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Research Paper

# Assessment of Domestic Water Usage and Wastage in Urban Bangladesh: A Study of Rajshahi City Corporation

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**Abstract**

This study investigates domestic water consumption and waste patterns in Rajshahi City Corporation (RCC), Bangladesh, with an emphasis on identifying factors influencing water waste. Employing a mixed-methods approach involving surveys, monitoring, and interviews, the research evaluates both quantitative and qualitative data. The findings indicate significant positive correlations between water consumption, education level, water safety awareness, availability, and source proximity. Notably, a negative relationship between consumption and water source closeness is observed. Variations in consumption across residential zones, including households exceeding recommended water consumption, are highlighted. Water waste practices, such as taps left running and excessive usage, are identified. Additionally, inadequate access to clean drinking water is also revealed. The study offers insights into research-based strategies to conserve water, enhance sustainable management, and ensure efficient urban water resource utilization in Bangladesh.

**Keywords**: domestic water use; safety of water; urban water consumption; water wastage pattern; water supply

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## 1. Introduction

Access to clean and sufficient water is crucial for human health, well-being, and economic development (Ahmed, 2023). Water quality is one of the most critical factors in human physiology. Thus, Water is one of the 30 substances necessary for maintaining life, health, and ecosystems (Etim et al., 2013). About 1.1 billion people cannot access improved water supplies (Ochilova et al., 2021). Due to population growth, land use, excessive groundwater use, and economic growth over the past century, water demand and water quality have been declining. Moreover, due to unexpected urbanization, Bangladesh has experienced extreme poverty and disparities in access to water services (Kashem et al., 2023). Domestic water consumption and waste patterns play a vital role in this context, as they directly impact the availability and sustainability of water supplies. As a result, water quality is at an all-time low, and health risks related to poor water quality are of significant concern in Rajshahi City Corporation (RCC). RCC's supply water quality still needs to be improved. It has an excessive amount of iron and odor issues. Extreme levels of turbidity and hardness are also present (Ferdous et al., 2018). High concentrations of iron and manganese, coliform bacteria contamination, arsenic contamination, and total hardness are the main factors limiting the availability of drinking water in the RCC (Rasul & Jahan, 2010). These conditions make the water unsafe for drinking and have been linked to high levels of morbidity in the RCC. The RCC's supply water quality has remained relatively high. Despite its poor quality, people still use this unsafe water daily. People in the RCC use water for various purposes. In this context, domestic water consumption varies depending on consumers' living conditions in urban and rural areas (Abubakar, 2019). The researchers mainly focus on the residents' urban domestic water consumption and waste behavior. Household water consumption may include drinking, cooking, washing clothes and utensils, cleaning, bathing, etc. A study by Bari et al. (2015) found that people use the most water when they shower (125 LPCD), go to the bathroom (63 LPCD), wash their hands and brush their teeth (32 LPCD), and prepare the dishes (30 LPCD). Their research revealed that Greater Kuala Lumpur residents consumed an average of 288 liters of water daily.

Despite the significant variations in water consumption, it is clear that showering makes up the most significant portion of domestic water use. It is important to remember that even though showering accounts for most household water use, other activities like using the toilet, washing hands, and doing the dishes also contribute significantly. Daily water consumption may be correlated with some other variables. The amount of water used was significantly associated with several socioeconomic factors, the size of the household, and the type of water sources used by the individual (Abubakar, 2019; Koop et al., 2019). Moreover, a household's distance from the water source can be another critical factor in water consumption (Behailu et al., 2016). Specifically, households with a lower economic status located further from the water source tended to use less water than those with a higher financial status or who were closer to a water source. The size of the household, the availability of the water supply, and the education and age of the household's head are important factors that influence how much water is used (Koop et al., 2019). The findings of these studies demonstrate that the amount of water consumed by households is heavily influenced by various socioeconomic factors. Furthermore, water availability and the cultural practices or habits of water consumers typically determine the variability of water consumption. Moreover, water consumption patterns also depend on a household's age, sex, and region of residence (Rosinger & Young, 2020). Thus, it is clear that the amount of water a household uses is affected by a wide range of factors, from availability to socioeconomic and demographic factors. This information is important as it provides a better understanding of how water consumption patterns can vary from region to region and how these factors influence the amount of water consumed.

While numerous studies on domestic water use and waste patterns have been carried out in various nations worldwide, Rajshahi City Corporation in urban Bangladesh has yet to be the subject of one. There is a need for more in-depth studies that concentrate on behavior change, even though existing research has identified common waste practices and factors influencing water waste. By examining household waste and water usage patterns in Rajshahi City Corporation, Bangladesh's fourth-largest city, this study seeks to overcome that gap. This study evaluates domestic water use and waste patterns in urban Bangladesh, focusing on Rajshahi City Corporation. This study attempts to provide significant insight into the current water management practices in the city and propose recommendations for enhancing water conservation efforts by examining the factors that affect water consumption and identifying typical waste practices. The results of this study will advance our understanding of water use and waste in the cities of

