Journal of Rural and Community Development

Village Water Boards And Sustainability of the Rural Water System in Belize

Authors: Olusola Oladeji, Isodoro Charles Galvez, &Angella Edith Baitwabusa

Citation:
Oladeji, O., Galvez, I. C., & Baitwabusa, A. E. (2025). Village water boards and sustainability of the rural water system in Belize. *The Journal of Rural and Community Development*, *20*(3), 1–18.

Publisher:
Rural Development Institute, Brandon University.

Editor:
Dr. Doug Ramsey

ISSN: 1712-8277 © Authors
www.jrcd.ca

Village Water Boards and Sustainability Of the Rural Water System in Belize

Olusola Oladeji
UNICEF Belize
Belize City, Belize
ooladeji@unicef.org

Isodoro Charles Galvez
Ministry of Rural Transformation, Community Development, Labour, and Local Government, Belmopan, Belize
coord.rwsu@labour.gov.bz

Angella Edith Baitwabusa
UNICEF Belize
Belize City, Belize
baitwaedith@gmail.com

Abstract

Background: The United Nations Sustainable Development Goal (SDG) 6 aims to ensure the availability and sustainable management of water and sanitation for all by 2030. This study examines the community-based water management system in Belize, focusing on the activities and characteristics of village water boards in promoting functional and sustainable rural water systems.

Methods: This exploratory study employed both qualitative and quantitative approaches. Qualitative data was collected from documents detailing the management of rural water systems and the roles of village water boards. Quantitative data involved a retrospective review of the 2023 performance assessment report for all 108 established village boards.

Results: The results are categorized into two themes: (1) Description of the village water boards and their roles in managing rural water systems, and (2) Analysis of selected management characteristics of village water boards that enhance water system sustainability. The Village Water Board (VWB) system in Belize operates as a 'supported community-based management model,' receiving government assistance in areas such as training, spare parts/supplies, technical guidance, and procurement of skilled artisans or mechanics when needed. Among the 108 VWBs, 22 (20%) held monthly meetings more than 10 times a year; 57 (53%) provided between 18-24 hours of water supply daily; and 84 (78%) generated revenue from water users. However, only 54 (65%) of those generating revenue were able to cover operational and maintenance costs to ensure a regular water supply.

Conclusion: The government provides support and oversight for village water boards. The study has identified key indicators to monitor their performance and effectiveness, which are vital for ensuring the sustainability of rural water systems.

Keywords: Village water boards, water management, sustainability, rural water system

Conseils villageois de l'eau et durabilité du système d'eau en milieu rural au Belize

Olusola Oladeji
UNICEF Belize, Belize City, Belize
ooladeji@unicef.org

Isodoro Charles Galvez
Ministry of Rural Transformation, Community Development, Labour, and Local Government, Belmopan, Belize
coord.rwsu@labour.gov.bz

Angella Edith Baitwabusa
UNICEF Belize, Belize City, Belize
baitwaedith@gmail.com

Résumé

Contexte : L'objectif de développement durable (ODD) 6 des Nations Unies vise à garantir la disponibilité et la gestion durable de l'eau et de l'assainissement pour tous d'ici 2030. Cette étude examine le système de gestion communautaire de l'eau au Belize, en se concentrant sur les activités et les caractéristiques des conseils villageois des eaux, dans la promotion de systèmes ruraux fonctionnels et durables d'approvisionnement en eau.

Méthodes : Cette étude exploratoire a utilisé des approches à la fois qualitatives et quantitatives. Les données qualitatives ont été recueillies à partir de documents détaillant la gestion des systèmes d'approvisionnement en eau en milieu rural et les rôles des conseils villageois des eaux. Les données quantitatives ont été obtenue à partir d'un examen rétrospectif du rapport d'évaluation des performances de 2023 pour l'ensemble des 108 conseils villageois établis.

Résultats : Les résultats sont classés en deux thèmes : (1) description des conseils villageois des eaux et de leurs rôles dans la gestion des systèmes d'approvisionnement en eau en milieu rural, et (2) analyse de certaines caractéristiques de gestion des conseils villageois des eaux qui améliorent la durabilité des systèmes d'approvisionnement en eau. Le système du Village Water Board (VWB) au Belize fonctionne comme un « modèle de gestion communautaire soutenu », recevant une aide gouvernementale dans des domaines tels que la formation, les pièces de rechange/fournitures, les conseils techniques et le recrutement en artisans ou mécaniciens qualifiés en cas de besoin. Parmi les 108 VWB, 22 (20 %) ont tenu des réunions mensuelles plus de 10 fois par an ; 57 (53 %) ont fourni entre 18 et 24 heures d'approvisionnement en eau par jour ; et 84 (78 %) ont généré des revenus provenant des utilisateurs de l'eau. Cependant, seulement 54 (65 %) de ceux qui ont généré des revenus ont été en mesure de couvrir les coûts d'exploitation et de maintenance pour assurer un approvisionnement régulier en eau.

