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Original Article

Climate-Smart Water Management in Religious Settings: Optimizing Ablution Water for Environmental and Public Health Sustainability

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Abstract

Background

Religious institutions constitute significant yet underexplored environments for advancing climate-responsive water management strategies. In Islam, ablution (wudu) is a mandatory ritual purification performed before prayer to ensure personal hygiene. Although spiritually fundamental, the frequent daily performance of ablution may result in considerable water consumption, particularly in regions experiencing water stress. Amid escalating climate change impacts, growing water scarcity, and concerns regarding public health sustainability, improving the efficiency of ritual water use has become increasingly critical. This study evaluates ablution practices from a climate-smart perspective to identify opportunities for enhancing water-use efficiency within religious settings.

Methods

A quantitative cross-sectional study was conducted to assess water-use behaviour during ablution, focusing on duration and volume of water consumed per session. A total of 103 participants who regularly performed ablution and provided informed consent were included. Individuals with physical limitations affecting ablution performance, incomplete sessions, or missing data were excluded. Direct measurements of ablution duration (minutes) and water consumption (litres) were recorded and analysed using descriptive statistical methods. Educational attainment was examined as a potential determinant of water-use efficiency.

Results

Considerable variation in ablution water use was observed across educational groups. Participants with higher educational attainment demonstrated shorter ablution durations and lower average water consumption per session. In contrast, individuals with Matric-level education recorded the longest mean duration (5.77 minutes) and the highest average water use (6.50 L), contributing disproportionately to overall consumption despite representing a smaller proportion of the sample. The overall mean ablution duration and water use were 3.98 minutes and 3.57 L, respectively. The findings indicate an inverse association between educational attainment and water-use efficiency, highlighting behavioural determinants relevant to climate-smart water management

Conclusion

The findings reveal an inverse association between educational level and water consumption during ablution, suggesting that education plays a key role in fostering efficient water-use behavior. These results highlight the importance of targeted educational and awareness initiatives to promote sustainable ablution practices and support broader water conservation strategies.

Keywords: Ablution; Water Use Efficiency; Educational Attainment; Ablution Practices Climate Change Adaptation, Environmental Health

Introduction

Water is an indispensable resource for human survival, and its conservation and sustainable management constitute a collective environmental and societal responsibility. Within Islamic practice, ablution (wudhu) is a mandatory ritual purification performed multiple times daily prior to prayer and other acts of worship. The procedure involves sequential washing of the hands, mouth, nose, face, arms, and feet, along with wiping of the head and ears. Beyond its religious significance, ablution serves as a structured hygienic practice that promotes physical cleanliness. In Islamic doctrine, the validity of prayer is contingent upon prior ablution, underscoring its central role in both spiritual and bodily purification. Etymologically, ablution denotes cleanliness and refinement, reflecting its dual function in maintaining hygienic standards and ritual purityr[2].

Ablution (Wudu) is a mandatory ritual purification performed prior to each prayer in Islam, involving the systematic washing of designated body parts. The process begins with the formulation of intention, followed sequentially by cleansing of the hands, rinsing of the mouth, cleaning of the nose, washing of the face, and washing of the arms up to the forearms. This is followed by wiping the head and ears with wet hands and washing the feet up to the ankles. Adherence to the prescribed order and proper execution of each step are essential components of valid ablution, as its completion is a prerequisite for the acceptance of prayer.

Beyond its hygienic function, ablution embodies spiritual discipline and mindfulness, reinforcing humility, self-regulation, and attentiveness in worship. Importantly, Islamic teachings emphasize moderation in water use during ablution, reflecting principles of environmental stewardship and responsible resource management. This practice highlights the ethical obligation to conserve water, promoting awareness of sustainable consumption even within routine religious observance[4].

Excessive water consumption during ablution represents a growing concern, particularly in mosque settings where the ritual is performed frequently and collectively. Overuse is often driven by limited awareness of water conservation principles, inefficient plumbing infrastructure, and the absence of systematic monitoring mechanisms to regulate consumption. In the context of climate change and increasing water scarcity, repetitive ablution practices conducted without water-efficient systems may contribute substantially to avoidable water loss. Accordingly, improving the management of ablution water use constitutes a practical and sustainable strategy for strengthening institutional water conservation efforts.

