

Evaluating the Effectiveness of Sustainable Water Management Practices in Promoting Community Health in Kavango East Region of Namibia

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Abstract

Poor water management doesn't just lead to water scarcity; it is also driving a health crisis in Namibia. The aim of this study was to generate solid, applicable, evidence-based insights that will inform and enhance the present community water management policy and practice in a way that markedly improves community health. This study adopted a qualitative research approach. Sixteen participants selected using purposive sampling. Four participants answered semi structured questionnaires and twelve were interviewed. Data was analysed using thematic analysis. On the impact of sustainable water management, the study found social, economic and environmental protection as benefits to the community. On support provided by government, the study found effective support in some areas and failure in other areas. Specifically, delays, budget dry up, ineffective engagement of the grassroots community and selective development were found as short comings by government. These barriers were established to be the major causes of ineffective sustainable water management. Health and quality were found to exist in areas where there is clean water, while most rural places that are far away from institutions were found to use unsafe water. Therefore, the study revealed that sustainable water management practices are promoting health in a few areas of the region, with a larger part left out. The exclusion of these areas implies that, Namibia will not be able to achieve Sustainable Development Goal six. The study recommended inclusive engagement of the community and adoption of contextualised interventions to promote sustainable water management. In addition, the study recommended benchmarking to create opportunities to learn from the best. Furthermore, realistic robust strategic planning was indicated as necessary to help leadership in prioritizing sustainable water management projects. Moreover, a stakeholder integrated approach is recommended, to enhance synergetic benefits and taking all on board.

Keywords: Sustainable, Barriers, Effectiveness, Water Management, Drip Irrigation.

Introduction

The provision of water and its effective management is a major global challenge especially in dry and semi-dry nations like Namibia. Despite some progress, access to clean, reliable drinking water remains a big problem for many of Namibia's rural inhabitants (Salom & Khumalo, 2022). Seventeen percent of residents in Namibia live without essential drinking water services (Hegga et al. 2020). This situation demands urgent solutions to water management and provision, especially in rural areas with very constrained resources.

Recent research has shown the multidimensional relationship that exists among the provision of water, the health of rural communities, and the rural economic structure in Namibia. Lewis and Claasen (2018) revealed that inadequate rural water infrastructure and poor management contribute to unacceptably high incidence rates of waterborne diseases. Between 2015 and 2020, 12% of all reported disease cases in Namibia were waterborne (cite source of data). Of these, the leading cause was diarrhea (Salom & Khumalo, 2022). Moreover, Olivier and Xu (2024) reported that the time burden of water collection adversely affects the educational and economic opportunities of women and girls, who are the principal water gatherers in rural Namibia.

Although managing water on a community basis seems to work well, recent research carried out by Olivier and Xu, (2024) indicates that this approach does not often yield sustainable results because it lacks the necessary technical and financial expertise. This disparity between good policy and limited on-the-ground reality provides a formidable obstacle to overcome in the quest for water management that is both sustainable and in line with the "Water for All" vision. These challenges are made worse by climate change. Over the last 30 years, average temperatures in Namibia have increased by 1.2°C (Namibia Meteorological Service, 2023). Unfortunately, projections indicate that the frequency and intensity of severe droughts will continue to rise (Clarke et al, 2022). This has the adverse effects of more frequent and more intense drought, further compounding the water situation in rural Namibia. Climate variability has a direct and pronounced effect on both the quantity and quality of water, requiring an unfathomable number of adaptations to an equally unfathomable number of water management strategies (Ngarava et al. 2019). Climate change is disrupting the water cycle, leading to shifts in rainfall patterns and intensity. This can result in more frequent floods and droughts, affecting water availability and causing water shortages in some regions. Additionally, changes in temperature and precipitation can impact water quality by altering nutrient levels, increasing evaporation rates, and promoting the growth of harmful algae (van Leeuwen, et al, 2024).

Despite the stated challenges above, there is a dearth of literature on the limited water access in Namibia and the resultant health implications. Almost none exist on how well the current sustainable practice of water management works to promote good health in the rural communities of Namibia. And what little has been said (Liehr et al. 2021), focuses on the technological solutions and not on the neglected parts of the social and health challenge. This study attempts to fill this gap by improving current understanding on how to manage water in ways that also might improve health.

Problem Statement

If everything were to work out as hoped, the communities in rural Namibia would have unending access to clean water due to sustainable management practices. These practices would be suitable for the local context, affordable, and resilient against climate change. The

management of water would be integrated with the health of the community, resulting in a significantly improved quality of life for community members through their conservation and protection of water resources.

Unfortunately, the situation in Namibia's rural communities is far from ideal. Even with the support of the Namibian government and international development agencies, water management remains a challenge. According to the Namibia Statistics Agency (2023), 35% of rural households must travel over 30 minutes to collect water, often from unreliable sources. The Namibian Integrated Rural Water Supply and Sanitation Policy of 2008 aims to ensure that at least 80% of rural households have access to potable water within 20 minutes of their homes, unfortunately currently, only 42% of rural communities in Namibia have this access. Meanwhile, a study by Nguvauva et al. (2024) reveals that 60% of community-based water management projects in rural Namibia face sustainability issues within five years of implementation.