Conclusion : Le gouvernement fournit un soutien et assure la supervision des conseils villageois des eaux. L'étude a identifié des indicateurs clés pour surveiller leur performance et leur efficacité, qui sont essentiels pour garantir la durabilité des systèmes d'approvisionnement en eau en milieu rural.

Mots clés : conseils villageois des eaux, gestion de l'eau, durabilité, système d'approvisionnement en eau en milieu rural

1.0 Introduction

The United Nations Sustainable Development Goal (SDG) 6 aims to "ensure availability and sustainable management of water and sanitation for all" by 2030 (United Nations, 2015, p. 6). Access to safe water and sanitation is essential for child survival and development (World Health Organization [WHO]/UNICEF, 2021). Recent progress towards achieving SDG 6 includes an increase in the global population using safely managed drinking water services from 69% in 2015 to 73% in 2022 (WHO, UNICEF & World Bank, 2022). However, the coverage of these services varies significantly across different regions, rural and urban areas, and wealth quintiles (Van Houweling et al., 2017; Moriarty et al., 2013).

A major challenge to water supply is the sustainability of infrastructure, particularly in rural areas. To address these challenges, many countries have adopted community-based water management models that emphasize community participation and ownership of rural water systems (Moriarty et al., 2013; Marks & Davis, 2012). This approach aligns with SDG 6 Target 6.B, which aims to "support and strengthen the participation of local communities in improving water and sanitation management" (UN Water, 2021, p. 33). The success of community management often depends on external support, such as training, technical guidance, and skilled artisans or mechanics, which enhance the functionality and sustainability of rural water systems (Thapa et al., 2021; World Bank Group, 2017; Cord et al., 2022).

Community-based committees have been found to be effective in enhancing the functionality of water systems. However, the success of community management varies, and studies have suggested the need to re-evaluate the assumptions surrounding the community management model and implement approaches that support and strengthen water committees (Whaley & Cleaver, 2017; Machado et al., 2022).

The government of Belize has established village water boards as community-based platforms to manage basic water systems in rural areas, ensuring sustainable water management. Currently, 108 village water boards oversee water systems in 126 villages or communities, covering 65% of Belize's 194 rural areas. This study aims to describe the community-based water management system in Belize, evaluate the management activities and characteristics of the village water boards in promoting effective and sustainable rural water systems, and identify areas for improvement to strengthen these boards.

2.0 Methods

2.1 Study Design

This exploratory study utilized both qualitative and quantitative methods.

2.2 Study Sites

The study was conducted in Belize, an upper middle-income country in the Latin America and Caribbean region. Belize has a population of approximately 400,000, divided into four administrative regions with 194 villages and 10 main cities. Water services in Belize are split between urban and rural areas. Urban areas are served by Belize Water Services Limited (BWS), the sole licensed water and sanitation provider in the country. Rural water services are managed by Village Water Boards (VWBs) under the Village Councils Act Chapter 88. VWBs operate autonomously

and independently from village councils, managing rudimentary water systems within their village or multiple villages. Each VWB comprises seven members: five appointed by the Minister of Labor in consultation with the village council and area representative, and two from the village council (the chairman and a council member). The Ministry of Rural Transformation, Community Development, Labour, and Local Government (MRT) oversees rural water services, providing financial oversight, capacity-building support, facilitating the establishment of VWBs, and approving village-level tariffs.

2.3 Data Collection

Qualitative data was obtained from MRT's annual reports and relevant documents outlining the roles of village boards. Quantitative data was from a retrospective analysis of the 2023 performance evaluations for all 108 village boards. These evaluations, conducted annually by MRT, identify the recipient of the recognition award for the best-performing village water board. Data collection was carried out using a form designed to capture essential information on the functionality of the village water boards according to their terms of reference.

After extracting the data, two main categories of activities and characteristics were identified and evaluated:

Activity Level

- Regular meetings
- Daily water provision hours
- Water system disinfection

Financial Management

- Revenue generation
- Timely submission of monthly finance reports
- Annual savings

Key Indicators

1. Village Water Boards Monthly Meetings: Each board is required to hold monthly meetings. The scoring system for the number of meetings held annually is as follows:
    - 0-5 meetings
    - 6-10 meetings
    - More than 10 meetings
2. Daily Access to Water: Number of hours of water is available per day for users:
    - < 6 hours
    - 6-12 hours
    - 12-18 hours
    - 18-24 hours

3. Disinfection of Water: Regular treatment of the water system to ensure quality:
    - Yes
    - No
4. Revenue Generation: Payments collected from water users:
    - Yes
    - No
5. Timely submission of Monthly Financial Reports: Number of monthly financial reports to the government by the 15th of the following month
    - 0-5 meetings
    - 6-10 meetings
    - >10 meetings
6. Savings: Amount saved at the end of the year after annual expenditure on operation and maintenance:
    - Yes
    - No

2.4 Data Analysis

Data entry was performed using EPI-data version 3.1, and analysis was conducted using SPSS software version 23. Univariate analysis was performed, and findings were presented using frequency (n) and percentage (%) distribution table.