Technological interventions, including the installation of sensor-based taps and flow-regulating devices, have been introduced to reduce water wastage during ablution. Nevertheless, individuals often lack awareness of the actual volume of water consumed per session, resulting in continued inefficiencies. The integration of structured water-monitoring systems within mosques and other Islamic institutions could enhance accountability and promote responsible consumption behaviors. Despite emerging technological solutions, empirical research examining water-use patterns during ablution particularly within the socio-cultural and religious context of Muslim communities remains limited. A nuanced understanding of the religious significance of ablution is therefore essential for designing effective, culturally appropriate water conservation strategies. Unregulated water use during this ritual may lead to substantial cumulative waste, underscoring the need for awareness initiatives and behavioral interventions aimed at fostering sustainable ablution practices [10].

Despite these advancements, individuals often need help to gauge the amount of water they use for ablution, leading to wastage. Introducing water monitoring for ablution practices could be crucial in addressing this issue[8]. Through the implementation of water monitoring systems, mosques, and other Islamic institutions can manage water usage during ablution activities. Water monitoring for ablution activities holds great importance in Muslim communities[9].

However, this study identified a paucity of research examining water consumption during ablution, particularly in relation to the cultural norms and religious values that shape practices within Muslim communities. A comprehensive understanding of the spiritual and cultural significance of ablution is therefore critical for developing effective and context-sensitive strategies to improve water-use efficiency. Unregulated water consumption during ablution may result in substantial cumulative wastage, as illustrated in Figure 1. Accordingly, this initiative seeks to enhance awareness of individual water-use behaviors during ablution and to promote more sustainable consumption practices consistent with both religious teachings and environmental responsibility. [10]

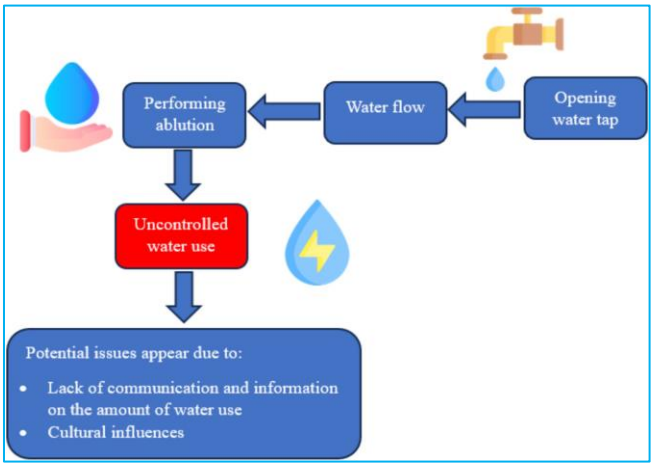

Figure 1. Challenges in Water Usage During Ablution Practices (Ghazali et al., 2024).

Ethical principles were rigorously upheld throughout the study. Participation was entirely voluntary, and informed consent was obtained from all respondents prior to data collection. Confidentiality and anonymity were strictly maintained to protect participant privacy. Cultural and religious sensitivities associated with ablution were carefully respected, and no modifications were made to participants' customary practices, ensuring that observations reflected natural behavior without external influence

Sociocultural Factors and Water-Use Monitoring

Culture plays a critical role in shaping human behavior and user preferences related to water usage during ablution activities [11] In many cultural contexts, there is a growing emphasis on sustainable practices aimed at ensuring efficient water use during ablution, particularly in regions where water scarcity presents a significant challenge. As awareness of environmental sustainability increases, cultural norms are gradually evolving to support water conservation efforts while maintaining religious obligations. Given the religious importance of ablution in Islam, it is essential to consider cultural values and practices that influence attitudes and behaviors toward water use during this ritual. Integrating cultural perspectives into water conservation initiatives can enhance their effectiveness while respecting religious traditions and community values [12].

It is a widespread practice to classify men and women as masculine and feminine. This practice results in a substantial variation in gender roles between countries, necessitating the implementation of various effective remedies[13]. The values vary widely from country to country, with some nations emphasizing assertiveness, competition, goal accomplishment, and success as masculine characteristics. Cultural factors exert a significant influence on individuals' awareness, attitudes, and usage patterns of water taps during ablution activities. Established cultural norms, traditions, and belief systems shape behavioral responses and perceptions related to water conservation and sustainable water use [14].

