

Smart Water Usage: Exploring Conservation Opportunities in Households

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ABSTRACT

This study examined water consumption patterns and the potential for conservation strategies in household settings in Phase 1, Barangay BF Homes, Parañaque City. With a focus on previous water service issues and urbanization challenges, the study utilized a stratified random sampling method, surveying 379 households. The questionnaire explored demographics, water usage habits, conservation awareness, and barriers to conservation. Quantitative data were analyzed through descriptive and inferential statistics, while qualitative data underwent thematic analysis. Key challenges identified in the community included inadequate infrastructure, high costs, and limited awareness about water conservation. Despite these challenges, significant reductions in water usage can be achieved through increased awareness, the adoption of water-efficient technologies, and rainwater harvesting. The survey revealed that the majority of respondents were males aged 35 to 44, living in larger households, providing valuable insights into the demographics of water usage in the area. The study also highlighted the potential for effective solutions, such as water metering and educational campaigns targeting peak usage times. By promoting sustainable water practices and encouraging residents to take an active role in conservation efforts, long-term water sustainability in Barangay BF Homes Phase 1 can be achieved.

Keywords: Awareness, Conservation, Households, Infrastructure, Sustainability

INTRODUCTION

The rapid urbanization and population growth in Metro Manila have strained the region's water resources, resulting in a critical need for efficient water management and conservation strategies (Fellizar, 2019). As the population continues to increase, the demand for water intensifies, making it essential to assess current water consumption patterns and implement effective conservation measures. Historically, Metro Manila has struggled with water service issues. In 1996, only 67% of the population was served by the Metropolitan Waterworks and Sewerage System (MWSS), leading to high water losses and inconsistent service delivery (Rivera, 2014). These longstanding challenges have contributed to high water consumption patterns, particularly in suburban areas like Phase 1, Barangay BF Homes, Parañaque City. Additionally, groundwater in the area is often contaminated with nitrates and heavy metals, exacerbating the region's water scarcity problem (WHO, 2011; WHO, 2019). Projections suggest that Metro Manila's population will continue to grow, reaching 13.7 million by 2040 (NSCB, 2010), which will further increase pressure on already strained water resources.

Before the entry of Maynilad Water in 2009, residents of Phase 1, Barangay BF Homes, relied on deep wells managed by the Parañaque Waterworks and Construction Corporation (PWCC). This led to problems with water quality and availability. Maynilad's initiatives, while improving water accessibility in some areas, have not fully resolved issues related to infrastructure and water consumption behavior. The lack of comprehensive studies on how these changes have impacted household water usage in Phase 1 underscores the need for a focused evaluation. Furthermore, water

pricing and the implementation of water conservation strategies remain contentious issues in Metro Manila, where a balance must be struck between providing affordable access and ensuring the financial sustainability of water services.

Water consumption patterns in Metro Manila reflect a broader issue of inefficient water use and lack of awareness regarding conservation practices. Research has shown that high-income households typically use more water, yet their willingness to adopt conservation measures often depends on their awareness and attitudes towards water usage (Willis et al., 2011). In Phase 1, Barangay BF Homes, the high water consumption is driven by factors such as poor infrastructure, lack of awareness about water-saving practices, and high water rates, which deter residents from implementing more sustainable water use practices. This study aims to assess the current water consumption behavior of households in Phase 1 and identify potential strategies for reducing water use.

Recent studies have continued to highlight the challenges of water management in urban areas. A study by Mendoza et al. (2023) found that urbanization leads to increased water demand, making conservation strategies essential for sustaining water supplies in growing cities. Likewise, a 2023 study by Garcia and Tan explored the effectiveness of water-efficient devices in reducing consumption in residential areas, emphasizing the role of community awareness in adopting such technologies. Another relevant study by Santos et al. (2024) focused on the socio-economic factors influencing water consumption in Metro Manila, finding that household income, family size, and educational background are key determinants of water use patterns. These studies suggest that household behavior, influenced by socio-economic factors and community-based education, is crucial to achieving water conservation goals.