Bangladesh. This will be an invaluable tool for formulating evidence-based strategies for sustainable water management for policymakers, urban planners, and water management authorities. The significance of this study lies in its potential to address the critical water issues that Rajshahi City Corporation and comparable urban areas of Bangladesh are currently facing, resulting in improved water conservation and improved quality of life for the urban residents. Moreover, access to clean and safe water is a fundamental human right and critical to sustainable development. The United Nations' Sustainable Development Goal 6 (SDG 6) emphasizes the global commitment to ensure the availability and sustainable management of water for all. As part of this broader agendum, the research investigates the intricate dynamics of domestic water consumption and waste patterns within the urban context of Rajshahi City Corporation in Bangladesh. This study contributes to realizing SDG 6's aspirations for equitable and efficient water resource management by examining the interplay between water usage behaviors, socio-economic factors, and availability. In a world suffering from increased water stress and scarcity, understanding the complexities of water consumption patterns becomes crucial in formulating effective strategies that balance human needs, environmental conservation, and achieving sustainable development goals.

## 2. Methods

### 2.1 Study Area

The study area of this research is Rajshahi City Corporation (RCC) in Bangladesh (Figure 1). One of Bangladesh's first municipalities, Rajshahi, was founded in 1876 and upgraded to a city corporation in 1987. It has a surface area of 96.72 square kilometers, is located between 24° 21' and 24° 25' N and 88° 32' and 88° 40' E, and has a population of about 0.85 million. According to 2011 census report, RCC had a population of 449,757, up from the beginning of 1991, when it had a population of 284,056. Currently, there are about 0.85 million people living in the RCC, with a population density of 4,318 people per square kilometer. RWASA (Rajshahi Water Supply and Sewerage Authority) supplies water to Rajshahi City through a distribution network in the RCC region to meet the water demand. The increased population in RCC has caused an increased demand for water services, which has put pressure on the existing water resources. Water scarcity and a lack of other essential services have caused great suffering in the RCC. Most people in the RCC regions rely on submersible pumps and tube wells for water. Many people mainly depend on submersible pumps for managing drinking water. They also rely on government-provided water for bathing, cooking, and other activities (the government provides water through a pipe network). The study examines the relationship between various factors influencing residents' water consumption in the RCC. The factors under exploration encompass age, gender, income, and education level. Additionally, an assessment has been conducted on the distance of the RCC from the nearest water source and the water quality provided by the government. By examining these factors, a comprehensive understanding of RCC residents' varying water consumption patterns is anticipated, facilitating insights into equitable access to safe drinking water strategies.

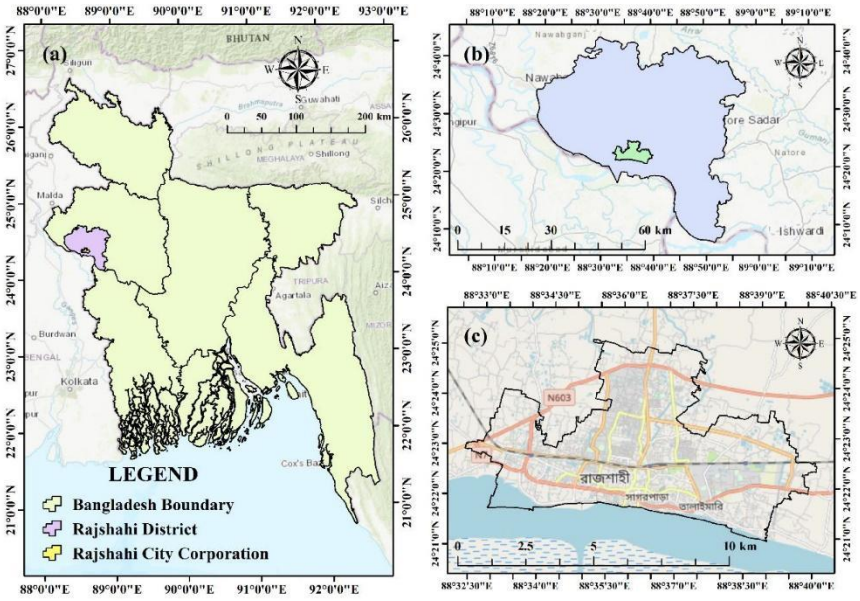


**Figure 1.** Location of the study area (a) in Bangladesh (b) in Rajshahi district (c) RCC (Dey et al., 2021)

### 2.2 Materials and Method

This study employs a mixed-methods research design to assess domestic water usage and waste in the Rajshahi City Corporation (RCC). It combines qualitative and quantitative approaches, where data have been collected from primary and secondary sources. Primary sources included household surveys, in-depth interviews, and focus group discussions. On the other hand, various research reports and articles, official statistics, relevant books, daily newspapers, etc., have been used as secondary data sources. Simple random sampling techniques have been employed for selecting household members or participants. The structured questionnaire used in the household surveys has gathered information on water consumption patterns, sources of water, respondents' behaviors, and conservation practices. Using the questionnaire, data have been collected from 384 stakeholders in the RCC. In-depth interviews have been conducted with key stakeholders, including officials from the RCC, the water supply authority, and relevant non-government organizations. Focus group discussions have been organized with community members to explore their perceptions, behaviors, and attitudes toward water usage and waste.

