

Towards Sustainable Water Management: Insights from Camp Lapu-Lapu, Cebu City, Philippines

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Abstract

Aim/Purpose: This study examined water management practices and utilization in a military establishment, with a specific focus on Camp Lapu-Lapu in Cebu City, Philippines. The study aimed to identify existing water management systems, examine factors influencing water-saving behaviors, assess gaps in current practices, explore strategies for improving sustainability, and propose an enhanced water management framework applicable to military and similar institutional settings.

Introduction: Water sustainability has emerged as a critical concern globally, particularly in urban and institutional environments where consumption is high and resource availability is increasingly constrained. Military establishments represent a unique context for water governance due to their hierarchical structure, operational demands, and dependence on a continuous and reliable water supply for both domestic and strategic functions. In the Philippine context, military camps often operate within water-stressed urban areas, heightening the importance of efficient demand management, infrastructure resilience, and institutional accountability. While previous studies have examined household water consumption and governance frameworks, limited empirical research has focused on water management systems within military establishments. This study addressed this gap by providing an integrated analysis of human behavior, institutional governance, and sustainability outcomes shaping water management in Camp Lapu-Lapu.

Methodology: A mixed-methods research design was employed to capture both behavioral and institutional dimensions of water management. Both the quantitative and qualitative instruments were subjected to content validation by a subject-matter expert in water management and a psychometrician to ensure the clarity, relevance, and appropriateness of the items. The quantitative component involved a survey of 75 household respondents residing within Camp Lapu-Lapu. The instrument measured the extent of water demand management practices, motivations for conservation, and factors influencing the non-practice of water-saving behaviors. Descriptive statistics such as frequency distributions, percentages, weighted means, and standard deviations were used to summarize patterns of practice and engagement. The qualitative component engaged 10 key informants directly involved in water operations, monitoring, infrastructure management, and policy enforcement within the camp. Data were collected through semi-structured interviews, supplemented by observations and document analysis.

Findings: Quantitative findings revealed that respondents practiced basic water conservation behaviors most of the time. The most consistently observed practices were hygiene-related and habitual actions such as turning off taps while brushing teeth, washing hands responsibly, fixing minor leaks, and reporting water losses to management. These behaviors were primarily motivated by hygiene needs, physical necessities, and personal responsibility. In contrast, practices requiring

greater effort, infrastructure, or technical support, such as rainwater harvesting, greywater reuse, and participation in conservation seminars, were less frequently observed, indicating limitations in institutional facilitation and resource availability.

Qualitative findings revealed four major institutional dimensions shaping water management in Camp Lapu-Lapu, summarized under the themes of policy-driven conservation measures, resource diversification and efficiency, infrastructure and technology adaptation, and stakeholder engagement and accountability. Policy directives, including utility reduction targets and energy conservation regulations, provided a formal foundation for conservation efforts. However, gaps were identified in monitoring and enforcement mechanisms, resulting in inconsistent compliance over time. Infrastructure limitations such as aging pipelines, recurring leaks, and insufficient storage capacity further constrain efficient water use. Participants also highlighted challenges related to stakeholder engagement, including limited consultation, uneven awareness initiatives, and perceptions of water as a free resource, which contributed to overconsumption.

Integration of quantitative and qualitative findings indicated that while individual-level behaviors supported conservation, long-term water sustainability in military establishments depends on institutional-level improvements. These include strengthened monitoring systems, consistent policy enforcement, infrastructure optimization, resource diversification strategies, and collaborative governance arrangements.

Contribution/Impact on Society: This study contributes to the growing body of knowledge on water sustainability by extending empirical inquiry into military and institutional contexts, which remain underrepresented in water governance research. By integrating behavioral insights with institutional analysis, the study demonstrates that effective water management requires alignment between individual practices, organizational policies, and infrastructural capacity. The findings underscore the importance of accountability, leadership enforcement, and participatory governance in sustaining conservation efforts. The proposed water management framework offers a replicable model that can inform policy development and operational planning in other military camps and similar institutional environments.

Recommendations: The study recommends strengthening monitoring and enforcement mechanisms by establishing clear performance indicators, conducting regular inspections, and consistently applying sanctions. Investment in infrastructure upgrades, including leak detection systems, water-efficient fixtures, and storage facilities, is essential to enhance supply resilience. Capacity-building initiatives and awareness programs should be expanded to reinforce conservation norms and discipline. Additionally, collaboration with external agencies and utilities is recommended to support resource diversification and technical innovation.