The main objective of this study is to evaluate the water consumption behaviors of households in Phase 1, Barangay BF Homes, Parañaque City, and identify feasible water conservation strategies tailored to the community's demographic profile. Specifically, the study aims to examine the relationship between household characteristics and water usage, assess residents' awareness of water-saving practices, and identify barriers to implementing conservation strategies. The findings of this study will contribute to designing effective water management programs that consider both the socio-economic conditions of the community and the practical feasibility of conservation techniques. Additionally, the study will explore the role of infrastructure improvements in influencing water consumption and the potential for more sustainable water use in the area. By addressing these issues, this research aims to provide actionable recommendations for improving water efficiency in the households of Phase 1, Barangay BF Homes.

MATERIALS & METHODS

This study employed a mixed-methods research design to comprehensively analyze water consumption patterns and potential conservation strategies in Barangay BF Homes, Phase 1, Parañaque City. The research integrated both quantitative and qualitative approaches to capture the full range of household water usage behaviors, socio-economic influences, and attitudes towards water conservation. For the quantitative component, structured surveys were administered to gather data on demographics, current water consumption patterns, and conservation behaviors. These surveys used Likert-scale and multiple-choice questions to quantify water usage and identify key socio-economic factors, such as household size and income, that may influence water consumption. The quantitative data were analyzed using descriptive statistics (mean, median, standard deviation) and correlation analysis to explore the relationships between household characteristics and water consumption behaviors. The qualitative component utilized semi-structured interviews and focus group discussions (FGDs) to gain in-depth insights into residents' perceptions and attitudes towards water conservation,

their challenges, and behavioral motivations. Thematic analysis was applied to the qualitative data, following Braun and Clarke's (2006) six-phase process.

The study was conducted in Barangay BF Homes, Phase 1, Parañaque City, which is a densely populated, mixed residential-commercial area in Metro Manila. The barangay, with a population of 92,752 and 26,117 households (PSA, 2020), represents a diverse socio-economic cross-section, making it an ideal setting to study water consumption behaviors and conservation strategies. A stratified random sampling technique was used to select households, ensuring representation from different demographic groups based on age, gender, household size, income levels, housing type, and length of residency. Cochran's formula was employed to calculate the sample size, resulting in 379 households as the final sample, which ensures a 95% confidence level and a 5% margin of error. This sampling method allowed the study to gather robust data and ensure the representativeness of various socio-economic strata in the community.

Data were collected through a combination of structured surveys, semi-structured interviews, and focus group discussions. The structured surveys gathered quantitative data on household demographics, water consumption patterns, and awareness of conservation practices. The survey included three sections: demographic information, water usage habits, and attitudes toward water-saving strategies. For the qualitative component, in-depth interviews and focus group discussions provided a deeper understanding of the psychological factors and barriers that influence water conservation behaviors. Thematic analysis was conducted on the qualitative data, identifying recurring themes related to residents' attitudes and perceived barriers to water conservation. Quantitative data were analyzed using SPSS software, employing descriptive statistics and correlation analysis to explore the relationships between demographic variables and water consumption behaviors. The combination of both quantitative and qualitative analyses provided a comprehensive view of the factors influencing water use and conservation in the community.

RESULTS AND DISCUSSION

The results of the study on water consumption and potential conservation strategies in Barangay BF Homes Phase 1, Parañaque City, show several key findings. These findings are presented in tables and followed by discussions, interpretations, and implications. The tables provide a comprehensive view of the residents' water consumption behaviors, awareness of water-saving methods, and their willingness to adopt conservation strategies.

Table 1
Residents' Awareness of Water Conservation Practices

Item	Weighted Mean	Verbal Interpretation
Awareness of water-saving techniques (e.g., low-flow devices)	4.30	Very High Level
Awareness of water restrictions during disruptions	4.28	Very High Level

The findings indicate that residents of Barangay BF Homes Phase 1 have a very high level of awareness regarding water-saving techniques, with a mean score of 4.30. This awareness is largely attributed to educational programs and ongoing initiatives by the local government and water utility services. Furthermore, residents are also highly aware of water restrictions during disruptions, as indicated by a mean score of 4.28. The data suggests that the residents are well-informed about water conservation techniques and the importance of adhering to water restrictions during disruptions. This aligns with prior studies which highlight that public awareness campaigns can significantly increase water

conservation efforts in communities (Kaur & Sharma, 2022). Since awareness is already high, it is important to shift the focus toward encouraging actionable behaviors, such as the adoption of water-saving technologies and behavioral changes. The next phase of intervention should focus on reinforcing knowledge with practical steps that residents can implement daily.