The data have been analyzed using simple and suitable mathematical and statistical tools like frequency, percentage, arithmetic mean, and standard deviation using the SPSS program. Using the SPSS program, Pearson correlation and various tests like the chi-square and One Sample T-test have been used to examine the relationship between the dependent and independent variables. Results have been presented through graphs, tables, narrative texts, simple computations, and logical reasoning. Data integration has been employed to combine quantitative and qualitative findings, providing a comprehensive understanding of water usage and waste patterns.

## 3. Results and Discussions

### 3.1 Water Consumption Related to Other Variables

Urban household water consumption is subject to a wide range of influencing factors, with each factor significantly contributing to the overall water usage within a household. A correlation matrix is constructed to comprehensively understand the relationship between water consumption and these influencing elements. This matrix encompasses 11 variables meticulously designed to illustrate the intricate relationship between urban household water consumption and the diverse array of factors that impact this consumption pattern (Table 1). The correlation matrix allows researchers to identify factors

that have a stronger or weaker influence on water consumption. By analyzing the matrix, policymakers and urban planners can prioritize interventions and develop strategies to promote more sustainable water usage in urban areas. The correlation matrix shows that there is a significant relationship between water consumption and factors like age, profession, educational level, monthly income, source of water, safety of water, remoteness of the source of water, and availability of water. The most significant factor influencing water use is the safety of water, which is significantly positively correlated with water use ($r = 0.523$, $p<0.05$). Thus, the correlation matrix indicates that water safety is a major factor in determining water consumption in urban households. Moreover, people are more likely to drink safe water than unsafe water. Therefore, it is evident that improving water safety and increasing awareness of the health risks associated with unsafe water can help reduce overall water consumption in urban households. The availability of water supplies is another factor that displayed a statistically significant correlation with domestic water consumption. According to Table 1, there is a significant correlation between the amount of domestic water consumption and the availability of water ($r = 0.449$, $p<0.05$). It implies that people living in areas with a high availability of water tend to consume more water than those living in areas with limited access to a reliable water supply. This is an important finding, as it indicates that water availability can influence the amount of water used for domestic purposes. As the availability of water supplies increased, it appears that domestic water consumption also increased.

There is also a significant correlation between the amount of domestic water consumption and the distance to the water source ($r = 0.232$, $p<0.05$). This indicates that people living closer to water sources may be more likely to use more domestic water. Access to the water source is complicated in the selected study area. As a result, households located in remote areas are often limited in terms of water consumption due to the difficulty of accessing their source. Consequently, access to a water source is an important factor in determining water consumption behavior. In developing countries, inadequate infrastructure and the lack of safe, reliable water sources are major issues that prevent many households from accessing sufficient amounts of water. The household's level of education also demonstrated a statistically significant correlation with domestic water use. Domestic water consumption and household education level have a positive and significant relationship ($r =.311$, $p<0.05$). As the educational level of the household increases, their water consumption also increases. Households with higher educational levels also have greater access to financial resources, making it easier to invest in water. Additionally, higher education levels are associated with larger households or more luxurious lifestyles, both of which can contribute to increased water usage. Thus, this suggests that the educational level of the household can play a significant role in determining the amount of water they consume. Therefore, there is a statistically significant negative correlation between the source of the water and the amount of domestic water used ($r = -0.537$, $p<0.05$). In this regard, the source of water can have a significant impact on water consumption behavior. People living in urban slums often lack access to enough water, which can lead to decreased water consumption behavior. This can be especially detrimental to those in lower socio-economic classes, who cannot purchase more water from other sources. Furthermore, the household's monthly income can have a minor but positive impact on water consumption ($r = 0.107$). Low-income households often cannot afford the extra water needed for their daily needs, leading to decreased water consumption. In addition to this, there is a significant negative relationship between the age of the household and the amount of domestic water consumption ($r = -0.156$). The age of people was significantly correlated with water use, such that younger people consumed more water than older people. Older people may have different attitudes toward environmental issues, as a result of which they are less knowledgeable about and less concerned with water conservation. Table 1 also reveals that there is a statistically insignificant and negative correlation between household profession and water use ($r = -0.109$).