This adverse situation has serious and complex repercussions. Poor water management leads not only to water scarcity but also drives a health crisis in Namibia. "Waterborne diseases account for 30% of all outpatient visits in rural health facilities," according to the Namibia Ministry of Health and Social Services (2023: page number). Inadequate and unsafe water fosters various pathogens that can enter people's bodies and cause illness. Coping with the consequences of this polluted water while living in a persistently water-scarce environment imposes what Shikangala and Haimbili (2022) estimate as a 15% toll on the annual income of the average rural Namibian family—expenses and lost productivity that could have been used for other improvements in their lives. The task of collecting water primarily falls to women and girls, who often have to carry heavy containers over long distances through harsh terrain. Even when water is available, it is frequently contaminated.

These multiple, interconnected problems demand a thorough reassessment of current sustainable water management practices and their effects, or lack thereof, on the health of rural Namibian communities. This study seeks to fill that knowledge gap. The aim is to generate solid, applicable, evidence-based insights that will inform and enhance the current community water management policy and practice in a way that markedly improves community health.

Study Objectives

The research focused on the following specific objectives;

- i. To assess the impact of the current sustainable water management practices in rural Kavango, Namibia;
- ii. To evaluate the effectiveness of government support strategies on implementing sustainable water management practices in rural Kavango, Namibia;
- iii. To investigate the impact of sustainable water management practices on quality of water and effects on health in rural Kavango, Namibia; and

- iv. To determine strategies that can be put in place to enhance effective sustainable water management practices in rural Kavango, Namibia

Theoretical Framework (Social-Ecological Systems (SES) framework)

A theoretical framework is indispensable in research as it provides a structured and coherent perspective that guides the investigation of complex phenomena. It establishes the foundation for formulating research questions, designing methodology, and interpreting results. Theoretical frameworks are instrumental in clarifying concepts, proposing relationships among variables, and predicting outcomes. In the realm of environmental and social sciences, the application of a theoretical framework significantly enhances the understanding of interactions between human and ecological systems. One such framework, the Social-Ecological Systems (SES) framework, has proven particularly beneficial. This framework is used in the current study to explore the intricate and dynamic interplay between societal actions and ecological responses, offering insights into sustainable management and conservation strategies.

The origins of the Social-Ecological Systems theory are anchored in the work of Elinor Ostrom and her colleagues, who sought to address the "tragedy of the commons." This scenario involves individual users acting independently according to their self-interest, detrimentally affecting the common good by depleting or spoiling shared resources. Ostrom's seminal work, "Governing the Commons" (1990), challenged prevailing management approaches to shared resources and introduced a complex, nuanced framework for understanding how communities manage common-pool resources (CPRs) sustainably. This framework has evolved through extensive empirical research and has been enriched by insights from disciplines such as ecology, economics, and sociology, demonstrating its interdisciplinary nature and wide applicability (Cox, 2014; Partelow, 2015).

At its core, the SES framework posits that human-environment systems are interconnected and interdependent, comprising a 'resource system' (which provides resource units), 'resource units' (components utilised), 'actors' (users or stakeholders), and 'governance systems' (institutions and rules governing resource use). This framework underscores the importance of comprehending these components and their complex interactions, which are often non-linear, self-organised, and adaptive. Additionally, it highlights the significance of scale, noting that processes and effects can vary substantially across different spatial, temporal, or institutional scales. These principles highlight the capacity of social-ecological systems to maintain ecological functions and services while supporting human communities (Folke et al., 2016; Binder et al., 2016).

Several scholars have critiqued and discussed the SES framework, focusing on its application and theoretical foundations. Colding and Barthel (2019) emphasise the need to integrate more dynamic social processes, such as social learning and cultural adaptation,

into the framework. Critiques, such as those by Epstein et al. (2015), highlight that the SES framework occasionally neglects the power asymmetries and political influences that can significantly affect resource governance outcomes. Moreover, Biggs et al. (2015) point out the challenges of applying the SES framework across varying scales and contexts, noting that its flexibility can sometimes result in inconsistencies in its application and interpretation.

The relevance of the Social-Ecological Systems theory to the current study lies in its ability to furnish a comprehensive understanding of how local communities interact with and influence their natural environments. By employing the SES framework, the study aims to show the mechanisms through which community practices and ecological processes reciprocally influence each other, providing insights into the sustainability of local resource management practices. This approach is especially pertinent for evaluating the impact of community-led conservation initiatives and understanding the resilience of ecological systems amid socio-economic changes (Leslie and McCabe, 2013; Virapongse et al., 2016). Therefore, the SES framework not only frames the empirical inquiries of the study but also enriches its contributions to theory and practice in environmental management and community development.

Conceptual Framework of the Study

The conceptual framework underpinning this study is based on the Integrated Water Resources Management (IWRM) approach, which underscores the interconnectedness of water, land, and related resources in enhancing economic and social well-being without jeopardizing the sustainability of ecosystems (Savenije & Van der Zaag, 2018). Within the Rural Namibian context, this framework is structured around three critical dimensions: water availability and access, water quality management, and community health outcomes. It posits that sustainable water management practices directly influence both the availability and quality of water, which subsequently affect health outcomes within the community.