In several cultural settings, ablution is closely associated with concepts of purity and ritual cleanliness, which often encourages individuals to use excessive amounts of water to ensure thorough cleansing. This cultural emphasis on meticulous performance can lead to increased water consumption during ablution. Moreover, societal norms and collective expectations significantly shape attitudes toward water use, with higher volumes of water sometimes perceived as a reflection of greater religious devotion or commitment. Such culturally embedded perceptions may limit awareness of water conservation and reduce the willingness to adopt water-efficient practices during ablution rituals. Accordingly, this study examines the relationship between cultural values, user preferences, and ablution water consumption behaviors within the RMU context. In view of the increasing importance of sustainable water management in institutional environments, the primary objective of this study is to systematically examine ablution water usage patterns across different user groups and locations at RMU, with the aim of developing targeted and effective strategies for optimizing water conservation. To achieve this objective, the study is structured into several interrelated components. First, it analyses the influence of demographic characteristics, including gender and user roles such as students, faculty, staff, and other users, on ablution practices and associated water consumption. Second, the study investigates variations in ablution water usage across different settings, including homes, mosques, schools or colleges, and other locations, to identify differences in consumption behaviour. The study further examines the relationship between prayer times, frequency of ablution, and key usage indicators, such as total water consumption, duration of ablution, and the type of container or facility utilized. Finally, this study analyses ablution water consumption in relation to educational level, quantified water use (L), types of containers used, and study settings, and proposes practical, context-specific water conservation measures tailored to RMU.

Materials & Methods

This study employed a quantitative cross-sectional approach design to examine ablution water usage and associated behavioral factors within RMU and related environments. The study was conducted over a period of (October,20th 2025 to January10th 2026).

The study population comprised individuals who regularly perform ablution, including students, faculty members, administrative staff, and community members performing ablution in mosques and homes. A total of 103 respondents were selected using a purposive convenience sampling technique to ensure the inclusion of active ablution practitioners across different locations.

The sample size comprised 103 participants who met the inclusion criteria of the study.

Data were collected using two complementary tools. First, direct observation and water measurement were conducted in real-life settings. All water used during ablution was collected in a container placed beneath the tap, and both the total volume (litres) and duration (minutes) of each ablution session were recorded to obtain accurate quantitative measurements. Second, a structured questionnaire was administered to gather demographic and behavioural information, including gender, user role, location of ablution, prayer times, frequency and duration of ablution, and type of facility used. The questionnaire was adapted from previous

studies on ablution water-use behaviour and conservation practices (e.g., Abu Rozaiza, 2002; Ghazali et al.), with modifications made to suit the local context and study objectives.

Water consumption was quantified using a standardized container-based measurement method. A mug was used as the primary measurement unit and calibrated against a 1.5-liter container. Repeated calibration showed that two full mugs corresponded to approximately 2 liters. The total volume of water used per ablution was calculated by converting the number of mugs used into liters.

All data were entered and analyzed using SPSS (version 26.0). Quantitative data were analyzed using descriptive statistics, including frequencies, percentages, means, and ranges, with graphical comparisons across gender, location, and user roles. Qualitative data obtained from observations and interviews were analyzed thematically to identify behavioral patterns, inefficiencies, and opportunities for improving water conservation during ablution.

Results

The results show that the majority of respondents were **male**, accounting for **61 participants (59.2%),** while **42 respondents (40.8%)** were **female.** This indicates that males were more represented than females in the study sample (Table 1).

Table 1. Demographics of the Study Population

Educational Level	Number	Percentage (%)
Matric	10	9.7
Bachelors	21	20.4
Masters	30	2.9
Doctorate	69	67

The results present the distribution of educational attainment among the 103 participants. The majority held a Doctorate degree (67%)**,** followed by **(**Bachelor's degree holders 20.4%)**,** Matric-level education (9.7%)**,** and Master's degree holders (2.9%)**.** Analysis of ablution water-use behaviour revealed a clear inverse association between educational level and water consumption**.** Participants with higher educational attainment (Bachelor's and Doctorate) demonstrated greater water-use efficiency**,** characterized by shorter ablution durations and lower water volumes per session. Conversely, participants with Matric-level education exhibited the highest mean water consumption (6.50 L) and longest mean duration (5.77 minutes)**,** disproportionately contributing to overall water use.