Research Limitation: The study was limited to a single military establishment, which may affect the generalizability of findings to other contexts. The quantitative data relied on self-reported practices, and the cross-sectional design limited assessment of long-term behavioral change. Infrastructure conditions were assessed through existing records and observations rather than experimental interventions.

Future Research: Future studies may conduct comparative analyses across multiple military camps or institutional settings, employ longitudinal designs to examine sustained behavioral change, or evaluate the effectiveness of specific interventions. Further research may also explore relationships between organizational culture, leadership practices, and compliance with sustainability initiatives.

Keywords: *Water conservation practices, water management, water sustainability*

Introduction

Water is fundamental to human survival, public health, economic productivity, and environmental sustainability. It is essential not only for hydration and physiological regulation, but also for food production, industrial activities, sanitation, and ecosystem integrity (Young et al., 2021). The World Health Organization estimates that a substantial proportion of the global disease burden could be prevented through improved access to safe and clean water, underscoring the strong link between water security and human well-being (Prüss-Üstün et al., 2008). Despite its central role in sustaining life and development, access to adequate freshwater resources has become increasingly constrained worldwide due to population growth, urbanization, climate change, and inefficient water management systems (Dalezios et al., 2018; Garrick et al., 2017).

Globally, freshwater constitutes only a small fraction of the Earth's total water resources, with approximately 2.5 percent available as freshwater, and an even smaller proportion readily accessible for human use (Qdais, 2003). This physical limitation has been exacerbated by rising demand and uneven distribution, resulting in water stress in many urban and institutional settings. In developing countries, rapid urbanization often outpaces infrastructure development and governance capacity, intensifying pressures on already limited water supplies (Liyanage & Yamada, 2017).

In the Philippines, water scarcity has emerged as a significant national concern despite the country's tropical climate and relatively high annual rainfall. Urban centers such as Cebu City experience water stress driven by rapid economic growth, spatial variability in water availability, and increasing competition among domestic, commercial, and institutional users (The World Bank Group, 2003). Central Visayas, where Cebu City is located, lacks major river basins capable of retaining surface water runoff and relies heavily on groundwater sources, making the region particularly vulnerable to water shortages and quality degradation (Rubio et al., 2008; Tabios III, 2020). These conditions have heightened the urgency of adopting more sustainable and demand-responsive water management strategies across all major sectors.

Military establishments represent a critical yet underexamined institutional context in water sustainability research. As secured, self-contained communities, military camps combine residential, administrative, medical, and operational functions, resulting in complex water-use patterns that extend beyond typical household consumption (Makropoulos et al., 2019). In the Philippines, the Armed Forces of the Philippines (AFP) has been recognized in national security frameworks as a key actor in promoting sustainable development, where environmental sustainability is increasingly viewed as an integral dimension of national security (National Security Policy, 2017). However, despite their strategic importance and substantial water requirements, military establishments have received limited empirical attention in studies of institutional water sustainability.