**Table 1.** Relationship between water consumption and other variables

| | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* |
|---|---|---|---|---|---|---|---|---|---|---|
| Water Consumption | 1 | | | | | | | | | |
| Gender | -.071 | 1 | | | | | | | | |
| Age | **-.156**** | -.139** | 1 | | | | | | | |
| Profession | -.109* | .011 | -.239** | 1 | | | | | | |
| Education Qualification | **.311**** | -.213** | -.268** | .007 | 1 | | | | | |
| Monthly Income | .107* | -.377** | .341** | -.338** | .312** | 1 | | | | |
| Source of Water | **-.537**** | .040 | .259** | .004 | -.187** | .068 | 1 | | | |
| Safety of Water | **.523**** | -.042 | -.240** | -.029 | .239** | -.022 | -.742** | 1 | | |
| Remoteness of the Water Source | **.232**** | -.062 | .023 | -.010 | .092 | .062 | -.176** | .192** | 1 | |
| Availability of Water | **.449**** | -.012 | -.295** | -.038 | .229** | -.010 | -.785** | .773** | .072 | 1 |

** Correlation is significant at 0.01 level.
* Correlation is significant at 0.05 level.

### 3.2 Daily Water Consumption Scenery

The amount of water consumed daily by people and its application area are shown in Table 2. On average, per household, people drink 19 liters of water every day. This is an average and won't accurately reflect the usage of many individuals. Most water consumption is used for cleaning, washing, and bathing. Each household uses 30 liters of water daily for cooking, 125 liters for bathing, and 119 liters for cleaning. People use more water for bathing purposes. Cleaning also plays an important role in using much more water. The people of RCC use 294 liters of water per household for drinking, bathing, cooking, and other purposes.

**Table 2.** Per Capita Water Consumption

| | **Maximum L (Mean L)** | **Source of Water** | **Safety of Water** | **Duration of Water Supply** |
|---|---|---|---|---|
| Drinking | 60 (19.87) | Supply = 128 (33.3)<br>Tube well = 30 (10.0)<br>Submersible = 226 (58.9) | Very Safe = 30 (7.8)<br>Safe = 209 (54.4)<br>Neither Safe nor | Always = 175 (45.6)<br>Most of the time = 67 (17.4)<br>Sometimes = 92 (24.0)<br>Rarely = 50 (13.0) |
| Cooking | 100 (30.51) | Supply = 220 (57.3) | Unsafe = 22 (5.7) | |
| Bathing | 500 (125.12) | Tube well = 14 (3.6) | Unsafe = 118 (30.9) | |
| Cleaning | 350 (119.32) | Submersible = 150 (39.1) | Very Unsafe = 5 (1.3) | |

**Note.** Parenthesis in the Table indicates %

### 3.3 Sources of Water

Water comes from a variety of sources in the RCC. Submersible pumps are primarily used by the residents of RCC to collect their drinking water. For managing drinking water, they also rely on tube wells and other private sources. Table 2 shows that 58.9% (N = 226) of the inhabitants primarily depend on submersible pumps to collect drinking water. Additionally, tube wells are used by 10% of all respondents. Table 2 also makes clear that 33% (N =128) of urban residents drink water that is provided by the government. Most people have separate sources for drinking and cooking water. In this regard, a large population depends on the water the government provides for bathing, cooking, cleaning, and other uses. Table 2 shows that 57% (N = 220) of the respondents depend on public water supplies to meet their needs for drinking, cooking, and other uses. The water is provided by the government. This supply system also uses water pumped up from the ground via a network of pipes that span the city. The government's water supply is unsatisfactory, so most people collect their drinking water using submersible pumps. The supplied water has issues with odor, iron, and a dark color, respectively. Government water is frequently contaminated with trash, filth, and an offensive odor (Ferdous et al., 2018). The source of the water can have a significant impact on how much water people use. Table 1 also demonstrated that the water source has a significant negative correlation with water consumption. Some people draw water from a residential pump or a long-distance tube well. They attempt to drink less water. Some people also use their own submersible pumps to collect their own drinking water. They try to consume more water in this regard (Barakoti et al., 2019). Moreover, water consumption depends on the type of water source system. In this regard, those who obtain their drinking water from a submersible pump, however, might not be aware of the significance of protecting this invaluable resource. It is important to educate individuals who rely on submersible pumps for their drinking water about the importance of preserving this precious resource. By understanding the significance of water conservation, residents can consciously reduce waste and ensure its long-term availability for themselves and future generations.

### 3.4 Safety of Water

Bangladesh's water is arsenic-contaminated (Nasher, 2022). This has caused major health issues for the local people and has become an immense challenge for the country. Contaminated water leads to many illnesses, such as diarrhea, skin diseases, and other major health complications (Hasan et al., 2019). Moreover, groundwater contains bacteria and other harmful elements. Surface water is not regarded as a direct source of drinkable water because it is already polluted. One of the main causes of groundwater contamination is arsenic pollution, which affects over 70 million people globally. Even though 97% of the population has access to water, the purity of the water is never guaranteed. Iron, arsenic, and many other harmful elements have been found in the water that is supplied by the RCC. The safety of water is an important factor that affects the consumption of water. From Table 2, It is understood that only 54.4% (N = 209) of respondents believe that their water usage is safe. A large number of people (30.9%, N = 118) think that using water is not safe for them. These results suggest that, although the vast majority of respondents have access to treated and safe water, their knowledge about it is not sufficient to consume this water with confidence.