At its core, the implementation of IWRM hinges on the uninterrupted exchange of information and the fostering of collaborative linkages among all pertinent stakeholders. This iterative process commences with the detection of prevailing issues, followed by the understanding of the synergistic advantages that sustainable water management practices can provide for the well-being of the community and the safeguarding of natural resources. The subsequent phase entails the identification of appropriate tools and the formulation of stakeholder-centric strategies, ensuring that solutions are tailored to local exigencies. The implementation of these strategies is followed by ongoing monitoring, evaluation, and adaptive management to sustain system effectiveness and resilience. This structured, collaborative framework aligns seamlessly with the overarching objective of this study: to achieve sustainable water management and enhance community health outcomes within the rural Namibian environment.

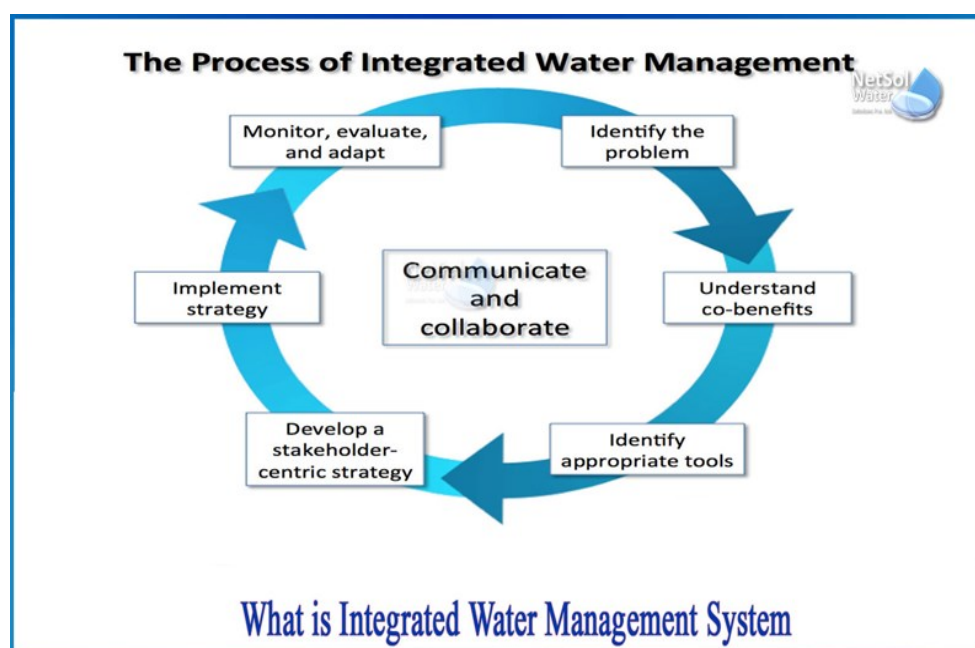


Figure 1: Conceptual framework, Source; field data, 2025

Literature Review

Overview of the Problem

Namibia faces significant challenges in water management due to its arid climate and uneven rainfall distribution, which disrupt ecological balance and hinder socio-economic development, especially in rural areas reliant on agriculture. The scarcity of water resources not only threatens ecological stability but also poses serious risks to food security and economic growth. Recent studies emphasize the urgent need for sustainable water management practices, such as groundwater management, rainwater harvesting, and wastewater recycling, to mitigate the adverse effects of water scarcity on community health and agricultural productivity (Olivieri et al., 2022; Mosimane & Kamwi, 2020).

Moreover, the introduction of governmental initiatives aimed at decentralizing water management is critical for enhancing accessibility and sustainability. These strategies empower local populations by involving them more actively in the stewardship of their water resources, allowing for tailored solutions that meet specific regional needs. However, despite these policy measures, the effectiveness of decentralized water management in rural regions remains a topic of ongoing research, with challenges such as inadequate infrastructure, financial constraints, and socio-demographic factors influencing access to water and sanitation services (Hegga et al., 2020).

Socio-Demographic Determinants of Water Access

The relationship between socio-demographic factors and access to water in rural Namibia reveals critical disparities affecting public health and economic development. Higher

educational attainment correlates with better sanitation and water access, as educated households are more likely to understand the health benefits associated with improved sanitation and potable water (Mosimane & Kamwi, 2020). This connection underscores the necessity for intensified educational initiatives focused on sustainable water use and hygiene practices, particularly in remote areas where traditional educational strategies may not be effective.

Economic status also plays a significant role in determining access to water and sanitation facilities. In rural Namibia, financial stability enables households to invest in essential infrastructure such as plumbing and modern sanitation systems, which are often out of reach for lower-income families. This economic divide manifests in disparities in access to clean water across different socio-economic strata, further exacerbating health inequalities and hindering community development (Hegga et al., 2020). Addressing these socio-demographic determinants is crucial for promoting equitable access to water and sanitation services, ultimately improving public health outcomes.