2.4.1. Ethical Approval. The study did not involve human subjects, so no ethical approval was obtained. It involved a retrospective review of data from annual reports and online documents.

3.0 Results

The results are divided into two main themes: (1) Description of the village water boards and their roles in managing rural water systems, and (2) Analysis of selected management characteristics of village water boards that enhance water system sustainability.

3.1 Description of the Village Water Boards and Their Roles in Rural Water Management

To enhance sustainable water supply in rural areas, the Government of Belize implemented a decentralized model. This strategy empowers community members to manage local water points. Village water boards were established as community platforms to oversee the management of basic water systems, promoting sustainable water practices in rural areas.

The rural water sector in Belize is regulated by the Village Councils Act, Chapter 88 of the Substantive Laws of Belize, Revised Edition 2011 (Judiciary of Belize, 2011), which outlines the structure of the Village Water Boards. These boards are

designed to be financially autonomous and independent from village councils, responsible for the day-to-day management and operation of basic water supply systems in their village or sometimes serving multiple villages.

The Village Council Act authorizes the Minister of Rural Transformation, Community Development, Labour, and Local Government to establish a seven-member VWB comprised of volunteers. This board includes five members appointed by the minister after consulting with the area representative and Village Council, and two automatic appointees: the chairperson of the Village Council and a member of the Village Council nominated by the Village Council. The board members volunteer their time and do not receive any formal incentives or compensation.

The VWB is tasked with the strategic and financial management of the Rural Water Systems (RWS), as well as the daily operations, maintenance, and sustainability of rural water systems. Their responsibilities include:

- Conducting all necessary operations and maintenance activities to ensure uninterrupted water service, including routine system checks, planned, preventative, or corrective maintenance, and repairs.
- Regulating pumping hours to ensure continuous water supply, including monitoring log sheets for pump operators to complete before and after pumping and disinfection activities.
- Maintaining proper records and accounts, including keeping an up-to-date cash book, having an updated bank account, and submitting monthly, semi-annual, and annual financial reports to the Ministry.
- Expanding the water supply system for the village or community as needed.
- Carrying out disconnection procedures.
- Collecting user fees.
- Laying water pipes in the village or community.
- Efficiently performing any other functions related to the water supply in the village or community.

Currently, 108 VWBs voluntarily manage rural water systems in 126 villages, providing water to nearly 120,000 people. The VWBs are supervised by the Rural Community Development Officers (RCDOs) of the Ministry of Rural Transformation, Community Development, Labour, and Local Government, who offer financial oversight and capacity-building support. Training for the VWBs includes financial management and reporting, maintenance and troubleshooting of rural water systems, water treatment (chlorination), and leadership and management capacity building (Ministry of Labour, Local Government, Rural Development, 2024).

3.2 Analysis of Selected Management Characteristics of the Village Water Boards

Table 1 analyzes the performance of the 108 village water boards using six key indicators of management activities and characteristics essential for promoting water system sustainability. These indicators are categorized into (1) Activity-level interventions, including monthly meetings, daily water supply, and disinfection of

water systems, and (2) Financial management, including revenue generation, timely submission of financial reports, and annual savings.

Table 1. *Performance Evaluations for all 108 Village Water Boards in 2023*

Management variables	**Number (percentage)**
Activity Level	
Committee meets regularly within a year	
0-5 times	31(29)
6-10 times	55(51)
>10 times	22(20)
Access to water supply (number of hours of water supply per day)	
< 6hours	8(8)
6-12 hours	13(12)
12-18hours	29(27)
18-24hours	58(53)
Routine disinfection of water system	
Yes	48(45)
No	60(55)
Financial management	
Revenue generation	
Yes	84(78)
No	24(22)
Revenue generated enough to cover operation and maintenance costs	
Yes	54(65)
No	30(35)
Methods of revenue generation	
Metering system	57(53)
Flat rate system	51(47)
Timely submission of monthly financial report	
<5 reports	10(9)
6-10 reports	12(11)
>10 reports	86(80)

Table 1 continued

Savings made at the end of the year*	
<5,000BZD	54 (50.4)
5,000- <10,000BZD	15(14)
10,000- 50,000BZD	33(30)
>50,000BZD	6(5.6)

Note: *2BZD=1USD

3.2.1. Activity Level Interventions Analysis:

- **Monthly Meetings:** Village water board members are expected to meet monthly. The table shows that 22 (20%) of the 108 village water boards met more than 10 times in a year; 55 (51%) met between 6 and 10 times, and 31 (30%) met at least 5 times in a year.
- **Water Supply:** Daily water supply in the villages ranges from less than 6 hours to 24 hours. Fifty-eight (53%) of the 108 village water boards provided between 18-24 hours of water supply to their villages, 29 (27%) provided water between 12-18 hours, and 8 (8%) provided water for less than 6 hours daily.
- **Routine Disinfection of Water Systems:** Disinfection using chlorine is expected to be done routinely, with water treatment charts placed in pump houses for operators to follow. However, only 48 (45%) of the village water boards routinely disinfected their water systems.

