital Maintenance. Gaps in enforcement of the statute to ensure that district assemblies provide direct support to community organizations.	Ghana	[29]
Community management lagging in delivering the expected benefits in technical and financial performance.	Uganda	[30]
Community-managed projects performed better on technical sustainability than the local government.	Ethiopia	[31]
The water supply system needs to be better managed so that it has sustainability in its systems. System maintenance support is needed to keep the project going.	Nigeria	[32]
Community management lacks knowledge and assistance to meet the demands of the supply system.	Tanzania	[33]
Community participation in decision making.		[34]
Some of these associations have been around for decades and are essential pillars of local society.	Colombia	[35]
The government is betting on community management to achieve access to water in the country. The authors believe that the involvement of dynamic NGOs and the community will be essential to improve the management outcome. Furthermore, the interaction of knowledge from both parties will promote a breakthrough.	Indonesia	[36]
Community associations have demonstrated their ability to adequately maintain water supply systems in rural communities through joint initiatives with local governments.		[3]
Community organizations and municipalities have demonstrated their ability to adequately maintain water supply systems in rural communities. It also speaks of the successful experience of the SISAR model.	Brazil	[19]
There needs to be greater recognition by society of the need to protect the system so that management occurs correctly.	Canada	[37]

Several authors have identified critical factors that influence the quality-of-service provision and the sustainability of the systems managed by the communities, highlighting the need to develop strategies that can improve effectiveness. Despite presenting areas of study in different countries, some factors were frequently observed. The CMWS presents a potential alternative for providing water supply in rural regions and in places where the government is unable to act effectively.

3.2. Key Measures of Sustainability and Indicators

This art of study focused on identifying some of the most important factors influencing sustainability (Table 2).

Table 2. The main long-term sustainability factors in recent literature are separated into levels of responsibility.

Level	Long-Term Sustainability Factors	Number Times Cited in Studies
Community	Inadequate community-based capacities (technical, financial, and management)	23
	Inefficient systems (location, functionality, water treatment, and adequate technology)	14
	Vulnerability to adverse external factors and occurrences	13
	Inappropriate and irregular tariffs	13
	Conflicts of interest	7
	Limitations due to community dynamics	9
	Ineffectual management of committees	8
	Underdeveloped sense of community ownership	6
	The poor involvement of the in the system	4
	User dissatisfaction	3
	The prospect of using water for the community (multiple uses vs domestic)	2
Local/Regional	Unequal female participation in management	1
	Unequal participation of the most disadvantaged population in the system	1
	Lack of preventive maintenance and external post-construction support	12
	Insufficient municipal support	9
	Ineffectual state support	3
National and Policies	Support from NGOs and outside actors	3
	Inadequate protection for watersheds	1
	Non-integration between national government institutions and formal institutional arrangements	11
	Political interference and the absence of supporting legislation	5
National and Policies	Readability of spaces categorized as rural or urban in public policies	2
	Weakness of the current monitoring and evaluation system related to the water sector	1

Based on Table 2, 69% of the 151 critical factors raised were related to the community level. This highlights the importance of community scope to achieve sustainable supply, as well as the relevance of local characteristics in the implementation of facilities and the community's capacity for operation, maintenance, management, and charging fees to meet expenses and operational costs.

The most cited factors were related to the technical, financial, and management capacity of systems. Rural communities often receive the facilities provided by the local government or NGOs, but not the necessary support from these institutions for technical training and financial support for the eventual maintenance or replacement of parts and equipment [38,39]. On the other hand, studies indicate that the design and implementation of the facilities do not meet the needs of communities and climatic conditions, and do not suit the available technical capacity. This generates an ineffective water supply [26,40].

Another critical factor that has been discussed is the vulnerability of communities to climatic and external factors [16,41–44]. Drought was identified as a critical adverse factor affecting water supply sustainability. Lack of access to water resources makes the local population search for alternative sources of domestic supply [45]. This practice often places residents in situations of inadequate water security for the health of users.