There are a lot of reasons for drinking unsafe water. Among them, distance is an important reason for drinking unsafe water. Distance is a critical factor in improving water quality (Nygren et al., 2016). Besides that, distance plays an important role in preserving water quality and ensuring available water to the residents. It also plays an important role in water consumption (Ibrahim et al., 2021). A Chi-square test was performed to understand the effect of distance on the safety of water. The chi-square test results are presented in Figure 2. A chi-square test for independence with $\alpha = 0.05$ has been used to assess whether the distance was related to the safety of the water. The chi-square test was statistically significant, $\chi 2$ (4, N= 384) = 22.951, P<0.05 (P= 0.000), with Phi and Cramer's V ($\phi$) coefficient of 0.244, indicating a medium relationship between distance and safety of water. As seen in Figure 2, many people are drinking unsafe water because of its remoteness.

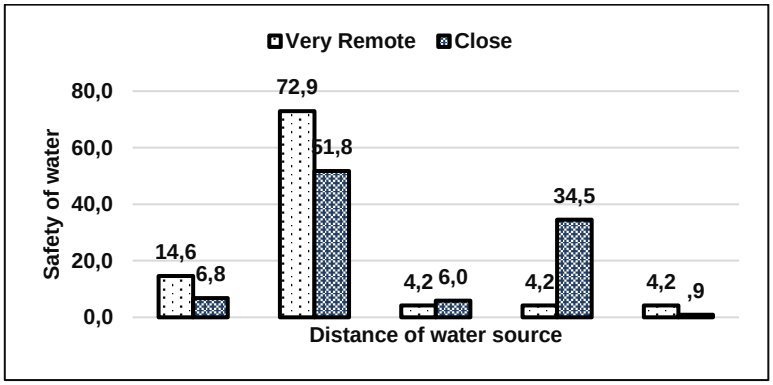


**Figure 2.** Effect of Distance in Ensuring Clean Water

The quality, accessibility, and reliability of the water source can have a significant impact on the amount of water that is consumed by a population. In areas where water sources are unreliable or inaccessible, people may be unable to access enough water for their basic needs. Additionally, the safety of the water source is also a key factor in determining how much water a resident can consume. If the quality of the water is uncertain, people may choose to use other sources of water, such as bottled water or others. This can lead to decreased consumption of water and potential health risks if the alternative water sources are not safe. For example, if the water source is contaminated, people may avoid drinking it, leading to lower water consumption. On the other hand, if the water source is easily accessible and reliable, people may consume more water.

### 3.5 Availability of Water

The residents of the RCC do not have access to available water. The supply length within cities frequently varies, as it does across seasons. During the dry season, the RCC suffers severe water shortages. Table 2 indicates that water doesn't remain all the time. Every day, people receive water for a specific amount of time. It isn't accessible 24 hours a day. The duration of the water supply has an impact on the consumption habits of the RCC citizens. While a significant portion of respondents, comprising 46% (N = 175), reported an absence of water scarcity issues, the remaining 54% highlighted concerns regarding water supply challenges. Notably, a substantial 13% characterized their water supply situation as 'terrible.' This distribution underscores a noteworthy divide in water availability perceptions among the surveyed population. This issue has significant implications for citizens living in the RCC areas, as the duration of the water supply affects their water consumption habits. For example, when the supply of water is limited, households may try to limit their use of it to conserve it. As such, this could lead to some households neglecting basic needs such as laundry, washing dishes, and even bathing or resorting to buying water from private sources to fulfill their daily needs. Moreover, Wardak and Abed (2019) highlighted that water availability is critical in promoting water consumption. Therefore, it is clear that the duration of the water supply and its implications on water consumption habits have serious implications for people living in the RCC areas. To conclude, the duration of the water supply is a crucial factor for household water consumption in the RCC areas.

### 3.6 Patterns of Water Wastage

The issue of providing everyone in the community with access to clean water and sanitary facilities is water waste. On the other hand, many individuals do not have access to the daily amounts of water they require (Stavenhagen et al., 2018). In urban Bangladesh, the issue of water wastage is particularly concerning, with an alarming average wastage of up to 113 liters of water per person each day. This significant water loss translates into substantial financial losses daily (Shuaib & Rana, 2020), raising

profound concerns, especially in a world where many people still lack access to clean water facilities. Water can be wasted in a variety of ways. Some people take a long time in the shower when they take a bath. A lot of individuals constantly waste water for cleaning and other uses. The per capita water consumption pattern varies greatly among different countries and regions around the world. Some countries have abundant water resources and high per capita water consumption, while others have limited water resources and low per capita water consumption. In general, developed countries tend to have higher per capita water consumption due to factors such as high standards of living, widespread use of water-intensive technologies and industries, and a greater reliance on water-intensive agriculture. On the other hand, many developing countries face water scarcity due to factors such as limited access to clean water, inadequate water infrastructure, and over-extraction of groundwater. In these countries, per capita, water consumption is often much lower. The residents of the RCC, consume 294 liters of water per person per day. Additionally, Libya uses 354 liters of water per person each day, ranking first in the world for water consumption. Greater Kuala Lumpur needs 268 liters of water per capita. Additionally, Melbourne, USA, and the India each use 240, 262, and 117 liters of water (Table 3).