3.2.2. Financial Management Analysis:

- **Revenue Generation:** Eighty-four (78%) of the 108 village water boards generate revenue from water users, while 23 (22%) do not. However, only 54 (65%) of those generating revenue cover operational and maintenance costs to ensure regular water supply. Revenue is generated from monthly payments for water used by each household, with payment modalities and rates varying by community agreements and bylaws. Fifty-seven (53%) of the village water boards use a metering system to determine payment rates, while 51 (47%) operate on a flat rate system.
- **Submission of Monthly Financial Reports:** Village water boards are expected to submit monthly financial reports to the government by the 15th of the following month. Findings show that 86 (80%) of the 108 village water boards submitted more than ten monthly reports on time, 12 (11%) submitted between 6 and 10 reports on time, and 10 (9%) submitted less than 5 reports on time.
- **Annual Savings:** Annual savings by the village water boards assess the sustainability of the water supply, which can be used to expand water infrastructure or address other community needs. The analysis shows that annual savings range from over $25,000 to less than $2,500, with 6 (6%) of the 108 village boards saving over $25,000, 32 (30%) saving between $5,000 and $25,000, and about half saving less than $2,500.

4.0 Discussion

This study explores the structure and management practices of VWBs in Belize, focusing on activities that enhance the effectiveness and sustainability of rural water systems. Key activities identified include revenue collection from users, regular committee meetings, and maintaining financial and maintenance records. These findings align with previous research by Foster (2013), Fisher et al. (2015), and Schweitzer & Mihelcic (2012), which also identified these management activities as crucial for promoting water system sustainability in Sub-Saharan Africa and the Dominican Republic.

The VBWs have established rules and guidelines that define their functions, decision-making processes, and responsibilities to improve their performance. Similarly, a study by Madrigal et al. (2011) on water committees in Costa Rica found that having a set of working rules and local accountability were linked to higher performance scores.

In Belize, the VWB system operates under a 'supported community-based management model.' This model involves assistance from government authorities such as the Ministry of Rural Development, Belize Water Services, and the Ministry of Health and Wellness. They provide support, including training, spare parts, technical guidance, and skilled artisans or mechanics when needed. This approach is common in many countries, particularly in Latin America and the Caribbean (LAC), and has proven effective in maintaining functional and sustainable rural water systems (REAL-Water, 2023; WaterAid, 2018).

In contrast, the 'unsupported community-based management model' found in many low and middle-income countries often results in poor performance due to limited or no training and sole management responsibility falling on the community (REAL-Water, 2023; WaterAid, 2018; World Bank Group, 2017). Approximately 80,000 Community Water Boards (CWB) operate in LAC, demonstrating that community management is a viable alternative for providing water and sanitation services, especially in rural areas (Rodríguez et al., 2024). However, unlike Belize, where the government provides external support, in most LAC countries, NGOs primarily offer this support (REAL-Water, 2023; Nhaurire et al., 2023; Rodríguez et al., 2024).

Belize is one of the top fifteen countries in LAC for community involvement in water and sanitation management (UN Water, 2021). Water committees are required to hold regular meetings and keep detailed records of their activities and finances. The study found that over 70% of village water boards in Belize met at least once every two months and maintained good records of their meetings. This is a significant improvement from a 2013 study, which showed that only 54% of boards had enough active members to meet quorum, affecting their ability to convene regularly (Grau et al., 2013).

Similar results were observed in Ghana, Sierra Leone, Uganda, Zambia, and Ethiopia, where water committees met at least every three months (Foster, 2013; WaterAid, 2018; Fechter, 2019). In contrast, in India and Mozambique, meetings typically occurred only in response to issues like breakdowns or irregular water supply (Nhaurire et al., 2023; Singh, 2019; Ganesh et al., 2023). Regular meetings and up-to-date records were linked to better committee functionality and improved water system service levels (Foster, 2013; WaterAid, 2018; Fechter, 2019).