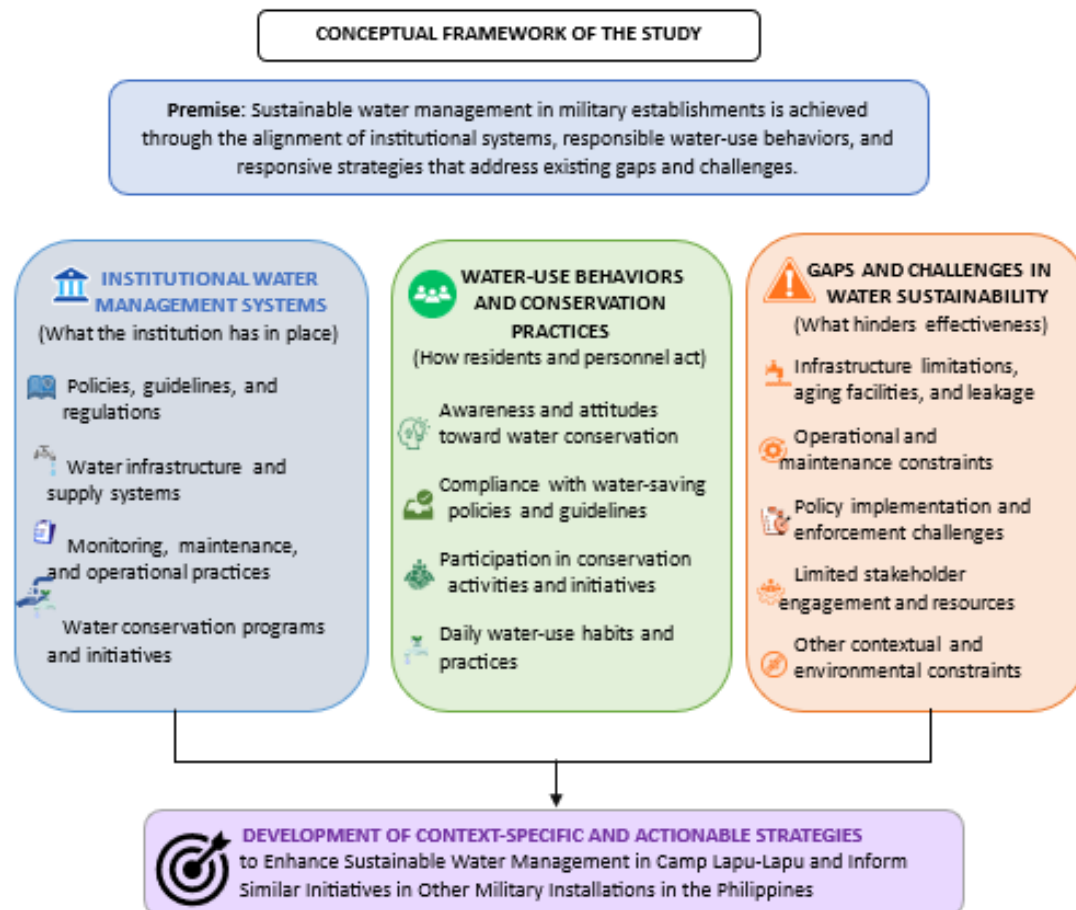
Camp Lapu-Lapu in Cebu City, the headquarters of the Visayas Command of the AFP, illustrates the intersection of urban water stress and institutional vulnerability. The camp depends largely on municipal water utilities that also serve surrounding civilian populations, including residential communities and commercial establishments, thereby intensifying competition for limited water resources (Rubio, 2021). The absence of dedicated alternative water sources and the limited adoption of advanced monitoring and conservation technologies have further constrained the camp's capacity to ensure a reliable and sustainable water supply. These conditions expose both military operations and residential life within the camp to the broader challenges of Cebu's urban water crisis.

Objectives of the Study

This study aimed to examine water sustainability in military establishments by analyzing water management practices and water-use behaviors in Camp Lapu-Lapu, Cebu City, Philippines. Specifically, it sought to assess the existing institutional water management systems in the camp, identify factors influencing residents' engagement in water-saving practices, and determine gaps that hinder effective water conservation. Based on the findings, it aimed to develop practical, context-specific strategies to improve sustainable water management in Camp Lapu-Lapu and to provide

insights applicable to other military installations in the Philippines. These objectives served as the foundation of the study's conceptual framework as presented in Figure 1.

Figure 1 *The Conceptual Framework of the Study*



Review of Related Literature

Water Sustainability and Demand Management

Water sustainability refers to the responsible use and management of water resources to ensure long-term availability while balancing social, economic, and environmental needs. Globally, increasing population growth, urbanization, and climate variability have intensified pressure on finite freshwater resources, making demand-side management a critical strategy for addressing water scarcity (Abansi et al., 2018; Qdais, 2003). Water demand management emphasizes efficiency, conservation, and behavioral change rather than sole reliance on supply expansion, recognizing that unsustainable consumption patterns often exacerbate scarcity even in water-abundant regions (Arfanuzzaman & Rahman, 2017).

In the Philippine context, water sustainability challenges persist despite the presence of multiple water-related policies and institutions. Fragmented governance, infrastructure limitations, and weak enforcement mechanisms have constrained effective implementation, particularly in urban areas such as Cebu City (Tabios III, 2020; The World Bank Group, 2003). These conditions underscore the need to examine how institutional settings manage water resources and how demand-side strategies can be strengthened to improve sustainability outcomes.

Factors Influencing Water Use and Behavior

Water use behavior is shaped by the interaction of economic conditions, personal attitudes, and institutional contexts. While income, household size, and pricing influence consumption in civilian

settings (Howe, 2005), these factors are less salient in institutional environments where water is subsidized or perceived as freely available. Behavioral studies emphasize that attitudes, habits, and personal norms strongly influence conservation, often more than formal enforcement mechanisms (Russell & Fielding, 2010). In military settings, these behavioral drivers intersect with discipline, command influence, and peer norms, which can promote compliance but may also weaken individual accountability, particularly where water use is communal or unmetered (Hanna-Somers et al., 1997).