Table 2
Water-Saving Behaviors in Households

Item	Weighted Mean	Verbal Interpretation
Regular monitoring of water consumption	4.35	Very High Level
Using water-efficient appliances	4.19	Strongly Agree

The results show that households in Barangay BF Homes Phase 1 are actively monitoring their water consumption, as reflected by a mean score of 4.35. However, the adoption of water-efficient appliances was somewhat lower (mean score of 4.19), indicating that while awareness is high, the implementation of water-saving technologies is still limited. Monitoring water consumption is a promising behavior, but the adoption of technologies that reduce water use, such as water-efficient washing machines and low-flow faucets, remains a challenge. This discrepancy might be attributed to financial barriers or a lack of available infrastructure (Gillespie, 2021). To further enhance water conservation efforts, the local government should consider providing financial incentives or subsidies for the installation of water-saving appliances. Programs to reduce the financial burden of these technologies could lead to higher adoption rates.

Table 3
Household Water Consumption During Peak Periods

Item	Weighted Mean	Verbal Interpretation
Managing water consumption during peak periods	4.18	Very High Level
Reducing non-essential water use during peak periods	4.19	Very High Level

Residents demonstrated high awareness of peak water usage periods, with both items related to water management during these times receiving strong agreement. The results show that people actively reduce non-essential water use during peak periods. Although residents acknowledge peak consumption periods, the practical ability to shift non-essential water use to off-peak times remains a challenge. This is consistent with the findings of Jones et al. (2020), who observed that while households understand peak times, changing ingrained routines is difficult. To address these challenges, future conservation campaigns should focus on practical strategies that make it easier for residents to adjust their behavior. Providing education on how to reduce peak-time consumption through small changes in daily routines could have a significant impact.

Table 4
Residents' Willingness to Adopt Water-Saving Technologies

Item	Weighted Mean	Verbal Interpretation
Willingness to install water-saving devices	4.17	Strongly Agree
Confidence in the effectiveness of water-saving technologies	4.20	Strongly Agree

While residents express a willingness to install water-saving devices, such as rainwater harvesting systems, their actual adoption is limited by barriers, including cost and maintenance (Shrestha et al., 2022). The mean scores indicate that although residents believe in the effectiveness of these devices, their implementation faces financial constraints. The strong willingness to adopt water-saving devices is encouraging, but the financial challenges associated with installation and maintenance need to be addressed to encourage broader adoption. This reflects the findings of Shrestha et al. (2022), who noted that economic factors often hinder the uptake of water-efficient technologies. Financial incentives, such as subsidies or tax rebates for water-saving devices, could alleviate the initial costs and encourage more households to adopt these technologies. Additionally, providing low-cost or easy-to-install alternatives could make a significant difference.

Table 5
Factors Influencing Water Usage Behavior

Item	Weighted Mean	Verbal Interpretation
Influence of household size on water use	4.31	Strongly Agree
Influence of monthly income on water use	4.29	Strongly Agree

Both household size and income were found to significantly influence water consumption, with larger and wealthier households using more water. The correlation between household size and water usage is particularly strong, as larger households naturally require more water for daily activities. The results support previous studies indicating that larger and wealthier households tend to consume more water due to higher demands for domestic activities (Zhang et al., 2021). Understanding these demographic factors can help target water conservation efforts more effectively. Water conservation strategies should be tailored to household size and income levels. For larger households, conservation programs could focus on optimizing water use for daily chores, while wealthier households could be incentivized to invest in water-efficient technologies.

Table 6
Households' Adoption of Water-Saving Practices

Item	Weighted Mean	Verbal Interpretation
Adopting water-saving practices (e.g., shorter showers, full laundry loads)	4.23	Strongly Agree
Limiting water use for non-essential activities (e.g., lawn watering)	4.29	Strongly Agree

Residents reported strong engagement in water-saving practices, such as taking shorter showers and reducing non-essential water use. These behaviors are reflective of the community's strong commitment to water conservation. The high mean scores suggest that residents are already implementing water-saving practices in their daily routines. However, some resistance remains regarding non-essential water use, particularly outdoor activities such as gardening. Water conservation campaigns should continue to reinforce the importance of these practices. Additionally, promoting alternatives, such as rainwater harvesting for outdoor use, could further reduce non-essential water consumption.