**Table 3.** Comparison of per capita water consumption with other countries (LPCD)

| Activities | This Study | Grater Kuala Lumpur | Libya | Melbourne | U.K. | USA | China | Sierra Leone | India |
|---|---|---|---|---|---|---|---|---|---|
| Bathing | 125 | 125 | 160 | - | - | 212 | - | - | - |
| Cleaning | 119 | 81 | 132 | - | - | 96 | - | - | - |
| Cooking | 30 | 39 | 15 | - | - | | - | - | - |
| Drinking & Others | 19 | 23 | 47 | - | - | 64 | - | - | - |
| Total | 294 | 268 | 354 | 240 | 146 | 262 | 70 | 112 | 117 |

*Source: Grater Kuala Lumpur (Bari et al., 2015), Libya (Alharsha et al., 2019), Melbourne (Rhodes et al., 2012), UK (Vieux et al., 2020), USA (Inskeep & Attari, 2014), China (Fan et al., 2017), Sierra Leone (Ibrahim et al., 2021), India (Singh & Turkiya, 2013)*

These findings suggest that there is a significant disparity in water consumption between developed and developing countries. The comparison of daily water usage across different regions yields concerning findings into water consumption patterns and highlights the contextual influences on this vital resource. In this study, the daily water usage of 294 liters per household demonstrates a significant volume, potentially indicating diverse water-related behaviors and needs within the studied population. This figure, higher than that of some developed countries like Korea, the UK, and the USA, underscores the significance of understanding the factors contributing to such consumption rates. The data reveals variations that could be attributed to a blend of cultural, economic, and infrastructural disparities among these regions. These differences underscore the role of cultural norms, technological advancements, climate conditions, and government policies in shaping water consumption behaviors.

Above the analysis, we observe that people in the RCC are wasting water. The average amount of water used by residents of the RCC in Bangladesh is shown in Table 4. In moderate temperatures around the world, a 1-tail T-test revealed an average water use of 250 liters per day (Haque & Islam, 2021). The study sample utilizes, on average, 294.8177 liters of water, as shown in Table 4. This exceeds the test value by 44.81771 liters. This indicates that Bangladesh's urban population uses more water than the world as a whole (44 liters extra). The result is statistically significant because the level of significance is 000 (< 0.05). From one sample T-test (Table 4), we understand that people usually waste about 44 liters of water per day on average.

**Table 4.** Per Capita Water Usage One-Sample T-Test with the Test Value of 250

| | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| Computed Daily Water Usage | 384 | 294.8177 | 169.84784 | 8.66751 |

| | T | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Computed Daily Water Usage | 5.171 | 383 | .000** | 44.81771 | 27.7758 | 61.8596 |

*Note.* ** indicates P<.05

Additionally, wastefulness rates were higher for graduate and postgraduate students. Table 5 reveals that postgraduates need 370 liters of water each day. On the other hand, illiterate people need 319 liters of water each day. So, water use is higher among educated people than uneducated people (Table 5). According to this study, higher education often leads to higher incomes, allowing these households to afford larger homes with more bathrooms and amenities that require more water. Educated people often have higher socio-economic status, leading to larger households, more water-intensive appliances, and a propensity for water-intensive activities such as gardening or swimming pools. Moreover, education can introduce a range of water-demanding activities and behaviors, such as advanced hygiene practices, hobbies, or business operations, that collectively contribute to higher water usage. This study also reveals that educated people allocate more time at home, increasing water usage.

**Table 5**. Daily water usage scenery based on Educational Qualification

| Educational Qualification | Mean | Minimum | Maximum | Percentage |
|---|---|---|---|---|
| Illiterate | 319.00 | 93.00 | 517.00 | 3.4% |
| Primary | 304.89 | 97.00 | 670.00 | 9.6% |
| Secondary | 208.83 | 36.00 | 495.00 | 14.1% |
| Higher Secondary | 187.60 | 35.00 | 578.00 | 22.9% |
| Graduate | 356.94 | 52.00 | 632.00 | 21.6% |
| Post Graduate | 370.37 | 65.00 | 695.00 | 28.4% |

There are a number of steps that can be taken to reduce water waste and improve clean water access for people living in the RCC. These steps include educating citizens on water and sanitation management, implementing efficient water and wastewater management systems, ensuring access to appropriate water resources and technologies, monitoring water quality and safety levels, creating incentives for the conservation of water resources, and establishing proper systems. Moreover, Water waste can be reduced by utilizing mobile technology. Water waste management can be controlled using mobile-enabled smart water level control systems (Shankar & Dakshayini, 2018). By monitoring and controlling water levels, as well as providing alerts when necessary, this technology can help reduce the amount of water wasted. Additionally, educational programs that encourage water conservation and Public awareness campaigns about the importance of conserving water can be implemented. Water waste can be decreased by raising awareness and feelings about waste water.