Gaps in Water Management Systems

Water management challenges in the Philippines stem largely from governance fragmentation, infrastructure deficits, and limited coordination rather than physical scarcity alone. Overlapping mandates among water agencies continue to hinder integrated planning and effective regulation (The World Bank, 2024). In urban areas such as Cebu, heavy dependence on groundwater has resulted in declining water quality, saltwater intrusion, and service interruptions (Fajardo, 2019). These systemic weaknesses affect military installations that rely on civilian utilities and operate under institutional constraints such as budget limitations and operational priorities, reinforcing reactive approaches to water management.

Water Management in Institutional and Military Settings

Institutional water use differs from household consumption due to scale, operational requirements, and governance structures. Military establishments, in particular, function as self-contained communities that integrate residential, administrative, medical, and operational activities, resulting in complex and continuous water demand (James, 2017). Studies have shown that military installations are often significant water consumers, yet they remain underrepresented in water sustainability research and policy discourse (Makropoulos et al., 2019).

International experiences suggest that military camps can serve as models for sustainable water management when supported by integrated governance, monitoring systems, and conservation technologies. However, such initiatives are often resource-intensive and difficult to replicate in developing-country contexts (Koch & Kodack, 2012). In the Philippines, AFP camps remain largely dependent on civilian water utilities and aging infrastructure, limiting their capacity to adopt advanced conservation and monitoring technologies. This dependence exposes military installations to the same supply interruptions and inefficiencies faced by surrounding urban communities, highlighting the vulnerability of institutional water systems in water-stressed environments.

Behavioral Dimensions of Water Use: Theory of Planned Behavior

Understanding water sustainability requires attention not only to infrastructure and policy but also to human behavior. The Theory of Planned Behavior (TPB) posits that individuals' actions are shaped by attitudes toward the behavior, perceived social norms, and perceived behavioral control (Ajzen, 2005). TPB has been widely applied in environmental and resource management studies to explain pro-environmental behaviors, including water conservation (Bamberg & Möser, 2007).

Within institutional contexts such as the military, behavior is influenced by hierarchical structures, organizational norms, and perceived authority. Studies have shown that when conservation practices are reinforced through institutional norms and leadership support, individuals are more likely to engage in sustainable behaviors (Yuriev et al., 2018). TPB thus provides a useful framework for examining how attitudes, norms, and perceived constraints shape water-use behaviors among residents and personnel in military establishments.

Institutional and Socio-Ecological Perspectives on Water Sustainability

Beyond individual behavior, water sustainability is shaped by institutional arrangements and broader socio-ecological interactions. Institutional Theory explains how formal rules, norms, and cultural-cognitive structures influence organizational behavior and decision-making (Scott, 2014). In

highly structured organizations such as the military, compliance with institutional rules and perceived legitimacy often play a decisive role in shaping resource management practices.

Complementing this perspective, the Socio-Ecological Systems (SES) framework emphasizes the interconnectedness of social institutions, governance systems, and ecological resources (Ostrom, 2009). Applied to water management, the SES framework highlights the importance of adaptive governance, stakeholder participation, and feedback mechanisms in sustaining shared resources. For military establishments embedded within urban ecosystems, this framework underscores the need to align institutional practices with local environmental conditions and broader governance systems to achieve long-term sustainability.

Synthesis and Research Gap

The literature indicates that effective water sustainability depends on the interaction of demand management strategies, institutional governance, and human behavior. While global and national studies have advanced understanding of water demand management and conservation behaviors, limited empirical research has examined how these dynamics operate within military establishments, particularly in developing-country contexts such as the Philippines. Existing gaps remain in understanding how institutional structures, behavioral factors, and environmental constraints intersect to shape water management practices in AFP camps. Addressing these gaps provides a critical foundation for developing context-specific strategies to enhance water sustainability in military settings.

Methodology

In this study, a mixed-methods research design was adopted to examine water management practices and water-use behaviors in Camp Lapu-Lapu, Cebu City, Philippines. For the quantitative component, a descriptive survey design was employed. The target population consisted of 300 households residing within Camp Lapu-Lapu. Using Slovin's formula (as cited in Tejada & Punzalan, 2012) with a 10% margin of error, a sample of 75 respondents was determined. Respondents were selected through systematic sampling based on household listings provided by camp administrators.