Groundwater Management Challenges

Groundwater management in rural Namibia is hindered by over-extraction and inadequate management strategies, leading to resource depletion. Studies have shown that extraction rates often exceed natural recharge rates, particularly in regions like the Grootfontein-Tsumeb-Otavi triangle, resulting in significant sustainability concerns (Ihemba & Esterhuyse, 2020). The absence of comprehensive management strategies that account for the complex hydrogeological conditions further complicates the situation. Effective integrated water resource management, which considers both surface and groundwater, is essential for addressing these challenges and ensuring the long-term viability of water resources.

Climate change introduces additional complexities to groundwater management, as altered rainfall patterns and increased evaporation rates affect recharge rates and water availability. These climatic changes, coupled with high demand for agricultural and domestic use, place immense pressure on water supplies in rural areas. Community-based resource management approaches have shown promise in mitigating these challenges by involving local stakeholders in decision-making processes, promoting sustainable water usage, and enhancing resilience to environmental changes (Mapani et al., 2023; Liehr et al., 2018). Ensuring effective governance frameworks that promote conservation and sustainable practices is vital for navigating these multifaceted challenges.

Community-Based Resource Governance

Community-based resource governance is crucial for sustainable development in water-scarce regions, particularly in Namibia. Research indicates that while community management can enhance resource distribution and promote local participation in conservation efforts, it may also exacerbate existing socio-economic disparities if not

implemented equitably (Mapani et al., 2023). Effective resource management often requires certain levels of literacy and economic stability, which are not uniformly present among community members. Consequently, individuals with greater economic advantages may dominate communal resources, leading to increased inequalities.

The governance model based on community resource management typically emphasizes collective decision-making and shared responsibility. However, conflicts can arise when participation or benefits are not evenly distributed among community members, highlighting the need for equitable distribution policies and transparent mechanisms that facilitate community engagement (Vollan et al., 2020). Such inclusive governance structures are essential for mitigating potential conflicts and ensuring the long-term success of resource management initiatives, fostering a sense of ownership and responsibility among community members.

Technological Innovations in Water Management

Recent technological advancements have demonstrated considerable potential in addressing the pressing issue of water scarcity affecting numerous regions worldwide. Innovations such as smart irrigation systems, which utilize sensors and Internet of Things (IoT) technology, have significantly improved water use efficiency in agriculture by providing precise water delivery tailored to the specific needs of crops (Olatunde et al., 2024). Furthermore, the application of AI-driven predictive analytics allows for forecasting water usage and optimizing distribution, which conserves water and reduces operational costs, particularly in areas facing intensified water scarcity due to climate change. The CuveWaters project in Namibia exemplifies how integrating diverse technological solutions can enhance water management in arid regions. This initiative combines rainwater harvesting, groundwater desalination, and water reuse systems to establish a sustainable water supply for both domestic and agricultural purposes. By customizing each technology to meet specific environmental conditions and community needs, CuveWaters has effectively demonstrated a scalable approach to addressing water scarcity (Liehr et al., 2018). This project highlights the importance of community involvement and capacity building, ensuring that local populations are equipped to manage and maintain the technologies implemented.

Governance and Policy on Water Security

Effective governance and policy frameworks are essential for ensuring long-term water security in regions facing scarcity. Comprehensive management plans that integrate sustainable practices across all levels of government are vital for mitigating risks associated with water scarcity. Policies should encompass the entire water cycle from supply and distribution to wastewater treatment and reuse to achieve a holistic approach to water management (Olivieri et al., 2022; Thonicke et al., 2020). This comprehensive planning

aligns water resource management with environmental and public health goals, promoting sustainable development.

Challenges in governance often arise from the complexities of implementing expansive water resource management plans, particularly regarding coordination among various governmental bodies and stakeholders. Policy fragmentation can lead to inefficiencies and conflicts, impeding the achievement of water security objectives. Effective water governance requires robust regulatory frameworks that clearly delineate the roles and responsibilities of all parties involved, fostering cooperation across sectors and regions (Mishra et al., 2021). Adaptive management strategies that incorporate ongoing scientific research and stakeholder feedback are crucial for keeping governance frameworks relevant and effective in addressing emerging challenges.

Key Legislations and Policies on Water Governance in Namibia

Several key legislations, including the Water Resources Management Act and the National Water Policy, provide foundational frameworks for water governance in Namibia. The Water Resources Management Act establishes a comprehensive framework for managing, developing, and conserving water resources, aiming to ensure their sustainable utilization while promoting stakeholder involvement (Mapani et al., 2023). This legislation emphasizes the importance of integrated planning and management, striving to preserve water for future generations while addressing current needs equitably. The National Water Policy serves as a directive for all actions related to water resources in Namibia, promoting principles of sustainability, equity, and efficiency in water utilization. It emphasizes public participation in water management processes, asserting that engaging local stakeholders is essential for the effective execution of water-related projects (Schnegg & Bollig, 2016). Additionally, the Pollution Control and Waste Management Bill addresses pollution and waste management issues that directly impact water quality, establishing standards for waste disposal and treatment, particularly in industrial and agricultural sectors (Klitenberg & Seely, 2018).