Community water committees are essential for managing and overseeing water disinfection, particularly in small communities without centralized water treatment facilities. These committees ensure safe drinking water by implementing various disinfection methods and educating the community on water safety practices (WHO, 2012; AWWA, 2021). Similarly, VWBs in Belize are tasked with disinfecting the water system to provide safe quality water to the communities. In the study, 48 VWBs (45%) routinely disinfected their water systems through chlorination, an improvement from 38% in 2013 (Grau et al., 2013). However, several challenges hindered this process, including financial limitations, logistical issues, limited knowledge and capacity, and consumer concerns about the taste and smell of chlorinated water (Grau et al., 2013). The use of innovative technologies that could alleviate financial constraints and address other concerns associated with current chlorination methods has been recommended (AWWA, 2021; Nambi Katu, 2025).

The study examines the financial management practices of VWBs, highlighting their success in revenue generation, timely report submission, and savings. It notes significant variations in financial performance across different VWBs and districts. Revenue generation from water users is essential for the sustainability of community-managed water sources. Research indicates a strong positive correlation between fee collection and the functionality of water systems, emphasizing the importance of effective financial management (Foster, 2013; Adank et al., 2014; Fisher et al., 2015; World Bank Group, 2017; Thapa et al., 2021).

In Belize, VWBs generate revenue from monthly household payments for water usage, with payment methods and rates varying by community. Some communities use metering systems, while others charge flat rates. Metered systems typically charge between $5 and $10 for 1,000 gallons of water, plus 1 cent for each additional gallon. Non-metered systems charge a flat rate of $5 to $10 monthly (Ministry of Rural Transformation, Community Development, Labour and Local Government [MRTCDLLG], 2022). Metered systems have an average collection rate of 85%, which covers management and operational expenses and saves about 15% of monthly revenues. In contrast, flat-rate systems have a 50% collection rate, covering only operational expenses (MRTCDLLG, 2022).

Water metering provides a more accurate and equitable way to charge for water services, helping to cover the costs of operating and maintaining the water system. It also improves financial management by enabling precise tracking of revenues and expenditures. Metering can encourage water conservation practices, reduce pumping hours, and lower operational costs by making users more aware of their consumption (Gwozdziej-Mazur & Swietochowski, 2018; Ingram & Menon, 2020). A study in England found that universal metering led to a 22% decrease in water consumption (Ornaghi & Tonin, 2021), while a study in Palestine reported that tariff collection rates rose from 40% to over 90%, boosting revenue by 1.93 times after installing water meters (Ogata et al., 2023).

Approximately 80% of VWBs generate revenue, but only about 65% can cover their operational and maintenance costs to ensure a consistent water supply. This is an improvement from 2013, when around 44% of VWBs had collection rates below 60% (Grau et al., 2013). The increase in collection revenue may be attributed to improved collection efficiency, better financial management, and the increased use of water metering systems. Currently, 53% of VWBs use metering systems to determine payment rates, up from 36% in 2013 (Grau et al., 2013). The government provides these water meters, as most VWBs cannot afford them (MRTCDLLG, 2022; Grau et

al., 2013). This trend is similar to findings from other studies where water meters were donated by the government or NGOs to support community water committees (Bhatta et al., 2024; Tantoh, 2021; Ogata et al., 2023; Ornaghi & Tonin, 2021).

The introduction of water meters has sparked varied reactions among community members. Some perceive it as a revenue-generating measure that may conflict with community-focused development, while others view it as a means to promote efficient water use, fair distribution, and infrastructure maintenance (Gwoździej-Mazur & Świętochowski, 2018; Tantoh, 2021; Bhatta et al., 2024; Solis & Bashar, 2022). Balancing the social and economic aspects of water supply is essential for community wellbeing, resilience, and sustainability. This balance can be achieved through transparent communication, community involvement in decision-making regarding the implementation of water meters, subsidies and support for indigent households, and equitable pricing where basic water needs are affordable, but higher usage is charged at a higher rate to encourage conservation (Platukyte, 2016; Gwoździej-Mazur & Świętochowski, 2018; Tantoh, 2021; Solis & Bashar, 2022). In Belize, before introducing a water metering system in a community, there is typically adequate sensitization and community involvement in the decision-making process, including obtaining written acceptance documents signed by community members and their leaders (MRTCDLLG, 2022).

Research has shown a link between the amount of fees collected and the functionality of water systems. Adank et al. (2014) found a correlation between system functionality and revenue collection levels that exceeded annual expenditures. Similarly, Alexander et al. (2015) discovered that higher monthly fees were associated with better functionality of water systems in Ethiopia.

The ability of water committees to collect sufficient funds for operation and maintenance (O&M) and repairs, rather than just generating funds, is seen as a measure of financial management (Chowns, 2015; Madrigal et al., 2011; Marks et al., 2014). However, none of these studies establish a statistical relationship between funds collected and improved water system outcomes. Financial challenges arise when community water committees cannot generate enough resources to support operational costs and maintenance, often due to tariff payment levels (World Bank Group, 2017; REAL-Water, 2023; Thapa et al., 2021).

A study in Indonesia using Bayesian belief network analysis found that systems without fee collection are 20 times more likely to be non-functional compared to those with fee collection (Daniel et al., 2023).