A structured questionnaire was used to measure water management practices, water-use behaviors, and perceived challenges related to water sustainability. Before administration, the survey instrument underwent content validation by a subject matter expert in water management to ensure relevance, clarity, and alignment with the study objectives. The instrument was also reviewed by a psychometrician to assess item construction, scale appropriateness, and construct alignment. Reliability was further supported through standardized administration procedures and consistency in response patterns.

The study's quantitative component primarily utilized descriptive statistics, including frequency counts, percentages, weighted means, and standard deviations, to summarize respondents' water-use behaviors, perceptions, and reported management practices. Consequently, interpretations regarding the influence or effect of a specific factor on water sustainability should be understood as exploratory rather than explanatory.

For the qualitative component, a case study research design was employed, focusing on Camp Lapu-Lapu as a bounded institutional setting where water sustainability practices could be examined in depth. Purposive sampling was used to select 10 key informants who were directly involved in water management, infrastructure maintenance, and policy implementation within the camp. Data were gathered through in-depth interviews, supplemented by non-participant observation and document analysis to contextualize institutional practices and operational processes. Qualitative data were analyzed using Braun and Clarke's (2022) six-phase thematic analysis framework, which involved data familiarization, initial coding, theme generation, theme review, theme definition, and reporting. This systematic process enabled the identification of recurring themes related to infrastructure limitations, governance mechanisms, behavioral influences, and opportunities for enhancing water sustainability.

Ethical considerations were carefully observed throughout the conduct of the study, particularly given the military context of the research site. Before data collection, permission to conduct the study was obtained from the appropriate camp authorities and institutional administrators. Participants were informed about the purpose of the study, the voluntary nature of their participation, and their right to withdraw at any point without penalty. Informed consent was secured from all participants before the administration of surveys and interviews. To ensure confidentiality and data protection, respondents were not required to disclose personal identifying information. For the qualitative participants, pseudonyms were assigned to protect their identities. Interview transcripts, survey responses, and related research records were securely stored and accessed only by the researchers.

Findings/Results

The findings of this study are presented according to the four research questions. Results integrate quantitative survey data from 75 respondents and qualitative evidence from 10 interviews, observations, and document analysis to provide a comprehensive account of water management practices and water-use behaviors in Camp Lapu-Lapu, Cebu City.

Water Management Practices Implemented in Camp Lapu-Lapu to Promote Water Sustainability

Survey results indicated that respondents practiced water-saving behaviors most of the time. The most consistently practiced behaviors were simple hygiene-related actions, such as turning off taps while brushing teeth and washing hands responsibly. Other commonly reported practices included leak reporting, mindful garden watering, and avoiding unnecessary water use. However, practices that required additional effort or infrastructure, such as rainwater harvesting, greywater reuse, and participation in conservation seminars, were reported less frequently. These patterns suggested that water-saving practices were more prevalent when they were habitual, low-cost, and easily integrated into daily routines.

Qualitative findings identified four major institutional dimensions of the camp's water management system, collectively summarized as PRIS: (a) Policy-driven conservation, which included formal directives, compliance protocols, and troop information and education activities; (b) Resource diversification and efficiency, such as limited rainwater harvesting, wastewater reuse for non-potable purposes, and reliance on the Metropolitan Cebu Water District as an alternative supply; (c) Infrastructure and technology adaptation, including leak management, fixture upgrades, and the use of pump-and-tank systems to stabilize water supply; and (d) Stakeholder engagement and accountability, which emphasized inter-unit coordination, external partnerships, and a shared responsibility for conservation among personnel. These dimensions were aligned with institutional and governance-oriented approaches to water sustainability, which emphasize the interaction of formal rules, operational systems, and shared responsibility in managing common resources (Ostrom, 2009; Scott, 2014). Overall, the findings indicate that water management in Camp Lapu-Lapu was guided by formal policies and operational measures, but it remained constrained by infrastructure and resource limitations.

Perceived Factors Influencing Residents' Engagement in Water-Saving Practices in Camp Lapu-Lapu

Quantitative results showed that respondents identified several motivations associated with their engagement in water-saving practices. Hygiene emerged as the strongest motivating factor, followed by physical needs such as cooking and drinking, and a personal stance toward water conservation. These findings were consistent with prior studies indicating that basic needs and personal attitudes strongly shape household and institutional water-use behavior (Ajzen, 2005; Dolnicar et al., 2012). Other motivating factors included morale and welfare considerations, command guidance, mission accomplishment, beautification of surroundings, and budget concerns.