Water Quality and Community Health

The connection between water quality and community health is critical, particularly in areas with limited access to clean water. Contaminated water sources can lead to severe health outcomes, including diseases such as cholera and diarrhoea, which disproportionately affect vulnerable populations (Lewis & Claasen, 2018). The presence of pathogens and chemical pollutants in groundwater can significantly deteriorate health outcomes, underscoring the necessity for stringent water quality monitoring and the adoption of effective water purification technologies to safeguard public health. Moreover, prolonged exposure to contaminated water can result in the bioaccumulation of heavy metals and other toxins in the human body, potentially causing long-term health effects such as kidney damage and cancer (Palansooriya et al., 2020). The ecological repercussions of poor water

quality, such as declines in fish populations, further threaten food security and livelihoods, exacerbating socio-economic challenges faced by communities (Ofori et al., 2021). Addressing these issues necessitates a multifaceted strategy that includes enhancing water treatment systems and promoting community awareness and involvement in water management practices.

Study Methodology

This study investigated the relationship between water management and the health of rural communities in Namibia using a qualitative approach within an interpretivist framework. It emphasizes the unique cultural, historical, and environmental contexts of rural Namibians by employing in-depth interviews, focus groups, and observations to gather nuanced perspectives. The research population consisted of 16,800 households in the Kavango East Region, with a purposive sample of 16 respondents, including community and health experts. Data collection primarily relies on semi-structured interviews guided by a comprehensive interview guide, supplemented by questionnaires. Thematic analysis was used for data analysis, ensuring validity and reliability through methodological triangulation and careful preparation. Ethical considerations included informed consent, confidentiality, and voluntary participation, with measures in place to protect participants from harm and ensure data security.

Data Presentation and Analysis

Sustainable water management practices in place

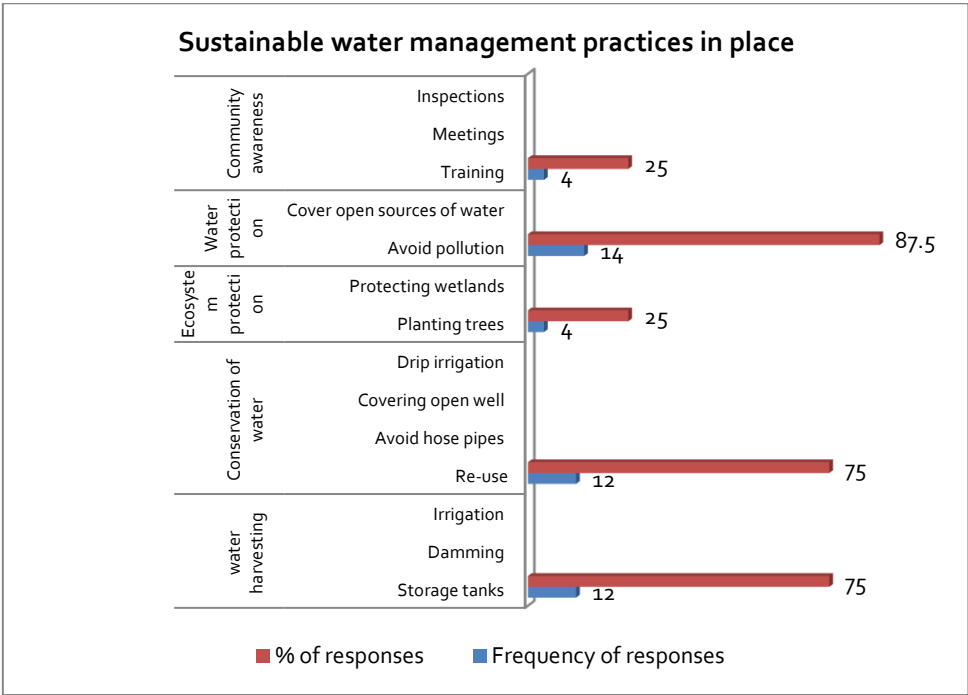


Figure 2: sustainable water management practices in pace, Source: Field data, 2025

In the Kavango East Region, sustainable water management practices include water harvesting, primarily conducted at schools, clinics, and public offices, as CM 4 noted, “These places harvested water because they have facilities.” While some isolated homesteads also participate in this practice, many community members lack the means to do so due to their housing structures. Conservation efforts emphasize reusing and recycling water, with CM 12 stating that “covering well reduced evaporation and water lasted until the next rain.” The community actively engages in tree planting, as OF 1 mentioned, “areas where there are dense forests receive good rainfall,” highlighting the critical role trees play in the water cycle. However, pollution from practices such as laundering in rivers threatens water quality, as expressed by OF 3, who stated, “Community members (men) put roots of a certain plant to kill fish.” This underscores the necessity for education on sustainable practices. Community education and awareness campaigns are essential, as OF 2 noted, to address ignorance and negative attitudes, indicating that changing mindsets is crucial for fostering sustainable water use behaviors.