Most research on the financial management of community water systems highlights monetary fee collection. However, non-monetary contributions, such as communal labor or goods, are also used for payment in some communities (Fechter, 2019). Studies conducted in Ghana, Kenya, and Zambia suggest that non-monetary payments can improve inclusivity and community participation in water management (Behnke et al., 2017). Although Belize does not currently utilize non-monetary contributions, this payment method could be considered for indigent households to ensure equitable access to quality water services.

Some VWBs were able to save funds after covering operation and maintenance costs, indicating financial durability. Sufficient revenue to cover operation and maintenance and significant savings have been identified as indicators of financial durability (Schweitzer & Mihelcic, 2012). Positive relationships between savings and improved functionality of water systems have been found in studies in Uganda

and the Dominican Republic (van den Broek & Brown, 2015; Schweitzer & Mihelcic, 2012). However, a study in Ghana reported that savings are not necessarily an indicator of effective management, as committees with no savings may have higher functionality due to regular spending on maintenance (Fechter, 2019). This study did not compare savings and functionality of water systems.

5.0 Limitations and Strengths of the Study

This study utilized secondary data, which inherently includes the usual limitations of routine data research. It provides an in-depth analysis of the structure, management activities, and characteristics of the VWB, which are crucial for sustaining water systems. However, it does not explore the link between these management activities and the outcomes of the water systems. Despite this, the study identifies key indicators for tracking progress in community involvement in water management and the functionality and sustainability of rural water systems. Further research is suggested to examine the relationship between the management activities of the VWBs and water system outcomes, such as the functionality of water sources and user satisfaction.

6.0 Conclusions & Recommendations

The study has identified key indicators to monitor the performance and effectiveness of village water boards, which are essential for ensuring the sustainability of rural water systems. The government provides support and oversight for these boards.

To enhance the performance of the water board members, it is essential to implement a performance-based incentive structure aligned with key management activities. This approach can motivate and encourage better performance. Additionally, regular training programs focused on financial management and water quality assurance are crucial for building the capacity and skills of water board members. Providing targeted support to underperforming village water boards is also important. It is recommended that Village Water Board members possess the minimum education and technical skills required for their roles. Securing community support for metering all water systems can significantly boost revenue generation, which is essential for the maintenance and operation of these systems. This strategy not only ensures sustainability but also improves efficiency.

References

Adank, M., Kumasi, T. C., Chimbar, T. L., Atengdem, J., Agbemor, B. D., Dickinson, N., & Abbey, E. (2014). *The state of handpump water services in Ghana: Findings from three districts*. 37th WEDC International Conference, Hanoi, Vietnam. https://www.semanticscholar.org/paper/The-state-of-handpump-water-services-in-Ghana%3A-from-Adank-Kumasi/27fe16ea94ac8f52f2bb1b09f1e5ac5be636fca9

Alexander, K. T., Tesfaye, Y., Dreibelbis, R., Abaire, B., & Freeman, M. C. (2015). Governance and functionality of community water schemes in rural Ethiopia. *International Journal of Public Health, 60*, 977–98. https://doi.org/10.1007/s00038-015-0675-x

AWWA Disinfection Committee (2021). Emerging trends in disinfection: Lessons from AWWA's Disinfection Survey. *Journal – American Water Works Association, 113*(1), 20–28. https://doi.org/10.1002/awwa.1648

Behnke, N. L., Klug, T., Cronk, R., Shields, K. F., Lee, K., Kelly, E. R., Allgood, G., & Bartram, J. (2017). Resource mobilization for community-managed rural water systems: Evidence from Ghana, Kenya, and Zambia. *Journal of Cleaner Production, 156*, 437–444. https://doi.org/10.1016/j.jclepro.2017.04.016

Bhatta, R., Loc, H. H., Babel, M. S., Chapagain, K. (2024). Assessment and enhancement of community water supply system sustainability: A dual framework approach, *Environmental and Sustainability Indicators, Volume, 24*, 100486. https://doi.org/10.1016/j.indic.2024.100486

Chowns, E. (2015). Is community management an efficient and effective model of public service delivery? Lessons from the Rural Water Supply Sector in Malawi. *Public Administration and Development, 35*(4), 263–276. https://doi.org/10.1002/pad.1737

Cord, C., Javernick-Will, A., Buhungiro, E., Harvey, A., Jordan E., Lockwood, H., & Linden, K. (2022). Pathways to consumer demand and payment for professional rural water infrastructure maintenance across low-income contexts. *Science of The Total Environment, 815*, 152906. https://doi.org/10.1016/j.scitotenv.2021.152906

Daniel, D., Djono, T. P. A., Iswarani, W. P. (2022). Factors related to the functionality of community-based rural water supply and sanitation program in Indonesia. *Geography and Sustainability, 4*(1), 29–38. https://doi.org/10.1016/j.geosus.2022.12.002