Qualitative analysis revealed three dominant themes influencing water-saving behaviors. First, policy and leadership influence highlighted the importance of clear directives, visible leadership support, and enforcement mechanisms in shaping compliance. The prominence of leadership

directives and enforcement mechanisms supports Institutional Theory, which explains how formal authority and organizational norms shape individual behavior within structured settings such as the military (Scott, 2014). Second, a sense of duty and discipline reflected military culture, wherein personnel viewed water conservation as an inherent responsibility and professional obligation. This emphasis on duty and discipline reflects the role of normative pressure highlighted in the theory of planned behavior, where perceived social expectations influence behavioral compliance (Ajzen, 2005). Third, knowledge and awareness emphasized the role of troop information and education sessions, visual reminders, and feedback mechanisms in reinforcing conservation practices. These findings suggested that both behavioral motivations and institutional culture play critical roles in shaping water-use behaviors within the camp.

Gaps in the Current Water Management Systems in Camp Lapu-Lapu

Survey findings revealed perceived demotivating factors that hindered consistent water-saving practices. Hygiene and physical needs, which are commonly viewed as essential drivers of water use, emerged as the leading demotivators when respondents failed to practice Water Demand Management. Similar tensions between necessity and conservation have been documented in institutional water-use studies, particularly in settings where water is perceived as readily available (Qdais, 2003). Other reported barriers were mission-related pressures, limited availability of water-saving facilities, budget constraints, time limitations, and the perception that water within the camp was free and abundant.

Interviews with key informants identified five major systemic gaps. First, weak monitoring and enforcement were evident in the absence of structured metrics, irregular assessments, and inconsistent application of sanctions. Second, infrastructure limitations included aging pipelines, recurring leaks, and insufficient investment in storage and conservation technologies. Third, gaps in stakeholder engagement were reflected in limited consultation and a lack of sustained training and awareness programs. Fourth, overconsumption and abuse of free water were linked to the absence of pricing or accountability mechanisms. Finally, inconsistent policy implementation showed that initial compliance often declined over time due to weak follow-through and monitoring. The findings further align with institutional and socio-ecological perspectives, which emphasize that sustainability efforts falter when governance systems fail to adapt and enforce collective rules consistently (Ostrom, 2009).

Proposed Actionable Strategies to Improve Water Management Systems in Camp Lapu-Lapu

Findings revealed a set of actionable strategies, derived from participants' accounts, that address behavioral, institutional, and infrastructural challenges in water management. Six major themes emerged as responses to the identified gaps: (a) behavioral and cultural shifts, (b) strategic leadership, (c) collaborative governance, (d) policy enforcement and monitoring, (e) education and awareness, and (f) infrastructure and technology optimization. Together, these themes reflected a multi-level approach to strengthening water sustainability in Camp Lapu-Lapu, consistent with integrated water management frameworks (Ostrom, 2009; United Nations, 2022).

First, behavioral and cultural shifts emphasized the importance of personal accountability and collective mindset change in sustaining water conservation practices. Participants noted that conservation was more likely to be practiced consistently when personnel internalized responsibility for water use and reframed conservation as part of military discipline and operational duty rather than as externally imposed rules. These findings aligned with the theory of planned behavior, which posits that attitudes, norms, and perceived responsibility influence conservation behavior (Ajzen, 2005). Second, strategic leadership emerged as a critical driver of sustainability, with participants highlighting the need for clear role assignment, continuous oversight, leadership modeling, and regular review of water-related policies to ensure relevance and effectiveness under changing conditions.

Third, collaborative governance was identified as essential for improving water management systems, particularly through coordination with external agencies such as water utilities, local

government units, and regulatory bodies, as well as through interunit cooperation within the camp. These collaborative arrangements enabled timely responses to water-related concerns, strengthened accountability, and aligned institutional practices with broader water governance systems. Fourth, policy enforcement and monitoring focused on the consistent application of rules through designated monitoring personnel and the implementation of penalties for noncompliance. Participants emphasized that continuous monitoring and clear consequences were necessary to prevent water loss, deter wasteful behavior, and reinforce discipline.