The impact of the current sustainable water management practices in rural Kavango, Namibia

Table 1: Themes and sub themes on the impact of sustainable water management practices (n=16)

Themes	Sub themes	Frequency of responses	% of responses
Social benefits	• Water shared equal • Improved health • Empowerment of community	16	100
Economic benefits	• Increase in agriculture production • Development in other areas (technology and infrastructure)	10	62.5
Water availability	• Easy access • Conservation of water	14	87.5
Protection of environment	• Protects water sources • Quality of water • Climate change resilience	8	50

Source filed data, 2025

The findings highlight the significant social and economic benefits derived from sustainable water management practices in rural communities. Participants emphasized that access to clean water improves overall well-being, with community members noting, “The

availability of piped water in some communities enhances equitable access to water. This creates equality” (CM 4) and “The obvious benefit of sustainable water management is improved health. The community has access to clean water” (CM 11). Officials from the Ministry of Agriculture, Water and Forestry also noted that these practices foster community empowerment and responsibility, stating, “Taking charge of water sources by the community develops responsibility and empowerment” (OF 1) and “Water is conveniently available and it creates more time to do other commitments, hence enhancing community development” (OF 3). Economically, participants recognized increased agricultural productivity and job creation through technological advancements, as CM 12 remarked, “Both directing running water into fields and drip irrigation has impact on group growth. This ensures high crop productivity.” Overall, these insights reflect the daily realities of the community, confirming that sustainable water management not only enhances health and social interactions but also significantly contributes to economic development and improved livelihoods.

The effectiveness of government support strategies on implementing sustainable water management practices in rural Kavango, Namibia

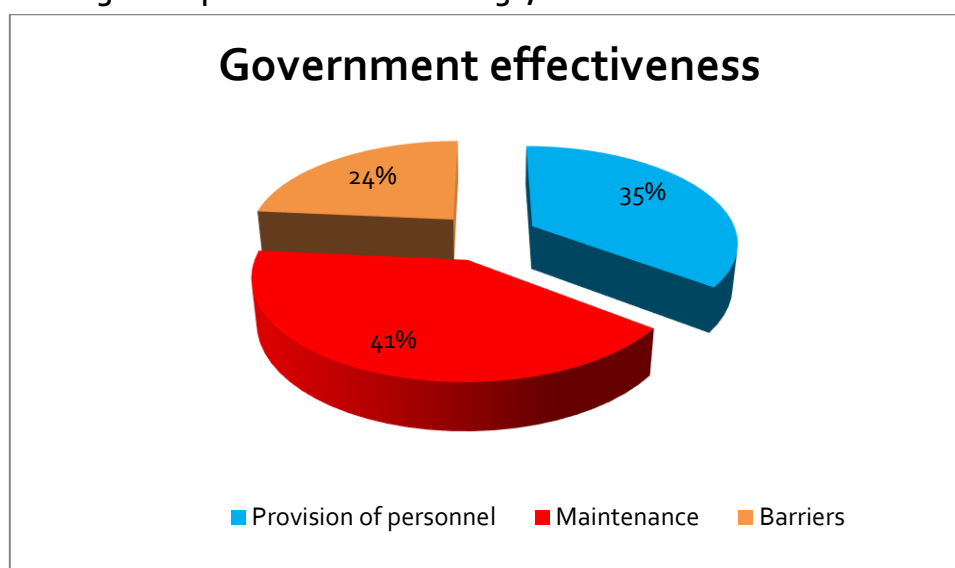


Figure 3: Key themes in Government effectiveness in supporting SWMP

Source, field data, 2025

The pie chart illustrates that government effectiveness is primarily influenced by maintenance (41%), followed by the provision of personnel (35%) and barriers (24%), indicating that effective maintenance is crucial for optimal government performance.

Table 2, shows themes and sub themes that emerged from research question two that required information on the government’s effectiveness in supporting sustainable water management practices.

Table 2: Government effectiveness in supporting sustainable water management practices (n=16)

Theme	Sub themes	Frequency of responses	Percentage of responses
Provision of personnel	• Education and awareness • Demonstrations • New projects	12	75
Maintenance	• Routine • Repairs	14	87.5
Barriers	• Delays • Incomplete projects • Exclusion	10	50

The provision of personnel by the government plays a crucial role in sustainable water management, as community members highlighted the Ministry of Agriculture, Water and Forestry's efforts in conducting outreach programs to educate locals. However, challenges arise when community leaders fail to disseminate this information effectively, leading to ignorance about sustainable practices, as noted by a participant: "Sometimes the community leaders sit on the information, or do not report to the grassroots level" (CM 7). Additionally, despite government support in maintaining water sources, delays in repairs of broken equipment, such as boreholes, pose significant challenges. Community members expressed frustration, stating, "Sometimes it takes more than two months for the responsible team to report for repairs" (CM 6). Furthermore, barriers such as halted projects and poor communication exacerbate the situation, with participants indicating that "meetings on sustainable water management are mostly held at constituency or regional level" (CM 13), resulting in a knowledge gap at the grassroots level. Overall, while the government provides essential support for sustainable water management, these barriers hinder effective implementation and community engagement.

The impact of sustainable water management practices on quality of water and effects on health in rural Kavango, Namibia

The following themes and sub themes were derived from research question three that sought to establish the impact of sustainable water management practices on quality of water and effects on health.

Table 3: The impact of sustainable water management practices on quality of water and effects on health (n=16).