Fechter, A. (2019). *Water committee activities and characteristics affecting water system management in Northern Ghana.* https://doi.org/10.17615/zx55-st42

Fisher, M. B., Shields, K. F., Chan, T. U., Christenson, E., Cronk, R. D., Leker, H., Samani, D., Apoya, P., Lutz, A., & Bartram, J. (2015). Understanding handpump sustainability: Determinants of rural water source functionality in the Greater Afram Plains region of Ghana. *Water Resources Research, 51*(10), 8431–8449. https://doi.org/10.1002/2014WR016770

Foster, T. (2013). Predictors of sustainability for community-managed handpumps in Sub-Saharan Africa: Evidence from Liberia, Sierra Leone, and Uganda. *Environmental Science & Technology, 47*(21), 12037–12046. https://doi.org/10.1021/es402086n

Ganesh, S. R., Kumar, S., Ganesh, S., Sonali, S., Sitanshu Sekhar, K., Gautam, R., & Premarajan, K. C. (2013). Assessment of village water and sanitation committee in a district of Tamil Nadu, India. *Indian Journal of Public Health, 57*(1), 43–6. https://doi.org/10.4103/0019-557x.111376

Grau, J., del Rosario Navia, M., Rihm, A., Ducci, J., Martin, D., & Kuratomi, T. (2013, December). *Water and sanitation in Belize*. Technical note no. IDB-TN-609. Inter-American Development Bank. https://publications.iadb.org/publications/english/document/Water-and-Sanitation-in-Belize.pdf

Gwoździej-Mazur, J. & Świętochowski, K. (2018). Analysis of the water meter management of the urban-rural water supply system. Proceedings of 10th Conference on Interdisciplinary Problems in Environmental Protection and Engineering EKO-DOK, 2018, E3S Web of Conferences. 44, 00051. https://doi.org/10.1051/e3sconf/20184400051

Ingram, W., & Memon, F. A. (2020). Rural water collection patterns: Combining smart meter data with user experiences in Tanzania. *Water*, *12*(4), 1164. https://doi.org/10.3390/w12041164

Judiciary of Belize. (2011, December 31). *Belize Village Council Act Chapter 88* Revised Edition. https://www.ruraltransformation.gov.bz/docs/12/Town_Councils_Act_-_Cap_87.pdf

Machado, A. V. M., Oliveira, P. A. D., & Matos, P. G. (2022). Review of community-managed water supply—factors affecting its long-term sustainability. *Water, 14*(14), 2209. https://doi.org/10.3390/w14142209

Madrigal, R., Alpízar, F., & Schlüter, A. (2011). Determinants of performance of community-based drinking water organizations. *World Development, 39*(9), 1663–1675. https://doi.org/10.1016/j.worlddev.2011.02.011

Marks, S. J., & Davis, J. (2012). Does user participation lead to sense of ownership for rural water systems? Evidence from Kenya. *World Development*, *40*(8), 1569–1576. https://doi.org/10.1016/j.worlddev.2012.03.011

Marks, S. J., Komives, K., & Davis, J. (2014). Community participation and water supply sustainability: Evidence from handpump projects in rural Ghana. *Journal of Planning Education and Research*, *34*(3), 276–286. https://doi.org/10.1177/0739456X14527620

Ministry of Rural Transformation, Community Development, Labour and Local Government. (2022). *Belize.* Annual Comprehensive Report on Rudimentary Water Systems.

Ministry of Rural Transformation, Community Development, Labour and Local Government. (2024). *Belize*. Water Board Training Manual.

Moriarty, P., Smits, S., Butterworth, J., & Franceys, R. (2013). Trends in rural water supply: Towards a service delivery approach. Water alternatives, 6(3), 329

Nambi Katu, K. (2025). Water purification technologies: Innovations and challenges. *Research Invention Journal of Engineering and Physical Sciences, 4*(1), 23–29. https://doi.org/10.59298/RIJEP/2025/412329

Nhaurire, A. F., Wells-Brown, T., & Capurchande, R. (2023). Water committees in the implementation of decentralization measures in the water sector in Gaza Province, Mozambique: Ownership and resistance. *AQUA - Water Infrastructure, Ecosystems and Society*, 72(11), 1987–2000. https://doi.org/10.2166/aqua.2023.059

Ogata, R., Thapa, P., Sato, H., Masouleh, F., Souqia, K. (2023). Prepaid water meters and water distribution system improvement: A case study of Jenin city, Palestine. *Utilities Policy, 85*, 2023, 101682. https://doi.org/10.1016/j.jup.2023.101682

Ornaghi, C. & Tonin, M. (2021). The effects of the universal metering programme on water consumption, welfare and equity. *Oxford Economic Papers*, *73*(1), 399–422. https://doi.org/10.1093/oep/gpz068