## Conclusion

Water is essential for life, so it is not surprising that people consume it for various purposes. The main aim of this study was to look at how people in urban Bangladesh use water and whether they waste it. People use water for things like drinking, cooking, cleaning, and bathing. It is found that factors like age, job, education, and income can affect how much water someone uses. If people think the water is safe, they tend to use more of it. Also, how far they are from a water source can influence water use. In Rajshahi City Corporation, many people don't have enough water, and they often use different sources for different tasks. On average, each household uses 294 liters of water and wastes about 44 liters every day. Surprisingly, educated people tend to waste more water. In this present situation, people in the RCC regions should be much more careful regarding water wastage.

To combat water wastage, governments, and NGOs should strive to spread awareness of the importance of conserving this limited resource. By educating people and providing them with necessary resources, they should focus on setting up programs that help to conserve water as well as discourage wasteful practices. Furthermore, water waste management can be controlled using mobile-enabled smart water level control systems (Shankar & Dakshayini, 2018). By monitoring and controlling water levels, as well as providing alerts when necessary, this technology can help reduce the amount of water wasted. Additionally, educational programs that encourage water conservation and public awareness campaigns about the importance of conserving water can be implemented. Water waste can be decreased by raising awareness and feelings about waste water (de Miranda Coelho et al., 2016).

The government should take the necessary steps to utilize surface water, such as river water and rain water. The government should implement projects related to surface water and groundwater purification plants. The government and NGOs should also encourage using water-saving techniques such as rainwater harvesting, wastewater reuse, and efficient irrigation systems. By investing in developing infrastructure related to water resources, the government can ensure that the environment is preserved and that water is used sustainably.

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## Reference

Abubakar, I. R. (2019). Factors influencing household access to drinking water in Nigeria. *Utilities Policy*, *58*, 40–51. https://doi.org/10.1016/j.jup.2019.03.005

Ahmed, S. (2023). SDG on health and socio-economic barriers: An empirical study in Bihar. *International Journal of Social Sciences*, *11*(4), 207–212. https://doi.org/10.46852/2249-6637.04.2022.2

Alharsha, I., Memon, F., & Farmani, R. (2019). An assessment of per capita water consumption in Sirte, Libya. *New Trends in Urban Drainage Modelling*, 969–975. https://doi.org/10.1007/978-3-319-99867-1_167

Barakoti, S., Celik, I., Moorhead, D., & Apul, D. (2019). Diversity analysis of water sources, uses, and flows from source to use in the USA. *Science of the Total Environment*, *652*, 1409–1415. https://doi.org/10.1016/j.scitotenv.2018.10.335

Bari, M. A., Begum, R. A., Nesadurai, N., & Pereira, J. J. (2015). Water consumption patterns in Greater Kuala Lumpur: Potential for reduction. *Asian Journal of Water, Environment and Pollution*, *12*(3), 1–7. https://doi.org/10.3233/AJW-150001

Behailu, B. M., Suominen, A., Katko, T. S., Mattila, H., & Yayehyirad, G. (2016). Comparison of community managed projects and conventional approaches in rural water supply of Ethiopia. *African Journal of*

*Environmental Science and Technology*, *10*(9), 292–306. https://doi.org/10.5897/ajest2016.2132

De Miranda Coelho, J. A. P., Gouveia, V. V., De Souza, G. H. S., Milfont, T. L., & Barros, B. N. R. (2016). Emotions toward water consumption: Conservation and wastage. *Revista Latinoamericana de Psicologia*, *48*(2), 117–126. https://doi.org/10.1016/j.rlp.2015.09.006

Dey, N. N., Al Rakib, A., Kafy, A.-A., & Raikwar, V. (2021). Geospatial modelling of changes in land use/land cover dynamics using Multi-layer Perceptron Markov chain model in Rajshahi City, Bangladesh. *Environmental Challenges*, *4*, 100148. https://doi.org/10.1016/j.envc.2021.100148

Etim, E. E., Odoh, R., Itodo, A. U., Umoh, S. D., & Lawal, U. (2013). Water quality index for the assessment of water quality from different sources in the Niger Delta Region of Nigeria. *Frontiers in Science*, *3*(3), 89–95. https://doi.org/10.5923/j.fs.20130303.02

Fan, L., Gai, L., Tong, Y., & Li, R. (2017). Urban water consumption and its influencing factors in China: Evidence from 286 cities. *Journal of Cleaner Production*, *166*, 124–133. https://doi.org/10.1016/j.jclepro.2017.08.044

Ferdous, L., Kafy, A.-A., & Poly, S. A. (2018). Assessment of water supply system and water quality of Rajshahi WASA in Rajshahi City Corporation (RCC) area, Bangladesh. *1st National Conference on Water Resources Engineering (NCWRE 2018)*. https://www.researchgate.net/publication/323992585_Assessment_of_Water_supply_system_and_water_quality_of_Rajshahi_WASA_in_Rajshahi_City_Corporation_RCC_area_Bangladesh

Haque, A. K. M. M., & Islam, M. T. (2021). Urban local government and water consumption pattern in Bangladesh: Challenges of suistainable water management. *Evolving Horizons*, *10*(November), 14–22.