Theme	Sub themes	Frequency of response	% of responses
Positive	- Clean water - Conservation of water	12	75
negative	- Unprotected water - Wastage of water	4	25
TOTAL		16	100

The findings of the study reveal both positive and negative aspects of sustainable water management in the Kavango East Region. On the positive side, community members recognized that sustainable practices enhance water quality and health, with CM 8 stating, "a Protect source of domestic water ensure access to clean water and promotes health." This reflects a commitment to responsible water management, particularly in areas with protected boreholes and tap water. However, the negative aspects highlight significant challenges, as many participants reported a lack of clean water sources. CM 6 noted, "The majority of the people who live along the Kavango River still use water from Kavango... There is no quality," while CM 16 mentioned that families rely on open wells, leading to reported cases of waterborne diseases. Officials from the Ministry of Agriculture, Water and Forestry acknowledged these disparities, indicating that clean water is prioritized for institutions but lacking in many communities. The study underscores a critical gap in sustainable water management, emphasizing that "development and provision of better water services follow institutions," which poses a barrier to achieving Sustainable Development Goal six.

Strategies that can be put in place to enhance effective sustainable water management practices in rural Kavango, in Namibia

This question sought to determine what should be done to ensure an inclusive effective sustainable water management practice in Kavango East Region. The following themes and sub themes emerged from the findings.

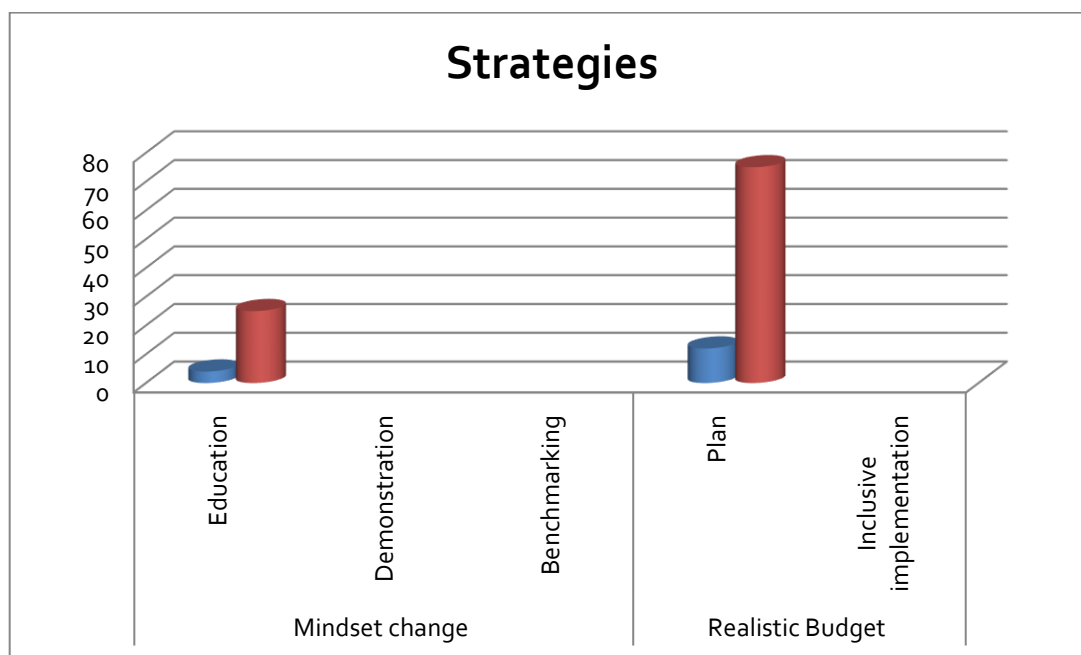


Figure 4: Strategies to be put in place to enhance effective sustainable water management practices

Source, Field data, 2025

The study highlights the need for a mindset change among community members regarding sustainable water management. Officials from the Ministry of Agriculture, Water and Forestry emphasized that “some of the community members are conservative,” particularly the elderly, who view traditional practices, like using water from open sources, as safe. To address this, OF 4 suggested that “practical demonstrations would convince the community members” of the benefits of sustainable practices. Community members echoed this sentiment, with CM 7 proposing benchmarking by taking leaders to successful sustainable water management sites to inspire change. Additionally, the necessity for a realistic budget was underscored, as CM 6 noted, “The tradition of abandoning projects makes the community lose confidence,” highlighting the importance of adequate funding to ensure project completion. Officials acknowledged challenges in securing funds due to competing national priorities, but stressed that empowering communities to take ownership of projects could foster accountability and enhance sustainability. Generally, both mindset change and realistic budgeting are crucial for effective sustainable water management in the region.

Discussion of Findings**The Impact of Current Sustainable Water Management Practices in Rural Kavango, Namibia**

According to the study findings, in the Kavango East Region, sustainable water management practices include water harvesting, primarily at schools and public facilities, which rely on adequate infrastructure for effective collection. While some isolated homesteads also harvest rainwater, many community members face challenges due to their housing structures. Conservation efforts focus on reusing and recycling water, alongside measures like covering open wells to reduce evaporation. The community engages in tree planting to protect ecosystems, as dense forests contribute to rainfall. However, pollution from practices such as laundering in rivers poses significant threats to water quality, highlighting the need for education on sustainable practices. Community awareness campaigns are vital for changing negative attitudes and fostering sustainable water use behaviors.