The inappropriateness and irregularity of tariffs were also identified as important critical factor. The establishment of tariffs must consider the economic conditions of the community, including vulnerable families. Additionally, facilities must be operated and maintained [18,46,47]. Inappropriate or insufficient financial support makes services unsustainable. In the long term, it makes the system structures vulnerable to failures and breakdowns [19,48,49]. Therefore, while the particularities of each region and community must be considered, it is valid to consider a strategic plan that can be used as an initial structure to make the CMWS more sustainable.

3.3. Recommendations to Improve Sustainability and Long-Term Impacts of CMWS

To improve the sustainability of the water supply in rural communities, data regarding strategies used by communities to solve or alleviate the problems encountered during community management were collected (Table 3). This table shows the main strategies identified in this international review, which are organized by the number of citations. Despite the need to consider the particularities of each region and community, several authors have indicated general strategies that can be used to address the critical factors raised.

Table 3. Strategies to improve long-term sustainability of CMWS according to recent literature.

Strategies to Improve Sustainability	Citations
Empowerment/effective community engagement	27
Post-construction support	13
Greater and broader engagement with community actors and water management institutions	12
Operational/professional training	9
Co-funding shared by local governments and community members	9
Recognition of local water body capacity and water control	9
Research development	5
Holistic approach to addressing challenges	4
Involvement of women in the operation and management	4
Political recognition of local water systems	3
Risk and management assessment framework	3
Improvements to the infrastructure	3
Assignment of tariffs to system operation and maintenance services	2
Quality and structure of treatment system	2
Environmental education	2
Proper maintenance of systems	2
Adoption a monitoring framework	2
Submission of system management to the federal organization	1
Broad process of decentralization of services	1
Empowerment of community agencies and district assemblies	1
Updated technology supported by the government	1
Expand the multiple uses of water	1
Consider the relative importance and the scale of the type of productive activity to be implemented	1
Establishment of associations involving various community organizations	1

Several studies have shown that community participation, empowerment, and a sense of ownership are necessary for an efficient of water supply in rural areas [26,28,43,50]. Additionally, it is possible to perceive the need for external support for the system's sustainability [34,40,51]. Most of the factors and strategies to improve the sustainability of the CMWS were addressed at the community level, following the same scheme for the different levels of critical factors (Figure 2). The convergence of critical factors and sustainability strategies at the community level reaffirms the importance of considering the particularities of the community and needs of each population for achieving supply sustainability.

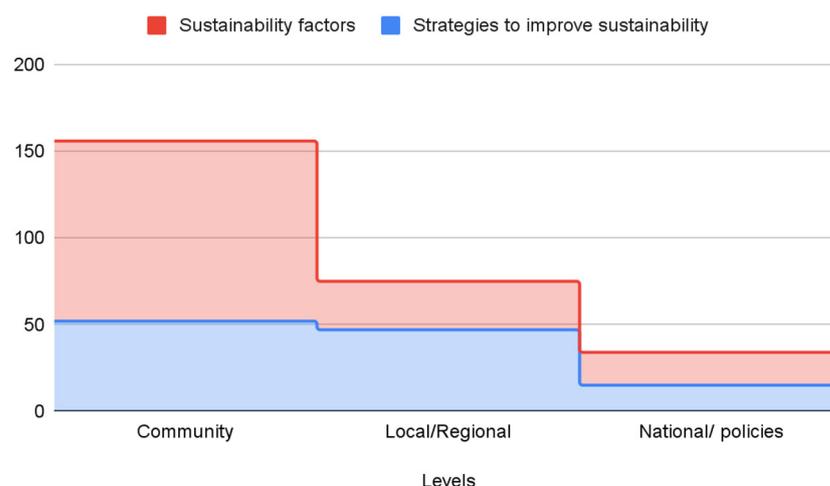


Figure 2. Percentage of factors and strategies to improve sustainability cited in the literature is divided into levels of responsibility.