Water-Use Patterns During Ablution (Liters)

The results reveal considerable variation in water consumption during ablution, with an overall mean of 3.57 L per session (Table 2). Most participants used between 3.00 and 3.27 L, indicative of relatively efficient water-use practices. However, a smaller subset of individuals consumed substantially higher volumes, up to 6.50 L per ablution, which disproportionately influenced the overall mean and reflects lower water-use efficiency (Fig. 3).

Distribution of Ablution Practices Across Study Settings

The results (Table 2**)** demonstrated that majority of ablution practices occurred at home (48%) and the workplace (46%)**,** while a smaller proportion of participants performed ablution at a masjid (7%)**.** This distribution highlights that the largest opportunities for water conservation interventions are in domestic and workplace settings**,** where most water is consumed. Although the masjid contributed minimally to overall water use, institutional and community-level strategies could still enhance efficiency in public religious facilities. These findings underscore the importance of targeting climate-smart water management initiatives in settings where daily ablution is most frequent, providing practical pathways for reducing water consumption and promoting environmental sustainability in line with public health objectives.

Interpretation based on percentage distribution

From a proportional perspective, most ablution practices were contributed by groups accounting for 42%, 30%, and 16% of the total sample, while only 13% of respondents belonged to the smallest group. Despite its limited representation, this group contributed disproportionately to overall water consumption and longer

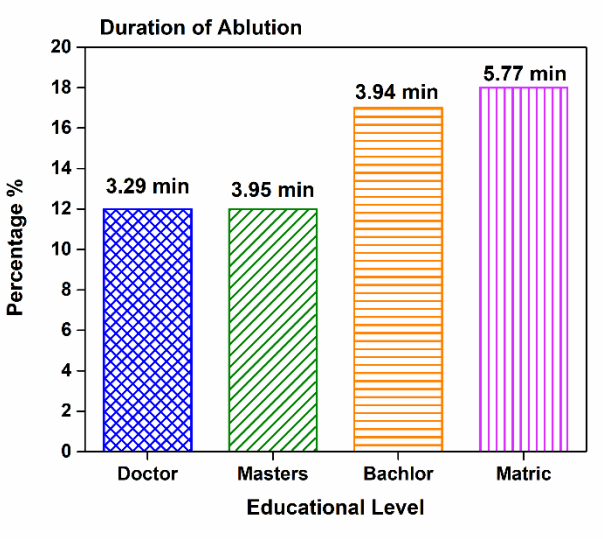

Figure 2. Ablution Duration Based on Educational Level

Table 2. Study settings used for Ablution Practices

Place	Participants	Proportion	CI
Home	49	0.476	.0.38-0.58
Masjid	7	0.068	0.03-0.14
Work place	47	0.456	0.38-0.58

Table 3. Association of Educational Level with Ablution Water Use.

Education level	Participants (n %)	Ablution water /L	Duration of ablution (min)
Doctor	31 (30%)	3.27	3.29
Masters	43(41.7%)	3.12	3.95
Bachelor	16 (15.5%)	3.00	3.94
Matric	13(12.6%)	6.50	5.77
Total	103	3.57	3.98

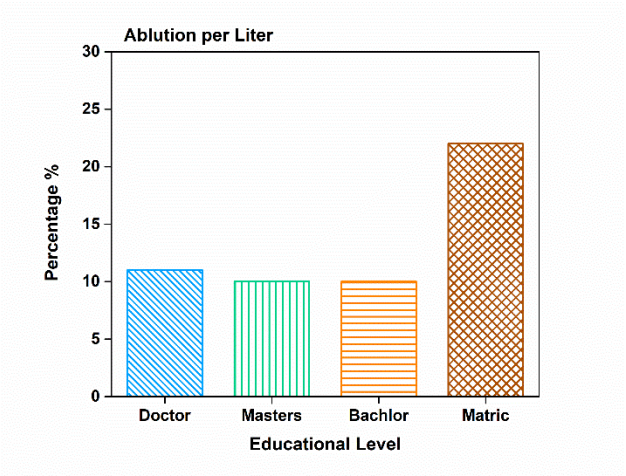

Figure 3. Ablution Water Consumption (L) Based on Educational Status.