The findings indicate that sustainable water management practices in rural Kavango yield significant social and economic benefits. Community members reported that access to clean water fosters equality, with one stating, "The availability of piped water in some communities enhances equitable access to water" (CM 4). This aligns with studies highlighting the health benefits of improved water access, such as reduced waterborne diseases (WHO, 2020). Additionally, the economic impact is notable, as increased agricultural productivity through sustainable practices was emphasized, with participants noting that techniques like drip irrigation lead to higher crop yields (CM 12). This reflects broader research indicating that sustainable water management can enhance food security and livelihoods in rural areas (FAO, 2018). Overall, the data suggest that these practices not only improve health outcomes but also significantly contribute to the economic development of the community.

The Effectiveness of Government Support Strategies on Implementing Sustainable Water Management Practices in Rural Kavango, Namibia

The effectiveness of government support strategies is crucial for the successful implementation of sustainable water management practices. Participants noted that the provision of personnel for education and awareness campaigns is vital, with 75% recognizing the government's role in outreach (n=16). However, barriers such as delays in repairs and incomplete projects were highlighted, with one participant stating, "Sometimes it takes more than two months for the responsible team to report for repairs" (CM 6). This resonates with findings from other studies, which indicate that effective communication and timely maintenance are essential for community trust and engagement in water management (Mapani et al., 2023). Furthermore, the lack of grassroots communication exacerbates these challenges, as noted by CM 7, emphasizing the need for improved

dissemination of information. Overall, while government support is acknowledged, addressing these barriers is essential for effective community engagement and sustainable practices.

The Impact of Sustainable Water Management Practices on Quality of Water and Effects on Health in Rural Kavango, Namibia

The findings reveal both positive and negative impacts of sustainable water management on water quality and health in the Kavango East Region. On the positive side, 75% of participants reported access to clean water, which significantly enhances health outcomes, as highlighted by CM 8: "A protected source of domestic water ensures access to clean water and promotes health." This is consistent with global health studies that link clean water access to improved health metrics (UNICEF, 2021). However, negative aspects persist, particularly among those relying on unprotected sources, with CM 6 noting that many still use water from the Kavango River, leading to health risks. This reflects broader challenges faced in rural areas where access to safe drinking water remains inadequate (WHO, 2020). The study underscores the need for targeted interventions to bridge the gap in water quality and health outcomes, particularly for marginalized communities.

Strategies to Enhance Effective Sustainable Water Management Practices in Rural Kavango, Namibia

The study identifies critical strategies necessary for enhancing sustainable water management practices in Kavango. A significant emphasis was placed on the need for a mindset change among community members, with suggestions for education and practical demonstrations (25% of responses). Officials highlighted the conservative attitudes of some community members, particularly the elderly, who are resistant to changing traditional practices. This reflects findings from other studies that emphasize the importance of community engagement and education in fostering acceptance of new practices (Steimanis et al., 2023). Additionally, the necessity for a realistic budget was underscored, with 75% of participants advocating for proper planning and inclusive implementation. CM 6 noted, "The tradition of abandoning projects makes the community lose confidence," indicating that adequate funding is essential for project sustainability. This aligns with research suggesting that community ownership and financial investment are crucial for the success of water management initiatives (Da Silva, 2019). Overall, these strategies highlight the need for a comprehensive approach that combines mindset change and financial planning to promote effective sustainable water management in the region.

Conclusion

The study conclusions were as follows:

- i. The study identified social, economic, and environmental benefits from sustainable water management practices, significantly enhancing community well-being.

- ii. While government support in education, awareness, and maintenance of water management equipment was noted, issues such as project delays, abandonment, and poor grassroots engagement hindered effective implementation.
- iii. Access to clean water was primarily available at institutions like schools and clinics, while communities relying on unprotected sources faced health risks, highlighting disparities in water quality.
- iv. Participants suggested fostering a positive mindset through education, implementing pilot projects to demonstrate benefits, engaging community leadership, and ensuring realistic strategic planning to prevent project abandonment.

Recommendations

Based on the results of the study, the researcher recommends the following:

- a) The Regional authority needs to create short, medium and long term sustainable water management plans to help in prioritizing projects
- b) The regional authority should adopt an integrated approach on sustainable water management at all levels.
- c) When holding meetings and training personnel, the authorities at all levels should include the grassroots community.
- d) Leadership at all level of the region should contextualize all programs to accommodate local culture.
- e) The regional authority should every year facilitate bench marking to expose community to best practices.
- f) All level of the region should seek alternative ways of raising money to support sustainable water management projects.
- g) The regional authority should at least twice a year invite the media, to its sustainable water management projects.
- h) All levels of region should organize sustainable water management competitions to show case best projects and learn from each other.

Recommendations for future research and further practice

- i. It is essential to undertake studies in various regions to evaluate the management of sustainable water projects. This initiative will facilitate knowledge sharing, enhance collaboration, and foster improvements in practices across different areas.
- ii. Policymakers should prioritize equity in development initiatives to ensure that resources and opportunities are distributed fairly. This approach will help prevent disparities and promote inclusive growth.

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