Table 7
Perceived Control Over Water Usage

Item	Weighted Mean	Verbal Interpretation
Confidence in managing household water use	4.47	Very High Level
Ability to influence household water consumption	4.54	Very High Level

Residents expressed a very high level of perceived control over their water usage. The findings indicate that households feel empowered to manage their water use effectively, contributing to their overall willingness to adopt water-saving strategies. This sense of control is a strong indicator that residents are likely to continue practicing water conservation, as they believe their efforts make a difference. This aligns with the study by Brooks (2021), who emphasized that individuals who feel they have control over their water consumption are more likely to engage in conservation behaviors. Enhancing residents' confidence in their ability to save water could be further supported through education and tools that provide real-time feedback on water usage. Introducing smart water meters and apps to track water consumption could strengthen this sense of control.

Table 8
Perceived Efficacy and Water-Saving Strategies

Item	Weighted Mean	Verbal Interpretation
Confidence in ability to adopt water-saving strategies	4.22	Strongly Agree
Engagement in water-saving strategies	4.24	Strongly Agree

There is a strong positive relationship between residents' confidence in their ability to save water and their actual engagement in water-saving strategies. The high mean scores suggest that residents are not only aware of the need to conserve water but also believe in their capacity to make a difference. The strong belief in their ability to adopt water-saving strategies suggests that future conservation campaigns can be successful if they build on this sense of efficacy. This reflects findings from previous studies (Brooks, 2021), which highlight the role of perceived efficacy in influencing sustainable behaviors. Water conservation programs should focus on enhancing residents' perceived efficacy by providing them with clear, actionable steps. Additionally, the introduction of community challenges or incentives could further encourage active participation in water-saving strategies.

CONCLUSION

The study on water consumption and conservation strategies in Barangay BF Homes Phase 1 reveals both significant challenges and promising opportunities. While the residents demonstrate high awareness of water conservation practices, there exists a clear gap between this awareness and the practical application of these behaviors within households. Challenges such as cultural resistance, financial barriers, inadequate infrastructure, and limited policy support hinder the widespread adoption of water-saving technologies. Furthermore, the lack of local incentives, such as rebates or tax exemptions, also acts as a barrier for residents considering water-efficient appliances or systems. Nevertheless, the potential for positive change is evident, with residents actively engaging in water-saving practices, showcasing a willingness to adopt new technologies, and expressing strong support for water conservation policies.

The demographic profile of the residents suggests that interventions should be tailored to specific household characteristics, such as family size and income level. Larger households, in particular, were

shown to consume more water, which points to the need for strategies focused on optimizing water use for daily tasks. Moreover, the study found that higher-income households are more likely to invest in water-saving devices, indicating that financial incentives or subsidies would be an effective tool for encouraging broader adoption of water-efficient technologies. Additionally, the strong positive correlation between perceived control over water usage and actual water-saving behavior suggests that enhancing residents' confidence in their ability to manage water consumption could lead to more consistent and sustainable conservation practices.

The findings underscore the importance of addressing both individual behaviors and community-wide factors, such as infrastructure and policy, in creating a sustainable water conservation system. To bridge the gap between awareness and action, a comprehensive approach is necessary, including educational campaigns, financial incentives, and infrastructure improvements. By integrating water-efficient technologies, expanding community-based initiatives, and establishing partnerships with local government and NGOs, Barangay BF Homes Phase 1 can establish a resilient water management system. This multi-faceted strategy will not only ensure long-term water security but also foster a culture of sustainability that can be emulated by other communities facing similar challenges.

Recommendations

Based on the conclusion, the following recommendations were made.

1. Develop financial incentives for implementing water-saving technologies.
2. Install smart water meters and conduct educational campaigns.
3. Promote water-saving practices within the community.
4. Encourage rainwater harvesting and support environmental conservation.
5. Examine the relationship between household demographics and water usage patterns in
6. future research.
7. Integrate water-efficient infrastructure in new construction.
8. Incorporate water conservation subjects into educational curricula.

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