3.4. Empowerment/Effective Community Engagement

Of the selected articles, 23 discussed social engagement as a well-regarded practice for the sustainability of the rural water supply system (Table 4) [19,26,52,53]. Effective community participation over a long period promotes the understanding of management standards and incorporates them into training of the committee overseeing the water supply [14,45]. Local management users should be involved in community practices, whether in community management decisions, administration, or even maintenance, to obtain the knowledge necessary for effective management in the community. The involvement of users with structured training in operating the system guarantees more certainty in decisions that are essential for resourceful management. In addition, long-term public participation is also a challenge. The community’s persistence in management also negatively affects the functionality of the system [34,36,54].

Table 4. The authors’ opinions on empowerment and effective community engagement as a recommendation to improve sustainability.

Author’s Opinion	Countries	Source
The community seeks empowerment in relation to management to address the government’s negligence in providing water services to rural regions.		
There is continuous top-down management of natural resources and there is little community participation in decisions and decisions.	Cameroon	[26,49]
Active community participation in the stages of the rural water supply system is beneficial for water supply.		
The community engaged in environmental conservation activities and in helping environmental systems that can protect the living.		[50]
Community knowledge must be intertwined with the support of the institution that supports community management. In addition, users need training to handle the supply system.	Indonesia	[36]
The lack of sustainability of services can be addressed with effective community involvement.		[55]
Community participation can help the durability of water system infrastructure.	Nepal	[56]
Due to lack of funding, the community needs to organize and use its knowledge to deal with critical factors, such as environmental impacts.	South Africa	[43]
The elimination of the community contribution risks reintroducing paternalism into the water sector.	Ghana	[28]
The community needs to be prepared to deal with system problems, such as parts failure.		[57]

Table 4. Cont.

Author's Opinion	Countries	Source
It is necessary to involve citizens through co-production to aid in the sustainability of the system.	Ghana and Nigeria	[58]
Long-term community involvement needs a period of time to understand management standards and incorporate them into training.	Zambia, Ghana and Kenya	[14]
Community organizations and municipalities have demonstrated their ability to adequately maintain water supply systems in rural communities, requiring the participation of all, including community engagement.	Brazil	[19]
The community needs to get involved in the project, understand the proper care required for the sustainability of the water supply system and develop their own environmental education.	India	[52,53]
Community input is required in the planning and construction of the system, as well as financial contribution and work involved.	Kyrgyzstan	[59]
Community management must be a vehicle to empower communities, while bringing greater equity of use.	Uganda	[60]
Community participation in community management decision making whether in administration, maintenance, operation or others.	Colombia	[34]
Community participation in managementsystems is one of the ways of system development that the author reports.	Nicaragua	[61]

Consequently, the population needs to understand the technologies used in the communities to ensure an understanding of the operation, maintenance, and repair practices. In synergy with these activities, environmental education promotes more effective management, such as better water conservation [52,53,62] This knowledge establishes society's autonomy in dealing with repairs in relation to periodic interruptions, such as systems failures or even poor community management, since funding is not always necessary to solve the unavoidable issues that occur in these regions [43,57]. However, in some cases, there is still little community participation in decision-making issues, and the elimination of community input can reintroduce paternalism in the water sector [28] Locals in these regions need to understand that community management guarantees empowerment that also promotes paths to attain their basic rights [60].

3.5. Post-Construction Support

The selected articles highlighted the need for post-construction support to ensure that rural water supply systems are efficiently managed. This assistance guarantees that system operations, governance, and financial management function in a sustainable manner (Table 5).

User-managed water supply systems in rural communities require care to maintain sustainability. Post-construction support with practical, financial, and technical actions is one of the most important aspects of the system [33]. It is necessary for the general population to understand the techniques that should be used in the management of systems to guarantee operation, maintenance, and repair [57]. Even with this specialization of users, there are considerable technical visits by professionals to supervise the service, guaranteed by the government or other investors. This requirement is considerable because not all issues can be resolved by users and operators [52,53]. In addition, the government's support in the post-construction phase of the system is of great importance so that those in the community who manage the technical aspects of water supply management are in tune with those who manage community health. Whether with maintenance or repair classes and/or assistance with repairs, the government, funding agencies, non-governmental organizations, and private sector bodies that propose to help must be aware and involved so that the system operates with continuity and safety [29,46,64].