Hasan, M. K., Shahriar, A., & Jim, K. U. (2019). Water pollution in Bangladesh and its impact on public health. *Heliyon*, *5*(8). https://doi.org/10.1016/j.heliyon.2019.e02145

Ibrahim, A. S., Memon, F. A., & Butler, D. (2021). Seasonal variation of rainy and dry season per capita water consumption in Freetown city sierra Leone. *Water (Switzerland)*, *13*(4), 499. https://doi.org/10.3390/w13040499

Inskeep, B. D., & Attari, S. Z. (2014). The water short list: The most effective actions US households can take to curb water use. *Environment: Science and Policy for Sustainable Development*, *56*(4), 4–15. https://doi.org/10.1080/00139157.2014.922375

Kashem, S., Tahsin, N., Subah, Z., Murshed, S. B., Nowreen, S., & Mondal, M. S. (2023). Assessing the right to water of the urban poor in Dhaka city. *GeoJournal*, *88*(3), 1–22. https://doi.org/10.1007/s10708-022-10804-3

Koop, S. H. A., Van Dorssen, A. J., & Brouwer, S. (2019). Enhancing domestic water conservation behaviour: A review of empirical studies on influencing tactics. *Journal of Environmental Management*, *247*, 867–876. https://doi.org/10.1016/j.jenvman.2019.06.126

Nasher, N. M. R. (2022). Groundwater quality of arsenic contaminated aquifers in the Munshiganj district, Bangladesh using water quality index. *HydroResearch*, *5*, 71–84. https://doi.org/10.1016/j.hydres.2022.08.001

Nygren, B. L., O'Reilly, C. E., Rajasingham, A., Omore, R., Ombok, M., Awuor, A. O., Jaron, P., Moke, F., Vulule, J., Laserson, K., Farag, T. H., Nasrin, D., Nataro, J. P., Kotloff, K. L., Levine, M. M., Derado, G., Ayers, T. L., Lash, R. R., Breiman, R. F., & Mintz, E. D. (2016). The relationship between distance to water source and moderate-to-severe diarrhea in the global enterics multi-center study in Kenya, 2008-2011. *American Journal of Tropical Medicine and Hygiene*, *94*(5), 1143–1149. https://doi.org/10.4269/ajtmh.15-0393

Ochilova, N. R., Muratova, G. S., & Karshieva, D. R. (2021). The importance of water quality and quantity in strengthening the health and living conditions of the population. *Central Asian Journal of Medical and Natural Science*, *2*(5). https://doi.org/10.47494/cajmns.v2i5.403

Rasul, M. T., & Jahan, M. S. (2010). Quality of ground and surface water of Rajshahi City Area for sustainable drinking water source. *Journal of Scientific Research*, *2*(3), 577–584. https://doi.org/10.3329/jsr.v2i3.4093

Rhodes, B. G., Fagan, J. E., Tan, K. S., & Water, M. (2012). Responding to a rapid climate shift–experiences from Melbourne, Australia. *IWA World Congress on Water, Climate and Energy (Dublin, Ireland, 13–18 May 2012)*. https://green-cape.co.za/assets/Uploads/IWA-WCE-Paper-Rhodes-29Feb-2012-final.pdf

Rosinger, A. Y., & Young, S. L. (2020). In-home tap water consumption trends changed among US children, but not adults, between 2007 and 2016. *Water Resources Research*, *56*(7). https://doi.org/10.1029/2020WR027657

Shankar, S., & Dakshayini, M. (2018). IoT-Mobile enabled smart water level controlling system to regulate water wastage. *2018 International Conference on Advances in Computing, Communications and Informatics, ICACCI 2018*. https://doi.org/10.1109/ICACCI.2018.8554373

Shuaib, A. S. M., & Rana, M. M. P. (2020). Assessing water supply for the urban poor in Rajshahi City, Bangladesh. *Management of Environmental Quality: An International Journal*, *31*(1), 75–88. https://doi.org/10.1108/MEQ-06-2019-0138

Singh, O., & Turkiya, S. (2013). A survey of household domestic water consumption patterns in rural semi-arid village, India. *GeoJournal*, *78*(5), 777–790. https://doi.org/10.1007/s10708-012-9465-7

Stavenhagen, M., Buurman, J., & Tortajada, C. (2018). Saving water in cities: Assessing policies for residential water demand management in four cities in Europe. *Cities*, *79*, 187–195. https://doi.org/10.1016/j.cities.2018.03.008

Vieux, F., Maillot, M., Rehm, C. D., Barrios, P., & Drewnowski, A. (2020). Trends in tap and bottled water consumption among children and adults in the United States: Analyses of NHANES 2011–16 data. *Nutrition Journal*, *19*(1), 1–14. https://doi.org/10.1186/s12937-020-0523-6

Wardak, H. A., & Abed, S. Y. (2019). Analysis of factors affecting water consumption in Jeddah City. *2019 Industrial & Systems Engineering Conference (ISEC)*, 1–6. https://doi.org/10.1109/IASEC.2019.8686495