Fifth, education and awareness strategies highlighted the role of troop information and education sessions, along with visual and informal reminders, in embedding conservation values into daily military routines. These strategies reinforced understanding of water conservation policies and normalized conservation behaviors through repeated cues and structured learning. Education and awareness strategies were consistent with evidence showing that sustained information and cues reinforce conservation behavior (Dolnicar et al., 2012). Finally, infrastructure and technology optimization addressed structural barriers to sustainability by emphasizing water-efficient equipment, low-cost innovations, rainwater catchment systems, and water reuse practices. Participants viewed these measures as practical, adaptable solutions that reduce dependence on primary water sources while improving system efficiency under resource constraints.

Collectively, the six themes demonstrated that improving water management systems in Camp Lapu-Lapu requires an integrated approach that aligns behavioral change, leadership practices, collaborative governance, enforcement mechanisms, education, and infrastructure development. These actionable strategies directly respond to the identified gaps in monitoring, policy consistency, infrastructure, and cultural orientation, providing an empirical foundation for strengthening water sustainability in AFP camps.

Discussion and Implications

The findings of this study described institutional arrangements, behavioral motivations, and infrastructural constraints observed in relation to water sustainability practices in Camp Lapu-Lapu. This multidimensional pattern is consistent with prior research emphasizing that sustainable water management cannot be achieved through technical solutions alone, but it also requires coordinated attention to governance systems and human behavior (Arfanuzzaman & Rahman, 2017; Qdais, 2003).

The predominance of habitual and low-effort water-saving practices among residents corroborates earlier studies indicating that conservation behaviors are more likely to be adopted when they align with routine activities and require minimal behavioral disruption (Bamberg & Möser, 2007; Kollmuss & Agyeman, 2002). From the perspective of the Theory of Planned Behavior, these findings suggest that favorable attitudes toward water conservation and perceived behavioral control, such as the ease of turning off taps or reporting leaks, played a significant role in shaping residents' actions (Ajzen, 2005). However, the limited adoption of practices that require infrastructure investment, such as rainwater harvesting and greywater reuse, reflected constraints on perceived behavioral control, where individuals lack the means or authority to act despite positive attitudes toward conservation.

The findings indicated the prominent role of leadership, command guidance, and institutional discipline on water-saving behaviors, further supporting the relevance of Institutional Theory in explaining the findings. Institutional Theory posits that behavior within organizations is shaped by formal rules, norms, and shared meanings that define acceptable conduct (Scott, 2014). In Camp Lapu-Lapu, water conservation behaviors were reinforced through military norms of discipline, duty, and compliance, suggesting that institutional legitimacy and hierarchical authority served as powerful mechanisms for regulating behavior. This finding corroborates prior research showing that environmental initiatives in highly structured organizations are more effective when embedded within existing governance and command structures (Makropoulos et al., 2019).

At the same time, the identified gaps in monitoring, enforcement, and infrastructure revealed limitations in institutional capacity that undermine sustained water sustainability. Weak enforcement

and inconsistent policy implementation echo findings from water governance studies in developing contexts, where institutional fragmentation and resource constraints often hinder effective implementation despite the presence of formal policies (Tabios III, 2020; The World Bank Group, 2003). The perception of water as a free and abundant resource within the camp further aligned with earlier research indicating that the absence of pricing or accountability mechanisms can lead to overconsumption and reduced motivation to conserve (Qdais, 2003).

The Socio-Ecological Systems (SES) framework provides additional explanatory power by situating Camp Lapu-Lapu within a broader urban and environmental context. The camp's reliance on municipal water utilities and aging infrastructure illustrates the interconnectedness of social institutions and ecological resources emphasized by Ostrom (2009). The findings suggest that water sustainability in military establishments cannot be addressed in isolation but must be aligned with local water governance systems, environmental constraints, and external stakeholders. This interdependence explains why institutional efforts within the camp were constrained by broader urban water stress in Cebu City.

Implications for Policy and Practice

The findings imply that military establishments can leverage organizational culture and leadership structures to promote water sustainability, but such efforts must be supported by robust monitoring systems and adequate infrastructure. Integrating water conservation into command responsibility, performance evaluation, and routine inspections may strengthen compliance and sustain behavior over time. Additionally, investments in leak detection, water-efficient fixtures, and decentralized water reuse systems are necessary to translate conservation intent into measurable outcomes. Strengthening partnerships with local water utilities and regulatory agencies may also enhance institutional resilience within water-stressed urban environments.

Implications for Research and Theory

From a theoretical perspective, this study reinforces the complementary value of combining the Theory of Planned Behavior, Institutional Theory, and the Socio-Ecological Systems framework in examining institutional water sustainability. While TPB explains individual-level motivations and constraints, Institutional Theory accounts for organizational norms and enforcement mechanisms, and the SES framework situates these dynamics within broader environmental and governance contexts. Empirically, the study contributes to the limited body of research on water sustainability in military establishments, particularly in developing-country settings, and demonstrates the utility of mixed-methods approaches in capturing both behavioral patterns and institutional dynamics.