Table 5. The authors' opinions on post-construction support as a recommendation to improve sustainability.

Authors' Opinion	Countries	Source
It is important to integrate the various attributes into a single dimension in assessing the sustainability of the system. Studies comparing systems at the municipal or federal level can also help government agencies formulate policies and identify post-construction support strategies.	Colombia	[34]
Even after the construction of the system, actions must and need to be taken so that it works in the best possible way to guarantee the quality of safe water for the community's residents.	Brazil	[18]
Post-construction support needs to take place at all times for systems to be sustainable. This assistance will ensure that the operations, governance and financial management of the system are working at their best, guaranteeing the safe and efficient supply of rural communities.	Ghana	[29]
There is a need for government or agency support for the system to function safely and efficiently. This post-build support assists in the sustainability of the system.	India	[52]
Government intervention is important so that the system is better used by the community where community management is implemented.	Mexico	[63]
Political and cultural intervention, public actors, and the local population can guarantee the functionality of the water supply system in rural communities. For this, constructive participation is required.	Northwest of Cameroon	[26]
Support to communities helps with management and repairs and provides training for water system operators and management. In addition, technical visits help resolve issues and ensure access to materials unavailable in the community.	-	[57]
Channeled networks must rely on the help of a professional support service for the proper functioning of the system, guaranteeing supply. This is possible due to the combination of sufficient financial and technical resources with post-construction support.	-	[4]
Supporting the community with practical actions and financial and technical support is extremely important during and after the construction of the system.	Ghana, Kenya, Zambia	[33]
Support to communities in management is necessary, whether technical and/or financial. This support is necessary to guarantee the sustainability of the implemented system. This backup mechanism must involve all interested parties.	Sudan	[64]
The support of research institutions, city halls, sanitation companies, and social organizations is necessary to improve the dynamics of the supply system and guarantee sustainability.	Brazil	[38]
Every step of the installation of the water supply system in rural communities must be followed with care and attention. The post-construction stage is also very important for keeping the system in operation. It is necessary to invest in the knowledge of the community to efficiently generate the system and this requires that external support is always present to give all the necessary assistance.	Uganda	[30]

As the energy consumption of these water supply systems is often high, it is necessary to devise strategies that promote the economy of this resource as one of the ways to guarantee the quality of the whole system. Therefore, some research institutions, in synergy with local governments, companies, and social organizations, have come together to promote the generation of photovoltaic energy to reduce electricity costs. Political intervention by public actors and the local population can guarantee the functionality of the water supply system in rural communities [26,38].

3.6. Greater Engagement with Community Actors and Water Management Institutions

The lack of community involvement between community agents and institutions managing water resources makes sustainability of the system difficult. This lack of integration is a worrying problem that strongly interferes with the water supply in rural communities (Table 6).

Table 6. The authors' opinions on greater and wider engagement with community actors and water management institutions as a recommendation to improve sustainability.

Authors' Opinion	Countries	Source
The lack of integration of community actors with non-governmental institutions can generate management problems.	South Africa	[44]
Community knowledge together with institutional support tends to improve the development of community water supply management.	Indonesia	[36]
Greater community participation in empowering the management of new projects, the creation of a stronger institution begins.	Ethiopia	[31]
The involvement of actors beyond local governments and communities in community management is necessary.	Brazil	[19]
The relationship between the government, public actors, and the population would develop the CWMS.	Cameroon	[26]
To ensure an effective water supply system in rural communities, better performance by community actors at various levels with the help of the community is needed.	India	[65]
The support of entities such as government agencies can promote the sustainability of rural water supply, as the fees charged, which are adequate to the economic standards of society, do not always cover all the necessary expenses.	India	[52]
The support of external actors is of great importance for achieving the goals outlined in ODS 6.		[45]
Water associations should organize resource mobilizations to assist with system operations, such as maintenance, repair, and upgrades. Integrating the community and support institutions promotes success in these issues.	Ghana, Kenya and Zambia	[66]