Discussion

Water conservation during ablution is strongly emphasized in Islamic teachings and is exemplified by the practice of our Holy Prophet. According to narrations recorded in *Sahih Al-Bukhari* [8] (Hadith 201) and *Sahih Muslim* [29] (Hadith 325), the Holy Prophet performed ablution using a minimal amount of water, underscoring the principle of moderation and responsible water use. The present findings provide insight into the relationship between educational level and water-use behavior during ablution, as reflected by the demographic distribution and water-consumption patterns shown in Table 1. The demographic characteristics observed in the present study are consistent with those reported by Ghazali et al., who examined age, gender, and educational distribution in the design and implementation of an online monitoring system for ablution water use that incorporated users' cultural preferences (Ghazali et al.,2024).

Despite the emphasis on water conservation in Islamic teachings, contemporary practices indicate that Muslims often use more water than recommended during ablution. In present study, the volume of water used during ablution ranged from 3.00 L **(**minimum) 6.50 L (maximum**)** across respondents Table 3. These results are consistent with previous study of Abu Rozaiza 2002, who assessed water consumption in approximately 40 mosques, and reported ablution water use ranging from 3 to 7 L per person per session**.** These findings are consistent with the variability observed in the present study and provide important context for understanding current ablution water-use patterns. The location of ablution significantly influences where and how water is used**.** In this study, ablution was mainly performed at home (49%) and the workplace (46%)**,** with only 7% in mosques Table 2. This suggests that most water is used in private or semi-private settings. These findings align with Abu Rozaiza (2002b), who reported lower water use in regular mosques (2.5–4.5 L) compared to highly crowded religious sites (5–7.5 L).

Education in ablution is commonly conveyed through informal observation, with elders performing the ritual in the presence of younger family members. However, this traditional method often lacks consistency and effectiveness, leading to gaps in foundational knowledge. Supporting this concern, Jazilah (2017) found that a large proportion of children aged 5–6 years were unable to correctly perform wudhu when preparing for prayer. The findings of the present study align with this observation, as individuals with lower educational attainment demonstrated longer ablution durations and greater water consumption, while higher

educational levels were associated with more efficient practices. In present study, the total water used during ablution varied across educational groups, with the lowest average consumption observed among Bachelor's degree holders (3.00 L), followed by Master's (3.12 L) and Doctorate-level respondents (3.27 L). The highest water consumption was recorded among Matric-level respondents (6.50 L), indicating a substantial increase in water use compared to all other groups. These results suggest that insufficient early guidance in ablution may have lasting effects on both procedural accuracy and water-use behavior, highlighting the importance of structured educational interventions.

Strengths: This study provides quantitative evidence on water-use behaviour during ablution, examining both duration and water volume across multiple educational levels. By highlighting education as a key determinant of water-use efficiency, the research identifies behavioural patterns relevant to climate-smart water management in religious settings. The inclusion of diverse educational categories allows for a comparative assessment, offering actionable insights for interventions that simultaneously promote sustainable water use and public health outcomes.

Limitations: The findings should be interpreted in the context of several limitations. The modest sample **size** and reliance on descriptive statistics limit the generalizability of results and preclude causal inference. Additionally, the study did not account for contextual factors such as water fixture type, water pressure, or facility location, which may influence ablution water consumption. These factors should be considered in future research to provide a more comprehensive understanding of water-use efficiency.

Future Implications Future studies should employ larger, more diverse samples and use inferential and multivariate analyses to elucidate determinants of ablution water behaviour. Including variables such as demographic characteristics, behavioural awareness, and water-saving technologies would enable a holistic evaluation of climate-smart water management in religious settings. Intervention-based and longitudinal designs could further assess the long-term impact of educational and awareness programs on sustainable water-use practices.

Policy Recommendations:

The study highlights the need for targeted educational interventions **to p**romote efficient ablution practices, especially among lower-education populations. Religious authorities and policymakers should integrate water conservation principles into religious education and encourage the use of water-efficient fixtures. Aligning ritual practices with sustainable water management can advance both environmental and public health goals.

Conclusion

The findings of this study indicate that educational attainment is a key determinant of water-use efficiency during ablution. Participants with higher education consistently demonstrated shorter ablution durations and lower water consumption, while those with Matric-level education exhibited the highest water use, disproportionately contributing to overall consumption. With an overall mean duration of 3.98 minutes and mean water use of 3.57 L, the results reveal a clear inverse relationship between education and water consumption. These outcomes underscore the potential for educational and awareness-based interventions to promote climate-smart ablution practices, reducing water waste in religious settings while maintaining ritual compliance. Implementing targeted programs that combine religious guidance and sustainability education can contribute to both environmental conservation and public health resilience, particularly in regions facing water scarcity

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