Platukyte, S. (2016). *Water metering in rural, piped, community-managed water systems in the developing world* [Master's thesis, University of South Florida] USF Tampa Graduate Theses and Dissertations. https://digitalcommons.usf.edu/etd/6130

REAL-Water. (2023). Emerging findings in rural water service management. United States Agency for International Development (USAID) Rural Evidence and Learning for Water Project. https://www.rural-water-supply.net/_ressources/documents/default/1-1180-74-1740333321.pdf

Schweitzer, R. W., & Mihelcic, J. R. (2012). Assessing sustainability of community management of rural water systems in the developing world. *Journal of Water, Sanitation and Hygiene for Development, 2*(1), 20–30. https://doi.org/10.2166/washdev.2012.056

Silva Rodriguez de San Miguel, J. A., Trujillo Flores, M. M., Lámbarry Vilchis, F. L., Rivas Tovar, L. A., & Bernal Pedraza, A. Y. (2015). Community water management in Latin America and the Caribbean: Challenges for Mexico. *Journal of Sustainable Development, 8*(3), 102. https://doi.org/10.5539/jsd.v8n3p102

Singh, J. (2019). Gram Panchayat water supply and sanitation committees in Ropar District of Punjab (India): Rhetoric and realities. *Journal of Emerging Technologies and Innovative Research, 6*(6), 79–84. https://www.jetir.org/papers/JETIR1908949.pdf

Solis, M., & Bashar, S. B. (2022). Social equity implications of advanced water metering infrastructure. *Utilities Policy, 79*,101430. https://doi.org/10.1016/j.jup.2022.101430

Thapa, D., Prevost, C., & Widjanarko, B.Y, H. (2023, February 15). *Enhancing rural water sustainability through frontline provider collaboration: Lessons from Indonesia's PAMSIMAS Project.* World Bank Group. United States of America. Retrieved from https://coilink.org/20.500.12592/fpbvr3

Thapa, D., Christophe, P., Widjanarko, B. Y. H. W. (2021). *Enhancing frontline Provider Collaboration to Improve Rural Water Sustainability: Operational Lessons from Indonesia's Community-Led Water Supply Project—PAMSIMAS*. Washington, DC: World Bank Group. https://documents1.worldbank.org/curated/en/099432502152310834/pdf/IDU0b72badac0bf25049ec0bb7701d596409238b.pdf

Tantoh, Henry. (2021). Water metering in piped community-based water supply systems: the challenge of balancing social and economic benefits. Development in Practice. 31. 1-13. 10.1080/09614524.2021.1937546.

United Nations. (2015). SDG 6: Ensure availability and sustainable management of water and sanitation for all. *United Nations.* Retrieved November 17, 2024, from https://sdgs.un.org/goals/goal

UN WATER. (2021). Progress on Community Participation (SDG target 6.b). *United Nations*. https://sdg6data.org/en/indicator/6.b.1#:~:text=To%20track%20progress%20towards%20the,the%20actual%20level%20of%20participation

van den Broek, M., & Brown, J. (2015). Blueprint for breakdown? Community Based Management of rural groundwater in Uganda. *Geoforum, 67*, 51–63. https://doi.org/10.1016/j.geoforum.2015.10.009

Van Houweling, E., Hall, R., Carzolio, M., & Vance, E. (2017). 'My neighbour drinks clean water, while I continue to suffer': an analysis of the intra-community impacts of a rural water supply project in Mozambique. *The Journal of Development Studies, 53*(8), 1147–1162. https://doi.org/10.1080/00220388.2016.1224852

WaterAid. (2018). *Strengthening the sustainability of multi-village water schemes through professionalizing community management. A case study*. Ethiopia: WaterAid. Retrieved November 16, 2024, from https://coilink.org/20.500.12592/8qcdcd

Whaley, L., & Cleaver, F. (2017). Can 'functionality' save the community management model of rural water supply? *Water Resources and Rural Development, 9*, 56–66. https://doi.org/10.1016/j.wrr.2017.04.001

World Health Organization. (2012). *Water safety planning for small community water supplies. Step-by-step risk management guidance for drinking-water supplies in small communities*. World Health Organization. https://apps.who.int/iris/bitstream/10665/75145/1/9789241548427_eng.pdf

World Health Organization/UNICEF. (2021, September 13). *Progress on household drinking water, sanitation and hygiene 2000-2020: Five years into the SDGs*. Geneva: World Health Organization. https://www.who.int/publications/i/item/9789240030848

World Health Organization/UNICEF/World Bank. (2022). State of the world's drinking water: An urgent call to action to accelerate progress on ensuring safe drinking water for all. Geneva: World Health Organization. https://www.who.int/publications/i/item/9789240060807

World Bank Group. (2017). *Sustainability assessment of rural water service delivery models: Findings of a multi-country review*. Policy Brief. Washington, DC: World Bank. https://doi.org/10.1596/27988