It is important that water committees achieve synergy with supporting government institutions, community participants, and the entire local population to develop water supply management in rural communities [3,44,66–68]. Without this support, management tends not to progress because of the problems arising from the lack of integration between the parties. This difficulty is common; as an example, it occurs during drought in South Africa due to the difficulty in relationships, communication, and contact between community actors. The responsibilities of the actors in the region are undefined, causing disarray in the local administration [26,44]

In some communities, the fees charged to the population do not meet the system's needs, as their value is not consistent with the economic standards of the society in question [52]. Critical factors such as this harm the functionality of rural water services. The water supply system in some regions of Espírito Santo and Paraná, Brazil, are entirely community-managed, creating difficulties for the development of organizations [19]. Community actors, in turn, need to play their role at various levels within the community, including devising strategies for users to strongly participate in the system [65], and applying their knowledge about management to solve problems caused by the scarcity of resources. On the other hand, the conflict of interests between management and the founding institutions negatively influences the sustainability of the system [36,69].

3.7. Operational/Professional Training

The sustainability of water supply system users must also be developed so that they reach the efficiency of operation and management. Consequently, capacity building and training for maintenance, operation, and repair are essential for rural communities (Table 7).

Some strategies allow for better efficiency of water supply systems in rural communities, such as education and professional and technical training for users, so that they have a greater ability to manage the system [30,71]. The training of users makes it possible to properly supervise the water supply systems in communities, while also counting on the support of local authorities, especially in the post-construction period [61].

Table 7. The authors' opinions on operational/professional training as a recommendation to improve sustainability.

Authors' Opinion	Countries	Source
The involvement of community organizations can help improve outcomes. The financial and technical support from NGOs that the community receives can help in the empowerment of users.	Indonesia	[36]
Sustainability needs both financial and practical assistance from agencies. It is necessary that the committees have technical skills to be able to operate the system properly.	Zimbabwe	[70]
The implementation of educational programs is recommended for communities.	USA	[71]
In order to make the system more practical, technical and administrative training is recommended for the community.		[72]
Several points for good development are indicated to the community, including technical capacity.	Costa Rica	[73]
There is a need for training and support for operation for up to two years, in order to ensure the proper functioning of the system in the community.	Kyrgyzstan	[59]
The capacity building of the committees helps in the supervision of the water supply systems in the communities. In addition, such community participation is necessary, but local authorities must still provide sustained post-construction support.	Nicaragua	[61]
It is necessary to invest in the knowledge, skills, and resources needed at the community level for the sustainability of the system.		[30]
Applying approaches to enhance learning and behavior change will help bring about beneficial program outcomes from investments in training.	Uganda	[74]

Therefore, programs of investment in professional training and support for operation for at least two years post-construction promote practicality in the system [59,72]. The financial and technical support of NGOs, received by some communities, can assist in training for machine operation in a structured way. Such training for managers promotes the financial and practical sustainability of the system [36,70].

3.8. Co-Funding Shared by Local Governments and Community Members

Eight articles covering the co-financing needed for community management to achieve the quality and sustainability of rural water supply systems were selected (Table 8).

The need to balance financial relationships in the community management of water supply is fundamental to the sustainability of the system in rural communities. Knowledge of the financial issues, good administration, and management of community water supplies is crucial to meet the demands of the local society. In addition, co-financing is very important so that communities can enjoy better efficiency in water supply by developing projects to improve water quality [33,40,50,78]. However, there are examples of inadequate financial support that create problems in the maintenance of systems. Therefore, in addition to external support, there must be an oversight to create responsibility from the Community Water and Sanitation Agency and also from the District Assemblies [29,63].

Therefore, the economics of management must be clear and open to the entire population and supporters, both to understand which part still needs better investment and to bring reliability and allow for the fluidity of the system [79]. Infrastructure development in these communities depends on raising financial resources that meet costs and developing operating systems as needed [23,76]. Some communities still suffer from inadequate funding, which makes it difficult to develop their infrastructure [66,79]. The ineffectiveness of watering points due to wear and tear and lack of equipment maintenance is a relevant factor that prevents communities from achieving quality in management; this is either due to the lack of foreign investment or taxation about the use of the resource [50,77,79]. By reaching operating cost rates that are within the means of community users in addition to the investment by the government and donors with co-financing, sustainability

of community management can be achieved and access to clean and safe water can be ensured [40,75].