Overall, the findings suggest that enhancing water sustainability in military establishments requires an integrated approach that aligns behavioral incentives, institutional governance, and ecological realities. Such alignment not only strengthens water security within military camps, but it also supports broader societal efforts toward sustainable resource management.

Conclusion

This study examined water sustainability in a military establishment by analyzing water management practices and water-use behaviors in Camp Lapu-Lapu, Cebu City, Philippines. The findings demonstrate that water sustainability in military contexts is shaped by the interaction of institutional governance, organizational culture, individual behavior, and infrastructural capacity. While the camp has established foundational policies and operational measures to promote water conservation, their effectiveness remains constrained by inconsistent enforcement, infrastructure limitations, and external dependence on municipal water systems in a water-stressed urban environment.

The study highlights that water-saving behaviors were more consistently practiced when they were habitual, low-cost, and reinforced through leadership and institutional norms. In contrast, practices requiring infrastructure investment or systemic change were less frequently adopted,

underscoring the need for organizational support and resource allocation to enable sustained conservation. These findings emphasize that behavioral commitment alone is insufficient to achieve long-term water sustainability without corresponding institutional capacity and governance mechanisms.

Several limitations should be acknowledged. The study focused on a single military establishment, which may limit the generalizability of the findings to other camps with different operational contexts or resource conditions. The quantitative component relied on self-reported data, which may be subject to response bias. In addition, the cross-sectional design captured practices and perceptions at a specific point in time and did not account for seasonal variations in water availability or consumption.

Future research may extend this work by conducting comparative studies across multiple military installations to examine variations in water management practices and institutional capacity. Longitudinal designs could also provide deeper insight into the sustainability of conservation initiatives over time. Further investigation into the cost-effectiveness of infrastructure upgrades and the role of incentive mechanisms may also strengthen evidence-based policy development for water sustainability in military and other institutional settings.

Overall, this study contributes to the growing body of literature on institutional water sustainability by demonstrating the importance of aligning human behavior, organizational culture, governance structures, and infrastructure development. Strengthening this alignment can enhance water security in military establishments and support broader societal efforts toward sustainable water management.

Limitations of the Study

This study has several limitations that should be considered in interpreting the findings. First, the quantitative component primarily utilized descriptive statistics to summarize respondents' perceptions, practices, and experiences related to water sustainability at Camp Lapu-Lapu. While this approach was appropriate for exploring existing conditions and perceived factors associated with water-saving practices, it does not establish causal or predictive relationships among variables. Consequently, interpretations regarding the relationships among institutional practices, behavioral motivations, and water sustainability outcomes should be understood as exploratory rather than explanatory.

Second, the study was conducted within a single military establishment, which possesses unique institutional, operational, and environmental characteristics. Camp Lapu-Lapu consists of diverse operational units, offices, residential quarters, and service facilities that may differ in water usage patterns, infrastructure conditions, resource access, and operational priorities. Such structural heterogeneity within the camp may have influenced participants' responses and experiences. Therefore, the findings may not fully represent all units within the camp nor be readily generalizable to other military establishments in the Philippines or other institutional contexts.

Third, the military setting of the study may also have influenced participants' responses. Given the hierarchical structure, culture of discipline, and respect for authority within military establishments, some respondents may have exercised caution in expressing criticisms or concerns regarding institutional policies, leadership practices, and operational weaknesses related to water management. This may have contributed to social desirability bias or restrained responses despite assurances of confidentiality and voluntary participation. To minimize these effects, the study implemented measures such as informed consent procedures, anonymous survey responses, confidential handling of records, and the use of pseudonyms for qualitative participants. Nevertheless, the possibility of response bias remains a limitation of the study.

Finally, although the mixed-methods design provided a broader understanding of water sustainability practices and challenges within Camp Lapu-Lapu, the findings reflect conditions specific

to the period in which the study was conducted. Changes in institutional policies, environmental conditions, infrastructure development, or resource availability over time may influence future water management practices and sustainability efforts within the camp.

Author Contributions

Manolito V. Belleza: Conceptualization, methodology, validation, data gathering, writing – original draft; **Catherine C. Valera:** Data analysis, methodology, writing – original draft, writing – review and editing.

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