Table 8. The authors' opinions on co-funding shared by local governments and community members as a recommendation to improve sustainability.

Authors' Opinion	Countries	Source
Fees for the society's water services must be compatible with economic sustainability and the social sphere. It should be noted that all fees charged to users must be directed towards minor repairs and preventive maintenance. The money responsible for meeting the most elaborate demands must come from governments and donors.	Democratic Republic of Congo	[40]
The lack of financial support from the external fund makes it difficult to repair accidents with equipment and pipes in the water supply system. Financial investment is crucial to develop projects in the community.	Indonesia	[50]
Financial support provided by government economic funds to achieve effective community-management development on the ground, demonstrating higher priorities.		[75]
Fundraising is intended to develop the infrastructure of local community management.	South Africa	[23]
The sustainability of the system is contingent on financial issues.		[73]
From the release of financial resources, it is possible to implement management development approaches according to the system's operating needs.	Zimbabwe	[76]
Waterpoint functionality may not be effective due to factors, such as lack of community resource usage fees. Without proper maintenance or insufficient financial equipment and water points end up deteriorating.	Kenya	[77]
The growth of the self-financed water supply is necessary for the development of the supply system. Although much progress has been made, there remains a problem with funding.	Sub-Saharan	[66]

3.9. Influence on Women's Lives

The influence of an effective and sustainable water supply and CWMS affects all community residents, but has a more significant effect on the lives of local women (Table 9).

Table 9. Authors' opinions on the influence of water and CWMS on women's lives.

Authors' Opinion	Countries	Source
Post-construction maintenance needs to be through an institution that has the participation of women.	Ethiopia	[31]
Water (un)availability at the household level affects men and women differently.		
The social construction of gender roles influences men's and women's needs.		
There is low community involvement in local governance structures, and in most village assemblies, that of women is even less.	Tanzania	[80]
In the Village Water Committees, women's representation is regulated by a quota system, but women rarely occupy leadership positions.		
Men have traditionally determined water management policy, despite the dominant role of women in water collection.		
There is a difference between women's knowledge of the value of water and participation in domestic activities.	Ghana	[81]
Gender and power dynamics created structural barriers such that women would be less likely to access certain water sources in specific contexts.		
Reaffirms the role of gender reinforced by the cultural norms of some societies.	Nigeria	[82]
There is a relationship between fetching water and the risk of sexual abuse against women.		
Girls are more likely to be victims of sexual assault or rape while fetching water.	Uganda	[83]
Lack of water puts women in positions of susceptibility to spousal abuse.		

When it comes to the influence of community water supply on women's lives, the dichotomy between the reality that women face and the needs that gender specifies is clear. In the literature, it is clear that in communities that resort to alternative sources of water, women are responsible for fetching water and associated physical and domestic activities, such as house cleaning, hygiene, and food preparation [59,80]. Often, women's responsibility for fetching water results in time poverty, limiting time for work outside the home, educational activities, care, and leisure [84].

Poor access to water, sanitation, and hygiene (WaSH) diminishes health status; however, women accessing water are disproportionately affected [83,85]. Vulnerability studies note that these vulnerabilities are related to pre-existing social inequalities in terms of restricted access to assets (physical, financial, human, social, and natural) and unequal power relations [86].

Although gender influences access to drinking water, the participation of women as members of water committees and the creation of public policies that emphasize this issue remains a challenge to be resolved [87]. At the local level, changing perspectives, promoting the importance of equity in participation in decision-making, and empowering women and the communities in which they live are also challenging [31,80,87].

The lack of equitable gender participation in rural water supply has become a cause-consequence challenge. The under-representation of women in community committees and decision-making cause women to be vulnerable to local issues of access to water [80]. Meanwhile, the lack of empowerment and interest in participating in such activities may be a consequence of pre-existing social patterns that hold women responsible for domestic activities but do not value them in positions where their voices can be heard. The relationship between gender and water as well as the role of women at the local level is discussed in the literature, but there is still a gap between the aspirations to practice women's empowerment and its implementation in effective policies and practices [83,88].

3.10. Framework of the Critical Factors

This review made it possible to identify critical CMWS sustainability factors that can be attributed to different areas of responsibility. However, there is no scheme for attributing responsibilities to each level. Therefore, this study proposes a framework to assign accountabilities for each level to enable better structuring for future decision-making that promotes the sustainability of systems (Figure 3).

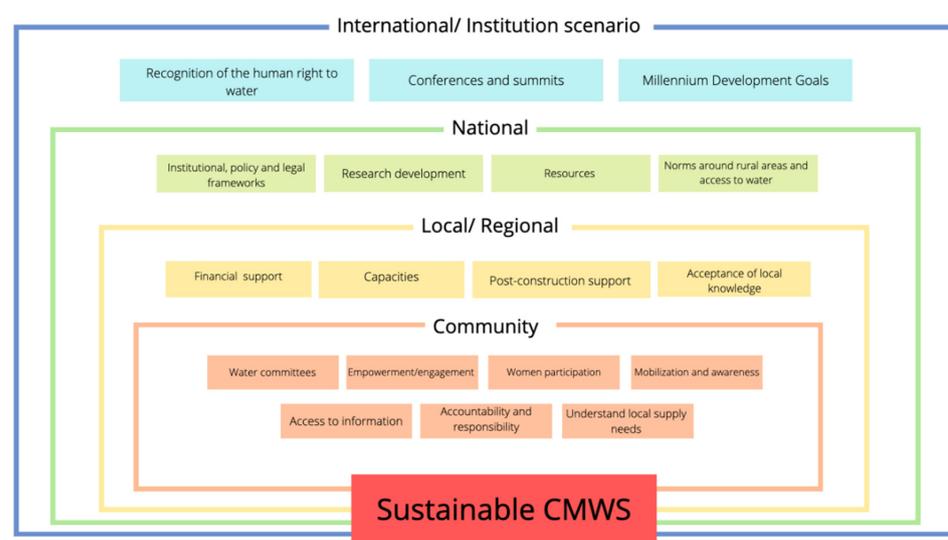


Figure 3. Framework of critical sustainability factors of community-managed water supply (CMWS) in levels of responsibility based on the authors' experience in the area of water supply in rural communities.

The development of programs, conferences, and international summits has stimulated interest in achieving the human right to water and supplying the water demand of rural communities. It has also created favorable interest in national governments for meeting critical factors. At the national level, critical factors are related to the development of policies and norms, availability of resources, and the expansion of research on the subject, whereas uncoordinated development policies and weak institutional structures become yet another challenge for the sustainability of community management [69]. The intent is that rural communities in the country have access to information and knowledge, resources for the implementation of systems, and institutional tools that favor community management. At the local and regional levels, there are critical factors related to the direct support for management units. This scope should provide CMWS with training for managers, population knowledge, and post-construction support. At the community level, critical factors are related to engagement, participation, the interest of the population in management, the creation of water committees, and equitable participation of genders in management.

4. Conclusions

The review supports better knowledge on CWMS, and suggests that sustainability requires an action plan that aims to supply critical factors. Despite the particularities of each community and region, it was possible to observe convergence in the factors that prevent sustainable access to water in rural communities around the world. This shows that several communities have deficiencies in their management and that most of them are linked to the technical and operational capacity of their systems, in addition to the inadequacy of the systems currently installed at each location. Recommendations to improve sustainability also indicated a convergence in the action plan aimed at the community level, in which empowerment and engagement of the population, as well as post-construction support and a better relationship between stakeholders, were the most cited strategies. Our research contributes to the ongoing discourse that links governance and water security. However, we recognize the limitations of a theoretical survey and do not intend to generalize the needs of rural communities around the world.

The proposed structure should help simplify the complexities of community management. The tiered accountability framework will support professionals and decision-makers to better design, implement, and achieve sustainable water supply in rural communities.

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